FORESTHILL PUBLIC UTILITY DISTRICT

Water System Master Plan

January 2008

Prepared for
Foresthill Public Utility District

Prepared by
ECO:LOGIC Engineering

ECO:LOGIC
Consulting Engineers

FORESTHILL PUBLIC UTILITY DISTRICT

Water System Master Plan

January 2008

REGISTERED PROFESSIONAL ENGINEER
GERRY O. LABUDDE
No. 055767
Exp. 12-31-08
CIVIL
STATE OF CALIFORNIA

1-8-08

Prepared for:

Foresthill Public Utility District
24540 Main Street
Foresthill, California 95631

Prepared by:

ECO:LOGIC Engineering

ECO:LOGIC

Consulting Engineers

Contents

Foresthill Public Utility District Water System Master Plan

1 INTRODUCTION 1-1
1.1 Background 1-1
1.2 Scope 1-1
1.3 Acknowledgments 1-2

2 EXECUTIVE SUMMARY 2-1
2.1 Land Use and Water Demands 2-1
2.1.1 Historical Water Use and Future Projections 2-3
2.2 Water Supply Yield Study 2-7
2.2.1 Hydrology Development 2-7
2.2.2 Drought Frequency Analysis 2-7
2.2.3 Methodology 2-8
2.2.4 Results 2-9
2.3 Treatment System 2-10
2.3.1 Existing System 2-10
2.3.2 Treatment Plant Improvements 2-13
2.3.3 Capital Cost Estimate 2-16
2.4 Transmission, Distribution and Storage 2-16
2.4.1 Existing System 2-16
2.4.2 Transmission Main/Storage Improvements 2-18
2.4.3 Capital Cost Estimate 2-19
2.5 Proposed Methodology For Connection Charge Calculation 2-22
2.6 Implementation Plan 2-25
2.6.1 Transmission System Improvements 2-25
2.6.2 Water Supply 2-27
2.6.3 Connection Charge 2-27
2.6.4 Future Updates 2-27

3 LAND USE AND WATER DEMAND 3-1
3.1 Purpose and Scope 3-1
3.2 Land Use 3-1
3.3 Existing Land Use 3-1
3.4 Future Land Use 3-1
3.5 Future Land Use 3-3
3.6 Historical Water Use and Water Demand Factors 3-6
3.6.1 Summary of Water Production and Peaking Factors 3-7
3.6.2 Annual Production 3-7
3.6.3 Unaccounted Water 3-7
3.6.4 Peaking Factors 3-9

3.7 Water Demand Factors 3-10
3.7.1 Water Use Comparison 3-12
3.8 Projected Water Demands 3-13

4 WATER SUPPLY YIELD STUDY 4-1
4.1 Hydrology Development 4-1
4.2 Water Supply Reliability Standard 4-3
4.3 Drought Frequency Analysis 4-3
4.4 Log Pearson Type III Analysis of 1958 – 2003 Hydrology Data 4-4
4.5 Simulation Model Development 4-5
4.6 Study Results 4-7
Study 1 – Log Pearson Analysis – Existing Reservoir 4-7
Study 2 - Log Pearson Analysis – Enlarged Reservoir 4-7
Study 3 – OASIS Simulation – Existing Reservoir 4-8
Study 4 - OASIS Simulation – Enlarged Reservoir 4-8
4-7 Conclusions 4-8

5 WATER TREATMENT FACILITIES 5-1
5.1 Existing System 5-1
5.1.1 Raw Water Supply 5-1
5.1.2 Treatment System 5-1
5.1.3 Treated Water Storage and Chlorine Contact Time (CT) 5-5
5.1.4 Booster Pump Station 5-6
5.2 Treatment Plant Improvements 5-7
5.2.1 Raw Water Supply 5-7
5.2.2 Treatment Facilities 5-8
5.3 Capital Cost Estimate 5-13

6 TRANSMISSION, DISTRIBUTION AND STORAGE 6-1
6.1 Existing System 6-1
6.1.1 Transmission Pipelines 6-1
6.1.2 Distribution Pipelines 6-2
6.2 Existing Transmission/Distribution system evaluation 6-2
6.2.1 Hydraulic Model 6-2
6.2.2 Existing System Modeling Results 6-4
6.2.3 Improvements to the Existing System 6-5
6.3 Transmission pipelines and storage system build-out 6-7
6.3.1 Pipeline Improvements 6-8
6.3.2 Storage Improvements 6-8
Distribution System Storage Site 1 (DS 1) 6-10
Distribution System Storage Site 2 (DS 2) 6-10
6.5 Cost Estimate 6-11

7 PROPOSED METHODOLOGY FOR CONNECTION CHARGE CALCULATION 7-1
7.1 Proposed Methodology 7-2
7.1.1 Formulation of Charge 7-2
7.1.2 Indexing of Fees 7-5

8 IMPLEMENTATION PLAN 8-1
8.1 Treatment Plant Improvements 8-1
8.1.1 Storage 8-1
8.1.2 Filtration 8-3

8.1.3 Miscellaneous Improvements 8-4
8.2 Transmission System Improvements 8-4
8.3 Water Supply 8-4
8.4 Connection Charge 8-6
8.5 Future Updates 8-6

