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HGE PROJECT # 05.62

WATER SYSTEM CAPITAL FACILITIES AND WATER CONSERVATION AND MANAGEMENT PLANS

CITY OF SISTERS
DESCHUTES COUNTY
OREGON

September 2005

HGE PROJECT # 05.62

Water System Capital Facilities and Water Conservation and Management Plans

CITY OF SISTERS

DESCHUTES COUNTY
OREGON

SEPTEMBER 2005

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CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
WATER CONSERVATION and
MANAGEMENT PLANS

EXECUTIVE SUMMARY

HGE INC

S.1 PURPOSE

The purpose of this Water System Capital Facilities Plan is to provide the City of Sisters with a comprehensive water utility planning document through the year 2025, and to identify improvements needed to satisfy water demand of a growing community, including anticipated future regulatory requirements. In addition, the Capital Facilities Plan, with Oregon Human Services approval, will provide the basis for funding application preparation and approval.

S.2 POPULATION AND GROWTH

Current population is estimated at 1768 residents. Year 2025 population of 3,747 residents was projected and based on both the Deschutes County Coordinated Population Forecast and in the Sisters Comprehensive Plan. This reflects an average annual growth rate in excess of 3.8% for the planning period.

S.3 EXISTING WATER SYSTEM

Sisters' water system dates back to the 1930's. Supply is currently provided by two wells. Water is treated by disinfection for public safety, currently by a gaseous chlorine feed system. There is one 1.6 MG reservoir of concrete prestressed post-tensioned type, constructed in 1995. Distribution mains vary from 4" to 12" diameter. The system includes 939 active service connections, seven (7) of which are located outside City limits.

S.4 WATER REQUIREMENTS

Current water requirements:

Average Daily Demand:	0.602 million gallons per day (mgd)
Maximum Monthly Demand:	1.396 mgd
Maximum Day Demand:	1.944 mgd
Peak Hour Demand:	3.490 mgd

Year 2025 water requirements:

Average Daily Demand:	1.300 mgd
Maximum Monthly Demand:	3.07 mgd
Maximum Day Demand:	4.19 mgd
Peak Hour Demand:	7.52 mgd

Year 2025 water requirements are projected with system losses of 15%, based on current water usage. This assumes that leakage and losses will be reduced, and that conservation efforts will reduce peak usage during the planning period.

S.5 FIRE FLOW

Fire flow rates are generally adequate throughout the City, and meet the requirements of the Sisters-Camp Sherman RFPD. However, the computer analysis identified several areas of low capabilities for fire protection, primarily in areas where old 4" mains exist. These lines need to be replaced because of age and service to residents, and will provide major benefit to fire capabilities throughout the City. In addition, infill is occurring in many of the areas with smaller existing mains, and this growth will require increasing water service. However, the duration and reliability of adequate fire flows is limited, and continued growth will further stress the system. Loss of a well during peak usage periods will create an emergency, and fire demands under this type of emergency could be a disastrous situation.

S.6 WATER SOURCES

Sisters has two developed well sources: Well No. 1 (City Well) and Well No. 2 (High School Well). The City holds two groundwater rights (one for each well) and numerous surface water rights. Existing groundwater rights should provide for average daily demands through the planning period, but some means of converting groundwater rights will become of increasing importance. A water right transfer will be necessary from Well No. 2 to the ultimate location of the planned Well No. 3.

One of the wells is located within City limits, and one is outside City limits. Any source of contamination within the developed parts of the City could, in theory, adversely affect the well supply within a 5 to 10 year period. In view of this, the City should take source protection seriously. Continuous review of the Source Water Assessment Report prepared in 2004 by Oregon Department of Human Services (DHS) is recommended. Contaminated sources typically require treatment (at best) or abandonment (at worst). Development of either a treatment facility or a complete new water supply to replace one of the existing wells would be very expensive for Sisters and would result in considerable inconvenience to water users prior to construction of the needed facilities.

S.7 WATER QUALITY AND DISINFECTION

Water quality associated with the active production wells is generally non-problematic. All measurable chemical concentrations well within regulated maximum contaminant limits (MCLs) or established standards. Distribution water quality is also good with levels of lead and copper well below action levels.

Sisters is not required to disinfect, but provides disinfection for public safety. Each of the well sources has gaseous chlorination for disinfection, and there are supplemental disinfection systems provided at the 1.6 MG storage reservoir, and in the transmission system for emergency purposes.

There are currently no treatment related needs or deficiencies. This determination does not extend to monitoring requirements (including the new requirements for DBPs and MRDLs).

S.8 WATER STORAGE

Sisters has a single 1.6 MG reservoir of concrete prestressed post-tensioned type, constructed in 1995. This reservoir is in excellent condition, and will provide good service through the planning period. Overall storage capacity will become a significant concern with continuing growth, and a second reservoir will be required by 2025. The Water System Capital Facilities Plan considered numerous options including the expansion of well capacity as a means of providing additional "storage", but a new 2.5 MG ground level storage reservoir will provide the best service for the expanding community. In addition to storage capacity, location of a reservoir on McKinney Butte will provide a tremendous improvement in water supply for consumptive and fire protective purposes.

S.9 DISTRIBUTION

The majority of the City's waterlines have been installed since 1980, including major system improvements in 1995. A second 12" transmission system was installed in 2002, providing redundancy to protect against a loss of portions of the single pipeline from the storage reservoir to the City. Overall, Sisters has a very good transmission and distribution system for future expansion. The distribution system is well looped with very few dead end lines. Layout is rational and systematic with 10" or 12" lines forming a distribution gridiron with internal loops. Commercial areas are well served with 10" and 12" lines looped to provide fire flows. System pressures are well within normal ranges. Hydrants are generally well distributed (with a few exceptions).

S. 10 WATER MANAGEMENT AND CONSERVATION PLAN

A stand-alone water management and conservation plan is provided in Section 10, to address requirements of OAR 690-086. The City of Sisters has been working with a regional alliance to identify and develop strategies for water use reduction and mitigation. The City Council should also consider a new rate structure based on an increased base rate for all meters, and escalating rates for metered usage. Water use conservation is encouraged by rates, requirements for low water vegetation for new development, and by the recent creation of a xeriscape landscaping guide.

Water auditing is recommended in this plan to provide more accurate records of non-metered consumption from the system. Losses from the water system have been summarized and provided in graphical form, and alternatives for reduction in water losses are recommended. Replacement of water meters on a scheduled interval is also recommended. The City should consider the installation of smart controllers for all irrigation meters, to reduce demand during wet weather periods.

A mutual water curtailment element is recommended in accordance with OAR 690-086-0160, with stages of alert for potential water shortages or water service difficulties. Projection are made for utilization of existing water rights, and a need is acknowledged that additional water rights will need to be acquired for long-term growth of the City.

S.11 IMPROVEMENT RECOMMENDATIONS - DISCUSSION

S.11.1 Well Supply Recommendations

Sisters well supply is very marginal at this time for meeting water demands of the community during Maximum Daily Demand periods. During the summer of 2005, well production could not maintain reservoir levels during peak usage periods, and additional well capacity must be developed. A water system should be able to satisfy maximum demands with its largest well out of service or storage capacity adequate to provide for demands during emergency conditions. Sisters currently does not have well capacity to provide for Maximum Daily Demands with both existing wells in operation, and reservoir storage cannot be maintained if an emergency should occur. Improved source capacity will be a necessity.

A well site will need to be located that provides minimum setbacks either through purchase, exchange, or easement. Two alternative well locations are shown on *Figure 9.3*, and the site designated as Well No. 3 would be preferred if the City could exchange an existing well site located at the end of Curtis Court. This site provides improved fire protection benefits over the alternate Well No. 4, and would improve water system capabilities tremendously. Alternative locations north of Barclay Drive may also be available from other planned developments, and this general location will provide the preferred location for a well, taking into account the hydraulic benefits of a source in this vicinity. An opinion of probable cost for a new well including construction, contingencies, potential site purchase, surveying, engineering, legal and administration, is $597,650.

S.11.2 Water Rights Recommendations

A portion of the water right associated with Well No. 2 should be transferred to the new Well No. 3 to avoid mitigation and costs involved, and to provide an alternate point of diversion. This will allow for certification of this water right and allow more flexibility in well utilization.

The City should continue to pursue acquisition of additional ground water rights for future usage, including the potential for mitigation using existing surface water rights. It appears possible that the existing surface water rights could be used for mitigation, and that ground water irrigation rights should be available for conversion to ground water irrigation rights. This alternative needs to be pursued, because it would provide for increased water usage during high usage periods, which is largely related to summer irrigation.

All water rights related work should be completed with the assistance of a qualified water rights examiner. A budget (planning) allowance for the water rights related work is $7,500.

S.11.3 Treatment/Disinfection Recommendations

There is always some potential for future regulatory changes, or water quality changes, that will necessitate treatment or further disinfection requirements.

To maintain water quality and to provide protection against coliform findings in the distribution system, it is recommended that each well be provided with an on-site chlorine generator. This type of disinfectant system provides for employee and public safety, and will assure that a chlorine residual is maintained at all times. Costs are provided with recommended improvements for each of the existing wells and for the proposed new well. Opinions of probable cost for adding disinfection to Well No. 3 are provided within the estimate provided in Section S10.1 for Well Supply Recommendations.

S.11.4 Storage Recommendations

Storage recommendations are addressed in Section 8, and include a new 2.5 MG reservoir located on McKinney Butte. Recommendations also include reconditioning of the exterior walls on the existing 1.6 MG reservoir. An opinion of probable cost for reservoir improvements, including construction, contingencies, potential site purchase, surveying, engineering, legal and administration, is $4,185,000. These improvements, including the recommendation for new reservoir placement on McKinney Butte are important, because the reservoir will serve as an additional supply interconnecting with the existing distribution grid to provide improved fire protective benefits for the City. If it is impossible to acquire a site at the correct elevation on McKinney Butte, it would be possible to construct a second reservoir on USFS land near the existing reservoir, but this alternative would need to include replacement of the existing transmission line with a new, larger main to the junction where the two existing transmission mains divert flows to town.

S.11.5 Distribution Recommendations

The Master Plan includes an analysis and recommendations for distribution improvements, with priorities provided as follows:

Priority I improvements include:

1. Installation of transmission main line meters and vaults for measuring supply quantities through each main.

2. Increasing the size of all pre-1980 distribution piping, providing improved fire protection and improved service throughout the City.

3. Installation of a new 16" distribution main from Well No. 3, interconnecting with the existing distribution grid system.

Priority II improvements include:

4. Replacement of existing water meters for improved performance.

5. Installation of new 12" distribution mains to provide capacity for new development, and to improve fire protective capabilities of the distribution system.

Priority I improvements can, and should, be implemented immediately. Revenues are available in collected Systems Development Charges for much of the planned construction, with additional funds to be acquired when State or Federal loans become available. Priority II improvements should be implemented when construction funds can be made available. It is recommended that construction loans be acquired for all recommended improvements to allow for construction with current dollars, and with repayment at very favorable rates through several funding programs that are currently available.

An opinion of probable cost for Priority 1 transmission and distribution improvements, including construction, contingencies, easements, surveying, engineering, legal and administration, is $1,772,520. Similar costs for Priority 2 transmission and distribution are anticipated to cost $ 1,526,320.

S.12 WATER RATES

The last water rate increase became effective in March 1995, and the City of Sisters removed a monthly bond repayment charge of $ 6.00 per month in 2002. Current minimum usage charges are $16.50 per month for residential service. In the future, costs should be raised annually to account for inflationary increases, which would allow the City to stay current with water system revenues.

A new water rate structure is recommended to provide revenues for project costs of system improvements that are related to equipment replacement and increased operation and maintenance expenses. It is recommended that the City continue with a base rate and an overage rate in accordance with existing policy, with an increase of $ 4.00 per month to a total monthly fee of $ 20.50 per month for residential rates. Commercial charges should be raised accordingly, and overage rates should be increased to $ 2.15 per 1000 gallons to encourage conservation in accordance with Oregon Administrative Rules. An increase should also be made in bulk water rates, to at least $ 4.50 per 1000 gallons.

S.13 FINANCING AND RATE IMPACTS

Probable financing will likely be limited to loans (based on project scope, cost, impact on rates, and City eligibility). Loans can be obtained from either Rural Development (RD) or Oregon Economic and Community Development (OECDD). RD has a longer term (40 years

vs. 20 years), and a lower interest rate (4.5% versus 6.5%). However, RD tends to have a more complicated application and environmental reporting requirements.

After a selection of the initial project scope, the City should contact OECDD to schedule a one-stop meeting with available state and federal funding agencies, to discuss project needs. When the project is presented to all the funding agencies, each agency will evaluate their programs potential to assist with financing the needed water improvements.

It is recommended that the City increase its current rate structure to provide revenues for construction, and to finance needed improvements. A modest increase in monthly use fees is recommended as previously described. Note, rates shown are based on 2005 dollars. Depending on when the rates are implemented, additional increases may be needed for inflation and other budget changes.

S.14 SYSTEM DEVELOPMENT CHARGE (SDC) RECOMMENDATIONS

The City should modify the current water system SDC to include recommended system improvements planned for development with SDC's. Water SDCs are typically based on some definable indicator of relative system utilization. EDUs are a commonly used basis. EDU's are most accurately determined from accumulated water meter sizing and estimated usage for planned developments.

Improvement SDCs apply to capacity related system upgrades or expansions. Maintenance costs, such as the water reservoir rehabilitation, are not eligible. Reimbursement SDCs can also be used to pay for loan costs specifically related to a construction project, and would be easily developed for repayment of costs incurred for planned improvements. SDCs of either type can and should be updated annually to account for inflation, based on an index such as the Engineering News Record Index. Construction improvements to be funded with SDCs for Priority I and Priority II total $ 5,857,480.

SDCs are often political and will involve time for development and for public meetings that will be needed for adoption. It is recommended that a separate SDC document be developed for presentation to the City Council and the public.

CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
WATER CONSERVATION and
MANAGEMENT PLANS

SECTION 1
INTRODUCTION

1.1 GENERAL

Sisters is located in Deschutes County, 21 miles northwest of Bend and 20 miles west of Redmond *(Figure 1.1)*. The major transportation routes between the mid-Willamette Valley and central and eastern Oregon pass through Sisters. The City is a focal point for travelers, tourists, and part-time residents. Sisters was established along the Santiam and McKenzie Wagon Roads (then Highways), around 1880, and became an incorporated City in 1946.

Resident population was estimated in 2004 as approximately 1590 people, with a significant influx of retirees, tourists, travelers, part time residents and associated commercial development. Sisters has been rapidly growing since completion of a new wastewater system in 2002, which allowed for a number of residential developments to occur.

1.2 BACKGROUND

The City of Sisters owns and operates a municipal water supply system. The system dates back to at least the 1930's, when records show the City began to obtain water rights. An upgrading of source capabilities was completed in the late 1960's, with a new surface water intake and impoundment on Pole Creek, a transmission main into town along Elm Street (Three Creek Lake Road), and new disinfection facilities. In addition, a supplemental intake was provided South of town, where the Pole Creek line crossed Squaw Creek, and surface water from Squaw Creek was planned to supply the community during extreme cold weather periods. Much of the distribution system was originally installed in very shallow trenches, often with 12" or less of protection from cold weather. During 1973, Pole Creek froze completely above the impoundment, and residents faced periodic water outages. Reports of freezing of the distribution system inside the community are also frequently heard, and some of the original wrapped steel pipe had the wrapping burned off in an attempt to defrost the pipelines and furnish water to the community.

Much of the original steel water system has been replaced over time, with asbestos cement and more recently PVC AWWA C-900 Piping. A new well was developed in 1975 as a supplemental water source for the City, and a second well was added in 1991. During 1994, major improvements were provided to the municipal water system, including construction of a 1.6 MG concrete prestressed post-tensioned reservoir. The community has utilized good planning since the 1970's to size all new facilities for growth, and the water system is generally in good condition at this point. Some of the older lines will need replacement with continued obsolescence, and community growth will dictate substantial improvements in capacity. An infiltration gallery was installed in the Pole Creek impoundment in the 1980's, and this was converted to a slow sand filter in later years, but the surface water system was unable to supply a reliable water supply to meet requirements of the Surface Water Treatment Rule. At this time, groundwater is the only water source for the City of Sisters.

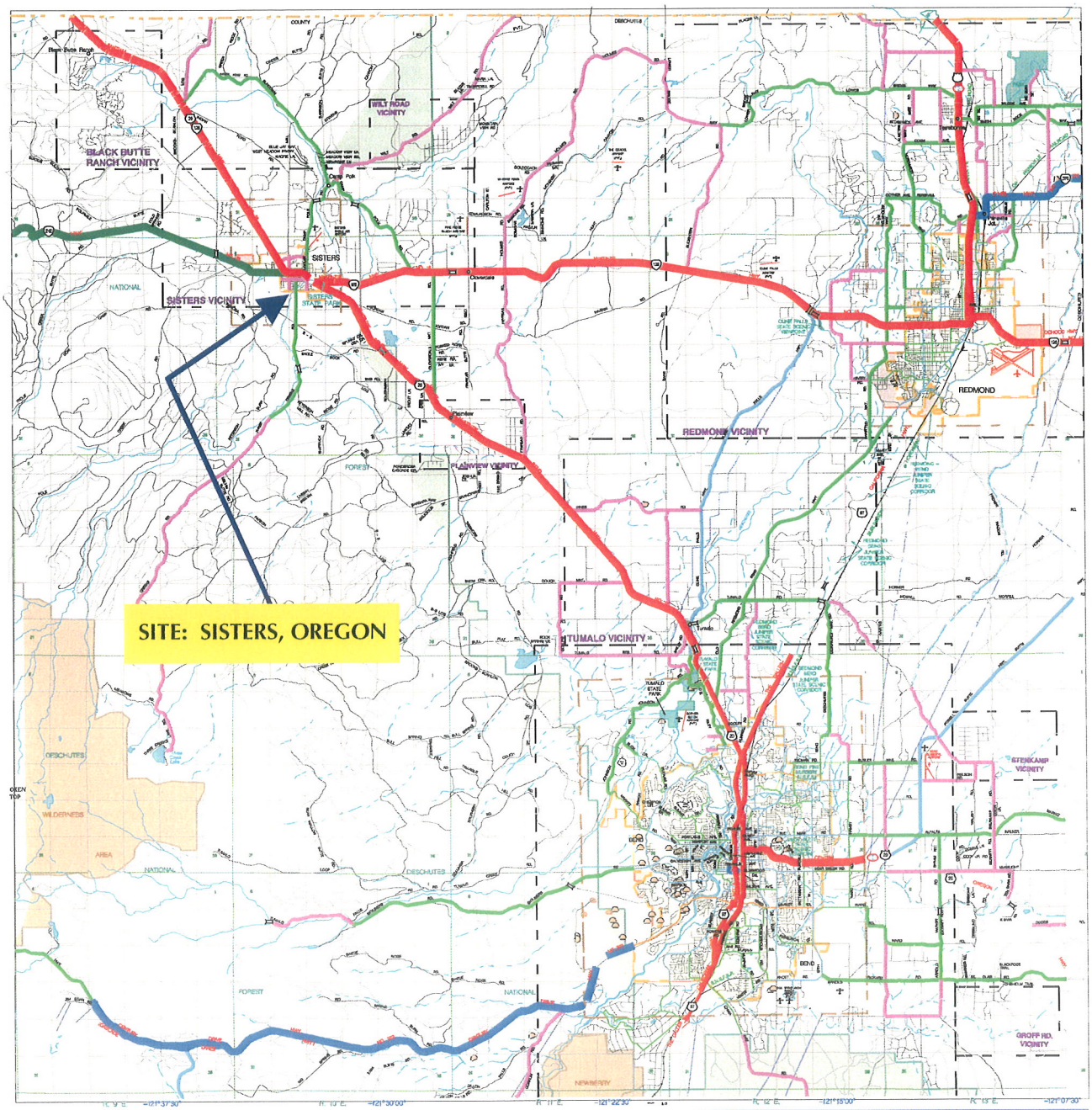


Figure 1.1
VICINITY PLAN

CITY OF SISTERS
Deschutes County
Water System Capital Facilities Plan

1.3 PREVIOUS PLANNING DOCUMENTS

Master Planning for public water improvements in Sisters has occurred on a regular basis in Sisters since the early 1970's, including the following:

1. "Comprehensive Water System Development Program," February 1975, HGE Inc. Engineers & Planners.
2. "Comprehensive Water System Development Program Update," September 1982, OBEC Consulting Engineers.
3. "Water Facilities Study," April 1988, Westech Engineering, Inc.
4. "Water System Master Plan," March 2000, HGE Inc., Architects, Engineers, Surveyors & Planners.
5. "Municipal Water Supply Data Package," May 2005, Newton Consultants Inc., and David Evans and Associates, Inc.

1.4 CURRENT SITUATION

The City of Sisters is experiencing rapid growth, which has continued at more than 11% annually since 2002. This level of growth has exceeded previous planning projections. In July 2005, the City completed a new Comprehensive Plan dating to 2025, which forecasts a population of 3,747 residents and expansion of the Urban Growth Boundary by 53 acres. The City needs a Water System Capital Facilities Plan designed with capacity to provide for an anticipated 20-year planning period. Water Rights for future community consumption are a concern, and will be addressed in this plan.

1.5 AUTHORIZATION

The City of Sisters retained HGE Inc., Architects, Engineers, Surveyors & Planners to prepare a Water System Capital Facilities Plan for current and anticipated future zoning of property within the Sisters Urban Growth Boundary (UGB). The existing agreement for consulting services was amended for HGE to develop the Water System Capital Facilities Plan. The amendment for consulting services was finalized on June 9, 2005.

1.6 ORGANIZATION

The overall structure of this Water System Capital Facilities Plan follows the flow of water from the source to the consumer. Separate chapters have been written to evaluate each of the following system components; water requirements, water supply, water quality and treatment, treated water storage, and treated water transmission and distribution. Tables and figures in this report are numbered consecutively within each chapter, and they generally appear in the text of the report on the page or pages following the first reference. A complete list of tables, figures, and plates is contained in the Table of Contents.

1.7 PLANNING AREA

The planning area used in this Water System Capital Facilities Plan is the area encompassed by the 2025 anticipated Sisters UGB. Areas outside these boundaries are included only to the extent that they pertain to water supply, storage, or transmission. The planning area, including adjacent areas relevant to planned facilities outside the UGB, are shown in *Figure 1.2.*

1.8 PLANNING SCOPE

The objective of this plan is to establish a short-term and long-term water system capital facilities plan for the present and future needs of the City of Sisters. Overall, the scope of work is meant to provide documentation for securing future water rights from the Oregon Water Resources Department, and to satisfy requirements for potential funding sources, although grant and low interest loan monies may be very difficult to obtain for Sisters. Needs will be addressed relative to water source, treatment, storage, transmission, and distribution. An outline of basic considerations of the facilities plan is as follows:

1. Describe the existing water facilities and the area to be served. Include land use, current and estimated future population, and environmental concerns.

2. Determine existing water requirements based on estimated water consumption, land use plans, and fire flow requirements. Include estimates of average daily use, maximum daily use, maximum hourly use, and peak instantaneous demand. Prepare an estimate of water demands for the next 20 years, to the year 2025.

3. Evaluate the potential water sources for present and future needs, including quantity and water rights. Include description of required or anticipated treatment /disinfection needs.

4. Description of the existing distribution, transmission, and storage systems and their ability to meet existing and future water demand. Long-range system needs will also be developed by the application of growth projections into the model, and with a detailed layout of future system needs arranged in priorities.

5. Conduct cost-benefit analysis of fire protection capabilities.

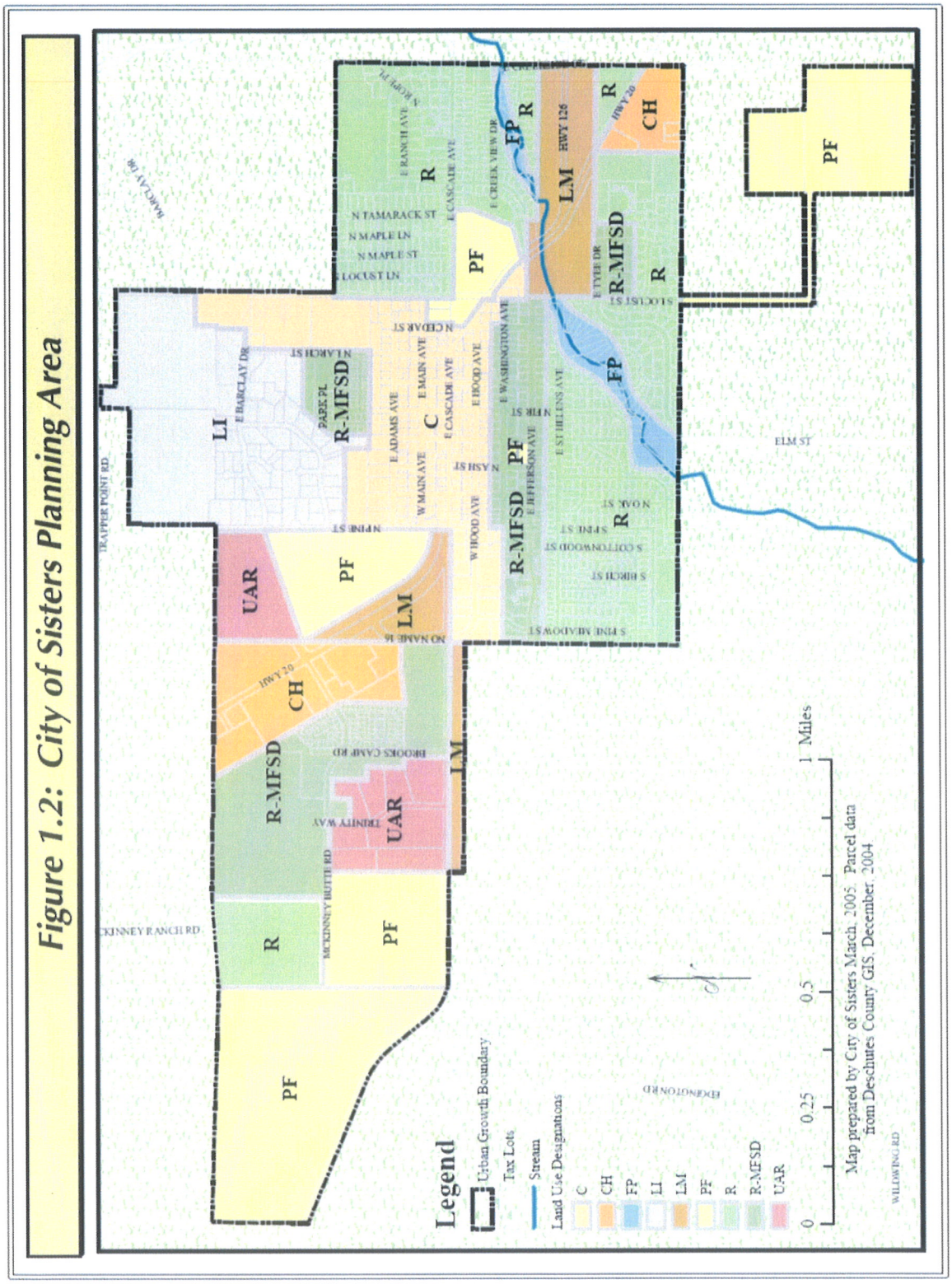
6. Prepare a Water Conservation and Management Plan.

7. Prepare a base map and show the proposed water distribution system.

8. Opinions of probable costs for various alternatives will be prepared and recommendations will be separated into priorities for development.

9. Recommendations will include a detailed plan for financing proposed improvements with local funds, federal financing, and/or a bonding program.

10. Preparation of a complete report of the work. Data will be presented to show various proposals, complete with supporting data, preliminary drawings or sketches, and opinions of probable costs.



CITY OF SISTERS
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SECTION 2
METHODOLOGY FOR EVALUATION

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SECTION 2
METHODOLOGY USED FOR WATER SYSTEM EVALUATION

2.1 GENERAL

This section of the study covers the procedure used to establish the design parameters for the proposed water system, priorities for implementation, and the method used to develop opinions of probable cost.

2.2 DESIGN PERIOD

This study is based on a 20-year planning period with future projections to the year 2025. It is felt that this time frame is adequate to allow for adaptation to future needs, while being short enough to ensure that the facilities will be effectively utilized within their economic life. System recommendations are developed for construction in phases (priorities) and all components are designed to allow future expansion. Alternate recommendations are made to future improvements which are dependent on grown patterns and other variables which cannot be accurately predicted at this time.

2.3 SYSTEM CAPACITY AND LAYOUT

Capacity requirements and consequent system sizing are based on evaluations of population, land use, and fire flow requirements. Field visits were conducted to map commercial and residential development anticipated to require service and to determine the relative density of development. Potential water demand is estimated based on published typical usage for comparable facilities, and on company experience with facilities in other communities. System layout includes an allowance for service connections; however, several of the larger commercial, industrial, and institutional customers, may require additional piping to service or reach all of its buildings or all of their connections. The larger facilities will also require larger meters, service lines, and possibly on-site hydrants.

2.4 REGULATORY REQUIREMENTS

Pertinent regulatory stipulations and requirements of the Safe Drinking Water Act are summarized in Chapter 7. Chapter 10 contains a stand-alone Water Conservation and Management Plan as required under OAR Chapter 690, Division 86.

2.5 PRIORITIES

Major water system construction requires considerable financial resources. In developing a water system capital facilities plan, it is necessary to consider the relative importance of the proposed improvements and to assign priorities to the development program accordingly. An advantage of the phased approach, especially in regard to supply and storage, is the allowance of time in which actual system usage and growth can be evaluated in order to refine the sizing of subsequent improvements.

By prioritizing the proposed improvements, construction costs can be extended over a longer period of time in an effort to remain within the financial capabilities of the community. This will allow the City to take maximum advantage of potential Federal and State grants and loans that are available to assist small communities with major water improvements. Initial improvements should be based on the most immediate critical needs and should provide the greatest benefit at the lowest cost. Later improvements should follow the short- and long-range guidelines and meet future demands as the community develops and can finance the improvements.

2.6 BASIS FOR OPINIONS OF PROBABLE COST

2.6.1 General

Opinions of probable cost presented in this study include four components, each of which is discussed separately in this section. It must be recognized that opinions of probable cost are preliminary and are based on the level and detail of planning presented in this study. As any project element proceeds forward, it may be necessary to update the costs from time to time, as more information becomes available.

2.6.2 Construction Cost

Opinions of probable construction costs in this capital facilities plan are based on actual construction bidding results for similar work, published cost guides, and other construction cost experience of the authors within the state of Oregon. Opinions of probable cost are based on preliminary layouts of the proposed improvements.

Future changes in the cost of labor, equipment, and materials, may justify comparable changes in the opinions of probable cost presented herein. For this reason, it is common engineering practice to relate the costs to a particular index that varies in proportion to long-term changes in the national economy. The Engineering News Record (ENR) Construction Cost Index is most commonly used. It is based on a value of 100 for the year 1913, and the values since 1980 are shown in *Table 2.1* along with calculated annual percent increases.

All costs in this study are based on the July 2005 ENR Construction Cost Index value of 7,430. Opinions of probable costs should be updated at the actual time of funding applications and prior to a general obligation bond election. Note that when the community secures financing, a "reserve factor" should be added at that time for estimated increases in cost due to inflation. Estimates can be prepared at any future date by comparing the future ENR Construction Cost Index with the index value of 7,430; however, this approach is generally only considered valid for a 2 or 3 year period since construction techniques and materials change with time. If more time than this has elapsed, opinions of probable cost should be updated by an Engineer.

Table 2.1: Engineering News Record Construction Cost Index with Calculated Annual Percent Increases

YEAR	20-CITY ENR (August)	% CHANGE	YEAR	20-CITY ENR (August)	% CHANGE
1980	3,304		1997	5,854	3.6
1981	3,616	9.4	1998	5,929	1.3
1982	3,899	7.8	1999	6,091	2.7
1983	4,066	4.3	2000	6,233	2.3
1984	4,146	2.0	2001	6,389	2.5
1985	4,195	1.2	2002	6,592	3.2
1986	4,295	2.4	2003	6,733	7.0
1987	4,401	2.5	2004	7,188	6.8
1988	4,541	3.2	July 2005	7,430	3.4
1989	4,607	1.5			
1990	4,751	3.1			
1991	4,892	3.0			
1992	5,032	2.9			
1993	5,230	3.9			
1994	5,433	3.9			
1995	5,506	1.3			
Aug. 1996	5,652	2.7			
Average Annual Increase (%)					**3.5**

2.6.3 Contingencies

In recognizing that the opinions of probable cost are based on preliminary design, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties that cannot be foreseen at this time, but which may tend to increase final costs. A contingency factor of 10 percent of the construction cost has therefore been added.

2.6.4 Legal and Administrative

An allowance of 5 percent of the projected construction cost has been added for legal and administration. This allowance is intended to include internal project planning and budgeting, grant administration, liaison, interest on interim financing, legal services, review fees, legal advertising, and other related expenses associated with the project.

2.6.5 Opinion of Probable Cost Summary

Opinions of probable costs presented in this study include a combined allowance of 35 percent for contingencies, engineering, legal, and administrative costs.

2.7 RECOMMENDED IMPROVEMENTS

The assessment of the proposed water system will be summarized and a recommended plan for construction will be developed in Section 13. Financing of the construction will be considered in Section 12.

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SECTION 3
EXISTING WATER SYSTEM

3.1 INTRODUCTION

This section includes a brief description of existing water facilities in Sisters. Following sections discuss components of the system in more detail and present recommended improvements.

System locations and sizing were developed from available records in the City, including extensive updates available in HGE files, prior planning studies and construction plans, on-site inspections, and the detailed knowledge of City staff.

3.2 WATER SOURCES

Sisters currently relies on two developed groundwater sources (Well No. 1 [*City Well*] and Well No. 2 [*High School Well*]) to supply the City's water needs. One well is located inside City limits and one well is located outside City limits. *Figure 3.4 and Figure 3.5* (shown at the end of this Section 3) show well locations. Each well functions as the primary well for portions of the year, with Well No. 1 functioning as the primary well in the winter months, and Well No. 2 functioning as the primary well during summer usage periods. Both wells are controlled via radio telemetry, based on level in the reservoir. In addition, Well No. 1 is set to operate in a secondary manner on pressure, and will supplement the delivery of water whenever pressures fall within the water system.

Figure 3.1: Well No. 1

Both wells were originally designed to pump 750 gpm, although Well No. 1 is now delivering approximately 600 gpm. The pump in Well No. 1 needs to be replaced with a new unit to bring the capacity back to approximately the original design capacity. Photographs of Well No. 1 and Well No. 2 are presented as *Figure 3.1* and *Figure 3.2,* respectively.

Figure 3.2: Well No. 2

3.3 WATER TREATMENT

Source water is disinfected at each well with gaseous chlorine injection system. While Oregon Department of Human Services (DHS) does not require disinfection for groundwater sources, the City of Sisters maintains a chlorine residual to provide positive protection for public health. No other treatment is required or provided in the Sisters water system.

3.4 WATER PRESSURES AND SERVICE ZONES

The City of Sisters' water system operates within a single pressure and service zone. Static system pressures range from approximately 70 psi in the south end of the City to 79 psi at the northeast corner of the City; 70 psi along Hwy. 20 near the Three Winds Shopping Complex, and approximately 54 psi at the high school on the west end of the City. Pressurization is provided by the City reservoir located approximately 2 miles southwest of Sisters, and located on U.S.F.S. land.

3.5 TREATED WATER STORAGE

Sisters has one single 1.6 million gallon prestressed post-tensioned concrete reservoir. The reservoir was constructed in 1994, rehabilitated in 2003 on the roof structure, and is in very good condition. This reservoir is located adjacent to the Pole Creek reservoir, which supplied the City with surface water for many years. *Figure 3.5* indicates the location of the existing 1.6 million gallon reservoir, and *Figure 3.3,* below, is a photograph of the existing facility.

Figure 3.3: Existing 1.6 Million Gallon Reservoir

3.6 TRANSMISSION AND DISTRIBUTION

Two transmission mains provide water to the City. An upgrade of the transmission system was completed in the 1960's, which included a new 12" transmission main from the current location of the concrete storage reservoir Northerly to the Old Brooks-Scanlon haul road, and along the haul road to Elm Street where the system is interconnected with the distribution system. When Well No. 1 was constructed in 1975, it provided an interconnection between the existing transmission main on Elm Street, and the distribution system at the South end of Pine Street. This transmission main crosses under Squaw Creek, which always was a source of concern for damage created by high water flows. A second 12" transmission main was extended from the Brooks-Scanlon haul road in 2002, extending in a North-South direction across Pine Meadow Ranch to interconnect with the distribution system in South

FIGURE 3.4: EXISTING WATER SYSTEM

SISTERS WATER SYSTEM CAPITAL FACILITIES PLAN

SISTERS, OREGON

HGE INC

ARCHITECTS, ENGINEERS, SURVEYORS, & PLANNERS

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19 N.W. Fifth Avenue/Portland, Oregon 97209 (503) 222-1687

LEGEND

- PRE 80 WATERLINE
- POST 80 WATERLINE
- (W) PRODUCTION WELL
- (R) RESERVOIR

WELL NO. 2

WELL NO. 1

SISTERS HIGH SCHOOL

SISTERS JR. HIGH SCHOOL

SISTERS ELEM. SCHOOL

URBAN GROWTH BOUNDARY/CITY LIMITS

12" TRANS LINE

FOR CONTINUATION SEE FIGURE 3.5

Pine Meadow Street. The 1960's transmission system was constructed of asbestos-cement pipe materials, and the 2002 transmission main utilized AWWA C-900 PVC pipe materials.

Distribution mains within the City total approximately 31.4 miles and range in diameter from 4 inches to 12 inches. Major portions of the distribution system were replaced in 1994 during a major upgrade of the water system. Pipe materials in the distribution system include asbestos cement, PVC, and steel.

Figures 3.4 and *3.5* show the distribution system and differentiate between pre- and post-1980 construction.

