City of Carnation

Comprehensive Water System Plan 2008

Approved July 2009

CITY OF CARNATION

COMPREHENSIVE WATER SYSTEM PLAN
2008

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APPROVAL

Reviewed by Washington State Department of Health in accordance with the provisions of WAC 246-290-100 and approved on July 27, 2009.

Approved by the City of Carnation through City Ordinance.

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CHAPTER 1 DESCRIPTION OF WATER SYSTEM

BACKGROUND

In 1999, the City of Carnation prepared a new Comprehensive Water System Plan to update the City's 1990 Comprehensive Water Plan. This new plan was further updated in October 2000 to address comments made by the King County Department of Natural Resources (DNR) during their draft plan review.

The October 2000 version of the Comprehensive Water System Plan was submitted to the Washington State Department of Health (DOH), the Washington State Department of Ecology (DOE), and the King County Utilities Technical Review Committee (UTRC). The DOH and DOE approved the plan, but the UTRC gave only a conditional approval, which was contingent upon addressing several comments. The UTRC meeting minutes are included in **Appendix B.**

The Comprehensive Water System Plan 2003 Supplement was prepared by Roth Hill Engineering Partners, LLC to address the conditions of approval required by the UTRC, as well as the comments by the DNR that were not addressed in the October 2000 update. King County has not approved the City's Plan due to reservations regarding population projections from the 2000 Plan.

AUTHORIZATION

This Comprehensive Water System Plan is prepared in conformance with WAC 246-290-100 and DOH standards which require a "Group A" public water system serving more than 25 customers to update their comprehensive water plans at least once every six years. The City of Carnation is located within the boundary of the East King County Coordinated Water System Plan (CWSP).

The preparation of this 2008 Comprehensive Water System Plan was authorized by the City of Carnation.

PURPOSE OF THE STUDY

This study re–evaluates and updates the previous Comprehensive Water Plan recognizing the changes in the system, population growth expected due to a new sewer system plus changes in legal requirements (e.g., municipal water law, treatment, rules, etc.), and reduced planning area.

The objectives of this plan are to:

- Describe existing service areas, types of uses and designated planning areas within the City. Evaluate the planned service area characteristics including population, water supply and service area policies.

- Describe and inventory the existing water system facilities. Evaluate the existing system's performance and identify problem areas.
- Evaluate historical growth and projected future growth of the City's service area. Identify future growth areas and analyze future impacts and demands on the City's water supply to assist in an orderly growth of the City and its water service area
- Update the Wellhead Protection Program for the springs and well location.
- Identify and clarify existing water rights for the well and spring sites and type of source.
- Evaluate water conservation programs, cross-connection program, well and spring contamination susceptibility and water quality.
- Develop a capital improvement program (CIP) for the City which will recommend a logical list of system improvements to maintain current industry standards and meet proposed City growth.
- Develop a Plan of Operation to meet existing & future water supply needs, as well as monitoring and reporting requirements of the State Board of Health in coordination with the CWSP.
- Prepare a financial plan for the utility.

LIST OF ACRONYMS

AC	Asbestos Cement
ADD	Average Day Demand
AF/Y	Acre-feet Per Year
APWA	American Public Works Association
AWWA	American Water Works Association
BMP	Best Management Practices
CBD	Central Business District
CCL	Contaminant Candidate List
CCP	Cross-Connection Control Program
CCR	Consumer Confidence Report
CCS	Cross-Connection Specialist
CDC	Center for Disease Control and Prevention
CDL	Commercial Drivers License
CERB	Community Economic Revitalization Board
CFR	Code of Federal Regulations

CIP	Capital Improvement Program
CMC	City of Carnation Municipal Code
CPR	Conservation Planning Requirements
CPR	Cardiopulmonary Resuscitation
CT	Concentration of Chlorine in mg/l multiplied by disinfectant contact time in minutes
CWSP	Coordinated Water System Plan
D/DBP	Disinfectants and Disinfection By-Products
DNR	Department of Natural Resources
DOE	Department of Ecology
DOH	Department of Health
EKC RWA	East King County Regional Water Association
EPA	Environmental Protection Agency
ERU	Equivalent Residential Unit
ESA	Endangered Species Act
FACA	Federal Advisory Committee Act
fps	Feet Per Second
FY	Fiscal Year
GFC	General Facilities Charge
GIS	Geographic Information System
GMA	Growth Management Act
GO Bonds	General Obligation Bonds
GPM	Gallons Per Minute
GUI	Groundwater Under the Influence of Surface Water
GWI	Groundwater Under the Influence of Surface Water
GWR	Groundwater Rule
HAA	Halo Acetic Acid
HDPE	High Density Polyethylene
HGL	Hydraulic Grade Line
IBC	International Building Code
IDSE	Initial Distribution System Evaluation
IFC	International Fire Code
IOC	Inorganic Chemicals
LCR	Lead and Cooper Rule
LFC	Local Facilities Charge
LID	Local Improvement District
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal

M/DBP	Microbial/Disinfection By-Product
MDD	Maximum Day Demand
MG	Million Gallons
Mg/l	Milligrams Per Liter
MMM	Multimedia Mitigation Program
NDWAC	National Drinking Water Advisory Council
NE	Northeast
OFM	Office of Financial Management
O&M	Operation and Maintenance
PAA	Potential Annexation Area
pCi/L	PicoCuries Per Liter
PHD	Peak-Hour Demand
PRV	Pressure Reducing Valve
PSI	Pounds Per Square Inch
PWS	Public Water System
PWTF	Public Works Trust Fund
Qa	Annual Quantity
Qi	Instantaneous Quantity
RCW	Revised Code of Washington
ROE	Report of Examination
RSA	Retail Service Area
SEPA	State Environmental Protection Act
SDWA	Safe Drinking Water Act
SOC	Synthetic Organic Chemicals
SR	State Route
THM	Trihalomethanes
UCM	Unregulated Contaminant Monitoring
UCMR	Unregulated Contaminant Monitoring Rule
UGA	Urban Growth Area
µg/l	Micrograms/liter
ULID	Utility Local Improvement District
USGS	United States Geologic Survey
UTRC	Utilities Technical Review Committee
VA	Vulnerability Assessment
VOC	Volatile Organic Compounds
WAC	Washington Administrative Code
WDM	Water Distribution Manager
WDM	Water Department Manager

WHPA	Wellhead Protection Area
WHPP	Wellhead Protection Plan
WLCAP	Water Loss Control Action Plan
WQMR	Water Quality Monitoring Report
WSDOT	Washington State Department of Transportation
WUE	Water Use Efficiency

PLAN COMPATIBILITY

The City of Carnation realizes the importance of regional plans that foster coordination between municipalities to direct and preserve water as a limited resource.

The 2008 Carnation Water Comprehensive Plan is prepared within the scope of the Carnation Comprehensive Plan. The plan is designed to highlight the goals and objectives of the community's current and future water needs. The plan is designed to be coordinated with Water District 119, Water District 127 and Ames Lake Water District.

The City of Carnation Comprehensive Water Plan is also in compliance and coordinated with the goals and objectives of the following regulatory documents:

- WAC 246-290-100
- RCW Chapter 70.116
- City of Carnation Municipal Code
- City of Carnation Comprehensive Plan
- King County Comprehensive Plan with updates through 2006
- East King County Coordinated Water System Plan

SEPA REQUIREMENTS

The Plan is categorically exempt from SEPA since the system has fewer than 1,000 connections.

OWNERSHIP AND MANAGEMENT

The City of Carnation owns and operates a municipal "Group A" water system with existing service connections under 1,000. The water system, which includes the reservoir, springs, well and distribution network is managed by the City of Carnation Public Works Department. The Department is responsible for day-to-day operations and for the implementation of this Comprehensive Water System Plan.

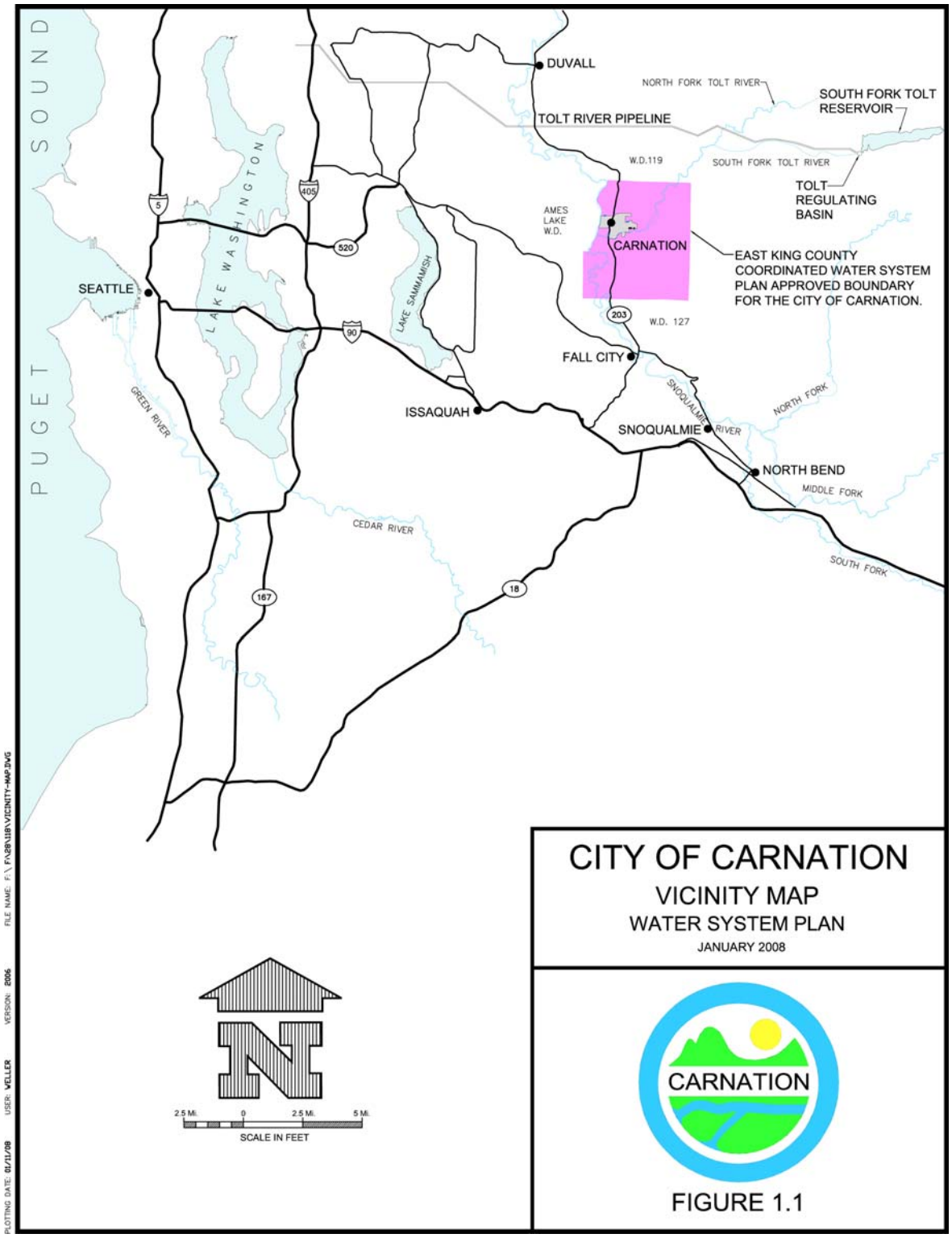
RETAIL SERVICE AREA AND CWSP/PROPOSED PLANNING AREA

The City of Carnation Planning Area lies within the critical water supply area, as outlined in the CWSP and is shown on the Vicinity Map (**Figure 1.1**). The current boundaries "Planning Area" encompasses approximately 21 square miles. Prior to the adoption of the CWSP, the original Planning Area was approximately 4.3 square miles in size. In an effort to coordinate water use between water districts, the East King County Water Utility Coordinating Committee proposed new boundaries that increased the City's original Planning Area from 4.3 square miles to the current Planning Area of 21 square miles. The existing planning area was adopted by the City Council in December 1989. Upon review of the area, the City proposes a reduction in the planning area to 9.068 square miles, as some of the existing planning area is not feasible to serve due to steep topography and the Snoqualmie River. Additionally, some of the existing planning area is designated for forest resources, which does not require water service. Some of the existing planning area will not be economically feasible to serve. Also, Carnation has limited water rights and will prioritize service to the urban area and retail service area. It is understood that the CWSP will need to be changed to reflect Carnation's new planning area. The proposed planning area is shown in **Figure 1.2**.

ADJACENT PURVEYORS

The Carnation 21–square-mile water service "Planning Area" consists largely of the Snoqualmie and Tolt River Valleys. The remainder of the service area includes some of the higher foot hills and plateaus of the Cascade Mountains. The area is bordered by Water District 119 to the north, Ames Lake Water District to the West, Water District 127 to the south, and the unclaimed foothills of the Cascades to the East. There are no municipal purveyors close enough to consider interties.

Figure 1.1
Vicinity Map



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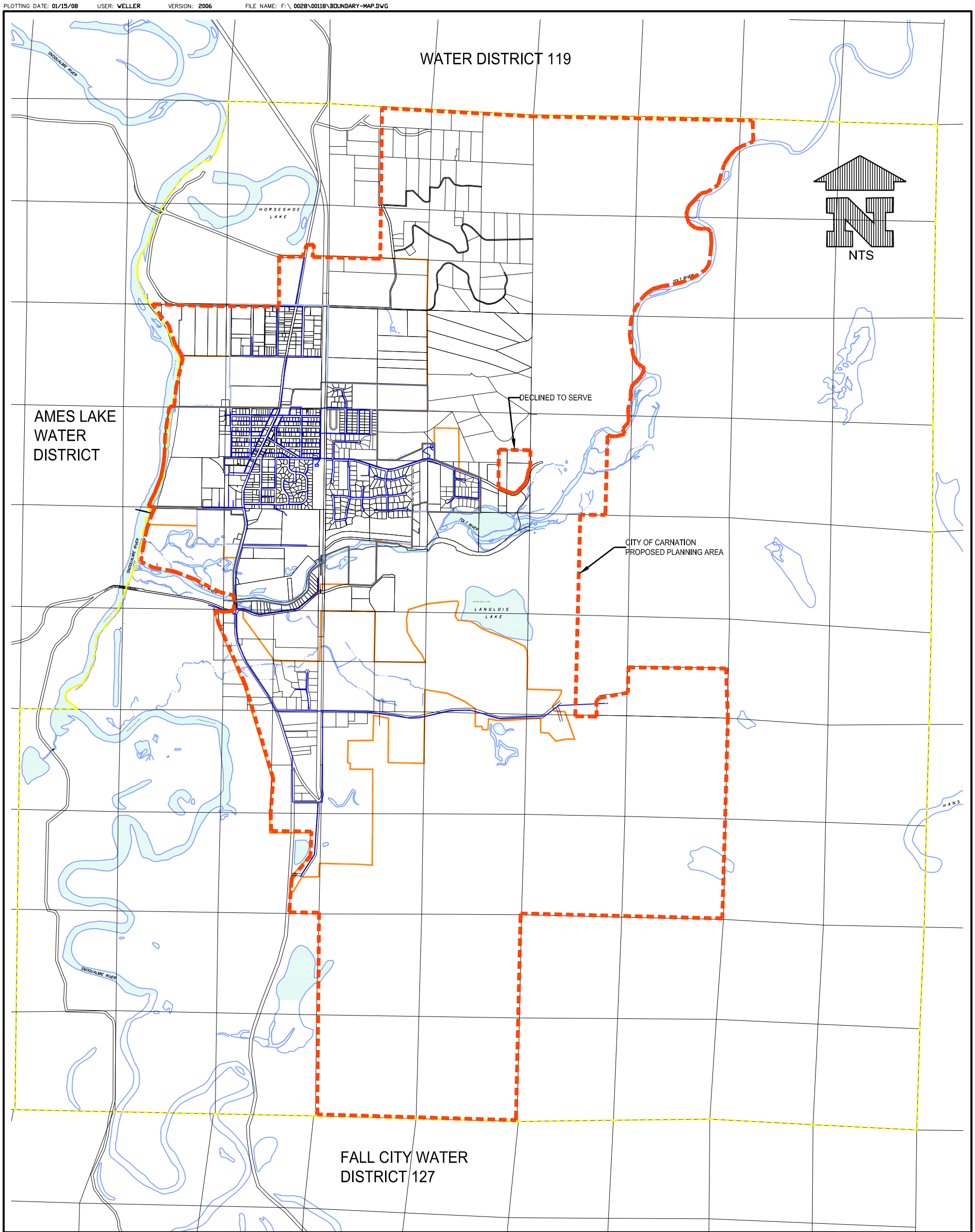

CITY COUNCIL:
FRED BERESWILL
MIKE FLOWERS
LEE GRUMMAN
STUART LISK
JEFF LIM

CITY MANAGER:
CANDICE BOCK

CITY OF CARNATION
KING COUNTY

WATER COMPREHENSIVE PLAN
PROPOSED PLANNING AREA
FIGURE 1.2

LEGEND

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- PROPOSED WATER PLANNING AREA
- CURRENT WATER PLANNING AREA
- RETAIL WATER SERVICE AREA
- WATER PIPES

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WATER SYSTEM DEVELOPMENT HISTORY

During the early development of the City, the source of water was a spring located in a 16-acre tract of the Weyerhauser Timber Company. Later the City purchased the original 16-acres plus an additional 64 acres from Weyerhauser. These 80 acres currently constitute the spring site. The original water distribution system was developed by extending watermains as needed to serve the City's growth. Old wood stave pipes were replaced with steel and asbestos cement pipe. Continued growth required modification of the spring intake by construction of a three-manhole intake system at the springs to increase water capacity to 320 gallons per minute (GPM). In 1978, a new well was drilled within the city limits to supplement the spring. The well produces 700 GPM. In 1990, the City constructed a 238,200-gallon reservoir off of Tolt River Road, 3/4 of a mile east of SR 203. The City also installed a new 12-inch main along Tolt Avenue and Tolt River Road. The well, reservoir, the springs, pressure reducing/pressure sustaining valve at the Tolt River, and transmission mains are the main components of the City's current water system.

The following is a summary of the main components of the City of Carnation's water system:

- **The Well:** Current Supplemental Water Permit for 800 gpm and current capacity of 700 gpm
- **The Springs:** Current Water Right Claim of 628 gpm and current capacity of 380 gpm
- **The Springs Horizontal Wells:** Two wells installed under the existing spring intake system connected via a 6-inch HDPE pipe which connects via a tee and gate valve to the transmission line.
- **The Reservoir:** Total volume 238,200 gallons
- **The Pressure Reducing/Pressure Sustaining Valve:** The pressure reducing valve (PRV) at Tolt River, pressure set 77 psi
- **The Pipe Transmission/Distribution Network:** 11.805 miles. The piping ranges in size from 2 inches to 12 inches

The City has three franchise agreements with King County to construct, operate and maintain a water system outside the current City limits. Franchise 2651 expired in 2001 and Franchise 445 expires in 2008. The Franchise 6022 was granted to the City in June 1984 for a period of 25 years. This expires in 2009 so renewal needs to occur soon. It is expected that all three franchises will be consolidated into one.

WATER SOURCE

Well

The well is located in Loutsis Park near the intersection of Entwistle Street and Milwaukee Avenue and was constructed in April, 1978. The well's pump has a rated capacity of 700 gpm at a Hydraulic Grade Level (HGL) of 227.5 feet and is activated by pressure within the system sensed at the well. The well has historically been activated for peak periods, to replenish low reservoir levels or to provide adequate pressure and volumes for fire flows.

Springs: Groundwater Source

The springs are the primary source of water supply for the City of Carnation's system throughout most of the year. They are situated in an 80 acre tract owned by the City about 2.5 miles southeast of the city center in the south half of the southeast quarter, Section 23-25-7. The spring watershed is in City of Carnation jurisdiction, but is surrounded by unincorporated King County. The source of the springs is water fed by an unnamed aquifer flowing through pre-Frasier deposits of sand and gravel. The water from the aquifer surfaces from the ground to form a natural spring at the location of the intake manifolds near the center of the property.

The springs have been determined to be not under the direct influence of surface water and are not a groundwater source under the influence of surface water (GUI). Continuous sampling and testing has shown no significant occurrence of insects, micro organisms, algae, or large diameter pathogens. Also, there has been no indication of rapid shifts in water characteristics such as turbidity, temperature, conductivity or PH correlating to climatological or surface water conditions.

Source Verification

In 1993, Cadman, Inc. proposed the development of the sand and gravel mining operation on the Ben Jones property located 1,000 feet west of the City of Carnation Springs. As part of the SEPA review process, Cadman, Inc. performed a hydrogeologic evaluation to study any potential impacts the proposed gravel mining operation may have on the City of Carnation's spring source.

The "Hydrogeologic Evaluation of the Ben Jones Property and the City of Carnation Springs Carnation" December 1, 1993 study, performed by Hart Crowser included a collection of all available data on the geology, groundwater conditions, existing water supply users in the area and the completion of a field exploration program to fill any data gaps in existing information. The study included six borings which were drilled to access, collect and analyze subsurface conditions beneath the gravel resource. Four of these borings

included monitoring wells. Two of these wells; Monitoring Well MW-1 and MW-2, were located within the City of Carnation Springs Property, 300 feet and 550 feet respectively, uphill from the spring intake.

The evaluation of the wells MW-1 and MW-2 soil boring logs showed that pre-Frasier deposits comprised the aquifer supplying water to the City of Carnation springs. These deposits were typically weathered, often orange-brown sand and gravel, over 100 feet thick and located beneath Vashon Till.

The report concluded that the source of the springs is groundwater supplied from an aquifer. The evaluation of the soils data and the monitoring results of the ground water levels at the spring and various well locations found that the ground water monitoring wells and the water serving the springs are on the same hydraulic gradient and supplied from the same source aquifer. A copy of the report was provided with the previous Water System Plan.

Springs Temperature Monitoring

The City has installed temperature gauges to monitor ground water temperature in the Spring Intake Manholes. These gauges show little if any temperature variation of the ground water and help confirm the report findings. Over one year's worth of temperature gauge readings conducted at one-hour intervals, then at 6-hour intervals, show a constant temperature of 47 degrees in Spring Intake Manhole: #2 and #3 with only a few readings at 48 degrees. Spring Intake Manhole #1 showed a greater variation in temperature, between 47 and 49 degrees. This variation is due in part to the poor water production of the intake which intercepts a minimal amount of flow from the springs and is subjected to greater temperature variations from the surrounding manhole.

Springs Horizontal Wells

The City drilled two horizontal wells to supplement the aging spring intake system. Wells are tied into existing systems and are on-line and recent information (January 2008) shows they are producing approximately 55 gpm.

DISTRIBUTION SYSTEM

Intake and Transmission System

The spring intake system consists of a series of collection piping serving as a manifold which intercepts subsurface (ground) water fed by an unnamed aquifer flowing through pre-Frasier deposits of sand and gravel. The ground elevation at the springs is approximately 456.0 feet (U.S.G.S. Datum). The water is directed to an intake structure (baffled, 72-inch manhole with an 8-inch overflow and an 8-inch intake pipe) which gravity flows into an 8-inch steel pipe. Just below the spring intake at elevation is 333.87 is the gas chlorination

station and building. A new source meter was installed in a vault in late 2007. The meter was designed with piping changes so it will flow full and will provide more accurate readings.

From the meter vault, water is conveyed via an 8–inch pipeline to the City. An in-line Pressure Reducing/PRV is located on the south side of Tolt River and set at pressure elevation 229.0 feet (77 psi). The 8-inch transmission line extends from the PRV to EFR Station 85 where it is connected to a 12-inch transmission line. This 12-inch transmission line runs northerly along Tolt Avenue from the Fire Station to the Carnation Elementary School at the north city limits and along Commercial/Tolt River Road from Tolt Avenue to the reservoir site.

Distribution Network

The watermains in the City of Carnation water supply system include newer 12- and 8-inch mains and older 6-inch and 4-inch piping. Most of the 8-inch main is ductile iron pipe and all of the 4-inch piping material is steel. Historic City Council meeting minutes indicate the dates of approval for the purchase of some of these steel materials, and there are lines in excess of 50 years old. The minutes do not indicate the location where the pipe was installed.

Figure 1.3 shows the distribution network of the City's existing system and estimated sizes.

Springs Gravity Intake

The City of Carnation's water system is considered a multiple source system with the springs as one source and the well as the second source. The amount of storage required for a multiple source is less than for a single source. The multiple source designation is conditioned on automatic backup power being available at the well. This improvement is prioritized in Chapter 8.

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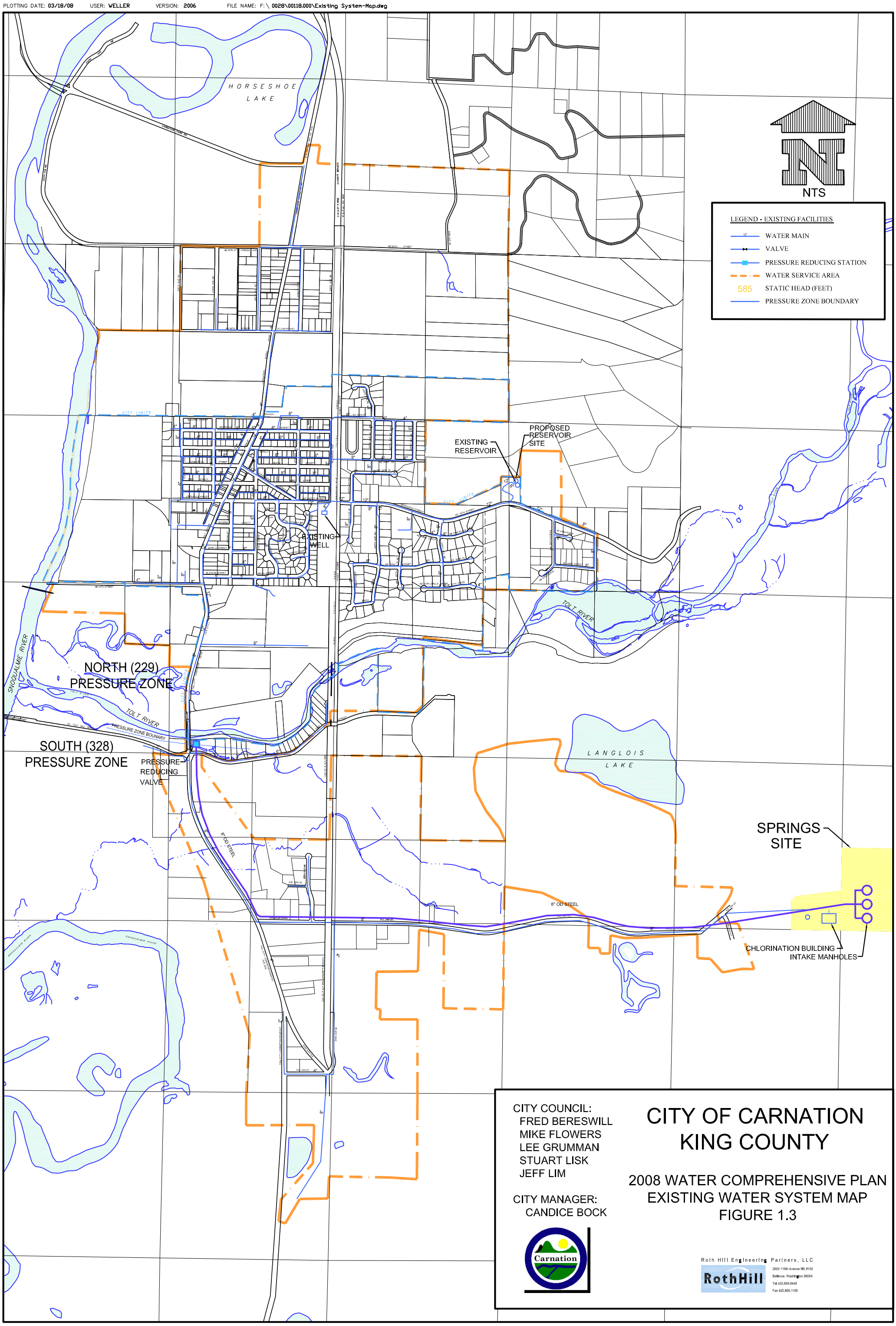


CITY COUNCIL:
FRED BERESWILL
MIKE FLOWERS
LEE GRUMMAN
STUART LISK
JEFF LIM

CITY MANAGER:
CANDICE BOCK

CITY OF CARNATION
KING COUNTY

2008 WATER COMPREHENSIVE PLAN
EXISTING WATER SYSTEM MAP
FIGURE 1.3

Carnation

Roth Hill Engineering Partners, LLC
RothHill
2600 116th Avenue NE #100
Bellevue, Washington 98004
Tel 425.869.9448
Fax 425.869.1190

Reservoir

Currently, the water system has one reservoir with a total volume of 238,200 gallons. The reservoir is a reinforced concrete stand pipe. It has a 26-foot diameter base and a height of 60 feet with a base elevation of 169.00 feet (USGS Datum). Filling the reservoir is accomplished by pressure within the City's system and an altitude valve to control the tank "Full" cutoff point.

