Oregon
Theodore R. Kulongoski, Governor

Department of Land Conservation and Development
635 Capitol Street NE, Suite 150
Salem, Oregon 97301-2524
Phone: (503) 373-0050
First Floor/Coastal Fax: (503) 378-6033
Second Floor/Director's Office: (503) 378-5518
Web Address: http://www.oregon.gov/LCD

NOTICE OF ADOPTED AMENDMENT

June 26, 2006

TO: Subscribers to Notice of Adopted Plan or Land Use Regulation Amendments

FROM: Mara Ulloa, Plan Amendment Program Specialist

SUBJECT: City of North Plains Plan Amendment
DLCD File Number 002-06

The Department of Land Conservation and Development (DLCD) received the attached notice of adoption. Due to the size of amended material submitted, a complete copy has not been attached. A copy of the adopted plan amendment is available for review at the DLCD office in Salem and the local government office.

Appeal Procedures*

DLCD ACKNOWLEDGMENT or DEADLINE TO APPEAL: July 12, 2006

This amendment was submitted to DLCD for review 45 days prior to adoption. Pursuant to ORS 197.830 (2)(b) only persons who participated in the local government proceedings leading to adoption of the amendment are eligible to appeal this decision to the Land Use Board of Appeals (LUBA).

If you wish to appeal, you must file a notice of intent to appeal with the Land Use Board of Appeals (LUBA) no later than 21 days from the date the decision was mailed to you by the local government. If you have questions, check with the local government to determine the appeal deadline. Copies of the notice of intent to appeal must be served upon the local government and others who received written notice of the final decision from the local government. The notice of intent to appeal must be served and filed in the form and manner prescribed by LUBA, (OAR Chapter 661, Division 10). Please call LUBA at 503-373-1265, if you have questions about appeal procedures.

***NOTE:** **THE APPEAL DEADLINE IS BASED UPON THE DATE THE DECISION WAS MAILED BY LOCAL GOVERNMENT. A DECISION MAY HAVE BEEN MAILED TO YOU ON A DIFFERENT DATE THAN IT WAS MAILED TO DLCD. AS A RESULT YOUR APPEAL DEADLINE MAY BE EARLIER THAN THE ABOVE DATE SPECIFIED.**

Cc: Gloria Gardiner, DLCD Urban Planning Specialist
Meg Fernekees, DLCD Regional Representative
Don Otterman, City of North Plains

<paa> ya/

FORM 2

D L C D NOTICE OF ADOPTION

DEPT OF

JUN 22 2006

LAND CONSERVATION AND DEVELOPMENT

This form must be mailed to DLCD within 5 working days after the final decision per ORS 197.610, OAR Chapter 660 - Division 18

(See reverse side for submittal requirements)

Jurisdiction: NORTH PLAINS Local File No.: NONE (If no number, use none)

Date of Adoption: 6/19/06 (Must be filled in) Date Mailed: 6/21/06 (Date mailed or sent to DLCD)

Date the Notice of Proposed Amendment was mailed to DLCD: FEB 27, 2006

✓ Comprehensive Plan Text Amendment

___ Comprehensive Plan Map Amendment

___ Land Use Regulation Amendment

___ Zoning Map Amendment

___ New Land Use Regulation

___ Other: _____ (Please Specify Type of Action)

Summarize the adopted amendment. Do not use technical terms. Do not write "See Attached."

UPDATE WATER MASTER PLAN AND INCORPORATE INTO COMPREHENSIVE PLAN

Describe how the adopted amendment differs from the proposed amendment. If it is the same, write "Same." If you did not give notice for the proposed amendment, write "N/A."

SAME

Plan Map Changed from: — to _____

Zone Map Changed from: — to _____

Location: _____ Acres Involved: _____

Specify Density: Previous: _____ New: _____

Applicable Statewide Planning Goals: ELEVEN

Was an Exception Adopted? Yes: ___ No: ✓

DLCD File No.: _____

Did the Department of Land Conservation and Development receive a notice of Proposed Amendment FORTY FIVE (45) days prior to the first evidentiary hearing. Yes: ✓ No: ____

If no, do the Statewide Planning Goals apply. Yes: ___ No: ____

If no, did The Emergency Circumstances Require immediate adoption. Yes: ___ No: ____

Affected State or Federal Agencies, Local Governments or Special Districts: _____

CITY OF NORTH PLAINS

Local Contact: DON OTTERMAN Area Code + Phone Number: 503-647-5555

Address: 31360 NW COMMERCIAL ST. City: NORTH PLAINS

Zip Code+4: 97133 Email Address: don@northplains.org

ADOPTION SUBMITTAL REQUIREMENTS

This form **must be mailed** to DLCD **within 5 working days after the final decision** per ORS 197.610, OAR Chapter 660 - Division 18.

1. Send this Form and TWO (2) Copies of the Adopted Amendment to:

ATTENTION: PLAN AMENDMENT SPECIALIST
DEPARTMENT OF LAND CONSERVATION AND DEVELOPMENT
635 CAPITOL STREET NE, SUITE 150
SALEM, OREGON 97301-2540

2. Submit **TWO (2) copies** the adopted material, if copies are bounded please submit **TWO (2) complete copies** of documents and maps.

3. Please Note: Adopted materials must be sent to DLCD not later than **FIVE (5) working days** following the date of the final decision on the amendment.

4. Submittal of this Notice of Adoption must include the text of the amendment plus adopted findings and supplementary information.

5. The deadline to appeal will not be extended if you submit this notice of adoption within five working days of the final decision. Appeals to LUBA may be filed within TWENTY-ONE (21) days of the date, the "Notice of Adoption" is sent to DLCD.

6. In addition to sending the "Notice of Adoption" to DLCD, you must notify persons who participated in the local hearing and requested notice of the final decision.

7. Need More Copies? You can copy this form on to 8-1/2x11 green paper only ; or call the DLCD Office at (503) 373-0050; or Fax your request to:(503) 378-5518; or Email your request to Mara.Ulloa@state.or.us - ATTENTION: PLAN AMENDMENT SPECIALIST.

ORDINANCE NO. 352
CITY OF NORTH PLAINS, OREGON

AN ORDINANCE AMENDING ORDINANCE NO. 270 BY ADOPTING A REVISED WATER MASTER PLAN AND INCORPORATING THE REVISED WATER MASTER PLAN INTO THE COMPREHENSIVE PLAN.

WHEREAS, the City Council on March 20, 2000, by Ordinance No. 270 adopted a revised Water Master Plan and incorporated the Water Master Plan into the City's Comprehensive Plan; and

WHEREAS, Oregon Administrative Rules require cities to review adopted Water Master Plans every five years and make whatever changes are necessary; and

WHEREAS, the City of North Plains retained Murray Smith and Associates to review and update the Water Master Plan;

THE CITY OF NORTH PLAINS ORDAINS AS FOLLOWS:

Section 1. The following master planning documents are adopted and included in the Comprehensive Plan:

(A) Water System Master Plan dated December 2005 and prepared by Murray, Smith & Associates, Inc. as the specific development and policy document for the provision of water.

INTRODUCED on the 5th day of June, 2006, **AND ADOPTED** this 19th day of June, 2006.

CITY OF NORTH PLAINS, OREGON

By: Herbert L. Hirst
Herb Hirst, Council President

ATTEST:

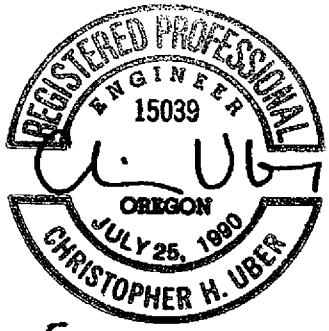
By: Debbie Owens
Debbie Owens, City Recorder

WATER SYSTEM MASTER PLAN

FOR

CITY OF NORTH PLAINS

DECEMBER 2005



EXPIRES 6/30/06

EXPIRES 12/31/06

MURRAY, SMITH & ASSOCIATES, INC.
Engineers/Planners
121 SW Salmon, Suite 900
Portland, Oregon 97204

04-0719.108

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1. INTRODUCTION

2. EXISTING WATER SYSTEM

3. SERVICE AREA, LAND USE AND WATER REQUIREMENTS

4. PLANNING AND ANALYSIS CRITERIA

5. WATER SYSTEM ANALYSIS

6. RECOMMENDATIONS AND CAPITAL IMPROVEMENT PLAN

APPENDICES

A. Figure 1 - Proposed Water System Plan Map
B. Cost Allocations for Water System Improvements
C. Water Storage Capacity Analysis
D. References

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Introduction

The purpose of this Water Master Plan (WMP) is to provide the City of North Plains a comprehensive planning document that provides basic information and guidance necessary for the sound stewardship of the municipal water system within its water service boundary. This plan is important because it:

- Compiles basic information relevant to the water system.
- Describes the basic functional parameters of the system.
- Highlights known system deficiencies.
- Describes and graphically illustrates recommended improvements.
- Presents basic cost information for general budgeting and the development of an adoptable 20-year capital improvements program.
- Provides a physical tool for informing individual citizens and other interested parties of the existing system and proposed improvements.
- Serves as an invaluable resource for gaining public support for needed improvements.
- Facilitates logical planning decisions relative to other City programs.

How This Plan Should Be Used

This Water Master Plan Update should be used in the following manner:

- This master plan should be viewed as a dynamic working document.
- The plan should be reviewed annually for the purpose of prioritizing and budgeting for needed improvements.
- Plan mapping should be updated to reflect current development and constructed system upgrades.
- Specific recommendations set forth in this plan should be considered as conceptual only. Additional details and potential alternatives should be investigated and analyzed in the preliminary engineering phase of final project designs.
- Cost estimates should be considered as planning level only, and should be updated and refined with preliminary engineering and final project designs.
- This plan should be used as the guiding document for future water system improvements.

Authorization

In 2004, the firm of Murray, Smith & Associates, Inc. (MSA) was authorized by the City of North Plains to prepare this Water System Master Plan.

Compliance

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61 and applicable elements of Division 86.

Planning Period

The planning period for this master plan is 20 years. Planning and facility sizing recommendations use estimated water demands at saturation development. Saturation development occurs when all existing developable land within the planning area has been developed. This planning document assumes saturation development may occur by approximately the year 2011.

Study Area

The City of North Plains water service area currently serves a population of approximately 1,700 people and provides potable water to residential, commercial, and industrial services. The study area for this plan is the City's entire urban growth boundary (UGB), which includes the existing urban City limits and approximately 147 acres of land outside of the City limits that have been designated for expansion. The study area, UGB and City limits are illustrated on Figure 2-1.

Existing Water System

Supply

The City recently completed construction of a connection to the Joint Water Commission's (JWC) 72-inch diameter transmission main in Hillsboro. The JWC is a regional water supplier and a partnership of the Cities of Hillsboro, Forest Grove, Beaverton, Tigard and the Tualatin Valley Water District. The City of North Plains negotiated an agreement with the JWC to provide a maximum rate of flow not to exceed 875 gallons per minute (gpm) and a maximum volume of water not to exceed 1.05 million gallons per day (mgd). One of the City's existing groundwater wells, Well No. 3, is used as an emergency backup supply source.

Water Rights

The City of North Plains holds a groundwater use right with the Oregon Water Resources Department. This permit provides for groundwater production up to the amount of 1.43 cubic feet per second (cfs) (642 gallons per minute (gpm) or 0.92 million gallons per day (mgd)). In February 2005, the City submitted a claim of beneficial use on this permit from Well No. 3. The amount claimed was 1.32 cfs (592 gpm or 0.85 mgd). Following approval of the claim, it is anticipated that the City will, in due course, be issued a water right certificate for the amount claimed from Well No. 3.

Storage

The City of North Plains' water system contains one storage reservoir, with a total storage capacity of approximately 1.0 million gallons (MG). This reservoir is located on the same site and adjacent to the City's booster pump station at the intersection of NW Commercial Street and NW 321st Avenue at an approximate ground elevation of 177 feet. The reservoir overflow elevation is approximately 208 feet. The reservoir is a 41-foot diameter bolted steel reservoir with a wall height of 33 feet. The reservoir is filled through a connection to the distribution system which is controlled by an altitude valve located inside the booster pump station.

