City of Moscow
Comprehensive Water System Plan

Adopted
January 2012

Golder Associates

Taylor Engineering, Inc.

HDR

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

RECEIVED
JAN 0 3 2012
City of Moscow

1118 F Street • Lewiston, Idaho 83501 • (208) 799-4370

C.L. "Butch" Otter, Governor
Toni Hardesty, Director

December 30, 2011

Mr. Les MacDonald
City of Moscow
206 East Third Street
Moscow, Idaho 83843

Subject: Record #2673.01; City of Moscow Comprehensive Water System Plan:

Dear Mr. MacDonald:

The Plan for the subject project appears to meet State of Idaho standards and is approved. The City should use this Plan as a basis for future water system improvements.

Please note that plans and related documents must be submitted to DEQ for review and approval before any construction may proceed. Also, any significant changes or revisions to the Plan must be reviewed and approved by DEQ.

We encourage the City to review the Plan on a regular basis and make revisions accordingly so that it stay relevant and current.

Please don't hesitate to contact me if you have questions or comments. My phone number is 208-799-4370 and e-mail address is Thomas.Moore@deq.idaho.gov.

Sincerely,

Thomas J. Moore, P.E.
Regional Engineering Manager

c: David P. Keel, HDR Engineers, Inc.
Clayton Steele, Regional Administrator

City of Moscow

Comprehensive Water System Plan

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January 2012

Certificate of Engineer

City of Moscow
Comprehensive Water System Plan

The material and data contained in this report were prepared under the responsible charge of the undersigned, whose seal as a professional engineer, licensed to practice in the State of Idaho, is affixed below.

David P. Keil
HDR Engineering, Inc.

PROFESSIONAL ENGINEER
REGISTERED
10382
STATE OF IDAHO
DAVID P. KEIL
12/16/11

Tables

Figures

Appendices

1. Introduction

The City of Moscow (City) distributes drinking water throughout the area bounded by its City Limits, with the exception of an area in the southwest portion of the City that is served by the University of Idaho. The City has prepared this 2011 Comprehensive Water System Plan (CWSP) in support of its continued commitment to providing safe and reliable water to its customers.

The CWSP was developed considering the regulatory requirements and facility and design standards pertaining to public drinking water systems, as set forth in IDAPA 58.01.08 (Idaho Rules for Public Drinking Water Systems). The CWSP describes the City's water distribution facilities, operations and compliance with state and federal drinking water regulations. It identifies capital project needs for the coming years, as well as the City's financial plan to fund these needs.

1.1. System Overview

The City of Moscow was founded in the 1870s, with the City's first water supply well drilled in 1892. The water system has evolved over more than one hundred years, and now relies upon five groundwater wells withdrawing water from the Wanapum and Grande Ronde aquifers in the Palouse Groundwater Basin.

The City currently provides water service to a population of approximately 23,000, via a distribution system comprised of roughly 93 miles of pipelines and four reservoirs with a total storage volume of 4.75 million gallons.

Growth in the City is expected to result in a water system service population of 30,000 in 2030, and up to 46,000 in 2060. The water system will continue to be upgraded and expanded, to meet needs associated with this growth, as well as changing regulatory requirements.

Further information on the City's service area, facilities and operations is presented in subsequent chapters of this CWSP.

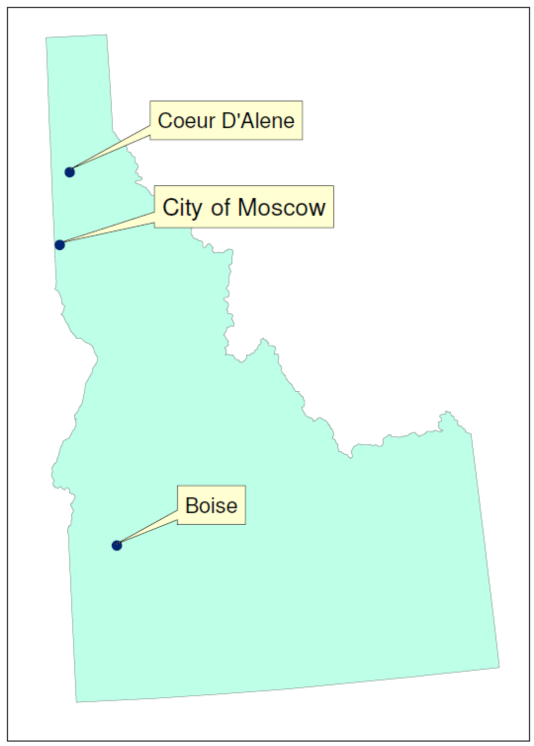


Figure 1-1 Location Map

1.2. Planning Objectives

This CWSP was developed to meet the following objectives:

- Provide estimates of expected population growth in the City's service area, to enable planning for new facilities or upgrades to existing facilities. Despite the current economic downturn, further growth is expected, mostly to the northeast and south of existing developed areas.

- Construct a computerized hydraulic model of the distribution system to reflect existing infrastructure and current operating conditions/parameters. This model was a key working tool used during development of the CWSP to evaluate adequacy of City facilities and to plan for improvements. It will continue to be used by the City in the future as the system is modified to address deficiencies and respond to growth.
- Evaluate the feasibility and cost-effectiveness of various long-term water supply options. The City's existing sources and planned near-term supply improvements (i.e., New Cemetery Well and Well 10) are sufficient to meet needs through the 20-year planning horizon. Furthermore, existing groundwater rights are adequate to support demands through the 50-year planning horizon. However, due to observed declines in regional groundwater levels in the City's source aquifers, the City is pro-actively considering alternative future supplies that could be used in conjunction with its existing groundwater wells to meet future growth needs while sustainably managing regional water resources. Such supplies considered at this preliminary planning stage include aquifer storage and recovery, surface water storage, river supply, and the use of reclaimed water to replace drinking water used for non-potable purposes. The analysis presented in this CWSP will serve as a foundation for continued evaluation of future supply options during subsequent CWSP updates.
- Prepare a Capital Improvement Program (CIP) and review financial needs for implementation.
- Evaluate compliance with facility and design standards set forth in IDAPA 58.01.08, primarily in sections 500 through 552. These standards have historically guided the development of the water system and are referenced throughout the CWSP as the basis for design and implementation of future system improvements.

1.3. Organization of Comprehensive Water System Plan

This Water Comprehensive Plan is organized in the following chapters:

Chapter 1: Introduction

Chapter 2: System Description

Chapter 3: Policies, Plans, and Agreements

Chapter 4: Demand Forecast

Chapter 5: Conservation Program

Chapter 6: Water Rights and Supply Options

Chapter 7: System Analysis

Chapter 8: Capital Improvement Program

Chapter 9: Financial Program

In addition to these chapters, the Appendices to this CWSP contain information related to the topics listed above.

2. Water System Description

2.1 Background and Description of Service Area

2.1.1 Water System Ownership and Management

The City of Moscow owns and operates its municipal water system. A vicinity map showing the location of Moscow is presented on Figure 2-1. A map showing the city limits is presented on Figure 2-2. The IDEQ water system identification number is ID2290023. An elected Mayor and City Council govern the City. The City's current physical and mailing addresses are:

Physical Address:

City of Moscow Public Works
Department
221 East Second Street
Moscow, Idaho 83843

Mailing Address:

City of Moscow Public Works
Department
PO Box 9203
Moscow, Idaho 83843

The Public Works Director is responsible for the management, operations, business administration, and final decisions related to the City's water system. The Water /Wastewater Manager works directly for the Public Works Director. An organizational chart of the water system management is provided in Appendix 2-1.

2.1.2 Background

The following excerpt from the 1999 City of Moscow Comprehensive Plan describes the early history of the City:

The early settlers of the late nineteenth century found the hill land of the Palouse region very promising for agriculture. Growing cereal crops began with considerable success, the major problems being transportation of the crops to the Snake River for shipment and the distance to travel for goods and services. To obtain retail goods, residents had to travel to Walla Walla, Washington, a distance of 100 miles. To move the crops to market, wheat and lentils were hauled by wagon to Wawawai on the Snake River, down the treacherous walls of the canyon, and floated on the Columbia River to Portland, Oregon. In response to these hardships, retail shops were started in Moscow. In 1885, the first railroad was built to serve the community. The town thus became a trade center for the Palouse region.

To keep the northern part of the Idaho territory from joining Washington or Montana in a quest for statehood, the southern Idaho farmers promised the northern settlers that the state's land grant university would be located there. In 1889, the University of Idaho was established by the Territorial legislature and was located in Moscow, which helped the city gain the prestige of county seat.

The City today still reflects the importance of agriculture and the university. The city benefits from a variety of community events. Retail trade and service establishments are *numerous as a result of the university students, faculty, and staff who comprise the majority of the city's population, and the farm population in the surrounding area of Latah County and Whitman County, Washington. Moscow maintains several recreational parks and a vibrant, pedestrian-oriented downtown. Several turn of the century commercial buildings and the Fort Russell residential district carry over Moscow's historic character to current residents and visitors. Multi-family and other student-oriented housing is found throughout the city, as well as single-family dwelling neighborhoods. The university buildings, agricultural warehouses, and the shopping districts stand out in the view of the city from the hillsides. Wheat and lentil fields surround the community with open space. All of these aspects of the city contribute to our unique sense of place.*

Latah County was first settled in the mid-1860s. When the first post office opened in 1872, the town was called Paradise Valley (Paradise Creek flows through town, westward to Pullman), but the name was changed to Moscow in 1875. The City incorporated in 1887. The first well was drilled in 1892 (Well No. 1). The well was artesian but by 1914, the water level was reported to be over 100 feet below the surface.

In 1892, the University of Idaho (UI) opened its doors. UI maintains a separate water system within the City that also relies on groundwater as a source of supply. The systems are intertied for exchange of water during emergency conditions.

Throughout the growth and development of the Moscow water system, the City has been dependent upon the Palouse Groundwater Basin for its supply. The Basin consists primarily of two aquifers: the Wanapum (shallow) and Grande Ronde (deep). The Wanapum and Grande Ronde Formations are part of the Columbia River Basalt Group, which consists of thousands of feet of lava flows that covered much of eastern Washington and northeastern Oregon during eruptions that occurred millions of years ago.

A total of five production wells are now in use in Moscow. Three wells draw water from the deeper Grande Ronde aquifer and the other two from the shallow Wanapum aquifer. In addition, two shallower wells were drilled near the cemetery within the Wanapum but currently the wells are not in use. Both the Grand Ronde and Wanapum aquifers are experiencing declining water levels. The Palouse Basin Aquifer Committee (PBAC) monitors groundwater levels in the area. It is a voluntary, multi-jurisdictional committee with representatives from the cities, counties and universities in the Basin (Idaho: City of Moscow, Latah County and University of Idaho; Washington: Whitman County, City of Pullman, City of Palouse, City of Colfax and Washington State University). PBAC works to ensure a long-term, quality water supply for the Palouse Basin region. In the 2007 Palouse Ground Water Basin Water Use Report, PBAC made the following statement concerning the declining aquifer levels:

Water levels in the Grande Ronde have historically declined at a rate of between 1 and 2 feet per year for 70 or more years. Water levels in the Wanapum dropped drastically in the 1950s and early ‘60s, but recovered in the 1970s and ‘80s when much of the pumping switched to the deeper Grand Ronde. Although absolute values are still uncertain, it is thought that there is limited recharge to the Wanapum and very little recharge to the Grande Ronde.

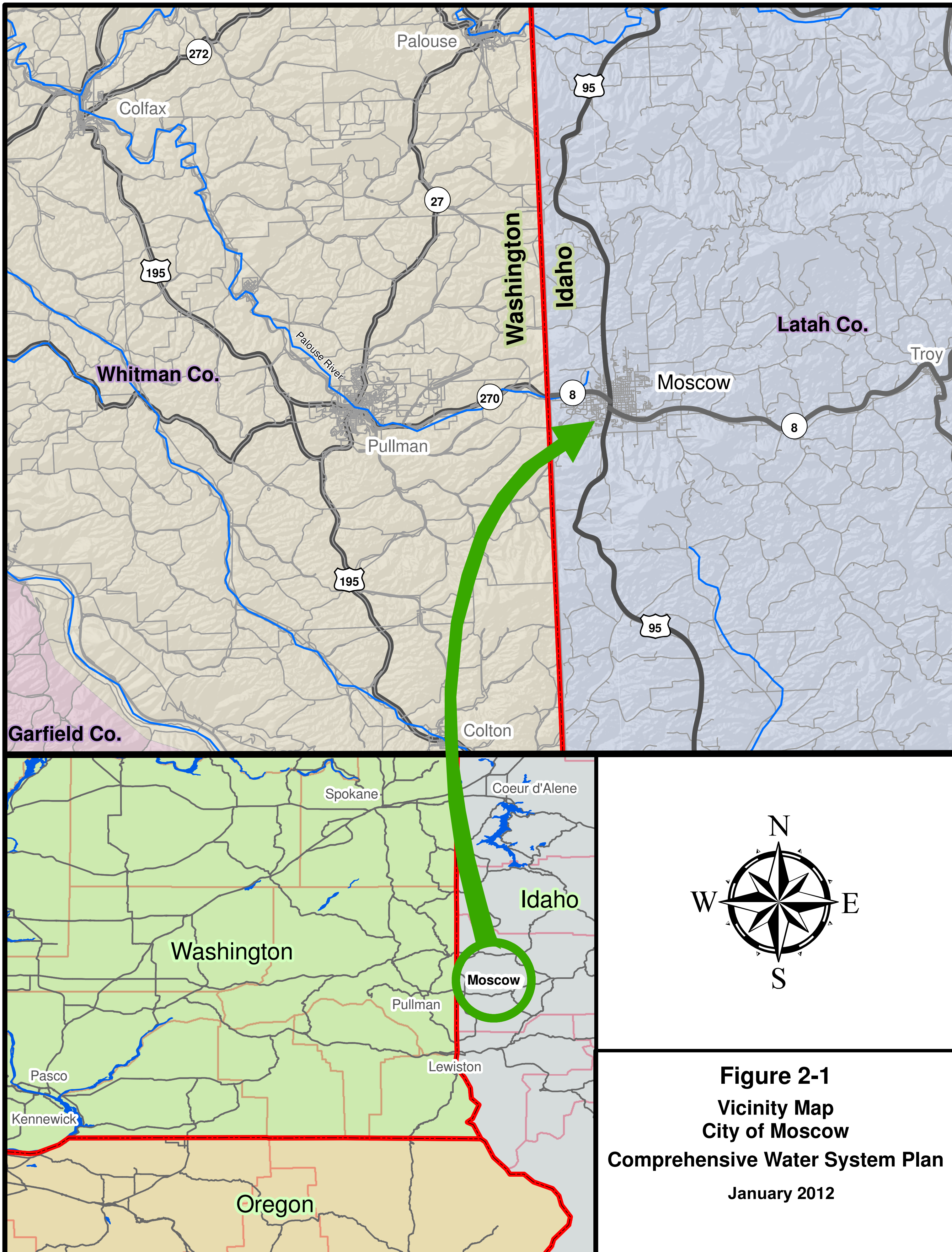


Figure 2-1

Vicinity Map
City of Moscow
Comprehensive Water System Plan

January 2012

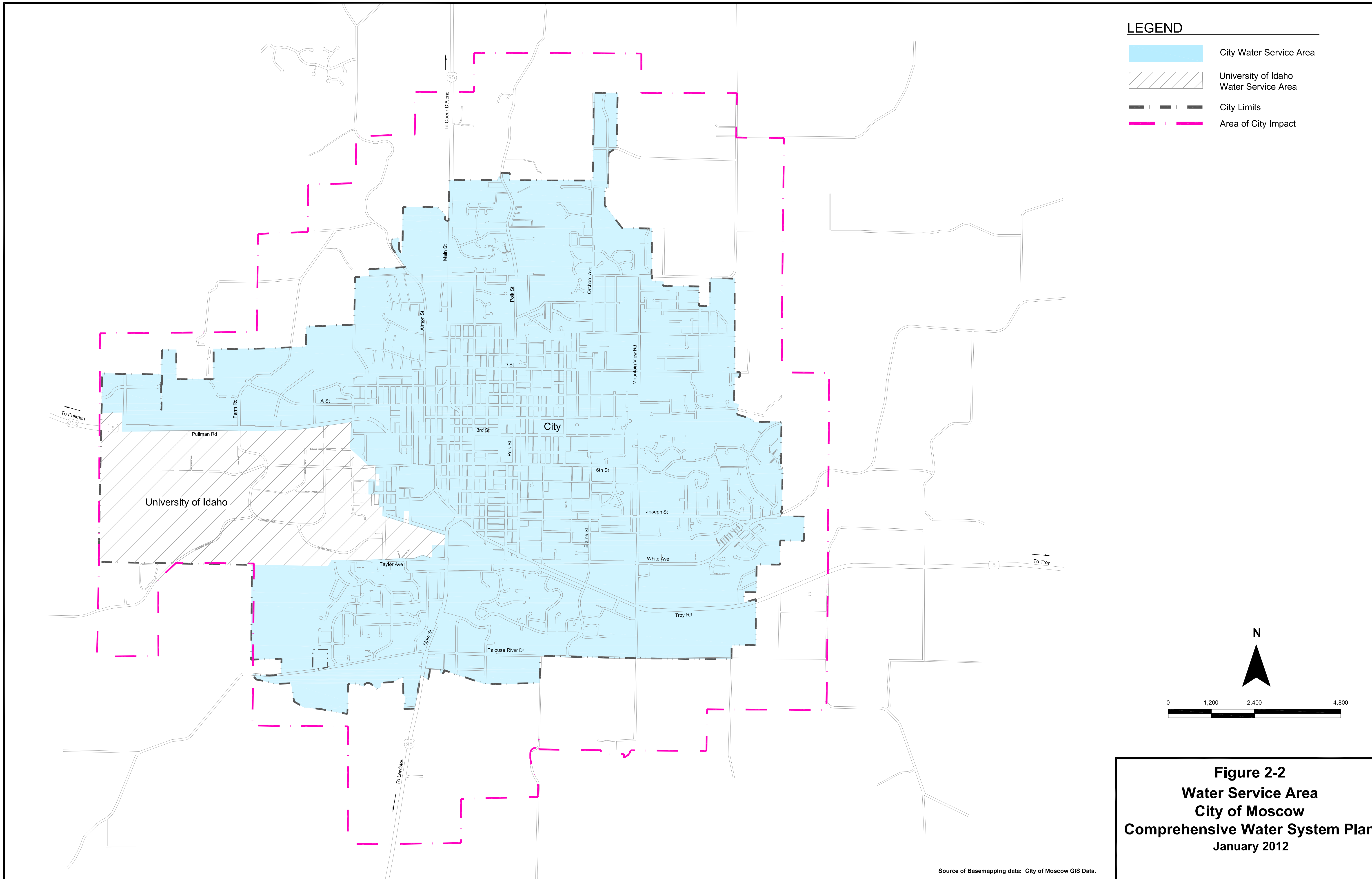


Figure 2-2
Water Service Area
City of Moscow
Comprehensive Water System Plan
January 2012

A summary of the construction of major system features for the City of Moscow is provided in Table 2-1.

Table 2-1 History of the City of Moscow Water System

Date	Description
1875	Moscow established
1892	Well No.1 drilled & University of Idaho opens
1919	Northwest tank constructed
1925	Well No. 2 drilled
1928	Well No. 3 drilled
1940	Northeast tank constructed
1958	Taylor Booster Station constructed
1955	Old Cemetery Well drilled – private well
1955-1958	Well No. 6 drilled (began in 1955 completed in 1958)
1956	Pump in Well No. 1 lowered
1963	Last pumping record of Well No.1 (later abandoned)
1964	Well No. 8 drilled
1968	Southeast tank & booster station constructed
1971	Indian Hills booster constructed
1973	Ponderosa booster constructed
1978	Old Cemetery Well acquired from private party
1980	Vista booster constructed
1982	Well No. 9 drilled
1989	Stopped pumping Old Cemetery Well
1989	White Avenue booster constructed
1990	Ponderosa booster rebuilt
1991	Vista tank constructed
1993	Moser booster constructed
1996	New Cemetery Well drilled
1997	Indian Hills booster rebuilt
2006	Vista booster pump replaced

2.1.3 Physical Characteristics

The following excerpt for the 1999 City of Moscow Comprehensive Plan describes the physical characteristics of the area:

The Palouse region of the Columbia Plateau is characterized by rolling hills rising between 20 and 80 feet above the local drainages. Underlying the surface are thick layers of basalt rock which have been buried by windblown sediments or loess. The loess is over 150 feet deep in some places and has been shaped by wind and snow into hills. Drainage courses have cut through the deep soil and have deposited alluvial material in their valleys.

The major soil that has developed in the loess deposits around Moscow is Palouse Silt Loam, the most productive of the soils in the Palouse region for agriculture. Associated soils are found in smaller areas. Besides being highly productive for agriculture, these soils are characterized by a high water capacity potential and by a potential for severe erosion when stripped of vegetation. In the alluvium deposits of the drainage courses, Caldwell Silt Loam and its associated soils have developed. . .

In addition to the valuable agricultural soils, clay deposits rich in alumina and ilmenite, a source of titanium, exist in the northeast Moscow area. These clay deposits contain enough alumina that mining in the future is possible.

As a result of the fine agricultural soils and reasonably mild climate, dryland wheat, pea, and lentil farming have been successful in the Palouse. The urban community of Moscow has developed completely surrounded by some of the most productive agricultural lands in the world. In addition to producing valuable crops and income for Moscow's businesses, agriculture has been responsible for maintaining the open space surrounding the city.

Moscow's climate is reasonably mild, with summer temperatures reaching above 90°F only for short periods of time, and winter temperatures below 0°F occurring only occasionally. Annual precipitation averages 22 to 23 inches, with November through January being the wettest months, and July and August the driest. The growing season averages 150 days.

Two watercourses have developed alluvial valleys through the area. Paradise Creek begins in the Palouse Range to the northeast of Moscow. It runs along the east side of the city limits, cuts through the southeast corner of town, follows the Railroad rights-of-way through the center of town, and on to the west toward Pullman. A small tributary named Hogg Creek cuts through the northwestern area of the city and flows into Paradise Creek along the Pullman Road. The South Fork of the Palouse River normally has year-round flow and contains a declining population of brook and rainbow trout. The valleys of these three waterways, with more level land than is found in other areas around the city, attract development. Both the river and the creeks, however, are subject to occasional flooding during winter and early spring, when warming conditions bring melting snow and heavy precipitation.

As stated previously, the City obtains its groundwater supply from the Palouse Groundwater Basin. The Basin also serves the cities of Pullman, Palouse, Colfax, Uniontown, and Colton, Washington State University, the University of Idaho, and rural residents. The water supply for the basin is withdrawn from several different geologic formations, the most productive of which is the Grand Ronde Basalt. Today, groundwater levels are declining, causing the basin to become the subject of numerous published studies, beginning in 1897 and continuing to the present. The City has implemented water conservation measures in an effort to reduce its impact on the aquifer, a comprehensive discussion of which is presented in Chapter 5: Water Conservation.

2.1.4 Inventory of Existing Facilities

A map showing the City's current water facilities is shown on Figure 2-3. The water system consists of five active wells, four storage reservoirs, seven booster stations (one of which is a peaking and fire demand booster station at the Southeast Reservoir), and approximately 93 miles of water distribution lines. The City has one pressure zone serving the entire City with six booster stations that run constantly to serve pockets of residential homes. The smallest pocket is 22 homes and the largest is 166 homes. The main pressure zone has a hydraulic grade line (HGL) at 2,790 feet, which is the overflow elevation for all storage reservoirs except for the Southeast Reservoir, which has an overflow elevation of 2,652 feet. A map showing how water is moved between the pressure zones is shown on Figures 2-4 and 2-5.

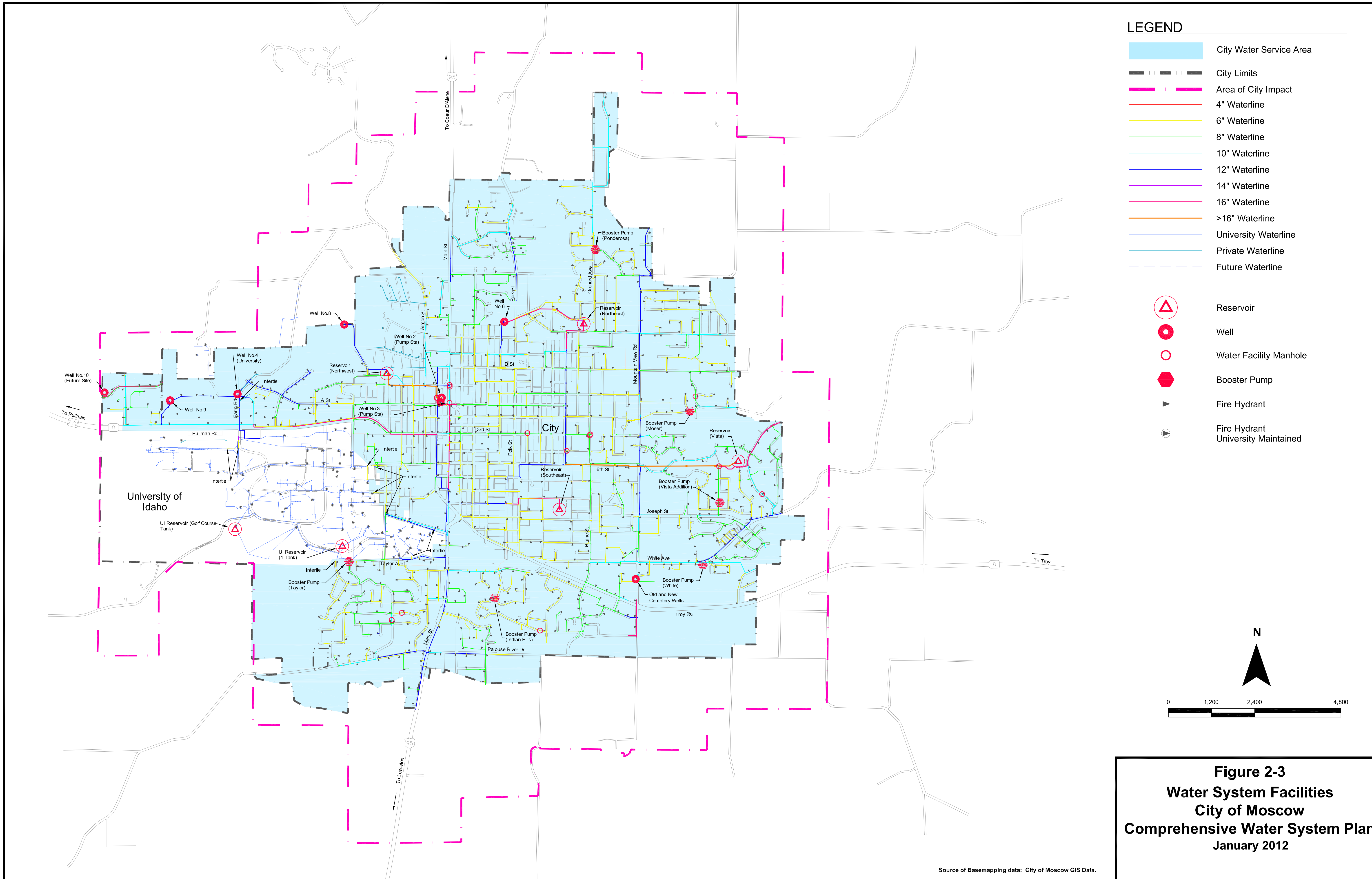
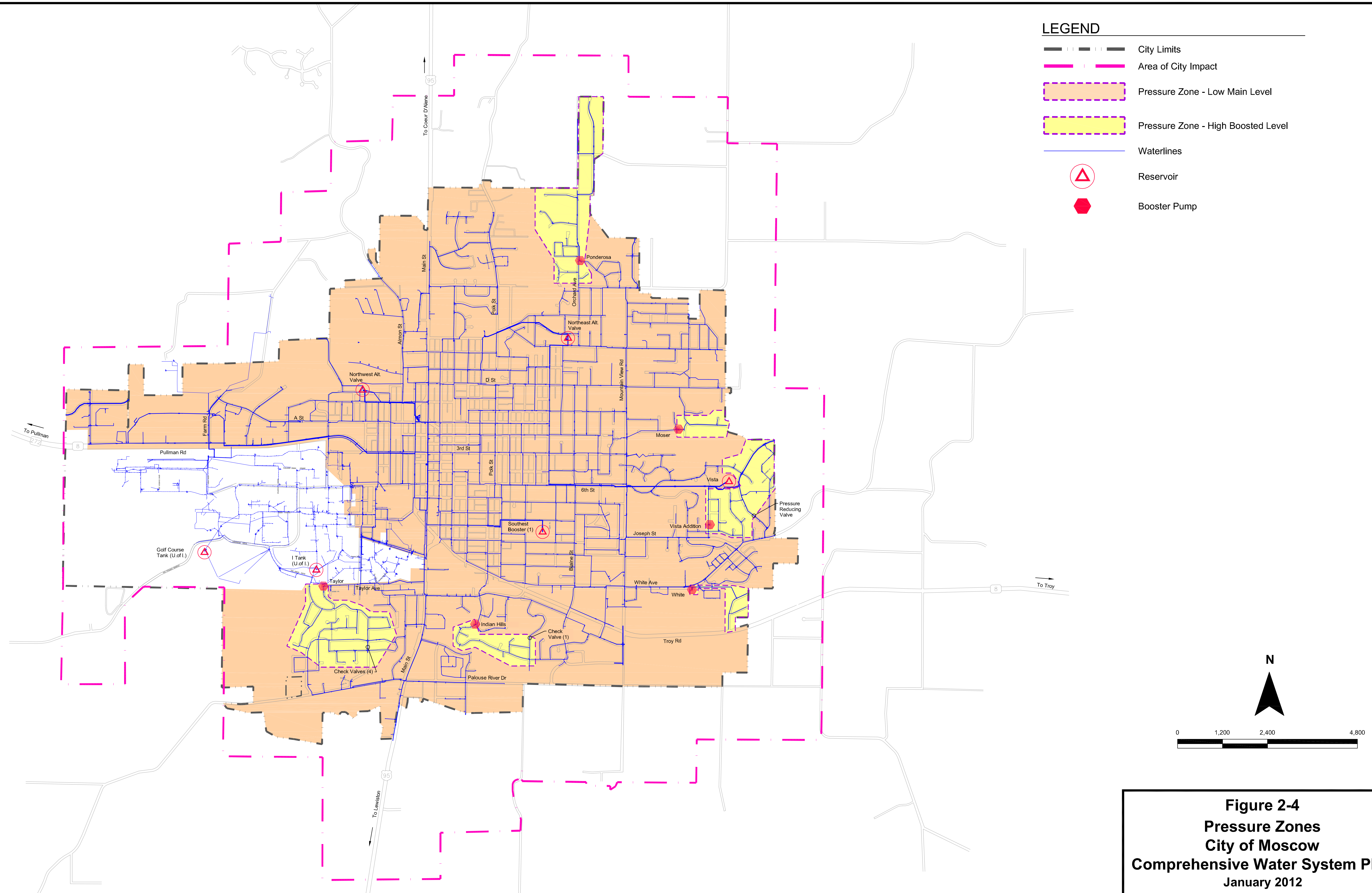


Figure 2-3
Water System Facilities
City of Moscow
Comprehensive Water System Plan
January 2012



Source of Basemapping data: City of Moscow GIS Data.

Figure 2-4
Pressure Zones
City of Moscow
Comprehensive Water System Plan
January 2012

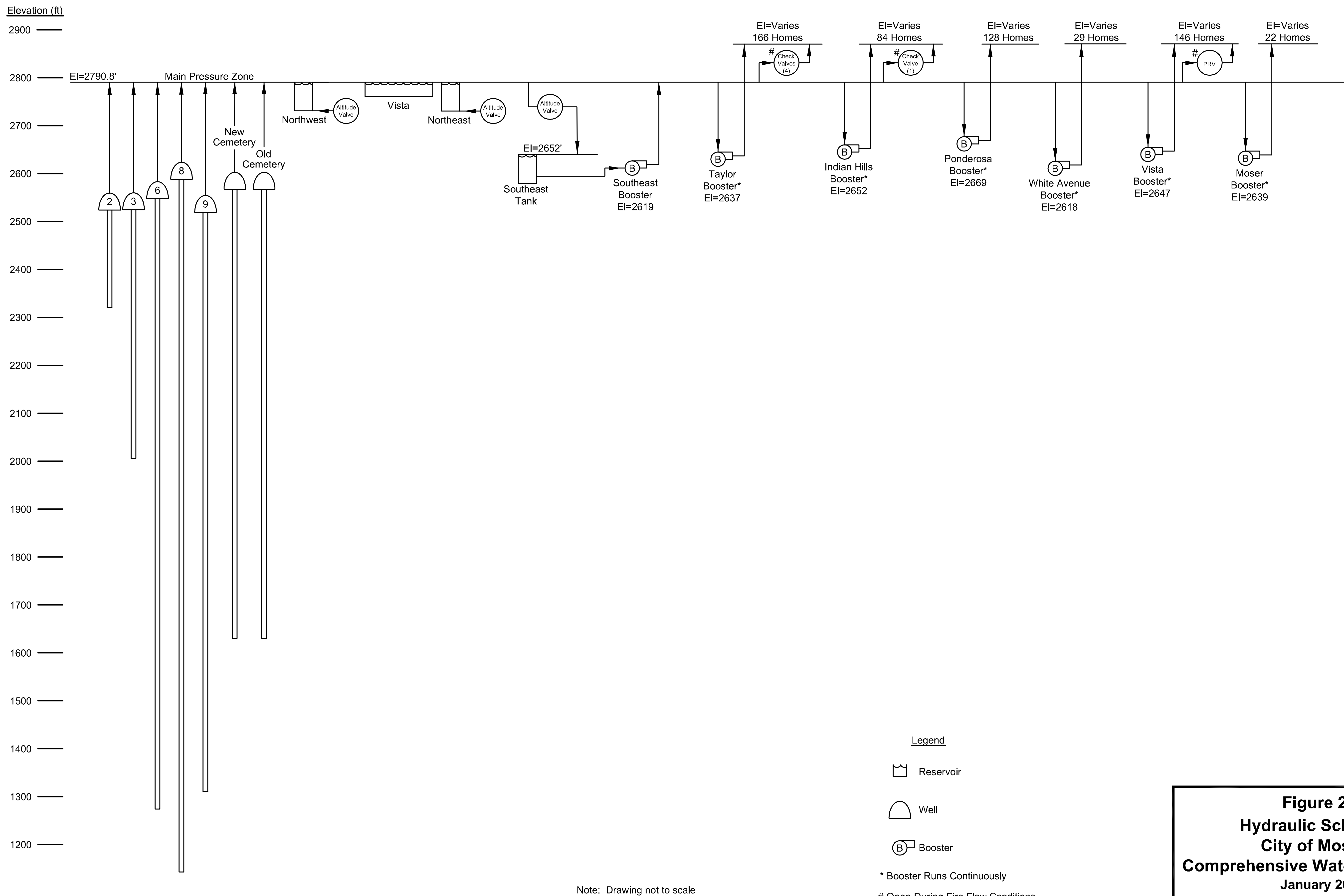


Figure 2-5
Hydraulic Schematic
City of Moscow
Comprehensive Water System Plan
January 2012

2.2 Source and Quality of Supply

2.2.1 Wells

The Moscow drinking water supply is provided from groundwater wells. The first well for the city of Moscow was drilled in 1892. Well No. 1, located near the intersection of “A” and Jackson Streets, was originally a flowing artesian well and the current water level is approximately 100 feet below the surface. Well No. 1 was eventually abandoned with the construction on Well No. 2. In 1925, Well No. 2 was drilled at the intersection of “A” and Jackson Streets. Well No. 3 was drilled at the same location in 1928. Well No. 4 was drilled in 1939 near Mountain View Road and Sixth Street, but no water was found and it was abandoned. In 1948, Well No. 5 was drilled in the northeast section of town but was abandoned due to lack of production. Well No. 6 was drilled in 1955 near the intersection of Public Avenue and Van Buren Street to a depth of 280 feet and completed in 1958-59 to a depth of 1,305 feet. Also in 1955, the Old Cemetery Well was drilled, was acquired by the City in 1978 with production suspended in 1988/89 because of sand problems. Well No. 7 was drilled in 1961 but drill tools were lost in the shaft and the well was abandoned. Adjacent to Well No. 7, Well No. 8 was drilled in 1964 to a depth of 1,442 feet and placed in operation in 1965. In 1982, Well No. 9 was drilled northwest of the Palouse Mall. In 1996, the New Cemetery Well was drilled adjacent to the Old Cemetery Well, but completion of this well has not yet occurred due to sanding problems. Currently, Well Nos. 2, 3, 6, 8, and 9 are the sources for drinking water. The New Cemetery Well hasn’t been fully developed and may have some potential if the sand problems can be resolved.

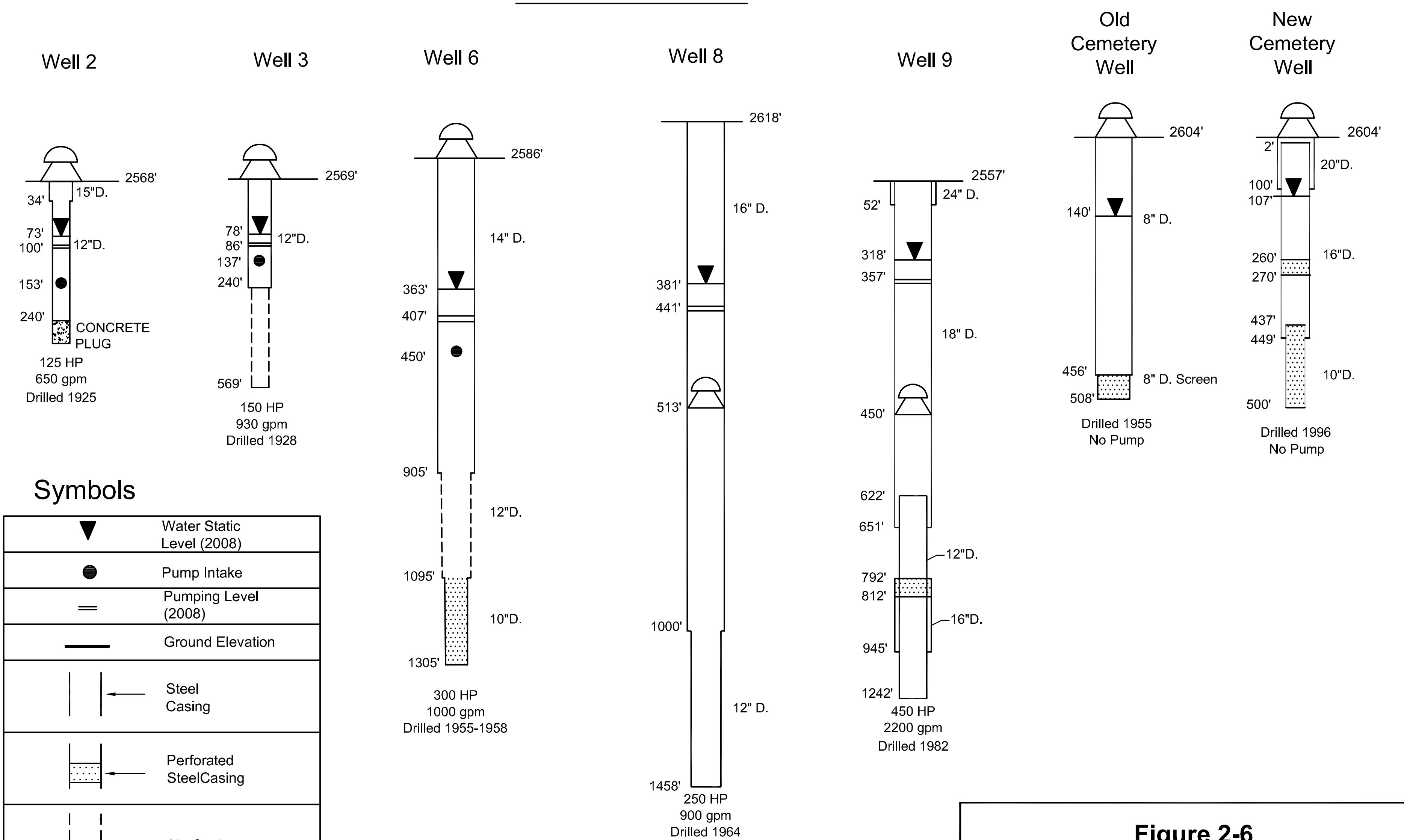
The City’s well characteristics are shown on Figure 2-6 and are summarized in Table 2-2.

2.2.2 Interties

The City’s water system shares ten interties with the University of Idaho for emergency situations. The interties are all valved and remain closed under normal circumstances. The university system has higher pressure than the City system, therefore in the event of a leak, the university system would flow into the City’s system under normal circumstances.

In the eighteen year history of the City of Moscow and University of Idaho (UI) interties, water has only been supplied to the University on one occasion due to a fire on the campus. Because the interties are rarely used, they are not metered. The City and UI do not have a written agreement for shared water use between the systems as this has historically been a verbal agreement. Moscow does not purchase from other suppliers nor does it provide water to any wholesale customers.

Well Data



Symbols

▼	Water Static Level (2008)
●	Pump Intake
═	Pumping Level (2008)
━	Ground Elevation
Steel casing symbol	Steel Casing
Perforated casing symbol	Perforated SteelCasing
Dashed casing symbol	No Casing
Pump symbol	Pump

Note:
1. Actual 2010 pumping capacities shown
2. Drawing not to scale

Figure 2-6
Well Characteristics
City of Moscow
Comprehensive Water System Plan
January 2012

Table 2-2 Summary of City of Moscow Well Characteristics

Characteristic	Well No. 2	Well No. 3	Well No. 6	Well No. 8	Well No. 9	Old Cemetery Well	New Cemetery Well
Date Drilled/Redrilled	1925	1928	1955-1959	1964	1982	1955	1996
Status	Active	Active	Active	Active	Active	Inactive	Inactive
Wellhead Elevation (feet)	2568	2569	2586	2618	2557	2604	2604
Pump Intake Depth (feet) bgs	153	137	450	513	450	No Pump	No Pump
Well Diameter (inches) and Depth (feet) bgs	15” to 34’ 12” to 240’ Concrete plug at 240’	12” to 240’ Uncased to 569’	14” to 905’ Uncased 905’ to1,095’ 10” from 1,095’ to 1,305’	16” to 1,000’ 12” to 1,458’	24” from 0’ to 52’ 18” from 0’ to 651’ 12” from 622’ to 1242’ 16” from 792’ to 945’	8” to 456’ 8” screen to 508’	20” from 0’ to100’ 16” from 2’ to 449’ 10” from 437’ to 500’
Well Depth (feet) bgs	240	569	1305	1458	1242	508	500
Well Casing Depth (feet) bgs	240	240	905	1458	1242	508	500
Screen Interval (feet)bgs	None	None	1095-1305	None	792- 812	456-508	260-270 437-500
Rated Capacity (gpm)	1200	1400	1200	1150	2350	-	-
Actual Capacity (gpm)	650	930	1000	900	2200	-	-
Pump Type	Lineshaft Turbine	Lineshaft Turbine	Lineshaft Turbine w/ Oil Lube	Submersible	Submersible	-	-
Motor Horsepower (HP)	125	150	300	250	450	-	-
Emergency Power	Generator	Generator	None	None	None	None	None

1. bgs = below ground surface
2. Well No. 1 is abandoned.

2.2.3 Quality of Supply

The City of Moscow has historically provided high quality water to its residents and is currently in compliance with water quality monitoring requirements. The City of Moscow regularly monitors for coliform, contaminants, and turbidity. The following is an excerpt from the Source Water Assessment Final Report by the Idaho Department of Environmental Quality dated September 2001:

> *On over 4,000 sampling events there have been only a few total coliform bacteria detections in composite water samples recorded since 1992. When re-sampled, total coliform was not found at any of the previous contaminated sample locations. These isolated microbial detections and two trace level detections of volatile organic compounds (VOC) represent the only significant water chemistry problems that have been recorded in the public water system. The inorganic compound (IOC) nitrate was detected on one occasion for Wells #2 and #3, but at levels well below the Maximum Contaminant Level (MCL). No detections of soluble organic carbon (SOC) are recorded for the system.*

Since writing the Assessment, the following statement appeared in the City of Moscow 2008 Annual Water Quality Report:

> *The City of Moscow has never had a sample exceed the MCL from any of the identified sources for possible contamination.*

2.3 Historic Production Characteristics

The City of Moscow has historically obtained its municipal water supply from groundwater, as described in Section 2.2.1. Originally, shallow wells in the Wanapum aquifer provided the City's water; however, due to declining water levels and water quality in that aquifer, deeper wells were later drilled into the Grande Ronde aquifer in the mid-1950s. Since the City began to pump from the Grande Ronde aquifer, the Wanapum aquifer has recovered substantially. Currently the City has active wells in both aquifers. During 2006 through 2008, approximately 74% of the City's supply came from the deeper Grande Ronde aquifer (from Wells 6, 8, and 9), while 26% of the City's supply came from the Wanapum aquifer (from Wells 2 and 3). Figure 2-7 provides a comparison of the amount of water historically withdrawn from the two aquifers.

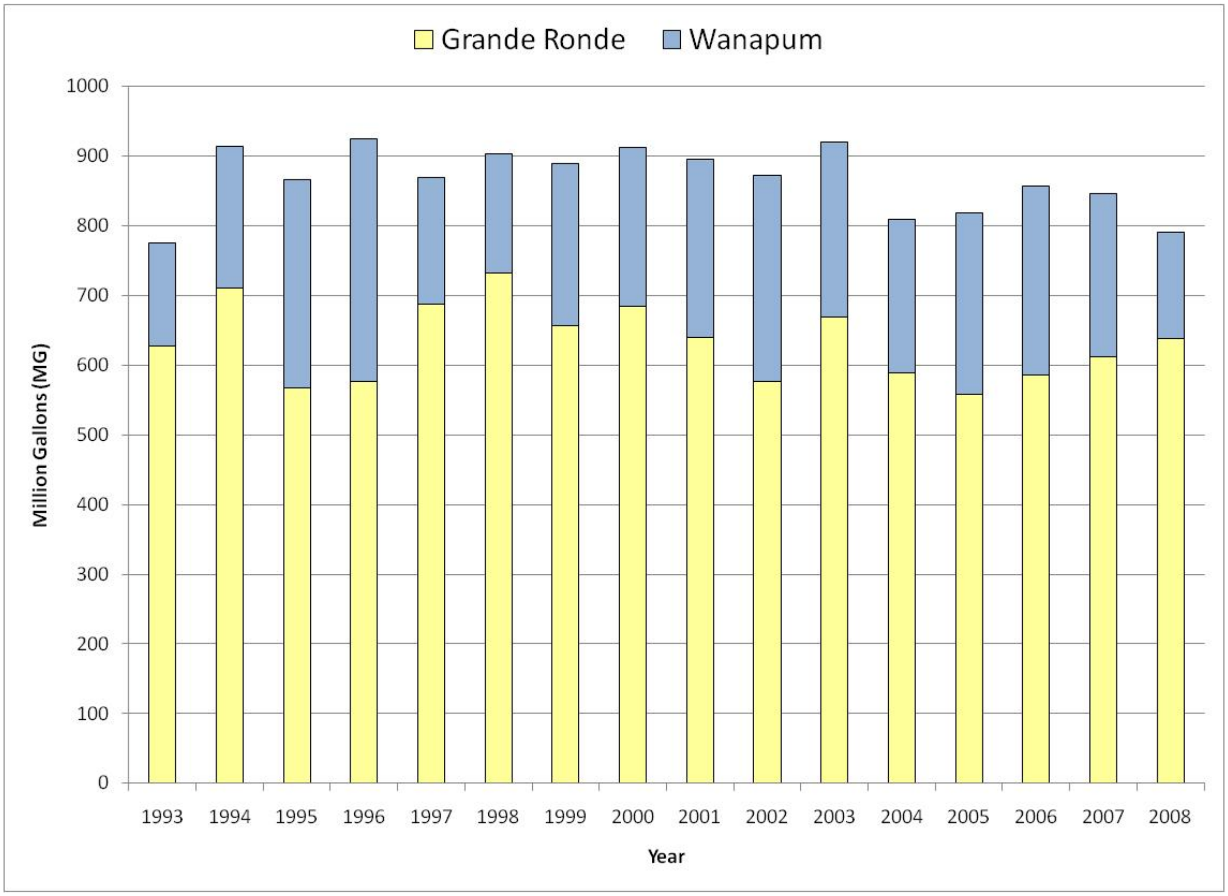


Figure 2-7 Grande Ronde vs. Wanapum Pumping Comparison

Historically, source meters have over-registered production primarily due to iron buildup on flow meter tubes and turbines. This has recently been identified as an issue at all wells, except for Well 6. The City has implemented a cleaning schedule to avoid iron buildup and maintain accurate production metering. The meter heads for Wells 2 and 3 are cleaned every six months, while those for Wells 6, 8, and 9 are cleaned every year. In addition, since the late 1990s, the City has pulled each well pump on a five-year rotational basis, with the pumps sent to the manufacturer to be either rebuilt or refurbished with parts replaced, cleaned, and calibrated.

Additional information regarding historical water production is presented in Chapter 4, along with comparisons of production to consumption by City customers.

2.4 Water Treatment Facilities

The City uses chlorine gas at all active wells to treat the groundwater prior to distribution. In addition, at Wells 2 and 3 Potassium Permanganate and Chlorine are used in Manganese Green Sand Filters to remove iron and manganese. The Jackson Street Filtration Plant contains four green sand filters which are commonly called cigar filters that are 32 feet long.

All sources contain some fluoride, which is naturally occurring at levels between 0.5 – 1.4 mg/L. The City does not add fluoride to any sources.

2.5 Storage

The City's four reservoirs have a total capacity of 4.75 million gallons (MG). The four reservoirs are the Northwest, Northeast, Vista, and Southeast. A summary of the characteristics of the City's reservoirs is presented in Table 2-3 and reservoir locations are shown on Figure 2-3.

Table 2-3 Summary of City of Moscow Reservoir Characteristics

Characteristic	Northwest	Northeast	Vista	Southeast
Status	Active	Active	Active	Active
Date of Construction	1919	1940	1991	1968
Storage Capacity (gallons)	250,000	500,000	2,000,000	2,000,000
Type of Construction	Riveted	Steel	Steel	Steel
Altitude Valve	Yes	Yes	No	Yes

2.6 Booster Stations

Six booster stations exist to transfer water from the primary pressure zone to six various pressure zones. These boosters run continuously to provide domestic flow and pressure. Fire flow is provided from the primary pressure zone to the Taylor, Indian Hills and Vista pressure zones. A seventh booster pump provides additional water into the primary pressure zone from the Southeast Reservoir, for both operational and fire suppression purposes. A summary of the boosters is as follows:

- Taylor Booster Station - located on the southwest side of the City south of the University of Idaho.
- Indian Hills Booster Station - located east of the Taylor Booster Station, but still along the south side of town.
- White Avenue Booster Station - located in the southeast portion of Moscow.
- Vista and Moser Booster Stations - located along the east side of Moscow, with the Moser located further to the north-central portion of Moscow.
- Ponderosa Booster Station - located in northeast portion of City.
- Southeast Booster Station - located toward the south-central portion of Moscow. This booster is fed from the Southeast Reservoir.

Specific booster pump station locations, and their respective pressure zones, are noted on Figure 2-4. A summary of the booster station characteristics is presented in Table 2-4.

Table 2-4 Summary of the City of Moscow Booster Station Characteristics

Characteristic	Taylor	Indian Hills	White*	Vista	Moser	Ponderosa**	Southeast**
Motor Horsepower (HP)	20	25	10	15	7.5	10	40, 75, & 125
Rated Capacity (gpm)	700	225	250	580	225	200	700, 1200, & 2000
Date Installed	1958	1971 (rebuilt 1997)	1989	1980 (pump replaced 2006)	1993	1973 (rebuilt 1990)	1968
Operational Status	Active	Active	Active	Active	Active	Active	Active

* - with fire pump (currently disabled)
** - with fire pump (active)

2.7 Distribution System

The City has approximately 93 miles of transmission and distribution piping ranging in size from 4 to 24 inches.

Hydrants are spaced at approximately 300-foot intervals in the central business district and in commercial areas, and at approximately 600-foot intervals in residential areas.

2.8 Pressure Reducing Valves

The City currently has one pressure reducing valve on the edge of the Vista Booster pressure zone. This valve allows water into the Vista Booster pressure zone when the pressure in the zone drops below the set point of the downstream side of the valve. This primarily occurs during fire events.

2.9 Telemetry

The City has been using remote telemetry to control its water system and to acquire water system data since 1968. Autocon Industries installed the first SCADA (Supervisor Control and Data Acquisition) system in 1968 using frequency shift (mark and space) technology. This system gathered data and monitored water and sewer equipment using 30-day roll charts and pulse counters to count the pulses created by a switch commonly called a T-switch. The system served the City well and was updated in the 1970s to include additional sites and equipment. The current system was installed in 1994 using remote transmitting units (RTUs), leased phone lines, and three computers (Human Machine Interface or HMIs). Computers provide an operator interface for control and gathering information as well as redundancy. Only one computer is required to operate the system and the other computers provide additional access points as well as redundancy (hot standby). The computers supply information to a Microtel 500 Alarm Dialer to notify operators when problems occur.

The System uses Onspec 4000 SCADA software to control equipment, gather data, and report status. Onspec creates historical files that track water levels in wells, water tank levels, start/stop times, wet well levels, and records each event. Alarm points and conditions are created and adjusted within Onspec to allow flexibility of operation. Selective data is graphed and trended to supply the operator with information about the operation of the water and sewer collection system. Un-interruptible Power Supply (UPS) is provided for each computer, the dialer, and each remote site. The Water Department facilities are also served by a standby generator that also provides power to the Northwest Tank in the event of an extended power outage. The UPS units provide battery power for SCADA operation for several hours. In the event of power failure the generator will supply the Water Department Office/Northwest Tank. Most remote sites will operate on battery power for several hours, and some sites have standby generators available.

Information from the remote units is transmitted to the water department and is displayed graphically on the computers. From this location the operator can change set points, operate components in manual and automatic modes, and display and manipulate data. Alarms are also displayed on each of the computers and key personnel are automatically notified via pager or cell phone. Alarms for a majority of the remote sites include pump failure, smoke or fire, flooding, intrusion, and system pressure.

Basic telemetry system information is shown in Table 2-5.

Table 2-5 Summary of City of Moscow Telemetry Characteristics

Item	Data
Year Constructed	1994, upgraded in 1999 to present (ongoing)
Manufacturer	Autocon/Onspec
Systems on Telemetry	Wells No. 2, 3, 6, 8, and 9 Reservoirs NW, NE, SE and Vista Boosters: Indian Hills, Ponderosa, Moser, Taylor, Vista and White Ave
Communication	Leased Line
Graphical Interface	Onspec 4000
Alarm System	Microtel 500 Automatic Dialer, 40 Channel

2.10 Reliability and Emergency Operation

The City has incorporated the following elements into its water system infrastructure and operations to provide for reliability and to meet emergency operation requirements set forth in IDAPA 58.01.08, Section 501.07.

1) Redundant Water Supply. As described in more detail in Section 7.1, the City has conducted an analysis of its water sources and their ability to meet current and projected demands assuming the largest source is out of service. The City's planned Well 10 (see Chapter 8 for details) will provide the system with a redundant source, such that this reliability criterion can be met.

2) Standby Storage. As described in more detail in Section 7.2, the City has conducted an analysis of its storage capacity and ability to meet needs when its groundwater sources are unavailable (e.g., during power outages). As noted in Chapter 7, the City's existing storage reservoirs provide more than adequate volumes to meet IDEQ's 8-hour standby

storage requirement. In addition, the City has analyzed the ability of its existing storage facilities to meet needs assuming the largest reservoir and largest source are offline. Under such an extreme scenario, the City's storage volumes are not able to meet standby and fire suppression needs. The City's planned reservoirs (see Chapter 8 for details) will provide redundant storage to increase this element of system reliability.

3) Standby Power – Wells. As noted in Table 2-2, permanent standby generators (with automatic switch-over) are provided at Wells 2 and 3. Such facilities are not presently provided at Wells 6, 8, and 9. However, Capital Improvement Program (CIP) Project M-4 will provide for provision of such emergency power facilities at each of these wells.

4) Standby Power – Booster Pump Stations. The six booster pump stations that serve the high level boosted zones do not currently have standby power. However, in the event of a power outage, pressure is maintained in these boosted zones above 20 psi, so long as storage levels do not drop significantly. However, to improve system reliability, the City is planning to include standby power generators at their upgraded booster pump stations (see Projects PS-1 through PS-6 in Chapter 8). In addition, the City has two portable generators (70 kW and 150 kW) that can be used at the Southeast Booster Pump Station (which pumps water from the Southeast Reservoir into the main pressure zone. These generators are shared with sewer lift station pumps, depending upon needs during power outages.

5) Emergency Response Plan. The City has prepared an emergency response plan to guide actions and procedures in the event emergency situations arise. This document, entitled "Emergency Response Plan Update Terrorism Annex-Drinking Water System (December 16, 2004)", is maintained in hard copy in the Public Works Director's Office and the Water/Wastewater Manager's Office, along with a Vulnerability Assessment that was also completed in 2004. The emergency response plan contains drinking water system incident response procedures, emergency notification checklists, emergency equipment lists, and emergency supplier vendor lists. This plan, along with drinking water system standard operating procedures, guides City staff efforts during emergency operations.

3. Service Area Policies, Plans, and Agreements

The City of Moscow's program to provide a comprehensive and reliable system for delivering water supply to its customers is part of a larger network of plans, policies and agreements that address water supply and land use in the Moscow area. This chapter provides a brief description of selected plans, policies and agreements that relate to the Moscow water system.

3.1 City of Moscow Municipal Code

The operation of Moscow's water system is governed by Moscow's Municipal Code, which is established by the Moscow City Council through City ordinances. The municipal code is typically translated by Moscow Public Works staff into operational memoranda, policies, and guidelines.

The municipal codes related to the water system are contained in Title 5 Public Ways and Property and Title 7 Construction Regulations of the Moscow Municipal Code, as shown in Table 3-1. The pertinent chapters within those titles are described below and the full text is provided in Appendix 3-1.

Table 3-1 Water Related Municipal Codes

Title	Chapter	Topic
Title 5 Public Ways and Property	Chapter 4 Water Regulations	Contains the majority of the water service regulations.
Title 5 Public Ways and Property	Chapter 5 Restrictive Use of Water	Prohibits/restricts outdoor water use during water emergencies.
Title 5 Public Ways and Property	Chapter 17 Water Conservation	Prohibits outdoor irrigation between 10:00am and 6:00pm during the outdoor irrigation season.
Title 7 Construction Regulations	Chapter 9 Cross-Connections; Water Supply	Prohibits cross-connections and requires backflow prevention devices.

3.1.1 Title 5 Public Ways and Property; Chapter 4 Water Regulations

This chapter of Title 5 of the municipal code contains the majority of the water service codes. The content primarily relates to conditions of service and rates, both of which are discussed in more detail below. The code also discusses other topics such as infrastructure ownership and water waste.

Key aspects related to conditions of service include the following:

- Property owners are required to connect to the public water system if a water line exists in the street/easement.

- The City does not have a duty to serve water outside the City limits. Water service outside the City limits can be discontinued at any time.
- Water service can be discontinued for non-payment.
- Water line extensions must meet the minimum specifications and standards established by the City. Plans must be submitted to the City for review and approval and the City will inspect new connections.
- Water line extensions will be paid for by the property owner requesting water service.

Key aspects related to rates include the following:

- All customers must receive water through a City-furnished, and customer paid for, water meter.
- The City has established charges for the installation of meters, connection fees, and late water payments.
- Customers pay a base rate for maintenance and operation of the water system.
- Customers also pay a volume charge. There are different per unit volume charges for: 1) customers within the City, 2) customers outside the City, and 3) the Moscow Cemetery Maintenance District.
- The water bill is the responsibility of the property owner; however, it can be paid by tenants or agents of the property owner.
- The City has established procedures to address disputed charges.

3.1.2 Title 5 Public Ways and Property; Chapter 5 Restrictive Use of Water

This chapter of Title 5 of the municipal code gives the city council and the mayor the authority to declare a water emergency if necessary and to prohibit and/or restrict outdoor water use during a water emergency.

3.1.3 Title 5 Public Ways and Property; Chapter 17 Water Conservation

This chapter of Title 5 of the municipal code documents the City's intent to promote the responsible use of water and focuses on outdoor irrigation. The primary focus is the establishment of an "outdoor irrigation season" outside of which irrigation is prohibited, and the prohibition of irrigation between 10:00am and 6:00pm during the outdoor irrigation season. An additional focus is the prohibition of watering impervious surfaces by an irrigation system.

The dates of the outdoor irrigation season shall be established each year and published no later than May 1 with the end of the season being advertised two weeks prior to the end date.

Exemptions to the prohibition exist for certain uses such as:

- Efficient irrigation methods (e.g., soaker hoses, drip irrigation)
- Commercial nurseries

- Irrigation from non-potable sources (e.g., gray water, reclaimed water, rain water)
- Non-irrigation outdoor uses (e.g., dust control, fire protection, street cleaning)

Variances can be granted based on hardship or special circumstances (e.g., newly seeded lawn). Violations are considered misdemeanors and can be punished pursuant to Idaho state code. However, the City must attempt to contact the violator in order to resolve the issue prior to pursuing redress through the court system.

3.1.4 Title 7 Construction Regulations; Chapter 9 Cross-Connections; Water Supply

This chapter of Title 7 of the municipal code pertains to preventing contamination of the public water system by prohibiting cross-connections and requiring backflow prevention devices in certain circumstances. The chapter documents that the City has the authority to establish requirements more stringent than State requirements.

The chapter covers the following topics:

- Types of customers that are likely to be required to have backflow prevention devices
- Types of backflow prevention devices that are acceptable
- Identification of where backflow prevention devices should be installed
- Installation and cost of backflow prevention devices is the responsibility of the customer
- Annual inspections of backflow prevention devices are required
- Failure to comply with the requirements is grounds for termination of water service

3.2 City of Moscow Comprehensive Plan

The *City of Moscow Comprehensive Plan* (adopted December 2009) documents the community's values and policies that guide the long-range physical development of the City and its Area of City Impact. Several sections of the Comprehensive Plan have direct relevance to this Comprehensive Water System Plan, as shown in Table 3-2 and discussed below.

Table 3-2 Comprehensive Plan Relevance

Chapter	Section	Relevance to Comprehensive Water System Plan
Chapter 1 – A Vision for Moscow	Section 1.2 Community Context	Current and projected population
Chapter 2 – Community Character and Land Use	Section 2.2 Housing Section 2.6 Land Use	Current housing and future needs Existing and future land use
Chapter 5 – Public Utilities, Services, and Growth Capacity	Section 5.3 Potable Water	Ability of the water system to support future growth

3.2.1 Chapter 1 – A Vision for Moscow

Chapter 1 of the Comprehensive Plan includes information related to current and projected population. This information was used as input in developing the demographics for the water demand forecast in Chapter 4 of this Comprehensive Water System Plan.

3.2.2 Chapter 2 – Community Character and Land Use

Chapter 2 of the Comprehensive Plan includes information related to existing and future housing and land use. That information was used as input in developing the demographics for the water demand forecast in Chapter 4 of this Comprehensive Water System Plan. Additionally, the land use information guided allocation of the water demand forecast across Moscow's water service area, for use in hydraulic modeling and system analysis.

Moscow's land use designations are provided in Table 3-3. The table groups the numerous land use designations into five land use categories, which are then correlated to the five demand forecasting categories. For example, the second row in the table shows that the Suburban Residential land use designation is put into the Low Density Residential land use category, which is associated with the Single Family and Mobile Homes demand forecasting categories. This land use information is shown on Figure 3-1, which combines land use and information related to future growth in order to show where the City currently serves water and where it anticipates serving water for the 5-year, 20-year, and 50-year time frames.

Table 3-3 Land Use

Land Use Designation	Definition	Land Use Category	Demand Forecasting Category
Agriculture	Rural lands adjacent to the City limits and throughout the Area of City Impact.	Agriculture / Forestry / Farm & Ranch / Transitional	Not Given Demands
Suburban Residential	Individual residences on larger lots and acreages.	Low Density Residential	Single Family and Mobile Homes
Auto-Urban Residential	Subdivisions with lots ranging in size from 6,000 to 9,600 square feet and where there are no alleys.	Low Density Residential	Single Family and Mobile Homes
Auto-Urban Residential (Moderate Density)	Multiple-family and manufactured homes.	High Density Residential	Multifamily and Mobile Homes
Urban Residential	Near downtown neighborhoods that have garage access by way of alleys and also where there is a moderate incidence of accessory residential units.	High Density Residential	Multifamily and Duplex
Urban Residential (Moderate Density)	Neighborhoods that abut downtown and where there is a high incidence of multiple-family dwellings.	High Density Residential	Multifamily and Duplex
Suburban Commercial	Properties that reflect a suburban characteristic with an increased amount of landscape surface area and a residential-like building design.	Commercial	Non-Residential
Auto-Urban Commercial	Commercial land uses along the community's main corridors, including those approaching downtown.	Commercial	Non-Residential
Urban Mixed	Areas around the historic downtown core that have a similar character and are also within the current CB, Central Business zone.	Mixed Use	Non-Residential
Auto-Urban Industrial	The more intensive industrial uses principally along the railroad tracks and U.S. 95 to the south and located within the "I", Industrial zone.	Industrial	Non-Residential
Public and Semi-Public	Government buildings and properties, as well as semi-public or institutional uses such as churches, schools, and hospitals.	Commercial	Non-Residential
Research/Technology Park	The Alturas Business Park which has a campus-like setting with an open plaza area.	Commercial	Non-Residential
Parks, Recreation, and Open Space	The City's developed and undeveloped parks and pathways, as well as public and semi-public open spaces on University grounds and designated open areas within private developments.	Institutional / Government Public Facility & Use	Non-Residential
University	Land owned by the University of Idaho and is a part of or directly adjacent to campus. This designation excludes the open and recreational areas that are characterized as Parks, Recreation, and Open Space.	Institutional / Government Public Facility & Use	Not Given Demands
Vacant	Areas within the City that are currently not developed.	Various	Not Given Demands

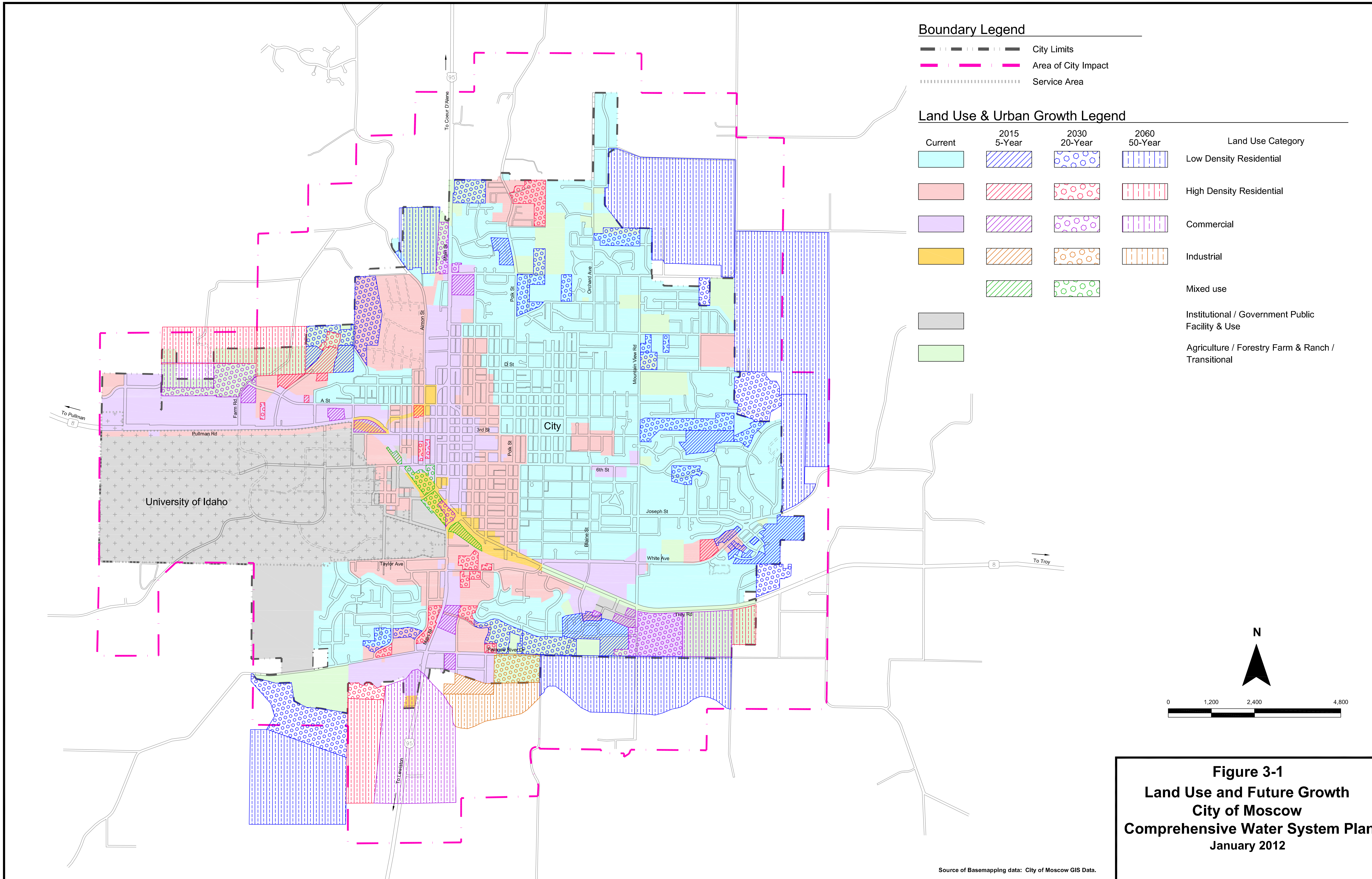


Figure 3-1
Land Use and Future Growth
City of Moscow
Comprehensive Water System Plan
January 2012

3.2.3 Chapter 5 – Public Utilities, Services, and Growth Capacity

Chapter 5 of the Comprehensive Plan evaluates the City's projected growth in light of its available water supply; public facilities, infrastructure and services; and available land for development and redevelopment. That effort is guided by the following general goals:

- Provide for sustainable growth while conserving natural resources and enhancing the character of the community and region.
- Provide for the orderly and efficient delivery and location of public facilities, utilities and services to the residents and businesses within the community.
- Advocate and practice the sustainable management and development of local and regional water resources and supplies to meet the needs of both current and future residents.
- Direct growth to areas that can be most efficiently and economically served with public services and utilities while planning for future capacity needs.

The City's projected growth reflects the *Latah County Comprehensive Plan*, which calls for the unincorporated county to preserve its rural character, with most growth to be accommodated in and around incorporated cities. As the county's most populated city, Moscow is the logical place for most of the county's growth to occur. Moscow's ability to provide water service to new development is critical to its role as a growth center.

The Moscow Comprehensive Plan identifies two water system related issues that could impact the City's ability to accommodate growth. First, Moscow may need to diversify its supply source due to declining aquifers levels. Second, the City's water system infrastructure is aging and requires appropriate re-investment and will eventually need expansion. This Comprehensive Water System Plan addresses both of these issues. The City is currently exploring alternative water sources, as discussed in Chapter 6 Water Rights and Supply Options. The City is also evaluating increased water conservation opportunities, as discussed in Chapter 5 Conservation. The adequacy of the water system infrastructure was assessed and projects were developed to address deficiencies, as discussed in Chapter 7 System Analysis and Chapter 8 Capital Improvement Program.

The Moscow Comprehensive Plan calls for the following specific implementation actions:

1. Prepare a Comprehensive Water System Plan that addresses alternative renewable water supplies, analyzes the City's production storage and distribution facilities, expands the effluent reuse for irrigation, and addresses the potential for additional water conservation measures.
2. Prioritize the development of Well No. 10 and the redevelopment of the cemetery well to provide adequate redundancy in production capacity.
3. Identify and develop alternative water supplies, such as surface water impoundments or aquifer storage and recovery.
4. Preserve aquifer recharge areas within the City's jurisdiction if and when they are identified.

5. Continue to participate in Palouse Basin Aquifer Committee in the management of the regional resource, and review and update the management plan to ensure that it is based on the best available data and science.
6. Promote water conserving development practices such as clustering on small lots with common open space that is not irrigated, the provision of smaller lot sizes and greater development densities where appropriate.
7. Continue and enhance existing water conservation programs and increase awareness of xeriscaping techniques to reduce irrigation demand.
8. Anticipate Department of Environmental Quality (DEQ) rulemaking that will address emerging contaminants.

The City is working to implement these actions, some of which are directly related to this Comprehensive Water System Plan. Action #1 is accomplished by preparing this plan. Action #2 (well development) is addressed in Chapter 7 System Analysis. Action #3 (alternative supplies) is addressed in Chapter 6 Water Rights and Supply Options. Action #6 (conservation) is addressed in Chapter 5 Conservation.

3.3 Intertie Agreement with University of Idaho

The City has ten emergency interties with the University of Idaho's water system. The interties are described in Section 2.2.2 and are shown on Figure 2-3. The City and the University of Idaho do not have a formal written agreement related to these interties; the agreement has historically been a verbal agreement.

3.4 Reclaimed Water Agreement with University of Idaho

The City has a reclaimed water agreement with the University of Idaho whereby the City produces reclaimed water at its Wastewater Treatment Plant and provides the reclaimed water to the university for irrigation purposes. The agreement was signed on June 21, 1977 and has been actively exercised since then. Currently the university uses the reclaimed water to irrigate lawns, playfields, and the golf course. Additional information regarding the City's reclaimed water program is provided in Chapter 6.

4. Planning Data and Demand

This chapter discusses planning data and the City of Moscow's demand forecast. The information is presented in three main sections: the first section summarizes historical and projected demographic data for Moscow; the second section summarizes Moscow's water use characteristics including production, consumption, water balance, and water use factors; and the third section combines the demographics and the water supply characteristics to develop Moscow's demand forecast for the next 50 years.

A 50-year planning horizon of 2011 to 2060 was used for this plan. The 20-year forecast (i.e., through 2030) was used for the system analyses presented in Chapter 7, including existing source and storage capacity evaluations and the hydraulic modeling utilized in analyzing the water distribution system. The 50-year forecast was used in evaluating the sufficiency of water rights to meet projected needs and in considering various long-term water supply options, as summarized in Chapter 6.

The last year of historical data that was analyzed was 2008, since that was the last full year of data available when this analysis began. The demands for the interim years of 2009 and 2010 were therefore projected.

4.1. Demographics – Historical and Projected

Several demographic units were analyzed for this water system plan. The demographic units are listed below and information is provided regarding how the demographic units relate to the demand forecast.

Single Family Dwelling Units: The number of single family dwelling units is one of four demographic units used for the residential component of the demand forecast.

Duplex Dwelling Units: The number of duplex dwelling units is one of the four demographic units used for the residential components of the demand forecast.

Multifamily Dwelling Units: The number of multifamily dwelling units is one of the four demographic units used for the residential component of the demand forecast. Note this is the number of multifamily households (e.g., apartments) and not the number of multifamily connections (e.g., apartment buildings).

Mobile Home Dwelling Units: The number of mobile home dwelling units is one of the four demographic units used for the residential component of the demand forecast.

Developed Non-Residential Acres: The number of developed non-residential acres is the demographic unit used for the non-residential component of the demand forecast.

Population: The population growth rate is used as an input to the residential demographic categories.

Table 4-1 presents recent demographic data, as well as projections for the forecasting period. The demographics are for Moscow's retail service area (i.e., areas where the City of Moscow provides water). This is not the same as the demographics within the City's municipal boundary or urban growth area, since some of the demographics within the City are provided water by the University of Idaho water system. The data is based on information from the City of Moscow Comprehensive Plan, the City of Moscow Planning Department, and the U.S. Census.

Table 4-1 Demographics for Moscow Retail Service Area[1]

Calendar Year	Planning Year	Population		Single Family Dwelling Units		Duplex Dwelling Units		Multifamily Dwelling Units		Mobile Home Dwelling Units		Developed Non Residential Acres	
		Number	Annual Growth Rate	Number	Annual Growth Rate	Number	Annual Growth Rate	Number	Annual Growth Rate	Number	Annual Growth Rate	Number	Annual Growth Rate
2008	n/a	22,312	-0.32%	4,205	n/a	979	n/a	3,804	n/a	590	n/a	938	n/a
2009	n/a	22,629	1.42%	4,251	1.11%	994	1.58%	3,881	2.04%	591	0.24%	942	0.44%
2010	n/a	22,950	1.42%	4,299	1.11%	1,010	1.58%	3,960	2.02%	593	0.24%	946	0.45%
2011	1	23,276	1.42%	4,346	1.11%	1,026	1.58%	4,040	2.01%	594	0.24%	951	0.44%
2012	2	23,606	1.42%	4,395	1.12%	1,042	1.57%	4,120	2.00%	596	0.25%	955	0.45%
2013	3	23,942	1.42%	4,444	1.12%	1,059	1.57%	4,202	1.99%	597	0.25%	959	0.46%
2014	4	24,282	1.42%	4,494	1.12%	1,075	1.57%	4,285	1.98%	599	0.25%	964	0.47%
2015	5	24,626	1.42%	4,544	1.13%	1,092	1.57%	4,370	1.97%	600	0.26%	968	0.48%
2016	6	24,976	1.42%	4,596	1.13%	1,109	1.57%	4,455	1.96%	602	0.26%	973	0.49%
2017	7	25,331	1.42%	4,648	1.13%	1,127	1.56%	4,542	1.95%	603	0.26%	978	0.49%
2018	8	25,690	1.42%	4,701	1.14%	1,144	1.56%	4,630	1.94%	605	0.26%	983	0.50%
2019	9	26,055	1.42%	4,754	1.14%	1,162	1.56%	4,719	1.93%	607	0.27%	988	0.51%
2020	10	26,425	1.42%	4,808	1.14%	1,180	1.56%	4,809	1.92%	608	0.27%	993	0.52%
2021	11	26,800	1.42%	4,863	1.14%	1,198	1.55%	4,901	1.91%	610	0.27%	998	0.52%
2022	12	27,181	1.42%	4,919	1.15%	1,217	1.55%	4,994	1.90%	612	0.28%	1,003	0.53%
2023	13	27,567	1.42%	4,976	1.15%	1,236	1.55%	5,089	1.89%	613	0.28%	1,009	0.54%
2024	14	27,958	1.42%	5,033	1.15%	1,255	1.55%	5,184	1.88%	615	0.28%	1,014	0.55%
2025	15	28,355	1.42%	5,091	1.16%	1,274	1.55%	5,281	1.87%	617	0.29%	1,020	0.55%
2026	16	28,758	1.42%	5,150	1.16%	1,294	1.54%	5,380	1.86%	619	0.29%	1,026	0.56%
2027	17	29,166	1.42%	5,210	1.16%	1,314	1.54%	5,480	1.86%	620	0.29%	1,031	0.57%
2028	18	29,581	1.42%	5,271	1.17%	1,334	1.54%	5,581	1.85%	622	0.30%	1,037	0.57%
2029	19	30,001	1.42%	5,333	1.17%	1,355	1.54%	5,683	1.84%	624	0.30%	1,043	0.59%
2030	20	30,427	1.42%	5,395	1.17%	1,376	1.54%	5,788	1.83%	626	0.30%	1,050	0.59%
2040	30	35,034	1.42%	6,071	1.20%	1,601	1.52%	6,914	1.76%	647	0.34%	1,119	0.68%
2050	40	40,339	1.42%	6,849	1.22%	1,860	1.51%	8,211	1.71%	670	0.38%	1,203	0.77%
2060	50	46,448	1.42%	7,745	1.25%	2,159	1.49%	9,704	1.67%	697	0.42%	1,305	0.87%

1. The methodology used to generate these demographics was as follows:
   a. Used the following known data: 2007 population from City of Moscow Comprehensive Plan page 2.7; 2008 population per City of Moscow Planning Department; 2008 number of dwelling units (by type) from City of Moscow Comprehensive Plan page 2.6 (excludes group living quarters (e.g., dorms); population per dwelling unit from 2000 US Census; historical annual population growth rate of 1.42%, per City of Moscow Planning Department; historical distribution of building permits by dwelling type, per City of Moscow Planning Department; 2007 and 2008 total developed non-residential acres, per City of Moscow Planning Department; and number of developed non-residential acres added each year, per City of Moscow Planning Department.
   b. Developed population numbers by increasing the 2008 population by the 1.42% annual growth rate.
   c. Decreased population by 8% to account for population living on campus and therefore not served by Moscow water.
   d. Calculated the number of total dwelling units based on each year's population and the household size.
   e. Calculated the number of total dwelling units added each year.
   f. Allocated the dwelling units added each year to each dwelling type (single family, duplex, multifamily, mobile home) based on the historical distribution of building permits by dwelling type.
   g. Calculated the number of total dwellings units for each dwelling type.
   h. For developed non-residential acres, calculated the total number for each year based on the total number from the previous year plus the acres added each year.

4.2. Water Use Characteristics

4.2.1. Production, Purchases, and Peaking Factor

Moscow's water source is groundwater from its five production wells. Figure 4-1 shows the percent of supply from each well based on 2006-2008 averaged data. Well 9 has the highest production of the five wells, producing 34% of the city's supply.

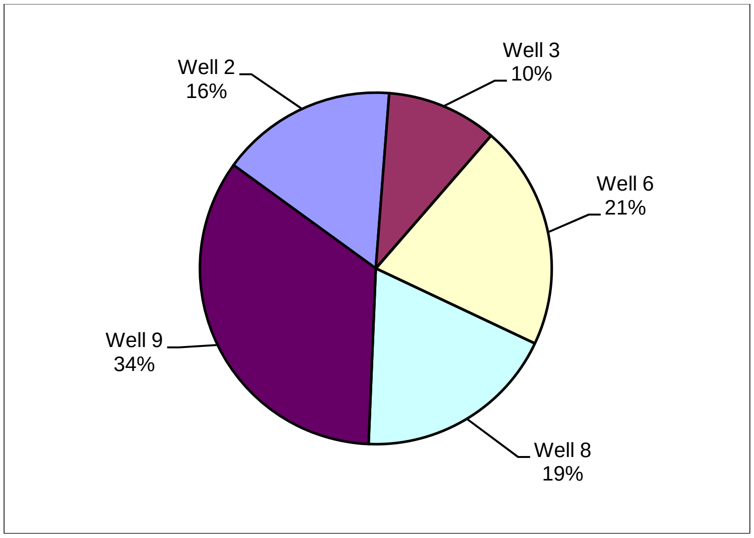


Figure 4-1 Production by Source (2006–2008)

Figure 4-2 shows an eight-year history of Moscow's water production. Water production has ranged from a low of 792 million gallons (mg) in 2008 to a high of 920 mg in 2003. Table 4-2 shows the 2006-2008 average production from each well. The total 2006–2008 average production was 831 mg. The 2006-2008 average production by month is shown in Figure 4-3. As with most water utilities, Moscow's production increases in the summer months due to irrigation use.