APPENDICES

A Reservoir Yield Data

TABLES

Table 2-1 Existing Land Use[a] 2-2
Table 2-2 Community Development within Foresthill PUD Service Area, 2006 and Build-out, Acres 2-3
Table 2-3 Estimated Units – Current and Build-Out 2-3
Table 2-4 Annual Water Production 2-4
Table 2-5 Water Use Peaking Factors 2-5
Table 2-6 Recommended Water Demand Factors 2-5
Table 2-7 Water Demand Estimates 2-6
Table 2-8 Summary of Reservoir Yield Results 2-10
Table 2-8 Proposed Improvements[a] 2-17
Table 2-9 Existing Distribution System Improvements Cost Estimate 2-20
Table 2-10 Distribution System Storage Improvements Cost Estimate 2-21
Table 2-11 Build-out Transmission Pipeline Improvements Cost Estimate 2-22
Table 2-12 Summary of Connection Charge Components 2-23
Table 2-13 Meter Equivalence Ratios and Proposed Connection Charge 2-24
Table 3-1 Existing Land Use 3-3
Table 3-2 Community Development within Foresthill PUD Service Area, 2006 and Build-out, Acres 3-5
Table 3-3 Estimated Units – Current and Build-Out 3-6
Table 3-4 Annual Water Production 3-7
Table 3-5 Unaccounted Water 3-9
Table 3-6 Maximum Day 3-9
Table 3-7 Water Use Peaking Factors 3-10
Table 3-8 Water Use Comparison, gpd/unit 3-11
Table 3-9 Recommended Water Demand Factors 3-12
Table 3-10 Neighboring Water Agency Demands (gpd/unit) 3-13
Table 3-11 Water Demand Estimates 3-13
Table 4-1 Annual Inflow Summary 1958 - 2003 4-5
Table 4-2 Master Plan and Updated Annual Yield Values Comparison 4-5
Table 5-1 Water Treatment Plant Design Criteria 5-4
Table 5-2 Booster Pump Station 5-7
Table 5-3 Treated Water Storage Criteria 5-11
Table 5-4 Proposed Improvements[a] 5-14
Table 6-1 Recommended Improvements for Existing Pipes 6-6
Table 6-2 Existing and Proposed PRV Controls 6-7
Table 6-3 Recommended Transmission and Storage System Improvements 6-9
Table 6-4 Distribution System Cost Assumptions 6-11

Table 6-5 Existing Distribution System Improvements Cost Estimate 6-12
Table 6-6 Distribution System Storage Improvements Cost Estimate 6-13
Table 6-7 Build-out Transmission Pipeline Improvements Cost Estimate 6-14
Table 7-1 Summary of Connection Charge Components.....7-3
Table 7-2 Meter Equivalence Ratios and Proposed Connection Charge.....7-3
Table 7-3 Minimum Proposed Connection Charge for Meters 1.5-inch and Larger.....7-4
Table 8-1 Filter Capacity.....8-3
Table 8-2 Estimated Reservoir Yield 8-5

FIGURES

Figure 2-1 Monthly Water Production Data.....2-4
Figure 2-2 Annual Inflow, North Shirttail Creek 2-8
Figure 2-3 Annual Flow Data, North Shirttail Creek 2-9
Figure 2-4 Existing Water Treatment Plant Schematic 2-11
Figure 2-5 Existing Treatment Plant Site Plan 2-12
Figure 2-6 Treatment Plant Site Plan Buildout - 6 MGD.....2-14
Figure 2-7 Implementation of Water Treatment Plant Improvements 2-27
Figure 3-1 Existing Land Use.....3-2
Figure 3-2 Existing Zoning 3-4
Figure 3-3 Monthly Water Production Data.....3-8
Figure 4-1 Sugar Pine Storage.....4-2
Figure 4-2 Annual Inflow, North Shirttail Creek 4-4
Figure 4-3 Annual Flow Data, North Shirttail Creek 4-6
Figure 5-1 Existing Water Treatment Plant Schematic 5-2
Figure 5-2 Existing Treatment Plant Site Plan 5-3
Figure 5-3 Treatment Plant Site Plan Buildout - 6 MGD.....5-8
Figure 6-1 Existing Water Distribution System .....Back of Binder
Figure 6-2 Existing Water Distribution System with Improvements .....Back of Binder
Figure 6-3 Build Out Water Distribution System.....Back of Binder
Figure 8-1 Implementation of Water Treatment Plant Improvements 8-2

Section 1

Introduction

1.1 BACKGROUND

The Foresthill Public Utility District currently serves approximately 2,200 customers with treated water, of which approximately 2,100 are residential customers and about 90 are commercial customers. The District's service area comprises the unincorporated community of Foresthill, California, the primary commercial areas serving that community as well as a sizable residential development known as Todd Valley. The Foresthill area is located on the ridge between the North and Middle forks of the American River commonly referred to as the Foresthill Divide.

The District currently incorporates an area of approximately 13,000 acres and contains primarily residential development. The District has a population of approximately 5,200.

The primary purpose of this Master Plan is to develop an improvement plan consisting of water supply, transmission/distribution pipelines, and storage and facilities to provide domestic water service for future growth.

The projected growth and land uses used to determine the magnitude and location of future water demands within the District's service area are based on Placer County's 1981 Foresthill General Plan and Environmental Impact Report (the 1981 Plan). The Placer County Community Development Resource Agency (CDRA) is in the process of updating the 1981 Plan, which could affect the water demand projections.

1.2 SCOPE

The scope of this work consists of the following major elements:

- Review existing reports, drawings, land use and zoning maps, and other relevant drawings.
- Evaluate existing facilities and operational data.
- Project future water demands based on historical water use data and approved land uses as defined in the 1981 General Plan.
- Estimate the reliable yield from the Sugar Pine Reservoir Project, which consists of an update and confirmation to previous work included in the 1992 Water System Master Plan (Giberson & Associates).
- Identify water infrastructure needs to meet future water demands and correct existing deficiencies in the system.

- Provided descriptions of improvements including capital costs for the improvements.
- Recommend a suggested procedure for calculating the water connection charge for master planned facilities
- Develop a logical expansion plan that can be phased.

1.3 ACKNOWLEDGMENTS

The cooperation, input and support received from District staff was appreciated and provided valuable insight to the current system. We would like to specifically thank and acknowledge Kurt Reed and his staff that provided input and information, including Pat Pappas, and Chad Odell.

SECTION 2

Executive Summary

This Master Plan has been prepared on behalf of the Foresthill Public Utility District (District). The primary purpose the Master Plan is to develop an improvement plan consisting of water supply, transmission/distribution pipelines, storage and pumping facilities to provide domestic water service throughout the District's service area.