Pumping

The City's existing booster pump station includes one 120 gallon per minute (gpm) pump, one 500 gpm pump, and one 3,600 gpm fire pump. Under typical operations the booster pump station serves only to help maintain water quality in the reservoir; however, during high demand periods or fire events the pump station serves to supplement the supply from the JWC connection.

Distribution System

The City's water distribution system is composed of various pipe types in sizes up to 16 inches in diameter. The total length of piping in the service area is approximately 61,350 feet, or approximately 11.6 miles. The pipe material types include cast iron, ductile iron, polyvinyl chloride (PVC), and galvanized iron. The majority of the piping in the system is ductile iron and cast iron. Table ES-1 presents a summary of pipe lengths by diameter.

Table ES-1
Distribution System Pipe Summary

Pipe Diameter (inch)	Estimated Length (lf)
2	600
4	5,000
6	15,800
8	23,500
10	1,400
12	9,000
14	5,400
16	650
Total [1]	61,350

Note: 1. The City's water system also includes approximately 18,470 linear feet of ductile iron transmission main supply piping, most of which lies outside of the study area (see Figure 1 in Appendix A).

Existing Water Demands

Based on the City's most recent historical water use patterns and population, the water service area's average day per capita consumption has ranged from 115 to 128 gpcd since 2002. For the purposes of this plan, estimated average daily water usage per capita is assumed to remain constant at approximately 125 gpcd. As conservation plays an increasing role in water usage patterns, it is anticipated that the City's average daily per capita usage may ultimately be reduced over time.

Water Demand Projections

In recent years, the maximum day per capita usage has ranged between 2.2 and 2.4 times the average daily water usage per capita. For this study, a peaking factor of 2.4 is used to establish the future maximum day per capita usage at approximately 300 gpcd. Total estimated average and maximum day water demands for the City are then developed by multiplying the estimated per capita usage by the anticipated population for each year. To provide an estimate of peak hourly usage, a peak hour factor of 1.5 is applied to the estimated maximum day water demands. A 1.5 peak hour factor is consistent with water demand patterns of other communities in the region of similar size and type. Table ES-2 presents a summary of water demand forecasts in five year increments to the year 2021, the year of forecasted saturation development, including average day, maximum day and peak hour estimates.

Table ES-2
Population Forecasts and
Estimated Water Demand Summary

Year	Population	Water Demand (mgd)		
		Average Day Demand [1] (ADD)	Maximum Day Demand [2] (MDD)	Peak Hour Demand [3]
2005	1,700	0.21	0.51	0.77
2010	2,404	0.30	0.72	1.08
2015	3,699	0.46	1.11	1.66
2020	5,231	0.65	1.57	2.35
2021-- Saturation Development	**5,390**	**0.67**	**1.62**	**2.43**

Notes: 1. Average Day Demand equals the Population multiplied by the estimated average daily per capita usage for the service area (125 gpcd).
2. Maximum Day Demand equals the Population multiplied by the estimated maximum daily per capita usage for the service area (300 gpcd).
3. Peak Hour Demand equals 1.5 times the Maximum Day Demand.

Water Supply Source

As previously described, the City's primary water supply is provided through a newly constructed 16-inch diameter transmission main connected to the Joint Water Commission (JWC) supply system. With a maximum day supply allowance of 1.05 mgd, the JWC source is adequate to meet the City's maximum day demands for the next five to ten years; however, it is estimated that an additional 0.57 mgd of maximum day supply capacity is needed prior to saturation development.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommendation presented in this study. Itemized project cost estimate summaries are presented in Appendix B. This appendix also includes a cost data summary for recommended water main improvements developed on a unit cost basis. Project costs include construction costs and an allowance for administrative, engineering, contingencies and other project related costs.

The estimated costs included in this plan are planning level budget estimates presented in 2005 dollars. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating, the October 2005 ENR CCI for Seattle, Washington of 8,409 is referenced.

Recommended Improvements

General

Presented below are recommended water system improvements for supply, storage, pumping, and distribution system piping. Project cost estimates are presented for all recommended improvements and annual budgets are presented for recommended capital improvement programming. The recommendations are presented by project type and discussed in order of need. A summary of all the recommended improvements is presented in Table ES-3. The table provides for prioritized project sequencing by illustrating fiscal year (FY) project needs for each facility and improvement category. The proposed improvements listed are phased and sequenced for construction over the planning period of 20 years. It is recommended that the City's capital improvement program (CIP) be funded at approximately $220,000 annually for storage, pumping and distribution system piping improvements. While the funding needs for certain water system improvements may exceed this amount the proposed improvements listed in Table ES-3 are phased and sequenced so that the ultimate 20-year average annual capital requirement is approximately $220,000 per year in 2005 dollars.

Study Recommendations

It is recommended that the City take the following actions:

1. Formally adopt this study as the City of North Plains' Water System Master Plan for the water service area.
2. Adopt the prioritized recommended system improvements described in Section 6 and specifically listed on Table ES-3 as the capital improvement plan (CIP) for the water service area.
3. Develop and adopt a financing plan to implement the capital improvements recommended in this study.
4. Review and update this plan within five to seven years to accommodate changed or new conditions.

Summary

North Plains continues to experience steady population and water demand growth. This water system master plan evaluated the City water system's ability to adequately meet existing and future water needs. The ultimate completion of recommended improvement to the distribution system will ensure that the water system has adequate storage, pumping and distribution system piping capacity to meet these needs well into the future. A financial planning and analysis study should be undertaken to determine the ultimate impact of the capital improvement program on City rate payers and new development and to determine overall capital funding needs.

Table ES-3
City of North Plains
Water System Master Plan
Capital Improvement Program Summary

Category	Project Description	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	Estimated Total Project Costs
Telemetry & Control	New Telemetry and Control (SCADA) System				Telemetry and Control System $85,000																	
	Sub-Total	$ -	$ -	$ -	$ 85,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 85,000
Pumping Facilities	Pump Station Upgrades				P.S. Upgrades $170,000																	
	Booster Pump Station						P.S. No. 2 $450,000															
	Sub-Total	$ -	$ -	$ -	$ 170,000.00	$ -	$ 450,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 620,000.00
Distribution System Piping	Fire Flow and Distribution Improvements		(8") Wascoe 309th to 311th $44,100		(8") Main $50,960		(12") Gordon $45,500		(12") Glencoe $58,500		(12") Commercial $182,000		(8") Gordon $67,620		(8") North $137,200							
		(8") 309th $80,360		(8") Lenox $32,340		(8") Wascoe 318th to 319th $46,060		(12") Cottage $122,000		(12") 313th $92,300		(8") Hillcrest $82,320		(8") Highland $49,000		Wascoe Gordon to Timeric $191,100					
	Main Replacement Program	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	
	Sub-Total	$ 130,360.00	$ 94,100.00	$ 82,340.00	$ 100,960.00	$ 96,060.00	$ 95,500.00	$ 172,000.00	$ 108,500.00	$ 142,300.00	$ 232,000.00	$ 132,320.00	$ 117,620.00	$ 99,000.00	$ 187,200.00	$ 241,100.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 2,281,360.00
Storage Facilities	New Reservoir						1.02 MG Reservoir $1,250,000															
	Sub-Total	$ -	$ -	$ -	$ -	$ -	$ 1,250,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,250,000
	Total	**$ 130,360**	**$ 94,100**	**$ 82,340**	**$ 355,960**	**$ 96,060**	**$ 1,795,500**	**$ 172,000**	**$ 108,500**	**$ 142,300**	**$ 232,000**	**$ 132,320**	**$ 117,620**	**$ 99,000**	**$ 187,200**	**$ 241,100**	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 4,236,360**

SECTION 1
INTRODUCTION

Authorization

In 2004, the firm of Murray, Smith & Associates, Inc. was authorized by the City of North Plains to prepare this Water System Master Plan.

Purpose

The purpose of this study is to perform a comprehensive analysis of the City of North Plains water supply and distribution system. This study identifies system deficiencies, determines future water distribution system and supply requirements, and recommends water system facility improvements that correct existing deficiencies and that provide for future system expansion. The City is currently experiencing significant service area and water demand growth, and is anticipating accelerated near term growth through two large service area expansions to the north and east of the City. This study will provide the City the guidance needed for the sound stewardship of the water system in anticipation of such near term growth and for growth over the next 20 years and beyond.

Compliance

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61 and applicable elements of Division 86.

Scope

The scope of work for this study includes the following work tasks:

- ***Data Gathering*** -- Compilation and review of existing maps, drawings, data, plans, studies and reports related to all aspects of water system operations and functions.

- ***Develop Inventory of Existing Facilities*** -- Preparation of an inventory of existing water system facilities including groundwater wells, transmission and distribution piping, storage reservoirs, pumping stations, and telemetry and control systems.

- ***Develop Population and Water Demand Estimates*** -- Review of information related to service area, land use, population distribution, and historical water demands. Development of population projections and water demand estimates for existing and undeveloped areas within the City's current water service area, including proposed service expansion areas within the Urban Growth Boundary (UGB) and outside of the City limits.

- ***Establish System Analysis and Planning Criteria*** -- Development of system performance criteria for distribution and transmission systems and storage, pumping and supply source facilities. Development of analysis and planning criteria for pressure zone service pressure limits, for emergency fire suppression water needs, and for water quality goals as well as for other system performance parameters.

- ***Prepare Water System Hydraulic Model*** -- Preparation of a computerized water distribution system hydraulic network analysis model using Haestad Methods' WaterCAD hydraulic modeling software.

- ***Perform Water System Analysis*** -- Perform a detailed analysis of the City's source, supply, transmission and distribution systems, analyze storage and pumping capacity needs, and evaluate pressure zone limits.

- ***Develop Recommended System Improvements*** -- Develop recommended water system facilities improvements which correct existing deficiencies and that provide for future system expansion.

- ***Prepare Capital Improvement Plan*** -- Develop and present the Capital Improvement Plan, which includes estimated project costs for recommended water system improvements and recommended project scheduling and sequencing.

- ***Prepare Water System Master Plan Document*** -- Prepare a water system master plan that documents and describes the planning and analysis work including mapping and graphics and presents recommendations and a capital improvement program (CIP).

SECTION 2
EXISTING WATER SYSTEM

General

This section describes the City of North Plains water service area and existing water system facilities. Included in this section is a discussion of existing supply and transmission facilities, groundwater wells, system pressures, storage and pumping facilities, and distribution system piping.

Background and Study Area

The City of North Plains water service area currently serves a population of approximately 1,700 people and provides potable water to residential, commercial, and industrial services. The study area for this plan is the City's entire urban growth boundary (UGB), which includes the existing urban City limits and approximately 146 acres of land outside of the City limits that have been designated for expansion. The study area, UGB and City limits are illustrated on Figure 2-1.

The City recently completed construction of a connection to the Joint Water Commission's (JWC) 72-inch diameter transmission main in Hillsboro. The JWC is a regional water supplier and a partnership of the Cities of Hillsboro, Forest Grove, Beaverton, Tigard and the Tualatin Valley Water District. The connection to the JWC system now serves as the City's primary water source with the City's groundwater supply well serving as an "emergency backup" source. The City also has a ground level reservoir and constant pressure pumping facility. The City's water distribution system has one pressure zone serving all customers with ground elevations ranging from approximately 160 feet to 210 feet above mean sea level (msl). Figure 1 of Appendix A illustrates the City of North Plains' water service area limits, supply system and distribution facilities. Figure 1 is also a digital representation of the computerized distribution system hydraulic model used for the system analysis.

Supply Sources

The City of North Plains supplies potable water to its customers through a connection to the JWC water supply system. The City negotiated an agreement with the JWC to provide a maximum rate of flow not to exceed 875 gallons per minute (gpm) and a maximum volume of water not to exceed 1.0 million gallons per day (mgd). The City's existing groundwater well, Well No. 3, is used as an emergency backup supply source. A more detailed description of each supply source is presented below.