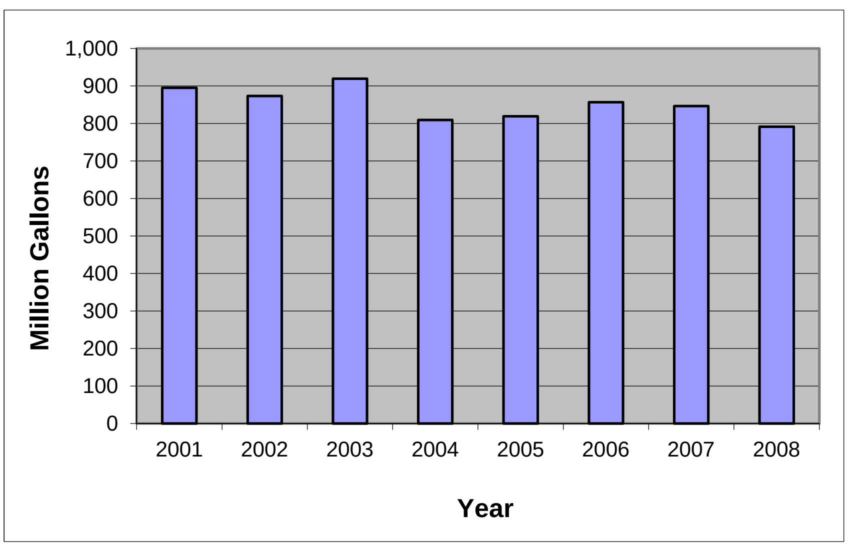


Figure 4-2 Annual Production (2001–2008)

Table 4-2 2006-2008 Average Production (million gallons)

Month	Well 2 [1]	Well 3 [1]	Well 6	Well 8	Well 9	Total	Percent
Jan	15	3	13	8	13	51	6%
Feb	8	2	12	14	13	49	6%
Mar	7	2	12	15	15	52	6%
Apr	8	6	10	14	15	53	6%
May	10	13	10	13	21	68	8%
Jun	11	11	15	13	27	77	9%
Jul	17	12	20	16	56	121	15%
Aug	17	13	20	20	46	117	14%
Sep	12	7	18	15	35	87	10%
Oct	8	7	13	12	20	60	7%
Nov	11	5	13	8	11	49	6%
Dec	11	2	15	6	14	48	6%
Total	135	84	172	155	286	831	100%
Percent	16%	10%	21%	19%	34%	n/a	n/a

1. The production in Well 2 and Well 3 for January through April is abnormally low due to problems with the pump in Well 2. Normally, production numbers for those wells in January through April would be 10 to 12 million gallons.

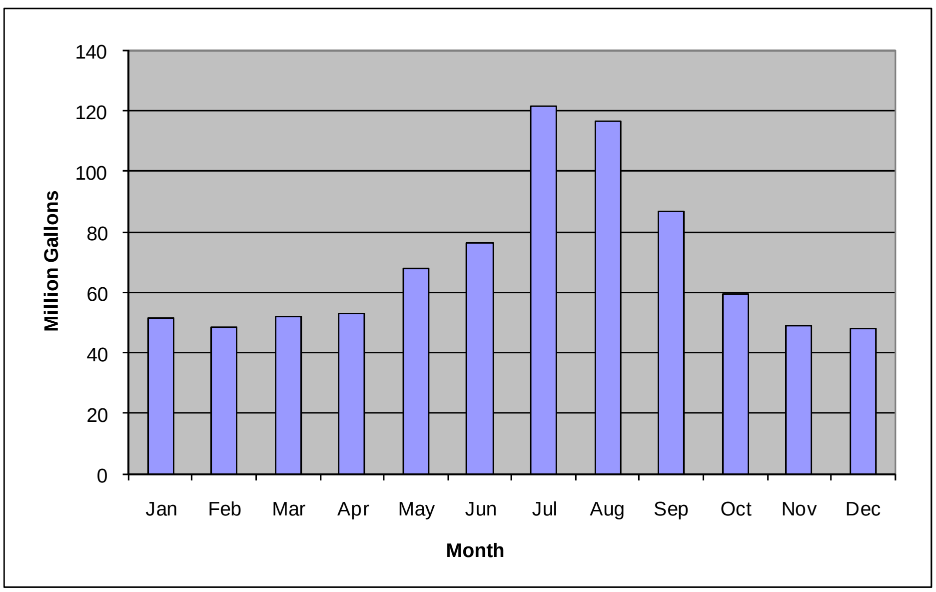


Figure 4-3 Monthly Production (2006–2008 Average)

Table 4-3 shows the average day to maximum day peaking factors for 2001 to 2008. The maximum day peaking factor has ranged from 2.1 to 2.5, and averaged 2.2 for 2006-2008.

Table 4-3 Peaking Factor – Average Day to Maximum Day

Year	Average Day (mgd)	Maximum Day		Peaking Factor
		(mgd)	Date	
2001	2.5	5.5	8/9/2001	2.3
2002	2.4	6.0	7/18/2002	2.5
2003	2.5	5.4	7/18/2003	2.1
2004	2.2	4.9	7/15/2004	2.2
2005	2.2	5.0	7/25/2005	2.2
2006	2.3	4.9	7/23/2006	2.1
2007	2.3	5.2	8/1/2007	2.2
2008	2.2	4.8	8/26/2008	2.2
2006-2008 Average	2.3	4.9	n/a	2.2

4.2.2. Customer Categories, Connections, and Consumption

Moscow's billing system contains 18 customer categories. For the purpose of demand forecasting, those 18 categories were aggregated into five categories, as shown in Table 4-4.

Table 4-4 Customer Categories

Customer Category	
Original From Billing System	Aggregated For Water System Plan
1. Single Family	Single Family
2. No Sewer Residential	
3. Residential Water Only	
4. Duplex	Duplex
5. Apartments	Multifamily
6. Rooming House	
7. No Sewer Multi	
8. Mobile Homes	Mobile Homes
9. General Commercial	Non-Residential
10. Schools	
11. Churches	
12. Restaurants	
13. Motels	
14. Mixed Use	
15. Bars	
16. Other Commercial	
17. No Sewer Commercial	
18. Water Only	

Table 4-5 provides the number of connections from 2005 to 2008. At the end of 2008, Moscow had 5,468 connections, the vast majority of which (91%) were residential.

Table 4-5 Number of Connections

Customer Category	2005	2006	2007	2008	2006-2008 Average #	2006-2008 Average %
Single Family	3,950	4,042	4,119	4,199	4,120	77%
No Sewer Residential	0	32	0	0	11	0.2%
Residential Water Only	0	7	0	0	2	0.04%
Duplex	318	318	327	326	324	6%
Apartments	377	386	403	406	398	7%
Rooming House	26	22	0	22	15	0.3%
No Sewer Multi	0	12	0	0	4	0.1%
Mobile Homes	6	6	6	7	6	0.1%
General Commercial	0	0	394	395	263	4.9%
Schools	13	12	12	13	12	0.2%
Churches	25	24	23	22	23	0.4%
Restaurants	35	38	34	35	36	0.7%
Motels	6	7	7	7	7	0.1%
Mixed Use	24	18	22	23	21	0.4%
Bars	4	4	5	6	5	0.1%
Other Commercial	364	356	0	0	119	2.2%
No Sewer Commercial	0	44	0	0	15	0.3%
Water Only	0	0	7	7	5	0.1%
Total	5,148	5,328	5,359	5,468	5,385	100%

Table 4-6 provides the 2006-2008 average consumption, by customer category and by month. Figure 4-4 shows the allocation between the customer categories. The majority (80%) of Moscow's water is used by the four residential categories. Non-residential demand represents 20% of water use.

Table 4-6 2006-2008 Average Water Consumption (million gallons)

Customer Category	Consumption[1]													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Percent
Single Family	19	19	19	19	27	28	53	67	53	27	19	19	371	50%
Duplexes	3	3	3	2	3	3	3	5	4	3	3	3	36	5%
Apartments	14	14	14	13	16	12	13	16	19	16	14	14	175	24%
Mobile Homes	1	1	1	1	1	1	1	1	1	0	1	1	9	1%
Non-Residential	10	10	10	10	12	12	17	19	19	14	10	10	152	20%
Total	46	46	46	45	59	55	87	108	97	59	46	46	743	100%

1. Meters are not read in the winter due to snow covering the meters. Winter bills are estimated based on previous use and then adjusted as necessary in March once meters are read again. The billing in March may be negative to compensate for overestimating winter use. For this table, the Nov to Mar numbers have been averaged to present a more accurate representation of actual usage.

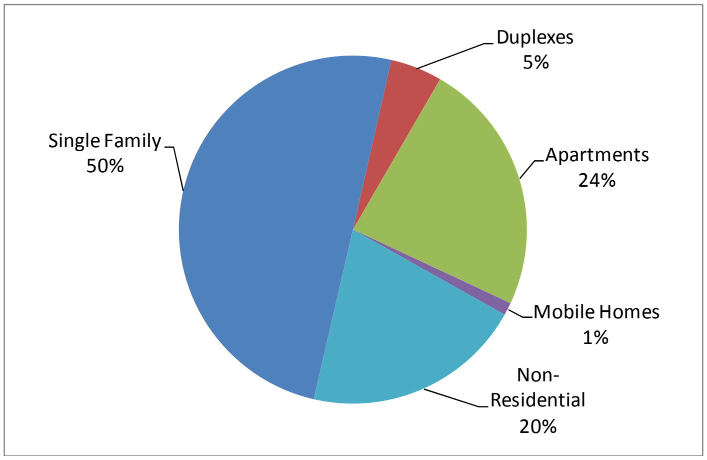


Figure 4-4 Consumption by Customer Category (2006–2008)

Customers with large water demands are of special interest because their demand could have significant impact on the overall demand for Moscow. In some cases, large customers may require special treatment for the demand forecast. This is necessary if their demand is expected to change significantly and if that change will not be addressed via the standard demand forecast methodology. Moscow's 10 largest customers from 2006 to 2008 were reviewed. They include apartment complexes, medical facilities, a school, retail, and a cemetery. No special treatment was deemed necessary for those customers.

4.2.3. Water Balance, Non-Revenue, and Leakage

A water balance is an accounting for all water that is produced. Table 4-7 shows Moscow's 2008 water balance. The table is a slightly modified version of the format recommended for use by the American Water Works Association.

Table 4-7 Water Balance (2008)

	Level 1	Level 2	Level 3	Volume (mg)		% of Production
Water Production	Revenue Water	Billed Authorized Consumption	1. Billed Water Exported	0		0%
			2. Billed Metered Consumption	723	1	91%
			3. Billed Unmetered Consumption	0		0%
	Non-Revenue Water	Unbilled Authorized Consumption	4. Unbilled Metered Consumption	28	2	3.5%
			5. Unbilled Unmetered Consumption	1.4	3	0.2%
		Apparent Losses	6. Unauthorized Consumption	0		0%
			7. Customer Metering Inaccuracies	0.5	4	0.1%
		Real Losses	8. Known Leakage	1.1	5	0.1%
			9. Assumed Leakage	38	6	5%
Total				792	7	100%

1. Data Source: "UB Data by Month 040710" spreadsheet provided by City staff.
2. Includes 3,427,000 gallons for filter backwash and 24,100,013 gallons for public facilities and parks.
3. Includes 145,750 gal. for flushing, 100,000 gal. for fire fighting, 584,000 gal. for Well #8 control valve, and 526,715 gal. for construction.
4. Includes 537,441 gallons for dead meters.
5. Includes 1,098,482 gallons for leakage.
6. Total Water Production minus all other categories.
7. Data Source: "Pump2008_FX" spreadsheet provided by City staff.

The water balance allocates Water Production to different categories at three different levels.

Level 1 allocates the water to either Revenue Water or Non-Revenue Water. Revenue Water generates income while Non-Revenue Water does not. Moscow's 2008 water production is divided into 91% Revenue Water and 9% Non-Revenue Water.

Level 2 splits Non-Revenue Water into the following three sub-categories, which are useful in identifying potential additional revenue sources and identifying the magnitude of leaks or other losses that could be addressed:

Unbilled Authorized Consumption: Includes uses such as water system flushing, firefighting, and unbilled contractor use. Moscow's 2008 unbilled authorized consumption is estimated at approximately 4%.

Apparent Losses: Includes unauthorized uses and customer meter inaccuracies, both of which are lost revenue opportunities. Moscow's 2008 apparent losses are estimated at less than 1%.

Real Losses: Includes various types of system leaks. A certain level of leakage is unavoidable; however, leakage beyond that level should be repaired to avoid unduly burdening both the natural resource and the physical infrastructure. Any amount that cannot be assigned to another category is considered a real loss under the American Water Works Association's protocol. Moscow's 2008 real losses are estimated at approximately 5%.

Level 3 further splits water into additional sub-categories to support additional estimation and water management.

Table 4-8 shows a longer history of some of the water balance elements, namely non-revenue water and distribution system leakage. The table shows data from 2005 to 2008. Non-revenue water as a percent of billed consumption is used to develop the non-revenue component of the demand forecast and averaged 12% from 2006 to 2008. Note that this is intentionally different from "non-revenue as a percent of production", which is shown in Table 4-7. Distribution system leakage averaged 7% over that same time period.

Table 4-8 Non-Revenue Water and Distribution System Leakage (million gallons)

Year	Water Produced[1]	Authorized Consumption		Non-Revenue Water[4]		Distribution System Leakage[5]	
		Billed Consumption[2]	Unbilled Consumption[3]	Qty	Percent of Billed Consumption	Qty	Percent of Production
2005	819	719	28	100	14%	72	9%
2006	857	762	32	95	12%	62	7%
2007	846	743	29	103	14%	75	9%
2008	792	723	29	69	10%	40	5%
2006-2008 Average[6]	**831**	**743**	**30**	**89**	**12%**	**59**	**7%**

1. Data Source: Water production spreadsheets provided by City staff.
2. Data Source: Water consumption spreadsheets provided by City staff.
3. Estimated by City staff. For 2008, includes all estimated authorized unbilled consumption. For other years, only includes filter backwash and public facilities and parks.
4. This calculation is water production minus billed consumption. These numbers are used to develop the non-revenue portion of the demand forecast. Note that this is intentionally different than "non-revenue as a percent of production", which is what is shown in Table 4-7.
5. Distribution system leakage is defined as water production minus authorized consumption.
6. Data is presented for four years, however the average uses 2006-2008 to focus on current trends.

4.2.4. Water Use Factors and Equivalent Residential Units

Water use factors were calculated for the five aggregated customer categories. Table 4-9 shows the inputs and the results of the calculations. For the single family category, the water use factor is 247 gallons per day (gpd) per dwelling unit. For the duplexes category, the water use factor is 100 gpd per dwelling unit. For the multifamily category, the water use factor is 126 gpd per dwelling unit. For the mobile home category, the water use factor is 40 gpd per dwelling unit. For the non-residential category, the water use factor is 444 gpd per developed acre.

Table 4-9 Water Use Factors and ERUs (2006-2008 Average)

Customer Category	Consumption (gpd)[6]	Dwelling Units or Developed Acres[7]	Consumption Per Dwelling Unit or Developed Acre (gpd)	Number of ERUs[9]
Single Family[1]	1,016,135	4,120	247[8]	4,120
Duplexes[2]	97,969	979	100	397
Multifamily[3]	479,737	3,804	126	1,945
Mobile Homes[4]	23,799	590	40	96
Non-Residential[5]	416,866	938	444	1,690
Total	2,034,506	n/a	n/a	8,249

1. This includes the following customer categories: single family, no sewer residential, residential water only.
2. This includes the duplex customer category.
3. This includes the following customer categories: apartments, rooming houses, and no sewer multi.
4. This includes the mobile home customer category.
5. This includes the following customer categories: general commercial, schools, churches, restaurants, motels, mixed use, bars, other commercial, and water only.
6. Data Source: "UB Data by Month 040710" spreadsheet provided by City staff.
7. For single family, this is the 2006-2008 average number of single family connections. For the other categories, these are from the demographics table and are only for 2008.
8. This number, 247 gallons per day, is the City of Moscow's ERU value. ERUs, or equivalent residential units, are a method of representing water use by non-residential customers as an equivalent number of residential customers. Moscow's ERU value is the average amount of water used by a single family dwelling unit. Moscow's ERU value is calculated by dividing the single family consumption category by the number of single family dwelling units.
9. The number of ERUs in any customer category is calculated by dividing that customer category's consumption by the ERU value.

Table 4-9 also shows the number of Equivalent Residential Units, or ERUs, in each customer category. ERUs are a method of representing water use by non-residential customers as an equivalent number of residential customers. Moscow's ERU value is 247 gallons per day, which is the average amount of water used by a single family dwelling unit. Moscow's ERU value is calculated by dividing single family consumption by the number of single family dwelling units. The number of ERUs for each customer category is obtained by dividing the consumption for a customer category by 247. The 2006-2008 average number of ERUs was 8,249.

4.3. Demand Forecast

4.3.1. Demand Forecast Methodology

The methodology used to develop the demand forecast is shown graphically in Figure 4-5. The basic process is to combine demographic data with water use factors to develop the retail demands. Demands are also developed for non-revenue water. The retail and the non-revenue demands are summed to create the total average day demand. To generate the total maximum day demand, a peaking factor is applied to the average day demand. More details on each step are provided below.

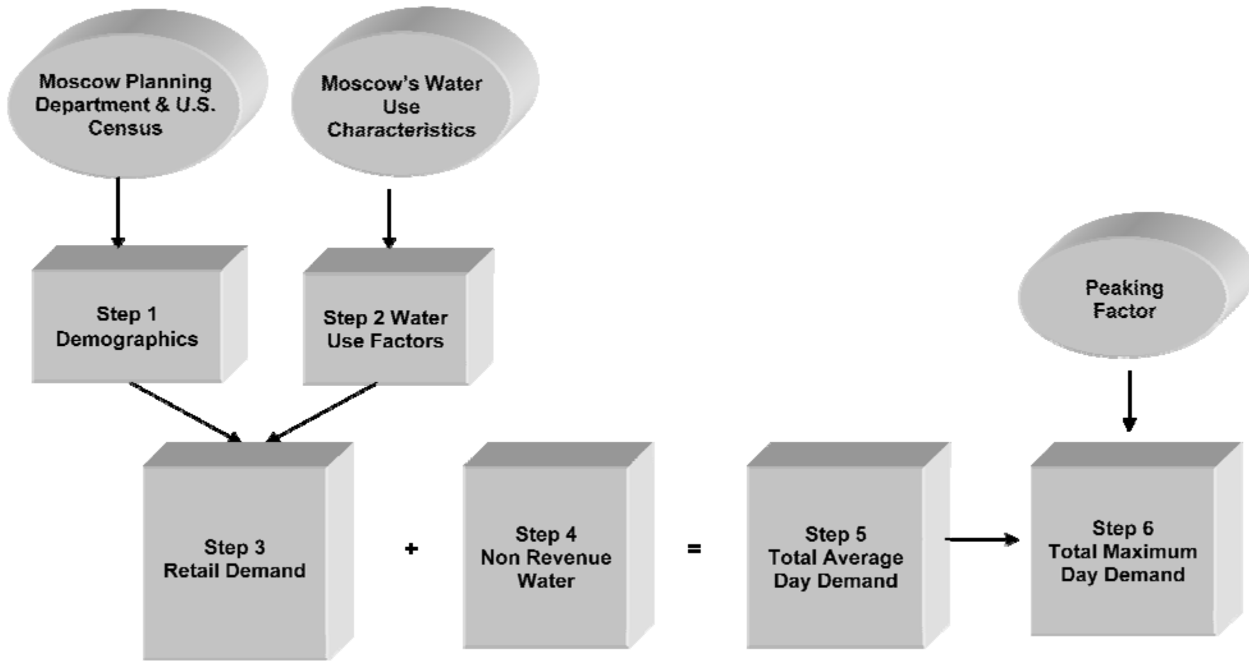


Figure 4-5 Demand Forecast Methodology

- **Step 1 Demographics:** As described in Section 4.1, the demographics are based on information from the City of Moscow Comprehensive Plan, the City of Moscow Planning Department, and the U.S. Census.
- **Step 2 Water Use Factors:** Water use factors were developed per the methodology described in Section 4.2.4.
- **Step 3 Retail Demand:** The demographic projections (from Step 1) were multiplied by the water use factors (from Step 2) to generate the demand for the single family, duplexes, multifamily, mobile homes, and non residential customer categories.
- **Step 4 Non-Revenue Demand:** The sum of all demands was multiplied by the average 2006 to 2008 "non-revenue water as % of billed consumption" from the water balance table, which is 12%.
- **Step 5 Total Average Day Demand (ADD):** The average day demand was calculated by adding the demands from all preceding steps.
- **Step 6 Total Maximum Day Demand (MDD):** To generate the total maximum day demand, a peaking factor was applied to the average day demand. A peaking factor of 2.2 was used, which is the 2006-2008 average peaking factor.

4.3.2. Demand Forecast Results

The projected demands are provided in Table 4-10. The table shows the demand forecast for the 50-year planning period, and also includes historical demands back to 2005.

Table 4-10 shows the total average day demand increasing from 2.4 mgd in 2011, which is Year 1 of the planning period, to 4.4 mgd in 2060, which is Year 50 of the planning period. The maximum day demand is expected to increase from 5.2 mgd in 2011 to 9.7 mgd in 2060.

Figure 4-6 graphically presents the average day and maximum day demands. Figure 4-7 shows the various components of the average day demand in order to provide information about the relative magnitude of each component.

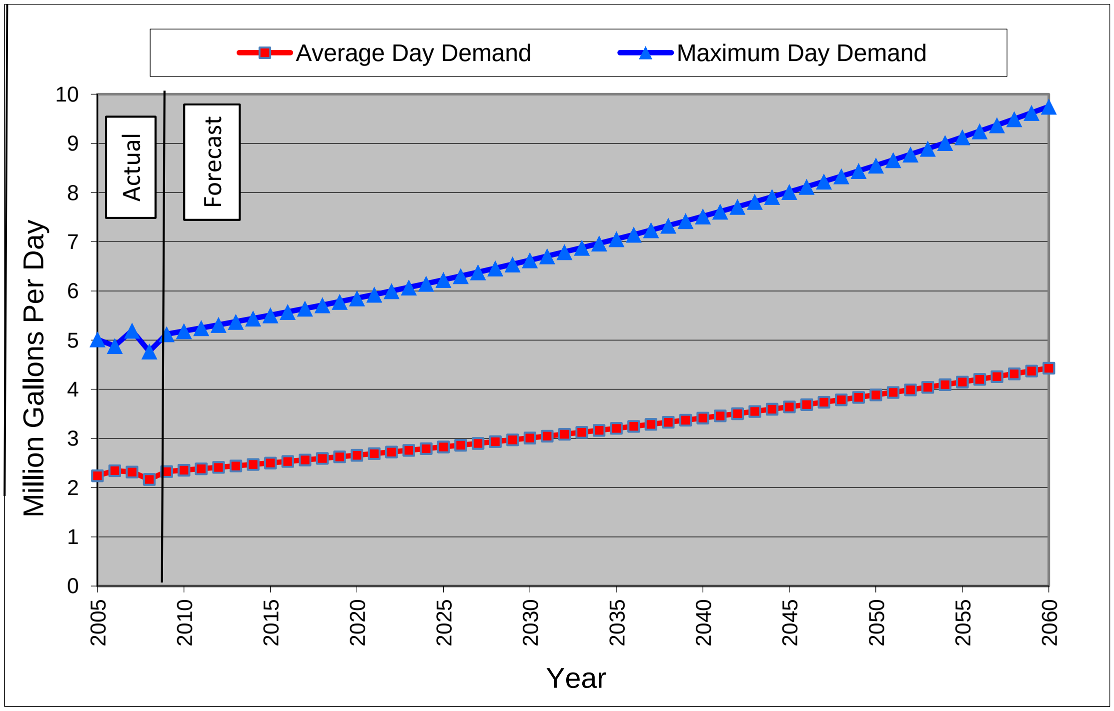


Figure 4-6 Demand Forecast Summary

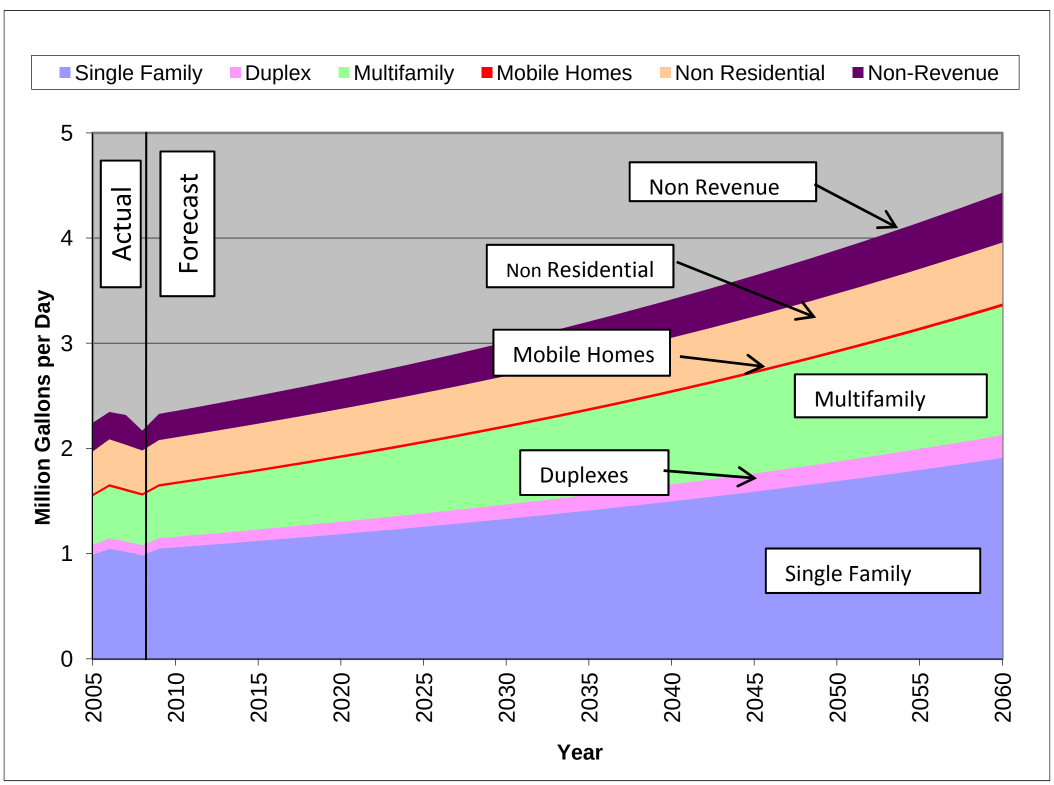


Figure 4-7 Demand Forecast by Sector (Average Day Demand)

Table 4-10 Demand Forecast

Calendar Year	Plan Year	Demographics[1]					Water Use Factors (gpd)[2]					Demand								
												Average Day Demand (ADD mgd)								Maximum Day Demand (MDD gpd)[11]
		Single Family Dwelling Units	Duplex Dwelling Units	Multifamily Dwelling Units	Mobile Home Dwelling Units	Developed Non-Residential Acres	Per Single Family Dwelling Unit	Per Duplex Dwelling Unit	Per Multifamily Dwelling Unit	Per Mobile Home Dwelling Unit	Per Developed Non-Residential Acre	Single Family[3]	Duplex[4]	Multifamily[5]	Mobile Homes[6]	Non-Residential[7]	Subtotal[8]	Non-Revenue[9]	Total[10]	
2005	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.99	0.10	0.46	0.02	0.40	1.97	0.27	2.2	5.0
2006	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.05	0.10	0.49	0.02	0.43	2.09	0.26	2.3	4.9
2007	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.02	0.10	0.48	0.02	0.42	2.04	0.28	2.3	5.2
2008	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.98	0.10	0.47	0.02	0.41	1.98	0.19	2.2	4.8
2009	n/a	4,251	994	3,881	591	942	247	100	126	40	444	1.05	0.10	0.49	0.02	0.42	2.08	0.25	2.3	5.1
2010	n/a	4,299	1,010	3,960	593	946	247	100	126	40	444	1.06	0.10	0.50	0.02	0.42	2.11	0.25	2.4	5.2
2011	1	4,346	1,026	4,040	594	951	247	100	126	40	444	1.07	0.10	0.51	0.02	0.42	2.13	0.25	2.4	5.2
2012	2	4,395	1,042	4,120	596	955	247	100	126	40	444	1.08	0.10	0.52	0.02	0.42	2.16	0.26	2.4	5.3
2013	3	4,444	1,059	4,202	597	959	247	100	126	40	444	1.10	0.11	0.53	0.02	0.43	2.18	0.26	2.4	5.4
2014	4	4,494	1,075	4,285	599	964	247	100	126	40	444	1.11	0.11	0.54	0.02	0.43	2.21	0.26	2.5	5.4
2015	5	4,544	1,092	4,370	600	968	247	100	126	40	444	1.12	0.11	0.55	0.02	0.43	2.24	0.27	2.5	5.5
2016	6	4,596	1,109	4,455	602	973	247	100	126	40	444	1.13	0.11	0.56	0.02	0.43	2.26	0.27	2.5	5.6
2017	7	4,648	1,127	4,542	603	978	247	100	126	40	444	1.15	0.11	0.57	0.02	0.43	2.29	0.27	2.6	5.6
2018	8	4,701	1,144	4,630	605	983	247	100	126	40	444	1.16	0.11	0.58	0.02	0.44	2.32	0.28	2.6	5.7
2019	9	4,754	1,162	4,719	607	988	247	100	126	40	444	1.17	0.12	0.60	0.02	0.44	2.35	0.28	2.6	5.8
2020	10	4,808	1,180	4,809	608	993	247	100	126	40	444	1.19	0.12	0.61	0.02	0.44	2.38	0.28	2.7	5.9
2021	11	4,863	1,198	4,901	610	998	247	100	126	40	444	1.20	0.12	0.62	0.02	0.44	2.41	0.29	2.7	5.9
2022	12	4,919	1,217	4,994	612	1,003	247	100	126	40	444	1.21	0.12	0.63	0.02	0.45	2.44	0.29	2.7	6.0
2023	13	4,976	1,236	5,089	613	1,009	247	100	126	40	444	1.23	0.12	0.64	0.02	0.45	2.47	0.29	2.8	6.1
2024	14	5,033	1,255	5,184	615	1,014	247	100	126	40	444	1.24	0.13	0.65	0.02	0.45	2.50	0.30	2.8	6.1
2025	15	5,091	1,274	5,281	617	1,020	247	100	126	40	444	1.26	0.13	0.67	0.02	0.45	2.53	0.30	2.8	6.2
2026	16	5,150	1,294	5,380	619	1,026	247	100	126	40	444	1.27	0.13	0.68	0.02	0.46	2.56	0.31	2.9	6.3
2027	17	5,210	1,314	5,480	620	1,031	247	100	126	40	444	1.29	0.13	0.69	0.03	0.46	2.59	0.31	2.9	6.4
2028	18	5,271	1,334	5,581	622	1,037	247	100	126	40	444	1.30	0.13	0.70	0.03	0.46	2.62	0.31	2.9	6.5
2029	19	5,333	1,355	5,683	624	1,043	247	100	126	40	444	1.32	0.14	0.72	0.03	0.46	2.66	0.32	3.0	6.5
2030	20	5,395	1,376	5,788	626	1,050	247	100	126	40	444	1.33	0.14	0.73	0.03	0.47	2.69	0.32	3.0	6.6
2040	30	6,071	1,601	6,914	647	1,119	247	100	126	40	444	1.50	0.16	0.87	0.03	0.50	3.05	0.36	3.4	7.5
2050	40	6,849	1,860	8,211	670	1,203	247	100	126	40	444	1.69	0.19	1.04	0.03	0.53	3.47	0.41	3.9	8.6
2060	50	7,745	2,159	9,704	697	1,305	247	100	126	40	444	1.91	0.22	1.22	0.03	0.58	3.96	0.47	4.4	9.7

Shaded rows indicate key planning years: 2008 ("current"); 2015 (5-year); 2030 (20-year)

1. From demographics table.
2. From water use factors table.
3. The number of single family dwelling units multiplied by the water use per single family dwelling unit.
4. The number of duplex dwelling units multiplied by the water use per duplex dwelling unit.
5. The number of multifamily dwelling units multiplied by the water use per multifamily dwelling unit.
6. The number of mobile home dwelling units multiplied by the water use per mobile home dwelling unit.
7. The number of developed non-residential acres multiplied by the water use per developed non-residential acre.
8. The sum of the previous five demand categories.
9. The subtotal ADD demand multiplied by the 2006-2008 average non-revenue water as a percent of consumption, which is 12%. (Note this is intentionally different than non-revenue as a percent of production.)
10. The subtotal ADD demand plus the non-revenue water.
11. The total average day demand multiplied by a peaking factor of 2.2 which is the 2006-2008 average peaking factor.

5. Water Conservation

This section describes the City of Moscow's (Moscow) current water conservation program, and summarizes the future direction of the program.

5.1 Current Conservation Program

Moscow's interest in water conservation is driven by a desire to minimize the City's impact on the Grande Ronde and Wanapum aquifers and specifically to comply with the September 1992 Ground Water Management Plan set in place by the Pullman-Moscow Water Resources Committee, now called the Palouse Basin Aquifer Committee (PBAC). That plan includes a goal of limiting increases in water use to 1% compounded yearly based on a five-year moving average starting with 1986 and a cap of 125% of the 1981-1985 average (875 MG).

Moscow has had a coordinated conservation program since 1997. The City's efforts have been concentrated in data gathering and distribution of educational information and conservation devices to the public.

Key milestones in the City's conservation program are as follows:

- 1997 Began distribution of low flow devices.
- 1999 Began education program.
- 2004 Established conservation specialist position.
- 2004 Completed water conservation plan. (Developed by consultant.)
- 2005 Established tiered rate billing structure.
- 2011 Completed draft water conservation plan. (Developed by City staff.)

The City's current conservation program features both system-side and demand-side elements, as shown in Table 5-1.

Table 5-1 Current Conservation Program

System-Side	Demand-Side
• Meter calibration • Water balance accounting • Leak detection	• Free low flow showerheads • Free shower timers • Free toilet leak detection dye tablets • Free toilet tank displacements bags • Free bathroom and kitchen faucet aerators • Free pre-rinse sprayheads for restaurants • Free rain sensors for automatic irrigation systems • Free timer with auto shutoff for manual irrigation systems • Free spring-loaded hose nozzles for hand-held irrigation • Audits for outdoor irrigation • Public information and education: demonstration garden, school programs, and promotion through various outlets (e.g. the City website, newsletters, bus posters, display boards, booths at community events, messages on customer bills, the annual water quality report, flyers, awards recognition, conferences and speaker presentations.) • Restricted irrigation times • Tiered rate structure • Water Conservation Plan

5.2 Future Conservation Program

The City is currently evaluating the future direction of the water conservation program. City staff recently prepared the *City of Moscow Water Conservation Plan - Draft March 2011* (see Appendix 5-1) which analyzed various conservation strategies and developed options for the future direction of the City's conservation program. The conservation plan covers a 10-year planning period from 2012 to 2021. The start year is 2012 to allow for sufficient time for Public Works staff to work with City Council to make a final determination on the appropriate program to implement.

The draft conservation plan evaluated 29 conservation measures for potential implementation. Conservation measures are hardware or behavior changes that result in water savings, such as low flow showerheads or taking shorter showers. Table 5-2 lists the 29 evaluated conservation measures and shows their applicability to the single family, multifamily, and non-residential sectors.

Table 5-2 Evaluated Measures

#	Measure	Sector		
		Single Family	Multifamily	Non-Residential [2]
1	Ultra low flow toilet (ULFT) rebates - 1.6 gpf	X	X	X
2	High efficiency toilet (HET) rebates - 1.0 gpf	X	X	X
3	Low volume urinal rebates - 1.0 gpf			X
4	Waterless urinal rebates			X
5	Free toilet-leak detection tablets and repair information	X	X	X
6	Free toilet-tank displacement devices	X	X	X
7	Encourage reduced toilet flushes	X	X	
8	Free low-flow showerheads - 2.5 gpm	X	X	X
9	Encourage reduced shower use (5-minute timer)	X	X	
10	Instant hot water valve rebate	X	X	
11	Free bathroom faucet aerators - 2.2 gpm	X	X	X
12	Free kitchen faucet aerators - 2.2 gpm	X	X	
13	Encourage reduced faucet use	X	X	
14	Efficient clothes washer rebates	X	X	
15	Encourage reduced partial clothes washer loads	X	X	
16	Air-cooled ice machines rebates			X
17	Free audits for automatic irrigation	X	X	X
18	Free audits for manual irrigation	X	X	X
19	Free outdoor irrigation devices	X	X	X
20	Free low water use plant guidebook	X	X	X
21	Rain barrel rebates - 50 gallon	X	X	
22	Encourage less lawn	X	X	X
23	Free efficient restaurant spray heads			X
24	Encourage reduced hotel bedding and towel washing			X
25	Minimize system leaks			X [1]
26	Minimize flushing water			X [1]
27	Minimize backwashing water			X [1]
28	Maintain flow meters			X [1]
29	Sub-meter multifamily households		X	

gpf = gallons per flush
gpm – gallons per minute
1. This measure is aimed at the City's water system infrastructure.
2. This includes commercial, institutional, industrial, and in some cases public facilities.

The draft conservation plan developed four packages of conservation measures for potential implementation. The packages will be discussed with the City Council and a determination will be made as to the most appropriate package for the City to implement. That discussion is expected to occur in late 2011 or early 2012. The packages are summarized in Table 5-3 and further details regarding each package are provided in subsequent sub-sections. Package A reflects the measures the City is currently implementing. Packages B, C, and D are different versions of more aggressive measures that achieve higher levels of water conservation. The savings of the packages range from approximately 44 to 87 million gallons saved annually at full program implementation. The total (10-year) direct cost of the packages ranges from $226,000 to $1,268,000. The packages result in demand reductions in 2021 ranging from 4.6% to 9.1%, based on a demand forecast developed by City staff for the draft conservation plan. That City-developed demand forecast is slightly different than the consultant-developed demand forecast in Chapter 4 of this Comprehensive Water System Plan. Only Package C meets the PBAC water use reduction goal. Figure 5-1 is a figure from the draft conservation plan showing: 1) demands that would meet the PBAC goal, 2) a demand forecast with current conservation, and 3) demand forecasts incorporating each conservation package.

Table 5-3 Summary of Packages

	Package A	Package B	Package C	Package D
Annual Water Savings at Full Implementation of Program (gallons)	43,609,000	67,485,000	87,478,000	69,827,000
Reduction in Year 2021 Demand	4.6%	7.1%	9.1%	7.3%
Achieve PBAC Goal	No	No	Yes	No
Total (10-Year) Direct Cost [1]	$226,000	$701,500	$1,268,000	$820,000
Average Annual Direct Cost [1]	$22,600	$70,150	$126,800	$82,000

Source is Table 3-8 from *City of Moscow Water Conservation Plan Draft March 2011*.

1. Direct costs include costs for hardware, rebates, and audits. It does not include marketing, distribution or staffing costs.

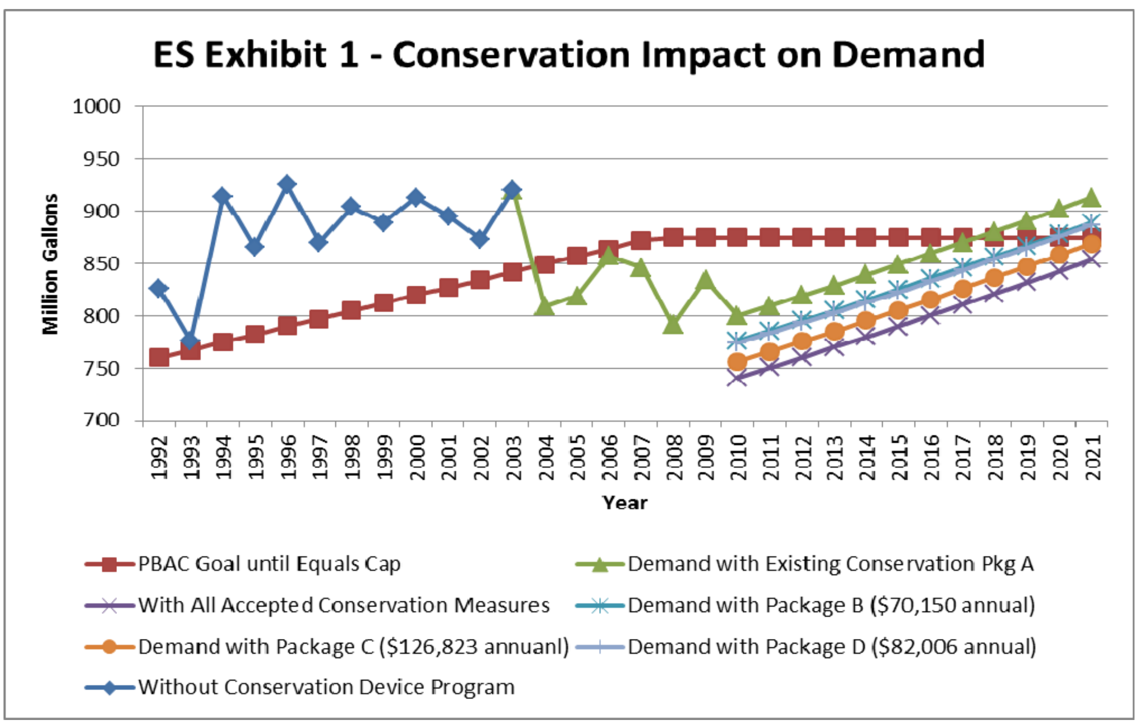


Figure 5-1 Conservation Impact on Demand

5.2.1 Conservation Package A

Package A was designed to reflect the types of conservation measures that Moscow is currently implementing. However, Package A may reflect a higher implementation level (e.g., distributing more devices) for these measures compared to Moscow's current program. Table 5-4 shows the measures in Package A. The table categorizes the measures by sector (single family, multifamily, and non-residential), as well as by whether they focus on indoor or outdoor water savings. The table includes one key savings number and two key costs numbers. The savings are the annual water savings once the measure is fully implemented to all anticipated participants. The first cost number is the direct cost over the planning period, which includes the cost of hardware, rebates, and audits, but excludes marketing, distribution and staff costs. The second cost number is the cost per 1,000 gallons saved over the planning period, which is the cost-effectiveness of each measure. Package A saves approximately 44 million gallons annually at full implementation of the program. The total direct cost of Package A is $226,000 and the package costs $0.52 per 1,000 gallons of saved water.

5.2.2 Conservation Package B

Package B was designed to reflect a more aggressive conservation program, compared to Package A. The details of Package B are provided in Table 5-5. Package B saves approximately 68 million gallons annually at full implementation of the program. The total direct cost of Package B is $701,500 and the package costs $1.04 per 1,000 gallons of saved water.

Package B contains all the measures in Package A, plus adds the following measures:

- Ultra Low Flow Toilets (ULFT) - 1.6 gpf for single family
- Ultra Low Flow Toilets (ULFT) - 1.6 gpf for multifamily
- Ultra Low Flow Toilets (ULFT) - 1.6 gpf for non-residential
- Free low water use plants guidebook for single family
- Free low water use plants guidebook for multifamily
- Low volume urinal rebates - 1.0 gpf for non-residential

Table 5-4 Conservation Package A

Sector	Measure	Annual Water Savings at Full Program Implementation (gallons)[1]	Direct Cost over Planning Period	Cost per 1,000 Gallons Saved Over Planning Period[2]
Single Family Indoor	Free toilet-leak detection tablets and repair information	1,448,090	$551	$0.04
	Free toilet-tank displacement devices	2,848,084	$5,444	$0.19
	Encourage reduced toilet flushes	2,403,216	$0	$0.00
	Free low-flow showerheads - 2.5 gpm	2,662,976	$7,676	$0.29
	Encourage reduced shower use (5-minute timer)	1,142,017	$16,962	$1.49
	Free bathroom faucet aerators - 2.2 gpm	3,156,120	$1,478	$0.05
	Free kitchen faucet aerators - 2.2 gpm	887,659	$2,502	$0.28
	Encourage reduced faucet use	1,401,567	$0	$0.00
	Encourage reduced partial clothes washer loads	883,104	$0	$0.00
Single Family Outdoor	Free audits for automatic irrigation	5,472,000	$102,547	$1.87
	Free outdoor irrigation devices	168,825	$22,591	$13.38
	Encourage less lawn	645,914	$0	$0.00
Multifamily Indoor	Free toilet-leak detection tablets and repair information	1,305,579	$276	$0.02
	Free toilet-tank displacement devices	2,470,400	$2,623	$0.11
	Encourage reduced toilet flushes	2,266,968	$0	$0.00
	Free low-flow showerheads - 2.5 gpm	2,577,247	$4,952	$0.19
	Encourage reduced shower use (5-minute timer)	1,105,252	$10,944	$0.99
	Free bathroom faucet aerators - 2.2 gpm	3,054,515	$795	$0.03
	Free kitchen faucet aerators - 2.2 gpm	859,082	$2,421	$0.28
	Encourage reduced faucet use	1,356,446	$0	$0.00
	Encourage reduced partial clothes washer loads	272,424	$0	$0.00
Multifamily Outdoor	Free outdoor irrigation devices	168,825	$19,131	$11.33
	Encourage less lawn	184,623	$0	$0.00
Non-Residential Indoor	Free toilet-leak detection tablets and repair information	316,019	$34	$0.01
	Free toilet-tank displacement devices	366,204	$340	$0.09
	Free low-flow showerheads - 2.5 gpm	876,693	$20,847	$2.38
	Free bathroom faucet aerators - 2.2 gpm	2,931,782	$392	$0.01
	Free efficient restaurant spray heads	208,311	$1,698	$0.82
Non-Residential Outdoor	Free outdoor irrigation devices	168,825	$2,108	$1.25
Total		43,608,767	$226,312	$0.52

1. The savings from free riders, those who would have implemented the measure even without the City's program, are excluded in order to reflect the true cost-effectiveness of the measures.
2. This cost effectiveness number is based on the 2012-2021 planning period and assumes full implementation of each measure in 2012. Additionally, the savings from free riders are excluded in order to reflect the true cost-effectiveness of the measures.

Table 5-5 Conservation Package B

Sector	Measure	Annual Water Savings at Full Program Implementation (gallons)[1]	Direct Cost over Planning Period	Cost per 1,000 Gallons Saved Over Planning Period[2]
Single Family Indoor	**Ultra low flow toilet (ULFT) rebates - 1.6 gpf**	**11,434,200**	**$298,185**	**$2.61**
	Free toilet-leak detection tablets and repair information	1,448,090	$551	$0.04
	Free toilet-tank displacement devices	2,848,084	$5,444	$0.19
	Encourage reduced toilet flushes	2,403,216	$0	$0.00
	Free low-flow showerheads - 2.5 gpm	2,662,976	$7,676	$0.29
	Encourage reduced shower use (5-minute timer)	1,142,017	$16,962	$1.49
	Free bathroom faucet aerators - 2.2 gpm	3,156,120	$1,478	$0.05
	Free kitchen faucet aerators - 2.2 gpm	887,659	$2,502	$0.28
	Encourage reduced faucet use	1,401,567	$0	$0.00
	Encourage reduced partial clothes washer loads	883,104	$0	$0.00
Single Family Outdoor	Free audits for automatic irrigation	5,472,000	$102,547	$1.87
	Free outdoor irrigation devices	168,825	$22,591	$13.38
	Free low water use plants guidebook	**645,914**	**$1,056**	**$0.16**
	Encourage less lawn	645,914	$0	$0.00
Multifamily Indoor	**Ultra low flow toilet (ULFT) rebates - 1.6 gpf**	**9,917,929**	**$143,691**	**$1.45**
	Free toilet-leak detection tablets and repair information	1,305,579	$276	$0.02
	Free toilet-tank displacement devices	2,470,400	$2,623	$0.11
	Encourage reduced toilet flushes	2,266,968	$0	$0.00
	Free low-flow showerheads - 2.5 gpm	2,577,247	$4,952	$0.19
	Encourage reduced shower use (5-minute timer)	1,105,252	$10,944	$0.99
	Free bathroom faucet aerators - 2.2 gpm	3,054,515	$795	$0.03
	Free kitchen faucet aerators - 2.2 gpm	859,082	$2,421	$0.28
	Encourage reduced faucet use	1,356,446	$0	$0.00
	Encourage reduced partial clothes washer loads	272,424	$0	$0.00
Multifamily Outdoor	Free outdoor irrigation devices	168,825	$19,131	$11.33
	Free low water use plants guidebook	**184,623**	**$1,215**	**$0.66**
	Encourage less lawn	184,623	$0	$0.00
Non-Residential Indoor	**Ultra low flow toilet (ULFT) rebates - 1.6 gpf**	**650,623**	**$12,415**	**$1.91**
	Low volume urinal rebates - 1.0 gpf	**1,142,557**	**$18,623**	**$1.63**
	Free toilet-leak detection tablets and repair information	316,019	$34	$0.01
	Free toilet-tank displacement devices	366,204	$340	$0.09
	Free low-flow showerheads - 2.5 gpm	876,693	$20,847	$2.38
	Free bathroom faucet aerators - 2.2 gpm	2,931,782	$392	$0.01
	Free efficient restaurant spray heads	208,311	$1,698	$0.82
Non-Residential Outdoor	Free outdoor irrigation devices	168,825	$2,108	$1.25
Total		67,584,613	$701,497	$1.04

BOLD TEXT = Measures in addition to those in Package A.

1. The savings from free riders, those who would have implemented the measure even without the City's program, are excluded in order to reflect the true cost-effectiveness of the measures.
2. This cost effectiveness number is based on the 2012-2021 planning period and assumes full implementation of each measure in 2012. Additionally, the savings from free riders are excluded in order to reflect the true cost-effectiveness of the measures.

5.2.3 Conservation Package C

Package C was designed to reflect a more aggressive conservation program, compared to Packages A and B. The details of Package C are provided in Table 5-6. Package C saves approximately 87 million gallons annually at full implementation of the program. The total direct cost of Package C is $1,268,000 and the package costs $1.45 per 1,000 gallons of saved water.

Package C contains all the measures in Package B, plus adds the following measures:

- High Efficiency Toilets (HET) - 1.0 gpf for single family
- High Efficiency Toilets (HET) - 1.0 gpf for multifamily
- High Efficiency Toilets (HET) - 1.0 gpf for non-residential

5.2.4 Conservation Package D

Package D was designed to be similar to Package C, but to lower the cost by reducing the number of toilets rebated to each participating customer. For many measures, including toilet rebates, in order to fully capture the water savings potential, several fixtures must be replaced for each customer. For example, it is estimated there is an average of 2.25 toilets per single family household and therefore typically it is assumed that there will be an average of 2.25 toilet rebates per single family household. However, for Package D the number of toilet rebates was reduced to one per single family or multifamily household and two per non-residential customer. This reduction in rebates also reduces the savings achieved by the toilet rebate measures.

The details of Package D are provided in Table 5-7. Package D saves approximately 70 million gallons annually at full implementation of the program. The total direct cost of Package D is $820,000 and the package costs $1.17 per 1,000 gallons of saved water.

Table 5-6 Conservation Package C

Sector	Measure	Annual Water Savings at Full Program Implementation (gallons)[1]	Direct Cost over Planning Period	Cost per 1,000 Gallons Saved Over Planning Period[2]
Single Family Indoor	Ultra low flow toilet (ULFT) rebates - 1.6 gpf	**11,434,200**	**$298,185**	**$2.61**
	High efficiency toilet (HET) rebates - 1.0 gpf	**10,182,815**	**$368,821**	**$3.62**
	Free toilet-leak detection tablets and repair information	1,448,090	$551	$0.04
	Free toilet-tank displacement devices	2,848,084	$5,444	$0.19
	Encourage reduced toilet flushes	2,403,216	$0	$0.00
	Free low-flow showerheads - 2.5 gpm	2,662,976	$7,676	$0.29
	Encourage reduced shower use (5-minute timer)	1,142,017	$16,962	$1.49
	Free bathroom faucet aerators - 2.2 gpm	3,156,120	$1,478	$0.05
	Free kitchen faucet aerators - 2.2 gpm	887,659	$2,502	$0.28
	Encourage reduced faucet use	1,401,567	$0	$0.00
	Encourage reduced partial clothes washer loads	883,104	$0	$0.00
Single Family Outdoor	Free audits for automatic irrigation	5,472,000	$102,547	$1.87
	Free outdoor irrigation devices	168,825	$22,591	$13.38
	Free low water use plants guidebook	**645,914**	**$1,056**	**$0.16**
	Encourage less lawn	645,914	$0	$0.00
Multifamily Indoor	Ultra low flow toilet (ULFT) rebates - 1.6 gpf	**9,917,929**	**$143,691**	**$1.45**
	High efficiency toilet (HET) rebates - 1.0 gpf	**9,325,067**	**$187,641**	**$2.01**
	Free toilet-leak detection tablets and repair information	1,305,579	$276	$0.02
	Free toilet-tank displacement devices	2,470,400	$2,623	$0.11
	Encourage reduced toilet flushes	2,266,968	$0	$0.00
	Free low-flow showerheads - 2.5 gpm	2,577,247	$4,952	$0.19
	Encourage reduced shower use (5-minute timer)	1,105,252	$10,944	$0.99
	Free bathroom faucet aerators - 2.2 gpm	3,054,515	$795	$0.03
	Free kitchen faucet aerators - 2.2 gpm	859,082	$2,421	$0.28
	Encourage reduced faucet use	1,356,446	$0	$0.00
	Encourage reduced partial clothes washer loads	272,424	$0	$0.00
Multifamily Outdoor	Free outdoor irrigation devices	168,825	$19,131	$11.33
	Free low water use plants guidebook	**184,623**	**$1,215**	**$0.66**
	Encourage less lawn	184,623	$0	$0.00
Non-Residential Indoor	Ultra low flow toilet (ULFT) rebates - 1.6 gpf	**650,623**	**$12,415**	**$1.91**
	High efficiency toilet (HET) rebates - 1.0 gpf	**385,843**	**$10,268**	**$2.66**
	Low volume urinal rebates - 1.0 gpf	**1,142,557**	**$18,623**	**$1.63**
	Free toilet-leak detection tablets and repair information	316,019	$34	$0.01
	Free toilet-tank displacement devices	366,204	$340	$0.09
	Free low-flow showerheads - 2.5 gpm	876,693	$20,847	$2.38
	Free bathroom faucet aerators - 2.2 gpm	2,931,782	$392	$0.01
	Free efficient restaurant spray heads	208,311	$1,698	$0.82
Non-Residential Outdoor	Free outdoor irrigation devices	168,825	$2,108	$1.25
Total		87,478,338	$1,268,227	$1.45

BOLD TEXT = Measures in addition to those in Package B.

1. The savings from free riders, those who would have implemented the measure even without the City's program, are excluded in order to reflect the true cost-effectiveness of the measures.
2. This cost effectiveness number is based on the 2012-2021 planning period and assumes full implementation of each measure in 2012. Additionally, the savings from free riders are excluded in order to reflect the true cost-effectiveness of the measures.

Table 5-7 Conservation Package D

Sector	Measure	Annual Water Savings at Full Program Implementation (gallons)[1]	Direct Cost over Planning Period	Cost per 1,000 Gallons Saved Over Planning Period[2]
Single Family Indoor	**Ultra low flow toilet (ULFT) rebates - 1.6 gpf**	**5,081,876**	**$132,527**	**$1.16**
	High efficiency toilet (HET) rebates - 1.0 gpf	**4,525,696**	**$163,920**	**$1.61**
	Free toilet-leak detection tablets and repair information	1,448,090	$551	$0.04
	Free toilet-tank displacement devices	2,848,084	$5,444	$0.19
	Encourage reduced toilet flushes	2,403,216	$0	$0.00
	Free low-flow showerheads - 2.5 gpm	2,662,976	$7,676	$0.29
	Encourage reduced shower use (5-minute timer)	1,142,017	$16,962	$1.49
	Free bathroom faucet aerators - 2.2 gpm	3,156,120	$1,478	$0.05
	Free kitchen faucet aerators - 2.2 gpm	887,659	$2,502	$0.28
	Encourage reduced faucet use	1,401,567	$0	$0.00
	Encourage reduced partial clothes washer loads	883,104	$0	$0.00
Single Family Outdoor	Free audits for automatic irrigation	5,472,000	$102,547	$1.87
	Free outdoor irrigation devices	168,825	$22,591	$13.38
	Free low water use plants guidebook	**645,914**	**$1,056**	**$0.16**
	Encourage less lawn	645,914	$0	$0.00
Multifamily Indoor	**Ultra low flow toilet (ULFT) rebates - 1.6 gpf**	**7,934,343**	**$114,953**	**$1.16**
	High efficiency toilet (HET) rebates - 1.0 gpf	**6,216,711**	**$150,113**	**$1.61**
	Free toilet-leak detection tablets and repair information	1,305,579	$276	$0.02
	Free toilet-tank displacement devices	2,470,400	$2,623	$0.11
	Encourage reduced toilet flushes	2,266,968	$0	$0.00
	Free low-flow showerheads - 2.5 gpm	2,577,247	$4,952	$0.19
	Encourage reduced shower use (5-minute timer)	1,105,252	$10,944	$0.99
	Free bathroom faucet aerators - 2.2 gpm	3,054,515	$795	$0.03
	Free kitchen faucet aerators - 2.2 gpm	859,082	$2,421	$0.28
	Encourage reduced faucet use	1,356,446	$0	$0.00
	Encourage reduced partial clothes washer loads	272,424	$0	$0.00
Multifamily Outdoor	Free outdoor irrigation devices	168,825	$19,131	$11.33
	Free low water use plants guidebook	**184,623**	**$1,215**	**$0.66**
	Encourage less lawn	184,623	$0	$0.00
Non-Residential Indoor	**Ultra low flow toilet (ULFT) rebates - 1.6 gpf**	**325,311**	**$6,208**	**$0.95**
	High efficiency toilet (HET) rebates - 1.0 gpf	**161,424**	**$5,134**	**$1.33**
	Low volume urinal rebates - 1.0 gpf	**1,142,557**	**$18,623**	**$1.63**
	Free toilet-leak detection tablets and repair information	316,019	$34	$0.01
	Free toilet-tank displacement devices	366,204	$340	$0.09
	Free low-flow showerheads - 2.5 gpm	876,693	$20,847	$2.38
	Free bathroom faucet aerators - 2.2 gpm	2,931,782	$392	$0.01
	Free efficient restaurant spray heads	208,311	$1,698	$0.82
Non-Residential Outdoor	Free outdoor irrigation devices	168,825	$2,108	$1.25
Total		69,827,222	$820,061	$1.17

BOLD TEXT = Measures with reduced numbers of rebates, compared to Package B and Package C.

1. The savings from free riders, those who would have implemented the measure even without the City's program, are excluded in order to reflect the true cost-effectiveness of the measures.
2. This cost effectiveness number is based on the 2012-2021 planning period and assumes full implementation of each measure in 2012. Additionally, the savings from free riders are excluded in order to reflect the true cost-effectiveness of the measures.

6. Water Rights and Future Supply Options

6.1 Water Rights Evaluation

6.1.1 Existing Water Rights

The City currently has ground water rights for municipal supply and for irrigation issued by the Idaho Department of Water Resources (IDWR) for a total instantaneous quantity (Qi) of 18.91 cubic feet per second (cfs), which is equivalent to 8,504 gallons per minute (gpm) and a total annual quantity (Qa) of 6,215.7 acre-feet per year (AF/yr). Table 6-1 summarizes the City's water rights. It is noted that these totals include Water Right Number 87-4023, which is for irrigation of 58 acres of cemetery ground, and does not include municipal supply as an authorized use. By subtracting the amounts associated with this water right, the totals for the City's water rights that include municipal supply as an authorized use are 17.24 cfs (7,754 gpm) and 6,041.7 AF/yr.

Table 6-1 Water Rights Summary

Water Right Number	Well Number	Priority Date	Maximum Instantaneous Withdrawal (Qi)		Maximum Annual Quantity (AF/yr) (Qa)	Purpose of Use
			cfs	gpm		
87-2023	2, 3, 6	04/03/1964	8.23	3,700	866.7	Irrigation, Municipal, Domestic
87-2025	8	03/16/1965	2.44	1,098	894	Municipal
87-4023	Cemetery	06/01/1952	1.67	750	174*	Irrigation (58 acres)
87-7034	Cemetery	08/04/1977	1.45	652	945**	Municipal
87-7069	9, 10	02/26/1981	5.12	2,304	3,336**	Municipal
Total			18.91 cfs	8,504 gpm	6,215.7 AF/yr	
Total (Municipal Only)			17.24 cfs	7,754 gpm	6,041.7 AF/yr	

* Annual quantity based on 58 acres irrigation at 3 AF/yr per acre.

** Annual quantity based on continuous pumping of Qi for 90% of year.

It also should be noted that three of the City's water rights do not include a limitation for the annual quantity (Qa). In order to determine a value for planning purposes, a calculation was made to arrive at an annual quantity for these rights as shown in Table 6-1. The irrigation water right calculation was based on allocating three acre-feet per acre for the 58 acres of irrigation authorized on the water right, for a total annual quantity of 174 acre-feet. This assumed annual irrigation volume is based on the annual quantity allocated under a separate water right (Number 87-7083) of 39 acre-feet for the irrigation of 13 acres. This water right is not included in Table 6-1 since this right is strictly used for irrigation of a park and is not owned or operated by the City. The calculations for the annual quantities for those municipal water rights without an allocated annual quantity were based on pumping the authorized instantaneous quantities for 90 percent of the time on an annual basis.

The City currently has five active production wells (Nos. 2, 3, 6, 8, and 9). The City received approval from IDWR on January 27, 2009, for a Transfer of Water Right No. 87-7069 to add an additional point of withdrawal, which the City has identified as the future Well No. 10. The location of this well has been identified but the well has not been drilled at this time.

6.1.2 Comparison of Water Rights to Demand Forecast

An analysis of the City's existing municipal water rights compared against existing and forecast water demands is summarized in Table 6-2. By comparing water rights with 2008 levels of demand, the City currently has excess water rights of 6.4 mgd (9.95 cfs) for instantaneous flows and 3.2 mgd (3,549 AF/yr) for annual quantities.

The projected water rights status at the forecast five-, twenty-, and fifty-year water demands is also presented in Table 6-2. The Average Day Demand (ADD) and Maximum Day Demand (MDD) forecasts from Chapter 4 are used in this analysis to define annual and instantaneous water demands, respectively.

According to the forecast, the City's existing water rights (both Qa and Qi) are sufficient to meet projected demands through the 50-year planning horizon. Figure 6-1 also depicts the results of this analysis.

The maximum number of ERUs that the City's current water rights can serve is 21,862 based on annual quantities, and 20,442 based on instantaneous flows (calculated using 247 gpd/ERU [ADD] and 543 gpd/ERU [MDD]).

Table 6-2 Comparison of Existing Water Rights and Projected Demands

Permit, Certificate or Claim #	Name of Rightholder or Claimant	Priority Date	Source Name/ Number	Primary or Supplemental	Existing Water Rights: Maximum Instantaneous Flow Rate(Qi) cfs	Existing Water Rights: Maximum Annual Volume(Qa) AF/yr
Permit/Certificate						
1. 87-2023	Moscow	4/3/64	Wells 2, 3, 6	Primary	8.23	866.7
2. 87-2025	Moscow	3/16/65	Well 8	Primary	2.44	894
3. 87-4023	Moscow	6/1/52	Cemetery	Primary (Irrig)	1.67	174 *
4. 87-7034	Moscow	8/4/77	Cemetery	Primary	1.45	945**
5. 87-7069	Moscow	2/26/81	Wells 9, 10	Primary	5.12	3,336**
Total					18.91 (12.2 mgd)	6,215.7 (5.5 mgd)
Total(Municipal Only)					17.24 (11.1 mgd)	6,041.7 (5.4 mgd)
Current Water Right Status						
Current Consumption (2008)					7.29 (4.7 mgd)	2,466.2 (2.2 mgd)
Current Water Right Status (Excess)					9.95 (6.4 mgd)	3,575.5 (3.2 mgd)
Projected (5-year) Water Right Status						
Projected Consumption (2015)					8.53 (5.5 mgd)	2,802.5 (2.5 mgd)
Projected Water Right Status (Excess)					8.71 (5.6 mgd)	3,239.2 (2.9 mgd)
Projected (20-year) Water Right Status						
Projected Consumption (2030)					10.23 (6.6 mgd)	3,363.0 (3.0 mgd)
Projected Water Right Status (Excess)					7.01 (4.5 mgd)	2,768.7 (2.4 mgd)
Projected (50-year) Water Right Status						
Projected Consumption (2060)					15.04 (9.7 mgd)	4,932.4 (4.4 mgd)
Projected Water Right Status (Excess)					2.20 (1.4 mgd)	1,109.3 (1.0 mgd)

* Annual volume calculated, based on 58 acres irrigation at 3 AF/yr per acre.
** Annual volume calculated, based on continuous pumping at Qi rate for 90% of the year.

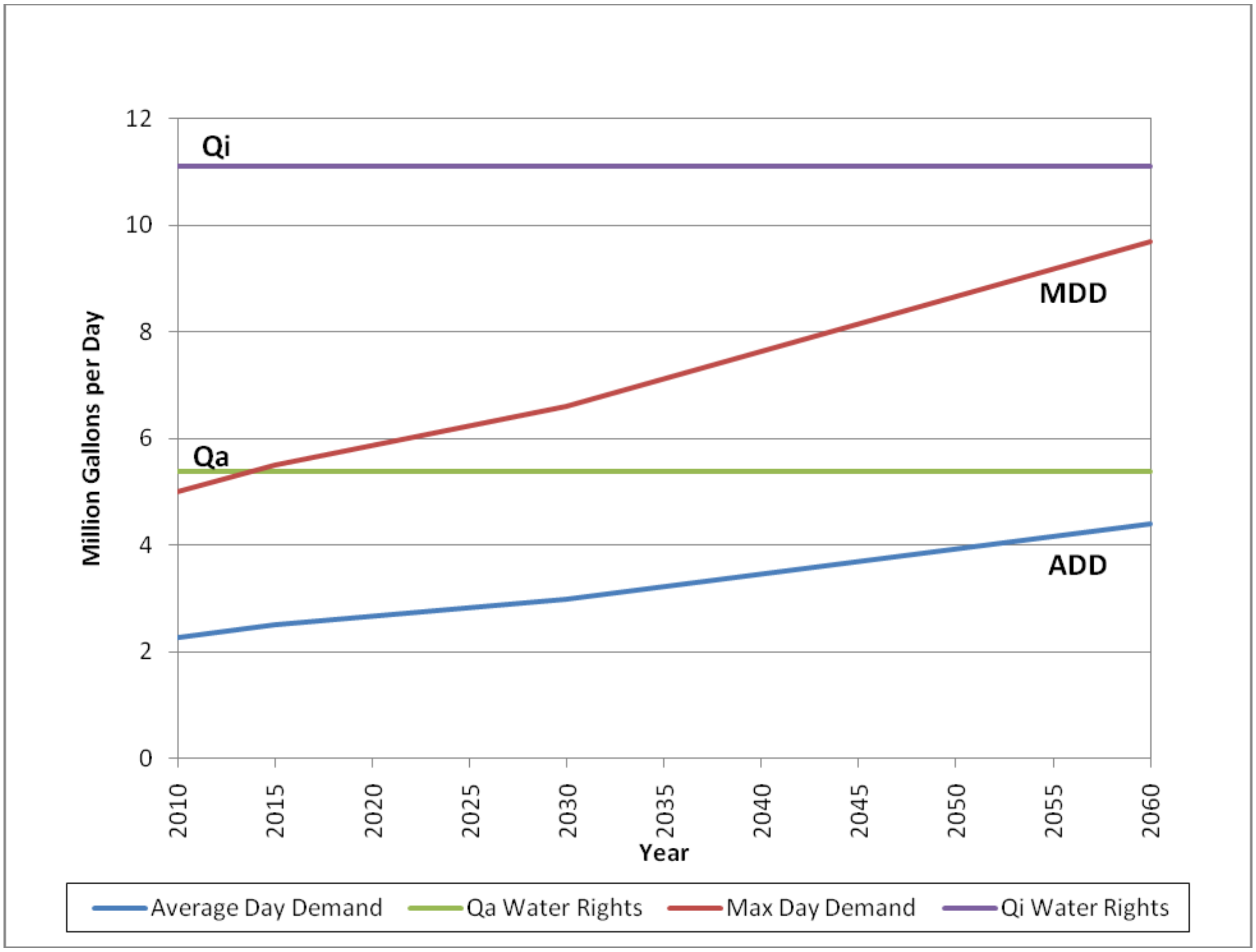


Figure 6-1 Projected Water Consumption and Existing Water Rights

6.2 Interties

The City has eight interties with the University of Idaho (UI). These interties are not considered as a source of supply, as they are currently only utilized under emergency conditions. Section 3.2 provides more information on the City's interties.

6.3 Future Supply Options

As noted in Section 7.1.2, the City's existing well supplies are capable of meeting system needs through the 20-year planning horizon, under the assumption that all sources are operable. However, DEQ requires consideration of source capacities under the condition of the largest source being out of service. In such a scenario (i.e., with Well 9 not available), the City would have a source of supply deficiency by 2015 (i.e., existing source capacity, less the largest source, is not capable of meeting MDD in 2015). Therefore, the City must plan for additional supplies to bolster system reliability and redundancy in the near-term, while being mindful of the pressures of additional long-term growth upon existing supplies.

Furthermore, as noted in Section 2.1.2, the groundwater aquifers from which the City's wells withdraw water have been experiencing declining water levels for many years. For this reason, in addition to the supply capacity driver mentioned above, the City has begun exploring the feasibility and potential cost of developing additional, alternative water supplies to aid in meeting future needs and to support sustainable management of the Palouse Basin groundwater supply.

The following sections describe a variety of potential future supply sources, including additional groundwater development, expanded/enhanced conservation, water reclamation, aquifer storage and recovery, surface water storage, and regional surface water supplies. The chapter concludes with a planning-level, life-cycle cost-effectiveness comparison between the alternatives.

The discussion here is limited and based primarily upon previous studies and other work being done by the City concurrent to this Comprehensive Water System Plan (CWSP). This is a preliminary analysis that could serve as a foundation for more in-depth evaluation of future supply options.

6.3.1 Additional Groundwater Development

To simply meet the objective of accommodating increasing demands, the City could develop additional groundwater supplies. The planned completion of the New Cemetery Well and development of the proposed Well 10 will satisfactorily address the need to increase system redundancy for the near-term, but these improvements alone will not support continued demand growth anticipated throughout the 50-year planning horizon. Additional groundwater wells (beyond Well 10) could be a potential source of future supply. However, it should be noted that such an approach does not address the other objective mentioned above regarding reducing stress to the area groundwater aquifers, in light of already declining water levels.

In the cost comparison provided at the end of this chapter, well development costs are estimated at approximately $1.5 million for a well similar in size, depth, and nature to the proposed Well 10. This includes planning, design, land acquisition, and well completion. The annual operating cost (primarily power cost of the well pump) is estimated to be approximately $90,000. This results in a cost-effectiveness of approximately $0.14 per 1,000 gallons, or $45 per AF.

6.3.2 Enhanced Conservation Program

The City's existing conservation efforts have been concentrated in data gathering and distribution of educational information and conservation devices to the public. Conservation measures include meter calibration, water balance accounting, leak detection, free residential conservation devices, and providing information and education. The City's future conservation program could include a range of enhanced or additional measures, such as expansion of free conservation devices, rebates, audits, and public education programs. Four alternative conservation packages are presented in Chapter 5. Conservation Package A, which most closely resembles the current conservation practices, would result in a projected 4.6% reduction in demand, costing the City $0.52 per 1,000 gallons saved. Conservation Package C, which amounts to the greatest water savings, would result in a projected 9.10% reduction in demand, costing the City $1.45 per 1,000 gallons saved.

6.3.3 Water Reclamation

Water reclamation provides an alternative source of supply through the reduction of potable water used in non-potable applications such as turf and landscape irrigation. Previous studies have evaluated the feasibility of implementation of a water reclamation program that extends beyond provision of service to the University of Idaho. These studies include:

- *Reuse Study for the City of Moscow*, Kimball Engineering, December 2001.
- *City of Moscow/University of Idaho Wastewater Reuse Capacity Assessment*, March 2010, JUB Engineers, Inc.
- *Comprehensive Wastewater Plan,* Keller Associates, 2011.

History of Existing Program

The City and the University of Idaho (UI) entered into an agreement on June 21, 1977 to reuse Wastewater Treatment Plant (WWTP) effluent for irrigation purposes on UI land. The agreement listed conservation of underground water supply in the Moscow basin, reduction in the fertilizer requirements for large irrigated green areas, and creation of a long-term uninterruptible source of irrigation water supply as goals. The IDWR issued a Water Right License (Water Right No. 87-07026) to the UI for a peak diversion rate of 1.15 million gallons per day for the period April 1 to November 1, with an annual volume of 594.0 acre feet. The City has been providing UI with recycled water (treated wastewater) for irrigation of green spaces since 1977.

Kimball Study

The Kimball study analyzed options for meeting future phosphorus effluent limits during the growing season by using Moscow WWTP effluent for land application (irrigation). A second objective for land application was to reduce the demand for City water by using recycled effluent for irrigation. The Kimball study provided a list of areas within the City that could be irrigated with recycled water and estimated the irrigation demand at each site. Cost estimates for storage, pumping, and piping totaled $3,940,000 to produce 64 million gallons per year. The report concluded that the land available within the City for irrigation with recycled water was insufficient to use all of the City's effluent and thus eliminate discharge during the phosphorus effluent limit period of May 15 to October 15. Necessary facilities to produce and deliver reclaimed water include modifications to the WWTP as well as new off-site infrastructure.

JUB Study

The JUB study provided a planning level analysis of the potential for using reclaimed water from the City's WWTP for irrigation of a 27-acre City ball field complex located in the southwest corner of Moscow on Palouse River Drive. The report concluded that the WWTP has sufficient flow to provide irrigation water for the ball field complex, but that UI does not have the infrastructure to transmit the irrigation water to the complex. The report developed six concepts to upgrade the UI infrastructure to provide irrigation water to the complex, with preliminary cost estimates ranging from $1,300,000 to $2,114,000 for these scenarios.

Comprehensive Wastewater Plan

In the latest Comprehensive Wastewater Plan, Chapter 5 presents an updated summary of reuse options with new considerations. One option for providing recycled water is to treat raw wastewater in small satellite (scalping) plants located close to the point(s) of use. Three potential sites were identified in the eastern portion of the system. Another option is to expand recycled water distribution from the existing WWTP. This would involve installing a distribution pipeline system to deliver water to the areas in east Moscow. In Table 6-3, preliminary cost estimates are summarized for three scalping plants and the expansion of WWTP reclaimed water distribution option.

Table 6-3 Reclaimed Water Production / Distribution Options

Item	Project Cost	Annualized Cost[1]	Annual O&M Cost	Total Annual Cost	Annual mg Recycled	Annual $/gal
1 Scalping Plant 1	$4,800,000	$385,164	$50,000	$435,164	17.14	$0.0254
2 Scalping Plant 2	$7,600,000	$609,843	$75,000	$684,843	25.88	$0.0265
3 Scalping Plant 3	$3,300,000	$264,800	$50,000	$314,800	10.9	$0.0289
4 Storage and Distribution Piping from WWTP	$7,100,000	$569,722	$35,000	$604,722	44.36	$0.0136

1. Annualized cost at 5% and 20 years financing.

This analysis indicates that it is more cost-effective to convey reclaimed water from the existing WWTP to use sites rather than construct scalping plants that would provide the same amount of recycled water.

6.3.4 Aquifer Storage and Recovery

Aquifer Storage and Recovery (ASR) involves the appropriation and storage underground of surface water when supply exceeds demand, and recovering that water during peak demand periods. The water is recharged to an aquifer using wells, and typically the stored water can be recovered from the aquifer with little change in water quality.

A planning-level ASR feasibility assessment was prepared for the City, in conjunction with development of this CWSP. A copy of the full report is provided in Appendix 6-1. The assessment references the draft WRIA 34 Storage Assessment Report prepared for the Palouse Basin, which suggests that excess winter water is available from the South Fork of the Palouse River which could be used to meet the City's future demand and perhaps offset declining groundwater levels.

A brief summary of the assessment findings is provided below.

ASR System Development and Expansion Approach

Development of an ASR system for the City would involve an evaluation of the City's existing infrastructure to select locations where ASR facilities can feasibly be developed and provide the most benefits to the City's water system. When choosing the location of an ASR facility, an assessment of relative capital expenditures necessary to develop a functional ASR facility would be considered and if feasible, using existing piping, storage and distribution system infrastructure could provide a substantial cost benefit. Additional considerations in selecting the ASR facility location may include where the facility can boost system pressure or increase chlorine residuals.

Selecting an appropriate location for an ASR well can significantly reduce overall capital expenditures. Existing wells completed in the target aquifer can be considered, or a new well can be installed to ensure proper implementation of the full ASR operation can be achieved. Primary considerations to selecting an existing well for retrofit are well capacity and well construction. An evaluation of existing information regarding well yield, performance, groundwater quality and existing pumping and wellhead equipment can be conducted to help assess the City's existing wells for potential ASR well candidates.

Receiving Aquifer

The two aquifers targeted by the City's wells are the shallower Wanapum and deeper Grande Ronde basalt groups, part of the regional Columbia River Basalt Group. Both aquifers have been identified as having a potential for use as an ASR storage aquifer. Because the Grande Ronde basalt receives limited recharge and water levels have declined, the deeper portion of the system may represent the most likely storage target for two reasons: the storage capacity is established, and the benefit of replacing extraction with withdrawing stored water would be demonstrable.

A hydrogeologic characterization report would provide a more detailed conceptual model of the aquifer system and assess hydrogeologic properties such as transmissivity, storativity and geochemical compatibility using available aquifer test data. Much work has been completed in this area, and it is likely that the results of the Framework Project underway with the Palouse Basin Aquifer Committee would represent the bulk of this report. Evaluating test data to assess potential recovery and injection rates and the presence of storage-limiting boundary conditions is a key element of a feasibility study.

Source Water

Water quality tests in the South Fork of the Palouse River indicate the presence of fecal coliforms, ammonia-N and has exhibited high pH and increased turbidity levels, particularly in the winter months. Elevated concentrations of nitrite and nitrate have also been observed during winter and spring months as runoff occurs. Recent studies suggest that ammonia levels have been reduced to meet Washington state standards at the border of Washington and Idaho. Although water of the Palouse River may meet groundwater quality standards, pre-treatment to drinking water standards will likely be necessary to further improve injected water quality and prevent anti-degradation to the receiving aquifer.

Facility Elements

Primary facility elements of an ASR system include:

- An ASR well, which can be new or existing;
- Pumping equipment and flow control valves for injection and recovery;
- Water treatment facilities;
- Infrastructure to move source water to the water treatment facility, and from the treatment facility to the ASR well;
- Infrastructure to move recovered water to the water treatment facility, then to distribution; and,
- A real-time monitoring system to track ASR recharge, aquifer pressure buildup and recovery volumes to ensure system operation meets permitting requirements.

Permitting

Several permits are required for developing an ASR system that meets state and federal standards. The application for an ASR permit (underground injection control permit) is composed of several different elements that are described below:

- **Underground Injection Control Permit** – IDWR regulates the injection of fluids into wells under the Underground Injection Control Program. Any system which injects water into the subsurface is required to be permitted through IDWR.
- **Water Rights** – Both surface and groundwater rights will be required for an operational ASR system.
- **Well Construction Permit** – New well installation, and existing well modifications for use as an ASR well will require a well construction permit.
- **Water Quality** – Water quality standards and regulations apply to both injected and recovered water. Injected water standards are regulated by State groundwater quality standards and anti-degradation laws. Recovered water will be required to meet drinking water quality standards prior to distribution.
- **Water Discharge** – Most operating ASR systems require periodic back-flushing of the ASR well (pumping the well to waste at high discharge rates) to eliminate clogging that occurs even when high quality water is injected. This may require a National Pollutant Discharge Elimination System (NPDES) permit.
- **Land Use –** Land use permits may be required if the property is not currently zoned for municipal water supply and storage.

Schedule and Cost

General ASR costs were considered as part of the 2007 Palouse Watershed (WRIA 34) Multi-Purpose Storage Assessment. These estimates, provided below, are based on limited nationwide research of ASR systems and each ASR system has its own site specific costs.

- Feasibility reports and pilot testing for systems with existing infrastructure range from $100,000 to $500,000. In Moscow, the availability of hydrogeologic characterization data would likely lead to a Feasibility Study cost lower than this, possibly in the $40,000 to $50,000 range if no numerical flow modeling is required.
- In terms of recovery capacity, unit costs for ASR facilities in the northwest range from $200,000 to $600,000/million gallons per day (mgd) with an overall average of $400,000/mgd.

Based on a generalized understanding of supply availability and the City's well system, a hypothetical ASR system can be conceptualized. It is likely that a 3-well system recharging at an average rate of 700 gpm for four months each year could be developed using existing wells, resulting in approximately 360 million gallons of storage annually. It is likely that this volume could be recovered to the City's supply system at approximately 2,700 gpm (average) for three months. This portion of the project could be developed for approximately $740,000, based on a summary of ASR facility development costs presented in Appendix 6-1. If three new wells are installed to operate the system as a true peaking supply (i.e. in addition to the City's existing wells), a planning-level estimate would be to add approximately $1 million per new well increasing the overall project costs to approximately $4 million. For planning purposes, the latter cost is assumed.

In addition, it is estimated that membrane treatment would cost approximately $5 million for a 2,100 gpm (3 mgd) facility, and that conveyance pumping and piping from the river to the wells would cost approximately $3 million. These are very preliminary estimates, and are based upon assumption used to generate similar estimates in the City of Pullman's Water System Plan. If ASR is considered further, these cost estimates require re-evaluation.

Therefore, the total capital cost is estimated to be approximately $12 million, associated with a yield of 360 million gallons annually.

6.3.5 Surface Water Storage

Surface water storage and supply involves the diversion of rivers within the regional basin. Possibilities have been presented for different sites in the surrounding mountains for the creation of reservoirs with constructed dams. A study of surface water storage sites was conducted concurrent to development of this CWSP, as documented in *City of Moscow Surface Water Feasibility Study – Draft*, SPF Water Engineering, April 1, 2011 (SPF Study). A summary of those study findings is provided below.

The SPF Study presents a hydrologic analysis of watershed yield to determine the amount of water available on Moscow Mountain, and a preliminary analysis of surface water storage capacity. The study identifies four basins (Flannigan Creek, Hatter Creek, South Fork Palouse River, and Felton Creek) as having the potential for storing water in suitable volumes to bolster the City's water supply. Water from these basins could be used in the following three ways:

1) Treated and used directly in the City's municipal water system.

2) Used for non-potable irrigation in a separate water system.

3) Treated and used for ASR.

Table 6-4 lists each basin's potential reservoir size if constructed to retain a volume equal to 1.5 times the estimated watershed yield. Aggregate costs (including reservoir, conveyance, and treatment) for various alternatives involving the four basins and the three implementation approaches range from approximately $5 million to $68 million.

Table 6-4 Surface Water Storage and Supply Analysis

Parameter	Reservoir Sites			
	Flannigan Creek	Hatter Creek	South Fork Palouse	Felton Creek
Annual Average Watershed Yield (acre-feet)	4,400	2,400	700	1,300
Dam Height (feet)	102	105	111	92
Dam Length (feet)	894	1,175	737	965
Reservoir Surface Area (acres)	179	86	33	48
Reservoir Volume (acre-feet)	6,600	3,600	1,300	2,000

None of the surface water storage and supply options is cost-effective if compared with developing additional groundwater resources or implementing other alternative supplies. However, these options might become more feasible if declining groundwater levels drive the City to move to surface water supplies. Key findings of the SPF Study are:

a) The least expensive alternative considered is the provision of irrigation water from the upper South Fork Palouse River drainage.

b) The least expensive potable supply alternative is to divert water from a modestly-sized South Fork Palouse River reservoir with partial use of an ASR strategy.

c) The least expensive large-volume alternative would be direct use from the Flannigan Creek site. Due to its magnitude in cost and water volumes, this alternative bears comparison with other regional supply solutions, such as lifting water from the Clearwater or Snake Rivers for multiple Palouse communities.

d) If land acquisition costs and/or environmental constraints become challenges, the most feasible option could become that of in-town seasonal diversions from the South Fork Palouse River and/or Paradise Creek in combination with an ASR strategy.