3.7 FIRE PROTECTION

Capabilities and Resources. The amount of water used in fire fighting in comparison to total yearly water consumption is negligible, but heavy demands during major potential fires greatly influence the design of the distribution system and storage reservoirs. Fire protection in Sisters is provided by the Sisters-Camp Sherman Rural Fire Protection District. Inside the City, the fire district relies on fire hydrants to supply water for fire protective purposes. Minimum requirements are 1,000 gpm in residential areas, and 1,500 gpm in commercial and industrial areas, for 6 hours.

Fire Protection Class Rating. The Insurance Service Office (ISO) sets the class rating for a community's ability to provide fire protection. A community's class rating is one of the criteria insurance companies use for establishing homeowners' insurance rates. Six inches is the minimum pipe diameter recognized by the Insurance Services Office as providing fire protection. Generally, an improvement in fire rating is difficult because rating involves both the capabilities of the water system and the fire department. Class 1 is the highest rating, and Class 10 is the poorest. Sisters has a good fire rating, with a Class 5 rating within the City limits. This fire rating is good in comparison to most communities in Oregon, and an improvement in the water supply would have a limited impact on fire insurance premiums.

In addition to the distance from a hydrant, the amount of water flow (fire flow) available at the hydrant is considered when setting insurance rates. Recommended quantities of fire flow are different for commercial and residential property, and are dependent on a number of factors such as building size, distance between buildings, building construction type, etc.

Fire flow evaluations are based on a limited level of fire suppression deficiencies. Fully sprinklered buildings, regardless of size, and any building with a needed fire flow of over 3,500 gpm will not be considered when establishing a community's protection class, except for response distance and aerial ladder needs. Buildings that have larger than a 3,500 gpm needed fire flow, and are not sufficiently protected, may have a poorer class assigned to that individual property. This puts the responsibility of fire protection for large properties or large fire protection problems on the individual property owners instead of on the community.

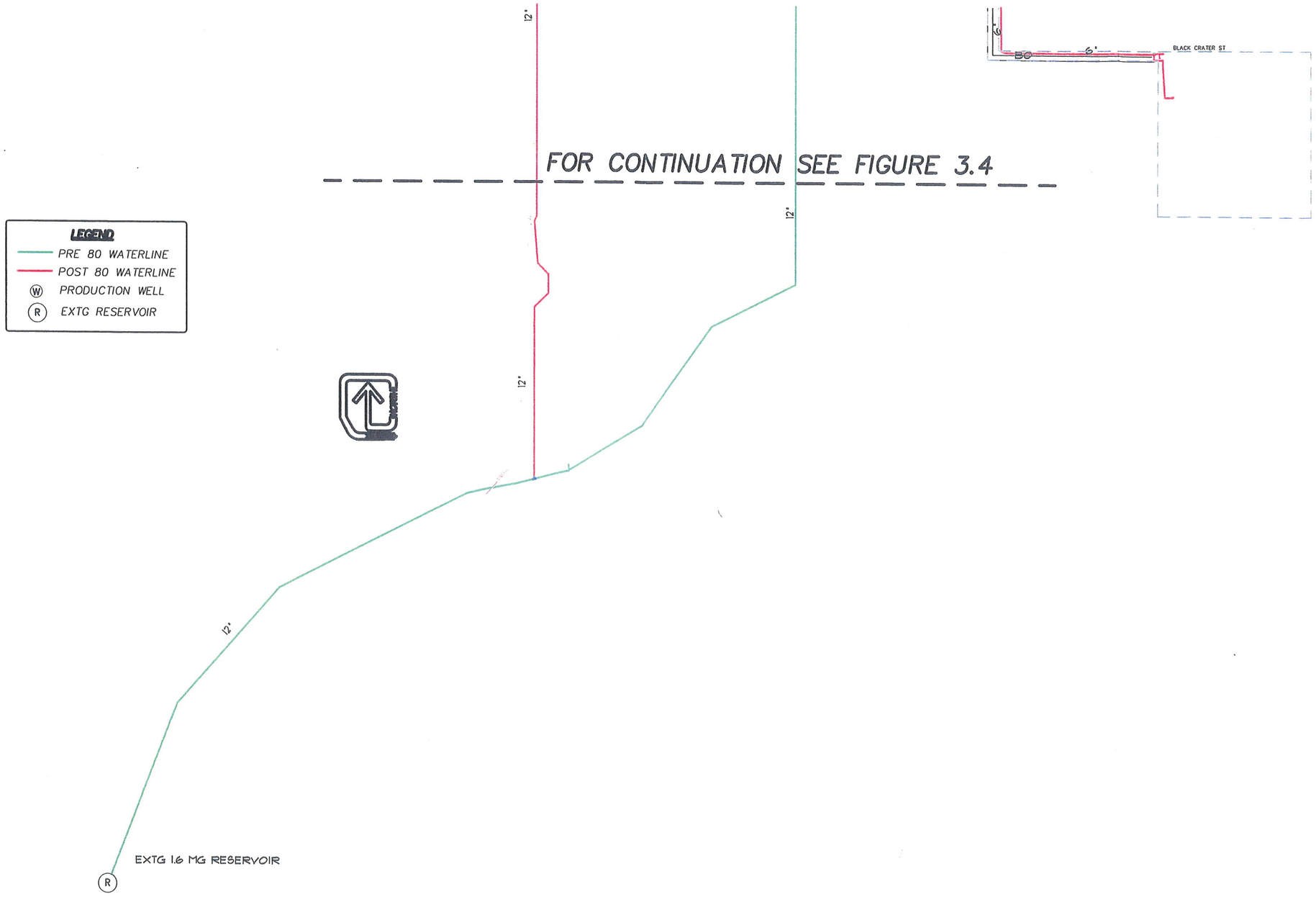

FIGURE 3.5: EXISTING WATER SYSTEM

SISTERS WATER SYSTEM
CAPITAL FACILITIES PLAN
SISTERS, OREGON

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Distribution lines need to be adequately sized to carry fire flow from storage reservoirs to fire hydrants. In the evaluation of distribution line sizing for Sisters, the desired fire flows are 2,500 gpm in the main commercial district, 2,000 gpm in the industrial parks, and 1,500 gpm for residential areas. The evaluation of distribution line sizing will be discussed in greater detail in Chapter 9.

CITY OF SISTERS
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SECTION 4
POPULATION AND LAND USE

4.1 HISTORICAL POPULATION

Sisters maintained a historical population from 600 residents to 690 residents for more than 30 years through the year 1990. Population growth was relatively stagnant between 1980 to 1990, but averaged approximately 2 percent a year from 1990 to 1996. The population reached 775 residents in 1996. Beginning in 1997, when the people approved construction funding for a public sewer system, growth has escalated rapidly, in similar fashion to the growth throughout all of Deschutes County. By the year 2000, population in Sisters had reached 975 residents, and growth has continued in excess of 11% per year since that time.

4.2 CURRENT POPULATION

The predicted population in 2005 for the City of Sisters is estimated at 1,768 residents in both the Deschutes County Coordinated Population Forecast and in the City of Sisters Comprehensive Plan.

4.3 PROJECTED FUTURE POPULATION IN 20 YEARS

The City of Sisters Planning Department and Deschutes County have estimated that population in the City will be moderate within the 20-year planning period. Population is anticipated to grow over 5% per year between 2005 and 2011. From 2012 to 2025 population is expected to grow at 3.13% per year. Population projections by both agencies anticipate that the City will reach 3,747 residents by 2025. Assuming a 3.13% growth rate between 2010 and 2025 is a reasonable long-term growth rate similar to the long-term historical growth rate for Deschutes County, and will allow for an approximate doubling of population in 20 years.

4.4 COMPARISON WITH PREVIOUS GROWTH PROJECTIONS

Previous population projections by the City of Sisters and Deschutes County, and projections in the 1988 Water Facilities Study (Westech Engineering), and 1997 Wastewater System Facilities Plan (HGE Inc., Architects, Engineers, Surveyors & Planners) substantially underestimated the growth that has occurred in the City. The 1988 projection estimated that approximately 1,100 people would reside in Sisters by the year 2005, while the remaining projections all anticipated a population in the range of 1,000 people by the year 2005. Growth has been much more rapid than anticipated in projections during the 1980's and 1990's.

4.5 CAPITAL FACILITIES PLAN POPULATION FORECASTS

Development is rapidly occurring in Sisters and is anticipated to result in population growth of 3.8% per year between 2005 and 2025. (Source: Sisters Coordinated Population Forecast, 2005.) A population of 3,747 residents is forecast for year 2025.

4.6 ULTIMATE BUILDOUT

The aforementioned population estimates assume year 2025 buildout of vacant land inside the UGB and land proposed to be included in the UGB. Ultimate population in the Sisters UGB is difficult to estimate with continuing infill and partitioning of lots in older sections of the City. It is anticipated that many of the older residents will maintain larger lot sizing, and that future years will see a tendency towards partitioning of lots for coming generations, taking into account increasing land values. Growth projections should occur within the proposed expanded UGB, with the potential for continuing population expansion as existing land area continues to be redeveloped into smaller partitions. The Sisters Planning Department anticipates increasing occupancy rates to occur within the 20-year planning period with an average of 2.2 people per dwelling unit by 2021.

4.7 LAND USE

4.7.1 Current Land Use

Current land use is shown on *Figure 1.2* based on Sisters's Comprehensive Plan and zoning ordinances. The Urban Growth Boundary (UGB) is recommended for expansion to include land for residential expansion.

4.7.2 Comprehensive Plans and Zoning Ordinance Revisions (Draft)

The City of Sisters adopted a new Comprehensive Plan in August 2005. The revisions include an updated existing land use tabulation, buildable lands inventory, and UGB expansion, and zoning changes.

4.7.3 General Comments

Sisters is primarily a residential community, with a significant tourist based economy. The City has a vibrant commercial district located on either side of U.S. Highway 20, and an expanding industrial district. Historically, there has not been a clear division between residential and industrial areas. As a result, the City has developed a zoning system that restricts industrial development to designated areas, while permitting residential development to develop in areas zoned for industrial purposes. Future industry, according to the City's Comprehensive Plan, will be encouraged to locate in areas with readily available utilities and minimal conflicts with existing development.

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SECTION 5
WATER REQUIREMENTS

HGE INC

5.1 INTRODUCTION

This section analyzes current water requirements for Sisters, including water production and water demand. The analysis was developed using water production records provided by City staff, and obtained from the web site for Oregon Water Resources.

5.1.1 Basis for Projected Future Water Requirements.

Future water requirements are based in part, on future water demand being proportional to future population growth. Implicit in this determination is the assumption that the relative proportions of residential, commercial, industrial, and institutional use will remain constant.

5.1.2 Demand Definitions.

The following terminology is used to define characteristics of water use:

Average Daily Demand (ADD): Total use for the year divided by the number of days in the year; expressed in gallons per day (gpd).

Maximum Month Demand (MMD): Total use for the month with the highest total use during the year, divided by the number of days in the month; expressed in gpd.

Maximum Day Demand (MDD): Total use for the day with the highest total use during the year; expressed in gpd.

Peak Hour Demand (PHD): Total use for the hour with the highest total use for the year; expressed in gpd.

Flow and demand parameters are typically abbreviated and expressed as:

mgd: millions of gallons per day
gpd: gallons per day
gpcd: gallons per capita per day

Other flow and demand rates commonly used include:

gpm: gallons per minute
cfs: cubic feet per second

Totalized flow and demands are commonly referred to as:

gal: gallons
MG: million gallons
cf: cubic feet

5.2 CURRENT WATER REQUIREMENTS

To determine water requirements, water usage records for a 3-year period from December 2000 to September 2003 were examined. Production records for this period are presented as a monthly summary in *Table 5.1* for each calendar year.

Table 5.1: Well Water Production
(January 2002 - December 2004)

Month/Year	Total (gal.)[1]	Average Day		
		(gal.)	(gpm)	(gpcd) [3]
2002				
January	5,016,378	161,819	112.4	118.98
February	5,227,615	186,701	129.7	137.28
March	4,821,513	155,533	108.0	114.36
April	7,933,820	264,461	183.7	194.46
May	19,318,758	623,186	432.8	458.23
June	27,063,154	902,105	626.5	663.31
July	32,408,997	1,045,452	726.0	768.71
August	36,863,908	1,189,158	825.8	874.38
September	31,836,344	1,061,211	737.0	780.30
October	16,879,949	544,514	378.1	400.38
November	6,793,918	226,464	157.3	166.52
December	5,006,411	161,497	112.2	118.75
TOTAL	**199,170,765**	**545,673**	**378.9**	**401.23**

Month/Year	Total (gal.)[1]	Average Day		
		(gal.)	(gpm)	(gpcd) [3]
2003				
January	6,461,097	208,422	144.7	145.75
February	6,722,899	240,104	166.7	167.90
March	5,133,066	165,583	115.0	115.79
April	8,628,844	287,628	199.7	201.14
May	13,147,081	424,099	294.5	296.57
June	29,330,901	977,697	679.0	683.70
July	43,266,763	1,395,702	969.2	976.02
August	42,853,659	1,382,376	960.0	966.70
September	33,080,690	1,102,690	765.8	771.11
October	19,057,901	614,771	426.9	429.91
November	6,578,766	219,292	152.3	153.35
December	5,425,888	175,029	121.5	122.40
TOTAL	**219,687,555**	**601,884**	**418.0**	**420.90**
2004				
January	7,982,479	257,499	178.8	172.82
February	10,200,899	351,755	244.3	236.08
March	8,619,828	278,059	193.1	186.62
April	13,259,040	441,968	306.9	296.62
May	18,698,458	603,176	418.9	404.82
June	25,265,323	842,177	584.8	565.22
July	34,812,073	1,122,970	779.8	753.67
August	41,382,692	1,334,926	927.0	895.92
September	34,140,030 *	1,138,001	790.3	763.76
October	19,610,580 *	632,599	439.3	424.56
November	6,769,550 *	225,652	156.7	151.44
December	5,949,919	191,933	133.3	128.81
TOTAL	**226,690,871**	**619,374**	**430.1**	**415.69**

1. All monthly flows recorded on 20th of listed month.
2. * Assumed average increase for first 8 months because reservoir was overflowing to Pole Creek (Control Failure). Average of first 8 months was 2.9% increase over prior year
3. Population Bases: 2002: 1,360 persons; 2003: 1,430 persons; 2004: 1,490 persons, PSU estimates

Average daily production (2002 - 2004 from *Table 5.1*) is approximately 0.589 mgd, but flows are increasing to correspond with construction of new homes and increased tourism. New homes in Sisters are rapidly replacing older homes, and include outside irrigation and the installation of interior appliances that utilize increasing quantities of water. Peak usage occurs in summer (typically July or August). Maximum month demand (MMD) from Table

5.1 is 1.396 mgd (July 2003). Maximum day demand (MDD), based on known well production records reviewed, is 1.944 mgd. Peak hour demand (PHD) is estimated at 3.49 mgd. The PHD estimate is based on an empirical formula (Equation 5-3) from "*Water System Design Manual*, August 2001" by the Washington State Department of Health (DOH #331-123). The equation and computation are provided below:

$$\mathbf{PHD = (MDD/1440)[(C)(N)+F]+18}$$

Where:

PHD	=	*Peak Hourly Demand (gallons per minute, gpm)*
C	=	*Coefficient Associated with Ranges of ERUs*
N	=	*Number of Equivalent Service Connections, ERUs*
F	=	*Factor Associated with Ranges of ERUs*
MDD	=	*Maximum Day Demand, (gpd/ERU)*

There are 922 current active service connections, including many restaurants, motels, commercial buildings, and three schools. For purposes of the computation, equivalent residential units (ERUs) are estimated at 1241[1]. For a range of **N**(ERUs) > 500: **C** = 1.6 and **F** = 225.

$$MDD = \frac{(0.944 \text{ mgd})(10^6 \text{ gal/MG})}{1241 \text{ ERUs}}$$

$$PHD = (MDD/1440)[(1.6)(1241)+225]+18$$
$$= 2{,}423 \text{ gpm}$$
$$= 3.49 \text{ mgd}$$

Current water demands are summarized in *Table 5.2.*

Table 5.2: Current Water Production Demands - 2003

Demand Parameter	Current Demand (mgd)	Ratio of Demand Parameter to ADD	Estimated Production Flow per Capita[1] (gpcd)
ADD	0.602	1	421
MMD	1.396	2.32	977
MDD	1.944	3.23	1,360
PHD	3.490	5.80	2442

[1] Based on Population of 1430 and 2003 records, which are latest yearly accurate recorded data.

[1] ERUs are typically determined by examining metered water use records for typical customers and customer categories. A complete analysis of users was completed in February 1996 for a water rate study, and the ratio of total ERU's to residential ERU's was utilized to estimate the ERU's for this analysis.

5.3 CONCERNS REGARDING CURRENT WATER REQUIREMENTS

Relative to population, water consumption in Sisters is high. In most smaller communities, typical residential water consumption, exclusive of irrigation, is approximately 50 - 70 gpcd. With allowances for commercial and institutional use, seasonal irrigation, and limited unaccounted for water, overall average water production expressed on a per capita basis would be 100 - 120 gpcd. The influence of tourists is obviously a major factor in Sisters water usage. *Table 5.2* shows an annual average for Sisters of 421 gpcd.

Review of winter monthly data in *Table 5.1* shows averages of 114 - 140 gpcd for some of the winter months, although per capita water usage is obviously increasing. Sisters has developed numerous weekend events to bring tourists to the City, and this is evident with the level of water consumption throughout most of the year. A large portion of the Sisters water distribution system was replaced in 1994; however, many older lines remain and could be a source of some system losses. Several creek crossings also exist, and could be potential locations for leaks. Summer water production is approximately 5 - 7 times higher than winter, indicating high summer irrigation usage for new homes, and the influence of summer tourists.

The City installed water meters in 1994, and many new meters have been installed since that time, including a conversion of meters to radio read technology. All water consumption is metered, but consumption is high for a number of reasons, including tourist usage and a need for irrigation for residences during the hot, dry summer months.

5.4 WATER CONSERVATION

As a general term, water conservation refers to the recognition of water as a limited resource and the policies and efforts implemented to limit water withdrawals accordingly. Conservation (in Oregon) is defined more formally by OAR 690-400-0010(5) as meaning elimination of waste "or otherwise improving efficiency in the use of water while satisfying beneficial uses by modifying the technology or method for diverting, transporting, applying, or recovering the water, by changing management of water use, or by implementing other measures."

Increased competition for an ever dwindling resource has prompted the State to approach the matter through regulatory actions. Oregon Administrative Rules Chapter 690, Division 86, includes requirements for preparation and submittal of Water Management and Conservation Plans (WMCP). A WMCP is a document that describes the supplier's system, usage, management, and conservation. The WMCP is a requirement for action by Oregon Water Resources Department (OWRD) on water rights related work such as permit extensions, or approvals. Originally, it provided OWRD with information on the supplier's system and needs, and guidance on planning and conservation matters for the supplier. Today, it is interpreted more as a contract between the supplier and the State. OWRD is looking for concrete and verifiable plans, and implementation schedules, rather than general recommendations or exhortations "to consider . . ." WMCP updates are required every 10

years; a progress report is required 5 years after submittal of the WMCP. WMCPs are taking on an importance comparable to Water System Capital Facilities Plans.

A WMCP for Sisters is included in Section 10. The plan contains requirements of the guidebook provided for Oregon Municipal Water Suppliers from the Oregon Water Resources Department. In addition, the City of Sisters is participating in broader regional alliances to develop strategies aimed at conserving and developing water resources in Central Oregon.

The most important conservation related issue for the City to address is reduction of system losses within the water system, which are very high at this point. Strategies for reducing system losses are discussed in Chapter 10.

5.5 FIRE FLOW REQUIREMENTS

The amount of water used for fire fighting in comparison to total yearly water consumption is negligible; however, heavy demands during major fires greatly influence the design of the distribution system and storage reservoirs. Recommended quantities of fire flow are different for commercial, industrial and residential property, and are dependent on a number of factors such as building size, distance between buildings, building construction, etc.

Recommended fire flows for single-family residential dwellings can be based on a complicated formula that includes square footage as a variable. A typical residential fire flow recommendation is 1,000 to 1,500 gpm, though smaller dwellings and wider spacing generally reduce the actual need. Dwellings with less than 3,600 square feet are identified by the Uniform Fire Code (UFC) as requiring a minimum of 1,000 gpm. Insurance Services Office (ISO) recognizes distance between residences as a significant factor. ISO recommendations include a needed fire flow of 500 gpm for one and two family dwellings, two stories or less, with a distance between buildings of over 100 feet. The ISO recommendations increase to 1,500 gpm for separation distances of less than 11 feet. Higher fire flows are needed for larger buildings and higher densities of construction characteristic of core commercial areas and schools.

Actual fire flow needs in any given area may vary widely according to the actual construction present. The Sisters-Camp Sherman Fire Protection District has established minimum hydrant flow requirements of 1,000 gpm for residential areas, and 1,500 gpm for commercial and industrial areas. They also will require that fire hydrants be available within 400 feet of any structure (800 foot hydrant spacing). "Fire hydrant capacity is established to provide for needed flow at 20 psi residual pressure," and hydrant capacity in Sisters is often substantially greater than the fire department minimum requirements. Sisters currently has a Class 5 fire protection rating (where Class 1 is best and Class 8 is worst). 40 percent of the overall grading is based on the community's water supply and characteristics. The class rating is very important in establishing local property insurance premiums. Cost of maintaining or upgrading a water system to the individual customer can often be offset, at least in part, by reduced insurance premiums associated with a more favorable system rating. In a conversation with Fire Marshall David Wheeler, ISO is currently reviewing of the rating

based on recent improvements to the water system.

The ISO review will need to address the duration of the fire flows anticipated and measured in the City. With the City's 1994 distribution improvements, major system expansion in the last 15 years, and the second transmission system installation in 2002, flow capabilities of the water system have been greatly enhanced. Flow duration is also adequate with the City's two wells (1,350 gpm combined capacity) and a 1,600,000 gallon gravity storage reservoir. Current PHD is estimated at 2423 gpm; consequently, there is zero well capacity available for fire protection, and all protection must be derived from storage. *Table 5.3* shows generalized fire flow capabilities of the current water system.

Table 5.3: Current (Generalized) Fire Flow Capability in Sisters [1]

Well Capacity		Reservoir Capacity		System Capacity	
System Water Demand (gpm)	Excess Well Capacity (gpm)	Flow (gpm)	Associated Duration (minutes)	Flow (gpm)	Duration (minutes)
2423 (PHD)	0	2,500	448	1,427	448
2423 (PHD)	0	1,500	622	527	622
2423 (PHD)	0	1,000	772	(73)	772
2423 (PHD)	0	500	1,017	(573)	1017
970 (MDD)	380	2,500	755	2,880	755
970 (MDD)	380	1,500	851	1,880	851
970 (MDD)	380	1,000	1,159	1,380	1,159
970 (MDD)	380	500	1,818	880	1,818
410 (ADD)	940	2,500	1,026	3,440	1,026
410 (ADD)	940	1,500	2,857	2,440	2,857
410 (ADD)	940	1,000	26,667	1,940	26,667
410 (ADD)	940	500	No Limit	1,440	No Limit

[1] Assumes there is no power outage since neither of the current wells has a backup power source.

A recommended flow duration for fire flows up to 2,500 gpm is two hours. From this perspective, Sisters has a system capacity of approximately 880 - 3573 gpm (depending on the system demand) for a minimum of seven hours. More is always desirable and no specified flow/duration can assure the City that it is fully protected from all fire related scenarios, particularly in a wild fire situation.

Generally, fire flow is provided by means of reservoir storage capacity that is allocated and reserved for fire protection. A flow of 2,500 gpm for a duration of two hours would require 300,000 gallons of reservoir storage capacity; a flow of 1,500 gpm for a duration of two hours would require 180,000 gallons of reservoir storage capacity. As an alternative, fire flow strategies may rely on excess supply (well) capabilities.

5.6 PROJECTED WATER PRODUCTION REQUIREMENTS

Projecting water production requirements for Sisters requires a fair amount of speculation, anticipating reduction in water losses and conservation by the community. Quantifying that reduction is highly uncertain and speculative until the sources of leakage are found, and until conservation results are achieved. "Target design numbers" from *"Water System Usage Guidelines,"* 1999, prepared by various state and federal, funding and regulatory agencies in Oregon, are provided for comparative purposes.

Table 5.4: Per Capita Water Demand Comparisons

Flow Parameter	Per Capita Water Demands	
	Sisters [1]	"Guidelines" Design
ADD	421	235
MMD	997	--
MDD	1,360	588
PHD	2,442	1,175

[1] Includes 28.3% "unaccounted for" water in 2003 and 2004.

For planning purposes, projected water requirements in Sisters will be based on the current usage plus 15% system losses for a year 2025 population of 3,747 persons. Design per capita demands and water production requirements are shown in *Table 5.5*, anticipating conservation to reduce system demands. Total system demand is illustrated in *Figure 6.1.*

Table 5.5: Year 2025 Design Per Capita Demands and Water Production Requirements

Flow Parameter	Per Capita Demand (gpcd)	Ratio of Demand Parameter to ADD	Water Production Requirements[1]	
			(mgd)	(gpm)
ADD	346	1	1.30	903
MMD	819	2.37	3.07	2,132
MDD	1,118	3.23	4.19	2,910
PHD	2,007	5.8	7.52	5,222

[1] Population Basis: 3,747 persons

CITY OF SISTERS
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SECTION 6
WATER SOURCES

6.1 WATER RIGHTS INVENTORY

The City of Sisters participated with other Deschutes County cities in developing a Municipal Water Supply Report in May, 2005. This report evaluated water rights and made recommendations for future water supply needs in the City. Water rights are shown in *Table 6.1*; water right certificates are included in *Appendix 6.2.*

Table 6.1: City of Sisters Water Rights

Source Type	Location or Facility Name	Beneficial Use Type	Application File No.	Permit, Transfer or Certificate	Priority Date	Rate	
						CFS	MGD
GW	12196 City Well #1	Municipal	10545	Certificate 66520	2/24/83	1.78	1.15
GW	30258 H.S. Well #2	Municipal	12591	Permit 11418	6/25/1991	3.34	2.16
City of Sisters Ground Water Rights Total Rate						**5.12**	3.31
SW	12198 Pole Creek	Municipal	44263	Certificate 65091	11/17/1967	1.45	0.94
SW	12198 Sisters Res.	Municipal	44263	Certificate 65091	11/17/1967		
SW	12150 7 Springs	Municipal	17149	Certificate 13509	11/1/1937	1.25	0.81
SW	13151 2 Springs	Municipal	17149	Certificate 13509	11/1/1937		
SW	13152 Pole Creek Swamp Springs	Municipal	16404	Certificate 13501	4/7/1937	1.25	0.81
SW	29954 Springs	Municipal	12560	Certificate 10028	2/11/1929	0.2	0.13
SW	30259 Pole Creek	Municipal	T 3733	Certificate 67706	12/31/1885	0.2	0.13
City of Sisters Surface Water Rights Total Rate						**4.35**	2.81
R	12197 Pole Creek	Municipal	43919	Certificate 65090	8/10/1967	6.3 ac	

Per capita water demand for Average Daily Demand and Maximum Daily Demand was estimated by annual population growth projections, utilizing existing usage figures, with potential conservation. These estimates of future water demand were used to generate the projections shown in *Figure 6.1.* The authorized rates of appropriation for both groundwater and surface water rights presently held by the City of Sisters are also shown on *Figure 6.1.* Oregon law on water rights is undergoing extensive changes, and the Oregon State Legislature has modified statutes for the Deschutes Basin extensively in the past few years. At the present time, new groundwater permits in the upper Deschutes Basin are subject to regulatory constraints for protection of scenic waters and for existing senior water rights. Mitigation rules were developed in OAR 690-505 to offset potential groundwater pumping impacts on surface waters, and to allow issuance of new groundwater permits by the Oregon Water Resources Department (OWRD). New water supply development must now account for some key considerations: 1) supply for increasing demand, 2) optimization of existing permits and water rights, and 3) mitigation for new permits. It is extremely unfortunate that

representatives of the City of Sisters filed for a groundwater certificate for the City well in 1983, which capped the permitted water use from this well at 1.78 cfs. The original permit approved for this well was for 2.93 cfs, and the reduced allocation will be a major issue over time. While this loss of right was not a major issue at the time, new regulations make it very difficult to increase water appropriations. During the preparation of this Water System Capital Facilities Plan, we did discuss this issue at length with OWRD, and with the Watermaster's Office, in the hopes that the certificate was intended to prove usage on a portion of the well. Apparently there is no file information in this regard, and the certificate is the final allocation of water rights for the City well.

Figure 6.1: Demand Graph

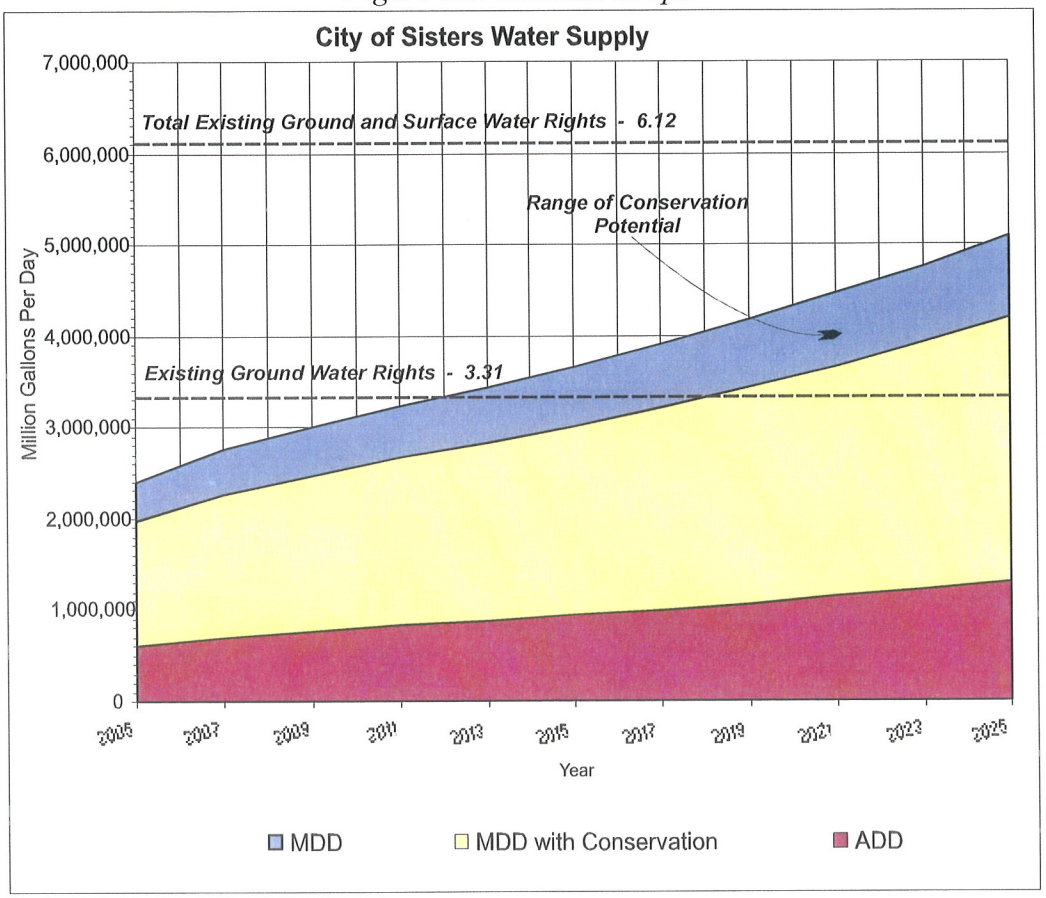

Figure 6.1 illustrates that Sisters will not utilize all of it's groundwater rights by 2025, on an Average Daily Demand Basis at projected growth. It is projected that existing rights will provide capacity to approximately 2040 if population projections correlate with actual growth. These projections assume that current policy remains in effect, and that water rights continue to be considered on an annual rather than a peak usage basis. The City also has numerous surface water rights that are not currently being utilized, but could be resurrected in the future. OWRD policy is continually changing, and it was originally believed that these surface water rights could be utilized for mitigation and leasing to other parties until demand reached the point that City usage demanded the water. OWRD has now ruled that mitigation and leasing to other parties will not be permitted. However, in discussions with OWRD staff

in this regard, it may be possible for the City to mitigate their surface water rights and secure ground water irrigation rights equal to the mitigation for summer months when water demand is high. Oregon House Bill 3494 became effective on July 29, 2005, and makes provisions for mitigation of surface rights to groundwater rights and OWRD will need to evaluate HB 3494 to determine whether it will apply to the City of Sisters. This would basically require mitigation to allow surface water rights to remain in the streams, with a conversion of rights to an irrigation allocation, and then a subsequent conversion to an increased ground water right for the summer months. In effect, the rights cannot be sold, but potentially could be converted for usage within the City. This issue is complex, and beyond the scope of this plan, but we recommend that the City retain a water rights examiner to pursue this issue with OWRD to reach resolution. A budget (planning) allowance for the water rights related work is $ 7,500.

If it is not possible to convert the existing surface water rights to groundwater rights under some type of agreement with OWRD, the City may be forced in the future to either mitigate the purchase of new rights, receive new rights from new subdivisions which desire water service from the City, install a water treatment facility to utilize surface water, or continue exploring strategies to reduce water demand. Surface water treatment is extremely expensive from both a capital and O & M standpoint, and this should be the last option for consideration. Another issue for consideration would be the conversion percentage that would apply for surface water vs groundwater, and the OWRD transfer and mitigation policy in effect at the time of conversion. For purposes of this report, we assumed that all surface water rights would remain available for the future demands of the City, and could be converted to an equal volume of groundwater rights through mitigation. Based on our analysis, with both groundwater and surface water rights held by the City, Average Daily Demands would not exceed the allocated water rights until approximately 2049. The Average Daily Demands and the Maximum Daily Demands do not exceed the combined water rights for the City of Sisters through the period of this Water System Capital Facilities Plan, under the current interpretation of water rights by OWRD. However, provisions for obtaining new water rights to serve long-term needs must be a continual consideration.

6.2 FUTURE WATER SUPPLY NEEDS

The City of Sisters is projected to need average daily flows of 1.30 MGD by the year 2025 to meets total system demands. Maximum daily demands are anticipated to reach 4.19 MGD by the year 2025, and peak hourly demands will reach 7.52 MGD on an hourly basis. Groundwater rights currently held by the City should provide adequate water for the projected average daily demands through the planning period, which is the current basis of OWRD for measuring water usage. If the regulations are later interpreted on a maximum daily demand basis, the City could not meet peak daily demands in year 2025.

Some means of utilizing existing surface water rights will need to be in place before 2040, when average daily demand is projected to exceed existing groundwater rights. An alternative would be new water rights, which should be transferred as a condition of approval for all new annexations to the City, and for approval of all new subdivisions which will

develop in the future. Usage estimates have projected savings in consumption from conservation, and the City of Sisters has groundwater available for average daily needs of the community through year 2025. However, as growth continues, the City needs to make every effort to both mitigate for usage of existing surface water rights; require transfers of new rights from potential new development or annexations; and to negotiate with existing irrigation Districts for acquisition of new water rights or usage permits that will satisfy future needs of the City. Any potential to reduce overall system demand should also be pursued.

6.3 WELL SOURCES

Well data for Well No. 1 and Well No. 2 is summarized in *Table 6.2.* Well logs are included in *Appendix 6.1.* Well locations are shown on *Figure 3.5.* Additional well information and photographs are provided in Section 3.

Table 6.2: Well Data Summary

Item	***Well No. 1 (City Well)***	***Well No. 2 (High School Well)***
Construction Date	1975	1991
Well Depth (ft.)	211'	302'
Static Water Depth (ft.)	85'	101'
Pump Setting (ft.)	120'	158'
Casing Perforation Depth Range (ft.)	50-195.6'	242' - 302'
Grout Seal Depth (ft.)	40'	34'
Casing Diameter (in.)	14"-12"	14"-10"
Pump Type	Line Shaft Turbine	Line Shaft Turbine
Horsepower	75 Hp	75 Hp
Capacity (Measured)	750 Original-600 Present	750 gpm
Flowmeter	Yes	Yes
Flowmeter Type	Propeller	Propeller
Emergency Generator	Purchased, being installed in 2005	Purchased, being installed in 2005
Fuel/Tank	Diesel mounted under generator	Diesel mounted under generator
Alarm	Siren at wellsite. Light at wellsite.	Siren at wellsite. Light at wellsite

The well building for Well No.1 (City Well) was constructed in 1976, and is in fair condition. The structure includes within a single room: piping, valving, flowmeter, controls and pump to waste.) The station is small, lacks ventilation, and has safety concerns that need

to be addressed. The motor for the pump was rebuilt once, and has functioned well since the original construction, but is becoming antiquated for dependable performance. Electrical switchgear has had several problems through the years, and many electrical modifications with different contractors. Soft starting equipment was installed in 1995 to reduce power demand, and the installation was modified to allow remote operation from Well No. 2 by radio telemetry. In general, the electrical for this station is antiquated and difficult to maintain. Original construction plans are no longer accurate, and electricians have difficulty understanding operation of the facility. A separate room has been provided for the addition of gaseous chlorine as a disinfectant.

Ventilation for this building is poor, and reliability will become an increasing concern. Gaseous chlorine poses safety concerns, and a better alternative would be to install an on-site chlorine generator for this facility.

The well building for Well No. 2 (High School Well), was constructed in 1992, and is generally in good condition. A chlorine leak developed in the mid 1990's, and electrical controls were rebuilt in 1995. This facility includes two rooms within a single building. One room includes piping, valving, flowmeter, pump to waste, and electrical controls. A second room is provided for gaseous chlorine, which is used as a disinfectant.

The electrical controls include soft starts for pump efficiency, and a radio controlled system to operate both Well No. 1 and Well No. 2, with level signals received from the storage reservoir. Once again, gaseous chlorine is a safety concern, and on-site generation facility would function well at this location.