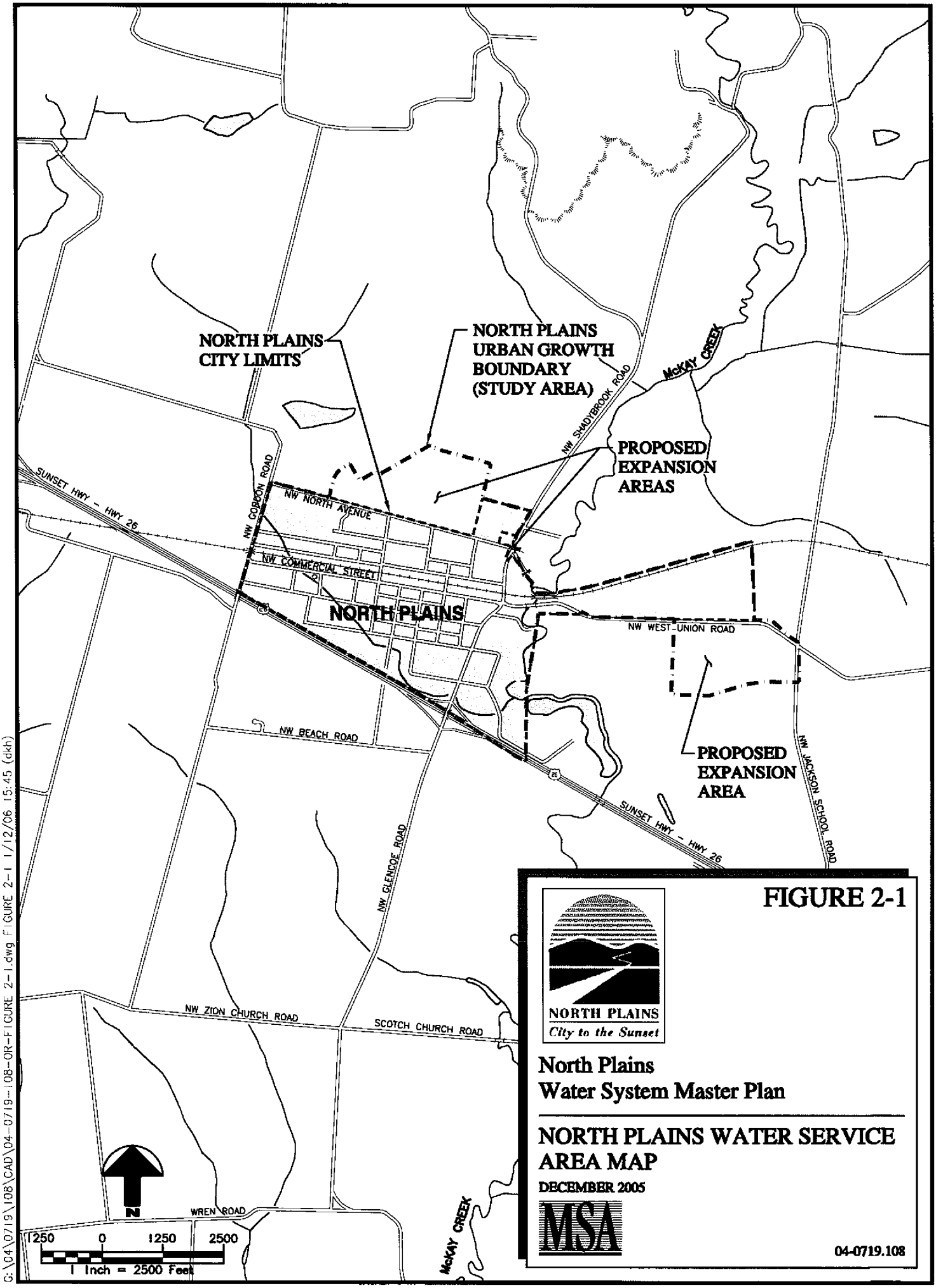


FIGURE 2-1

NORTH PLAINS
City to the Sunset

North Plains
Water System Master Plan

NORTH PLAINS WATER SERVICE AREA MAP

DECEMBER 2005

MSA

04-0719.108

G:\04\0719\108\CAD\04-0719-108-OR-FIGURE 2-1.dwg FIGURE 2-1 1/12/06 15:45 (dkh)

Joint Water Commission Supply

The City of North Plains recently connected to a new water supply source from the JWC. The JWC draws raw water from the Tualatin River and impoundments on the Trask River (Barney Reservoir) and Scoggins Creek (Henry Hagg Lake) in the Coast Mountain Range. Water is withdrawn from the Tualatin River via the Springhill River intake and raw water pump station and treated at the adjacent treatment plant. The JWC Water Treatment Plant currently has a treatment capacity of approximately 70 mgd. From the treatment plant water is pumped to the 20 million gallon (MG) Fernhill Reservoir east of the treatment plant (a second reservoir at the site is currently under construction). From the Fernhill reservoir water flows by gravity through a 72-inch diameter transmission main to the City of Hillsboro and communities to the east.

The City of North Plains' new water supply source connection to the JWC system is provided through the Glencoe Road 16-inch Water Transmission Line that extends approximately 3.5 miles from JWC facilities in Hillsboro to the City of North Plains. The recently completed project includes the following elements:

- A connection to the existing 72-inch diameter JWC transmission main at the intersection of NW Evergreen Road and NW Glencoe Road.
- A metering station consisting of a 10-inch diameter electromagnetic flow meter and meter bypass at the intersection of NW Evergreen Road and NW Glencoe Road.
- A backflow prevention station, consisting of a 10-inch diameter double check backflow prevention assembly and bypass, at the intersection of NW Evergreen Road and NW Glencoe Road.
- Approximately 19,000 feet of 16-inch diameter transmission main on NW Glencoe Road, NW Beach Road, NW 316th Place and NW 314th Avenue.
- A pressure and flow control station, including parallel 10-inch and 6-inch diameter control valves, and a connection to the City's distribution system on NW 314th Avenue near the City's southerly border, directly north of Highway 26.

Well No. 3

Well No. 3 serves as an emergency backup supply source and is housed within the City's booster pump station building located at the intersection of NW Commercial Street and NW 321st Avenue. In an emergency the well may be controlled manually to pump water directly into the City's 1.0 MG ground-level reservoir. The well has a current production capacity of approximately 500 gpm (0.7 mgd). The well includes a 50 horsepower pump motor, a 12-inch diameter casing, and has a depth of approximately 485 feet below ground surface (bgs). Water from Well No. 3 is chlorinated at the wellhead just prior to being pumped into the reservoir. Table 2-1 presents a summary of the City's wells.

Wells No. 1 and 2

Well No. 1 is located approximately 30 feet easterly of City Hall near the intersection of NW Commercial Street and NW 313th Avenue. Well No. 1 is periodically used for irrigation purposes only. Well No. 1 has a 6-inch diameter casing and a depth of approximately 710 feet bgs. Well No. 2 is located within the City's pump station and is currently not operational. The motor has been refurbished but the pump is non-functional. Well No. 2 has a 6-inch diameter casing and a depth of approximately 440 feet bgs.

Table 2-1
Groundwater Well Pump, Depth and Production Summary

Well No.	Horse-power (hp)	Total Well Depth (feet)	Casing Diameter (inches)	Approximate Existing Production Capacity (gpm)
1	N/A	710	6	N/A (Irrigation Only)
2	N/A	440	6	Not operational
3	60	485	12	500
Total Supply Source Production Capacity [1]				**500 (0.7 mgd)**

Notes: 1. Total supply source production capacity is the sum of the production capacities of all operational well pumps.

Water Rights Summary

The City of North Plains holds a groundwater use right with the Oregon Water Resources Department. This permit provides for groundwater production from Well Nos. 1, 2 and 3 up to the amount of 1.43 cubic feet per second (cfs) (642 gallons per minute (gpm) or 0.92 million gallons per day (mgd)). In February 2005, the City submitted a claim of beneficial use on this permit from Well No. 3. The amount claimed was 1.32 cfs (592 gpm or 0.85 mgd). No claims were made regarding Well Nos. 1 and 2. Well No. 2 is not currently operational, and Well No. 1 is considered to be a non-exempt use. Following approval of the claim, it is anticipated that the City will, in due course, be issued a water right certificate for the amount claimed from Well No. 3.

System Pressure

Pressure zones are typically defined by ground topography and designated by overflow elevations of water storage facilities or discharge hydraulic grades of pressure reducing facilities or booster pumping facilities serving the zone. The City of North Plains' water service area has one pressure zone operating at an approximate hydraulic grade line (HGL) of 365 feet, or approximately 85 psi, which is the discharge pressure setting of the JWC

supply source pressure reducing/flow control facility. Additionally, system pressures are maintained by the City's booster pump station during high demand periods.

Storage

The City of North Plains' water system contains one storage reservoir, with a total storage capacity of approximately 1.0 MG. This reservoir is located on the same site and adjacent to the City's booster pump station at the intersection of NW Commercial Street and NW 321st Avenue at an approximate ground elevation of 177 feet. The reservoir overflow elevation is approximately 208 feet. The reservoir is a 41-foot diameter bolted steel reservoir with a wall height of 33 feet. The reservoir is filled through a connection to the distribution system which is controlled by an altitude valve located inside the booster pump station.

Pump Station

Under typical operations the booster pump station serves only to help maintain water quality in the reservoir. The pump station typically operates on a daily timer to pump water from the reservoir into the distribution system. During the night the altitude valve opens to fill the reservoir. This typical daily operation serves to provide turnover and circulation of the stored water in the reservoir in order to maintain proper disinfection residual levels in the tank. A low level cutout switch turns off all booster pumps when the reservoir is down 31 feet below the overflow elevation.

Occasionally, during very high demand scenarios, the booster pump station serves to supplement the supply from the JWC system. The JWC source connection and the booster pump station operate in a coordinated fashion to provide a constant pressure water supply to the distribution system. A discussion of the coordinated operation of the two system components is presented below. The pump station includes four pumps. A summary of basic data on these pumps is shown in Table 2-2.

Table 2-2
Summary of Existing Pumps

Pump No. or Name	Nominal Capacity (gpm)	Motor Horsepower (HP)	Comments
1	120	10	Not in service
2	500	40	Lead pump, variable speed, maintains 82 psi discharge pressure
3	200	15	Lag pump, constant speed
Fire	3,600	--	Direct drive fire pump, 375 HP natural gas fueled engine

System Operation Overview

Under normal conditions, water is supplied from the JWC source to the distribution system through a 6-inch diameter flow control valve located in the pressure reducing/flow control facility at the northerly end of the Glencoe Road 16-inch Diameter Transmission Line on NW 314th Avenue. As water demands increase and system pressures drop, the City's booster pump station's two smaller pumps operate to maintain system pressures. If pressures further continue to decrease, the fire pump operates together with the smaller pumps to maintain system pressures. Under very high or emergency demand conditions, if water system pressures continue to decrease, the 10-inch diameter pressure reducing valve in the pressure reducing/flow control facility opens to allow unlimited supply from the JWC. As currently configured, the 6-inch diameter flow control valve discussed above has 4-inch diameter internal components which may be replaced with 6-inch diameter components as overall system demands rise over time.

As demands decrease and the system pressures increase, the pumps and valves automatically respond in reverse order beginning with the closure of the JWC 10-inch diameter pressure reducing valve. As system pressures rise to 70 psi, the fire pump shuts down followed by the booster pumps at 75 psi. Table 2-3 summarizes these operation settings.

Table 2-3
Valve and Pump Station Operational Settings

Facility	Pressure (psi)	Comments
JWC Supply - 6" Valve (Ground elevation = 175)	82 [1]	Maintains supply pressure of 82 psi at existing ground-level reservoir (ground elevation = 175) and flow up to 875 gpm.
Pump Station - Smaller Pumps	70 - 75 [2]	Both small pumps (Nos. 2 and 3) cycle on and off starting at 75 psi with both on at 70 psi. Pump No. 2 cycles on first, it runs up to full speed, then Pump No. 3 starts.
Pump Station - Fire Pump	65 - 70 [2]	Fire pump starts at 65 psi and turns off at 70 psi
JWC Supply - 10" Valve	60 [2]	Opens at 60 psi and maintains this pressure with no flow rate restriction

Notes: 1. Valve discharge pressure setting
2. Station discharge pressure settings

Distribution System

The City's water distribution system is composed of various pipe types in sizes up to 16 inches in diameter. The total length of piping in the service area is approximately 61,350 feet, or approximately 11.6 miles. The pipe material types include cast iron, ductile iron, polyvinyl chloride (PVC), and galvanized iron. The majority of the piping in the system is ductile iron and cast iron. Table 2-3 presents a summary of pipe lengths and materials by diameter.