Additional investigation of potential constraints such as environmental concerns (including wetlands presence, endangered species issues, presence of cultural resources, and water quality issues) is required should the City elect to move forward with any of these options. Potential impacts to existing water rights by a new reservoir will also need to be thoroughly considered.

6.3.6 Surface Water Supply

The *Reconnaissance Report: Palouse River Basin, Idaho and Washington* (US Army Corps of Engineers, 1989) was commissioned to evaluate the feasibility of solving flooding and other water resource problems in the upper Palouse River Basin of Idaho and Washington. As part of this evaluation, diverting surface water for municipal water supply use was presented as an option with associated costs developed for treatment and conveyance. Estimates to divert a portion of the Snake River, including two pump stations, a water treatment plant, and 21.6 miles of transmission piping totaled $92,300,000 (in 2010 dollars). The annual operating cost was estimated at $17,350,000 to treat 25,000 acre-feet of municipal supply.

Although this alternative is included in the cost comparison presented in Section 6.4, it is noted that beyond cost there are significant factors that would make implementation of this option challenging, including water rights, environmental, and jurisdictional considerations. The *Reconnaissance Report* addresses many of these issues. However, an updated assessment of such factors would be necessary if this option is to be further explored.

6.4 Comparison of Alternatives

Table 6-5 provides a planning-level cost-effectiveness comparison amongst the alternatives described above. From this type of long-range perspective, one can readily discern that the development of additional groundwater supplies and continued implementation of conservation provide the most cost-effective means of increasing supply yield (or lessening demand, in the case of conservation). However, as has been noted previously, additional groundwater supplies do not support the objective of lessening withdrawals from the Palouse Basin. And conservation, while cost-effective relative to other options, is limited in the amount of water savings that can be achieved, relative to the amount of supply obtained through other alternatives.

Also limited in its ability to increase supply yield is water reclamation. At this time, the high capital cost and relatively low yield render expansion of the City's reuse program not cost-effective. Although more cost-effective than reuse, the ASR, surface water storage, and regional surface water supply alternatives have significant upfront capital costs, as well as a variety of legal, environmental, and permitting challenges that must be considered.

The City will continue to explore these long-term water supply options, with re-evaluation occurring when new information potentially of significance becomes available. Specific factors that would trigger further analysis might include accelerated demand growth that begins to outpace that projected in this CWSP, changing regulatory requirements that render certain alternatives more or less feasible, and updated technologies that might lower the cost of implementation of the more capital-intensive options.

Table 6-5 Water Supply Options Cost-Effectiveness Comparison

Alternative	Estimated Yearly Water Savings/ Supply (MG)	Estimated Yearly Water Savings/ Supply (AF)	Estimated Water Savings/ Supply 2020–2060 (MG)[1]	Estimated Water Savings/ Supply 2020-2060 (AF)[1]	Capital Cost to Implement ($)[2]	Annual Operating Cost ($)[2]	Present Worth Cost ($)[3]	PW Cost per 1,000 gallons[3]	PW Cost per AF[3]
New Well[4]	578	1,774	23,126	70,977	$1,500,000	$88,200	$3,163,000	$0.14	$45
Conservation[5]					$0				
Package A	43.6	134	1,744	5,354	-	$22,600	$509,000	$0.29	$95
Package C	87.5	268	3,499	10,739	-	$126,800	$2,853,000	$0.82	$266
Reuse – Irrigation[6]	44.4	136	1,774	5,446	$7,100,000	$35,000	$6,366,000	$3.59	$1,169
ASR[7]	360	1,105	14,400	44,195	$12,000,000	$58,000	$10,734,000	$0.75	$243
Surface Water Storage[8]	1,433	4,400	57,329	176,000	$53,664,000	$2,340,000	$94,821,000	$0.65	$210
Regional Water Supply[9]	8,150	25,000	326,000	1,000,000	$92,318,000	$17,351,000	$462,969,000	$1.42	$463

1. Assuming supply alternative is implemented for a 40 year period, beginning in 2020.
2. Capital and annual O&M costs are in 2010 dollars.
3. Present Worth costs are stated in 2010 dollars and assume alternatives are implemented in 2020, an inflation rate for annual operating costs of 3%, and a discount rate of 5%.
4. Operating cost includes power cost only. Assumes 450 horsepower motor running at 450’ TDH for 12 hours/day for 365 days at a cost of $0.06/kilowatt hour.
5. Based on the conservation program estimates presented in Chapter 5.
6. Based on program estimates from Chapter 5 of the draft Comprehensive Wastewater Plan (2011) for distribution from the WWTP.
7. Assumes recharge into three new wells at a rate of 700 gpm per well, for four months. Capital costs include (in 2010 dollars): $4M for hydrogeological work, new well development, and ASR facilities; $5M for membrane treatment; $3M for conveyance pumping and piping. Operating costs assume a 150 horsepower motor running for 24 hours/day for four months at a cost of $0.06/kilowatt hour.
8. Based on estimated yields and costs for Alternative A-1 (Flannigan Creek direct use), as presented in SPF Study (April 2011).
9. Based on estimates developed by the US Army Corps of Engineers, 1989.

7. System Analysis

This chapter provides an evaluation of the water system's ability to meet current and projected water supply needs. Source and storage capacity analyses are presented, followed by an evaluation of the distribution system piping network and an assessment of water quality and related treatment needs. Required system improvements are also described throughout the chapter.

7.1. Source Capacity Analysis

7.1.1. Design Criteria

According to DEQ planning requirements (IDAPA 58.01.08, Subsection 501.17), under normal operating conditions, with any source out of service, the remaining source or sources shall be capable of providing either the peak hour demand of the system or maximum day demand (MDD) plus equalization storage for the demand year.

The source capacity analysis presented below examines the ability of the City's existing sources of supply to meet this requirement. The analysis is conducted by comparing the City's water demand forecast, presented in Chapter 4, with current source capacities. Because the City has distribution storage that provides equalizing storage capacity to aid in meeting peak hour needs, the source capacity analysis compares supply capacities against MDD.

7.1.2. Source Capacity Evaluation

Table 7-1 summarizes the comparison of the City's total available source capacity, based on current operating conditions during summer months, with current and future system-wide maximum day demands. Assuming all five wells are on-line, the total current source capacity is sufficient to meet demands through 2030. However, assuming the largest source (Well 9) is out of service, there is a source capacity deficiency of approximately 0.5 mgd in 2015. This deficiency increases to 1.6 mgd by 2030, without additional source capacity brought on-line.

Therefore, the City is planning the development of additional groundwater supplies in the near-term to bolster source reliability and redundancy, and to better position the system to meet needs through the 20-year planning horizon. These supplies include the completion of the New Cemetery Well and development of Well 10, both of which are described further in Chapter 8. While the additional capacities of these two supplies are unknown, as they have not been implemented, the expected capacities are approximately 650 gpm for the New Cemetery Well (so as to maximize the current water right), and 2,200 gpm for Well 10 (i.e., similar in size to Well 9). Together, this offers approximately 4 mgd of additional supply to the system, to be considered as redundant supply in the near-term, but which could also be used to support growing MDD into the future. For use of Well 10 in this manner (i.e., not solely as a supplemental source to Well 9), additional water rights or a change in existing rights would be necessary in order to operate Wells 9 and 10 simultaneously.

As discussed in Chapter 6, the City has explored at a very cursory level alternative sources of supply that may factor into the City's long-term water supply portfolio, in order to meet continued growth but also to enhance reliability and lessen the reliance upon area groundwater. The City will continue exploring development of such supplies, with the timing of implementation dependent in part upon the future productivity of existing groundwater supplies and the actual pace of demand growth.

Table 7-1 Evaluation of Source Adequacy

	Year			
	2008	**2015**	**2030**	**Max[3]**
Projected EDUs and Demand [1]				
Equivalent Dwelling Units (EDUs)	8,780	10,133	12,191	9,222
Average Day Demand (mgd)	2.17	2.50	3.01	2.28
Maximum Day Demand (mgd)	4.77	5.51	6.62	5.01
Evaluation of Existing Sources				
Available Existing Source (mgd) [2]				
Well 2 (650 gpm)	0.94	0.94	0.94	0.94
Well 3 (930 gpm)	1.34	1.34	1.34	1.34
Well 6 (1000 gpm)	1.44	1.44	1.44	1.44
Well 8 (900 gpm)	1.30	1.30	1.30	1.30
Well 9 (2200 gpm)	3.17	3.17	3.17	3.17
Total Available Source - (mgd)	8.18	8.18	8.18	8.18
Source Surplus/(Deficiency) (mgd)	**3.41**	**2.67**	**1.55**	**3.17**
Less Largest[4] (mgd)	**0.24**	**(0.49)**	**(1.61)**	**0.00**

1. From demand forecast. EDUs calculated as Average Day Demand / EDU water use factor (247 gpd/EDU).

2. Source pumps are operating at the maximum production rate (i.e., for 24 hours per day).

3. Maximum EDUs to be served with current sources, based on maximum production rate (i.e., 24 hours per day). Max EDUs = Total Available Source / Maximum Day Demand per ERU (543 gpd/EDU).

4. Assumes largest source (i.e., Well 9) is out of service.

7.2. Storage Capacity Analysis

7.2.1. Design Criteria

According to DEQ requirements, water system storage volume is comprised of five separate components:

- Operational Storage
- Equalization Storage
- Fire Suppression Storage
- Standby Storage
- Dead Storage

These required volume components are illustrated in Figure 7-1. All storage components are described in more detail below.

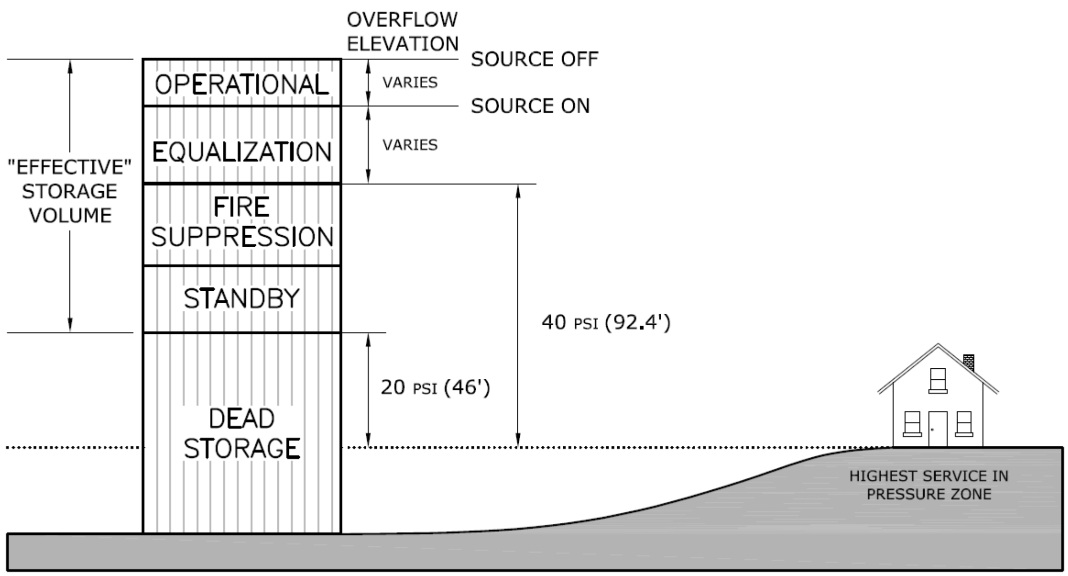


Figure 7-1 Storage Components

Operational Storage

Operational storage supplies water when, under normal conditions, the sources are off. This component is the larger of: a) the volume required to prevent excess pump cycling and ensure that the following volume components are full and ready for use when needed; or, b) the volume needed to compensate for the sensitivity of the water level sensors.

Equalization Storage

Equalization storage is the total volume needed to moderate daily fluctuations in diurnal demands during periods when the demand exceeds the capacity of the supply system. Equalization storage requirements are greatest on the day of peak demand. Operation of a properly balanced system results in replenishment of storage facilities during times of day when the demand curve is below the capacity of the supply system, and depletion of storage facilities when the demand exceeds the supply capacity. The equalization volume of a storage tank must be located at an elevation that provides a minimum pressure of 40 pounds per square inch (psi) to all customers served by the tank.

There is no specific equation or algorithm defined by DEQ for determining equalization storage. In this analysis, the Washington State Department of Health's equation for equalization storage[1] was used as it is a conservative approach assuming a period of 150 minutes for the peak hour demand. The equation is as follows:

[PHD - Total Available Source] x 150 minutes

Fire Suppression Storage

The required fire flow volume for a given pressure zone is calculated as the required fire flow multiplied by the required duration, as established by the local fire authority. More detail on such requirements within the City is provided below in Section 7.3. The maximum fire

[1] Washington State Water System Design Manual (December 2009).

suppression storage volume considered in this analysis is 2.61 million gallons, which is based on a fire flow requirement of 7,250 gpm for 4 hours, followed by a reduced flow rate of 3,625 gpm for another 4 hours. The fire flow volume of a storage tank must be located at an elevation that provides a minimum pressure of 20 psi to all customers served by the tank.

Standby Volume

Standby storage provides a measure of reliability or factor of safety should sources fail or when unusual conditions impose higher than anticipated demands. Water systems are required to have sufficient dedicated on-site standby power, with automatic switch-over capability, and/or storage so that water may be treated and supplied to pressurize the entire distribution system during power outages. During a power outage, the water system shall be able to meet the operating pressure requirements of 20 psi for a minimum of eight hours at average day demand plus fire flow where provided.

Dead Storage

That component of storage that is either not available for use in the system or that can provide only substandard flows and pressures.

7.2.2. Storage Capacity Evaluation

The storage capacity evaluation is based upon two primary calculations:

1. Comparison of available versus required storage located at an elevation that provides at least 40 psi to the highest customer in the zone. This evaluates the ability of existing storage facilities to provide required operational and equalization storage volumes under current and future conditions.
2. Comparison of available versus required storage located at an elevation that provides at least 20 psi to the highest customer in the zone. This evaluates the ability of existing storage facilities to provide required operational, equalization, standby, and fire suppression storage volumes under current and future conditions.

There are six "island" pressure zones in the City served by booster pump stations and that have no independent storage. The storage capacity evaluation considers the entire system together, as all storage is present within the City's single main pressure zone. As such, fire suppression and standby storage volume requirements associated with the "island" pressure zones have been incorporated, even though these volumes are only available to those zones via the booster pump stations.

The two calculations mentioned above were performed for the entire system, and for two different scenarios. The first considers all storage reservoirs and sources in operation. To assess system reliability, the second scenario considers the largest source and storage reservoir being out of service.

Table 7-2 provides a summary of the storage capacity analysis for the water system, assuming all sources and storage reservoirs are on-line. Under these conditions, there is projected to be a surplus of storage within the 20-year planning horizon of 0.15 million gallons.

In Table 7-3, a summary of the storage evaluation is presented when the largest source (Well 9) and the largest reservoir (SE Reservoir or Vista, as they are the same size) are offline. When Well 9 is offline, the equalization storage requirement increases as the total source available is less than the peak hour demand. And with the SE Reservoir unavailable, deficiencies exist in the ability of the system to meet standby and fire flow needs. Under this scenario, there is currently a deficiency of 1.59 million gallons, which is projected to increase to 2.18 million gallons by the end of the 20-year planning horizon.

To bolster the system's storage capacity reliability, and plan for future growth, the City has included new reservoirs in its 20-year CIP, as described in more detail in Chapter 8.

Table 7-2 Evaluation of Storage Capacity

	Year			
	2008	**2015**	**2030**	**Max[10]**
Projected EDUs and Demand[1]				
Equivalent Dwelling Units (EDUs)	8,780	10,133	12,191	13,077
Average Day Demand (mgd)	2.17	2.50	3.01	3.23
Maximum Day Demand (mgd)	4.77	5.51	6.62	7.11
Available Source (mgd)[2]				
Well 2 (650 gpm)	0.94	0.94	0.94	0.94
Well 3 (930 gpm)	1.34	1.34	1.34	1.34
Well 6 (1000 gpm)	1.44	1.44	1.44	1.44
Well 8 (900 gpm)	1.30	1.30	1.30	1.30
Well 9 (2200 gpm)	3.17	3.17	3.17	3.17
Total Available Source (mgd)	8.18	8.18	8.18	8.18
Required Storage Calculations				
Operational Storage (mg)[3]	0.72	0.72	0.72	0.72
Equalizing Storage (mg)[4]	0.00	0.08	0.27	0.35
Standby Storage (mg)[5]	0.72	0.83	1.00	1.08
Fire Flow Storage (mg)[6]	2.61	2.61	2.61	2.61
Required Storage				
Greater than 40 psi at highest meter (mg)[7]	0.72	0.80	0.98	1.06
Greater than 20 psi at highest meter (mg)[8]	4.05	4.24	4.60	4.75
Existing Storage Greater Than 40 psi (mg)[9]				
NE Reservoir	0.28	0.28	0.28	0.28
NW Reservoir	0.20	0.20	0.20	0.20
SE Reservoir [11]	0.00	0.00	0.00	0.00
Vista Reservoir	0.65	0.65	0.65	0.65
Total Existing Storage at 40 psi (mg)	1.12	1.12	1.12	1.12
Storage Surplus/(Deficiency) at 40 psi (mg)	**0.41**	**0.33**	**0.14**	**0.06**
Existing Storage Greater Than 20 psi (mg)[9]				
NE Reservoir	0.50	0.50	0.50	0.50
NW Reservoir	0.25	0.25	0.25	0.25
SE Reservoir [11]	2.00	2.00	2.00	2.00
Vista Reservoir	2.00	2.00	2.00	2.00
Total Existing Storage at 20 psi (mg)	4.75	4.75	4.75	4.75
Storage Surplus/(Deficiency) at 20 psi (mg)	**0.70**	**0.51**	**0.15**	**0.00**

1. Projected demands from Chapter 4. EDUs calculated as Average Day Demand / EDU water use factor (247 gpd/EDU).
2. Available source assumes source pumps are on for 24 hours in a day, at the maximum production rate.
3. Required Operational Storage is based on current operating levels (i.e., first source is called when Vista Reservoir level drops to 10').
4. Required Equalizing Storage is equal to [((PHD) - Total Available Source) x 150 minutes].
   PHD: (Maximum Day Demand per EDU / 1440) * [(C) * (N) + F] + 18
   (C & F values obtained from Table 5-1 in Washington State DOH Dec 2009 WSDM)

5. Required Standby Storage is 8 hours of Average Day Demand (per IDAPA 58.01.08, See 501.07).
6. Required Fire Flow Storage = 7,250 gpm x 4 hours + 3,625 gpm x 4 hours
7. Total required storage greater than 40 psi is equal to the total of operational and equalizing storage.
8. Total required storage greater than 20 psi is equal to the total of operational, equalizing, standby, and fire flow storage.
9. The storage volume available in existing reservoirs at 40 and 20 psi is calculated based on the elevation of the highest customer (~2680 ft). A few services (<20) on Pintail Lane, near the NW Reservoir, and near the Vista Reservoir are located at elevations between 2680 and 2695 ft. These locations are therefore not provided 40 psi when the reservoirs are drawn down to a level assuming Operational and Equalizing Storage is depleted. Pressures observed in the hydraulic model at these locations under these conditions range from 34-40 psi. In addition, the area is fully developed, so it is assumed no new building permits will be issued in these specific localized lower pressure areas.
10. Maximum EDUs served by Available Storage.
11. With an overflow elevation of 2,656 ft, none of the storage volume in the SE reservoir is available to the highest customer elevation via gravity. However, the entire storage volume is available to assist in satisfying Standby and Fire Flow needs, via the SE Booster Pump Station.

Table 7-3 Evaluation of Storage Capacity without Largest Source and Reservoir

	Year		
	2008	**2015**	**2030**
Projected EDUs and Demand[1]			
Equivalent Dwelling Units (EDUs)	8,780	10,133	12,191
Average Day Demand (mgd)	2.17	2.50	3.01
Maximum Day Demand (mgd)	4.77	5.51	6.62
Available Source (mgd)[2]			
Well 2 (650 gpm)	0.94	0.94	0.94
Well 3 (930 gpm)	1.34	1.34	1.34
Well 6 (1000 gpm)	1.44	1.44	1.44
Well 8 (900 gpm)	1.30	1.30	1.30
Well 9 (2200 gpm)	3.17	3.17	3.17
Total Available Source (mgd)	8.18	8.18	8.18
Without Largest Source (mgd)	5.01	5.01	5.01
Required Storage Calculations			
Operational Storage (mg)[3]	0.72	0.72	0.72
Equalizing Storage (mg)[4]	0.29	0.41	0.60
Standby Storage (mg)[5]	0.72	0.83	1.00
Fire Flow Storage (mg)[6]	2.61	2.61	2.61
Required Storage			
Greater than 40 psi at highest meter (mg)[7]	1.00	1.13	1.31
Greater than 20 psi at highest meter (mg)[8]	4.34	4.57	4.93
Existing Storage Greater Than 40 psi (mg)[9]			
NE Reservoir	0.28	0.28	0.28
NW Reservoir	0.20	0.20	0.20
SE Reservoir [11]	0.00	0.00	0.00
Vista Reservoir	0.65	0.65	0.65
Total Existing Storage at 40 psi (mg)	1.12	1.12	1.12
Storage Surplus/(Deficiency) at 40 psi (mg)	**0.12**	**(0.00)**	**(0.19)**
Existing Storage Greater Than 20 psi (mg)[9]			
NE Reservoir	0.50	0.50	0.50
NW Reservoir	0.25	0.25	0.25
SE Reservoir [11]	0.00	0.00	0.00
Vista Reservoir	2.00	2.00	2.00
Total Existing Storage at 20 psi (mg)	2.75	2.75	2.75
Storage Surplus/(Deficiency) at 20 psi (mg)	**(1.59)**	**(1.82)**	**(2.18)**

1. Projected demands from Chapter 4. EDUs calculated as Average Day Demand / EDU water use factor (247 gpd/EDU).
2. Available source assumes source pumps are on for 24 hours in a day, at the maximum production rate. Largest source assumed off-line for purpose of Equalizing Storage volume calculation.

3. Required Operational Storage is based on current operating levels (i.e., first source is called when Vista Reservoir level drops to 10').
4. Required Equalizing Storage is equal to [((Peak Hour Demand) - Total Available Source) x 150 minutes].
   Peak Hour Demand: (Maximum Day Demand per EDU / 1440) * [(C) * (N) + F] + 18
   (C & F values obtained from Table 5-1 in Washington State DOH Dec 2009 WSDM)
5. Required Standby Storage is 8 hours of Average Day Demand (per IDAPA 58.01.08, Sec 501.07).
6. Required Fire Flow Storage = 7,250 gpm x 4 hours + 3,625 gpm x 4 hours
7. Total required storage greater than 40 psi is equal to the total of Operational and Equalizing Storage.
8. Total required storage greater than 20 psi is equal to the total of Operational, Equalizing, Standby, and Fire Flow Storage.
9. The storage volume available in existing reservoirs at 40 and 20 psi is calculated based on the elevation of the highest customer (~2680 ft). A few services (<20) on Pintail Lane, near the NW Reservoir, and near the Vista Reservoir are located at elevations between 2680 and 2695 ft. These locations are therefore not provided 40 psi when the reservoirs are drawn down to a level assuming Operational and Equalizing Storage is depleted. Pressures observed in the hydraulic model at these locations under these conditions range from 34-40 psi. In addition, the area is fully developed, so it is assumed no new building permits will be issued in these specific localized lower pressure areas.
10. Maximum EDUs served by Available Storage.
11. With an overflow elevation of 2656 ft, none of the storage volume in the SE Reservoir is available to the highest customer elevations via gravity. Therefore, no portion of this tank is assumed available to meet Operational and Equalizing needs. However, the entire storage volume is available to assist in satisfying Standby and Fire Flow needs, via the SE Booster Pump Station. But for the purpose of this analysis, the focus of which is to analyze system reliability, the SE Reservoir is considered unavailable to meet any storage needs.

7.3. Distribution System Analysis

7.3.1. Analysis Methodology

The City's water distribution system was analyzed and deficiencies were identified for the following two conditions: peak hour demands, and maximum day demands plus fire flow. All modeling calculations were performed within the Infowater software produced by MWHSoft, Inc.

7.3.2. System Components

The Infowater software allows all pipes and junction nodes in the City's distribution system to be entered into one complete model, which consists of approximately 1,700 pipes and 1,400 junction nodes, along with pressure reducing stations, reservoirs, and pump stations.

Prior to development of this Water Comprehensive Plan, the first version of the City's hydraulic model was built by Taylor Engineering. System maps, record drawings, and other system information were used to construct the facilities within the model to represent the City's water system. All pump stations, wells, and storage tanks were checked with the City's current operational practices according to staff input.

7.3.3. Water Demand Allocation

Chapter 4 presents information on water demands for the City's water system for the existing system and provides an estimate of projected water demands for the five-year (2015) and twenty-year (2030) planning horizons. For the hydraulic model, the demand forecast numbers were used to determine the total demand for customers within the City's service area.

Demand allocation (i.e., spatial distribution of demand within the system) was performed by HDR Engineering. GIS data for the current land use was imported into the model and every node was assigned one of four designations: Single Family, Multi-Family, Non Residential, or Large User. Large Users are defined as specific accounts with much higher than average water consumption records. Eighteen accounts were defined as Large Users.

The total system demand defined in the water demand forecast was divided amongst all the nodes in the model by usage type. Each pressure zone was analyzed independently, considering the number of EDUs contained within each zone. A peaking factor was developed in the demand forecast from historical billing records and was applied for the maximum day demand. As enough data were not available to determine the peak hour demand, a formula developed by the Washington State Department of Health was used to determine peak hour demand. The formula is as follows:

*Peak Hour Demand = (Maximum Day Demand per EDU / 1440) * [(C) * (EDU) + F] + 18*

(C & F values obtained from Table 5-1 in Washington State DOH Dec 2009 WSDM)

The demands developed for average day, maximum day, and peak hour demand included a global adjustment for non-revenue water. Demand allocation was assumed to be the same for the existing system, five-year and twenty-year planning horizons.

7.3.4. Calibration

A critical step in the development of a hydraulic model prior to using it as a predictive tool is that of calibration. Calibration typically consists of measuring pressure and flows in the field and comparing them with model-generated pressures and flows. A key to successful calibration is ensuring that all system parameters or boundary conditions are collected at the time of testing. These boundary conditions typically consist of the demand for the day of testing, along with reservoir levels and pump station and well flows.

During the testing, a pressure gage was placed on the “residual” hydrant and pressure was measured under normal operating conditions (no hydrant flow). Once the pressure was recorded, a second hydrant was opened and the flow at the second hydrant was measured. While the hydrant was being flowed, the pressure was monitored at the residual hydrant. Once the flow and pressure came to equilibrium, the residual pressure was recorded. Typically a minimum of a 10 psi drop in pressure at the residual hydrant was desired in order to adequately stress the system.

During the pressure and flow testing, boundary conditions were being recorded using SCADA at City headquarters for all reservoirs, booster stations and wells. Flow from hydrants was measured using one of two methods: a flow totalizer or a pitot gage. The flow totalizer measured a total volume from the hydrant over a period of time. The volume was then divided by the time period to derive a flow rate. The pitot gage was placed directly in the hydrant flow discharge and a resulting flow pressure was then converted to a flow rate depending on the size of the port flowed and the resulting pressure.

The static pressure tests provide a comparison of pressures between the field and the model under normal demand conditions. Thirteen pressure and flow tests were collected during three days in October of 2009. One test was conducted for each of the six elevated pressure zones to record the behavior of these zones. At that time of year, demands were near typical average day demand as the large irrigation demand in the summer is not present. The static calibration provides the user with a good overall sense of the accuracy of the model node elevations, tank elevations and PRV settings.

7.3.5. Modeling Scenarios

The City has a distribution system with approximately 93 miles of transmission and distribution pipe. Aging infrastructure, inadequately sized pipes and increasing demands all contribute to areas of low pressure during peak hour demands and substandard fire flows at locations or areas where the existing system cannot provide adequate service during existing and future maximum day demand conditions. The model was used to identify improvements that would increase the distribution system capacity to meet the required level of service for static pressures and fire flows.

In accordance with IDAPA 58.01.08, a minimum pressure of 40 psi must be maintained at all customer connections while the system is to provide peak hour demand (PHD) conditions with equalizing storage depleted in the reservoirs. A minimum of 20 psi must be maintained for fire flows under MDD conditions with equalizing and fire flow storage depleted. If these criteria could not be met, improvements were identified and through an iterative trial-and-error process, implemented until pressure criteria could be satisfied with a minimum of total pipe and facility additions.

A number of steady state hydraulic analyses were completed for the water system for existing (2008), five-year (2015), and twenty-year (2030) demand conditions. These considered peak hour demand and fire flow demand (MDD plus fire flow) conditions. Table 7-4 describes the modeling scenarios conducted, and the sequence within which they were performed. The results of the peak hour and fire flow analyses are described in greater detail below.

Table 7-4 Modeling Scenarios

Description	Demand	Purpose
Existing Year Peak Hour	2008 Peak Hour Demand	Evaluate system
Existing Year Fire Flow	2008 Maximum Day Demand plus fire flow	Evaluate system
Plan Year 5 Peak Hour	Plan Year 5 Peak Hour Demand	Evaluate system performance and develop CIP for Plan Year 5 peak hour conditions
Plan Year 5 Fire Flow	Plan Year 5 Maximum Day Demand plus fire flow	Evaluate system performance and develop CIP for Plan Year 5 fire flow conditions
Plan Year 20 Peak Hour	Plan Year 20 Peak Hour Demand	Evaluate system and develop CIP for Plan Year 20 peak hour conditions
Plan Year 20 Fire Flow	Plan Year 20 Maximum Day Demand plus fire flow	Evaluate system performance and develop CIP for Plan Year 20 fire flow conditions

7.3.6. Peak Hour Analysis Results

In peak hour demand analyses, initial tank levels for all reservoirs and tanks were set at a level such that the equalizing and operating portions of storage were depleted.

For the City of Moscow, under peak hour conditions, a few small pockets of low pressure and a large area of high pressure in the western portion of the system are observed. There are four low pressure areas, two of which are a result of the high service elevations, while the other two are in areas around the SE and Vista Reservoirs. For the low pressure areas with services, there are approximately 30 services affected.

Table 7-5 and Figure 7-2 provide detail on the areas of low pressure. Particular areas are assigned a label. For locations “A” and “B,” there are no affected services, but services are present at locations “C” and “D”. Currently, there are no planned improvements to address these deficiencies, as these conditions have existed for some time and there are no plans for new development in these specific areas.

The area of high pressure in the western portion of the City affects a large area of the system, with some locations experiencing pressures over 120 psi. The high pressure in this area is caused primarily by the low elevation of this portion of the system, but is exacerbated when Well 9 pumps against closed altitude valves in the NE and NW Reservoirs (i.e., when those reservoirs are full and Vista Reservoir is still filling). Under such conditions, pressures increase in some parts of the western portion of the City and in downtown by five psi.

Increased west-east distribution system capacity is required to address this high pressure issue. Project D-24 in the CIP (see Chapter 8) offers one potential solution, through the addition of a 24-inch main to replace existing 8-inch and 12-inch piping through a portion of downtown, so as to provide a larger and more direct route for water to be transmitted from the westerly wells to the Vista Reservoir.

Table 7-5 Peak Hour Demand Analysis Results - Areas of Low Pressure (Near or Less Than 40 psi)

Area ID	Description	Notes
A	Area near Vista Reservoir and transmission main. Pressures of 10-28 psi.	No services in this location. No additional planned services. No improvements planned.
B	Area near SE Reservoir. Pressures of 14-25 psi.	No services in this location. No additional planned services. No improvements planned.
C	High Elevation area in Main Zone along Pintail Lane. Pressures of 34-40 psi	Fourteen services are affected at this location. No improvements planned.
D	High Elevation area in Main Zone along Summit St and Rolling Hills Dr. Pressures of 36-40 psi.	Sixteen services are affected at this location. No improvements planned.

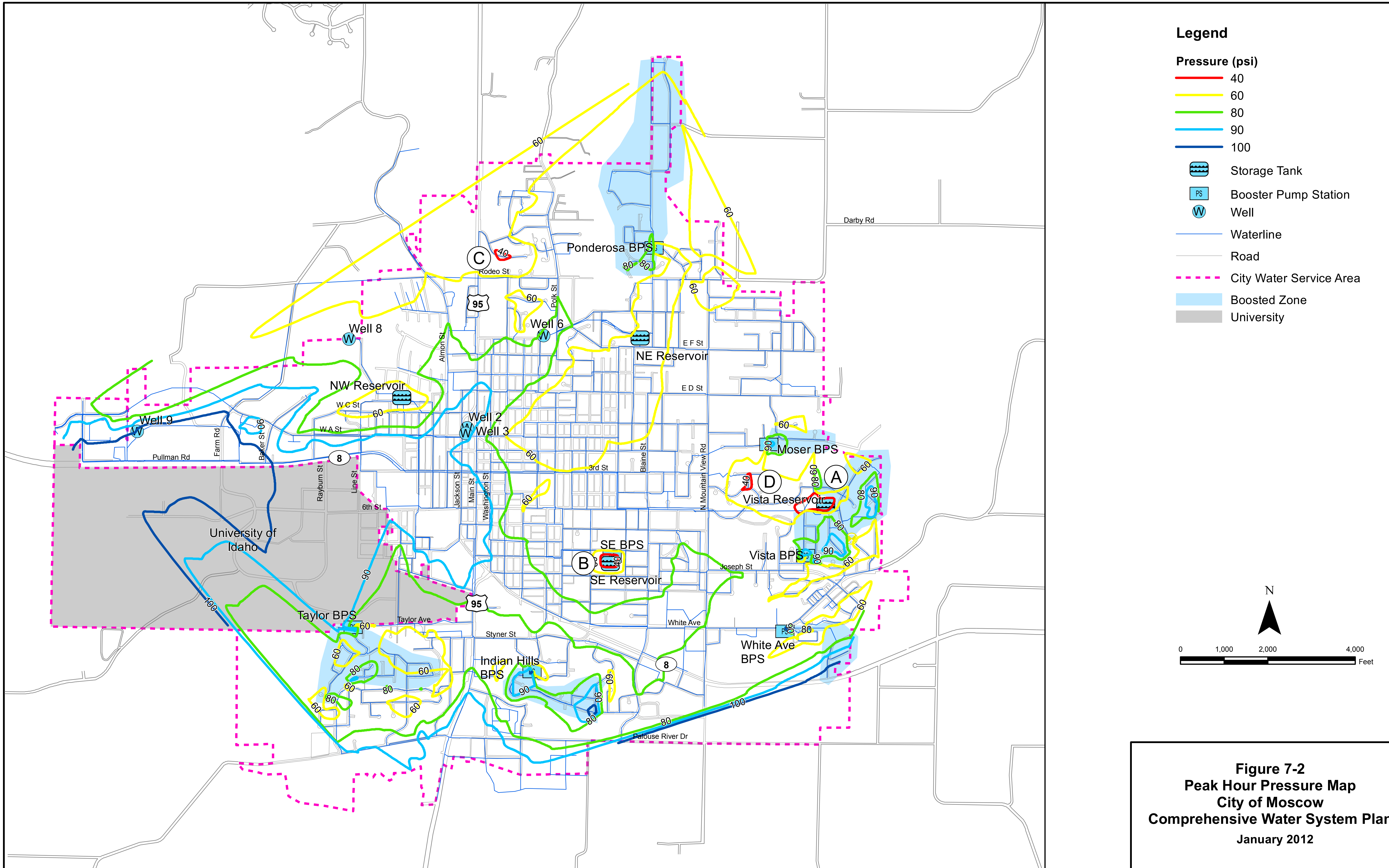


Figure 7-2
Peak Hour Pressure Map
City of Moscow
Comprehensive Water System Plan
January 2012

7.3.7. Fire Flow Analysis Results

Fire flow analyses were conducted for the entire City of Moscow system. The fire flow demands were assigned based on zoning according to the following categories, as established by the Fire Department: 1,500 gpm for Single Family Residential, 4,250 gpm for Multi-Family Residential, 7,250 gpm for General Business and Industrial, and 2,250 gpm for Neighborhood Business.

In the base fire flow analysis, each node of the distribution system is evaluated to determine its ability to provide the above fire flow requirements. In this manner, the available fire flow at each node, evaluated independently, can be assessed.

Table 7-6 and Figure 7-3 detail the nature and location of each individual or group of deficiencies found in the system. Numerous deficiencies have been identified in the model caused by inadequately sized piping throughout the system and inadequately sized booster pump stations for the elevated pressure zones. Improvements have been listed that improve or eliminate these deficiencies in the future. A portion of the deficiencies listed do not have an assigned improvement, because the Annual Small Waterline Replacement program will address the deficiency.

At location "A," deficiencies are present in the commercial area that is supplied by a single 10-inch main. Project D-33 will provide an additional connection to this portion of the system and eliminate the fire flow deficiency along W A St.

At locations "B" and "C," there are deficiencies at hydrants located along 6-inch water lines. For "B," there are adjacent hydrants on 10-inch and 16-inch water lines that can provide the fire flow requirement. For "C," projects D-18, D-19, and D-20 offer minimal improvement, but the deficiency can be eliminated if these water lines are replaced with larger diameter pipes.

At location "D," the deficiencies present can be satisfied by using multiple hydrants and so no improvements are recommended.

At location "E," deficiencies are present in a multi-family area and at a radio station along Almon St. Project D-22 will extend a 16-inch water line along Farm Rd to connect to Rodeo Dr, which would create a loop at the end of Almon St and increase fire flow availability.

At locations "F," "G," "H," "I," "M," and "R," the deficiencies in each boosted pressure zone are the result of the booster pump stations sized for domestic flow only, with the exception of Ponderosa BPS, which contains a fire pump. Additional piping projects have also been recommended to improve fire flow availability is some of these zones as needed.

At locations "J" and "L," fire flow availability is restricted by the size of the piping in the commercial area. The installation of the 12-inch water line creating a loop to Palouse River Rd and the connection along Mountain View Rd, almost eliminate the deficiency at "J," while replacing the 6-inch water line on White Ave with a 10-inch main greatly increases the fire flow availability at "L."

At locations "K," "N," "O," and "P," commercial and multi-family fire flow requirements are not met due to 6-inch and 8-inch piping, especially at locations on dead-end lines. Piping projects D-13, D-26, and D-27 increase connectivity but deficiencies still persist. The addition of project

D-31 at "N" eliminates the fire flow deficiency. Upsizing the small diameter piping would increase the fire flow availability in these areas.

Location "Q" identifies some localized fire flow deficiencies that are a result small diameter water lines. Projects D-28, D-29, and D-30 replace the deficient water lines with larger diameter piping and eliminate the deficiencies.

Figure 7-4 presents system-wide fire flow deficiencies, assuming all improvements noted above are implemented by 2030, thereby showing the reductions in fire flow deficiencies at the noted areas.

Extreme Fire Event Analysis

The base fire flow analysis described above examines the fire flow availability at each individual node in the hydraulic model. However, it is acknowledged that during large fire events, multiple fire hydrants are typically used to achieve the flow rates required to suppress the fire (e.g., one hydrant is incapable of providing flow rates of 4,250 or 7,250 gpm). Therefore, additional analyses were conducted to explore the ability of the distribution system to address "Extreme Fire Events". Such events were defined as:

- For Single-Family Residential, an event involving ten homes, requiring a fire flow of 1,500 gpm for two hours per home. This reflects the potential need for suppressing fires on the perimeter of the City, in the urban/wildland interface.
- For Multi-Family Residential, an event involving three buildings, with a fire flow of 4,250 gpm for two hours per building.
- For Commercial, a single large event requiring 7,250 gpm for the first four hours, followed by 3,625 gpm for an additional four hours. This reflects the potential need for suppressing a fire in the downtown commercial core of the City.

All of these analyses were run as extended period simulations in the hydraulic model, to explore impacts to reservoir levels and system pressures over the duration of the fire event, as opposed to the steady state simulation approach used for the base fire flow analysis (which considers only a "snapshot" in time at the end of a fire).

While not necessary to support development of the Comprehensive Water System Plan, the results of these "Extreme Fire Event" analyses are included in Appendix 7-1 as they are informative of the capabilities of the distribution system when stressed. In general, the system is not able to fully support the significant fire flow requirements associated with the Single-Family and Multi-Family Residential events, but it is capable of supporting the large singular fire events in the downtown commercial core. More details are provided in Appendix 7-1.

Table 7-6 Fire Flow Analysis Results

ID	Location	Description	Fire Flow Requirement (gpm)[1]	Current Available Fire Flow (gpm)	2030 Available Fire Flow (gpm)	Improvements
A	Warbonnet Dr and A St	Commercial fire flow on 8" and 10" water lines	7,250	2,700-5,000	6,600-10,000	D-33 to extend 16" loop to A St
B	Alley behind Best Western on SH 8	Commercial fire flow on 6" dead end main	7,250	2,150-3,550	2,150-3,550	No improvement, other hydrants on 10" waterline available
C	Baker St, Peterson Dr, A St	Commercial fire flow on 6" waterlines	7,250	4,000-5,400	>7,250	Annual small waterline replacement; D-18, D-19, and D-20
D	Downtown Central Business	Commercial fire flow on 6" and 8" waterlines	7,250	2,500-5,000	2,500-5,000	No improvements, deficiency is met by using multiple hydrants
E	Almon St	6" waterline restricts available flow	7,250	600-3,000	3,000-4,000	D-25 to install 12" on Almon St and D-22 to install new 12" from Farm Rd to Rodeo Dr
F	Ponderosa Zone	Fire pump does not serve the southern portion of the zone, and is deficient in capacity	1,500	750-1,450	1,500	PS-5 to replace ex BPS, D-10 and D-11 complete loops in the zone
G	Moser Zone	BPS is sized for domestic flow	1,500	750-1,300	1,700-2,500	PS-3 to replace ex BPS
H	Vista Zone	BPS is sized for domestic flow and high elevation in the zone limits flow through the PRV	1,500 [2]	600-2,000	1,500-2,500	PS-2 to replace ex BPS. Fire pump sized to provide 1,500 (to meet requirements of existing large structures of Trinity Baptist Church and Fairview Village Estates).
I	White Ave Zone	BPS is sized for domestic flow	1,500	550-600	>1,400	PS-1 to replace ex BPS
J	South of SH 8 from Blaine St to Mountain View Rd	Commercial fire flow in 8" piping	7,250	4,500-5,000	>6,200	D-7 to complete loop from Palouse River Rd
K	Pine Cone Rd, Northwood Dr, Indian Hills Dr, Hawthorne Dr, Rowe St	Multi-family fire flow in 6" piping	4,250	1,500-4,000	>3,900	D-26 and D-27 to complete loops on Hawthorne Dr and Rowe St, small waterline replacement
L	White Ave	Commercial fire flow in 6" piping	7,250	3400-4300	>7,000	D-31 to replace 6" with 10"
M	Indian Hills Zone	BPS is sized for domestic flow	1,500	800-1500	>1,200	PS-6 to replace ex BPS and D-32 to increase 6" main to 8"
N	Nursery St	Commercial fire flow on dead end 8" waterline	7,250	3,000-3,600	>6,700	D-21 to install new piping in planned SE Industrial Park to complete loops on Nursery St
O	W Palouse River Dr	Commercial fire flow on 6" and 10" main	7,250	3,500-4,800	3,600-5,300	D-13 increases fire flow slightly
P	Lauder Ave, Lenter St, Levick St	Multi-family fire flow in 6" piping	4,250	1,500-3,000	>4,250	Annual small waterline replacement to upsize 6" branches and 4" piping
Q	Narrow St, Elm St, Lilly St	Multi-family and Commercial fire flow in 4" piping	4250, 7,250	2,000-2,200	3,600-5,300	D-28, D-29, and D-30 to replace 4" piping
R	Taylor Zone	BPS is sized for domestic flow	1,500	900-1,500	>1,300	PS-4 to replace ex BPS

(1) Based on zoning, except where noted.
(2) Portions of the Vista Zone are zoned such that the fire flow requirement in some areas is technically 4,250 gpm (e.g., at an assisted living facility) or 7,250 (e.g., at a church). However, these facilities were constructed such that their building permits were issued indicating that 1,500 gpm of fire flow is sufficient (e.g., through the use of building sprinkling systems).

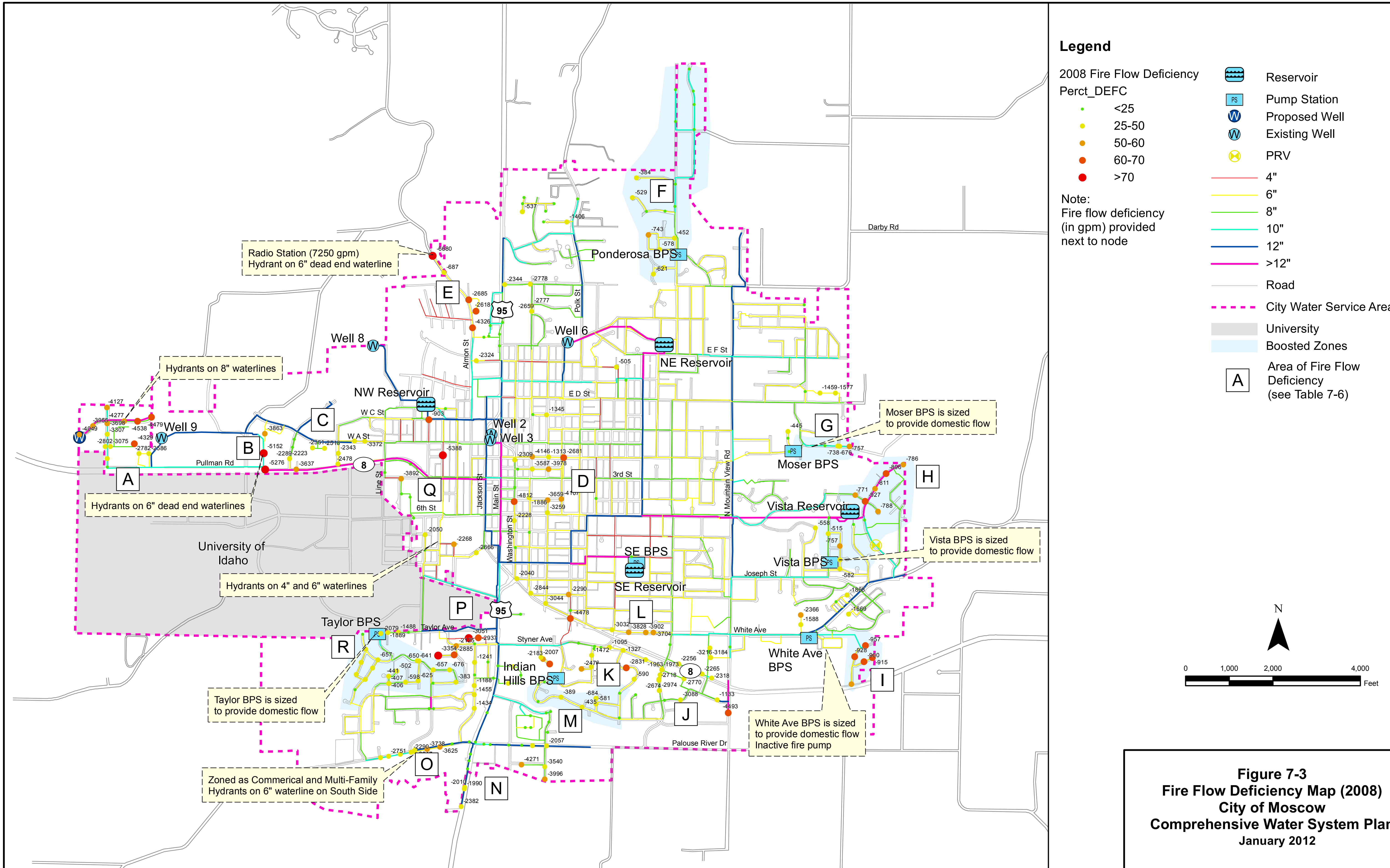


Figure 7-3
Fire Flow Deficiency Map (2008)
City of Moscow
Comprehensive Water System Plan
January 2012

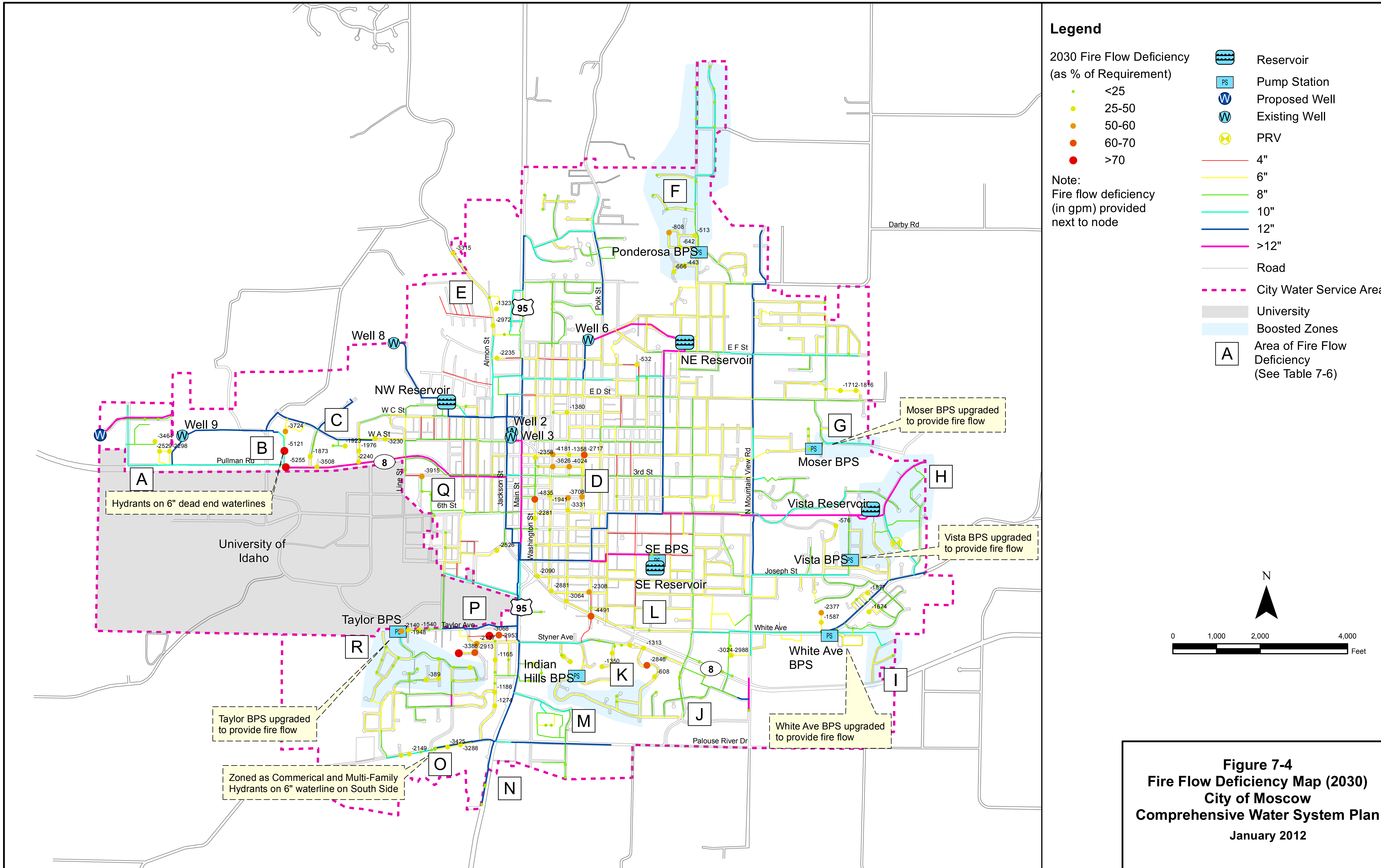


Figure 7-4
Fire Flow Deficiency Map (2030)
City of Moscow
Comprehensive Water System Plan
January 2012

7.3.8. Extended Period Simulation Analysis

In contrast to steady state simulation, extended period simulation (EPS) in the hydraulic model evaluates the function and operation of the system over time. As noted in the above section, EPS was used to evaluate Extreme Fire Events and their impacts to the system. Additional EPS scenarios were evaluated in the model to analyze other system functionality and explore benefits of certain proposed improvements. It should be noted that the model was not calibrated for EPS and the results of these analyses are preliminary in nature. The following is a list of EPS analyses performed in the hydraulic model. The results of all of these are discussed in greater detail in Appendix 7-1.

- Extreme Fire Event Analysis – Discussed in the prior section regarding fire flow analyses.
- Well 10 Transmission Analysis – Analyses were performed to evaluate the benefit and need of proposed piping improvements associated with Well 10. See Section 7.3.9 for detailed discussion.
- Vista Reservoir Offline – An analysis of the system was run with the Vista Reservoir offline. The SE BPS controls were reconfigured such that the BPS would operate in this condition, so that water from the SE Reservoir would be available to meet fire flow and standby needs. While the results are preliminary, this analysis suggests that the water system can continue in normal operation with the Vista Reservoir offline, so long as SE Reservoir water is available.
- 16” Transmission Main on SH8 Out of Service – Prompted by a main line break that occurred during the course of the hydraulic analysis, an evaluation was conducted regarding the ability of the system to deliver fire flow to the western commercial area of the City when the 16” transmission main on SH8 is out of service. The closure of the transmission main causes significant fire flow deficiencies in this portion of the system; however, when Well 9 is operating, a supply of 2000 gpm can be delivered to most of the area.

7.3.9. Well 10 Transmission Analysis

Prior to the analysis conducted during the development of this Plan, transmission piping projects were identified that might be necessary with the development of Well 10 (to be located in proximity to Well 9), in order to connect this new source of supply to the system and to support concurrent conveyance of water from both Wells 9 and 10 into the system in the future.

Two scenarios were used to evaluate the benefit of the previously identified project improvements:

- One Well. If only one well is operating (either Well 9 or 10), only project D-33 is required for system operation. This is the anticipated operation in the near-term; meaning that Well 10 will initially serve as a supplemental (or redundant) source of supply to Well 9. Under this condition, no other piping improvements are necessary.
- Two Wells. If both wells are operating simultaneously, which is anticipated to be a longer-range operational condition when demands require it, projects D-17, D-18, D-19, and D-20 are necessary to maintain system pressures within a reasonable range.

A more detailed description of this analysis is provided in Appendix 7-1. Following this analysis, a new CIP project was envisioned. Project D-33 was added to enable a simpler and more direct connection of Well 10 to the system. It replaces project D-17 as the sole project necessary for the connection of Well 10. However, project D-17 is necessary when both wells are being operated simultaneously, as are projects D-18 through D-20. In addition, project D-24 (a 24" transmission main proposed through the downtown area) is likely necessary to mitigate the impact upon system pressure of both wells pumping.

7.4. Water Quality and Treatment Evaluation

Water quality challenges and concerns are described below, along with recommendations for addressing each. This is followed by an evaluation of treatment options and the recommended operational and capital improvements regarding water quality that the City plans to implement over the next 20 years. Specific capital improvement projects are described in detail in Chapter 8.

7.4.1. Water Quality Challenges and Concerns

The City of Moscow obtains its drinking water from five groundwater sources: Wells 2, 3, 6, 8, and 9. All wells are chlorinated and Wells 2 and 3 are treated through a greensand filtration system. The City also has a planned site for Well 10 which is fairly close to Well 9.

The City has historically received numerous complaints regarding distribution system water aesthetics. They include:

- Chlorine taste,
- Rotten egg odor or musty smell,
- Dirty or colored (black to yellow) water,
- Staining of fixtures, and
- Metallic taste.

Additionally, the City's water is corrosive, particularly at Wells 2 and 3 which have a pH of 6.8. Table 7-7 summarizes water quality parameters that are of concern regarding the water quality issues.

Table 7-7 Well Flow Rate and Water Quality [1]

Parameter	Well 2 Raw	Well 3 Raw	Wells 2 & 3 Treated	Well 6 Raw	Well 8 Raw	Well 9 Raw
Flow rate (gpm)	850 [2]	1,200	2,050	1,200	1,100	2,350
Ammonia (mg/L as N)	ND	0.13	NR	0.20	0.19	0.14
Hydrogen Sulfide (mg/L)	ND	ND	NR	ND	ND	ND
Sulfate (mg/L)	64.8	128.8	NR	6.4	5.4	2.5
pH	6.8	6.8	NR	8.2	7.6	7.7
Hardness (mg/L as $CaCO_3$)	140	219	NR	76	80	104
Iron (mg/L) [3]	1.4	7.6	0.1	0.08	0.46	0.88
Manganese (mg/L) [3]	0.22	0.71	0.02	0.02	0.05	0.08

ND = Non Detect

NR = Not Reported

(1) Raw water quality data for the listed parameters was taken from an April 2004 Technical Memorandum by J-U-B Engineers entitled "Distribution System Water Quality Assessment and Review of Operational Practices." Well capacity rates as observed in 2009, at the time of this analysis. As noted earlier in Chapter 7, well production capacities decreased in 2010.

(2) Flow rate for Well 2 can be increased up to 1,200 gpm but sanding occurs above 850 gpm.

(3) The secondary Maximum Contaminant Levels (MCL) for iron and manganese are 0.30 and 0.05 mg/L, respectively. The suggested concentrations for iron and manganese entering a chlorinated distribution system are 0.06 and 0.01 mg/L.

Chlorine Taste

City staff indicate that the "chlorine" complaints tend to increase as chlorine dosing increases. The chlorine taste that customers complain about may very well be from free chlorine. However, it is more likely that the chlorine taste is from dichloramine or trichloramine.

Wells 3, 6, 8, and 9 have a significant concentration of ammonia in their water. When ammonia-bearing water is chlorinated, the ammonia is first converted to monochloramine (i.e., chloramination). Chlorine addition beyond monochloramination results first in the formation of dichloramine, then in the formation of trichloramine, and then finally in the decomposition of both dichloramine and trichloramine. This decomposition of the ammonia is referred to as breakpoint chlorination. A stable free chlorine residual is not possible until the breakpoint reaction is complete. Additionally, the chlorine in chlorinated water that comes in contact with ammonia-bearing water (including chloraminated water) will be used up in the breakpoint reaction resulting in a lower free chlorine residual or no free chlorine at all.

Dichloramine and trichloramine as well as the intermediate decomposition products impart a particularly chlorinous taste to the water. If the chlorine dosed to Wells 3, 6, 8, and 9 is greater than required for chloramination but insufficient for breakpoint chlorination, then it is very likely that customers will complain about a chlorine taste.

Recommendations

- Evaluate the free and total chlorine and extent of breakpoint chlorination at Wells 3, 6, 8, and 9.
- If the breakpoint chlorination reaction is not proceeding to completion, perform jar testing to define chlorine requirements.
- Results of the jar testing may lead the City to increase chlorine dosages.
- The City should conduct routine monitoring of both free and total chlorine.

Rotten Egg or Musty Odor

Another typical complaint has been a rotten egg odor or musty smell. This is typically caused by hydrogen sulfide. However, as seen in Table 7-7, hydrogen sulfide has not been detected in the raw water. Despite this, there may still be hydrogen sulfide in the water. The most likely explanation is the formation of hydrogen sulfide in the distribution system. Water from all the wells contain sulfate, with Wells 2 and 3 being particularly high. Sulfate can be reduced to hydrogen sulfide under anaerobic conditions. Anaerobic conditions can exist in ammonia-bearing water that was not sufficiently chlorinated, or in dead-ends, or in oversized or infrequently used pipes. The City's distribution system contains all of these elements.

Recommendations

- Reduce low chlorine locations in the distribution system by
  - Dosing sufficient chlorine for complete breakpoint chlorination.
  - Increasing minimum residual chlorine levels in the distribution system.
  - Flushing dead ends.
  - Eliminating dead ends through looping.

Manganese/Iron Related Complaints

The other customer complaints are either discolored water (yellow, red, brown, or black), staining of fixtures or clothes, or a metallic taste. These complaints are typically due to the presence of iron and/or manganese in the water.

When the raw water is chlorinated, most of the iron is immediately oxidized. The manganese in the water will also oxidize but may take hours to days to completely oxidize. Once oxidized, the iron and manganese oxides will settle in the distribution system piping. This typically occurs in the system headers coming off the wells (due to the higher concentrations in these areas) and in slower moving areas such as oversized pipelines and in reservoirs. Hydraulic disturbances (e.g., fire flows) fluidize the settled material resulting in slugs of discolored water. Oxidized iron and manganese also can impart a metallic taste to the water. The staining of fixtures is most likely due to manganese oxides precipitating on the fixtures.

The EPA's secondary maximum contaminant levels for iron and manganese are 0.30 and 0.05 mg/L, respectively. However, these levels generally result in precipitation issues in the distribution system. The typical recommendation for iron and manganese entering the distribution system is 0.06 and 0.01 mg/L, respectively.

There are typically two methods to treat iron and manganese bearing water. First is to treat the water using oxidation-filtration such as a greensand filtration system. Greensand filtration is more effective with higher pH water and requires sufficient oxidant (permanganate or chlorine) for complete oxidation of the iron and manganese. Also note that chloramine is not a powerful enough oxidant to regenerate the media. Therefore when chlorine is added to ammonia-bearing water, sufficient chlorine needs to be added to produce a free chlorine concentration as discussed above under Chlorine Taste.

The other treatment method is the addition of a sequestrant to the water. The sequestrant is typically a polyphosphate compound which surrounds the iron or manganese ions, preventing oxidation. Over several days, the polyphosphate breaks down into orthophosphate which attaches to iron in the piping or is incorporated into the iron scale, both of which assist in preventing future iron pipe corrosion.

As can be seen in Table 7-7, raw water from Wells 2 and 3 have very high concentrations of iron and manganese as well as high water hardness. Water from these wells is currently being treated using a greensand filtration process, with the treated water iron and manganese concentrations being 0.10 and 0.02 mg/L, respectively.

Water from Well 6 has iron and manganese concentrations slightly above the recommended values and may not be contributing to the colored water episodes. Wells 8 and 9 have iron and manganese concentrations well above the recommended valves and are likely responsible for the bulk of the colored water episodes. The iron and manganese concentration in these waters is within an effective treatment range by either greensand filtration or sequestration.

Recommendations

- Treat Wells 8 and 9 for iron and manganese using either sequestration or greensand filtration.

7.4.2. Treatment Options Evaluation

Wells 2 and 3 Filter Plant Evaluation

The water from Wells 2 and 3 is currently being treated using a greensand filtration process at the City's filter plant with the treated water iron and manganese concentrations being 0.10 and 0.02 mg/L, respectively. Although this is higher than the suggested concentrations of 0.06 and 0.01 mg/L for iron and manganese, respectively, the system does appear to be functioning adequately and is probably not significantly contributing to the colored water issue. It may be possible to lower these effluent concentrations to the recommended levels by increasing the pH of the incoming water.

Table 7-7 shows that water from Well 3 has 0.13 mg/L of ammonia. This concentration requires approximately 1.0 mg/L of chlorine for the completion of the breakpoint reaction. Chlorine for the residual is in addition to this. The treated water from the filter plant should be frequently tested for both free and total chlorine and possibly total ammonia to ensure the breakpoint reaction is proceeding to completion.

Backwash water and filter-to-waste water from the greensand filters flows into a basin under the floor. This waste water is then pumped out to the municipal sewer system. The wasting of this water results in a cost for sewering the water as well as a loss of water that could be used in the distribution system. A significant portion of this water could be recycled into the process by allowing the solids in the waste water to settle and decanting the cleaner water off the top. The decanted water would be injected into the raw water prior to oxidation. Periodically, the bottom layer of high solids water could be sewered.

Recommendations

- Regularly test the treated water for both free and total chlorine to make sure the Well 3 water is being breakpoint chlorinated.

- Regularly test the treated water to ensure that iron or manganese breakthrough is not occurring prior to backwashing. If iron or manganese is breaking through, perform subsequent analysis to determine if it is soluble or precipitated iron or manganese.
- Evaluate increasing the pH of Well 2 and 3 water prior to the greensand filters for improved manganese removal and improved corrosion characteristics in the distribution system.
- Investigate decanting and recycling backwash water to minimize water loss and sewage costs including performing a solids settling test on the filter backwash water.

Well 6 Evaluation

Well 6 is an active well treated only by chlorination. Table 7-7 shows the water has 0.20 mg/L ammonia. This concentration requires approximately 1.5 mg/L of chlorine for the completion of the breakpoint reaction. Chlorine for the residual is in addition to this.

Recommendations

- Regularly test the treated water for both free and total chlorine to verify the water is being breakpoint chlorinated.

Wells 8, 9, and 10 Facilities Evaluation

Wells 8 and 9 are active wells that only chlorinate the water. Well 10 is a proposed well in the same general area and it is assumed that it will have similar quality water to Wells 8 and 9.

Table 7-7 identifies water from Wells 8 and 9 having 0.19 and 0.14 mg/L of ammonia. These concentrations require approximately 1.4 and 1.1 mg/L of chlorine, respectively, for the completion of the breakpoint reaction. Chlorine for the residual is in addition to this. Frequently testing the treated water for both free and total chlorine and possibly total ammonia is necessary to ensure the breakpoint reaction is proceeding to completion.

Table 7-7 also shows that water from Wells 8 and 9 has 0.05 and 0.08 mg/L manganese and 0.46 and 0.88 mg/L iron, respectively. This iron and manganese is most likely the primary source of the colored water complaints. These concentrations can be effectively treated with either sequestration or greensand. As sequestration is significantly less expensive, it is recommended that this be evaluated first. This evaluation should include a sequestration jar test to compare the effectiveness of different sequestrants and to select a proper dose. After testing, complete an economic analysis looking at both capital and operating costs, and select preferred approach.

If sequestration is not an appropriate solution, use of greensand filtration will likely be required. Greensand system design requires a pilot test to determine the hydraulic loading rate (i.e., the size of the filters), chemical usage, run time, backwash frequency, and settling-ability of the solids in the backwash.

Because of the close proximity between Well 9 and the future Well 10, it is likely that a combined Well 9 and 10 treatment facility would be more economically feasible.

Recommendations

- Regularly test the treated water for both free and total chlorine to make sure the water is being breakpoint chlorinated.
- Perform sequestration evaluation jar tests on Well 8 and 9 water to determine the effectiveness of several different sequestrants at different concentrations. The goal of this is to find a sequestrant brand and a dose rate that works effectively on the City's water.
- If sequestration is not going to be used on Wells 8, 9 and 10, evaluate greensand filtration by performing a pilot test.
- Evaluated a new greensand facility for Well 9 and possible for a combined Well 9 and 10.

8. Capital Improvement Program

This chapter describes the methodology used in developing the City of Moscow's water system Capital Improvement Program (CIP), and presents the costs and schedules for projects planned for implementation in 2011-2030.

8.1. Development of CIP

The CIP was prepared by first identifying projects that address water system needs or deficiencies, as documented in earlier chapters of the CWSP. In addition, recurring or annual capital projects related to system maintenance (e.g., water main replacement programs) have also been included in the list of improvements.

A 20-year implementation schedule of the projects was then developed. Generally, projects of higher priority (i.e., those that address current system needs) were scheduled for implementation within the five-year planning horizon (2011-2015). Projects that serve anticipated future needs associated with system growth, or are less critical to system operation, were scheduled for implementation between 2016 and 2030. Detailed scheduling of the higher priority projects was based primarily upon the City's existing forecast of project implementation timelines and a detailed prioritization process wherein the City evaluated each project against a set of prioritization criteria. Appendix 8-1 provides the detailed results of the project prioritization process.

Planning-level cost estimates have been developed for each capital project included in the 2011-2030 CIP. Generally, each project cost includes the following components:

- **Base construction cost.** Includes all labor and material costs needed to construct a project. For pipeline and valving projects, construction costs were estimated based upon unit construction costs derived from bid tabulations for recent City projects and similar water distribution projects for other utilities in the area (e.g., City of Pullman). As such, these estimates incorporate all construction-related costs, including items such as mobilization and pavement restoration.
- **Construction contingency.** Takes into account the uncertainties associated with estimating project costs at this planning level. Calculated as 30 percent of the total of base construction plus sales tax.
- **Design engineering.** Includes City and consultant design costs, and other related cost items, such as permitting and construction administration. For most projects, this is calculated as 25 percent of the base construction cost. However, a higher percentage of the base construction cost is used for projects with more complex design or permitting needs.

These elements are summed to determine the total project-level cost estimate for a project, as expressed in 2010 dollars.

Where applicable, design costs are scheduled one year in advance of construction costs, to reflect the phasing typically used for larger projects.

8.2. Planned Projects

Table 8-1 presents the City's schedule of CIP projects planned for implementation between 2011 and 2030. Figure 8-1 provides the locations for the major planned improvements. Descriptions of each project follow.

In total, the City's five-year CIP (for years 2011-2015) includes approximately $9.9 million in improvements. The long-term CIP (2016-2030) includes approximately $93.5 million in additional improvements.

Table 8-1. Capital Improvement Program (2011-2030)

Project No.	Description	Purpose of Project (1)	Base Project Cost (2010 Dollars)	Schedule and Cost of Improvements (in thousands of dollars) 2011	2012	2013	2014	2015	5-yr CIP TOTAL	2016-2030 (2)	20-yr CIP TOTAL
Water System Projects											
Water Supply											
S-1	Well 10	Deficiency	2,300	2,300					2,300	0	2,300
S-2	Cemetery Well Development	Improve	500	500					500	0	500
S-3	Fe and Mn Sequestration and Breakpoint Chlorination Testing	Improve	15		15				15	0	15
S-4	Fe and Mn Sequestration Facilities	Improve	170						0	170	170
S-5	Fe and Mn Filtration Facilities	Improve	8,400						0	8,400	8,400
S-6	Long-term Water Supply Facilities	Growth	68,000						0	68,000	68,000
S-7	Filter Backwash Reclamation System	Improve	10					10	10	0	10
S-8	Well 6 Building Replacement	O&M	200					200	200	0	200
S-9	Well 6 Submersible Pump Modifications	O&M	300		300				300	0	300
Water Storage											
ST-1	Northwest Tank Replacement (1 MG)	Improve	1,970	100		300	1,570		1,970	0	1,970
ST-2	New Water Tank/Reservoir (2 MG)	Growth/Improve	3,150	45					45	3,105	3,150
Water Pump Stations											
PS-1	White Ave BPS Replacement	Deficiency	200						0	200	200
PS-2	Vista BPS Replacement	Deficiency	225		225				225	0	225
PS-3	Moser BPS Replacement	Deficiency	225			225			225	0	225
PS-4	Taylor BPS Replacement	Deficiency	200						0	200	200
PS-5	Ponderosa BPS Replacement	Deficiency	200				200		200	0	200
PS-6	Indian Hills BPS Replacement	Deficiency	225						0	225	225
Water Distribution System											
Projects Addressing Previously Identified Deficiencies											
D-1	Steel Main Replacement Program (annual)	Improve	60	60	60	60	60	60	300	360 2016-2021	660
D-2	Valve Replacement/Insertion Program (annual)	O&M	40	40	40	40	40	40	240	600	840
D-3	Fire Hydrant Replacement Program (annual)	O&M	30	30	30	30	30	30	150	450	600
D-4	Yoke Replacement Program (annual)	O&M	80				80	80	160	1,200	1,360
D-5	Lead Joint Main Replacement (annual)	Improve	135	135	135	135	135	135	675	2,025	2,700
D-6	Polk St: 8" main to complete loop (500')	Improve	70	70					70	0	70
D-7	East Palouse River Drive: 12" main to complete loop at dead end (1300')	Deficiency	200						0	200	200
D-8	6th St: 8" main to complete loop at dead end (600')	Improve	80		80				80	0	80
D-9	Walenta Dr: 8" main to complete loop at dead end (400')	Improve	60			60			60	0	60
D-10	Orchard Street and Arborcrest Road: 10" main to complete loop (800')	Improve	120						0	120	120
D-11	Pheasant Run and Christopher Lane: 8" main to complete loop (500')	Improve	70						0	70	70
D-12	Franklin Rd to Polk St: 8" main to complete loop (900')	Improve	130						0	130	130
D-13	Sunnyside Addition: 8" main from Victoria Dr to Palouse River Dr (1300')	Improve	180						0	180	180
D-14	Well 6 Discharge Line Revisions (800')	Improve	130						0	130	130
D-15	Warbonnet Drive: Replace 10" with 16" main from SR8 to A Street (1200')	Improve	210						0	210	210
D-16	SR8: Replace 10" with 16" main from University Inn (Farm Road) to Warbonnet Drive (3600')	Improve	630						0	630	630
D-17	A Street Extension: 16" main from existing terminus of system east of Warbonnet Drive to Farm Road (2,600')	Deficiency	460						0	460	460
D-18	A Street: 12" main from Peterson to Line Street (660')	Improve	100						0	100	100
D-19	A Street: Replace 8" with 16" main from Line Street to Jackson Street (2300')	Improve	400						0	400	400
D-20	Line Street: Replace 8" with 16" main from A Street to SR8 (400')	Improve	70						0	70	70
D-21	SE Industrial Park: Install 8" (2600') and 12" (4500')	Growth	1,060						0	1,060	1,060
D-22	Farm Rd Expansion: 16" from Farm Rd and A St to Rodeo Dr (7,600')	Growth	1,320						0	1,320	1,320
D-23	Mountain View Rd: 12" to complete loop on Mountain View Rd (150')	Improve	20	20					20	0	20
Newly Identified Projects											
D-24	Downtown Transmission: Replace 8" with 24" main on 3rd St from Jackson St to Hayes St and 12" on Hayes St from 3rd St to 6th St (4,400')	Improve	840						0	840	840
D-25	Almon St Transmission: Replace 6" with 16" main with extension north (4300')	Deficiency	750					750	750	0	750
D-26	Rowe St: 8" main to complete loom to Northwood Dr (300')	Deficiency	50		50				50	0	50
D-27	Hawthorne Dr: 8" main to complete loop to Indian Hills Dr (300')	Deficiency	50			50			50	0	50
D-28	Narrow St: Replace 4" with 8" main from Deakin Ave to College St (600')	Deficiency	80				80		80	0	80
D-29	Elm St: Replace 6" with 8" main Idaho Ave to 7th St (400')	Deficiency	60					60	60	0	60
D-30	Lilly St: Replace 4" with 8" main (800')	Deficiency	120						0	120	120
D-31	White Ave: Replace 6" with 10" main from Blaine St to Lynn St (1400')	Deficiency	210						0	210	210
D-32	Indian Hills Dr: Replace 6" with 8" from Northwood Dr to Atsirk St (2,300')	Deficiency	320						0	320	320
D-33	A St Connection: New 16" main from A St South to connect to 12" by Well 9 (900')	Improve	150	150					150	0	150
D-34	SR 8 AC Replacement: Replace 10" AC piping with new 16" main (800')	Improve	140		140				140	0	140
Water Maintenance and Operations											
M-1	GPS Mapping	O&M	35	35					35	0	35
M-2	Water System Security Improvements (annual)	O&M	20	20	20	20	20	20	100	20 Ends in 2016	120
M-3	Water Quality Study	O&M	70			70			70	0	70
M-4	Standby Power Generation Facilities	O&M	240	80	50		110		240	0	240
M-5	Chlorination Process Conversion	O&M	160		160				160	0	160
M-6	Water Department Operations Facility	O&M	2,000						0	2,000	2,000
M-7	Maintenance Management System	O&M	35	35					35	0	35
M-8	SCADA Improvements	O&M	250	50	50	50	50	50	250	0	250
M-9	Wireless Field Access to GIS and CMMS	O&M	20		20				20	0	20
Total Water System Improvements				**3,670**	**1,375**	**1,040**	**2,375**	**1,435**	**9,935**	**93,525**	**103,460**

Notes:

(1) Purpose of Project: Deficiency = Addresses deficiencies identified in the Water System Plan; Improve = Does not address a deficiency, but improves overall system operation; Growth = Required to address growth/expansion of the distribution system; O&M = Necessa

(2) Total costs associated with projects implemented in 2016 through 2030. Specific years of project implementation are noted where applicable.

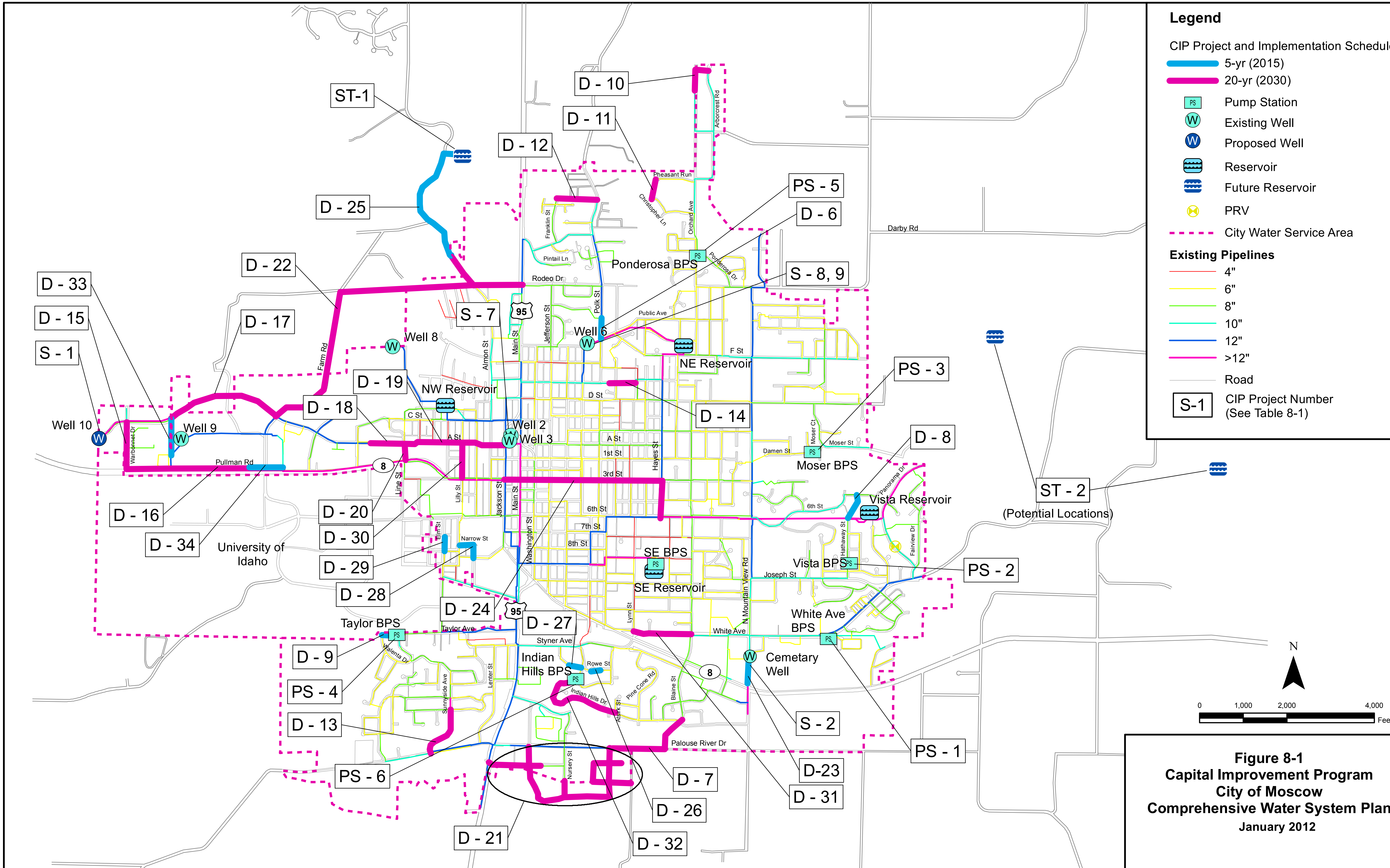


Figure 8-1
Capital Improvement Program
City of Moscow
Comprehensive Water System Plan
January 2012

8.2.1. Water Supply and Treatment

The following are water source-related or treatment-related capital projects that address deficiencies or needs described in Chapter 7.

- **S-1 Well 10**

  A new well source will be developed at the western boundary of the system along A Street. The proposed Well 10 will be sized to match the current capacity of Well 9. Well 10 will initially operate as a redundant supply to Well 9, utilizing the same water rights. In the future, as system demands increase, Well 10 may be operated in conjunction with Well 9. Such operation will require additional water rights and additional distribution piping improvements, as discussed in Section 8.2.4.

- **S-2 Cemetery Well Development**

  Complete development of the new cemetery well facility including refurbishment of the existing filtration system, installation of a new well house, on-site hypochlorite generation system, and well pump, motor, and associated piping and control systems.

- **S-3 Fe and Mn Sequestration and Breakpoint Chlorination Testing**

  Conduct jar testing to evaluate breakpoint chlorination at Wells 6, 8, and 9. At the same time, conduct jar testing of sequestrants at Wells 8 and 9 to compare effectiveness of different sequestering agents and to select proper doses.

- **S-4 Fe and Mn Sequestration Facilities**

  If the results of S-3 indicate that sequestration at Wells 8 and 9 is successful and practical, this project involves implementation of sequestration facilities at those facilities. This will be done to also incorporate Well 10.

- **S-5 Fe and Mn Filtration Facilities**

  If the results of S-3 indicate that sequestration is not effective, this project involves implementation of greensand filtration facilities at Wells 8 and 9, that latter of which would be sized to accommodate Well 10. This will require the following steps for implementation:

  - Run a greensand pilot test at Wells 8 and 9 to determine the hydraulic loading rate, chemical usage, run time, backwash frequency, and settlability of the solids in the backwash.
  - Perform an economic analysis of both capital and operating costs of greensand facilities at Wells 8 and 9.
  - Evaluate various scenarios involving development of greensand facilities for Wells 8, 9, and/or 10 at individual well sites or at a common site.

- **S-6 Long-term Water Supply Facilities**

  The City has conducted preliminary evaluations of additional water supply options to bolster system reliability and aid the system in meeting long-term (i.e., 50-year) needs. Recent studies have explored the feasibility of alternatives such as surface water supplies and surface water storage facilities, aquifer storage and recovery, and reclaimed water. This project listing serves to acknowledge that such analysis will continue and that the City will likely plan significant supply project implementation in the long-term. The cost presented in Table 8-1 represents the high end of estimates associated with the development of a Moscow Mountain surface water storage and supply facility.

- **S-7 Filter Backwash Reclamation System**

  This project involves implementing a reclamation system at the Wells 2 and 3 filter facility, so as to reduce water waste involved with this treatment process. Further evaluation of the feasibility of this project is needed, as there are complicating factors, such as the presence of groundwater being introduced into the sump at the facility (i.e., the sump captures water from multiple sources, not just the treatment backwash). For planning purposes, a modest amount has been budgeted to further explore this project. Additional funds will be needed once the project is more clearly defined.

- **S-8 Well 6 Building Replacement**

  Existing structure is deteriorating beyond reasonable repair costs and poses potential security problems.

- **S-9 Well 6 Submersible Pump Modifications**

  Lower the pump due to excessive drawdown. Add a new booster station to bring discharge pressures from site up to system levels. Resolve current oil lube pump issues, and update electrical systems, controls, etc.

8.2.2. Water Storage

The following storage-related capital projects address deficiencies or needs described in Chapter 7.