The scope of this work consists of the following major elements:

- Review existing reports, drawings, land use and zoning maps, and other relevant drawings.
- Evaluate existing facilities and operational data.
- Project future water demands based on historical water use data and approved land uses as defined in the Placer County's 1981 Foresthill General Plan and Environmental Impact Report (General Plan).
- Estimate the reliable yield from the Sugar Pine Reservoir Project, which consists of an update and confirmation to previous work included in the 1992 Water System Master Plan (Giberson & Associates).
- Identify water infrastructure needs to meet future water demands and correct existing deficiencies in the system.
- Provide descriptions of improvements including capital costs for the improvements.
  - Recommend a suggested procedure for calculating the water connection charge for master planned facilities
- Develop a logical expansion plan that can be phased.

A summary of the Water System Master Plan including results and recommendations is included in this section.

2.1 LAND USE AND WATER DEMANDS

Land uses and water demands within the District water service boundary were developed. Water demand projections are based on historical water use data and projected build-out within the current District boundary using approved land uses as defined by the existing General Plan. Existing land uses are summarized in Table 2-1.

Table 2-1
Existing Land Use[a]

Land Use	Total Acres Within the District Boundary	Estimated Developed Acreage Within District Boundary[b]	Estimated Vacant Acreage Within District Boundary
Forest Residential 4.6 - 20 Ac. Min.	1,121	418	703
Forestry 20 - 160 Ac. Min.	3,322	1,101	2,221
Commercial	79	42	37
Industrial	305	167	138
Rural Estate 2.3 - 4.6 Ac. Min.	5,234	2,671	2,563
Public Facilities	26	10	16
Low Density Residential 2 - 4 DU./Ac.	99	77	22
Medium Density Residential 4 - 10 DU./Ac.	170	140	30
Rural Residential 1 - 2.3 Ac. Min	2,844	2,286	558
Water Influence[c]	123	91	32
Total	13,323	7,003	6,320

[a] Source: Placer County Community Development Agency. All acreages shown are approximate and are within the current District boundary.
[b] Estimated acreage based on County tax role data.
[c] Water influence is a land use found in the 1981 Foresthill Community Plan and defined in the Placer County General Plan as a land use designation which identifies significant lakes, reservoirs, and other bodies of water. Areas potentially impacted by inundation zone of the proposed Auburn Dam were included in this land use description.

Future growth within the District's service area boundary is estimated based on the land designations in the General Plan and information provided by the Placer County Community Development Resource Agency (CDRA). The Placer County CDRA is updating the Foresthill Divide Community Plan and has prepared and circulated a draft for review and comment. It is not certain when the final plan will be adopted, partially due to differing opinions and interests regarding land uses in the Foresthill area.

A projection of potential development through build-out of property within the existing District service area using the current land use designations was made. Two estimates were made:

- Unconstrained – Assumption that all lands within the District will develop based on current land use designations.
- Constrained – Assumption that certain lands within the District will not develop due to geographic conditions and/or or County policies similar to those used by the CDRA during development of the Community Plan update, but applied to existing lands within the District.

Table 2-2 includes a summary of the total acreage that could be developed for various land use categories for the constrained and unconstrained conditions. The estimated area currently developed as of 2006 is also included based on County Assessor tax data.

Table 2-2
Community Development within Foresthill PUD Service Area, 2006 and Build-out, Acres[a]

Year	Residential	Commercial[c]	Industrial
2006 [b]	6,785	52	167
Build-out – Unconstrained	12,869	105	305
Build-out – Constrained	11,250	94	291

[a] The acreages presented here are approximate and include areas designated (planned or existing) for right-of-way, easements, etc.
[b] Source: Placer County Assessor's Office.
[c] Includes area designated as Public Facilities in Table 3-1.

Table 2-3 includes an estimation of the number of potential units (as services) for residential, commercial and industrial service based on the constrained and unconstrained condition.

Table 2-3
Estimated Units – Current and Build-Out[a]

District Meter Category	Current Units[b]	Total Units at Build-out	
		Unconstrained	Constrained
Residential, services	1,781	5,500	4,500
Multi-family Residential, services	330	2,400 [c]	500 [d]
Commercial, services	87	190 [e]	170 [e]
Industrial, services	1	280 [f]	250 [f]

[a] Represents the potential number of units that could be added through build-out as equivalent dwelling units (EDUs). EDU represents the equivalent of one single family residence. Residential units in build-out projections rounded to the nearest 100. Commercial/industrial units rounded to the nearest 10.
[b] Source: Based on input from District staff and meter data provided by Foresthill PUD.
[c] Based on total potential units from properties with either Commercial or Medium Density land use designation. No reduction is taken for density on commercial units. Units on Commercial parcels already developed have been subtracted out of the increase in residential units (approximately 40 acres vacant @ 21 units per acre=840 multi-family units).
[d] Based on total of potential units from properties with Medium Density land use designation. Assumes no residential development on property with commercial land use designation. Development has been adjusted downward according to the constraints identified on particular parcels. Assumes density no greater than 4 units per acre.
[e] Based on data provided by the Placer County Assessor's Office, total acreage of parcels within the District Boundaries with a Commercial land use designation, but no structure on the property is approximately 50 acres. It is assumed that a commercial use is approved on each 0.5 acres. In the constrained case, development has been adjusted downward according to the constraints identified on particular parcels.
[f] Assumes that approximately 138 acres of undeveloped Industrial property remains within the District service area and that this property will develop as light industrial or commercial type uses. Assumes development of commercial-type use on each remaining 0.5 acre. In the constrained case, development has been adjusted downward according to the constraints identified on particular parcels.

2.1.1 HISTORICAL WATER USE AND FUTURE PROJECTIONS

Historical water use and development of future water demands are summarized herein. Detailed descriptions of the methodology and assumptions used to estimate future demands are included in Section 3 of this plan.

Water production data from the water treatment plant were evaluated based on daily operating logs from 2003 through 2005 and summarized in Table 2-4. Water use varies from season to season depending on temperature and precipitation. The monthly distribution of water production is included in Figure 2-1 along with average annual production rates from 2003 through 2005.

Table 2-4
Annual Water Production

Year	Water Production, MG	Annual Rainfall Total[a]
2003	336.3	48.66
2004	386.5	35.17
2005	361.4	72.31

[a] Source: California Department of Water Resources (CDEC), historical accumulated precipitation, Foresthill Ranger Station. Precipitation reported is water year (October 1 through September 30), beginning in October 2002.