Table 2-4
Distribution System Pipe Summary

Diameter (inch)	Materials (linear feet)			Total Length (lf)
	Ductile or Cast Iron	PVC	Galvanized	
2	-	-	600	600
4	5,000	-	-	5,000
6	12,500	3,300	-	15,800
8	18,450	5,050	-	23,500
10	-	1,400	-	1,400
12	-	9,000	-	9,000
14	-	5,400	-	5,400
16	650		-	650
Total [1]	36,600	24,150	600	61,350

Note: 1. The City's water system also includes approximately 18,470 linear feet of ductile iron transmission main supply piping, most of which lies outside of the study area (see Figure 1 in Appendix A).

Telemetry and Control System

The City of North Plains does not have a telemetry or supervisory control system. The pump station is operated by a control system within the pump station.

Summary

This section presents a summary of the City of North Plains' existing water system, including the supply system, storage and pumping facilities, and distribution system piping. Also included is a discussion of existing groundwater wells and system pressures and operation. Section 3 presents a summary of existing land uses within the water service area and develops estimates of the future population and water demand requirements.

SECTION 3
SERVICE AREA, LAND USE AND WATER REQUIREMENTS

General

This section develops and presents population projections and estimated water demand forecasts for the City of North Plains water service area. Population and water demand forecasts are developed from regional and City planning data, current land use designations, historical water demand records and previous City water supply planning work. Also included in this section is a discussion of the water service area limits and a summary of the current land use and zoning designations within the service area.

Service Area

The City's water system currently provides service to the area within the existing City limit boundary, which includes approximately 531 acres of residential, commercial, and industrial land. The anticipated future water service area for this plan includes approximately 675 acres within the established Urban Growth Boundary (UGB) that lies entirely within Washington County. Several areas within the UBG that are currently outside of the City limits have recently been designated for inclusion within the City limits. There is one proposed 74-acre expansion area to the north and one proposed 70-acre expansion area to the east. In addition, there are two smaller proposed future development areas in the northeasterly portion of the City that total approximately 2 acres. For the purposes of this study, all four areas have been included in the long-term demand estimates and are illustrated as highlighted areas on Figure 1 in Appendix A.

Planning Period

The planning period for this water system master plan is 20 years. Based on estimated probable infill densities and anticipated development rates, saturation development within the Urban Growth Boundary is anticipated to occur in 2021. Saturation development occurs when all existing developable land within the service area has been developed. With the estimate for saturation development expected to occur within the 20-year planning horizon, all planning and facility sizing recommendations are based on saturation development conditions. Thus, such recommendations reflect the ultimate size of facilities needed for the planned service area.

Land Use

Land use and zoning classifications for North Plains' existing water service area within the City limits are established under the City's current Comprehensive Plan. Land use and zoning classifications for proposed expansion areas have been assumed based on City planning staff input and reflect land use types of adjacent areas. Table 3-1 summarizes land use, zoning classifications, and associated acreage within the City limits and the UGB.

Table 3-1
Land Use Summary

Zone	Zone Description	Area within North Plains UGB (gross acres)
R7.5	Single-Family Residential	92
R5	Single-Family Residential	92
R2.5	Multi-Family Residential	90
C1	General Commercial	17
C2	Highway Commercial	53
M1	Light Industrial	20
M2	General Industrial	167
NC [1]	Expansion Areas (2 total)	144
FD10	Future Development (10 acre min.)	2
	Total	**677**

Note: 1. Land use and zoning classifications have not yet been designated by City planning. See Figure 1 in Appendix A for locations within UGB.

Population Estimates

Historical Population

Historical population data was obtained through data provided by the City of North Plains and the Center for Population Research and Census (CPRC) at Portland State University. The CPRC data represents estimates of North Plains' population within the existing City limits as of July 1 of each year. Population estimates for the beginning of each decade are based on census counts published by the U.S. Census Bureau, while annual estimates between the census counts are derived by analyzing supplemental data, including economic changes, the number of building permits issued, and annexations. Table 3-2 presents a summary of this historical population data from 1980 through 2004. The annual growth rate over this period varied between -1.2 and 5.1 percent and the overall annual growth rate for this period averaged approximately 3.4 percent. The most current published population figures estimate the City's 2004 population at 1,650. The 20-year planning period begins in 2005 with an estimated population of 1,700.

Table 3-2
Historical and Current Population Summary

Year	Population	Average Annual Growth Rate
1980	715	-
1990	972	3.1%
2000	1,605	5.1%
2001	1,660	3.4%
2002	1,660	0%
2003	1,640	-1.2%
2004	1,650	0.6%
2005	***1,700***	4.2%

Population Forecast

In 2000, the US Census Bureau reported the City of North Plains population to be 1,605 with a total of 633 housing units. Based on this data, there were approximately 2.5 persons per equivalent dwelling unit (EDU). This estimate of persons per EDU was used in determining the projected population for future years and at saturation development.

Total saturation development population estimates were developed by analyzing two components of development growth. The first component is infill development of residential areas within the existing City limits. The second component is development of proposed annexations of undeveloped areas outside the existing City limits but within the existing UGB. These proposed annexations are referred to as "expansion areas" in this study and on Figure 1 in Appendix A.

Infill Development

Infill development was estimated by determining the maximum number of potential residential lots available for development within the existing City limits. These lots were identified by first identifying the area in acres of developable land for each zoning classification type. These areas were reduced by an estimated reduction factor to accommodate for anticipated non-buildable areas, such as public rights-of-way and other non-buildable areas. The remaining estimated buildable area was then multiplied by the maximum number of lots per acre as designated for each zoning type. The resulting number of lots was multiplied by the estimated City average of 2.5 persons per dwelling unit to determine the additional population due to infill development. Table 3-3 summarizes the estimated population increase due to infill development at saturation.

Table 3-3
Existing City Limit Infill Development Forecast

Zone	Undeveloped Area (Acres)	Percent Buildable	Net Buildable (Acres)	Max. Lots per Acre	Max. Lots	Persons Per EDU	Additional Population
R7.5	14.0	75%	10.5	5.8	61	2.5	152
R5	13.9	75%	10.4	17.4	181	2.5	453
R2.5 [1]	60.4	50%	30.3	17.4	527	2.5	1318
Total					**689**	**2.5**	**1923**

Notes: 1. Approximately 35% of undeveloped R2.5 zones include flood plain

Expansion Area Development

At the time of this writing there are a total of five areas that are outside of the current City limits and under consideration for City expansion. Estimated population increases associated with development of proposed expansion areas were determined by evaluating City planning projections on the rate of growth and by estimating the total possible development capacity of the areas at saturation. The City estimates that up to 700 residential dwelling units will be constructed in the north and east expansion areas within 11 years following their annexation. The State of Oregon Department of Land Conservation and Development has estimated that up to 538 residential dwelling units will be constructed in these two expansion areas. Based on these two estimates and the estimated 2.5 persons per equivalent dwelling unit, the projected population increase due to development of north and east expansion areas ranges from approximately 1,345 people to 1,750 people. For the purposes of this study, the more conservative higher demand value of 1,750 people is used.

In addition to the north and east expansion areas, two other areas within the UGB are identified as future development areas (annexations). A 7.9-acre annexation area, just south of NW West Union Road in the vicinity of McKay Creek, was recently approved by voters for inclusion within the City and is anticipated to be officially annexed early next year. This area is zoned R2.5 and its anticipated population is identified in this report as infill population which is included in Table 3-3 above. A 1.6-acre area zoned R7.5 just westerly of the intersection of NW Glencoe Road and NW North Avenue is also a proposed annexation area. The final area is a proposed 1.5-acre area at the northwest corner of the intersection of NW North Avenue and NW Shadybrook Road is currently occupied by a Portland General Electric (PGE) power sub-station. It is not anticipated that any residential development will occur on this site after annexation. The anticipated maximum estimated population contribution from the 1.6-acre annexation totals approximately 17 people. This projection is based on the use of 75 percent of total developed area for dwelling units at maximum density with 2.5 persons per unit. Table 3-4 summarizes the maximum population increase due to the three proposed developable expansion areas at saturation development.

Table 3-4
Expansion Areas Development Forecast

Zone	Undeveloped Area (Acres)	Percent Buildable	Net Buildable (Acres)	Max. Lots per Acre	Max. Lots	Persons per EDU	Additional Population
North Exp. Area [1]	74.13	n/a	n/a	n/a	350[1]	2.5	875
East Exp. Area [1]	69.87	n/a	n/a	n/a	350[1]	2.5	875
R7.5 Exp. Area	1.6	75%	1.2	5.8	7	2.5	17
Total	**145.6**				**707**	**2.5**	**1,767**

Notes: 1. Saturation development EDU's for North and East Expansion Areas provided by City staff. Estimated total EDU's of 700 is used in lieu of calculations based on net area and density and the approved EDU's of 538 as per periodic review. This approach was selected to provide conservative (high) population estimates.

Estimated population increases due to infill development and proposed annexations were added to the FY 2005/06 population estimate to determine the projected total population at saturation development. Table 3-5 summarizes the projected saturation development population.

Table 3-5
Saturation Development Population Projection Summary

Population Component	Population
Infill Population Increase	1,923
Expansion Area Population Increase	1,767
Estimated 2005 Population	1,700
Projected Total Saturation Development Population	**5,390**

The annexation of the proposed north and east expansion areas is anticipated to occur in 2006. The City anticipates rapid development of these areas to begin within 2 years of annexation and continue for approximately 11 years. To reflect this anticipated short-term increase in development rate, an annual population growth rate of approximately 9 percent was assumed for 11 years of the planning period beginning in 2008. An annual population growth rate of approximately 4.5 percent was assumed for all other years of the planning period up to saturation development. As discussed above, the historical annual growth rate over the period from 1980 to 2005 averaged approximately 3.4 percent. A growth rate of 4.5 percent was assumed for all other years considering the recent increased rate of development

within the City, as well as the anticipated development of the other smaller annexation areas described previously. Table 3-6 illustrates beginning of fiscal year population estimates in 5-year increments through saturation development.

Table 3-6
Population Forecast Summary

Year	Population
2005	1,700
2010	2,404
2015	3,699
2020	5,231
2021 (Saturation Development)	**5,390**

For water system planning purposes, it is generally considered most prudent to plan facility improvements for saturation development capacity requirements. By assuming full occupancy at saturation development, this methodology helps avoid the construction of new facilities that will need to be upsized in future years for increased capacity needs. The planning period for this master plan is 20 years and saturation development is anticipated to occur within that time frame. Recommendations presented in this plan are intended to maximize efficiency and avoid undesirable facility upsizing in future years where practical.

Water Demand Estimates

The term "water demand" refers to all the water requirements of the system including domestic, commercial, municipal, institutional and industrial as well as unaccounted-for water. Water demand estimates were developed from a review of historical water consumption records provided by the City, and population forecasts generated as part of this planning work. Demands are discussed in terms of gallons per unit of time such as gallons per day (gpd), million gallons per day (mgd), or gallons per minute (gpm). Demands are also related to per capita use as gallons per capita per day (gpcd).

Historical Water Use

The City of North Plains maintains records of historical monthly water usage by customer, which was used to calculate historical total annual consumption. The average day demand (ADD), often referred to as the average annual daily demand, is determined by dividing the total annual consumption by 365 days. The historical maximum day demand (MDD) is identified from historical consumption patterns. The peaking factor is calculated by dividing the historical MDD by the historical ADD. Table 3-7 summarizes this data for the years 2002 through 2004.

Table 3-7
Historical Water Use Summary

Year	Water Service Area Population	Water Demand (mgd)		
		Average Day Demand (ADD)	Maximum Day Demand (MDD)	Calculated Peaking Factor
2002	1,660	0.21	0.46	2.2
2003	1,640	0.21	0.51	2.4
2004 [1]	1,650	0.19	0.41	2.2

Notes: 1. Oregon Canadian Forest Products Inc. is no longer using City water.