- **ST-1 Northwest Tank Replacement (1 MG)**

  Replacement of a small capacity elevated tank that is over 75 years old. Anticipated maintenance costs for the next ten years are in excess of $350,000. Estimated replacement cost consists of $100,000 for removal of existing tank and $2,000,000 for a new 1 MG replacement tank or standpipe. A proposed location with high elevation is in the northwest portion of the system along Almon Street. There is land above 2740 feet at this location; however, the availability of that land for purchase and/or use as a storage reservoir site has not been confirmed. If located in this vicinity, the future reservoir could have a base elevation of 2740 feet and an overflow elevation of 2,790 feet to match the hydraulic grade of the Vista Reservoir. At a height of 50 feet, the diameter would be 30 feet.

- **ST-2 New Water Tank/Reservoir (2 MG)**

  A new 2 MG storage tank will be installed to provide additional storage in the system, aiding in bolstering system reliability and also supporting future growth in the eastern portion of the City. Potential locations for such a tank, based on suitable ground elevations in the northeast area of the City, are identified on Figure 8-1.

8.2.3. Booster Pump Stations

The following booster pump station capital projects address deficiencies or needs described in Chapter 7. See Chapter 7 for detailed discussion of referenced deficiencies that are addressed by specific projects. All booster pump station replacement projects will consider the incorporation of standby power provisions during design.

- **PS-1 White Avenue BPS Replacement**

  Replacement of the existing pump station with an upgraded facility. The pump station currently provides domestic flow and has an inactive fire pump. It will be replaced with an above-grade facility capable of more efficiently providing domestic capacity via two variable frequency drive (VFD) pumps (allowing for redundancy), and provision of fire suppression via a fire pump. This project addresses fire flow deficiency "I."

- **PS-2 Vista BPS Replacement**

  Replacement of the existing pump station with an upgraded facility. The current pump station is sized only for domestic flow and is installed below-grade. It will be replaced with an above-grade facility capable of more efficiently providing domestic capacity via two VFD pumps (allowing for redundancy), and provision of fire suppression via a fire pump. The location is anticipated to be moved north on Hathaway Street, potentially on the water department's "park" property in this vicinity, to connect to the 24-inch transmission main from the Vista Reservoir. This project addresses fire flow deficiency "H." In addition, the pumps should be sized to accommodate future demands growth in the eastern portion of the City. During design of this upgrade, consideration should be given to connecting the Moser and Vista pressure zones, particularly in light of the planned future northeast tank (project ST-2).

- **PS-3 Moser BPS Replacement**

  Replacement of the existing pump station with an upgraded facility. The current pump station is sized only for domestic flow and is installed below-grade. It will be replaced with an above-grade facility capable of more efficiently providing domestic capacity via two VFD pumps (allowing for redundancy), and provision of fire suppression via a fire pump. This project will likely require the purchase of property, and its location is anticipated to be moved from Damen Street to Moser Court. The new location is on an 8-inch main which will provide sufficient capacity for the operation of the fire pump. The pump station is currently supplied by a 6-inch main which would restrict the fire flow capacity of the proposed pump station upgrade. This project addresses fire flow deficiency "G." During design of this upgrade, consideration should be given to connecting the Moser and Vista pressure zones, particularly in light of the planned future northeast tank (project ST-2).

- **PS-4 Taylor BPS Replacement**

  Replacement of the existing pump station with an upgraded facility. This is the oldest pump station, having been installed in the 1950s. A new above-grade pump station will provide domestic flow via two VFD pumps (allowing for redundancy), and provision of fire suppression via a fire pump. This project addresses fire flow deficiency "R."

- **PS-5 Ponderosa BPS Replacement**

  Replacement of the existing pump station with an upgraded facility. The current pump station is sized for domestic and fire flow capacity, and is installed below-grade. The current configuration includes a separate location for the fire pump which only serves the northern portion of the boosted zone. A new above-grade pump station will include domestic capacity via two VFD pumps (allowing for redundancy), along with a fire pump, at the same location as the existing domestic pump so as to provide fire flow to the entire boosted zone.

- **PS-6 Indian Hills BPS Replacement**

  Replacement of the existing pump station with an upgraded facility. The current pump station is sized only for domestic flow and is installed below-grade. It will be replaced with an above-grade facility capable of more efficiently providing domestic capacity via two VFD pumps (allowing for redundancy), and provision of fire suppression via a fire pump. This project addresses fire flow deficiency "M." In order for the fire flow capacity of the pump station to be fully effective, project D-32 is required to increase the capacity of the main downstream from the pump station.

8.2.4. Water Distribution System

The following transmission and distribution-related capital projects address deficiencies or needs described in Chapter 7. See Chapter 7 for detailed discussion of referenced deficiencies that are addressed by specific projects.

- **D-1 Steel Main Replacement Program**

  Replacement of aging and undersized steel water mains. Approximately 5,000 feet to be replaced over ten years at an estimated cost of $100-$150 per lineal foot.

- **D-2 Valve Replacement/Insertion Program**

  Replacement of old valves and installation of new valves where currently lacking. Estimate is based on average of 12.5 valves per year at $3,200 per valve.

- **D-3 Fire Hydrant Replacement Program**

  Replacement of old and malfunctioning fire hydrants throughout the city. Estimate is based on average of 7.5 fire hydrants per year at $4,000 per hydrant.

- **D-4 Yoke Replacement Program**

  Remove and replace approximately 500 galvanized service lines and yokes. Estimated cost is $1,800 per service.

- **D-5 Lead Joint Main Replacement**

  Replacement of approximately 18,000 feet of lead joint main throughout the City.

- **D-6 Polk Street**

  New 8-inch main to complete loop on Polk Street. Approximately 500 feet from Public Avenue to existing 12-inch main on Polk Street.

- **D-7 East Palouse River Drive**

  New 12-inch main to complete loop on East Palouse River Drive. Approximately 1,300 feet from dead end of main to Blaine Street. This project addresses fire flow deficiency "J."

- **D-8 6th Street**

  New 8-inch main to complete loop on 6th Street approximately 600 feet from existing 24-inch transmission main at Hathaway Street to existing 8-inch main on 6th Street. This project eliminates dead ends.

- **D-9 Walenta Drive**

  New 8-inch main to complete loop on Walenta Drive. Approximately 400 feet from dead end main on Walenta Drive to high pressure side of Taylor Avenue.

- **D-10 Orchard Street and Arborcrest Road**

  New 10-inch main to complete loop between Arborcrest Road and Orchard Street. Approximately 800 feet from the existing dead end main on Arborcrest Road to the existing dead end main on Orchard Street. This project addresses fire flow deficiency "F" along with project D-11.

- **D-11 Pheasant Run and Christopher Lane**

  New 8-inch main to complete loop between Pheasant Run and Christopher Ln. Approximately 500 feet from the existing dead end main on Pheasant Run to the existing dead end main on Christopher Lane. This project addresses fire flow deficiency "F" along with project D-10.

- **D-12 Franklin Road to Polk Street**

  New 8-inch main to complete loop between Franklin Road and Polk Street. Approximately 900 feet from the existing dead end main on Franklin Road to the existing 10-inch main on Polk Street.

- **D-13 Sunnyside Addition**

  New 8-inch main along Sunnyside Avenue approximately 1300 feet from Palouse River Drive to Victoria Drive. The project completes a loop.

- **D-14 Well 6 Discharge Line Revisions**

  Revisions at Well 6 to replace existing discharge line. Reroute project involves approximately 800 feet of 12-inch main on E Street. This project will occur after Project S-9 is completed.

- **D-15 Warbonnet Drive**

  Replace existing 10-inch main from A Street to SR8 with approximately 1125 feet of 16-inch main. The project bolsters reliability in this portion of the distribution system.

- **D-16 SR8: University Inn to Warbonnet Drive**

  Replace existing 10-inch main from University Inn (Farm Road) to Warbonnet Drive with 3600 feet of 16-inch main. The project bolsters reliability in this portion of the distribution system.

- **D-17 A Street Extension**

  New 16-inch main to complete loop along A Street, approximately 2600 feet, from an existing terminus of the system east of Warbonnet Drive to Farm Road. This project is needed in future years, when Wells 9 and 10 pump together to meet increased demands.

- **D-18 A Street: Peterson Drive to Line Street**

  New 12-inch main along A Street, approximately 660 feet, to extend an existing 12-inch main between Peterson Drive and Line Street. This project is identified as part of the future Well 10 system improvements. This project also addresses a portion of the fire flow deficiency "C" along with projects D-19 and D-20.

- **D-19 A Street: Line Street to Jackson Street**

  Replace an 8-inch main along A Street with approximately 2300 feet of 16-inch from Line Street to Jackson Street. This project is identified as part of the future Well 10 system improvements. This project also addresses a portion of the fire flow deficiency "C" along with projects D-18 and D-20.

- **D-20 Line Street**

  Replace an 8-inch main along Line Street with approximately 400 feet of 16-inch main from A Street to SR8. This project is identified as part of the future Well 10 system improvements. This project also addresses a portion of the fire flow deficiency "C" along with projects D-18 and D-19.

- **D-21 SE Industrial Park**

  A development in the southern portion of the water system for an Industrial Park. The development, southeast of E Palouse River Drive and Main Street will add approximately 2600 feet of 8-inch main and 4500 feet of 12-inch main. This project will address the fireflow deficiency "N."

- **D-22 Farm Road Expansion**

  New 16-inch main extending approximately 7600 feet along Farm Road from A Street to Rodeo Drive and creating a loop to Almon Street. This project is for the future expansion of the water system to the Northwest and provides transmission for a future reservoir on Almon Street. This project also addresses fire flow deficiency "E" along with project D-25.

- **D-23 Mountain View Road**

  New 12-inch main to complete a loop along Mountain View Road approximately 150 feet from an existing 10-inch main to a 16-inch main.

- **D-24 Downtown Transmission**

  Replace an existing 8-inch main along 3rd Street from Jackson Street to Hayes Street and an existing 12-inch main on Hayes Street from 3rd Street to 6th Street with approximately 4400 feet of 24-inch main. This project reduces the high pressures experienced by the westerly and downtown portions of the distribution system when Well 9 is pumping and the NW and NE Reservoir altitude valves are closed.

- **D-25 Almon Street Transmission**

  Replace 6-inch main with 16-inch main on Almon Street north of the point of connection for project D-22 and extend the 16-inch main approximately 4300 feet to a future reservoir location. This project will provide transmission for the future reservoir ST-1. This project also improves fire flow availability to the Radio Station on Almon Street noted as fire flow deficiency "E" along with project D-22.

- **D-26 Rowe Street**

  New 8-inch main to complete a loop, approximately 300 feet, from Rowe Street to Northwood Drive. This project addresses the fire flow deficiency "K" by in increasing connectivity in the area.

- **D-27 Hawthorne Drive**

  New 8-inch main to complete a loop, approximately 300 feet, from Hawthorne Drive to Indian Hills Drive. This project addresses the fire flow deficiency "K" by in increasing connectivity in the area.

- **D-28 Narrow Street**

  Replace a 4-inch main on Narrow Street with approximately 600 feet of 8-inch main. This project addresses a portion of the fire flow deficiency “Q.”

- **D-29 Elm Street**

  Replace a 6-inch main on Idaho Avenue with approximately 400 feet of 8-inch main. This project addresses a portion of the fire flow deficiency “Q.”

- **D-30 Lilly Street**

  Replace a 4-inch main on Lilly Street with approximately 800 feet of 8-inch main. This project addresses a portion of the fire flow deficiency “Q.”

- **D-31 White Avenue**

  Replace 6-inch main along White Avenue from Blaine Street to Lynn Street with approximately 1400 feet of 10-inch main. This project addresses the fire flow deficiency “L.”

- **D-32 Indian Hills Drive**

  Replace 6-inch main on Indian Hills Drive from Northwood Drive to Atsirk Street with approximately 2300 feet of 8-inch main. This project increases the potential capacity of the Indian Hills BPS. The planned improvements to the pump station include a fire flow capacity upgrade which is currently limited by the existing 6-inch main. This project, in conjunction with project PS-6, addresses the fire flow deficiency “M.”

- **D-33 A Street Connection**

  New 16-inch to complete a loop, approximately 900 feet, from the existing 16-inch main on A Street east of Warbonnet Drive to the existing 12-inch main adjacent to Well 9. This project is identified as part of the Well 10 system improvements. It is the sole project necessary for the installation of the Well 10 when Well 9 and Well 10 operate separately. This project also addresses the fire flow deficiency “A.”

- **D-34 SR8 AC Replacement**

  Replace an existing 10-inch AC main along SR8 with approximately 800 feet of 16-inch DI main.

8.2.5. Water Maintenance and Operations

The following are maintenance and operations-related capital projects that address deficiencies or needs.

- **M-1 GPS Mapping**

  Complete GPS field survey.

- **M-2 Water System Security Improvements**

  Installation of security lighting, motion detection devices and fencing over a ten year period. These items were addressed in the 2004 vulnerability assessment.

- **M-3 Water Quality Study**

  Study methods to further improve water quality and develop a capital plan for necessary improvements, not included above.

- **M-4 Standby Power Generation Facilities**

  Installation of on-site generators at three well sites (Wells 6, 8, and 9) to provide emergency power for water production.

- **M-5 Chlorination Process Conversion**

  Change in method of chlorination from chlorine gas to on-site generation or other method to eliminate potential safety issues and buildup of chlorine byproducts in dead-end water mains.

- **M-6 Water Department Operations Facility**

  Construction of a new building at a new site for use by the Water Department. Location could be at the existing Street Department site or may be in conjunction with a new Public Works Maintenance facility at a new undetermined site.

- **M-7 Maintenance Management System**

  Purchase and implementation of a maintenance management system.

- **M-8 SCADA Improvements**

  SCADA improvements are intended to replace and or upgrade a system that is 15 years old. The cost of full replacement in one project is significant and outside of the City's budget resources. A phase approach with the following steps is most likely to be implemented. The complete process is likely to take three to four years.

  - Replace the computers, operating system and associated software that gather and display information from remote sites and allow control of associated equipment.
  - Install a master Programmable Logic Controller (PLC).
  - Replace remote transmitting units with PLCs.
  - Consider use of radio rather than phone lines.
  - Add additional data points such as motor temperature or amperage or other useful information.

- **M-9 Wireless Field Access to GIS and CMMS.**

  Provide for ability of field staff to access GIS and CMMS remotely via laptops.

9. Financial Plan

The effective implementation of a Comprehensive Water System Plan (CWSP) is dependent upon accurately developing a plan that can be financially supported by the utility; will meet State and local regulatory requirements; and provides the flexibility to deal with unforeseen changes.

This chapter presents a financial plan that reviews the revenues and expenses for the City's water system. The financial plan includes projected operating and capital costs of the system for the six-year time horizon of FY 2011 to 2016. The revenues and expenses used in the financial plan were obtained from the City's FY 2011 and FY 2012 budget and escalated for future years. The capital costs contained within the financial plan utilize the Capital Improvement Plan (CIP) in Chapter 8 of this CWSP. The results of the financial plan outline the annual operating and capital needs of the water system and determine if the current water utility revenues are sufficient to cover operating and capital costs. As necessary, the level of rate adjustment needed to fully fund operating and capital costs is provided.

This analysis is not intended to provide a detailed review of cost of service or rate design analysis. It is developed to evaluate the adequacy of rate revenue and other miscellaneous revenues to meet the projected financial obligations of the utility. The analysis determines any adjustments in rates needed to fully fund operating and capital expenses of the utility, as developed within this financial plan.

9.1 Past Financial History

The past four years of financial information for the water utility were evaluated to gain an understanding of the past performance and current financial status of the utility.

Provided below in Table 9-1 is a summary of the four-year financial history (FY 2007 – FY 2010) for the City's water utility. The City's capital improvement projects have been funded primarily through water utility rates and reserves.

Table 9-1. Summary of Five-Year Financial History ($000s)

	FY 2007	FY 2008	FY 2009	FY 2010
Revenues				
Rate Revenue	$3,020	$3,030	$3,015	$3,031
Miscellaneous Revenue	214	194	305	182
Total Revenue	**$3,234**	**$3,224**	**$3,320**	**$3,213**
Expenses				
General O&M	$1,508	$1,657	$1,864	$1,847
Capital Improvement Projects	363	735	121	103
Transfers	733	917	1,380	1,174
Debt Service	0	0	0	0
Total Expenses	**$2,603**	**$3,310**	**$3,365**	**$3,124**
Balance/(Deficiency)	**$631**	**($86)**	**($45)**	**$89**

As can be seen in Table 9-1, the utility has historically had adequate funding to meet operating and capital needs during the four year period reviewed. When deficiencies occur, that is typically due to capital investments. In those instances capital reserves are utilized to fund the difference. The City has two reserve funds, an operating reserve and a capital reserve. The operating reserve is primarily in place to fund any one-time increases in O&M expenses minimizing short-term rate increases and provide coverage if revenues do not meet target levels. The Capital reserve is in place to fund specific capital improvements or overall capital improvements to minimize the impact the capital projects may have on rates (i.e., long-term debt).

9.2 Review of the City's Water Rates

The City has adopted water rates to meet its financial requirements. Provided in Table 9-2 are the FY 2010 water rates of the City.

Table 9-2. Overview of the City's Current Water Rates

	Meter Size	Base Rate
Monthly Fixed Charge		
Single Family	per meter	$18.90
Multi-Family & Commercial	5/8 inch	$18.90
	1 inch	$23.65
	1 1/2 inch	$47.20
	2 inch	$75.50
	3 inch	$141.55
	4 inch	$238.60
Consumption Charge		
Single Family Residential		
Block 1	0 – 700 cf	$1.60 ccf
Block 2	701 – 2,000 cf	$1.90 ccf
Block 3	Over 2,001 cf	$3.25 ccf
Multi-Family & Commercial		
All Usage	per ccf	$1.90 ccf
Moscow Cemetery		
All Usage	per ccf	$0.70 ccf

The City's rate structure consists of a base charge and a usage (commodity) charge for each hundred cubic foot (ccf) of water used. Residential consumption rate is based on an increasing three block rate structure. For the first block, a customer can use up to seven hundred cubic feet (ccf), or the equivalent of a little over 5,000 gallons before paying a higher cost per cubic foot of water used. Blocks 2 and 3 are designed to encourage water conservation for outside usage. Multi-Family, Commercial, and the Moscow Cemetery customer usage is based on a uniform rate structure.

9.3 Development of the Financial Plan

A financial plan was developed to address projected revenues and expenses of the water system for FY 2011 through FY 2016. The plan demonstrates the City's ability to meet its operational and capital improvement needs and debt service through water utility rate revenues.

In developing the financial forecast, a cash basis approach was used to determine the total need to fund the water utility's operating and capital costs. The cash basis approach includes four cost components: operating & maintenance (O&M) expenses, transfers, debt service, and capital funding from rates. This is the method used in the City's past rate study and the rate study currently underway. The City's FY 2011 and FY 2012 water utility budget was used as a starting point.

Projections for future years were obtained by applying annual escalation factors. The escalation factors ranged from 2% to 4%, depending on the type of cost being escalated. Projected growth rate in FY 2012 is projected to be 0.5%; thereafter the projected growth rate increases by 0.2% each year until FY 2015 when it levels out at 1.0% each year. These same values were used for other growth-related revenues in development of the financial plan.

9.3.1 Water Utility Revenues

The first component of the financial plan reviews the sources of funds of the water system. There are two primary types of revenues received for operations:

- Rate revenues – received from water sales to customers, and
- Miscellaneous revenues – received from water main permit test fees, turn on/off fees, refunds & reimbursements, tap fees, and investment interest.

Rate revenues are projected to be $3.14 million in FY 2011. Rate revenue growth is projected at the same percentages as the previously mentioned growth factors. The growth factors for rate revenues are 0.5% in FY 2012, 0.7% in FY 2013, 0.9% in FY 2014, and 1.0% in FY 2015 and FY 2016. This minor escalation resulted in projected revenue of approximately $3.27 million in FY 2016. The majority of miscellaneous revenue is from investment interest, which averages about $97,000 FY 2011 through FY 2016.

The total revenues available for the operating needs of the water system total $3.2 million in FY 2011 and increase to $3.4 million by FY 2016, as shown later in this chapter and below in Table 9-3.

Table 9-3. Projected Six-year Revenue ($000s)

Sources of Funds	Budget			Projected		
	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Rate Revenue	$3,144	$3,229	$3,251	$3,280	$3,312	$3,346
Miscellaneous Revenue	94	49	45	49	50	51
Total	$3,238	$3,278	$3,296	$3,329	$3,361	$3,396

9.3.2 Water Utility Expenses

The second part of the financial plan is a review of the applications of funds, or expenses, of the water utility. Expenses include operating & maintenance expenses, transfers, debt service, and capital improvement projects funded from rates. These costs are summarized below, and are provided in Table 9-5, later in this chapter.

Operation & Maintenance Expenses. The FY 2011 and FY 2012 budgets were used as a starting point for the O&M expenses of the water system. As stated previously, escalation factors were applied to the budgeted O&M expenses to obtain projected costs for FY 2013 through 2016. It should be noted that an additional full time operator was included in the projections starting in FY 2013. Other than this addition, no other extraordinary cost changes were assumed as part of the projected costs in future years. O&M expenses are projected to range from $1.9 million in FY 2011 to $2.5 million in FY 2016. This increase is due primarily to assumed inflationary factors.

Transfers. The water system has several transfer obligations. These include transfers to the General Fund, Street Fund, Parks and Recreation, Fleet Management, and Information System. Each transfer fund was escalated using general cost inflation. For the study, the projected inflationary cost is 2.6% annually.

Debt Service. The City currently has no outstanding debt service. However, an SRF loan is in the process of being obtained to help fund the Well 10 project. In addition, additional long-term borrowing is necessary to fund the capital program. Specifically in FY 2014 and FY 2015 additional long-term borrowing is assumed to fund the capital improvement plan. The remaining capital improvement projects are assumed to be funded through a combination of existing reserves and rates.

Provided below in Table 9-4 is a summary of the annual O&M expenses, debt service, and transfer payments.

Table 9-4. Projected Six-year Expenses ($000s)

Sources of Funds	Budget			Projected		
	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
O&M Expenses	$1,990	$2,170	$2,225	$2,297	$2,371	$2,479
Debt Service	0	137	137	263	323	323
Transfer Payments	992	962	988	1,015	1,043	1,072
Total	$2,981	$3,269	$3,351	$3,576	$3,738	$3,875

Total operating expenses, less capital, range from $3.0 million in FY 2011 to $3.9 million in FY 2016. The increase is the result of assumed inflation on O&M expenses, additional debt service for the SRF loan, and future long-term borrowing in FY 2014 and FY 2015, and assumed inflationary increases in annual transfer payments. The next aspect of the water utility expenses is the capital expenses. Capital expenses impact rates through annual rate funded capital and debt service on long-term borrowing.

Capital Improvement Projects Expenses and Funding. The CIP of the utility contains needed infrastructure improvements, as presented in the previous section of this Plan. The CIP contains a number of renewal and replacement projects, and some improvements in order to address deficiencies in some facilities. Renewal and replacements are, as the name suggests, the replacement of existing and worn out (depreciated) facilities. Some of the renewals and replacement projects are also major maintenance projects. Growth related facilities, on the other hand, are those related to system expansion and new customers.

The analysis developed assumes the City strives to fund capital projects from rates in an amount equal to or greater than the annual depreciation expense for the water utility. This financial target aides the utility in achieving financial stability in a number of ways. First, existing customers pay for rehab and replacement of facilities from which they benefit, just as customers must pay for maintenance and rehab of their own vehicles and homes. This is an equitable approach to paying for existing infrastructure needs, with revenue from existing customers. Secondly, funding capital projects from rates helps the utility to meet debt service coverage ratio requirements. This is an important financial performance target as this parameter helps to keep future borrowing costs low, and therefore helps to keep rates as low as possible in the future.

While depreciation expense represents a financial accounting principle of the useful life of a physical asset, it does not equal the actual cost to replace that asset. Therefore, the target of funding annual depreciation expense should always be considered a minimum funding level. Whenever possible, this level of funding should be increased.

Capital project costs average $1.7 million per year over the six-year plan, and range from a low of $365,000 to a high of $3.67 million. Project costs decrease between FY 2013 through FY 2015 to an annual average of $1.34 million. CIP costs through FY 2016 total $10.27 million over the 6-year period. Funding for the CIP will come from a mix of sources that include water capital reserves, water connection fees, loans, and assumed revenue bonds. The City currently has a projected balance greater than $2.9 million in reserves to aide in funding capital. A portion of these funds are applied to the projected CIP. In this way rates are also used to fund the capital projects in future years.

Table 9-5. Summary of Water Capital Improvement Projects ($000s)

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Capital Improvements						
Water Supply	$2,800	$315	$0	$0	$210	$$0
Water Storage	145	0	300	1,570	0	0
Water Pump Stations	0	225	225	200	0	0
Water Distribution System	505	535	375	425	1,155	345
Water Maintenance & Operations	220	300	140	180	70	20
Total Capital Improvements	$3,670	$1,375	$1,040	$2,375	$1,435	$365
Less: Outside Funding Sources						
Annual Capital Transfer	$500	$525	$550	$575	$600	$625
Transfer: To Water Capital	85	98	99	100	101	102
Interest Income	72	55	40	23	27	35
State Revolving Fund	2,300	0	0	0	0	0
Revenue Bond Proceeds	0	0	0	1,570	750	0
New Low-Interest Loan Proceeds	0	0	0	0	0	0
Total Outside Funding	$2,957	$678	$689	$2,268	$1,477	$761
Funded From Water Capital Reserve	$713	$697	$351	$107	($42)	($396)

The funding of capital from rates, shown as the annual capital transfer in Table 9-5, is targeted toward funding at a level of annual depreciation expense. In the last rate study completed for the City, the FY 2009 targeted rate funding for capital was $550,000. For this analysis it was assumed that a similar level of capital funding through rates would be funded. Without this level of funding additional long-term borrowing will be necessary to fund the capital improvement plan. It is recommended that whenever the City can increase this level of funding for capital, it should target annual depreciation expense. As noted above, this funding source helps the City maintain a strong debt service coverage ratio, which is important to maintaining lower interest rates on future revenue bonds.

As a result of using low-interest loans and future revenue bonds for capital financing purposes, debt service payments have an impact on rates. However, by spreading the cost of these projects over time to existing as well as new customers, those customers benefiting from the improvements over the life of the improvements are the ones who pay for those benefits.

These various capital funding sources shown in Table 9-5 above are discussed in more detail below.

9.3.3 Internal Sources of Funds

Water utility reserves are a combination of rate and other service fees and charges that exceed expenses in any given year. These funds accumulate and can be used to fund capital projects. The utility maintains a minimum level of 90 days O&M expenses to cover expenses during cash flow fluctuations. The utility also maintains a minimum of the average annual routine CIP over the 6-year period, not including any unusual or one-time large capital projects. For the water utility, this average is approximately $1.07 million. This level of reserve can be used to fund capital in a year when the CIP total exceeds the average, as a way of avoiding spikes in rates that otherwise would be necessary to fund those capital improvements.

9.3.4 External Sources of Funds

There are outside agency grant and loan funding programs that can be used to fund a portion of the City's CIP. These funding sources are listed and described below. It is important to note that these sources do not provide full funding of construction projects. If successful in obtaining the outside funding, the City will need to supplement these funds with other sources of revenue to ensure implementation of the recommended capital improvement projects. The City should monitor future opportunities to obtain these potential funding sources.

- State Revolving Fund
- Revenue Bond

State Revolving Fund (SRF). Each state receives annual allocations in the form of a Capitalization Grant. The SRF program has experienced significant changes over the last few years. The SRF program is funded by a combination of repayment of loans previously made by DEQ and grant money supplied by EPA. Owners of public water systems can apply for SRF funds annually through competitive application process which generally has as application deadline around January. Applications are ranked by state officials based on need, sustainability, and other criteria. SRF loans are available to all community public water systems, and non-profit, non-community public water systems, except federally and state owned systems.

The terms of the loan, for the FY 2012 funding period, range between 0% and 1.75%. However, the 0% loans are for disadvantaged communities. The loans must be repaid between 20 and 30 years from the project completion. In addition, eligible systems must demonstrate "adequate operational, technical, and financial capability to maintain compliance," have an approved CWSP to ensure the applicant project is included in the CWSP Capital Improvement Program, and meet other eligibility criteria.

Revenue Bonds. Revenue bonds are another external source of funding for capital projects. The sale of revenue bonds is the most common source of funds for construction of major utility improvements. Water rate revenue and charges are the main source of funds for debt service (principal and interest) payments. A key benefit of revenue bonds is the exemption of federal income tax.

A determination of the utility's ability to repay debt is an important consideration. A debt service coverage ratio (total revenue, less O&M expenses, divided by debt requiring a coverage ratio) is calculated and the utility's finances are reviewed in order to verify debt payments will be feasible. Coverage ratios of 1.25 (25 percent more than the debt payment) are typical, but coverage of 1.5 is a more prudent financial target for financial planning purposes. A bond rating agency financial review generally includes both current and past budgets, financial statements, and budgetary practices and polices, and reserve balances.

While the above list of possible grant, loan and other funding opportunities for the City is not exhaustive, it does however, highlight the most probable outside funding sources available to the City for its capital improvements.

9.4 Summary of the Financial Projections

A summary of the financial plan and resulting financial status of the water system is provided below in Table 9-6. This is an abbreviated summary of a more detailed analysis that was developed for the City, and provides a summary of the major elements of the City's analysis, along with the findings and conclusions.

Table 9-6. Summary of the City's Six-Year Financial Plan ($000s)

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Sources of Revenue						
Rate Revenues	$3,144	$3,229	$3,251	$3,280	$3,312	$3,346
Miscellaneous Revenues	94	49	45	49	50	51
Total Sources of Revenue	$3,238	$3,278	$3,296	$3,329	$3,361	$3,396
Expenses						
Operations & Maintenance Exp.	$1,990	$2,170	$2,225	$2,297	$2,371	$2,479
Capital Funded Through Rates	500	525	550	575	600	625
Annual Debt Service	0	137	137	263	323	323
Transfers	992	962	988	1,015	1,043	1,072
Total Expenses	$3,481	$3,794	$3,901	$4,151	$4,338	$4,500
Balance/(Deficiency) of Funds	($243)	($516)	($605)	($822)	($977)	($1,103)
Balance as a % of Rate Revenue	**7.7%**	**16.0%**	**18.6%**	**25.0%**	**29.5%**	**33.0%**
Debt Service Coverage Ratios:						
Before Rate Adjustments	0.00	1.06	0.60	0.06	0.00	0.00
After Rate Adjustments	0.00	4.82	5.01	3.18	2.85	2.93
Ending Reserve Fund Balance	$3,273	$2,333	$1,828	$1,709	$1,737	$2,134
Minimum Fund Target	$1,556	$1,600	$1,614	$1,631	$1,650	$1,676

As can be seen from the results in Table 9-6, in order for the City to fund the full capital plan (as summarized in Table 9-5 and detailed in Table 8-1), and meet all operating expenses, rate adjustments will be required. The row labeled "Balance as a % of Rate Revenue" is *cumulative.* Therefore, the total adjustment required to rates over the six-year projected period is 33.0%. For example, if no adjustments were made until FY 2016, a 33.0% adjustment would be necessary. In practical terms, such a deferral would also require capital and operational reductions until that time period. Rather than implementing a 33.0% rate adjustment in FY 2012, a gradual implementation plan was developed for the City's review and consideration.

It is important to note that this level of adjustment is predicated upon an assumed percentage of growth and inflation to occur over the FY 2012 – FY 2016 period. Should this growth or inflation change, the level of required rate adjustment will need to be adjusted. It should be noted that the City is currently developing a comprehensive rate study that will take a more in-depth review of the City's capital funding plan and establish rates to meet the City's goals and objectives.

Debt service coverage ratios are a strong indicator of financial viability. The ratio is decreasing each year if no rate adjustment is implemented. If rate adjustments are implemented during the review period, the debt service coverage ratios will improve, as shown in Table 9-6 with the gradual rate adjustments implemented. It should be noted that the debt service coverage ratio assumes a conservative calculation. It assumes all outstanding debt is included and transfers are included as a priority expense as well. In most cases, SRF loans are not subject to debt service coverage requirements. In addition, all or part, of the transfers can be excluded depending on the specific bond covenants.

As can be seen in Table 9-6, the operating reserve balance is used for operating costs in the first few years. The operating fund balance minimum target is the equivalent of 90 days of O&M expenses. The City's fund balance remains above this reserve minimum target level throughout the review period.

As noted earlier, under internal sources of funds, the City also has funds available for capital purposes. The fund balance will depend on the annual cost of the capital projects and the other funding sources available. The target of approximately $1.0 million for the 6-year average annual routine capital projects is maintained in all but the last year of the review period. It is considered reasonable for the capital fund balance to fluctuate, even below the minimum target level, especially in a year when the level of capital expenditures is three times higher than the average. The assumption is that the fund balance will recover

To implement the necessary rate adjustments needed to fully fund utility expenses as determined within this plan a rate transition plan was developed. The rate transition plan includes the approved 4% rate increase in FY 2012 followed by annual adjustments of 9.5% in FY 2013 and FY 2014. These adjustments are followed by assumed inflationary adjustments of 3.5% in FY 2015 and FY 2016. These latter two rate increases essentially parallel the annual inflationary assumptions. It should be noted that by transitioning the rates in FY 2012 through FY 2014 additional reserve funds will be utilized to fund annual operating and capital expenses. Provided in Table 9-7 is a summary of the rate adjustments necessary to fund the plan as developed within this study.

Table 9-7. Six-Year Rate Adjustment Transition Plan

	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Phased-in Rate Adjustments	4.0%	9.5%	9.5%	3.5%	3.5%

Based on the analysis developed herein, it appears that water rates will need to be adjusted to fund the operating and capital needs of the City's water utility. These additional rate adjustments are primarily driven by the long-term debt funding of the capital improvement projects as developed within this plan. Again, the City is developing a comprehensive rate study and the more in-depth analysis of the current water rates will provide a final rate transition plan to meet the City's goals and objectives for future rates.

Figure 9-1. Summary of the Rate Transition Plan

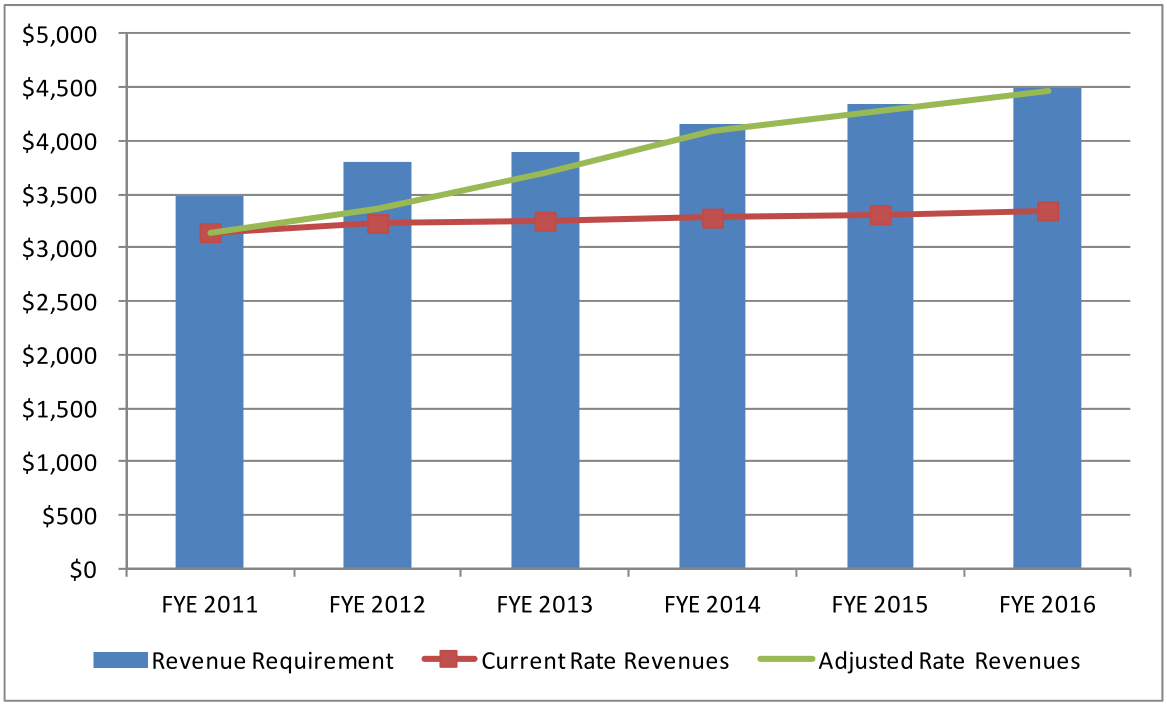


Figure 9-1 indicates that if rates are adjusted as developed, adequate revenue will be generated to fund the operational and capital expenses and debt service of the utility, as presented within this study. The City may implement the rate adjustments at different levels in any given year. If rate adjustments are lower than these gradually implemented adjustments, operational or capital expenditures will need to be reduced or delayed, or reserves used to a greater degree, in order to fully fund the operating and capital costs as developed within this Plan.

9.5 Rate Impacts

The rate adjustments presented in Table 9-7 have been applied to the average residential rate to provide a review of the relative rate impacts. Table 9-8 provides a summary of the projected billing impact to an average residential customer using 8,000 cubic feet (8 CCF) of water in a month.

Table 9-8. Projected Monthly Average Residential Cost (1)

	$/Month	Change from Prior Year
Present Bill (FY 2011)	$32.00	$0.00
FY 2012	$33.28	$1.28
FY 2013	$36.44	$3.16
FY 2014	$39.90	$3.46
FY 2015	$41.30	$1.40
FY 2016	$42.75	$1.45

1. Assumes a 3/4" meter using 10 cubic feet. The City bills customers monthly.

Based on the financial plan developed herein, it appears that the rates will need to be adjusted more than inflationary impacts, primarily as a result of additional debt related to capital improvements. At the end of the five-year transition period, average residential rates will have increased approximately $10.75 per month.

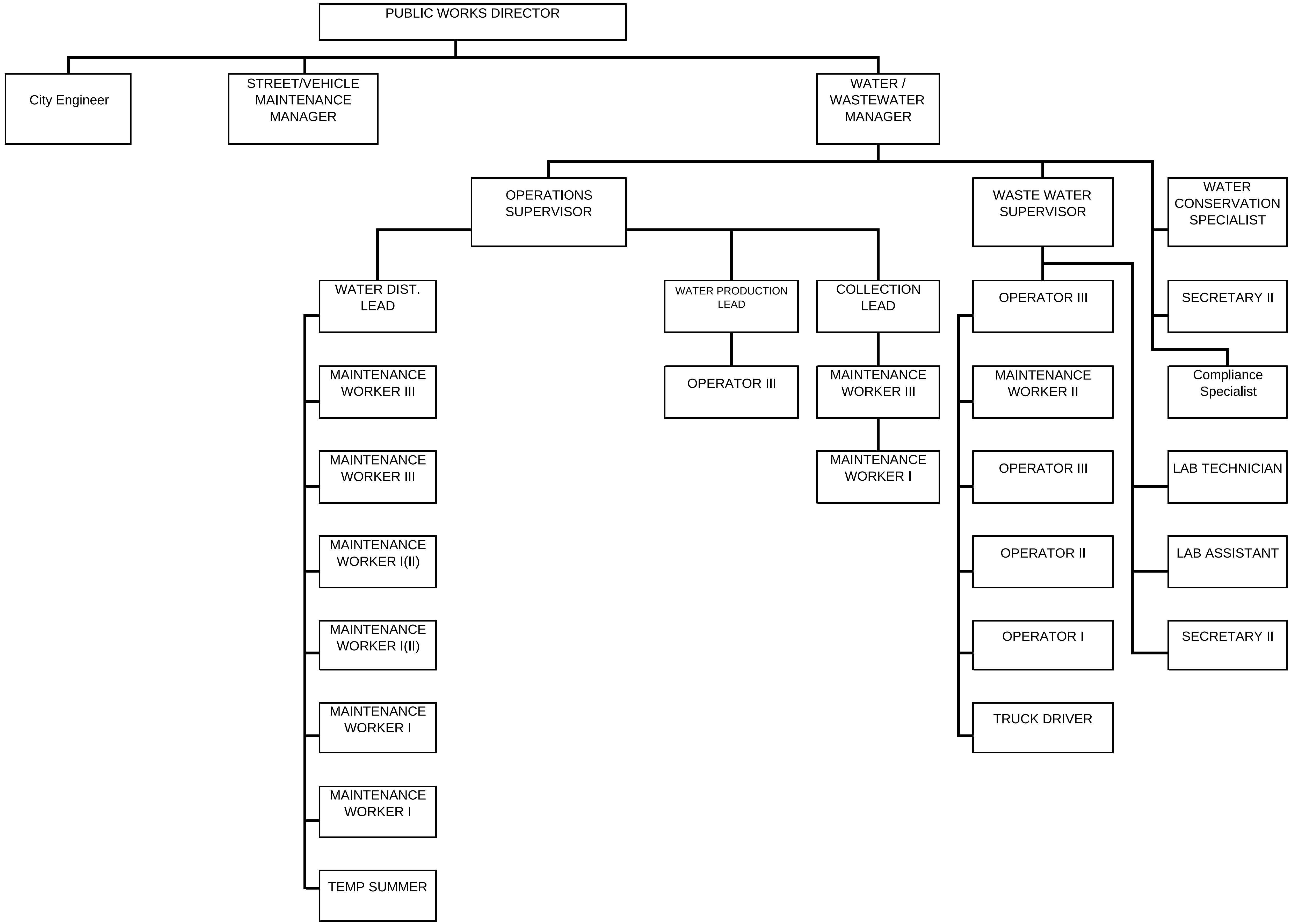
9.6 Summary

The financial plan results presented in this chapter indicate that water rates for the six-year projected time horizon of FY 2011 to FY 2016 will require adjustments to fund the projected O&M, capital, and debt service requirements. This chapter identifies the overall level of rate impact that may occur should the capital improvement plan provided in Chapter 8 move forward. Again, it is important to remember that the capital improvements are in 2011 dollars. Inflationary costs may slightly increase the necessary rate adjustments as presented in this section of the Plan. The City is currently developing a comprehensive rate study to determine the actual rate adjustments necessary to move forward with the adopted capital plan for each year and meet the City's current goals and objectives.

The City has demonstrated its commitment to responsible management of the utility by past rate adjustments and by funding adequate levels of operations, capital, reserves, and capital funding from rates. Continued prudent fiscal management will enable the water utility to continue to operate on a financially sound basis.

Appendix 2-1
Public Works Organizational Chart

PUBLIC WORKS WATER DEPARTMENT STAFF ORGANIZATION



Appendix 3-1
Moscow City Code (Excerpts)

Chapter 4

WATER REGULATIONS

Sec. 4-1. Premises to Connect to Water Line.

The City is hereby empowered, and it is hereby made its duty in all cases where there is a public water line in any street, or easement in the City to compel every owner of land, buildings or premises used for human occupancy, employment, recreation, or used for other purposes requiring potable water and abutting on such street or easement or within three hundred feet (300') of the same, to construct or cause to be constructed a sufficient water service line which shall connect said land, building or premises to said water line within ninety (90) days after date of official notice, unless in the opinion of the City such connection is not desirable.

Every owner of premises shall connect said land, building or premises to such nearest accessible water line within ninety (90) days after date of official notice.

Sec. 4-2. Water Distributed Through Meters.

All property owners upon whose premises water is consumed by the owners, by tenants or otherwise, must have a water meter to be furnished by the City at the expense of the property owner, installed in, at and upon the respective premises, and all City water used therein or upon said premises shall pass through and be measured by said water meter. In the event that any property owner shall refuse to allow such meter to be installed or refused to pay for the same, or refuse to pay for the metered water used, it shall be the duty of the City to forthwith discontinue the water from the premises of such property owner or the property.

Sec. 4-3. Meters Requirement and Installation Charge.

Each residence and business establishment to which water is supplied by the City, whether inside or outside of the City, must have a separate meter connection directly to the main, excepting however, those portions of buildings used principally for offices or apartments where the property owner furnishes the water supplied to the tenants.

Before a meter is installed, the property owner shall pay to the City the cost of said meter together with the cost of installation thereof as determined by the City.

Sec. 4-4. Charges Against Property Owner.

When a meter has been installed, water will not thereafter be supplied to the premises of such property or property owner, except upon metered water rates. All water charges shall be the ultimate responsibility of the property owner; provided, however, that a non-property owner or tenant may pay said water charges.

In the event a tenant or other non-property owner is to pay water charges on behalf of the property owner, the name and address of the tenant or non-property owner shall be submitted to the City.

Sec. 4-5. Damage to Meters, Liability.

When any water meter or meter box has been damaged by reason of the negligence of the user of City water or a third party, or by reason of the defective condition of the plumbing on the premises of the water user, or by reason of the backing up of hot water from premises of the water user, then such water user shall pay for the replacement or repair of said meter in an amount to be determined by the City.

Sec. 4-6. Requirements After Repairs for Turning on Water.

Whenever the City is called upon to repair or replace a meter which has been damaged as set forth in Code Section 5-4-5, it may, at its discretion, refuse to repair or replace said meter, and disconnect the water service line to said premises, and refuse to connect same until a check valve is installed between the water meter and the premises on which water is used, in order to prevent the water from backing up from said premises, and it may also require that a safety valve or "pop off" be placed in service to relieve pressure on the hot water tank or other plumbing fixtures located upon said premises. Whenever the City finds an electrical hazard, especially those caused by faulty electrical equipment where a water pipe ground exists, work will stop and the electrical inspector notified. Work will resume after the problem is corrected or all power on the property is turned off. Within thirty (30) days the cause of the problem must be determined and permanently corrected.

Sec. 4-7. Maintenance and Repair of Meters.

The City will repair or replace all defective meters without cost to the property owner, except in those instances where the meter has been damaged by reason of the negligence of the water user, or by reason of the defective condition of the plumbing on the premises of the water user, or by reason of the backing up of hot water from the premises of the water user.

Sec. 4-8. Unlawful to Waste Water.

It shall be unlawful for any person to waste water or allow it to be wasted by imperfect or leaking stops, valves, pipes, closets, faucets or other fixtures, or to use water closets without self-closing valves, or to use water in violation of the Chapter regulating said use of water.

If such waste of water continues after receiving notice from the City to make repairs and to desist from the waste of water, the City shall shut off the water supply from such premises until the necessary repairs have been made.

Sec. 4-9. Inspection and Right of Entry.

The City and the duly authorized agents of the City bearing proper credentials and identification shall be permitted at proper and reasonable hours of the day to enter all properties, premises or buildings to which water is furnished from the City water system for testing or inspection or repair of any part of the public water system and sewer collection system. Also, the City and the duly authorized agents of the City bearing

proper credentials and identification shall be permitted to enter all private properties through which the City holds a duly negotiated easement for the purpose of, but not limited to, inspection, observation, repair and maintenance of any portion of the City water system and sewer collection system lying within said easement.
(Ord. 99-25, 7/19/99)

Sec. 4-10. Water Rates.

The Council shall establish water rates which shall be effective from and after approval by resolution adopted by the Council. Said water rates shall include rates for:

A. Installation costs of meters.
B. Minimum service charge for maintenance of water system.
C. Water rate charge for water furnished within boundaries of the City.
D. Water rate charge for water furnished outside boundaries of the City.
E. Water rate charge for Moscow Cemetery Maintenance District.
F. Water rate charge for the University of Idaho water system.
G. Connection fee.
H. Late water charges.

All water charges shall be the responsibility of the owner of the property which receives the water. The City is authorized to receive payment from either the property owner or tenant or agent of the property owner on his behalf.

Sec. 4-11. Water Service Outside City Limits.

In the event of need and/or at the discretion of the Council, any service outside the City limits may be terminated at any time by order of the Council. The fixing of water rates for water service outside the City is not to be read as imposing a duty upon the City to make such water service.

Sec. 4-12. Water Billing Regulations.

The City shall establish by rule and regulation a system of billing, collection and enforcement of all water charges. Said system shall be effective after approval by the Council and shall include:

A. Reading meters and establishing water charges.
B. Notice of any delinquency to be made to both property owner, agent and tenant if applicable prior to shut off of water for nonpayment of water charges.
C. Provisions limiting the liability of nonresident property owners for delinquent tenant water charges to a maximum of three (3) times the previous year's monthly average billing.
D. Discontinuance of water service for nonpayment of water charges after notice of delinquency.
E. Penalty for payment after due date.
F. Connection fee for reconnecting water service.
G. Discontinuance of water for failure to pay all services provided by the City after notice of delinquency.

Sec. 4-13. Meter Reread on Disputed Charges.

Where any questions arise as to the validity of any amount due for water consumed during one month, the City is hereby authorized to have the water meter, through which the water flows, over which controversy arises, tested, read and investigated, and, if such meter is found to have been over-read or an overcharge made to the customer, such customer shall be given credit for the amount of the overcharge on future charges against the customer for water consumed.

Sec. 4-14. Refunds.

No officer shall rebate or refund any money for overcharges on water consumed until a full investigation by the City has been made, and report having been filed with the Mayor and Council, and an order made by the Council ordering such rebate.

Sec. 4-15. Deposits.

All applications to have water turned on shall be made to the City. The City may require a deposit fee established from time to time by Resolution of the Council. Water may be discontinued for failure to make said deposit.

(Ord. 2009-19, 08/17/2009)

Sec. 4-16. Return of Deposits.

Deposits shall be returned by the City at the end of tenancy, upon showing to the City that all arrearages for water rents and fines, if any, have been paid to the City. Deposits shall not otherwise be returned and no interest shall be paid upon return of the deposit.

Sec. 4-17. Regulation.

The City is authorized to deny use of water to any and/or to restrict use of water by any water user when said denial or restriction is necessary for the public welfare.

Sec. 4-18. Water System Property of City.

All mains, service lines up to and including the meter, pipes, hydrants and fixtures now laid, constructed or installed, or hereafter to be laid, constructed or installed in, under, across or through the streets, avenues, alleys and other thoroughfares of the City or easement rights of way granted to the City or adjacent territory, for supplying water to the City and the inhabitants thereof are hereby declared to be the property of the City, under the control thereof and subject to the provisions of this Chapter. No person or persons will be allowed to claim the right to exclusive use of any such water line.

Sec. 4-19. Service Connections.

No property service connections to a City water line shall be made without a permit being issued by the City and the installation of a proper water meter by the City. All such connections shall be made under the supervision of the City and no connections shall be covered until the work has been inspected by the City. No property shall be granted a service connection unless there is an existing water main which abuts and is contiguous to said property, and which will provide the shortest service connection feasible to the premises on said property.

Further, the City may require installation of adequate water lines for fire prior to granting connection to a City water line.

Sec. 4-20. Temporary Connections.

Temporary connections to the City water line may be authorized. Said temporary connection shall not be made to the water lines unless a permit is granted by the City.

The City is authorized to regulate the use of temporary connections to the City water line by restricting the amount of water to be taken, time of taking, place of taking and type of connection to be used. The City shall charge a reasonable fee for use of water by temporary connection to the water line.

Sec. 4-21. Water Line Extension.

The total expense of extending any existing water mains, laterals or lines through the streets, avenues, alleys and other thoroughfares of the City or easement rights of way granted to the City or adjacent territory for supplying water to property within the area to be served by such extension shall be borne by the property owners desiring service at the time of installation. In no instance will property owners be required to pay the costs or part thereof of a preceding extension.

Sec. 4-22. Water Line Extension Plans and Approval.

Plans for the extension of any water mains, laterals or lines through the streets, avenues, alleys and other thoroughfares of the City or easement rights of way granted to the City or adjacent territory shall be submitted to the City for approval. In no instance shall construction on such water line extensions begin prior to the approval of the City. All plans submitted for approval shall be clearly and neatly drawn to a scale of not more than one hundred feet (100') to one inch (1") showing the placement of all valves, meters, hydrants, other accessories and connections, their size and type. All lots or parcels of land affected by the water line extension will be shown on each plan together with the names of the property owners.

Sec. 4-23. Water Line Extension Specifications.

Extensions to any water mains, laterals or lines through the streets, avenues, alleys and other thoroughfares of the City or easement rights of way granted to the City, or adjacent territory must meet the minimum specifications and standards as established by the City.

Sec. 4-24. Connection Revocation.

The City shall revoke any permanent or temporary connection to a service or a water line or extension thereof which is made contrary to plans and specifications submitted to, and approved by, the City or which is thereafter altered contrary to plans and specifications previously submitted to, and approved by the City.

Sec. 4-25. Rules and Regulations.

The City is authorized to recommend rules and regulations to enforce the provisions of this Chapter. Said rules and regulations shall be effective after approval by the Council.

Chapter 5

RESTRICTIVE USE OF WATER

Sec. 5-1. Emergency Declared.

Due to reduced gallonage on hand in the water system of the City, an emergency exists and is hereby declared, and all property owners, tenants or other persons in charge of premises where water is consumed by sprinkling of lawns, gardens and exterior premises from the water system of the City may be prohibited from such water consumption or may be restricted in the use of such water consumption except during the hours to be defined by Resolution of the Council and published by Proclamation of the Mayor.

Sec. 5-2. Extent of Water Usage.

The Mayor and Council are hereby authorized to declare an emergency and may by proclamation totally prohibit the use of City water for the sprinkling of lawns, gardens, and exterior premises, and any other use of City water designated by resolution of Council; or the Mayor and Council are hereby authorized, if a partial use of City water for the sprinkling of lawns, gardens, and exterior premises shall be permitted during such emergency, to declare such an emergency and publish such hours of sprinkling pursuant to Resolution of the Council.

Sec. 5-3. Allowed Uses.

The Mayor and Council are hereby authorized to change, alter, increase or decrease by Resolution of the Council the hours of sprinkling permitted according to the exigencies of the emergency, with any change in hours to be published as set forth hereinabove .

Sec. 5-4. Notice.

The Mayor shall have the authority to announce the emergency and publish the prohibition of the use of City water for the sprinkling of lawns, gardens, and exterior premises, and any other use of City water designated by Resolution of Council; or the Mayor shall have the authority, if a partial use of City water for the sprinkling of lawns, gardens, and exterior premises shall be permitted during such emergency, to publish the permissive hours of sprinkling by Proclamation, and shall have authority to announce termination of the emergency, and all of the foregoing shall be published in each instance three (3) times in three (3) consecutive issues of the City's official newspaper.

Chapter 17

WATER CONSERVATION

Sec. 17-1. Purpose.

The purpose of this Chapter is to highlight the importance of water conservation and to promote the responsible use of water within the City through reasonable regulation.
(Ord. 2004-27; 05/17/2004)

Sec. 17-2. General Water Usage Regulations.

No person who uses water from the City water supply system shall make, cause, use or permit the use of such water in a manner contrary to the provisions of this Chapter whether or not such person is an account holder or customer of such City water supply system.
(Ord. 2004-27; 05/17/2004)

Sec. 17-3. Definitions.

For purposes of this Chapter, the following term(s) shall have the meaning given herein:

A. Automatic shut-off mechanism. A device or attachment which immediately and automatically shuts off the flow of water from a hose when the hose is not being physically held or operated by a person, such as a pistol or trigger spray hose nozzle or other automatic positive shut-off nozzle. A device or attachment which shuts off water flow by measuring or metering water (such as a mechanized water timer) or a device or attachment which shuts off water flow after a certain measurement of time (such as an electronic water timer), is not an automatic shut-off mechanism for purposes of this Chapter.

B. Impervious Surface. A durable surface made of or similar to gravel, asphalt, concrete, cement, brick, or combination thereof, which is laid down on or applied to an area including, but not limited to, a sidewalk, parking lot, etc., for the purpose of creating a permanent or semi-permanent surface which could sustain vehicular, foot, or bicycle traffic or other means of transportation, and where vegetation is unlikely to grow.
(Ord. 2007-13, 11/19/2007)

C. Irrigation System. Any device(s) or system(s) utilizing a hose, pipe, and/or other conduit which connects to any source of ground and/or surface water and through which water is conveyed and/or drawn in order to apply such water to land, crops, plants, and/or other vegetation including, but not limited to, sprinklers, in-ground irrigation, or a similar system. "Irrigation system" shall not include an automatic shut-off mechanism, as defined in this Chapter.
(Ord. 2007-13, 11/19/2007)

D. Outdoor Irrigation. The act or process of watering or wetting landscaping, grass, trees, plants, and/or other vegetation by causing water from the City's water supply to flow upon, over, through or into property with sprinklers, sprinkler hoses, soaker hose(s) (water weeping types), drip irrigation systems, in-ground irrigation systems, or by other similar means. Irrigation with hand-held hose(s) of one inch (1") or less inside diameter equipped with an automatic shut-off

mechanism or irrigation using a container of five (5) gallons or less shall not be considered outdoor irrigation for purposes of this Chapter.
(Ord. 2004-27; 05/17/2004; 2007-13, 11/19/2007)

E. Outdoor Irrigation Season. The period within each calendar year declared by the Public Works Director during which Outdoor Irrigation is allowed within City limits. The Public Works Director shall declare and advertise the beginning date of the Outdoor Irrigation Season no later than May 1st of each year. The Public Works Director shall declare and advertise the ending date of the Outdoor Irrigation Season at least two (2) weeks prior to such ending date.
(Ord. 2007-13, 11/19/2007)

Sec. 17-4. Outdoor Irrigation of Impervious Surfaces Prohibited.

No person shall cause or permit an irrigation system under the ownership, supervision, and/or control of such person to apply water directly or indirectly to an impervious surface, unless otherwise allowed by this Chapter.
(Ord. 2007-13, 11/19/2007)

Sec. 17-5: Outdoor Irrigation Season and Hours.

Outdoor Irrigation shall be allowed only between the hours of 6:00 p.m. and 10:00 a.m. local time, during the Outdoor Irrigation Season unless modified by variance pursuant to this Chapter. Outdoor Irrigation shall be prohibited at all times not within the declared Outdoor Irrigation Season. Outdoor Irrigation by means of soaker hose(s), (water weeping types) or drip-irrigation systems may occur at any time during the Outdoor Irrigation Season specified herein.
(Ord. 2004-27; 05/17/2004; 2007-13, 11/19/2007)

Sec. 17-6. Exemptions from Water Conservation Regulations.

The following uses of water shall not be regulated by this Chapter:

A. Water required to be used for the control of dust or compaction of soil by this Code or by State and/or Federal statute or regulation;

B. Water used to prevent or abate public health, safety or accident hazards including, but not limited to, fire suppression, fire prevention, and sanitation when a reasonable alternative method is not available;

C. Water used for inspection, maintenance, installation or repair of automatic landscape sprinkling systems or of the City's water supply system (including fire hydrants and training facilities);

D. Water used by City or its agents or franchisees for street sweeping, construction, and maintenance; sewer maintenance; or other established utility and/or public works practices;

E. Water used for purposes other than outdoor irrigation in the normal and customary course of a business operation and water used by a commercial nursery for watering of nursery stock;

F. Where water used for outdoor irrigation is gray water (household waste water other than from water closets or kitchen sinks), treated waste water or effluent, reused water, or water from a source other than the City water system, such as collected rainwater.
(Ord. 2004-27; 05/17/2004; 2007-13, 11/19/2007)

Sec. 17-7. Variance from Water Conservation Regulations.

The Public Works Director or designee may grant permission to an applicant for variance from the provisions of this Chapter where it is established that there is a hardship or special circumstance which requires such a variance (e.g., establishment of newly seeded or sodded turf grass and/or landscaping; application

of chemicals which requires immediate irrigation to preserve lawn or landscaping; physical necessity; etc.). When granting a variance, the Public Works Director or designee shall establish such conditions and limitations as are necessary to further the purposes of this Chapter.
(Ord. 2004-27; 05/17/2004; 2007-13, 11/19/2007)

Sec. 17-8. Penalties

A. Any person violating any of the provisions of this Chapter shall be guilty of a misdemeanor and, upon conviction thereof in a court of competent jurisdiction, shall be punished pursuant to this Code and the Idaho Code.
B. The imposition of a penalty for any violation of this Chapter shall not excuse the violation or permit it to continue.
C. Each day or part thereof in which an activity occurs which is prohibited by this Chapter, shall constitute a separate offense.
D. For purposes of this Chapter, no violation shall be prosecuted unless the Public Works Director or designee or the City Police Department has made at least one (1) attempt to contact and to request relief from the person responsible for the violation.
(Ord. 2004-27; 05/17/2004; 2007-13, 11/19/2007)

Chapter 9

CROSS-CONNECTIONS; WATER SUPPLY

Sec. 9-1. Purpose and Scope.

The purpose of this Chapter is to protect the public health of water consumers by the control of actual and/or potential cross-connections.

An additional purpose of this Chapter is to acknowledge the City's authority granted by Article XII, Section 2 of the Idaho Constitution and by Title 50, Chapter 3 of the Idaho Code, to promote and maintain the peace, good government and welfare of the City in a manner not inconsistent with the laws of the State of Idaho.

(Ord. 2004-05; 01/05/04)

Sec. 9-2. Definitions.

A. *Backflow*. The flow, other than the intended direction of flow of any foreign liquids, gases, or substances into the distribution of a public water supply.

B. *Backflow Prevention Assembly – Approved.* A backflow preventor which is designed to be in-line tested and repaired. An "assembly" shall consist of the backflow prevention unit, two resilient seated shutoff valves and test cocks. Approval of backflow assemblies by the City shall be on the basis of a favorable laboratory and field evaluation by an approved testing laboratory and the State of Idaho Drinking Water Regulations.

C. *Backflow Prevention Device*. A backflow preventor that is not designed for in-line testing.

D. *Contamination*. Any physical arrangement whereby a public water supply is connected, directly or indirectly, with any other water supply system, sewer, drain, conduit, pool, storage reservoir, plumbing fixture, or other device which contains or may contain contaminated water, sewage, or other waste or liquids of unknown or unsafe quality which may be capable of imparting contamination to the public water supply as a result of backflow.

E. *Public Water Supply*. Any system or water supply intended or used for human consumption or other domestic uses, including source, treatment storage, transmission and distribution facilities, where water is furnished to any collection or number of individuals, or is made available to the public for human consumption or domestic use.

Sec. 9-3. Cross-Connections.

A. The City shall have the authority to establish requirements more stringent than Idaho State Drinking Water Regulations contained in Idaho Administrative Procedure Act (IDAPA) Section 58.01.08, if it is deemed that conditions so mandate. The control or elimination of cross-connections shall be in accordance with this Chapter together with the latest editions of the Pacific Northwest Section of the American Water Works "Cross Connection Control Manual Accepted Procedure and Practice" and the Foundation for Cross-Connection Control and Hydraulic Research "Manual of Cross-Connection Control." The City Engineer or designee shall adopt rules and regulations as necessary to carry out the provisions of this Chapter.

B. No water service connection to any premises shall be installed or continued in use unless the water supply is protected by a backflow prevention assembly or a backflow prevention device as may be required by this Chapter. The installation or maintenance of a cross-connection which may endanger the water quality of the potable water supply of the City shall be unlawful and is prohibited. Any cross-connection now existing or hereinafter installed which endangers such water quality is hereby declared to be a public nuisance and the same shall be abated.
(Ord. 2004-05; 01/05/04)

Sec. 9-4. Use of a Backflow Prevention Assembly.

A. A backflow prevention assembly shall be installed on any premises where, in the judgment of the City Engineer or designee, the nature and extent of the activities undertaken, or the materials stored on the premises, would present an immediate and dangerous hazard to health and/or be deleterious to the quality of the water should a cross-connection occur. The installation of the backflow prevention assembly shall occur even though a cross-connection may not exist at the time the backflow prevention assembly is installed. The City Engineer or designee shall determine the need for a backflow prevention assembly after considering conditions that include, but are not limited to, the following:

1. Premises having an auxiliary water supply.
2. Premises having internal cross-connections that are not correctable, or intricate plumbing arrangements which make it impracticable to ascertain whether or not cross-connections exist.
3. Premises where entry is restricted so that inspections for cross-connections cannot be made with sufficient frequency or at sufficiently short notice to assure that cross-connections do not exist.
4. Premises having a repeated history of cross-connections being established or re-established.
5. Premises on which any substance is handled under pressure so as to permit entry into the public water supply, or where a cross-connection could reasonably be expected to occur. This shall include the handling of process waters and cooling waters.
6. Premises where materials of a toxic or hazardous nature are handled in such a way that if back siphonage should occur, a serious health hazard might result.
7. The following types of facilities will fall into one of the above categories where a backflow assembly is required to protect the public water supply. A backflow prevention assembly shall be installed at such facilities unless the City Engineer or designee determines that no hazard exists:

a. Hospitals, mortuaries, clinics, dental clinics, veterinarian clinics, and the like.
b. Laboratories.
c. Metal plating industries.
d. Piers and docks.
e. Sewage treatment plants.
f. Food or beverage processing plants.
g. Restaurants.
h. Chemical or other industrial plants.
i. Petroleum processing or storage plants.
j. Radioactive material processing plants or nuclear reactors.
k. Where a single water service is used to supply three (3) or more businesses.
l. Where the meter serving the property is one and one-half inches (1 1/2") or larger.
m. Any building on a hill or

building with three (3) or more floors having any plumbing fixtures that are thirty feet (30') or higher above the water meter face.

n. Agricultural chemical storage, formulation and distribution facilities.

o. Tank truck fill stations.

p. Car washes.

q. Fire sprinkler systems.

r. Any other agricultural, commercial, and industrial facility that has the potential to introduce contaminants into the public water system.

8. Other premises, as specified by the City Engineer or designee, where backflow prevention assemblies are required to protect the public water supply.

B. The type of protective assembly required shall depend on the degree of hazard which exists:

1. An Air-Gap separation or a Reduced Pressure Backflow Assembly shall be installed where the public water supply may be contaminated with sewage, industrial waste of a toxic nature, or other contaminant which could cause a health or system hazard.

2. In the case of a substance which may be objectionable but not hazardous to health, a Double Check Valve Assembly, Pressure Vacuum Breaker Air-Gap separation, or a Reduced Pressure Backflow Assembly shall be installed.

3. All fire sprinkler systems shall have as a minimum level of protection, an approved Double Check Valve Assembly. If it is determined that a potential health hazard exists, an approved Reduced Pressure Backflow Assembly shall be required by the City..

C. A backflow prevention assembly required by this Chapter shall be installed at the meter, at the property line of the premises when meters are not used, or at a location designated by the City Engineer or designee. The assembly shall be located so as to be readily accessible for maintenance and testing, and furthermore, where no part of the assembly will be submerged.

D. A backflow prevention assembly required by this Chapter shall be installed under the supervision of, and with the approval of, the City Engineer or designee.

E. Any protective assembly required by this Chapter shall be a model approved by the City Engineer or designee. A Double Check Valve Assembly, Pressure Vacuum Breaker, or a Reduced Pressure Backflow Assembly will be approved if it has successfully passed performance tests of the University of Southern California Engineering Center or other testing laboratories satisfactory to the City Engineer or designee. Every assembly required in this Chapter shall be furnished and installed by and at the expense of the customer.

F. A backflow prevention assembly installed pursuant to this Chapter , shall be inspected and tested annually, or more often if necessary. Inspections, tests and maintenance shall be at the customer's expense. Whenever an assembly is found to be defective, it shall be repaired, overhauled or replaced at the customer's expense. Inspections, tests, repairs and records thereof shall be accomplished under the City Engineer's or designee's supervision by certified testers. Rates shall be as established by Resolution from time to time by the Council.

G. No underground sprinkling system shall be installed without an adequate backflow prevention assembly at the point from which the water for irrigation is taken from the public water supply.

H. Failure of the customer to cooperate in the installation, maintenance, testing or inspection of a backflow prevention assembly required by this Chapter shall be grounds for the termination of water service to the premises, or, in the alternative, the installation of an air-gap separation at the customer's expense.
(Ord. 2004-05; 01/05/04)

Sec. 9-5. Cross-Connection Inspection.

A. No water shall be delivered to any structure hereafter built within the City or within areas served by City water until the same shall have been inspected by the City Engineer or designee for possible cross-connections and been approved as being free of same.
B. Any construction for industrial or other purposes which is classified as a hazardous facility pursuant to this Chapter, where it is reasonable to anticipate intermittent cross-connections, or as determined by the City Engineer or designee, shall be protected by the installation of one or more backflow prevention assemblies at the point of service from the public water supply or any other location designated by the City Engineer or designee.
C. Inspections shall be made periodically of all buildings, structures, or improvements of any nature now receiving water through the City's system, for the purpose of ascertaining whether cross-connections exist. Such inspections shall be made by the City Engineer or designee.

Sec. 9-6. Installation Permits and Installation.

If cross-connection control device(s) are found to be necessary, the owner of the property served must apply to the City Engineer or designee for a permit as specified in Title 5, Chapter 4, of this Code. The device shall be installed per the latest edition of Uniform Plumbing Code or per City Engineer’s direction.

Sec. 9-7. Additional Remedies.

In the event an improper cross-connection is not corrected within the time limit set by the City , or, in the event the City Engineer or designee is refused access to any property for the purpose of determining whether or not cross-connections exist, delivery of water to the property shall cease until the deficiency is corrected to the City Engineer’s or designee's satisfaction. In addition, the City Engineer or designee may effect the necessary repairs or modifications at the expense of the property owner and refuse delivery of water to the property until the cost thereof shall have been paid.

Sec. 9-8. Violations; Penalties.

Any person who violates, disobeys, omits, neglects, refuses to comply with, or resists the enforcement of any of the provisions of this Chapter or the rules and regulations as adopted by the City Engineer or designee, shall be deemed guilty of a misdemeanor and, upon conviction thereof, shall be punished pursuant to this Code and the Idaho Code unless otherwise specifically provided for in this Chapter.

Appendix 5-1
Water Conservation Plan (Draft March 2011)

City Of Moscow

Water Conservation Plan

March 2011

By M. Nichole Baker, Moscow Water Department Staff, Water Conservation Program Coordinator

Contents

Executive Summary

Introduction

The goal of this plan is to establish the City of Moscow as a leader and example in efficient water use. In the past, reductions of the total pumping rate have been consistent with the Palouse Basin Aquifer Committee (PBAC) *Moscow Action Plan* 1% pumping level limit, capped at 875 Million Gallons (MG) with goals to continue this success within reasonable limits due to population growth. This plan reviews current and recommended programs. The City of Moscow is a growing city which draws water resources from two aquifers, the Grande Ronde and the Wanapum. Since the amount of water resources in our aquifer is unknown, it is wise for the City to balance water resources and the increasing demand for water. It is also important for the City of Moscow to meet the growth expectations and comply with the September 1992 Ground Water Management Plan set in place by the Pullman-Moscow Water Resources Committee, now called the Palouse Basin Aquifer Committee (PBAC). In order to meet the goals set by PBAC, the City encourages efficient use and reuse of available water supplies as well as promotes the adoption of new conservation programs. Furthermore, this is a long-term conservation plan geared to extend our current supply of aquifer water resources and is not a curtailment plan.

Beyond the use of tiered rates, ordinances, and resolutions are ways to motivate individuals to save water. However, some aspects of water conservation is not something that can be imposed on the public and must be addressed as a voluntary and willing objective to be attained by the public and municipality. The use of our water resources is a shared responsibility and partnership of pumping entities and our citizens of the City of Moscow. Conservation is a fundamental part of our citizen's lifestyle and will lead to successful water conservation goals. It is up to the City to lead by example and offer the assistance and support necessary for our citizens to partake in proper stewardship of our aquifer resources. This 2010 Water Conservation Plan includes several proposed water conservation support programs for our community. Solutions were developed, cost and benefits were calculated, and several support programs are included in order to raise public awareness and participation. Measures and incentives which proved to be less productive are briefly discussed, but have been eliminated from the final list of recommended programs.

Forecasts

Population growth and its impact on water use is a key factor in predicting the benefits of a water conservation plan. Consequently, water demand estimates with a 1.42% population growth (see Section 2.2 for details on population growth estimates) factored in are used in this plan. Below is a look at forecasts showing pumping numbers which take into account growth with and without conservation efforts.

The primary method used to forecast future water demand is based on a projection by customer class, which allows us to look at different water use categories. The per capita water use data (Section 2.3.4) was not chosen for forecast projections because per capita is not as accurate and does not allow us to look at different water use categories. The forecast also assumes that each customer class will grow by 1.42% (see Section 2.2) and employment will remain steady (Appendix C). The demographic information can be more closely reviewed as part of Appendix C. It is important to note that total water use of non-billed water is also applied, but not included with the customer class forecasts, an attribute the per capita data cannot provide.

In order to exclude the university residential population (those that receive water from the University of Idaho system), the population is based on customer accounts as opposed to Census Population data. In using these accounts, it is assumed that there are 10 units per Multi-Family account and that each household has 2.25 individuals. Single Family and Multi-Family households are put together to account for residential use but are separate from Commercial use. It is important to note that the irrigation needs for Single Family and Multi-Family houses may differ in that there is potentially less landscape per Multi-Family resident than there is for Single Family residents. There are also difficulties in determining irrigation needs between Single Family and Multi-Family households because some of the Multi-Family accounts may partly be comprised of the transient populations of students that leave for the summer. Consequently, the two categories are considered for outdoor residential water use as well as residential indoor water use, due to similar needs. The per capita calculations for ES Table 1 vary significantly from that of Table 2-7a in Section 2.3.4 because this forecast does not include commercial or non-revenue use as part of each customer's daily use. Additionally, all non-revenue water is calculated as unbilled water. The following table uses the calculated use factor to project water use without the adoption of additional conservation efforts by the City. In the American Water Works Association Manual 52 on water conservation planning, two ways to determine per capita water use are presented. One method looks at total water production as proportional to population growth, whereas per capita use will not change in the future. However, the second method used is a projection by customer class. This method can look at residential use and commercial use, therefore creating a more accurate look at per capita. It is important to note that the demand forecasts are sensitive to pumped total for the year that data is extrapolated.

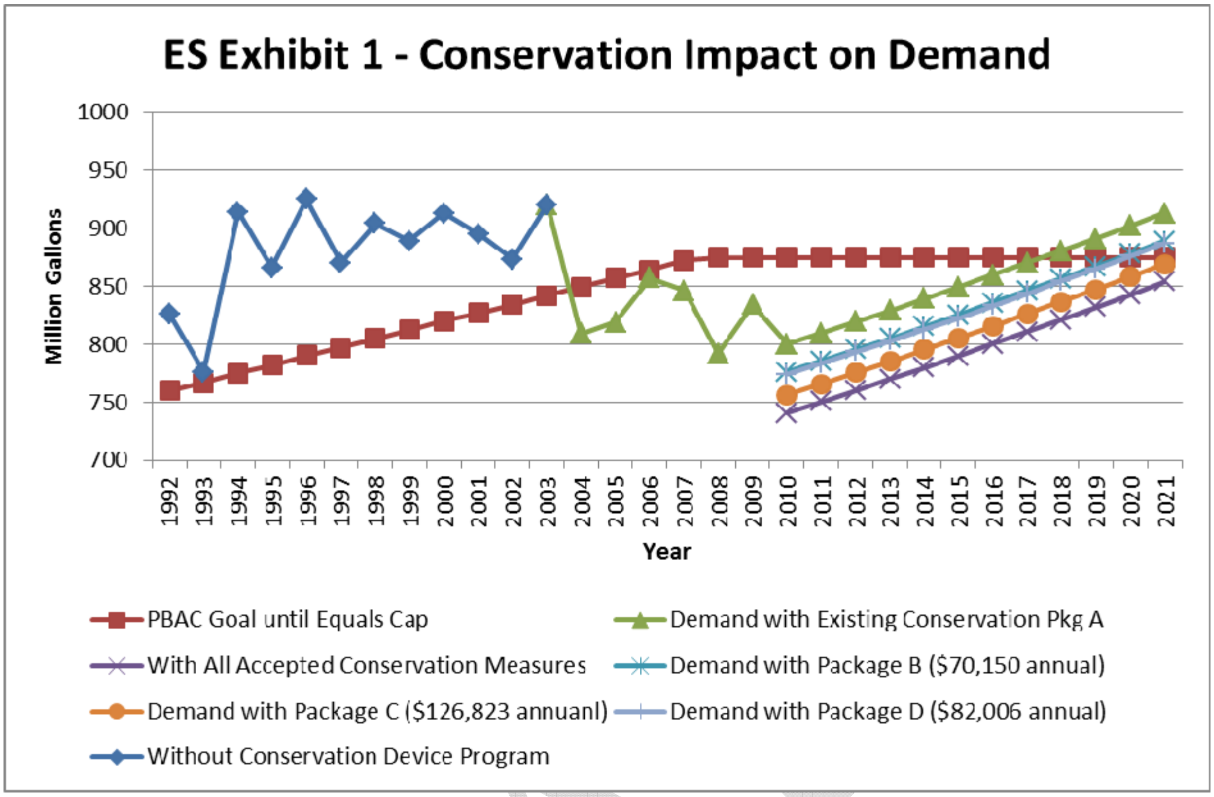
ES Exhibit 1 compares the forecast of water consumption without further conservation efforts against the added conservation packages described in this plan. Recommended measures to save water are included as part of the conservation package descriptions in Section 8. Incentives are also included as part of the plan. However, these incentives are not calculated in measures related to conservation forecasts because, in terms of practicality, incentives do not save water but serve more to highlight additional, underlying benefits of such a plan (i.e. outreach and education).

ES Table 1

Forecast Projections by Customer Class and Non-revenue (Unbilled) Water without Conservation

2009 Data			**2009 Total Pumped MG**		**834**
Customer Class	**Accounts**	**Total Billed Water(MG)**	**Billed(mgd)**	**Population**	***Use Factor (gal)**
Residential-SF HH	5,245	366	1.00	11,801	85
Residential-MF	4,472	234	0.64	10,062	64
Residential Total	**9,717**	**600**	**1.64**	**21,863**	74
Commercial	**942**	179	**0.49**	**13,188**	37
Unbilled Water		**55**			6.6%
1st Planning Year 2012			**2012 Total Pumped MG**		**863**
Customer Class	**Households**	**Total Billed Water (MG) No Conservation**	**Billed(mgd)**	**Population**	
Residential-SF	5,437	380	1.04	12,233	
Residential-MF	4,716	247	0.68	10,611	
Residential Total	**10,153**	**626**	**1.72**	**22,844**	
Commercial	**955**	**182**	**0.50**	**13,370**	
Unbilled Water		**55**			
Last Planning Year 2021			**2021 Total Pumped MG**		**957**
Customer Class	**Households**	**Total Billed Water (MG) No Conservation**	**Billed(mgd)**	**Population**	
Residential-SF	6,061	423	1.16	13,637	
Residential-MF	5,511	288	0.79	12,400	
Residential Total	**11,572**	**711**	**1.95**	**26,037**	
Commercial	**998**	**190**	**0.52**	**13,972**	
Unbilled Water		**55**			

Notes:
Forecast Projection Formulas from AWWA Manuel 52, pages 45-46
Account and Population Data from 2010 HDR Water Comprehensive Plan
SF = Single Family, MF = Multi Family, C = Commercial, HH = Household
SF = Singe Family and Duplex, MF = Apartments and Mobile Home Courts, C = Commercial
Population from 2010 Water Comprehensive Plan with 1.42% assumed growth
Percentage of billed water from Utility Data Source 2009, non-revenue water based on FY2009 Data
Employment is an assumption based on fixed data from 2004 EES Plan of 14 employees per customer account
National Average of 2.25 persons per HH
Total Billed = Year 2009 Pumping Reports minus FY2009 non-revenue data
*Use Factor is used to determine projections of water pumped, AWWA manuel 52, pages 45-46
*Use Factor: Residential Factor gpcd = gallons per person per day, Commercial Factor ged = gallons per employee per day



Projection forecast have been derived by using actual pumping data with future population growth and how that affects the Use Factor (gallons per person per day) as shown in ES Table 1. The potential water savings for each conservation package is then deducted from the usage expected with the existing program. It is important to note that the savings is based on average annual water saving of a fully implemented program and does not account for a phase in approach. According to these projected forecasts, if additional (beyond the Existing Program – Package A) conservation efforts are not implemented in the near future, by 2018 the City of Moscow will exceed the PBAC cap of 875 MG pumped annually. However, the additional conservation efforts recommended in this plan can extend the years until exceeding the PBAC cap.

Plan Recommendations

Measures are discussed in detail in Section 3 and conservation plan packages in Section 8; however the tables below, Table 3-3 below shows the overview of the screening results of accepted measures and Table Packages A – D overview selected measures. In addition to the Package options, plan phasing (briefly discussed in Section 3.7.1), could lower cost by choosing one of the packages, but limiting the funds allowed for a measure. For example, a first come first serve approach to the toilet rebate until the budget is reached.

Recommended incentives can be viewed in greater detail in Section 3.6 and many have already been implemented by the City. Accepted incentives are those that have already been implemented and would be low cost and capable of being combined with other programs. Regulatory incentives are not considered acceptable because they require input from other departments; however, they have been listed and some may be recommended. Refer to Sections 6 and 7 for details regarding Public Facilities and Industrial Professional Sector recommendations.

Table 3-3 - City of Moscow Potential Conservation Recommendations for Measures

Customer Class	Conservation Measure	Annual Water Savings (excluding savings from free riders) gpy	Annual Water Savings Ranking	Costs (excluding savings from free riders) Total Cost Over Plan	Dollar per 1000 gals Over Plan	Costs Ranking	Results of Screening Relative Rankings for Savings and Cost
SF Indoor	Low-volume toilets - 1.6gpf	11,434,220	High	$298,185	$2.61	Med	Accept*
	HET toilets - 1.0gpf	10,182,815	High	$368,821	$3.62	High	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Instant Hot Water Valve	5,641,446	Med	$67,575	$1.20	Low	Accept*
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Efficient clothes washers	1,954,517	Med	$45,050	$2.30	Med	Accept*
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Audits for manual irrigation	3,628,800	Med	$269,001	$7.41	High	Reject
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	50 gallon Rain Barrel Catchment	11,730	Low	$12,122	$103.34	High	Reject
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	9,917,929	High	$143,691	$1.45	Low	Accept*
	HET toilets - 1.0gpf	9,325,067	High	$187,641	$2.01	Med	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Instant Hot Water Valve	5,131,655	High	$34,149	$0.67	Low	Accept*
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Efficient clothes washers	992,423	Med	$4,575	$0.46	Low	Accept*
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Audits for automatic irrigation	3,110,400	Med	$337,896	$10.86	High	Reject
	Audits for manual irrigation	2,073,600	Med	$349,416	$16.85	High	Reject
	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	50 gallon Rain Barrel Catchment	11,730	Low	$9,644	$82.22	High	Reject
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
	Sub-Meter Multi-Family Households	2,705,299	Med	$216,600	$8.01	High	Reject
CI Indoor	Low-volume toilets	650,623	Med	$12,415	$1.91	Med	Accept*
	HET toilets	385,843	Med	$10,268	$2.66	Med	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Waterless urinals	489,847	Med	$8,982	$1.83	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Air-cooled ice machines	1,063,084	Med	$3,037	$0.29	Low	Accept*
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
	Hotel bedding and towel message	170,895	Med	$0	$0.00	Low	Accept*
CI Outdoor	Audits for automatic irrigation	1,612,800	Med	$264,470	$16.40	High	Reject
	Audits for manual irrigation	1,036,800	Med	$259,480	$25.03	High	Reject
	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Low water use plants guide book	92,160	Low	$82	$0.09	Low	Reject
	Less Lawn	92,160	Low	$0	$0.00	Low	Reject
	Annual Total Water Savings for All	117,297,704	Total All Cost	$3,150,304	Annual All Cost	$315,030	
	Annual Total Water Savings for Accept + Accept*	102,922,225	Total A + A* Cost	$1,431,593	Annual A + A* Cost	$143,159	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	59,313,459	Total A* Cost	$1,205,281	Annual A* Cost	$120,528	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

Table 3-8 - City of Moscow Conservation Package Comparison	Package A	Package B	Package C	Package D
Annual Water Savings at Full Implementation of Program*	43,608,766	67,584,632	87,478,357	69,827,221
Reduction in Year 2021 Demand (Planning Period 2012-2021)	4.6%	7.1%	9.1%	7.3%
Achieve PBAC Goal	No	No	Yes	No
Annual Cost^	$22,631	$70,150	$126,823	$82,006
Total Cost~	$226,312	$701,497	$1,268,226	$820,060

Notes:
*Annual water savings once all measures are implemented.
^Annual costs vary depending on how plan is phased in, but assumed phased in evenly over planning period.
~Direct cost, not including staff, advertising, and distribution.