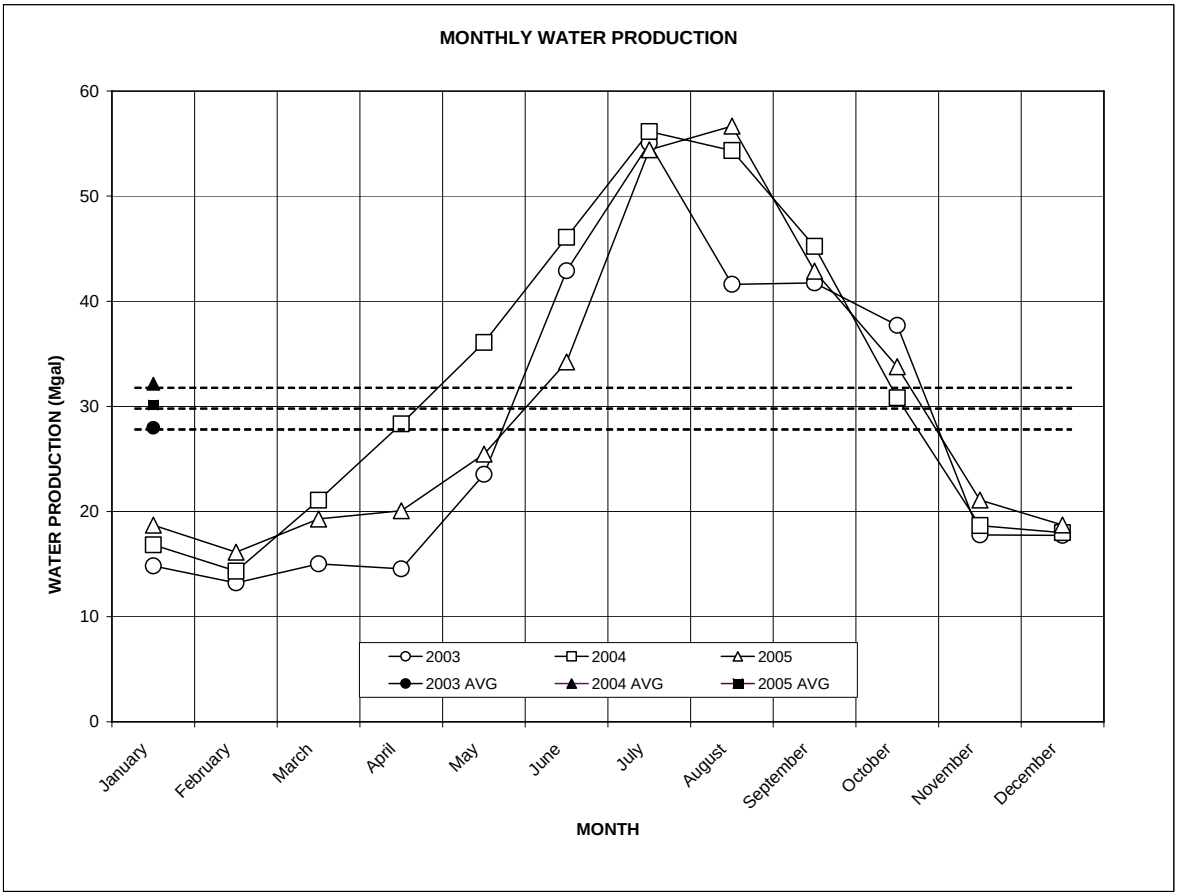


Figure 2-1
Monthly Water Production Data

Water demands also vary hourly throughout the day and estimation of the peak demands are necessary to size treatment, storage and distribution system improvements. Key peaking factors expressed as multiples of average flows include the maximum day and peak hour demands used in the analysis are summarized in Table 2-5.

Table 2-5
Water Use Peaking Factors

Year	Max Month/Annual Average[a]	Max. Day/Annual Average[b]	Peak Hour/Max. Day[c]
2003	1.775 / 0.921 = 1.9	2.32 / 0.921 = 2.5	-
2004	1.811 / 1.056 = 1.7	2.256 / 1.056 = 2.1	-
2005	1.828 / 0.990 = 1.8	2.246 / 0.990 = 2.3	-
Average	1.8	2.3	1.5 – 1.7
Value Used[d]	N/A	2.5	1.7

[a] Based on Peak Month production, converted into per day units (Mgal/d).
[b] Based on Maximum Daily production, and Annual Average Daily production, with units of Mgal/d.
[c] Peak hour flows are not recorded and typical values from published data are used.
[d] Peaking factor used for projecting future flows in this report.

Water demand factors were developed based on historical usage data from billing records and adjusted upwards to compensate for "consumptive creep" in usage rates within the District over time. The increased usage rate is likely due to changing demographics within the foothill community as a whole. Historically Foresthill has been somewhat isolated due to its location on the Divide and many of the homes were used for vacationing and seasonal use. Recent improvements to Foresthill Road have made access to the area safer and faster. Due to the relatively high cost of land in Placer County and the desire to develop in Placer County, the demographics are changing in the foothills. This change is affecting other foothill communities along the Interstate 80 corridor. Residential water use is still lower in Foresthill than compared to neighboring communities. Water demand factors used to project future water use are summarized in Table 2-6 and do not include unaccounted water.

Table 2-6
Recommended Water Demand Factors

Water User	Annual Average Water Demand Factor, gpd/unit[a]
Residential	450
Multi-family Residential	330
Commercial	1,420
Industrial	250

[a] Does not include unaccounted water. Residential and multi-family residential factors listed are in units of gpd/EDU. Commercial and industrial factors are in units of gpd/connection.

The land uses and development projections have been combined with the water demand and peaking factors to project future water demands within the District which are summarized in Table 2-7.