Pressure Reducing Valve (PRV)

The PRV is located near the bridge crossing the Tolt River and divides the system into two pressure zones. The system north of the PRV (Tolt River) operates at a pressure setting of about 77 psi or a HGL of 229 feet (U.S.G.S. Datum) while the system south of the PRV operates at a variable pressure of zero at the springs to 111 psi at the PRV. The PRV maintains the hydraulic grade line within the City at elevation 229 which is the reservoir "Full" level. As water demands increase within the City, flows from the reservoir and springs increase to meet this demand. All demands south of the PRV are met by the springs. Should the demand by the City exceed the springs supply and the reservoir cannot maintain a "Full" position, the water level in the tank may drop. Elevation 210.4 feet is equivalent to a pressure of 53 psi at the well pump house. The well pump is turned on when the pressure drops below 53 psi. The well pump will continue pumping until the water level inside the reservoir reaches elevation 222.0 feet. At this elevation, the pressure (58 psi at the well pump) turns the well pump off, triggered by an altitude valve. The remainder of water in the reservoir from elevation 222.0 feet to elevation 229.0 feet is filled by the springs as demand and spring supply allow, thereby conserving energy and equipment. The function of the altitude valve serves as a safety cut-off valve to prevent overfilling the reservoir should there be a malfunction of the well pump pressure "Off" switch.

Well Pump

The well pump has a rated capacity of 700 gpm at a Hydraulic Grade Line (HGL) of 227.5 feet. The well is activated by pressure within the water system as measured at the well. A digital totalizer meters the pump's total volume and a seven-day chart recorder monitors the system's pressure at the pump house.

WATER QUALITY AND TREATMENT

The City has two sources of groundwater. The first source is the springs located about 2.5 miles southeast of the City. The water from the springs is chemically treated by a gaseous chlorinator installed on the 8-inch pipeline. The chlorination building is located downstream of the spring intake at elevation 333.87.

The second source is a non-chlorinated well located within City limits. Since the well and springs are tied into the same piping network, the water system has a residual chlorine content that generally varies from 0.1 to 0.3 mg/l. In general, the springs and well water are of excellent quality water.

WATER RIGHTS

The City of Carnation maintains active water rights and permits from the Washington State Department of Ecology for both the well and the springs (**Table 1.1**).

Table 1.1
Carnation Water Rights

Source	Water Resource Document	Priority Date	Document No.	Instantaneous Rate (gpm)	Annual Rate (acre-ft per year)
Springs	Water Right Claim	Dec. 1916 June 14, 1974	___	628 gpm	1000 ac-ft/yr
Well	Certificate of Water Right	April 4, 1977	G1-22827C	800 gpm	538 ac-ft/yr

Appendix C contains copies of the water rights for both the well and springs.

SERVICE CONNECTIONS

The City serves water customers both inside and outside the City limits and all customers are on metered services. Monthly billing records show the type of accounts and whether they are inside or outside the City limits. These billing records also delineate customers according to the number and type of service connections.

For end of 2007, the percentage, types and category of use for these service connections are as follows:

- Single-Family Residential Dwelling Accounts: 719 – 544 in City and 175 are outside City
- Multifamily Accounts: 22 with 64 total apartments – 21 inside City and 1 outside City
- Commercial/Business Accounts: 82 – 76 inside, 6 outside (includes farms)
- Total Units: 834

The City's water system serves is primarily single-family residential, with 719 out of 834 (86%) customers. Multifamily units are close to 100% occupied and are assumed fully occupied for this study.

CHAPTER 2 POLICIES, CRITERIA AND STANDARDS

INTRODUCTION

The City of Carnation manages and operates its water system in accordance with all known federal, state and local regulations. The City guides the development and financing of the infrastructure required for water services and ensures consistency in service levels and customer relations. While the City has some discretion in setting the performance, design criteria and standards for its water system, these must meet or exceed the minimum standards for public water supplies set by the DOH through Washington Administrative Code (WAC) 246-290 and the East King County Coordinated Water Supply Plan (CWSP). Together, policies and criteria provide direction on the desired level of services to utility customers.

The goal of these policies is to provide guidelines for all City customers and documentation of the commitments to existing and potential water system customers.

Other publications, such as the City's Combined Water and Sewer Utility Technical Standards and the Carnation Municipal Code, document the design standards and procedures for development of the water system. The Combined Water and Sewer Utility Technical Standards are included in **Appendix D**.

The City of Carnation's Water System Plan establishes the following goals for water service:

Goal 1: Provide safe, reliable and timely water service to City consumers at a fair and reasonable price.

Goal 2: Ensure that water service is available to support development that is consistent with the City's policies and criteria, as well as current land use plans and development regulations of the State of Washington, King County and the City.

Goals 3: Protect the natural environment with design, construction, operational, and conservation procedures.

The City's policies are grouped by major categories. These categories are:

- Service Area, Extension and Service Ownership
- System Reliability and Emergency Management Plan
- Fire Protection
- Coordination and Cooperation with Other Agencies

- Water System Planning, Design, and Construction
- Environmental Stewardship
- Water Use Efficiency
- Operational
- Financial

SERVICE AREA, EXTENSION, AND SERVICE OWNERSHIP

Service area and extension policies define the Water Service Area and conditions for service extension within those boundaries. The service policies define the level of service provided to water system customers, as well as public and private **service ownership** and responsibility for water system components.

Service Area

The City will serve all customers within its retail water service area (RSA) as defined herein and will plan to eventually provide service outside its RSA boundary but within its water service planning area.

Local Government Consistency

The City Water Comprehensive Plan will be consistent with local land use authorities (City of Carnation and King County).

Duty to Serve

The City is committed to providing retail water service to all property within its defined RWSA in a timely and reasonable manner, consistent with applicable City codes and standards, the Municipal Water Law, Washington State Department of Health rules and regulations and other applicable federal, state and local laws. Pursuant to RCW 43.20.260, as a municipal water supplier as defined in RCW 90.03.015, the City has a duty to provide retail water service within its RWSA if:

- City water service can be available in a timely and reasonable manner;
- The City has sufficient water rights and other sources of supply to provide the service;
- The City has sufficient capacity to serve the water in a safe and reliable manner as determined by DOH; and
- It is consistent with the requirements of applicable comprehensive plans or development regulations adopted under chapter 36.70A RCW (GMA) or any other applicable comprehensive plan, land use plan, or development regulation adopted by a city, town, or county for the service area.

The City defines "timely" as the availability of retail water service consistent with the terms and conditions presented in applicable City codes and standards. For example, the owners of properties which may directly connect to the City's existing water system without the need for the extension of that system should be able to obtain water service within 120 days after the City receives an application for a water meter and the property owner requesting water service has complied with all applicable City water service policies and procedures and has paid all applicable meter, connection and administrative rates, fees and charges to the City. The owners of property which require the extension of the City's water system to make water service available to the property should be able to obtain water service following the owner's execution of an extension agreement with the City, the preparation of a design of the extension required to connect the property to the City's existing water system by the owner's engineer and the approval of the extension design by the City, the construction of the extension by the owner's contractor, the owner's payment of all applicable City developer extension, meter, connection and administrative rates, fees and charges to the City, and the transfer of the ownership of the extension to the City by the property owner, all in accordance with the terms and conditions of the extension agreement and applicable City codes and standards. The party entering into the extension agreement with the City has one year from the date of the mutual execution of the extension agreement to complete this process to obtain retail water service from the City to the property.

The City defines "reasonable" retail water service as follows:

- Water service that is consistent with applicable local land use plans and development regulations;
- The conditions of water service and associated fees, costs and charges are consistent with the conditions of service described in this Plan and applicable adopted City code, policies and standards; and
- The conditions of service and associated fees, costs and charges are consistent with the City’s requirements applied to other property owners requesting water service who are similarly situated and are requesting the same type or level of water service from the City.

As addressed elsewhere in this Plan (Chapter 6 "Source Water Protection"), the City has sufficient water rights to provide retail water service within its RWSA.

However, in the event an individual applicant for water service or a party seeking a developer extension contends the availability of District water service is not "timely and reasonable," the applicant shall request that the City consider the applicant's complaint and that the applicant be given a hearing the Utility Hearing Board to present the applicant's evidence that City water service is not available on a "timely and reasonable" basis consistent with applicable code, policies and procedures and applicable state law. Decisions by the Utility Hearing Board may be appealed to the Hearing Examiner by filing a written

request with the City Clerk within five business days of the date of the Board's written decision. The Hearing Examiner shall review the appeal in a closed-record proceeding with no new factual information allowed and with no oral argument. Applicants shall be required to utilize and exhaust this City administrative hearing procedure as a precondition to requesting that anybody on behalf of the East King County Coordinated Water System Plan or King County consider any appeal or contention that City retail water service is not available to the applicant's property on a "timely and reasonable" basis.

Developer Improvements

It is standard City policy that the costs for all new water main extensions and appurtenances required to serve a development must be paid for by the developer. The construction plans for the water system improvements are prepared by an engineer chosen by the developer. System design must meet established minimum City standards and be reviewed and approved for construction by the City Engineer. Installation is performed by a City approved contractor. On completion of construction to the City's satisfaction, the improvements are conveyed by deed to the City. The City design standards require that the new water mains to be extended to the extreme end of the property being developed, unless waived by the City due to site constraints.

The City is will entertain a "Latecomers Agreement" with a developer who paid the initial water main improvement cost for any property which could receive service from the improvement at a later date. The agreement is typically for the maximum 15-year term allowed under State law.

Satellite System Management

The King County Coordinated Water System Plan (CWSP) outlines a Satellite System Management Program under which an established water purveyor can provide operation and management service to small water systems servicing properties outside the purveyor's boundaries. The City currently is not, and does not intend to become, a DOH "approved" satellite system management agency, which would allow it to operate small Group B water systems outside of the City's water service area.

At this time, the City is not planning to operate any satellite water systems within the City's Water Service Area. If a proposed water system is located less than 1,000 feet from an existing water main, the City will require service to the area with a direct water main extension. There may be proposed systems to which service is not available from the existing City water system because of location or special land use requirements. At this point, the City will not be providing service to these individual property owners or water systems. A letter of service declination will be prepared for these instances.

Wholesaling of Water

The City does not currently wholesale water to other customers. Any future plan to wholesale water will be considered on a case by case basis and shall comply with the City's water rights and other applicable regulations.

SYSTEM RELIABILITY AND EMERGENCY MANAGEMENT PLANNING

Service reliability policies and criteria define the City's standards to construct and maintain reliable water system infrastructure and equipment. The Emergency Management Plan states the City's responsibility to maintain an updated Emergency Response Plan and to take reasonable action in case of emergencies.

Security

The City shall make reasonable attempts to protect the security of its water system. The City shall determine what information about the system should remain unavailable to the public.

Emergency Response Plan

The City has an updated Emergency Response Plan that focuses on problems created by major disasters (such as earthquakes, floods or windstorms) as part of the City's operations program in conjunction with this Plan. The Plan addresses emergency provisions and procedures to be in place to operate the water system during emergencies. This Plan will be available as required by existing federal, state and local regulations.

Cross-Connection Control Program

The City shall provide water that meets federal and state water quality standards to all water system customers during normal operations. The City shall take any necessary action to ensure that all water quality standards are met, which includes the implementation of its Cross-Connection Control Program. A new Cross Connection Control Program has been prepared in conjunction with this Plan and adopted by the City through the new water and sewer code (CMC). In the future it will be updated on an as needed basis as laws or City requirements change.

FIRE PROTECTION

Fire Flow Requirements

The **fire protection policies** outline the City's fire flow capabilities and commitment to required system improvements.

The City will provide and plan to maintain the necessary system infrastructure to supply water for fire-fighting purposed to utility customers in the Urban Growth area. Fire flow required to be provided to structures will be determined by the Fire Marshall in accordance with the IFC. The City will plan to provide 2,000gpm for 2 hours in the CBD within the next six years and 2,500gpm for two hours by 2028. The City will remedy its commercial fire flow deficiency (stated elsewhere in this document) by the end of 2009.

COORDINATION AND COOPERATION WITH OTHER AGENCIES

Coordination with Other Agencies

These policies summarize the City's willingness to **coordinate and cooperate** with **other agencies**.

The City will coordinate with adjacent jurisdictions to determine applicable regulatory requirements and opportunities for joint projects where it benefits the City. Inter-local agreements should be prepared between the pertinent parties on all joint projects.

Mutual Aid

The City will participate in mutual aid for its neighboring water systems.

Emergency Interties

Currently, there are no significant water systems adjacent to the City's RSA or planned to be in the foreseeable future. No emergency interties are planned.

WATER SYSTEM PLANNING, DESIGN AND CONSTRUCTION

Planning Objectives

Water system planning and design policies define the methods and procedures the City uses to determine what facilities are needed to meet anticipated growth.

The City will plan and design water system facilities that can deliver continuous, safe water supply to meet customer demand and be consistent with all applicable federal, state and local regulations. This will be accomplished through the development and review of the

City's Comprehensive Plan that will be updated every six years per State regulations along with development and maintenance of its City Standards documents.

System Planning

The City shall plan the construction of its infrastructure to accommodate growth while maintaining stable rates and charges.

Standby Storage and Fire Suppression Storage

Storage shall be allowed to be nested (as allowed by DOH) for the foreseeable future. In the urban area, fire suppression storage will be provided to meet the IFC requirements and standards established in another section. In the rural area, fire suppression storage will not be provided. Storage volumes will be provided that meet DOH standards.

Water System Standards

All improvements to the water system, whether accomplished by Developer Extension Agreements, Local Improvement Districts (ULIDs), or other method are required to meet the minimum design and construction standards established by the City. The standards contained in the City of Carnation Water System Standards conform of the Washington State Department of Health, East King County Coordinated Water System Plan and the American Public Works Association. Work performed in unincorporated King County shall additionally comply with King County Road Standards.

Industry Standards

Except where the standards provide otherwise, all materials and methods of construction are required to conform to the latest edition of the "Standard Specifications for Road, Bridge and Municipal Construction" (WSDOT/APWA) prepared by the Washington State Department of Transportation and the Washington Chapter of the American Public Works Associations, the American Water Works Association (AWWA) and East King County Coordinated Water System Plan standards as amended by the City in writing and through the standard City's construction details.

System Pressures

System pressures will be maintained between 30 and 100. If system pressures will be greater than 80 psi, customer owned pressure reducing valves are required per the plumbing code.

Velocity Criteria

The City has established a system wide velocity criterion that pipe velocities shall not exceed 8 feet per second during peak hourly demand conditions and also 10 feet per second during maximum day demand conditions with fire flow.

Pipe Sizing

All water mains are to be sized using the current edition of "Sizing Guidelines for Public Water Supplies" published by DOH or by an acceptable hydraulic analysis submitted by a licensed engineer. Water main size shall be adequate to provide maximum instantaneous demand flows plus the required fire flow while maintaining minimum system pressures. The required minimum residual pressure for fire flow at the hydrant shall be 20 psi with 20 psi maintained throughout the system per DOH requirements. Future extension of the main must be considered in the sizing of new lines unless otherwise directed by the City. In general, the minimum diameter of any new pipe that serves a fire hydrant or is likely to be extended in the future is 8 inches. Smaller pipes are allowed on a case by case basis into cul-de-sacs where it is unlikely that the system can or will be extended. In no case will the pipe be less than 6 inches in the Urban Area. Also, see the City's Combined Water and Sewer Utility Technical Standards for additional details

Looping of Mains

The ultimate capability and reliability of any public water system depends on the amount of looping in the system. The City requires all developers to extend any new water main to the end of their property and to install tees, valves, and blow-offs or hydrants where future extension of the main is expected. All piping shall be looped except where an exemption is granted by the City Public Works Director

Fire Hydrants

Except where the standards provide otherwise, at least one hydrant shall be installed at all intersections and fire hydrants are to be located at a maximum spacing of 600 feet for residential areas or as required by the fire department.

Gate Valves

Gate valves are required at all crosses and tees, in a configuration which allows isolation of any connecting line. In general, this requires the number of valves to be one less than the number of connecting lines. In addition, all mains shall have isolation valves at city block intersections and at a maximum spacing of 600 feet or as directed by the City of Carnation.

Air and Vacuum Release Valves

Air and vacuum release valves shall be installed at all local high points in the water main and shall be in conformance with the Standard Plans prepared by the City Engineer.

Water Meters

All service connections to the system shall be metered. Size of the meter shall be determined by the flow demands of the connection. The service shall conform to the Standard Plan prepared by the City Engineer.

Source Meters

All active water sources shall be metered and will be calibrated every three years.

Wholesale Meters

Wholesale meters to customers will be considered on a case by case basis where legally allowed if a wholesale agreement is in place.

Blow-Offs

A blow-off assembly is required on all dead end runs and at points of low elevation in the distribution system. The blow-off shall conform to the Standard Plan prepared by the City Engineer.

Water Main Placement

Water mains are to be installed in a location which is compatible with the existing distribution system, the terrain and the location of other utilities. All mains, hydrants, valves, meters and other appurtenances are to be installed within a public right-of-way or dedicated utility easements. Easements are required to be at least 15 feet in width unless a reduction is granted by the Public Works Director with the main installed no closer than 5 feet from the easement's edge. Typically, mains are located on the north and east side of the right-of-way. There may be special circumstances, such as conflicts with other utilities, where the City will allow other water main locations.

Minimum cover for water mains from top of pipe to finish grade shall be 36 inches for 8-inch diameter and smaller mains and 48 inches for 12-inch diameter and larger mains. Water mains designed with greater than 60 inches cover must be approved by the City.

Dechlorination of Flush Water

For all sterilization of water mains, the Contractor shall be responsible for disposal of treated water flushed from mains and at no time shall chlorinated water from a new main be flushed into a body of fresh water. This is to include lakes, rivers, streams, storm drainage systems, and any and all other waters where fish or other natural water life can be expected. The method of dechlorination shall provide finished, dechlorinated water with a pH that shall not adversely affect the receiving waters or system.

ENVIRONMENTAL STEWARDSHIP

The **environmental stewardship policies** outline the City's dedication protect the environment.

Wastewater Reuse

The City is committed to wastewater reuse. Reuse can serve as cost-effective and environmentally beneficial sources of water for industrial processes, sanitation and irrigation thereby increasing the security and reliability of the drinking water supply.

The City in coordination with King County, as part of the City's sewer treatment plant, is enhancing the Chinook Bend Natural Area with reclaimed wastewater.

Water Resource Protection

The City shall protect water sources within the City from degradation related to its actions, facilities or programs.

Endangered Species Act Compliance

The City recognizes that several fish species native to the Puget Sound region in which Carnation is located have been listed as either Threatened or Endangered under the Endangered Species Act (ESA). With this in mind, the City will implement those Best Management Practices (BMPs) it deems necessary to prevent, or minimize risk of, an unauthorized "take" of a protected species when maintaining and operating the water system, replacing existing water facilities, and constructing new water facilities.

WATER USE EFFICIENCY

The **water use efficiency policies** summarize the City's responsibility to continue promoting programs that address using water efficiently.

The City will set a WUE target for demand side water use reduction of 1% per ERU per year for six years.

Distribution Leakage Standard

The City will be diligent in its goal to reduce levels of distribution system leakage to from 40% in 2007 to 25% within six years and meet the overall water use efficiency goal for Distribution Leakage (10%) by 2028

OPERATIONAL

The **operational policies** summarize the City's commitment to resolving customer complaints, and providing a safe work environment, training, and certification opportunities for its employees.

Customer Complaints

The City is committed to resolving customer complaints. All complaints are recorded and forwarded to the public works staff for resolution.

Employee Safety

The City is committed to providing safe and healthy working conditions at all facilities and complying with rules, laws and regulations pertaining to the safety and health of employees

Employee Training

The City encourages participation in workshops, seminars and other education programs to improve job skills.

Employee Certification

The City will pay fees and employee's time for the required certification continuing education classes, testing, as well as required annual renewal fees.

FINANCIAL

The **financial policies** summarize the City's general financial policies and criteria, including water rate structure, development charges, capital improvements financing, and reserves.

Minimum Fund Balances

A minimum balance target of 60 days of operations and maintenance shall be kept for operating reserve.

A capital contingency reserve shall be established. The City will work toward establishing a reserve of 1% of rolling 5-year CIP.

System Reinvestment

The City shall establish rates, charges and fees to maintain sufficient funds to operate, maintain, and upgrade its water system as necessary to provide safe reliable water service to its customers. These rates should include amounts sufficient to fund the annual system depreciation expense. Rates should be evaluated as part of the annual budget process. This will ensure that forecasted expenses and impacts for regulations are reflected in the rate structure.

Debt Management

The City actively pursues low cost loans and grants, where appropriate, and issues revenue bonds to finance capital project costs in excess of available cash resources. For bond debts, the rate revenues will provide a minimum of 1.25 debt coverage based on operating revenues.

Connection Charges

A general facilities charge (GFC) is a connection charge that shall be charged for each residential and commercial connection to the water main. The total fee amount includes the customer's fair share of the existing system and future general system improvements. This charge does not include expenses related to installation of the physical service. The charge for each structure will be based on the water meter size required to provide peak flow to the facility.

Capital Facility Plan

The City is establishing 6- and 20-year Capital Improvement Plans in conjunction with this Plan. The CIP should address required repairs to the water system, planned replacement of aging facilities, upgrades to the existing facilities to provide additional capacity for projected growth and construction of general facilities to aid growth.

Miscellaneous Charges

The City shall include charges for other items relating to the water system including reconnection of water services, engineering and attorney fees for reviewing developer extensions, and plans. Theses charges are outlined in the City's fee schedule.

Charge for Service Outside of the City Limits

The City shall impose higher rates for service outside of the City limits. This is because the cost to provide service is higher in these areas. These charges are outlined in the City's fee schedule.

CHAPTER 3 BASIC PLANNING DATA AND WATER DEMAND FORECASTING

INTRODUCTION

This chapter presents an analysis of historical water use from 2002 to 2006 as well as population projections in order to estimate future water demand and supply needs for the City's water system. Historical consumption and supply data are used to develop the value of an Equivalent Residential Unit (ERU) and the maximum-day peaking factor. This data is then used to convert the population projections into projected average and maximum day future demands for the planning period. The future water demands are used to establish criteria for the hydraulic analysis of the water system and for development of the recommended Capital Improvement Program.

SOURCE

The City of Carnation produces its water from spring source augmented by a well source, as described further in Chapter 6. The annual quantity of water produced is summarized in **Table 3.1** below. The water usage is measured and recorded at each source weekly. A more detailed record of water produced monthly by each source is included in **Appendix E**.

Table 3.1
Total Water Production

	2002	2003	2004	2005	2006
Spring Source (MG)	136.58	140.70	137.94	124.32	132.31
Well Source (MG) *	0.84	15.31	3.19	Not available*	2.57
Annual Production (MG)	137.42	156.01	141.13	124.32	134.89

* 2005 well production was not available due to a meter malfunction.

HISTORICAL WATER USE AND CONNECTIONS

The City provided water to 824 retail customers as of the end of 2006. Customer meters are read on a monthly basis. Over the last five years, the City has experienced minimal growth, with the number of connections increasing by 3% per year. Total water consumed has remained relatively constant.

Retail Customer Classes

Single-family residences accounted for 86% of system connections and 73% of metered water use from 2002 to 2006. This has been consistent over the history of the system. There have been 15 new single-family connections, or an increase of 2%, since 2002.

The multifamily customer class has increased by one connection since 2002. There are 22 accounts using 9% of the total metered water.

There are 82 commercial accounts that make up just 10% of the system connections. Commercial customers use 15% of the total water. There have been six new commercial connections, or an increase of 8%, since 2002.

Irrigation accounts are tracked separately. There are 14 accounts, which is an increase of three from 2002. Irrigation accounts for 4% of total water use.

Figure 3.1 shows the average annual water use for each customer class as a percentage of the total water purchased. As noted earlier, water use is predominately single-family residential and commercial customers.

The historical number of customers, by customer class, is shown in **Figure 3.2** and a table detailing the number of connections by year is included in **Appendix F**.

Figure 3.1
Average Water Use by Customer Class (2002-2006)

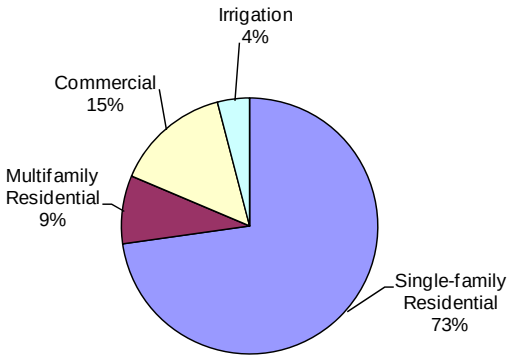
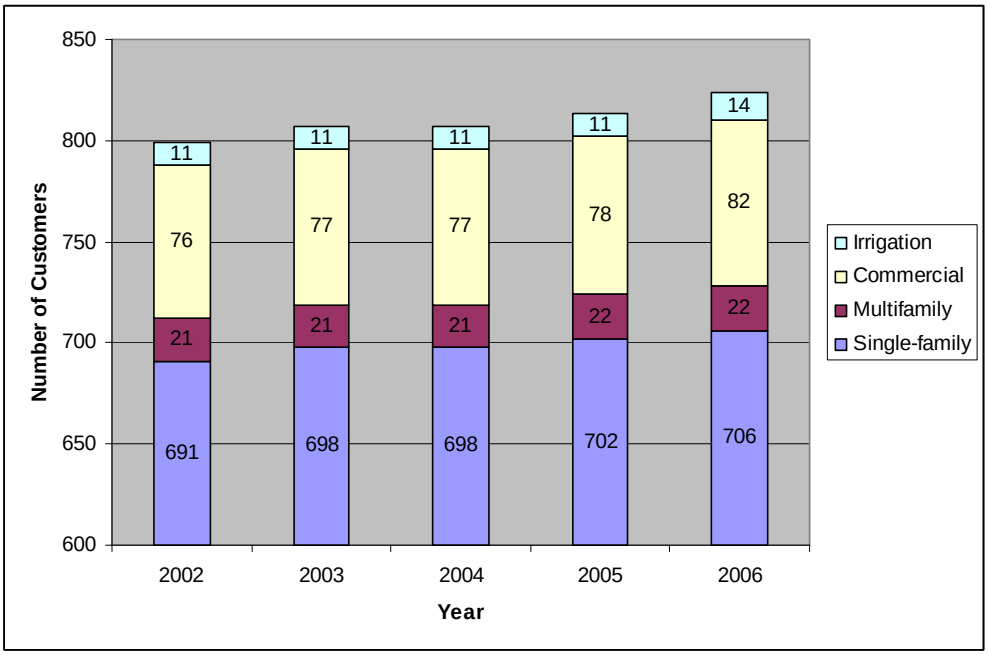
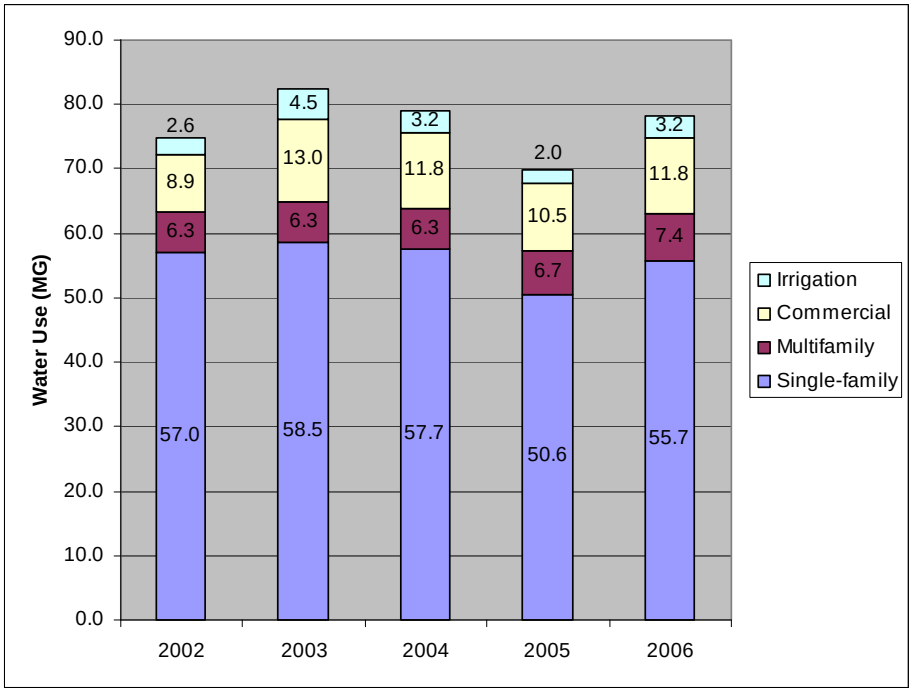


Figure 3.2
Historical Number of Connections by Customer Class



The last five years of water usage by customer class is summarized in **Figure 3.3**. Variations between years typically reflect changes in customer demands based on a variety of factors such as seasonal weather patterns, growth within the service area, and City policies. A table detailing water consumption by customer class is included in **Appendix F**.