Table Package A - City of Moscow Existing Conservation Measures, No Additional Meaures

Customer Class	Conservation Measure	Annual Water Savings (excluding savings from free riders) gpy	Ranking	Costs (excluding savings from free riders) Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	Results of Screening Relative Rankings for Savings and Cost
SF Indoor	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
CI Indoor	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
CI Outdoor	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

Table Package B - City of Moscow Existing Conservation Measures, Additional Meaures							
		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Low-volume toilets - 1.6gpf	11,434,220	High	$298,185	$2.61	Med	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	9,917,929	High	$143,691	$1.45	Low	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
CI Indoor	Low-volume toilets	650,623	Med	$12,415	$1.91	Med	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
CI Outdoor	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Annual Total Water Savings for Accept + Accept*	67,584,632	Total A + A* Cost	$701,497	Annual A + A* Cost	$70,150	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	23,975,867	Total A* Cost	$475,185	Annual A* Cost	$47,519	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.

Already Implemented Measures

*Not Already Implemented Measures

SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

Table Package C - City of Moscow Existing Conservation Measures, Additional Meaures Expanded							
		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Low-volume toilets - 1.6gpf	11,434,220	High	$298,185	$2.61	Med	Accept*
	HET toilets - 1.0gpf	10,182,815	High	$368,821	$3.62	High	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	9,917,929	High	$143,691	$1.45	Low	Accept*
	HET toilets - 1.0gpf	9,325,067	High	$187,641	$2.01	Med	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
CI Indoor	Low-volume toilets	650,623	Med	$12,415	$1.91	Med	Accept*
	HET toilets	385,843	Med	$10,268	$2.66	Med	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
CI Outdoor	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Annual Total Water Savings for Accept + Accept*	87,478,357	Total A + A* Cost	$1,268,226	Annual A + A* Cost	$126,823	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	43,869,591	Total A* Cost	$1,041,914	Annual A* Cost	$104,191	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

Table Package D - City of Moscow Existing Conservation Measures, Additional Meaures Limited							
		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Low-volume toilets - 1.6gpf	5,081,876	High	$132,527	$1.16	Low	Accept*
	HET toilets - 1.0gpf	4,525,696	Med	$163,920	$1.61	Low	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	7,934,343	High	$114,953	$1.16	Low	Accept*
	HET toilets - 1.0gpf	6,216,711	High	$150,113	$1.61	Low	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
CI Indoor	Low-volume toilets	325,311	Med	$6,208	$0.95	Low	Accept*
	HET toilets	161,424	Med	$5,134	$1.33	Low	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
CI Outdoor	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Annual Total Water Savings for Accept + Accept*	69,827,221	Total A + A* Cost	$820,060	Annual A + A* Cost	$82,006	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	26,218,456	Total A* Cost	$593,747	Annual A* Cost	$59,375	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

Future Evaluation and Effectiveness of Plan

It is important to evaluate what works and does not work with the Water Conservation Plan and to adjust accordingly for cost benefit analysis, budget constraints, and water savings. It is also important to determine which measures and incentives have higher participation rates. Additionally, it is pertinent to identify the source of our water savings, despite the difficulty in identifying the exact cause of why pumping levels decrease (i.e. weather, rates, measures, incentives, etc.). Finally, it is important to exercise flexibility in amending the program with regards to the evaluation of what works and what does not.

1 Introduction

1.1 Background

The City of Moscow water system relies on groundwater from two aquifers: the Grande Ronde and Wanapum aquifers. The City also obtains water from five groundwater wells: two in the shallow Wanapum (Wells No. 2 and 3) and three in the deep Grande Ronde (Well No. 6, 8, and 9). Together these aquifers make up the Palouse Ground Water Basin. Moscow is one of many users that draw upon these water sources, including regional cities and towns, two major universities, and others.

While the two aquifers have been studied, supply and recharge remains to be understood. Studies suggest the Grand Ronde does not recharge whereas the Wanapum may recharge; however location and quantity remain unknown. Consequently, if a finite amount of water is available in the Grande Ronde, ground water withdrawals by all parties need to be managed in order to keep the aquifers available for continued use. The City has participated in the Palouse Basin Aquifer Committee (PBAC) for many years to share information with other water users and develop ground water management approaches. In addition Moscow has a 1% voluntary goal which is capped at 875 MGY and in 2006 through 2009, the City met its voluntary PBAC goals, 857 MG, 846 MG, 792 MG, and 834 MG, respectively. While these goals have been met, the City is approaching its 875 MGY production limit, placing further emphasis on the conservation program in the reduction of per capita water consumption.

This Water Conservation Plan, prepared in 2010 (WCP 2010) reviews a range of techniques to reduce the City of Moscow's water consumption, thereby reducing ground water withdrawals. Conservation methods implementing measures and incentives are presented for four major water user types:

- Single and Multi-Family Sector
- Commercial and Institutional Sector
- Public Facility Sector
- Industry Professional Sector

Several conservation measures and incentives are evaluated in this WCP 2010 (Section 3). However, to help offset costs of plan implementation, three alternative plan packages (Section 8) are evaluated for the City to adopt one package option toward the Conservation Program:

- 75% Plan
- 25% Plan
- Phased-In Plan (Over the 10 year plan period, years 2012-2021)

This 2010 City of Moscow Water Conservation Plan was prepared by Water Conservation Program Coordinator Nichole Baker. This plan references work previously done by Economic and Engineering Services, Inc., City of Moscow Water Conservation Plan dated April 9, 2004 along with several other references (Appendix E).

1.2 Conservation Methods

Water conservation methods have been divided into two categories: measures and incentives. Measures are defined as hardware and behavior changes that promote water savings, such as low flow showerheads or taking shorter showers. Incentives are defined as motivators for people to enact such measures that fall into three categories: educational, financial, and regulatory. Beneficial water conservation methods have been highlighted in the sections to follow. See Section 3, Water Conservation Element Overview, for more details.

1.3 Goals and Objectives

The following is a statement of goals and objectives developed for the Water Conservation Plan. It is important to note that while the primary goal and objectives are interrelated, the order in which they appear does not imply priority of one objective over another.

Moscow Water Conservation Plan Goal

Implement Water Conservation Plan over the next ten years to continue to meet the Palouse Basin Aquifer Committee (PBAC) voluntary goals set forth by the Ground Water Management Plan of September 1992.

Limit increases in water use to 1% compounded yearly, based on a five-year moving average, with a cap of 125% (875 MG).

Moscow Water Conservation Plan Objectives

The American Water Works Association (AWWA) supports the following conservation principles and practices (2006 M52 Manual):

1. Efficient utilization of sources of supply;

2. Appropriate facility rehabilitation or replacement;

3. Leak detection and repair;

4. Accurate monitoring of consumption and billing based on metered usage;

5. Full cost pricing;

6. Establishment of water-use efficiency standards for new plumbing fixtures and appliances, and the change of existing high-water-use plumbing fixtures to a more efficient design;

7. Encouragement of the use of an efficient irrigation system and landscape materials;

8. Development and use of education materials on water conservation;

9. Public information programs promoting efficient practices and water conservation by all customers;

10. Integrated resource planning;

11. Water reuse for appropriate uses; and

12. Continued research on efficient water use practices.

1.4 Plan Organization

Section 2 describes the City of Moscow's population and water production and sales. Section 3 gives an overview of conservation elements and screening process. The following Sections 4 through 7 cover the main areas of water conservation techniques listed as measures and incentives. In addition, each water user type is defined along with the conservation methods to be implemented for each user type. User types include Single Family Sector (SF) and Multi-Family Sector (MF), Commercial /Industrial Sector (CI), Public Facilities Sector (PF), and Industry Professional Sector (IP).

This plan contains appendices that summarize current and previous water conservation activities and lists all measures and incentives that were considered. The plan also evaluates the measures and incentives and includes a list of references used to complete the Water Conservation Plan. Tables and exhibits can be found throughout the document.

1.5 Pricing for Conservation

Water pricing is an effective tool for managing consumption. In fall 2005, the City of Moscow adopted a tiered rate pricing structure (Table 1-1) in addition to fixed charges. This tiered rate structure is based on a block design and organized according to consumption and customer class. The three-tiered consumption rates apply to residential and duplex customers (one connection/meter per dwelling unit) only. Rates are based on low, medium, and high use with cost per hundred cubic feet (ccf) increasing with each increased consumption tier/block. Commercial and Multi-Family (one connection/meter per rental complex with several dwelling units) customers are priced at one bulk water rate with pricing staying consistent regardless of water use. Single Family residential and duplex consumers make up approximately 47% of the City's water consumption, Multi-Family customers make up approximately 30% and Commercial customers make up approximately 23% of the City's water consumption (Table 2-9).

A change in water production can impact sewer revenues for accounts that are charged sewer rates in correlation with water consumption. However, this will not affect the majority of customers because they are billed on a fixed monthly rate plus metered consumption. Only churches, some commercial and mixed-use (i.e. apartments above a restaurant with same owner) services are billed based on metered water.

Table 1-1

City of Moscow Pumping (millions of gallons MG) with Tiered Rate Highlighted

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total MG
2002	51.9	50.2	54.2	57.4	66.8	89.5	131.3	*108.1	96.1	64.4	52.5	51.1	765.4
2003	52.9	55.7	58.9	61.7	69.1	110.8	140.3	121.8	87.7	64.6	48.3	47.8	919.5
2004	51.7	50.1	50.5	57.0	62.5	79.4	123.7	103.8	71.1	60.7	49.4	49.2	809.3
2005	51.4	48.5	52.4	53.7	60.4	72.4	114.5	119.5	89.8	57.6	48.4	50.5	819.0
2006	50.4	48.1	52.1	54.2	73.4	75.4	125.9	122.9	92.2	64.2	49.7	48.0	856.5
2007	52.9	48.6	53.6	52.9	69.0	83.6	124.3	118.7	85.3	57.6	51.0	49.2	846.4
2008	51.0	49.1	51.2	52.5	61.1	70.6	114.2	108.0	84.0	56.8	46.2	47.4	792.1
2009	49.1	47.4	51.5	53.2	64.6	87.2	113.4	105.7	96.4	65.2	48.3	52.2	834.2

Tiered water system in place.

*Emergency measures with Well No.9 pump failure

Although Moscow met its PBAC water conservation goals for 2006 through 2009, it is difficult to know the extent to which the tiered structure rate has influenced citizen water use with only four years of data. Rates are currently raised every October to accommodate the revenue projections completed every five years. As commonly recommended in the industry, rate adjustments can also account for a revenue neutral municipality (revenues received closely match expenditures incurred during the same time period).

Understanding the impact the City's tiered rate structure has had on water use can help determine conservation success by way of the tiered rate. For future tiered rate structure evaluation, it might be important to evaluate whether or not the blocks demonstrating an increase in cost could be measured based on the following criteria:

1) What is the total impact on water use?
2) Is there a reduction in peak season demand?
3) Do larger users pay less?
4) Do the customers understand the rate structure?

2 Population, Water Production and Water Sales

2.1 General Information

The purpose of this section is to review the available data on water production, consumption, and projected growth. The following list of data sources was reviewed:

- 2004 City of Moscow Water Conservation Plan by EES and JUB Engineers.
- 2007 Annual Report, Palouse Basin Aquifer Committee (PBAC).
- 2008 Annual Report, Palouse Basin Aquifer Committee (PBAC).
- City of Moscow, Water Department Production Records, 1963-2009 (By Year) and PBAC Modified (1999 discovery of Wells No. 2 and 8 over-registering, adjusted 1986 to 1998) 1986-2009 Production Records.
- City of Moscow, Water Department, Annual Water Metered Records, including top water users by generic category (2009).
- City of Moscow Comprehensive Plan 1995, 1999, revised in 2009.
- City of Moscow Census Data, 1970-2009.
- City of Moscow Press Release by City Supervision on 1/14/2009, City of Moscow Census Data, Census Bureau July 1, 2007 population estimate.
- City of Moscow 2010 Water Comprehensive Plan prepared by HDR.

2.2 Population Forecast

Population growth in Moscow will bring with it a water demand component that must be considered in both the conservation plan and in setting benchmarks to determine whether the City is meeting its conservation goals.

Census data for the last 37 years is shown in Table 2-1, below:

Table 2-1
City of Moscow Census Data

Year	Population	Annual Growth Rate
1970	14,146	
1980	16,513	1.6
1990	18,519	1.2
2000	21,291	1.4
2006	22,352	0.8
2007	24,329	0.9

The census figures include the University of Idaho student population, some of whom live on campus and primarily utilize the University’s water system, which is separate from the City’s system. As of July 1, 2007, the most recent population estimate for Moscow was 24,329.

According to the census data shown in Table 2-1, the annual growth rate in the 1990's exceeded one percent, implying a growth rate above one percent. While population growth between 2001 and 2007 fell below one percent, a 1.42% projection rate is more appropriate due to the updates from the 2007 census data indicating a population of 24,329. Table 2-2 depicts a project population based on 1.42% growth rate based on the most recent 2007 Census data and includes all of Moscow's population.

Table 2-2
Moscow Population Projections Based on Census Data and 1.42% Growth

Year	Census Population	1.42% Annual Growth
2007	24,329	
2010		24,946
2012		25,659
2015		26,768
2020		28,723
2021		29,131

Table 2-3 is the population estimates of Moscow water customers taken from the 2010 Water Comprehensive Plan. These estimates will be used in the demographic screening section because it is more specific to the number of water customers and does not include the complete population (i.e. students not on City water). Based on the available data, the Water Conservation Plan will assume an overall population growth rate of 1.42% over the planning period 2012 through 2021.

Table 2-3
Moscow Population Projections Based on Water Customers and 1.42% Growth
2010 Moscow Water Comprehensive Plan

Year	Census Population	Served by Moscow Water
2007	24,329	22,383
2010		22,950
2012		23,606
2015		24,626
2020		26,425
2021		26,800

Served by Moscow Water from 2010 HDR Water Comprehensive Plan Data

2.2.1 Large Customer Additions and Subtractions

There are no immediate large new water customers or expected closings/reductions in operation of exiting major businesses identified at the time of completion.

One potential large water user is a new ball-field complex off Palouse River Drive. The site is approximately 44 acres and will likely be developed over a two to five-year time period. A comparison with Moscow's Mountain View Park was done for the 2004 EES Plan to estimate the water demand that would come with such a complex. Mountain View Park uses approximately 5.5 million gallons each year for irrigation and has about 12 irrigated acres. Assuming 24 acres are irrigated at the new complex, the average seasonal demand would be 11 million gallons. Council discussion voted no potable water to be used. One approach to address this increase in water demand from the City's standpoint would be to tie in to the University of Idaho's reclaimed water system and utilize wastewater treatment plan effluent instead of potable water.

Subdivisions and commercial developments, regardless of size, were not considered separately from the previously identified growth rates. This is due to the anticipated 1.42% growth rate and includes ongoing subdivision and development activity.

2.3 Water Production

The City of Moscow has historically obtained its municipal water supply from groundwater. Shallow wells in the Wanapum aquifer originally supplied the City's water. However, due to declining water levels and water quality in that aquifer, deeper wells were later drilled into the Grande Ronde aquifer. Since the City began pumping water from the Grande Ronde aquifer, the Wanapum aquifer has recovered substantially and the City currently has wells in both aquifers. In recent years, City production from the Grande Ronde aquifer has essentially stabilized with more emphasis on production from the Wanapum wells (see Table 2-4 and Exhibit 2-1).

Table 2-4
Combined, Grande Ronde Aquifer (Wells 6, 8, 9) and Wanapum Aquifer (Wells 2,3)
Water Production By Year and Percent Pumped

Year	Combined MG	Grande Ronde	Wanapum	% Grande R.	% Wanapum
1993	776	627	149	81%	19%
1994	914	710	204	78%	22%
1995	866	567	299	65%	35%
1996	925	577	348	62%	38%
1997	870	688	182	79%	21%
1998	904	733	171	81%	19%
1999	889	657	232	74%	26%
2000	913	684	229	75%	25%
2001	895	640	255	72%	28%
2002	873	577	296	66%	34%
2003	920	669	251	73%	27%
2004	809	589	220	73%	27%
2005	819	558	261	68%	32%
2006	857	586	271	68%	32%
2007	846	612	234	72%	28%
2008	792	638	154	81%	19%
2009	834	532	302	64%	36%
			Average	**72%**	**28%**

2.3.1 Yearly Production Levels

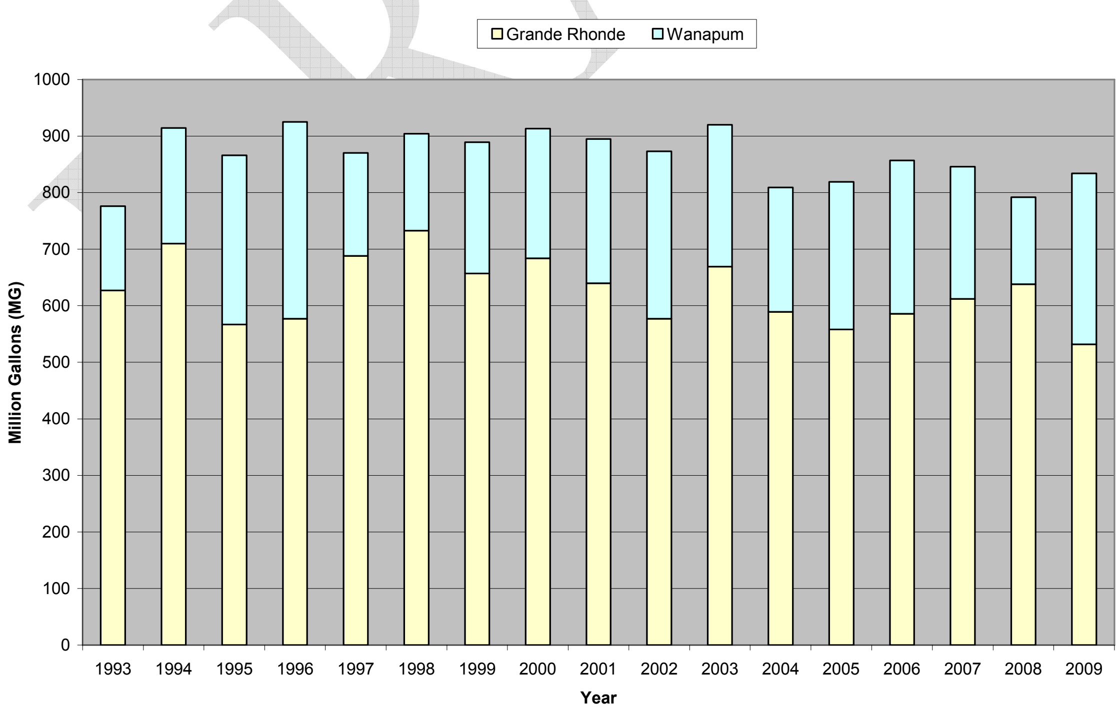
Yearly production levels for all water sources, based on City records, is shown in Table 2-5. It should be noted that in 1999 the City determined its source meters at Wells No. 2 and 8 were over-registering. PBAC subsequently adjusted production totals for these wells backward from the period of 1986 to 1998. However, there is no way to accurately determine how long the meters were out of calibration, nor the magnitude of the calibration problem in each year therefore the data in table 2-4 and 2-5 is from the City of Moscow's pumping records and are not adjusted totals.

Table 2-5
City of Moscow Yearly Water Production (MG)

Year	MG
1993	776
1994	914
1995	866
1996	925
1997	870
1998	904
1999	889
2000	913
2001	895
2002	873
2003	920
2004	809
2005	819
2006	857
2007	846
2008	792
2009	834

A comparison of the relative contributions from both aquifers is shown in Exhibit 2-1.

Exhibit 2-1 - Grande Ronde vs Wanapum Pumping Comparison



Over-registering of production can increase discrepancy between production and sales. Over-registering occurs due to iron buildup on flow meter tubes and turbines. The flow meters on Wells No. 2, 3, 8, and 9 were cleaned of iron deposits and as a result, the metered flow values decreased. Iron buildup has been identified as a problem with all well meters, with Well No. 6 being the exception. After the City identified the iron buildup problem, a cleaning schedule was created to address the problem. The meter heads for Wells No. 2 and 3 are cleaned every 6 months and Wells No. 6, 8 and 9 are cleaned annually. Since the late 1990's, each pump is pulled from its well and sent to the manufacturer to be rebuilt with parts replaced, cleaned and calibrated on a five-year rotation. Due to an over-registering caused by iron build-up of Well No. 3 in 2009, the cleaning schedule will be temporarily changed in 2010 for Wells No. 2, 3, and 8 being cleaned of iron every 3 months and Wells No. 6 and 9 cleaned on an annual basis.

2.3.2 Monthly Production Levels

Month to month production from all wells is shown in Table 2-6 and Exhibit 2-2 for 2000 to 2007.

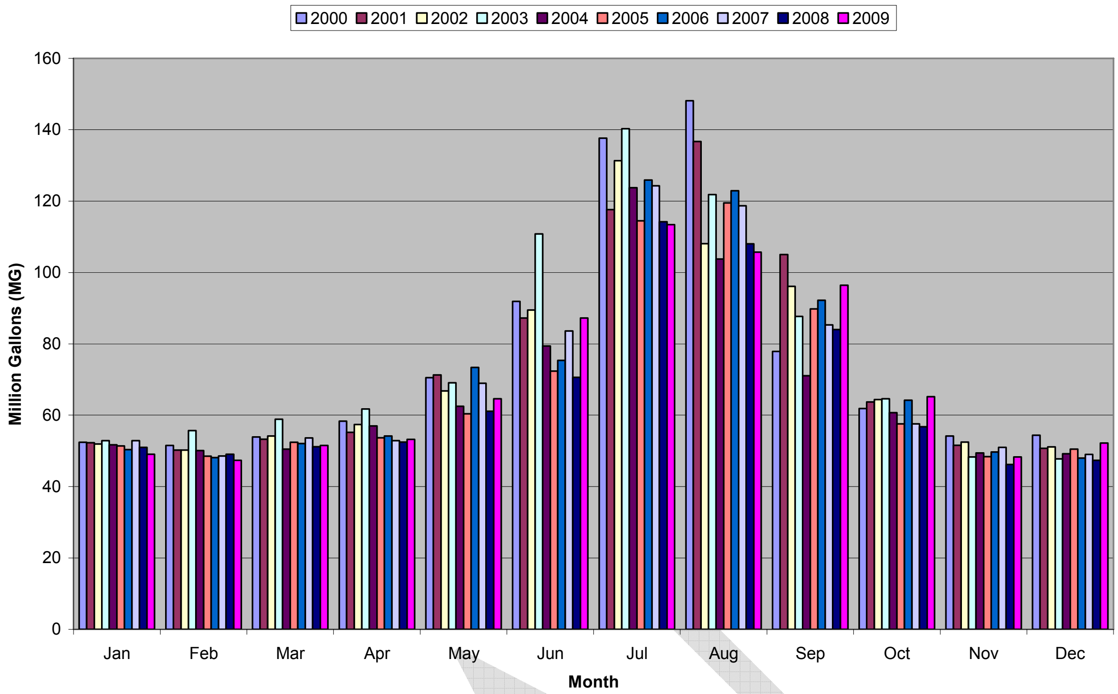
Table 2-6
Water Production (MG) by Month (2000-2009)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	52.4	51.5	53.9	58.3	70.5	91.9	137.6	148.1	77.9	61.9	54.2	54.4
2001	52.3	50.2	53.3	55.2	71.3	87.2	117.6	136.7	105.0	63.7	51.6	50.7
2002	51.9	50.2	54.2	57.4	66.8	89.5	131.3	108.1*	96.1	64.4	52.5	51.1
2003°	52.9	55.7	58.9	61.7	69.1	110.8	140.3	121.8	87.7	64.6	48.3	47.8
2004^	51.7	50.1	50.5	57.0	62.5	79.4	123.7	103.8	71.1	60.7	49.4	49.2
2005	51.4	48.5	52.4	53.7	60.4	72.4	114.5	119.5	89.8	57.6	48.4	50.5
2006	50.4	48.1	52.1	54.2	73.4	75.4	125.9	122.9	92.2	64.2	49.7	48.0
2007	52.9	48.6	53.6	52.9	69.0	83.6	124.3	118.7	85.3	57.6	51.0	49.2
2008-	51.0	49.1	51.2	52.5	61.1	70.6	114.2	108.0	84.0	56.8	46.2	47.4
2009	49.1	47.4	51.5	53.2	64.6	87.2	113.4	105.7	96.4	65.2	48.3	52.2

*Emergency measures with Well No. 9 pump failure
°In 2003, voluntary daytime irrigation restrictions during summer
^In 2004, mandatory resolution and daytime irrigation ordinance restrictions from April 1st to Oct 31st
-In 2008, irrigation season is now declared annually

The City of Moscow monthly production for both aquifers is shown in Exhibit 2-2.

Exhibit 2-2 - City of Moscow Monthly Production (2000-2009)



Moscow ties in with the University of Idaho water system for emergency purposes. The university system has higher water pressure than the City system, so in the event of a leak, the university system would leak into the City system (the purpose was to provide emergency low either direction, however the UI has the slightly higher tanks.. There has been one instance in the last 18 years when the City made water available to the University, and that was after a campus fire depleted the U of I system. It is also important to note that Moscow does not purchase from other suppliers nor does it provide water to any wholesale customers.

2.3.3 Average and Maximum Day Production

City records were examined for the last seven years to determine the average day and maximum day demand. See Table 2-7.

Table 2-7
Average and Maximum Day Production

	2003	2004	2005	2006	2007	2008	2009
Avg. Day Demand, MG	2.52	2.22	2.24	2.35	2.32	2.17	2.29
Avg. Day Demand (Nov-Apr)*	1.82	1.67	1.67	1.66	1.68	1.64	1.67
Avg. Day Demand (May-Oct)	3.23	2.72	2.79	3.01	2.93	2.69	2.69
Maximum Day Demand, MG	5.38	4.95	^4.76	4.88	^4.59	^4.76	5.12
Date Max Day Occurred	18-Jul	15-Jul	9-Aug	23-Jul	5-Jul	15-Aug	2-Jul

*Nov-Apr data taken from the previous and current year. For example; 2003 represents Nov- Apr of 2002/2003.
Maximum Day Demand varies depending on when the wells were read and recorded.

^Max Daily Demand = If the highest day demand varied from the previous or following day and/or it was a weekend reading, then the time reading was inconsistent; in this case, the next highest demand day was recorded as Max Daily Demand.

2.3.4 Per Capita Water Use

Although the per capita data in Table 2-7a was compiled in order to get an idea of individual residential water use. The pumped-water statistics include non-revenue and commercial use water. Therefore, each residential consumer statistic pertaining to pumped water is included in the per capita use category. Estimated population was based on data available before the official 2007 Census data was released. The University Residents and Greek Resident data was retrieved from University of Idaho staff.

Table 2-7a
Per Capita Water Use in the City of Moscow

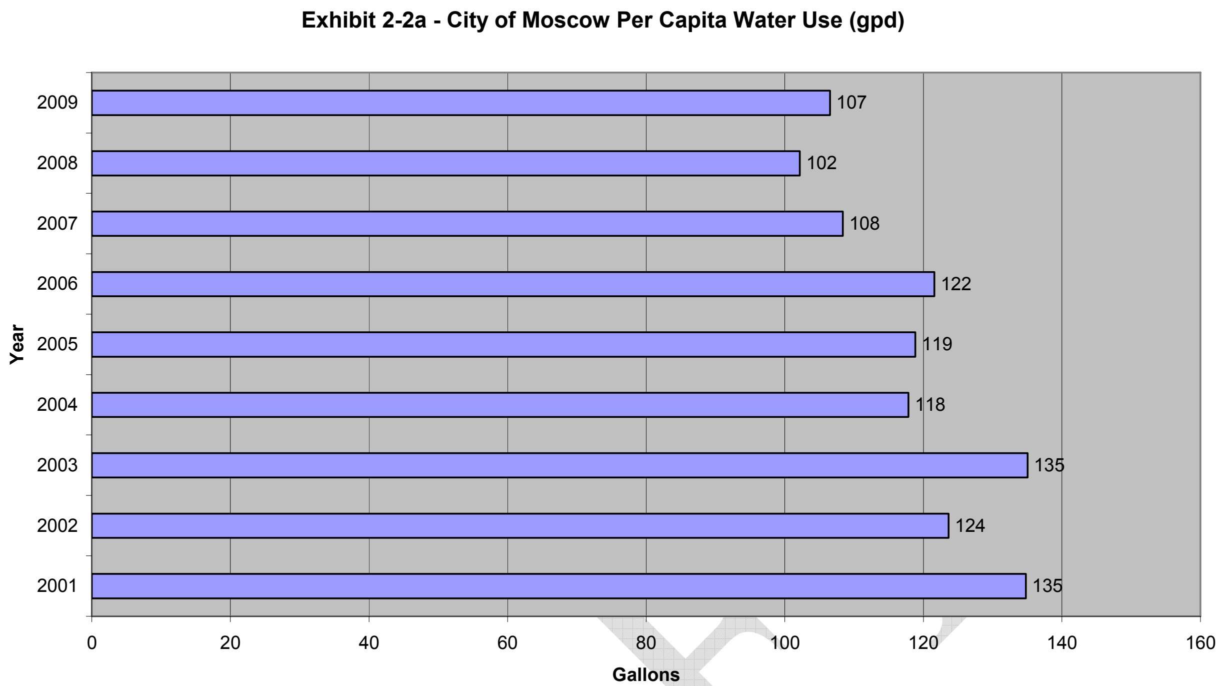
Year	Estimated Population	University Residents	Greek Residents	Total University Residence	Total Moscow w/o Univ. Res.	Yearly Pumping City(MG)	Per Capita (gpd)
2001	21,465	1,992	1,279	3,271	18,194	895,102.5	135
2002	21,640	1,909	1,176	3,085	18,555	837,433.5	124
2003	21,816	1,971	1,191	3,162	18,654	919,521.8	135
2004	21,994	2,016	1,167	3,183	18,811	809,268.6	118
2005	22,173	2,042	1,254	3,296	18,877	818,964.2	119
2006	22,352	1,916	1,139	3,055	19,297	856,506.6	122
2007	24,329	1,796	1,140	2,936	21,393	846,416.3	108
2008	24,252	1,865	1,161	3,026	21,226	791,531.3	102
2009	24,596	1,927	1,215	3,142	21,454	834,218.8	107

City population numbers obtained from the City of Moscow 1999 Community Development Department for 1995-2006 and U.S. Census Bureau for 2007, with a 1.42% increase after 2007 from the 2010 Water Comp Plan.

Growth between documented US Census Bureau population data was based on the growth between those document years and assumes a population growth each year.

University Residents (Dorms and Married Student Housing) on UI water - population numbers obtained from the University of Idaho, Parking and Transportation Services Director, Carl Root, via email communications on 1/5/2010 for 2001-2009 and assumes that the number of University Residents that receive UI water is consistent each year.

University Resident Greek Residents on UI water population numbers obtained from the University of Idaho Director of Greek Life, Matthew J. Kurz via email communications on 1/5/2010 and assumes that 8% of sororities and 2% fraternities are not at greek resident.



2.3.5 Events Affecting Production

A few significant events during recent years have affected water production levels. The first occurred in August 2002 when City Well No. 9 experienced a pump failure. On August 12, 2002, the City called for voluntary conservation and on August 14, emergency conservation measures were enacted, including a ban on all outside watering. The watering restrictions were lifted on September 3, 2002, after the pump had been repaired.

Another event occurred following growing concern over declining aquifer levels. On June 9, 2003, the Moscow City Council instituted a voluntary daytime restriction on outdoor watering through September 15, 2003. That deadline was extended to November 1, 2003 after which the restriction was officially lifted.

To curb landscape watering use, a Water Conservation Ordinance and Water Waste Resolution was passed by the Moscow City Council on May 17, 2004. The Ordinance restricted outdoor watering to the hours of 6 p.m. to 10 a.m. from April 1 to October 31. The Resolution restricted the use of poorly-maintained plumbing and water systems. On October 22, 2007 the Moscow City Council passed amendments to the ordinance which defined a set landscape irrigation watering season, to be determined annually, as well as prohibited the watering of impervious surfaces.

2.3.6 Historical Pumping vs. PBAC Targets

In 1992, the Palouse Basin Aquifer Committee (PBAC) set target limits for its members of a one (1%) percent pumping increase, compounded yearly, based on a five-year moving average beginning with the 1982-1986 period, and a cap of 125% for the 1981-1985 production average (700 MG for Moscow). (See Exhibit 2-3, production data are based on PBAC adjusted numbers). The 125% cap is approximately 875 million gallons (MG) per year for the City of Moscow. These target levels are irrespective of whether the Grande Ronde or Wanapum aquifer is the source of pumping. In 2006 through 2009 the City of Moscow met the PBAC 1% Voluntary Limit.

Exhibit 2-3 - Moscow Yearly Water Production and PBAC Goals

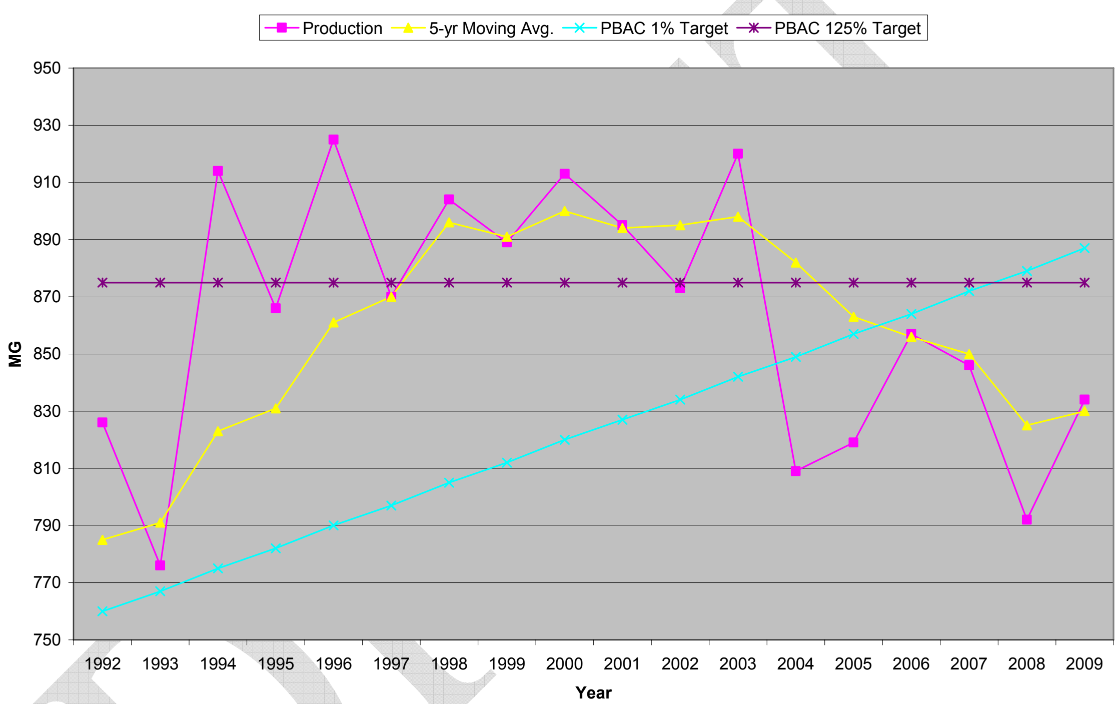


Table 2-8 shows the yearly difference between the pumping target level and the actual production level. In the early years of the target the yearly pumping rate was either near or below the target goal. However, in recent years the actual production levels have consistently exceeded the target values. The "actual" data presented in Table 2-8 are based on PBAC adjusted figures (1992-1998) due to meter over-registering concerns, as discussed in Section 2.3.1. The remaining years show unadjusted data. The net "overage" for the years 1992-2009 is 575 MG.

Table 2-8 Yearly Amount Under or Over PBAC 1% Target (MG)

Year	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Target	760	767	775	782	790	797	805	812	820
Actual	754	720	848	791	858	826	846	889	913
Diff.	6	47	(73)	(9)	(68)	(29)	(41)	(77)	(93)
Year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Target	827	834	842	849	857	864	872	879	887

Actual	895	873	920	809	819	857	846	792	834
Diff.	(68)	(39)	(78)	40	38	7	26	87	53
							Net Overage =		(575)

Note: Figures for 1992 – 1998 are PBAC adjusted values due to meter over-registering concerns.

2.3.7 Electrical Costs of Water Production and Treatment

Cost figures for delivering safe drinking water and processing the flow at the Waste Water Treatment Plant (WWTP) include such items as energy, chemicals, labor, capital cost, and waste water processing. The following section evaluates electrical costs. It should be noted that natural gas costs were evaluated by the City's Sustainability Department, but not included in this report because this energy source is used for buildings and is not directly affected by water production and waste water flow. A further look into costs and potential savings is described in Section 3.4. As Table 2-8a shows, the largest area of electrical use are the wells.

In 2008, the Sustainability Intern for the City of Moscow evaluated energy use in reference to the City's carbon footprint, therefore this information is available for the year 2005. For this section, the following data was reviewed:
Excel document from Sustainability Department Municipal Electricity Use 2005
Excel document from Sustainability Department Water Sewer Electricity Use 2005

Table 2-8a 2005 Water and Sewer Electricity Costs	kWh	Cost
Lift Stations	38934	$3,837
Boosters/Reservoirs	310,121	$20,965
Wells	2,368,940	$148,756
WWTP	2,176,800	$120,650.00

Exhibit 2-3a Water and Sewer Electricity Use 2005 Comparison

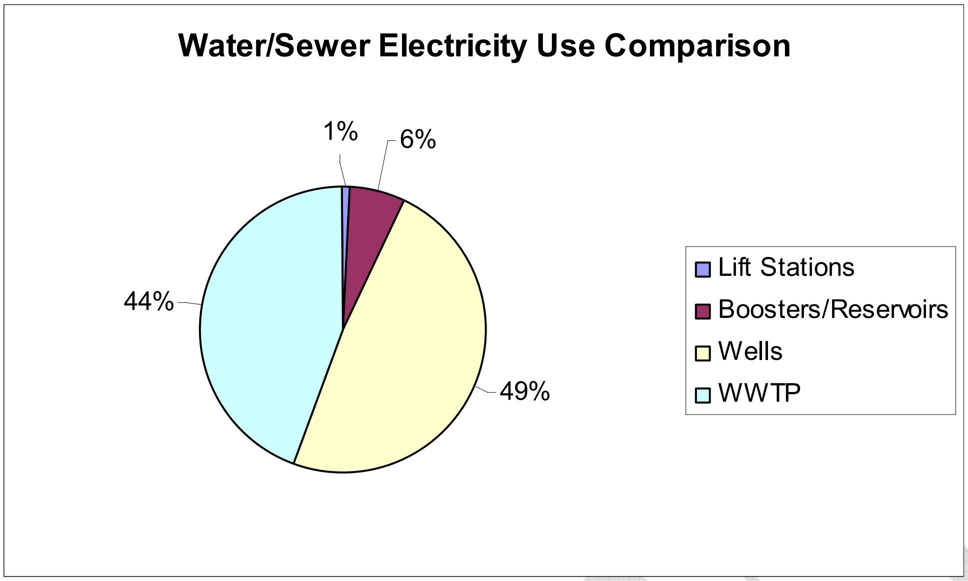


Exhibit 2-3b Municipal Electricity Use 2005 Comparison

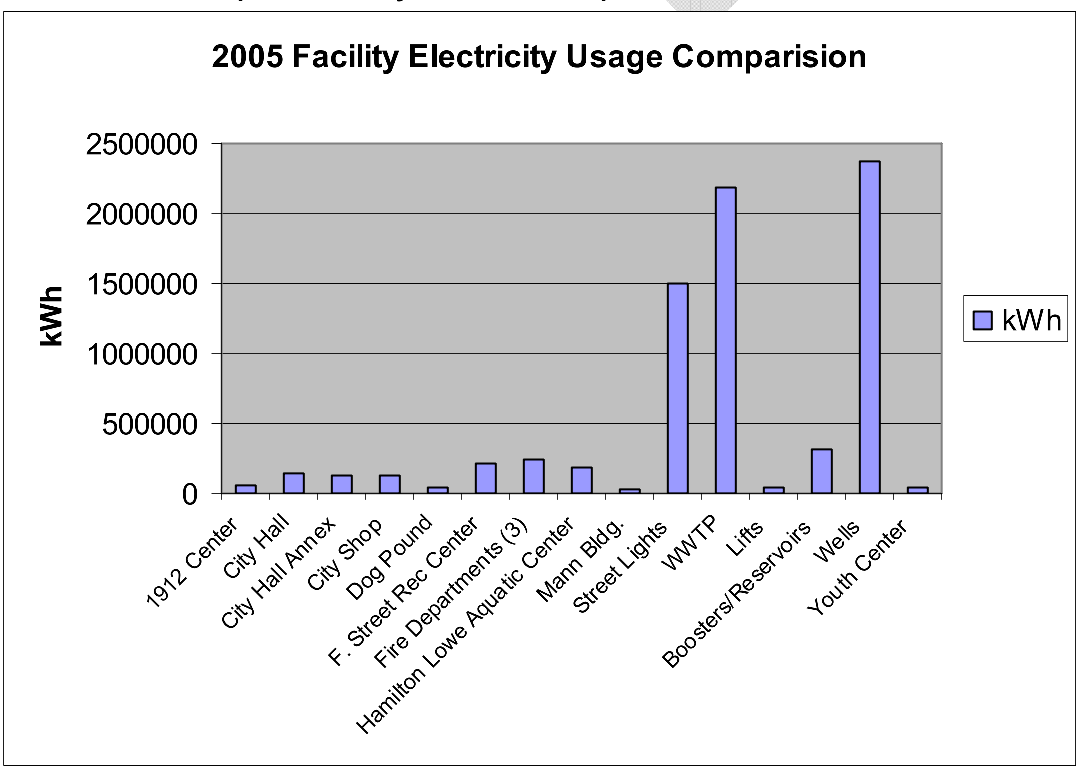
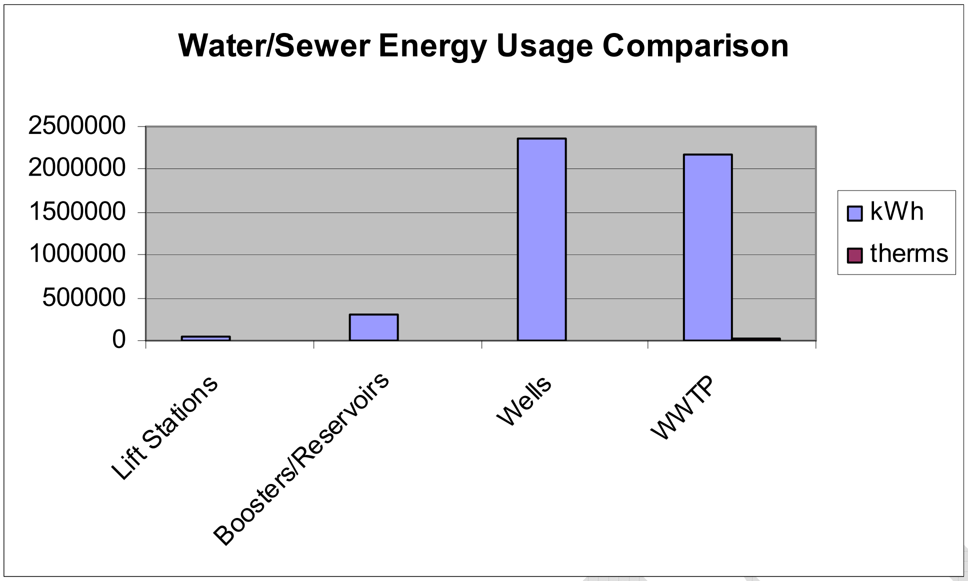


Exhibit 2-3c Municipal Electricity Use 2005 Comparison

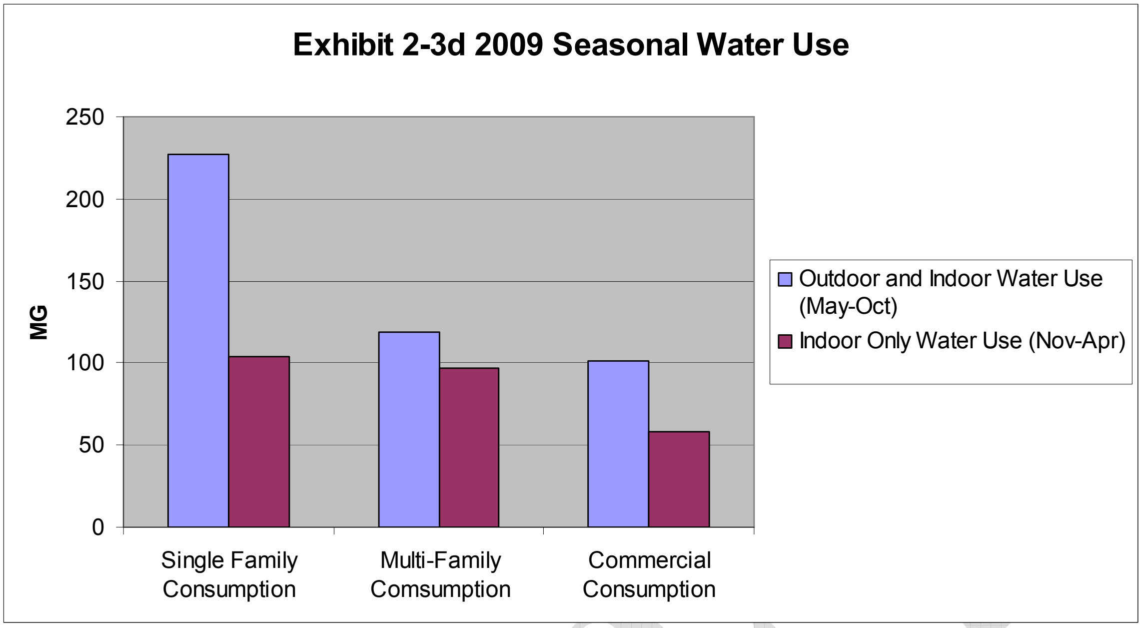


2.3.8 Seasonal Production

Season production figures for 2000 through 2009 are evaluated in Table 2-8b. Exhibit 2-3d shows the seasonal use by consumption class for the year 2009. These calculations are based on May – October as the designated seasonal or outdoor irrigation months and November – April as the non-seasonal use or indoor only months. Seasonal water use is then compared with the annual use to get a percentage. It is assumed seasonal water use is associated with outdoor use, such as irrigation for landscaping.

Table 2-8b
2000-2009 Average Peak Season Use (May – October)

Year	Non-Seasonal Water Use	Seasonal Water Use
2000	70%	30%
2001	69%	31%
2002	71%	29%
2003	64%	36%
2004	75%	25%
2005	73%	27%
2006	69%	31%
2007	71%	29%
2008	62%	38%
2009	64%	36%
Average	69%	31%



2.4 Water Sales

Table 2-9 shows the number of accounts and correlating water consumption figures within the three (3) billing categories for 2009. Data from 2009 is used here because it is the most current year in which consumption figures were calculated from the City's billing system software. The data in Table 2-9 is from an export of the Utility Data Base, in its entirety, to provide usage by customer class. Consumption totals for each customer class exported from the Utility Data are considered to be the most accurate and were used to calculate Table 2-9. Single Family Residential customers include customers with a single meter per dwelling unit. Multi-Family customers include customers with a single meter for several dwelling units. There are data inconsistencies with the demographics used for population increase and water use forecasts.

Table 2-9
Accounts and Consumption by Billing Category (2009)

Billing Category	# of Accounts	% of Accounts	Consumption (MG)	% of Total Consumption
Single Family Residential	4292	76%	331	46.87%
Multi-Family	775	14%	215	30.53%
Commercial	592	10%	159	22.60%
Total	**5659**	**100%**	**706**	**100%**

Single Family Residential = Households, duplexes, and triplexes.
Multi-family = Apartments and mobile home courts.

Exhibit 2-4 shows a graph of the percent of accounts and percent consumption for the year 2009. There are a higher number of accounts than consumption for the Single Family Residential customer because one meter is servicing one household, whereas Multi-Family and Commercial accounts have one meter to service many people and/or households.

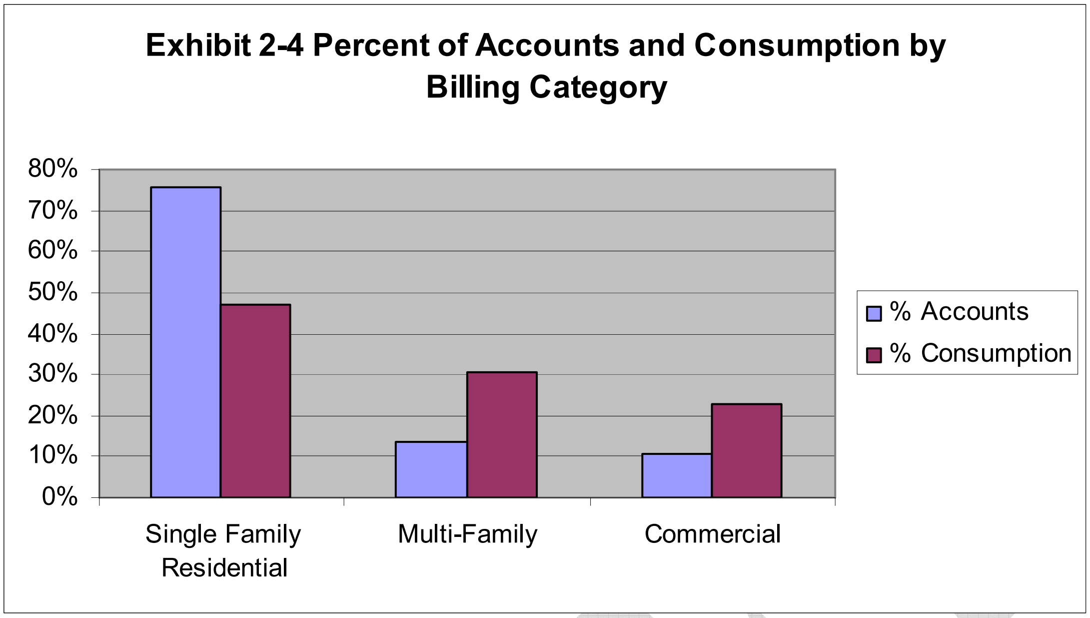
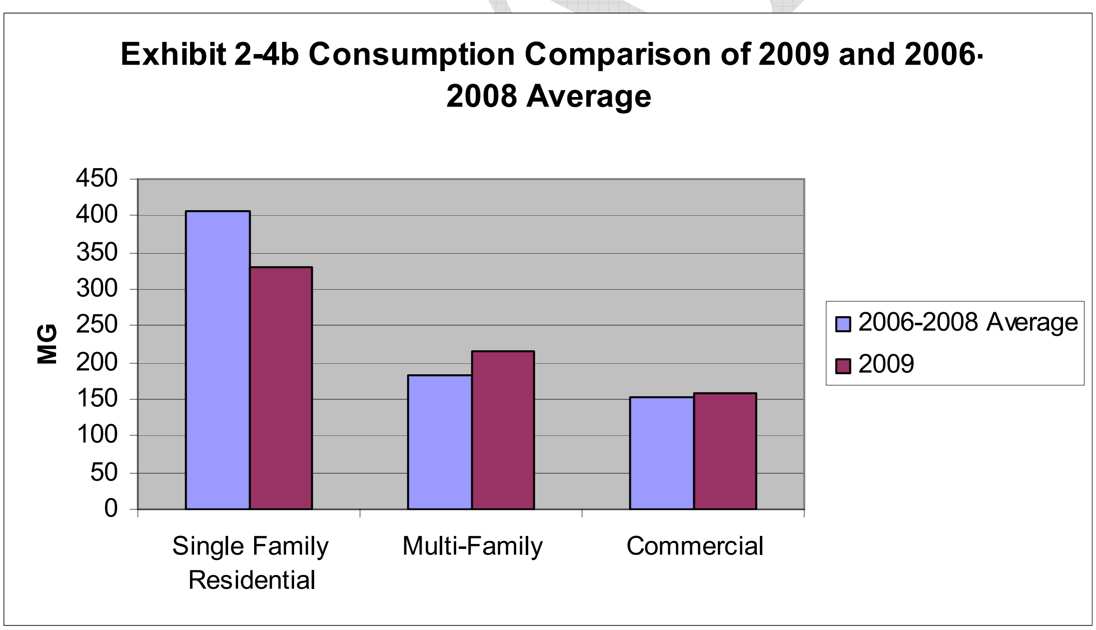


Exhibit 2-4b shows a graph of the consumption by customer class for the year 2009 and compared to the 2006-2008 average for those same billing categories. The Single Family Residential customer use has gone down while with the Multi-Family customer shows a slight increase and the Commercial customer consumption has stayed consistent.



2.5 Non-revenue Water

An accounting of all water sources was completed in order to develop a comprehensive data set of the City's water system. In addition to metered sales of water, non-revenue water use needs to be examined. Non-revenue water is either accounted for or unaccounted for. Accounted-for sources are typically fire hydrant flushing, fire-fighting, metering, and city park irrigation. Unaccounted-for sources tend to be inaccurate flow meters and leaking water lines. Accounted-for and unaccounted-for water is calculated by taking the difference between the total volumes of water produced and water sales.

An accounting of the City's water is completed annually. It is important to note the data presented here is for the months of October through September, the City's fiscal year. Metered billed, metered produced and total pumped are show below to compare billed watered, non-revenue but accounted for water, and non-revenue but unaccounted for water.

For this section, the following data was reviewed:
Water Accounting FY 2009 from the Finance Department (data for audit)

Table 2-10
Summary of: Water Accounting FY 2009

Meter Reading Month	2009 Metered Billed Customer (gal)	2009 Metered Production (gal)	Total Pumped FY 2009 (MG)
October	55,771,516	56,755,800	56.8
November	48,229,192	46,176,600	46.2
December	47,581,080	47,350,500	47.4
January	47,249,066	49,092,400	49.1
February	47,479,180	47,425,300	47.4
March	30,984,150	51,448,700	51.5
April	43,102,625	53,156,800	53.2
May	45,048,278	64,619,500	64.6
June	65,405,599	87,215,300	87.2
July	76,912,509	113,399,700	113.4
August	161,322,999	105,701,400	105.7
September	95,123,272	96,401,900	96.4
TOTAL (gal)	**764,209,465**	**818,743,900**	**818.9**
NON-REVENUE WATER (total billed vs. total metered)	**54,534,435**	**6.66%**	

Non-Revenue Water (Accounted-For) (gal):		
Fire Hydrant Flushing	6,462,400	
Fire Fighting	120,000	
Backwashing	5,609,000	Per metered records
Well No. 8 Pump Control Valve	657,000	Estimated
Leakage	988,500	
Dead Meters	473,200	
Public Facilities and Parks	2,732,000	Per metered records
New Main/Subdivisions	0	Estimated

Wells Over-registering	7,537,153	Well Metering Maintenance Program
Construction Bulk Water	641,200	This water was billed but not metered
TOTAL (Non-revenue) Accounted-for Water)	**25,220,453**	Production-Billed-Non Revenue-Other
TOTAL (Non-revenue Unaccounted-for Water)	**29,313,982**	
NON-REVENUE WATER (Unaccounted-for water vs. total production)	**3.58%**	

2.5.1 Accounted-For Water

Accounted-for sources are typically fire hydrant flushing, fire-fighting, metering, and city park irrigation, while unaccounted-for sources tend to be inaccurate flow meters and leaking water lines.

Fire Hydrant Flushing
Fire hydrants are routinely flushed throughout the City in an effort to improve water quality within the distribution system. In addition, flushing is required by Idaho drinking water regulations. Flushing involves opening fire hydrants to flush out stale water by promoting the movement of fresh water through the water mains. Hydrants are flushed until the flow of water coming through the hydrant clears up, after which they are shut off. Areas susceptible to water quality complaints, such as dead-end water mains, are typically flushed at a higher frequency than areas with greater movement of water through the water lines. Water lines are typically sized to provide an adequate turnover of water, fire flow and domestic uses without pressure loss, but this is not always possible due to future development and topography.

Table 2-10 shows an estimate of the number of gallons of water used each year in water main flushing. The hydrant flushing process is calculated based on the approximate flow rate of each hydrant, which have either been metered or tested in the past. In order to save water, the hydrant flushing program is based on a preventative approach on a needed basis per Department of Environmental Quality (DEQ) regulations based on requirements that the system be flushed at six month intervals and customer complaints or water quality needs. Water quality complaints usually refer to odor or taste.

In addition to the use of booster stations, flushing on a needed basis, and flushing just until the water clears up, the City's filter plant treats the water in order to reduce the need for flushing and to increase water quality. Potassium permanganate is added to the iron-rich water pumped from the Wanapum, which is then filtered with greensand filters. Chlorine is also added to reduce taste and odor complaints. Any significant increase of hydrant flushing from one fiscal year to another is due to increased customer complaints. In the past, the Water Department flushed hydrants at a lower capacity to test what amount of flushing was adequate for DEQ regulations and customer satisfaction.

Fire Fighting
Fire-fighting water use varies depending on the needs of the community for the year. Water used for training and the filling of trucks is estimated and not metered.

Backwashing
There are four greensand filters for Wells No. 2 and No. 3 in the Wanapum aquifer that help improve water quality by removing iron and manganese. After these filters become plugged with iron and manganese, they are cleaned through the process of backwashing. Backwash flow and turbidity meter flow is metered and a total for the 2009 fiscal year is shown in Table 2-10. Backwashing generally uses 88,000 gallons per backwash cycle and is conducted for every 3-4 million gallons pumped from the Wanapum. Backwashing occurs most frequently during the peak season summer months when pumping increases. Variations in the amount of water used for backwashing can be caused by the amount of iron present in Well No. 2 (1.25 ppm) and Well No. 3 (7.65 ppm). Well No. 2 produces more water than Well No. 3 before the filters need to be cleaned (backwashed).

Well No. 8 Pump Control Valve
Wells No. 2, 3, 6, 8, and 9 constitute the City's total current water production sources. All five wells have Sparling propeller-type flow meters to determine the total volume of pumped water. On start-up every well discharges water for a short period of time to prevent damage from water hammer. The discharge feature on each well, with Well No. 8 being the exception, occurs before the flow meter. Therefore, the amount of water used for the Well No. 8 control valve is estimated and is a necessary feature to prevent water hammer from occurring and damaging the well.

Leakage
Some leakage can be accounted for based on estimates of the known start date to the time the leak is repaired. Start dates are based solely on the date Water Department Staff is alerted to the leak therefore any potential water loss before that time is unknown.

Dead Meters
Moscow had approximately 5,650 meters in 2009, with the majority of them being 5/8" meters. Billing software can detect dead meters to inform Water Department staff to change those out. Based on bench test results, decreased accuracy in customer meters tends to under-register the quantity delivered to customers, leading to an increase in non-revenue water. Meters are replaced and/or repaired when they become unreadable or appear to malfunction. Dead meters are replaced when identified and if a misread is caught, it is corrected in the billing software.

Public Facilities and Parks
Non-revenue water sources for the City include irrigation of city parks, some school grounds, certain city buildings and public building supply. All parks and facilities are currently metered. City irrigation systems and all other irrigation of parks are maintained by the Parks and Recreation Department or Water Department of the City of Moscow. Upgrades have been made to increase irrigation efficiency and there are plans to add

more automatic in-ground irrigation systems to areas that are currently being manually watered. Other upgrades include a central irrigation management system, which became fully operational in spring 2009. The new irrigation management software allows parks staff to monitor, adjust, and turn systems on and off remotely. The software also allows staff to monitor water use and identify and repair irrigation system breaks in a timely manner.

New Main and New Subdivisions
Water is calculated based on the need to fill a new main, chlorinate it, flush it, and fill it until the water passes testing for bacteria.

Wells Over-registering
In 1999, the City determined that its source meters at Wells No. 2 (1997) and No. 8 (1999) were over-registering due to the accumulation of iron deposits inside these flow meteres.

Over-registering of production, and consequently the increased discrepancy between production and sales, has recently occurred due to iron buildup on flow meter tubes and turbines. This iron buildup can lead to over-registering and an increased discrepancy between water produced and water sold. As the iron buildup coats the inside of the flow tube it reduces the diameter, which increases the velocity through the flow meter for the same volume of water pumped. The flow meters on Wells No. 2, 3, 8, and 9 were cleaned of iron deposits and as a result, the metered flow values decreased. Iron buildup has been identified as a problem with all well meters, except Well No. 6. After the City recognized the iron buildup problem, a schedule was put in place for cleaning. The meter heads for Wells No. 2 and 3 are cleaned every six months (higher susceptibility to iron build-up) and Wells No. 6, 8 and 9 are cleaned every year.

Construction Bulk Water
Construction bulk water is revenue based, but listed as accounted-for non-revenue because it is not billed through the City's software billing system. The construction water uses are billed the bulk rate of $1.80 ccf.

2.5.2 Unaccounted-For Water

Analysis of unaccounted-for water resulted in the discovery of a discrepancy between water being metered at the source to water given to the end user. This discrepancy has been analyzed to identify potential revenue-producing opportunities, as well as recoverable losses and leaks. Possible sources of water and revenue losses with the City water system are described below.

This section discusses the efficiency of the municipality connections, infrastructure, and lines to evaluate if there is opportunity for water savings. The existing leak detection program surveys approximately 90% the City's distribution system for 14 days out of the year. According to the American Water Works Association guidelines, Moscow's water system should not exceed 10% of unaccounted-for water. In 2009, the total unaccounted-for water was 3.58% (Table 2-10). The City is running under 10%, meeting this guideline, and therefore no plans to change the leak detection program at this time.

Leakage
Leaks prior to discovery, undiscovered leaks, and known leak estimation discrepancy can all be causes of water loss which increases non-revenue water loss.

Customer Meters
Meters that are dead, older, and/or inaccurate can create revenue losses. A decrease in accuracy tends to under-register the quantity delivered to customers based on bench test results. This leads to an artificial increase in non-revenue water, thereby reducing City revenues from water sales.

Water Reservoirs
While uncommon, tanks can overflow during equipment testing and calibration. Tanks need to be drained for cleaning and for maintenance purposes but the City also cleans the tanks without draining them by way of underwater inspections.

Pump Control Valves
Every well has a pump control valve that sends a small volume of water to waste when each pump starts and stops. With the exception of Well No. 8, this discharge occurs prior to being taken into account by each well's production flow meter and is not included with the City's control valve non-revenue water calculations. This is necessary to prevent potential damage to water mains caused by water hammer.

3 Water Conservation Element Overview

3.1 Introduction and Definitions

This section defines the conservation measures and incentives evaluated in the Water Conservation plan. The City has already carried out some water conservation activities and the plan discusses these existing programs as well as new programs. In order to recommend measures and incentives, water savings and costs were evaluated.

Methods to promote water conservation consist of measures and incentives. Measures are hardware and behavior changes that promote water savings, such as low flow showerheads or taking shorter showers. Incentives are motivators for people to enact measures and fall into three categories: educational, financial, and regulatory (see Appendix D for Ordinance and Resolution).

The City of Moscow water users consist of Single Family, Multi-Family, and Commercial/Institutional Sectors. However, since water savings can be achieved beyond the major user base, two more sectors are included: Public Facilities and Industry Professionals.

3.2 Conservation Measures Summary

Twenty-nine (29) potential conservation measures were evaluated for consideration of this 2010 Water Conservation Plan. Not all of these measures were selected, but each one is listed and evaluated. Appendix B lists of all the measures evaluated in this plan**.** Since evaluating every possible conservation measure would have been impractical, measures were chosen based on successful programs implemented in other communities that appear to have good applicability to Moscow's community and climate. Consequently, conventional measures were evaluated knowing that other more innovative measures were available. Seventeen (17) of the evaluated measures were evaluated in the 2004 EES Plan and that screening process has been retained in the evaluation toward recommendations.

The measures address both indoor and outdoor water conservation, as well as residential and commercial sector. Measures selected for evaluation are listed in Table 3-1 and their specific definitions and target audiences follow. Table 3-1 shows how each measure can be used for the Single Family/Multi-Family, Commercial, and Public Facilities sectors and includes specific conservation elements for this 2010 Water Conservation Plan (WCP).

As mentioned before, every measure considered for the Water Conservation Plan can also be reviewed in Appendix B. Measures were chosen based on either success of other communities, programs already implemented by the City and from the 2004 EES Plan. Further discussion of the conservation elements for each sector can be found in Sections 4 through 7. As described in the screening section of Section 3.5, Measures that proved to be less productive and more expensive to the City were discarded. Those that were recommended were found to be feasible and cost effective as described by the screening process. To offset costs of the use of all measures and incentives, Section 8 recommends three alternative plan packages for the City to choose from. This section, Section 3, review describes all possible measures and incentives.

Table 3-1
Evaluated Conservation Measures for 2010 WCP

No.	Measure	SF/MF	CI	PF
1	Low-volume toilets	X	X	X
2	HET toilets	X	X	X
3	Low-volume urinals		X	X
4	Waterless urinals		X	X
5	Toilet-leak detection and repair	X	X	
6	Toilet-tank displacement devices	X	X	
7	Decreased toilet flushes	X		
8	Low-flow showerheads	X	X	
9	Decreased shower use (5-minute timer)	X		
10	Instant Hot Water Valve	X		
11	Faucet aerators-bathroom	X	X	X
12	Faucet aerators-kitchen	X		
13	Decreased faucet use	X		
14	Efficient clothes washers	X		
15	Eliminate partial clothes washer loads	X		
16	Air-cooled ice machines		X	
17	Audits for automatic irrigation	X	X	X
18	Audits for manual irrigation	X	X	X
19	Outdoor device giveaways	X	X	
20	Low water use plants guide book	X	X	
21	50 gallon Rain Barrel Catchment	X		
22	Less Lawn	X	X	X
23	Efficient restaurant spray heads		X	
24	Hotel bedding and towel message		X	
25	Infrastructure Leak Detection and Repair			X
26	Flushing Water Use Reductions			X
27	Backwashing Water Use Reduction			X
28	Flow Meter Maintenance			X
29	Sub-Meter Multi-Family Households	X		

SF=Single Family, MF=Multi-Family, CI=Commercial/Institutional, PF=Public Facilities, IP = Industrial Professionals

3.3 Conservation Incentives Summary

Forty-five (45) potential conservation incentives were evaluated for consideration in this 2010 Water Conservation Plan. Not all of these incentives were selected, but each one is listed and evaluated. Appendix B lists all the incentives evaluated in this plan**.** Like with the measures, incentives were chosen based on successful programs implemented in other communities that also appear to have good applicability to Moscow's community and climate. Seventeen (17) of the evaluated incentives were evaluated in the 2004 EES Plan and considered in this WCP.

Incentives that proved to be less productive and more expensive to the City were discarded. Those that were recommended were found to be feasible and cost effective as described by the screening process. The following are ways to motivate individuals to enact the previously mentioned measures.

Table 3-2
Evaluated Conservation Incentives for 2010 WCP

No	Incentive	SF/MF	CI	PF	IP
1	PIE: Brochures	X			
2	PIE: Flyers	X			
3	PIE: Bill Messages	X			
4	PIE: Consumption Information to Customer	X			
5	PIE: City Website	X			
6	PIE: Newsletter	X			
7	PIE: Bus Ads	X			
8	PIE: Billboards	X			
9	PIE: Radio Ads	X			
10	PIE: Television Ads	X			
11	PIE: School Programs	X			
12	PIE: Community Events	X			
13	PIE: Tours of Facilities	X			
14	PIE: Press Releases	X			
15	PIE: Demonstration Wisescape Gardens			X	
16	PIE: Lawn Watering Guide	X			
17	PIE: Landscape Guide Book	X			
18	PIE: Wisescape Program-Award Program	X	X	X	X
19	PIE: Mailings	X	X		
20	PIE: Door Hangers	X	X		
21	PIE: Outreach to home and garden centers	X	X		
22	PIE: Personal Contact	X	X		
23	Financial: Free Devices	X	X	X	
24	Financial: Free Irrigation Audits	X	X	X	
25	Financial: Free Landscape Guide Booklet	X	X	X	X
26	Financial: Rebate Program – Toilet	X	X		
27	Financial: Rebate Program – Urinals		X		
28	Financial: Rebate Program – Hot Water Valve	X			
29	Financial: Rebate Program – Clothes Washer	X	X		
30	Financial: Rebate Program – Cooling System		X		
31	Financial: Rebate Program – Ice Machines		X		
32	Financial: Rebate Program – Rain Barrel	X	X		
33	Financial: Tiered Rate	X*			
34	Financial: Tiered Rate Expansion	X**	X		
35	Financial: Sub-Meter Program	X**			
36	Financial: Efficient Parks Irrigation System			X	
37	Financial: UI Effluent Program			X	
38	Regulatory: Ordinance	X	X	X	X
39	Regulatory: Resolution	X	X	X	X
40	Regulatory: New Development Reduce Lawn	X	X	X	X
41	Regulatory: New Development Water Use				X
42	Regulatory: New Development Top Soil				X

43	Regulatory: Certified Irrigator				X
44	Regulatory: New Home Owners Program				X
45	Regulatory: Add to Metered Routes			X	

SF=Single Family, MF=Multi-Family, CI=Commercial/Institutional, PF=Public Facilities, IP=Industry Professionals
PIE=Public Information and Education
*All Single Family residential and some Multi Family residents are billed on the tiered rate
**Multi Family only

3.4 Determining Water Savings and Costs for Measures

The Executive Summary shows projected water use with and without the implementation of a water conservation plan for the City of Moscow. Conservation can reduce average and peak water demand as well as lower operations, maintenance, and capital costs. Current water use is shown in Section 2. This section evaluates the benefits, costs and water savings for the measures and incentives described in Sections 4 through 7.

The methodology for determining water savings and cost is generally the same for all conservation measures. The basic method is to compile community demographic information; calculate the participation rate based on those demographics and assumptions; calculate the savings based on industry-accepted values achieved by shifting to more efficient hardware or behavior; calculate the cost based on industry-accepted values for those shifts. A detailed description of this process is provided below and is referenced from Appendix C.

3.4.1 Demographics and Assumptions for Measures

It is important to evaluate demographics for the City of Moscow (Appendix C for more details) because increased demand rates can be slowed by conservation despite the effects of demographic influences.

For this plan, the planning period is from 2012 to 2021, a total of 10 years. 2012 was chosen because of the time frame needed to approve the plan through the appropriate steps with the administrative procedures. The length of the planning period was chosen for spreading the total cost of the plan over a period of time but also to accelerate water savings. A ten-year period was chosen in order to find a balance between the timeliness of a water conservation plan and its cost to the City.

Numbers for existing Single Family and Multi-Family households, as well as Commercial accounts, were compiled from 2009 data provided by the City Finance Data. Numbers for additional information such as Multi-Family Households number of units per apartment National Average assumptions, National Average persons per household assumptions, and businesses are also described in greater detail in Appendix C. Population was then calculated by applying the growth rate recommended in Section 2, which in this case is an annual growth rate of 1.42 percent. A distinction is made between both existing and future households (residential) and commercial accounts since the applicability of a conservation measure may often differ between these two groups.

Page 2 of Appendix C documents the assumptions about the percentage of households and businesses with particular features such as the percentage of households with appliances being evaluated. The assumptions used were taken from the 2004 EES Plan, Appendix C. This information is used to help calculate the participation rate. The assumptions are broken down by Single Family households, Multi-Family households, and Commercial, as well as existing and future housing or businesses. The Public Facilities category is not included because the measures are recommendations as described in Section 6. The category of Industrial Professionals is also not included because these are looked at by means of incentives. Although there is no current tracking of the latter two customer categories, it is important to include them in a city-wide conservation effort. It is difficult to track them because Public Facility water use is a non-revenue source and Industrial Professionals can include businesses outside the Moscow area.

3.4.2 Participation for Measures

Participation is especially important in the evaluation of residential and commercial use of measures. Participation affects water savings figures as well as the cost associated with implemented programs. Participation is calculated by determining the number of eligible households or businesses. That figure is then broken down into the number of target households or businesses and further reduced to the participating number. Definitions are as follows:

- **Eligible:** Households or businesses that have the appropriate fixture or behavior for the measure. For example, households or businesses that utilize a toilet.
- **Target:** Eligible households or businesses that have not already implemented the measure. For example, those with a toilet that do not already have an efficient 1.6 gpf model.
- **Participating:** Target households or businesses that implement the measure. For example, households or businesses with a toilet that do not already have an efficient 1.6 gpf model, and who will purchase an efficient 1.6 gpf model, fall under this category. Participation rates can increase or decrease the value of implementing measures. For example, while waterless urinals save more water per flush than low-volume urinals, the participation rate for waterless urinals is usually much lower than for low-volume urinals, thus making the overall savings for waterless urinals lower than that of low-volume urinals.

Three concepts are included in this plan and are as follows:

- **Free-ridership:** Free-ridership is a concept that involves the reduction of the participation number by a significant amount. Free-riders are households that would implement a measure, even without the conservation plan or incentives. For example, a household that was already planning to replace a toilet and that takes the utility money because it is available would be considered a free-rider. It is important to note that the utility money in this example does not serve as a motivator for the household to implement the measure, as the utility would be spending money on water savings that would have been incurred anyway. The incorporation of free-ridership is an important element and is thus included in the plan's analysis. (The assumptions for the percent of free riders are taken from the 2004 EES Plan).

- **Plumbing Codes:** Another aspect similar to free-ridership is plumbing code savings. Plumbing codes make it possible for certain conservation measures to duplicate water savings that would occur eventually without cost to the utility. The plumbing code was changed in 1994 to require toilets, urinals, showerheads, and faucets to be water efficient. Since fixtures have a limited lifespan, pre-1994 fixtures will be replaced with efficient models. The City can accelerate the water savings by offering water efficient fixtures.
- **Participating Households or Businesses:** The number of participating households or businesses is a key factor in calculating both water savings and costs. The number is derived by adding together the existing target and future target to represent the total of current and future population, reducing that number according to the participation rate, and then reducing that figure by the number of free-riders. The percentage of the population that has not yet implemented measures and the participation rate source are from the 2004 EES Plan. Participation rates can increase or decrease the value of implementing measures. For example, participation rates for waterless urinals are usually much lower than those for low-volume urinals, thus making the overall savings for waterless urinals lower than that of low-volume urinals.

Some of the data used was taken from the 2004 EES Plan (please refer to Appendix C for more details), while other data was taken from national averages. The data used by the EES Plan is sound and the sources vary from actual averages to subjective professional estimates. Additional measures are included and, therefore, the best available data and professional estimates were applied.

3.4.3 Water Savings for Measures

Water savings are estimated by determining the unit savings of the conservation measure compared to previous hardware or behaviors; excluding the university residents that receive water from the University of Idaho (demographic information for this plan is based on population statistics of Moscow water customers only). The calculations also include university students that live off campus. Appendix C also assumes year-round occupancy of all the account holder households, which is not accurate of the student transient population. Savings data was taken from several sources, including the existing 2004 EES Plan, manufacturer information, along with other references (see Appendix D).

3.4.4 Costs for Measures

Costs (refer to Appendix C) are estimated by determining the unit cost of each proposed conservation measure. Participation information (derived from the available demographic estimates) is then used to calculate total costs of the program. Direct costs to the City are included while costs such as labor, marketing, and distribution (indirect costs) are excluded. It is assumed that all measures are installed at the expense of the customer. "Measures per Participating Household" calculations are also included because some households qualify for more than one measure, such as three bathrooms with three showerheads. That number is the average used for each measure and is taken from the 2004 EES Plan. It is important to note that the toilet rebate lists one measure per household, although the average number of bathrooms (toilets) is 2.25. This adjustment was made with the assumption that a toilet rebate program may be limited to one per household in order to keep costs down, with potential phasing in of multiple rebates in the future. Cost for production of water used for backwashing, flushing, etc. is not included and is discussed in further detail in Section 2.3.7. The Total Cost over the Plan Period (ten years) shows how much the program will cost in order to achieve the water savings that measure will produce. The cost for every 1000 gallons saved is used to determine if a program is cost effective.

3.5 Screening Methodology and Results for Measures

Screening against the plan's goals allows the City to justify which measures, current and new, should be chosen for this 2010 plan. Appendix C supplies the data for determining which conservation measures will best fit the goals of the conservation plan through the screening process, which is based on a ranking system (see below). As stated in Section 1.3, the water conservation goals for the City are:

Implement Water Conservation Plan programs over the next ten years to continue to meet the Palouse Basin Aquifer Committee (PBAC) voluntary goals set forth by the Ground Water Management Plan of September 1992.
Limit increase in water use to 1% compounded yearly, based on a five-year moving average, with a cap of 125% (875 MG).

Screening Criteria:

1. Quantity of water saved – Refers to the overall amount of water saved.
2. Cost of program – Total cost and cost-effectiveness, including avoided costs and staffing.
3. Public acceptance – Will the goal be considered reasonable to the public.
4. Practical to implement – It is easier to change a customer's hardware than to change a behavior.

The quantity of water savings is the first criteria to be considered. Table 3-3 looks at gallons saved and ranks the savings according to quantity while excluding the savings from free riders. This plan is consistent with the 2004 EES Plan ranking as such:

- **Low = Under 100,000 gallons per year (gpy)**

- **Medium = 100,000 – 5,000,000 gpy**
- **High = Over 5,000,000 gpy**

Cost figures are the second criteria to be considered and Table 3-3 examines these figures. The cost of conservation was compared to the peak season variable water rate specific to the City of Moscow. As stated in the 2004 EES Plan, the peak season variable rate is defined in the industry as the variable cost of supplying a unit of water. The middle and last tiers are assumed to be peak season use tiers and ranked as follows:

- **Low = At or below the customer middle tiered rate of $1.90**
- **Medium = Up to $3.25**
- **High = Over $3.25**

The comparison of water savings rankings to cost is used in determining the probability the measure will be accepted by the public. Measures with a low water savings classification are rejected due to inefficiency, regardless of cost. In addition, measures with relatively high cost-to-water saved ratios are rejected. There is one exception to these rules (i.e. outdoor device giveaways considering the public already uses this program and it is supported by the Water Conservation Ordinance). The comparison is as follows:

- **High Savings, Low Cost = Accepted**
- **High Savings, Med Cost = Accepted**
- **High Savings, High Cost = Accepted**
- **Med Savings, Low Cost = Accepted**
- **Med Savings, Med Cost = Accepted**
- **Med Savings, High Cost = Rejected**
- **Low Savings, Low Cost = Rejected**
- **Low Savings, Med Cost = Rejected**
- **Low Savings, High Cost = Rejected**

The Table 3-3 shows all recommended savings and costs to implement all accepted measures, for a more economical approach, plan package alternatives are described in Section 8. The cost to implement all accepted measures over the ten-year period would be approximately $1.4 million with an annual savings of approximately 102.9 million gallons of water at full implementation of the conservation plan (see Appendix A).

Table 3-3 - City of Moscow Potential Conservation Recommendations for Measures

		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Low-volume toilets - 1.6gpf	11,434,220	High	$298,185	$2.61	Med	Accept*
	HET toilets - 1.0gpf	10,182,815	High	$368,821	$3.62	High	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Instant Hot Water Valve	5,641,446	Med	$67,575	$1.20	Low	Accept*
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Efficient clothes washers	1,954,517	Med	$45,050	$2.30	Med	Accept*
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Audits for manual irrigation	3,628,800	Med	$269,001	$7.41	High	Reject
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	50 gallon Rain Barrel Catchment	11,730	Low	$12,122	$103.34	High	Reject
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	9,917,929	High	$143,691	$1.45	Low	Accept*
	HET toilets - 1.0gpf	9,325,067	High	$187,641	$2.01	Med	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Instant Hot Water Valve	5,131,655	High	$34,149	$0.67	Low	Accept*
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Efficient clothes washers	992,423	Med	$4,575	$0.46	Low	Accept*
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Audits for automatic irrigation	3,110,400	Med	$337,896	$10.86	High	Reject
	Audits for manual irrigation	2,073,600	Med	$349,416	$16.85	High	Reject
	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	50 gallon Rain Barrel Catchment	11,730	Low	$9,644	$82.22	High	Reject
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
	Sub-Meter Multi-Family Households	2,705,299	Med	$216,600	$8.01	High	Reject
CI Indoor	Low-volume toilets	650,623	Med	$12,415	$1.91	Med	Accept*
	HET toilets	385,843	Med	$10,268	$2.66	Med	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Waterless urinals	489,847	Med	$8,982	$1.83	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Air-cooled ice machines	1,063,084	Med	$3,037	$0.29	Low	Accept*
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
	Hotel bedding and towel message	170,895	Med	$0	$0.00	Low	Accept*
CI Outdoor	Audits for automatic irrigation	1,612,800	Med	$264,470	$16.40	High	Reject
	Audits for manual irrigation	1,036,800	Med	$259,480	$25.03	High	Reject
	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Low water use plants guide book	92,160	Low	$82	$0.09	Low	Reject
	Less Lawn	92,160	Low	$0	$0.00	Low	Reject
	Annual Total Water Savings for All	117,297,704	Total All Cost	$3,150,304	Annual All Cost	$315,030	
	Annual Total Water Savings for Accept + Accept*	102,922,225	Total A + A* Cost	$1,431,593	Annual A + A* Cost	$143,159	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	59,313,459	Total A* Cost	$1,205,281	Annual A* Cost	$120,528	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

While these figures may seem costly, several of the accepted measures have already been implemented by the City and are therefore are included in the existing budget. The existing conservation budget also includes the Public Information and Education, which is considered an incentive. Also included is the life-cycle of each measure as well as how much of the population is eligible now and in the future (Appendix C). The addition of measures not currently implemented by the City would be approximately $121,000 annually with an annual water savings of approximately 59 million gallons. Adjustments for cost could be made through changes to the amount of the rebates, eligibility, and other implementation considerations (see Section 3.7). Appendix C contains detailed information on water savings and cost figures.