Existing Water Demands

Based on historical water consumption patterns, the water service area's average day demand (ADD) has been approximately 0.21 million gallons per day (mgd). Since April of 2004, Oregon Canadian Forest Products Inc., which is a large industrial consumer within the water service area, switched from the City system to private wells to supply their irrigation needs. This has significantly reduced the total consumption of water as reflected in the City's annual water production records. Recent average daily water demand usage since that time has been approximately 0.19 mgd. For the purpose of this study, it is assumed that all industrial consumers within the UGB will be served by City water within the planning period and the demands of Oregon Canadian Forest Products Inc. are therefore included in the City's total demand estimates at the start of the planning period.

Water Demand Projections

Future water demand estimates were developed by projecting historical consumption forward, using the previously presented population forecasts. As growth continues, both residential infill development within the current City limits area and development in the expansion areas within the UGB are expected, resulting in significantly increased overall water demands.

Based on the City's most recent historical water use patterns and population, the water service area's average day per capita consumption has ranged from 115 to 128 gpcd since 2002. For the purposes of this plan, estimated average daily water usage per capita is assumed to remain constant at approximately 125 gpcd. As conservation plays an increasing role in water usage patterns, it is anticipated that North Plains's average daily per capita usage may ultimately be reduced over time.

In recent years the maximum day per capita usage has ranged between 2.2 and 2.4 times the average daily water usage per capita. For this study a peaking factor of 2.4 is used to establish the future maximum day per capita usage at approximately 300 gpcd. Total estimated average and maximum day water demands for the City are then developed by

multiplying the estimated per capita usage by the anticipated population for each year. To provide an estimate of peak hourly usage, a peak hour factor of 1.5 is applied to the estimated maximum day water demands. A 1.5 peak hour factor is consistent with water demand patterns of other communities in the region of similar size and type. Table 3-8 presents a summary of water demand forecasts in five year increments to the year 2021, the year of forecasted saturation development, including average day, maximum day and peak hour estimates.

Table 3-8
Population Forecasts and
Estimated Water Demand Summary

Year	Population	Water Demand (mgd)		
		Average Day Demand [1] (ADD)	Maximum Day Demand [2] (MDD)	Peak Hour Demand [3]
2005	1,700	0.21	0.51	0.77
2010	2,404	0.30	0.72	1.08
2015	3,699	0.46	1.11	1.66
2020	5,231	0.65	1.57	2.35
2021-- Saturation Development	**5,390**	**0.67**	**1.62**	**2.43**

Notes: 1. Average Day Demand equals the Population multiplied by the estimated average daily per capita usage for the service area (125 gpcd).
2. Maximum Day Demand equals the Population multiplied by the estimated maximum daily per capita usage for the service area (300 gpcd).
3. Peak Hour Demand equals 1.5 times the Maximum Day Demand.

Summary

This section presents a discussion of existing and projected land uses within the study area, estimates of the current and future population, and forecasts of future water demands. Section 4 outlines the planning criteria that, in conjunction with the water demand estimates developed in this Section, are used in the system analysis presented in Section 5.

SECTION 4
PLANNING AND ANALYSIS CRITERIA

General

This section develops and presents the planning and analysis criteria used for the water system analysis. Criteria and planning assumptions are presented for the City of North Plains' supply and transmission system, distribution system piping, pressure zone, and storage and pumping facilities. Recommendations of water needs for emergency fire suppression are also presented. The water demand forecasts developed in Section 3 are used with these criteria in Section 5 for the analysis of North Plains' water system.

Supply and Transmission Evaluation and Analysis Criteria

The City's supply and transmission systems must be capable of providing estimated maximum day demands for the 20-year planning horizon. The capacity of each element of the supply and transmission system are evaluated in this plan to determine if adequate capacity exists to meet the water system needs through the planning period. If it is determined that additional supply and transmission system capacity is required to meet water system needs, analysis of improvement options will be completed and recommendations will be included in this plan.

As described in Section 2, the City's primary water supply is provided through a connection to the JWC Supply System with a 16-inch diameter transmission main. The City also maintains a groundwater well, used for emergency supply backup purposes. The JWC source water is supplied directly to the distribution system through a pressure reducing/flow control facility. This supply connection also serves to fill the City's 1.0 MG reservoir through the distribution system. The agreement with JWC restricts the maximum rate of flow to 875 gpm (1.26 mgd) and the maximum volume of water to 1.05 mgd. The emergency supply groundwater well (Well No. 3) operates to pump water directly into the City's 1.0 MG reservoir. Water is pumped from the reservoir into the distribution system by the City's booster pump station. Further analysis of the supply, treatment and transmission systems is contained in Section 5, and recommendation for supply, treatment and transmission system improvements are presented in Section 6.

Distribution System

The water distribution system should be capable of operating within certain system performance limits, or guidelines, under several varying demand and operational conditions. The recommendations of this plan are based on the following performance guidelines, which have been developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, operational practices of similar water providers, and discussions with City water system operations staff. The analysis criteria are as follows:

1. The distribution system should be capable of supplying the peak hourly demand while maintaining minimum service pressures of not less than approximately 85 to 90 percent of normal system pressures.

2. The distribution system should be capable of providing the recommended fire flow to a given location while, at the same time, supplying the maximum day demand and maintaining a minimum residual service pressure at any meter in the system of 20 pounds per square inch (psi). This is the minimum water system pressure required by the Oregon State Department of Human Services Drinking Water Program.

3. The distribution system should be looped as much as practical to provide optimal water circulation, water quality, improved fire flow capacity, and greatly improved system reliability and redundancy.

Proposed or new water mains should be at least 8 inches in diameter in order to supply minimum fire flows. In special cases, 6-inch or 4-inch diameter mains are acceptable if no fire hydrant connection is required, there are limited services on the main, the main is dead-ended and looping or future extension of the main is not anticipated.

System Pressure Criteria

As discussed in Section 2, the City has one pressure zone. For planning and analysis purposes, and for the purposes of performing the distribution system hydraulic analysis, it is assumed that the hydraulic grade line of the water system is approximately 365 feet. The hydraulic grade line is based on the pressure settings of the pressure reducing facility at the City's connection to the JWC, as well as control settings at the booster pump station.

Pressure zones are usually defined by ground topography and designated by overflow elevations of water storage facilities or outlet settings of pressure reducing facilities or discharge pressures of booster pump stations serving the zone. Typically, water from a reservoir will serve customers by gravity within a specified range of ground elevations so as to maintain acceptable minimum and maximum water pressures at individual service connections. When it is not feasible or practical to site a reservoir such that the water surface elevation is at the hydraulic grade of a given pressure zone then pumping facilities or pressure reducing facilities are used to adjust the reservoir pressure for serving the pressure zone.

Generally, 100 psi is considered the desirable maximum upper pressure limit within a water distribution system and 45 psi the lower limit. The JWC supply and the pump station are set to maintain a supply pressure of 85 psi, which is the desired service pressure setting for the City. Whenever feasible, it is desirable to achieve no less than 45 psi at the point of the highest fixture within a given building being served. Conformance to this pressure range may not always be possible or practical due to topographical relief, existing system

configurations and economic considerations. Table 4-1 summarizes the service pressure criteria used in the analysis of the City's water system.

Table 4-1
Recommended Service Pressure Criteria

Condition	Pressure (psi)
Minimum Service Pressure Under Fire Flow Conditions	20
Minimum Normal Service Pressure	45
Maximum Service Pressure	100

Storage Volume

There are two independent criteria for analyzing storage volume needs in North Plains. One is based on standards of water industry practice and the other is based on the City's agreement with the JWC. In accordance with AWWA standards and other regional water system design guidelines, water storage facilities are typically intended for three purposes: Operational (or "equalization") storage, fire storage, and emergency storage. Thus, the recommended storage volume must be equal to or greater than the sum of the operational, fire and emergency storage volume components. A brief discussion of each storage volume component is provided below. In addition to the above storage volume criteria, the City's agreement for purchasing water from the JWC stipulates criteria for storage capacity. To limit the need for the City to supply peak system demands directly from the JWC supply, a storage volume or supplemental water supply, equal to three times the average day demand is required. For the purposes of this analysis, the recommended storage volume will equal the greater of the two criteria described above.

Operational Storage

Operational storage is required to meet water system demands in excess of delivery capacity from the supply source. Based on existing demands the delivery capacity from the supply source for North Plains is sufficient to meet maximum day demands for a 24 hour period. While the agreement with JWC currently restricts the maximum volume of water to 1.05 mgd, this analysis assumes that either a new source will be developed in the future or an increased supply will be negotiated with the JWC. Thus, the operational storage volume for North Plains should provide for the difference between the peak hour demand and the maximum day demand (on a 24-hour duration basis).

This planning methodology is intended to provide sufficient operational storage on a daily basis when high demand conditions occur repeatedly over the course of several days. For this system operational storage volume in the amount of 25 percent of maximum day demand is considered appropriate.

Emergency Storage

Emergency storage is often provided to accommodate certain emergencies such as pipeline failures, equipment failures, power outages or natural disasters. The amount of emergency storage provided can be highly variable depending upon an assessment of risk and the desired degree of system reliability. Provisions for emergency storage in other systems vary from none to a volume that would supply a maximum day's flow or higher. Considering that the City of North Plain's distribution system is supplied from a connection to the historically reliable JWC system, and the City maintains an emergency backup supply well, it is recommended that North Plains provide a minimum emergency storage volume to supply approximately 25 percent of maximum day demand. This amount of storage volume for emergency purposes is consistent with accepted water industry practices and guidelines.

Fire Storage

Fire storage should be provided to meet the single most severe fire flow demand within each zone. The fire storage volume is determined by multiplying the recommended fire flow rate by the expected duration of that flow. Specific fire flow quantity and duration recommendations are discussed below.

Fire Flow Recommendations

While the water distribution system provides water for domestic uses, it is also expected to provide water for fire suppression. The amount of water recommended for fire suppression purposes is typically associated with the local building type or land use of a specific location within the distribution system. Fire flow recommendations are typically much greater in magnitude than the normal maximum day demand present in any local area. Adequate hydraulic capacity must be provided for these large occasional fire flow demands.

A summary of fire flow recommendations by land use designation is presented in Table 4-2. The recommended fire flows presented in Table 4-2 were developed through a review of fire flow criteria adopted by similar communities, fire flow guidelines as developed by the AWWA, the Insurance Services Office (ISO), recommendations of the Uniform Fire Code, and discussions with the North Plains Fire Department.

Table 4-2
Summary of Land Use and
Recommended Fire Flows

City of North Plains Zoning Classification		Recommended Fire Flow (gpm)
R7.5	Single-Family Residential	1,500
R5	Single-Family Residential	1,500
R2.5	Multi-Family Residential	1,500
C1	General Commercial	3,500
C1	Highway Commercial	3,500
M1	Light Industrial	3,500
M2	General Industrial	3,500
CS	Community Service	3,500

Water stored for fire suppression is typically provided to meet the single most severe fire flow demand within each zone. The recommended fire storage volume is determined by multiplying the fire flow rate by the duration of that flow. Table 4-3 summarizes recommended fire flow durations. Therefore, the maximum fire flow storage required is 3,500 gpm X 3 hours = 0.63 MG.

Table 4-3
Recommended Fire Flow Duration Summary

Recommended Fire Flow (gpm)	Duration (hours)
Up to 3,000	2
3,000 to 4,000	3

Pumping Capacity

The City's water system is supplied by a connection to the JWC system and includes an emergency backup well. With this arrangement, the City's water service area is classified as an "open system", with primary flow and system pressure provided by an outside water supply source. Minimum pumping capacity requirements for an open system is required to meet MDD conditions with all pumps in service, and meet ADD conditions with the largest pump out of service (firm capacity). Therefore, the total capacity of the City's pump station should equal or exceed maximum day demands, and the firm capacity of the pump station should equal or exceed average day demands.

Summary

The criteria developed in this section are used to assess the system's ability to provide adequate water service under existing conditions and to guide improvements needed to provide service for future water needs. Planning criteria for the transmission and supply system, distribution system, pressure zone, and storage and pumping facilities are presented herein. Section 5 presents the analysis of the water distribution system and identifies recommended improvements based on the criteria provided in this section. A similar analysis and recommendation of improvements to the water supply system is offered in Section 6. Cost estimates and a recommended capital improvement plan are developed and presented in Section 7.