Figure 3.3
Historical Water Use by Customer Class



DISTRIBUTION LEAKAGE

Distribution leakage is calculated as the difference between the total amount of water produced and the total water measured as consumed by the City's customers. The Water Use Efficiency (WUE) Rule, effective January 22, 2009 for the City, requires that the three-year average of distribution leakage be maintained at less than 10% of the supply. Distribution leakage does not include accounted-for non-revenue water usage such as water used for fire protection, flushing, construction, and other maintenance and operations practices. However, to be credited, this must be accounted for by metering or by estimating using credible means. All water that is not accounted for is considered distribution leakage.

The City has not historically tracked water used for non-revenue purposes. Typical water systems use less than 5% of their annual water usage for flushing and other maintenance purposes. Because the City has no formal flushing program, this water volume is probably much less. It is recommended that the City track non-revenue water usage such as for fire protection, flushing, construction, and other maintenance and operations practices. This should reduce "distribution losses" by 5 to 10%.

Most watermains in the City's distribution system are between 45 and 70 years old. The mains are therefore susceptible to frequent leaks. In 2004 the City began a Water Line Leak Location Program to identify major leaks within the distribution system. Two surveys were completed in 2004 covering most of the system and resulting in an estimation of 45.2 MG of leakage, or 32.0% of the water produced. The leakage could be lower depending on how long the leak was active. However, the leak location project only identified major leaks, so it is not an estimate of all leakage.

Estimated leakage by the leak location program in 2005 and 2006 was 14.2% and 6.8% respectively. The leak surveys only covered the north, south and west portions of the system (approximately 70%) in 2005, and only the north and south portions (approximately 10%) in 2006. Because less of the system was surveyed, and less of the leakage was accounted-for, the leakage estimates for these years is probably low. Distribution leakage overall decreased by 3.1% from 2004 to 2006.

Table 3.2 summarizes the difference in known leaks and calculated distribution leakage. Overall, data from the leak detection surveys indicate that actual distribution leakage is approximately 30-35% of total water produced.

Table 3.2
Estimated Volume of Known Leaks

	2002	2003	2004	2005	2006
Distribution Leakage (MG)	62.62	73.69	62.17	54.47	56.77
Total Produced (MG)	137.42	156.01	141.13	124.32	134.89
Estimated Leakage (MG)	-	-	45.20	17.61*	8.94*
% of Total Produced	-	-	32.0%	14.2%*	6.6%*
Unaccounted-for Leakage (MG)	-	-	17.0	36.9	47.8
% of Total Produced	-	-	12.0%	29.6%	35.5%

* Leak surveys performed in 2005 and 2006 did not include all of the system, as described above.

Another consideration in quantifying distribution leakage is metering of retail water. In addition to the possibility of unauthorized connections, existing meters may be inaccurate. Thirty percent of water service meters in the system are over 25 years old. Water meters slow down with time and report lower volumes of water. It is estimated that water meters are reporting approximately 3% less than what is actually being consumed. A meter replacement project was begun in 2005. The City plans to replace 10% of its meters per year for the next several years. There is not yet sufficient data to accurately quantify the impact this will have.

The source meter at the spring was replaced at the end of 2007 because of age and inaccuracy. It has likely been reporting higher volumes of water than actually

pass through the meter. The meter calculates flow rate based on velocity, and the pipe does not flow full at times especially during the peak summer months. These metering inaccuracies could be responsible for up to 25% of the calculated distribution leakage. Early new meter data indicates a water use reading reduction of approximately 25% from the old meter readings.

Based on leak estimates, meter inaccuracies, flushing, and other maintenance practices, actual distribution leakage is estimated to be approximately 30 to 35%. However, based on recommendations from DOH, distribution leakage is projected at 40% in 2008 for planning purposes. The City's goal is to reduce distribution leakage to 10% by 2028. To achieve this reduction the City has set a goal to track water used for maintenance, operations, and fire protection by the end of 2008. An extensive watermain replacement program is also planned and should bring unaccounted water volumes lower as well.

EQUIVALENT RESIDENTIAL UNITS (ERUs)

The demand of each customer class can be expressed in terms of ERUs for demand forecasting and planning purposes. One ERU is defined as the average quantity of water used by one typical, full-time, single-family residence. The quantity of water used by other connections, and by the whole system, can be expressed in terms of ERUs. **Table 3.3** shows the historical annual average water consumption by customer classification including non-revenue use used to project the ERU planning value.

Based on the last five years the average gallons per day per residential connection (ERU) are equal to 219 gallons/connection-day. However, because water use varies, an ERU planning value of 225 gallons/connection-day is used for demand forecasting. Also shown on **Table 3.3** is the water used by the average connection from each customer class in ERUs. This is based on the average day demand per ERU of 225 gallons. The number of ERUs per account for multifamily, commercial, and irrigation classes are 3.9, 2.0, and 3.8 respectively.

The average daily consumption for a single-family account used in the 1999 Comprehensive Water System Plan was 323 gallons. This value was based on an older methodology using average use during the peak three months of the peak historic year. The current ERU planning value of 225 gallons/day/ERU is a reduction of 30% from that number.

Distribution leakage and other non-revenue water are not associated with a customer classification and not included in the ERU value. It is allocated as a percent of the total water used.

Table 3.3
Historical Average Day Demand Water Consumption by Customer Class

Classification	Daily Consumption	2002	2003	2004	2005	2006	Average	2007 Comp Plan	ERUs Per Account
Single-family Residential	Gallons per account	226	230	226	197	216	219	225	1.0
Multifamily Residential	Gallons per account	823	828	819	838	923	846	885	3.9
Commercial	Gallons per account	320	462	419	369	395	393	450	2.0
Irrigation	Gallons per account	637	1,127	809	508	621	740	850	3.8
Distribution Leakage	% of total consumption	45.6%	47.2%	44.1%	43.8%	42.1%	44.6%	40.0%	--

The ERUs per accounts for the multifamily residential class listed in Table 3.3 match the amount of units per structure. The units per structure were calculated by dividing the total number of multifamily residential units by the total number of structures. These numbers are shown below.

- Total Number of Multifamily Residential Units – 78
- Total Number of Multifamily Structures – 20
- Average Units per Structure – 3.9

MAXIMUM DAY DEMAND AND PEAKING FACTORS

Historical water use can also be described in terms of average day demand (ADD) and maximum day demand (MDD). MDD is used for storage and fire flow analysis. The system demand ratio, or peaking factor, illustrates the relative magnitude of peak-day demands compared to average system demands. Determination of MDD is critical because it is the benchmark utilized by a number of the water system criteria discussed in Chapter 2. Supply capability, pump station discharge rates, reservoir capacity and pump sizes are all determined from MDD data.

MDD data was not available for either of the City's sources, as the meters are read weekly. The Water System Planning Handbook (DOH Pub. #331-068) suggests a peaking factor of 2.0. However, typical water use by other water purveyors in the region suggests that this is too low. A more conservative MDD/ADD ratio of 2.50 is used for projecting water use in this Plan. A recommendation to read the sources daily during the peak months is made with this Plan.

CURRENT AND HISTORIC POPULATION

Current population within the Water Service Area is approximately 2,900, based on the observed number of households multiplied by the average household size of 2.98 average persons per household recorded by the 2000 US Census. Current population within Carnation city limits is 1906, as reported for 2006 to the Office of Financial Management (OFM).

As can be seen from **Table 3.4**, population growth within City of Carnation limits doubled between 1980 and 2000, but the City has experienced almost no growth in recent years. Growth has been limited due to the lack of a public sewer system; the sewer system is currently under construction and is expected to be operational in 2008.

Table 3.4
Historical Population: City of Carnation

Year	Pop	% change
1980	951	
1981	954	0.32%
1982	951	-0.31%
1983	975	2.52%
1984	1100	12.82%
1985	1172	6.55%
1986	1062	-9.39%
1987	1195	12.52%
1988	1250	4.60%
1989	1245	-0.40%
1990	1243	-0.16%
1991	1272	2.33%
1992	1299	2.12%
1993	1396	7.47%
1994	1472	5.44%
1995	1540	4.62%
1996	1594	3.51%
1997	1721	7.97%
1998	1806	4.94%
1999	1871	3.60%
2000	1893	1.18%
2001	1920	1.42%
2002	1905	-0.78%
2003	1905	0.00%
2004	1905	0.00%

Table 3.4 Historical Population: City of Carnation		
Year	**Pop**	**% change**
2005	1895	0.52%
2006	1900	0.26%
2007	1906	0.32%
1980-1990		3.07%
1990-2000		5.23%
2000-2007		0.68%

Source: Washington State Office of Financial Management

Population outside city limits but within the Water Planning Area is estimated at approximately 1,000 persons, based on the number of households observed within that area.

CURRENT AND FUTURE LAND USE

Land use and zoning designations and regulations are important factors in determining future water requirements. Land use and zoning determine the area available for various types of development including both single-family and multifamily residential development, as well as commercial and other types of land use, which provide the economic base necessary to support residential development. The current zoning for the City's water service area is shown in **Figure 3.4** and the land use is shown on **Figure 3.5**.

Current Land Use

Carnation's Water Service Area consists of a "rural city" (the City of Carnation) a small community located along SR 203, and surrounding rural lands. The primary land use within the service area is single-family residential, although other uses within city limits include some limited number of multifamily units, commercial and light industrial developments, plus several public uses such as an elementary school, middle school, library, etc. Outside the city limits, land use within the service area can be characterized as rural residential with some agricultural use, primarily livestock. Non-residential development outside the Urban Growth Area (UGA) is limited, although there are two privately-owned camps, one of which operates as non-community public water systems.

The City of Carnation has land use authority including zoning and permitting for the parcels within City limits. King County has land use jurisdiction for the parcels outside the City limits which includes the City's Potential Annexation Area (PAA) and land outside the UGA but within the water planning boundary.

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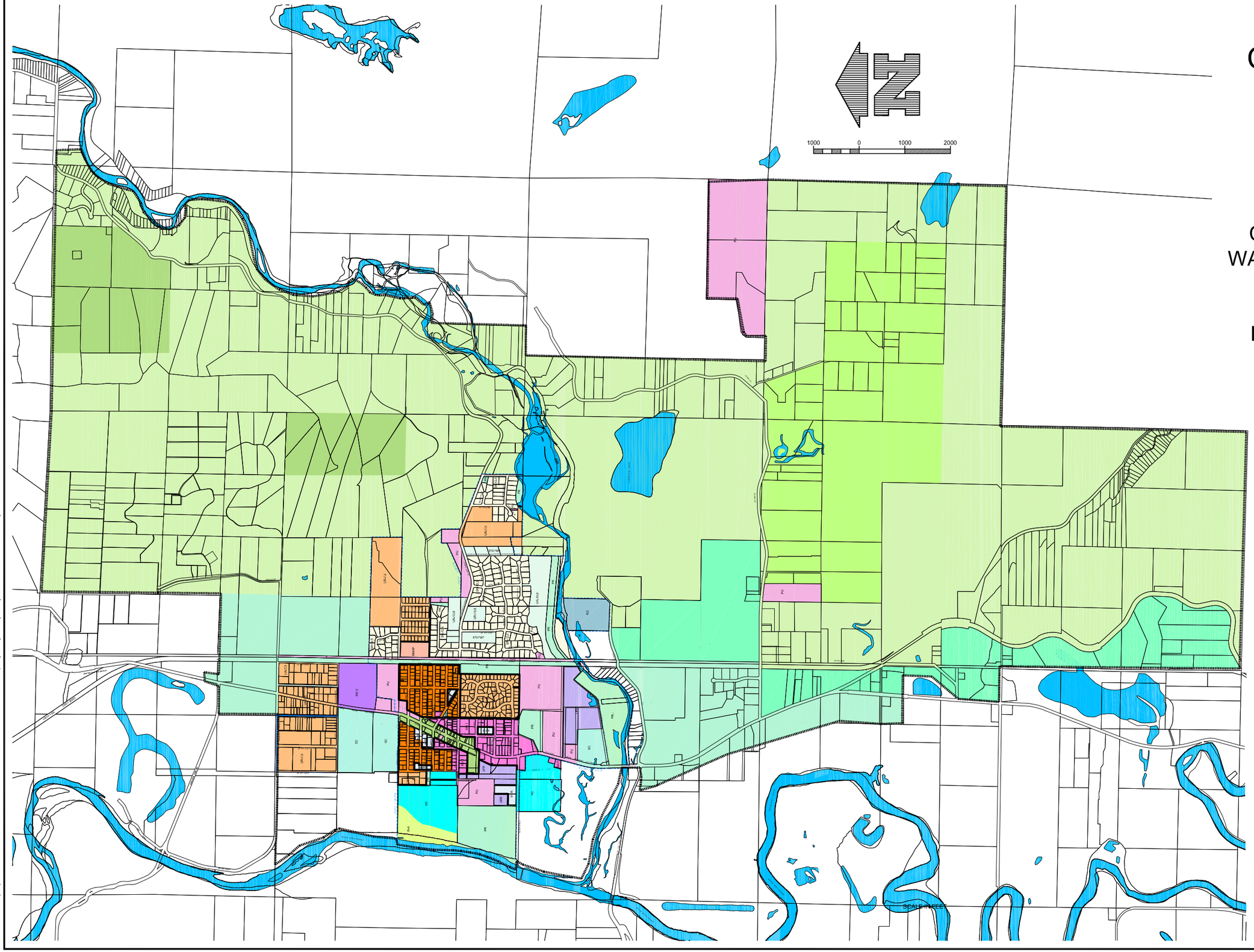
CITY OF CARNATION

2008 COMPREHENSIVE WATER SYSTEM PLAN

ZONING DECEMBER 2006

FIGURE 3.4



LEGEND:

- URBAN GROWTH BOUNDARY
- CONTIGUOUS CITY LIMITS
- R-A RESIDENTIAL-AGRICULTURE
- SR-12.5 RESIDENTIAL SINGLE FAMILY
- UR-5 URBAN RESIDENTIAL SINGLE FAMILY
- UR-7.5 URBAN RESIDENTIAL SINGLE FAMILY
- UR-10.8 URBAN RESIDENTIAL SINGLE FAMILY
- RMHP RESIDENTIAL MOBILE HOME PARK
- MFR MULTIFAMILY RESIDENTIAL
- CBD CENTRAL BUSINESS DISTRICT
- MU 1 MIXED USE
- MU 2 MIXED USE 2
- HC HORTICULTURAL COMMERCIAL
- SC SERVICE COMMERCIAL
- LI/M LIGHT INDUSTRIAL / MANUFACTURING
- PU PUBLIC USE
- PR PARKS
- EO EMPLOYMENT OFFICE

COUNTY ZONING:

- RURAL AREA - 5- SPECIAL OVERLAY
- RURAL AREA - 5
- RURAL AREA - 10
- AGRICULTURE - 10
- AGRICULTURE - 35

Roth Hill Engineering Partners, LLC

RothHill

2600 116th Avenue NE #100
Bellevue, Washington 98004
Tel 425.869.9448
Fax 425.869.1190

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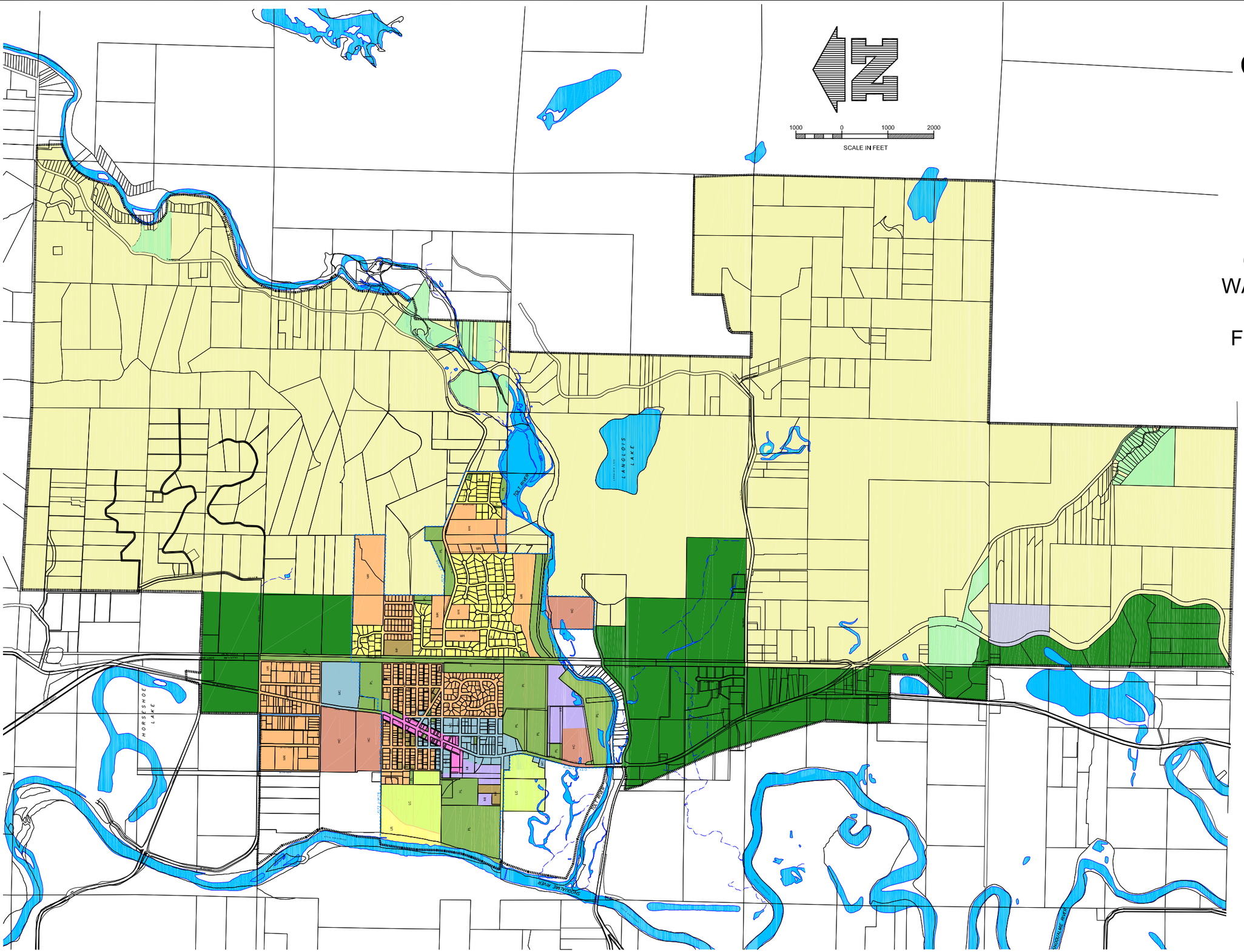
CITY OF CARNATION

2008 COMPREHENSIVE WATER SYSTEM PLAN

FUTURE LAND USE OCTOBER 2007

FIGURE 3.5



LEGEND:

- URBAN GROWTH BOUNDARY
- CARNATION CITY LIMITS
- LR — LOW DENSITY RESIDENTIAL
- MR — MEDIUM DENSITY RESIDENTIAL
- MF — MEDIUM DENSITY MULTI-FAMILY RESIDENTIAL
- LC — LOW INTENSITY COMMERCIAL
- MC — MEDIUM INTENSITY COMMERCIAL
- HC — HIGH INTENSITY COMMERCIAL
- MI — MEDIUM INTENSITY INDUSTRIAL
- CBD — CENTRAL BUSINESS DISTRICT
- PL — PUBLIC LANDS
- VA — VACANT

COUNTY ZONING:

- RURAL RESIDENTIAL
- PARKS
- MINING
- AGRICULTURE

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PLOTTING DATE: 04/25/2008 USER: WELLER VERSION: 2006 FILE NAME: F:\ F:\0026\0011B\Future Land Use-122707.DWG11 x 17 Land Use

Zoning

Carnation's UGA consists of current city limits plus the PAA, which may be annexed into the City in the future. In accordance with the state Growth Management Act statute (RCW 36.70A) lands outside the UGA must remain rural, as Carnation is east of the King County urban growth boundary.

The City of Carnation adopted a Comprehensive Land Use Plan in accordance with the Growth Management Act (RCW 36.70A) in February of 2005. The City's zoning map is adopted based on the land use designations developed as part of the Land Use Plan and map. The City amended the Comprehensive Land Use Plan in 2006 and in 2007, including amendments to the zoning map that increased density slightly in the older portion of the city and an amendment to the zoning code that increased density in the multifamily zone.

Zones within the City include single-family residential use at densities ranging from approximately three units per acre to approximately 8 units per acre; a multifamily zone that allows 24 units per acre; mixed use zones that allow single-family, multifamily and commercial uses or a combination of residential and commercial use, several commercial zones, a light industrial zone, a public use designation and a park zone.

Within the PAA, approximately half of the land area is zoned for single-family residential use, with the other half zoned for mixed and commercial uses.

Outside the UGA, the King County zoning consists of single-family agricultural zones with parcels of 5, 10 or 35 acres. This area is considered "rural" as defined by the Growth Management Act (GMA), and both uses and residential density are limited. There are two existing camps, which are the only uses that could be considered commercial. Other commercial uses would not be allowed under the existing zoning.

POPULATION FORECAST

Population forecasting was performed for current city limits based on the current zoning, for the PAA based on the zoning that would be in effect upon annexation, and for the parcels outside the UGA based on current King County zoning.

Table 3.5 shows the population projections for the water service area, based on the number of dwelling units projected both within and outside the UGA, multiplied by the average persons per household of 2.98 identified in the 2000 Census. These population forecasts reflect the household and employment growth targets identified in the King County Countywide Planning Policies that are in turn based on the Office of Financial Management (OFM) projections. The total population projected is approximately 6,200, with a projected number of households at 2,083. Of this projected population growth, approximately 30% is expected to be outside the UGA.

Table 3.5
Household Projections

Year	In City Limits	% Increase	In PAA	% Increase	Outside UGA	% Increase	Total	% Increase
2008	649	--	74	--	281	--	1005	--
2014	936	44.2%	118	58.7%	366	30.2%	1420	41.3%
2018	993	6.1%	161	36.0%	437	19.3%	1590	12.0%
2028	1069	7.7%	360	123.8%	654	49.7%	2083	31.0%

Within the Carnation Urban Growth Area

Population forecasts preformed for the last Water System Plan and for the Comprehensive Sewer Plan pre-dated the City's adoption of a Comprehensive Plan zoning map. As the zoning map is now available, this Water System Plan can utilize this more detailed land use information as the basis of the population and employment forecasts within the City's UGA. **Table 3.5** shows that a total of 1,069 households would be possible within city limits given the current zoning, assuming that most parcels develop to the extent possible. This represents an additional 420 new dwelling units.

Carnation's available land for residential development is somewhat limited: there are approximately 75 acres that are considered vacant and re-developable within the residential zones. The forecasted growth rates in **Table 3.5** are based on the assumption that these parcels will develop soon after sewers become available in 2008. The projected increase in the growth rate from 2009 to 2012 represents an estimate of when these larger parcels will be subdivided and available for houses.

A significant proportion of the new households will be the result of infill development, as the new sewer system allows smaller lots than are typical within some areas of the city, most notably the older platted portion. This type of development is expected to occur at a steadier rate over time, although it is assumed that the first few years after the sewers become operational will probably see more robust growth, and infill development will taper out over time. The lack of developable land within the City's current limits will probably limit growth towards the end of the twenty year planning period.

Residential development within the Potential Annexation Area will occur in the single-family and mixed use zones. New households were projected based on the number of lots that could be developed in the single-family zone, plus an estimate of new households that might be developed in the Mixed Use zone, assuming that smaller lots such as townhouses or cottages will be developed as permitted in that zone. Approximately 286 new dwelling units can be built once the PAA is

annexed into the City of Carnation and served by sewers, for a total of 360 dwelling units in the PAA. Growth rates within the PAA are expected to average approximately 8% over the 20- year period, beginning in 2008. Although substantial growth will not occur until annexation, there are many existing tax lots that can legally be built on with septic systems.

Total projected new households for the Carnation UGA are 706. This projection exceeds the 2022 growth target of 246 new households identified in the Countywide Planning Policies, which were set prior to Carnation's development of a public sewer system. Total population within the UGA is projected to be slightly over 4,100 at build-out of the current zoning.

Outside the Urban Growth Area

Zoning in the areas outside of the UGA is consistent with Rural Lands as defined by the GMA. Single-family residential and/or agriculture are the primary uses, and minimum lot sizes vary from 5 acres to 35 acres. There are only two non-residential uses, consisting of two camps which are non-community public water systems. Both of these camps and the Tolt MacDonald Park Campground are served by City of Carnation's water system.

There are approximately 600 parcels that are within the City's Water Service Area but outside the UGA, but many parcels are vacant. There are 269 dwelling units at the current time in this area. A build-out analysis of this area includes those parcels that could be subdivided. A Letter of Water Availability for 56 lots was counted as one potential subdivision although it encompasses several parcels (the Letter of Water Availability has not yet been issued). In addition, there are numerous legal lots that pre-date the zoning in this area. These lots are legally developable with private septic systems for wastewater and can also include private wells if over 5 acres. Where these lots are less than 5 acres in size, they can be developed on private septic systems if they are served by a public water system, assuming they have adequate area for the necessary drainfield. It was assumed that any parcel over one-half acre in size could develop if served by City of Carnation water.

Full build-out of the parcels outside the UGA could develop approximately 654 new dwelling units. Given the average persons per household, the population projected for this area at build-out outside the UGA is estimated to be approximately 2,000. The growth rate is projected to be an average of 4.5% per year over the 20-year period.

Population and Household Growth within the Water Planning Area

Total build-out of 2,083 households could occur within the Water Planning Area over the next twenty years. Total population is projected to be 6,200.

However, not all of the households within the Water Planning Area but outside the UGA will be served by the City of Carnation water system, as many of the parcels are larger enough to be served by private wells. Currently, the City has approximately 70 customer services that are outside the UGA within its Retail Service Area, although there are approximately 200 parcels in that area.

A conservative estimate that half of the parcels outside the UGA would be served by City of Carnation water would result in a total projection of 1,800 households or residential services.

EMPLOYMENT FORECAST

Employment projections within the City of Carnation UGA were made as part of the Buildable Lands Analysis. Based on the land capacity within each commercial, industrial or mixed use zone, total employment capacity within the current City limits was estimated at 936 jobs, of which approximately 100 would be light industrial and the remainder would be commercial or office type employment. Employment potential within the PAA based on land capacity was estimated at approximately 637 jobs, primarily commercial based. Total employment within the UGA based on land capacity of the current zoning is approximately 1,575 jobs.

New commercial development is not expected in the rural areas outside of the City of Carnation UGA as the current zoning under King County only permits rural residential and agricultural uses.