3.6 Determining Program Incentives

Incentives are evaluated separately from measures because they create difficulty in calculating the amount of water saved. Educational incentives do not save water in and of themselves but play a critical role in motivating people to enact a measure. The following is a description of accepted, rejected and recommended incentives based on generalized cost estimates:

- **Low Cost, up to $1000 per year = Accepted**
- **Med Cost, $1001 - $5000 per year = Accepted**
- **High Cost, over $5000 per year = Rejected**
- **Already Implemented = Accepted**
- **Determined in Measures Evaluation = Accepted or Rejected**
- **Incentives by Other City Departments = Recommended**

Table 3-4
Ranking of Conservation Incentives for 2008 WCP

Incentive	Ranking Parameter	Ranking Results
PIE: Brochures	Already Implemented	Accepted
PIE: Flyers	Already Implemented	Accepted
PIE: Bill Messages	Already Implemented	Accepted
PIE: Consumption Information to Customer	Already Implemented	Accepted
PIE: City Website	Already Implemented	Accepted
PIE: Newsletter	Already Implemented	Accepted
PIE: Bus Ads	Not Available	Rejected
PIE: Billboards	High Cost	Rejected
PIE: Radio Ads	Already Implemented	Accepted
PIE: Television Ads	Already Implemented	Accepted
PIE: School Programs	Already Implemented	Accepted
PIE: Community Events	Already Implemented	Accepted
PIE: Tours of Facilities	Already Implemented	Accepted
PIE: Press Releases	Already Implemented	Accepted
PIE: Demonstration Wisescape Gardens	Already Implemented	Accepted
PIE: Lawn Watering Guide	See Measures Results	Accepted
PIE: Landscape Guide Book	See Measures Results	Accepted
PIE: Wisescape Program-Award Program	Already Implemented	Accepted
PIE: Mailings	Already Implemented	Accepted
PIE: Door Hangers	Already Implemented	Accepted
PIE: Outreach to home and garden centers	Low Cost	Accepted
PIE: Personal Contact	Already Implemented	Accepted
Financial: Free Devices	See Measures Results	Accepted
Financial: Free Irrigation Audits	See Measures Results	Accepted
Financial: Free Landscape Guide Booklet	See Measures Results	Accepted
Financial: Rebate Program – Toilet	See Measures Results	Accepted
Financial: Rebate Program – Urinals	See Measures Results	Accepted
Financial: Rebate Program – Hot Water Valve	See Measures Results	Accepted
Financial: Rebate Program – Clothes Washer	See Measures Results	Accepted

Financial: Rebate Program – Ice Machines	See Measures Results	Accepted
Financial: Rebate Program – Rain Barrel	See Measures Results	Rejected
Financial: Tiered Rate	Already Implemented	Accepted
Financial: Tiered Rate Expansion	Other Department	Recommended
Financial: Sub-Meter Program	See Measures Results	Rejected
Financial: Efficient Parks Irrigation System	Already Implemented	Accepted
Financial: UI Effluent Program	Already Implemented	Accepted
Regulatory: Ordinance	Already Implemented	Accepted
Regulatory: Resolution	Already Implemented	Accepted
Regulatory: New Development Reduce Lawn	Other Department	Recommended
Regulatory: New Development Water Use	Other Department	Recommended
Regulatory: New Development Top Soil	Other Department	Recommended
Regulatory: Certified Irrigator	Other Department	Recommended
Regulatory: New Home Owners Program	Other Department	Recommended

3.7 Implementation Considerations

In order to successfully implement this conservation plan, it is important to evaluate factors that include the combination of measures and incentives, marketing and distribution, and cost.

3.7.1 Plan Phasing, Combining Measures and Incentives

For some measures and incentives, it will be more efficient to combine them rather than to implement them separately. Combining measures and incentives is advantageous because it reduces marketing and distribution costs. Combining is appropriate when the target audience and marketing and distribution methods for the measure/incentive are the same.

Plan phasing is important to consider because it affects costs and staffing needs. While it would be beneficial to begin implementing all measures and incentives during the first year, this would require higher staffing needs and increase costs. Consequently, the phasing of measures and incentives over the course of the planning period is recommended. The packages listed thus far break down the annual cost as implemented evenly over the 10 year plan, therefore limiting customer rebate benefits per fiscal year.

Industry standards for phasing are classified by customer class, measure or incentive, or a combination of both. Customer class phasing means that all measures or incentives aimed at a particular customer class are implemented first, after which the focus moves to another customer class. Phasing by measure or incentive pertains to the implementation of a specific measure or incentive for a customer class. Combining both standards may also prove to be more time and cost effective.

3.7.2 Marketing and Distribution

Costs, staffing, and customer participation rates are affected by how a measure or incentive is marketed. Typically, the conservation measure or incentive can be marketed through advertising, individual contact, and door-to-door marketing. The approach is dependent on the target audience size and the marketing methods for the product. By providing information about the benefits of water conservation serves as an effective marketing tool and helps motivate a positive change in behavior for people.

3.7.3 Costs

In addition to the costs for conservation materials, there are indirect costs such as staffing, marketing, and distribution. A majority of this indirect cost is covered by the staffing of the current Water Conservation Program Coordinator full-time position implemented by the City. Marketing and distribution is not included in the screening process (includes direct costs only, i.e. hardware costs) and will add to the cost of the program. Combining measures and incentives will help to keep these costs down and is also important in order for the full-time staff Conservation Program Coordinator to implement measures and incentives without requiring additional staffing.

3.7.3.1 Avoided Costs to the City through Conservation

It is important to examine production costs by way of energy, capital cost, and waste water processing. Water conservation provides the potential for savings to the City through reduced budget items such as electrical costs for pumping, reduced chemical use, and reduced capital costs due to putting off the building of new surface water infrastructure, for example. Considering the City's current water system is outdated and in need of improvements, conservation would allow the City to concentrate on updating the system instead of toward improvements and finding new ways to produce more water.

Although the Water Department and Waste Water Treatment Plant (WWTP) do incur other costs, the costs directly related to water production are included in Table 3-5 below. For example, labor is not included in Table 3-5 because jobs are still needed to maintain water production. Natural gas is also excluded because it is used for the buildings and conservation will not affect its use.

Aside from the direct correlation of electricity savings for the wells that pump the water, savings such as chemical and electrical costs for lift stations, boosters, and the WWTP are included in Table 3-5. The chemicals used to treat water are proportional to the amount of water pumped and chemical use will go down with less water being pumped. In addition, the WWTP will see a small amount of savings. The WWTP will still run the whole process despite the amount of flow, but components of it may be run less often or require less time. With the recent variable speed drive improvement to Well No. 2 energy efficiency should increase. Please refer to Section 2 for more details on electrical costs for the Water Department and WWTP. The following table shows the budgeted amount for costs that may be directly affected by water pumping.

For this section, the following data was reviewed:

2009 Budget Request – Department: Water 220-220-70, pages 1-9
2009 Budget Request – Department: Sewer 230-230-60, pages 1-9

Table 3-5
FY 2009 Water Production Costs Affected by Conservation

Item	Cost	Savings	Note
Alternative Water Supply Study	$157,800	unknown	Cost of study will still take place, but may defer infrastructure.
Chemicals	$20,000	$25/MG*	Chemical use dependent upon aquifer and well use.
Electricity	$212,000	$265/MG**	Majority of cost due to wells.

*Based on Fiscal Year 2009 Budget Request and 800 MG pumped
**Based on Fiscal Year 2005 pumping and costs, 10% increase for each fiscal year and 800 MG pumped

Lift Stations and Boosters were considered as another potential savings in cost but are not included as an avoided cost. The Lift Station will not show a savings because rain events will affect the inflow and infiltration. The Boosters are currently small pumps that constantly run. However, energy savings for boosters will not come from conservation but the Water Department plans to upgrade these booster stations to be more efficient.

4 Water Conservation Elements for the Single Family and Multi-Family Residential Sectors

4.1 Introduction

Measures are hardware and behavior changes that promote water savings, such as low flow showerheads or taking shorter showers. Measures are described in the following section, although not all may be recommended.

Conservation measures for the Multi-Family sector are identical to the Single Family sector and are therefore lumped together. However, for conservation incentives, the two sectors do differ. Differences between the two regarding incentives are explained in each section. Single Family, duplex and triplex are affected by this and defined by a single meter servicing each dwelling unit. Multi-Family units are defined by a meter servicing more than one dwelling unit.

The target audience for indoor devices will be pre-1994 households, due to the 1992 U.S. Energy Policy Act which established national maximum allowable water-flow rates for toilets (1.6 gpf), urinals (1 gpf), showerheads (2.5 gpm), and faucets (2.2 gpm), and which became effective in 1994.

Single Family and Multi-Family households are combined to account for residential use. It is important to note that the irrigation needs for Single Family and Multi-Family households may differ in that there is potentially less landscape per Multi-Family resident than there is for Single Family residents. However, both residential categories will be similar in indoor use needs.

4.2 Single Family and Multi-Family Conservation Measure Descriptions

Low-Volume Toilets
Target: Housing older than 1994
Provide rebates for residents to replace non-efficient toilets with efficient 1.6 gallon per flush (gpf) toilets. The target is current housing, older than 1994, that has not already had toilet upgrades. All residences since 1994 were built with 1.6 gpf toilets due to the 1992 U.S. Energy Policy Act which established national maximum allowable water-flow rates for toilets, urinals, showerheads, and faucets, and became effective in 1994.

High Efficiency Toilets (HETs)
Target: All households
Provide rebates for residents to replace non-efficient toilets with efficient HET toilets of 1.3 gpf or less. This system does not require significant behavioral changes for there to be water savings. The target is all households wanting to upgrade their toilet.

Toilet-leak Detection and Repair
Target: All households
Provide free toilet-leak detection tablets in order for residence to determine if their toilets leak. Additionally, provide detailed information on how leaks can be fixed. The target is all Single and Multi-Family households, of which 25 percent will find leaks, according to national averages. Moscow currently offers free toilet-leak detection tablets to its residents.

Toilet-tank Displacement Devices
Target: Housing older than 1994
Provide free toilet-tank displacement devices, which are placed in the toilet-tank to displace water. The target is current housing, older than 1994, that has not already had toilet upgrades or displacement devices installed. The City currently offers free toilet-tank displacement bags for its residents.

Decrease Toilet Flushes
Target: All households
Successfully induce residents to flush less by not using the toilet as a trash can.

Low-flow Showerheads
Target: All households
Provide free efficient (2.5 gpm or less) showerheads for residents to replace their non-efficient showerheads. The target is current households, older than 1994, that have not already had showerhead upgrades. Provide free efficient (2.0 gpm or less) showerheads for residents to replace showerheads of higher output than 2.0 gpm or showerheads in disrepair. The target is all current households. Moscow currently offers free low-flow showerheads to its residents.

Decrease Shower Use
Target: All households
Successfully persuade residents to shorten their shower times. The target is all households. The City currently offers free shower timers aimed at educating and assisting customer to reduce their show times.

Instant Hot Water Valve
Target: All households
This system does not require significant behavioral changes for there to be water savings. The valve is installed near hot water used to prevent the waste of hot water due to waiting for hot water to get to the shower faucet. When the water in your hot water pipe and the

control valve cools below the user adjustable temperature (77-140 degrees F), the thermal materials within the control valve contract, and silently open the valve. Thermal convection within your hot water tank naturally circulates the cooled water through your existing cold water pipes and back to the hot water tank for reheating.

Faucet Aerators (Bathroom)
Target: All households
Provide free efficient (2.2 gpm or less) bathroom faucet aerators for residents to replace their non-efficient faucet aerators. The target is current households, older than 1994, that have not already had aerator upgrades. Provide free efficient (2.0 gpm or less) faucet aerators for residents to replace faucet aerators of higher output than 2.0 gpm or faucet aerators in disrepair. Target audience is all current households. The City currently offers free low-flow showerheads to its residents.

Faucet Aerators (Kitchen)
Target: All households
Provide free efficient (2.2 gpm or less) kitchen faucet aerators for residents to replace their non-efficient faucet aerators. The target is current households, older than 1994, that have not already had aerator upgrades. Provide free efficient (2.0 gpm or less) faucet aerators for residents to replace faucet aerators of higher output than 2.0 gpm or faucet aerators in disrepair. The target is all current households. The City currently offers free low-flow showerheads to its residents.

Decreased Faucet Use
Target: All households
Successfully persuade residents to shorten their combined bathroom and kitchen faucet use by two minutes. This could be accomplished by turning off the tap when lathering hands, brushing teeth, or scrubbing dishes.

Efficient Washing Machines
Target: All households
Provide rebates for residents to replace non-efficient washing machines. The target is all households with non-efficient washing machines.

Eliminate Partial Washing Machine Loads
Target: All households
Successfully persuade residents to eliminate all partial loads of laundry. The target is all households with washing machines.

Audit for Automatic Irrigation
Target: Households with automatic irrigation systems
Provide free landscape water use audits to customers to identify both hardware and scheduling improvements that could be made to conserve water. Additionally, in order to help ensure savings, the auditor includes suggestions for reprogramming the customers irrigation controllers based on the audit results. Furthermore, a free rain sensor shut-off device which can be installed in the system by the customer will be available to systems

not already equipped with one. The City currently offers free audits and rain sensors to residents with automatic irrigation systems.

Audits for Manual Irrigation
Target: Households with manual irrigation systems
Provide free landscape water use audits to customers to identify both hardware and schedule improvements that could be made to conserve water. Additionally, in order to help ensure savings, the audit includes providing an automatic shut-off timer for sprinklers attached to hoses and providing a rain gauge to help residents determine if enough rain has fallen to eliminate the need for supplemental watering. Rain gauges can also be used to determine the precipitation output of sprinklers to help customers determine the most efficient amount of water to apply to their lawn. The City currently offers free rain gauges and hose timers to its residents.

Outdoor Device Giveaway
Target: All households
Provide free outdoor devices to all households interested. Hose timers, rain gauges, and hand-held spray nozzles will be given out to manual irrigators. Rain sensors, rain gauges, and hand-held spray nozzles will be given out to automatic irrigators. Rebates or free rotator irrigation heads may be worth investigating. The target is any household that would like to have a more efficient landscaping system. The City currently gives out all of these items free to its residents.

Low Water Use Plant Guide Book
Target: Households with landscaping
Landscape with low water use plants through the use of a landscape guide booklet. This booklet will need to be created specifically for the Moscow region. The target is new household construction, as well as households redoing their landscape.

50 gallon Rain Barrel Catchment
Target: All households
Offer rebates and purchase information to individuals interested in this alternative form of landscape watering. The target will be all households inquiring about rain barrels.

Less Lawn
Target: All households with landscaping
Successfully persuade residents to limit lawn to functional areas. Offer landscape information to individuals interested in this alternative form of landscaping. The target will be all households with new or existing landscape that want to have a low water use yard.

Sub-Meters added to Multi-Family HH
Target: Mobile Home Courts
Work in cooperation with the Public Water Department to add sub-meters to mobile home courts and apartment complexes that currently have only main connections and not

individual household connections. The target is mobile home courts and apartments with residents that do not have separate meters.

4.3 Conservation Incentives

Incentives are motivators and underlying benefits that encourage people to enact measures. These incentives fall into three categories: educational, financial, and regulatory. They are described below, although not all may be recommended. The conservation message remains the same for both Single Family and Multi-Family households because both customer bases are residents of Moscow.

The incentives are the same for both customer bases with two exceptions: tiered rate billing and metered billing. Multi-Family customers, such as the owners, pay a bulk water rate instead of the tiered rate. However, Multi-Family residents that receive water from the same meter as the other units, for example, in an apartment complex, are not held accountable for their water use. To address both of these issues, Multi-Family customers have additional recommendations for a Tiered Rate Expansion as well as a Sub-meter Rebate Program.

4.3.1 Public Information and Education Incentives (PIE)

Brochures
Brochures can be produced in order to accommodate a variety of conservation messages and are currently being used as part of the PIE Program administered by the City. The content can be general or detailed. They are distributed at events, presentations, and at City buildings. The costs involved include production, printing, and distribution. Additional costs are low because the majority of production and distribution is done in-house.

Flyers
Flyers can also be produced in order to accommodate a variety of conservation messages and are currently being used as part of the PIE Program administered by the City. The content is usually general given their limited space. They are distributed at events, presentations, posted around town and at City buildings. The costs involved include production, printing, and distribution. Additional costs are low because the majority of production and distribution is done in-house.

Bill Message
Conservation messages are currently being used by the City. However, the bill message is limited to one line of text due to the City's billing system software. The Water Conservation phone number is included on the bill and the cost is free due to adding a line of text to an already existing bill.

Consumption Information on Bill

It is a common practice for utilities to include consumption information on utility bills. This is available to help customers understand how much water they use in comparison to previous time periods. There are several comparisons that can be used to inform the customer about their water use. However, due to the City's limited billing system software, the consumption information available to customers is also limited. The current consumption information compares the current bill cycle's consumption to that of the same time period for the previous year. The cost is free due to the information and printing which already exists for billing.

City Website
The City's website is an excellent venue for conveying water conservation messages since it has unlimited space and can be frequently updated. Websites can only reach customers who seek out the information and are a great tool for support of other PIE vehicles.

Newsletter
Newsletters are a common way for utilities to communicate with their customers through multi-focused or specific articles about conservation. The City currently distributes a quarterly newsletter to approximately 11,700 customer households. The newsletter focuses on conservation, with an occasional multi-focused article. Billing stuffers are not an option for the City because the bills are sent out on a postcard, so the newsletter is distributed by direct mail. Costs for the newsletters are high but reach close to all of the customers (however, some are not included due to mailing list limitations and not all members of the household check and read the mail). Costs include production (in-house staff and PCEI staff), printing, and postage.

Bus advertisements
Brief conservation messages can be advertised on or in buses. The Moscow Valley Transit (MVT) and the Wheatland Express are the two currently available bus systems for advertising; however, the MVT does not feature advertising upon last inquiry. In addition, the Wheatland Express is generally focused on the universities, which are not the City's targeted audience. Consequently, cost analysis is not necessary due to the lack of City transportation advertising options.

Billboards
Billboards are less frequently used for water conservation messages and the amount of information contained in a billboard is limited. Costs include production, printing, advertising and the lease of billboard space and can range from $700.00 to $2500.00 month. Overall costs are high, but exposure is effective.

Radio Advertisements
Radio ads are a cost effective medium and can reach a wide range of customers based on station demographics. The City currently uses an annual contract with Inland Northwest Broadcasting, more specifically KZZL, KROA, KMAX, and KRPL. Inland Northwest Broadcasting is cost effective due to contract fees increasing by 5% yearly and allowing

free non-profit air time. Total costs (from Fiscal Year 2009 budget) of the radio contract as $4,296.24 or $7.90 average per 30 second advertisement.

Television Advertisements
The City has historically used the City's channel TV-13 to advertise conservation messages. As per Water Department employee Mike Dimmick, the City has advertised on TV-13 since 2003. The costs are low because production is done in house and there is no fee for use of the TV-13 air time.

School Programs
The 2000 U.S. Census indicates that 24.2% of the homes in Moscow had school age children living with them. School visits have been utilized by the City to relay conservation messages since 1999, the year the first school tour of the filter plant took place. Changes have been made to this program in that more schools are visited since the inception of the program. The current school program includes visits to the Water Department when requested as well as a trained professional from PCEI, paid by the City. In addition, school events are funded by the City. Detailed curriculum has been created via contracted work with PCEI and approximately 26 lesson plans which follow Idaho State Achievement Standards have been created. Currently (from Fiscal Year 2009 budget) PCEI is scheduled to make 33 classroom visits at $130.00 each visit, for a total of $4,290.00 and run two school events for a total of $3,750.00. Grand total costs for contracted work is $8,040.00 with other costs being supplies (shower timers), printing, and in-house costs for tours.

Community Events
Community events have been utilized by the City to promote conservation messages since 1997. Events visited are chosen based on previous attendance history. Events can target a wide range of user types and are more cost-effective because the City can go to the people, thereby saving on advertising costs. The exception of this is the Water Department's Open House which includes a water conservation table as one of the multi-focused booths. Costs include labor for City staff and contracted help as well as event booth space rental and materials given out. Contractual cost to PCEI for labor (from Fiscal Year 2009 budget) is $2,700.00.

Tours of Facilities
The City offers free tours of the water treatment plant, which is also a way to promote water conservation. Interested parties and schools contact the Water Department to schedule a tour date. Tours also take place during the annual Water Department Open House. Costs involve staff time needed to lead the tours.

Press Releases
Press releases are used by the City to get the conservation message out regarding upcoming events. However, the City is not in control of whether the press release is picked up by media outlets. Costs include production of the press release, but are otherwise free.

Wisescape Award Program
In 2008, the City developed a Wisescape Award Program which recognizes those businesses and residents that have made conservation efforts by minimizing resources for landscape purposes. The program is also intended to motivate others to switch to more efficient landscaping while maintaining an aesthetically pleasing landscape. Costs to continue this program include production, labor, printing, display materials, and awards costs.

Lawn Watering Guide
The creation of a detailed booklet for those that have and prefer to keep a traditional landscape can help spread the conservation message. The booklet may include efficiency guidelines for their landscape, tips, audit guidelines, etc. This guide can reach customers that chose not to have a Wisescape yard. Costs include production, printing, and distribution.

Landscape Guide Book
The creation of a detailed booklet for those that would like to transform their landscape into a water efficient landscape can help customers save water. The booklet may include efficiency guidelines for their landscape, planning, tips, audit guidelines, etc. This guide can reach customers that chose to have a Wisescape yard and can be supported by demonstration gardens (description in Public Sector Incentives). Costs include production, printing, and distribution.

Mailings
Postcards can be mailed to inform customers of events such as Wisescape, summit, and Open House. The City currently uses postcard mailings to inform customers of irrigation regulations. Costs include production, printing, and postage.

Door Hangers
The City currently uses door hangers when a customer needs a reminder regarding irrigation regulation. This is cost effective when only a small portion of the customers receive a door hanger. Costs include production, printing, and distribution.

Outreach to home and garden centers
Outreach to home and garden centers can be difficult and time consuming because it requires their cooperation with the City. The City has contacted local nurseries in regards to the Wisescape Award with little cooperation. Only one entity agreed. Costs include labor.

Personal Contact
The City currently contacts customers needing reminders regarding the irrigation season, after more efficient lines of communication have been attempted. This is cost effective when only a small portion of the customers are contacted. Costs are labor related.

4.3.2 Financial Incentives

Device Giveaway
Free to all Moscow residents with no initial cost for the customer to implement. There are potential savings for water and electricity. Costs to the City are evaluated in Section 3.5.

Free Irrigation Audits
Free to all Moscow residents with no initial cost to the customer. Products may need to be purchased to increase irrigation efficiency; however, the consultation, audit testing, and potential water savings will save the customer money. Costs to the City are evaluated in Section 3.5.

Free Landscape Guide Book
Free to all Moscow residents with the motivation for customers to save money through their water savings. The purchase of labor and products may be necessary to the customer; however, free landscape ideas on how to convert to more efficient landscaping would mean additional savings to the customer. Costs to the City are evaluated in Section 3.5.

Toilet Rebate
Moscow currently does not have a toilet rebate program, but our neighbors in Pullman, WA do. According to a conversation with Art Garro in 2008, Pullman's goal is to provide 150 toilet rebates to approved installations. The rebate amount is $100.00 for a toilet to code and $125.00 for an HET toilet. A financial rebate in the Moscow area may motivate customers to remove high water use toilets. It may be pertinent to discuss the possibility of a toilet recycling option for the unwanted toilets with Latah Sanitation. This option may further motivate customers that would feel wasteful about replacing an older (pre-1994) toilet that is still in working condition. Costs to the City are evaluated in Section 3.5.

Instant Hot Water Valve Rebate
Instant hot water valve rebates may motivate customers to replace older hot water valves with an instant hot water valve. Costs to the City are evaluated in Section 3.5.

Washing Machine Rebate
Washing machine rebates may motivate customers to replace inefficient washing machines with water efficient ones. Costs to the City are evaluated in Section 3.5.

Rain Barrel Rebate
Rain barrel rebates may motivate customers to supplement landscape irrigation with a rain barrel catchment system. Costs to the City are evaluated in Section 3.5.

Tiered Rate
The current structure, as of October of 2005, is the Inclining Block Structure with three (3) tiers for pricing. All customers in the same class pay a base rate plus the rate dependent on consumption. The tiered system allows for progressively higher rates per block of water charged. The 2009 Fiscal Year rate for residential/duplex/triplex customers is $1.50 ccf for the 0-700 ccf block, $1.80 ccf for the 701-2000 ccf block, and

$3.25 ccf for the over-2000 ccf block. The Inclining Block Structure can target the high volume users. Multi-Family and Commercial users pay a flat fee in addition to a flat fee of $1.80 ccf. The City could look into a tiered rate for all users in addition to the residential user.

Tiered Rate Expansion

The target is Multi-Family customers that receive water from the same meter as other unit dwellings. The City could look into a tiered rate for all users in addition to the residential user. It has also been suggested that Multi-Family customers be charged by the tiered rate.

Sub-Meter Program

The target is Multi-Family residents that receive water from the same meter as other unit dwellings. By offering a rebate to the owners to install a sub-meter for each unit dwelling, residents of the rental unit will be accountable for their water use, thus allowing the owner to bill each tenant according to what they use. By having the end water user accountable for their water use, an average of a 16.4% water savings is possible, according to an EPA/Aquacraft study.

4.3.3 Regulatory Incentives

Ordinance #2007-13

The previous Ordinance #2004-27 was created to control the use of sprinklers from 6 p.m. to 10 a.m., with the use of watering with an automatic shut-off nozzle allowed at all times. The watering season was from April through October, with no regulations outside of those months. The new ordinance was amended in 2007 and prohibits the watering of impervious surfaces as well as defines an irrigation season. The irrigation season will be declared each season and irrigating with sprinklers, drip, and soaker irrigation outside of that defined season is prohibited. Automatic shut-off nozzle use is allowed at all times.

Resolution #2004-12

Resolution #2004-12 was created in 2004 with the goal to prevent water waste by requiring maintenance of connected facilities. Every water user is required to keep sprinklers, faucets, valves, hoses and all other apparatuses connected to the City water system in good condition. In the event of ill-working apparatuses, the City will contact the owner. If maintenance is not carried out by the owner, there are a series of fines that can follow, starting at $50.00 and up to $200.00 with a discontinuation of service possible.

Reduced Lawns for New Developments

New homes with non-established yards are easier to transform into water efficient landscapes because the cost will be incurred to install some form of landscape and it is easier to convince the owner to invest initially in order to save later in water use. An ordinance or voluntary program (much like the City's Green Building Program) for new homes to avoid large turf areas could save water use during the peak season. Cost would be to create, implement, and support the ordinance.

5 Water Conservation Element for the Commercial and Institutional Sectors

5.1 Introduction

Measures are hardware and behavior changes that achieve water savings. The following are described below, although not all may be recommended.

The conservation measures and incentives for the commercial and institutional sectors target non-residential water customers. Non-residential, business water consumption in Moscow comprises 22% (see table 2-9) of the total water used.

The target audience for indoor devices will be pre 1994 businesses, due to the 1992 U.S. Energy Policy Act which established national maximum allowable water-flow rates for toilets (1.6 gpf), urinals (1 gpf), showerheads (2.5 gpm), and faucets (2.2 gpm), and became effective in 1994.

5.2 Commercial Conservation Measures

Low-Volume Toilets
Target: Businesses older than 1994
Provide rebates for residents to replace non-efficient toilets with efficient 1.6 gallon per flush (gpf) toilets. The target is current businesses, older than 1994, that have not already had toilet upgrades. All buildings since 1994 were built with 1.6 gpf toilets due to the 1992 U.S. Energy Policy Act which established national maximum allowable water-flow rates for toilets, urinals, showerheads, and faucets.

High Efficiency Toilets (HETs)
Target: All businesses
Provide rebates for residents to replace non-efficient toilets with efficient HET toilets of 1.3 gpf or less. This system does not require significant behavioral changes for there to be water savings. The target is all businesses wanting to upgrade their toilet.

Low-Volume Urinals
Target: All businesses
Provide rebates for replacing high water use urinals for lower flow urinals. This system does not require significant behavioral changes for there to be water savings. The target is all businesses wanting to upgrade their urinals.

Waterless Urinals
Target: All businesses

Provide rebates for replacing high water use urinals for waterless urinals. This system does not require significant behavioral changes for there to be water savings. The target is all businesses wanting to upgrade their urinals.

Toilet-leak Detection and Repair
Target: All businesses
Provide free toilet-leak detection tablets in order for businesses to determine if their toilets leak. Additionally, provide detailed information on how leaks can be fixed. The City currently offers free toilet-leak detection tablets to its residents and businesses.

Toilet-tank Displacement Devices
Target: Businesses older than 1994
Provide free toilet-tank displacement devices, which are placed in the toilet-tank to displace water. The target is current businesses, older than 1994, that have not already had toilet upgrades or displacement devices installed. The City currently offers free toilet-tank displacement bags for Moscow businesses.

Low-flow Showerheads
Target: Hotels and/or motels
Provide free efficient (2.5 gpm or less) showerheads for business such as hotel/motel to replace their non-efficient showerheads. The target is current hotels/motels older than 1994 that have not already had showerhead upgrades. Provide free efficient (2.0 gpm or less) showerheads for hotels to replace showerheads with higher output than 2.0 gpm, as well as showerheads in disrepair. The City currently offers free low-flow showerheads to Moscow businesses.

Faucet Aerators (Bathroom)
Target: All businesses
Provide free efficient (2.2 gpm or less) bathroom faucet aerators for businesses to replace their non-efficient faucet aerators. The target is current businesses older than 1994 that have not already had aerator upgrades. Provide free efficient (2.0 gpm or less) faucet aerators for businesses to replace faucet aerators with output higher than 2.0 gpm, as well as faucet aerators in disrepair. The City currently offers free low-flow showerheads to Moscow businesses.

Air-cooled Ice Machines
Target: Businesses with water cooled
Provide financial assistance for customers to switch from water-cooled ice machines to air-cooled ones. The target is businesses with ice machines, such as restaurants, bars, hotels, and motels.

Audits for Automatic Irrigation
Target: Businesses with auto irrigation systems
Provide free landscape water use audits to customers to identify both hardware and scheduling improvements that could be made to conserve water. Additionally, in order to help ensure savings, the audit includes suggestions for reprogramming the customers'

irrigation controllers based on the audit results. Furthermore, a free rain sensor shut-off device which can be installed in the system by the customer will be available to systems not already equipped with one. The City currently offers free audits and rain sensors to Moscow businesses with automatic irrigation systems.

Audits for Manual Irrigation
Target: Businesses with manual irrigation systems
Provide free landscape water use audits to customers to identify both hardware and schedule improvements that could be made to conserve water. Additionally, in order to help ensure savings, the audit includes providing an automatic shut-off timer for sprinklers attached to hoses and provides a rain gauge to help residents determine if enough rain has fallen to eliminate the need for supplemental watering. Rain gauges can also be used to determine the precipitation output of sprinklers to help customers determine the most efficient amount of water to apply to their lawn. The City currently offers free rain gauges and hose timers to Moscow businesses.

Outdoor Device Giveaway
Target: All businesses
Provide free outdoor devices to all interested businesses. For manual irrigators, hose timers, rain gauges, and hand-held spray nozzles will be given out. For automatic irrigators, rain sensors, rain gauges, and hand-held spray nozzles will be given out, as well. Rebates or free rotator irrigation heads may be worth investigating. The target is any business that would like to have more efficient landscaping. The City currently gives out all of these items to Moscow businesses.

Low Water Use Plant Guide Book
Target: Businesses with landscaping
Landscape with low water use plants through the use of a landscape guide booklet. This booklet needs to be created for the Moscow region specifically. The target is new business construction, as well as businesses redoing their landscape.

Less Lawn
Target: All businesses with landscaping
Successfully persuade businesses to limit lawn to functional areas. Offer landscape information to individuals interested in this alternative form of landscaping. The target is all businesses that have new or existing landscape that want to have a low water use landscape.

Efficient Restaurant Spray Heads
Target: All commercial restaurants
Offer free water efficient dish washing rinse power rinse spray nozzles to restaurants not already outfitted with one. The target is businesses with inefficient rinse nozzles, such as restaurants, bars, hotels, and motels.

Hotel bedding and towel message
Target: All commercial hotels/motels

Offer free message cards to be placed within each room to reuse bedding and towels for the same customer. The target is businesses such as hotels and motels.

5.3 Commercial Conservation Incentives

Conservation incentives are motivators for people to enact measures that will help conserve water and they fall into three categories: educational, financial, and regulatory. The following are described below, although not all may be recommended.

5.3.1 Public Information and Education Incentives (PIE)

Wisescape Award Program
In 2008, the City developed a Wisescape Award Program which recognizes those businesses and residents that have made conservation efforts by minimizing resources for landscape purposes. The program is also intended to motivate others to switch to more efficient landscaping that is still aesthetically pleasing. Costs to continue this program include production, labor, printing, display materials, and awards.

Mailings
Postcards can be mailed to inform customers of events, such as Wisescape, summit and Open House. The City currently uses postcard mailings to inform customers of irrigation regulations. Costs include production, printing, and postage.

Door Hangers
The City currently uses door hangers to contact customers needing a reminder regarding irrigation regulation. This is cost effective when only a small portion of the customers receive a door hanger. Costs include production, printing, and distribution.

Outreach to home and garden centers
Outreach to home and garden centers can be difficult and time consuming because it requires cooperation from local home and garden centers. The City has contacted local nurseries in regards to the Wisescape Award with little cooperation. Only one entity agreed. Costs include labor.

Personal Contact
The City currently contacts customers needing reminders regarding the irrigation season after other, more efficient lines of communication, have been attempted. This is cost effective when only a small portion of the customers are contacted. Costs are labor-related.

5.3.2 Financial Incentives

Device Giveaway
Free to all Moscow businesses with no initial cost for the customer to implement, with potential savings for water and electricity. Costs to the City are evaluated in Section 3.5.

Free Irrigation Audits
Free to all Moscow businesses with no initial cost to the customer. Products may need to be purchased to increase irrigation efficiency; however, the consultation, audit testing, and potential water savings will save the customer money. Costs to the City are evaluated in Section 3.5.

Free Landscape Guide Book
Free to all Moscow businesses with the motivation for customers to save money through their water savings. Although the purchase of labor and products may be necessary to the customer, free landscape ideas on how to convert to more efficient landscaping would mean additional savings to the customer. Costs to the City are evaluated in Section 3.5.

Toilet Rebate
Moscow currently does not have a toilet rebate program, but Pullman residents do. According to a conversation with Art Garro in 2008, Pullman's goal is to provide 150 toilet rebates to approved installations. The rebate amount is $100.00 for a toilet to code and $125.00 for an HET toilet. A financial rebate in the Moscow area may motivate customers to remove high water use toilets. It may be pertinent to discuss the possibility of a toilet recycling option for the unwanted toilets with Latah Sanitation. This option may further motivate customers that would feel wasteful about replacing an older (pre-1994) toilet that is still in working condition. Costs to the City are evaluated in Section 3.5.

Low-Volume Urinal Rebate
Low-volume urinal rebates may motivate customers to replace non-efficient urinals with efficient 1.0 gpf urinals or waterless urinals. Costs to the City are evaluated in Section 3.5.

Air-cooled Ice Machines
Financial rebates may motivate customers to switch from water-cooled ice machines to air-cooled ice machines; more specifically, restaurants, bars, hotels and motels. Costs to the City are evaluated in Section 3.5.

Tiered Rate Expansion
The current structure, as of October of 2005, is the Inclining Block Structure with three (3) tiers for pricing. All customers in the same class pay a base rate plus the rate dependent on consumption. The tiered system allows for progressively higher rates per block of water charged. The 2009 Fiscal Year rate for residential/duplex/triplex customers is $1.50 ccf for the 0-700 ccf block, $1.80 ccf for the 701-2000 ccf block, and $3.25 ccf for the over 2000 ccf block. The Inclining Block Structure can target the high volume users. Multi Family and Commercial users pay a flat fee in addition to a flat fee of $1.80 ccf. The City could look into a tiered rate for all users in addition to the residential user.

5.3.3 Regulatory Incentives

Ordinance #2007-13

The previous Ordinance #2004-27 was created to control the use of sprinklers from 6 p.m. to 10 a.m., with the use of watering with an automatic shut-off nozzle allowed at all times. The watering season was from April through October, with no regulations outside of those months. The new ordinance was amended in 2007 and prohibits the watering of impervious surfaces as well as defines an irrigation season. The irrigation season will be declared each season and irrigating with sprinklers, drip, and soaker irrigation outside of that defined season is prohibited. Automatic shut-off nozzle use is allowed at all times.

Resolution #2004-12

Resolution #2004-12 was created in 2004 with the goal to prevent water waste by requiring maintenance of connected facilities. Every water user is required to keep sprinklers, faucets, valves, hoses and all other apparatuses connected to the City water system in good condition. In the event of ill working apparatuses, the City will contact the owner. If maintenance is not carried out by the owner, there are series fines that can follow, starting at $50.00 up to $200.00 with a discontinuation of service possible.

Reduced Lawns for New Developments

New homes with non-established yards are easier to transform into water efficient landscapes because the cost will be incurred to install some form of landscape and it is easier to convince the owner to invest initially in order to save later in water use. An ordinance or voluntary program (much like the City's Green Building Program) for new homes to avoid large turf areas could save water use during the peak season. Cost would be to create, implement, and support the ordinance.

6 Water Conservation Element for the Public Facility Sector

6.1 Introduction

The following section discusses recommended measures and incentives for the City to follow. Many have already been implemented, with additional suggestions made. It is **important for the City to lead by example and thus far the City is progressive** toward the community's conservation goals. The following are described below, although not all may be necessary. The selection parameters are as follows:

- **Already Implemented = Accepted**
- **When Replacements Needed = Accepted**
- **High Cost = Rejected**
- **Other Departments = Recommended**

Table 3-6
Ranking of Conservation Measures and Incentives for Public Facilities

Measure or Incentive	Ranking Parameter	Ranking Results
Low-volume toilets	When Replacements Needed	Accepted
HET toilets	When Replacements Needed	Accepted
Low-volume urinals	When Replacements Needed	Accepted
Waterless urinals	Difficult Maintenance	Rejected
Faucet aerators-bathroom	Already Implemented	Accepted
Audits for automatic irrigation	Other Department	Recommended
Audits for manual irrigation	Other Department	Recommended
Less Lawn	Other Department	Recommended
Infrastructure Leak Detection and Repair	Already Implemented	Accepted
Flushing Water Use Reductions	Already Implemented	Accepted
Backwashing Water Use Reduction	Already Implemented	Accepted
Flow Meter Maintenance	Already Implemented	Accepted
PIE: Demonstration Wisescape Gardens	Already Implemented	Accepted
PIE: Wisescape Program-Award Program	Already Implemented	Accepted
Financial: Free Devices	Already Implemented	Accepted
Financial: Free Irrigation Audits	Other Department	Recommended
Financial: Free Landscape Guide Booklet	See Measures Results	Accepted
Financial: Efficient Parks Irrigation System	Already Implemented	Accepted
Financial: UI Effluent Program	Already Implemented	Accepted
Regulatory: Ordinance	Already Implemented	Accepted
Regulatory: Resolution	Already Implemented	Accepted
Regulatory: New Development Reduce Lawn	Other Department	Recommended
Regulatory: Add to Metered Routes	To track non-revenue water	Accepted

6.2 Public Facilities Conservation Measures

Low-Volume Toilets
Target: Public Buildings older than 1994
Replace non-efficient toilets with efficient 1.6 gallon per flush (gpf) toilets in public buildings. The target is public buildings older than 1994, that have not already had toilet upgrades. All buildings since 1994 were built with 1.6 gpf toilets due to the 1992 U.S. Energy Policy Act which established national maximum allowable water-flow rates for toilets, urinals, showerheads, and faucets, and became effective in 1994.

High Efficiency Toilets (HETs)
Target: Public Buildings
Replace non-efficient toilets with efficient HET toilets of 1.3 gpf or less. This system does not require significant behavioral changes for there to be water savings. The target is public buildings older than 1994 that have not already had toilet upgrades.

Low-Volume Urinals
Target: Public Buildings
Provide rebates for replacing high water use urinals for lower flow urinals. This system does not require significant behavioral changes for there to be water savings. The target is public buildings that have not already had urinal upgrades.

Waterless Urinals
Target: Public Buildings
Provide rebates for replacing high water use urinals for waterless urinals. This system does not require significant behavioral changes for there to be water savings. The target is public buildings that have not already had urinal upgrades.

Faucet Aerators (Bathroom)
Target: Public Buildings
Provide free efficient (2.2 gpm or less) bathroom faucet aerators for public buildings to replace their non-efficient faucet aerators. The target is current public buildings older than 1994 that have not already had aerator upgrades. Provide free efficient (2.0 gpm or less) faucet aerators for public buildings to replace faucet aerators of higher output than 2.0 gpm or faucet aerators in disrepair. The target is all current public buildings. The City currently offers free low-flow showerheads to its residents and businesses.

Audit for Automatic Irrigation
Target: Public Parks irrigation systems
Encourage parks managers to set up an irrigation audit schedule/irrigation management program that routinely identifies both hardware and scheduling improvements that could be made to conserve water. Furthermore, a free rain sensor shut-off device which can be installed into the system by the parks facility crew will be available to systems not

already equipped with one. Currently, the Parks Department has upgraded many of the irrigation systems within the City.

Audits for Manual Irrigation
Target: Public Parks with manual irrigation systems
Encourage parks managers to set up an irrigation audit schedule that routinely identifies both hardware and scheduling improvements that could be made to conserve water. Additionally, in order to help ensure savings, rain gauges can be provided to assist the parks facility crew in determining if enough rain has fallen to eliminate the need for supplemental watering. Rain gauges can also be use to determine the precipitation output of sprinklers to help managers determine the most efficient amount of water to apply to their lawns. The City currently offers free rain gauges and hose timers to its residents and businesses.

Less Lawn
Target: All public buildings with landscaping
Successfully limit lawn to functional areas and maintain a low water use landscape. The target will be all public building landscapes that have new or existing landscape that is not used for public recreation.

Infrastructure Leak Detection
Target: Public Water Department
Maintain system to keep leaks at a minimum and repair any leaks found within a reasonable amount of time. Currently, the Water Department is efficient and no recommendations are needed.

Flushing
Target: Public Water Department
Maintain water quality in accordance with DEQ regulations while minimizing flushing for conservation. Currently, the Water Department is efficient and no recommendations are needed.

Backwashing
Target: Public Water Department
Maintain water quality in accordance with DEQ regulations while minimizing the needed backwashing for conservation. Currently, the Water Department is efficient and no recommendations are needed.

Flow Meter Cleaning
Target: Public Water Department
Maintain well flow meters to keep accurate data of water pumped. Currently the Water Department is efficient with a five (5) year maintenance schedule and no recommendations are needed.

6.3 Conservation Incentives

Incentives are motivators for people to enact measures and fall into three categories: educational, financial, and regulatory. The following are described below, although not all may be recommended.

6.3.1 Public Information and Education Incentives (PIE)

Demonstration Wisescape Gardens

Demonstration gardens are often used to show the principles of water-wise landscaping and to show that landscaping with low water use plants and limited lawn can be attractive. Demonstration gardens are usually put in visible and key locations such as City parks, City Hall, utility headquarters, and water and wastewater treatment plants. The City has helped finance a demonstration garden at the University of Idaho arboretum. Additionally, in 2008, the City developed a Wisescape Award Program which recognizes those businesses and residents that have made conservation efforts by minimizing resources for landscape purposes. The program is also intended to motivate others to switch to more efficient landscaping that is still aesthetically pleasing. In 2008, the Water Department wanted to lead by example by transforming the site at 201 N. Main from the traditional grass landscape to a Wisescape Demonstration Garden. Planting was completed in 2009, with signs, brochure guide, and other details to follow as funding permits. Additional City funded Wisescape gardens are at the 120 West A St Water Department and along Highway 8, both planted in 2010. Once the initial planting and reconstruction costs are paid for, cost will include upkeep and maintenance of the property. This is considered to be a low cost because once the Wisescape plantings are established, labor and resource needs will be reduced from what was traditionally planted.

Wisescape Award Program

In 2008, the City developed a Wisescape Award Program which recognizes those businesses and residents that have made conservation efforts by minimizing resources for landscape purposes. The program is also intended to motivate others to switch to more efficient landscaping that is still aesthetically pleasing. Costs to continue this program include production, labor, printing, display materials, and awards.

6.3.2 Financial Incentives

Device Giveaway

Free for all Moscow public buildings with no initial cost for the maintenance department to implement, with potential savings for water and electricity. Costs to the City are evaluated in Section 3.5.

Free Irrigation Audits

Free for all Moscow public buildings with no initial cost to the maintenance department. Products may need to be purchased to increase irrigation efficiency; however, the consultation, audit testing, and potential water savings will save the customer money. Costs to the City are evaluated in Section 3.5.

Free Landscape Guide Book
Free for all Moscow public buildings maintenance departments with the motivation to save money through their water savings. Although the purchase of labor and products may be necessary to the customer, free landscape ideas on how to convert to more efficient landscaping would mean additional savings to the customer. Costs to the City are evaluated in Section 3.5.

Efficient Parks Irrigation System
It is important for the City to lead by example through efficient irrigation practices. Moscow's public parks are currently being metered. City irrigation systems and all other park irrigation are maintained by the Parks and Recreation Department or Water Department of the City of Moscow. Upgrades are being made to increase irrigation efficiency and there are plans to add more automatic in-ground irrigation systems to areas that are currently being manually watered. Other upgrades include a central irrigation management system, which became fully operational in spring 2009. The new irrigation management software will allow parks staff to remotely monitor, adjust, and turn systems on and off. The software will also allow staff to monitor water use and identify and repair irrigation system breaks in a timely manner. It is recommended that an audit of the irrigated parks to be completed for all existing and future public parks. An audit of the City's parks in cooperation with the new software management system could lead to more efficient irrigation. Please see Section 2.5 for more details on Moscow's parks.

University of Idaho Effluent Program
Since the 1970's, the City of Moscow has provide the treated effluent from the Waste Water Treatment Plan (WWTP) to the University of Idaho's grounds, golf course, and arboretum. The WWTP will continue to do so and the costs will be considered null because this program is already instated and the treatment of the water is required regardless of the end distribution site.

6.3.3 Regulatory Incentives

Ordinance #2007-13
The previous Ordinance #2004-27 was created to control the use of sprinklers from 6 p.m. to 10 a.m., with the use of watering with an automatic shut-off nozzle allowed at all times. The watering season was from April through October, with no regulations outside of those months. The new ordinance was amended in 2007 and prohibits the watering of impervious surfaces as well as defines an irrigation season. The irrigation season will be declared each season and irrigating with sprinklers, drip, and soaker irrigation outside of that defined season is prohibited. Automatic shut-off nozzle use is allowed at all times.

Resolution #2004-12
Resolution #2004-12 was created in 2004 with the goal to prevent water waste by requiring maintenance of connected facilities. Every water user is required to keep

sprinklers, faucets, valves, hoses and all other apparatuses connected to the City water system in good condition. In the event of ill-working apparatuses, the City will contact the owner. If maintenance is not carried out by the owner, there are series fines that can follow, starting at $50 up to $200 with a discontinuation of service possible.

Reduced Lawns for New Developments

New public buildings with non-established yards are easier to transform into water efficient landscapes because they are starting with nothing and are planning to plant. An ordinance or voluntary program (much like the City's Green Building Program) for new homes to avoid large turf areas could save water use during the peak season. Cost would be to create, implement, and support the ordinance.

Add to Metered Routes

Target: All Public Facility Buildings and Parks

Public Facilities are not currently read on a monthly basis. It is recommended that all metered Public Facilities are added to the monthly read meter route to keep a better record of non-revenue water and to see if water savings can be made to those buildings and public parks.

7 Water Conservation Element for the Industry Professional Sector

7.1 Introduction

The Industry Professional sector's conservation techniques focus on incentives only. Non-residential commercial customers are covered in Section 5 and consequently there may be some overlap with this section. However, this sector refers more specifically (but not limited to) to realtors, developers, irrigation professionals, and landscape architects. The percentage of water use cannot be determined for the Industry Professionals sector but it is important to include this sector due to their leadership roles within the community and may or may not be a Moscow water customer (meter). It is also important to note that as of 1994, the Plumbing Codes to install water conserving devices are required, so all new homes will be equipped with efficient indoor devices. The selection parameters are as follows:

- **Already Implemented = Accepted**
- **Low Cost = Accepted**
- **Other Departments = Recommended**

Table 3-7
Ranking of Conservation Incentives for Industrial Professionals

Incentive	Ranking Parameter	Ranking Results
PIE: Wisescape Program-Award Program	Already Implemented	Accepted
Financial: Free Landscape Guide Booklet	Already Implemented	Accepted
Regulatory: Ordinance	Already Implemented	Accepted
Regulatory: Resolution	Already Implemented	Accepted
Regulatory: New Development Reduce Lawn	Other Department	Recommended
Regulatory: New Development Water Use	Other Department	Recommended
Regulatory: New Development Top Soil	Other Department	Recommended
Regulatory: Certified Irrigator	Low Cost	Accepted
Regulatory: New Home Owners Program	Low Cost	Accepted

7.2 Industry Professionals Conservation Incentives

Incentives in the educational, financial and regulatory categories are discussed in the following sections, although not all may be recommended.

7.2.1 Public Information and Education Incentive (PIE)

Wisescape Award Program
In 2008, the City developed a Wisescape Award Program which recognizes those businesses and residents that have made conservation efforts by minimizing resources for

landscape purposes. The program is also intended to motivate others to switch to more efficient landscaping that is still aesthetically pleasing. Costs to continue this program includes production, labor, printing, display materials, and awards.

7.2.2 Financial Incentive

Free Landscape Guide Book
Free for all Moscow water customers or Industry Professionals serving Moscow's water customers with the purpose of motivating Industry Professionals to have more efficient landscape choices to save their customers money through their water savings. Although the purchase of labor and products may be necessary of the customer, free landscape ideas on how to convert to more efficient landscaping would mean additional savings to the customer. Costs to the City are evaluated in Section 3.5.

7.2.3 Regulatory Incentives

Ordinance #2007-13
The previous Ordinance #2004-27 was created to control the use of sprinklers from 6 p.m. to 10 a.m., with the use of watering with an automatic shut-off nozzle allowed at all times. The watering season was from April through October, with no regulations outside of those months. The new ordinance was amended in 2007 and prohibits the watering of impervious surfaces as well as defines an irrigation season. The irrigation season will be declared each season and irrigating with sprinklers, drip, and soaker irrigation outside of that defined season is prohibited. Automatic shut-off nozzle use is allowed at all times.

Resolution #2004-12
Resolution #2004-12 was created in 2004 with the goal to prevent water waste by requiring maintenance of connected facilities. Every water user is required to keep sprinklers, faucets, valves, hoses and all other apparatuses connected to the City water system in good condition. In the event of ill-working apparatuses, the City will contact the owner. If maintenance is not carried out by the owner, there are series fines that can follow, starting at $50.00 up to $200.00 with a discontinuation of service possible.

Reduced Lawns for New Developments
New homes with non-established yards are easier to transform into water efficient landscapes because the cost will be incurred to install some form of landscape and it is easier to convince the owner to invest initially in order to save later in water use. An ordinance or voluntary program (much like the City's Green Building Program) for new homes to avoid large turf areas could save water use during the peak season. Cost would be to create, implement, and support the ordinance.

Water Use Projections for New Developments
Moscow's population increases each year and with that, so does the need for responsible and smart growth by our community and business leaders. The Planning and Zoning Commission is an integral part of Moscow's growth. An ordinance or voluntary program

(much like the City's Green Building Program) to establish guidelines and/or require any potential future developments to project water use will help toward responsible water for future growth.

Top Soil Program for New Developments
New home landscapes often suffer from poor soils, which can create a higher amount of irrigation run-off as well as produce poor plant growth. During the creation of a subdivision, it is not uncommon for the top soil to be removed. An ordinance or voluntary program (much like the City's Green Building Program) may motivate developers to return quality top soil to a newly developed site. Costs would be to create, implement, and support the ordinance.

Certified Irrigator Program
Home owners often employ irrigation professionals to install, maintain, and/or repair outdoor irrigation systems. A voluntary program (much like the City's Green Building Program) where irrigation professionals can become certified in irrigation efficiency knowledge and techniques, like the one offered through the Irrigation Association, may motivate professionals to practice water wise techniques. The groups of individuals or companies participating could be added to the City's website for potential future clients.

New Home Landscape Program
A voluntary program could be created for realtors selling houses within the City's limits. The City could provide information with conservation messages and available programs, rebates, and giveaways.

8 Water Conservation Element Package Options

As stated in Chapter 3, Table 3-3 (table below), the cost to implement all accepted measures over the ten-year period would be approximately $1.4 million with an annual savings of approximately 102.9 million gallons of water at full implementation of the conservation plan (see Appendix A). Alternative plan packages have been evaluated in this chapter to allow for a more economical conservation plan.

Table 3-3 - City of Moscow Potential Conservation Recommendations for Measures							
		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Low-volume toilets - 1.6gpf	11,434,220	High	$298,185	$2.61	Med	Accept*
	HET toilets - 1.0gpf	10,182,815	High	$368,821	$3.62	High	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Instant Hot Water Valve	5,641,446	Med	$67,575	$1.20	Low	Accept*
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Efficient clothes washers	1,954,517	Med	$45,050	$2.30	Med	Accept*
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Audits for manual irrigation	3,628,800	Med	$269,001	$7.41	High	Reject
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	50 gallon Rain Barrel Catchment	11,730	Low	$12,122	$103.34	High	Reject
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	9,917,929	High	$143,691	$1.45	Low	Accept*
	HET toilets - 1.0gpf	9,325,067	High	$187,641	$2.01	Med	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Instant Hot Water Valve	5,131,655	High	$34,149	$0.67	Low	Accept*
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Efficient clothes washers	992,423	Med	$4,575	$0.46	Low	Accept*
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Audits for automatic irrigation	3,110,400	Med	$337,896	$10.86	High	Reject
	Audits for manual irrigation	2,073,600	Med	$349,416	$16.85	High	Reject
	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	50 gallon Rain Barrel Catchment	11,730	Low	$9,644	$82.22	High	Reject
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
	Sub-Meter Multi-Family Households	2,705,299	Med	$216,600	$8.01	High	Reject
CI Indoor	Low-volume toilets	650,623	Med	$12,415	$1.91	Med	Accept*
	HET toilets	385,843	Med	$10,268	$2.66	Med	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Waterless urinals	489,847	Med	$8,982	$1.83	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Air-cooled ice machines	1,063,084	Med	$3,037	$0.29	Low	Accept*
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
	Hotel bedding and towel message	170,895	Med	$0	$0.00	Low	Accept*
CI Outdoor	Audits for automatic irrigation	1,612,800	Med	$264,470	$16.40	High	Reject
	Audits for manual irrigation	1,036,800	Med	$259,480	$25.03	High	Reject
	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Low water use plants guide book	92,160	Low	$82	$0.09	Low	Reject
	Less Lawn	92,160	Low	$0	$0.00	Low	Reject
	Annual Total Water Savings for All	117,297,704	Total All Cost	$3,150,304	Annual All Cost	$315,030	
	Annual Total Water Savings for Accept + Accept*	102,922,225	Total A + A* Cost	$1,431,593	Annual A + A* Cost	$143,159	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	59,313,459	Total A* Cost	$1,205,281	Annual A* Cost	$120,528	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

All the proposed packages include the same demographics, assumed participation rates, and assumed eligible customers (Appendix C). The differences between the packages are the measures chosen to be included in the City's program, with the exception of Package D, which also limits the number of measures per customer.

The evaluation of the four alternative packages summarizes the water savings and cost, Table 3-8. Additional combinations of the accepted measures are possible, as well as having rebates at a first come, first serve basis as funding allows.

Table 3-8 - City of Moscow Conservation Package Comparison				
	Package A	**Package B**	**Package C**	**Package D**
Annual Water Savings at Full Implementation of Program*	43,608,766	67,584,632	87,478,357	69,827,221
Reduction in Year 2021 Demand (Planning Period 2012-2021)	4.6%	7.1%	9.1%	7.3%
Achieve PBAC Goal	No	No	Yes	No
Annual Cost^	$22,631	$70,150	$126,823	$82,006
Total Cost~	$226,312	$701,497	$1,268,226	$820,060

Notes:
*Annual water savings once all measures are implemented.
^Annual costs vary depending on how plan is phased in, but assumed phased in evenly over planning period.
~Direct cost, not including staff, advertising, and distribution.

8.1 Package A - Existing Program

The City of Moscow has an existing conservation program. The measures included in the Existing Program have passed the screening process (Section 3.5). Since the City has an expansive existing program, it is important to evaluate the minimalistic and therefore most economical package, which is the Existing Program. Below is a look at keeping the program as is, with no additional measures, if the City does not do anything more than what the City is already doing. The existing conservation budget also includes the Public Information and Education, which is considered an incentive. The table below, Table Package A, lists the measures already in place for the City.

Table Package A - City of Moscow Existing Conservation Measures, No Additional Meaures							
		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
CI Indoor	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
CI Outdoor	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

8.2 Package B - Additional Measures#

This approach is Package A plus additional measures which were chosen based on popularity with other city conservation efforts and inquiries within the City of Moscow. The additional measures that were chosen are:

Single Family, Multi-Family - $50.00 toilet rebate for a 1.6 gpf toilet and a free giveaway low water use plants guide book. The toilet rebate is based on 2.25 toilet rebates allowed per household for Single Family, and 1.25 toilet rebates allowed per Multi-Family unit (based on a 10 unit national average).
Commercial - $50.00 toilet rebate for a 1.6 gpf toilet and $50.00 rebate for low volume urinals. The toilet rebate is based on 4 allowed toilet rebates and 1.5 urinal rebates per participating commercial customer.

The table below, Table Package B lists the measures already in place for the City; all those in Package A with the additional measures added. The table includes the total cost to the City with the assumed number of residents that are eligible and how many will participate. The annual cost is assuming that those eligible and participating would be collecting rebates over the planning period of ten years.

Table Package B - City of Moscow Existing Conservation Measures, Additional Meaures							
		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Low-volume toilets - 1.6gpf	11,434,220	High	$298,185	$2.61	Med	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	9,917,929	High	$143,691	$1.45	Low	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
CI Indoor	Low-volume toilets	650,623	Med	$12,415	$1.91	Med	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
CI Outdoor	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Annual Total Water Savings for Accept + Accept*	67,584,632	Total A + A* Cost	$701,497	Annual A + A* Cost	$70,150	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	23,975,867	Total A* Cost	$475,185	Annual A* Cost	$47,519	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

8.3 Package C - Additional Measures Expanded

This approach is Package B plus the additional measure of the $125.00 rebate to those who chose to replace a pre-1994 toilet with a High Efficiency Toilet (HET), chosen based on popularity with other city conservation efforts and inquiries within the City of Moscow. The additional measures that were chosen are:

Single Family, Multi-Family - $50.00 toilet rebate for a 1.6 gpf toilet, $125.00 HET toilet rebate, and free giveaway low water use plants guide book. The toilet rebate is based on a 2.25 toilet rebates per household for Single Family, and 1.25 toilet rebates per Multi-Family unit (based on a 10 unit national average).

Commercial - $50.00 toilet rebate for a 1.6 gpf toilet, $125.00 HET toilet rebate, and $50.00 rebate for low volume urinals. The toilet rebate is based on 4 toilet rebates and 1.5 urinal rebates per participating commercial customer.

The table below, Table Package C lists the measures already in place for the City, lists all those in Package B with the additional HET toilet rebate. The table includes the total cost to the City with the assumed number of residents that are eligible and how many will participate. The annual cost is assuming that those eligible and participating would be collecting rebates over the planning period of ten years.

Table Package C - City of Moscow Existing Conservation Measures, Additional Meaures Expanded							
		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Low-volume toilets - 1.6gpf	11,434,220	High	$298,185	$2.61	Med	Accept*
	HET toilets - 1.0gpf	10,182,815	High	$368,821	$3.62	High	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	9,917,929	High	$143,691	$1.45	Low	Accept*
	HET toilets - 1.0gpf	9,325,067	High	$187,641	$2.01	Med	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
CI Indoor	Low-volume toilets	650,623	Med	$12,415	$1.91	Med	Accept*
	HET toilets	385,843	Med	$10,268	$2.66	Med	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
CI Outdoor	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Annual Total Water Savings for Accept + Accept*	87,478,357	Total A + A* Cost	$1,268,226	Annual A + A* Cost	$126,823	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	43,869,591	Total A* Cost	$1,041,914	Annual A* Cost	$104,191	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

8.4 Package D – Additional Measures Limited

This approach is Package C with limited rebates.

The table below, Table Package D lists the measures already in place for the City, lists all those in Package C with the limited amount of rebates allowed per household or customer. The table includes the total cost to the City with the assumed number of residents that are eligible and how many will participate. The annual cost is assuming that those eligible and participating would be collecting rebates over the planning period of ten years.

Table Package D - City of Moscow Existing Conservation Measures, Additional Meaures Limited							
		Annual Water Savings (excluding savings from free riders)		Costs (excluding savings from free riders)			Results of Screening Relative Rankings for Savings and Cost
Customer Class	Conservation Measure	gpy	Ranking	Total Cost Over Plan	Dollar per 1000 gals Over Plan	Ranking	
SF Indoor	Low-volume toilets - 1.6gpf	5,081,876	High	$132,527	$1.16	Low	Accept*
	HET toilets - 1.0gpf	4,525,696	Med	$163,920	$1.61	Low	Accept*
	Toilet-leak detection and repair	1,448,090	Med	$551	$0.04	Low	Accept
	Toilet-tank displacement devices	2,848,084	Med	$5,444	$0.19	Low	Accept
	Decrease toilet flushes	2,403,216	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,662,976	Med	$7,676	$0.29	Low	Accept
	Decreased shower use	1,142,017	Med	$16,962	$1.49	Low	Accept
	Faucet aerators-bathroom	3,156,120	Med	$1,478	$0.05	Low	Accept
	Faucet aerators-kitchen	887,659	Med	$2,502	$0.28	Low	Accept
	Decreased faucet use	1,401,567	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	883,104	Med	$0	$0.00	Low	Accept
SF Outdoor	Audits for automatic irrigation	5,472,000	High	$102,547	$1.87	Low	Accept
	Outdoor device giveaways	168,825	Med	$22,591	$13.38	High	Accept
	Low water use plants guide book	645,914	Med	$1,056	$0.16	Low	Accept*
	Less Lawn	645,914	Med	$0	$0.00	Low	Accept
MF Indoor	Low-volume toilets - 1.6gpf	7,934,343	High	$114,953	$1.16	Low	Accept*
	HET toilets - 1.0gpf	6,216,711	High	$150,113	$1.61	Low	Accept*
	Toilet-leak detection and repair	1,305,579	Med	$276	$0.02	Low	Accept
	Toilet-tank displacement devices	2,470,400	Med	$2,623	$0.11	Low	Accept
	Decrease toilet flushes	2,266,968	Med	$0	$0.00	Low	Accept
	Low-flow showerheads	2,577,247	Med	$4,952	$0.19	Low	Accept
	Decreased shower use	1,105,252	Med	$10,944	$0.99	Low	Accept
	Faucet aerators-bathroom	3,054,515	Med	$795	$0.03	Low	Accept
	Faucet aerators-kitchen	859,082	Med	$2,421	$0.28	Low	Accept
	Decreased faucet use	1,356,446	Med	$0	$0.00	Low	Accept
	Eliminate partial clothes wash loads	272,424	Med	$0	$0.00	Low	Accept
MF Outdoor	Outdoor device giveaways	168,825	Med	$19,131	$11.33	High	Accept
	Low water use plants guide book	184,623	Med	$1,215	$0.66	Low	Accept*
	Less Lawn	184,623	Med	$0	$0.00	Low	Accept
CI Indoor	Low-volume toilets	325,311	Med	$6,208	$0.95	Low	Accept*
	HET toilets	161,424	Med	$5,134	$1.33	Low	Accept*
	Low-volume urinals	1,142,557	Med	$18,623	$1.63	Low	Accept*
	Toilet-leak detection and repair	316,019	Med	$34	$0.01	Low	Accept
	Toilet-tank displacement devices	366,204	Med	$340	$0.09	Low	Accept
	Low-flow showerheads	876,693	Med	$20,847	$2.38	Med	Accept
	Faucet aerators-bathroom	2,931,782	Med	$392	$0.01	Low	Accept
	Efficient restaurant spray heads	208,311	Med	$1,698	$0.81	Low	Accept
CI Outdoor	Outdoor device giveaways	168,825	Med	$2,108	$1.25	Low	Accept
	Annual Total Water Savings for Accept + Accept*	69,827,221	Total A + A* Cost	$820,060	Annual A + A* Cost	$82,006	
	Annual Total Water Savings for Accept (Existing)	43,608,766	Total A Cost	$226,312	Annual A Cost	$22,631	
	Annual Total Water Savings for Accepted* (New)	26,218,456	Total A* Cost	$593,747	Annual A* Cost	$59,375	

Cost are direct Cost to City, not including staff, marketing, and distribution costs.
Already Implemented Measures
*Not Already Implemented Measures
SF Outdoor device giveaways accepted because program supports Water Conservation Ordinance.

Single Family, Multi-Family - $50.00 toilet rebate for a 1.6 gpf toilet and free giveaway low water use plants guide book. The toilet rebate is based on a limit of 1 person per household for Single Family, and limit of 1 rebate per Multi-Family unit (based on a 10 unit national average).
Commercial - $50.00 toilet rebate for a 1.6 gpf toilet, $125.00 HET toilet rebate, and $50.00 rebate for low volume urinals. The toilet rebate is based on a limit of 2 rebates for toilets and urinals remaining the same at 1.5 rebates per participating commercial customer. The detailed comparison for the rebates for Package B, C, and D are listed below:

Package B, and C all include the toilet rebate program that includes (participate rates from Appendix C):

1. 2.25 toilet rebates at $50.00 for 1.6 gpf toilets for each single family household with a 75% participation rate is 2,651 households.
2. 2.25 toilet rebates at $125.00 for HET toilets for each single family household with a 25% participation rate is 1,311 households.
3. 1.25 toilet rebates at $50.00 for 1.6 gpf toilets for each multi-family household with a 75% participation rate is 2,299 per multi-family household.

4. 1.25 toilet rebates at $125.00 gpf toilet rebates for each multi-family household with a 25% participation rate is 1,201 per multi-family household.
5. 4 toilet rebates at $50.00 for 1.6 gpf toilets for commercial with a 50% participation rate is 62 commercial customers.
6. 4 toilet rebates at $125.00 for gpf toilets for commercial with a 10% participation rate is 21 commercial customers.

Package D reduces the number of allowed rebates as follows:

1. 1 toilet rebate at $50.00 for 1.6 gpf toilet for each single family household with a 75% participation rate is 2,651 households.
2. 1 toilet rebate at $125.00 for HET toilet for each single family household with a 25% participation rate is 1,311 households.
3. 1 toilet rebate at $50.00 for 1.6 gpf toilets for each multi-family household with a 75% participation rate is 2,299 per multi-family household.
4. 1 toilet rebate at $125.00 for HET toilet for each multi-family household with a 25% participation rate is 1,201 per multi-family household.
5. 2 toilet rebates at $50.00 for 1.6 gpf toilets for commercial with a 50% participation rate is 62 commercial customers.
6. 2 toilet rebates at $125.00 for HET toilets for commercial with a 10% participation rate is 21 commercial customers.

Appendix A
City of Moscow's Current and Historical Conservation Efforts

1.0 General Information

Water conservation involves a variety of methods and devices to reduce water consumption. The City of Moscow has implemented some water conservation measures in the past. The following data is available and has been compiled:

- Conservation water savings for 2007 based on devices distributed by the City and prepared by Nichole Baker of the City of Moscow Water Department.
- Conservation budget item in the City's Fiscal Year 2007 Budget.
- Water Conservation Activities summarizing City of Moscow Water Conservation History.
- Conservation History by Date.

2.0 Previous Conservation Activities

The City has undertaken a number of water conservation related activities in the past. These include planning activities within the Water Department and in conjunction with the Palouse Clearwater Environmental Institute specified via contract. In the past, the City Sustainability Commission has also worked with the Water Department to meet conservation goals. The distribution of water savings devices and educational incentives has also been included in the City's water conservation efforts.

In 2003, the Water Department hired the consultants at EES in association with JUB Engineers to produce the City of Moscow Water Conservation Plan of April 9, 2004. That plan suggested several different conservation package options and is a reference for this report.

Table 1, City of Moscow Conservation History by Date, data was collected from the following sources:

- Tom Scallorn, Moscow Water Department
- Gary Smith, Moscow Water Department
- Nichole Baker, Moscow Water Department
- 2005, 2006, 2007 Distribution Expenditures
- PCEI Invoice October 1, 2006 – March 31, 2007
- History files from 2005 and 2007
- Water Conservation Activities Report, 11/18/2003
- Conservation Summary City of Moscow, 3/6/2007

Coordinated conservation measures began in the City as early as 1997. Efforts have been concentrated in data gathering and distribution of educational information and conservation devices to the public. Table 1 outlines various water conservation related activities completed by the City of Moscow through 2007.

Table 1 City of Moscow Conservation History by Date	
Date	Conservation History By Date
1970-current	Supply the U of I with Waste Water Treatment Plant effluent water for parks and lawns.
1992-current	Provide pumping data to PBAC.
4/16/1997	Start distribution of conservation devices.
5/22/1997	Sealed an old abandoned well on Taylor Ave. to protect aquifer from contamination.
10/6/1997	Meters for Wells No. 2 and 3 calibrated at Sparling Instruments, 10/20/1997.
10/15/1997	Meter tubes were pulled and cleaned (iron buildup causes high readings).
10/20/1997	New meter tube for Well No. 2.
1997	Started program to recalibrate flow meters every five years.
2/2/1998	Installed poly pipe into Well No. 2 for new Drexelbrook static level measurement (more accurate air measurement).
5/6/1998	Expand conservation giveaway program.
5/26/1998	Well No. 8 control water no longer dumps into Well No. 7 (plugged).
1/29/1999	Meters for Wells No. 8 and 9 were sent to Sparling for calibration.
5/4/1999	Conservation education program implemented.
10/22/1999	Checked Well No. 2 for iron buildup on the impeller.
4/17/2001	Cheyanne Largato started as part-time conservation employee.
5/9/2001	Water Week Open House implemented for annual event.
2001-current	Participated with University of Idaho Arboretum to install ¼ acre demonstration garden for low water use landscaping.
2001-current	Began including conservation information on the Consumer Confidence Report for July mailing.
3/29/2002	Planted test plots for tuff grass at the Waste Water Treatment Plant.
7/19/2002	Expansion of device giveaway program implemented.
7/30/2002	Aquifer test.
10/1/2002	Mark Cook and Mike Dimmick did an aquifer demonstration for PCEI on White Ave.
11/21/2002	Provided aquifer model for a Water Forum at the 1912 building.
6/2003	City Council implemented a voluntary water time from 6 p.m. to 9 a.m.
9/30/2003	Cleaned the iron from all well meters and tubes to determine the effects of the iron buildup.
11/17/2003	Wrote history of conservation.
11/18/2003	Water Conservation Activities report written.
11/19/2003	Mike Dimmick writes a report on device water savings.
2003	Customer survey on conservation sent to customers.
2003	Metered city parks and buildings and started tracking non-revenue water.

2003	Conservation display board with devices at City Hall billing area.
2003	3-year Water Conservation Plan prompted by the City Council.
4/1/2004	Spalding meter calibration for Well No. 2.
4/9/2004	EES Water Conservation Plan for City of Moscow completed.
5/2004	Water Matters newsletter publication impletmented.
5/17/2004	Water Conservation Ordinance # 2004-27 passed by the City Council.
5/17/2004	Water Waste Resolution # 2004-12 passed by the City Council.
9/30/2004	Gary Smith writes a Standard Operating Procedure for meter cleaning to include the routine meter cleaning schedule.
10/2004	Water Matters Newsletter sent to customers.
11/23/2004	Water Department assists with the digging and preparation of an old well on private property (owned by Chuck Bond) for a PBAC test well.
2004	Water rate study implemented.
2/28/2005	Proposal from Phase II of Water Department's PIE program released.
3/14/2005	Conservation Channel 13 advertisements begin.
3/15/2005	Ordinance and devices flyer distributed throughout town.
3/27/2005	Radio advertising regarding Water Conservation Ordinance begins.
3/30/2005	Internet conservation advertisement implemented.
4/3/2005	Certified Landscape Irrigation Auditor program implementation.
4/14/2005	Christy Schwartz, replacement Water Conservation Specialist start date.
5/23/2005	Bus poster advertising for water conservation ordinance and devices.
6/2/2005	Rate design presentation to City Council.
7/9/2005	Booth event program implementation.
10/2005	Tiered rate billing structure started.
10/6/2005	Palouse Basin Water Summit sponsorship implementation.
10/17/2005	Informational video made for Water Department.
12/5/2005	Conservation message added to utility billing.
12/16/2005	PCEI contract implementation.
2005 - 2011	Xeriscape flower bed at Water Department planted.
5/2/2006	Workshop program implemented.
9/2006	Lesson plan program implemented.
10/2006	Divers used to clean Vista and SE reservoir.
3/6/2007	Conservation Summary for City of Moscow written by Tom Scallorn.
3/26/2007	Nichole Baker, replacement Water Conservation Specialist start date.

3.0 Conservation Budget

The City of Moscow has identified conservation-related items in its Fiscal Year 2008 Budget, some of which are direct, while others are indirect. These are shown in Table 2.

Table 2
City of Moscow Fiscal Year 2008 Conservation-Related Budget Items

Item	**Budget Amount ($)**
Full-Time Water Conservation Staff	37,440
Appliance Rebate	20,000
Public Information and Education Contract	20,000
Devices	10,000
Xeriscape University of Idaho	1,500
Education Material	3,000
Website Development	1,000
Advertising	5,000
Printing and Postage	18,110
Travel and Meetings	750
Total	**$116,800**

4.0 Water Saved from Previous Conservation Activities

4.1 Indoor Device Water Savings

The City of Moscow Water Department prepared an estimate of the water saved based on conservation devices distributed to the public in 2007. The assumptions for the data are based on 2002 census data stating there are 2.58 people per household (HH) and based on 90% utilization of the devices. This participation is assumed to be high because the individual had to pick up the devices at the Water Department; therefore it is assumed if the effort was made, the installation would follow. Please see Table 3 for the estimated water saved by indoor conservation devices distributed by the City in 2007.

Table 3
Residential Estimated Water Saved by Indoor Conservation Devices Distributed in 2007

Conservation Device	**# HH that Received Conservation Devices**	**Total Water Savings per Year (gallons)**
Showerhead SF	147	1,730,047
Showerhead MF	125	1,686,712
Shower Timer SF, MF	978	547,064
Dye Tablets SF, MF	127	245,020
Toilet Tank Bags	74	270,817
Faucet Aerators SF	138	2,372,707

Faucet Aerators MF	82	1,702,518
Total	**1671**	**8,554,885**

SF=Single Family, MF=Multi-family, HH=Household, gpy=gallon per year
Assumptions: Source, if not specified, Amy Vickers & Associates
2.58 Persons per occupied U.S. household per 2002 U.S. Census Bureau, Current Population Reports, P20-547, (infoplease.com)
Toilet leakage is somewhat less than the average 9.5 gpcd reported in 1999 REUS with 25% of US homes having toilet leaks.
Showerheads 2.5 flow rates based on 80 psi is equivalent to a showerhead with a flow rate of 2.2 gpm at 60 psi
The average residential indoor water-use rate for showering is 8.2 min. per shower; however, on a daily basis, 11.6 gallons per capita is used for showering at an average flow rate of 2.2gpm, or 5.3 minutes per capita per day for showering. Shower timers distributed are 5 minutes.
The average faucet use per person per day is 8.1 min/day is 2.2 gpm at 60 psi
The national average number of flushes per person per day is 5.1.
City of Moscow Average is 60 psi per Tom Scallorn 12/4/07
Average Water Use Assumptions based on National Averages:
8.5 gpcd for toilet leaks
1994-present toilets 1.6 gpf
1980-1994 toilets 4.0 gpf
1950-1960 toilets 5 gpf
Pre-1950 toilets 7 gpf
1994-present showerhead 2.5 gpm
1980-1994 showerhead 3.25 gpm
Pre-1980 showerhead 6.5 gpm
1994-present aerator 2.5 gpm
1980-1997 aerator 2.75 gpm
Pre-1980 aerator 5 gpm

Showerhead: The showerhead savings includes all Moscow households that received showerheads, handheld showerheads, and/or shower shut-off valves in 2007. The number of people per residential household or per multi-family unit was calculated according to the information turned in by those that received the devices. According to national averages, residential indoor shower frequency is 8.2 min. per shower; however, on a daily basis, 11.6 gallons per capita is used for showering at an average flow rate of 2.2 gpm, or 5.3 minutes per capita per day for showering. The Moscow City system has an average psi of 60.

Shower Timer (5 min): 0.3 minutes were taken of the national average shower time of 5.3 minutes with the flow rate of 2.2 gpm at 60 psi, per capita per day. 1069 shower timers were distributed, but an estimated 976 households received the timers based on the information turned in by those that received the devices. In addition, it was assumed that for each visitor who received a shower timer at a Moscow public event, they represented a household in the Moscow area.

Dye Tablets: Based on a national average that 25% of all U.S. households have a leaking toilet and that toilet leaks account for the majority of the 9.5 gpcd indoor leaks. For the Moscow water savings, an 8.5 gpcd was used for water loss due to toilet leaks, assuming that 8.5 gpcd was a fair representation of the national average 9.5 gpcd majority.

Toilet Tank Bags: The toilet tank banks displace up to 0.8 gallons of water per flush. The number of people per residential household or per multi-family unit was calculated according to the information turned in by those that received the devices. The national average is 5.1 flushes per capita per day.

Faucet Aerators: Both the kitchen and the bathroom aerators are included in the estimate for the single family and multi-family residential water savings for 2007. The number of people per residential household or per multi-family unit was calculated according to the information turned in by those that received the devices. According to national averages, residential indoor faucet frequency is 8.1 min. per day at an average flow rate of 2.2 gpm at 60 psi. The Moscow City system has an average psi of 60.

4.2 Outdoor Device Water Savings

The peak irrigation season for Moscow is the months of May through October. These dates were chosen because that is when water production goes up and can more than double during the hot, dry months. The savings estimates for outdoor devices are based on units given out and not on households that received the items. It is done per device because that is the data available for gallons saved. The calculations are based on the average water use during the months of May through October for 2007. This average was subtracted from the average use of the months September through April in order to account for irrigation use. Based on this data, an average of 230 million gallons of water was attributed to irrigation for the months of May through October, with 5409 meters in 2007. This participation is assumed to be high because the individual had to pick up the devices at the Water Department. Therefore, it is assumed that if the effort was made, installation and use would follow.

Table 4
Residential Estimated Water Saved by Outdoor Conservation Devices Distributed in 2007

Conservation Device	# of Conservation Devices Distributed	Total Water Savings per Year (gallons)
Automatic Rain Shut-off	14	6,699
Water Hose Timers	378	180,884
Automatic Shut-off Nozzle	256	unknown
Total	**648**	**187,583**

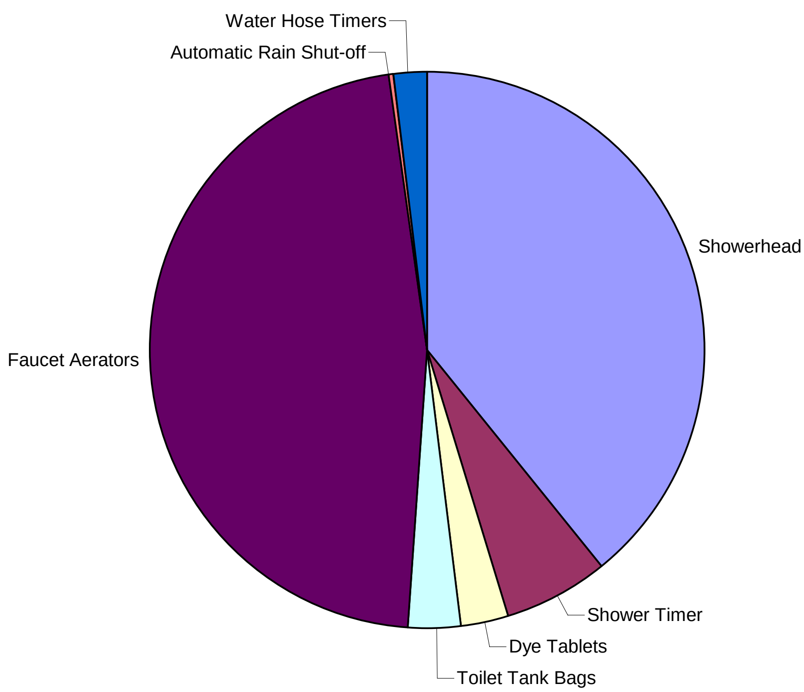
gpy=gallon per year
Assumptions: Source EES 2004 WCP, City of Plant City Florida Study
Based on a 90% participation rate
Based on the irrigation peak months of pumping May – October
7089 gallons per customer (meter) per irrigation month, of which 90% participation was calculated.

Automatic Rain Shutoff for Auto Sprinkler System: National average for this type of device is 7.5% of total irrigation.

Water Hose Timers for Irrigation: National average for this type of device is 7.5% of total irrigation.

Automatic Shut-off Nozzles: This device is given out in order to allow individuals the option of 1) supplemental watering, 2) irrigating at times not allowed by other forms of irrigation as per the Ordinance Irrigation Season, and 3) a way to save water by preventing water from running straight from a hose. A study indicates there is a 5 gpm savings when an automatic shut-off nozzle is used as compared to it not being used. However, it is difficult to calculate how much irrigation is used by customers by way of automatic shut-off nozzles compared to a hose with an open end.

Exhibit 5 - 2007 Water Savings by Device



Appendix B
City of Moscow's List of Measures and Incentives

Appendix B1 Evaluated Conservation Measures for 2010 WCP				
No.	Measure	SF/MF	CI	PF
1	Low-volume toilets	X	X	X
2	HET toilets	X	X	X
3	Low-volume urinals		X	X
4	Waterless urinals		X	X
5	Toilet-leak detection and repair	X	X	
6	Toilet-tank displacement devices	X	X	
7	Decreased toilet flushes	X		
8	Low-flow showerheads	X	X	
9	Decreased shower use (5-minute timer)	X		
10	Instant Hot Water Valve	X		
11	Faucet aerators-bathroom	X	X	X
12	Faucet aerators-kitchen	X		
13	Decreased faucet use	X		
14	Efficient clothes washers	X		
15	Eliminate partial clothes washer loads	X		
16	Air-cooled ice machines		X	
17	Audits for automatic irrigation	X	X	X
18	Audits for manual irrigation	X	X	X
19	Outdoor device giveaways	X	X	
20	Low water use plants guide book	X	X	
21	50 gallon Rain Barrel Catchment	X		
22	Less Lawn	X	X	X
23	Efficient restaurant spray heads		X	
24	Hotel bedding and towel message		X	
25	Infrastructure Leak Detection and Repair			X
26	Flushing Water Use Reductions			X
27	Backwashing Water Use Reduction			X
28	Flow Meter Maintenance			X
29	Sub-Meter Multi-Family Households	X		

SF=Single Family, MF=Multi Family, CI=Commercial/Institutional, PF=Public Facilities, IP =Industrial Professionals

Appendix B2 Evaluated Conservation Incentives for 2010 WCP					
No	Incentive	SF/MF	CI	PF	IP
1	PIE: Brochures	X			
2	PIE: Flyers	X			
3	PIE: Bill Messages	X			
4	PIE: Consumption Information to Customer	X			
5	PIE: City Website	X			
6	PIE: Newsletter	X			
7	PIE: Bus Ads	X			
8	PIE: Billboards	X			
9	PIE: Radio Ads	X			
10	PIE: Television Ads	X			
11	PIE: School Programs	X			
12	PIE: Community Events	X			
13	PIE: Tours of Facilities	X			
14	PIE: Press Releases	X			
15	PIE: Demonstration Wisescape Gardens			X	
16	PIE: Lawn Watering Guide	X			
17	PIE: Landscape Guide Book	X			
18	PIE: Wisescape Program-Award Program	X	X	X	X
19	PIE: Mailings	X	X		
20	PIE: Door Hangers	X	X		
21	PIE: Outreach to home and garden centers	X	X		
22	PIE: Personal Contact	X	X		
23	Financial: Free Devices	X	X	X	
24	Financial: Free Irrigation Audits	X	X	X	
25	Financial: Free Landscape Guide Booklet	X	X	X	X
26	Financial: Rebate Program – Toilet	X	X		
27	Financial: Rebate Program – Urinals		X		
28	Financial: Rebate Program – Hot Water Valve	X			
29	Financial: Rebate Program – Clothes Washer	X	X		
30	Financial: Rebate Program – Cooling System		X		
31	Financial: Rebate Program – Ice Machines		X		
32	Financial: Rebate Program – Rain Barrel	X	X		
33	Financial: Tiered Rate	X*			
34	Financial: Tiered Rate Expansion	X**	X		
35	Financial: Sub-Meter Program	X**			
36	Financial: Efficient Parks Irrigation System			X	
37	Financial: UI Effluent Program			X	
38	Regulatory: Ordinance	X	X	X	X
39	Regulatory: Resolution	X	X	X	X
40	Regulatory: New Development Reduce Lawn	X	X	X	X
41	Regulatory: New Development Water Use				X
42	Regulatory: New Development Top Soil				X
43	Regulatory: Certified Irrigator				X
44	Regulatory: New Home Owners Program				X
45	Regulatory: Add to Metered Routes			X	

SF=Single Family, MF=Multi Family, CI=Commercial/Institutional, PF=Public Facilities, IP=Industry Professionals
PIE=Public Information and Education
*All Single Family residential and some Multi Family residents are billed on the tiered rate
**Multi Family only

Appendix C
Screening

- Demographics
- Assumptions
- Participation
- Water Savings
- Cost

Demographics

Parameter	First Planning Year	Last Planning Year	Change
Year	2012	2021	10
Population	23,606	26,800	3,194
SF Households	5,437	6,061	624
MF Household	4,716	5,511	795
Commercial Accounts	955	998	43
Person Per HH	2.25	2.25	0
Employees per Commercial	14	14	0
Employment	7,756	9,002	1,246

Notes:

HH = Household

Population from 2010 HDR Water Comp Plan data with 1.42% assumed growth

SF HH includes Duplexes

MF HH = number of MF accounts multiplied by the National Average of 10 units per MF account

Commercial Accounts include Churches and Schools

Employment is an assumption based on fixed data from 2004 EES Plan

National Average of 2.25 persons per HH

Population Growth Projections Based on HDR Water Comp Plan

Year	2007 Census Data	Served by Moscow	SF HH Served	MF HH Served	CI Acct Served
2007	24,329	22,383			
2008		22,312	5,184	4,394	938
2009		22,629	5,245	4,472	942
2010		22,950	5,309	4,553	946
2011		23,276	5,372	4,634	951
2012		**23,606**	**5,437**	**4,716**	**955**
2013		23,942	5,503	4,799	959
2014		24,282	5,569	4,884	964
2015		24,626	5,636	4,970	968
2016		24,976	5,705	5,057	973
2017		25,331	5,775	5,145	978
2018		25,690	5,845	5,235	983
2019		26,055	5,916	5,326	988
2020		26,425	5,988	5,417	993
End Planning Year: **2021**		**26,800**	**6,061**	**5,511**	**998**

Assumed Growth of 1.42%, Source HDR Water Comp Plan

Served by Moscow = 8% decrease due to on campus living.