Table 2-7
Water Demand Estimates

Demands	Current	Build-Out	1992 Water Master Plan
Residential, gpd	673,200	2,025,000	1,662,380
Multi-family Residential, gpd	80,500	165,000	317,460
Commercial, gpd	121,800	238,000	191,700
Industrial, gpd	250	62,500	159,100
Average Day Demand (ADD), gpd [a]	875,750	2,490,500	2,330,640
Production	**Current**	**Build-Out**	
Unaccounted Water (UA), gpd [b]	87,600	249,050	
Total Avg. Day w/UA, gpd [c]	963,350	2,739,550	
Max. Day Demand, gpd [d] [e]	2,280,000	6,475,300	
Peak Hour, gpm [f]	2,650	7,525	

[a] Based on demands calculated from land uses and water demand factors.
[b] Unaccounted water calculated at 10-percent of demands.
[c] Based on ADD + UA.
[d] MDD based on historical data from current condition.
[e] MDD for build-out estimated based on (2.5 x ADD) + UA.
[f] Peak hour demand estimated based on (1.7 x MDD) + UA.

To conveniently express development as it relates to water demands within the District the concept of an equivalent dwelling unit (EDU) is introduced. For the purposes of this Master Plan, an EDU represents the demand placed on the system by a single family residential unit, and is not necessarily representative of the number of service connections.

The number of EDUs is calculated by dividing the total water production by the single family residential usage rate, including unaccounted water. The estimated number of EDUs under current and build-out scenarios is summarized below, and calculated based on 450 gpd demand plus 10-percent unaccounted water (495 gpd/EDU). An additional 3,588 EDU are anticipated through build-out and represents a combination of residential, commercial and industrial development.

Current: 1,946

Build-out: 5,534

The annual water demand based on the average daily demand, including unaccounted water, under current and future demand conditions within the District boundary are as follows:

Current: 1,079 acre-ft

Build-out: 3,069 acre-ft

2.2 WATER SUPPLY YIELD STUDY

The estimated yield from the Sugar Pine Reservoir Project was calculated. The yield is important to understand because the reservoir represents the District's primary water supply. The currently accepted estimated yield from the project was provided in the Water System Master Plan prepared in the 1992 Master Plan by Giberson & Associates, Inc. The District desired to revisit the estimated yield by updating the historical data available since the 1992 Water System Master Plan was prepared. ECORP Consulting prepared the analysis with input from ECO:LOGIC and District staff.

Two methods were used to calculate the estimated yield of the Sugar Pine Reservoir. The first includes an update of the Log Pearson Type III analysis using the District's adopted Reliability Standard, and extending the period of record using an additional 12 years of stream flow data through 2003 similar to the analysis included 1992 Master Plan. The second method used to calculate the yield used the OASIS model, developed by HydroLogics, Inc. Oasis is a comprehensive water resources systems modeling software which uses multiple input such as reservoir operating data (e.g. spills, releases, elevations, etc.), climatic conditions, and demand patterns and simulates the reservoir responses over time based on the input/outputs.

2.2.1 HYDROLOGY DEVELOPMENT

Both methods used to calculate the reservoir yield rely on historical watershed hydrology. Unimpaired daily flow records for North Shirttail Creek exist from 1956 through 1984. After 1985, flow records are impaired by Sugar Pine Reservoir operations. Prior to the construction of Sugar Pine Dam, the daily USGS flow records were converted into acre-feet, and then accumulated into monthly volumes. After the construction of the Dam, operations records were used to construct the hydrology used in the modeling analyses.

The District has adopted a Water Supply Reliability Standard (Reliability Standard) as a method to determine the yield of the project. The 1992 Master Plan defines the Reliability Standard as a 10-year drought followed by a 100-year drought followed by a mean year. To determine these levels, the 1992 Master Plan analyzed 36 water years of annual yield from North Shirttail Creek, 1956 through 1991. A frequency analysis was done to relate the magnitude of the periodic low annual yields from North Shirttail Creek to their frequency of occurrence through the use of Log-Pearson type III probability distributions. From this analysis, annual volumes for a 10-year drought, 100-year drought, and a mean year were determined.

2.2.2 DROUGHT FREQUENCY ANALYSIS

The analysis for the 1992 Master Plan used annual flow data from 1956 through 1991. The 1992 Master Plan reports that prior to construction of Sugar Pine Reservoir, the Bureau of Reclamation collected flow data on North Shirttail Creek from 1955 through 1985. Since 1985, the District has been collecting operational data and calculating the inflow to the reservoir. Figure 2-2 illustrates both the data used for the 1992 Master Plan, and the data developed by ECORP during this study.

Because the 1976-77 period is before the construction of the reservoir, the flow data comes from the USGS gage #11426400 records, not operational records. There was a significant difference noted in the inflow volume used during the 1992 Master Plan and data used in this study. The differences in 1976 data are of particular concern because the 1976-77 drought is the driest two year period for the 1958 through 2003 period of record and it defines the critical period (minimum inflow and available water) for this system. The District's Reliability Standard has been based on a 10-year, 100-year, average year sequence of inflow, but in fact, the 1976 and 1977 critical period is more severe than the design event historically used to determine yield from the project. As discussed below, the actual flows from the 1976/77 was used to calculate the yield as well, and is less than the yield calculated using statistical data and return frequencies.