PROJECTED WATER DEMAND

Projecting future water demand is one of the key elements of the comprehensive water planning process. Identification of system improvements such as supply, pumping, storage and piping requirements are all related to demand projections.

Future water system demands are based on projected ERUs, which in turn are based on the projected water consumption by customer classification and the projected number of accounts discussed at the beginning of this chapter. **Table 3.6** shows the projected ERUs for the City's Retail Water Service Area over the planning period. It does not include distribution leakage or wholesale customer demand.

Table 3.6
Projected ERUs

Classification	2008	2014	2018	2028
North (229) Zone				
Single-family Residential	640	932	1,021	1,265
Multifamily Residential	88	128	140	174
Commercial	152	222	243	301
Irrigation	54	78	86	106
Subtotal	934	1,360	1,490	1,846
South (328) Zone				
Single-family Residential	85	110	131	197
Total				
Single-family Residential	725	1,043	1,152	1,461
Multifamily Residential	88	128	140	174
Commercial	152	222	243	301
Irrigation	54	78	86	106
Total	1,019	1,471	1,621	2,042

The ADD for the entire City was based on multiplying the projected ERUs by the planning value of 225 gpd per ERU. The projected MDD is simply the projected ADD multiplied by the MDD/ADD factor of 2.5, as discussed previously. For the total water demand, we added the non-revenue water to the annualized ADD. ADD and MDD are calculated without non-revenue water. The existing and projected average and maximum daily demands for the City's water system, without Water Use Efficiency (WUE) reduction, are shown in **Table 3.7**. The existing and projected annual demands, without WUE reduction, are shown in **Figure 3.6**.

The ADD and MDD projections (without WUE reduction) were utilized in Chapter 4, System Analysis, and in Chapter 6, Water Rights and Supply Analysis. The deficiencies identified serve as the basis for the Capital Improvement Plan in Chapter 7. The WUE projections are included annually in Chapter 5 for the 6-year comprehensive planning period (2008 to 2011).

Figure 3.6
Projected Annual Demand, Including Wholesale, without WUE Reduction

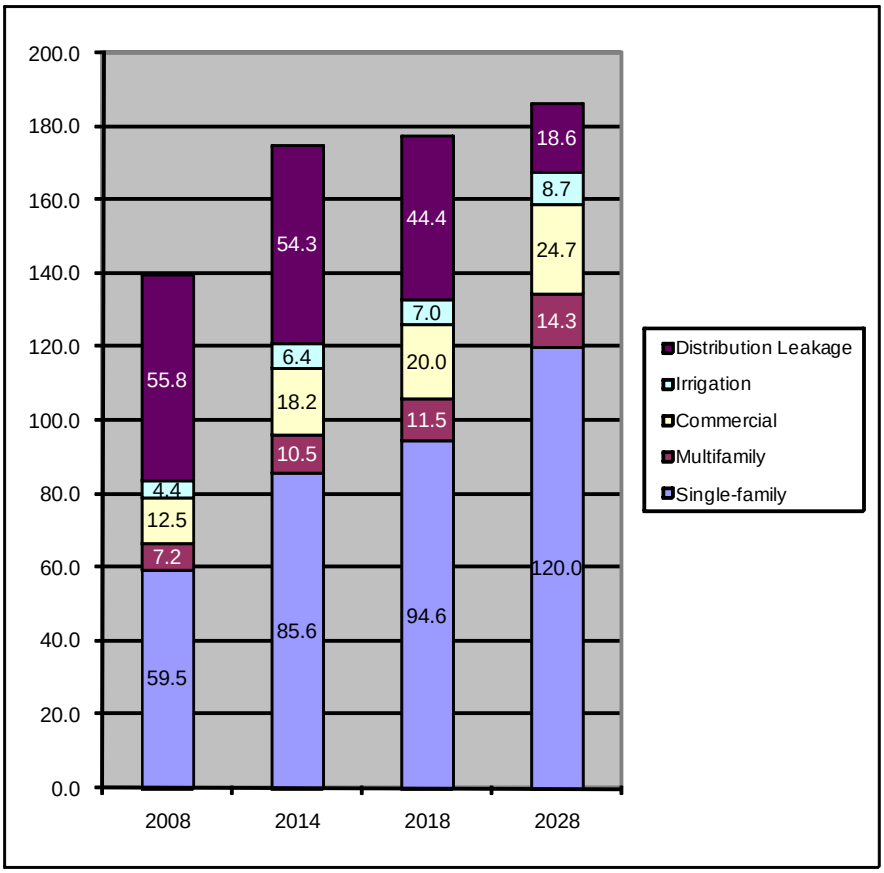


Table 3.7
Projected Average And Maximum Daily Demands without Water Use Efficiency (WUE) Reduction

	2008			2014			2018			2028		
Classification	Avg. Day (gpd)	Max. Day (gpd)	Annual (MG)	Avg. Day (gpd)	Max. Day (gpd)	Annual (MG)	Avg. Day (gpd)	Max. Day (gpd)	Annual (MG)	Avg. Day (gpd)	Max. Day (gpd)	Annual (MG)
SF in UGA	144,032	360,079	52.6	209,786	524,464	76.6	229,686	574,214	83.8	284,531	711,327	103.9
SF out of UGA	19,045	47,613	7.0	24,802	62,004	9.1	29,576	73,941	10.8	44,285	110,714	16.2
Total SF	163,077	407,692	59.5	234,587	586,468	85.6	259,262	648,156	94.6	328,816	822,041	120.0
Multifamily	19,783	49,458	7.2	28,815	72,037	10.5	31,548	78,871	11.5	39,082	97,704	14.3
Commercial	34,293	85,733	12.5	49,949	124,872	18.2	54,687	136,718	20.0	67,745	169,364	24.7
Irrigation	12,092	30,229	4.4	17,612	44,029	6.4	19,282	48,206	7.0	23,887	59,716	8.7
Non-Revenue	152,830	382,075	55.8	148,694	371,735	54.3	121,593	303,983	44.4	51,059	127,648	18.6
Total	382,075	955,187	139.5	479,657	1,199,142	175.1	486,373	1,215,932	177.5	510,589	1,276,472	186.4

CHAPTER 4 SYSTEM ANALYSIS

HYDRAULIC ANALYSIS

An integral part of the comprehensive planning process is a thorough hydraulic analysis of the City's water system facilities. The purpose of the analysis is to evaluate the ability of the system transmission and distribution piping, well pump, storage facilities, PRVs and other components to supply water to the City's customers. Results of the analysis identify deficiencies in meeting DOH and City standards, as well as improvements required to resolve deficiencies. The scope of the hydraulic analysis includes the following:

- Perform a storage analysis of the system based on existing and future demand conditions
- Assign demands to the model based on the existing and future system, using the data developed in Chapter 3
- Evaluate system performance compared to DOH and City criteria and identify deficiencies
- Compare various improvement alternatives
- Identify selected improvements to resolve existing deficiencies
- Document any special operational requirements

Hydraulic Model

The City's model was developed using H_2OMap Water GIS version 7.0 (by MWH Soft), and was used for the hydraulic analysis described in this chapter. H_2OMap Water is a stand-alone GIS-based hydraulic model, and combines spatial analysis tools and mapping functions with water distribution network modeling.

The hydraulic model performs simultaneous pressure and flow calculations throughout the distribution system piping under varying demand conditions and operational scenarios. It evaluates the interaction between system demand (including potential fire flows), supply, storage, pumping and distribution piping. Steady state (static) analyses can be performed to identify areas of low or high pressure and excessive velocities and/or pressure loss in pipes. Extended period simulations can also be performed to evaluate operational characteristics such as the relationship between pump station operations and reservoir levels over a 24-hour (diurnal) period. The GIS integration allows for a graphical representation and interface with the water distribution system and analysis results data. Pipes can be color coded to identify physical characteristics such as pipe flow rates, velocities and head losses. Node data such as elevation or pressure, etc., can similarly be graphically represented.

The model was created at the end of 2006 by Roth Hill Engineering, and has been updated to reflect one CIP project since its creation. Future updates are anticipated and are accomplished by manually inputting construction record drawing data into the model. Modeling data includes the following physical and operational characteristics:

Pipe Data

Pipe information includes diameter, length, Hazen Williams "C" value, material and status (open or closed). Pipe materials and "C" values typically are closely related. Simulation of closed valves is controlled in the model by closing pipes. Dead-end lines containing hydrants are typically simulated as part of this analysis to verify fire flow adequacy. All looped portions of system piping are included in the model.

Node Data/System Demands

Nodes include elevation and demand (average day, maximum day and peak hour) in the model. Node demands were assigned in the model based on the water demand calculations as described in Chapter 3, and as described herein. Separate residential demands were calculated for the South (328) and North (229) Zones. For the South Zone, residential demand was uniformly distributed between the nodes. For the North Zone, slightly larger residential demands were applied to the newer developments (Swiftwater and River's Edge) in the eastern portion of the city, since most of the lots and houses are larger compared to the rest of the city, and more irrigation is likely during peak demand portions of the year. Smaller residential demands were applied to the remainder of the city. For commercial nodes, all of which are located in the North Zone, larger demands were assigned on a case-by-case basis related to usage. The remainder of the commercial demand was uniformly distributed throughout the central business district, which lies along the Tolt Avenue corridor. Point loads (demands) were applied to represent future residential and commercial development where applicable. The point loads were applied in areas north and northeast of the city. Limited elevation verification was performed during model development.

For the Comprehensive Plan model used for this analysis, updated system demands were input to the model based on water use and other planning data and related system demands previously presented in this document. The system demands in the model were globally factored to match the current (2008) and 2028 Average Day Demand (ADD) and Maximum Day Demand (MDD) scenarios. Peak-Hour Demands (PHD) were calculated per Equation 5-3 provided in the DOH Manual (August 2001), which is based on MDD and the number of total ERUs.

Fire Flow Requirements

Fire flow requirements were assigned in the model based on the following categories:

- Single-family residential: 1,000 gallons per minute (gpm) for two hours.
- Tolt Middle School: 1,000 gpm for two hours. Future building additions will require higher fire flow per IBC, IFC requirements.
- Tolt Elementary School: 2000 gpm for two hours.
- 2008 Commercial: 2,000 gpm for two hours.
- 2028 Commercial: 2,500 gpm for two hours.

Supply Data

Supply to the City's system is generally represented as inflow nodes to represent water supplied from the spring source and well. Inflow nodes can be configured to vary flow with time as necessary to simulate actual conditions. The City's spring source is represented as a reservoir with a constant hydraulic gradeline and a flow control valve set to simulate a maximum output of 350 gpm, which was determined through review of City's flow meter records. The well is represented as a node with a constant negative demand to simulate outflow when operational. This flow rate was adjusted as necessary for the various scenarios analyzed.

Storage Data

This data includes the physical configuration of the storage tank, including dimensions and minimum, maximum and pumping level water elevations. Data was provided by the City for the existing tank and input to the model previously during model development.

Pump Data

Well pumps or pump stations with multiple pumps can be represented in the model. Pumps can be assigned pump curves or can be defined as constant supply nodes. If pump curves are used, the pump status can be automatically controlled by operational conditions such as storage tank level or node pressure. Supply nodes can be utilized to input nominal flow rates for water supplied to the system, if desirable, or if pump curves are unavailable. The city does not currently operate any pump stations, but does own and operate a well pump. The well pump is turned on or off in the model based on tank settings and discharges at an assumed constant flow rate.

Pressure Reducing Valve (PRV) and Pressure Sustaining Valve (PSV) Data

PRVs are designed to limit the pressure on the downstream end to not exceed a pre-set value when the upstream pressure is above this setting. PRVs are characterized in the model with a downstream pressure setting, head loss through the valve, elevation and the valve diameter. PRV stations usually consist of a smaller, normal duty valve and a larger valve set to open at a lower pressure and used to supply peak or emergency flows. For this analysis, the main PRV station was simulated by setting the larger valve at the normal pressure setting and ignoring the smaller valve. Pressure sustaining valves are designed to maintain a minimum pressure on their upstream end when the downstream pressure is below that value. A PSV is characterized in the model with an upstream pressure setting and a valve diameter.

The City of Carnation has one combination PRV/PSV station located at the boundary between the South (328) and North (229) Zones, at the intersection of Fall City-Carnation Road and NE 32nd Street. The PRV is modeled as an 8-inch diameter valve with a downstream pressure setting which would limit the pressure to the North Zone to approximately 77 psi. The PSV is modeled to maintain a minimum pressure of approximately 90 psi in the South Zone.

Model Calibration

The scope of the hydraulic analysis for this Comprehensive Plan did not include model calibration; however, the City's hydraulic model was recently developed under a separate project and was calibrated at that time. Hydrant flow tests were performed at six different locations, and pressures (before, during, and after flow testing) were recorded for each test. Demands were assumed to be average day conditions in the model. Comparison of the test results with the model results indicated that generally the model accurately reflected conditions in the existing system. Elevations were updated in a small number of locations in the model, and Hazen Williams "C" values were adjusted as necessary based on possible deterioration of the watermain due to age, until the model pressures correlated to the field pressure test data. "C" values were generally assigned to the model as follows:

Ductile Iron:	130
Asbestos Cement:	120
Steel:	100
PVC:	140
Galvanized Iron:	100

EVALUATION OF DISTRIBUTION SYSTEM

After updating model system demands and verifying "C" values and model settings, the model was used to perform a comprehensive evaluation of the distribution system. The evaluation consisted of performing a series of model simulations, under varying system demands and operational parameters, to determine compliance with DOH and City criteria and standards. Operational parameters that were manipulated included initial tank levels, well pump status and settings, the spring supply, status of valves, and various piping configurations as necessary. System minimum and maximum pressures, fire flow residual pressures and maximum velocities were all analyzed. Where model results identified deficiencies in meeting the specified criteria, alternative system improvements were identified, input to the model, and analyzed to verify compliance with the criteria. A generalized discussion of the analysis for each main scenario, as well as identified deficiencies and improvements are discussed herein. Recommended improvements are included in the Improvement Plan in Chapter 8.

2008 SYSTEM ANALYSIS

The distribution system for this analysis represented the existing system as described in Chapter 1 and within this chapter. Reservoir settings for the analysis were determined based on existing equalizing, fire flow, and standby storage volume requirements (further discussed in this chapter). Per DOH recommendations, fire flow analysis should be performed with the assumption that the largest water source is unavailable. Therefore, the well pump was assumed to be off for the analysis below.

Peak Hourly Demand Pressure (PHD) Analysis

Minimum service pressures must be greater than 30 psi during PHD conditions, with tank elevations set at the bottom of equalizing storage levels. Model results indicate that all service pressures meet this criterion. Operational and equalizing storage levels were based on the 2008 storage analysis.

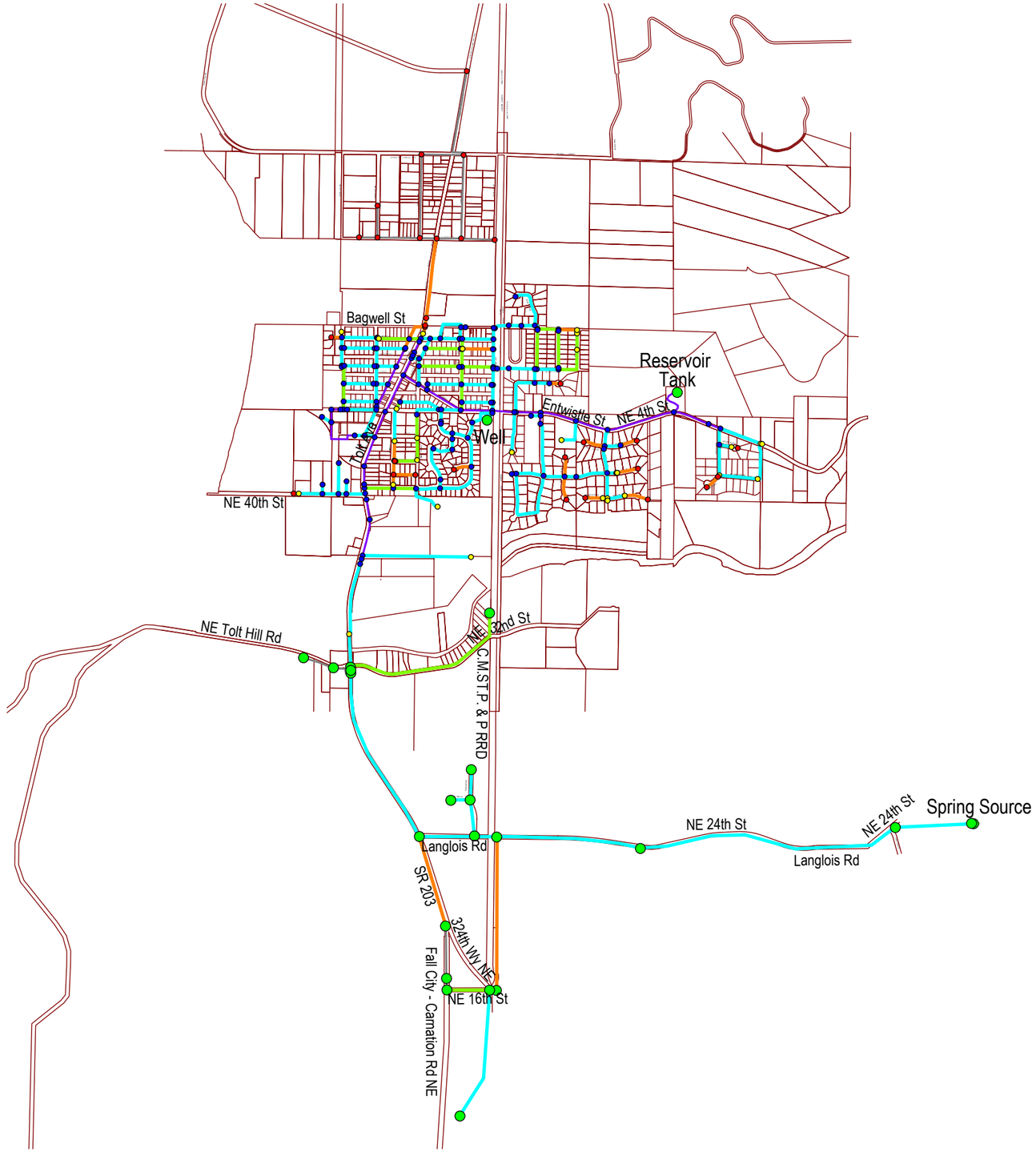
Fire Flow Analysis

The ability of the distribution system to provide required fire flow rates while maintaining a minimum 20 psi residual system pressure and not exceeding velocity criteria is a significant component in determining pipe sizes and system configurations. Two system-wide fire flow analyses were performed as part of this hydraulic analysis. Individual 1,000 gpm fire flows were simulated for nodes located in single-family zoned areas. For commercial areas, a 2,000 gpm fire flow is required.

All fire flow analyses were simulated in conjunction with the MDD scenario, per DOH requirements. The model is used to perform fire flow analyses by applying the specified flow individually in turn to each node identified for the analysis. For a 2,000 gpm flow rate, the fire flow is manually re-simulated by assigning 1,000 gpm each to two adjacent node/hydrant locations. This is done because the model cannot automatically split the fire flow rate between multiple hydrants as part of its analysis routine. In addition, the automated fire flow analyses performed by the model are only able to identify residual pressures, not velocity. The residual velocities were checked, per DOH criteria, during manual simulation of fire flow rates. The process of checking fire flow velocities was expedited by realizing that certain pipe configurations convey adequate fire flow rates with acceptable velocities. Fore example, the maximum flow rate at 8 feet per second is approximately 1,250 gpm in a dead-end 8-inch diameter main, while smaller dead-end mains would not be able to convey a 1,000 gpm fire flow.

Analysis results indicate the system gradient and capability to convey fire flow rates is adequate to supply 1,000 gpm to most of the single-family zones. The exceptions are located on sections of the existing main in McKinley Avenue between Myrtle Street and Blanche Street, and the adjacent alley between McKinley Avenue and King Street, where the watermain is constructed of older 6-inch steel pipe, and there is inadequate looping of the water system. According to DOH criteria, the minimum allowable size for a watermain supplying a hydrant is 6-inches. There is also a residential area north of the city which is served by 2-inch diameter galvanized metal pipe and 4-inch diameter steel pipe that cannot be supplied 1,000 gpm for fire flow. Currently, it is outside the City limits but within the Urban Area and should be provided with fire flow. Results of this analysis showing deficiencies are shown in **Figures 4.1A and 4.1B**. Results of the analysis also indicate that minimum service pressures are maintained under 1,000 gpm fire flow conditions to most areas of the city. However, the same portions of the system which do not meet the fire flow requirements for 1,000 gpm do not meet minimum pressure requirements. Deficiencies determined in the residual system pressure analysis are shown in **Figures 4.2A and 4.2B**.

A fire flow analysis requires that the initial water level in the tank be set at the bottom of fire suppression storage levels after operation storage and equalizing storage are subtracted. A 2,000 gpm fire flow analysis could not be performed, since the existing tank does not have any capacity after equalizing, operational, and fire-suppression storage are removed. After subtracting out operation and equalizing storage, 190,000 gallons would remain in the tank. A 2,000 gpm fire flow for two hours requires 240,000 gallons, which would completely drain the tank and leave a deficit. Furthermore, the tank cannot provide adequate pressures of twenty psi throughout the system when it is near the bottom.



JUNCTION FIRE FLOW (gpm)

- Less than 1,000
- 1,000 ~ 1,500
- Greater than 1,500
- Not Analyzed

PIPE DIAMETER

- 2-inch
- 4-inch
- 6-inch
- 8-inch
- 12-inch

Figure 4.1A

2008 System Analysis - 1,000 gpm - Available Fire Flow

Figure 4.1B

2008 System Analysis - 1,000 gpm - Available Fire Flow

Enlarged View

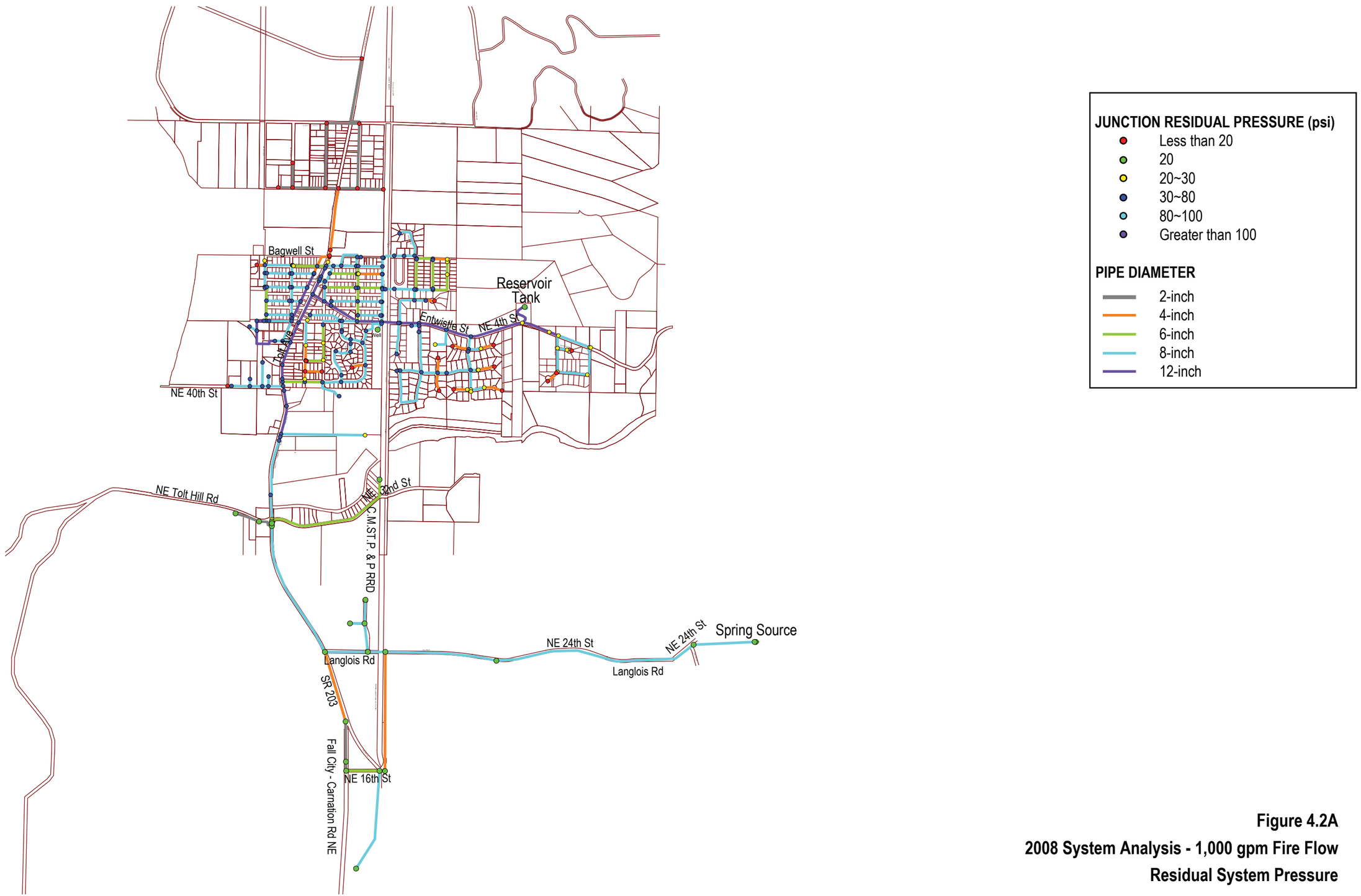


Figure 4.2A
2008 System Analysis - 1,000 gpm Fire Flow
Residual System Pressure

JUNCTION RESIDUAL PRESSURE (psi)

- Less than 20
- 20
- 20~30
- 30~80
- 80~100
- Greater than 100

PIPE DIAMETER

- 2-inch
- 4-inch
- 6-inch
- 8-inch
- 12-inch

Figure 4.2B
2008 System Analysis - 1,000 gpm Fire Flow
Residual System Pressure - Enlarged View

A supplemental analysis for 2,000 gpm fire flow was performed using alternate assumptions. In this case, the well pump was turned on. Results of this analysis indicated that most of the system could meet minimum service pressure requirements under these conditions. Only a small portion of the water system located in and around the River's Edge development had pressures below 20 psi. This problem is due to the higher elevation of this area relative to the reservoir tanks and the rest of the water system.

Standby storage and fire suppression storage levels were based on the 2008 storage analysis. For the year 2008, fire suppression storage is greater than standby storage. Therefore, the fire suppression storage governed.

In order to resolve the deficiencies determined through the 2008 analysis, the following improvements, which are shown in **Figure 4.3** were modeled:

- Upsize the existing 4-inch watermain on McKinley Avenue between Blanche Street and Eugene Street and on the existing 6-inch watermain between King (Stossel) Street between Myrtle Street and Entwistle Street to 8-inch pipe.
- Installation of a new 8-inch watermain on King Street between Blanche Street and Myrtle Street, with connections to the existing watermains on Myrtle Street and the adjacent alley to provide looping.
- Upsize the existing 4-inch watermain on Carnation-Duvall Road (SR 203) between Morrison Street and NE 55th Street to 12-inch pipe.
- Upsize the existing 4-inch watermain in Alley "J" between Alley "A" and Bagwell Street, the existing watermain in Bagwell Street between Alley "J" and Tolt Avenue, and the existing 6-inch pipe on Morrison Avenue between Alley "J" and Tolt Avenue to 12-inch pipe.
- Connect the 12-inch watermain at the intersection of Tolt Avenue and Commercial Street to the 12-inch watermain at the intersection of Commercial Avenue and Alley "J" with a new 12-inch pipe to provide looping.
- Upsize the existing 6-inch watermain in Spillman Avenue between Entwistle Street and Morrison Street to 8-inch pipe.

Maximum Velocity Analysis

A model simulation has been performed during PHD conditions to identify any pipe velocities exceeding 8 ft/s. No excessive system pipe velocities were identified under these conditions.