SF HH = SF + Duplexes

MF HH + Apt = Mobile Homes

CI Acct = Commercial

Assumptions of Eligibility

Percent of HH with the Following Feature	Eligible SF HH Exisiting	Eligible SF HH Future	Eligible MF HH Exisiting	Eligible MF HH Future	Eligible CI Exisiting	Eligible CI Future
Toilet - Tank Style	100%	100%	100%	100%	20%	20%
Toilet - Tank with leaks	25%	10%	25%	10%	5%	5%
Urinals	0%	0%	0%	0%	80%	80%
Showerhead	100%	100%	100%	100%	40%	0%
Faucet	100%	100%	100%	100%	100%	100%
Clotheswasher	90%	100%	50%	90%	2%	2%
In-ground Irrigation	25%	35%	45%	60%	50%	50%
Not In-ground Irrigation	75%	65%	55%	40%	50%	50%
New Landscapes	5%	100%	5%	100%	5%	50%
Existing Landscapes	100%	N/A	100%	N/A	100%	100%
Irrigated Landscaping	80%	80%	70%	70%	50%	50%
Water Heaters	100%	100%	100%	100%	100%	100%
Toilet - HET Style	100%	100%	100%	100%	20%	100%
Ice Machine	N/A	N/A	N/A	N/A	10%	10%
Restaurant Dish Rinse Nozzle	N/A	N/A	N/A	N/A	10%	10%
Single Meter, Many Users	N/A	N/A	100%	100%	100%	100%

Notes:
SF = Single Family
MF = Multi Family
HH = Household
CI = Commercial
Source from 2004 EES Plan

CI Hotels in Moscow ID (per phone call 4/4/09)	Hotel SH	CI + Hotel SH	% of CI acct	# Restaurants	% Restaurants
University Inn	173	1,413	33	56	6
Palouse Inn	100				
Super 8	60				
Royal Motor Inn	20				
La Quinta	76				
Hillcrest	35	Mean Unit/hotel			
Total	464	77			

Appendix C Continued - City of Moscow Potential Conservation Participation Rate

Customer Class	Conservation Measure	Target Group	Existing (E) or Future (F) Customers	Free Riders	Existing Eligible	Existing Not Already Implemented	Existing Target	Future Eligible	Future Target	Total Target	Participation Rate	Total With Free Riders	Total W/out Free Riders
SF Indoor	Low-volume toilets - 1.6gpf	SF HH w/out efficient toilet	E	50%	100%	65%	3,534	0%	0	3,534	75%	2,651	1,325
	HET toilets - 20% more savings	SF HH w/out HET efficient toilet	EF	25%	100%	85%	4,621	100%	624	5,245	25%	1,311	984
	Toilet-leak detection and repair	SF HH w/ leaks	EF	0%	25%	50%	680	10%	62	742	25%	186	186
	Toilet-tank displacement devices	SF HH w/ old fixture and w/o device	E	50%	100%	50%	2,719	0%	0	2,719	50%	1,359	680
	Decrease toilet flushes	SF HH	EF	0%	100%	50%	2,719	100%	624	3,343	25%	836	836
	Low-flow showerheads	SF HH w/ old fixtures	EF	5%	100%	35%	1,903	100%	624	2,527	50%	1,263	1,200
	Decreased shower use (5-minute timer)	SF HH	EF	0%	100%	35%	1,903	100%	624	2,527	25%	632	632
	Instant Hot Water Valve	SF HH	EF	10%	100%	99%	5,383	100%	624	6,007	10%	601	541
	Faucet aerators-bathroom	SF HH w/ old fixtures	EF	5%	100%	35%	1,903	100%	624	2,527	50%	1,263	1,200
	Faucet aerators-kitchen	SF HH w/ old fixtures	EF	5%	100%	35%	1,903	100%	624	2,527	50%	1,263	1,200
	Decreased faucet use	SF HH	EF	0%	100%	35%	1,903	100%	624	2,527	25%	632	632
	Efficient clothes washers	SF HH w/ non-efficient model	EF	10%	100%	99%	5,383	100%	624	6,007	10%	601	541
	Eliminate partial clothes washer loads	SF HH w/ closewashers	EF	0%	90%	50%	2,447	100%	624	3,071	25%	768	768
SF Outdoor	Audits for automatic irrigation	SF HH w/ in-ground systems	EF	10%	25%	100%	1,359	35%	218	1,578	25%	394	355
	Audits for manual irrigation	SF HH w/out in-ground systems	EF	10%	75%	100%	4,078	65%	406	4,483	25%	1,121	1,009
	Outdoor device giveaways	SF HH w/ irrigating landscape	EF	10%	80%	35%	1,522	80%	499	2,022	50%	1,011	910
	Low water use plants guide book	SF HH new construction, remodel	EF	0%	5%	100%	272	100%	624	896	10%	90	90
	50 gallon Rain Barrel Catchment	SF HH irrigating landscape	EF	0%	80%	100%	4,350	80%	499	4,849	10%	485	485
	Less Lawn	SF HH new construction, remodel	EF	0%	5%	100%	272	100%	624	896	10%	90	90
MF Indoor	Low-volume toilets - 1.6gpf	MF HH w/out efficient toilet	E	50%	100%	65%	3,065	0%	0	3,065	75%	2,299	1,150
	HET toilets - 20% more savings	MF HH w/out HET efficient toilet	EF	25%	100%	85%	4,009	100%	795	4,804	25%	1,201	901
	Toilet-leak detection and repair	MF HH w/ leaks	EF	0%	25%	50%	590	10%	80	669	25%	167	167
	Toilet-tank displacement devices	MF HH w/ old fixture and w/o device	E	50%	100%	50%	2,358	0%	0	2,358	50%	1,179	590
	Decrease toilet flushes	MF HH	EF	0%	100%	50%	2,358	100%	795	3,153	25%	788	788
	Low-flow showerheads	MF HH w/ old fixtures	EF	5%	100%	35%	1,651	100%	795	2,446	50%	1,223	1,162
	Decreased shower use (5-minute timer)	MF HH	EF	0%	100%	35%	1,651	100%	795	2,446	25%	611	611
	Instant Hot Water Valve	MF HH	EF	10%	100%	99%	4,669	100%	795	5,464	10%	546	492
	Faucet aerators-bathroom	MF HH w/ old fixtures	EF	5%	100%	35%	1,651	100%	795	2,446	50%	1,223	1,162
	Faucet aerators-kitchen	MF HH w/ old fixtures	EF	5%	100%	35%	1,651	100%	795	2,446	50%	1,223	1,162
	Decreased faucet use	MF HH	EF	0%	100%	35%	1,651	100%	795	2,446	25%	611	611
	Efficient clothes washers	MF HH w/ shared non-efficient	EF	10%	50%	99%	2,334	90%	716	3,050	10%	305	274
	Eliminate partial clothes washer loads	MF HH w/ shared closewashers	EF	0%	50%	50%	1,179	90%	716	1,895	25%	474	474
MF Outdoor	Audits for automatic irrigation	MF accounts w/ in-ground systems	EF	10%	45%	100%	2,122	60%	477	2,599	50%	1,300	1,170
	Audits for manual irrigation	MF accounts no in-ground systems	EF	10%	55%	100%	2,594	40%	318	2,912	50%	1,456	1,310
	Outdoor device giveaways	MF account w/ irrigating landscape	EF	10%	70%	35%	1,155	70%	557	1,712	50%	856	770
	Low water use plants guide book	MF accts new construction,remodel	EF	0%	5%	100%	236	100%	795	1,031	10%	103	103
	50 gallon Rain Barrel Catchment	MF accounts irrigating landscape	EF	0%	70%	100%	3,301	70%	557	3,858	10%	386	386
	Less Lawn	MF accts new construction,remodel	EF	0%	5%	100%	236	100%	795	1,031	10%	103	103
	Sub-Meter Multi-Family Households	MF accounts one meter/mult.units	EF	25%	100%	75%	3,537	100%	795	4,332	10%	433	325
CI Indoor	Low-volume toilets	CI accounts w/old toilets	E	50%	20%	65%	124	0%	0	124	50%	62	31
	HET toilets - 20% more savings	CI accounts w/old toilets	EF	25%	20%	85%	162	100%	43	205	10%	21	15
	Low-volume urinals	CI accounts w/old urinals	E	50%	80%	65%	497	0%	0	497	50%	248	124
	Waterless urinals	CI accounts w/ old urinals	EF	50%	80%	100%	764	80%	34	798	10%	80	40
	Toilet-leak detection and repair	CI accounts w/ tank toilets	EF	0%	5%	50%	24	5%	2	26	25%	7	7
	Toilet-tank displacement devices	CI accounts w/ tank toilets	E	50%	20%	50%	96	0%	0	96	50%	48	24
	Low-flow showerheads	CI accounts w/ showers	EF	5%	40%	35%	134	0%	0	134	50%	67	64
	Faucet aerators-bathroom	CI accounts w/ old fixtures	EF	5%	100%	35%	334	100%	43	377	50%	189	179
	Air-cooled ice machines	CI accts w/ water cooled ice mach.	EF	10%	10%	75%	72	10%	4	76	20%	15	14
	Efficient restaurant spray heads	CI accounts w/ non-efficient sprayer	EF	10%	10%	35%	33	10%	4	38	50%	19	17
	Hotel bedding and towel message	CI motel/hotel accounts	EF	50%	40%	50%	191	0%	0	191	50%	96	48
CI Outdoor	Audits for automatic irrigation	CI accounts w/ in-ground systems	EF	10%	50%	100%	478	50%	22	499	50%	250	225
	Audits for manual irrigation	CI accts w/out in-ground systems	EF	10%	50%	100%	478	50%	22	499	50%	250	225
	Outdoor device giveaways	CI w/ irrigation landscape	EF	10%	50%	35%	167	50%	22	189	50%	94	85
	Low water use plants guide book	CI accts new construction,remodel	EF	0%	5%	100%	48	50%	22	69	10%	7	7
	Less Lawn	CI accts new construction,remodel	EF	0%	5%	100%	48	50%	22	69	10%	7	7

Notes:

Eligible = Have the fixture/behanior for the measure, i.e. those with an inefficient toilet

Target = Those that have not already implemented the measure, i.e. those that have a toilet that is not an efficient model

Participating = Those willing to implement the measure, i.e. those with an inefficient toilet, that do not already have one, willing to purchase and efficient one

Calculation of Existing Target based on first year population

Calculations of Future Target based on difference between first and last planning year population

HH = Household

SF=Single Family

MF = Multi Family

CI = Commercial

Source from 2004 EES and assumptions = Free Rider, Eligible, and Not Already Implemented, Participation Rate

Tankless Water Heater percentages = used efficient clothes washer number due to lack of information on participation potential

Exiting or Future = Wheather the measure affects existing or future customers

Eligible percentage based on assumption data

Free riders = those would would implement regardless of program, but still use program resources. City spends but does not gain water savings

CI Hotel based on number of units = one showerhead

Appendix C Continued - City of Moscow Potential Conservation Savings

Customer Class	Conservation Measure	Target Group	gal per capita or employee per day	gal per HH or business per day	gal per HH or business per year	Savings: Annual pgy – W/ free riders (inflated savings)	Annual pgy – Without free riders (true savings)	Season	Days in Effect	Annual gpd – W/ free riders (inflated savings)	Annual gpd – Without free riders (true savings)	Peak Season gpd – W/ free riders (inflated savings)	Peak Season gpd – Without free riders (true savings)	Gallons Per Plan Period – W/ free riders (inflated savings)	Gallons Per Plan Period – Without free riders (true savings)	1,000 Gallons Per Plan Period – W/ free riders (inflated savings)	1,000 Gallons Per Plan Period – Without free riders (true savings)
SF Indoor	Low-volume toilets - 1.6gpf	SF HH w/out efficient toilet	10.5	23.6	8,628	22,868,440	11,434,220	Full Year	365	62,653	31,327	62,653	31,327	228,684,400	114,342,200	228,684	114,342
	HET toilets - 1.0gpf	SF HH w/out HET efficient toilet	12.6	28.4	10,353	13,577,087	10,182,815	Full Year	365	37,197	27,898	37,197	27,898	135,770,867	101,828,151	135,771	101,828
	Toilet-leak detection and repair	SF HH w/ leaks	9.5	21.4	7,806	1,448,090	1,448,090	Full Year	365	3,967	3,967	3,967	3,967	14,480,896	14,480,896	14,481	14,481
	Toilet-tank displacement devices	SF HH w/ old fixture and w/o device	5.1	11.5	4,191	5,696,168	2,848,084	Full Year	365	15,606	7,803	15,606	7,803	56,961,682	28,480,841	56,962	28,481
	Decrease toilet flushes	SF HH	3.5	7.9	2,876	2,403,216	2,403,216	Full Year	365	6,584	6,584	6,584	6,584	24,032,157	24,032,157	24,032	24,032
	Low-flow showerheads	SF HH w/ old fixtures	2.7	6.1	2,219	2,803,133	2,662,976	Full Year	365	7,680	7,296	7,680	7,296	28,031,330	26,629,764	28,031	26,630
	Decreased shower use (5-minute timer)	SF HH	2.2	5.0	1,808	1,142,017	1,142,017	Full Year	365	3,129	3,129	3,129	3,129	11,420,171	11,420,171	11,420	11,420
	Instant Hot Water Valve	SF HH	12.7	28.6	10,436	6,268,273	5,641,446	Full Year	365	17,173	15,456	17,173	15,456	62,682,728	56,414,455	62,683	56,414
	Faucet aerators-bathroom	SF HH w/ old fixtures	3.2	7.2	2,629	3,322,232	3,156,120	Full Year	365	9,102	8,647	9,102	8,647	33,222,317	31,561,201	33,222	31,561
	Faucet aerators-kitchen	SF HH w/ old fixtures	0.9	2.0	740	934,378	887,659	Full Year	365	2,560	2,432	2,560	2,432	9,343,777	8,876,588	9,344	8,877
	Decreased faucet use	SF HH	2.7	6.1	2,219	1,401,567	1,401,567	Full Year	365	3,840	3,840	3,840	3,840	14,015,665	14,015,665	14,016	14,016
	Efficient clothes washers	SF HH w/ non-efficient model	4.4	9.9	3,615	2,171,685	1,954,517	Full Year	365	5,950	5,355	5,950	5,355	21,716,851	19,545,166	21,717	19,545
	Eliminate partial clothes washer loads	SF HH w/ closewashers	1.4	3.2	1,150	883,104	883,104	Full Year	365	2,419	2,419	2,419	2,419	8,831,036	8,831,036	8,831	8,831
SF Outdoor	Audits for automatic irrigation	SF HH w/ in-ground systems	n/a	n/a	n/a	6,080,000	5,472,000	Peak	184	16,658	14,992	33,043	29,739	60,800,000	54,720,000	60,800	54,720
	Audits for manual irrigation	SF HH w/out in-ground systems	n/a	n/a	n/a	4,032,000	3,628,800	Peak	184	11,047	9,942	21,913	19,722	40,320,000	36,288,000	40,320	36,288
	Outdoor device giveaways	SF HH w/ irrigating landscape	n/a	n/a	n/a	187,583	168,825	Peak	184	514	463	1,019	918	1,875,830	1,688,247	1,876	1,688
	Low water use plants guide book	SF HH new construction, remodel	n/a	n/a	n/a	645,914	645,914	Peak	184	1,770	1,770	3,510	3,510	6,459,140	6,459,140	6,459	6,459
	50 gallon Rain Barrel Catchment	SF HH irrigating landscape	n/a	n/a	n/a	11,730	11,730	Peak	184	32	32	64	64	117,300	117,300	117	117
	Less Lawn	SF HH new construction, remodel	n/a	n/a	n/a	645,914	645,914	Peak	184	1,770	1,770	3,510	3,510	6,459,140	6,459,140	6,459	6,459
MF Indoor	Low-volume toilets - 1.6gpf	MF HH w/out efficient toilet	10.5	23.6	8,628	19,835,859	9,917,929	Full Year	365	54,345	27,172	54,345	27,172	198,358,585	99,179,293	198,359	99,179
	HET toilets - 1.0gpf	MF HH w/out HET efficient toilet	12.6	28.4	10,353	12,433,422	9,325,067	Full Year	365	34,064	25,548	34,064	25,548	124,334,221	93,250,666	124,334	93,251
	Toilet-leak detection and repair	MF HH w/ leaks	9.5	21.4	7,806	1,305,579	1,305,579	Full Year	365	3,577	3,577	3,577	3,577	13,055,786	13,055,786	13,056	13,056
	Toilet-tank displacement devices	MF HH w/ old fixture and w/o device	5.1	11.5	4,191	4,940,800	2,470,400	Full Year	365	13,536	6,768	13,536	6,768	49,407,999	24,704,000	49,408	24,704
	Decrease toilet flushes	MF HH	3.5	7.9	2,876	2,266,968	2,266,968	Full Year	365	6,211	6,211	6,211	6,211	22,669,676	22,669,676	22,670	22,670
	Low-flow showerheads	MF HH w/ old fixtures	2.7	6.1	2,219	2,712,892	2,577,247	Full Year	365	7,433	7,061	7,433	7,061	27,128,919	25,772,473	27,129	25,772
	Decreased shower use (5-minute timer)	MF HH	2.2	5.0	1,808	1,105,252	1,105,252	Full Year	365	3,028	3,028	3,028	3,028	11,052,522	11,052,522	11,053	11,053
	Instant Hot Water Valve	MF HH	12.7	28.6	10,436	5,701,839	5,131,655	Full Year	365	15,621	14,059	15,621	14,059	57,018,394	51,316,555	57,018	51,317
	Faucet aerators-bathroom	MF HH w/ old fixtures	3.2	7.2	2,629	3,215,279	3,054,515	Full Year	365	8,809	8,369	8,809	8,369	32,152,792	30,545,153	32,153	30,545
	Faucet aerators-kitchen	MF HH w/ old fixtures	0.9	2.0	740	904,297	859,082	Full Year	365	2,478	2,354	2,478	2,354	9,042,973	8,590,824	9,043	8,591
	Decreased faucet use	MF HH	2.7	6.1	2,219	1,356,446	1,356,446	Full Year	365	3,716	3,716	3,716	3,716	13,564,459	13,564,459	13,564	13,564
	Efficient clothes washers	MF HH w/ shared non-efficient	4.4	9.9	3,615	1,102,692	992,423	Full Year	365	3,021	2,719	3,021	2,719	11,026,925	9,924,232	11,027	9,924
	Eliminate partial clothes washer loads	MF HH w/ shared closewashers	0.7	1.6	575	272,424	272,424	Full Year	365	746	746	746	746	2,724,244	2,724,244	2,724	2,724
MF Outdoor	Audits for automatic irrigation	MF accounts w/ in-ground systems	n/a	n/a	n/a	3,456,000	3,110,400	Peak	184	9,468	8,522	18,783	16,904	34,560,000	31,104,000	34,560	31,104
	Audits for manual irrigation	MF accounts no in-ground systems	n/a	n/a	n/a	2,304,000	2,073,600	Peak	184	6,312	5,681	12,522	11,270	23,040,000	20,736,000	23,040	20,736
	Outdoor device giveaways	MF account w/ irrigating landscape	n/a	n/a	n/a	187,583	168,825	Peak	184	514	463	1,019	918	1,875,830	1,688,247	1,876	1,688
	Low water use plants guide book	MF accts new construction,remodel	n/a	n/a	n/a	184,623	184,623	Peak	184	506	506	1,003	1,003	1,846,230	1,846,230	1,846	1,846
	50 gallon Rain Barrel Catchment	MF accounts irrigating landscape	n/a	n/a	n/a	11,730	11,730	Peak	184	32	32	64	64	117,300	117,300	117	117
	Less Lawn	MF accts new construction,remodel	n/a	n/a	n/a	184,623	184,623	Peak	184	506	506	1,003	1,003	1,846,230	1,846,230	1,846	1,846
	Sub-Meter Multi-Family Households	MF accounts one meter/mult.units	n/a	22.8	8,327	3,607,066	2,705,299	Full Year	365	9,882	7,412	9,882	7,412	36,070,658	27,052,993	36,071	27,053
CI Indoor	Low-volume toilets	CI accounts w/old toilets	4.1	57.4	20,962	1,301,246	650,623	Full Year	365	3,565	1,783	3,565	1,783	13,012,459	6,506,230	13,012	6,506
	HET toilets	CI accounts w/old toilets	4.9	68.6	25,053	514,458	385,843	Full Year	365	1,409	1,057	1,409	1,057	5,144,576	3,858,432	5,145	3,858
	Low-volume urinals	CI accounts w/old urinals	1.8	25.2	9,203	2,285,115	1,142,557	Full Year	365	6,261	3,130	6,261	3,130	22,851,148	11,425,574	22,851	11,426
	Waterless urinals	CI accounts w/ old urinals	2.4	33.6	12,271	979,694	489,847	Full Year	365	2,684	1,342	2,684	1,342	9,796,943	4,898,471	9,797	4,898
	Toilet-leak detection and repair	CI accounts w/ tank toilets	9.5	133.0	48,572	316,019	316,019	Full Year	365	866	866	866	866	3,160,190	3,160,190	3,160	3,160
	Toilet-tank displacement devices	CI accounts w/ tank toilets	3	42.0	15,338	732,409	366,204	Full Year	365	2,007	1,003	2,007	1,003	7,324,086	3,662,043	7,324	3,662
	Low-flow showerheads	CI hotel/motel accounts	2.7	37.8	13,805	922,835	876,693	Full Year	365	2,528	2,402	2,528	2,402	9,228,348	8,766,931	9,228	8,767
	Faucet aerators-bathroom	CI accounts w/ old fixtures	3.2	44.8	16,361	3,086,086	2,931,782	Full Year	365	8,455	8,032	8,455	8,032	30,860,861	29,317,818	30,861	29,318
	Improved cooling system																
	Air-cooled ice machines	CI accts w/ water cooled ice mach.	*n/a	213.0	77,788	1,181,205	1,063,084	Full Year	365	3,236	2,913	3,236	2,913	11,812,047	10,630,842	11,812	10,631
	Efficient restaurant spray heads	CI accounts w/ non-efficient sprayer	2.4	33.6	12,271	231,456	208,311	Full Year	365	634	571	634	571	2,314,565	2,083,108	2,315	2,083
	Hotel bedding and towel message	CI motel/hotel accounts	0.7	9.8	3,579	341,791	170,895	Full Year	365	936	468	936	468	3,417,907	1,708,953	3,418	1,709
CI Outdoor	Audits for automatic irrigation	CI accounts w/ in-ground systems	n/a	n/a	n/a	1,792,000	1,612,800	Peak	184	4,910	4,419	9,739	8,765	17,920,000	16,128,000	17,920	16,128
	Audits for manual irrigation	CI accts w/out in-ground systems	n/a	n/a	n/a	1,152,000	1,036,800	Peak	184	3,156	2,841	6,261	5,635	11,520,000	10,368,000	11,520	10,368
	Outdoor device giveaways	CI w/ irrigation landscape	n/a	n/a	n/a	187,583	168,825	Peak	184	514	463	1,019	918	1,875,830	1,688,247	1,876	1,688
	Low water use plants guide book	CI accts new construction,remodel	n/a	n/a	n/a	92,160	92,160	Peak	184	252	252	501	501	921,600	921,600	922	922
	Less Lawn	CI accts new construction,remodel	n/a	n/a	n/a	92,160	92,160	Peak	184	252	252	501	501	921,600	921,600	922	922

Notes:

HH = Household

SF=Single Family

MF = Multi Family

CI = Commercial

Source from 2004 EES and assumptions

Savings Assumptions Source from Hanbook of Water Use and Conservation by Amy Vickers

Peak = May through October Irrigaion Season

*Cooling towers = insufficient data to calculate b/c site specific *Ice Machine information from City of Portland, source 2004

Hot Water Water Valve data from GAMA (American Manufacturing Association)

Outdoor data source: 2004 EES Plan, specifically for City of Moscow unless otherwise specified

Rain Barrel = 55 gal barrel

Outdoor devices based on 2007 giveaway data Exhibit 5

National Average of 2.25 persons per HH

Appendix C Continued - City of Moscow Potential Conservation Costs

Customer Class	Conservation Measure	Target Group	Lifespan (years)	Times Implemented in Planning Period	Cost per Fixture	Measure Per Participation HH or Business	Cost Per HH or Business	Total Cost Over Plan	Cost $ / 1,000 Gal Saved Over Plan Period: With savings from free riders	Cost $ / 1,000 Gal Saved Over Plan Period: Without savings from free riders
SF Indoor	Low-volume toilets - 1.6gpf	SF HH w/out efficient toilet	25	1	$50.00	2.25	$112.50	$298,185	$1.30	$2.61
	HET toilets - 1.0gpf	SF HH w/out HET efficient toilet	25	1	$125.00	2.25	$281.25	$368,821	$2.72	$3.62
	Toilet-leak detection and repair	SF HH w/ leaks	7.5	2	$0.66	2.25	$1.49	$551	$0.04	$0.04
	Toilet-tank displacement devices	SF HH w/ old fixture and w/o device	5	2	$0.89	2.25	$2.00	$5,444	$0.10	$0.19
	Decrease toilet flushes	SF HH	1	10	$0.00	2.25	$0.00	$0	$0.00	$0.00
	Low-flow showerheads	SF HH w/ old fixtures	12.5	1	$4.05	1.50	$6.08	$7,676	$0.27	$0.29
	Decreased shower use (5-minute timer)	SF HH	1	10	$1.79	1.50	$2.69	$16,962	$1.49	$1.49
	Instant Hot Water Valve	SF HH	20	1	$50.00	2.25	$112.50	$67,575	$1.08	$1.20
	Faucet aerators-bathroom	SF HH w/ old fixtures	10	1	$0.52	2.25	$1.17	$1,478	$0.04	$0.05
	Faucet aerators-kitchen	SF HH w/ old fixtures	10	1	$1.98	1.00	$1.98	$2,502	$0.27	$0.28
	Decreased faucet use	SF HH	1	10	$0.00	1.00	$0.00	$0	$0.00	$0.00
	Efficient clothes washers	SF HH w/ non-efficient model	13	1	$75.00	1.00	$75.00	$45,050	$2.07	$2.30
	Eliminate partial clothes washer loads	SF HH w/ closewashers	1	10	$0.00	1.00	$0.00	$0	$0.00	$0.00
SF Outdoor	Audits for automatic irrigation	SF HH w/ in-ground systems	5	2	$130.00	1.00	$130.00	$102,547	$1.69	$1.87
	Audits for manual irrigation	SF HH w/out in-ground systems	5	2	$120.00	1.00	$120.00	$269,001	$6.67	$7.41
	Outdoor device giveaways	SF HH w/ irrigating landscape	12.5	1	$14.90	1.50	$22.35	$22,591	$12.04	$13.38
	Low water use plants guide book	SF HH new construction, remodel	20	1	$11.79	1.00	$11.79	$1,056	$0.16	$0.16
	50 gallon Rain Barrel Catchment	SF HH irrigating landscape	10	1	$25.00	1.00	$25.00	$12,122	$103.34	$103.34
	Less Lawn	SF HH new construction, remodel	20	1	$0.00	1.00	$0.00	$0	$0.00	$0.00
MF Indoor	Low-volume toilets - 1.6gpf	MF HH w/out efficient toilet	25	1	$50.00	1.25	$62.50	$143,691	$0.72	$1.45
	HET toilets - 1.0gpf	MF HH w/out HET efficient toilet	25	1	$125.00	1.25	$156.25	$187,641	$1.51	$2.01
	Toilet-leak detection and repair	MF HH w/ leaks	7.5	2	$0.66	1.25	$0.83	$276	$0.02	$0.02
	Toilet-tank displacement devices	MF HH w/ old fixture and w/o device	5	2	$0.89	1.25	$1.11	$2,623	$0.05	$0.11
	Decrease toilet flushes	MF HH	1	10	$0.00	1.25	$0.00	$0	$0.00	$0.00
	Low-flow showerheads	MF HH w/ old fixtures	12.5	1	$4.05	1.00	$4.05	$4,952	$0.18	$0.19
	Decreased shower use (5-minute timer)	MF HH	1	10	$1.79	1.00	$1.79	$10,944	$0.99	$0.99
	Instant Hot Water Valve	MF HH	20	1	$50.00	1.25	$62.50	$34,149	$0.60	$0.67
	Faucet aerators-bathroom	MF HH w/ old fixtures	10	1	$0.52	1.25	$0.65	$795	$0.02	$0.03
	Faucet aerators-kitchen	MF HH w/ old fixtures	10	1	$1.98	1.00	$1.98	$2,421	$0.27	$0.28
	Decreased faucet use	MF HH	1	10	$0.00	1.00	$0.00	$0	$0.00	$0.00
	Efficient clothes washers	MF HH w/ shared non-efficient	13	1	$75.00	0.20	$15.00	$4,575	$0.41	$0.46
	Eliminate partial clothes washer loads	MF HH w/ shared closewashers	1	10	$0.00	0.20	$0.00	$0	$0.00	$0.00
MF Outdoor	Audits for automatic irrigation	MF accounts w/ in-ground systems	5	2	$130.00	1.00	$130.00	$337,896	$9.78	$10.86
	Audits for manual irrigation	MF accounts no in-ground systems	5	2	$120.00	1.00	$120.00	$349,416	$15.17	$16.85
	Outdoor device giveaways	MF account w/ irrigating landscape	12.5	1	$14.90	1.50	$22.35	$19,131	$10.20	$11.33
	Low water use plants guide book	MF accts new construction,remodel	20	1	$11.79	1.00	$11.79	$1,215	$0.66	$0.66
	50 gallon Rain Barrel Catchment	MF accounts irrigating landscape	10	1	$25.00	1.00	$25.00	$9,644	$82.22	$82.22
	Less Lawn	MF accts new construction,remodel	20	1	$0.00	1.00	$0.00	$0	$0.00	$0.00
	Sub-Meter Multi-Family Households	MF accounts one meter/mult.units	15	1	$50.00	10.00	$500.00	$216,600	$6.00	$8.01
CI Indoor	Low-volume toilets	CI accounts w/old toilets	25	1	$50.00	4.00	$200.00	$12,415	$0.95	$1.91
	HET toilets	CI accounts w/old toilets	25	1	$125.00	4.00	$500.00	$10,268	$2.00	$2.66
	Low-volume urinals	CI accounts w/old urinals	20	1	$50.00	1.50	$75.00	$18,623	$0.81	$1.63
	Waterless urinals	CI accounts w/ old urinals	20	1	$75.00	1.50	$112.50	$8,982	$0.92	$1.83
	Toilet-leak detection and repair	CI accounts w/ tank toilets	7.5	2	$0.66	4.00	$2.64	$34	$0.01	$0.01
	Toilet-tank displacement devices	CI accounts w/ tank toilets	5	2	$0.89	4.00	$3.56	$340	$0.05	$0.09
	Low-flow showerheads	CI hotel/motel accounts	12.5	1	$4.05	77.00	$311.85	$20,847	$2.26	$2.38
	Faucet aerators-bathroom	CI accounts w/ old fixtures	10	1	$0.52	4.00	$2.08	$392	$0.01	$0.01
	Air-cooled ice machines	CI accts w/ water cooled ice mach.	15	1	$200.00	1.00	$200.00	$3,037	$0.26	$0.29
	Efficient restaurant spray heads	CI accounts w/ non-efficient sprayer	5	2	$45.00	1.00	$45.00	$1,698	$0.73	$0.81
	Hotel bedding and towel message	CI motel/hotel accounts	1	10	$0.00	77.00	$0.00	$0	$0.00	$0.00
CI Outdoor	Audits for automatic irrigation	CI accounts w/ in-ground systems	5	2	$530.00	1.00	$530.00	$264,470	$14.76	$16.40
	Audits for manual irrigation	CI accts w/out in-ground systems	5	2	$520.00	1.00	$520.00	$259,480	$22.52	$25.03
	Outdoor device giveaways	CI w/ irrigation landscape	12.5	1	$14.90	1.50	$22.35	$2,108	$1.12	$1.25
	Low water use plants guide book	CI accts new construction,remodel	20	1	$11.79	1.00	$11.79	$82	$0.09	$0.09
	Less Lawn	CI accts new construction,remodel	20	1	$0.00	1.00	$0.00	$0	$0.00	$0.00

Notes:
HH = Household
SF=Single Family
MF = Multi Family
CI = Commercial
Source from 2004 EES and assumptions
Savings Assumptions Source from Hanbook of Water Use and Conservation by Amy Vickers
*Cooling towers = insufficient data to calculate b/c site specific *Ice Machine information from City of Portland, source 2004 EES
Outdoor data source: 2004 EES Plan, specifically for City of Moscow unless otherwise specified
Quote for Landscape Guide Book = Supplier Allegra, 20 pp, spiral bound, 100 quantity, not including labor or distribution
National Average of 2.58 persons per HH

Appendix D
City of Moscow's Water Regulations

- Ordinance No. 2007-13
- Resolution No. 2004-12

ORDINANCE NO. 2007 - 13

AN ORDINANCE OF THE CITY OF MOSCOW, IDAHO, A MUNICIPAL CORPORATION OF THE STATE OF IDAHO; PROVIDING FOR THE AMENDMENT OF MOSCOW CITY CODE TITLE 5, CHAPTER 17, TO ESTABLISH AN ANNUAL OUTDOOR IRRIGATION SEASON, TO LIMIT IRRIGATION TO SUCH SEASON, ANDTO PROHIBIT IRRIGATION OF IMPERVIOUS SURFACES; PROVIDING THAT THE PROVISIONS OF THIS ORDINANCE BE DEEMED SEVERABLE; AND PROVIDING FOR THIS ORDINANCE TO BE IN FULL FORCE AND EFFECT FROM THE DATE OF ITS PASSAGE, APPROVAL AND PUBLICATION ACCORDING TO LAW.

WHEREAS, City Council recognizes that the Grand Ronde aquifer that supplies most of Moscow's water is declining; and

WHEREAS, City Council recognizes the need to conserve water as a precious resource; and

WHEREAS, Council desires to highlight the importance of conserving water resources; and

WHEREAS, Council believes this Water Conservation Ordinance to be an important part of a broad and concerted effort to promote reasonable and responsible water use and conservation within the City; and

WHEREAS, Council believes that appropriate regulation of outdoor irrigation will result in water conservation; and

WHEREAS, Council believes that regulation of outdoor irrigation as provided herein is a reasonable measure which will not unduly interfere with the practices of Moscow citizens; and

WHEREAS, Council provides for certain exemptions to the outdoor irrigation restrictions; and

WHEREAS, Council wishes to prohibit watering of impervious surfaces;

NOW, THEREFORE, BE IT ORDAINED BY THE MAYOR AND COUNCIL OF THE CITY OF MOSCOW, IDAHO, AS FOLLOWS:

SECTION 1: That Moscow City Code Title 5 shall be amended by the addition of Chapter 17 as follows:

Sec. 17-1. Purpose.

The purpose of this Chapter is to highlight the importance of water conservation and to promote the responsible use of water within the City through reasonable regulation.

Sec. 17-2. General Water Usage Regulations.

No person who uses water from the City water supply system shall make, cause, use or permit the use of such water in a manner contrary to the provisions of this Chapter whether or not such person is an account holder or customer of such City water supply system.

Sec. 17-3. Definitions.

For purposes of this Chapter, the following term(s) shall have the meaning given herein:

A. Automatic shut-off mechanism. A device or attachment which immediately and automatically shuts off the flow of water from a hose when the hose is not being physically held or operated by a person, such as a pistol or trigger spray hose nozzle or other automatic positive shut-off nozzle. A device or attachment which shuts off water flow by measuring or metering water (such as a mechanized water timer) or a device or attachment which shuts off water flow after a certain measurement of time (such as an electronic water timer), is not an automatic shut-off mechanism for purposes of this Chapter.

B. Impervious Surface. A durable surface made of or similar to gravel, asphalt, concrete, cement, brick, or combination thereof, which is laid down on or applied to an area including, but not limited to, a sidewalk, parking lot, etc., for the purpose of creating a permanent or semi-permanent surface which could sustain vehicular, foot, or bicycle traffic or other means of transportation, and where vegetation is unlikely to grow.

C. Irrigation System. Any device(s) or system(s) utilizing a hose, pipe, and/or other conduit which connects to any source of ground and/or surface water and through which water is conveyed and/or drawn in order to apply such water to land, crops, plants, and/or other vegetation including, but not limited to, sprinklers, in-ground irrigation, or a similar system. "Irrigation system" shall not include an automatic shut-off mechanism, as defined in this Chapter.

~~B~~~~C~~D. Outdoor Irrigation. The act or process of watering or wetting landscaping, grass, trees, plants, and/or other vegetation by causing water from the City's water supply to flow upon, over, through or into property with sprinklers, sprinkler hoses, soaker hose(s) (water weeping types), drip irrigation systems, in-ground irrigation systems, or by other similar means. Irrigation with hand-held hose(s) of ~~three-quarters~~ one inch (1" ~~3/4"~~) or less ~~in~~ inside diameter equipped with an automatic shut-off mechanism or irrigation using a container of five (5) gallons or less shall not be considered outdoor irrigation for purposes of this Chapter.

~~D~~E. Outdoor Irrigation Season. The period within each calendar year declared by the Public Works Director during which Outdoor Irrigation is allowed within City limits. The Public Works Director shall declare and advertise the beginning date of the Outdoor Irrigation Season no later than May 1st of each year. The Public Works Director shall declare and advertise the ending date of the Outdoor Irrigation Season at least two (2) weeks prior to such ending date.

Sec. 17-4. Outdoor Irrigation of Impervious Surfaces Prohibited.

No person shall cause or permit an irrigation system under the ownership, supervision, and/or control of such person to apply water directly or indirectly to an impervious surface, unless otherwise allowed by this Chapter.

Sec. 17-4~~5~~5. Outdoor Irrigation Season and Hours.

~~From April 1 to October 31, o~~Outdoor ~~i~~Irrigation shall be allowed only between the hours of 6:00 p.m. and 10:00 a.m. local time, during the Outdoor Irrigation Season unless modified by variance pursuant to this Chapter.~~City Engineer.~~ Outdoor irrigation shall be prohibited at all times not within the declared Outdoor Irrigation Season. Outdoor ~~i~~Irrigation by means of soaker hose(s), (water weeping types) or drip-irrigation systems may occur at any time during the ~~o~~Outdoor ~~i~~Irrigation ~~s~~Season specified herein.

Sec. 17-~~5~~6. Exemptions from Water Conservation Regulations.

The following uses of water shall not be regulated by this Chapter:

A. Water required to be used for the control of dust or compaction of soil by this Code or by State and/or Federal statute or regulation;
B. Water used to prevent or abate public health, safety or accident hazards including, but not limited to, fire suppression, fire prevention, and sanitation when a reasonable alternative method is not available;
C. Water used for inspection, maintenance, installation or repair of automatic landscape sprinkling systems or of the City's water supply system (including fire hydrants and training facilities);
D. Water used by City or its agents or franchisees for street sweeping, construction, and maintenance; sewer maintenance; or other established utility and/or public works practices;
E. Water used for purposes other than outdoor irrigation in the normal and customary course of a business operation and water used by a commercial nursery for watering of nursery stock;
F. Where water used for outdoor irrigation is gray water (household waste water other than from water closets or kitchen sinks), treated waste water or effluent, reused water, or water from a source other than the City water system, such as collected rainwater.

Sec. 17-~~6~~7. Variance from Water Conservation Regulations.

The ~~City Engineer~~Public Works Director or designee may grant permission to an applicant for variance from the provisions of this Chapter where it is established that there is a hardship or special circumstance which requires such a variance (e.g., establishment of newly seeded or sodded turf grass and/or landscaping; application of chemicals which requires immediate irrigation to preserve lawn or landscaping; physical necessity; etc.). When granting a variance, the ~~City Engineer~~Public Works Director or designee shall establish such conditions and limitations as are necessary to further the purposes of this Chapter.

Sec. 17-~~7~~8. Penalties

A. Any person violating any of the provisions of this Chapter shall be guilty of a misdemeanor and, upon conviction thereof in a court of competent jurisdiction, shall be punished pursuant to this Code and the Idaho Code.
B. The imposition of a penalty for any violation of this Chapter shall not excuse the violation or permit it to continue.
C. Each day or part thereof in which an activity occurs which is prohibited by this Chapter, shall constitute a separate offense.
D. For purposes of this Chapter, no violation shall be prosecuted unless the ~~City Engineer~~Public Works Director or designee or the City Police Department has made at least one (1) attempt to contact and to request relief from the person responsible for the violation~~ and the violation has continued or resumed within two (2) hours of the initial contact or attempt to contact~~.

SECTION 2: SEVERABILITY. Provisions of this Ordinance shall be deemed severable and the invalidity of any provision of this Ordinance shall not affect the validity of remaining provisions. The remaining sections of Title 5 shall be in full force and effect.

SECTION 3: EFFECT ON OTHER ORDINANCES. Where the definitions contained in this Ordinance are in conflict with relevant portions of the City of Moscow, Idaho, Municipal Code, the definitions contained within those portions of the Moscow Municipal Code will be unaffected until such time, if any, as they are amended to be consistent with this Ordinance.

SECTION 4: EFFECTIVE DATE. This Ordinance shall be effective upon its passage, approval, and publication according to law.

PASSED by the City Council and APPROVED by the Mayor this 19th day of November, 2007.

Nancy Chaney, Mayor

ATTEST:

Stephanie Kalasz, City Clerk

CITY OF MOSCOW INCORPORATED JULY 12 1887 STATE OF IDAHO

RESOLUTION NO. 2004 - 12

A RESOLUTION OF THE CITY OF MOSCOW, IDAHO; ESTABLISHING CERTAIN POLICIES, GUIDELINES AND SURCHARGES TO ENCOURAGE AND SUPPORT WATER CONSERVATION WITHIN CITY LIMITS; PROVIDING THIS RESOLUTION TO BE EFFECTIVE UPON ITS PASSAGE AND APPROVAL.

WHEREAS, City Council recognizes that the Grande Ronde aquifer that supplies most of Moscow's water is declining; and

WHEREAS, City Council recognizes the need to conserve water as a precious resource; and

WHEREAS, Council desires to highlight and support the importance of conserving water resources; and

WHEREAS, Council believes this Water Conservation Resolution to be an important part of a broad and concerted effort to promote reasonable and responsible water use and conservation within the City; and

WHEREAS, Council desires to encourage responsible water use and to discourage wasteful practices; and

WHEREAS, Council believes that the policies, guidelines and surcharges related to water conservation herein are meant to recognize what is a practical approach to water conservation and meant to grant to the City Engineer the ability to use discretion and expertise when promoting water conservation within the City in accordance with this Resolution;

NOW, THEREFORE, BE IT RESOLVED by the Mayor and City Council of the City of Moscow as follows:

1. Purpose.

The purpose of this Resolution is to establish certain policies, guidelines and surcharges related to use of water within City limits in order to promote the responsible use of water within the City and to resolve issues related to water waste within the City in a reasonable and fair manner.

2. Policy.

It shall be the policy of the City to take measures not to interrupt water service to a water user as long as such measures do not create or sustain an unreasonable risk to the City's water system and do not allow a water user to unnecessarily or recklessly waste water. All water users shall be kept informed of the City's intentions where practicable. Education and accommodation will be practiced when working to resolve issues related to water waste. Water service will be interrupted only to the extent reasonably necessary to resolve water waste issues. In no case shall interruption of water service endanger the life or health of a water user.

3. Definitions.

For purposes of this Resolution, the following term(s) shall have the meaning given herein:

Water User or User: Any person who uses or causes, permits or allows the use of water from the City water supply system, whether or not such person is an account holder or customer of such City water supply system.

4. Water Waste. Maintenance of Connected Facilities.

Every water user shall be required to keep sprinklers, faucets, valves, hoses and all apparatuses connected to the City water system in good condition at such user's own expense and shall keep all faucets which discharge to a point of use closed when not in use. When it shall be found that any water fixture on the user's premises is broken or not in serviceable condition and such a condition results in the waste of a significant amount of water (as determined by the City Engineer or designee), the user shall be notified by the City of the fact by a method calculated to give actual notice and, should user fail to remedy the defect within five (5) working days of notification by the City, such user shall be charged and shall pay the following surcharge(s) for such defect:

1st Water Waste Event		$50
2nd Water Waste Event	If within 19 months of first offense	$100
3rd Water Waste Event	If within 19 months of first offense	$200

Any surcharge assessed shall be collected in the same manner as collection of fees for City water services.

5. Discontinuance of Service to Connected Facility.

A. If a water user is found by the City Engineer or designee to have four (4) water waste events within any nineteen (19) month period the City Engineer or designee may give notice to such user of intent to discontinue such user's water service.

B. The City Engineer shall inform the City Supervisor of the decision to discontinue service. The City Supervisor shall review the City Engineer's decision and relevant supporting documentation within three (3) days of its receipt. If the City Supervisor agrees with the determination of the City Engineer or designee, the City Supervisor shall give notice to the user of the intention to discontinue water service at least five (5) working days prior to a meeting at which the water user and/or representative, City Engineer or designee, and City Supervisor may discuss the matter. Notice shall inform the user of the time and place of the meeting and generally of the facts which led to the recommendation to discontinue water service. The user may either appear in writing or in person (with or without legal counsel) to discuss reasons why water service should not be discontinued. Failure by any user or their representative to appear before the City Supervisor at the scheduled meeting shall result in the forfeiture of the user's right to be heard by the City Supervisor. Upon consideration, the City Supervisor shall notify the user in writing of the determination within five (5) working days of the meeting. If the determination of the City Supervisor is to discontinue the user's water service, the City shall notify said user of the period during which the services will remain discontinued.

6. Restoration of Water Service.

Water service shall be restored under such terms and conditions the City Engineer determines are appropriate within the guidelines established by this Resolution.

7. Temporary Service Interruption Allowed For Water Waste.

Notwithstanding other provisions hereinabove, if the City Engineer or designee determines that a user engages or has engaged in practices which result in the reckless waste of water and continues to do so after reasonable notice (i.e., not less than six (6) hours) to discontinue said waste has been given, the City Engineer may do either of the following:

A. Interrupt water service for a period of time not to exceed twenty four (24) hours per act of water waste; and/or

B. Seek the assistance of the City Attorney to abate the water waste as a nuisance.

8. No Effect on Charges or Collections.

Nothing in this Resolution shall interfere or adversely affect in any way ordinances, policies and practices of the City related to payment and/or collection of fees and/or charges for water service.

PASSED AND APPROVED by the Mayor of the City of Moscow, Idaho, this 17th day of May, 2004.

____
Marshall H. Comstock, Mayor

ATTEST:

____
Stephanie Kalasz, City Clerk

Appendix E
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Appendix 6-1
Aquifer Storage and Recovery Feasibility Assessment

Golder Associates

TECHNICAL MEMORANDUM

Date: January 20, 2011

Project No.: 103-99760

To: Jeff Hansen

Company: HDR Engineering, Inc.

From: Phil Brown, RG, LHg. Golder
Lizzi Bartosik, Golder

RE: AQUIFER STORAGE AND RECOVERY FEASIBILITY ASSESSMENT FOR THE CITY OF MOSCOW COMPREHENSIVE WATER SYSTEM PLAN

1.0 INTRODUCTION

As a component of their Comprehensive Water System Plan, the City of Moscow (City) is evaluating the potential to utilize Aquifer Storage and Recovery (ASR) to complement the City's existing groundwater supply system. ASR has become an increasingly attractive water management tool because it is an inexpensive option for conserving and storing large quantities of water when compared to traditional storage systems such as reservoirs (tanks) and impoundments (dams). Most ASR systems store treated surface water by injecting it into a local groundwater aquifer during the wet season when surplus water is typically available, and recovering that water effectively during times of high demands and lower availability. ASR systems typically utilize the same well for both direct injection of diverted water into the aquifer, and recovery of that water for consumption. However, separate recharge and recovery wells do have applications in some settings. Water systems already using groundwater supply wells can often retrofit an existing well and pumping equipment with the necessary wellhead controls to operate both injection and recovery cycles presenting significant cost savings during ASR implementation.

ASR projects are typically implemented through three phases;

- Phase 1: Hydrogeologic Feasibility Study, Conceptual Design and Permitting;
- Phase 2: Pilot testing;
- Phase 3: Recharge facility expansion.

The initial phase includes conducting a hydrogeologic feasibility study, conceptual facility design and beginning the permitting process. The study is designed to evaluate the hydrogeologic characteristics of the aquifer and determine how the ASR system will fit into the City's water management plans and system operations. The feasibility study can also be coupled with the permitting process which requires aquifer characterization prior to issuing a permit. Phase one is often effective in gaining regulatory and public support for an ASR program which can increase the program's success.

Phase 2 Pilot Testing occurs once pertinent permitting is complete and includes either constructing a new well, or completing well retrofits to operate recharge and recovery cycles. Phase two begins injection,

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storage and recovery cycles and conducts water quality sampling, to determine optimum operation rates and recovered water quality throughout the cycle. Pilot testing can help identify potential problems prior to expansion to operational scale, and provides a potability check prior to delivering water to the municipal supply system. Phase 3 is expansion to operational scale testing, monitoring, and integration of the ASR operations into the City's distribution system.

This feasibility assessment was conducted to provide information regarding the following:

- General design criteria and facility elements;
- Permitting considerations;
- Estimated planning level costs;
- Common ASR implementation issues; and
- Overall ASR feasibility for the City.

This memorandum presents a basic description of the major components of a typical operational ASR system and its potential to augment the water supply capacity for the City Moscow, Idaho.

2.0 DESIGN CRITERIA

For ASR to be feasible, technical water supply and storage issues must be adequately satisfied before implementing a pilot testing program. These include:

- **Source Water Availability** – A suitable and legal source of water will need to be available for diversion and aquifer recharge. The recharge water would be available during times of availability considering both human and environmental needs, and when instream flows are met.
- **Source Water Quality –** In general, source water needs to meet potable standards (and sometimes exceed them depending on aquifer conditions) prior to recharge. If raw surface water will be the source, provision for bank filtration or treatment will be required prior to recharge operations, and should be considered in assessing the cost profile of stored water.
- **Infrastructure** – Adequate infrastructure is needed to deliver the recharge water to the storage aquifer. Specialized well construction, wellhead design, pump specifications and system modification may be required. Treatment of water prior to storage is often required and real-time monitoring of ASR recovery and recharge is needed during system operations to ensure they meet permitted requirements.
- **Suitable Receiving Aquifer** – The aquifer selected as the storage reservoir should have physical or hydrochemical boundaries to restrict movement of water stored and minimize water quality changes. Additionally, sufficient aquifer transmissivity and storage volume is required to accept recharge water and meet target storage volumes and rates.
- **Acceptable Water Quality** – Water quality standards apply to both injected and recovered water. Water treatment will likely be required pre-injection, though is rarely necessary on recovery.
- **Suitable Demand Profile** – ASR is best suited to work in conjunction with other water supply sources to meet seasonal water resource demands. ASR is typically used to meet peak demands (i.e. summer and fall) by storing water during low demands (i.e. winter

and spring). ASR systems utilize alternative source water other than water from the ASR well to supply potable water when the ASR well is recharging.

Each of these items, as they pertain to the City of Moscow, is discussed below.

2.1 Source Water

ASR systems divert and store surface water during high flow, low demand, times of the year (predominantly winter and spring). Work from the WRIA 34 watershed suggests excess water is typically available from the Palouse River system during winter months, could be utilized as the source water for an ASR project (Golder, 2007). Mean monthly flows in the South Fork can be found in the attached Figure 1. Peak flows are approximately 110 and 115 cubic feet per second (cfs) in February and March, respectively. Dependent upon available water rights, flow data suggests that water would be available for diversion from the South Fork of the Palouse River January through March and, if treated, could be utilized as the source water for an ASR system.

2.2 Infrastructure

Development of an ASR system for the City would involve an evaluation of the City's existing infrastructure to select locations where ASR facilities can feasibly be developed and provide the most benefits to the City's water system. When choosing the location of an ASR facility, an assessment of relative capital expenditures necessary to develop a functional ASR facility would be developed. If feasible, utilizing existing piping, storage, and distribution system infrastructure could provide a substantial cost benefit. Additional considerations in selecting the ASR facility location may include where the facility can boost system pressure or increase chlorine residuals.

Selecting an appropriate location for the ASR well can significantly reduce overall capital expenditures. Existing wells completed in the target aquifer can be considered, or a new well can be installed to ensure proper implementation of the full ASR operations can be achieved. Primary considerations to selecting an existing well for retrofit are well capacity and well construction. An evaluation of existing information regarding well yield, performance, groundwater quality and existing pumping and wellhead equipment can be conducted to help assess the City's existing wells for potential ASR well candidates. A well evaluation should also include a review of existing well construction to determine if the wells are adequately cased and sealed to ensure sanitary conditions and avoid mixing of the recharge water with shallow water-bearing zones.

The City currently utilizes five wells completed in two aquifers for its drinking water supply. It is almost certain that capital costs will be lower if existing wells are utilized rather than installing new well facilities. Water treatment and conveyance is a significant portion of project development costs for a utility without pre-existing water treatment facilities. To develop the most cost-efficient planning-level capital expenditure plan, the City would need to work through project elements to arrive at the optimum combination of:

- Likely intake locations;
- Property ownership for siting water treatment facilities;
- Type and location (intake site or wellhead) that best meets the City's needs;
- Proximity of the preceding locations to wells prioritized for conversion, and;
- Proximity to an appropriately-sized portion of the City's supply system if moving source water through the system is the preferred method of conveyance to the ASR well.

Once these factors are balanced, a planning-level cost estimate can be developed.

2.3 Receiving Aquifer

A suitable aquifer that can be utilized for water storage must be present for a successful ASR program. The receiving aquifer must have sufficiently high transmissivity (transmitting capacity) to receive injected water and it must be of sufficient size to meet the target ASR stored volume. The groundwater of the receiving aquifer must also be geochemically compatible with the injected water so that adverse chemical reactions such as mineral precipitation do not occur. Both the Grande Ronde and Wanapum basalt aquifers have been suggested as favorable for ASR operations (Golder, 2006).

The two aquifers targeted by the City's wells are the shallower Wanapum and deeper Grande Ronde basalt groups, part of the regional Columbia River Basalt Group. Both of these aquifers have been identified as having a potential for use as an ASR storage aquifer. Because the Grande Ronde basalt receives limited recharge and water levels have declined, the deeper portion of the system may represent the most likely storage target for two reasons:

1. The storage capacity is established, and;
2. The benefit of replacing extraction with withdrawing stored water would be demonstrable.

In general, groundwater quality in the deeper Grand Ronde basalts is of higher quality than the shallower Wanapum which is influenced by surface conditions and has more available iron for dissolution. Whether it is a bigger benefit to the City to improve water quality from its Wanapum wells or to provide a positive impact to the Grande Ronde water budget would need to be discussed further.

A hydrogeologic characterization report would provide a more detailed conceptual model of the aquifer system and assess hydrogeologic properties such as transmissivity, storativity and geochemical compatibility using available aquifer test data. Much work has been completed in this area, and it is likely that the results of the Framework Project underway with the Palouse Basin Aquifer Committee would represent the bulk of this submittal. Evaluating test data to assess potential recovery and injection rates and the presence of storage-limiting boundary conditions is a key element of a feasibility study. In addition, existing monitoring well networks would need to be evaluated for adequacy in an ASR context, to assess potential hydraulic interaction with nearby wells and hydrologic features.

The physical availability of groundwater and the sustainability of current withdrawals from the basalt aquifers of the Moscow/Pullman area has become an issue recently due to estimated low recharge and increased groundwater withdrawals resulting in declining groundwater levels (Golder, 2006). An ASR program that injects high quality treated surface water can help maintain or improve groundwater quality and reduce groundwater withdrawals, providing an overall benefit to the storage aquifer in the vicinity of the ASR site.

2.4 Acceptable Water Quality

Water quality of both the injected and recovered water needs to meet applicable standards for injection and potability. Injected water will need to meet state groundwater quality regulations and anti-degradation policies meaning that injected water must not significantly degrade the water quality of the receiving aquifer water. How this requirement is interpreted in the context of storing and recovering drinking water varies from State to State, and sometimes with regional jurisdiction. Recovered water must meet drinking water standards.

Water quality tests in the South Fork of the Palouse River indicate the presence of fecal coliforms, ammonia-N and has exhibited high pH and increased turbidity levels, particularly in the winter months. Recent studies suggest that ammonia levels have been reduced to meet Washington state standards at the border of Washington and Idaho (Golder, 2007). Although water of the Palouse River may meet groundwater quality standards, pre-treatment to drinking water standards will likely be necessary to further improve injected water quality and prevent anti-degradation to the receiving aquifer.

Water from the source water and receiving water will come in contact during storage potentially causing geochemical reactions. It has been our experience working extensively in the Columbia River basalts that these reactions are inconsequential. Still, the possibility of a precipitation reaction that could limit well performance exists, and therefore the geochemical compatibility of the two waters must be considered. As part of the Palouse Watershed (WRIA 34) Multi-Purpose Storage Assessment, Golder completed a brief water quality compatibility review to evaluate potential issues associated with mixing Palouse River water with typical basalt aquifer systems. The summary of review findings include:

- Mixing of Palouse River surface water and ground water from basalt aquifers may result in precipitation of few mineral phases (iron minerals);
- Mixing models suggest iron and manganese may exceed EPA secondary drinking water standards in recovered water;
- The generalized assessment did not reveal significant water quality limitations to the feasibility of ASR using the Palouse River as source water and using either the Grande

Ronde or Wanapum basalt aquifers (both currently used to supply groundwater to the City) as the storage reservoir.

Although iron and manganese are not commonly developed as a consequence of ASR operations, there is increased potential in areas where iron and manganese concentrations are already elevated. In the Moscow area, this concern would be primarily associated with Wanapum basalts, as the deeper Grand Ronde basalts typically exhibit lower concentrations. A more detailed geochemical compatibility evaluation using expected surface water characteristics (pH and cataion/anion profile) and samples from the two aquifer is recommended.

2.5 Demand Profile

ASR is best suited to meeting seasonal demands and typically works in conjunction with other water supply sources year round. It is important to evaluate monthly water demands, including trends and variability, to ensure ASR will be effective at supplementing peak demand. Using ASR to supplement seasonal peaks, typically observed in the summer months, is the most efficient use of an ASR system as the well undergoes recharge operations in the fall and winter months and will have limited use as a supply well during that time. If water supply is low during peak months, and supplementation or additional storage is required, ASR may be the most cost effective strategy to supplement peak demands.

3.0 FACILITY ELEMENTS

Primary facility elements of an ASR system include;

- An ASR well;
- Pumping equipment and flow control valves for injection and recovery;
- Water treatment facilities;
- Infrastructure to move source water to the water treatment facility, from the treatment facility to the ASR well;
- Infrastructure to move recovered water to the water treatment facility, then to distribution; and,
- A real-time monitoring system to track ASR recharge, aquifer pressure buildup and recovery volumes to ensure system operation meets permitting requirements.

The main system element required for an ASR system is the ASR well, which can be new or existing. If an existing well, pump and wellhead equipment can be adequately retrofitted to control recharge during ASR operations, future capital expenditures as part of the ASR implementation process could be significantly reduced. If the existing City wells are not suitable for ASR operations, or if significant retrofitting costs are potentially prohibitive to ASR development, a new well can be drilled and designed to accommodate ASR operations.

After an ASR well is selected from an existing well, or a new well is drilled to meet design criteria, the necessary equipment to run the ASR system will need to be installed. A vertical turbine or submersible pump can be selected dependent upon the operational capacity and well design. A flow control valve specifically designed to control projected injection rates and accommodate projected recovery rates will be required. Either onsite or automatic controlling of the valve using measured parameters such as flow rate, water level, surface piping pressure or other inputs is typically possible.

Water treatment facilities, system infrastructure and piping will need to be considered as part of the implementation process. The ASR well location can be selected by its proximity to the water treatment facility and the location of existing piping to decrease capital expenditures.

In addition to selecting an ASR facility location, a system to monitor ASR operations should be installed, if not already part of the infrastructure in a retrofitted well. This system may include a pressure sensor, or transducer, connected to a Supervisory Control and Data Acquisition (SCADA) system. A SCADA system with monitoring equipment will allow parameters such as water levels, system pressures, injection rates and volumes, and recovery rates and volumes during ASR cycles to be monitored continuously, and in real-time. This information may also be a reporting requirement for ASR associated permits.

4.0 REGULATION AND PERMITTING CONSIDERATIONS

Several permits are required for developing an ASR system that meets state and federal standards. The application for an ASR permit (underground injection control permit) is composed of several different elements that are used to evaluate the operations and monitoring of the proposed project, the legal framework for the project, the applicant's understanding of the hydrogeologic system, and the potential for impact to the environment. Permitting considerations for ASR systems include;

- **Underground Injection Control Permit** – The Idaho Department of Water Resources regulates the injection of fluids into wells under the federal Underground Injection Control Program. Any system which injects water into the subsurface is required to be permitted through the Idaho Department of Water Resources.
- **Water Rights** – Both surface and groundwater rights will be required for an operational ASR system. The surface water right will allow for water withdrawals from the South Fork of the Palouse River. Once the water has been injected, an additional groundwater right is needed to withdrawal water from the storage aquifer.
- **Well Construction** – New well installation, existing well modifications for use as an ASR well will require a well construction permit.
- **Water Quality** – Water quality standards and regulations apply to both injected and recovered water. Injected water standards are regulated by State groundwater quality standards and anti-degradation laws. Recovered water will be required to meet drinking water quality standards prior to distribution.
- **Water Discharge** – Most operating ASR systems require periodic back-flushing of the ASR well (pumping the well to waste at high discharge rates) to eliminate clogging that occurs even when high quality water is injected. This may require a National Pollutant Discharge Elimination System (NPDES) permit.
- **Land Use –** Land use permits may be required if the property is not currently zoned for municipal water supply and storage.

Each of these regulation and permitting considerations are discussed further in the following sections.

4.1 Underground Injection

Idaho regulates the construction and injection of fluids into wells in IDAPA 37.03.03 under the federal Underground Injection Control Program (UIC Program; 40 CFR 146). The three main requirements of the UIC program include;

1. A non-endangerment performance standard must be met, prohibiting injection that allows the movement of contaminated fluids into underground drinking water resources;
2. All well owners must provide inventory information;
3. Well must be registered with the appropriate State agencies.

Aquifer recharge wells qualify as Class V injection wells under state and federal standards. Additional requirements in the Idaho Administrative Code applicable to Class V injection wells are outlined in IDAPA 37.03.03 including construction requirements and operational conditions. IDAPA 37-03-03.050 (Rule 50) sets the standards for the injected fluid quality and location and use criteria.

The application information requirements are outlined in IDAPA 37.03.03. Information that may be required as part of the injection control permit includes, but is not limited to;

- General well information including facility location, well ownership, injection well location, class of the proposed injection well and construction information;
- Quality and character if injected fluids and groundwater of the receiving aquifer;
- Location of other wells including injection wells, drinking water wells and domestic wells;
- Location of springs and surface waters;
- Conceptual hydrogeologic model including the geologic and physical characteristics of the injection zone, groundwater gradients and flow directions, storage capacity estimates, potential impacts to wells; and,
- Maps depicting wells, surface waters, mines and quarries, residences, roads, bedrock outcrops and faults and fractures within two miles of the proposed injection well.

In general, the permitting application process for a Class V injection well is conducted as follows in accordance with IDAPA 037.03.03.040;

1. **Draft Permit** – The applicant will submit all information for evaluation. The Director will then prepare a draft permit or denial, which will include the application for permit, permit conditions or reasons for denial, and any compliance schedules or monitoring requirements.
2. **Public Notice** – A public legal notice will be provided to the public in the county that the well is located. A period of at least 30 days is allowed for any persons to submit comments and request a fact –finding hearing. A hearing will be conducted if deemed necessary.
3. **Review By Other State Agencies** – The Directors of other state agencies will have the opportunity to review and comment on the draft permit within 30 days of the public or legal notice.

4. **Fact-Finding Hearing** – A fact-finding hearing may be held at the Director's discretion or upon motion of any interested individual and notice will be provided to the applicant and persons requesting the hearing. Public notice will be made via press release in a newspaper circulated in the county of the injection well.

Upon completion of the draft permit, it will then be determined if the injection well is in compliance with standards and criteria and groundwater is protected from unreasonable contamination or deterioration thus preserving it for beneficial use. If these conditions are met a permit will be issued including all conditions of the permit to ensure groundwater sources are protected. The permitting process typically takes a minimum of two months to complete.

Once permitted, the ASR system operators will be required to monitor and report ASR system operations to the Department of Water Resources as conditions to the issued UIC permit.

4.2 Water Rights

Idaho Code 42-4201A authorizes the Idaho Department of Water Resources (IDWR) to issue water appropriation permits for aquifer recharge projects. Surface water and groundwater rights will be required to operate an aquifer recharge project in Idaho. Water appropriation rules and procedures are described in IDAPA 37.03.08. The City currently does not have an existing surface water right. Acquiring a water right for the source water for an ASR system could include;

1. Submitting a new application for water determined to be available in winter months; or,
2. Acquiring an existing water right and transferring it to a new place of use. If an irrigation water right is acquired, the transfer from peak appropriation to off-season withdrawal is likely to be seen as mitigation or benefit to the river which could potentially facilitate the review and approval of the transfer.

An application for water from the South Fork Palouse River would be the first critical step in developing an ASR system, as the water right application or transfer process can require a substantial amount of time (months to years).

In addition to the surface water right, a groundwater right is required to withdrawal, or recover, stored water because; after the recharge water mixes with groundwater in the storage aquifer it becomes public water (i.e. water of the state) which requires a groundwater right. Because the City currently utilizes groundwater for its municipal supply, ASR groundwater withdrawals may fall under existing groundwater rights or require a change to existing rights.

4.3 Well Construction

Construction standards for injection wells in the state of Idaho are included in IDAPA 37.03.03.045.04. IDWR requires a permit for constructing or modifying any well for injecting water into the ground. Currently, there are no rules specific to the design of an ASR well, and IDWR should be consulted prior to drilling a new, or retrofitting an existing injection well to ensure it meets construction standards. Generally, from a permitting stand point, existing water supply wells can be retrofitted for ASR.

4.4 Water Quality

Water quality standards apply to both injected and recovered water. Injected recharge water must, at minimum, meet groundwater standards established in IDAPA 58.01.11 and recharge operations cannot cause existing drinking water to exceed drinking water maximum contaminant levels. Additionally, Idaho Department of Environmental Quality has an anti-degradation policy which states that a release (or injection) of fluid with constituents exceeding background aquifer concentrations is considered degradation, even if applicable groundwater standards are not exceeded (IDAPA 58.011.400). Although this rule may be more stringent, discussions with the Idaho Department of Water Resources indicated an underground injection control permit could potentially allow for injection of water that exceeds background concentrations, but meets Idaho groundwater quality standards, and each scenario is site specific. Each permit and its applicable injected water quality standards are handled on a case by case basis by the State and additional regulations may apply (IDWR, 2010).

In addition to injected water quality standards, Idaho's UIC permit requires recovered water to meet drinking water quality standards that comply with the Safe Drinking Water Act. These standards are anticipated to be on track with the current City drinking water standards and monitoring policies. To prove compliance, routine inspection and monitoring would be required which would likely include water quality monitoring throughout the recovery cycle to determine if water quality changes as a function of recovered volume.

Overall, water treatment will likely be required both pre-injection to meet drinking water quality standards, and post-recovery as part of existing groundwater treatment likely already conducted by the City.

4.5 Water Discharge/Land Use

ASR wells typically require periodic back-flushing to avoid clogging and maintain ASR well production capacity. Back-flush water is often discolored from sediment and particulates and produces water with increased turbidity due to suspended solids. An NPDES permit will allow the immediate discharge of this water to surface water bodies if a storm or sanitary sewer is not available at the well site, or if the sewer system is not able to receive potentially high discharge rates.

In addition to the NPDES permit, a demonstration of land use compatibility with current zoning ordinances and laws may be required. Issues regarding land compatibility are not expected to impact ASR system implementation, particularly if an existing well or City-owned property is utilized. However, land use compatibility should be considered.

5.0 PLANNING LEVEL COSTS

General ASR costs were considered as part of the 2007 Palouse Watershed (WRIA 34) Multi-Purpose Storage Assessment. These estimates, provided below, are based on limited nationwide research of ASR systems and each ASR system has its own site specific costs.

- Feasibility reports and pilot testing for systems with existing infrastructure (wells) typically range from $100,000 to $150,000. In Moscow, the availability of hydrogeologic characterization data would likely lead to a Feasibility Study cost lower than this, possibly in the $40,00 to $50,000 range if no numerical flow modeling is required.
- ASR systems in the Pacific Northwest produce water ranging from $200,000/mgd to $600,000/mgd, with an overall average of $400,000/mgd, not including water treatment costs. The high end of this range is more likely when geologic controls limit recovery rates and/or storage volumes. System development and infrastructure costs do not increase proportionally with rate/volume.

Based on a generalized understanding of supply availability and the City's well system, a hypothetical ASR system can be conceptualized. It is likely that a 3-well system recharging at an average rate of 700 gpm for four months each year could be developed using existing wells, resulting in approximately 360 MG of storage annually. It is likely that this volume could be recovered to the City's supply system at approximately 2,700 gpm (average) for 3 months. Using unit costs in Table 1 below, this portion of the project could be developed for as little as approximately, $740,000, or 185,000/mgd summer capacity, not considering permitting, treatment, or conveyance associated with the new source of supply. If 3 new wells are installed to operate the system as a true peaking supply (i.e. in addition to the City's existing wells), a planning-level estimate would be to add approximately $1M per new well increasing the overall project costs to approximately $4,000,000, or $1,000,000/mgd (excluding new source permitting, treatment, and conveyance).

TABLE 1

Planning Level ASR Development Costs

ASR Development Element	Planning Level Cost Estimate	Notes
Underground Injection Control Permit	$5,000	Major cost elements of supporting documentation (i.e. characterization report) are estimated separately below.
Land Use Permitting	$1,000	Assumes ASR activities are consisted with current land use designations
Well Site Approval	$3,000	Assumes existing supply wells meet all setbacks
NPDES Permit	$0	Assumes settling and de-chlorination facilities can be used to avoid direct discharge, and managing pumped water can be accomplished using the City's existing stormwater permit.
Hydrogeologic Characterization Report	$40,000	Assumes all relevant hydraulic, hydrogeologic and water quality information has been collected.
Wellhead Conversion/Retrofit (each)	$180,000	Assumes downhole flow control valve required, bi-directional piping installed, and discharge to-waste capability onsite. Existing pumps, wellhouse, electrical, motor control, water level monitoring equipment can be re-used, no demolition required.
Additional Conveyance	$0	Assumes this portion of the ASR system (excluding treatment and conveyance from new source) can utilize existing infrastructure.
Year 1 Pilot Testing and Reporting	$150,000	Cost assumes water level and quality monitoring and one year operation data report. Assumes bulk of water level and quality monitoring is provided by a consultant.

6.0 COMMON ASR IMPLEMENTATION ISSUES

Both technical and non-technical issues have to be considered in this memorandum for a new ASR system. Issues that can be common either during implementation or after the system has been in operation can include;

- Regulatory Requirements and Public Involvement;
- Recovery Efficiency;
- Well Clogging;
- Disinfection Byproducts (DBPs);
- Cost Feasibility.

These common implementation issues discussed in the following sections have the potential to impact many ASR systems; however each system is site specific and other issues may not be identified until site specific design and implementation occurs.

6.1 Regulatory Requirements and Public Involvement

Prior to including ASR as a major component of a municipal water expansion plan, its full feasibility, including all regulatory requirements, must be confirmed. It's imperative that the surface water right and all necessary permits can be acquired or issued prior to including an ASR system as a major expansion element in a water system plan. Water right procurement and permitting problems can cause major setbacks stalling ASR system development.

Public opposition can also stall ASR development causing public meetings and formal hearings which often accompany the ASR system permitting process and development (Pyne, 1995). Surface water stakeholders as well local groundwater users can oppose ASR system operations without fully understanding how an ASR system operates. Public education is imperative to accurately present the cost and environmental benefits to an ASR project, particularly in regions with increased opposition.

6.2 Recovery Efficiency

Recovery efficiency, defined as the percentage of water volume stored that is subsequently recovered while meeting target water quality criteria, can change over time. Recovery efficiency is typically problematic in systems where ASR stores water into aquifers with objectionable water quality (i.e. high TDS or salinity). When parameters exceed set levels in these systems, recovery often ceases and the efficiency is then calculated by dividing the total volume recovered by the total volume of water stored. Systems with groundwater already meeting drinking water standards often have no problems recovering the full amount of permitted stored water. If objectionable water quality exists in the storage aquifer, water quality can, however, improve over successive cycles even when the same volume is stored. This is the product of a buffer zone being created around the ASR well.

6.3 Well Clogging

Well clogging occurs in nearly all ASR wells, particularly during recharge operations. Clogging can be caused by multiple processes such as increased bacterial growth (bio-fouling), entrained air, increased suspended solids, or mineral precipitation. Clogging is typically diagnosed when unexpected (not related to rate changes or previously observed aquifer response) head increases (buildup) occur within the well casing. This can necessitate reducing the injection rate (and therefore the volume stored) to maintain water levels within the well within the target range. It is our experience that particulate clogging is easily mitigated by back-flushing (pumping) the well at a rate higher than the recharge rate. Consequently, detention facilities, conveyance, or an NPDES permit for discharge may be required. It is common for the water to be detained onsite for settling and dechlorination prior to discharge to a nearby storm sewer at a controlled rate.

6.4 Disinfection Byproducts

Disinfection byproducts must be monitored in the recharge and recovered water, particularly if recharge water is chlorinated prior to injection. Disinfection byproducts are carcinogenic compounds that form when chlorinated water comes in contact with natural organic material. They include compounds such as trihalomethanes (THM's) and haloacetic acids (HAA's) and their concentrations can fluctuate throughout an ASR cycle. There is some evidence that DBP's decrease during storage; however, they should be monitored through successive cycles to ensure they remain below the permitted MCL's in both injected and recovered water (Pyne, 1995).

6.5 Cost Feasibility

The cost feasibility of ASR systems can be prohibitive if major infrastructure upgrades (i.e. a new water treatment facility) are coupled with minimal peak demand supplementation by the ASR system. If excess treatment capacity for a water treatment facility is available then capital improvement costs required to meet increased demand and provide additional supply from an ASR well may be reasonable. Additionally, when ASR is compared to the other storage options such as a new storage tank or surface water impoundment, ASR facilities may be considered quite cost effective due to the high volumes that can be stored. An assessment of existing infrastructure and upgrades required to implement an ASR system should be conducted to determine if the costs required to implement an ASR system are prohibitive.

7.0 ASR FEASIBILITY FOR MOSCOW, IDAHO

The major components that were identified that promote the feasibility of ASR development for the City of Moscow include;

- Recent WRIA 34 Reports suggest that excess winter water is available from the South Fork Palouse River, although this water will almost certainly require treatment if used for aquifer recharge.
- The existing wells the City utilizes are completed in the Wanapum and Grand Ronde basalt aquifers, both of which have been identified as favorable for ASR operations increasing the potential for cost effective implementation.
- The decreasing groundwater levels in the Wanapum basalt suggest low recharge and potential over-appropriation. Storage of high quality water can help maintain or improve groundwater quality and reduce overall groundwater withdrawals from the storage aquifer in the vicinity of the ASR site.

Assuming a surface water right can be obtained for the South Fork Palouse River, the source water and suitable aquifer are in place at the City of Moscow. Although an evaluation of the existing system infrastructure and capacity was not part of this scope, due to the already existing reliance on groundwater for municipal supply, implementing an ASR system is considered feasible. Further cost benefit analyses and hydrogeologic characterizations would provide more detail regarding the potential to utilize ASR as a water storage and additional supply for the City. These studies could determine any potential implementation issues that may be encountered during development, and provide a more detailed cost estimate for ASR facilities.

8.0 REFERENCES

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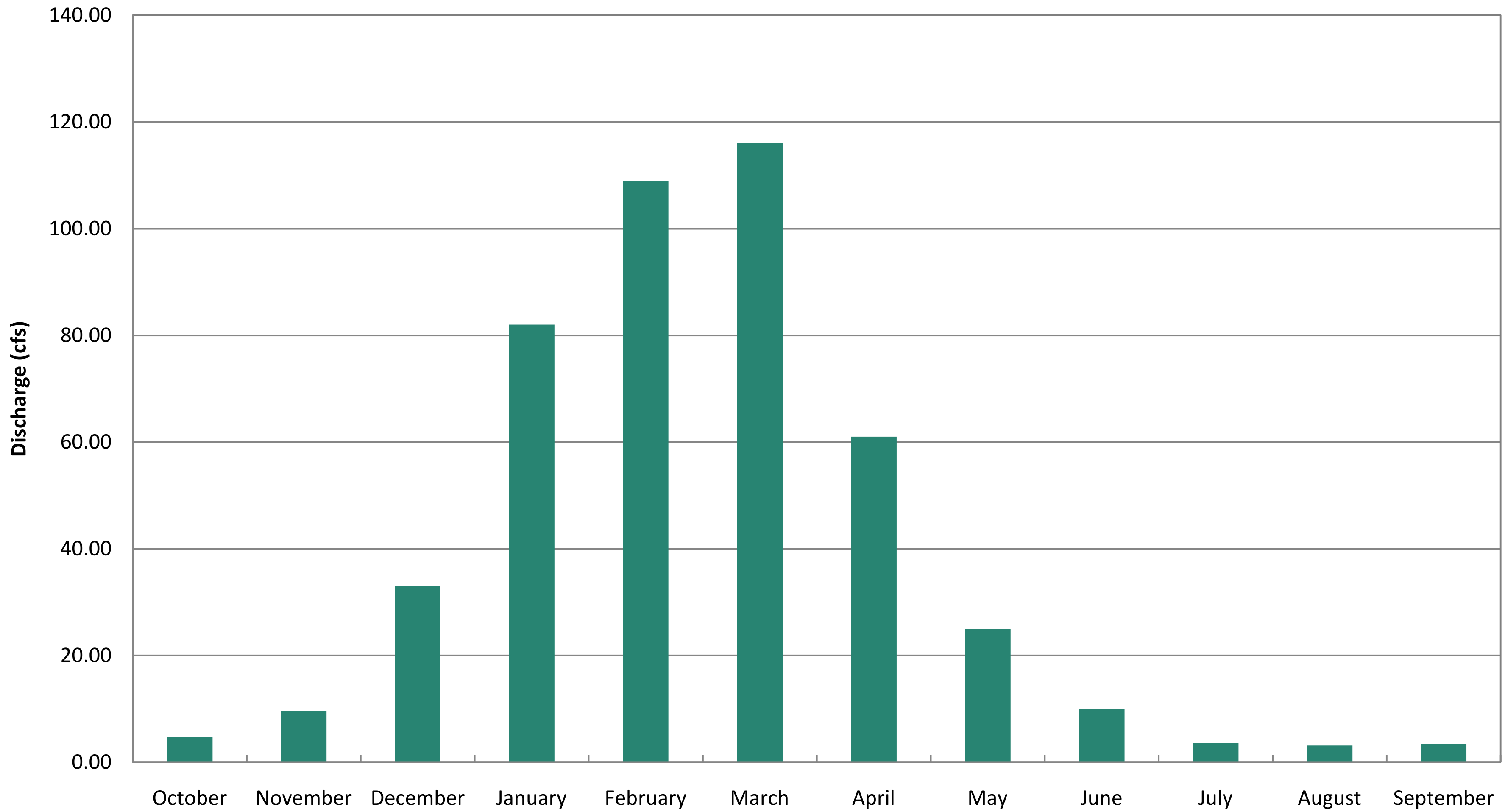
Golder Associates Inc., 2007. *Palouse Watershed Plan – Planning Unit Draft.* October 2007.

Idaho Department of Water Resources. 2010, Personal communication (email conversation) between Brian Ragan (Idaho Department of Water Resources Hydrogeologist) and Lizzi Bartosik (Staff Hydrogeologist, Golder) regarding: UIC regulations, August.

Pyne, R. David G. 1995. *Groundwater recharge and wells, a guide to aquifer storage and recovery*. Boca Raton, FL: CRC Press LLC.



Golder Associates	Period of Record 1934-1972 1960-1981 2001-2009	Title: Mean Monthly Discharge - South Fork Palouse River at Pullman, WA	Drawn: LMB Checked: YYY Reviewed: ZZZ
		Project Name: HDR/Moscow CWSP ASR/ID Project No.: 103-99760	
		Client Name: HDR Date: October 28, 2010	FIGURE 1

Appendix 7-1
Additional Hydraulic Model Analyses

Appendix 7-1
Additional Hydraulic Model Analysis

The following analyses were conducted to supplement the primary distribution system analysis prepared for the Comprehensive Water System Plan (CWSP). They considered system conditions and operations under specific scenarios that differ from those of the standard/routine analysis used for comprehensive planning purposes.

No. 1 – Well 10 Transmission Analyses

The City requested hydraulic analyses to determine the effect of system piping improvements associated with the installation of Well 10. Distribution and transmission projects had been identified previously by the City. These analyses examined the benefit associated with different projects as well as identified new projects to increase transmission capacity and reduce system pressure.