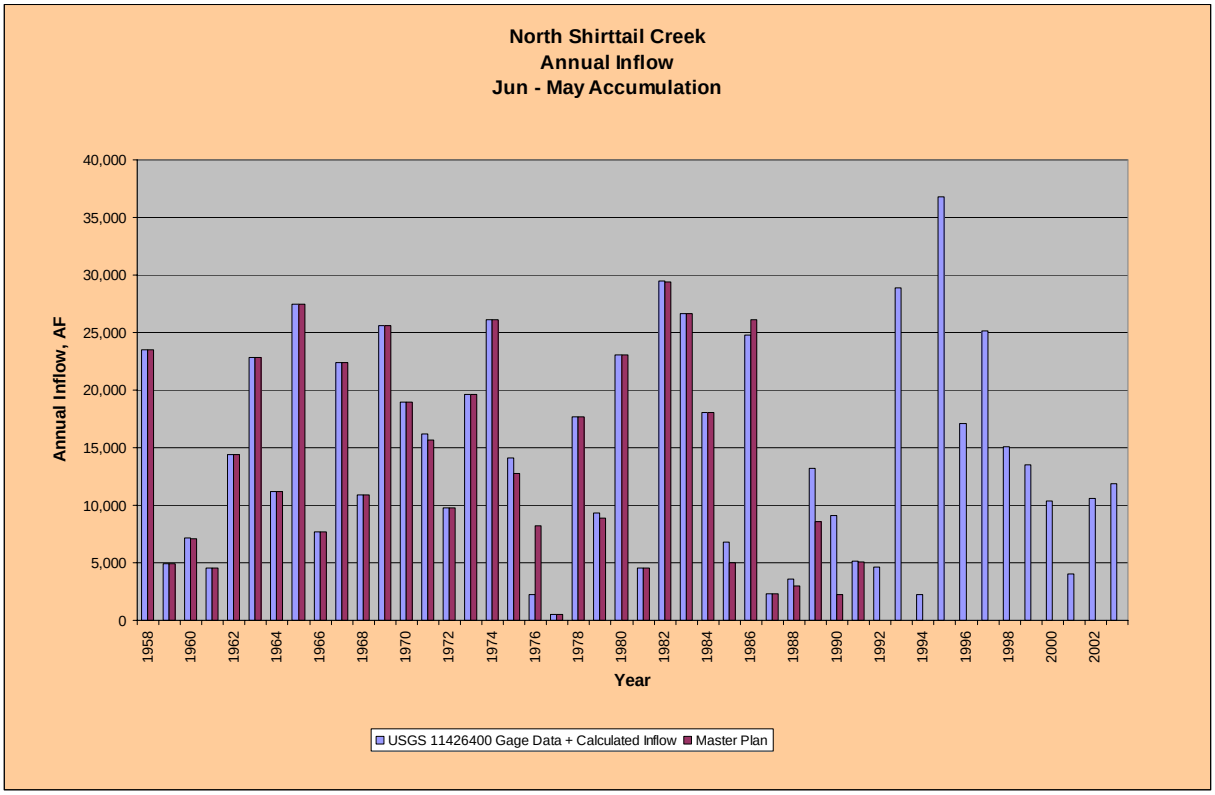


Figure 2-2
Annual Inflow, North Shirttail Creek

2.2.3 METHODOLOGY

Using the June through May annual inflow totals, a Log Pearson Type III distribution was performed on the 1958 through 2003 annual inflow data. Figure 2-3 illustrates the annual inflow to Sugar Pine Reservoir for the 1958 through 2003 period and a plot of the statistical 5-, 10-, 25- and 100-year droughts and the mean annual flow derived from the drought frequency curve.

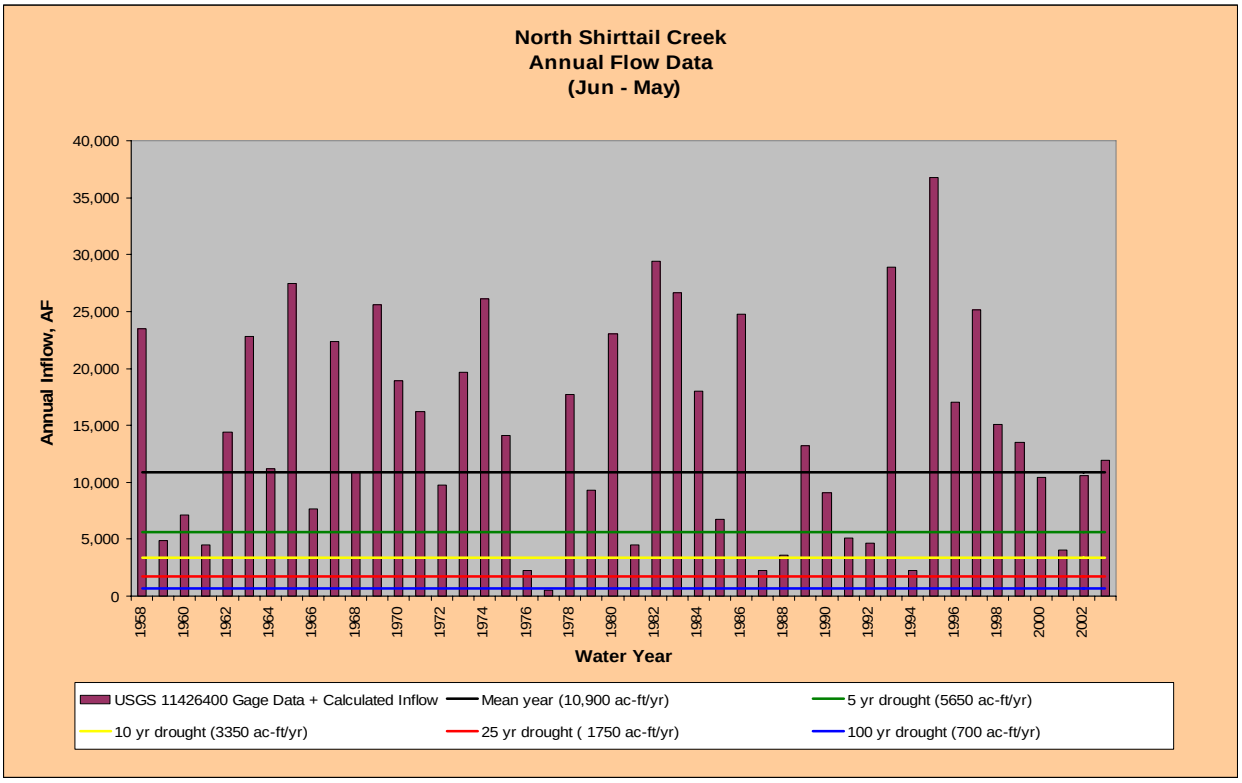


Figure 2-3
Annual Flow Data, North Shirttail Creek

A five year drought represents the anticipated flows that occur with an event that has the probability of occurring once every five years or has a 20-percent chance of occurring on a year to year basis. A 50-year drought event would statistically occur once every 50-years or have a probability of 2-percent chance of occurring. The inflow to the reservoir based on the 10, 100, and average year inflow defines the Reliability Standard.