6.4 WATER AVAILABILITY

Sisters water supply is very marginal at this time for meeting water demands of the community during Maximum Daily Demand periods. During the summer of 2005, well production could not maintain reservoir levels during Maximum Daily Demands, and additional well capacity must be developed. One well should always be available for redundancy purposes, and Sisters currently has no backup and well capacity which does not meet Maximum Daily Demands with both existing wells in operation. Since water rights are currently monitored on an Average Daily Demand basis, water rights are available for projected needs. Future water usage projections have been reduced for the future, anticipating that conservation would be implemented to limit system losses to 15%.

Increased well capacity will be a necessity, and a new well with capacity of 1,560 gpm, or 2,246,000 gpd will be required immediately. This well would function during peak demand periods, and the two existing wells should be capable of meeting system demands on an Average Daily Demand basis. To economize in operation, one of the two existing wells could operate full time during ADD periods, with the second pump utilized to maintain reservoir levels. The new pump would operate during heavy usage periods, with one of the smaller pumps operating to supplement flows and to maintain reservoirs levels during peak usage periods. The existing City Well No. 1 should be retrofitted with a new pump to

increase output to 750 gpm, and to lower the pump in the well, which would help to maintain reservoir levels during peak demand periods. Sisters has recently purchased standby generation units for Well No. 1 and Well No. 2, and these will be installed in the near future. The new well No. 3 should not require standby generation, since adequate capacity will be available from the existing wells to assure operation during peak demand periods. Well No. 3 and/or No. 4 should receive an on-site generation system for disinfection purposes. Modern telemetry should be provided for the entire system, to allow monitoring, well and reservoir operation from remote locations. Costs should be an integral portion of the electrical system provided for new source construction.

The City's water rights are adequate for projected needs during the planning period. Additional groundwater rights will be necessary before 2040, and this can be achieved through several alternatives described previously. The following considerations must be considered to maintain availability of an adequate water supply:

- If a power outage should occur during times of Maximum Daily Demand, the existing wells must have standby capabilities to keep the City supplied and to maintain reservoir levels.

- Construction of a proposed Well No. 3 or Well No. 4 should provide needed system capacity for the design period. The potential exists for an agreement to make water available from an existing well located in the vicinity of Well No. 4.

- Planning for the future should include a fourth well, which will be required in the foreseeable future.

- Location for water losses during summer months must be found, and the usage must either be metered or terminated.

- An increase in water rates incorporating consumption considerations, should lower City water demand consistent with future water requirements described in Section 5.

- Community growth must be consistent with projections.

- That maintenance of all wells be performed during non peak usage periods, such that all wells are available during periods of high demand.

- That source contamination does not occur.

6.5 SOURCE PROTECTION

All water sources are susceptible to contamination. Source protection involves a delineation of the area of significance surrounding the source, identification of potential risks, and contamination sources, and development of strategies to preserve source quality.

Oregon Department of Human Services (DHS) completed a delineation of a drinking water protection area (DWPA) for Sisters on September 26, 2002. Contours were developed for 1, 2, 5, and 10 year time of travel intervals. A full report *(Source Water Assessment Report)* was prepared in May 2004. The resulting report is included in *Appendix 6.3.* Major segments of the City are included within the 10 year time of travel contours.

Source protection should be taken seriously. Contaminated sources typically require treatment (at best) or abandonment (at worst). Treatment or development of a new source would be very expensive for Sisters and could result in considerable inconvenience to water users prior to construction of the needed facilities. Compliance by neighboring, or other, properties within the designated protection area will require goodwill efforts from both the City and property owners to ensure compliance with setbacks as well as other land and materials use issues that could adversely affect groundwater quality. City staff should be mindful of precautions related to fuel and chemical storage near the well sites, including potential hazards associated with leaks and spills. In the future the City may wish to develop a Community Drinking Water Protection Program. Minimum setback distances for wells are included in OAR 690-210-0030 and can be summarized as:

- 50 feet of any septic tank
- 100 feet of a septic drain line or sewage disposal structure or facility
- 50 feet of a closed sewage or storm drainage system
- 50 feet of a confined animal feeding or holding area
- 50 feet of any animal waste holding area such as a pond or lagoon
- 100 feet of any sewage sludge disposal area
- 500 feet of hazardous waste storage, disposal, or treatment unit.

6.6 WELL SUPPLY RECOMMENDATIONS

The existing wells have deficiencies meriting special attention during the planning period. A new well will need to be constructed immediately, with a transfer of water rights from Well No. 2. All wells should be converted to utilize on-site chlorine generators. Well No. 1 should have the pump replaced, and a complete new building and electrical system provided. Pumps from any of the wells may need to be rebuilt or replaced at some point in the planning period; however, given the relatively benign (non-corrosive) environment, this is by no means certain. Costs for rehabilitation or replacement of a pump can typically be handled with reserve funds or operating contingencies.

It is generally desirable for a community with a well supply to be able to meet its peak daily demand with its largest well out of service. Often this is achieved by providing sufficient

storage. Since Sisters has limited storage until a second reservoir is constructed, at least one backup well should be provided. By constructing one new well with capacity to serve current maximum demands, the City would maintain one of the two existing wells for redundancy until the second reservoir is constructed. Although the existing wells could not provide for maximum daily demand with the new, largest well out of service, one of the two existing wells would provide adequate backup capacity. A new reservoir is also proposed as a portion of this Water System Capital Facilities Plan, and a combination of increased storage and increased well capacity will provide adequate reliability for the City through the planning period. Reliability would be provided for both hydraulics, and to protect against contamination occurring at one of the wells.

A site would need to be located that provides minimum setbacks (see Section 6.4) either through purchase or from a proposed subdivision. While the existing wells are constructed in alluvial materials (sand, gravel, clay, etc.) and, presumably, these alluvial deposits extend throughout the City, it would nevertheless be advisable to include a qualified hydrogeologist on the design team to assist with locating a site. In addition, site selection should consider proximity to known potential contamination sources (see *Appendix 6.3*). Ideally, the well will be comparable to Well No. 2: approximately 300 feet deep, 14" casing, approximately 1,560 gpm, with a total dynamic head of approximately 290 feet. The well should be provided with on-site chlorine generation.

An opinion of probable cost for water rights related work is provided in *Table 6.3.* New construction of a building, electrical, telemetry, and on-site chlorine generation improvements at Well No. 1, is developed in *Table 6.4.* Installation of a new on-site chlorine generation unit and telemetry improvements at Well No. 2 is provided in *Table 6.5.* An opinion of probable cost for a complete new Well No. 3 is developed in *Table 6.6*, and a summary of water source costs is provided in *Table 6.7.*

Table 6.3: Water Rights Transfers and Related Work
Opinion of Probable Cost

	Opinion of Probable Cost
Water Rights Examiner Transfers of Existing Rights:	$7,500
Total Capital Costs:	**$7,500**

Table 6.4: Proposed Well No. 1 Improvements
Opinion of Probable Cost

	Opinion of Probable Cost
Mobilization:	$12,000
New Deep Well Vertical Turbine Pump	$27,500
Misc. Electrical/controls/telemetry:	$50,000
Misc. Plumbing:	$10,000
Well Building:	$125,000
Installation of On-Site Chlorine Generator:	$48,000

Subtotal Construction Cost:	**$272,500**
Engineering and Construction Observation:	$54,500
Legal and Administrative:	$13,625
Contingency:	$27,250
Total Capital Costs:	**$367,875**

Table 6.5: Well No. 2 - Installation of On-Site Chlorine Generator
Opinion of Probable Cost

	Opinion of Probable Cost
Mobilization:	$3,000
Installation of On-Site Chlorine Generator:	$48,000
Electrical Controls, Telemetry	$10,000
Subtotal Construction Cost:	**$61,000**
Engineering and Construction Observation:	$12,200
Legal and Administrative:	$2,550
Contingency:	$6,100
Total Capital Costs:	**$81,850**

Table 6.6: New (1,560 gpm) Well No. 3
Opinion of Probable Cost

	Opinion of Probable Cost
Mobilization	$20,000
New Well, (14" casing, 300' depth, 1,560 gpm):	$43,400
Pump Test, Grouting:	$5,100
New Deep Well Vertical Turbine Pump:	$27,500
Misc. Electrical/controls/telemetry:	$50,000
Misc. Plumbing:	$10,000
Well Building:	$125,000
Installation of On-Site Chlorine Generator:	$48,000
Subtotal Construction Cost:	**$329,000**
Engineering and Construction Observation:	$65,800
Legal and Administrative:	$16,450
Site Survey:	$3,500
Site Purchase:	$150,000
Contingency:	$32,900
Total Capital Costs:	**$597,650**

Table 6.7: Summary of Water Source Costs
Opinion of Probable Cost

	Opinion of Probable Cost
Water Rights Transfers and Related Work:	$7,500
Well No. 1 Proposed Improvements:	$367,875
Well No. 2 - Installation of On-Site Chlorine Generator:	$81,850
Well No. 3 - New (1,560 gpm):	$597,650
Subtotal Capital Costs:	**$1,054,875**
Total Capital Costs:	**$1,054,875**

6.7 WATER RIGHTS RECOMMENDATIONS

A portion of the water right associated with Well No. 2 should be transferred to the proposed Well No. 3. This can be done by designating the new well as an alternate point of diversion since, it appears, the wells draw from the same aquifer. This will preserve the water right and allow more flexibility in well utilization.

If a new well is constructed, then the City's existing water rights should be transferred to include it as an alternate point of diversion. This is essential to the use of the new well. New water rights are not readily available and the City require additional capacity.

Under emergency (fire flow) conditions, all wells may be operating. This possibility has been previously discussed with Water Resources on a similar project, since it was unclear as to whether or not this would be violating the rules. Surface waters can be used for fire protection without a water right (it is noted as an exempt use), but the rules are mute with regard to the use of groundwater for this purpose. Water Resources did not see a problem with use associated with a bonafide emergency.

CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
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WATER CONSERVATION and
MANAGEMENT PLANS

SECTION 7
WATER QUALITY AND TREATMENT

7.1 REGULATORY OVERVIEW

The 1974 Safe Drinking Water Act (SDWA) and subsequent amendments regulate drinking water quality at the federal level. The states may utilize the minimum requirements provided for by the federal regulations or develop more stringent standards. States also have flexibility in regulating treatment technologies and design parameters to achieve or assure the minimum requirements for finished water quality.

In Oregon, the Oregon Department of Human Services (DHS), Drinking Water Program has the primary responsibility of administering federal and state regulations of public water systems. Oregon Administrative Rules (OAR) Chapter 333 includes the rules for public water systems. The complete rules are available in several formats online at http://oregon.gov/DHS/ph/dwp/pwsrules.shtml.

Sisters is in compliance with all State Regulations of Chapter 333. However, to assure compliance with the regulations, the City has elected to provide groundwater disinfection in accordance with OAR 333-061-0032. Disinfection is provided to approximately 0.3 mg/l on a normal basis.

In 1994, the DHS notified the City of new monitoring requirements for disinfection by-products (DBPs) and maximum residual disinfection levels (MRDLs). Any community using a disinfectant is required to meet the new standards. Sisters relies on groundwater sources, but it is unlikely that DBPs are a concern because of the very limited level of disinfectant. The DHS website (http://www.oregon.gov/DHS/index.shtml) has a considerable amount of guidance information.

7.2 WATER QUALITY

7.2.1 Well Water Quality

Water quality associated with the two production wells is generally non-problematic with all measurable chemical concentrations well within regulated maximum contaminant limits (MCLs) or established standards. *Table 7.1* includes chemical concentrations for selected chemicals. Selection is from the Oregon Department of Human Services (DHS) Drinking Water Program database for Sisters, and from existing records of the City. Only chemical tests showing a positive result - as opposed to "no detection" (ND) - are included in the Table. DHS' database for Sisters includes test results from 1982 to 2005:

Table 7.1: Recent Historical Water Quality - Selected Parameters, 1982 - 2001

Parameter	Well No. 1 Concentration (mg/l)	Well No. 2 Concentration (mg/l)	MCL (mg/l)
Arsenic	0.0018-0.0030	0.0013	0.01[1]
Barium	-	0.003	2
Nitrate	0.08-0.49	0.17-1.02	10
Sodium	0.36 -5.00		--
Flouride	0.08-0.13	0.12	4.0
Chromium	0.0005	–	0.1
Sulfate		41	--
TThm*	0.0017 - 0.0086	ND	0.010

**Total Trihalomethanes*

7.2.2 Distribution System Water Quality

Distribution system sampling for copper has always been well below the action level for copper of 1.3 mg/l.

Distribution system sampling for lead has also always been well below the action level for lead of 0.015 mg/l.

7.3 EXISTING TREATMENT AND DISINFECTION FACILITIES

There are no treatment facilities in Sisters other than gaseous chlorination at each of the well sources and at the reservoir. While disinfection is not currently being used at the reservoir, it is available for emergency usage, and is available in the event of terrorist activities. Vacuum operated chlorinators are fed, via plastic tubing, directly into the water supply at either well, and at the existing 1.6 MG reservoir. The feed rate is controlled by manual adjustment of the rotometers on each unit. Monitoring of chlorine residual occurs throughout the distribution system. Disinfection is used when well pumps or the reservoir control structure is operating. Contact time is minimal, but disinfection is not required, and mixing occurs rapidly after introduction of chlorine.

Discussions with DHS did not indicate a concern with the present system. Sisters is not required to disinfect the existing wells and disinfection is viewed as "probably doing no harm." Based on this discussion, and review of current water quality and regulatory requirements, there are currently no treatment related needs or deficiencies. This determination does not extend to monitoring requirements - the City must comply with all monitoring and submittal requirements including new requirements for DBPs and MRDLs.

7.4 POTENTIAL FUTURE TREATMENT AND DISINFECTION NEEDS

There is always some potential for future regulatory changes, or water quality changes, that will necessitate treatment or disinfection.

Positive and recurring coliform findings in the distribution system could necessitate increased disinfection and the maintenance of a higher chlorine residual. On-site mixed oxidant generation is the generally preferred disinfectant in community water systems because of low operating cost, relative safety, and ease of handling. Provision of an on-site mixed oxidant generator for disinfection at each site would entail the following, which is not a mandatory requirement at this time:

- Provision of adequate contact time (30 minutes minimum) between mixed oxidant injection and first customer. Therefore, each source would need to have its own disinfection facilities.

- Since the City's wells are located in or adjacent to town, they have very short transmission mains. If contact time was required, it would need to be provided on site. This could be done with a suitably baffled tank but is not recommended at this time because disinfection is not required for a protected ground water system.

- On-site mixed oxidant generation equipment consists of an on-site mixed oxidant generator, a small mixing tank and chemical feed system. Typically, this is housed in a building such as a well building. The feed system is sophisticated enough to allow precise adjustment and consistent delivery of the mixed oxidant solution.

  Opinions of probable cost for adding disinfection including contact time are presented in *Tables 6.4, 6.5,* and *6.6.* If disinfection becomes a requirement, then any new wells would also need disinfection facilities.

A degradation in well water quality could also result in the need for treatment if any of the regulated chemical parameters are exceeded. A large unincorporated area is within the 10-year travel time area to either Well No. 1 or Well No. 2 (see *Appendix 6.3*); consequently, there will always be some potential for well contamination. Because of the very high cost of providing true treatment facilities, it is generally preferable to rehabilitate the well, or move it to another area. If contamination of a well should occur, the City should immediately contact DHS for guidance. Addressing the matter will probably require engineering assistance to develop short and long-term strategies for dealing with the problem.

CITY OF SISTERS
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SECTION 8
WATER STORAGE

HGE INC

8.1 REGULATORY OVERVIEW

There are no specific regulatory requirements related to capacity and sizing of reservoir storage for finished water in the State of Oregon. OAR 333-061-0025 requires water systems to maintain a minimum of 20 psi pressure at all service connections in the distribution system at all times. This requirement is related to reservoir storage insofar as compliance is generally not practicable without sufficient storage to meet equalization, fire flow, and emergency reserve demands. In Oregon, system storage needs are determined in accordance with applicable general standards or specific guidelines (Section 8.2).

8.2 STORAGE DESIGN GUIDELINES

8.2.1 Capacity Guidelines (Specific)

In 1999, an interagency team made up of personnel from the Department of Environmental Quality, Oregon Economic and Community Development Department, the Health Division, the Oregon Water Resources Department, the USDA-Rural Utilities Service, Rural Community Assistance Corporation, and the Department of Land Conservation and Development developed *"Water System Usage Guidelines - Developing Target Design Numbers for Community Water System Projects."* The Guidelines were developed as part of an effort to standardize interagency policies and, specifically, to address agency concerns that many water system improvement projects appeared to be "larger than needed." Size relates to cost, and, in turn, to the demand on limited grant and low interest loan funds available through state and federal agencies. The manifest agency goal is to balance level-of-service objectives with available funds in order to maximize the benefits to a larger pool of qualified applicants.

The guidelines are not intended as absolute criteria for design; rather they are a starting point. Increased storage beyond guideline recommendations will likely require adequate justification from the perspective of potential funding agencies involved in development of the guidelines.

Storage guidelines provide for *"two and one half day's storage at average daily demand*[1] *plus 180,000 gallons for residential fire protection."* For purposes of the computation, a guideline average daily demand usage of 235 gpcd is indicated. The figure is based on a state-wide average and includes allowances for commercial and industrial activity. Deductions are expected for predominantly residential communities, and higher usage may be justified based on unique circumstances such

[1] "Two and one half day's storage at average daily demand" is approximately equal to "maximum daily demand" in Oregon communities based on peaking factors (multiplier) frequently used in Master Planning.

as a high level of tourists or travelers. Sisters is experiencing rapid growth and increases in reservoir capacity are relatively inexpensive during the construction process.

8.2.2 Capacity Guidelines (General)

As noted above, (Section 8.2.1), the agency guidelines for Oregon were developed to address perceptions and concerns that many reservoir projects provided excessive capacity. Water System Capital Facilities Plans reviewed by the authors typically provide for "rule-of-thumb" reservoir capacity design of three times average daily usage plus fire flow (3xADD+FF). Fire flow storage is based on a desired flow rate multiplied by an appropriate duration. Fire flow capacity allowances incorporated in Master Plans vary considerably based on community characteristics, fire department recommendations, and consultant predictions. Capacity based on maximum day usage plus fire flow (MDD + FF) is also common and typically results in somewhat lower total capacity.

The rule of thumb approach, that favors either (3 x ADD) + FF or MDD + FF, gain their authority primarily through established and common usage amongst consulting engineers in Oregon, and throughout the country. The determination implicitly incorporates subjective considerations of risk and reliability.

8.2.3 Reservoir Storage Capacity Design Considerations

Typical reservoir storage requirements can be analyzed into three components: operational (or equalization) storage, emergency storage, and fire reserve.

Operational (or equalization) storage provides for any period during a 24-hour day where water demand exceeds supply capabilities (i.e., wells or treatment facilities) or for when supply sources are off-line. Operational storage can allow treatment facilities (with adequate capacity) to be operated for a minimal and continuous period of time, thereby reducing staff demands and associated costs. For well based systems, it allows efficient cycling of well pumps.

Emergency storage provides for interruption of supply. Supply can be interrupted for many reasons including, but not limited to: mechanical failure of required treatment or pumping facilities; source contamination; electrical outage with no, or inadequate, backup power provisions; or shut-downs for maintenance or improvements. Emergency storage is not intended to provide for extended interruptions of supply associated with droughts or catastrophic system failures requiring prolonged repairs or replacement.

Fire reserve provides storage volume based on the desired fire flow rate and duration of availability. It is important to note that in many communities, there are parts, such

as isolated pressure zones with relatively few connections, that may not be economically served with fire protection to the same extent as the bulk of the community. Fire reserve storage for reservoirs in these areas may be functionally nonexistent. Often, telemetry can be utilized on such reservoirs to trigger booster pumping as the reservoir level drops, and with further level drops, possibly triggering a high service pump to provide some minimal fire flows to the area.

Emergency storage and fire reserve are essentially a kind of insurance. As with any insurance, cost increases with extent of coverage and, to a large extent, the actual risks for any particular case are not fully known or quantified. Also, there are no guarantees associated with any storage recommendations that the volume will be adequate for any specific fire or emergency condition that may arise.

In general, from an emergency and fire reserve perspective, more storage is always better. For smaller communities, the desired fire reserve can be a major component of overall storage. However, too large a storage volume in relation to average or minimal daily demands can result in water quality problems (i.e., bacterial re-growth) related to dissipation of disinfectant residuals. If this occurs, additional disinfection facilities will be needed at the reservoirs, and Sisters has this capability in place for the existing reservoir.

For smaller communities, detailed and accurate data is rarely available, or practicably obtainable, for a precise quantification of operational and emergency storage requirements. Even when available, there are qualitative considerations (i.e., perceived risk) that are not easily quantified and incorporated.

The rule-of-thumb guidelines provide a reasonable basis for smaller community reservoir sizing and are not likely to result in water quality problems. However, because of the high influx of tourists in Sisters, it is critical that adequate storage be available to satisfy needs during peak demand periods, and it is recommended that consideration be given to storage in excess of the storage capacity guidelines recommended by the interagency team.

8.2.4 Other Storage Related Design Considerations

In addition to storage volume, there are several other considerations involved in developing new storage facilities:

Reservoir Types and Materials. Reservoir types include:

- Ground level, gravity flow storage is generally the most desirable storage from the standpoints of operational simplicity and cost. It requires available land at suitable elevations and within reasonable distance from the water system. This type of storage comes in various standard diameters and heights

and, within the variety available, it is often possible to adjust to the occasionally varying constraints of available site elevation and desired water surface elevation. Reservoirs with a height to width ratio greater than one are referred to as standpipes. A gravity based system remains operational during power outages.

- Ground level, pumped storage is commonly utilized for communities with no or limited access to sites with suitable elevation for gravity flow. These systems tend to be mechanically complex and vulnerable to operational and maintenance problems. Capital and O&M costs are significantly higher than a ground level, gravity based system - although, this may be offset by cost savings associated with reduced transmission main construction and potential elimination or reduction of site acquisition and development costs.

- Elevated storage is also frequently utilized by communities with no, or limited, access to sites with suitable elevation for ground level, gravity flow storage. This type of storage is rarely used for new construction in Oregon because of the general availability of hillsides and the additional costs associated with structural needs to meet seismic considerations. Costs can be up to ten times greater, on a per gallon stored basis, than on comparable ground storage; nevertheless, an elevated storage facility can, when coupled with adequate ground level, pumped storage, provide numerous benefits including:

    - Maintain an even and desirable system pressure without complex mechanical/pumping facilities.

    - Reduce reliance on ground storage, thereby minimizing cost of pressure reducing/then pressurizing flows through the ground level storage.

    - With level sensors and telemetry, the reservoir can be used to start/stop system components such as wells, treatment facilities, booster pumps, and fire pumps.

    - Depending on the site selected, the reservoir may provide local flow/pressurization if a key main is offline for maintenance/repair.

The selection of reservoir type will depend on the variables involved. In the absence of any special circumstances, ground level, gravity flow reservoirs are preferable because of cost (capital and O&M) and reliability.

Reservoirs are typically constructed from steel or concrete. Steel reservoirs are generally less expensive to construct for capacities typically utilized by smaller

communities, but are potentially more expensive to maintain because of susceptibility to corrosion. Material selection also depends on site conditions. If the reservoir is partially or completely buried, it should be constructed of concrete since it is not possible to access buried locations for painting.

Water Surface Elevations. Water surface elevation is important for any gravity based storage facility. Typically, water surface elevations are selected to match those in existing facilities within established pressure zones. For storage replacement projects, consideration of other elevations will often be warranted to address established or anticipated system pressure problems. With adequate valving and controls (i.e., altitude valve or equivalent) it is possible to have different maximum water surface elevations in different reservoirs within the same pressure zone; however, doing so makes the system considerably more complex and vulnerable to mechanical problems and/or additional O&M requirements.

The desired water surface elevation significantly limits reservoir site selection options if ground level storage with no booster pumping facilities is desired.

Site Location. As noted above, site elevation is a primary consideration in selecting a site for ground level storage with no booster pumping facilities. Additional considerations include:

- Whether to site additional storage adjacent to existing facilities or to distribute new storage to other locations. It is generally desirable to distribute storage to enhance system performance and reliability. This is particularly critical where long transmission mains exist, and where a water supply from more than one direction can supply the distribution grid for optimum performance, which will minimize line sizing. A reservoir supply from more than one location also improves performance and redundancy capabilities, since the transmission lines are separate. Reservoir location near existing facilities can often simplify site acquisition and reduce overall improvement costs.

- Whether a proposed site can be readily accessed at any time of year.

- Whether existing zoning and surrounding development will complicate, hinder, or prohibit development of proposed storage on any given site.

- Whether the site is suitable for constructing a reservoir. Water storage reservoirs are considered "essential structures." A geotechnical evaluation is required for any proposed site.

- Whether there are any probable environmental issues associated with the site.

- Whether the site can be kept relatively secure from vandalism or other unauthorized access.

8.3 EXISTING STORAGE FACILITIES

Existing storage is limited to a single ground level 1.6 MG prestressed concrete reservoir, constructed in 1995.

Location. The reservoir is located adjacent to the Pole Creek surface water reservoir, some 2.5 miles Southwest of the City. This facility is located on U.S.F.S. land, and the City was granted a conditional use permit for construction and continued operation of the storage reservoir, piping, and building structures on the site. In addition to the reservoir, a chlorination facility is provided at this site, for emergency reservoir disinfection in the event of potential terrorist activities, and for supplemental disinfection in the event that the water system should experience contamination concerns.

Site Characteristics. The reservoir site is timbered and is relatively flat, providing a serene setting for a reservoir. This site is immediately below the Pole Creek reservoir, which was utilized as an open storage facility for the City for many years, but is no longer operable. Disinfection is available at the site from a gaseous chlorination installation housed in a building structure, and reservoir controls and electrical are supplied from this structure. Chain-link fencing topped with barbed wire and locked gates surround the site. Site (fenced) dimensions are approximately 140' x 160'. Location is found on *Figure 3.5.* The site is bounded by Forest Service land, with a residence constructed in close proximity on the access road from the South.

Capacity. The existing reservoir is a prestressed post-tensioned concrete storage reservoir of the Morse Bros. type. Capacity is 1,600,000 gallons. It has dimensions of 112 feet (diameter) by 22 feet (height). The uppermost section is a conical roof that does not provide storage capacity. The top water level is at 22 feet and a reservoir located level controller is used to transmit telemetry for operations to Well # 2, although both wells pump based on levels received at Well # 2.

Water Surface Elevation. The reservoir's maximum water surface elevation is 3349.0 based on mean sea level. An overflow from the reservoir is provided with discharge to the abandoned Pole Creek Reservoir.

Construction. The reservoir is a pre-stressed concrete reservoir cast in the Morse Bros. Pre-cast factory in Harrisburg, Oregon. Walls and roof panels are pre-cast, with closure pours in the field after panels are welded together. There are forty (40) wall panels and forty (40) roof Tee sections which were delivered by truck and placed on a poured in-place concrete floor. Closure strips were installed in the field, and the reservoir was post-tensioned. A

concrete shot-crete layer was placed on the wall sections after post-tensioning was complete. The reservoir is accessed by an exterior ladder that extends to a fenced catwalk on one access hatch, and each of the hatches are surrounded by a similar fenced safety protection. Two access hatches are provided on top of the reservoir. There is also an interior ladder that extends down into the reservoir. A large vent is provided for ventilation. Depth information is conveyed to controls inside the Well No. 2 building.

Condition. The reservoir roof structure was rehabilitated by replacing the original closure pours and by reconditioning of the entire roof structure in 2003. The reservoir interior was also cleaned before being placed in operation. Work was completed by D & R Masonry Restoration, Inc. of Portland, Oregon. At completion, the reservoir was in excellent condition, and remains in good condition today, with the exception of the exterior wall paint system, which needs to be reconditioned. There was very little sediment in the reservoir after nine (9) years of operation, and the interior of the reservoir was in excellent condition. This reservoir is in excellent structural condition, and will function well through the year 2025. The only noted deficiency was a need to paint the exterior walls of the reservoir, and this should be scheduled within the next 10 years.

8.4 CAPACITY REQUIREMENTS

Alternate methods and results for computing total storage capacity are indicated in *Table 8.1*. The three methods selected are discussed in Section 8.2.1 and 8.2.2.

Table 8.1: Alternative Storage Capacity Computations

Data:	Population: (2025):	3,747 Persons
	Average Day Demand (ADD):	1,300,000 gpd
	Maximum Day Demand (MDD):	4,190,000 gpd
	Method (1) Fire Flow (FF):	180,000 gallons (1,500 gpm)
	Method (2) and (3) Fire Flow (FF):	210,000 gallons (1,750 gpm)
	Subtract Existing Storage Capacity:	1,600,000 gallons
a.	**Total Storage (No Allowance for Well Contributions)**	
Method	***Computed Capacity (gallons)***	***Needed Capacity (gallons)***
1. (346 gpcd x 2.5 days x Population) + FF1	3,421,500	1,821,150
2. MDD + FF2	4,400,000	2,800,000
3. (2.5 x ADD) + FF2	4,110,000	2,510,000

b. Total Storage (Allowance for Existing Well Capacity)

Existing Well Capacity: 1,350 gpm
Reduce FF Component by: 1,350 gpm X 120 minutes = 162,000
Subtract Existing Storage Capacity: 1,600,000 gallons

Method	*Computed Capacity (gallons)*	*Needed Capacity (gallons)*
1. (346 gpcd x 2.5 days x Population) + FF1	3,421,155	1,659,155
2. MDD + FF2	4,400,000	2,638,000
3. (3 x ADD) + FF2	4,110,000	2,348,000

c. Total Storage (Allowance for Existing and New Well Capacity)

Existing Wells Capacity: 1,350 gpm
Proposed New Well Capacities: 1,560 gpm
Method 1:
Reduce FF Component by: 2,910 gallons x 120 minutes = 349,200 gallons
Subtract Existing Storage Capacity: 1,600,000 gallons
Method 2 and 3:
Reduce FF Component by: 2,910 gallons x 120 minutes = 349,200 gallons
Subtract Existing Storage Capacity: 1,600,000 gallons

Method	*Computed Capacity (gallons)*	*Needed Capacity (gallons)*
1. (346 gpcd x 2.5 days x Population) + FF1	3,421,155	1,471,955
2. MDD + FF2	4,400,000	2,450,800
3. (3 x ADD) + FF2	4,110,000	2,160,800

Alternatives (b) and (c) above assume the complete well supply is available. This will not be the case if a well is offline for maintenance or if it does not have an emergency power source in the event of a power outage. The two existing wells will have standby generation installed in 2005 to function as an emergency power source.

It is recommended that at least one new well be constructed, and that a new reservoir be constructed with a capacity of 2,500,000 gallons. Alternate "a" - Existing storage was provided under Alternate "b". Existing needs, utilizing Alternate "b", equals (3 x ADD[2]) + FF2 - 1350(120), or 1,598,000 gallons. This is approximately equal to the existing reservoir.

[2]ADD = 620,000 gallons

Water rights will be an issue in the future, and the City of Sisters should actively pursue acquisition of additional water rights, as discussed in Chapter 6. Operating costs for proposed new wells should be a serious consideration, since power demand costs are a major factor in the cost of delivering water, and winter water demand is much less than during summer peak usage periods. However, with the existing two wells, if water rights can be acquired for a new well with capacity of 1,560 gpm, a single well can be developed to provide water during peak demand periods. This well will not require standby generation for a redundant power source, because the two existing wells can supply water demand with conventional or emergency power sources during non-peak usage periods. In either event, improvements for capacity will be needed for both source and reservoir needs.

8.5 STORAGE CAPACITY IMPROVEMENT OPTIONS

8.5.1 Option 1: Adding New Reservoir Storage Capacity

Ground Level Reservoir. Sisters is relatively flat, and an elevation comparable to the existing reservoir elevation would be preferable for needed additional storage. Elevation to achieve a ground level reservoir is possible on McKinney Butte Northeast of the City, or at the Pole Creek site Southwest of the City. Elevation for construction of a new reservoir is available in either direction, but McKinney Butte is much closer, and would provide a redundant storage and transmission line that would improve the performance of the distribution grid. A new transmission main from the Northeast side of the City would provide an additional supply line for emergency conditions and would be of much greater benefit than a second reservoir constructed at the Pole Creek site. If a site can be acquired at the correct elevation on McKinney Butte, it is recommended that construction of a new distribution reservoir be in this location. This area is developing for large residential tracts, and a site should be pursued at the earliest possible opportunity. A reservoir located in this area would appear to offer less of a security threat than the current reservoir location, although neither location should be a cause for concern. General requirements for development of this option include:

- Site acquisition (either purchase or long-term easement).
- Construction of approximately 6,500 lineal feet of 12" transmission main and 1,700 linear feet of 20" transmission main.
- Altitude valves at the new and existing reservoirs.
- Consideration of concrete construction instead of the more economical steel construction. Concrete provides for long-term economy in maintenance costs, and a reservoir location in this area should be at least partially buried for visual acceptance by the neighboring residential community.

Opinions of probable cost for a 2.5 MG prestressed, post-tensioned concrete reservoir, and reconditioning of the walls for the existing 1.6 MG reservoir are provided in *Table 8.2* and *8.3*.

Table 8.2: New 2,500,000 Gallon Reservoir
Opinion of Probable Cost

	Preliminary Opinion of Probable Cost
Concrete Reservoir (2,500,000 gallon); Installed and Painted	$2,000,000
Concrete Foundation	$120,000
Site Piping and Valving	$90,000
Excavation and Backfill	$60,000
Other Sitework (access, fencing, etc.)	$50,000
Telemetry	$25,000
Altitude Valves (2 ea)	$60,000
12" Transmission Main (4,700 LF)	$329,000
20" Transmission Main (1,700 LF)	$170,000
Subtotal Construction Costs	**$2,904,000**
Engineering and Construction Observation	$580,800
Legal and Administrative	$145,200
Site Survey	$20,000
Site Purchase	$200,000
Soil (Foundation and Seismic) Evaluation	$25,000
Contingency (10% Construction Cost)	$290,400
Total Capital Costs	**$4,165,400**

Table 8.3: Reconditioning of Exterior Walls for Existing 1.6 MG Reservoir
Opinion of Probable Cost

	Preliminary Opinion of Probable Cost
Preparation, Restoration, and Finish Coating	$14,000
Subtotal Construction Costs	**$14,000**
Engineering and Construction Observation	$3,500
Legal and Administrative	$700
Contingency (10% Construction Cost)	$1,400
Total Capital Costs	**$19,600**

In addition to the described construction costs, there are costs associated with site acquisition. Given the nature of the nearby property holdings, and the escalation of costs in the Sisters area, a budget of $ 200,000 should be set aside for property acquisition, or for acquiring a permanent easement for reservoir construction. A

budget allowance of $200,000 is recommended to cover costs associated with appraisals, review/County approvals, and conformance with funding agency procedures, as well as a site purchase or easement to site a reservoir on McKinney Butte. These costs are included in *Table 8.2*.

8.5.2 Option 2: Ground Level Reservoir and Booster Pump Station. A ground level storage reservoir could be constructed within the City limits if an associated booster pump station is also constructed. Such systems operate by reducing pressures as water from the system enters the reservoir, then re-pressurizing with booster pumps to pump water back into the system. Such pump stations tend to be mechanically complex with three or four pumps for the range of typical demands plus a high service pump for fire flows. Emergency power is also needed and should be adequate for operation of the fire pump. The facility should be located near one of the City's larger 12" looped mains. Opinions of probable costs for a 2,500,000 gallon nominal capacity reservoir, with booster pumping facilities are included in *Table 8.4*. In addition to construction costs, operation and maintenance costs and continuous power costs will substantially increase annual costs for operation of this alternative.

Table 8.4: New 2,500,000 Gallon Reservoir and Booster Pump Station Opinion of Probable Cost

	Preliminary Opinion of Probable Cost
Concrete Reservoir, (2,500,000 gallon); Installed and Painted	$2,000,000
Concrete Foundation	$120,000
Site Piping and Valving	$90,000
Excavation and Backfill	$50,000
Other Sitework (access, fencing, etc.)	$50,000
Telemetry	$25,000
Altitude Valve	$30,000
Booster Pump Station with Fire Pump and Emergency Power Generator	$400,000
Subtotal Construction Costs	**$2,765,000**
Engineering and Construction Observation	$553,000
Legal and Administrative	$138,250
Site Survey	$10,000
Site Purchase	$200,000
Soil (Foundation and Seismic) Evaluation	$35,000
Contingency (10% Construction Cost)	$276,500
Total Capital Costs	**$3,977,750**

8.5.3 Option 3: Elevated Reservoir. Elevated reservoirs tend to be cost prohibitive. Opinions of probable cost for a 2,500,000 gallon steel elevated reservoir (for seismic zone 2B) are shown in *Table 8.5*. Siting of elevated reservoirs is also difficult

because of the common concerns and opposition by surrounding property owners. In Sisters, any site selected would need to be near the looped 12" lines.

Table 8.5: New 2,500,000 Gallon Elevated Reservoir Opinion of Probable Cost

	Preliminary Opinion of Probable Cost
Steel Elevated Tank (2,500,000 gallon); Installed and Painted	$3,200,000
Foundation Construction	$120,000
Site Piping and Valving	$100,000
Excavation and Backfill	$30,000
Other Sitework (access, fencing, etc.)	$50,000
Telemetry	$25,000
Altitude Valve	$35,000
Subtotal Construction Costs	**$3,560,000**
Engineering and Construction Observation	$712,000
Legal and Administrative	$178,000
Site Survey	$10,000
Site Purchase	$200,000
Soil (Foundation and Seismic) Evaluation	$40,000
Contingency (10% Construction Cost)	$356,000
Total Capital Costs	**$5,056,000**

8.6 RECOMMENDED RESERVOIR STORAGE IMPROVEMENTS

It is recommended that the City of Sisters proceed with construction of a concrete prestressed post-tensioned ground level reservoir. (Option 1) First priority should be given to constructing the reservoir on McKinney Butte, to offer greatest benefit to the existing water system and the people of the community. A reservoir was proposed for this location in the 1988 Water Facilities Study, and the merits of construction at this location remain valid.