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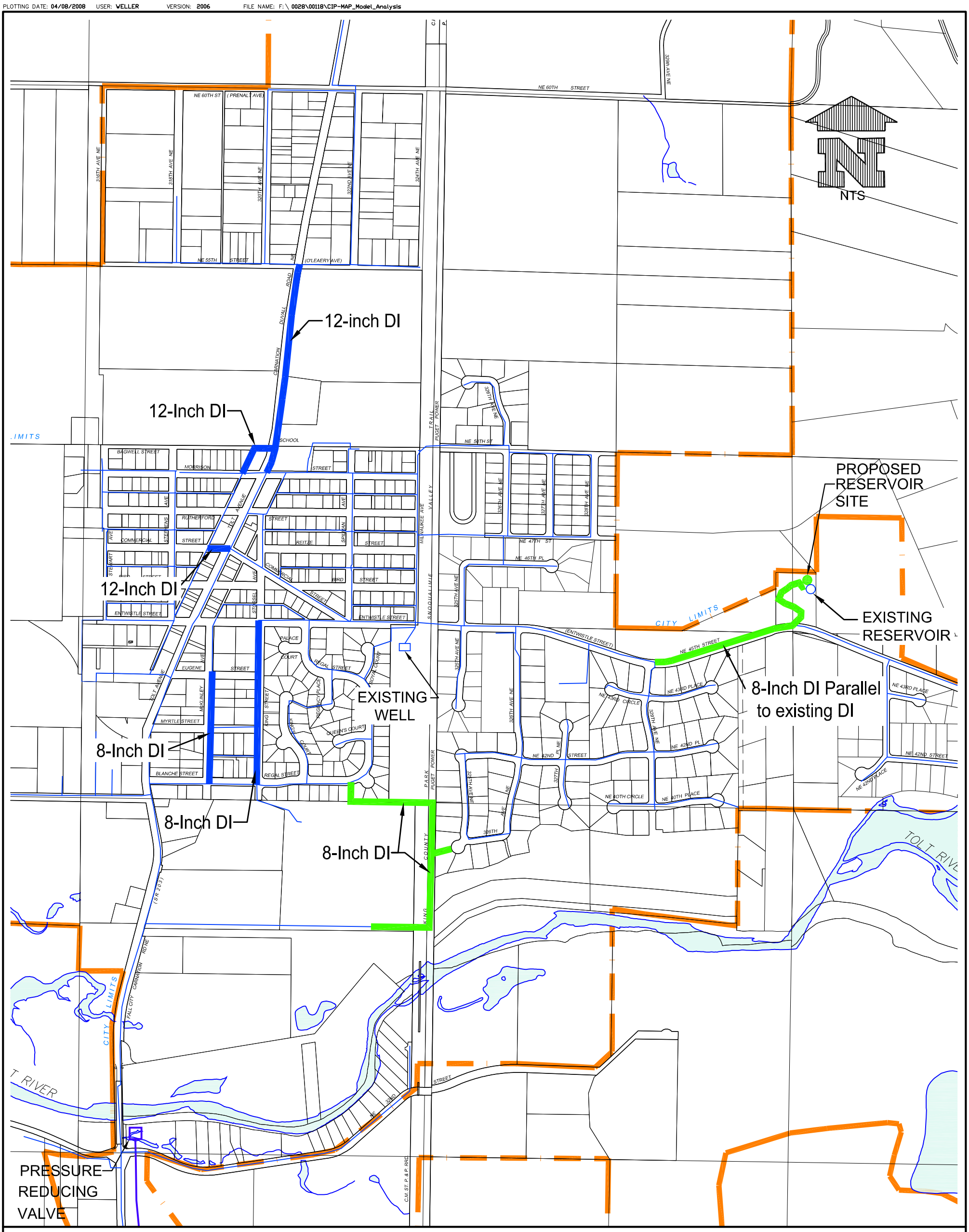

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CITY MANAGER:
CANDICE BOCK

CITY OF CARNATION
KING COUNTY

WATER COMPREHENSIVE PLAN
WATER SYSTEM ANALYSIS
FIGURE 4.3
REQUIRED IMPROVEMENTS

LEGEND - EXISTING FACILITIES

- WATER MAIN
- IMPROVEMENTS REQUIRED AFTER 2028 ANALYSIS
- IMPROVEMENTS REQUIRED AFTER 2008 ANALYSIS
- WATER SERVICE AREA

CARNATION

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2014 System Analysis

Prior to setting up the 2014 analysis, demand projections were compared to 2008 data. Because the demands for 2014 did not significantly vary from the 2008 demands due to planned water conservation improvements and growth projections, it was decided that no additional analysis would be completed for the 2014 scenario. Any deficiencies that would be identified in the 6-year period were identified and accounted for in the 2008 analysis.

2028 System Analysis

The 2028 analysis involved modification of the 2008 model to simulate 2028 ADD, MDD, and PHD scenarios. All system improvements identified as required to resolve deficiencies in the 2008 conditions hydraulic analysis are included in the 2028 model. These improvements include a substantial amount of pipe replacements and looping. The storage analysis for 2028 revealed a storage deficit, which increased in magnitude versus the 2008 storage deficit. This should be resolved by the construction of an additional storage facility. In order to run the 2028 scenario, the additional storage facility was added, assuming that it would be constructed prior to 2028. For analysis purposes and storage calculations, the additional storage facility was assumed to be identical in elevation to the existing reservoir. The reservoir settings were based on the 2028 operational, equalizing, fire flow, and standby storage volumes and associated water levels assuming two tanks will be online.

Peak Hourly Demand Pressure Analysis

Minimum service pressures must be greater than 30 psi during PHD conditions, with tank elevations set at the bottom of equalizing storage levels. Model results indicate that all service pressures would meet this criterion. Operational and equalizing storage levels were based on the 2028 storage analysis.

Fire Flow Analysis

Two system-wide fire flow analyses were performed as part of the 2028 analysis. Individual 1,000 gpm fire flows were simulated where nodes are located in single-family zoned areas. For commercial areas, a 2,500 gpm fire flow was simulated. Methodologies used for the 2028 analysis were the same as those performed for the 2008 analysis.

Analysis results indicate the system gradient and capability to convey fire flow rates is adequate, resulting in acceptable residual pressures for the 1,000 gpm fire flow requirements, and also indicate that all service pressures were greater than the minimum 20 psi required during the 1,000 gpm fire flow plus MDD condition. Results of the 2,500 gpm fire flow analysis indicate that portions of the watermain between the reservoirs and Central Business District are not large

enough to provide water to the system during fire flow conditions. Results shown in **Figure 4.4** indicate that two sections of the existing 12-inch pipe on NE 45th Street between the tanks and the King County Trail exceed the maximum velocity requirement of 8 fps. They also indicate pressures below 20 psi for large portions of the city, which are caused by the pipe capacity problems detailed above. Standby storage and fire suppression storage levels were based on the 2028 storage analysis. For the year 2028, fire suppression storage is greater than standby storage.

In order to resolve these deficiencies, the following improvements were modeled:

- Installation of an 8-inch pipe on NE 45th Street between the tanks and 329th Avenue NE running parallel to the existing 12-inch watermain to compensate for capacity deficiencies in the existing 12-inch watermain.

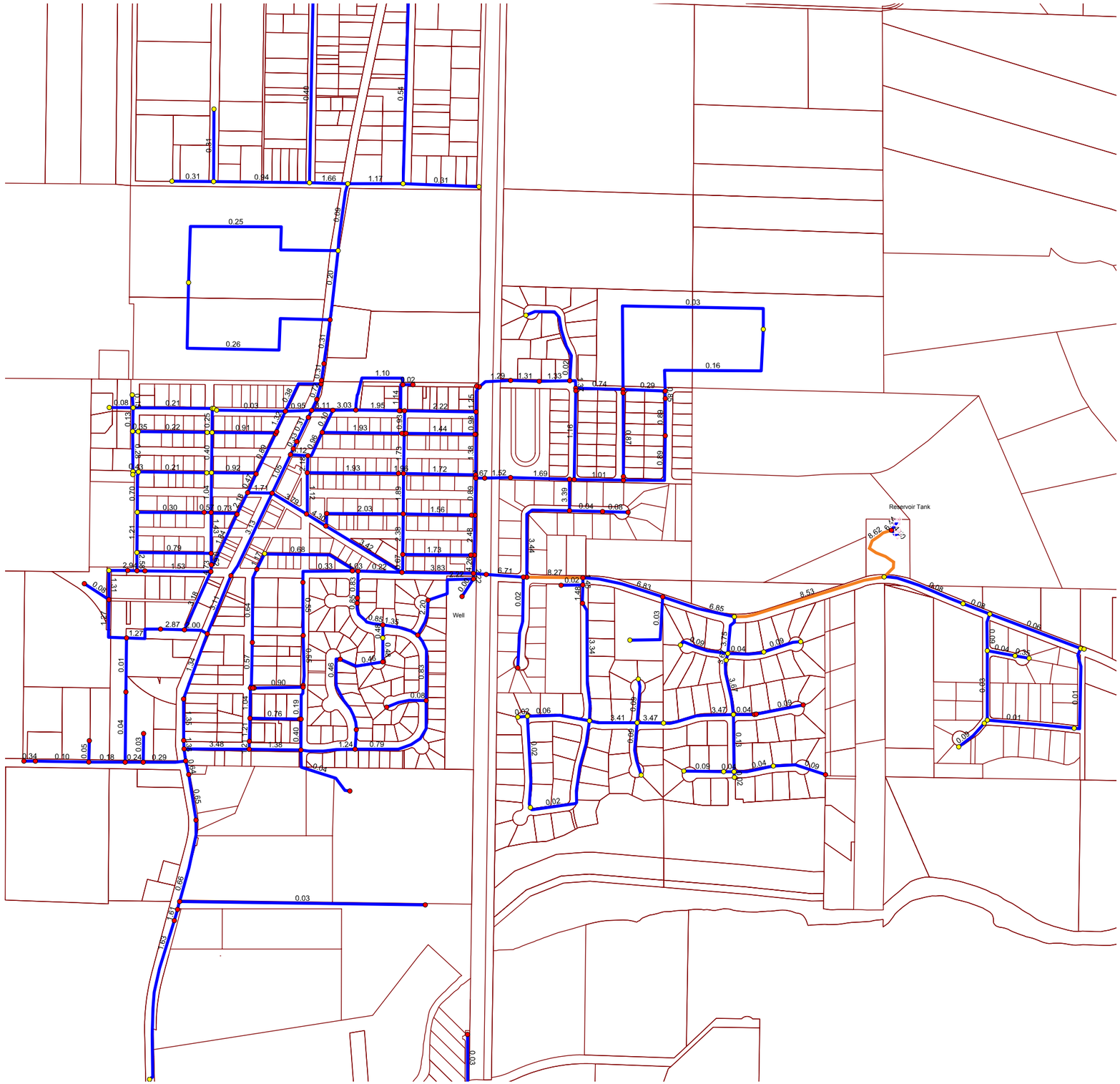
- Installation of an 8-inch pipe connecting the existing 8-inch watermain at the intersection of 326th Avenue NE and 325th Avenue NE to the 8-inch watermain on Regal Street east of Kings Court. This pipe would cross the Snoqualmie Valley Trail and Puget Power Right-of-Way to provide looping.

- Installation of an 8-inch pipe connecting the proposed 8-inch pipe crossing the Snoqualmie Valley Trail and Puget Power Right-of-Way to the existing 8-inch watermain which parallels the south line of the Tolt Middle school property to provide looping .

Results of this analysis show that the modeled improvements would provide the needed pipe capacity, while providing looping for a portion of the system. Results indicate residual pressures in all portions of the city to be above 20 psi, and all pipe velocities below 8 fps. Analysis results are shown in **Figure 4.5**. The modeled improvements required to eliminate the deficiencies in the 2028 water system are also shown in **Figure 4.3**.

Maximum Velocity Analysis

A model simulation has been performed during PHD conditions to identify any pipe velocities exceeding the specified criteria. No excessive system pipe velocities were identified under these conditions.



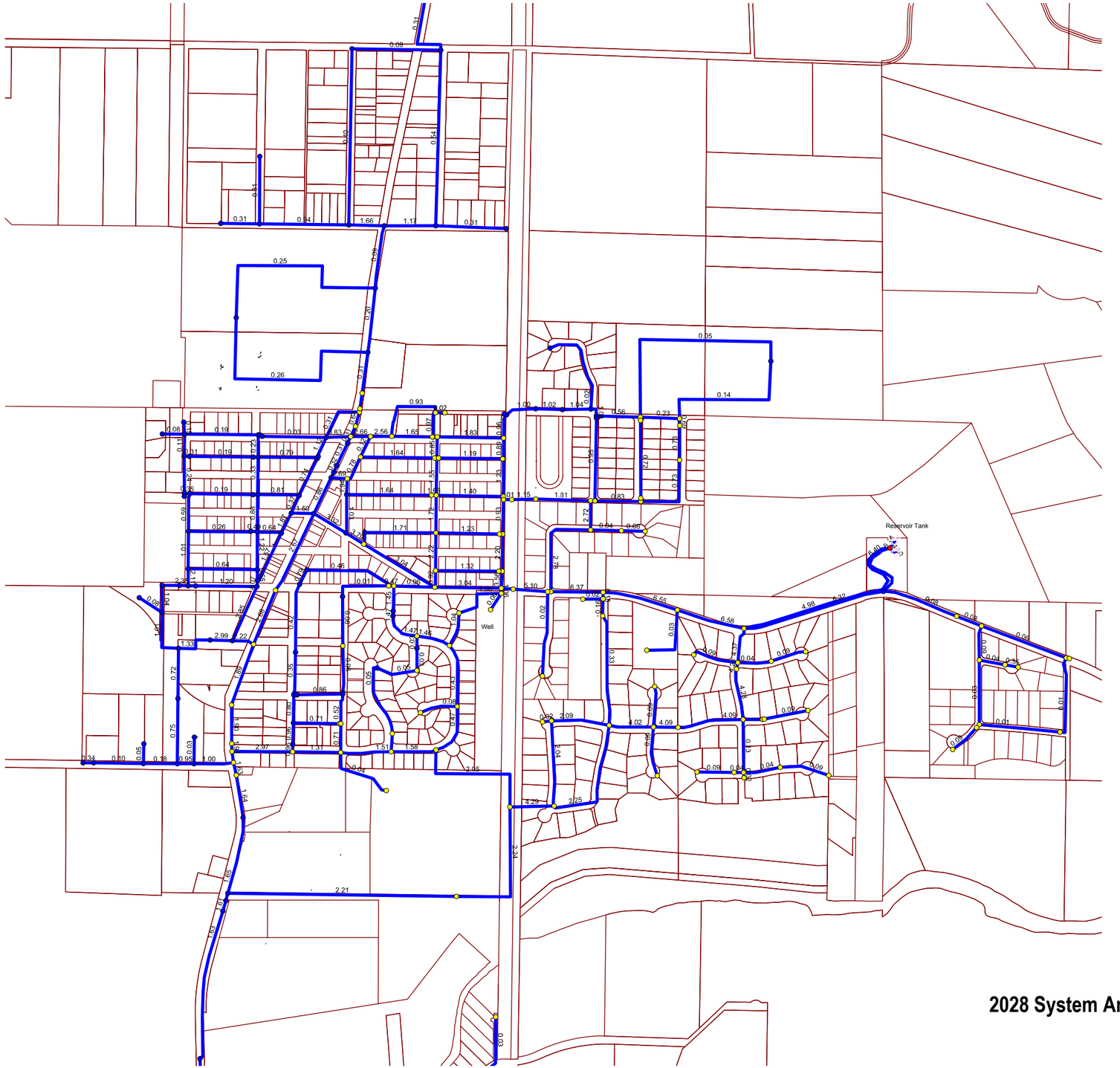
JUNCTION RESIDUAL PRESSURE (psi)

- Less than 20
- 20
- 20~30
- 30~80
- 80~100
- Greater than 100

PIPE VELOCITY

- Less than 7
- 7~8
- 8~10
- Greater than 10

Figure 4.4
2028 System Analysis - 2,500 gpm Fire Flow
Residual Pressure and Maximum Velocity Analysis



JUNCTION RESIDUAL PRESSURE (psi)

- Less than 20
- 20
- 20~30
- 30~80
- 80~100
- Greater than 100

PIPE VELOCITY

- Less than 7
- 7~8
- 8~10
- Greater than 10

Figure 4.5

2028 System Analysis - 2,500 gpm Fire Flow with System Improvements

Residual Pressure and Maximum Velocity Analysis

STORAGE ANALYSIS

The sources for the 2008 scenario include the spring source and the well as described in Chapter 1 – Existing Water System. There is a maximum water right for the spring of 628 gpm. However, physical characteristics currently limit the supply from the spring to an instantaneous maximum flow rate of approximately 350 gpm under normal operating conditions. The City's water system is divided into the South (328) and North (229) Pressure Zones. Storage for the North Zone is provided by a single storage tank as described in Chapter 1 . The south pressure zone contains no storage facility, and is supplied directly from the spring.

Under emergency low pressure conditions in the south zone, water could back feed from the North Zone through the PRV/PSV, but could not serve all customers in the zone and could only provide 20 psi to a few customers on the lower end of the North Zone.

The City must provide sufficient storage in its water system to ensure proper customer service. The volume of the storage required is composed of five individual components: equalizing storage volume, fire suppression storage volume, standby storage volume, operational storage volume, and dead storage. Standby storage volumes and fire suppression storage volumes are nested in the City's system; therefore, operational storage and equalizing storage volumes are assumed to be expended before fire suppression storage. The smaller of standby storage volume and fire suppression storage volume may be excluded from the storage calculations, per DOH standards for nested systems. The storage components for the City's tank are discussed in more detail below.

Operational Storage

The operational storage component consists of the volume in the existing tank between the overflow levels and the level where the well pump is called on to supply water from the well to keep the tanks full. The overflow level in the existing tank is 59.4 feet. The well pump is turned on when the water surface elevation in the tank drops approximately 7 feet below the overflow elevation.

Equalizing Storage

The equalizing volume, as defined by the DOH, is the total volume required to satisfy peak system demands that exceed the capacity of the supply and pumping facilities. The required equalizing storage was computed as the Peak Hour Demand (PHD) flow rate for the system, less the sum of the sources for a duration of 150 minutes (equation from DOH). Equalizing volume requirements are greatest on the day of maximum demand and are typically equal to 20-30% of the MDD.

Standby Storage

Emergency and reserve volume is required to supply reasonable system demands during a foreseeable system emergency or outage, such as major pipeline failure, well failure, power outage, valve failure, or another system outage. Emergency and reserve volume requirements are dependent upon average system demands and source of supply redundancy. The City has established a minimum standby volume criterion to provide sufficient standby storage to maintain service for two days of average day demand (ADD) assuming that the Spring source was available. Under existing conditions, the well pump does not have an emergency generator onsite, and is unavailable.

Fire Suppression Storage

Design criteria established by WAC 246-290-230 and DOH require that new or expanding water systems have the capacity to provide design fire flows during MDD conditions. Fire protection volume requirements are computed based on the size and duration of the largest required fire flow within the service area of the storage facility. Per Chapter 2, the City plans to provide for a system-wide fire flow of 1,000 gpm for two hours (0.12 MG) for single-family detached dwellings in residential zones. Commercial fire flow requirements were based on Table B105.1 of the International Building Code, as adopted by the City of Carnation, which determines fire flow rates based on calculated fire flow area and type of building construction. Current building size and construction for commercial facilities in Carnation require a fire flow rate of 2,000 gpm for two hours.

Fire protection volumes in excess of the above criteria may be required by the Fire Marshal to provide fire protection for specific types of building construction and use. The City will strive to provide and maintain the necessary system infrastructure as required by the DOH Water System Design Manual for fire-fighting purposes.

Dead Storage

Dead Storage is the volume of stored water between the bottom of the tanks and the elevation of the 20 psi hydraulic grade line during fire flow conditions. The amount of dead storage in the existing tank is insignificant, and not included in the storage analysis.

Sources of Supply

For the storage analysis associated with this Comprehensive Plan, the following sources of supply were considered:

Current (2008) Supply Sources

- The spring source tap was assumed to be open. It is the primary supply source and can deliver an estimated maximum flow rate of 350 gpm. During periods of low and average demand, the spring source supply is able to maintain the volume in the tank at maximum level. The maximum flow rate occurs when tank levels are lower, during higher demand conditions.

- The well located in Loutsis Park was assumed to be closed (off). This well is a secondary supply source to the system and has settings such that it is only operational when the reservoir level drops below 52 feet. This generally occurs during large demand or emergency conditions. The well is more frequently used during the summer.

2008 Storage Analysis Results

The results of the 2008 Storage Analysis are presented in **Table 4.1**. These results indicate an overall storage deficit of approximately 0.05 MG with a fire flow requirement of 2,000 gpm for two hours.

2028 Storage Analysis

During 2028, the City's sources were projected to remain unchanged from 2008. The City's storage capacity includes a future reservoir tank with a projected capacity of 0.56 MG. This additional storage tank will be required to address those deficiencies discussed in the 2008 analysis results and those created by the projected demands on the system. For purposes of the analysis, the proposed tank was situated at the same elevation as the existing tank. Tank overflow elevations and pump set point elevations were set at the same elevations as the existing tank.

Operational Storage

The operational storage level will remain the same, and volume will be increased from 2008 with the addition of the second storage tank.

Equalizing, Standby, and Fire Suppression Storage

The 2028 equalizing storage analysis features the same sources used for 2008. The methodology remains consistent with the 2008 analysis.

An emergency backup generator will be installed at the well pump by 2009. The well can pump approximately 700 gpm. The standby storage methodology for 2028 was changed from the 2008 method to include the well as an uninterruptable source. The increase in ERUs increases the standby storage needed to maintain service for two days of ADD assuming the well and spring sources are available.

The fire suppression analysis methodology remains consistent with the 2008 analysis, except that the largest fire flow was increased to 2,500 gpm for two hours.

2028 Supply Sources

The supply sources are the same as those used in the 2008 analysis.

2028 Storage Analysis Results

The results of the 2028 storage analysis are presented in **Table 4.1.**

Table 4.1
Storage Analysis

Tank	Operational Storage	Equalizing Storage	Calculated Standby Storage	Minimum Standby Storage	Fire Suppression Storage	Total Required	Total Capacity	Surplus (Deficit)
2008 Storage Analysis								
Existing Tank	0.030	0.020	0.0	0.200	0.240	0.290	0.236	(0.049)
Total	0.030	0.020	0	0.200	0.240	0.290	0.236	(0.049)
2028 Storage Analysis								
Existing Tank	0.028	0.034	0.0	0.124	0.091	0.185	0.236	0.051
Future Tank	0.066	0.079	0.0	0.285	0.209	0.430	0.558	0.128
Total	0.094	0.113	0.0	0.409	0.300	0.615	0.794	0.179

2008 ADD = 159 gpm (0.23 MGD)
2008 MDD = 398 gpm (0.57 MGD)
2008 PHD = 743 gpm (1.07 MGD)

2028 ADD = 319 gpm (0.46 MGD)
2028 MDD = 799 gpm (1.15 MGD)
2028 PHD = 1,383 gpm (1.99 MGD)

WATER QUALITY

The water quality within Carnation's water system is excellent from both the well and spring sources.

Well Water

The well water quality information is provided in **Appendix G**. The well water meets all regulations without treatment. The well is not currently chlorinated.

The well is planned to be upgraded to provide a chlorination system. See Chapter 8 for further discussion.

Spring Water

Water from the spring is also of excellent quality. The spring water is classified as groundwater source. Water quality information is attached in **Appendix G**. Gaseous chlorine is provided for disinfection purposes.

Water Quality and Sampling

A summary of the City's water quality sampling is given below. A more detailed review of water quality sampling and requirements is given later in this section.

Two bacteriological samples are taken for analysis on a monthly basis at sampling sites specified in the Coliform Monitoring Plan as required by WAC (see **Appendix I**).

Weekly samples are taken at the spring for water temperature, pH value and conductivity.

Chemical sampling is performed per the WQMR, as follows:

- Annual sampling for nitrates is taken from both spring and well.
- Inorganic chemicals are sampled every 8 years
- VOC's are sampled every three years. Samples were last taken in December of 2006
- SOCs – the City has a waiver that expires in December 2010
- Lead and copper sampling is done very 2 years. The City sampled for these in 2005
- Asbestos sampling will be performed in 2008
- DBP were sampled in September 2007

Applicable Drinking Water Quality Regulations

Table 4.2 lists the existing drinking water regulations applicable to water utilities using groundwater as the source of supply. The existing Washington Administrative Code (WAC) contains regulations for bacteriological contaminants, inorganic chemicals (IOCs) and inorganic physical parameters, volatile organic compounds (VOCs), synthetic organic chemicals (SOCs), radionuclides, disinfectants and disinfection by-products (D/DBP). Additional drinking water regulations will become effective in the next few years, and these

new regulations may define new regulatory requirements for radon, additional IOCs and SOCs, and bacteriological contaminants. A discussion of each of the existing rules follows **Table 4.2**.

Table 4.2
Summary of Existing Drinking Water Quality Regulations Relevant to Carnation

Rule	Target Constituents	Monitoring Required by City of Carnation	Effective Date
Total Coliform Rule	Total Coliform, E. coli, Fecal Coliform	Yes	In Effect
Primary Inorganics	Antimony, asbestos, barium, beryllium, cadmium, chromium, cyanide, mercury, nickel, nitrate, nitrite selenium, sodium, thallium	Yes	In Effect
Arsenic Rule	Arsenic	Yes	In Effect
Lead and Copper Rule	Lead and copper	Yes	In Effect (Revised 10 Dec. 2007)
Fluoride Rule	Fluoride	No	In Effect
Radionuclide Rule	Alpha particles, beta particles and photon emitters, radium-226 and 228, uranium	Yes	In Effect
Volatile Organic Chemicals	21 VOCs	Yes	In Effect
Synthetic Organic Chemicals	33 SOCs	Yes	In Effect
Disinfectants Disinfection Byproducts Rule, Stage 1	Disinfectant residuals, total trihalomethanes, five haloacetic acids	Yes	In Effect
Groundwater Rule	Virus	Yes	8 Jan. 2007
Secondary chemical and physical substances	Chloride, color, hardness, iron, manganese, specific conductivity, silver, sulfate, total dissolved solids, and zinc	Yes	In Effect

The City is required to conduct distribution system monitoring for bacteriological contaminants, chlorine residual, radionuclides, inorganic and organic chemicals, asbestos content, lead and copper, and DBPs.

Existing Drinking Water Quality Standards

The 1974 Safe Drinking Water Act (SDWA) and its 1986 and 1996 amendments established specific legislation for regulation of public water systems by federal and state governments. The federal government, specifically the U.S. Environmental Protection Agency (USEPA), is authorized to develop national drinking water regulations and oversee implementation of the SDWA. Once federal regulations are promulgated, states with primacy (such as Washington) must adopt regulations at least as stringent as the federal regulations and accept the primary responsibility for implementing and enforcing the regulations, according to a given schedule.

The State of Washington typically has 2 years to adopt a SDWA regulation after its promulgation by the EPA. The State has delegated the authority to oversee drinking water regulations to the State Department of Health (DOH). State drinking water regulations for Group A Public Water Systems are published in WAC 246-290, which establishes monitoring requirements, maximum contaminant levels (MCLs), and requirements for follow-up actions.

Primary MCLs are based on chronic and/or acute human health effects. Secondary MCLs are based on factors other than health effects, such as the aesthetic quality of the water. Public water purveyors must meet the requirements of the regulations on a day-to-day basis. Monitoring requirements are often established for regulated contaminants to verify that water systems demonstrate compliance with MCLs or treatment technique requirements. Public water suppliers are also required to retain certain records and submit reports to the DOH.

On August 6, 1996, the most recent amendments to the SDWA were signed into law as Public Law 104-182. The 1996 amendments updated the development of regulations concerning arsenic, radon, groundwater disinfection and filtration.

Bacteriological

Many serious diseases are caused by bacteria, a group of single-celled organisms. Indicator organisms are often used to monitor the bacteriological quality of drinking water. Indicator organisms tend to be present when pathogenic bacteria are found, have well established analytical methods, and are typically more resistant to inactivation by disinfectants than most waterborne pathogenic bacteria. Total coliform, which includes fecal coliform and *E. Coli* bacteria, are used as indicator organisms in drinking water systems. The Total Coliform Rule was developed with the purpose of improving public health protection by reducing fecal pathogens to low levels by control of total coliform bacteria. The Total Coliform Rule established an MCL based on the presence or absence of total coliforms.