SECTION 5
WATER SYSTEM ANALYSIS

General

This section presents an analysis of North Plains' water distribution system based on the water demand forecasts presented in Section 3 and the analysis criteria developed in Section 4. This section analyses the City's supply sources, evaluates the system's existing service pressures and storage and pumping capacity requirements, and presents the findings of a computerized hydraulic network analysis of the water distribution system. Through evaluation and analysis, system deficiencies were identified and improvement options were developed. Section 6 presents a recommended capital improvement program that includes prioritized recommended improvements to correct system deficiencies and provide for system expansion.

Water demand estimates for the study area were developed in 5-year increments through saturation development, estimated to occur in FY 2021/22, as shown on Table 5-1. These water demand estimates along with the planning criteria established in Section 4 are the basis for the analysis of the existing system and the development of recommended system improvements. All improvements to storage and pumping facilities and distribution piping are based on estimated maximum day demands at saturation development unless otherwise noted.

Supply Source Analysis

The City's primary water supply is provided through a newly constructed 16-inch diameter transmission main connected to the Joint Water Commission (JWC) supply system. The City has negotiated an agreement with the JWC that provides an instantaneous rate of flow not to exceed 875 gpm (1.26 mgd) and a maximum volume of water not to exceed 1.05 mgd. In addition, the City's existing well, Well No. 3, is operated as an emergency backup supply with a production capacity of approximately 0.9 mgd. The City's supply capacity is adequate to meet the current maximum day demands of approximately 0.51 mgd. The water demand analysis in Section 3 projects an estimated maximum day demand of approximately 1.62 mgd at saturation development. With a maximum day supply allowance of 1.05 mgd, the JWC source is adequate to meet the City's maximum day demands for the next five to ten years; however, it is estimated that an additional 0.57 mgd of additional maximum day supply capacity is needed prior to saturation development as shown in Table 3-8, which is repeated and presented as Table 5-1 for convenience.

Table 5-1
Population Forecasts and
Estimated Water Demand Summary

Year	Population	Water Demand (mgd)		
		Average Day Demand [1] (ADD)	Maximum Day Demand [2] (MDD)	Peak Hour Demand [3]
2005	1,700	0.21	0.51	0.77
2010	2,404	0.30	0.72	1.08
2015	3,699	0.46	1.11	1.66
2020	5,231	0.65	1.57	2.35
2021-- Saturation Development	**5,390**	**0.67**	**1.62**	**2.43**

Notes: 1. Average day demand equals the population multiplied by the estimated average daily per capita usage for the service area (125 gpcd).
2. Maximum day demand equals the population multiplied by the estimated maximum daily per capita usage for the service area (300 gpcd).
3. Peak hour demand equals 1.5 times the maximum day demand.

Water Rights

The City of North Plains holds a groundwater use permit with the Oregon Water Resources Department. This permit provides for groundwater extraction from Well Nos. 1, 2 and 3 up to the amount of 1.43 cubic feet per second (cfs) (642 gpm or 0.92 mgd)). In February, 2005, the City submitted a claim of beneficial use on this permit from Well No. 3. The amount claimed was 1.32 cfs (592 gpm or 0.85 mgd). No claims were made regarding Well Nos. 1 and 2. Well No. 2 is currently not operational and Well No. 1 is considered to be a non-exempt use and it was not included in the claim. Assuming the claim is approved, the City will in due course be issued a water right certificate for the amount claimed from Well No. 3.

Water System Pressure Analysis

As discussed in Section 2, North Plains' distribution system currently has one single pressure zone. The planning criteria developed in Section 4 established acceptable service pressure limits for the water system. Under normal operating conditions, water will be supplied to the service area primarily by the transmission line from JWC. Analysis of system pressures under average day, maximum day, peak hour, and fire flow conditions indicate that the City's distribution system will require improvements over the planning horizon and before saturation development. These improvements are discussed in Section 6.

Storage Capacity Analysis

The storage capacity analysis evaluates the City's existing storage capacity and determines the recommended storage volume needs for the water service area. Reservoir capacity requirements are developed based on the planning criteria presented in Sections 3 and 4. Estimated reservoir storage volume requirements are based on the sum of operational, fire suppression and emergency storage volume needs. In addition, the City's agreement with the Joint Water Commission stipulates that North Plains must maintain storage capacity or supplemental water supply equal or greater than three times the average day demand. Table 5-2 summarizes existing storage volume needs over the planning horizon and at saturation development.

Table 5-2
Storage Volume Analysis Summary

Storage Requirement (MG)[1]		Existing Storage Capacity (MG)	Storage Deficit (MG)	
FY 2005/06 (Existing)	FY 2021/22 (Saturation Development)		FY 2005/06 (Existing)	FY 2021/22 (Saturation Development)
0.89	2.02	1.00	0.00	1.02

Notes: 1. Storage capacity requirements equal the greater of the two storage capacity criteria stated in Section 4. See Table C-1 in Appendix C for required capacity under each criterion.

This analysis indicates that the City's storage requirements will exceed existing storage capacity within the next 5 to 7 years, and that an additional 1.02 MG will be required through saturation development. For discussion purposes, it was determined that additional storage would be required under the condition that no further annexations were to occur beyond those annexations completed at the time this document was published. Based on the above analysis, it is recommended that additional storage capacity be provided in the near term. Specific recommendations regarding future reservoir sizing and locations are presented in Section 6. It appears that the storage criteria based on the current JWC agreement governs; therefore, it is suggested that a review of the agreement, and possible renegotiation, be considered to confirm sizing requirements prior to building additional storage capacity. Storage capacity requirements for each criterion through the year 2025 are presented in Table C-1 in Appendix C.

Pumping Capacity Analysis

As presented in Section 2, under typical operations the booster pump station serves only to help maintain water quality in the reservoir. Typically each day the pump station operates on a timer to pump water from the reservoir into the distribution system. During the night an altitude valve opens to fill the reservoir from the distribution system. Occasionally, during

very high demand conditions, the booster pump station serves to supplement the supply from the JWC system by pumping water from the reservoir into the distribution system.

Pumping capacity requirements were evaluated using criteria established in Section 4. The total capacity of the City's pump station should equal or exceed maximum day demands, and the firm capacity of the pump station should equal or exceed average day demands. Firm pumping capacity is defined as the pumping capacity when the largest pump is out of service. For the pumping capacity analysis, water demand estimates in Tables 5-1 and 5-2 have been converted to gallons per minute (gpm). Table 5-3 presents a summary of pumping requirements, existing pumping capacity, and the surplus or deficit of capacity over the planning horizon in 5-year increments and at saturation development.

Table 5-3
Pump Station Capacity Analysis

Year	Pumping Capacity (gpm)					
	Requirement		Existing		Surplus (+) / Deficit (-)	
	Firm (ADD)	Total (MDD)	Firm	Total	Firm	Total
2005	147	354	200	700	53	346
2010	209	501	200	700	-9	199
2015	321	770	200	700	-121	-70
2020	454	1089	200	700	-254	-389
2021	468	1122	200	700	-268	-422

Based on this analysis, additional pumping capacity is required within the next 3 to 5 years. Specific recommendations regarding pumping improvements are presented in Section 6.

Distribution System Analysis

General

A hydraulic network analysis computer program was used to evaluate the performance of the existing distribution system and to aid in the development of proposed system improvements. The network analysis program determined pressure and flow relationships throughout the distribution system for a variety of critical hydraulic conditions. System performance and adequacy was then evaluated on the basis of water demand estimates developed in Section 3 and planning criteria presented in Section 4.

Hydraulic Model

For modeling purposes, the water distribution system was digitized onto a digital base map drawing file using WaterCAD network analysis software. This drawing file was then used to

perform the system analysis and to illustrate recommended improvements. The drawing file is presented as the "Proposed Water System Plan Map" Figure 1 in Appendix A.

All pipes on the map are shown as "links" between "nodes" which represent pipeline junctions or changes in pipe size. Within the program, pipes and nodes are numbered to allow for easy system updating and revision. These numbers have been assigned to frozen drawing layers and have not been shown for drawing clarity. Also within the program, diameter, material type and length are specified for each pipe, and an approximate ground elevation is specified for each node. For drawing clarity only pipe diameters are illustrated. Hydraulic elements such as closed valves, pressure reducing valves, pumps and reservoirs are also illustrated and incorporated into the model database.

Model Calibration

The hydraulic model simulates the City's existing water distribution system by approximating the length, diameter and friction loss characteristics of all distribution system piping. In addition, the modeling conditions are based on the assumption that the City's water supply is provided through the connection to the JWC system, as discussed in Section 2. It is anticipated that the City's pump station will operate as presented in Section 2 and is reflected in fire flow capacity estimates. Existing pump station performance and system pressure data was not sufficient to calibrate the hydraulic model with actual flow test data. As such, pipe friction loss coefficients and pump performance are estimated based on industry standards and local experience with water systems of similar size, age, pipe material and usage.

Modeling Conditions

To simulate system operation under maximum usage conditions, it is necessary to determine the water usage anticipated for the highest water use day of the year. For this purpose the maximum day demands at saturation development, previously presented as part of Table 5-1, were distributed throughout the system.

In order to use the computerized hydraulic model of the water system to assess system adequacy, several conditions were examined. The adequacy of the major transmission piping and the system's ability to provide recommended fire flows throughout the system were analyzed.

All fire flow modeling was performed assuming that the connection to the JWC system was supplying water and the fire pump was operating in accordance with the system operational settings as identified in Table 2-3. In addition, it was assumed that the system must be capable of providing the recommended fire flows while maintaining a minimum system pressure of approximately 20 psi to all services.

Modeling Results

Distribution System

Certain distribution system improvements are required to adequately supply the water system during maximum day demand conditions over the 20 year planning horizon, and at saturation development. In addition, distribution system improvements are needed to meet fire flow requirements. Improvement sequencing, pipe size recommendations, and detailed project cost estimates are presented in Section 6.

Fire Flow

Modeling results under maximum day demand conditions at saturation development indicate that improvements are required in order to provide recommended fire flows while maintaining minimum service pressures. Fire flows were simulated throughout the study area based on the estimated fire flow recommendations for representative land uses as presented in Section 4. The needed improvements are limited to upsizing existing distribution mains. The locations of improvements are indicated on Figure 1 in Appendix A. Improvement sequencing and pipe sizing recommendations are presented in Section 7 in addition to detailed project cost estimates.

System Expansion

As discussed in Section 3, the City of North Plains' UGB encompasses approximately 677 acres. The future water service area is defined by the established UGB, which includes 146 acres of land outside of the City limits that have been designated for annexation and residential development. The majority of the expansion area is comprised of two large annexations to the north and east of the existing City limits. The remaining approximately 2 acres are split between two smaller annexations. All four expansion areas are illustrated on Figure 1 in Appendix A. System improvements identified above in the distribution system and fire flow analysis will adequately supply these areas from the existing reservoir, pumping facility, and supply connection during the planning period.

Water Loss Evaluation

A review of water loss data for the past five years indicates that the City water service meter consumption totaled less than was produced by the City's wells. Table 5-4 shows the service meter consumption and water production totals for 1999 through 2003. The water works industry generally considers a level of unaccounted-for water of 15 percent or more to be excessive. The State of Oregon also recently adopted new administrative rules that establish acceptable water losses at this level. For the past three years, the City water losses have been less than this recommended maximum limit of 15 percent. In fact, the City water losses have been declining in recent years, likely due to recent replacements of older, leaking water

mains. At this time, it does not appear that a leak detection survey and leak repair program is needed. Should water loss percentages increase in the future, the City should consider increased monitoring and completing repairs as needed.

Table 5-4
Water Loss Evaluation Summary

Year	Metered Consumption (mg)	Total Well Production (mg)	% of Water Loss
1999	58.2	76.8	24%
2000	62.7	74.7	16%
2001	64.6	75.2	14%
2002	67.5	75.8	11%
2003	71.9	77.7	7.5%

Summary

This section developed and presented an analysis of the North Plains' water system. The analysis found that additional water supply capacity, storage volume, pumping capacity and piping improvements are needed to adequately meet near term needs and to provide for system expansion in the future. Section 6 presents specific recommendations and a capital improvement plan that includes proposed project sequencing, phasing requirements and project cost estimates.