Gravity storage has many benefits over a similar ground level reservoir with booster pumping from the City, and the long-term savings from gravity storage and maintenance requirements for the booster pumping system will be substantial. Elevated storage is more expensive to construct and maintain, and residents would likely have visual concerns with construction of this type of storage facility, particularly when gravity storage can readily be provided at a lesser expense. Recommended reservoir improvements appear as follows:

Table 8.6: Total Recommended Reservoir Requirements
Opinion of Probable Cost

	Preliminary Opinion of Probable Cost
2,500,000 Gallon Concrete Reservoir and Transmission Improvements	$2,904,000
Reconditioning of Exterior Reservoir Walls	$14,000
Subtotal Construction Costs	**$2,918,000**
Engineering and Construction Observation	$584,300
Legal and Administrative	$145,900
Site Survey	$20,000
Site Purchase	$200,000
Soil (Foundation and Seismic) Evaluation	$25,000
Contingency (10% Construction Cost)	$291,800
Total Capital Costs	**$4,185,000**

CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
WATER CONSERVATION and
MANAGEMENT PLANS

SECTION 9
WATER TRANSMISSION AND DISTRIBUTION

HGE INC

9.1 GENERAL

This section includes a description and consideration of the City's water transmission and distribution system. Transmission mains include the total length of piping from the reservoir through the two transmission mains to the distribution system in the City. Both transmission mains allow water flow in each direction, from the two well sources to the reservoir, and from the reservoir back to the distribution system that carries flow to residential, commercial, and industrial usage. Much of the distribution system has been replaced or enhanced since 1980, generally with piping of adequate capacity to provide for the growing community. Previous planning documents, and capable staff in Public Works have worked together to provide the community with a good water system that can be enhanced and expanded for year 2025 needs of the community.

9.2 EXISTING SYSTEM

Section 3 includes a brief description of the system along with an existing system layout broken into pre-1980 and post-1980 construction *(Figures 3.4 and 3.5)*.

Two transmission mains are utilized to provide water to the City. An initial upgrade of the transmission system was completed in the 1960's, which included a new 12" transmission main from the current location of the concrete storage reservoir Northerly to the Old Brooks-Scanlon haul road, and along the haul road to Elm Street where the system was interconnected with the distribution system. When Well No. 1 was constructed in 1975, it provided an interconnection between the existing transmission main on Elm Street, and the distribution system at the South end of Pine Street. This transmission main crosses under Squaw Creek, which previously had been a source of concern for damage caused by high water flows. A second crossing of Squaw Creek was installed for the interconnection to the South end of Pine Street. A second 12" transmission main was extended from the Brooks-Scanlon haul road in 2002, extending in a North-South direction across Pine Meadow Ranch to interconnect with the distribution system in South Pine Meadow Street. The 1960's transmission system was constructed of asbestos-cement pipe materials, and the 2002 transmission main utilized AWWA C-900 PVC pipe materials. A single 12" transmission main of asbestos-cement material remains above the interconnection with the new 12" transmission main to town, and this extends up to the reservoir site.

Transmission and distribution mains in the City water system total approximately 27.91 miles and range in diameter from 4 inches to 12 inches. Major portions of the distribution system were replaced in 1995 during a major upgrade of the water system.

9.2.1 Pipelines

The majority of the City's waterlines have been installed since 1980, including major system improvements completed in 1995. *Table 9.1* presents a pre-and post 1980 distribution pipe inventory.

Table 9.1: Distribution Pipe Inventory

Diameter	Length		
	Pre-1980 (LF)	Since 1980 (LF)	Combined Total (LF)
4"	17,065	--	17,065
6"	2,660	10,052	12,712
8"	0	39,670	39,670
10"	1,710	30,987	32,697
12"	10,600	34,626	45,226
Subtotal	**32,035**	**115,335**	**147,370**

Pipe materials include steel, PVC, and asbestos cement (AC). The distribution of materials in the system is largely related to age, with the smaller pipes installed prior to 1980 being steel, and larger pipes installed prior to 1980 being asbestos cement. All materials installed since 1980 are AWWA C-900 PVC.

9.2.2 Pressure Zones and Booster Pump Stations

There is a single pressure zone in the Sisters water system, with static system pressures typically ranging from 54 - 79 psi, dependent on elevation. Water is supplied to the system either directly from the well pumps or through the two transmission mains from the 1.6 MG storage reservoir - there are no booster pumps in the system.

Pressures range from approximately 70 psi in the South end of the City to 79 psi at the Northeast corner of the City; 70 psi along Hwy 20 near the Three Winds Shopping Complex, and approximately 54 psi at the high school on the West end of the City. The storage reservoir provides pressure to the system, and is located approximately 2 miles Southwest of Sisters.

9.2.3 Service Connections

In September 2005 there were 939 active service connections, with 7 connections outside City limits, and 17 services for City owned facilities. There are no inactive services at this time. In 1995, some commercial meters existed, but the majority of the system was not metered. The water system upgrade installed water services for all users. Since that time, all public usage has also been metered in order to determine potential water losses in the system, and all new construction has provided new services and meters. In recent years, all of the meters have been converted from manual read to radio read, which reduces manpower needs substantially for meter reading. It is believed that all water usage is currently metered.

9.3 CRITERIA FOR DISTRIBUTION NETWORK EVALUATION AND DESIGN

Pressure. DHS requires that a minimum pressure of 20 psi be maintained throughout the system. However, most household water-using appliances require pressures of 40 psi to operate properly. Maximum daily pressures should not exceed 90-100 psi. Variations in pressure throughout the system are related to piping size and arrangement, local fluctuations in demand, and, especially for static pressures, elevation. Generally, the lowest elevation users have the highest average system pressure. The Sisters water system easily meets all of this criteria.

Flow. Water mains are generally designed to provide the greater of either peak hour demand or maximum day demand plus fire flow. Fire flows are considerably more significant in the determination of main diameter. Generally, it is desired to size pipes large enough to keep frictional energy loss to less than 5 feet of head loss per 1000 feet of line length (equivalent to 2.2 psi of pressure loss per 1000 feet of line) during normal flows. This maintains residual water pressures at acceptable levels and conserves electrical costs for well pumping into the distribution reservoir(s).

Another general guideline is that water velocities in pipe lines should be less than 5 feet per second. This helps keep momentum forces (due to changes in flow directions), at fittings such as elbows, at acceptable levels. It may be acceptable to exceed these limits during emergency conditions such as a major fire. However, in general it is important to maintain velocities much lower than 5 fps (especially if it is a condition that occurs frequently, such as pumping from the wells) to minimize pressure surges and water hammer. For normal operating conditions it is recommended that pipe line velocity be kept at less than 2.5 fps.

Flow capacity of various size mains are tabulated below for the recommended maximum velocity of 5 fps for flow in one direction, and for flow arriving from two directions. The latter would reflect flow at a hydrant off a looped line. The table highlights why 6" and 8" lines are often specified as the minimum size desirable for municipal service, and why fire flows in Sisters are limited in capacity where 4" lines remain in service.

	Flow at 5 fps	
Line Diameter	*In One Direction (gpm)*	*From Two Directions (gpm)*
4"	196	392
6"	441	881
8"	783	1,567
10"	1,224	2,448
12"	1,762	3,525

Layout. Main construction should be interconnected into the system to form or complete loops or a gridiron wherever possible. In general, such construction will enhance the

hydraulic performance of the system. The Sisters water system is interconnected at most junctions, and offers a good gridiron for fire protective purposes. A comparison of looped distribution versus branching (also known as tree or dendritic) distribution is presented below. A looped system is desired because:

A. Water is carried by many interconnected pipes, which significantly increases the hydraulic capacity of the system.

B. Increased factor of safety. If a pipe is out of service, water can still be fed to customers from a different direction (pipeline).

C. Decreased line flushing.

Branching distribution systems are not desirable, if economics, land ownership, and geography allow a looped system, since:

A. Water is carried through single pipes which restricts the hydraulic capacity of the system.

B. If branched pipeline is out of service, customers are without water.

C. Sediments tend to settle out in dead end lines, which leads to the need for line flushing and, due to decaying chlorine residual, increases the potential of bacterial contamination.

Hydrants should be located at intersections, midway along blocks, and in general 400 feet or less from the nearest hydrant or user. Spacing can very according to land use and main layout. Placement at the end of dead end lines facilitates flushing and maintenance.

9.4 SYSTEM ASSESSMENT

Overall, Sisters has a very good distribution system for a community of its size. Notable characteristics include:

- The system is generally well looped, forming a grid; there are very few deadend lines. Most of the deadend lines are short (one block or less) and have a terminal hydrant to facilitate flushing.
- There is a rational and systematic layout of 8", 10" and 12" lines forming larger loops that promote hydraulic efficiency.
- The commercial and industrial areas are well served with 10" and 12" mains.
- Wells and reservoirs connect to looped 10" and 12" lines thereby allowing efficient transmission.
- System pressures are well within normal ranges - there are no low pressure or high pressure service areas.
- There are two 12" diameter transmission mains for much of the distance from the existing water storage reservoir, and a combination of the two municipal

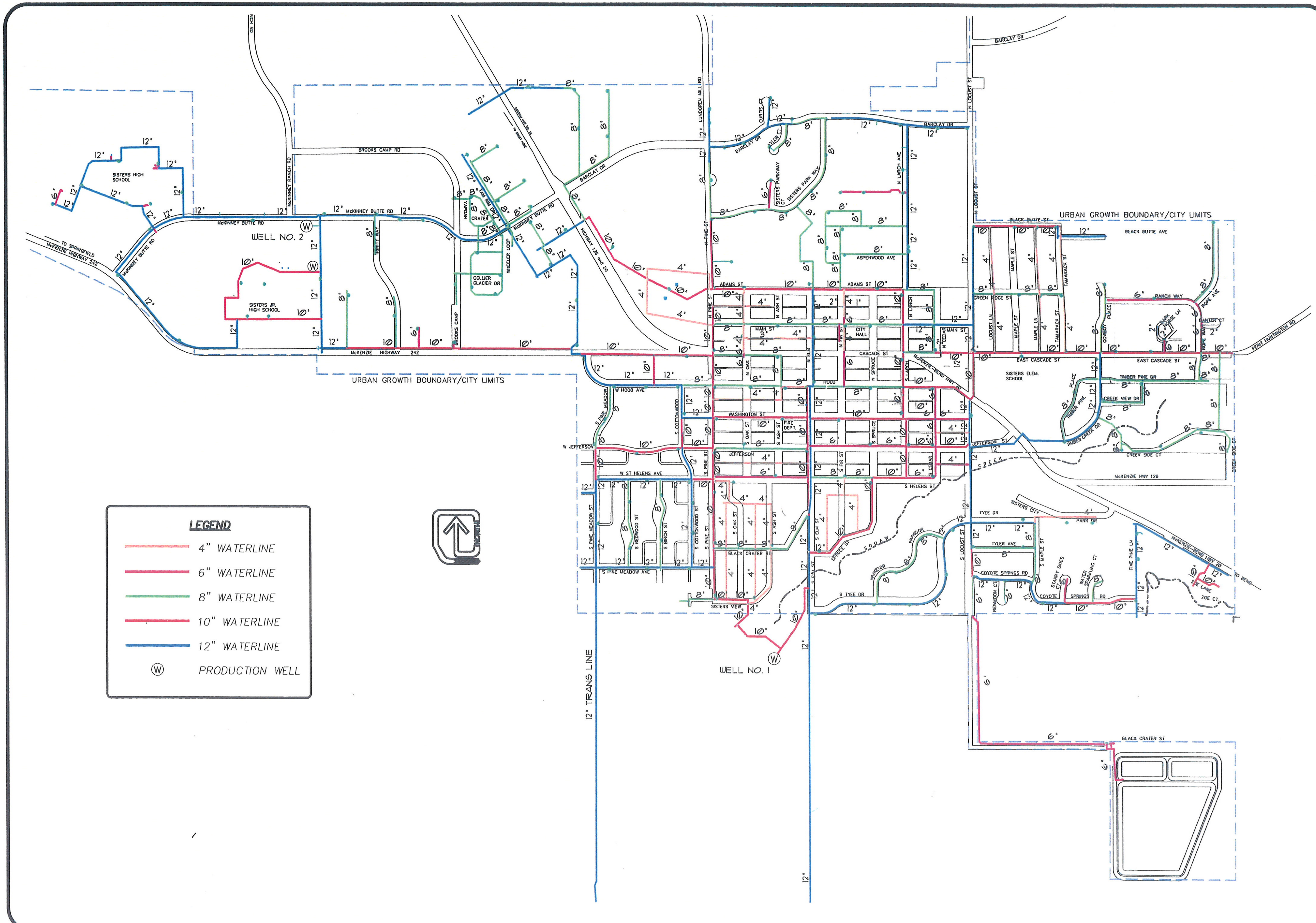


FIGURE 9.1: EXISTING WATER SYSTEM

SISTERS WATER SYSTEM
CAPITAL FACILITIES PLAN
SISTERS, OREGON

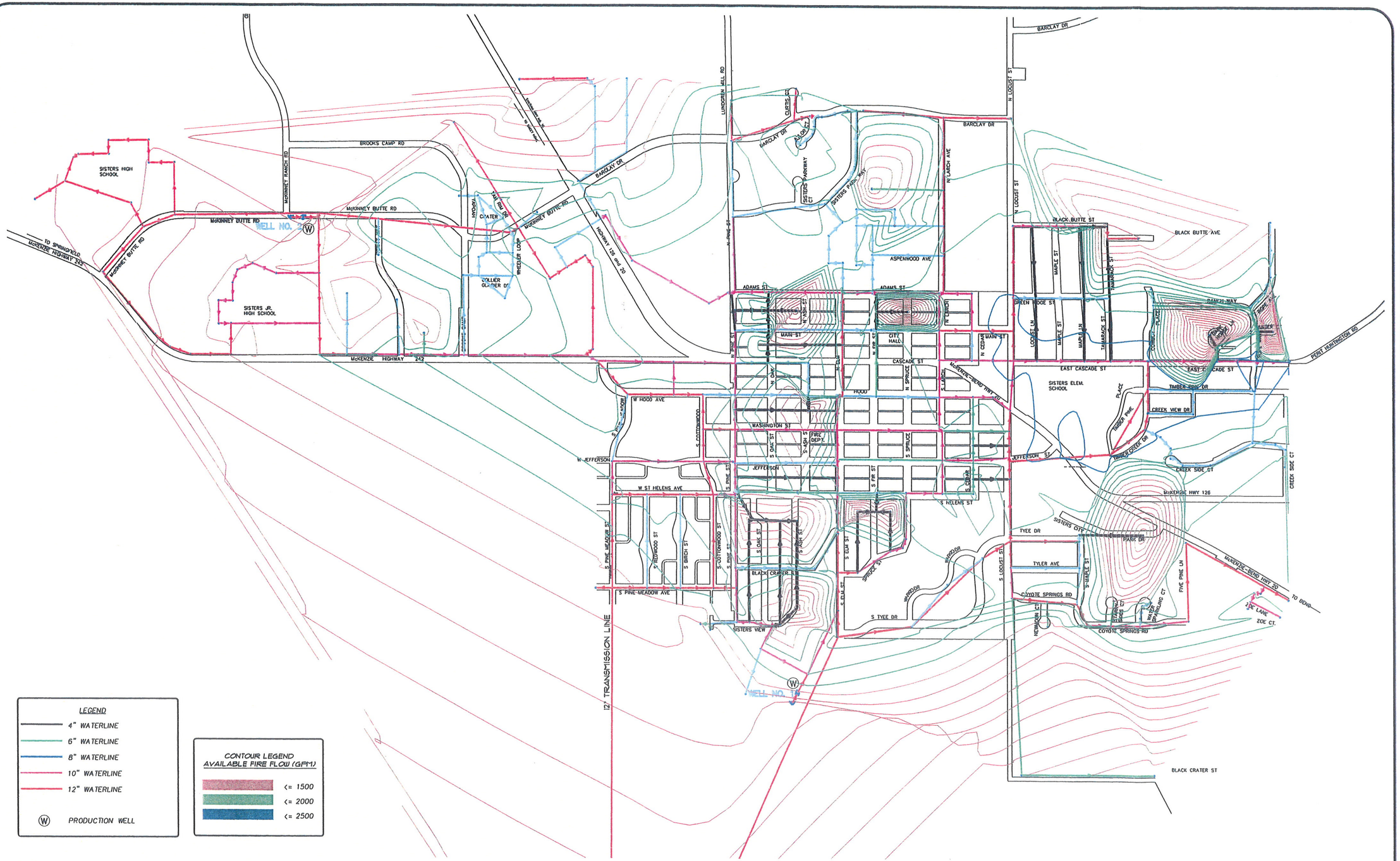
HGE INC
ARCHITECTS, ENGINEERS, SURVEYORS, & PLANNERS
375 Park Avenue/Coos Bay, Oregon 97420 (541) 269-1166
19 N. W. Fifth Avenue/Portland, Oregon 97209 (503) 222-1687

wells and the transmission lines provide adequate reliability and transmission in the event that one transmission main or one well is isolated for maintenance or repairs.

- Hydrants are, generally, well distributed throughout the system. The 400 foot diameter radiuses desired by the fire department provide adequate coverage based on ISO standards. However, in practice, service can be extended further though there will be proportional losses in fire flow capabilities due to the longer hose lengths involved. Hydrants off 4" lines do not provide recognized fire protection, and all 6" and smaller lines should be replaced to upgrade the overall capabilities of the distribution system, and to improve fire flows. Line replacements will improve fire protection for anticipated community growth. However, the current lines do provide fire flows that meet minimum standards adopted by the Sisters-Camp Sherman RFPD.
- Hydrant flow capabilities are generally excellent in areas served by the larger 8", 10" and 12" mains *(Figure 9.1)*. A computer generated fire system capability map is provided as *Figure 9.2*, which indicates where fire protective capabilities and volumes are available. These will all be substantially enhanced with recommended improvements. Flow capabilities of the system exceed current minimum standards of the fire department, but fire service to satisfy growth needs, will be dramatically improved with replacement of the older 4" and 6" distribution lines.
- Most of the system is less than 25 years old.
- The proposed layout of proposed improvements will suggest additional water sources and a second ground level reservoir that will interconnect with the distribution grid, dramatically improving fire flow capabilities for community growth.

Notable deficiencies include:

- The areas identified with less than 1,500 gpm fire capabilities are limited, and generally are located in close proximity to existing 4" water mains. Replacement of these pipelines will improve performance of the entire water system for fire protection and growth demands.
- The single 12" transmission main from where the line splits into two and the storage reservoir restricts flow into the system during maximum fire demand. Recommendations include a third well for improved system capabilities, and a second storage reservoir on McKinney Butte, which will reduce demand on this pipeline during maximum demand periods. If a second storage reservoir cannot be constructed on McKinney Butte, this transmission main should be replaced with a 20" line down to the junction with the two 12" transmission mains supplying the City.
- 4" lines are still present in several areas. These lines provide adequate service for current community needs, but additional growth will demand



LEGEND

- 4" WATERLINE
- 6" WATERLINE
- 8" WATERLINE
- 10" WATERLINE
- 12" WATERLINE
- (W) PRODUCTION WELL

CONTOUR LEGEND
AVAILABLE FIRE FLOW (GPM)

- <= 1500
- <= 2000
- <= 2500

PREDICTED FIRE FLOWS

FIGURE 9.2: EXISTING SYSTEM FIRE FLOWS USING COMPUTER MODEL

SISTERS WATER SYSTEM CAPITAL FACILITIES PLAN

SISTERS, OREGON

ARCHITECTS, ENGINEERS, SURVEYORS, & PLANNERS
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HGE INC

improved performance. In addition, the smaller lines are of an age and condition that warrants replacement. 6" mains are the smallest diameter recognized as providing fire protection by the American Water Works Association (AWWA).

- Older lines in the system may have age related problems that include leaks. This could be a factor in the City's relatively high water consumption, although losses seem to be higher in summer months than during the remainder of the year.

9.5 RECOMMENDED DISTRIBUTION IMPROVEMENTS

Recommended distribution and transmission system improvements are shown in *Figure 9.3.* Replacement of water meters for consumers is recommended on a fifteen (15) year cycle, such that accuracy of water sales is maintained, and meters function properly. We also recommend that main line meters be installed on each of the existing transmission mains into town, such that accurate records of water delivered through each main can be maintained. Replacement of pre-1980 distribution piping of 6" and smaller is recommended for improvements in system capacity for growth, and fire protection. In addition, main distribution grid improvements are recommended throughout town to improve system hydraulics and to provide improved fire protective capabilities. Sizing and placement of improvements to the main gridiron system have been developed in conjunction with the model generated to determine system capabilities and fire protective capabilities.

Table 9.2: Proposed Transmission and Distribution Improvements
Preliminary Opinion of Probable Cost

Project Description	*Qty*	*Unit*	*Unit Cost*	*Preliminary Opinion of Probable Cost*
Install new 12" main line meters and vaults	2	ea	$15,000	$30,000
Replace existing water meters	939	ea	$400	$375,600
6" Distribution Mains	9,235	LF	$55	$507,925
8" Distribution Mains	9,330	LF	$60	$559,800
10" Distribution Mains	1,650	LF	$65	$107,250
12" Distribution Mains	10,680	LF	$70	$747,600
16" Distribution Mains	1,200	LF	$90	$108,000
Subtotal Construction Costs				**$2,436,175**
Engineering and Construction Observation				$487,235
Legal and Administrative				$121,810
Contingency (10% Construction Cost)				$243,620
Easements		LS		$10,000
Total Capital Costs				**$3,298,840**

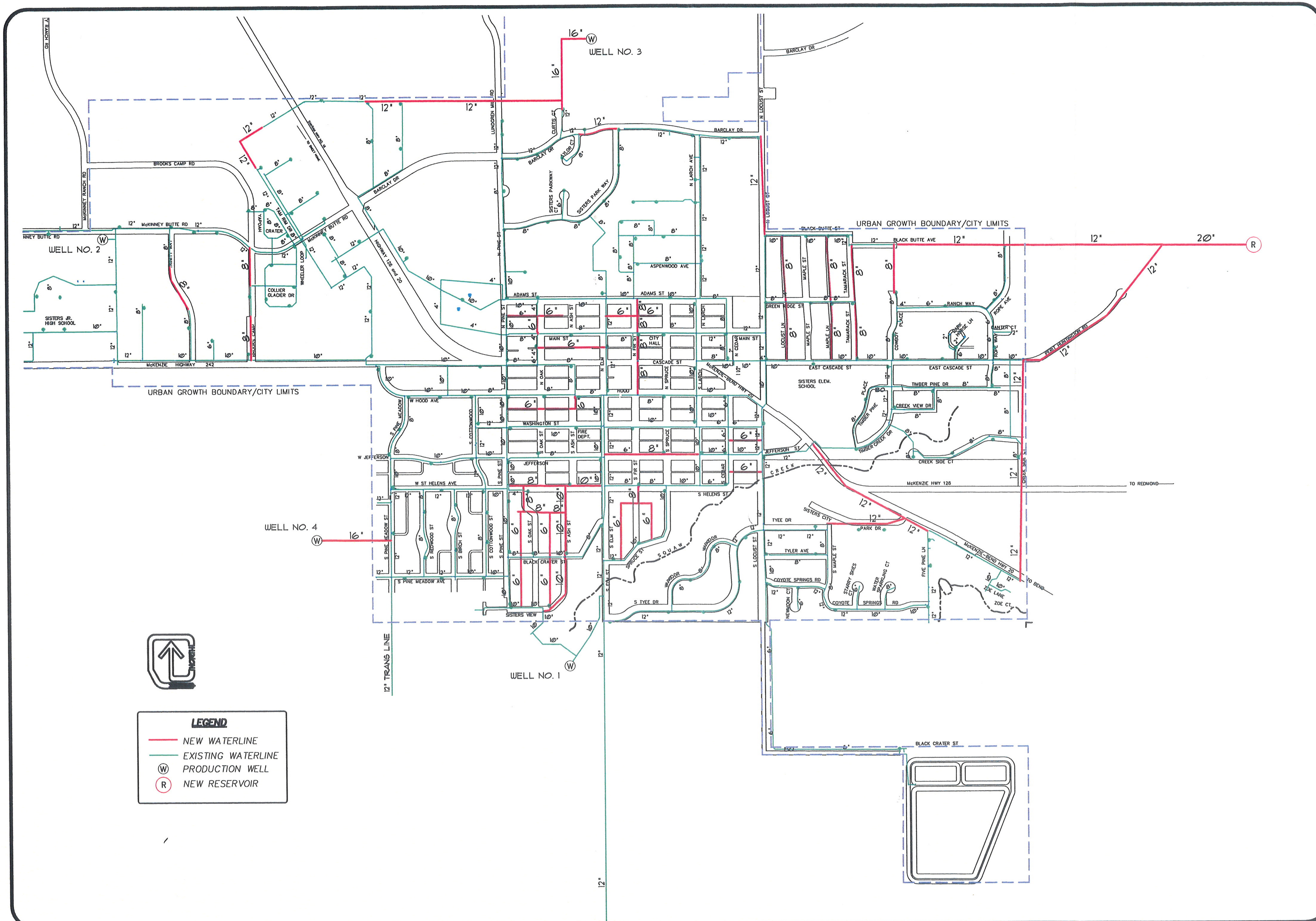

FIGURE 9-3: PROPOSED WATER SYSTEM

SISTERS WATER SYSTEM CAPITAL FACILITIES PLAN

SISTERS, OREGON

HGE INC. ARCHITECTS, ENGINEERS, SURVEYORS, & PLANNERS
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CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
WATER CONSERVATION and
MANAGEMENT PLANS

SECTION 10
WATER MANAGEMENT AND CONSERVATION PLAN

HGE INC

CITY OF
SISTERS

WATER MANAGEMENT
AND
CONSERVATION PLAN

September 2005

City of Sisters
150 N. Fir Street
Sisters, OR 97759

Prepared by:
HGE, Inc., Architects, Engineers, Surveyors & Planners
375 Park Avenue
Coos Bay, OR 97420

WATER MANAGEMENT AND CONSERVATION PLAN

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SECTION 10
WATER MANAGEMENT AND CONSERVATION PLAN

10.1 INTRODUCTION

As a general term, water conservation refers to the recognition of water as a limited resource and the policies and efforts implemented to limit water withdrawals accordingly. Conservation (in Oregon) is defined more formally by OAR 690-400-0010(5) as meaning elimination of waste "or otherwise improving efficiency in the use of water while satisfying beneficial uses by modifying the technology or method for diverting, transporting, applying, or recovering the water, by changing management of water use, or by implementing other measures."

Increased competition for an ever dwindling resource has prompted the State to approach the matter through regulatory actions. Oregon Administrative Rules Chapter 690, Division 86, includes requirements for preparation and submittal of Water Management and Conservation Plans (WMCP). A WMCP is a document that describes the supplier's system, usage, management, and conservation. The WMCP is a likely requirement for action by Oregon Water Resources Department (OWRD) on water rights related work such as permit extensions, or approvals. Originally, it provided OWRD with information on the supplier's system and needs, and guidance on planning and conservation matters for the supplier. Today, it is interpreted more as a contract between the supplier and the State. OWRD is looking for concrete and verifiable plans, and implementation schedules, rather than general recommendations or exhortations "to consider . . ." WMCP updates are required every 10 years; a progress report is required 5 years after submittal of the WMCP. WMCPs are taking on an importance comparable to Water Master Plans.

In general, suppliers with service populations of 1,001 to 7,500 which anticipate expansion or a new diversion of water under an extended permit for which resource issues have been identified under OAR 690-86(5)(i) are required to provide a Water Management and Conservation Plan. The City of Sisters will need to adopt this plan, with any required amendments, as a new Update to the Water Management and Conservation Plan, approved by the Oregon Water Resources Department on July 13, 1999 (*Permit # 13316*). Relevant sections of the Water System Capital Facilities Plan are referenced for brevity.

10.2 SUMMARY

Sisters is a rapidly growing Central Oregon community with a heavily tourist based economy. Water usage is largely residential, and includes extensive irrigation during the hot, dry, summer months. The City has worked diligently to conserve water since the 1980's, and water system improvements have dramatically reduced water usage. In the past two years, water losses have increased significantly during the summer months, and City staff are actively searching for locations where water losses may be occurring. The current rate structure provides an incentive for reasonable water use.

Existing water rights are adequate for the planning period (20 + years); however, a portion of the water rights associated with Well No. 2 needs to be transferred to a new site in order to provide for consumptive needs of the growing community.

A new well is needed to provide capacity during summer months, to enhance system reliability and to provide fire protection. The new well will need to be added to the existing water rights as an alternate point of diversion. This should provide capacity for the next planned well, but the community needs to make every possible effort to acquire additional water rights through mitigation, and from every development planned within the UGB. The City is working within a regional alliance to identify and develop strategies for water use reduction and mitigation in Central Oregon.

The most important conservation related issue is the implementation of City-wide metering and the development of an escalating rate structure that is based, on actual metered water consumption. A new rate structure is currently a priority for the City and implementation is anticipated to be complete in 2006. Low water use vegetation is recommended to new development wherever practicable. The City distributes informational pamphlets that recommend low water use landscaping. In addition, the City participated and supported the creation of a Central Oregon xeriscape landscaping guide. All new waterline installations are pressure tested against leakage. In addition, with changes in State requirements for plumbing fixtures, all new development and replacement of existing plumbing utilize low water use fixtures for conservation. The City writes a quarterly newsletter which is mailed to all water users, and this document includes distribution of low water landscape information. The newsletter is used as an educational tool describing numerous methods users can implement to decrease water usage.

The City should also implement water auditing. Water auditing utilizes existing water usage data and involves keeping track of all water uses including: estimates of water flushed from hydrants, water used for construction purposes, water used for specific purposes (park irrigation, public works, etc.) and other uses. Currently, the City provides meters for all consumptive uses other than for hydrant flushing, and total usage should be maintained for comparison with records of water production from the existing wells. Metered totals plus estimates of other uses are all totaled for a one year period. This total is then compared with the total water pumped to determine the amount of unaccounted for water. A 15 percent difference is a normal allowance for a system in good condition. In Sisters, some older lines will be scheduled for replacement, and other potential water losses from the system are being investigated. To facilitate the water audit process a file folder should be maintained for all metered usage, with additions to include estimates or measurements of water usage (along with dates, purpose, etc.). Estimates/measurements should be recorded and filed promptly to ensure inclusion. Metered connections are recorded as part of the billing process and need not be filed with the audit file until after the audit is completed.

Sisters has not experienced a water shortage, but the existing wells were unable to maintain reservoir levels during the summer of 2005. Changes in billing practices should result in water conservation and line replacements should further reduce overall water consumption.

A new well is projected for development, and no water shortage is projected. Development of a curtailment ordinance does not appear warranted at this time, although it should be considered with continuing growth.

10. 3 BACKGROUND INFORMATION

This document is intended to update the original 1995 City of Sisters Water Conservation Plan and the 1999 Update, and to achieve compliance with the 2003 Guidebook for Oregon Municipal Water Suppliers to develop water conservation and management plans. A new Water System Capital Facilities Plan is being developed for the City in 2005, and this document has been prepared to correlate directly with the Facilities Plan to eliminate duplication.

The City of Sisters is located in the western portion of Deschutes County, 21 miles northwest of Bend and 20 miles west of Redmond. Population in 2004 was estimated at 1590 people, with a significant influx of retirees, tourists, travelers, part time residents and associated commercial development.

Sisters has developed as an 1880 western theme town, with a largely tourist based economy. Population swells to as much as 10,000 people on summer days, particularly on holiday and special event weekends. The community has grown rapidly since the completion of a new sanitary sewer system in 2002, which allowed for construction of a number of new residential developments. Because of the tourist influence, the winter to summer variation in water consumption is much more pronounced than for many other Oregon communities.

There are other factors which must be considered when computing water consumption needs for Sisters. The climate is dry and sunny, with little rain in the summer months. Consumption due to the transient population is very large when compared to average usage per resident from other communities. Fire suppression is a priority, as there have been several large fires in the area during recent years. Water for fire suppression is imperative, and the City is located at the base of the Cascade Mountains, with large concentrations of pine and juniper forests, sagebrush and buckbrush.

10.4 PLANNING AREA

10.4.1 Population and Growth Characteristics

Sisters maintained a historical population from 600 residents to 690 residents for more than 30 years through the year 1990. Population growth was relatively stagnant between 1980 to 1990, but averaged approximately 2 percent a year from 1990 to 1996. The population reached 775 residents in 1996. Beginning in 1997, when the people approved construction funding for a public sewer system, growth has escalated rapidly, in similar fashion to the growth throughout all of Deschutes County. By the year 2000, population in Sisters had reached 975 residents, and growth has continued in excess of 11% per year since that time. Current population

for the City of Sisters is estimated at 1,768 residents in both the Deschutes County Coordinated Population Forecast, and in the Sisters Comprehensive Plan.

To accommodate this growth, the City is currently in the process of expanding the Urban Growth Boundary. As a part of that process, the City has projected that population will reach 3,747 residents by 2025.

10.4.2 Water Sources and Quality

Sisters currently relies on two developed groundwater sources (Well No. 1 [*City Well*] and Well No. 2 [*High School Well*] to supply the City's water needs. Location is shown on *Figure 3.1* of the accompanying Water System Capital Facilities Plan. Each well functions as the primary well for portions of the year, and is controlled by radio telemetry. Each well was originally designed to pump 750 gpm, although Well No. 1 is now delivering approximately 600 gpm because of wear. Groundwater is the preferred and most economical water source for Sisters, and additional wells will be necessary with continued growth of the community. Water quality is excellent at all times.

10.5 WATER DEPTHS IN WELLS

The water table in both of the Sisters wells has fluctuated substantially since their original construction. Water level in both wells seems to vary at approximately the same levels, indicating that both are consuming water from an interconnected aquifer. Records for Well No. 1 are provided from 1976 through 2004 in *Figure WM-1*, and records from Well No. 2 are provided from 1996 to 2004 in *Figure WM-2*.

Figure WM-1. Water Table Level - City Well (Well No. 1)

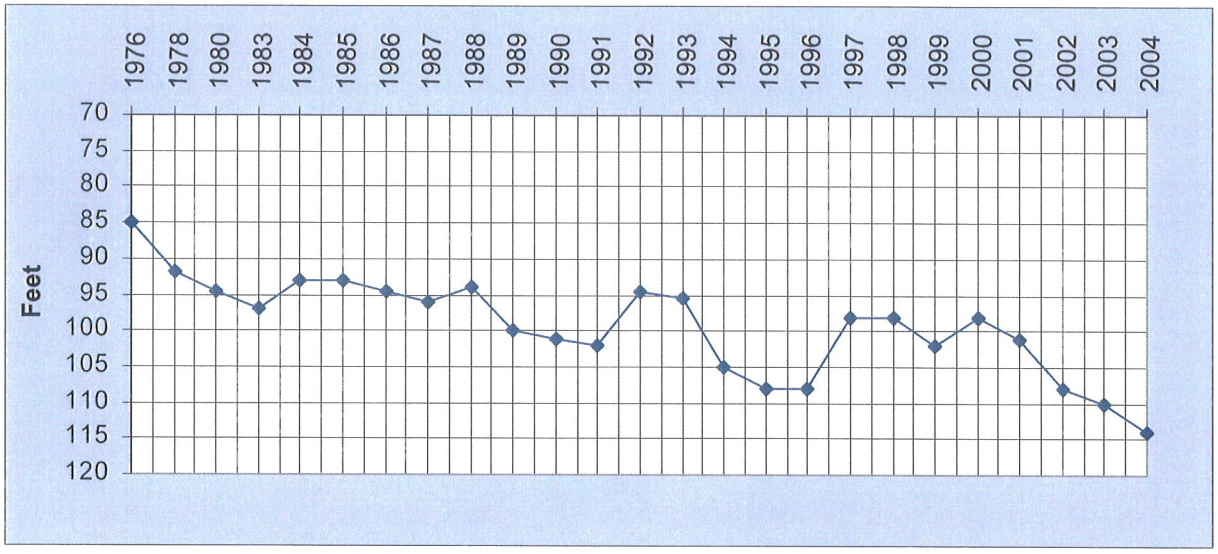
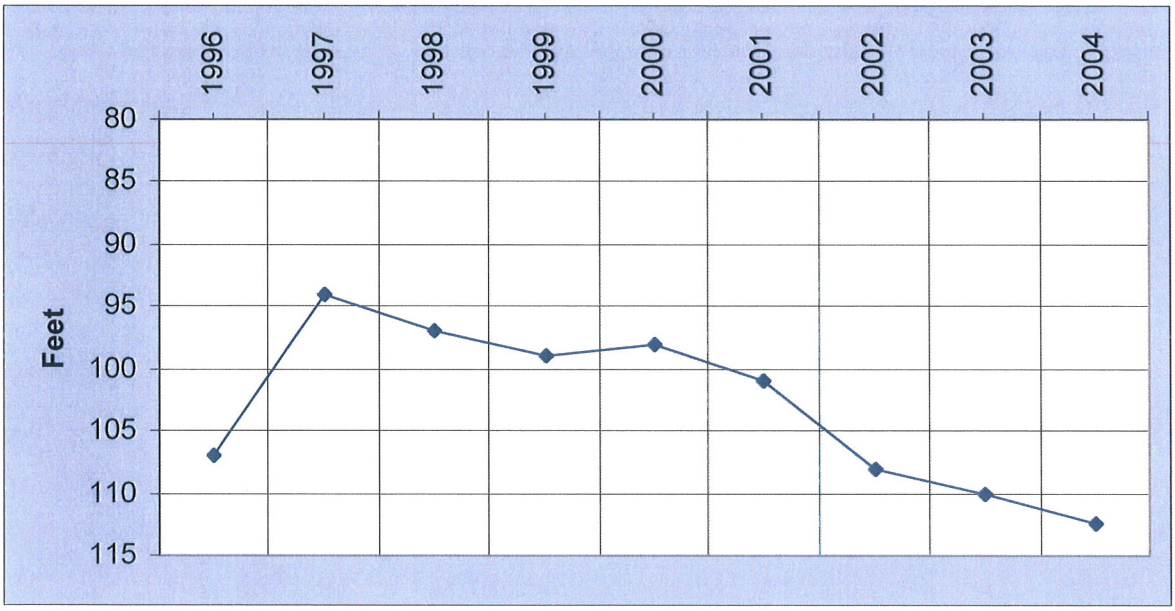


Figure WM-2. Water Table Level - High School Well (Well No. 2)

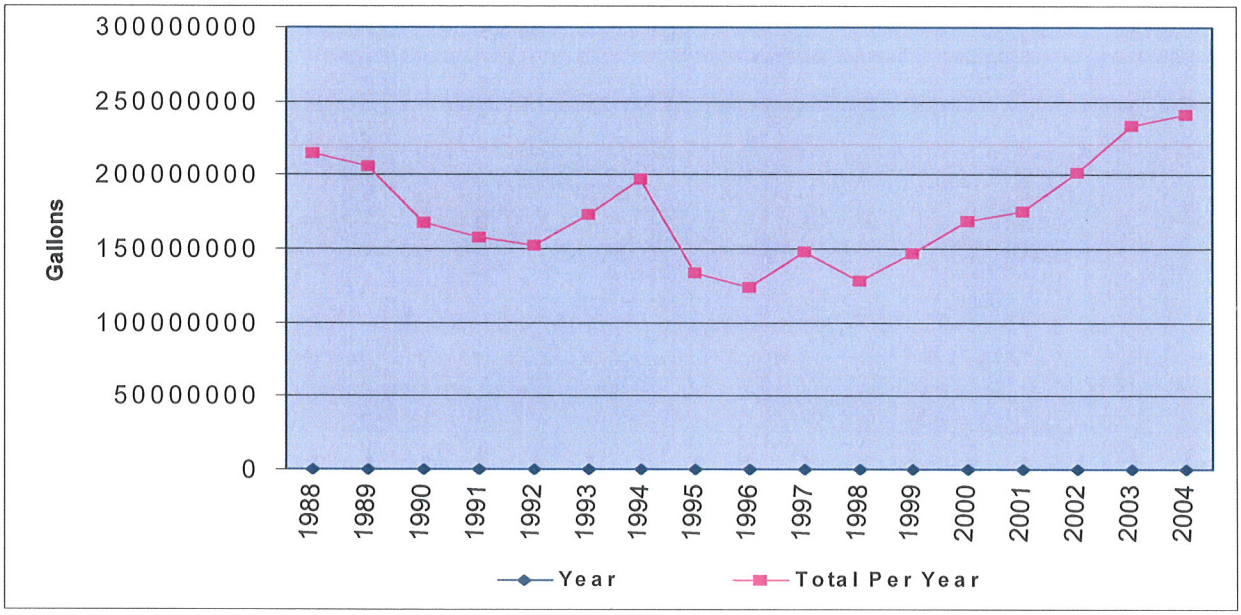


10.6 WATER CONSUMPTION

Sisters supplied its residents from Pole Creek Reservoir, an earthen structure constructed in 1964, for many years. In 1975, a municipal well (Well No. 1) was constructed, and began to supply the community with a secondary source of water. Initially, the well was used as a backup water source, but by the early 1990's well production exceeded usage from Pole Creek. A second well was developed in 1993, and the City was ordered by the Oregon Health Division to either provide surface water treatment for the Pole Creek source, or to cease operating this water source. Initially, the City attempted to operate their existing filtration system as a slow sand filter, but the system was ultimately taken off line in 2000.