Water samples collected for coliform monitoring must be obtained from sites that are representative of water quality in the distribution system. Each water

purveyor is required to prepare a coliform monitoring plan, which must be approved by DOH and available for inspection upon request. The City's Coliform Monitoring Plan is included in **Appendix I**. The City currently collects two coliform samples per month.

Violations of bacteriological MCLs are categorized as follows (WAC 246-290):

- Acute Violation: Coliform is present in a set of repeat samples collected as a follow-up to a sample containing fecal coliform or *E. Coli* present
- Non-acute Violation: During routine sampling, coliform is detected in more than one sample in a single month (for systems such as Carnation, collecting less than 40 samples per month)
- Acute Violation: Fecal coliform is present in a repeat sample, which is a sample collected to confirm the presence of total coliform detected in the routine sample
- Acute Violation: *E. Coli* is present in a repeat sample
- Acute Violation: Coliform is present in a set of repeat samples collected as a follow-up to a sample containing fecal coliform or *E. Coli* present

Disinfection By-Products

Trihalomethanes (THMs) and haloacetic acids (HAAs) are disinfection byproducts (DBPs) formed when organics in the water react with chlorine. The Stage 1 D/DBP Rule established MCLs for THMs and the sum of five of HAAs on a system-wide running annual average basis.

The Stage 2 D/DBP Rule created more stringent standards for THMs and HAAs, by requiring systems to meet MCLs at each sampling location in the distribution system, as opposed to a system-wide average.

The City adds chlorine (gaseous) to the water at the spring source for disinfection purposes. The well is planned to be chlorinated in the near future.

Disinfectant Residual

If chlorine products are used for disinfection, water entering the distribution system must contain a residual disinfectant concentration of free chlorine of at least 0.2 mg/l. Distribution system residual disinfectant concentrations measured as free chlorine must be detectable in at least 95% of the samples taken each calendar month. Groundwater systems are required to provide a CT (concentration of chlorine in mg/l multiplied by disinfectant contact time in minutes) of six, in accordance with WAC 246-260-451. Residual disinfectant concentration within the distribution system is measured at the same time and location that routine coliform samples are collected.

Asbestos

Because the City distribution system contains asbestos cement (AC) water lines, it must monitor for asbestos in accordance with 40 CFR 141.23(b). One sample in an area with AC pipe is required every nine years. The MCL for asbestos is 7 million fibers/liter for fibers longer than 10 microns. The City will take samples in 2008.

Lead and Copper

The purpose of the Lead and Copper Rule (LCR) is to protect public water system consumers from exposure to lead and copper in drinking water. Elevated levels of lead and copper are usually due to corrosion of copper or brass plumbing lines and fixtures.

In 2007, revisions to the LCR were completed to enhance implementation of the LCR in the areas of monitoring, treatment, customer awareness, lead service line replacement, and to improve compliance with the public education requirements of the LCR.

The LCR has four basic requirements for water suppliers: (1) to optimize their treatment systems to control corrosion in customers' plumbing; (2) to determine tap water levels of lead and copper for customers who have lead service lines or lead-based solder in their plumbing systems; (3) to rule out the source water as a source of significant lead levels; and (4) if lead action levels are exceeded, to implement public notices and public education programs to educate customers about lead and suggest actions they can take to reduce their exposure to lead. If a water system continues to fail to meet the lead action level after installing and optimizing corrosion control treatment, it must begin replacing the lead service lines under its ownership.

IOCs, VOCs, and SOCs

The State of Washington has adopted federal MCLs and monitoring regulations for IOCs and physical parameters, VOCs, and SOCs. The federal standards were originally promulgated in the Phase I Rule and updated in the Phase II and Phase V Rules. These regulations apply to the City.

Radionuclides

According to WAC 246-290-300(9), community water systems must monitor for radium-226 and 228 every 48 months unless the gross alpha particle activity is less than 5 pCi/L. Monitoring of artificial radioactivity is not required for community water systems serving less than 100,000 persons.

Arsenic Rule

The Arsenic Rule was promulgated on 22 January 2001 with an effective date of March 23, 2001. The Arsenic Rule set an MCLG of zero and lowered the enforceable MCL from 0.05 mg/l to 0.01 mg/l (10 µg/l). All community water systems were required to comply with the new MCL by January 23, 2006.

Groundwater Rule

The Groundwater Rule (GWR) was promulgated November 22, 2006 and became effective on January 8, 2007. The SDWA required the EPA to develop the GWR to improve disinfection of groundwater systems to protect public health. Occurrence studies have shown that pathogenic virus and bacteria have occurred in groundwater systems. The EPA developed a risk-targeting approach with the following major components:

- Periodic sanitary surveys of groundwater systems. States must complete the initial survey by December 31, 2012, for most community water systems.
- Source water monitoring to test for the presence of *E. coli*, enterococci, or coliphage. There are two monitoring provisions:
    - Triggered monitoring for systems that do not provide a minimum of 99.99 percent (4-log) inactivation or removal of viruses and that have a positive total coliform sample as part of the Total Coliform Rule distribution system sampling
    - Assessment monitoring, which may be required by the State at any time to identify high-risk systems
- Corrective actions for any system with a significant deficiency or source fecal contamination. The water purveyor must implement one or more of the following corrective actions:
    - Correct all significant deficiencies
    - Eliminate the source of contamination
    - Provide an alternative source of water
    - Provide treatment to reliably achieve 4-log virus inactivation or removal.
- Compliance monitoring for systems that already treat groundwater to verify 4-log virus inactivation or removal.

Anticipated Future Drinking Water Regulations

Anticipated drinking water quality regulations of relevance to the City are presented in **Table 4.3**. A brief discussion of each rule follows **Table 4.3**.

Table 4.3
Anticipated Drinking Water Quality Regulations Relevant to the City

Rule	Target Constituents	Monitoring Required by City of Carnation	Effective Date
Revised Total Coliform Rule	Total Coliform, E. coli, Fecal Coliform	No (see existing rule, in Table 4.1)	Unknown. (Discussions are ongoing to determine if revisions would improve public health)
Radon Rule	Radon	No	Unknown
Sulfate Rule	Sulfate	None. (EPA is no longer considering an MCL.)	Not applicable

Revised Total Coliform Rule

In the Stage 2 Microbial/Disinfection By-Products (M/DBP) Agreement-in-Principle negotiated by the M/DBP Federal Advisory Committee in 2000, EPA committed to initiating a stakeholder process for addressing "cross connection control and backflow prevention requirements and to consider additional distribution system requirements related to significant health risks." At least some of these new requirements would be included in a revised version of the Total Coliform Rule. Stakeholders disagreed as to whether this dialogue should be conducted by a committee convened under the Federal Advisory Committee Act (FACA) or in some less formal mode. The disagreement has significantly delayed the development of proposed rule language.

As of June 2007, discussions have led to an agreement on the structure of subsequent discussions, which could lead to development of new requirements and revisions to the Total Coliform Rule. The anticipated schedule for development of the proposed rule language is not known.

Disinfectants Disinfection Byproducts Rule, Stage 2

The Stage 2 D/DBP Rule will require each location in the distribution system to comply with the existing MCLs for THMs and HAAs. The Stage 2 sampling sites may differ from the Stage 1 sampling sites, and an initial distribution system

evaluation (IDSE) is required for most utilities in order to establish the new sampling sites.

Because the City's population served is less than 10,000 people and historical DBP levels are very low (typically less than the detection limits), the City may qualify for 40/30 certification. This certification demonstrates that total THMs and HAAs are less than 40 and 30 µg/L, respectively, based on sampling at the existing Stage 1 sites. Under this certification, a formal IDSE report is not required.

After the Stage 2 rule has been implemented, the City will be required to collect two annual DBP samples from two different sites. One site is intended to have the highest levels of THMs and the other the highest levels of HAAs, although given the large number of data below the detection limits, the City will have some flexibility in selecting the sampling sites.

Radon Rule

EPA withdrew the 1991 proposed MCL for radon on August 6, 1997. EPA then proposed a new regulation on November 2, 1999, to reduce public health risks from radon. The proposed regulation will apply only to community water systems that regularly serve 25 or more people and that use groundwater or mixed ground and surface water (e.g., systems serving homes, apartments and trailer parks). The proposed regulation will not apply to private wells or to systems that rely on surface water where radon levels in the water are very low.

The proposal provides states with the flexibility to limit exposure to radon by allowing them to focus their efforts on the greatest radon risks--those in indoor air--while also reducing the risks from radon in drinking water.

The first option allows states to choose to develop enhanced state programs to address the health risks from radon in indoor air, known as Multimedia Mitigation (MMM) programs, while individual water systems reduce radon levels in drinking water to 4,000 pCi/L or lower. EPA is encouraging states to adopt this option because it is the most cost-effective way to achieve the greatest radon risk reduction.

The second option applies if a state chooses not to develop an MMM program. Individual water systems in that state would be required to either reduce radon in their system's drinking water to 300 pCi/L or develop individual local MMM programs and reduce levels in drinking water to 4,000 pCi/L. Water systems already at or below the 300 pCi/L standard would not be required to treat their water for radon.

EPA has received substantial comment on the proposed rule and the timing for rule finalization is unclear.

Sulfate Rule

Sulfate was on the 1998 Contaminant Candidate List (CCL). To determine whether to regulate sulfate, EPA was guided by the National Drinking Water Advisory Council's (NDWAC) Work Group on CCL and the 6-Year Review process.

In 1979, EPA established a secondary maximum contaminant level (SMCL), a non-enforceable guidance level for aesthetic quality, at 250 mg/L for sulfate in drinking water. This standard has been adopted in WAC 290-246-320(3).

In 1985, EPA proposed a sulfate health advisory (HA) of 400 mg/L that was never finalized. The SDWA amendments of 1986 mandated the establishment of a maximum contaminant level goal (MCLG) for sulfate. After a proposal of two alternative MCLGs of 400 and 500 mg/L in 1990, and a re-proposal of a 500 mg/L MCLG and Maximum Contaminant Level (MCL) in 1994, a regulatory determination had not been finalized when Congress amended the SDWA in 1996.

Sulfate was monitored from 1993 to 1999 under the SDWA Unregulated Contaminant Monitoring (UCM) program. The SDWA amendments of 1996 required EPA to finalize a sulfate regulatory determination by August 2001 and to complete a joint study with the Center for Disease Control and Prevention (CDC). EPA and CDC jointly concluded it is unlikely that any adverse health effects would result from sulfate concentrations in drinking water below 600 mg/L for adults. An expert panel of scientists convened in September 1998 to supplement the EPA/CDC study concluded there was insufficient scientific evidence regarding health effects to justify a regulation and suggested that a health advisory be issued in areas where sulfate concentrations in drinking water exceed 500 mg/L.

Most drinking water source waters contain sulfate levels well below 500 mg/L. Because of its objectionable taste (the taste threshold for sulfate is 250 mg/L), people tend to decrease the quantity of high-sulfate water they drink at one time, thus reducing the likelihood of acute exposure. The EPA concluded that it is unlikely that regulation of sulfate would present a meaningful opportunity for health risk reduction, and thus there is no current plan to develop an MCL for sulfate.

Consumer Confidence Reports

The primary purpose of the Consumer Confidence Report (CCR) is to inform consumers about their drinking water. The CCR lists the contaminants, if any, that are in the drinking water and explains how these contaminants may affect their health. The CCR lists all regulated contaminants that have been detected in any amount, not just those concentrations that exceed state or federal standards. All Group A community water systems are required to produce and distribute an annual CCR to customers by July 1 each year to present information pertaining to the previous calendar year. A "customer" is anyone who regularly drinks water

from the system. Water systems are also required to provide a copy of their CCRs to the Department of Health Office of Drinking Water (ODW) by July 1, and a completed CCR certification form no later than October 1, every year.

Unregulated Contaminant Monitoring

The first unregulated contaminant monitoring (UCM) program consisted of two rounds, with sampling performed between 1988 and 1997. The State drinking water programs managed this original program and required public water systems (PWSs) serving more than 500 people to monitor contaminants.

The SDWA Amendments of 1996 redesigned the UCM program to incorporate a tiered monitoring approach. The Unregulated Contaminant Monitoring Rule (UCMR 1) required all large PWSs and a nationally representative sample of small PWSs (those serving less than 10,000 people) to monitor the contaminants between 2001 and 2005.

UCMR 2 is being conducted between 2007 and 2010. EPA is managing this second monitoring cycle, including a new set of unregulated contaminants. EPA is requiring select public water systems (PWSs) to monitor for 25 chemicals using five different analytical methods. All PWSs serving more than 10,000 people, and a representative sample of 800 PWSs serving 10,000 or fewer people, are required to conduct Assessment Monitoring (List 1) for 10 chemicals during a 12-month period between January 2008 and December 2010. All PWSs serving more than 100,000 people, 320 selected PWSs serving 10,001 to 100,000 people, and 480 selected PWSs serving 10,000 or fewer people are required to conduct the Screening Survey (List 2) for 15 contaminants during a 12-month period between January 2008 and December 2010.

WATER QUALITY MONITORING AND ANALYSIS

This section provides an analysis of the water quality testing performed by the City. The City is required to perform bacteriological, lead and copper, chlorine residual, DBP, IOCs, radionuclides, VOC/SOC and asbestos testing.

DOH performed a sanitary survey with the City in August 2007. The most major issue in the report is the vulnerability of the water supply line from the springs to the City. Other than that, minor issues need to be taken care of and the City was commended for its dedication to safe drinking water. The report resulting from the survey is included in **Appendix H**. The City's water quality monitoring report for the year 2007 is also included in **Appendix G**.

Results of Water Quality Monitoring by the City of Carnation

The results of the water quality monitoring completed by the City are discussed in the following sections.

Bacteriological

The City monitors for bacteriological contaminants in accordance with its Coliform Monitoring Plan, which is included in **Appendix I**. The City collects two samples monthly.

The City has had no coliform violations in its records - for at least the last ten years - and has remained in compliance with DOH monitoring and reporting requirements.

Lead and Copper

Lead and copper testing is completed every two years. The City last sampled for these in 2005. All results were below the action levels of 0.015 mg/L and 1.3 mg/L for lead and copper, respectively. The next sampling will be in 2007.

DBPs

The City collected DBP samples in September 2007. Collecting samples in September is consistent with the DOH requirement to obtain samples when the water temperature is warmest.

Analytical results for all DBP samples have been below the detection limit.

Radionuclides

Radionuclide samples are collected from the well every three years. Radium-228 samples were tested in 2005. No Radium -228 was detected in either source.

SOCs

The City has obtained a waiver for SOC sampling through 2007 and has applied for another waiver. The waiver includes regulated herbicides, insecticides, and pesticides. The last SOC sample was taken in 2003 and did not detect any SOC's. The next sample will be taken in 2009 at the earliest.

VOCs

The City collects one VOC sample from each source every 3 years based upon a State waiver. Samples were last taken in July2006.

No VOCs were detected in any samples collected in 2006.

IOCs

The City tests for the presence of IOCs, as required by DOH. The City collects annual nitrate samples from the well and spring every year. A complete inorganic

chemical analysis is completed every eight years. The last testing was completed in 2003. The next samples are sample are due in 2011.

Asbestos

Because the City's distribution system contains asbestos-cement (AC) pipes, it must monitor asbestos levels in the distribution system once every nine years. The City will perform initial sampling for asbestos in 2008.

CHAPTER 5 WATER USE EFFICIENCY

HISTORY

Water purveyors and cites in the Puget Sound region continue to experience population growth that will eventually demand more water than will be available from current regional supply sources.

In 1985, East King County was declared a Critical Water Supply Service Area (CWSSA), the area in which Carnation's water system is located.

In 1989, the East King County Regional Water Association (EKC RWA) formed to develop a Coordinated Water System Plan (CWSP). The CWSP included a water conservation element outlining regional and local conservation objectives, including a target reduction in water use of 6.5% by the year 2000, for purveyors such as the City serving 500 or more customers.

The City established a conservation goal of 1% per year for six years beginning in the year 2004. Water conservation measures have been taken and further measures will be developed to support this goal consistent with all local, state, and federal laws and regulations.

The Washington Water Utilities Council, and the Washington State Departments of Health (DOH) and Ecology (DOE) jointly developed the *Conservation Planning Requirements (CPR) Guidelines and Requirements for Public Waters Systems Regarding Water Use Reporting, Demand Forecasting Methodology, and Conservation Program*. Interim guidelines were first established in 1990, finalized, and approved in 1994. DOH published the *CPR* in 1994.

The *CPR* included guidelines for public water systems in preparing conservation plans and programs, to monitor water use and to implement the programs. The *CPR* suggested a conservation plan including three components: (1) water use data collection, (2) demand forecasting, and (3) conservation program development. DOH approval of a conservation plan was based upon review of all three components of the conservation plan. The only substantial difference between the CPR and the EKC CWSP is the quantitative target.

REGULATORY REQUIREMENTS

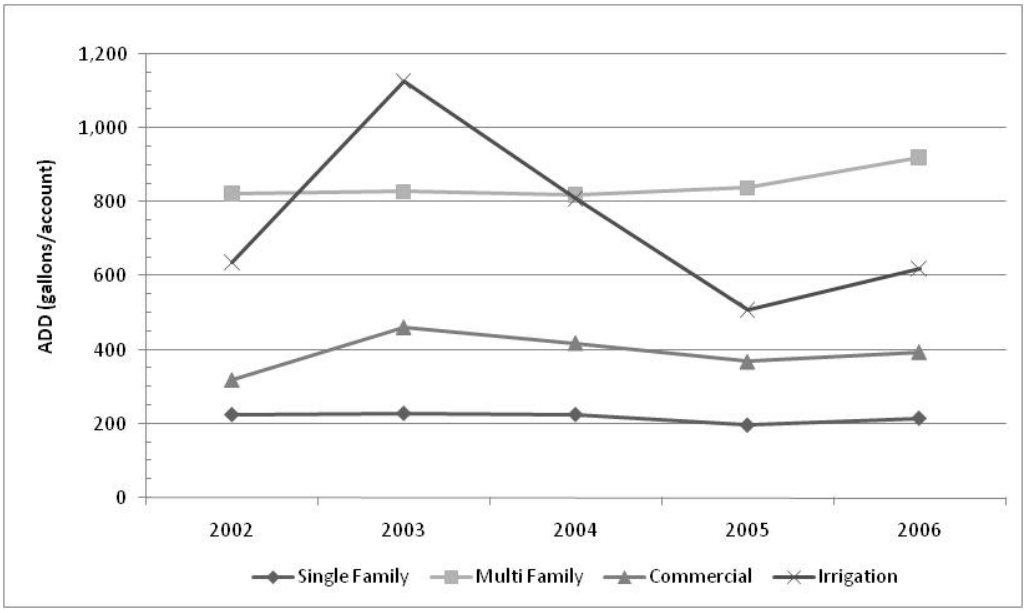
In 2003, the Municipal Water Supply – Efficiency Requirements Act was enacted. The Municipal Water Law, as it is commonly referred to, amended and clarified sections of the State Board of Health Code, Revised Code of Washington (RCW) 43.20; the laws governing Public Water Systems, RCW 70.119A; and sections of the state Water Code, RCW 90.03. These changes affect the water system planning processes and provide unique benefits to

qualifying water systems. Conservation requirements are also affected. As a subset to this Law, DOH finalized the Water Use Efficiency (WUE) Rule in December 2006, with an effective date of January 22, 2007. The WUE is discussed later in this chapter.

HISTORICAL WATER CONSERVATION PROGRAM

The City has been complying with the DOH Conservation Planning Requirements (CPR) for its historic program. The City's goal according to the Conservation Program was to achieve a target conservation consumption of 1% per year for six years beginning in 2004. The total consumption throughout this time has been relatively flat. The single-family customer class which has the largest number of connections (85% of the total) decreased its consumption by 10 gallons per day per account. As part of the development of the new WUE Program, the City represented its actual water usage and average day demand (ADD) by customer class from 2002 to 2006 as shown below in **Figure 5.1** and the data used to create this graph is found in Chapter 3 in **Table 3.3**.

Figure 5.1
ADD by Customer Classification



In accordance with the CPR, the City of Carnation (having fewer than 1000 connections) implemented four conservation measures, which were known as Public Education, Technical Assistance, System Measures, and Incentives/Other Measures. Under each one of these measures the City implemented a variety of measures to comply and achieve a savings in water consumption. The measures were:

- Customer monitoring and notification if deviation from past usage is significant
- Meter all source connections and require all water to be metered at point of use
- City encouraged the application of current technology to water use practices
- City would promote low water demand landscaping
- City implemented conservation rate structure

2008–2014 WATER USE EFFICIENCY PROGRAM

As noted earlier, the Water Use Efficiency Rule went into effect on January 22, 2007, for water suppliers with 1,000 or more connections. Water suppliers with fewer than 1,000 connections are required to comply by January 22, 2009. While Carnation is not yet required to comply with the WUE rule, the new program will be required during this planning period. The WUE rule affects all municipal water suppliers, which includes all Group A community water systems with 15 or more residential connections. Among the WUE rule's requirements is to create a WUE program. The Carnation Water System program will include:

- **Required WUE measures**

  Required measures do not count towards the minimum number of measures that must be implemented. The majority of the measures focus on supply side measures that are considered activities that the system implements to understand and control leakage.

- **Program measures**

  Program measures are activities that promote reduced consumption among the water customers and count towards the required measures that must be implemented. They are categorized into customer classes.

- **Evaluation of measures**

  The evaluation of measures is necessary to promote cost effectiveness and assure that the program is meeting the set goals.

- **Water Loss Control Action Plan**

  A Water Loss Control Action Plan is required by the WUE rule for any system that maintains distribution system leakage above 10%. Currently the City has a distribution system leakage at 40%.

- **Budget**

  A budget is required to assure that the program is implemented and maintained.

- **Demand Forecasting**

  Demand forecasting is included to show the water demand with and without the WUE rule.

- **Summary of Savings**

  By forecasting the demand with the WUE rule, the future savings is estimated.

The City has created its goal which will target to reduce ERU consumption by 1% per year. This goal was confirmed at a public meeting on May 20, 2008**.** A copy of the public notice is included in **Appendix J**.

The City's 2008–2014 Water Use Efficiency Program measures will be categorized into indoor residential, outdoor, and industrial/commercial/ institutional due to the cost-effectiveness evaluation categories according to WAC 246-290-810(4)(d). This program is essential for the City to achieve its water use efficiency goal.

Required WUE Measures

As mentioned above, the City is currently required to implement the following measures. Because these are mandatory they cannot be counted toward program measures:

1. **Install production (source) meters**

   The City will continue to meter all source connections. The City recently replaced the master meter at the spring source and will continue periodic meter testing and repair.

2. **Install consumption (service) meters**

   The City will continue to require all water to be metered at the point of use. The City will determine a schedule to replace meters on a regular schedule based on the size and age of the meter. Any persons who desire to use City water from an unmetered source must rent a meter and pay the City for water used.

3. Perform meter calibration

Source and service meters will be selected, operated, calibrated, and maintained according to generally accepted industry standards and manufacturing information. The City will require annual testing and replacement of large meters as necessary.

4. Implement a Water Loss Control Action Plan (WLCAP) to control leakage

Municipal water suppliers not meeting the distribution system leakage standard of 10% must develop and implement a WLCAP, which identifies the steps and timelines for reducing leakage. In the WLCAP, municipal water suppliers may address technical or economic concerns which affect their ability to comply with the standard. The City is currently not in compliance with Distribution System Leakage with leakage over 42% for the past three years. The City has developed a WLCAP, contained later in this chapter, and has been working with the DOH to implement a strategy for a reduction and eventual compliance with current requirements.

5. Educate customers about water use efficiency practices

The City will continue to educate customers on water use efficiency practices with informational pieces which may include utility inserts, newsletter articles, flyers, information on the CCR or other avenues. Informational brochures will remain available at the City Hall for customers.

This program will be important given the City's new sewer system. The City will also work with King County to help reduce impacts from the new treatment plant. Customers will be relatively new to water use in conjunction with sewage disposal and it will be necessary to continually educate customers about their water use to help them understand that more water used is more water disposed.

WUE Program Measures

The WUE Rule requires Carnation's water system to implement four water use efficiency measures in addition to the required measures discussed above. If a specific WUE measure is being implemented for different customer classes, it counts as multiple measures. While the City is required to implement four measures, it is anticipated the customer connections will exceed 1,000 during the six-year program, and the City will be required to implement five measures. The City has decided to implement five, but due to fifth measure crossing over customer classes, the City will implement six measures. The proposed program contains the following measures:

Residential and Industrial/Commercial/Institutional

1, 2. The City will add consumption history to water bills for residential, industrial, commercial, and institutional customers. This will count towards the implementation of two measures.

3, 4. The City will continue its conservation rate structure. This will be evaluated as needed. This will count towards the implementation of two measures.

Outdoor

5. Demonstration garden – The City will use Tolt Commons which already has Xeriscaping to teach the citizens about low water use landscaping.

6. The City's municipal code encourages all new developments to use planting materials that require only temporary irrigation systems. Such systems are encouraged to be removed after 24 months or two growing seasons, whichever occurs first, providing that the plantings are established.

Monitoring and Evaluating WUE Measures

Monitoring and evaluating the individual conservation measures during and after implementation of the WUE Program are essential for determining the effectiveness of the Program.

It is important to develop reliable data to use in analyzing the actual water use to identify whether goals and objectives are being met. The City should perform a year-end evaluation of the conservation measures. At a minimum, factors such as growth rate, water usage and conservation budget expenditures should be taken into account. Considering changes in population and growth rates will help determine the effect of the changes on the water demand.

Applicable monitoring data should be kept for each WUE measure including, but not limited to:

- The type of measure implemented, level of implementation, duration and date of implementation.
- The number of customers affected by the measure in each category, i.e., the number of customers who attended the Demonstration Garden.
- The expected amount of savings from each measure.
- The average water used in a specific activity, by category, before and after implementation of conservation measure.

Water Loss Control Action Plan

To be in compliance with the distribution leakage standard a Water Loss Control Action Plan (WLCAP) must be implemented. There are three levels of WLCAPs and they are categorized by percentage ranges of distribution leakage; 11-19%, 20-22%, and 30% or more. The City is categorized by highest level with greater than 30% of distribution leakage which requires aggressive action by implementing control methods within six months. Currently, the City has a three-year average of 42.9% leakage. Because of excessive leakage DOH has accepted a reduction to 10% by 2028. Achieving a 10% target percentage within the six-year WUE program is not a realistic goal. In order to comply with the WUE rule, the City is required to implement a WLCAP within six months. The following steps are needed:

1. Assess data accuracy

The City may not have accurate data and therefore is reporting a high distribution leakage number. The City has not historically tracked water used for non-revenue purposes. Typical water systems use less than 5% of their annual water usage for flushing and other maintenance purposes. While the City has no formal flushing program, a new public sewer system has been constructed recently including 11 miles of pipe and a wastewater treatment plant. Non-revenue water well during construction and wastewater treatment plan start-up may contribute significantly to UAW during 2007 and 2008. The City should track non-revenue water usage such as fire protection, flushing, construction, and other maintenance and operations practices. This should reduce “distribution losses” by an estimated five to ten percent.

2. Assess data collection methods and errors

The City may have inaccurate readings from their meters. Thirty percent of water service meters in the system are over 25 years old. Water meters slow down with time and report lower volumes of water. It is expected that water meters are likely reporting approximately three percent less than what is actually being consumed. A meter replacement project began in 2005. The City plans to replace 10% of its meters per year for the next several years. There is not yet sufficient data to accurately quantify the impact this will have.

The City recently replaced the spring source meter as it was found to be inaccurate. It is very likely that the previous meter was reporting higher volumes of water than what actually passes through. Preliminary readings show that the system draws approximately 25% less than what was being registered previously. The previous meter calculated flow based on velocity and the pipe does not flow full at times during the peak summer months.