Capital Improvement Projects Considered (note: numbering is different than that in the body of the CWSP):

1. Not Used
2. Warbonnet Drive: 16" main from SH8 to A Street (1125').
3. SH8: 16" main from University Inn (Farm Road) to Warbonnet Drive (3600').
4. A Street Extension: 16" main from existing terminus of system east of Warbonnet Drive to Farm Road (2,600').
5. A Street: 12" main from Peterson to Line Street (660'), 16" main from Line Street to Jackson Street (2300').
6. Line Street: 16" main from A Street to SH8 (400').
7. Additional Improvement: 24" on 3rd St from Jackson St to Hayes St (3,600'); Replace 12" on Hayes St from 3rd St to 6th St (800')

Key Findings (details are provided in Tables 7-1A and 7-1B):

With One Well in Operation:

- CIP No. 4 is needed with the installation of Well 10 to avoid increasing system pressures near Well 10.
- CIP Nos. 2, 3, 5, and 6 provide minimal improvement (1-2 psi reduction) with only one well operating.
- CIP Nos. 2-6 do not reduce system pressures east of Line St. There is a slight increase in pressure (1-2 psi) when the NE and NW Tanks are full.

Well 9 and 10 Simultaneous Operation:

- There is a net increase in system pressure west of Line St between one well pumping with no improvements and both wells pumping with CIP Nos. 2-6. The pressure increase is 5 psi when the tanks are filling, and 10 psi when the NE and NW Tanks are full
- CIP Nos. 4, 5, and 6 provide the largest reduction in system pressure.
- CIP Nos. 2 and 3 provide a minimal reduction in system pressure west of Line St (1-3 psi).

- CIP Nos. 2-6 slightly increases the system pressure (1-2 psi) east of Line St when the NE and NW tanks are closed. This is a result of the improvements concentrating the flow from the wells into the downtown area consisting of a network of smaller diameter mains.
- When the NE and NW Tanks are full, CIP No.7 reduces system pressure an additional 8 psi.
- After CIP Nos. 4 has been installed with Well 10, the projects that provide the greatest system benefit with both wells pumping are No. 6, the 12" portion of No. 5, and No. 7. CIP Nos. 2, 3, and the 16" portion of 5 offer minimal improvement.

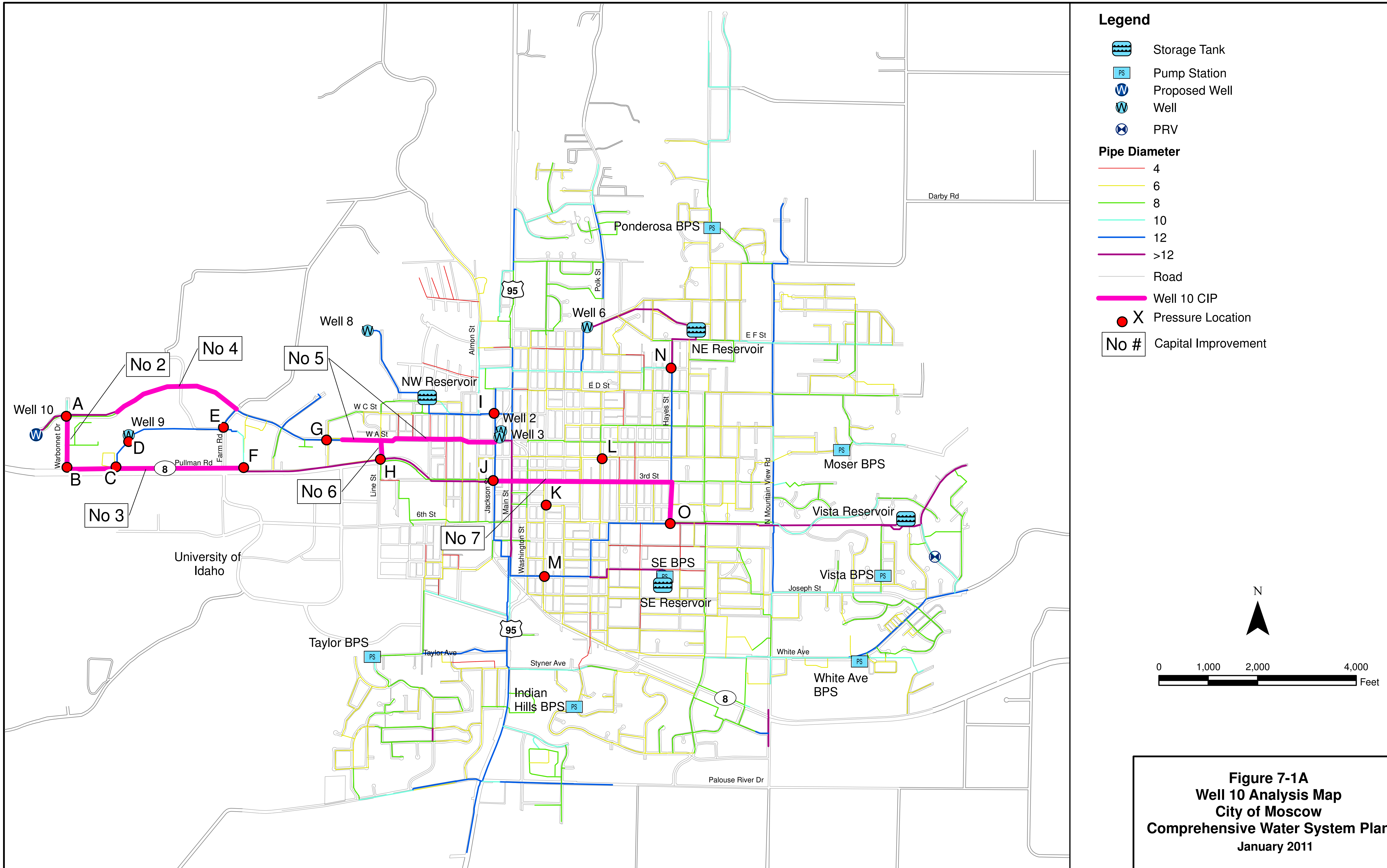


Figure 7-1A
Well 10 Analysis Map
City of Moscow
Comprehensive Water System Plan
January 2011

Table 7-1A Well 10 Analysis – One Well in Operation

Operating Condition											
NE and NW Tanks	FULL	FILLING	FULL	FILLING				FULL			
Wells in Operation	None	9	9	Well 10				Well 10			
CIP Scenarios	None	None	None	None	4	4,5,6	2-6	None	4	4,5,6	2-6
West of Line St	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)
A	85	90	101	111	89	88	86	119	100	98	97
B	108	113	124	123	111	109	109	132	122	120	119
C	108	113	125	113	110	109	108	123	121	120	119
D	103	108	119	106	104	103	102	117	115	114	113
E	105	106	118	105	106	105	104	116	117	116	115
F	105	105	116	104	104	103	103	115	115	114	114
G	89	89	101	88	89	87	87	99	101	98	98
H	100	99	110	98	98	98	98	109	109	109	109
East of Line St											
I	97	94	105	93	93	94	94	104	104	104	105
J	96	93	104	93	93	93	93	104	104	104	104
K	93	89	98	89	89	89	89	97	97	97	97
L	59	55	63	55	55	55	55	63	63	63	63
M	94	90	99	90	90	90	90	99	99	99	99
N	54	49	55	49	49	49	49	55	55	55	55
O	70	65	70	65	65	65	65	70	69	69	69

Table 7-1B Well 10 Analysis – Well 9 and 10 Simultaneous Operation

Operating Condition													
NE and NW Tanks	FULL	FILLING	FULL	FILLING					FULL				
Wells in Operation	None	9	9	Well 9 & 10					Well 9 & 10				
CIP Scenarios	None	None	None	None	4,5,6	2-6	4,5,6,7	4,7	None	4,5,6	2-6	4,5,6,7	4,7
West of Line St	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)
A	85	90	101	126	98	95	96	101	135	113	111	105	109
B	108	113	124	140	121	118	120	124	151	136	134	128	132
C	108	113	125	131	121	118	120	124	144	136	134	128	132
D	103	108	119	126	116	113	115	119	138	131	129	123	127
E	105	106	118	115	114	113	113	117	130	130	129	122	126
F	105	105	116	112	109	110	108	111	127	125	126	117	119
G	89	89	101	96	92	91	90	98	111	108	108	100	107
H	100	99	110	103	101	101	99	101	118	117	118	109	110
East of Line St													
I	97	94	105	95	95	95	94	93	111	111	112	103	103
J	96	93	104	95	95	95	93	93	110	111	111	101	101
K	93	89	98	90	90	90	89	89	102	103	103	97	97
L	59	55	63	56	56	56	55	55	67	68	68	63	63
M	94	90	99	91	91	91	91	91	103	104	104	98	98
N	54	49	55	50	50	50	50	50	58	58	58	57	57
O	70	65	70	65	65	65	65	65	71	71	71	72	72

No 2. - Available Fire Flow with 16” Transmission Main in Pullman Rd Out of Service

An additional analysis requested by the City was to determine the available fire flow in the western portion of the system with both the 16” transmission main on Pullman Rd and Well 9 offline. Figures 7-1B and 7-1C depict the results of the analysis for first the condition when Well 9 is operating with the transmission main open and second, the condition when Well 9 is off and the transmission main is closed. When the transmission main is closed on Pullman Rd, there are significant deficiencies throughout the western commercial area.

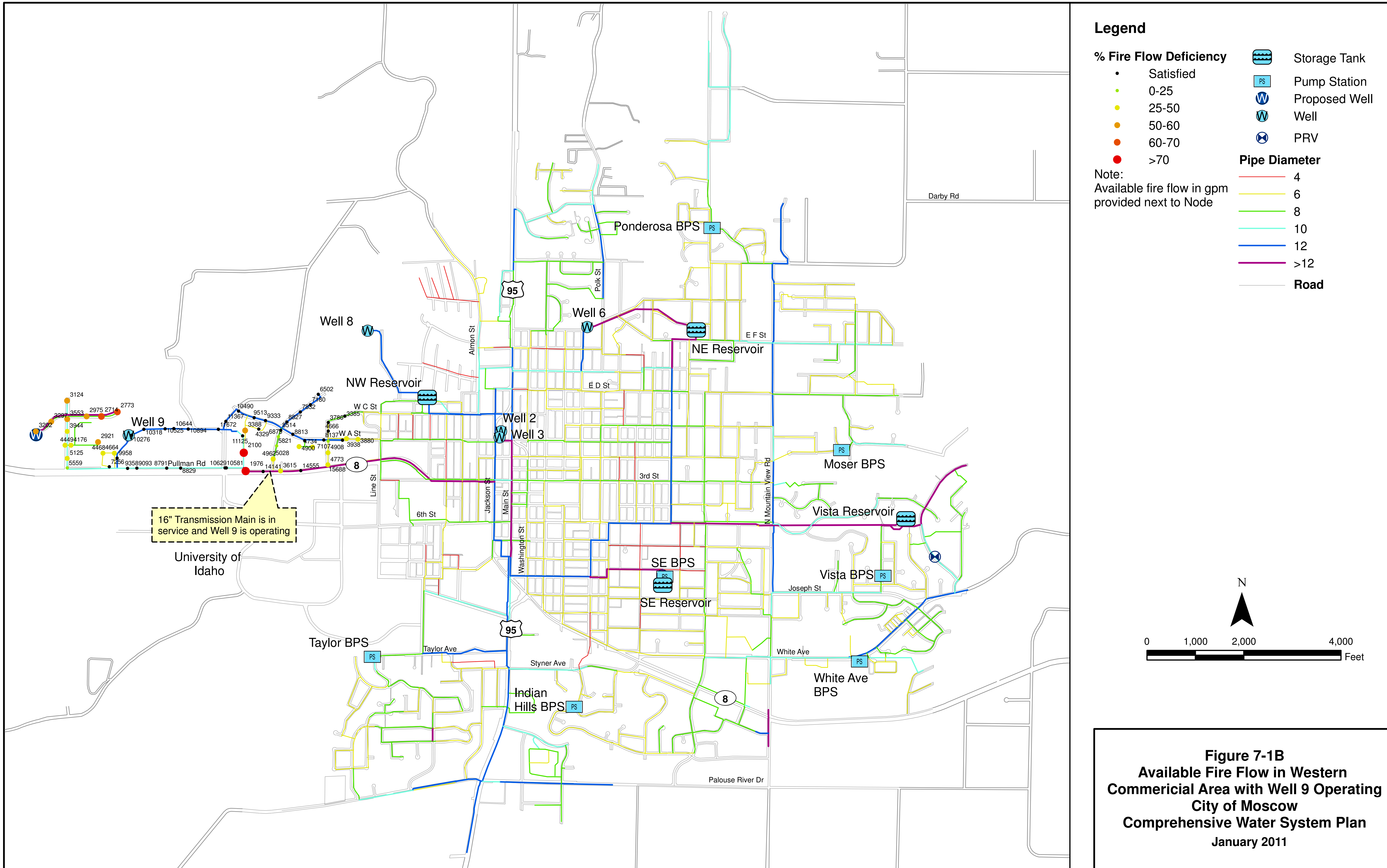


Figure 7-1B
Available Fire Flow in Western Commericial Area with Well 9 Operating
City of Moscow
Comprehensive Water System Plan
January 2011

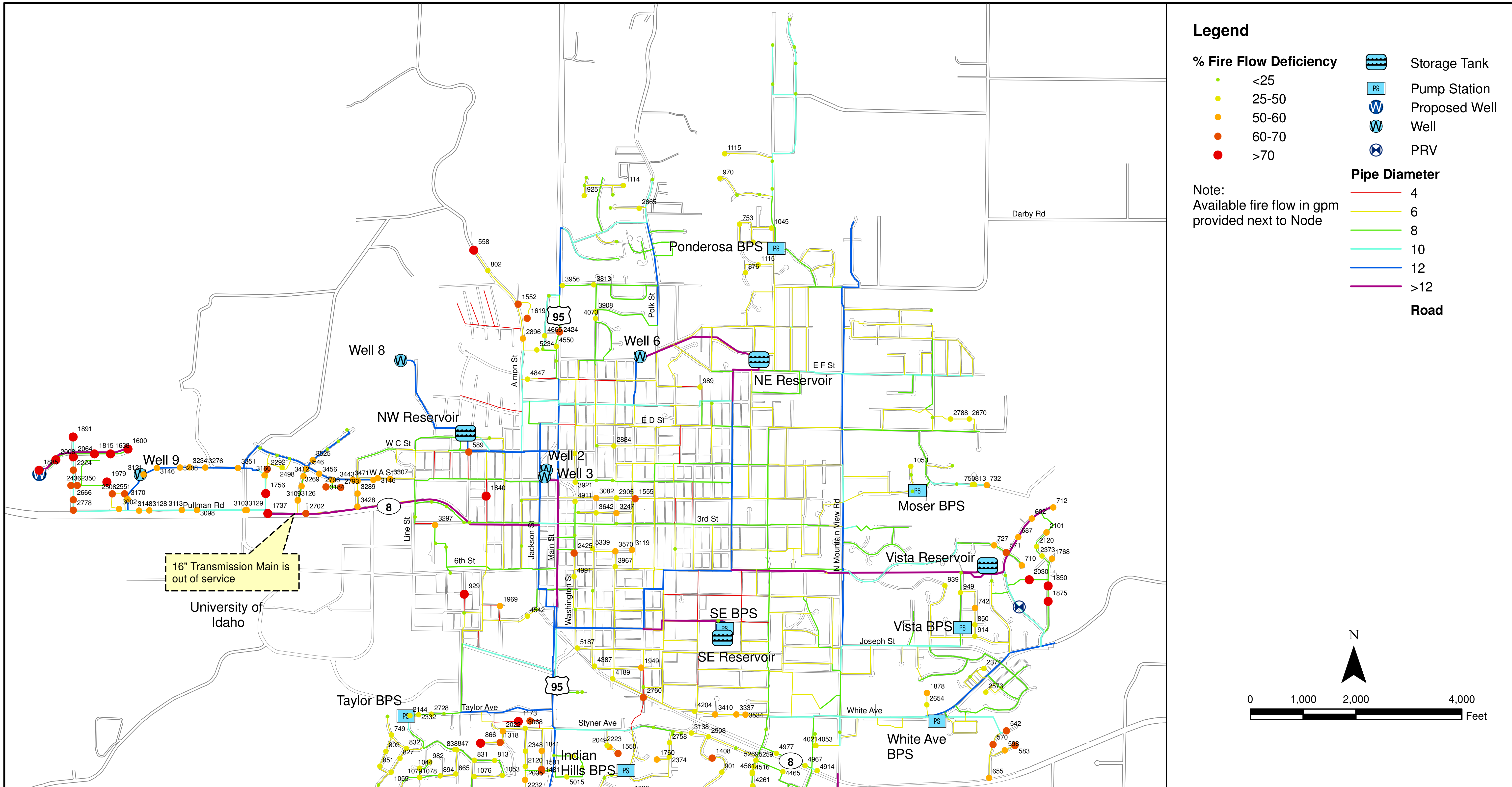


Figure 7-1C
Available Fire Flow w/ 16" Transmission Main and Well 9 Out of Service
City of Moscow
Comprehensive Water System Plan
January 2011

No 3. - EPS with Vista Offline

An extended period simulation (EPS) was conducted to evaluate system operations if the Vista Reservoir is taken off-line. If the system were to function without the Vista Reservoir, the well and SE Booster Control controls would need to be adjusted to maintain system operation. All controls are tied to the Vista Reservoir. A series of well control scenarios were run in the model to evaluate a potential function of the system without its main reservoir. In the following control scheme, the SE Booster Pump Station has operating controls tied to the NW reservoir, while all the wells are tied to the SE Reservoir. A float valve controls the flow into the SE Reservoir when the wells are pumping and the SE BPS is offline. Below are the actual controls that were used in the model.

SE Booster Controls (tied to the NW reservoir):
Pump 1 (600 gpm) – On when NW < 27, off when NW >30 (also closes when Filling Valve to SE is open)
Pump 2 (1200 gpm) – On when NW < 24, off when NW >30 (also closes when Filling Valve to SE is open)
Pump 3 (2200 gpm) – On when NW < 20, off when NW >30 (also closes when Filling Valve to SE is open)

Float valve on SE Reservoir:
Open when SE Reservoir <21, closes when >31 (also closes when well pumps are off)

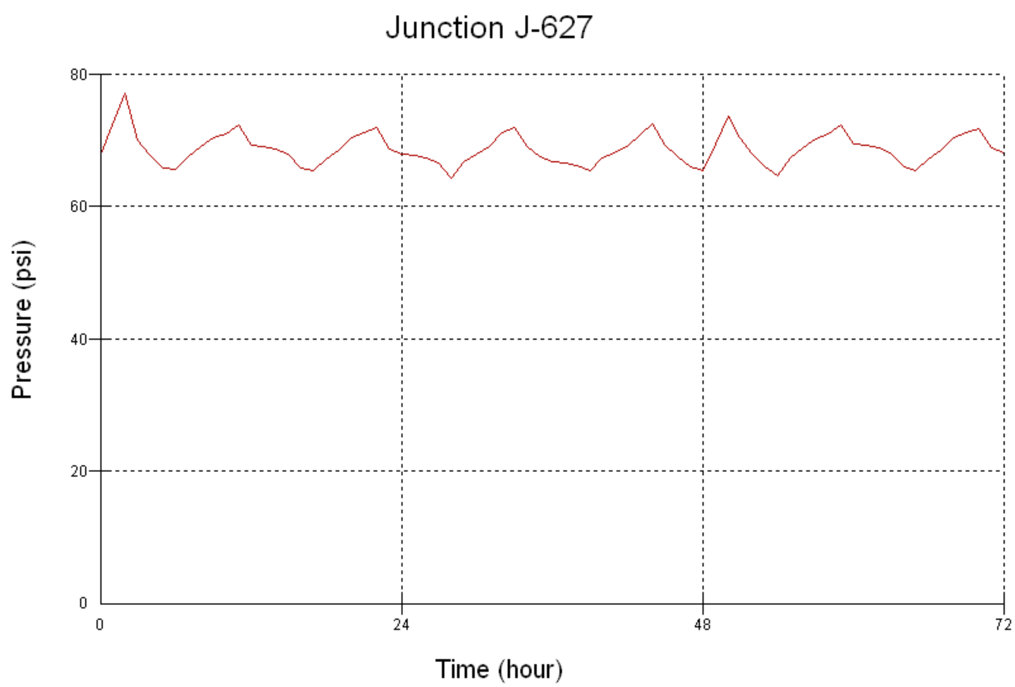
All wells:
On when SE Reservoir < 21, offline when SE Reservoir >31, also set to close when pressure at one node, depicted in the charts below is >80 psi.

Under these settings, the system can function and meet demands. The wells will cause a high pressure spike downtown if the SE BPS is offline, the NW and NE Reservoirs area full, and there is low demand in the system. The float valve is set to fill the SE Reservoir at a certain rate to maintain system pressures upstream, and as such, the condition can occur when the wells are pumping at a higher capacity then the total demand in the system and the rate of flow into the SE Reservoir. Further analysis should be performed to identify a viable solution if the system were to be operated without the Vista Reservoir for an extended period of time.

A series of charts is presented below showing the operation of the system during the EPS analysis. The charts depict system pressure, reservoir levels, and pump operations.

The following is the system pressure at the intersection of 6th St and Van Buren St (Moscow High School is adjacent). This is the normal pressure under MDD with the SE Reservoir offline.

Chart 7-1A– Normal System Pressure at 6th St and Van Buren St



The system pressure is shown below when Vista is offline and the SE Booster and Reservoir is operating.

Chart 7-1B– System Pressure at 6th St and Van Buren St with Vista Reservoir Offline

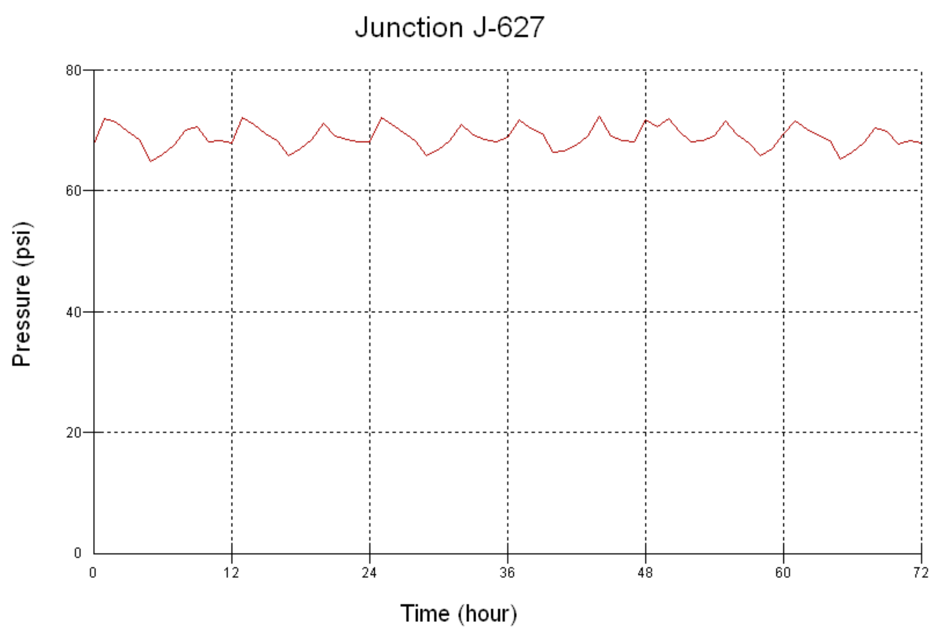


Chart 7-1C– SE Reservoir Level Profile with Vista Offline

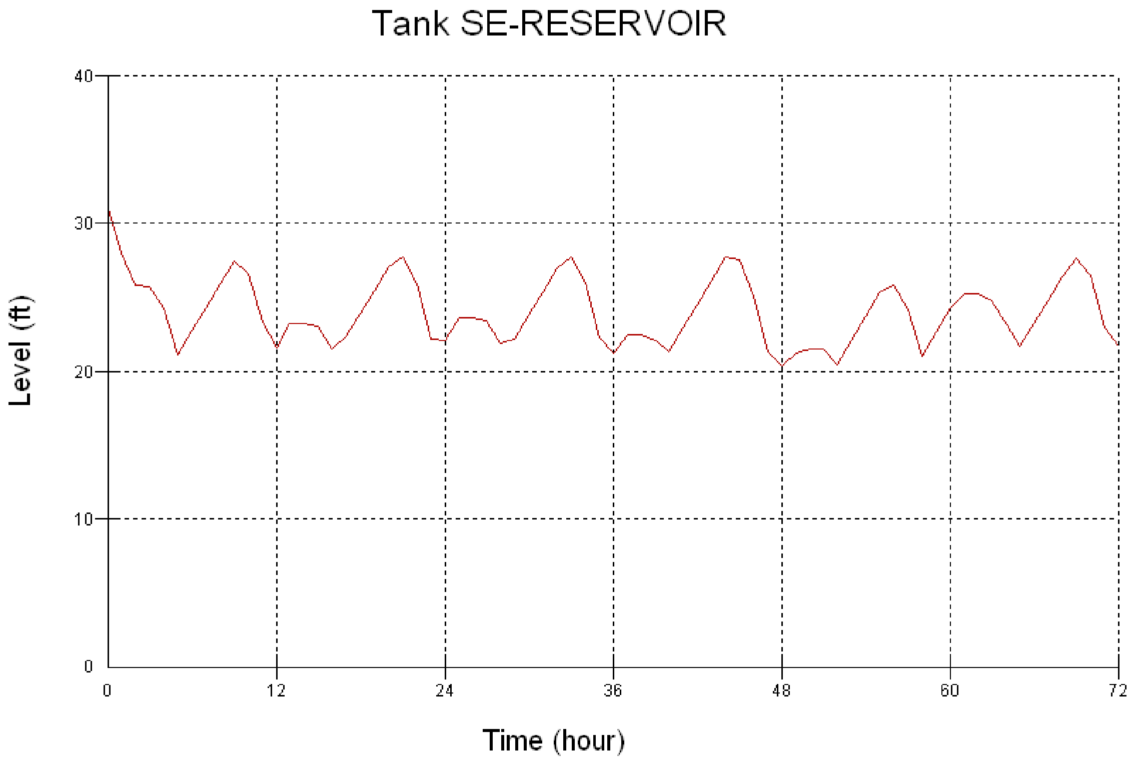


Chart 7-1D– NE Reservoir Level Profile with Vista Offline

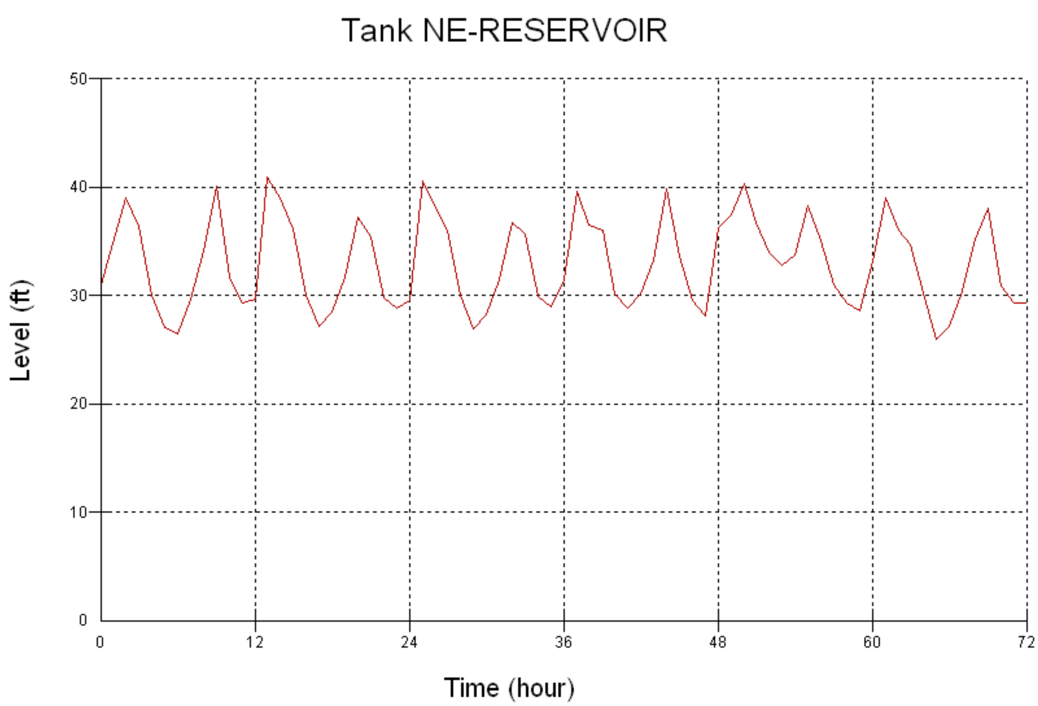


Chart 7-1E– NW Reservoir Level Profile with Vista Offline

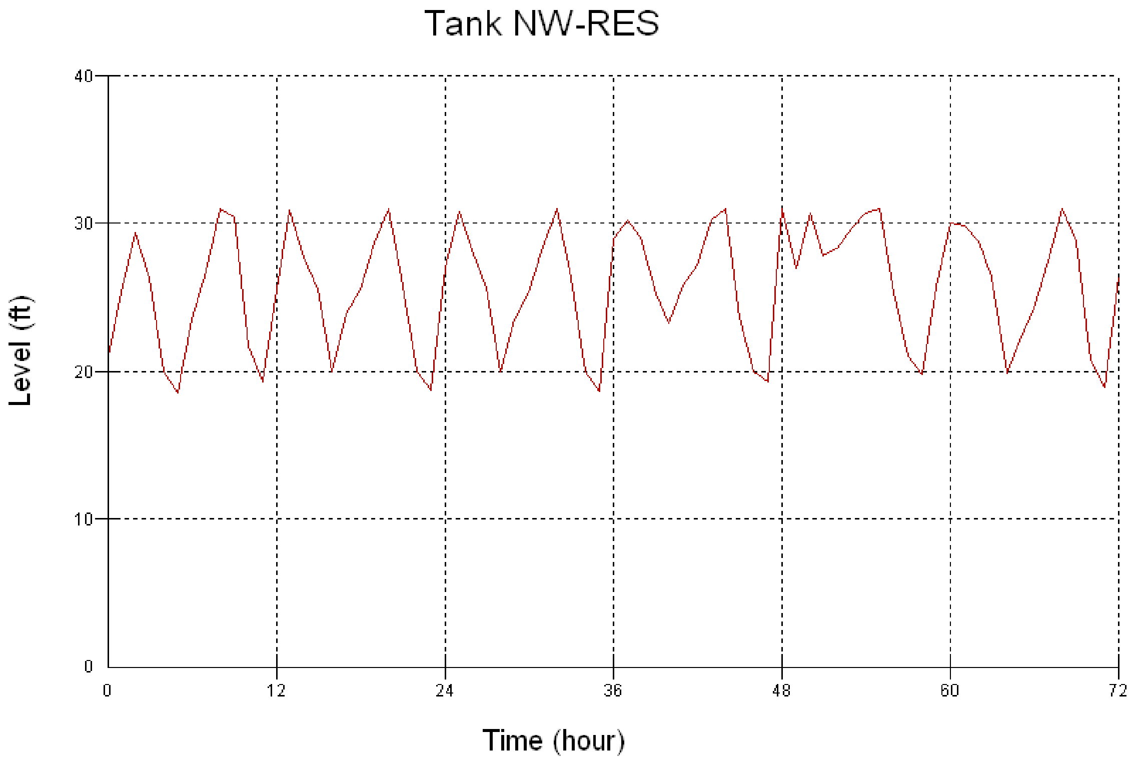


Chart 7-1F– Well Operation Profile with Vista Offline

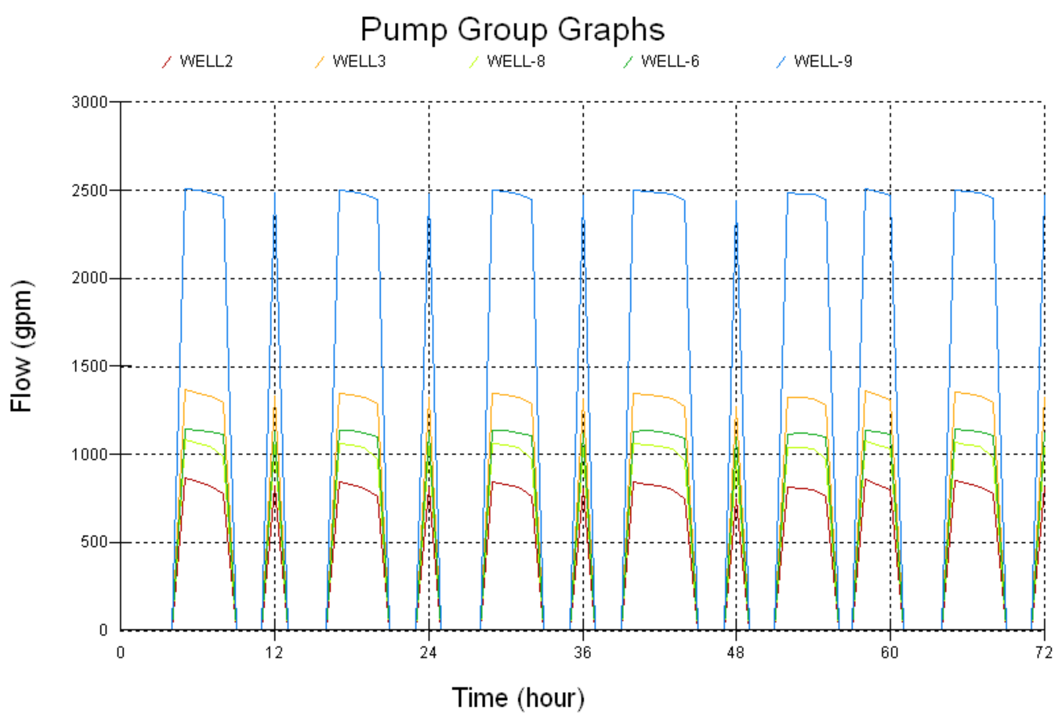
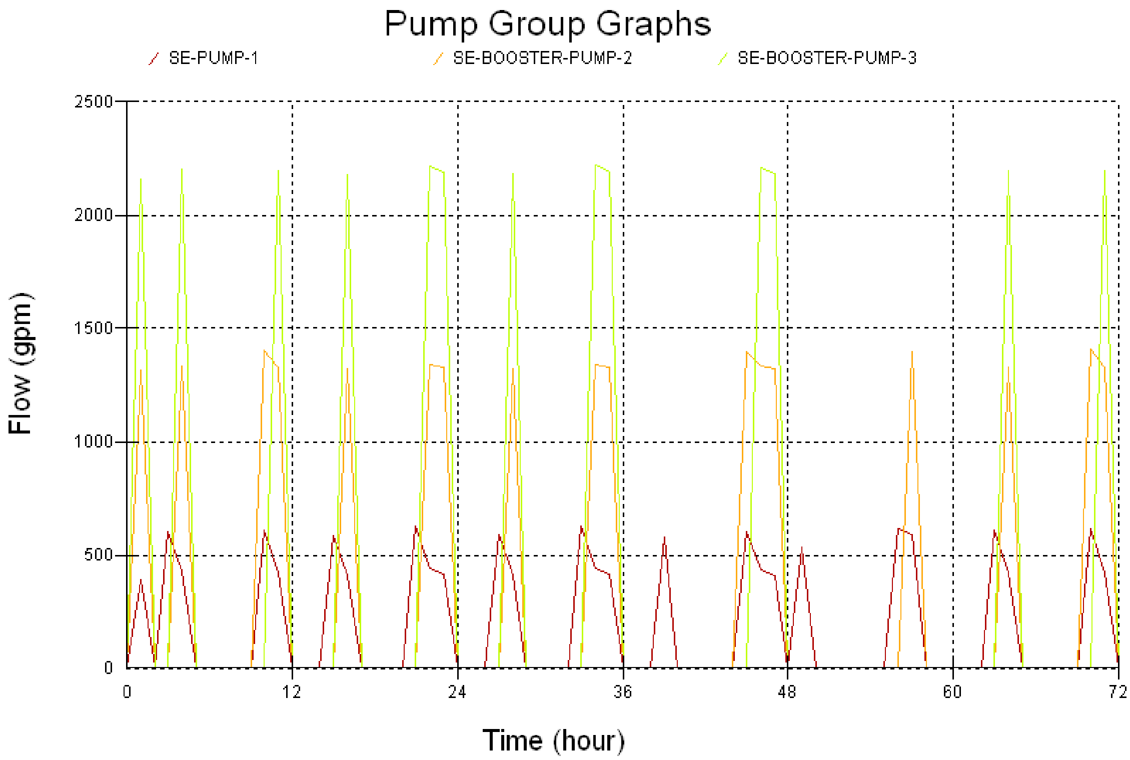


Chart 7-1G– SE Booster Pump Station Operation with Vista Offline


Pump Group Graphs
SE-PUMP-1
SE-BOOSTER-PUMP-2
SE-BOOSTER-PUMP-3
Flow (gpm)
2500
2000
1500
1000
500
0
0
12
24
36
48
60
72
Time (hour)

No. 4 – Extreme Event Fire Flow Analyses

The following are a series of analyses performed to determine fire flow provision under extreme "worst case" fire flow demands as defined by the City of Moscow Fire Department. The three fire flow scenarios analyzed in different parts of the system were for commercial, multi-family, and residential fire flow. The demands for each are as follows:

- Commercial Worst Case Scenario – 7,250 gpm for 4 hours followed by 3,625 gpm for 4 hours
- Multi-family Worst Case Scenario – 4,250 gpm for 2 hours per each of three structures for a total of 12,750 gpm
- Residential Worst Case Scenarios - 1,500 gpm for 2 hours per each of ten structures for a total of 15,000 gpm.

Figure 7-1D depicts the location of each analysis with detailed results presented below.

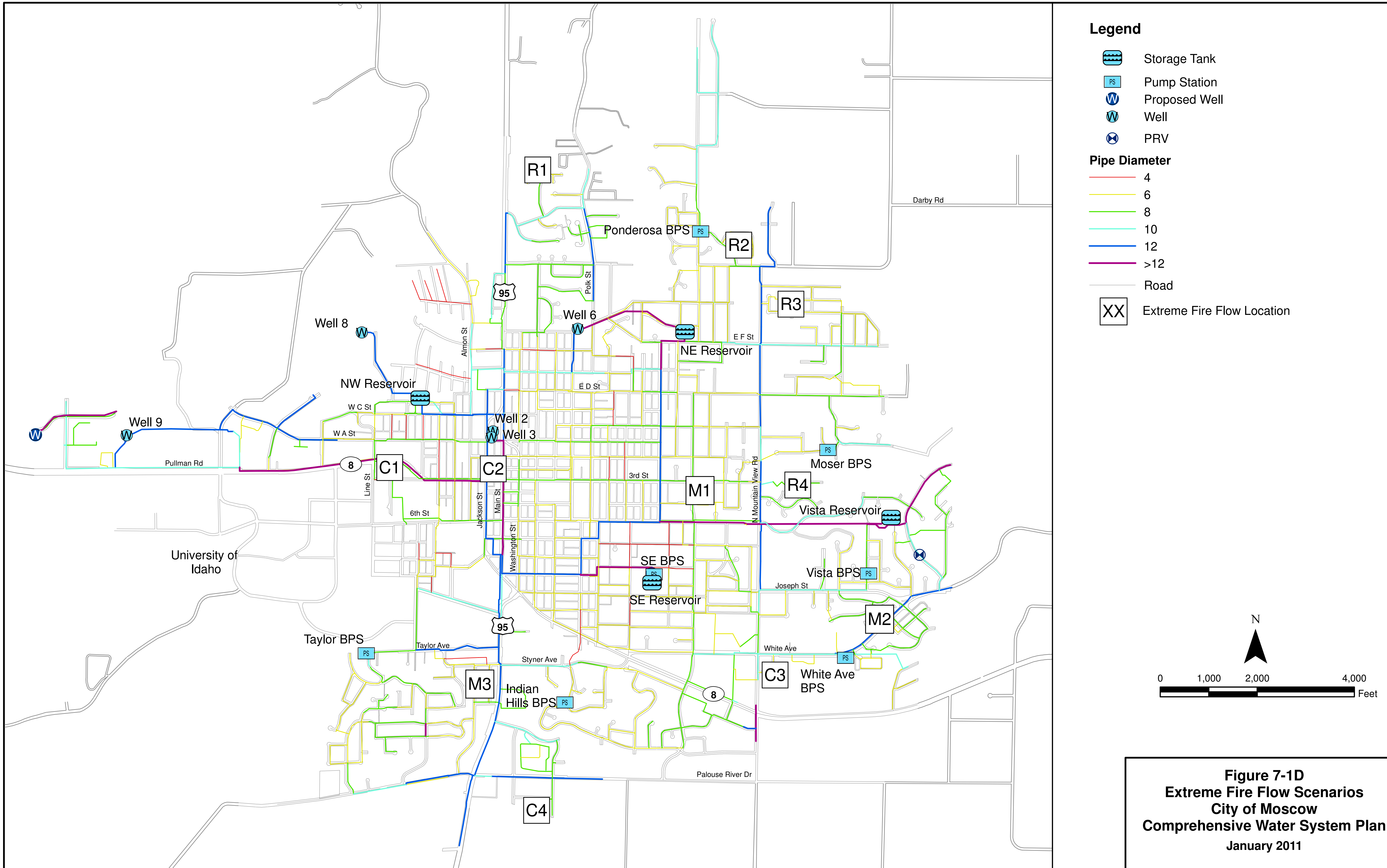


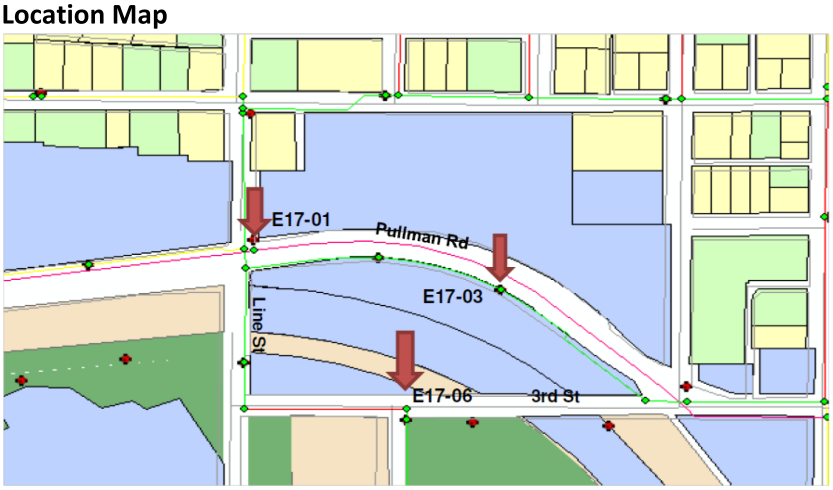
Figure 7-1D
Extreme Fire Flow Scenarios
City of Moscow
Comprehensive Water System Plan
January 2011

Scenario C1 – Motor Business Area Extreme Fire Flow Event

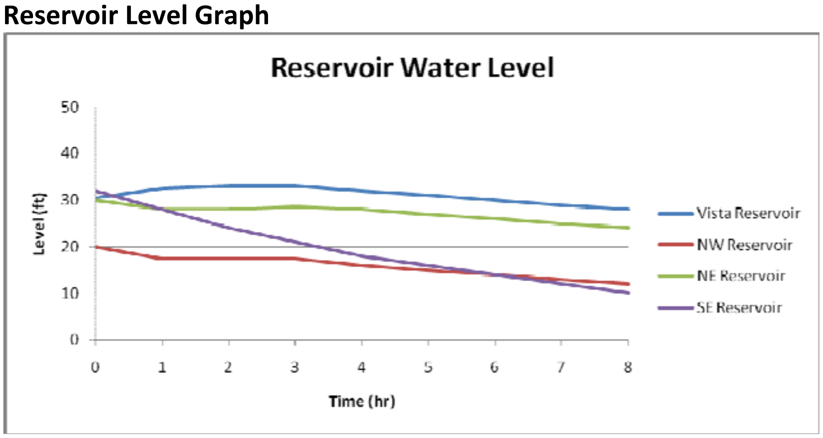
- **Conditions**
  - Hydrants flowing: E17-01, E17-03, and E17-06
  - Duration: 8 Hrs
  - All Wells and three pumps at SE BPS are operating
- **Objectives**
  - 7,250 gpm for 4 hours then 3,625 gpm for 4 hours
- **Result – Available or Not**
  - Yes

Time(hr)	Hydrant E17-01 Flow (gpm)	Hydrant E17-03 Flow (gpm)	Hydrant E17-06 Flow (gpm)	Total Combined Flow (gpm)
1	4250	2000	1000	7250
2	4250	2000	1000	7250
3	4250	2000	1000	7250
4	4250	2000	1000	7250
5	2125	1000	500	3625
6	2125	1000	500	3625
7	2125	1000	500	3625
8	2125	1000	500	3625

Location Map



Reservoir Level Graph



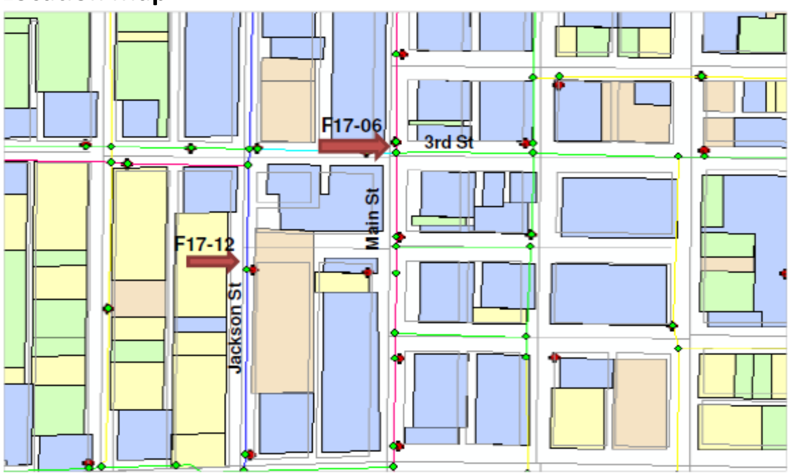
Scenario C2 - Central Business District Extreme Fire Flow Event

- **Conditions**

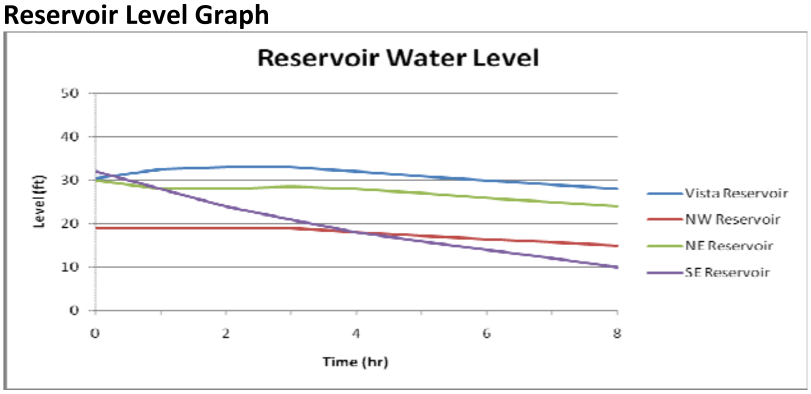
- Hydrants flowing: F17-06, F17-12
  - Duration: 8 Hrs
  - All Wells and three pumps at SE BPS are operating
- **Objectives**
  - 7,250 gpm for 4 hours then 3,625 gpm for 4 hours
- **Result – Available or Not**
  - Yes

Time(hr)	Hydrant F17-06 Flow (gpm)	Hydrant F17-12 Flow (gpm)	Total Combined Flow (gpm)
1	4250	3000	7250
2	4250	3000	7250
3	4250	3000	7250
4	4250	3000	7250
5	2125	1500	3625
6	2125	1500	3625
7	2125	1500	3625
8	2125	1500	3625

Location Map



Reservoir Level Graph

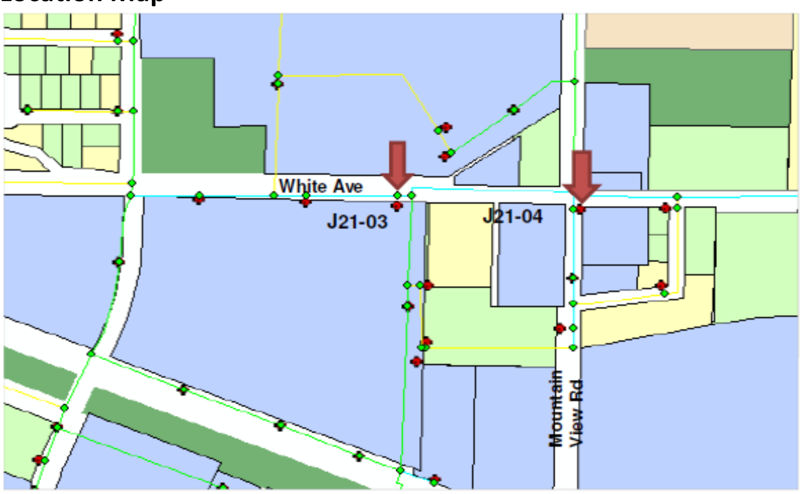


Scenario C3 - Commercial Extreme Fire Flow Event

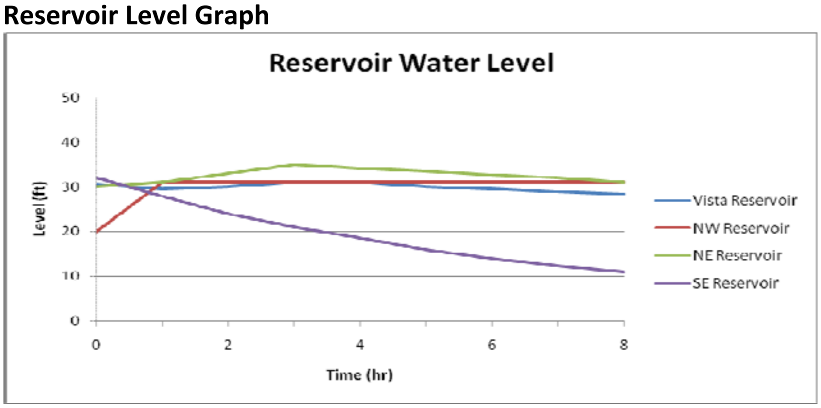
- **Conditions**
  - Hydrants flowing: J21-03, J21-04
  - Duration: 8 Hrs
  - All Wells and three pumps at SE BPS are operating
- **Objectives**
  - 7,250 gpm for 4 hours then 3,625 gpm for 4 hours
- **Result – Available or Not**
  - No - 6000 gpm for initial 4 hours

Time(hr)	Hydrant J21-03 Flow (gpm)	Hydrant J21-04 Flow (gpm)	Total Combined Flow (gpm)
1	2500	3500	6000
2	2500	3500	6000
3	2500	3500	6000
4	2500	3500	6000
5	1500	2125	3625
6	1500	2125	3625
7	1500	2125	3625
8	1500	2125	3625

Location Map



Reservoir Level Graph

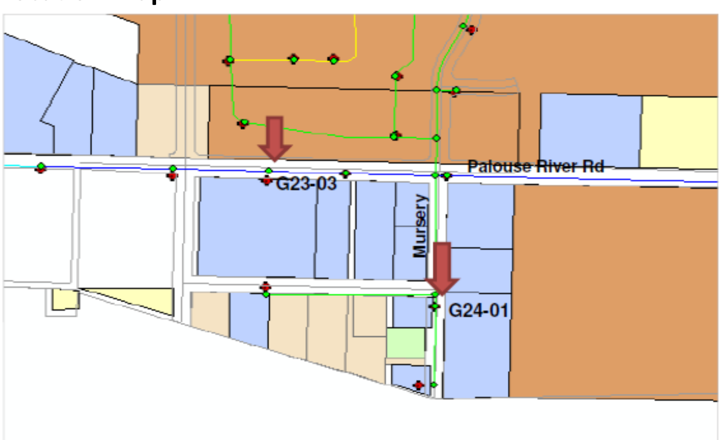


Scenario C4 - Commercial Extreme Fire Flow Event

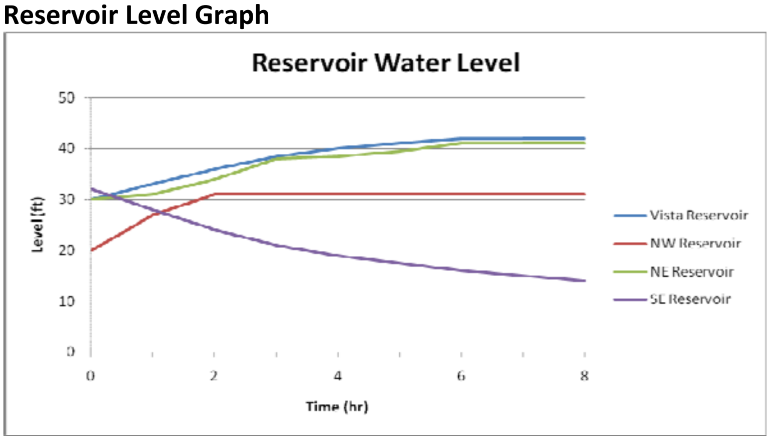
- **Conditions**
  - o Hydrants flowing: G24-01, G23-03
  - o Duration: 8 Hrs
  - o All Wells and three pumps at SE BPS are operating
- **Objectives**
  - o 7,250 gpm for 4 hours then 3,625 gpm for 4 hours
- **Result – Available or Not**
  - o No - 4000 gpm for initial 4 hours

Time(hr)	Hydrant G24-01 Flow (gpm)	Hydrant G23-03 Flow (gpm)	Total Combined Flow (gpm)
1	1500	2500	4000
2	1500	2500	4000
3	1500	2500	4000
4	1500	2500	4000
5	1250	2375	3625
6	1250	2375	3625
7	1250	2375	3625
8	1250	2375	3625

Location Map



Reservoir Level Graph

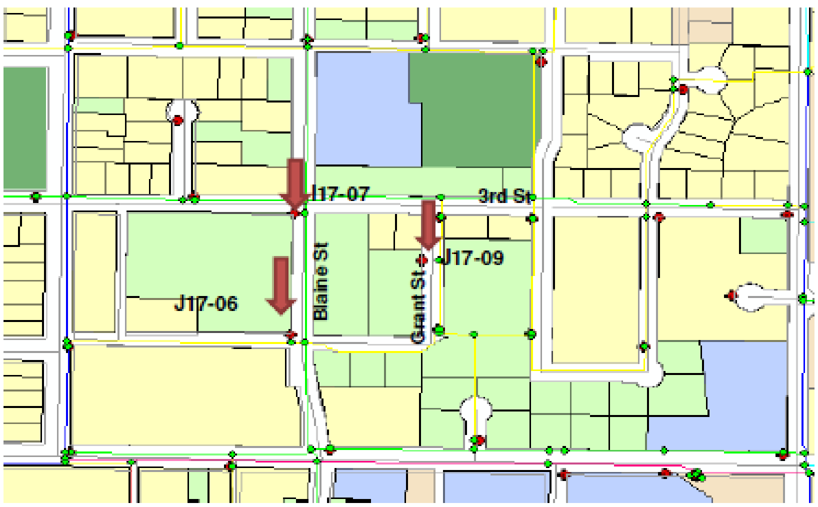


Scenario M1 - Multi-Family Fire Flow Event

- **Conditions**
  - Hydrants flowing: J17-09, I17-06, I17-07
  - Duration: 2 hrs
  - All Wells and three pumps at SE BPS are operating
- **Objectives**
  - 12,750 gpm for 2 hours
  - (4,250 gpm per structure for 2 hours for 3 total structures)
- **Result – Available or Not**
  - Yes

Time(hr)	Hydrant J17-09 Flow (gpm)	Hydrant I17-07 Flow (gpm)	Hydrant J17-06 Flow (gpm)	Total Combined Flow (gpm)
1	1223	8114	4021	13358
2	1143	7520	3853	12516

Location Map

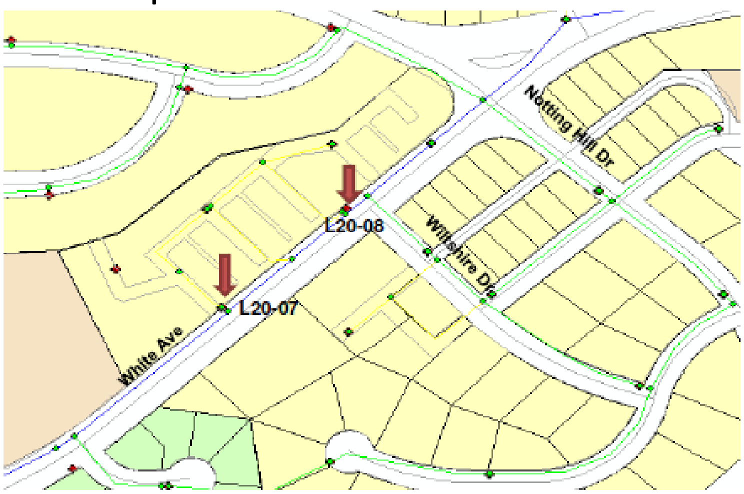


Scenario M2 - Multi-Family Fire Flow Event

- **Conditions**
  - Hydrants flowing: L20-08, L20-07
  - Duration: 2 hrs
  - All Wells and three pumps at SE BPS are operating
- **Objectives**
  - 12,750 gpm for 2 hours
  - (4,250 gpm per structure for 2 hours for 3 total structures)
- **Result – Available or Not**
  - No ~ 5460 gpm

Time(hr)	Hydrant L20-08 Flow (gpm)	Hydrant L20-07 Flow (gpm)	Total Combined Flow (gpm)
1	2754	2708	5462
2	2754	2708	5462

Location Map

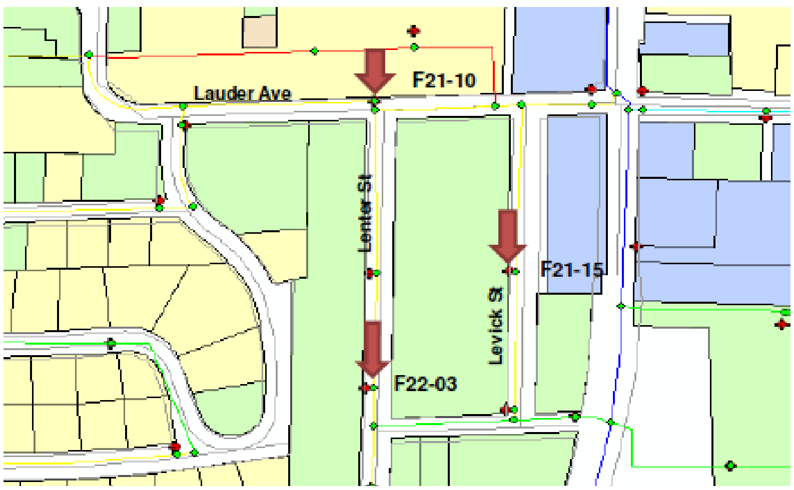


Scenario M3 - Multi-Family Fire Flow Event

- **Conditions**
  - o Hydrants flowing: F21-15, F22-03, F21-10
  - o Duration: 2 hrs
  - o All Wells and three pumps at SE BPS are operating
- **Objectives**
  - o 12,750 gpm for 2 hours
  - o (4,250 gpm per structure for 2 hours for 3 total structures)
- **Result – Available or Not**
  - o No ~ 3900 gpm

Time(hr)	Hydrant F21-15 Flow (gpm)	Hydrant F22-03 Flow (gpm)	Hydrant F21-10 Flow (gpm)	Total Combined Flow (gpm)
1	1191	523	2165	3880
2	1188	517	2157	3862

Location Map

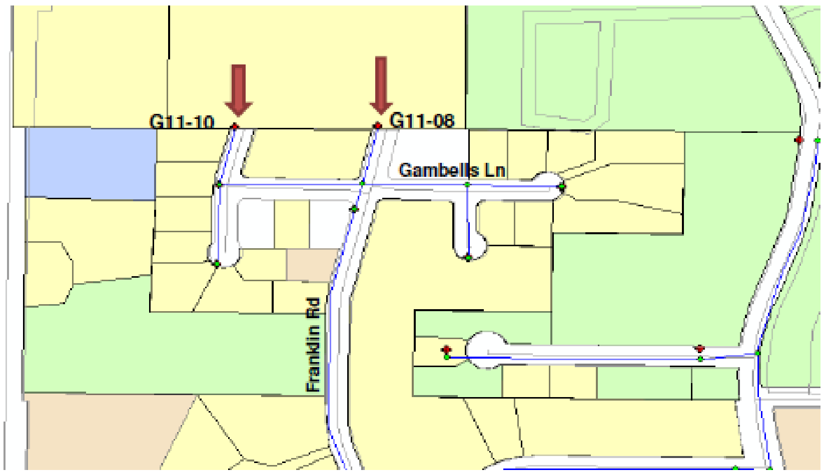


Scenario R1 - Single Family Residential Fire Flow Event

- **Conditions**
  - Hydrants flowing: G11-08, G11-10
  - Duration: 2 hrs
  - All Wells and three pumps at SE BPS are operating
- **Objectives**
  - 15,000 gpm for 2 hrs
  - (1,500 gpm per structure for 2 hours for 10 total structures)
- **Result – Available or Not**
  - No ~ 2000 gpm

Time(hr)	Hydrant G11-10 Flow (gpm)	Hydrant G11-08 Flow (gpm)	Total Combined Flow (gpm)
1	350	1609	1959
2	357	1631	1988

Location Map

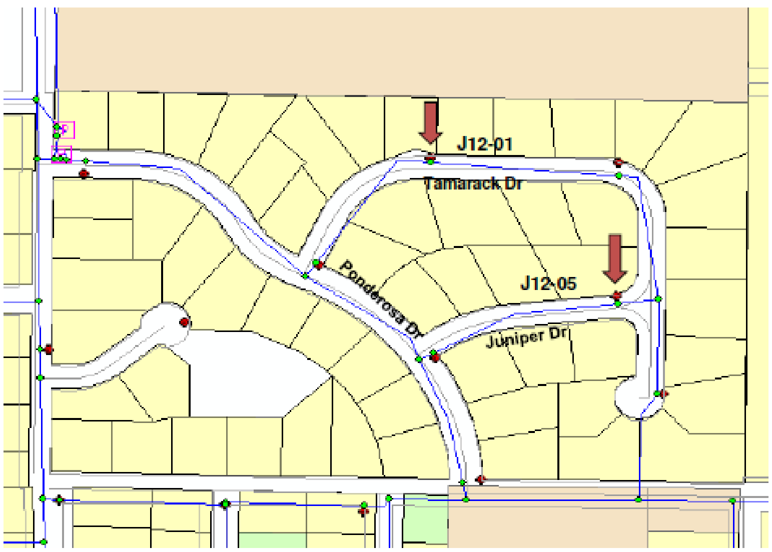


Scenario R2 - Single Family Residential Fire Flow Event

- **Conditions**
  - o Hydrants flowing: J12-01, J12-05
  - o Duration: 2 hrs
  - o All Wells and three pumps at SE BPS are operating
- **Objectives**
  - o 15,000 gpm for 2 hrs
  - o (1,500 gpm per structure for 2 hours for 10 total structures)
- **Result – Available or Not**
  - o No ~ 3400 gpm

Time(hr)	Hydrant J12-01 Flow (gpm)	Hydrant J12-05 Flow (gpm)	Total Combined Flow (gpm)
1	1355	2034	3388
2	1372	2062	3434

Location Map



Scenario R3 - Single Family Residential Fire Flow Event

- **Conditions**
  - Hydrants flowing: K17-06, K17-05
  - Duration: 2 hrs
  - All Wells and three pumps at SE BPS are operating
- **Objectives**
  - 15,000 gpm for 2 hrs
  - (1,500 gpm per structure for 2 hours for 10 total structures)
- **Result – Available or Not**
  - No ~ 5100 gpm

Time(hr)	Hydrant K17-06 Flow (gpm)	Hydrant K17-05 Flow (gpm)	Total Combined Flow (gpm)
1	3,011	2,037	5048
2	3,059	2,111	5170

Location Map

Appendix 8-1
CIP Project Prioritization

Technical Memorandum
City of Moscow Comprehensive Water System Plan

HDR

Date: December 30, 2010 (Updated January 28, 2011)

Subject: Capital Project Prioritization Approach

To: Les MacDonald and Tom Scallorn, City of Moscow

From: Jeff Hansen, HDR

HDR is assisting the City of Moscow in developing its 2010 Comprehensive Water System Plan (CWSP). One major element of this process is developing the water utility's Capital Improvement Plan (CIP). A procedure has been developed to systematically compare and prioritize a range of different capital projects. The protocol provided below provides a consistent basis for characterizing the benefits from capital projects, comparing projects and documenting the reasons why certain projects are selected for funding. However, a simple scoring system cannot fully cover every consideration that may apply to a wide range of projects. It is anticipated that this scoring procedure will be used as an initial step, and that the water utility's management will then review the results, assess other applicable information as appropriate, and then select a set of capital projects to advance.

This process was given a "trial run" at a November 4, 2010 workshop attended by City, HDR, and Taylor Engineering staff. The process was used to score and rank 10 projects. Refinements were made to the process and have been incorporated in the information below. City staff then completed the prioritization process by scoring all projects in late January 2011.

Criteria for Comparing Projects

Eight criteria are proposed for comparing projects, each intended to address the primary benefits provided by typical water utility capital projects. Each criterion has an associated scoring system that can be used to calculate a project priority score.

In addition to the raw scores, each of these criteria can be weighted. This allows some criteria to more strongly influence the selection and prioritization of projects. The eight criteria together with suggested weights are shown below.

Criteria	Weights
1. Reliability/Protection of Prior Investments	8
2. Regulatory Requirements (mandatory)	10
3. Growth/Expansion	5
4. Water Quality (non-regulatory)	3
5. Cost Control or Cost-Sharing Opportunities	7
6. Safety and Security	7
7. Environmental Stewardship	5
8. Information Benefits	4

Criteria Definitions and Scoring

This section provides a system for scoring each project based on the eight criteria listed above. It should be noted that any given project may be proposed in order to meet a specific need represented by a single criterion. However, many projects offer ancillary benefits as well. Therefore each project should be reviewed for the full range of criteria listed.

Reliability/Protection of Prior Investments

Reliability and Protection of Prior Investments refers to improvements in the reliability of actual water service; or reinvestment in existing facilities. Examples of projects in this category are:

- Replacement of leak-prone distribution pipe
- Installation of stand-by power at a treatment plant or pump station
- Any significant repair or replacement project
- Projects to protect the City's ground water resources for long-term viability

Project Ranking Scores	
Reliability/Protection of Prior Investments	**Ranking Score**
Weight = 8	
Project does not affect reliability or reinvest in, or protect existing physical assets/resources	0
Project offers slight reliability improvement or reinvestment in *non-critical* assets/resources.	1
Project offers significant reliability improvements or reinvestment in *non-critical* assets/resources	2
Project offers reliability improvements or reinvestment in *critical* assets/resources	3

Regulatory Requirements or Binding Commitments

The water industry is subject to federal, state and local regulations. New or more stringent regulations sometimes require construction of new facilities, or improvements to existing facilities. This criterion is intended to recognize the importance of meeting mandatory requirements. In addition, it addresses projects the City has agreed to through binding commitments to other agencies. Examples of projects for this criterion are:

- Additional/upgraded treatment facilities or processes required to meet drinking water standards.
- Infrastructure upgrades/replacements to address fire flow deficiencies.
- Franchise or contract required action or project.
- Projects required by contracts or Memoranda of Agreement the City has signed with other local jurisdictions, state agencies or Indian Tribes.

Project Ranking Scores	
Regulatory Requirements & Binding Commitments	**Ranking Score**
Weight = 10	
Project does not address regulatory requirements or binding commitments	0
Project addresses a deficiency in meeting *current (but not significant)* or *future* regulatory requirements or obligations (e.g., a project that partially reduces a fire flow deficiency or resolves a minor one)	1
Project addresses a deficiency in meeting *current and significant* regulatory requirements or obligations (e.g., a project that fully resolves a fire flow deficiency)	3

Growth/Expansion

This criterion is intended to work in conjunction with the City's comprehensive plan regarding growth and expansion. It would give priority to projects that increase the system's capacity to serve planned growth within the service area, and that are not funded by developer contributions. Examples of projects in this category are:

- Expansion of a treatment facility to provide capacity to new customers.
- Installation or expansion of storage facilities to meet increased supply needs to a zone.
- Up-sizing a pump station or transmission line.

Project Ranking Scores	
Growth/Expansion	**Ranking Score**
Weight = 5	
Project does not address growth or capacity needs	0
Project slightly improves capacity for future growth	1
Project provides significant expanded capacity for growth	3

Water Quality (Non-Regulatory)

This criterion addresses projects which enhance or improve the City's water quality but are not mandated under state or federal regulations. It would give priority to projects which either address standards that are not actually required, or invest in going well beyond required water quality standards. It is intended to allow consideration of these factors but avoid overlap with Criterion #2 (Regulatory-Driven or Mandated). Examples of projects in this category are:

- Water treatment projects that reduce taste, color or odor problems not mandated by law.
- Improve monitoring/testing facilities to improve tracking of water quality issues.
- Water main improvements/replacements or looping projects that will improve water quality in various areas of the system.

Project Ranking Scores	
Water Quality – Non-Regulatory	**Ranking Score**
Weight = 3	
Project will not affect water quality	0
Project will improve water quality for < 20% of customers	1
Project will improve water quality for > 20% of customers	3
Project will address a widespread customer concern	10

The scoring table above includes a category for projects addressing water quality concerns that are not required by law but that cause "widespread customer concern." This reflects the City's intent to avoid conditions that cause substantial dissatisfaction among customers with taste, odor or color of the City's water supply.

Cost Control

This criterion is intended to advance cost effective/reduced cost projects. It would give priority to projects which reduce future costs or are subsidized (partially or completely) by others. Examples of projects in this category are:

- Projects that qualify for one-time grants.
- Projects that can be coordinated with other projects where the City pays only a portion of the costs (e.g., combined utility replacement and street paving projects).
- Automation or other improvements that reduce labor or other operational costs.
- Installation of energy efficient equipment where the cost of the project is recovered from savings in energy costs.

Project Ranking Scores	
Cost Control	**Ranking Score**
Weight = 7	
Project will not result in cost savings	0
Project will result in slight cost savings	1
Project will result in significant cost savings	3

Safety and Security

This criterion is intended to advance projects which enhance or safeguard the public health and safety, or address security concerns related to the City's water system. Examples of projects in this category are:

- Security enhancements.
- Projects that enhance City worker safety or reduce liability due to safety issues.
- Projects that reduce public exposure to chemical hazards, such as those posed by some forms of chlorine storage.

Not included in this category are projects that address Regulatory Requirements, such as those that reduce fire flow deficiencies. Although those types of projects do have a positive impact on safety, scoring them here would result in double-counting.

Project Ranking Scores	
Safety and Security	**Ranking Score**
Weight = 7	
Project will not affect safety or security	0
Project will have slight effect upon safety or security	1
Project will have significant effect upon safety or security	3

Environmental Stewardship

This criterion is intended to advance projects which enhance the City's environmental stewardship. Examples of projects in this category are:

- Projects to improve fish habitat in local streams or lakes.
- Reclaimed water or conservation projects that reduce withdrawals of ground water or reduce impacts on stream flow.
- Projects that improve long-term sustainability of local aquifers.
- Projects that reduce carbon emissions.

Project Ranking Scores	
Environmental Stewardship **Weight = 5**	**Ranking Score**
Proposed project does not enhance environmental quality	0
Proposed project would provide only a limited enhancement of environmental quality	1
Proposed project would represent a significant enhancement to the natural environment or advance resource sustainability	3

Information Benefits

This criterion allows projects that generate valuable information for managing the water system or making decisions to receive points in the ranking system. Typically these will be studies, monitoring systems; or information hardware/software systems that are funded through the capital budget. Examples include:

- GIS mapping.
- Water quality study.
- Maintenance management software.

Project Ranking Scores	
Information Benefits **Weight = 4**	**Ranking Score**
Project does not improve information used for managing the water system	0
Project provides significant information for managing the water system	1

Further Considerations

The above project priority criteria are to be used as a starting point for the City to consider which capital projects will move forward into planning and execution. The criteria are meant to provide a consistent basis for ranking projects and to document the rationale for funding.

HDR has developed a simple spreadsheet for use in conjunction with the above ranking criteria. The spreadsheet calculates scores for each project by applying the individual criteria scores and weights.

The scoring system is intended to avoid "double-counting" of benefits under different criteria. If points are awarded to a benefit for one criterion, staff should be careful not to award points under another criterion for the same feature of the project. For example, safety improvements should not receive points under both the Safety/Security criterion and the Regulatory/Binding Commitments criterion, just because some safety improvements are mandated by law.

On the other hand, distinctive features of a project can receive points under multiple criteria. For example a project that meets water quality regulatory requirements and also expands capacity could receive points under both the Regulatory/Binding Commitments criterion and the Growth/Expansion criterion. In this case, it is different features of the project that lead to points being awarded in more than one criterion.

Capital Project Prioritization Scoring
Moscow 2010 Comprehensive Water System Plan

Code	Project Name	Purpose	Timeframe	Est. Cost	Protection of Investment	Regulatory/Mandated	Growth Need	Water Quality (Non-reg.)	Cost Control/Cost Share	Safety & Security	Environmental Stewardship	Information Benefits	TOTAL	RANK	TOTAL	RANK	TOTAL	RANK
				Weight (1 - 10)	8	10	5	3	7	7	5	4						
													ALL PROJECTS		PROJECTS ABOVE $500,000		PROJECTS BELOW $500,000	
Water Supply																		
S-1	Well 10	Growth	5-yr	$2,300,000	3	3	3	0	1	0	0	0	76	2	76	1	0	49
S-2	Cemetery Well Development	Improve	5-yr	$500,000	2	0	1	0	1	0	1	0	33	45	33	10	0	49
S-3	Mn Sequestration and Breakpoint Chlorination Testing	Improve	5-yr	$15,000	0	1	0	10	1	0	0	0	47	25	0	13	47	19
S-4	Fe and Mn Sequestration Facilities	Improve	20-yr	$170,000	0	0	0	10	1	0	0	0	37	39	0	13	37	31
S-5	Fe and Mn Filtration Facilities	Improve	20-yr	$8,400,000	0	0	0	10	1	0	0	0	37	39	37	9	0	49
S-6	Long-term Water Supply Facilities	Growth	50-yr	$68,000,000	0	1	3	10	0	0	3	0	70	6	70	2	0	49
S-7	Filter Backwash Reclamation System	Improve	20-yr	$10,000	0	0	1	0	1	0	1	0	17	53	0	13	17	41
S-8	Well 6 Building Replacement	O&M	5-yr	$200,000	3	0	0	0	1	1	0	0	38	34	0	13	38	26
S-9	Well 6 Submersible Pump Modifications	O&M	5-yr	$300,000	3	3	0	1	1	1	0	0	71	5	0	13	71	4
Water Storage																		
ST-1	Northwest Tank Replacement (1 MG)	Improve	5-yr	$1,970,000	1	1	3	0	1	1	0	0	47	25	47	7	0	49
ST-2	New Water Tank/Reservoir (2 MG)	Growth/Improve	20-yr	$3,150,000	0	1	3	0	0	0	0	0	25	49	25	11	0	49
Water Pump Stations																		
PS-1	White Ave BPS Replacement	Deficiency	20-yr	$200,000	0	3	1	0	3	1	0	0	63	9	0	13	63	7
PS-2	Vista BPS Replacement	Deficiency	5-yr	$225,000	0	3	3	0	3	3	0	0	87	1	0	13	87	1
PS-3	Moser BPS Replacement	Deficiency	5-yr	$225,000	0	3	3	0	3	1	0	0	73	3	0	13	73	2
PS-4	Taylor BPS Replacement	Deficiency	20-yr	$200,000	0	3	0	0	3	1	0	0	58	14	0	13	58	12
PS-5	Ponderosa BPS Replacement	Deficiency	5-yr	$200,000	0	3	3	0	3	1	0	0	73	3	0	13	73	2
PS-6	Indian Hills BPS Replacement	Deficiency	20-yr	$225,000	0	3	0	0	3	1	0	0	58	14	0	13	58	12
Water Distribution System																		
Projects Addressing Previously Identified Deficiencies																		
D-1	Steel Main Replacement Program (annual)	Improve	annual	$60,000	1	0	0	0	1	0	0	0	15	55	0	13	15	43
D-2	Valve Replacement/Insertion Program (annual)	O&M	annual	$40,000	2	1	0	0	1	1	0	0	40	32	0	13	40	24
D-3	Fire Hydrant Replacement Program (annual)	O&M	annual	$30,000	2	3	0	0	0	0	0	0	46	27	0	13	46	20
D-4	Yoke Replacement Program (annual)	O&M	annual	$80,000	2	0	0	0	3	0	0	0	37	39	0	13	37	31
D-5	Lead Joint Main Replacement (annual)	Improve	annual	$135,000	2	0	0	0	1	0	0	0	23	50	0	13	23	39
D-6	Polk St: 8" main to complete loop (500')	Improve	5-yr	$70,000	1	0	1	0	0	0	0	0	13	56	0	13	13	44
D-7	East Palouse River Drive: 12" main to complete loop at dead end (1300')	Deficiency	20-yr	$200,000	0	3	3	1	0	0	0	0	48	23	0	13	48	18
D-8	6th St: 8" main to complete loop at dead end (600')	Improve	5-yr	$80,000	0	0	1	1	0	0	0	0	8	59	0	13	8	47
D-9	Walenta Dr: 8" main to complete loop at dead end (400')	Improve	5-yr	$60,000	0	1	0	3	1	0	0	0	26	48	0	13	26	38
D-10	Orchard Street and Arborcrest Road: 10" main to complete loop (800')	Improve	20-yr	$120,000	1	3	3	1	0	0	0	0	56	16	0	13	56	14
D-11	Pheasant Run and Christopher Lane: 8" main to complete loop (500')	Improve	20-yr	$70,000	1	3	3	1	0	0	0	0	56	16	0	13	56	14
D-12	Franklin Rd to Polk St: 8" main to complete loop (900')	Improve	20-yr	$130,000	1	0	0	1	0	0	0	0	11	57	0	13	11	45
D-13	Sunnyside Addition: 8" main from Victoria Dr to Palouse River Dr (1300')	Improve	20-yr	$180,000	1	0	1	1	0	0	0	0	16	54	0	13	16	42
D-14	Well 6 Discharge Line Revisions	Improve	20-yr	$130,000	1	0	0	0	0	0	0	0	8	59	0	13	8	47
D-15	Warbonnet Drive: Replace 10" with 16" main from SR8 to A Street (1125')	Improve	20-yr	$210,000	2	0	1	0	0	0	0	0	21	51	0	13	21	40
D-16	SR8: Replace 10" with 16" main from University Inn (Farm Road) to Warbonnet Drive (3600')	Improve	20-yr	$630,000	2	0	1	0	0	0	0	0	21	51	21	12	0	49
D-17	A Street Extension: 16" main from existing terminus of system east of Warbonnet Drive to Farm Road (2,600')	Deficiency	20-yr	$460,000	3	1	3	0	0	0	0	0	49	22	0	13	49	17
D-18	A Street: 12" main from Peterson to Line Street (660')	Improve	20-yr	$100,000	3	3	1	0	0	0	0	0	59	13	0	13	59	11
D-19	A Street: Replace 8" with 16" main from Line Street to Jackson Street (2300')	Improve	20-yr	$70,000	3	3	3	0	0	0	0	0	69	7	0	13	69	5
D-20	Line Street: Replace 8" with 16" main from A Street to SR8 (400')	Improve	20-yr	$400,000	3	3	3	0	0	0	0	0	69	7	0	13	69	5
D-21	SE Industrial Park: Install 8" (2600') and 12" (4500')	Growth	20-yr	$1,060,000	0	3	3	1	0	0	0	0	48	23	48	6	0	49
D-22	Farm Rd Expansion: 16" from Farm Rd and A St to Rodeo Dr (7,600')	Growth	20-yr	$1,320,000	1	3	3	0	0	0	0	0	53	20	53	4	0	49
D-23	Mountain View Rd: 12" to complete loop on Mountain View Rd (150')	Improve	5-yr	$20,000	2	1	3	0	0	0	0	0	41	29	0	13	41	21
Newly Identified Projects																		
D-24	Downtown Transmission: Replace 8" with 24" main on 3rd St from Jackson St to Hayes St and 12" on Hayes St from 3rd St	Improve	20-yr	$840,000	3	1	1	0	1	0	0	0	46	27	46	8	0	49
D-25	Almon St Transmission: Replace 6" with 16" main with extension north (4300')	Deficiency	5-yr	$750,000	1	3	3	0	0	0	0	0	53	20	53	4	0	49
D-26	Rowe St: 8" main to complete loom to Northwood Dr (300')	Deficiency	5-yr	$50,000	1	3	0	1	0	0	0	0	41	29	0	13	41	21
D-27	Hawthorne Dr: 8" main to complete loop to Indian Hills Dr (300')	Deficiency	5-yr	$50,000	1	3	0	1	0	0	0	0	41	29	0	13	41	21
D-28	Narrow St: Replace 4" with 8" main from Deakin Ave to College St (600')	Deficiency	5-yr	$80,000	1	3	0	0	0	0	0	0	38	34	0	13	38	26
D-29	Elm St: Replace 4" with 8" main Idaho Ave to 7th St (400')	Deficiency	5-yr	$60,000	1	3	0	0	0	0	0	0	38	34	0	13	38	26
D-30	Lilly St: Replace 4" with 8" main (800')	Deficiency	20-yr	$120,000	1	3	0	0	0	0	0	0	38	34	0	13	38	26
D-31	White Ave: Replace 6" with 10" main from Blaine St to Lynn St (1400')	Deficiency	20-yr	$210,000	1	3	0	0	0	0	0	0	38	34	0	13	38	26
D-32	Indian Hills Dr: Replace 6" with 8" from Northwood Dr to Atsirk St (2,300')	Deficiency	20-yr	$320,000	0	3	1	0	0	0	0	0	35	43	0	13	35	34
D-33	A St Connection: New 16" main from A st south to connect to 12" by Well 9 (900')	Improve	5-yr	$150,000	3	3	1	1	0	0	0	0	62	10	0	13	62	8
D-34	SR 8 AC Replacement: Replace 10" AC piping with new 10" main (800')	Improve	5-yr	$140,000	3	0	1	0	0	1	0	0	36	42	0	13	36	33
Water Maintenance and Operations																		
M-1	GPS Mapping	O&M	5-yr	$35,000	1	1	0	1	1	0	0	1	32	46	0	13	32	36
M-2	Water System Security Improvements (annual)	O&M	annual	$20,000	1	1	0	0	0	3	0	0	39	33	0	13	39	25
M-3	Water Quality Study	O&M	5-yr	$70,000	0	0	0	10	0	0	0	1	34	44	0	13	34	35
M-4	Standby Power Generation Facilities	O&M	5-yr	$240,000	3	3	0	0	0	0	0	0	54	19	0	13	54	16
M-5	Chlorination Process Conversion	O&M	20-yr	$160,000	0	1	0	0	0	3	0	0	31	47	0	13	31	37
M-6	Water Department Operations Facility	O&M	20-yr	$2,000,000	1	0	0	0	3	3	1	0	55	18	55	3	0	49
M-7	Maintenance Management System	O&M	5-yr	$35,000	3	1	0	1	3	0	0	1	62	10	0	13	62	8
M-8	SCADA Improvements	O&M	5-yr	$250,000	3	1	0	1	3	0	0	1	62	10	0	13	62	8
M-9	Wireless Field Access to GIS & CMMS	O&M	5-yr	$20,000	0	0	0	0	1	0	0	1	11	57	0	13	11	45