Sisters has worked to conserve water consumption since the late 1980's. Leakage was a significant problem in the 1980's, and the community worked diligently to reduce system losses. The water system was not individually metered at that point, but the City reduced water production from 262,324,800 gallons per year in 1987 to 196,590,416 gallons per year in 1994, a production drop of 25%. In 1995, a major rehabilitation of the water system was undertaken, and the City provided meters for all consumers. Production in 1995 dropped to 133,763,262 gallons, a savings of 62,827,154 gallons, or a production drop of an additional 32%. Production in 1995 required just 133,763,262 gallons, or 51% of the water produced in 1985. Since 1995, system requirements have increased significantly with the corresponding increase in population. *Figure WM-3* illustrates where conservation has had a significant impact on water production needs.

Figure WM - 3. City of Sisters Water Production, 1988 to 2004



Consumption from the Sisters water system has also increased significantly in recent years, as addressed in Section 5 of the Water System Capital Facilities Plan. However, it appears that system losses have increased substantially on both a total loss basis and on a percentage basis, and the City is searching diligently for where losses are occurring. System losses in 2002 were 15.4%, which is reasonable for the Sisters system. However, losses increased to 26.6% in 2003, and to 29% in 2004, with most of the increase in losses occurring during the summer months. Some losses will always be present in a municipal system, including water for fire fighting, system flushing, line breaks, leakage, improperly registering meters, and possible unauthorized or unrecorded connections to the system. Unmetered usage is also a concern with many water systems, but all users through recorded connections in Sisters are now metered.

The City of Sisters is working diligently to reduce losses in the water system, and a strategy has been developed for reducing the difference between water production and consumption. Plans are also ongoing on a strategy to reduce consumption from the system's current strategy for reducing system losses and appear as follows:

1) Increased attention to annual water auditing.
2) Installation of main line meters to determine daily, weekly, and monthly consumption from the system.
3) Monitoring chlorine residuals on major irrigation users, and determining potential for non-metered usage.
4) Replacement of older distribution lines in system.

5) Leak detection on existing transmission and distribution lines to remain, if losses remain greater than 15%.

The following strategies will be followed to reduce overall system consumption:

1) Emphasis in the City newsletter on need for water conservation.
2) Implementation of xeriscape landscape guide for reduction of need for irrigation.
3) Installation of smart controllers on all irrigation lines, to reduce irrigation waste.
4) Replacement of meters on an on-going basis.
5) Implementation of a new escalating rate structure for consumption.
6) If necessary, adopt an ordinance for mandatory water curtailment during critical time periods.

Graphs of water production and consumption for 2002 *(Figure WM-4)*, 2003 *(Figure WM-5)*, and 2004 *(Figure WM-6)* are provided, and these illustrate graphically that the losses are increasing during summer periods. A graph is also provided to show water losses for the years 2002-2004 *(Figure WM-7)*.

Figure WM - 4. City of Sisters 2002 Water Production and Consumption

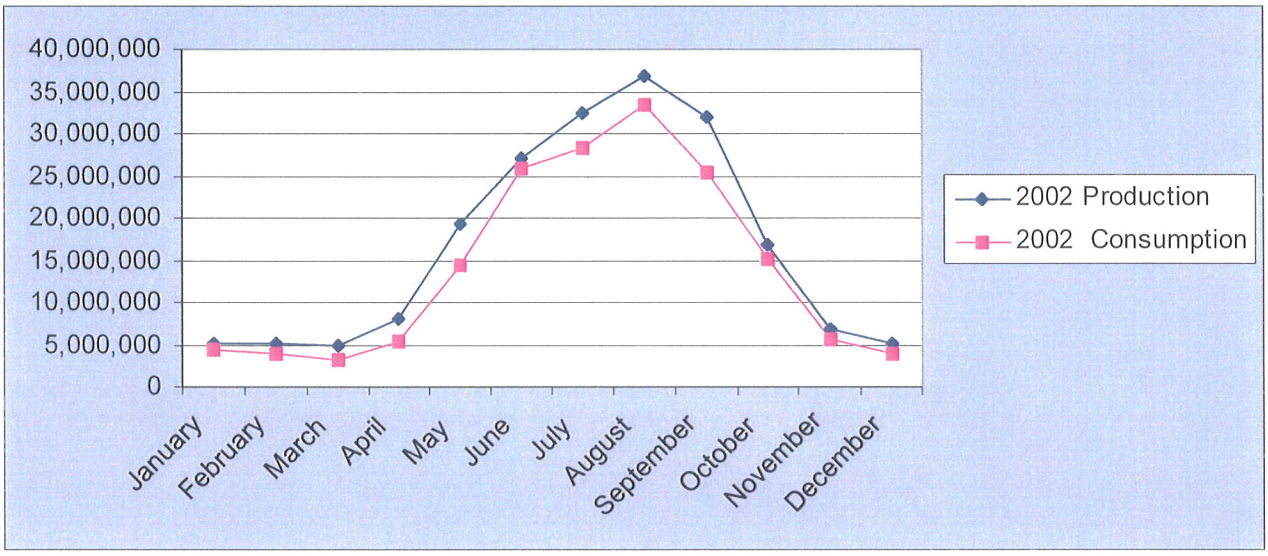


Figure WM - 5. City of Sisters 2003 Water Production and Consumption

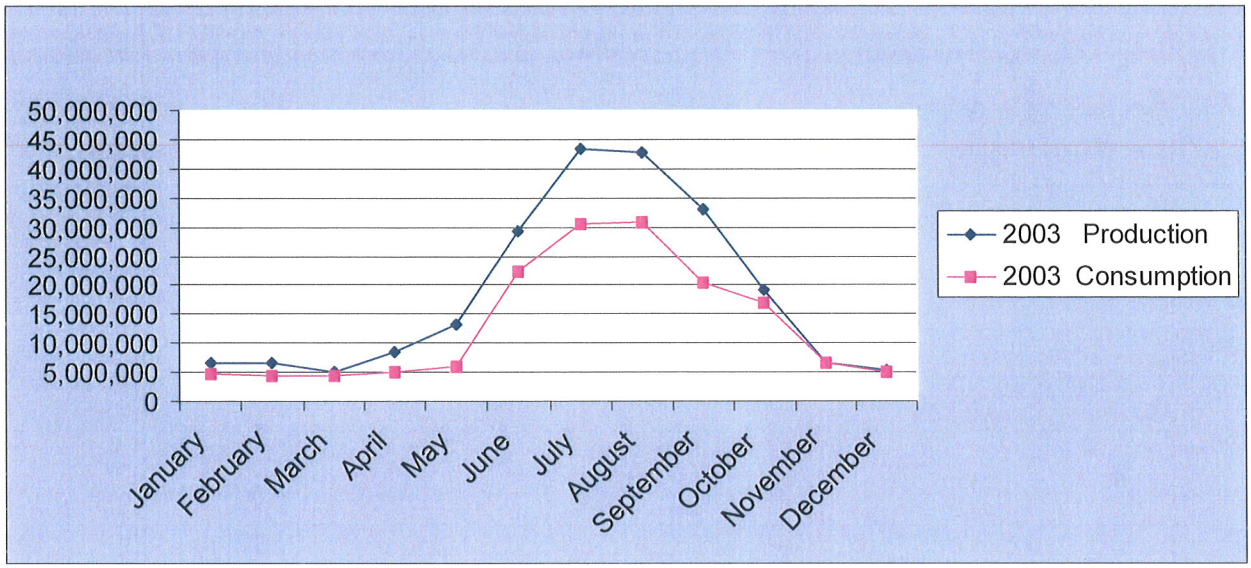


Figure WM - 6 City of Sisters 2004 Water Production and Consumption

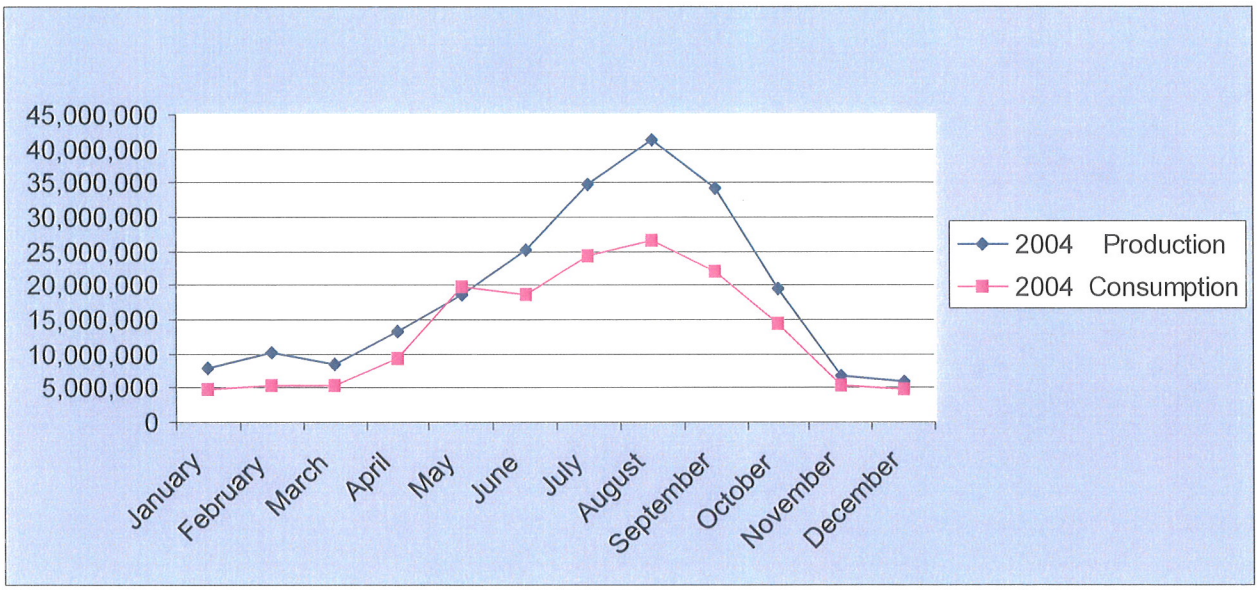
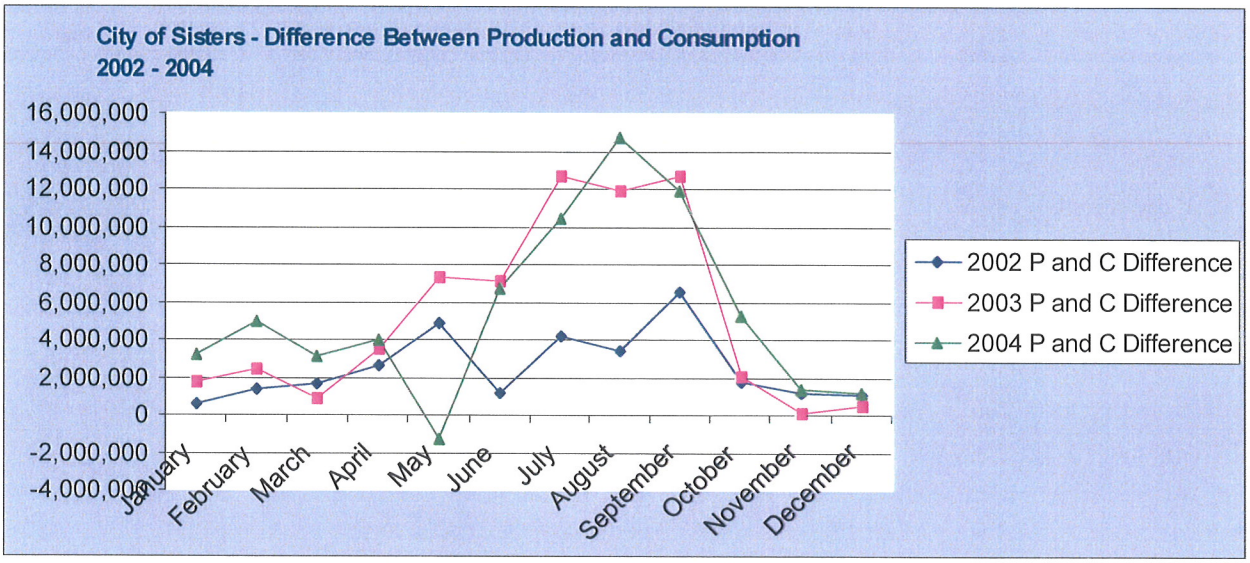


Figure WM - 7 City of Sisters 2002 - 2004 Water Losses



Specific correlation to elements of the Sisters water supply, provided for conformance with the guidebook for Oregon Municipal Water Suppliers, is provided as follows:

10.7 OAR 690-086 AND COMMENTS

10.7.1 OAR 690-086-0140 Municipal Water Supplier Description

The water supplier description element shall include at least the following information:

OAR 690-086-0140(1): **A description of the supplier's source(s) of water; including diversion, storage and regulation facilities; exchange agreements; intergovernmental cooperation agreements; and water supply or delivery contracts;**

Water sources are discussed in Section 6 of the accompanying Water System Capital Facilities Plan. There are no exchange agreements, intergovernmental cooperation agreements, or water supply or delivery contracts, except for water utilized for construction.

OAR 690-086-0140(2): **A delineation of the current service areas and an estimate of the population served and a description of the methodology(ies) used to make the estimate;**

See Section 2 of the accompanying Water System Capital Facilities Plan.

OAR 690-086-0140(3): **An assessment of the adequacy and reliability of the existing water supply considering potential limitations on continued or expanded use under existing water rights resulting from existing and potential future restrictions on the community's water supply;**

Water requirements are discussed in Section 5 of the accompanying Water System Capital Facilities Plan. Currently held water rights are adequate for meeting domestic demand during the planning period. The City currently has two wells; consequently, loss of a well would impact the adequacy and reliability to meet current and future summer flow requirements. A third well is needed and recommended for development in the Water System Capital Facilities Plan. A fourth well should be secured for service in years immediately after 2025, when a new Water System Capital Facilities Plan will need to address water supply for future years.

OAR 690-086-0140(4): **A quantification of the water delivered by the water supplier that identifies current and available historic average annual water use, peak seasonal use, and average and peak day use;**

See Section 5.2 of the accompanying Water System Capital Facilities Plan.

OAR 690-086-0140(5): **A tabular list of water rights held by the municipal water supplier that includes the following information:**

A tabular list of the City's water rights are included in Section 6 of the accompanying Water System Capital Facilities Plan. Well sources are further discussed in Section 6.3. Water right permits and certificates are included in *Appendix 6.2*; well logs are included in *Appendix 6.1.*, and surface water rights and certificates are discussed in Section 6.1. Water Supply availability and future need projections are included in Sections 6.1 and 6.2. The following subsections (a) through (h) of OAR 690-086-0140(5) are addressed to utilize available information from the Sisters Water System Capital Facilities Plan, 2005.

OAR 690-086-0140(5)(a): **Application, permit, transfer, and certificate numbers (as applicable);**

See comments under OAR 690-086-0140(5) above.

OAR 690-086-0140(5)(b): **Priority date(s);**

See comments under OAR 690-086-0140(5) above.

OAR 690-086-0140(5)(c): **Source(s) of water;**

See comments under OAR 690-086-0140(5) above.

OAR 690-086-0140(5)(d): **Type(s) of beneficial uses specified in the right;**

See comments under OAR 690-086-0140(5) above.

OAR 690-086-0140(5)(e): **Maximum instantaneous and annual quantity of water allowed under each right;**

See comments under OAR 690-086-0140(5) above.

OAR 690-086-0140(5)(f): **Maximum instantaneous and annual quantity of water diverted under each right to date;**

See comments under OAR 690-086-0140(5) above.

OAR 690-086-0140(5)(g): **Average monthly and daily diversions under each right for the previous year, and if available for the previous five years;**

See comments under OAR 690-086-0140(5) above and water usage data provided in Section 5 of the accompanying Water System Capital Facilities Plan.

OAR 690-086-0140(5)(h): **Currently authorized date for completion of development under each right; and**

See comments under OAR 690-086-0140(5) above. All rights are certificated with the exception of permit G-11418. A request was filed in April, 2005 to extend the completion date for accomplishing beneficial use of water from this permit to October 1, 2049.

OAR 690-086-0140(5)(i): **Identification of any streamflow-dependent species listed by a state or federal agency as sensitive, threatened or endangered that are present in the source, any listing of the source as water quality limited and the water quality parameters for which the source was listed, and any designation of the source as being in a critical ground water area.**

NA.

OAR 690-086-0140(6): **A description of customers served including other water suppliers and the estimated numbers; general water use characteristics of residences, commercial and industrial facilities, and any other uses; and a comparison of the quantities of water used in each sector with the quantities reported in the water supplier's previously submitted water management and conservation plan and progress reports;**

Customers and characteristics are discussed in Section 4.1 of the accompanying Water System Capital Facilities Plan. All usage has been developed on a residential equivalent basis. Data is available on quantification and comparison of usage among customer categories, but usage is predominately residential and tourist related. Projections have been made based on an equivalent residential usage for all consumption, and all services are metered.

OAR 690-086-0140(7): **Identification and description of interconnections with other municipal supply systems;**

There are no interconnections with other systems.

OAR 690-086-0140(8): **A schematic of the system that shows the sources of water, storage facilities, treatment facilities, major transmission and distribution lines, pump stations, interconnections with other municipal supply systems, and the existing and planned future service area; and**

See *Figures 3.4* and *3.5* of the accompanying Water System Capital Facilities Plan.

OAR 690-086-0140(9): **A quantification and description of system leakage that includes any available information regarding the locations of significant losses.**

See Section 5.3 of the accompanying Water System Capital Facilities Plan. Water pumped is high (on a per capita basis). Production and Consumption data for 2002-2004 are provided to show the extent of system losses. Factors possibly contributing to high water demand include an extremely high tourist demand, particularly during summer months, and heavy irrigation usage during dry summer months.

10.7.2 OAR 690-086-0150: Municipal Water Conservation Element

The water conservation element shall include at least the following:

OAR 690-086-0150(1): **A progress report on the conservation measures scheduled for implementation in a water management and conservation plan previously approved by the Department, if any;**

Conservation resulted in significant reduction in water losses in the late 1980's and early 1990's, which has offset significant population gains that have demanded increased water availability. The effects of conservation are shown graphically in Figure WM-3.

OAR 690-086-0150(2): **A description of the water supplier's water use measurement and reporting program and a statement that the program complies with the measurement standards in OAR chapter 690, division 85, that a time extension or waiver has been granted, or that the standards are not applicable;**

The City reports annually to the Water Resources Department as required. The water use reporting program does comply with the measurement standards provided in OAR, Chapter 690, Division 85 of the statutes. All well production is metered continuously for record purposes.

OAR 690-086-0150(3): **A description of other conservation measures, if any, currently implemented by the water supplier, including any measures required under water supply contracts;**

The City water usage rate structure is established for equity amongst all users. Conservation is encouraged through the City's quarterly newsletter. The City also participates in a regional alliance that develops conservation strategies and recently collaborated on a Central Oregon xeriscape landscape guide. At this time, the City has no mandatory curtailment ordinance. City has meters for all services, and records of all usage is monitored by City staff. Metering and application of a rate structure that charges a comparable rate for all consumption provides conservation of water from the Sisters water system.

OAR 690-086-0150(4): **A description of the specific activities, along with a schedule that establishes five-year benchmarks, for implementation of each of the following conservation measures that are required of all municipal water suppliers:**

OAR 690-086-0150(4)(a): **An annual water audit that includes a systematic and documented methodology for estimating any un-metered authorized and unauthorized uses;**

Annual water audits are recommended and should be implemented immediately to attempt to determine where water losses are occurring. The goal of water auditing is to track all use of water in the system. If unaccounted for water (the difference between water pumped and water used) exceeds 10 percent, some investigation work may be needed to track down where the losses are occurring. Leak protection is being pursued by implementation of main line meters to verify total usage. If a combination of metering, usage verification, and line replacements are not adequate for substantial savings in system losses, leak detection for existing lines will be pursued.

OAR 690-086-0150(4)(b): **If the system is not fully metered, a program to install meters on all un-metered water service connections. The program shall start immediately after the plan is approved and shall identify the number of meters to be installed each year with full metering completed within five years of approval of the water management and conservation plan;**

The City is fully metered, and City staff primarily utilize radio read technology to meter water usage on a monthly basis. A conversion program from manual meter reading to radio-read meters has been implemented by the City. Approximately 90% of the City's meters are now radio-read.

OAR 690-086-0150(4)(c): **A meter testing and maintenance program;**

A meter testing and maintenance program should be developed during 2006. Meters do operate at reduced efficiency in years after installation, and the City should be replacing meters on a maximum 15 year schedule after the meters are installed. Worn or malfunctioning meters tend to under report water used, which directly impacts billing revenues. All meters will be replaced or rehabilitated on a maximum 15 year schedule.

OAR 690-086-0150(4)(d) : **A rate structure under which customers' bills are based, at least in part, on the quantity of water metered at the service connections;**

Sisters currently meters all usage and has a rate structure charging a base rate for meter sizing and a comparable rate for all consumption over 10,000 gallons per meter. A new rate structure will be developed by 2007, and increased base rates with an escalating rate for consumption should further reduce the quantity of water usage by consumers.

OAR 690-086-0150(4)(e): **If the annual water audit indicates that system leakage exceeds 10 percent, a regularly scheduled and systematic program to detect**

leaks in the transmission and distribution system using methods and technology appropriate to the size and capabilities of the municipal water supplier; and

See comments under OAR 690-086-0150(4)(a) above.

OAR 690-086-0150(4)(f): **A public education program to encourage efficient water use and the use of low water use landscaping that includes regular communication of the supplier's water conservation activities and schedule to customers;**

Public education regarding efficient water use can, and should, be incorporated into public meetings associated with rate structure changes that will be implemented by 2007.

OAR 690-086-0150(5): **If the municipal water supplier proposes to expand or initiate diversion of water under an extended permit for which resource issues have been identified under OAR 690-086-0140(5)(i), a description of the specific activities, along with a schedule that establishes five-year benchmarks, for implementation of a system-wide leak repair or line replacement program to reduce system leakage to no more than 15 percent or sufficient information to demonstrate that system leakage currently is no more than 15 percent.**

NA.

OAR 690-086-0150(6): **If the municipal water supplier serves a population greater than 1,000 and proposes to expand or initiate diversion of water under an extended permit for which resource issues have been identified under OAR 690-086-0140(5)(i), or if the municipal water supplier serves a population greater than 7,500, a description of the specific activities, along with a schedule that establishes five-year benchmarks, for implementation of each of the following measures; or documentation showing that implementation of the measures is neither feasible nor appropriate for ensuring the efficient use of water and the prevention of waste:**

NA.

OAR 690-086-0150(6)(a) **A system-wide leak repair program or line replacement to reduce system leakage to 15 percent, and if the reduction of system leakage to 15 percent is found to be feasible and appropriate, to reduce system leakage to 10 percent;**

Existing older lines are planned for replacement in the near future. City staff are also searching for the source of 2003 and 2004 water system losses, and

leakage will be reduced to a minimum within 5 years. At this time, the City is conducting a meter audit, additional metering, and potentially implementing a leak detection program.

OAR 690-086-0150(6)(b): **Technical and financial assistance programs to encourage and aid residential, commercial and industrial customers in implementation of conservation measures;**

The City of Sisters will secure available brochure information to advise residents on savings associated with conservation and will publish information in the City newsletter and on their website.

OAR 690-086-0150(6)(c): **Supplier financed retrofitting or replacement of existing inefficient water using fixtures, including distribution of residential conservation kits and rebates for customer investments in water conservation;**

The City of Sisters is pursuing the installation of smart controllers for all irrigation meters, to reduce usage during wet weather periods.

OAR 690-086-0150(6)(d): **Adoption of rate structures, billing schedules, and other associated programs that support and encourage water conservation;**

All consumers receive metered water. The proposed rate structure encourages conservation. Adoption of a new rate structure is recommended, and described previously in this Water Management and Conservation Plan. Smart controllers are being considered for all irrigation meters.

OAR 690-086-0150(6)(e): **Water reuse, recycling, and non-potable water opportunities; and**

NA.

OAR 690-086-0150(f): **Any other conservation measures identified by the water supplier that would improve water use efficiency.**

The City of Sisters will address water conservation regularly in the City newsletter.

10.7.3 OAR 690-086-0160 Municipal Water Curtailment Element

The water curtailment element shall include at least the following:

OAR 690-086-0160(1): **A description of the type, frequency and magnitude of supply deficiencies within the past 10 years and current capacity limitation. The description shall include an assessment of the ability of the water supplier to maintain delivery during long-term drought or other source shortages caused by a natural disaster, source contamination, legal restrictions on water use, or other circumstances;**

Water requirements are discussed in Section 4 of the accompanying Water System Capital Facilities Plan. There have been no supply deficiencies in the past 10 years. There is no foreseeable capacity limitation other than the availability of adequate water rights. The aquifer under the City is large and fast moving. Water tables in the area are high. At this time, loss of one of the existing wells would require public notification and some curtailment of summer irrigation practices based on current usage. When the planned third well is placed in operation, capacity should exist in the short term to maintain delivery with one of the existing wells out of service.

It is anticipated that water usage will be significantly reduced with the implementation of a new escalating rate structure that is based, on actual usage (*see discussion under OAR 690-086-0150 (4)(d)*). Groundwater sources have been historically reliable for the City of Sisters, and the level of usage is such that a water curtailment plan does not appear to be warranted at this time. Should circumstances change and some restriction of water be necessary, the City should develop a water curtailment plan that conforms with OAR 690-086-0160.

OAR 690-086-0160(2): **A list of three or more stages of alert for potential shortage or water service difficulties. The stages shall range from a potential or mild alert, increasing through a serious situation to a critical emergency;**

See comments under OAR 690-086-0160(1) above. A potential alert would occur with loss of one of the existing wells, until the planned third well is constructed. At this stage, if the reservoir was low, the City Council would ask citizens for a voluntary reduction in outside watering. A serious situation would involve a major break in one of the transmission mains, or in a major distribution system, which would involve a loss of water and pressure in the system. This would be corrected with valving that is provided on all of the existing lines. If a serious alert became necessary, the City Council would curtail all outside watering, and would mandate voluntary water reductions. A critical emergency would be some act of sabotage that would involve more than one well, loss of more than one transmission main, or similar loss of primary water supply elements. If the emergency was extended, the City Council would reduce the 10,000 gallon minimum use amount, increase the

cost of water in excess of the minimum, and continue implementing the programs described above.

OAR 690-086-0160(3): **A description of pre-determined levels of severity of shortage or water service difficulties that will trigger the curtailment actions under each stage of alert to provide the greatest assurance of maintaining potable supplies for human consumption; and**

See comments under OAR 690-086-0160(1) above. Water curtailment would be triggered during a critical emergency involving loss of major facilities, as described under OAR 690-086-0160(2). Lesser stages of alert would likely not require water curtailment action.

OAR 690-086-0160(4): **A list of specific standby water use curtailment actions for each stage of alert ranging from notice to the public of a potential alert, increasing through limiting nonessential water use, to rationing and/or loss of service at the critical alert stage.**

See comments under OAR 690-086-0160(1), OAR 690-086-0160(2) OAR 690-086-0160(3) above.

10.7.4 OAR 690-086-0170 Municipal Water Supply Element

The water supply element shall include at least the following:

690-086-0170(1): **A delineation of the current and future service areas consistent with state land use law that includes available data on population projections and anticipated development consistent with relevant acknowledged comprehensive land use plans and urban service agreements or other relevant growth projections;**

Service areas, population projections, and land use is discussed in Section 1 and Section 4 of the accompanying Water System Capital Facilities Plan.

690-086-0170(2): **An estimated schedule that identifies when the water supplier expects to fully exercise each of the water rights and water use permits currently held by the supplier;**

Projections for water consumption are that the City of Sisters will fully utilize groundwater certificate 66520 and groundwater permit 11418 by the year 2040. Anticipated growth in Sisters will fully utilize surface water certificates 10028, 13501, 13509, 65091, 65090, and 67706 by the year 2049.

A detailed evaluation of water rights and water supply needs is provided in Section 6 of the accompanying Water System Capital Facilities Plan.

690-086-0170(3): **Based on the information provided in section (1) of this rule, an estimate of the water supplier's water demand projections for 10 and 20 years, and at the option of the municipal water supplier, longer periods;**

See Sections 1, 4, and 6 of the accompanying Water System Capital Facilities Plan.

690-086-0170(4): **A comparison of the projected water needs and the sources of water currently available to the municipal water supplier and to any other suppliers to be served considering the reliability of existing sources;**

NA.

690-086-0170(5): **If any expansion or initial diversion of water allocated under existing permits is necessary to meet the needs shown in section (3) of this rule, an analysis of alternative sources of water that considers availability, reliability, feasibility and likely environmental impacts. The analysis shall consider the extent to which the projected water needs can be satisfied through:**

NA.

690-086-0170(5)(a): **Implementation of conservation measures identified under OAR 690-086-0150;**

NA.

690-086-0170(5)(b): **Interconnection with other municipal supply systems and cooperative regional water management; and**

NA.

690-086-0170(5)(c): **Any other conservation measures that would provide water at a cost that is equal to or lower than the cost of other identified sources.**

NA.

690-086-0170(6): **If any expansion or initial diversion of water allocated under existing permits is necessary to meet the needs shown in section (3) of this rule,**

a quantification of the maximum rate and monthly volume of water to be diverted under each of the permits;

NA.

690-086-0170(7): **For any expansion or initial diversion of water under existing permits, a description of mitigation actions the water supplier is taking to comply with legal requirements including but not limited to the Endangered Species Act, Clean Water Act, Safe Drinking Water Act; and**

NA.

690-086-0170(8): **If acquisition of new water rights will be necessary within the next 20 years to meet the needs shown in section (3) of this rule, an analysis of alternative sources of the additional water that considers availability, reliability, feasibility and likely environmental impacts and a schedule for development of the new sources of water. The analysis shall consider the extent to which the need for new water rights can be eliminated through:**

New water rights will be pursued through agreements with existing water right holders desiring to annex property into the City of Sisters. Transfer of Well No. 2 rights to a third municipal well is anticipated in order to provide assured water service for municipal demand, and to utilize and preserve the water right. A new well is planned that will provide an alternate source to Wells No. 1 and No. 2, and will be available in the event of a fire emergency of sufficient magnitude as to require simultaneous operation of the City's wells. Water rights for the new well will be handled by transfers of the existing rights to an alternate point of diversion.

690-086-0170(8)(a): **Implementation of conservation measures identified under OAR 690-086-0150;**

NA.

690-086-0170(8)(b): **Interconnection with other municipal supply systems and cooperative regional water management; and**

NA.

690-086-0170(8)(c): **Any other conservation measures that would provide water at a cost that is equal to or lower than the cost of other identified sources.**

NA.

CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
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SECTION 11
WATER CAPITAL IMPROVEMENT PLAN

HGE INC

11.1 GENERAL

This section provides a summary of the City's water system capital improvement needs for the 20-year planning period, to the year 2025. Since financing of improvements will occur through separate funds, a breakdown of costs is provided for funding eligibility. It is recommended that financing of recommended improvements be achieved through loans from financing entities, which would allow for construction of needed improvements at the least possible cost to future residents of the City. However, priorities are also provided to allow for construction as local financing becomes available.

11.2 SOURCE RECOMMENDATIONS

A thorough review of water source needs is provided in Section 6. Improvement recommendations are summarized in *Table 11.1.*

Table 11.1: Source Improvements

	Preliminary Opinion of Probable Cost
Water Rights Transfers	$7,500
Well No. 1 Improvements	$367,875
Well No. 2 Improvements	$81,850
Well No. 3 Improvements	$597,650
Total Capital Costs	**$1,054,875**

Improvements to Well No. 1 are largely replacement of existing equipment, with the exception of telemetry and on-site chlorine generation. Telemetry and on-site chlorine generation costs are eligible for Systems Development Charges because they provide improved service for future users of the water system. Remaining improvements to Well No. 1 will need to be funded through user fees and would not be eligible for SDC revenues. All other source improvements are needed to provide capacity for growth, and will be eligible for System Development Charges.

Table 11.2: Capital Costs SDC Eligible for Source Improvements

	Preliminary Opinion of Probable Cost
Construction Cost - Telemetry and On-site Generation	$58,000
Engineering and Construction Observation	$11,600
Legal and Administrative	$2,900
Contingency (10% Construction Cost)	$5,800
Total SDC Eligible Costs for Well No. 1	**$78,300**
Capital Costs Eligible for Systems Development Charges	**$765,300**

11.3 SOURCE IMPROVEMENT RECOMMENDATIONS BY PRIORITY

The Water System Capital Facilities Plan includes recommendations for several source improvements. Recommended priorities appear as *Figure 11.3.*

Table 11.3: Source Improvement Recommendations by Priority

	Preliminary Opinion of Probable Cost
Priority I	
Water Rights Transfers	$7,500
Well No. 3 Improvements	$597,650
Total Priority I Source Improvements	**$605,150**
Priority II	
Well No. 1 Improvements	$367,875
Well No. 2 Improvements	$81,850
Total Priority II Source Improvements	**$449,725**
Total Capital Costs	**$1,054,875**

11.4 RESERVOIR RECOMMENDATIONS

Water reservoir recommendations are developed in Section 8. Reservoir recommendations are summarized in *Table 11.4.*

Table 11.4: Reservoir Improvements

	Preliminary Opinion of Probable Cost
New 2,500,000 Gallon Reservoir	$4,165,400
Reconditioning of Existing Reservoir Exterior Walls	$19,600
Total Capital Costs	**$4,185,000**

Reconditioning of existing walls for the reservoir would be classified as operation and maintenance, and would not be eligible for collection as Systems Development Charges.