SECTION 6
RECOMMEDATIONS AND CAPITAL IMPROVEMENT PLAN

General

This section presents recommended water system improvements based on the analysis and findings presented in Section 5. These improvements include proposed additional water supply capacity, storage volume, pumping capacity and piping improvements. The analysis found that certain improvements are needed to adequately meet near term needs and to provide for system expansion in the future. All proposed system improvements are illustrated on Figure 1 in Appendix A. Also presented is a capital improvement program (CIP) schedule for all recommended improvements.

Cost Estimating Data

An estimated project cost has been developed for each improvement project recommendation presented in this section. Itemized project cost estimate summaries are presented in Appendix B. Appendix B also includes a Piping Improvement Project Cost Estimate Summary developed on a unit cost basis for recommended water main improvements.

The cost estimates are based upon recent experience with construction costs for similar work in the region and assume improvements will be accomplished by private contractors. Cost estimates represent opinions of costs only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors.

The project costs presented in this plan include estimated construction costs plus an aggregate 40 percent allowance for contingencies, engineering, administration and other project-related costs. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. ENR provides monthly index estimates for 20 major U.S. metropolitan areas. The closest regional CCI provided by ENR is for Seattle, Washington. For purposes of future cost estimate updating, the October 2005 ENR CCI for Seattle, Washington of 8,409 is referenced.

Recommended Improvements

General

Presented below are recommended water system improvements for supply, storage, pumping, and distribution system piping. Project cost estimates are presented for all recommended improvements and annual budgets are presented for recommended capital improvement programming. The recommendations are presented by project type and discussed in order of need. A summary of all the recommended improvements is presented in Table 6-1. The

table provides for prioritized project sequencing by illustrating fiscal year (FY) project needs for each facility and improvement category. The proposed improvements listed are phased and sequenced for construction over the planning period of 20 years.

Supply Source Agreement

The City of North Plains recently implemented a new water supply source from the Joint Water Commission (JWC) that provides a peak flow of approximately 875 gpm and a maximum supply per day of 1.05 million gallons, as per the City/JWC supply agreement. As discussed in Section 5, system demands will exceed the currently agreed supply limits within 5 to 10 years. It is estimated that an additional 0.57 million gallons of maximum day supply capacity is needed prior to saturation development. Prior to this time, it is recommended that the City negotiate for additional supply capacity from the JWC or seek alternative supply sources.

It should be noted that Oregon Administrative Rules now mandate the preparation of a Water Management and Conservation Plan (WMCP) in accordance with Division 86 guidelines for all municipal water suppliers. As per the JWC/North Plains agreement, the City of North Plains effectively adopts the JWC Water Management and Conservation Plan, thereby satisfying the OAR requirements in this regard.

System Monitoring and Control

It is recommended that the City implement monitoring and control system improvements. One of the key reasons for implementing such improvements is to provide greater control of supply flows. The monitoring and control improvements would help the City stay within the instantaneous flow limit established by the City/JWC agreement. In addition, such improvements would allow the necessary control to help minimize the maximum day demands on the JWC source. By better controlling demand peaking, the City may defer the need to renegotiate the City/JWC agreement or develop other water sources and additional storage as long as practical. Also, by exhibiting a consistent pattern of mitigated demands on the JWC source, North Plains may be better positioned for possible renegotiation of the agreement if it occurs.

It is recommended that the City install a telemetry and control system within the next 5 years. Recommended improvements include a flow meter and additional valve control components installed within the existing supply pressure/flow control station, along with supervisory control and data acquisition (SCADA) system components installed and programmed at both the City's pump station and at the Public Works offices. The estimated project cost of the improvements is $85,000.

Pumping Improvements

The City's pump station currently houses one recently replaced 40 hp booster pump, one 15 hp booster pump, one non-operational booster pump, and one 3,600 gpm fire pump. The existing 3,600 gpm natural gas fueled fire pump is not considered as a booster pump for this analysis, and the City may continue to maintain it over the long term for emergency (fire) purposes, or remove it as may be desired.

As discussed in Section 4, with the City's water system being supplied by a connection to the JWC, the system is classified as an "open system", with primary flow and system pressure provided by an outside water supply source. Minimum pumping capacity for an open system is required to meet MDD conditions with all pumps in service, and meet ADD conditions with the largest pump out of service (firm capacity). The City's pump station will fail to meet these criteria within the next five to ten years as demands increase; therefore, it is recommended that the pump station be upgraded to include additional pumping capacity. It is recommended that the existing booster pumps be replaced by two new pumps, each with a capacity equal to or greater than the ADD demands at saturation development. For example, two 600 gpm pumps would accommodate the saturation development ADD demands and provide a firm capacity of 600 gpm, as well as meet the saturation development MDD demands with a total capacity of 1,200 gpm.

It is also recommended that the existing motor control center (MCC) be replaced or modified to include provisions for providing variable speed control to all booster pumps. Variable speed control of all of the pumps is recommended in order to optimize efficiency and performance of the pumps and limit operating costs. In addition, it is recommended to provide emergency backup power generation for the pump station so that operations may continue during a power failure scenario. The estimated project costs for the above pumping improvements are $170,000.

An additional ground level reservoir, as recommended later in this section, will require additional pumping facilities unless the reservoir is located at sufficient elevation to provide service by gravity. Local topography north of the City suggests that a reservoir located to provide service by gravity would require construction of an approximately 2.5 mile long transmission main. The costs of such a transmission main may be comparable to the costs of a pump station, including long term operation and maintenance, required by a ground level reservoir constructed within the service area. It is suggested that both alternatives be evaluated during the preliminary engineering phase of the proposed reservoir. For the purposes of establishing CIP budgets in this report a new 1,200 gpm pumping station is included with the recommendations for additional storage. Provisions for variable speed control and emergency backup power generation are recommended features of the pumping station. The estimated project costs for a new 1,200 gpm pumping station are $450,000.

Distribution System Improvements

The analysis found that distribution system water line improvements are needed to improve fire flow capacities within the distribution system and also provide improved hydraulic transmission capacity and accommodate system expansion needs. A detailed list of system piping improvements is located in Appendix B. The total costs for distribution piping improvements through the 20-year planning period are approximately $1,400,000. Table 6-1 presents recommended distribution system water line improvements, included in the CIP, for each fiscal year. Each improvement is identified by category and includes an estimated project cost. For the purpose of this section recommended distribution system improvements are grouped in the following general categories:

1. Distribution and Fire Flow Capacity Improvements
2. Developer contributions
3. Water main replacement program.

Below are brief summary descriptions of recommended water line improvements by category.

Distribution and Fire Flow Capacity Improvements

It is recommended that distribution system water line improvements be completed to improve fire flow capacities and to provide for system expansion needs. Approximately 13,150 linear feet of 12-inch and 8-inch diameter mains are recommended for construction. These improvements are required to meet existing and future fire flow needs and will also facilitate meeting system capacity requirements at saturation development.

Developer Contributions

On Figure 1 in Appendix A there are approximately 12,100 linear feet of 8-inch and 12-inch diameter piping shown serving certain undeveloped areas within the UGB. Such improvements are shown as dashed red lines on Figure 1. The improvement alignments shown are rough approximations of only the most significant piping required to serve these areas. It is assumed that all other developer installed piping will be a minimum of 8-inches in diameter. Since development details have yet to be established, the full extent of distribution piping required to adequately serve these areas is not shown. The total estimated construction cost for the developer contribution improvements shown on Figure 1 is approximately $1,490,000. It is anticipated that the funding and construction of these and certain other improvements required by development will be provided by private interests as these areas are developed. Consequently, construction costs for this work are not reflected in the CIP presented in this study, and thus not shown on Figure 6-1. Following the completion of these improvements it is expected that these facilities will become City-owned and operated. Brief descriptions of the more significant developer contribution improvements shown on Figure 1 are provided below.

12-inch diameter main serving northern expansion area – A minimum 12-inch diameter water main will be required to serve the proposed 74-acre residential expansion area on the City's northerly border. Construction costs for this waterline are estimated at approximately $400,000. This water main will provide service and fire flows within the northern expansion area.

12-inch diameter main serving eastern expansion area – A minimum 12-inch diameter water main will be required to serve the proposed 70-acre residential expansion area on the easterly end of the City. Construction costs for this waterline are estimated at approximately $670,000. This waterline will provide service and fire flows within the eastern expansion area.

Currently the easterly portion of the City is served by a single 14-inch diameter water main. While the existing 14-inch diameter main has adequate hydraulic capacity to serve the eastern expansion area, in addition to the easterly portion of the City which it currently serves, annexation and subsequent development of the eastern expansion area would warrant the need to provide redundant water supply to this area.

A second water main, extending from NW Commercial Street or NW Pacific Street, could serve the easterly portion of the City and would allow for looping of the pipeline system thereby improving water circulation, water quality, improved fire flow capacity, and greatly improved system reliability. A new water main extension would serve as a backup supply, providing water to a significant population in the event that the existing 14-inch diameter pipe serving this area is damaged or requires maintenance. A new water main would cost approximately $730,000. A more desirable alternative for providing redundant supply to the easterly portion of the City would be to locate the proposed 1.02 MG reservoir in this area. This reservoir could provide the same benefits regarding water circulation, water quality, improved fire flow capacity and redundancy as a second main. As discussed in this report, an additional reservoir is needed in the near future due to overall population and water demand growth. As development plans for the easterly expansion area progress, it is recommended that both alternatives for providing redundant supply be thoroughly evaluated. The reservoir located in the easterly portion of the City is the desired option and is thus shown on Figure 1, the Proposed Water System Plan Map. Both alternatives for providing redundant supply to the easterly portion of the City would be consistent with prudent planning practices, and would allow the City to uphold its responsibilities of providing adequate water service to its citizens.

8-inch diameter main serving northwestern industrial and residential area – A minimum 8-inch diameter water main will be required to provide service and fire flows to future industrial and residential development in the northwesterly portion of the City. The 8-inch diameter main would extend along NW Gordon Road and NW North Avenue. Construction costs for this waterline are estimated at approximately $250,000.

Water Main Replacement Program

It is recommended that the City's current water main replacement program continue. This program provides for the routine replacement of leaking, damaged and older water mains throughout the water system. The minimum recommended replacement size is 8 inches in diameter. It is recommended that $50,000 be budgeted annually for this program. This funding amount assumes an average service of approximately 100 years for water system piping.

Storage Capacity Improvements

Results of the storage capacity analysis indicate that the City will have a total storage capacity deficit of approximately 1.02 MG at saturation development based on demand estimates developed in Section 3 and storage criteria developed in Section 4. The City's storage requirements will exceed existing storage capacity within the next 5 to 7 years. As such, it is recommended that the City construct a new 1.02 MG reservoir by the year 2011 to provide sufficient storage capacity for the long-term. The estimated project cost for the recommended reservoir is $1,250,000, assuming a bolted or welded steel tank similar in type to the City's existing reservoir.

It is recommended that the City perform a siting study within the next five years for identifying site options for the proposed reservoir. As discussed, the reservoir is currently shown in the easterly portion of the City. If the reservoir is located elsewhere, it is recommended that redundant supply to the easterly portion of the City be provided by some other means. It appears that the City's existing reservoir site would be too small to accommodate a second reservoir without the acquisition of additional land. In addition, a new reservoir at, or adjacent to, the existing reservoir site would possibly allow the City to use a single pump station for both reservoirs; however, this site as well as others should be evaluated by a siting study to determine suitability for a new reservoir. As discussed previously, potential reservoir sites outside of the City that would allow for operation by gravity without pumping should be considered by any such siting study.

Land Acquisition

Land acquisition will likely be required to accommodate the recommendations of this study. A site will need to be acquired for the new reservoir. Any land acquisition should be completed well in advance of anticipated construction so that nearby development or other

uses do not preclude construction of facilities. Land acquisition should proceed immediately following completion of a siting study for the required additional storage.