A simulation model of Sugar Pine reservoir was developed to evaluate both the statistically derived Reliability Standard, and the period of record operations (based on historical flows in the watershed). Assumptions used in the simulation model include the physical characteristics of Sugar Pine reservoir, storage and diversion rights, downstream water rights, fish water release requirements and recreation requirements based on the Sugar Pine Fish Agreement dated 26 January 1967, and evaporation and rainfall information. With the exception of the physical characteristics of Sugar Pine reservoir, all the assumptions used in the simulation model were taken from the 1992 Master Plan and input into the model and include diversion rights, fish flow, recreation constraints, etc.

2.2.4 RESULTS

Four studies were completed for this analysis. Studies one and two were developed for the specific purpose of duplicating the Supply Reliability method contained in the 1992 Master Plan. The method was applied to both the current reservoir size and to an enlarged Sugar Pine Reservoir. The enlarged reservoir is based on an impoundment of 10,658 ac-ft, which is 3,658

ac-ft larger than the existing reservoir. The enlarged reservoir would include the addition of radial gates to increase the reservoir level about 20-feet. Results are summarized in Table 2-8.

Table 2-8
Summary of Reservoir Yield Results [a]

Methodology	Reservoir Configuration	Calculated Yield, ac-ft
Reliability Standard		
Study 1	Current Reservoir	2,750
Study 2	Modified Reservoir	4,150
Operations Simulation		
Study 3	Current Reservoir	2,150
Study 4	Modified Reservoir	3,450

[a] Does not include unaccounted water. Residential and multi-family residential factors listed are in units of gpd/EDU. Commercial and industrial factors are in units of gpd/connection.

Using this method with the extended hydrology record, the updated yield of the project is approximately 2,750 ac-ft, which is slightly higher than 2,610 ac-ft reported in the 1992 Master Plan using the same methodology. However, the analysis identified the 1975 through 1978 period as the critical period for the project and is more severe than the Design Event. Further analysis using a simulation based on the critical period identified that the annual delivery during the 1975 through 1978 period is approximately 2,150 ac-ft, significantly less than that calculated using the Design Event based on statistical analysis.

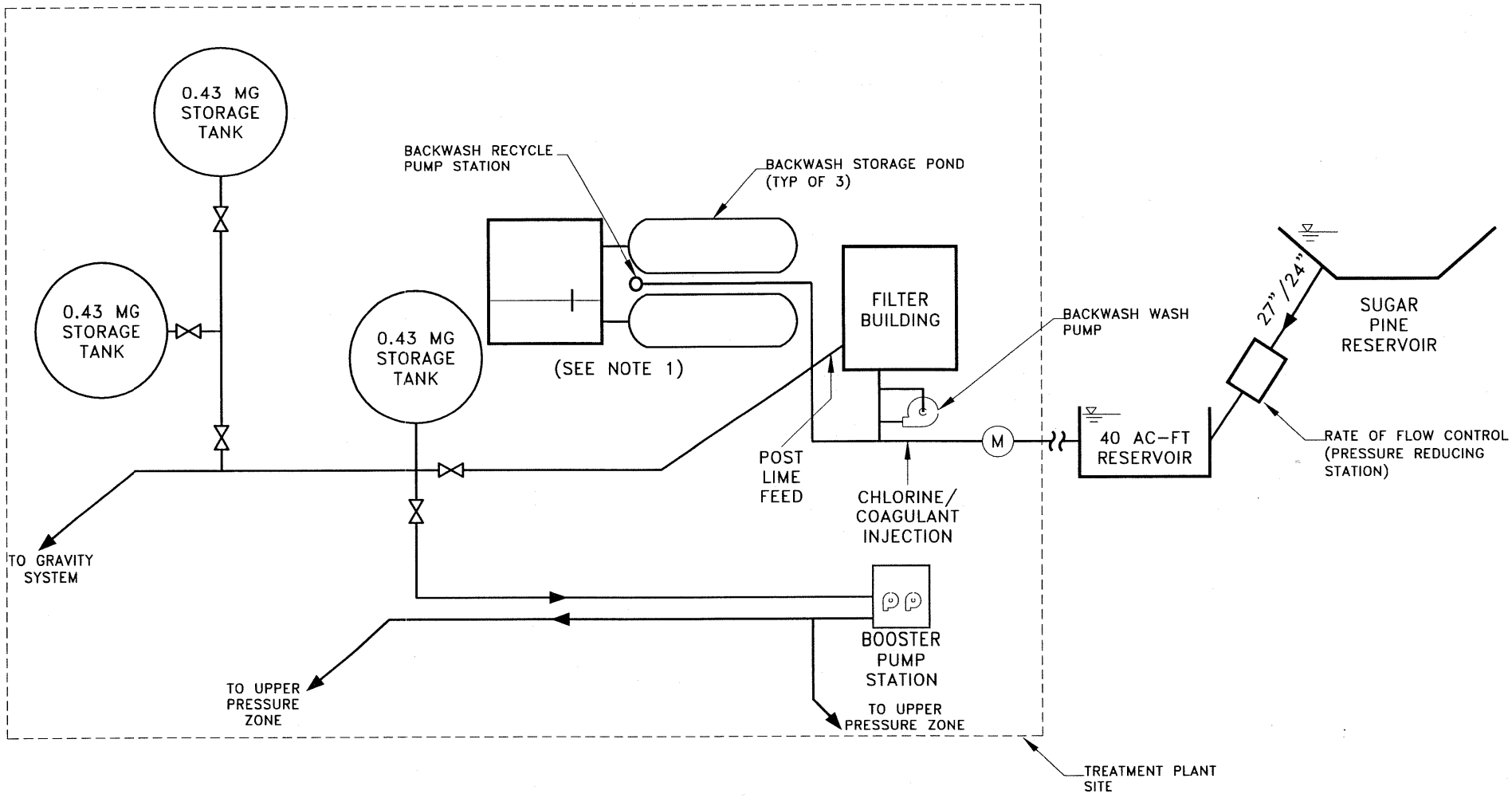
Under current development, approximately 1,079 acre-ft of water is needed to meet the current level of development and is well below the estimated reservoir yield during the critical design period. However, under the build-out condition, approximately 3,069 acre-ft of water is needed to meet projected demands. Under the current reservoir configuration conservation during the critical dry period would be required without increasing the reservoir capacity. Imposing conservation measures during dry periods is a common practice, and the District should consider developing a drought contingency plan to prepare for the potential of a shortfall in the future as the District continues to develop.