Table 11.5: Reservoir SDC Eligible Costs

	Preliminary Opinion of Probable Cost
Capital Cost of Reconditioning Existing Reservoir Exterior Walls	$19,600
Total User-Funded Operation and Maintenance Costs of Existing Reservoir	**$19,600**
Capital Costs Eligible for Systems Development Charges	**$4,165,400**

11.5 RESERVOIR RECOMMENDATIONS BY PRIORITY

The Water System Capital Facilities Plan includes recommendations for reservoir improvements. Reservoir improvements should all be provided in Priority II, as addressed in *Table 11.6.*

Table 11.6: Reservoir Priorities

	Preliminary Opinion of Probable Cost
Priority II	
Reservoir Improvements	$4,185,000
Total Capital Costs	**$4,185,000**

11.6 TRANSMISSION AND DISTRIBUTION RECOMMENDATIONS

Water transmission and distribution recommendations are developed in Section 9. A cost breakdown of system needs is provided on page 9-8. Transmission and distribution recommendations are summarized in *Table 11.7.*

Table 11.7: Transmission and Distribution Improvements

	Preliminary Opinion of Probable Cost
Capital Costs of Transmission and Distribution Improvements	$3,298,840
Total Capital Costs	**$3,298,840**

Transmission and distribution improvements related to replacement of existing meters are budgetary items that should be on a normal replacement schedule for continued accuracy. Remaining transmission and distribution improvements are eligible for Systems Development Charges because they provide improved service to future users of the water system.

Table 11.8: Capital Costs of Transmission and Distribution SDC Eligibility

	Preliminary Opinion of Probable Cost
Capital Cost of Water Meters	$507,060
Total User-Funded Operation and Maintenance Costs of Replacing Meters	**$507,060**
Capital Costs Eligible for Systems Development Charges	**$2,791,780**

11.7 TRANSMISSION AND DISTRIBUTION RECOMMENDATIONS BY PRIORITY

The Water System Capital Facilities Plan includes recommendations for several transmission and distribution improvements. Recommended priorities appear as *Table 11.9.*

Table 11.9: Transmission and Distribution Priorities

	Preliminary Opinion of Probable Cost
Priority I	
Install new 12" main line meters and vaults	$40,500
6" Distribution Mains	$685,700
8" Distribution Mains	$755,730
10" Distribution Mains	$144,790
16" Distribution Mains	$145,800
Total Priority I Improvements	**$1,772,520**
Priority II	
Replace Existing Water Meters	$507,060
12" Distribution Mains	$1,009,260
Easements	$10,000
Total Priority II Improvements	**$1,526,320**
Total Capital Costs	**$3,298,840**

11.8 TOTAL PRIORITIZED IMPROVEMENTS

A summary of prioritized improvements for improvements to the City of Sisters Water System appears in *Table 11.10.*

Table 11.10: Total Prioritized Improvements

	Preliminary Opinion of Probable Cost
Priority I	
Source Improvements	$605,150
Transmission and Distribution Improvements	$1,772,520
Total Priority I Improvements	**$2,377,670**
Priority II	
Source Improvements	$449,725
Reservoir Improvements	$4,185,000
Transmission and Distribution Improvements	$1,526,320
Total Priority II Improvements	**$6,161,045**
Total System Capital Costs	**$8,538,715**

11.9 FUNDING FOR PRIORITIZED IMPROVEMENTS

Need for Priority I improvements is imminent. All costs should be eligible for funding with Systems Development Charges. The City of Sisters has a current balance in the Systems Development Fund of $ 1,865,000, which can be applied to construction immediately after adoption of this Water System Capital Facilities Plan, and adoption of a new Systems Development Charge Ordinance. It is recommended that construction of Priority I improvements be implemented immediately, to the extent of available funding.

Priority II improvements will be dependent on funding which is not available at this time. It is recommended that funding be obtained through one of the grant and loan programs discussed in Section 12. This will provide for construction with current dollars, and repayment at very favorable rates that are available through several programs. In the long term, residents of the City of Sisters will receive the greatest benefit from this approach, at the least possible cost. Repayment of the needed loans should be from a combination of increased water rates and Systems Development Charges, as discussed in Section 12.

Table 11.11: Priority I Capital Costs and Recommended Funding Sources

	Preliminary Opinion of Probable Cost
Capital Cost of Priority I Improvements	**$2,377,670**
Capital Costs Eligible for Systems Development Charges	**$2,377,670**
SDC Funds Available September 05 for Construction	**$1,865,000**
Needed Construction SDC Funds for Completion of Phase I	**$512,670**

Table 11.12: Priority II Capital Costs and Recommended Funding Sources

	Preliminary Opinion of Probable Cost
Capital Cost of Priority II Improvements	**$6,161,045**
Total User-Funded Operation and Maintenance Cost of Source, Reservoir, Transmission and Distribution Improvements	**$816,235**
Capital Costs Eligible for Systems Development Charges	**$5,344,810**

Table 11.13: Total New-Funded Capital Costs and Recommended Funding Sources - Priority I and Priority II

	Preliminary Opinion of Probable Cost
New Funds Capital Water System Needs	**$6,673,715**
Total User-Funded Capital Needs	**$816,235**
Total Systems Development Eligible Costs	**$5,857,480**

CITY OF SISTERS
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SECTION 12
FINANCE OPTIONS

HGE INC

12.1 INTRODUCTION

The funding of needed water improvements for the City of Sisters may utilize one or more of the following funding sources:

- Sale of Bonds by Acquiring Federal or State Grants and/or Loans
- Special Assessments
- Local Improvement Districts
- Serial Levies
- Capital Improvements (Sinking) Funds
- Systems Development Charges

The most successful financing plans utilize state or federal grants and/or loans that best address the characteristics of needed improvements. It is difficult to finance improvements with grant funding alone, and grant funding in general is becoming very limited. Some level of local funding or borrowing from available loan programs is usually necessary, although some cities accumulate sufficient reserves for construction. Funding programs vary in terms of their economic impact on the community, and often are created with specific program focuses. Some programs are available to create and retain jobs or benefit areas of low to moderate income families. Other programs provide for specific types of infrastructure improvements, such as improvements to address water related compliance issues.

A thorough consideration of applicable state and federal funding programs, in addition to a potential means of securing local funding, is needed to minimize the long-term cost of water system improvements, while providing quality construction.

If the City decides to pursue agency funding for recommended projects, it should contact the Oregon Economic and Community Development Department *(OECDD)* for information and scheduling of a one-stop meeting. One-stop meetings are held in Salem (and several other locations). These meetings bring together staff from the various agencies that could potentially contribute funds, and representatives of the community, to discuss the project and funding needs.

This section is intended to provide a general overview of recently available programs. **Agency and program policies are continually evolving and specifics may vary if funding of improvements is delayed to any major extent.**

12.2 PUBLIC WORKS FINANCING PROGRAMS

Four grant programs and five loan/bond sale programs, which have the potential to provide funding for the City, are listed below.

Grants

Federal	• Economic Development Administration • Rural Development
Federal Administered by State	• Oregon Community Development Block Grants
State	• Special Public Works Fund • Water/Wastewater Financing Program

Loans/Bond Sales

Federal	• Rural Development
State	• Special Public Works Fund • Water/Wastewater Financing Program • Safe Drinking Water Revolving Loan Fund • Small Scale Energy Loan Program

Each of the available grant and loan programs varies in terms of the extent and complexity of the application process. In all cases, it is extremely important to communicate the program needs to the funding agency at the earliest possible date. A close working relationship with the potential grantor or lending agency can optimize the timing and amount of the grant and/or loan assistance. A brief overview of potential public works financing programs and an assessment of their availability follows.

12.2.1 Economic Development Administration

The emphasis of the Economic Development Administration (*EDA*) grant program is on projects which create permanent jobs, especially in economically depressed areas. Results from a survey of businesses must demonstrate that the creation of jobs will occur, in sufficient number, by virtue of building the improvements. There is a higher chance of receiving the grant if the community can demonstrate that the existing system is at capacity; for example, if there is a moratorium on new connections. Sisters utilized this program for sewer improvements in the Industrial Park during construction of the wastewater system.

Grants require a local match, usually in the 40% to 50% range of the project cost, although local match can be as low as 20%.

12.2.2 Rural Development

The Water and Wastewater Disposal Grants and Loans program is under the administration of U.S. Department of Agriculture, Rural Development *(RD)*, under the old guidelines of Farmers Home Administration *(FmHA)*. The program is limited to rural communities which have a population of less than 10,000 people; community population must not be likely to decline in the foreseeable future. The City meets this criteria.

RD Grant Program

RD utilizes "MEDIAN HOUSEHOLD INCOME" *(MHI)* in their computations for determining eligibility. This allows for single-person households to count as family-type households.

RD is currently basing its grant and loan determination on 2000 census data. Availability of grants from the RD is dependent on the *(MHI)*; projects are competitive with one another on the basis of community need.

Maximum grant availability based on MHI from the 2000 census data is as follows:

Less than $27,756 ..... 72% maximum grant
Greater than $27,756 ..... Ineligible for grant

The City of Sisters has a MHI *(2000 Census)* of $35,000 that no longer makes the City eligible for grant funding under this program. In addition, RD has a limited amount of grant funding available at the state and federal levels and requirements of the Safe Drinking Water Act and Clean Water Act have dramatically increased the current number of applications from Oregon communities. RD also requires eligible communities to finance the project with loans up to the extent of the communities' ability to pay; the grant is then available to cover the remainder. The actual formula to determine the maximum burden per household is quite complicated, and costs for commercial users are typically higher. RD determines the debt burden required in each case. Sisters previously utilized this program for water and wastewater system construction throughout the community.

RD Loan Program

The City falls within the established criteria for loans. Please note that this is an excellent financial assistance program. Items which determine a borrower's eligibility are listed below.

- Unable to obtain needed funds from other sources at reasonable rates and terms.

- Have legal capacity to borrow and repay loans, to pledge security for loans, and to operate and maintain the facilities or services.

- Be financially sound and able to manage the facility effectively.

- Have a financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay all facility costs, including costs that pertain to operation and maintenance. Furthermore, it must be shown that debts will be retired and financial reserves maintained.

RD loans currently have a 4.5 % interest rate. The maximum term for all loans to cities is 40 years. However, no repayment period can exceed any local statutory limitation on obligations.

12.2.3 Community Development Block Grant Program

The State of Oregon Economic and Community Development Department administers the Community Development Block Grant *(OCDBG)* program. This program is funded by the U.S. Department of Housing and Urban Development. Funds allocated under the heading of this grant program are provided for projects designed specifically to improve the conditions of low and moderate income housing areas. The maximum grant for a water or wastewater project is $1,000,000 which includes planning, engineering and construction.

To qualify for an OCDBG, the project must meet at least one of the following three national objectives of the federal OCDBG program. The primary national objective is one that limits OCDBG assistance to projects that principally benefit low and moderate income persons. OCDBG funds may be used to develop projects that are needed to benefit current residents, however, they must be built to include limited capacity for future development.

The current policy is that at least 51% of a city's population must have low and moderate incomes to be eligible. Grant awards will be based on the 2000 Census data or an OECDD recognized income survey. Sisters' low to moderate percentage, based on OECDD information, is 49.9% At present, the City does not qualify for OCDBG Funding, unless a special income survey was completed that demonstrates a higher low and moderate income percentage. This program was utilized for funding of individual sewer service laterals in the wastewater project.

12.2.4 Special Public Works Fund (SPWF)

The State of Oregon Economic and Community Development Department *(OECDD)* administers the Oregon Special Public Works Fund *(SPWF)* program. The SPWF program is capitalized through biennial appropriations from the Oregon Lottery

Economic Development Fund, through Oregon Bond Bank Fund sales for dedicated project funds, through loan repayments and other interest earnings. Applications may be submitted throughout the year. Loans and grants may be made available for infrastructure construction projects related to economic development and for the retention or creation of jobs.

Projects must build public infrastructure to assist a business expanding, thus creating jobs, or build needed infrastructure capacity for future economic growth in the community. OECDD has separated the program into three categories:

- Firm business commitment for permanent job creation
- Capacity building, high probability of job creation or retention.
- Capacity building for severely affected communities

Revenue bonds are limited obligations of the state of Oregon payable solely from, and secured by, the loan repayments and other revenue pursuant to agreements between the state of Oregon acting by and through its OECDD, and specific benefitted municipalities. The Oregon Bond Bank Fund pools municipal loans into one bond issue and provides small communities affordable access to the financial markets. Bonds are repaid by local revenues and at interest rates lower than what is available to most Oregon communities. The Oregon Bond Bank Fund also pays the cost of issuance and funds the debt service reserve.

The Oregon Bond Bank Fund substantially increases funds available through the SPWF program to assist Oregon municipalities, and offers communities a viable financing alternative. Revenue bonds sold through the Oregon Bond Bank Fund are not subject to the State Treasurer's moratorium on the issuance of new general obligation or certificates of participation debt. OECDD expects to regularly issue bonds to provide permanent financing for SPWF program applicants. Interest rates are anticipated to range from 5% to 6.5%. For bond-funded projects, the interest rate is often estimated at 6.5% with actual interest passed on to the applicant at the time of the bond sale.

OECDD plans to pass the exact interest rate allotted to the state for this program directly to borrowers. The state will pay for all debt reserve costs, bond issuance costs and attorneys fees. This is a loan program where the City could acquire funding directly from the state without the necessity for revenue or general obligation bonding.

A discussion of the three OECDD categories of the SPWF *(Bond Funds)* Program follow:

Firm Business Commitment (Bond Funds)
Grants of up to $500,000 are available for projects which have a firm commitment from a business(es) to create permanent jobs if the project is constructed. The grant is dependent on the number of jobs which would potentially be created with maximum assistance of up to $10,000 per job.

Capacity Building, High Probability of Job Creation/Retention
This category of the SPWF program finances only loans up to $10,000,000.

Capacity Building for Severely Affected Communities
SPWF has loans to $10,000,000 and grants up to $250,000 for severely affected communities. Communities are able to apply for grants of up to $250,000 from this fund even if they don't have a waiting business that needs the infrastructure. This provides communities who are seeking to attract business growth the chance to prepare in advance for these opportunities.

Sisters would need to demonstrate that a project is necessary to create and/or retain jobs in the industrial sector. SPWF staff emphasize that the program is primarily a loan program and that applicants should not be overly optimistic about securing maximum grant dollars.

12.2.5 Water/Wastewater Financing Program

The 1993 State Legislature created a Water Fund through Senate Bill 81 to provide financing for local governments to construct and improve public drinking water systems and public wastewater collection systems. The legislation was primarily intended to assist local governments meet regulations for the Safe Drinking Water Act and the Clean Water Act. In that respect, the Water/Wastewater Fund may assist both municipal drinking water projects and municipal wastewater collection and treatment projects. Program eligibility is limited to projects necessary to ensure that municipal water and wastewater systems comply with the requirements of the following:

1. Current drinking water quality standards administered by the Department of Human Services *(DHS)*, previously known as the Oregon Health Division *(OHD)*.

2. Wastewater quality statues, rules, orders, or permits administered by the Oregon Department of Environmental Quality *(DEQ)*.

The Water/Wastewater Fund is capitalized through a biennial appropriation from the Oregon Lottery Economic Development fund, bond sales for dedicated project funds, loan repayments, and interest earnings. The Fund is administered by the OECDD, Community Development Programs Section.

Loans and grants may be awarded for eligible projects. Loans will be based on a reasonable and prudent expectation of the City's ability to repay the loan, which is extremely favorable.

Grants may be awarded only if a loan is not feasible due to the following:

1. Financial hardship to the local government as determined by OECDD.

2. Special circumstances of the project.

Loans up to $10,000,000 and grants up to $500,000 (includes non-cash grants for issuance costs and debt service reserve) are available for projects financed with bond funds. Loan term is 20 years at a 5% - 6.5% interest rate. Loans and grants up to $500,000 are available to projects financed with direct lottery funds.

12.2.6 Safe Drinking Water Revolving Loan Fund

The Safe Drinking Water Revolving Loan Fund *(SDWRLF)* was created in 1996 by Congress to assist community and non-profit non-community drinking water systems to plan, design, and construct drinking water facilities needed to correct non-compliance with current or future drinking water standards. The program is administered by the Oregon Economic and Community Development and is funded by annual grants from the U.S. Environmental Protection Agency and 20% matching funds through a biennial appropriation from the Oregon State Legislature and/or through bond sales for dedicated project funds.

Highlights of the program include 1% financing (30-year term) for disadvantaged communities. A disadvantaged community is one whose average water cost for a residential customer is at least the state "average" and also meet two of the following criteria:

- For water system only communities, there is a per capita water system debt of at least $250. For communities with both water and sewer systems, the combined water and sewer system debt must be at least $500 per capita.

- At least 15% low and moderate income persons.

- Documented financial burden due to a national or state declared disaster that occurred within the past two years.

Interested applicants submit an initial "Letter of Interest". Projects are then ranked by the Department of Human Services *(DHS)* and OECDD to form a Project Priority List. Projects are ranked based on existing or potential noncompliance with Safe Drinking Water Act *(SDWA)* provisions. This program is notable in providing

ranking "points" for systems that may be close but not actually in violation of SDWA requirements. Top ranking applicants will be invited to submit a final application. The cut-off for any given year will vary according to the nature of competing projects and the availability of funds.

12.2.7 Oregon Department of Energy - Small Scale Energy Loan Program

Funds could be made available under this program as a demonstration project or as a conventional energy savings or conservation program. The Department of Energy's Small Scale Energy Loan Program *(SELP)* offers help to anyone who wants to save money on energy costs. SELP was created by Oregon voters in 1980, and has financed more than $150 million in projects since that time. This is a self-supporting program that operates without tax funds. A finished project must at least break even in power costs with the pre-study and improvement program. The pre-design phase would be utilized to generate data that would show power savings or creation for recommended improvements. This is a loan program repayable at 8% interest over a 15-year repayment period. A fee of one-tenth of one percent of the loan request is required at the time of application. Loan closing costs and fees vary.

12.3 LOCAL FUNDING SOURCES

A significant portion of a project may need to be financed with local funding sources. Local funding sources are listed below:

General Obligation Bonds
Revenue Bonds
Improvement Bonds *(Local Improvement District)*
Serial Levies
Sinking Funds
Ad Valorem Tax
System User Fees
Assessments
System Development Charges *(SDC's)*

The 1991 legislature clarified and defined the impact of Ballot Measure 5 on municipal finance in several special ways. Cities, counties, and special districts need to clearly understand, and follow these rules, when they consider bonding for the financing of needed improvements.

The following information was provided in part by Howard A. Rankin, retired Bond Counsel:

1. Chapters 287 and 288 of the Oregon Revised Statutes describe the borrowing and bonding of counties, cities, and special districts, generally.

2. The advance sheets of the Laws of 1991 indicate that the general bond limitations of ORS 287.004 are still in force. Except with regard to the old 3% limitation on all issued and outstanding bonds, on true-cash value of all taxable property within the city's boundaries, has been changed to a 3% limitation on "real market value" as determined by the County Assessor.

3. The above limitation still does not apply to bonds issued for water, sanitary or storm sewers, sewage disposal plants; nor to bonds issued to pay assessments for improvements in installments under statutory or charter authority (i.e. revenue bonds).

4. The City would need to check the charter for any additional impacts or limitations on bonding capabilities.

A description of each of the preceding listed funding sources follows.

12.3.1 General Obligation Bonds

Financing of water improvements by General Obligation *(G.O.)* Bonds is accomplished by the following procedures:

1. The Consulting Engineer prepares a detailed cost estimate to determine the total monies required for construction.

2. An election is held.

3. When voter approval is granted (by a majority of the registered voters), bonds are offered for sale. The money for detailed planning and construction is obtained prior to preparation of final engineering plans and the start of project construction unless interim financing has been developed.

G.O. bonds are backed by the full credit of the issuer and authorize the issuer to levy ad valorem taxes. The issuer can make the required payments on the bonds solely from the new tax levy or may instead use revenue from assessment, user charges, or some other source.

Oregon Revised Statutes limit the maximum term of G.O. bonds to 40 years for cities and 30 years for water districts. Except in the event that RD purchases the bonds, the realistic term for which general obligation bonds would be issued is 15 to 20 years.

Ballot Measure 5 has limited the ability of communities to levy property taxes. Capital improvement projects, such as the proposed water system improvements, are

exempt from property tax limitations if an election is held and new public hearing requirements are met.

Cities, counties and special districts (all non-school taxing entities) must be very careful when seeking approval from the voters for a general obligation bond, new tax base, annual budget levy, or special levy. The current law now requires that all non-school taxing entities, including cities, counties, and special districts, hold a special public hearing more than 30 days before filing the election statement with the County Clerk. Notice of this special public hearing must be sent to all other non-school taxing entities with overlapping taxing jurisdictions no later than 10 days before the special public hearing. This special public hearing offers the opportunity for all overlapping taxing entities to determine the compaction impact of the proposed election on their respective assessment capability. Effectively, the municipality proposing the election measure must be thoroughly prepared with notice of special public hearing published no later than 41 days before a final public hearing and filing of the election statement.

If the special public hearing procedures are not followed, and no certificate is included in the filing that attests that the special public hearing was conducted pursuant to law, the County Clerk is required to reject the filing for an election. This results in additional unnecessary delays. Consideration should be given to hiring a competent Bond Counsel before proceeding with a General Bond Election. This action will insure that all requirements of current law are met.

Since bonding requirements are very stringent, most recent municipal improvements have been financed with either revenue bonds or one of the state financing programs which can be accomplished outside of bonding requirements.

12.3.2 Revenue Bonds

A revenue bond is one that is payable solely from charges made for the services provided or from collection of Systems Development Charges, although the City would need to be very careful that SDC's would be collectible. Such bonds cannot be paid from tax levies or special assessments, and their only security is the borrower's promise to operate the water system in a way that will provide sufficient net revenue to meet the obligations of the bond issue. Revenue bonds are most commonly retired with revenue from user fees.

Successful issuance of revenue bonds depends on bond market evaluation of the dependability of the revenue pledged. Normally there are no legal limitations on the amount of revenue bonds to be issued, but excessive bond issue amounts are generally unattractive to bond buyers because they represent high investment risk. In rating revenue bonds, buyers consider the economic justification for the project,

reputation of the borrower, methods for billing and collection, rate structures, and the degree to which forecasts of net revenues are realistic. RD will fund revenue bonds in which user rates are committed for the repayment of the bonds.

Under the provisions of the Oregon Uniform Revenue Bond Act (ORS 288.805-288.945), municipalities may elect to issue Revenue Bonds for revenue producing facilities without a vote of the electorate. In this case, certain notice and posting requirements must be met including a mandatory 60-day waiting period. A petition signed by 5% of the municipalities' registered voters may cause the issue to be referred to an election.

Laws enacted by the 1991 legislature have eliminated the limitation on revenue bonds. The law formally required that the revenues pledged for payment of the bonds have a direct relationship to the services financed by the bonds. Current law now allows revenue bonds to be paid with any revenue pledged for "any public purpose," without the relationship restriction.

12.3.3 Improvement Bonds (Local Improvement District)

Improvement bonds may be issued to assess certain portions of water improvements directly against the parties being benefitted. An equitable means of distributing the assessed cost must be utilized so that all property, whether developed or undeveloped, receives the assessment on an equal basis. Cities are limited to improvement bonds not exceeding 3% of true cash value. For a particular improvement, all property within the assessment area is assessed on an equal basis, regardless of whether it is developed or undeveloped.

Improvement bond financing requires that an improvement district be formed, the boundaries established, and that benefitted properties and property owners be determined. The engineer usually determines an approximate assessment based on a square-foot, a front-foot basis, or a combined basis. Property owners are then given an opportunity to remonstrate against the project. The assessment against the properties is usually not levied until the actual total cost of the project is determined. Since this determination is normally not possible until the project is completed, funds are not available from assessments for the purpose of making monthly payments to the contractor. Therefore, some method of interim financing must be arranged, or a pre-assessment program, based on the estimated total costs, must be adopted. It is common practice to issue warrants, which are paid when the project is completed, to cover debts.

The primary disadvantages to this source of revenue (improvement bonds) are described below:

1. The property to be assessed must have a true cash valuation at least equal to 50% of the total assessments to be levied. This may require a substantial cash payment by owners of undeveloped property.

2. An assessment district is very cumbersome and expensive when facilities for an entire community are contemplated.

3. The project is impacted by Measure 5 tax limitations because the improvement bonds are backed or guaranteed by the city's authority to raise revenue via taxation. If the city is in compaction, then a general election (same procedures as for a general obligation bond) is required. If the city's property taxes are not under compaction, then the city can proceed with a L.I.D. as in the past; however, the project cost will count against the $10.00 limitation for non-school taxes.

This program should not be considered for improvements to satisfy the City's needs in general, but could be a definite consideration for specific projects benefitting an area of the community.

12.3.4 Serial Levies

Under Oregon Revised Statutes, if approved by the voters, the City can levy taxes for a fixed period of time to construct new facilities and maintain existing facilities. Generally, when a serial levy is presented to the voters, it is based upon a specific program and listing of planned improvements.

Since the time frame required for construction of the needed water improvements is quite limited, it is doubtful that residents could afford a serial levy of sufficient size to provide for needed construction revenues.

12.3.5 Sinking Funds

Sinking funds can be established by budget for a particular capital improvement need. Budgeted amounts, from each annual budget, are carried in a sinking fund until sufficient revenue is available for the needed project. Funds can also be developed with revenue derived from system development charges or serial levies. The City's water system financial needs can be met with a sinking fund, although the cost of needed facilities will be higher after funds are collected than if revenues are utilized to repay a loan for construction in the near term.

12.3.6 Ad Valorem Tax

Many communities utilize an ad valorem tax as the basis for repaying general obligation bonds for system expansions, and provide partial or full repayment through means of additional water use charges. This means of financing reach all properties to be ultimately benefitted by the water system, whether the property is presently developed or not. Construction costs are more equally distributed among all property owners and the program does not impose a penalty on existing residential or business development. However, with Oregon tax limitations and the public's perception of taxes, this means of securing funds would not be popular.

12.3.7 System User Fees

Monthly charges are made to all residences, businesses, etc., that are connected to the water system. Water use charges are established by resolution, and can be modified as needed to serve increased or decreased operating costs. Rates are established depending on the various classes of users and the metered demand through their connection. By establishment of proper use charges, the City could repay the local share of bond amortization without imposition of property taxes. Sisters reduced water use fees by $ 6.00 per month in recent years, when existing bonds were paid off. An increase in user fees could finance portions of the water system that are maintenance related, particularly if done in conjunction with a revenue bond.

12.3.8 Assessments

In some cases the beneficiary of a public works improvement can simply be assessed for the cost of the project. It is not uncommon for an industrial or commercial developer to provide up-front capital to pay for a community administered improvement which serves the development.

12.3.9 System Development Charges

System Development Charges *(SDC's)* are charges assessed against new development to recover the costs incurred by local government who provide the capital facilities required to serve the new development. SDC's apply to new developments that generate revenue for the expansion or construction of facilities located outside the boundaries of new development. When capital improvements increase usage, SDC's can be billed for water, wastewater, drainage and flood control, transportation, and parks or recreational facilities.

12.4 PROPOSED FINANCIAL PROGRAM

Initially it appears that either Rural Development or Water/Wastewater funding may be the most applicable since there are no outstanding compliance issues or anticipated commercial growth that will result in family wage jobs. Funding is likely to be predominantly loan, under any of the available funding programs.

A combination of increased user fees and systems development charges are recommended for funding of needed system improvements. Systems Development Charges should fund system improvements either through repayment of loans, or potentially by utilizing sinking funds to pay for improvements as monies become available. As discussed, utilization of sinking funds will cost substantially more for the recommended construction. Increased user fee revenues should be utilized for maintenance related issues. After selection of the initial project scope, the City should contact the OECDD to schedule a one-stop meeting with available state and federal funding agencies, to discuss project needs. When the project is presented to all funding agencies, each agency will evaluate their program's potential to assist with financing the needed water improvements, and the City can determine how construction can best be implemented.

CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
WATER CONSERVATION and
MANAGEMENT PLANS

SECTION 13
WATER RATES AND FINANCING

HGE INC

13.1 WATER FUND BUDGET

Table 13.1 includes recent water fund budgets. *Table 13.2* provides the information in summary form with a focus on ordinary revenue and expenses.

Table 13.1: Recent Water Fund Budgets

Description	Actual FY 02-03	Actual FY 03-04	Adopted FY-04-05	Adopted FY 05-06
Revenues				
Water Receipts	$274,243	$296,265	$328,817	$315,500
Interest Earned	$9,295	$6,053	$7,500	$9,000
Hook-up Fees	$615	$510	$300	$300
Bulk Water	$14,758	$1,389	$1,000	$1,500
Plan Check Fees	$980	$0	$0	$0
Engineering/New Development Fees	$2,143	$3,667	$5,000	$5,000
Water Processing/Trans Fee	$2,370	$2,480	$2,790	$3,000
Water Rights Leases	$0	$0	$0	$1,000
Miscellaneous	$3,647	$77	$1,000	$2,000
Meter Installation & Repair	$25,430	$29,027	$27,000	$30,000
Construction Inspection Fees	$0	$0	$16,016	$20,000
Squaw Creek Irrigation	$7,523	$5,220	$16,000	$6,000
Water Laterals Reimbursement	$28,461	$21,033	$37,500	$20,000
Total Revenues	**$369,465**	**$365,721**	**$442,923**	**$413,300**
Cash Carry Forward	-	-	$414,283	$432,028
Transfers In		$5,798		
Total Resources	$369,465	$371,519	$857,206	$845,328
Expenditures:				
Personal Services				
Salaries and Expenses	$93,351	$97,086	$104,868	$133,140
Total Personal Services	$93,351	$97,086	$104,868	$133,140
Materials & Services:				
Total Expenses	$124,957	$158,165	$211,783	$141,275
Total Materials & Services:	$124,957	$158,165	$211,783	$141,275
Capital Improvements:				
Capital Outlay	($343)	($26,512)	$131,889	$230,751
Engineering/New Development	$ 0-	$ -	$ -	$5,000
Fleet Leasing - Computer Hdwr	$343	$ -	$ -	$ -
Computer Hdwr & SF	$ -	$ -	$15,000	$15,000
IBM Computer HDR & SWR	$ -	$3,915	$ -	$ -
Water Laterals Reimbursement	$ -	$27,467	$37,500	$18,000
Construction Inspection	$ -	$ -	$14,560	$20,000

Description	Actual FY 02-03	Actual FY 03-04	Adopted FY-04-05	Adopted FY 05-06
Equipment/Vehicle Reserves	$ -	$ -	$5,000	$25,000
System Reserves	$ -	$ -	$ -	$ -
Total Capital Improvements:	$ -	$4,870	$203,949	$313,751
Transfers				
Total Transfers	($501,283)	$37,000	$162,000	$137,000
Depreciation	$76,736	$42,282	$80,000	$40,000
Operating Contingency	$ -	$ -	$94,606	$80,162
Total Water Fund Expenditures:	($206,239)	$339,403	$857,206	$845,328
Excess (Deficiency) of Revenues Over Expenditures	$575,684	$32,116	$ -	$ -

Table 13.2: Water Fund Budget Summary
Ordinary Revenue and Expenses

Description	Actual FY 02-03	Actual FY 03-04	Adopted FY-04-05	Adopted FY 05-06
Revenue:				
Total Revenue	$369,465	$371,519	$857,206	$845,328
Total Revenue:	**$369,465**	**$371,519**	**$857,206**	**$845,328**
Total Expenses:	($206,239)	$339,403	$857,206	$845,328

Reference to these Tables are made in sub-sections that follow.

13.2 WATER SYSTEM REVENUE

13.2.1 Current Water Rates

Current water rates became effective in March 1995, with an adjustment for meters larger than 3/4" in 1996. Repayment for the 1995 construction was provided with a $ 6.00 bond charge per equivalent dwelling unit (EDU). The surcharge was removed when the construction loan was retired, effectively lowering user rates. The current rate structures is provided in *Table 13.3*

Table 13.3: Existing Water Rates

METER SIZES	LOCATION	MINIMUM RATE	BASIC RATE USAGE	OVERAGE
5/8" and 3/4"	Inside City Outside City	$ 16.50 $ 24.75	10,000 gallons 10,000 gallons	$ 1.10 per 1,000 gallons $ 1.10 per 1,000 gallons
1" and 1-1/2"	Inside City Outside City	$ 18.50 $ 27.75	10,000 gallons 10,000 gallons	$ 1.10 per 1,000 gallons $ 1.10 per 1,000 gallons
2"	Inside City Outside City	$ 20.50 $ 30.75	10,000 gallons 10,000 gallons	$ 1.10 per 1,000 gallons $ 1.10 per 1,000 gallons
3", 4", 6", 8"	Inside City Outside City	$50.00 $75.00	10,000 gallons 10,000 gallons	$ 1.10 per 1,000 gallons $ 1.10 per 1,000 gallons

METER SIZES	LOCATION	MINIMUM RATE	BASIC RATE USAGE	OVERAGE
Standby Fire 4" and Smaller	Inside City Outside City	$10.00 $15.00	-0- gallons -0- gallons	$ 0.00 fire protection only $ 0.00 fire protection only
Standby Fire 6"	Inside City Outside City	$15.00 $22.50	-0- gallons -0- gallons	$ 0.00 fire protection only $ 0.00 fire protection only
Standby Fire 8"	Inside City Outside City	$20.00 $30.00	-0- gallons -0- gallons	$ 0.00 fire protection only $ 0.00 fire protection only
Bulk Rate By the Gallon				$ 3.30 per 1,000 gallons

13.2.2 Current Rate Revenue

Potential rate revenue, based on current service connections, is projected to equal $ 315,500 in the adopted 05/06 fiscal budget.

13.2.3 Property Taxes

Currently water system revenue includes no property tax component.

13.2.4 "Other" Revenue

Other revenue may include such revenue as contractor water purchases, interest, carry over funds, grants, etc. These sources, typically, contribute a relatively small portion of overall revenue and may vary considerably from year to year. Grant funding revenue may be significant; however, it is typically obtained and obligated for specific projects or purposes. Hook-up fees are generally developed to cover the actual cost of making a new connection. System development charges (SDCs) can only be used for adding system capacity and cannot be used for general operating and maintenance expenses.

13.3 WATER SYSTEM EXPENSES

13.3.1 Debt Service

The water system is currently debt free.

13.3.2 Operations and Maintenance (O&M)

Operations, maintenance, and administrative costs are summarized in *Table 13.1.* Current expenditures appear to approximate revenues in both actual and adopted budgets. There is a minimal cash carry forward fund to cover the costs of major equipment or facility replacements, and a small contingency. Sisters has a relatively simple water system, but replacements and maintenance are necessary. Mechanical equipment should be repaired or replaced as needed.

13.4 CURRENT RATES - ANALYSIS AND RECOMMENDATIONS

A simple formula for budget viability is: *Revenue - Expenses ≥ 0.* At the present time, with a minimum level of reserves for emergencies, the budget is in balance.

The City has actually lowered monthly total user costs since 1995, and rates should be adjusted upward for inflation on an annual basis.

The current rate structure is very simple and easy to apply. A specific reserve fund is probably not required, since unplanned expenses should not exceed the budgeted reserve amount. However, rates will need to be adjusted for equipment replacement and increased operation and maintenance expenses addressed in the Capital Improvement Plan provided in Section 12.

13.5 FUTURE RATES

Usage fees are currently divided into a base rate and an overage rate, which is typical for most municipal water systems. The base rate is fixed by meter size and category, and includes an allowance of 10,000 gallons of water for all meter sizes. Overage is currently charged at a rate of $ 1.10 per 1,000 gallons for all usage over the base rate. Oregon Administrative Rules encourage an escalating rate for overage, and this is recommended as a conservation incentive.

In Sisters, with largely residential usage, the majority of revenues are derived from the base rate. The purpose of rate development is to ensure a reliable revenue stream to meet the water system cost of operations, and an increase appears necessary at this time for only the needed revenue to pay for bond repayment. The overage component should encourage water conservation, and should lead to reduction of wasteful utilization practices. The combined base and overage cost are the basis of the monthly water system billing.

13.6 CAPITAL IMPROVEMENTS PLAN

13.6.1 Capital Improvements

Recommended Capital improvements are addressed in detail in the Water Capital Improvement Plan provided as Section 11. Costs are itemized in both priorities and by funding sources. It is recommended that bonds be issued for both Priority I and Priority II Improvements, in order to minimize capital costs and to maintain rates at the lowest possible level. Needed capital improvements to be funded by monthly usage fees total $ 823,735. Capital costs which are eligible for Systems Development Charges total $ 5,344,810.

13.6.2 Financing

A general discussion of financing options is presented in Section 12. Probable financing is limited to loans (based on project scope, cost, impact on rates, and City

eligibility). Loans can be obtained from either Rural Development (RD) or Oregon Economic and Community Development (OECDD). RD has a longer term (40 years vs. 20 years), but a lower interest rate (4.5% versus 6.5%). RD tends to have more complicated application and environmental reporting requirements. Since growth is occurring rapidly in Sisters, and needed funding to be financed with user fees is a relatively small amount, it is recommended that the repayment period be limited to 20 years with any funding option.

After a selection of the initial project scope, the City should contact OECDD to schedule a one-stop meeting with available state and federal funding agencies, to discuss project needs. When the project is presented to all the funding agencies, each agency will evaluate their program's potential to assist with financing the needed water improvements.

The following potential funding scenarios are based on loan only awards. These are examples only, interest rates and program guidelines are subject to change and will likely do so prior to agency application and acceptance.

Project Cost to be Financed by User Fees: **$ 823,735**

Assuming Financing through an OECDD Loan: (6.5% Interest; 20 year term)

Annual Payment: $74,785

Active Service Connections: 939
(Outside Users = 7)

Monthly Debt Service can be met by a $ 4.00 increase to the base rate for residential meters, and by the following increase to Inside City Rates, with a corresponding adjustment for outside users.

5/8" x 3/4"	-	$ 4.00 increase
1" and 1-1/2"	-	$ 4.50 increase
2"	-	$ 5.00 increase
3", 4", 6", and 8"	-	$ 12.50 increase

Overage above the 10,000 gallons provided in the base rate should be increased to a minimum of $ 2.15 per 1000 gallons to encourage conservation. Bulk water usage rates should increase to at least $ 4.50 per 1000 gallons.

13.7 SYSTEMS DEVELOPMENT CHARGES (SDCs)

System Development Charges (SDCs) can be charged to all users of transportation, water, sewer, storm drainage, and parks and recreation facilities. The fee is usually charged as each

piece of property is developed in the future and goes into a capital construction fund to pay for improvements required by growth in the community. The Oregon System Development Charges Act, House Bill 3224, became effective in 1991. Legislation requires that capital improvement plans be developed, and that methodology used to compute SDCs be documented and reviewed by the community before SDCs can be charged.