Unaccounted-for Water Evaluation

The analysis in Section 5 indicated that the City's water loss is within acceptable levels. It is recommended that the City continue monitoring water loss. The completion of recommended telemetry and control system improvements will allow the City to more closely and accurately monitor its water demand and consumption data.

Additional Recommendations

Financial Evaluation and Plan

A long-term financial planning evaluation and strategy is recommended to support the proposed capital improvement plan. The financial evaluation should include a cost-of-service analysis and income generating options that support an adequate funding source without placing an undue burden on existing customers. Adequate SDC's should be established to collect funds from new customers to pay for improvements that expand the capacity of the system. It is recommended that approximately $30,000 be budgeted to develop the financial plan.

Source Alternatives Study

As previously discussed, and based on estimates of future water demands presented in this study, the existing source capacity should be expanded within the planning horizon. Previously considered source alternative studies should be updated relative to this master plan's analysis, and an evaluation should be made of the need to pursue other alternatives as an option to the existing JWC supply.

Summary

A summary of all the recommended improvements is presented in Table 6-1. The table provides for prioritized project sequencing by illustrating fiscal year (FY) project needs for each facility or improvement category. The total estimated project costs of the recommended improvements are approximately $4.4 million over the 20-year planning horizon. It is recommended that the City's capital improvement program (CIP) be funded at approximately $220,000 annually for storage, pumping and distribution system piping improvements. Financial planning work is recommended to identify funding options and alternatives.

Table 6-1
City of North Plains
Water System Master Plan
Capital Improvement Program Summary

Category	Project Description	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	Estimated Total Project Costs
Telemetry & Control	New Telemetry and Control (SCADA) System				Telemetry and Control System $85,000																	
	Sub-Total	$ -	$ -	$ -	$ 85,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 85,000
Pumping Facilities	Pump Station Upgrades				P.S. Upgrades $170,000																	
	Booster Pump Station						P.S. No. 2 $450,000															
	Sub-Total	$ -	$ -	$ -	$ 170,000.00	$ -	$ 450,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 620,000.00
Distribution System Piping	Fire Flow and Distribution Improvements		(8") Wascoe 309th to 311th $44,100		(8") Main $50,960		(12") Gordon $45,500		(12") Glencoe $58,500		(12") Commercial $182,000		(8") Gordon $67,620		(8") North $137,200							
		(8") 309th $80,360		(8") Lenox $32,340		(8") Wascoe 318th to 319th $46,060		(12") Cottage $122,000		(12") 313th $92,300		(8") Hillcrest $82,320		(8") Highland $49,000		Wascoe Gordon to Timeric $191,100						
	Main Replacement Program	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	
	Sub-Total	$ 130,360.00	$ 94,100.00	$ 82,340.00	$ 100,960.00	$ 96,060.00	$ 95,500.00	$ 172,000.00	$ 108,500.00	$ 142,300.00	$ 232,000.00	$ 132,320.00	$ 117,620.00	$ 99,000.00	$ 187,200.00	$ 241,100.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 2,281,360.00
Storage Facilities	New Reservoir						1.02 MG Reservoir $1,250,000															
	Sub-Total	$ -	$ -	$ -	$ -	$ -	$ 1,250,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,250,000
	Total	**$ 130,360**	**$ 94,100**	**$ 82,340**	**$ 355,960**	**$ 96,060**	**$ 1,795,500**	**$ 172,000**	**$ 108,500**	**$ 142,300**	**$ 232,000**	**$ 132,320**	**$ 117,620**	**$ 99,000**	**$ 187,200**	**$ 241,100**	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ 4,236,360**

MSA

APPENDIX B

APPENDIX B
COST ALLOCATIONS FOR WATER SYSTEM IMPROVEMENTS

Appendix B contains cost estimates for recommended improvements for pumping, storage, telemetry and control, and system piping. These cost estimates are based on the Engineering News Record Construction Cost Index for Seattle, Washington of 8,409 (October 2005).

Table B-1
Piping Improvement Project Cost Estimate Summary [1]

Distribution and Fire Flow Capacity Improvements				
Location	**Size (inches)**	**Length (feet)**	**Unit Cost ($/lf)**	**Estimated Project Cost[1]**
NW Commercial Street	12	1,400	$130	$182,000
NW Cottage Street	12	940	$130	$122,200
NW Glencoe Road	12	450	$130	$58,500
NW 313TH Avenue	12	710	$130	$92,300
NW Gordon Road	12	350	$130	$45,500
NW Gordon Road	8	690	$98	$67,620
NW Highland Court	8	500	$98	$49,000
NW Hillcrest Street	8	840	$98	$82,320
NW Lenox Street	8	330	$98	$32,340
NW Main Street	8	520	$98	$50,960
NW North Avenue	8	1,400	$98	$137,200
NW Wascoe Street (Gordon Road to Timeric Sreet.)	8	1950	$98	$191,100
NW Wascoe Street (318th to 319th)	8	470	$98	$46,060
NW Wascoe Street (309th to 311th)	8	450	$98	$44,100
NW 309TH Street	8	820	$98	$80,360
			Total	**$1,281,560**

[1] The cost estimates presented are opinions of cost based on the assumptions stated and developed from information available at the time of the estimate. Final costs for all projects will depend on actual field conditions, on actual material and labor costs, final project scope, project implementation and other variables.

Table B-2
Telemetry and Control System
Project Cost Estimate Summary

Pump station project cost estimates are based on the following assumptions:

No rock excavation included.
No property acquisition costs included.
No backup power supply.
Construction by private contractors.
An ENR construction cost index of 8,409 for Seattle, Washington (October 2005).

Item No.	Description	Estimated Project Cost[1]
1.	Mobilization	$5,000
2.	Flow Control Station Controls and Telemetry	$10,000
3.	Flow Meter (Installed within Supply Flow Control Station)	$10,000
4.	Pump Station Control System Modifications	$15,000
5.	Public Works Telemetry and Control	$10,000
6.	System Programming	$10,000
	Total Construction Cost	$60,000
	40% Contingency, Administration & Engineering	$24,000
	Total Project Cost	$84,000
	SAY	$85,000

[1] The cost estimates presented are opinions of cost based on the assumptions stated and developed from information available at the time of the estimate. Final costs for all projects will depend on actual field conditions, on actual material and labor costs, final project scope, project implementation and other variables.

Table B-3
Pump Station Upgrades
Project Cost Estimate Summary

Pump station project cost estimates are based on the following assumptions:

No rock excavation included.
No property acquisition costs included.
No backup power supply.
Construction by private contractors.
An ENR construction cost index of 8,409 for Seattle, Washington (October 2005).

Item No.	Description		Estimated Project Cost[1]
1.	Mobilization		$10,000
2.	Mechanical		$40,000
7.	Controls		$20,000
8.	Electrical		$50,000
	Total Construction Cost		$120,000
	40% Contingency, Administration & Engineering		$48,000
	Total Project Cost		$168,000
		SAY	$170,000

[1] The cost estimates presented are opinions of cost based on the assumptions stated and developed from information available at the time of the estimate. Final costs for all projects will depend on actual field conditions, on actual material and labor costs, final project scope, project implementation and other variables.

Table B-4
1.02 MG Reservoir Construction – Bolted or Welded Steel
Project Cost Estimate Summary

Reservoir project cost estimates are based on the following assumptions:

No rock excavation included.
No property acquisition costs included.
Construction by private contractors.
An ENR construction cost index of 8,409 for Seattle, Washington (October 2005).

Item No.	Description		Estimated Project Cost[1]
1.	Reservoir Structure		$650,000
2.	Site Work		$45,000
3.	Drainage System – Including site storm drainage and reservoir overflow discharge		$25,000
4.	Access/Parking		$30,000
5.	Yard Piping		$60,000
6.	Electrical– Including reservoir telemetry		$25,000
7.	Landscaping/Fencing		$45,000
	Total Construction		$880,000
	40% Contingency, Administration & Engineering		$352,000
	Total Project Cost		$1,232,000
		SAY	$1,250,000

[1] The cost estimates presented are opinions of cost based on the assumptions stated and developed from information available at the time of the estimate. Final costs for all projects will depend on actual field conditions, on actual material and labor costs, final project scope, project implementation and other variables.

Table B-5
1200 gpm Pump Station Construction
Project Cost Estimate Summary

Pump station project cost estimates are based on the following assumptions:

No rock excavation included.
No property acquisition costs included.
No backup power supply.
Construction by private contractors.
An ENR construction cost index of 8,409 for Seattle, Washington (October 2005).

Item No.	Description	Estimated Project Cost[1]
1.	Mobilization	$20,000
2.	Site Work	$50,000
4.	Structure	$100,000
4.	Yard Piping	$20,000
5.	Mechanical	$35,000
9.	Controls	$20,000
10.	Electrical	$50,000
11.	Landscaping	$20,000
	Total Construction	$315,000
	40% Contingency, Administration & Engineering	$126,000
	Total Project Cost	$441,000
	SAY	$450,000

[1] The cost estimates presented are opinions of cost based on the assumptions stated and developed from information available at the time of the estimate. Final costs for all projects will depend on actual field conditions, on actual material and labor costs, final project scope, project implementation and other variables.

APPENDIX C

APPENDIX C
WATER STORAGE CAPACITY ANALYSIS

Table C-1 is a tabular analysis of water system storage capacity requirements based on the two separate criteria presented in Section 4. This table summarizes the required storage capacity for each criterion over the planning horizon and at saturation development. As shown, Criteria A governs until approximately 2012 at which time Criteria B storage requirements exceed Criteria A requirements.

Reservoir Storage Requirement Criteria

Criteria A - Regional Water Supply Design Criteria

Required Storage Volume = [Operational Storage] + [Fire Storage] + [Emergency Storage]
= [0.25 x MDD] + [3500gpm x 60min x 3hours] + [0.25 x MDD]
= 0.5 x MDD + 0.63 MG

Criteria B – Joint Water Commission Supply Agreement

Required Storage Volume = 3 x ADD

Table C-1
Storage Analysis by Criteria

Storage Capacity (MG)					
Year	Requirement		Existing	Surplus (-) / Deficit (+)	
	Criteria A (0.5 x MDD + 0.63 MG)	Criteria B (3 x ADD)		Criteria A (Req. – Exist)	Criteria B (Req. – Exist)
2005	0.89	0.64	1.00	-0.12	-0.36
2006	0.90	0.67	1.00	-0.10	-0.33
2007	0.91	0.70	1.00	-0.09	-0.30
2008	0.93	0.76	1.00	-0.07	-0.24
2009	0.96	0.83	1.00	-0.04	-0.17
2010	0.99	0.90	1.00	-0.01	-0.10
2011	1.02	0.98	1.00	0.02	-0.02
2012	1.06	1.07	1.00	0.06	0.07
2013	1.10	1.17	1.00	0.10	0.17
2014	1.14	1.27	1.00	0.14	0.27
2015	1.18	1.39	1.00	0.18	0.39
2016	1.23	1.51	1.00	0.23	0.51
2017	1.29	1.65	1.00	0.29	0.65
2018	1.35	1.80	1.00	0.35	0.80
2019	1.38	1.88	1.00	0.38	0.88
2020	1.41	1.96	1.00	0.41	0.96
2021	1.44	2.02	1.00	0.44	1.02
2022	1.44	2.02	1.00	0.44	1.02
2023	1.44	2.02	1.00	0.44	1.02
2024	1.44	2.02	1.00	0.44	1.02
2025	1.44	2.02	1.00	0.44	1.02

APPENDIX D
REFERENCES

Ameen, Joseph H., *Community Water System Source Book*, Fifth Edition, Technical Proceedings, 1971.

Distribution Network Analysis for Water Utilities, Manual M32, First Edition, American Water Works Association, 1989.

Distribution System Requirements for Fire Protection, Manual M31, Third Edition, American Water Works Association M31, 1998.

Hydraulic Handbook, Sixteenth Edition, Fairbanks Morse Pump Corporation, 1988.

Modeling, Analysis and Design of Water Distribution Systems, Lee Cesario, American Water Works Association, 1995.

Oregon Administrative Rules, Chapter 333: Public Water Systems, Department of Human Services, Oregon Health Division, October 15, 2002.