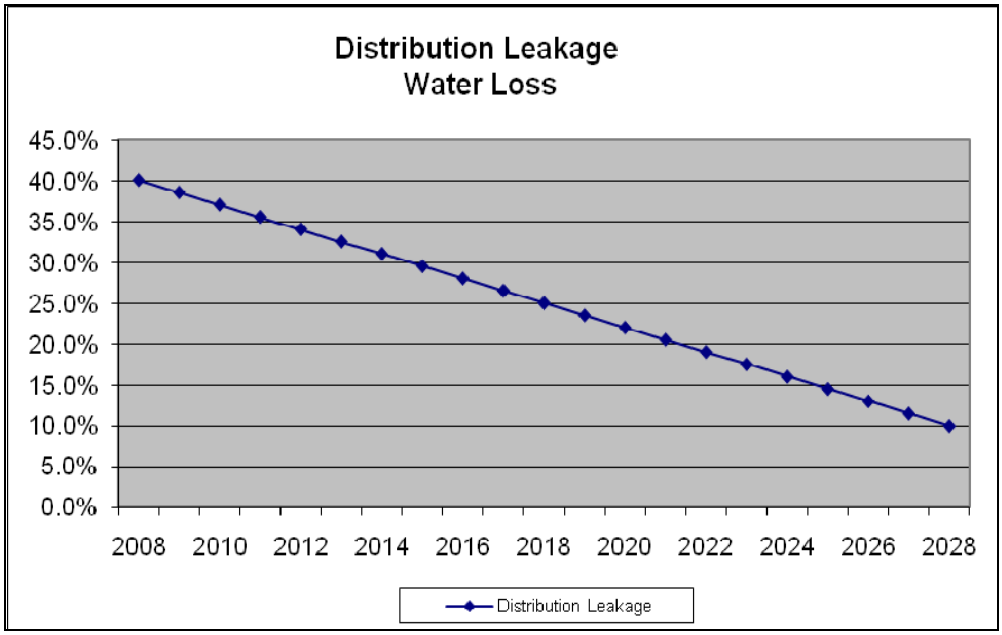
3. Implement field activities to reduce leakage within 12 months

The DOH has granted the City additional time to achieve compliance with the distribution leakage requirements - see **Appendix J**. The City was granted until 2028 to reduce their leakage to 10%. However, the City will ambitiously conduct a regular and systematic program of finding and repairing leaks in system mains. The City will survey its water system for leaks every year, and require contractors to use a hydrant meter during the construction of projects.

4. Implement additional water loss control methods to reduce leakage.

- The City will perform a thorough leak detection survey annually.
    - Budget - $2,000 per year
- Develop a schedule and budget for replacing old distribution lines, old meters and for the Control Program.
    - Most water mains in the City's distribution system are between 45 and 70 years old. The mains are therefore susceptible to frequent leaks. The City will develop a schedule and budget for replacing old lines in the CIP.
    - Meter replacement program - $10,000 per year

Figure 5.2
Distribution Leakage Water Loss



Budget for Water Use Efficiency Measures

The City will continue to use the current budget to fund the Water Use Efficiency Program.

Cost Analysis

The City has completed a cost analysis of their proposed conservation program using historical data and projected water savings. The City currently budgets approximately $15,000 annually for labor, materials and professional services for their conservation program. This annual expenditure is budgeted and expended through the City's operation and maintenance budget. The City currently has no capital improvement projects planned that are targeted for conservation programs.

The projected savings of water range from approximately 0.6 MG in 2009 to 5.5 MG in 2014. Based on the 2008 budget of $15,000, the projected unit cost of water saved by the City's program for 2009 is estimated to be $25,000 per MG and over $3,700 per MG in 2013 when adjusted for inflation and adjusted for increased water savings by the City customers.

The City currently utilizes a combination of spring source and a well which is used to supplement the spring. Water produced from the City's sources is estimated at $160 per MG, marginal cost. For purposes of this analysis, marginal costs for water produced by the City's spring and well include only the power and chemicals consumed plus 20% for labor. Debt service, depreciation or mechanical replacement costs were not included in the estimated marginal costs for water produced. Fixed costs such as debt service, annual operation and maintenance budgets and replacement costs were not included in the marginal cost analysis because these are fixed and essentially independent of the amount of water produced. Application of all fixed costs would suggest that water produced would range at approximately $3,000 per MG.

The City plans on collecting water use data by customer category and compare use patterns to analyze conservation trends. They will continue to allocate similar budget resources to future years. The City will plan on periodically analyzing the relationship between their annual costs of the program and water saved.

While the projected cost analysis would suggest that conservation is not necessarily an initiative that is supported by the immediate economics of the City, the Council has fully supported conservation initiatives and will continue to promote conversation with their customers. Their priority to manage the resource over the immediate cost impacts will continue.

Water Demand Forecast by Customer Class for the 2008 to 2014 Program

The water demand forecasted in Chapter 3 identifies each of the customer classes: Single-family Residential, Multifamily Residential, Commercial, and Irrigation, as well as Distribution Leakage. Those projections did not factor in Water Use Efficiency Program measures and they included distribution leakage. The projections below illustrated in **Figure 5.3** and **Table 5.1,** summarize the average day demand with and without water use reduction and do not include distribution leakage. Extracting the distribution leakage from the projections provides a better understanding of how the implemented measures will assist in reducing consumption.

Figure 5.3
Projected Demand (gpd) With and Without Water Use Efficiency and Without Distribution Leakage

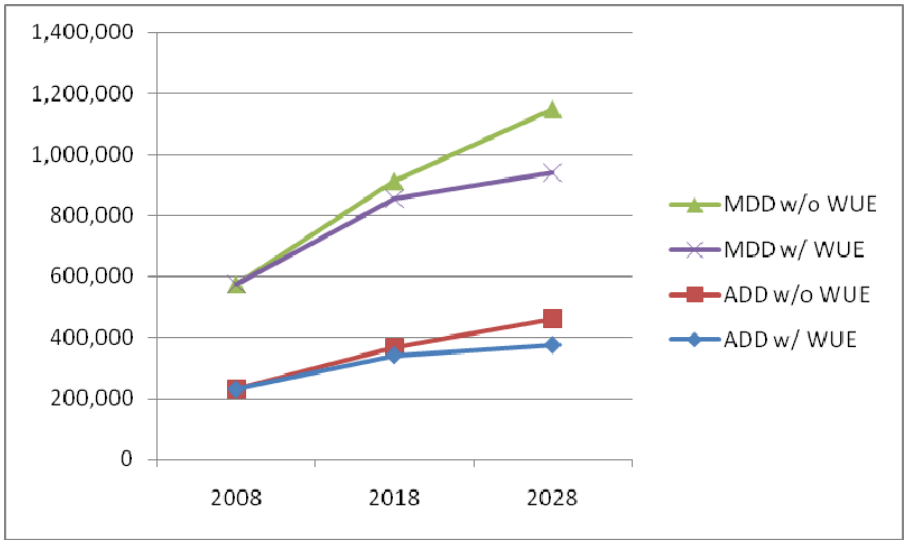


Table 5.1
Summary of Water Demand Forecast (MGD)

Classification	2008	2009	2010	2011	2012	2013	2014	2018	2028
ADD w/o WUE	0.23	0.25	0.26	0.28	0.30	0.31	0.33	0.36	0.46
ADD w/ WUE	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.34	0.38
MDD w/o WUE	0.57	0.62	0.66	0.70	0.74	0.79	0.83	0.91	1.15
MDD w/ WUE	0.57	0.61	0.65	0.69	0.72	0.76	0.79	0.85	0.94

Summary of Recommended Water Use Efficiency Savings

The City will need to maintain a successful WUE program to obtain the achievable goals in the next six years. The City's goal is to achieve a conservation savings of 1% water reduction of the ERU value per year for the next six years and decrease the distribution system leakage by 10% in the next twenty years. The savings achieved by the program elements were estimated based on best available information. The **Figure 5.4** below depicts the estimated average savings over the next six years by the sum of each WUE element. **Table 5.2** below represents the estimated total savings in million gallons per measure category from 2008 till the end of 2013.

Figure 5.4
Conservation Savings - % Total Yearly Savings by Measure Through 2013

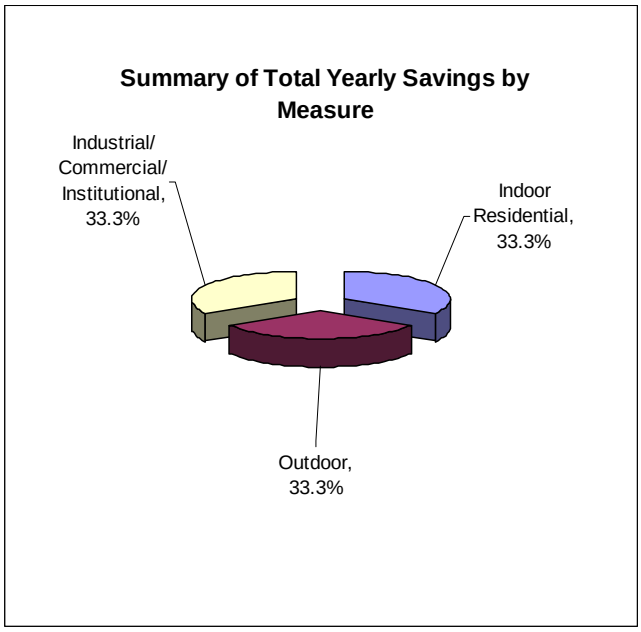


Table 5.2
Summary of Recommended Conservation Measures

Measure	Average Est. Percent of Total Savings from 2008 Through 2013	Estimated Total Reduction in in MG From 2008 Through 2013
Indoor Residential	33%	3.88
Outdoor	33%	3.88
Industrial/Commercial/Institutional	33%	3.88

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CHAPTER 6 SOURCE WATER PROTECTION

WATER RIGHTS

The City of Carnation currently holds two water rights: a groundwater certificate for the City's water well and a water right claim for the City's spring source. The Claim for the spring source authorizes the City to annually withdraw a total of 1,000 acre-feet (325 million gallons per year) with a maximum instantaneous withdrawal of 628 gallons per minute (0.9 MGD). The certificated water right for the well authorizes the City to withdraw 538 acre-feet per year (175 million gallons per year) with a maximum instantaneous withdrawal of 800 gpm (1.1 MGD). The water rights documents for the well and spring sources and Department of Health (DOH) Water Rights Self Assessment forms are included in **Appendix C**. **Table 6.1** shows the water rights held by the City.

Table 6.1
City of Carnation Water Rights Summary

Source	WR Document	Ecology ID	Priority Date	Qi (gpm)	Qa (AF/Y)
Spring	Claim	S1-117902CL	Dec. 1916	628	1000
Well	Certificate	G1-22827C	April 4, 1977	800	538
Total				**1,428**	**1,538**

The City's water right claim for the spring source, S1-117902CL, was granted by Ecology under a "grandfather use" clause in 1974. In 1978, Ecology and the City of Carnation agreed to cancel one of the City's surface water permits (S1-15903P) in order to secure water rights for a groundwater source in what is now known as Nick Loutsis Park. After construction of Well 1 in April of 1978, a permit and, finally, a water right certificate for non-additive groundwater withdrawal was granted. The City's water right certificate and the attached ROE detailing the conditions of the water right have certain provisions attached for the use of Well 1. The following items are included in the Dept. of Ecology's report of examination:

- The well is limited to a maximum instantaneous withdrawal (Qi) of 800 gpm.
- The City's well is "supplemental" to any other water right the City holds. The total annual use (Qa) shall not exceed 538.0 acre-feet per year (AF/Y) less any amount utilized under the spring claim, or any future water rights held by the City.
- The City's well must not interfere with the neighboring Hull well, which has a superior (older priority date) water right. The City is required to adjust their pumping rates, if needed, to avoid interference.

- The City must also maintain access ports and measure water levels, static and pumping, at least monthly.
- Lastly, the City must maintain a water conservation plan as approved by DOH.

Ecology erroneously stated in the Report of Examination (ROE) for the Certificate that the city had not timely filed its Claim for the spring source in June of 1974; however, the city had filed their claim by the deadline. The ROE states that the City had no water rights that would survive the development of the well since the Claim was invalid and was to be cancelled upon the development of the well. However, the ROE then states that the water right to the well would be "supplemental supply to any other rights". Since under the ROE, the City had no other water rights, the well would have to be considered a "primary" or non-supplemental source. As the city had timely filed the claim for the spring source in June of 1974, the city retains both water rights, and these would be considered additive. Therefore the city can withdraw a total of 1,538 ac-ft per year and has an instantaneous water right of 1,428gpm.

SUPPLY ANALYSIS

At present, the City's available water rights are in excess to its demand. Projected water demands are summarized in Chapter 3, on **Table 3.6**. These values are calculated based on the new ERU planning value of 225 gallons/day and a peaking factor of 2.5. The annual production was converted from the average daily demand to acre-feet per year for water right comparisons. **Table 6.2** shows the forecasted maximum daily demand (MDD) and annual production for the 1-, 6- and 20-year annual production forecasts without water use efficiency. **Table 6.3** shows the forecasted maximum daily demand (MDD) and annual production for the 1-, 6- and 20-year annual production forecasts with water use efficiency measures incorporated to meet 10% leakage by 2028. The DOH Water Rights Self Assessment forms, located in **Appendix C**, also apply to these comparisons.

Table 6.2
Quantitative Supply Analysis Without Water Use Efficiency

	Instantaneous rate (gpm)	Annual supply (AF/Y)
Well 1 pumping capacity	700	-
Available spring supply	380 to 620	> 612
Projected MDD and annual production - 2008	663	428
Projected MDD and annual production - 2014	832	537
Projected MDD and annual production - 2028	886	572
Water right claim / Spring	628	1,000
Water right certificate / Well 1	800	538
Total authorized water supply	**1,428**	**1,538**

Table 6.3 Quantitative Supply Analysis With Water Use Efficiency		
	Instantaneous rate (gpm)	**Annual supply (AF/Y)**
Well 1 pumping capacity	700	-
Available spring supply	380 to 620	> 612
Projected MDD and annual production - 2008	663	428
Projected MDD and annual production - 2014	795	513
Projected MDD and annual production - 2028	725	468
Water right claim / Spring	628	1,000
Water right certificate / Well 1	800	538
Total authorized water supply	**1,428**	**1,538**

The City's historical supply strategy has relied on their spring resources. Well 1 is used primarily in the late summer during periods of peak usage. As Carnation grows, Well 1 will become a more important water resource. As such, the City currently has a backup system in the event of a failure with the spring distribution system. Well 1 is capable of producing 700 gpm. Maximum daily demands will cross the 700 gpm threshold in the near future and Well 1 may not be capable of providing all of the City's emergency requirements, particularly in the summer months. The City may also wish to consider drilling a well or expanding the spring collection system at the location of the springs.

SOURCE WATER PROTECTION

The City's existing source water protection plan is outlined in the City of Carnation 2004 Comprehensive Plan. This document states that the well and the spring sources each have protection programs in place to minimize any potential contamination. These activities include frequent physical inspections and analytical testing of the source water itself. Additionally, a partial wellhead protection plan (WHPP) was drawn up in 1999 as part of an earlier Water Comprehensive Plan. From a source water protection standpoint, the City's water system has not significantly changed since 1978, when the well source was constructed in Nick Loutsis Park. The original DOH Ground Water Contamination Susceptibility Assessment Survey Forms for each source are located in **Appendix L**.

The City's water sources have maintained an excellent water quality record. Analytical testing for bacteria count is performed on a monthly basis. Testing for inorganic, regulated compounds and unregulated compounds is done on a three-year basis. According to the analytical results reviewed since 2003, there has been no significant water quality issues associated with the City's water system.

The City's most important water resource, the spring, is enclosed by a 200-foot radius fence to prevent intrusion from large animals and to deter people from trespassing. The source of the springs is an aquifer located on an unpopulated upland 1.5 miles southeast of the City. The aquifer is protected by an overlying layer of semi-permeable glacial till. The springs are continually monitored by the City and inspected by the Health Department. No source of contamination is allowed to be constructed, stored, disposed of, or applied within the sanitary control area of the spring. According to a spring water temperature study performed in 1994 and current analytical testing results, there have been no indications of rapid shifts in temperature or other parameters, such as turbidity, conductivity or pH. Also, continuous sampling and testing has shown no significant occurrence of insects or other macro organisms, algae or large-diameter pathogens. For these reasons, the springs are not considered to be groundwater under the influence of surface water (GWI).

The well source is located in Nick Loutsis Park, a 6-acre park owned by the City. The well site is monitored continually by the City and inspected by the Health Department for possible source contamination. The wellhead itself is protected by a locked structure. According to well construction records, a well seal was installed to 18 feet below ground surface. It is not known if the screened interval of the well is located in a confined aquifer. The original well construction report was not available from the City or from Ecology files. However, the geologic log for a test well drilled in Nick Loutsis Park in 1995 shows varying degrees of silt in the alluvial sediments overlying the completion zone of Well 1 – indicating a semi-confining unit may be present which helps protect the source water from potential surface contamination.

Wellhead Protection Planning

DOH has developed regulations that require Group A water systems using groundwater sources to develop and implement the WHP (WAC 246-290-135). The objective is to prevent releases of contaminants to groundwater in areas that contribute water to the public supply systems. This is to be accomplished by providing management zones around public wells, identifying existing groundwater contamination sources, and managing potential sources of groundwater contamination prior to their entry into the drinking water system. Under the WAC, local public water systems have the primary responsibility for developing and implementing local wellhead protection plans (WHPPs). However, due to the limited jurisdictional and regulatory authority afforded most purveyors, coordination with other local, State, and Federal agencies is essential to the successful implementation of a WHPP.

The basic elements of a WHPP include:

- Assessment of initial groundwater susceptibility for each water supply source

- Delineation of the wellhead protection area (WHPA) that directly contributes groundwater to each water supply well
- Inventory of land uses and identification of potential sources of contamination within each WHPA
- Documentation of notification to owner/operators of known or potential risk to the City's WHP areas
- Development of spill prevention plans and water contingency plans that minimize or eliminate the possibility of contamination to the groundwater supply and also development of options for maintaining water supply in the event the aquifer contributing to a source is contaminated

The State of Washington WHP program applies to the City's well and spring sources. The previous partial WHPP was issued as a part of a previous Water Comprehensive Plan, in 1998 and is reprinted here as **Appendix L**.

Recommendations

A new WHPP should be prepared in order to update the previous partial WHPP. The main consideration for developing a new plan is to fully revise and complete the hazard inventory, spill response, and contingency plans in order that a compliant WHPP can be submitted to DOH.

Additionally, the City should consider replacing the calculated fixed radius method to estimate the zone of contribution around the City well and springs. This method does not take into account any physical boundaries to the aquifers, ground water flow directions, or aquifer characteristics which would result in a change in the shape and direction of the zone of contribution for each well. A more detailed analysis of the zone of contribution is recommended so that potential contaminant sources up gradient of each source can be properly identified and accounted for in the wellhead protection plan.

CHAPTER 7 OPERATION AND MAINTENANCE PROGRAM

INTRODUCTION

This section of the report discusses the City's operation and maintenance program, staffing and operator certification, emergency response plan, water quality monitoring and records, and cross-connection control. It covers the water treatment and well/springs transmission pipelines and the City's water distribution system.

STAFFING AND OPERATOR CERTIFICATIONS

The City of Carnation currently has a full time staff of three maintenance personnel responsible for day-to-day operation and maintenance of the water system. The Public Works Director serves as head of Public Works for the City and oversees the public works staff. The Deputy City Clerk processes billings.

Operations Personnel

Christopher Hagedorn, Public Works Director, 425-333-4192

The City Public Works Director is responsible for the day-to-day supervision of the system operations, and oversees any and all maintenance projects. He is the liaison between the City Council and the implementation of City policies.

Vacant, Public Works Field Supervisor, 425-333-4192

The Public Works Field Supervisor maintains all systems, spring, well and pump, pipes, storage tank, and the chlorination system, in addition to reading meters, repairing pipes and installing water meters.

Certification: Water Distribution Manager – II (WDM-II)

Bob Gilbertson, Senior Journeyman Public Works Maintenance Worker, 425-333-4192

Senior Journeyman Public Works Maintenance Worker assists the Public Works Field Supervisor in the above tasks including maintaining all system components, meter reading, leak repair and water meter installation.

Certification: Water Distribution Manager – II (WDM-I)

Public Works Maintenance Worker, Ryan Dalziel

Public Works Maintenance Worker assists the Public Works Field Supervisor in the above tasks including maintaining all system components, meter reading, leak repair and water meter installation.

Certification: Water Department Manager – I (WDM-I) within 1 year of hire.

City Deputy Clerk, 425-333-4192

The Deputy City Clerk handles the daily administration of the water system. She prepares all vouchers and water bills, and receives inquiries or service complaints from water system customers.

Utilities and Public Facilities Committee

The City Council appoints two councilmembers to the "Utilities and Public Facilities Committee" in January of each year. The committee is responsible for studying issues related to the water system and presenting recommendations to the City Council.

SYSTEM OPERATION AND MAINTENANCE

The City's Public Works Department has developed a systematic operations and maintenance program for its water transmission and distribution system. Prompt and regular maintenance has helped maintain reliable system operations.

New Water System Installation

The City of Carnation's "Combined Water and Sanitary Sewer Utility Technical Standards" Manual provides the specific standards for repairs of the existing system and for the installation of water system expansions.

The requirements for the Water Distribution System, including water main extensions are contained within the Manual.

Existing Water System Repairs and Leak Detection

Undetected leaks have been a major source of water loss from the City's system. Leak detection programs were performed in 1993 and were again performed in 2004 through 2006. Leak detection was not continued in 2007 due to the city-wide construction of a sewer distribution system but will be performed in 2008. Fifty-eight distribution system leaks have been repaired between 2003 and the present, and approximately 15,000 linear feet of water mains have been replaced in that time-frame. However, unaccounted for water has remained over 40% and the City began a program of service meter replacement in 2006, with a goal of

replacing approximately 8% per year. As unaccounted for water still remained high, further analysis revealed that the source meter at the spring was not accurately measuring water use. A project to replace the source meter at the spring was completed in December 2007. Early data from the new source meter indicates that the previous meter was reading approximately 25% high compared to actual water use.

Inventory

The City maintains an inventory of materials necessary to install new water services, and maintain and make necessary repairs to the system. Corporation stops, meters and meter setters are stored for the purpose of installing new water services. Materials are kept in inventory for purposes of insuring proper operation of the disinfection system. Pipes, fitting and bedding materials are also part of the inventory for maintenance of the distribution system. The materials are stored at the maintenance shop and the inventory is managed by the public works field supervisor. Additional items are ordered as necessary.

The major vehicles owned by the City for the water system and their replacement costs and dates are shown in **Table 7.1**.

Table 7.1
Equipment Replacement

Item	Acquired	Life	Actual Cost	Replacement Cost	Replacement Year
Backhoe - CAT	2001	20	$66,510	$70,000	2014
Dump Truck - Int.	1983	15	$39,423	$35,000	2013
Pickup Truck - Chev	1994	10	$7,493	$16,000	2008
Pickup Truck - Dodge	1998	10	$16,780	$16,000	2010
Pickup Truck - Ford	2003	10	$9,000	$16,000	2013

Routine Operations, Water Quality Monitoring and Notification

The City maintains a regular schedule for system operation, water quality monitoring, testing and routine operation procedures. Sampling intervals and monitoring is performed per WAC 246-290-300 and includes bacteriological, inorganic and physical testing. Sampling results included in **Appendix C** show that both the spring and well are in compliance with state requirement and that the quality of water is excellent.

The City's typical maintenance schedule includes the following:

Routine Operation Procedures

- Weekly: record production volume at spring, inspect and make adjustments to the chlorination system as needed.
- Weekly: check well and well pump and record production, if any.
- Daily: check storage tank and measure draw down.
- Prior to peak demand season, drawdown the storage tank and discharge water in order to maintain water quality.
- Continuously, check for line leaks.

Preventative Maintenance Procedures

- Check condition of flow meters, chlorinator equipment and well pump.
- Keep vegetation trimmed from hydrants and other water system facilities, and to maintain access to operating valves.
- Keep vegetation trimmed along access road in watershed.
- Monitor system for leaks and check for vandalism.
- Perform internal inspection of storage tank per AWWA recommendation.

Safety Procedures

Awareness of potentially hazardous conditions and adherence to safe practices are essential in the workplace. A major element of the safety program for the City of Carnation public works department is to talk with every employee about safety issues they encounter on a regular basis at work, on the road, or in the field.

- Public Works Field Supervisor conducts a weekly safety meeting with operations staff to discuss various topics throughout the year and or as job requires.
- Public Works Supervisor and operations staff attend annual training provided by Evergreen Rural Water of Washington and Washington Environmental Training Center.
- Training topics include Electrical Safety and Operations, Confined Space Entry, Trenching Safety and Procedures, Asbestos Pipe Handling, Chemical Storage and Handling Procedures, and the correct use or Personal Protection Devices.

- The City requires all Public Works Personal to be subject to random drug and or alcohol testing.
- The City requires all Public Works Personal to receive training and carry a current card in First Aid, CPR, Traffic Flagging, including a Class B-CDL license.

Water Quality and Sampling

The operations staff routinely monitors water quality from its source and throughout the distribution system.

- Two bacteriological samples are taken for analysis on a monthly basis at sampling sites specified in the Coliform Monitoring Plan and required by WAC.
- Weekly samples are taken at the spring for water temperature, pH value and conductivity.
- Chemical sampling is performed per the WQMR, as follows:
- Annual sampling for nitrates are taken from both spring and well.
- Inorganic chemicals are sampled every 8 years
- VOC's are sampled every three years. Samples were last taken in December of 2006.
- SOCs – the City has had a waiver that expires in December 2010.
- Lead and copper sampling is done very 2 years. The City sampled for these in 2005.
- Asbestos sampling will be performed in 2008.
- DBP were sampled in September 2007.

Coliform Monitoring Plan

The City has prepared a coliform monitoring plan which is included in **Appendix I**. The City takes two samples per month from various areas of the City.

EMERGENCY RESPONSE PLAN

The City has prepared an Emergency Plan which includes implementation measures that will be followed if an event impacts any of the water system components. Potential events include natural disasters, such as floods or earthquakes, and human-caused disasters such as vandalism or hazardous substance release. The most common disaster experienced is loss of electrical power.

The City's water supply system is unusual in that the delivery of water for domestic use is not affected by power outages unless the outage occurs in the summer during peak demand. In general, power outages occur during the winter months due to windstorms. The system is gravity fed from the springs and would continue to provide reliable water delivery to customers during periods of extended power outages. The exception to this reliable supply is the Chlorination which does require power with the result that the system may be unchlorinated during an extended power outage without a generator. The City recently bought a generator that will be used to power the chlorination, among other things, during a power outage.

The City was not required to perform a formal vulnerability assessment (VA) because the system serves less than 3,300 connections.

The loss of service due to breaks in water mains constitutes a more realistic emergency situation for the City.

Contact Information for Emergencies

One of the following personnel is on duty or on-call at all times. They can be reached by telephone during working hours at 425-333-3192 or after hours at the emergency on-call phone number, 425-765-0508.

Christopher Hagedorn, Public Works Director
office 425-333-4192
cell 425-495-0612

Bob Gilbertson, Senior Journeyman Public Works Maintenance Worker
office 425-333-4192
shop 425-333-4484

For extended outages or major failures, contact the following:

King County Department of Health – 1-253-395-6750
After Hours – 1-877-481-4901
Washington State Department of Health – 1-206-418-5400 (day) or 1-877-4901 (night)

The following text describes the public notification procedures in the event that test results exceed the standards for Maximum Contaminant Levels (MCls) for drinking water.

Public Notification Procedures

Per WAC 246-290-71001, Public Notification, the purveyor shall notify the water system users when the system violates a National Primary Drinking Water Regulation and when any of the situations listed in Table 1 of 40 CFR 141.201 occur, except for (3)(b). Public notifications for violations and other situations are categorized into Tiers in accordance with the following:

(a) Tier 1 as described in Table 1 of 40 CFR 141.202(a);

(b) Tier 2 as described in Table 1 of 40 CFR 141.203(a); or

(c) Tier 3 as described in Table 1 of 40 CFR 141.204(a).

Additionally, the purveyor shall notify the water system users when the system:

(a) Is issued a departmental order;

(b) Fails to comply with a departmental order; or

(c) Is issued a category red operating permit.

Purveyor will seek immediate input from and work with state and local health agencies to accurately communicate and properly mitigate potential health effects resulting from any public health impact.