The Oregon System Development Charges Act permits two types of charges: 1) a reimbursement fee, and 2) an improvement charge. A reimbursement fee is a charge for unused capacity in existing capital improvements. An improvement charge is associated with capital improvements to be constructed, which creates new capacity. Both types of fees will likely be utilized for needed Systems Development eligible elements of needed improvements to the Sisters Water System.

CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
WATER CONSERVATION and
MANAGEMENT PLANS

APPENDIX 6.1
WATER WELL REPORT

HGE INC

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

1173

State Well No. .....
State Permit No. .....
Well No. 1

(1) OWNER:
Name City of Sisters
Address Sisters City Hall
Sisters, Oregon 97759

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

(5) CASING INSTALLED:
Threaded ☐ Welded ☒
14 " Diam. from + 2 ft. to 100 ft. Gage 250
12 " Diam. from 25 ft. to 111 ft. Gage 250
10 " Diam. from 0 ft. to 195.6 ft. Gage 250

(6) PERFORATIONS:
Perforated? ☒ Yes ☐ No
Type of perforator used ACY. and Machine
Size of perforations ¼ in. by 6" XXX and ¼" by 2"
1200 perforations from 50 ft. to 100 ft.
1560 perforations from 95.6 ft. to 195.6 ft.
..... perforations from ..... ft. to ..... ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.
Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level Davidson
Was a pump test made? ☒ Yes ☐ No If yes, by whom? Drilling
Yield: 549 gal./min. with 4 ft. drawdown after 1½ hrs.
" 902 " 7'4" " 4 "
" 1315 " 5'3" " 1 "
PUMP TEST 24 hrs.
Bailer XXX gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water 46 Depth artesian flow encountered ..... ft.

(9) CONSTRUCTION:
Well seal—Material used Cement and Bentonite
Well sealed from land surface to 40 ft.
Diameter of well bore to bottom of seal 18 in.
Diameter of well bore below seal 16 in.
Number of sacks of cement used in well seal 58 sacks
Number of sacks of bentonite used in well seal 150 lbs. sacks
Brand name of bentonite Western
Number of pounds of bentonite per 100 gallons of water 5½ gals. water per 100 lbs. Cement lbs./100 gals.
Was a drive shoe used? ☐ Yes ☒ No Plugs ..... Size: location ..... ft.
Did any strata contain unusable water? ☒ Yes ☐ No
Type of water? Surface depth of strata 3 feet
Method of sealing strata off casing and grout
Was well gravel packed? ☐ Yes ☒ No Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

(10) LOCATION OF WELL:
County Deschutes Driller's well number
NW ¼ SW ¼ Section 9 T. 15 S R. 10 E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 105 ft.
Static level 85 ft. below land surface. Date 10/2/75
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 10"
Depth drilled 211 ft. Depth of completed well 211 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Overburden	0	2	
Cong. Gray	2	21	
Clay and Cong. Brown	21	29	
Lava - Mild	29	111	
Sandstone & Cong. Brown	111	175	
Cong. Gray - Waterbearing	175	195	
Basalt	195	211	

Work started 4/3/ 1975 Completed 10/2 1975
Date well drilling machine moved off of well 10/3/ 1975

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] William D. Aiken (Drilling Machine Operator) Date 10/15 1975
Drilling Machine Operator's License No. 803

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name DAVIDSON DRILLING INC. (Person, firm or corporation) (Type or print)
Address 626 N.W. Parshall Way Redmond, Ore. 97
[Signed] Dr. Marlan Davidson (Water Well Contractor)
Contractor's License No. 548 Date 10/15/ 1975

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*46656-119

Well No. 2

(503) 845-6824

220 Academy St.
Mt. Angel, OR 97362

Driller Byco

(1) OWNER:
Name Hap Taylor Construction Well Number:
Address
City State Zip

(2) TYPE OF WORK:
☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Other

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☒ Irrigation
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval Yes ☐ No ☒ Depth of Completed Well 302 ft.
Explosives used Yes ☐ No ☒ Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
22"	0	39	Cement	0	39	93
17"	39	190				
14"	190	244				
13"	244	302				

How was seal placed: Method ☐ A ☐ B ☒ C ☐ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	18	+1	39	.375	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	14"	113	244	.250	☒	☐	☒	☐
	10"	238	302	.250	☒	☐	☒	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
☒ Perforations Method
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
242	302	16x3	2400	10"		☐	☒
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
1200	3 ft	220	8 hrs

Temperature of water 51° Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal desc.
County Latitude Long
Township 15 S N or S. Range 1 E
Section 5 ¼ ¼
Tax Lot Lot Block
Street Address of Well (or nearest address) Sister New Construction

(10) STATIC WATER LEVEL:
101 ft. below land surface.
Artesian pressure lb. per square inch.

(11) WATER BEARING ZONES:
Depth at which water was first found 105'

From	To	Estimated
251	273	120
283	288	
288	295	
295	301	

(12) WELL LOG:
Ground elevation

Material	From
Top soil	0
Cobbles with sand & dirt	1
Volcanic gravels	23
Basalt Black Pourus	34
Basalt grey hard	50
Cinders red	63
Volcanic gravels grey red	75
Basalt grey med fract.	98
Pumice White	103
Basalt grey Fractured	106
with round gravels	
Conglomerate brown	145
Rock grey hard	155
Rock soft grey & brown	160
gravel broken	175
Rock broken grey & brown	193
Conglomerate light brown	203
Rock broken with gravel	235
basalt grey hard & Pourus	241
basalt brown Pourus	251
basalt grey hard	273
Basalt Pourus grey & lavender	283
Cinders red	288
basalt Pourus brown	295
" " " hard	301

Date started 7-19-71 Completed 8-16

CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
WATER CONSERVATION and
MANAGEMENT PLANS

APPENDIX 6.2
WATER RIGHT CERTIFICATES

HGE INC

STATE OF OREGON

COUNTY OF DESCHUTES

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

CITY OF SISTERS
P.O. BOX 39
SISTERS, OREGON 97759

confirms the right to use the waters of A WELL in the DESCHUTES RIVER BASIN for the purpose of MUNICIPAL USE.

The right has been perfected under Permit G-9979. The date of priority is FEBRUARY 24, 1983. The right is limited to not more than 1.78 CUBIC FEET PER SECOND or its equivalent in case of rotation, measured at the well.

The well is located as follows:

NW 1/4 SW 1/4, SECTION 9, T 15 S, R 10 E, W.M.; 481.87 FEET SOUTH AND 706.96 FEET EAST FROM THE W 1/4 CORNER OF SECTION 9.

The right shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right, and to which such right is appurtenant, is as follows:

S 1/2 SE 1/4
SW 1/4
SECTION 4

E 1/2 SW 1/4
SE 1/4
SECTION 5

E 1/2 NE 1/4
NE 1/4 NW 1/4
NW 1/4 NE 1/4
SECTION 8

N 1/2
SECTION 9
TOWNSHIP 15 SOUTH, RANGE 10 EAST, W.M.

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described.

WITNESS the signature of the Water Resources Director, affixed JULY 19, 1991.

YOUNG
William H. Young

Recorded in State Record of Water Right Certificates numbered 66520.

G-10545.DM

STATE OF OREGON

COUNTY OF DESCHUTES

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

CITY OF SISTERS
P.O. BOX 39 503-549-6022
SISTERS, OREGON 97759

to use the waters of A WELL in the SQUAW CREEK BASIN for MUNICIPAL USE.

This permit is issued approving Application G-12591. The date of priority is JUNE 25, 1991. The use is limited to not more than 3.34 CUBIC FEET PER SECOND, or its equivalent in case of rotation, measured at the well.

The well is located as follows:

SW 1/4 SW 1/4, SECTION 5, T 15 S, R 10 E, W.M.; 40 FEET SOUTH AND 145 FEET WEST FROM NE CORNER, SW 1/4 SW 1/4, SECTION 5.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the proposed place of use under this permit is as follows:

SW 1/4 NE 1/4
SE 1/4 NW 1/4
S 1/2
SECTION 4
E 1/2 SW 1/4
SE 1/4
SECTION 5
N 1/2 NW 1/4
SE 1/4 NE 1/4
SECTION 8
W 1/2 NE 1/4
SE 1/4 NE 1/4
NW 1/4
NW 1/4 SW 1/4
SECTION 9
TOWNSHIP 15 SOUTH, RANGE 10 EAST, W.M.

The City shall develop a plan to monitor and report the impact of water use under this permit on water levels within the aquifer that provides water to the permitted well. The plan shall be submitted to the Department within one year of the date the permit is issued and shall be subject to the approval of the Department. At a minimum, the plan shall include a program to periodically measure static water levels within the permitted well or an adequate substitute such as water levels in nearby wells. The plan shall also stipulate a reference water level against which any water-level declines will be compared. If a well listed on this permit displays a total static water-level decline of 25 or more feet over any period of years, as compared to the reference level, then the City shall discontinue use of, or reduce the rate or volume of withdrawal from, the well. Such action shall be taken until the water level recovers to above the 25-foot decline level or until the Department determines, based on the City or the Department's data and analysis, that no action is necessary because the aquifer in question can sustain the observed declines without adversely impacting the resource or senior water rights. The City shall in no instance allow excessive decline to occur within the aquifer as a result of use under this permit.

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department approves or implements an alternative administrative action to mitigate the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

Within one year from the date the Water Resources Commission adopts rules describing the schedules, standards and procedures for water conservation management plans by water suppliers, the city shall submit a plan which is consistent with said rules.

Within one year of permit issuance, the city shall prepare a plan/timetable for the Water Resources Commission which shall indicate the steps which the City intends to pursue to obtain a long-term water supply.

The well shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water level elevation in the well at all times. When required by the department, the permittee shall install and maintain a weir, meter, or other suitable measuring device, and shall keep a complete record of the amount of ground water withdrawn.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

Actual construction work shall begin on or before February 3, 1993, and shall be completed on or before October 1, 1994. Complete application of the water shall be made on or before October 1, 1995.
B+C ext to 10-1-99
Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

This permit is for beneficial use of water without waste. The water user is advised that new regulations may require use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

Issued this date, FEBRUARY 3, 1992.

/s/ WILLIAM H. YOUNG

Water Resources Department
William H. Young
Director

STATE OF OREGON

COUNTY OF DESCHUTES

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

CITY OF SISTERS
SISTERS, OREGON 97759

confirms the right to use the waters of POLE CREEK AND SISTERS' RESERVOIR CONSTRUCTED UNDER PERMIT R-5054, a tributary of SQUAW CREEK, for the purpose of MUNICIPAL USE.

This right was perfected under Permit 32854. The date of priority is NOVEMBER 17, 1967. This right is limited to 1.45 CUBIC FEET PER SECOND, or its equivalent in case of rotation, measured at the point of diversion from the source.

The points of diversion are located as follows:

SE 1/4 NE 1/4, NE 1/4 NE 1/4, SECTION 19, T 15 S, R 10 E, W.M.; CREEK DIVERSION- 1810 FEET SOUTH AND 1100 FEET WEST, RESERVOIR OUTLET- 880 FEET SOUTH AND 750 FEET WEST, BOTH FROM THE NE CORNER OF SECTION 19.

This right shall conform to any reasonable rotation system ordered by the proper state officer.

A description of the place of use under this right, and to which this right is appurtenant, is as follows:

SW 1/4 NE 1/4
SE 1/4 NW 1/4
S 1/2
SECTION 4

E 1/2 SW 1/4
SE 1/4
SECTION 5

N 1/2 NE 1/4
SE 1/4 NE 1/4
SECTION 8

W 1/2 NE 1/4
SE 1/4 NE 1/4
NW 1/4
NW 1/4 SW 1/4
SECTION 9
TOWNSHIP 15 SOUTH, RANGE 10 EAST, W.M.

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described. The right is subject to minimum flows established by the Water Resources Commission with an effective date prior to this right.

WITNESS the signature of the Water Resources Director, affixed JANUARY 3, 1991.

/s/ WILLIAM H. YOUNG

William H. Young

Recorded in State Record of Water Right Certificates numbered 65091.

44263.DLM

Permit A-1—500—8-39

STATE OF OREGON

COUNTY OF DESCHUTES

CERTIFICATE OF WATER RIGHT

This Is to Certify, That SISTERS DOMESTIC WATER DISTRICT

of Sisters, State of Oregon, has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of 9 springs

a tributary of Squaw Creek for the purpose of Municipal

under Permit No. 12869 of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from November 1, 1937;

that the amount of water to which such right is entitled and hereby confirmed; for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 1.25 cubic feet per second,

or its equivalent in case of rotation, measured at the point of diversion from the stream. The point of diversion is located in the $SW\frac{1}{4}SW\frac{1}{4}$, Section 3 and $NW\frac{1}{4}NW\frac{1}{4}$, Section 10, Township 16 South, Range 9 East, W. M.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to of one cubic foot per second per acre,

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

$SW\frac{1}{4}SW\frac{1}{4}$
$SE\frac{1}{4}SW\frac{1}{4}$
$NW\frac{1}{4}SW\frac{1}{4}$
Section 4
$NE\frac{1}{4}NE\frac{1}{4}$
Section 8
$NW\frac{1}{4}NW\frac{1}{4}$
$NE\frac{1}{4}NW\frac{1}{4}$
Section 9
Township 15 South, Range 10 East, W. M.

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the State Engineer, affixed this 1st day of May, 193 41

CHAS. E. STRICKLIN
State Engineer

Recorded in State Record of Water Right Certificates, Volume 12, page 13509

STATE OF OREGON

COUNTY OF DESCHUTES

CERTIFICATE OF WATER RIGHT

This Is to Certify, That SISTERS DOMESTIC WATER DISTRICT

of Sisters, State of Oregon, has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of Pole Creek Swamp Springs a tributary of Squaw Creek for the purpose of Domestic and Municipal Supply under Permit No. 12597 of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from April 7, 1937;

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 1.25 cubic feet per second,

or its equivalent in case of rotation, measured at the point of diversion from the stream. The point of diversion is located in the SW¼SE¼, Section 35, Township 15 South, Range 9 East, W. M.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to of one cubic foot per second per acre.

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

SW¼ of Section 4
NW¼ of Section 9
Township 15 South, Range 10 East, W. M.

5

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the State Engineer, affixed this 1st day of May, 193/ 41

CHAS. E. STRICKLIN
State Engineer

Recorded in State Record of Water Right Certificates, Volume 12, page 13501

STATE OF OREGON

COUNTY OF DESCHUTES

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* THE SISTERS WATER USERS ASSOCIATION

of Sisters , *State of* Oregon , *has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of* Springs
a tributary of Squaw Creek *for the purpose of* Municipal supply
under Permit No. 8906 *of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* February 11, 1929;

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 0.2 cubic foot per second

The point of diversion is located in the SE¼SE¼ *of Section* 8 , *Township* 15 S , *Range* 10 E, *W. M. The use hereunder for irrigation shall conform to such reasonable rotation system as may be ordered by the proper state officer.*

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to one-eightieth of one cubic foot per second per acre, or its equivalent in case of rotation.

A description of the lands irrigated under the right hereby confirmed, and to which such right is appurtenant (if for irrigation, or any other purpose), is as follows:

PLACE OF USE:

Section 4,
Township 15 South, Range 10 East, W. M.,
being within the town of Sisters.

The right to the use of the water for any purpose is restricted to the lands or place of use herein described.

After the expiration of fifty years from the date of this certificate or on the expiration of any federal power license issued in connection with this right, and after not less than two years notice in writing to the holder hereof, the State of Oregon, or any municipality thereof, shall have the right to take over the dams, plants and other structures and all appurtenances thereto which have been constructed for the purpose of devoting to beneficial use the water rights specified herein, upon condition that before taking possession the State or municipality shall pay not to exceed the fair value of the property so taken, plus such reasonable damages, if any, to valuable, serviceable and dependable property of the holder of this certificate, not taken over, as may be caused by the severance therefrom of the property taken in accordance with the provisions of section 47-508, Oregon Code 1930.

WITNESS the signature of the State Engineer, affixed this 1st *day of* June , *193* 3

CHAS. E. STRICKLIN
State Engineer

Recorded in State Record of Water Right Certificates, Volume 9 , *page* 10028 .

STATE OF OREGON

COUNTY OF DESCHUTES

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

CITY OF SISTERS
SISTERS, OREGON 97759

confirms the right to use the waters of POLE CREEK, a tributary of SQUAW CREEK, for MUNICIPAL USE.

This right was confirmed by decree of the Circuit Court of the State of Oregon for CROOK County. The decree is of record at Salem, in the Order Record of the WATER RESOURCES DIRECTOR, in Volume 1, at Page 471. The date of priority is 1885.

The use is limited to 0.20 CUBIC FOOT PER SECOND or its equivalent in case of rotation, measured at the point of diversion from the source.

The quantity of water diverted at the new point of diversion shall not exceed the quantity of water available at the old point of diversion under the subject right.

The point of diversion is located as follows:

NE 1/4 NE 1/4, SECTION 19, T 15 S, R 10 E, W.M.; 1540 FEET SOUTH 36 DEGREES WEST FROM THE NE CORNER OF SECTION 19

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use to which this right is appurtenant is as follows:

NW 1/4 NE 1/4
SW 1/4
SW 1/4 SE 1/4
SECTION 4

E 1/2 SW 1/4
W 1/2 SE 1/4
SE 1/4 SE 1/4
SECTION 5

E 1/2 NE 1/4
SECTION 8

NE 1/4
NW 1/4
SECTION 9
TOWNSHIP 15 SOUTH, RANGE 10 EAST, W.M.

This certificate is issued to confirm a change in USE, PLACE OF USE AND POINT OF DIVERSION approved by an order of the Water Resources Director entered OCTOBER 28, 1977, and together with Certificate 45032, supersedes Certificate 864, State Record of Water Right Certificates.

This certificate does not confirm the status

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described and is subject to all other conditions and limitations contained in said decree.

WITNESS the signature of the Water Resources Director, affixed AUGUST 19, 1992.

Martha O. Pagel

STATE OF OREGON

COUNTY OF DESCHUTES

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

CITY OF SISTERS
SISTERS, OREGON 97759

confirms the right to store the waters of POLE CREEK, a tributary of SQUAW CREEK, in SISTERS' RESERVOIR, appropriated under Permit 32854, for the purpose of MUNICIPAL USE.

The right to store these waters has been perfected under Reservoir Permit R-5054. The date of priority is AUGUST 10, 1967. The amount of water entitled to be stored each year under such right is not more than 6.3 ACRE FEET.

The reservoir is located as follows:

NE 1/4 NE 1/4
SECTION 19
TOWNSHIP 15 SOUTH, RANGE 10 EAST, W.M.

The dam is to be operated and maintained in accordance to the approved plans and specifications.

The right to store and use the water for the above purpose is restricted to beneficial use at the place of use described.

WITNESS the signature of the Water Resources Director, affixed

CITY OF SISTERS
WATER SYSTEM
CAPITAL FACILITIES
and
WATER CONSERVATION and
MANAGEMENT PLANS

APPENDIX 6.3
SOURCE ASSESSMENT REPORT

HGE INC

SOURCE WATER ASSESSMENT REPORT

Summary of Analysis

City of Sisters
Sisters, Oregon
Deschutes County
PWS #4100826

May, 2004

Prepared By

Oregon Department of Human Services
Health Services
Drinking Water Program

And

Oregon Department of Environmental Quality
Water Quality Division
Drinking Water Protection

DHS Oregon Department of Human Services

DEQ State of Oregon Department of Environmental Quality

Available in Alternate Formats by contacting the DHS DWP at (541) 726-2587

City of Sisters
Source Water Assessment Report
Summary of Analysis

1. Introduction

The Source Water Assessment Program, mandated by the 1996 Amendments to the Safe Drinking Water Act, requires that states provide the information needed by public water systems to develop drinking water protection plans if they choose. That information includes the identification of the area most critical to maintaining safe drinking water, i.e., the Drinking Water Protection Area, an inventory of potential sources of contamination within the Drinking Water Protection Area, and an assessment of the relative threat that these potential sources pose to the water system.

The intent of this report is to present our conclusions regarding the source water assessment analysis for your water system. It is our hope that this information will be used as a basis for reducing the risk of contamination to your water source through the development of a voluntary Drinking Water Protection Plan (DWPP). Should you decided to proceed with the development of a DWPP, this document can serve as the foundation for the plan. If, however, a more in depth analysis of the local hydrogeology, water system susceptibility, and/or the water system specific assumptions is needed to help promote the development of a DWPP, a more comprehensive assessment analysis can be made available to you by contacting either the DHS Project Manager or the DHS Drinking Water Program Groundwater Coordinator.

The methodology that the Source Water Assessment results are based on is included in Appendix I, "Source Water Assessment Methodology". Appendix I includes a discussion of the source water assessment project; groundwater basics; and the processes involved with conducting the delineation, sensitivity analysis, potential contaminant source inventory, and overall water system susceptibility. Therefore, it is our intention that the assessment results, identified in this portion of the report, be used in conjunction with the methodology and rational presented in Appendix I. For instance, if questions arise regarding our conclusions with respect to a specific element of the assessment (i.e. type of delineation used, aquifer sensitivity, well construction sensitivity, etc...), the methodology that lead to our conclusions can be reviewed in Appendix I for further clarification.

We believe public awareness is a powerful tool for protecting drinking water and that the information provided in this report will help you increase local awareness regarding land use activities and local drinking water quality. We have also included a groundwater fact sheet in Appendix E and a list of Oregon specific drinking water protection information and resources in Appendix H.

2. Water System Background

The City of Sisters Water System is located in Deschutes County and serves approximately 820 people. Currently there are 600 connections. Drinking water is supplied by two wells, the City Well and the High School Well . An intake on Pole Creek serves as an emergency source of water. Treatment consists of chlorination for disinfection purposes.

2.1 Location of the Drinking Water Sources

We have located your drinking water sources using a Trimble GeoExplorer II Global Positioning System (GPS) unit. The data has been differentially corrected to remove some of the common positioning errors. The location of the source(s), with the corresponding Drinking Water Protection Area, has been placed in a Geographic Information System (GIS) layer and projected onto a USGS 7.5 minute topographic map that is included within this report. In order to be consistent with the topographic map, the projection uses the NAD1927 datum. The latitude and longitude values given on the map and below, however, reflect a projection in the more commonly used WGS1984 datum.

Data collection specifics include:

- 150 individual measurements,
- linked to a minimum of four satellites,
- a PDOP of less than 6 (pertains to precision of measurement), and
- a signal to noise ratio of greater than 5.

The raw data was subjected to differential correction using the PATHFINDER software. The location data for your drinking water source(s) using the WGS84 datum is as follows:

Source	Latitude	Longitude
City Well - Source BA	44° 16' 58.081" N	121° 32' 03.763" W
High School Well-Source CA	44° 17' 41.312" N	121° 34' 10.047" W

2.2 Source Construction

The City Well was completed in October, 1975. A 18-inch hole was drilled to 40 feet and a 16-inch hole continues to 211 feet. Groundwater was apparently encountered at 105 feet. The static water level (depth to water in the well when the pump is at rest) was reported as 85 feet. Fourteen-inch casing was installed from two feet above the surface to a depth of 199 feet, 12-inch casing was placed from 25 feet to 111 feet, and 10-inch casing was placed from the surface

to 195.6 feet. The casing was perforated from 50 to 195.6 feet. Cement and bentonite were placed in the annular space between the casing and the hole wall to a depth of 40 feet to serve as a casing seal. The casing seal is considered adequate;

The High School Well was completed in July, 1991. A 22-inch hole was drilled to a depth of 39 feet. A 17-inch hole continued to 190 feet, a 14-inch hole continued to 244 feet and a 13-inch hole continued to 302 feet. Groundwater was first reported at a depth of 105 feet with a static water level of 101 feet. Eighteen-inch casing was installed from 1 foot above the surface to 39 feet. A 14-inch liner was installed from 1.5 feet above the surface to 244 feet and a 10-inch liner continued to 302 feet. The 10-inch liner was perforated from 242 feet to 302 feet. Cement was placed in the annular space between the 18-inch casing and the upper bore hole wall to a depth of 39 feet to serve as the casing seal. This casing seal is judged to be adequate.

Well reports for both the City- and High School Wells are in Appendix D.

2.3 Nature and Characteristics of the Aquifer

The aquifer supplying the drinking water to the City of Sisters' Water System Wells consists of lava flows, cinders and sediments of the Deschutes Formation.

As described in the City's High School Well construction discussion above, the depth to first water encountered was approximately the same as the static water level after well completion. This is consistent with the results of hydrogeologic studies elsewhere in the area that the Deschutes Aquifer is unconfined in nature. This implies that the groundwater is under atmospheric pressure and there are no persistent materials of low permeability separating the aquifer from the surface. The well report for the City Well suggests that this aquifer may be locally confined in character. Based on the well reports, the aquifer consists of products of alternating periods of eruption (lava and cinders) and erosion (sediment) of the Cascade Range. The bulk of this occurred prior to the development of the High Cascade volcanoes, e.g., the Three Sisters, Mount Washington, Three-Fingered Jack and Mount Jefferson.

3. Delineation Results

The purpose of the Drinking Water Protection Area (DWPA) delineation is to identify the area at the surface which overlies the critical portion of the aquifer that's supplying groundwater to the water system's well(s) and/or spring(s). Therefore, DHS Drinking Water Program staff have collected and reviewed data for the purpose of delineating the DWPA for your water system. The area included in the DWPA is designed to approximate the next 10 or 15 years of groundwater supply for the water system, depending on delineation method, and is shown in Figure 1 (Appendix B). We have enhanced the usefulness of the DWPA map by identifying additional five-year, two-year, and one-year "Time-Of-Travel Zones" inside the DWPA.

The scope of work for this portion of the assessment included interviewing the water system operator, researching written reports, reviewing well logs, and establishing a base map of the delineated area. Based on the service population and the potential for mutual interference of the two wells, a two-dimensional analytical model was used to identify the extent of the DWPAs (See Appendix I for explanation of delineation process). The delineation of the DWPAs were accomplished using RESSQC, an analytical model included in the WHPA (Wellhead Protection Area) software (Blandford and Huyakorn, 1991) The resulting DWPAs for the City of Sisters' Wells are shown in Appendix B, Figure 1. A "buffer zone" has been added around the wells to account for an uncertainty in the direction of groundwater flow which would change the orientation of the capture zones. Specific information regarding the parameters used in the delineation process including; the delineation method, estimated pump rate, and aquifer characteristics can be found in Appendix E.

4. Sensitivity Analysis Results

After the Drinking Water Protection Area (DWPA) has been identified, aquifer susceptibility to potential contaminant sources inside the DWPA can be evaluated. Aquifer susceptibility is dependent on two factors, the natural environment's characteristics that permit migration of a contaminant into the aquifer (i.e., aquifer sensitivity) and the presence, distribution, and nature of the potential contaminant sources within the DWPA. It should be understood that the public water system's drinking water source cannot be susceptible to contamination, even if potential contaminant sources are present, unless the aquifer or the constructed source water intake are sensitive to contamination. Therefore, the intent of the sensitivity analysis is to identify those areas within the DWPA where the aquifer is most sensitive to contamination. The analysis is based on data collected or generated during the DWPA delineation process and is designed to meet the needs of other existing or developing programs such as Monitoring Waivers and the Groundwater Rule.

The results of the sensitivity analysis are provided in the tables that follow. Information and sensitivity ratings regarding the aquifer and water quality are provided in Table 4.1 while information and sensitivity ratings regarding the well and its construction is provided in Table 4.2. A clarification of the ratings is provided as comments where appropriate.

Based on this analysis, the drinking water source is considered moderately sensitive to contamination. This determination is based on the unconfined character of the aquifer, the presence of highly-permeable soils within the DWPAs and the age of the City Well.

Also contributing to sensitivity is the occurrence of nitrate concentrations at up to 1.02 mg/L suggests that a pathway may exist from the surface to the aquifer. Although this concentration is well below the Drinking Water Standard of 10 mg/L, it is greater than what can reasonably be attributed to natural sources.

Table 4.1. Aquifer Sensitivity Analysis.				
	Sensitivity			
Parameter	**H**	**M**	**L**	**Comments**
Depth to first water-bearing zone below casing seal.			✔	105 feet.
Aquifer characteristics and hydraulic nature.		✔		Unconfined, highly permeable
Overburden thickness and characteristics.		✔		85 to 105 feet of gravelly sediments, lava flows and cinders
Highest soil permeability in Protection Area.		✔		High
Traverse potential score (10 = High).			✔	Score = 2 (HS Well) to 5 (City Well)
Infiltration potential score (10 = High).			✔	Score = 3 to 4
Organic chemical detections.			✔	None
Inorganic chemical detections.			✔	None
Source related coliform detections.			✔	None detected.
Nitrate concentrations (Drinking Water Standard = 10 mg/L).		✔		Up to 1.02 mg/L in HS Well, less than 0.8 mg/L in City Well
Fractured bedrock near surface in Protection Area.			✔	None present.
Other wells score (Significant Risk = 400).			✔	Score = 19 to 28
Surface water within 500 feet of wellhead.		✔		Creek near City Well
Other: Arsenic			✔	Arsenic has been detected as high as 0.0018 mg/L. Below proposed standard of 0.010 mg/L; probably natural

Table 4.2. Well Construction Sensitivity Analysis.				
	Sensitivity			
Parameter	H	M	L	Comments
Casing depth (ft).				City Well: 195.6 HS Well: 39
Casing seal depth (ft).				City Well: 40 HS Well: 39
Well construction setback deficiencies from site visit.			✔	None observed.
Well report information missing or unknown.			✔	No
Casing seal information missing or unknown.			✔	No
Casing seal material.			✔	City Well: Cement HS Well: Cement and bentonite
Well open to multiple aquifers (commingling suspected).			✔	No
Casing seal construction.			✔	Adequate
Age of well.		✔		City Well constructed in 1975; HS Well in 1991.

5. Potential Contaminant Source Inventory

An inventory of potential contamination sources was performed within the Drinking Water Protection Area and the results are shown in Figure 2, Appendix B. The primary intent of the inventory was to identify and locate significant potential contaminant sources of concern. This inventory was conducted by reviewing applicable state and federal regulatory databases and land use maps, interviewing persons knowledgeable of the area, and conducting a windshield survey by driving through the drinking water protection area to field locate and verify as many of the potential contaminant source activities as possible. It is important to remember the sites and areas identified are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.

5.1 Potential Contaminant Sources within the Two-Year Time-of-Travel Zone for the Wells

The delineated two-year time of travel zone is primarily dominated by residential and municipal land uses. Five potential contaminant source locations were identified in the two-year time-of-travel zone and include Sisters High School with associated high capacity sewer system, Patterson Elk Ranch, an irrigation canal, Highway 242, and rural homesteads with associated septic systems (Figure 2, Appendix C and Table 2). All of the potential sources pose a relatively higher to moderate risk to the drinking water supply with the exception of the rural homesteads, which pose a lower risk. The septic systems associated with the high school and the rural homesteads have a high risk of transmitting micro-organisms to the groundwater.

5.2 Potential Contaminant Sources within the Five-Year and Ten-Year Time-of-Travel Zones for the Wells

The drinking water protection area within the five-year and ten-year time-of-travel zones is primarily occupied by forest land uses. No potential contaminant sources were identified in this area (Figure 2, Appendix C and Table 2). Area-wide potential sources such as the rural homesteads extend from the two-year time-of-travel zone into the ten-year time-of-travel zone. These land uses occur throughout the drinking water protection area and are shown on Figure 2 in the location nearest to the well.

6. Susceptibility of the Drinking Water Source

In general, Potential Contaminant Sources (PCSs) within the shorter time-of-travel zones pose a greater risk than those in the longer time-of-travel zones. Also of concern is the location and distribution of these sources with respect to high and moderately sensitive areas. Overlaying the PCS location map (Figure 2, Appendix B) on top of the sensitivity map for the water system provides a tool to determine the susceptibility of the community's drinking water supply to contamination from each PCS (see Figure 3, Appendix B).

6.1 Aquifer Susceptibility to Potential Contaminant Sources Inside the Drinking Water Protection Area.

Table 6.1, indicates the relationship between potential contaminant source risk, aquifer sensitivity, and estimated contaminant arrival time at the well, wellfield, and/or spring. The community can use the PCS location numbers on the inventory map in conjunction with the displayed aquifer sensitivity and relative risk rankings for each PCS from Table 2 (Appendix C) to identify the susceptibility of the drinking water source to contamination from each PCS and take steps to reduce the risk accordingly.

We have attempted to quantify the relative susceptibility of the water system with regard to the PCSs present in the Drinking Water Protection Area (DWPA) using Table 6.1. Across the top of the table, each Time-of-Travel (TOT) zone is subdivided to account for areas of high, moderate, and low sensitivity that may exist between each TOT. Potential contaminant source risk categories (high, moderate, and low) are listed down the left hand side of the table. The relative aquifer susceptibility to each PCS is demonstrated by the shading of each cell in the table. Cells that are shaded dark gray indicate a highly-susceptible condition, light gray shaded cells indicate a moderately-susceptible condition, and white cells indicate conditions of low susceptibility. The number in each cell indicates the number of potential contaminant sources that meet the conditions for that cell. Cells that do not contain a number indicate that there are no known potential contaminant sources that meet the conditions for the cell. Potential contaminant sources that meet the specific criteria for a cell in Table 6.1 can be identified by reviewing Table 2 in Appendix C. The number of potential contaminant sources is totaled across the bottom of the table.

Table 6.1.a. City of Sisters High School Well Susceptibility as a Function of PCS Risk, TOT Zone, and Aquifer Sensitivity.

	2-Yr TOT			2- to 5-Yr TOT			5- to 10-Yr TOT		
	High	Mod	Low	High	Mod	Low	High	Mod	Low
High Risk PCSs	1								
Moderate Risk PCSs	3								
Low Risk PCSs	2			1			1		
Total PCSs	6			1			1		

Table 6.1.b. City of Sisters City Well Susceptibility as a Function of PCS Risk, TOT Zone, and Aquifer Sensitivity.

	2-Yr TOT			2- to 5-Yr TOT			5- to 10-Yr TOT		
	High	Mod	Low	High	Mod	Low	High	Mod	Low
High Risk PCSs									
Moderate Risk PCSs	3								
Low Risk PCSs							1		
Total PCSs	3						1		

The distribution of high, moderate, and low sensitivity areas inside the Drinking Water Protection Area can be determined using either soil sensitivity (permeability) or the mapped distribution of Traverse Potential (TP) or Infiltration Potential (IP). In the case of the City of Sisters water system we have decided to rely upon soil permeability as an indicator of sensitivity (See tables 2a and 2b for factors that might increase or decrease sensitivity). Both moderately- and highly-permeable soils are found within the Drinking Water Protection Area. The IP score calculated for each well indicates a low sensitivity condition due to low rainfall amounts. If significant irrigation is occurring, particularly within the DWPA for the City Well, the IP score may be higher. It is reasonable to assume that the natural aquifer sensitivity to contamination throughout the DWPA is moderate to high (see pattern distribution in Figure 2).

During the potential contaminant source inventory, a total of five potential contaminant source locations and 12 potential contaminant sources were identified inside the DWPA. If any of these potential contaminant sources have been identified as an area-wide source, they have been evaluated with respect to each time-of-travel zone in which they occur. As a result, the total

number of potential contaminant sources evaluated in the above susceptibility tables may exceed the number identified on the potential contaminant source inventory map (Figure 2, Appendix B).

As indicated in the above tables, nine potential contaminant sources occur inside the 2-year TOT, one source falls between the 2- and 5-year TOTs, and two sources have been identified between the 5- and 10-year TOTs. Of the potential contaminant sources identified inside the 2-year TOT, one is of high-risk, six are of moderate-risk, and two are of low-risk. Based on the analysis results shown in the relative susceptibility table, we consider the City of Sisters to be highly susceptible to the moderate and high-risk potential contaminant sources identified inside the 2-year TOT (Potential contaminant Source Reference No. 1 through 4 on Figure 3, Appendix B). **Therefore we recommend that these potential contaminant sources not only be addressed in any Drinking Water Protection Plan but also in any Water System Emergency Response Plan.**

As a result of this analysis, we recommend that the water system develop a Drinking Water Protection Plan that addresses all high- and moderate-risk potential contaminant sources within the DWPA, beginning with those sources which represent the greatest susceptibility risk. At a minimum, the water system should work with representatives from those PCSs posing a moderate- to high-susceptibility risk within the DWPA to (1) determine the level of environmental protection employed in the day-to-day operations of the facility and (2) identify any reasonable Best Management Practices that will lead to an overall reduction of contamination risk.

6.2 Water System Susceptibility to Viral Contaminant Sources within the Two-Year Time-of-Travel Zone.

The area within the two-year TOT roughly identifies the next two years of groundwater supply for the water system. The two-year time frame is used as a conservative estimate of the survival time for some viruses. **Based on the assessment results, the drinking water source is considered moderately sensitive. Therefore, we consider the City of Sisters' water supply not to be susceptible to viral contamination** even though viral sources (high-capacity septic system, grazing animals and irrigation canal) were identified inside the two-year TOT.

7. Conclusions

The City of Sisters' water system draws water from an unconfined aquifer comprising lava flows, cinders and sediments within the Deschutes Formation. Assessment results indicate that the water system would be moderately to highly susceptible to a contamination event inside the identified Drinking Water Protection Area. The presence of one high-risk and several moderate-risk potential contaminant sources within the protection area was confirmed through a potential contaminant source inventory. Under a "worst case" scenario, where it is assumed that nothing is being done to protect groundwater quality at the identified potential contaminant sources, the assessment results indicate that the water system would be highly susceptible to several of the identified potential contaminant sources. In addition, the assessment results indicate that, at this time, the water system is not considered susceptible to viral contamination.