2.3 TREATMENT SYSTEM

Water treatment facilities are summarized in this section. Detailed discussion of the facilities is included in Section 5. Figure 2-4 includes a schematic of the overall raw water storage/supply, treatment processes and treated water storage facilities. Figure 2-5 includes a site layout with major facilities shown.

2.3.1 EXISTING SYSTEM

A brief description of the existing treatment plant is included below including raw water supply, treatment, chemical feed and storage. Detailed discussion of the systems is included in Section 5.



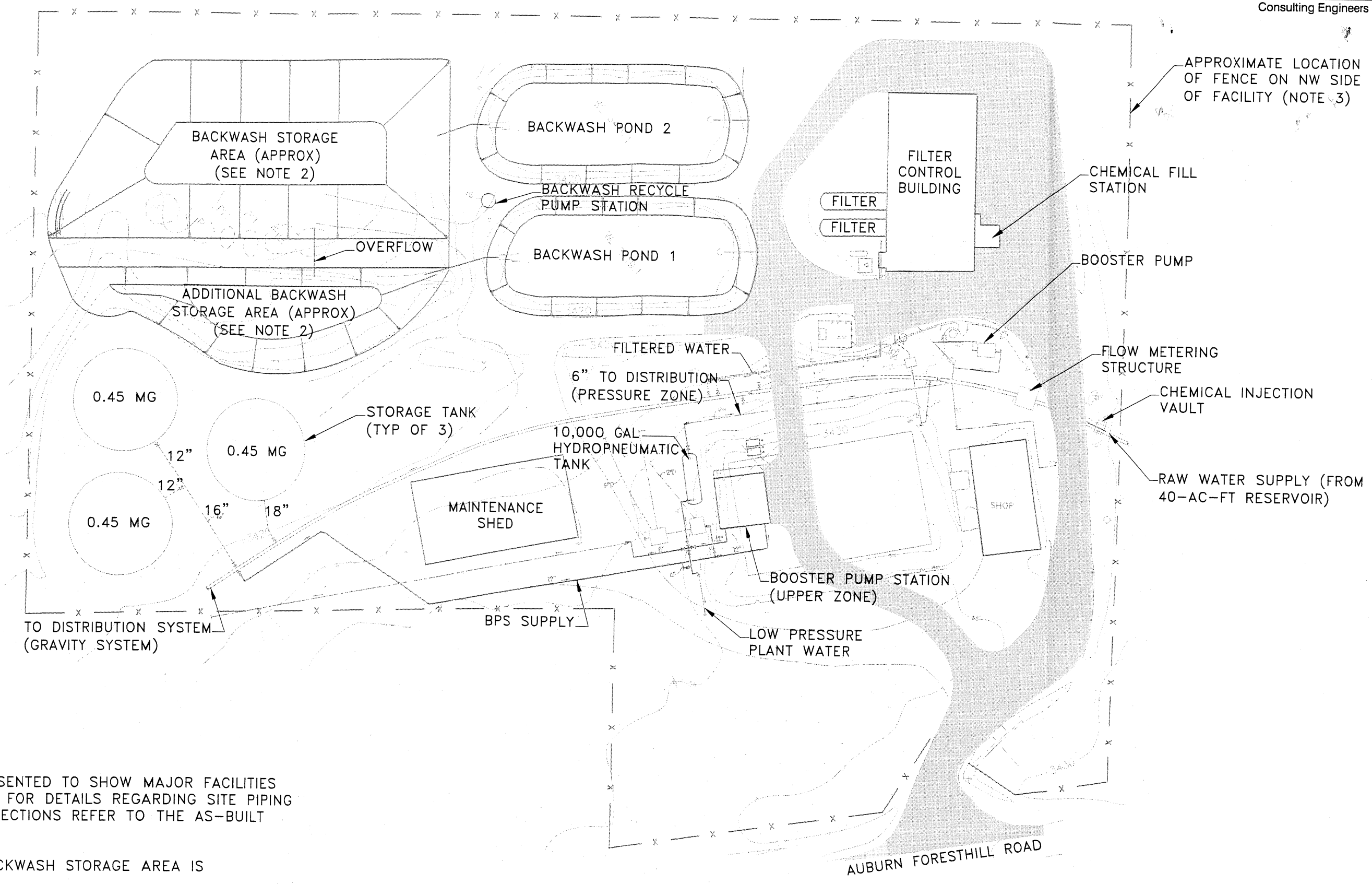
NOTES:

1. BACKWASH WATER IS PERCOLATED AND NOT RECYCLED; NO OFFSITE DISCHARGE OF BACKWASH WATER OCCURS.

FIGURE 2-4 EXISTING WATER TREATMENT PLANT SCHEMATIC

ECO:LOGIC
Consulting Engineers

SCALE 1"=50'



NOTES:

1. SITE PLAN PRESENTED TO SHOW MAJOR FACILITIES AND PIPELINES. FOR DETAILS REGARDING SITE PIPING AND INTERCONNECTIONS REFER TO THE AS-BUILT DRAWINGS.
2. ADDITIONAL BACKWASH STORAGE AREA IS APPROXIMATE.
3. NORTHERN BOUNDARY AND WIDTH OF PAVED AREA IS APPROXIMATE.

P:\FHILO6-(EXECUTIVE SUMMARY\FHILO6-001-FIGURE 2-5.dwg
Jan 07, 8:34am

FIGURE 2-5 EXISTING TREATMENT PLANT SITE PLAN