It is also important to remember that not all of the inventoried activities will need to be addressed if you choose to develop a Drinking Water Protection Plan. When developing a protection plan, potential contaminant sources which pose little or no threat to your drinking water supply can be screened out. For example, if any of the land use activities are conducted in a manner that already significantly reduces the risk of a contamination release, the facility would not need to re-evaluate their practices based on drinking water protection "management". One of the goals for developing a plan based on the inventory results is to address those land use activities that do pose high or moderate risks to your public water supply. The system should target these facilities with greater levels of education and technical assistance to minimize the risk of contamination.

Limited technical assistance is available through the DEQ and Drinking Water Program at DHS for water systems that choose to move beyond the assessments and voluntarily develop a Drinking Water Protection Plan. By using the results of the assessment, the water system/community can form a Drinking Water Protection Team comprised of individuals that have a stake in the plan's implementation.

Forming a local team to help with the development of a protection plan is very important. Oregon's drinking water protection approach relies upon the concept of "community based protection", as are many other water quality programs. This simply refers to the concept of allowing local control and decision-making to implement the water quality protection effort. Community-based protection is successful only with significant local citizen stakeholder involvement. Community-based protection can draw on the knowledge and successful adaptive practices within the area. Landowners generally know best how to achieve water resource restoration and protection as long as a thorough explanation of the problem is provided, the objectives to solve the problem are clearly defined, and technical assistance is available.

In community-based protection, citizens have more control and are therefore more likely to participate in the program and be more willing to assist with the educational and outreach effort which will make the plan successful. We recommend that the protection plan be developed so as to minimize any burdens on individual property owners, but maximize the equity in responsibility for reducing the risks of future contamination.

Protecting the drinking water supply in a community can also be a very effective way to encourage all citizens to participate in issues which directly affect everyone in that community. This often leads to more public involvement in other significant local decisions concerning future livability issues, e.g., land use planning. In communities already developing and implementing Drinking Water Protection Plans, the process has served to bring many diverse interests together on a common goal and strengthen the local rural and urban relationships through communication and increased understanding. The risks and sources of water quality problems are not only from industries, farmers, and managed forest, but every individual living, commuting, and working in that area.

Communities/water systems interested in developing Drinking Water Protection Plans may contact the Department of Environmental Quality (503-229-5413) or the DHS Drinking Water Program (541-726-2587) for further information.

Appendices

A. References

B. Figures

C. Inventory of Potential Contaminant Sources

D. Well Reports

E. Parameters Used in Delineation Model

F. Groundwater Fact Sheet

G. BMPs for Activities Commonly found in Drinking Water Protection Areas

H. Drinking Water Protection in Oregon

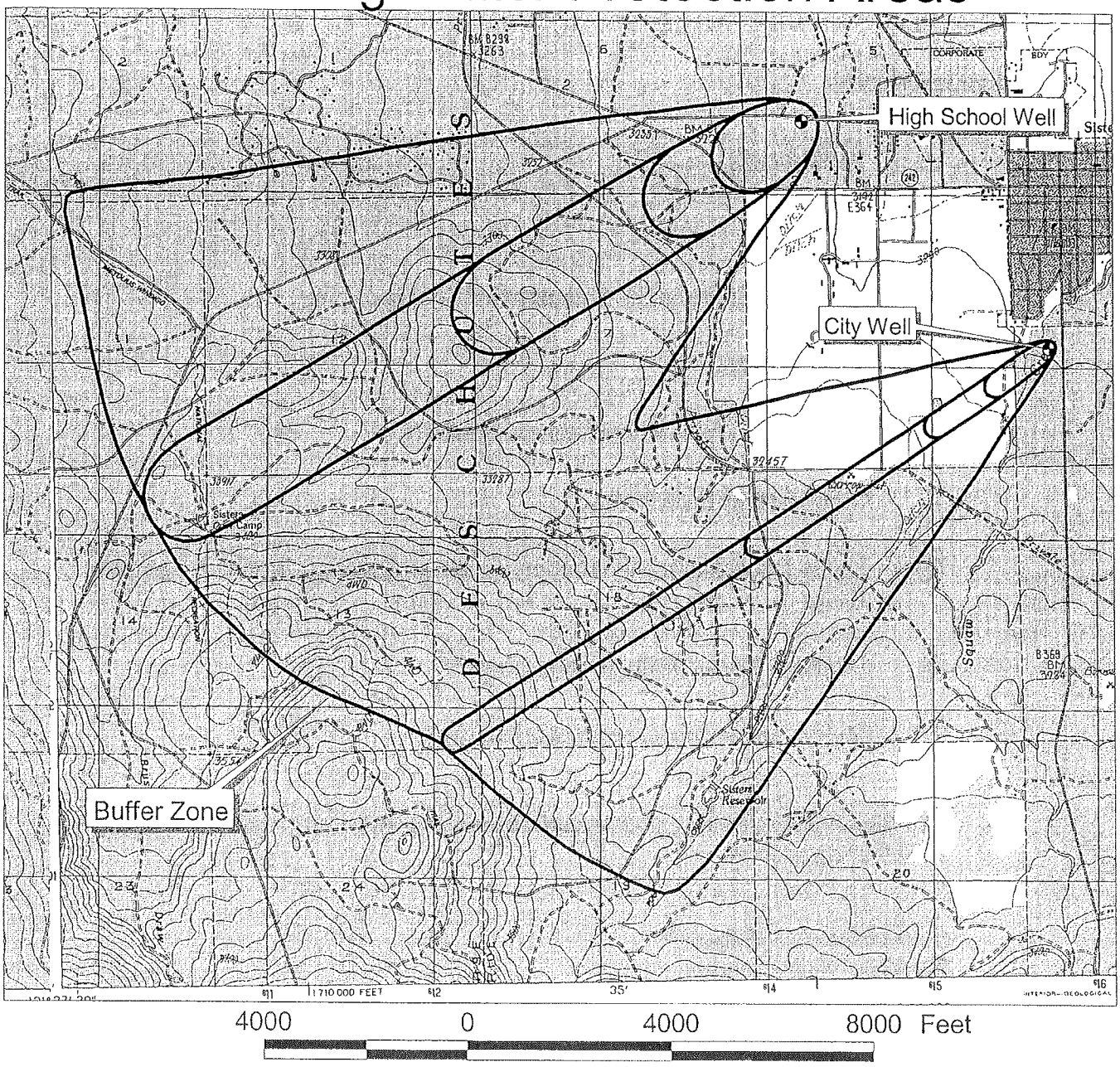
I. Source Water Assessment Methodology

Additional copies of the appendix materials are available upon written request to the following address:

Groundwater Coordinator
Drinking Water Program
Department of Human Services
444 A Street
Springfield, OR 97477

City of Sisters
Drinking Water Protection Areas

Figure 1



Drinking Water Protection Areas with the 1-, 2-, 5- and 10-year time of travel for groundwater to move through the aquifer to the wells. Also outlined is a buffer zone that reflects a degree of uncertainty with respect to the direction of flow.
Aquifer: Cascadian basalt and interbedded sediments
Aquifer Properties: unconfined
- Permeability: 100-150 ft/day
- Thickness: 60-90 ft
- Porosity: 0.25

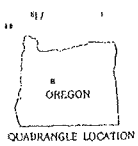
Pumprates (gpm): HS Well=378; City Well=95
Groundwater flow direction: N60E
Groundwater gradient: 0.004 ft/ft

PWS#4100826

Well Locations (WGS1984 datum):
HS Well: 44°17'41.312"N 121°34'10.047"W
City Well: 44°16'58.081"N 121°32'03.763"W
T15S R10E Secs 5 and 9
Deschutes County

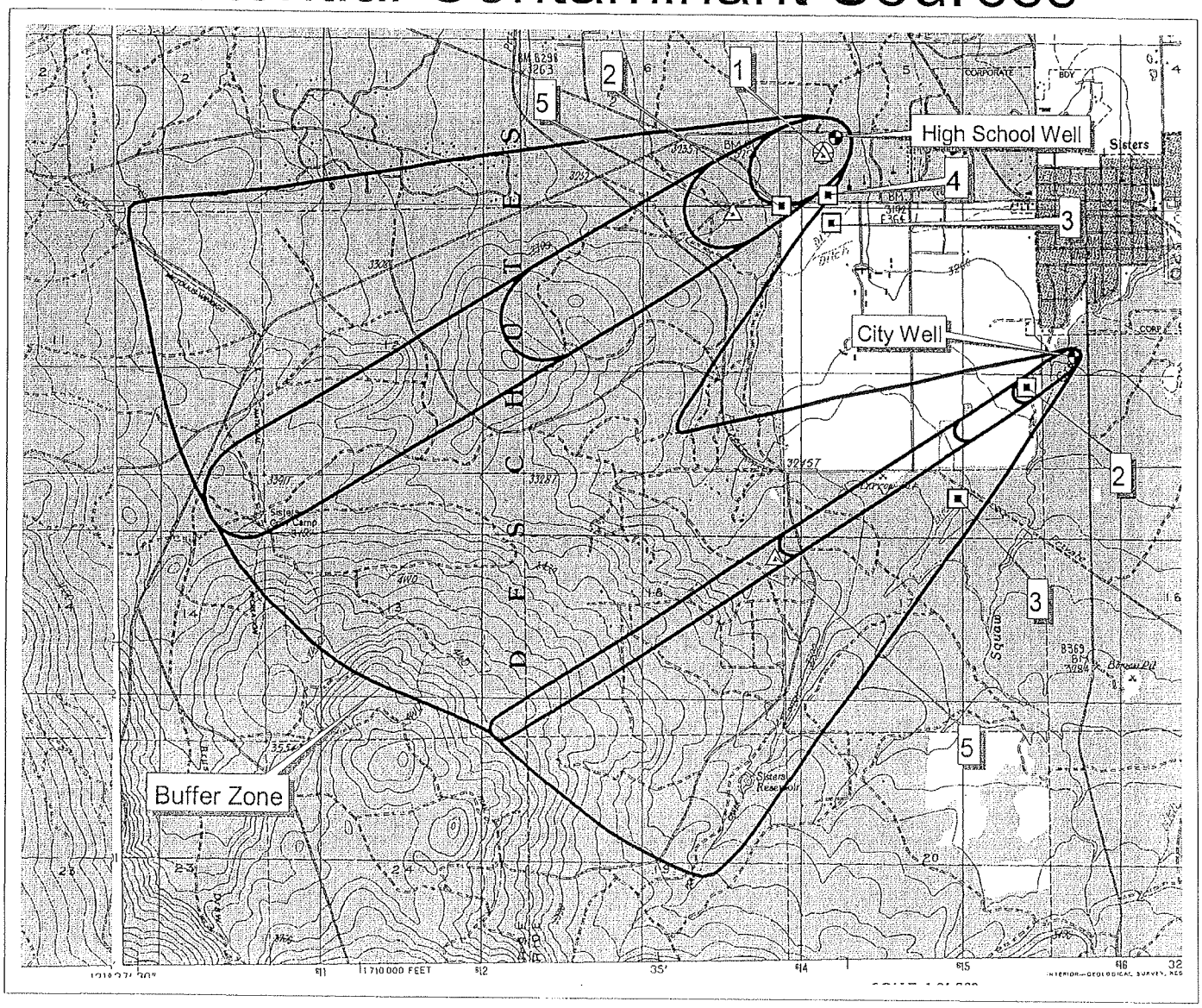
N

Prepared by: Amy Parmenter and
Dennis Nelson, RG1224
Drinking Water Program
Oregon Department of Human Services
April 30, 2002



City of Sisters
Potential Contaminant Sources

Figure 2



4000 0 4000 8000 Feet

Scale 1: 38,000

N

Drinking Water Protection Area (DWPA)
1, 2, 5, and 10 year Time of Travel (TOT)
Analytical Method

Prepared by: Kylee Godfrey 5/24/04
Project Manager: Dennis Nelson RG# 1224
File# 4100826

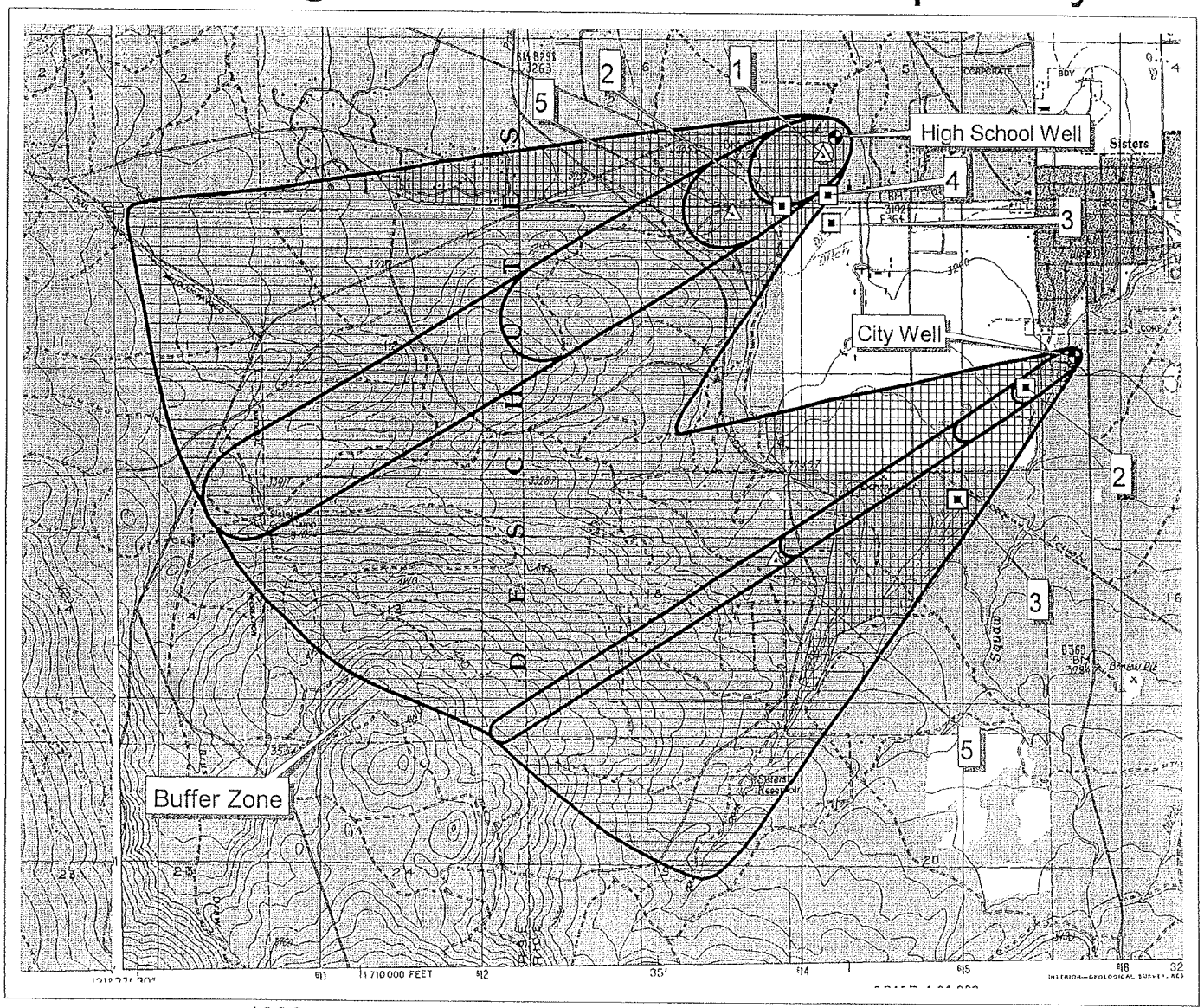
Potential Contaminant Sources
- ⊕ Higher Relative Risk
- ▣ Moderate Relative Risk
- △ Low Relative Risk

Note: Sites and areas noted in this figure are potential sources of contamination to the drinking water identified by Oregon drinking water protection staff. Environmental contamination is not likely to occur when chemicals are used and managed properly.

Numbers indicate potential contaminant sources which are explained in Appendix C, table 2.

City of Sisters
Drinking Water Source Susceptibility

Figure 3



Scale 1: 38,000

Drinking Water Protection Area (DWPA) 1, 2, 5, and 10 Year Time of Travel (TOT) Analytical Method

Potential Contaminant Sources

- ⊕ Higher Relative Risk
- ▣ Moderate Relative Risk
- △ Low Relative Risk

Sensitivity Analysis

- High Soil Sensitivity
- Medium Soil Sensitivity
- Low Soil Sensitivity

Note: Sites and areas noted in this figure are potential sources of contamination to the drinking water as identified by Oregon Drinking Water Protection Staff.
Environmental contamination is not likely to occur when chemicals are used and managed properly.

Features or activities that are identified as high or moderate risk that occur within an area designated as high or moderate sensitivity pose a greater risk to drinking water quality than those in areas of low sensitivity.

Numbers indicate potential contaminant sources indexed to Appendix C, Table 2.

N

APPENDIX C - INVENTORY OF POTENTIAL CONTAMINANT SOURCES
SISTERS, CITY OF - PWS # 4100826
OREGON SOURCE WATER ASSESSMENT

Inventory Results

Table 1. Summary of Potential Contaminant Sources by Land Use

Table 2. Inventory Results - List of Potential Contaminant Sources

Notes for Tables:

Sites and areas identified in these Tables are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.

Total number of sources listed in Table 1 in the DWPA may not add up to the total number of potential contaminants sources in Table 2 because more than one type of potential contaminant source may be present at any given facility.

Data collected by Kristy Sewell Oregon DEQ on 7/27/2002.

Acronyms:

AST - Aboveground Storage Tank
DC - DEQ's Dry Cleaner database
DEQ - Oregon Department of Environmental Quality
DWPA - Drinking Water Protection Area
ECSI - DEQ's Environmental Cleanup Site Information database
HWIMSY - DEQ's Hazardous Waste Information Management System database
LUST - DEQ's Leaking Underground Storage Tank database
NPDES - National Pollution Discharge Elimination System
PCS - Potential Contaminant Source
PWS - Public Water System
SFM - State Fire Marshall's database of hazardous materials
SIS - DEQ's Source Information System database (includes WPCF & NPDES permits)
SWMS - DEQ's Solid Waste Management System database
UST - DEQ's Underground Storage Tank database or Underground Storage Tank
WPCF - Water Pollution Control Facility
WRD - Oregon Water Resources Division database for water rights information

TABLE 1. SUMMARY OF POTENTIAL CONTAMINANT SOURCES BY LAND USE

PWS # 4100826 SISTERS, CITY OF

Residential/Municipal Land Uses

Potential Contamination Source	Note	Relative Risk Level	Total in DWPA
Airport - Maintenance/Fueling Area		Higher	0
Apartments and Condominiums		Lower	0
Campgrounds/RV Parks	(1)	Lower	0
Cemeteries - Pre-1945		Moderate	0
Drinking Water Treatment Plants		Moderate	0
Fire Station		Lower	0
Fire Training Facilities		Moderate	0
Golf Courses		Moderate	0
Housing - High Density (> 1 House/0.5 acres)		Moderate	0
Landfill/Dumps	(1)	Higher	0
Lawn Care - Highly Maintained Areas		Moderate	0
Motor Pools		Moderate	0
Parks		Moderate	0
Railroad Yards/Maintenance/Fueling Areas		Higher	0
Schools		Lower	1
Septic Systems - High Density (> 1 system/acre)	(1)	Higher	0
Sewer Lines - Close Proximity to PWS	(1)	Higher	0
Utility Stations - Maintenance Transformer Storage		Higher	0
Waste Transfer/Recycling Stations	(1)	Moderate	0
Wastewater Treatment Plants/Collection Stations	(1)	Moderate	0
Other			0

NOTES:
Sites and areas identified in this Table are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.
(1) - Potential source of microbial contamination
(2) - Drip irrigated crops, such as vineyards and some vegetables, are considered lower risk than spray irrigation
(3) - For groundwater public water systems, septic systems located within the 2-year time-of-travel (TOT) are considered moderate risks.

TABLE 1. SUMMARY OF POTENTIAL CONTAMINANT SOURCES BY LAND USE

PWS # 4100826 SISTERS, CITY OF

Commercial/Industrial Land Uses

Potential Contamination Source	Note	Relative Risk Level	Total in DWPA
Automobiles - Body Shops		Higher	0
Automobiles - Car Washes		Moderate	0
Automobiles - Gas Stations		Higher	0
Automobiles - Repair Shops		Higher	0
Boat Services/Repair/Refinishing		Higher	0
Cement/Concrete Plants		Moderate	0
Chemical/Petroleum Processing/Storage		Higher	0
Dry Cleaners		Higher	0
Electrical/Electronic Manufacturing		Higher	0
Fleet/Trucking/Bus Terminals		Higher	0
Food Processing		Moderate	0
Furniture/Lumber/Parts Stores		Moderate	0
Home Manufacturing		Higher	0
Junk/Scrap/Salvage Yards		Higher	0
Machine Shops		Higher	0
Medical/Vet Offices	(1)	Moderate	0
Metal Plating/Finishing/Fabrication		Higher	0
Mines/Gravel Pits		Higher	0
Office Buildings/Complexes		Lower	0
Parking Lots/Malls (> 50 Spaces)		Higher	0
Photo Processing/Printing		Higher	0
Plastics/Synthetics Producer		Higher	0
Research Laboratories		Higher	0
RV/Mini Storage		Lower	0
Wood Preserving/Treating		Higher	0
Wood/Pulp/Paper Processing and Mills		Higher	0
Other			0

NOTES:
Sites and areas identified in this Table are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.
(1) - Potential source of microbial contamination
(2) - Drip irrigated crops, such as vineyards and some vegetables, are considered lower risk than spray irrigation
(3) - For groundwater public water systems, septic systems located within the 2-year time-of-travel (TOT) are considered moderate risks.

TABLE 1. SUMMARY OF POTENTIAL CONTAMINANT SOURCES BY LAND USE

PWS # 4100826 SISTERS, CITY OF

Agricultural/Forest Land Uses

Potential Contamination Source	Note	Relative Risk Level	Total in DWPA
Auction Lots	(1)	Higher	0
Boarding Stables	(1)	Moderate	0
Confined Animal Feeding Operations (CAFOs)	(1)	Higher	0
Crops - Irrigated (inc. orchards, vineyards, nurseries, greenhouses)	(2)	Moderate	2
Crops - Nonirrigated (inc. Christmas trees, grains, grass seed, pasture)		Lower	0
Farm Machinery Repair		Higher	0
Grazing Animals (> 5 large animals or equivalent/acre)	(1)	Moderate	2
Lagoons/Liquid Wastes	(1)	Higher	0
Land Application Sites	(1)	Moderate	0
Managed Forest Land - Broadcast Fertilized Areas		Lower	0
Managed Forest Land - Clearcut Harvest (< 35 yrs.)		Moderate	0
Managed Forest Land - Partial Harvest (< 10 yrs.)		Moderate	0
Managed Forest Land - Road Density (> 2 mi./sq. mi.)		Moderate	0
Pesticide/Fertilizer/Petroleum Storage, Handling, Mixing, & Cleaning Ar		Higher	0
Recent Burn Areas (< 10 yrs.)		Lower	0
Managed Forest Lands - Status Unknown		Moderate	0
Other:		Moderate	2

NOTES:
Sites and areas identified in this Table are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.
(1) - Potential source of microbial contamination
(2) - Drip irrigated crops, such as vineyards and some vegetables, are considered lower risk than spray irrigation
(3) - For groundwater public water systems, septic systems located within the 2-year time-of-travel (TOT) are considered moderate risks.

TABLE 1. SUMMARY OF POTENTIAL CONTAMINANT SOURCES BY LAND USE

PWS # 4100826 SISTERS, CITY OF

Miscellaneous Land Uses

Potential Contamination Source	Note	Relative Risk Level	Total in DWPA
Above Ground Storage Tanks - Excluding Water		Moderate	0
Channel Alterations - Heavy		Lower	0
Combined Sewer Outfalls	(1)	Lower	0
Stormwater Outfalls	(1)	Lower	0
Composting Facilities	(1)	Moderate	0
Historic Gas Stations		Higher	0
Historic Waste Dumps/Landfills	(1)	Higher	0
Homesteads - Rural - Machine Shops/Equipment Maintenance		Higher	0
Homesteads - Rural - Septic Systems (< 1/acre)	(1)(3)	Lower	2
Injection/Dry Wells, Sumps - Class V UICs	(1)	Higher	0
Kennels (> 20 Pens)	(1)	Lower	0
Military Installations		Higher	0
Random Dump Sites		Moderate	0
River Recreation - Heavy Use (inc. campgrounds)	(1)	Lower	0
Sludge Disposal Areas	(1)	Moderate	0
Stormwater Retention Basins	(1)	Moderate	0
Transmission Lines - Right-of-Ways		Lower	0
Transportation - Freeways/State Highways/Other Heavy Use Roads		Moderate	1
Transportation - Railroads		Moderate	0
Transportation - Right-Of-Ways - Herbicide Use Areas		Moderate	0
Transportation - River Traffic - Heavy		Lower	0
Transportation - Stream Crossing - Perennial		Lower	0
UST - Confirmed Leaking Tanks - DEQ List		Higher	0
UST - Decommissioned/Inactive		Lower	0
UST - Nonregulated Tanks (< 1,100 gals or Large Heating Oil Tanks)		Higher	0
UST - Not Upgraded and/or Registered Tanks		Higher	0
UST - Upgraded/Registered - Active		Lower	0
UST - Status Unknown		Higher	0
Upstream Reservoirs/Dams		Lower	0
Wells/Abandoned Wells		Higher	0
Large Capacity Septic Systems (serves > 20 people) - Class V UICs	(1)	Higher	1
Construction/Demolition Areas		Moderate	0
Other			0

NOTES:
Sites and areas identified in this Table are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.
(1) - Potential source of microbial contamination
(2) - Drip irrigated crops, such as vineyards and some vegetables, are considered lower risk than spray irrigation
(3) - For groundwater public water systems, septic systems located within the 2-year time-of-travel (TOT) are considered moderate risks.

TABLE 2. INVENTORY RESULTS - LIST OF POTENTIAL CONTAMINANT SOURCES

PWS# 4100826 SISTERS, CITY OF

Reference No. (See Figure)	Potential Contaminant Source Type	Name	Approximate Location	City	Method for Listing	Proximity to Sensitive Areas	Relative Risk Level (1)	Potential Impacts	Comments
1	Schools	Sisters High School	SW of Well	Sisters	Field-Observation Interview	Within the 2-yr TOT. for HIGH SCHOOL WELL	Lower	Over-application or improper handling of cleaning products, pesticides or fertilizers used on the school grounds may impact drinking water. Vehicle maintenance wastes may contribute contaminants.	The City plans on bringing the sewer lines out along HWY 242 south of the high school well.
	Large Capacity Septic Systems (serves > 20 people) - Class V UICs						Higher	If not properly sited, designed, installed, and maintained, septic systems can impact drinking water.	The City plans on bringing the sewer lines out along HWY 242 south of the high school well.
2	Grazing Animals (> 5 large animals or equivalent/acre)	Patterson Elk Ranch/Soko Ranch	SW of Well	Sisters	Field-Observation Interview	Within the 2-yr TOT. for CITY WELL	Moderate	Improper storage and management of animal wastes may impact drinking water supply. Concentrated livestock may contribute to erosion and sedimentation of surface water bodies.	
	Crops - Irrigated (inc. orchards, vineyards, nurseries, greenhouses)						Moderate	Over-application or improper handling of pesticides/fertilizers may impact drinking water. Excessive irrigation may transport contaminants or sediments to groundwater/surface water through runoff. Drip-irrigated crops are considered to be a low risk.	
	Grazing Animals (> 5 large animals or equivalent/acre)					Within the 2-yr TOT. for HIGH SCHOOL WELL	Moderate	Improper storage and management of animal wastes may impact drinking water supply. Concentrated livestock may contribute to erosion and sedimentation of surface water bodies.	
	Crops - Irrigated (inc. orchards, vineyards, nurseries, greenhouses)						Moderate	Over-application or improper handling of pesticides/fertilizers may impact drinking water. Excessive irrigation may transport contaminants or sediments to groundwater/surface water through runoff. Drip-irrigated crops are considered to be a low risk.	

Note: Sites and areas identified in this Table are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.

(1) Where multiple potential contaminant sources exist at a site, the highest level of risk is used.

(2) See Table 3 for database listings (if necessary).

TABLE 2. INVENTORY RESULTS - LIST OF POTENTIAL CONTAMINANT SOURCES

PWS# 4100826 SISTERS, CITY OF

Reference No. (See Figure)	Potential Contaminant Source Type	Name	Approximate Location	City	Method for Listing	Proximity to Sensitive Areas	Relative Risk Level (1)	Potential Impacts	Comments
3	Other	Irrigation Canal	SW of Well	Sisters	Field-Observation Interview	Within the 2-yr TOT. for CITY WELL	Moderate	The impacts of this potential contaminant source will be addressed during the enhanced inventory.	
	Other					Within the 2-yr TOT. for HIGH SCHOOL WELL	Moderate	The impacts of this potential contaminant source will be addressed during the enhanced inventory.	
4	Transportation - Freeways/State Highways/Other Heavy Use Roads	Highway 242	Runs NW-SE Through Eastern Tip of DWPA	Sisters	Field-Observation Interview	Within the 2-yr TOT. for HIGH SCHOOL WELL	Moderate	Vehicle use increases the risk for leaks or spills of fuel & other haz. materials. Road building, maintenance & use can increase erosion/slope failure causing turbidity. Over-application or improper handling of pesticides/fertilizers may impact water.	
5	Homesteads - Rural - Septic Systems (< 1/acre)	Rural Homesteads	SW of Well	Sisters	Field-Observation Interview	Between 5-yr and 10-yr TOT for CITY WELL	Lower	If not properly sited, designed, installed, and maintained, septic systems can impact drinking water. Use of drain cleaners and dumping household hazardous wastes can result in groundwater contamination.	
	Homesteads - Rural - Septic Systems (< 1/acre)		West of Well			Within the 2-yr TOT. for HIGH SCHOOL WELL	Lower	If not properly sited, designed, installed, and maintained, septic systems can impact drinking water. Use of drain cleaners and dumping household hazardous wastes can result in groundwater contamination.	

Note: Sites and areas identified in this Table are only potential sources of contamination to the drinking water. Environmental contamination is not likely to occur when contaminants are used and managed properly.

(1) Where multiple potential contaminant sources exist at a site, the highest level of risk is used.

(2) See Table 3 for database listings (if necessary).

E TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
TATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date of well completion.

WATER WELL REPORT

STATE OF OREGON

(Please type or print)

(Do not write above this line)

State Well No. 15S/10E-9

State Permit No. _____

(1) OWNER:

Name City of Sisters CITY WELL

Address Sisters City Hall

Sisters, Oregon 97759

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED:

Threaded ☐ Welded ☒

14 " Diam. from +2 ft. to 100 ft. Gage 250
12 " Diam. from 25 ft. to 111 ft. Gage 250
10 " Diam. from 0 ft. to 195.6 ft. Gage 250

PERFORATIONS:

Perforated? ☒ Yes ☐ No.

Type of perforator used ACY. and Machine

Size of perforations ¼ in. by 6" X and ¼" by 2"

1200 perforations from 50 ft. to 100 ft.
1560 perforations from 95.6 ft. to 195.6 ft.
perforations from ft. to ft.

(7) SCREENS:

Well screen installed? ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:

Drawdown is amount water level is lowered below static level Davidson

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Drilling

Yield: 549 gal./min. with 4 ft. drawdown after 1½ hrs.
902 " 7'4" " 4 "
1315 " 5'3" " 1 "
~~Bailer test~~ PUMP TEST 24 hrs. gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m.

Temperature of water 46 Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Well seal—Material used Cement and Bentonite

Well sealed from land surface to 40 ft.

Diameter of well bore to bottom of seal 18 in.

Diameter of well bore below seal 16 in.

Number of sacks of cement used in well seal 58 sacks

Number of sacks of bentonite used in well seal 150 lbs. sacks

Brand name of bentonite Western

Number of pounds of bentonite per 100 gallons of water 5½ gals. water per 100 lbs. Cement lbs./100 gals.

Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.

Did any strata contain unusable water? ☒ Yes ☐ No

Type of water? Surface depth of strata 3 feet

Method of sealing strata off casing and grout

Was well gravel packed? ☐ Yes ☒ No Size of gravel:

Gravel placed from ft. to ft.

(10) LOCATION OF WELL:

County Deschutes Driller's well number

NW ¼ SW ¼ Section 9 T. 15 S R. 10 E W.M.

Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.

Depth at which water was first found 105 ft.

Static level 85 ft. below land surface. Date 10/2/75

Artesian pressure lbs. per square inch. Date

(12) WELL LOG:

Diameter of well below casing 10"

Depth drilled 211 ft. Depth of completed well 211 ft

Formation: Describe color, texture, grain size and structure of materials and show thickness and nature of each stratum and aquifer penetrated with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata*

MATERIAL	From	To	SWL
Overburden	0	2	
Cong. Gray	2	21	1
Clay and Cong. Brown	21	29	2
Lava - Mild	29	111	3
Sandstone & Cong. Brown	111	175	
Cong. Gray - Waterbearing	175	195	
Basalt	195	211	

RECEIVED
JAN 05 1976
WATER RESOURCES DEPT.
SALEM, OREGON

Work started 4/3/ 1975 Completed 10/2 19

Date well drilling machine moved off of well 10/3/ 19

Drilling Machine Operator's Certification:

This well was constructed under my direct supervisic Materials used and information reported above are true to t best knowledge and belief.

[Signed] William L. Aker Date 10/15 197
(Drilling Machine Operator)

Drilling Machine Operator's License No. 803

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report true to the best of my knowledge and belief.

Name DAVIDSON DRILLING INC. (Person, firm or corporation) (Type or print)

Address 626 N.W. Pershall Way Redmond, Ore.

[Signed] G. Gordon Davidson
(Water Well Contractor)

Contractor's License No. 548 Date 10/15/ 19

(503) 845-6824

Staco Well Services, Inc.

220 Academy St.
Mt. Angel, OR 97362

FIELD LOG

Driller Byron

(1) OWNER: Well Number
Name Hap Taylor Construction
Address
City CITY OF SISTERS State Zip

(2) TYPE OF WORK: HIGH SCHOOL
☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon WELL

(3) DRILL METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Other

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☒ Irrigation
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval Yes ☐ No ☒ Depth of Completed Well 302 ft.
Explosives used Yes ☐ No ☒ Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
22"	0	39	Cement	0	34	93
17"	39	190				
14"	190	244				
13"	244	302				

How was seal placed: Method ☐ A ☐ B ☒ C ☐ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing	18	+1	39	.375	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner	14"	1½	244	.250	☒	☐	☒	☐
	10"	238	302	.250	☒	☐	☒	☐

Final location of shoe(s)

PERFORATIONS/SCREENS:
☒ Perforations Method
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
242	302	8x3	2400	10"		☐	☒
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

WELL TESTS: Minimum testing time is 1 hour
☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
1200	3 Ft	220	1 hr 8 hrs

Aquifer tapped 51'
Depth Artesian Flow Found
Was water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL, by legal description:
County Latitude Longitude
Township 15.5 N or S, Range 10 E or W, WM.
Section 5 ¼ ¼
Tax Lot Lot Block Subdivision
Street Address of Well (or nearest address) Sisters School New Construction

(10) STATIC WATER LEVEL:
101 ft. below land surface. Date 7-31-91
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found 105'

From	To	Estimated Flow Rate	SWL
251	273	1200 +	101
283	288		101
288	295		101
295	301		101

(12) WELL LOG:
Ground elevation

Material	From	To	SWL
Top soil	0	1	
Cobbles with sand & dirt	1	23	
Volcanic gravels	23	34	
Basalt Black Pourus	34	50	
Basalt grey hard	50	63	
Cinders red	63	75	
Volcanic gravels grey & red	75	98	
Basalt grey med fract.	98	103	
Pumice White	103	105	
Basalt grey fractured	105		
with round gravels		145	101
Conglomerate brown	145	155	101
Rock grey hard	155	160	101
Rock soft grey & brown	160	175	101
Gravel broken	175	193	101
Rock broken grey & brown	193	203	101
Conglomerate light brown	203	235	101
Rock broken with gravel	235	241	101
basalt grey hard & Pourus	241	251	101
basalt brown Pourus	251	273	
basalt grey hard	273	283	
Basalt Pourus grey & lavender	283	288	
Cinders red	288	295	
basalt Pourus brown	295	301	101
" " " hard	301	302	

Appendix E: Parameters Used in Delineation Model

Delineation Method: ☒ Analytical ☐ Calculated Fixed Radius ☐ Enhanced CFR
☐ Numerical ☐ Hydrogeologic Mapping ☐ Analytic Element

Pump Rate (gpm): **City Well = 95** **High School Well 3= 378**

Source: ☒ System ☐ Water Resources Dept ☐ Comparable Community
☐ Pump Capacity ☐ Population Estimate ☐ 90% of Safe Yield

Nature of the Aquifer: ☐ Unknown ☒ Unconfined
☐ Semi-confined ☐ Confined

Aquifer name: **Gravelly sediments, lava flows and cinders within the Deschutes Formation**

Confining Unit lithology: NA
Depth to Confining Unit: NA
Confining Unit thickness: NA
Depth to Aquifer: 85-105 feet

Aquifer Characteristics:

Lithology:

☐ Unknown ☐ Sandy Silt ☒ Layered Volcanic Rocks
☐ Sand ☒ Sand & Gravel ☐ Fractured Volcanic Rocks
☒ Gravel ☐ Cobbles/Gravel ☐ Fractured Sedimentary Rocks
☒ Other: Cinders

Thickness (b): 60 to 90 feet

Effective Porosity (n): 0.25

Hydraulic Conductivity (Permeability): 100-150 ft/day ☐ N/A
☐ Estimated from lithology ☒ Specific Capacity (Well Report)
☐ Published Report ☒ Aquifer Test

Hydraulic Gradient: 0.004 Flow Direction: N60E ☐ N/A
☒ Published Report ☐ Graphical Solution ☐ Estimate
☐ Field Measurements ☐ Model Results

Other High Capacity Wells Accounted for: None