The City has many forms of communication available to notify its customers in the event of a public health risk. Methods of communication include:

- City Staff Direct Communication
- City of Carnation Web Site
- Where customers cannot be contacted immediately, purveyor will place a written notice on the front door handle, and a follow-up visit will be made to confirm that the customers received notice.
- Local media and newspapers

- Posting signs

Water Main Break

Water main breaks immediately affect customer services and the City has worked hard to keep these disruptions to a minimum. Water main construction specifications include installation of sets of three valves in a cluster at intersections to isolate breaks. Most of the system is looped to provide service while sections of pipe are repaired. The combination of loops and the valve system helps to minimize the loss of service to customers during main breaks.

In the event of an extended loss of water service or possible contamination of the water supply caused by breaks, the City is required to notify the Department of Health, Office of Drinking Water. The City also notifies the affected customers and instructs them to disinfect water (boil water advisory) or to conserve water until water supply and/or quality is restored.

CROSS-CONNECTION CONTROL PROGRAM

In compliance with WAC 246-290-490, the City passed an ordinance on January 17, 1995 addressing cross-connection issues. In 2008 the City adopted Ordinance No. 743 which updated Title 13 CMC and renamed this to Public Utilities. Cross-connections are addressed in Division VI 13.105 of this Code. The code requires annual testing of all backflow preventors and cross-connection devices. A Cross-connection Control Program (CCP) has been developed for the City. A copy of the CCP and the ordinance addressing cross-connection control are included in **Appendix M**.

The purpose of the Cross-Connection Control Program is to protect the health of water consumers and the potability of the City water system by assuring the inspection and regulation of plumbing in existing and proposed piping networks and the proper installation and surveillance of backflow prevention assemblies when actual or potential cross-connections exist and cannot be eliminated.

The City also requires the installation of backflow and cross-connection devices on new construction of the following:

- New meter setters
- Replacement of existing meter setters
- All irrigation systems
- All sprinkler systems.

The CCP includes a process for evaluating backflow requirements for new and existing customers. New residential services within the service area are required by the CCP to provide appropriate backflow assembly for special plumbing such as lawn sprinkler system, or for hazardous water use on premise. New non-residential services are required to provide the appropriate backflow assembly based on the hazard assessment performed by the Cross-Connection Specialist.

Existing non-residential customers are required to submit an evaluation by the CCS of the hazards posed by their plumbing system. Existing residential customers will required to submit a questionnaire that will indicate special plumbing or water use on premises. If customers fail to submit the required information, the city has the option to require an assessment by the CCS, require installation of a Reduced Pressure Backflow assembly or take other actions.

CUSTOMER COMPLAINT RESPONSE PROGRAM

Document, investigate, assess findings, and take corrective action

Document and file report

RECORDKEEPING AND REPORTING

Reporting performed by Public Works Field Supervisor.

Recordkeeping performed by City Deputy Clerk

Operation and Maintenance Improvements required:

- Altitude valve replacement at storage reservoir
- Leaking pipes – see Chapter 8

Replace:

- Well improvements/upgrades

CHAPTER 8 IMPROVEMENT PROGRAM

SUMMARY

A series of capital projects have been identified to address the requirements of the City, Washington State Department of Health (DOH), the East King County Coordinated Water System Plan, and other jurisdictions and agencies. The City is planning to focus on improving its system through emergency power additions, a new reservoir, and addressing the vulnerability of its transmission main from the spring source to the City. In City piping replacement projects are also addressed. These piping improvements are meant to provide fire flow to urban areas or replace old, leaking and undersized pipes. The City will also work to reduce its very high rates of unaccounted for water.

A source meter replacement project was completed at the end of 2007. The new meter installation was designed to ensure that the meter is flowing full and therefore will be more accurate than the previous meter. Additionally, to measure all of the water produced by the spring, a meter was installed in the pipe that discharges the overflow water back to the stream. This water was not previously measured. The meter is a different type of meter that measures partially full pipe flow.

The identified future piping additions to the system are schematic only. Refer to **Figure 8.1** Water System CIP Map in this chapter. Configuration of facilities and water mains may change as development occurs and land use policies change. Additional capacity improvements may be needed if development occurs more rapidly than is predicted.

PRIORITIZATION

In order to develop a prioritized list of capital projects, all potential projects were evaluated using the relevant criteria. The projects are prioritized based on the following criteria which are listed in order of decreasing importance:

- DOH Requirements
- System Wide Benefits
- Fire Flow in the Urban Area
- Hydraulic Capacity in the Urban Area
- Multiple Leaks
- Looping
- Hydraulic Capacity Outside of the Urban Area

DOH Requirements: These projects include a new storage tank, a new generator and disinfector at the well site and new water mains.

The City has inadequate storage capacity. Fire flow cannot be provided at the levels required by the DOH analysis. A new storage tank is planned for the north pressure zone to serve the whole system. An analysis of sizing and siting options for the tank was completed in a memorandum prepared by Roth Hill Engineering entitled Carnation Reservoir – Alternative Sites Evaluation, January 17, 2007.

A generator is required to be installed at the well in order to be in line with our assumptions in the calculations. This project is a City priority. Installation of the generator will reduce the cost of other facilities.

System-Wide Benefit: These projects include new installation and replacement of water mains or other improvements that provide improvement to all or almost all of the water system (e.g., more than just one street).

Fire Flow in the Urban Area: Projects identified in this category include installation of improvements to solve an existing fire flow deficiency in a location or area within the Urban Growth Boundary.

Hydraulic Capacity in the Urban Area: These projects include new installation and replacement of water mains to improve hydraulic capacity of specific streets and/or neighborhoods within the urban area.

Multiple Leaks: These projects include the replacement of leaking steel and AC water mains throughout the City.

Looping: These projects include the installation of water mains to improve water quality and hydraulics of the water system for specific streets and/or neighborhoods.

Hydraulic Capacity Outside of the Urban Area: These projects include new installation and replacement of water mains to improve hydraulic capacity of specific streets and/or neighborhoods in the rural area.

Obviously, most projects have applicability to more than one of these criteria. Because the overall list of improvement projects is not extensive, a formal procedure for prioritizing the projects is not employed, but priorities were discussed jointly with the City to determine the schedule of improvements.

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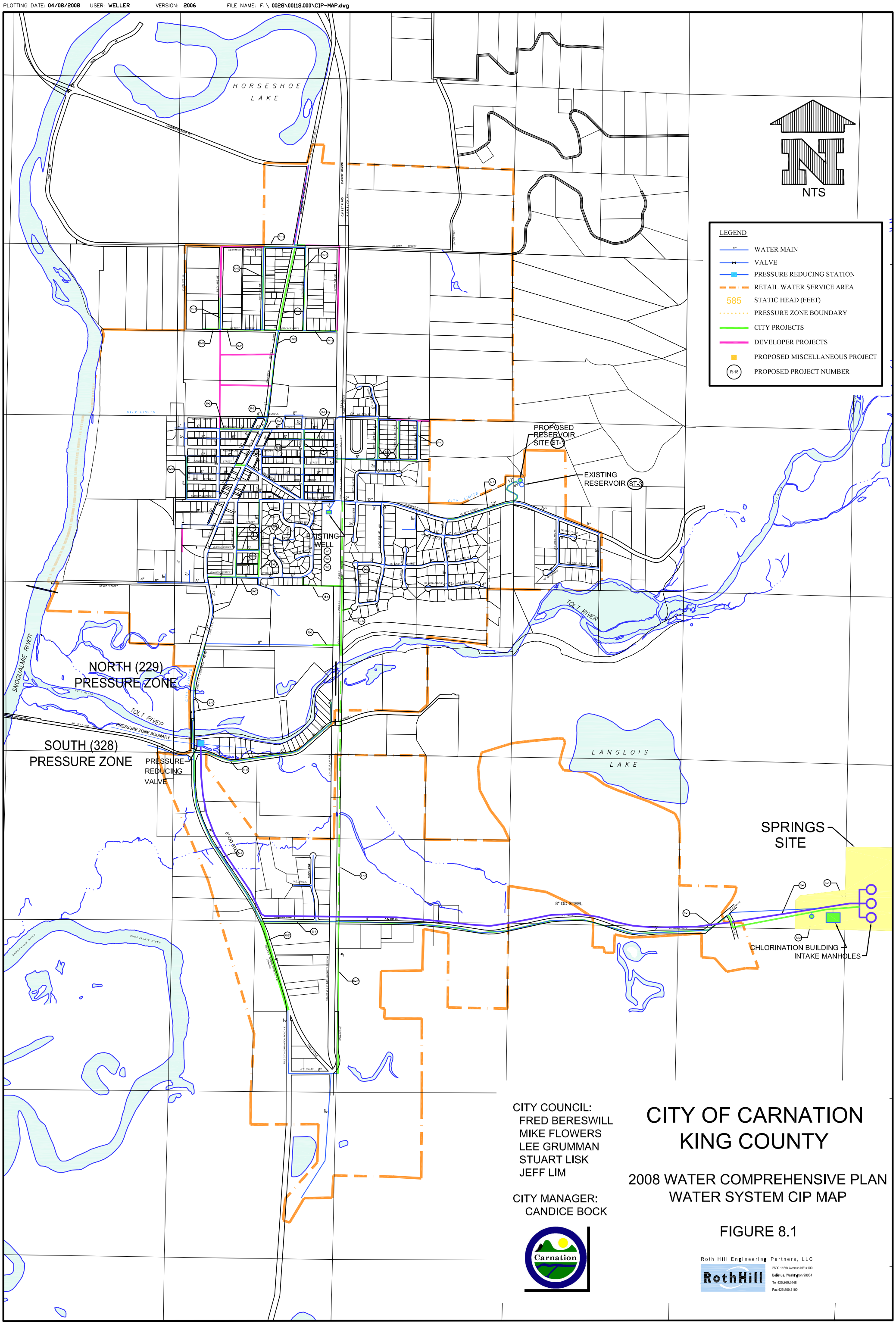

CITY COUNCIL:
FRED BERESWILL
MIKE FLOWERS
LEE GRUMMAN
STUART LISK
JEFF LIM

CITY MANAGER:
CANDICE BOCK

CITY OF CARNATION
KING COUNTY

2008 WATER COMPREHENSIVE PLAN
WATER SYSTEM CIP MAP

FIGURE 8.1

Roth Hill Engineering Partners, LLC
2600 116th Avenue NE #100
Bellevue, Washington 98004
Tel 425.869.9448
Fax 425.869.1190

Capital Improvement Scheduling

Identified projects are scheduled based upon priority within annual budgetary limitations. For more on the financial program, refer to Chapter 9. The City checks with the King County Department of Transportation to verify their intended roadway improvements and to schedule any necessary water facility construction in advance to avoid conflict with any of the County's. This scheduling coordination only affects the small portion of the water system outside the City limits. The City's staff reviews the upcoming City street improvements, if any, to schedule the water portion of the projects jointly as appropriate to minimize the cost to the ratepayers.

The City endeavors to utilize all sources of outside funding which may be available in order to finance its capital improvement projects.

The City's policies for developer extensions dictate that where projects identified in the Comprehensive Plan are adjacent to a proposed development, the developer shall construct those facilities. The improvements are included as part of the developer's overall construction responsibilities to build a project in the City.

IDENTIFIED IMPROVEMENTS

All identified capital improvements are summarized in the Capital Facilities Plan - **Table 8.1** (at the end of this chapter). Each project is identified with a 'key' composed of a letter followed by a number. The letter designates the type of project (see below) while the number is simply a listing within each letter category. All projects that have an identifiable site or sites associated with them are shown on **Figure 8.1**. At the appropriate geographical location, the figure shows the number 'key' from the table so that the projects listed in **Table 8.1** can be identified on the figure.

Associated with each improvement listed in **Table 8.1** is a projected cost and a start (implementation) year. The year designation is an indication of the project's priority relative to other improvements.

Water Mains

Water mains are grouped into two types in **Table 8.1**:

Water main Improvements designated by the letter 'N' for new mains and the letter 'R' for replacement mains. Additionally the spring source transmission main related improvements are designated by the letter 'S'.

Non-Pipe Projects

Identified source, storage, and other major capital improvement projects are also listed in **Table 8.1** as Miscellaneous Improvements and shown on **Figure 8.1** where applicable. The following letter designations are used:

- 'S' – Spring related improvements
- 'W' – Well site related improvements
- 'ST' – Storage
- 'O' – Other (these are system-wide projects relating operations, maintenance, and management activities)

It should be noted that the improvements listed in **Table 8.1** represent tentative priorities. It is difficult to prioritize projects into year-by-year categories because it may be necessary to reprioritize particular items as circumstances dictate. For example, this might result from changes in land use designations or development patterns.

MAJOR PROJECT CATEGORIES

Water Source Improvements

Spring Source

A source study (S5) will be conducted to evaluate the catchment supply at the spring source. The study will be performed by a hydro-geological consultant. The purposes of the study will be to analyze the existing and potential capacities of both the original water source and the two more recent horizontal wells. If the supply capacity can be increased, the study will recommend the necessary improvements implement this supply implementation. The intent will be to identify how the system can make full use of its water right (628 gpm) for this supply source if this is possible.

One potential improvement previously recommended by others is to upgrade Spring Intake Manhole #1. Upgrading the intake will deepen the perforated intake pipes and reduce any temperature variation. This recommendation will be evaluated as part of this study and could be implemented at the same time as project S1.

Spring Source Transmission Main

Currently, the main from the spring to the chlorination structure is at or above grade, either on the ground or just below it or elevated, supported by wood structures. The main is steel and is vulnerable to damage by trees, earthquake, or other causes. Four capital improvement projects are identified which comprise the entire pipeline from the spring source to the connection to the City's system at

approximately NE 35th Street on SR 203. They pipe segments have been divided into separate projects based on location and anticipated year of implementation. It is possible that all four improvements could be completed in one project, if funding is available.

Improvement project S1 is comprised of constructing a new 8-inch diameter transmission main from the spring to the meter vault adjacent to the chlorination building. Approximately 1,043 lineal feet of pipe are to be installed. The new pipe will replace the aging and exposed 8-inch diameter steel pipe. It is planned to replace the main with a more flexible pipe, possibly HDPE laid on the surface of the ground.

Transmission main S2 is a continuation of the S1 improvement from the meter vault to 344th Avenue NE. The existing pipe in this area is very close to the existing stream and has little or no cover over the pipe. The pipe is in very vegetated areas, some areas also have steep slopes so access to the pipe is a problem. The new pipe's route will be determined during design but is preliminarily thought that it should follow the access road location, which is farther from the stream, and accessible. The pipe diameter is proposed to be 8-inch with an overall length of approximately 1,328 lineal feet and replaces existing 8-inch diameter pipe.

It is planned to replace the old 8-inch diameter transmission pipe from 344th Avenue NE to the King County Park trail with new 12-inch pipe (S3). Overall length is approximately 6,320 lineal feet. This section has minimal cover as well and some portions of the pipe are exposed, especially at two stream crossings where the stream jumps the pipe.

Transmission main S4 is a continuation of S3 and likewise replaces 8-inch pipe with a new 12-inch diameter main extending from the King County trail westerly to SR 203 and thence northerly across the Tolt River to NE 35th Street. The overall length is estimated as 5,500 lineal feet.

An alternative route for the S4 transmission main is designated as S4A. This would be a new 12-inch diameter main (instead of a replacement pipe) extending from the west termination of the S3 project northerly along the King County Park trail to NE 35th Street. The estimated lineal footage for this alternative route is 6,600. A new PRV Station (O2) would be required for this alternative (see below). This pipe has the advantage of not being in and existing State Highway and would be less expensive than the other alternative.

Well Source

Three projects are identified for the City's well.

A new chlorination system (W1) will be installed. The method of chlorination will utilize a dry tablet system using calcium hypochlorite. The equipment will include an Accutab Model 3075(or equal) with a capacity of 5 to 50 pounds per day, a 22 gallon solution tank, a manual flow controller based on flow rate pumped from the well, electrical wiring, and other appurtenances. Alternatives were evaluated prior to making this recommendation.

The installation of a backup power generator at the well site (W2) is a high priority improvement. The purpose of the generator is to allow the well pump to be used in the event of an electrical power outage. Neither the size nor type of generator has been finalized but the capacity is preliminarily estimated at 75 kilowatts and the generator fuel will probably be either diesel or propane.

The installation of a data logger and flow meter replacement (W3) at the well house is identified. The data logger will store flow data electronically and permit the data to be downloaded into a lap top computer for record keeping purposes at the City Hall. The existing flow meter was installed in 1985 and is planned to be replaced with this improvement.

Water Storage Improvements

The City is currently deficient in storage per the DOH criteria. A new steel reservoir (ST1) is planned for construction. It will be located adjacent to the existing tank. A previous study reviewed alternative locations for the new tank and the existing site was determined to be the best site for the new reservoir. The tank will be approximately 60 feet in height, 40 feet in diameter, and will provide a minimum of 600,000 gallons of storage. The new reservoir will provide additional storage for the City's north pressure zone which comprises most of the water system.

Tank construction materials are most commonly either of steel or pre-stressed concrete. Concrete tanks are considered to have a higher initial cost but claim to have superior life-cycle costs because they don't corrode (in principle), don't need to be recoated, and, therefore, can be left in continuous service. Pre-stressed concrete tanks are low profile and can even be buried up to the roof line. A taller, above-ground tank, such as proposed above, would be made of steel. There is a northwest-based manufacturer of cast-in-place reinforced concrete tanks but their largest standard diameter is 30 feet although they do offer tanks up to 60 feet in height.

The City currently does not have any storage in the south pressure zone. A second small reservoir (ST2) to serve the City's south pressure zone is planned. The tank is proposed for location near the spring source and is intended to provide a supply of water, in the event the spring source is out of service, to those few of the City's customers that cannot be served by the well and existing reservoir (the PRV allows flow from north to south in the case of low pressure in the south zone). The size and configuration of the proposed tank has not been

finalized but for estimating purposes is sized at approximately 100,000 gallons to provide two days worth of standby storage to the south pressure zone. The reservoir would not provide fire flow storage since the City does not currently and does not plan to provide fire flow capability to these relatively few customers. A low level tank is currently envisioned.

The City plans to replace the altitude valve at the existing reservoir (ST3) because repair kits are no longer available for this.

Water Main Improvements

As shown in **Table 8.1**, water main improvements not related to the transmission mains from the spring, are categorized as being either new or replacement pipes. The proposed improvements have been identified to address the prioritization criteria listed at the beginning of this chapter. Except for replacement mains needed solely to replace existing pipe materials with long-term leakage problems, all of the water main improvements intended to meet hydraulically based criteria have been analyzed using the City's hydraulic model which is discussed in Chapter 4.

There are new water main projects and replacement projects of various lengths ranging from 200 to 2,700 lineal feet for the years 2008 to 2028. The proposed diameter of all the water mains is 8 inches except for strategic sections of pipe including along SR 203.

Other Capital Improvements

The City intends to install a telemetry system (O1). The intent is to monitor at City Hall all of the City's remote water facilities at the spring, well site, and reservoir site. The system will also be compatible with the City's sanitary sewer vacuum station. The communications technology to be used has not been determined.

As described earlier, the City strives to utilize outside funding sources whenever feasible. The cost of identifying and acquiring funding assistance, O7 is an on-going, multi-year activity.

As noted earlier, a new PRV Station (O2) would be required if the S4A alternative transmission main from the spring is chosen for construction. The project timing would necessarily be in conjunction with the S4A improvement.

Annual replacement of water meters (O3) is shown as a multi-year improvement. This is required because the City has many meters older than 15 years. The level of activity is dictated by the allocated funding of $10,000 annually. The meter replacement was started in 2006 and so far 85 of the 833 meters that the City has have been replaced.

The City has a history of leakage problems and leakage studies are part of the solution to identify where problems exist (O4). This is another on-going, multi-year activity.

Comprehensive plan updates for the years 2008 (O5) and 2016 (O6) are included in **Table 8.1**.

The City currently does not have any "as built drawings" of the area south of the Tolt River. Information provided on location and sizes of mains that was used for analysis is anecdotal and approximate. The City plans to develop base maps for the area south of the Tolt River as soon as it can be funded. Potholing and field surveying will be required as part of this improvement project. The City needs better maps for this area for record keeping and planning purposes. The mapping area is outside of the City's current corporate boundary.

The City's Wellhead Protection Plan will be updated to include the water system modeling to produce more accurate time of travel boundaries.

Opinion of Probable Project Costs

Water main project costs other than the transmission main from the spring are calculated as $175 per lineal foot for 8-inch mains including trench patch and $165 per lineal foot where no paving is required. We used a value of $180 per lineal foot for 12-inch mains. The 12" mains were thought to be able to be installed off of the side of the pavement. All costs are in 2007 dollars. These values were developed from a review of historical contract costs for similar projects in the rural King County area in the City itself and include construction costs, engineering (design and construction inspection/administration), surveying, taxes, and City administration. Additional costs relating to any land purchase, easements or unanticipated site-specific costs are considered to be speculative and not included. Costs shown are considered as preliminary and a project-specific opinion of probable construction cost will be prepared prior to initiating any specified project.

The spring source transmission main projects (S1-S4) are anticipated to have costs higher than those for other mains. There are many sensitive area and permitting hurdles to go through with those projects. These items tend to increase cost and delay project schedules (therefore also increasing costs).

Costs shown for other items are anticipated based on the information we have today without doing preliminary studies on all of the projects. The projected costs are shown in **Table 8.1.**

Table 8.1
Water System DRAFT CIP Improvements

Key	On	From	To	Old Pipe Size	New Pipe Size	Pipe Length	Project Budget (2007 Dollars)	Projected Start Year
Source Improvements								
- Spring related								
S1	Headworks Tr. Main- Spring to meter vault	Spring Source	Source meter Vault	8	8	1043	250,000	2011
S2	Headworks Tr. Main - Meter Vault to 344th	Source Meter Vault	344th Ave NE	8	8	1328	300,000	2011
S3	Tr. Main 344th to Trail	344th Ave NE	Trail	8	12	6320	2,000,000	2011
S4	Trail to Approx NE 35th (12" conn.)	Trail/ NE 24th	NE 35th	8	12	5500	2,200,000	2012
S5	Study of Spring Catchment Capacity						75,000	2010
- Well related								
W1	Well Chlorination	At well site					58,000	2008
W2	Well Generator -75KW?	At well site					90,000	2009
W3	Data Logger, new source meter	At well site					30,000	2009
Storage Improvements								
ST1	New Reservoir - North Pr. Zone -600k gallons	At Ex. Res site					1,500,000	2010
ST2	New Reservoir - South Pr. Zone (100k gallons)	At Spring Site +/-					250,000	2014
ST3	Replace altitude valve at existing reservoir						25000	2012
Misc CIP Improvements								
O1	Telemetry Control and Reporting						200,000	2012
O2	New PRV station - alt route						See ALT.	See ALT.
O3	Water Meter Replacements ($10,000/yr)						50,000	multi yr
O4	Leak Detection Studies						20,000	multi yr

Table 8.1
Water System DRAFT CIP Improvements

Key	On	From	To	Old Pipe Size	New Pipe Size	Pipe Length	Project Budget 2007 Dollars	Projected Start Year
O5	2008 Water Comprehensive Plan						150,000	2007/ 2008
O6	2016 Water Comprehensive Plan						175,000	2016
O7	Base Mapping South End w/ survey						20,000	2009
O8	Funding Assistance						50,000	multi yr
09	Water Modeling						30,000	2012
Water Main Improvements								
N1	PAA/ SR203 New Main	NE 55th St.	NE 60th St.	0	12	1600	280,000	2014
N2	King Street	Myrtle St.	Blanche St.	0	8	450	78,750	2009
N3	SR 203 Crossing	SR 203	Alley J	6	12	200	70,000	2013
N4	SR 203 Crossing	Commercial St.	Alley J	0	12	200	80,000	2012
N5	Trail connections -3 conns	Regal St	Trail	0	8	2383	417,025	2016
N6	NE 45th St and Tank Site - parallel line	329th Ave NE	Tank	0	12	1600	280,000	2018
R1	Spillman Avenue Replacement	Entwistle St.	Morrison St.	6	8	1100	192,500	2013
R2	Alley J and Bagwell Street Replacement	Morrison St.	Carnation Duvall Rd.	4	8	400	70,000	2015
R3	Morrison Street Replacement	Alley "J"	Stephens Ave.	6	8	500	87,500	2013
R4	326th Ave.	47th St.	50th St.	6	8	600	105,000	2020
R4	327th Ave.	47th St.	50th St.	6	8	600	105,000	2020
R4	328th Ave.	47th St.	50th St.	6	8	600	105,000	2020
R4	47th St.	327th Ave.	328th Ave.	6	8	300	52,500	2020
R5			326th Ave.	6	8	200	35,000	2018
R5			SVT	8	8	700	122,500	2018
R5	SVT	NE 50th St.	Alley E	8	8	300	52,500	2018
R5	Alley E	SVT	Alley K	4	8	1000	175,000	2018
R6	McKinley Avenue Replacement	Blanche	Eugene	4	8	800	140,000	2015

Table 8.1
Water System DRAFT CIP Improvements

Key	On	From	To	Old Pipe Size	New Pipe Size	Pipe Length	Project Budget (2007 Dollars)	Projected Start Year
R7	Blanche Street Replacement	Tolt St.	King St.	6	8	800	140,000	2008
R8	King/ Stossel Street Replacement	Myrtle St.	Entwistle St.	6	8	700	122,500	2009
R9	Myrtle Street Replacement	King St.	McKinley	6	8	400	70,000	2020
R10	Alley Between Myrtle and Blanche	King St.	McKinley	4	8	400	70,000	2021
R11	NE 55th Street Replacement	324th Ave.	316th/318th Ave.	6	8	2200	385,000	2015
R12	318th Avenue Replacement	55th St.	55th/60th St.	6	8	500	87,500	2015
R13	320th Avenue Replacement	55th St.	60th St.	6	8	1300	227,500	2017
R14	NE 60th Street Replacement	320th Ave.	322nd Ave.	6	8	700	122,500	2018
R15	322nd Avenue Replacement	55th St.	60th St.	6	8	1300	227,500	2017
R16	Stewart Avenue Replacement	Entwistle St.	Alley "B"	6	8	700	122,500	2020
R17	NE 32nd Street Replacement	Fall City Carnation Rd.	SVT	6	8	2700	472,500	2017
R18	Alley "E"	Alley K	Spillman	6	8	600	99,000	2015
R19	NE 55th ST. - West Stub	319th	west 300 ft	2	8	300	52,500	2016
R20	PAA/SR 203 Main Replacement	Bagwell St.	NE 55th St.	4	12	1600	264,000	2014
R21	Fall City Carn Rd.	Langlois/ NE 24th	xx Way NE	4	8	1500	262,500	2019
R22	KC Trail	Langlois/ NE 24th	NE 36th	4	8	2700	472,500	2013
	TOTAL						**12,809,275**	

Table 8.2 shows the improvements in another view. The improvements are shown by year for the first six years and then grouped into two other schedule groups – projects anticipated in year 7-10 and therefore eligible for GFC calculation, and projects anticipated in years 11-20. These projects will be reviewed and likely reprioritized in the next update of the Water Comprehensive Plan. These improvements are shown in 2007 dollars. A different version with escalated dollars shown is included in Chapter 9 – Financial.

Table 8.2
CIP Improvements Schedule

Improvement No.	Rank w/in Yr.	Improvement Description	Planned Improvement Schedule							
			2008	2009	2010	2011	2012	2013	2014-2017	2018-2027
W1		Well Chlorination	$58,000							
O5		2008 Water Comprehensive Plan	$150,000							
R7		Blanche Street Replacement	$140,000							
O3		Water Meter Replacements ($10,000/yr)	10,000	10,000	10,000	10,000	10,000			
O4		Leak Detection Studies	2,000	2,000	2,000	2,000	2,000	2,000	8,000	
W2	A	Well Generator -75KW?		$90,000						
N2	B	King Street		$78,750						
R8	B	King/ Stossel Street Replacement		$122,500						
W3	C	Data Logger, New Source Meter		$30,000						
O7	D	Base Mapping South End w/Survey		$20,000						
O8		Funding Assistance		$20,000	$10,000	$10,000	$10,000			
ST1	A	New Reservoir - North Pr. Zone -600k gallons			$1,500,000					
S5	B	Study of Spring Catchment Capacity			$75,000					
S1	A	Headworks Tr. Main- Spring to Meter Vault				$250,000				
S2	B	Headworks Tr. Main - Meter Vault to 344th				$300,000				
S3	C	Tr. Main 344th to Trail				$2,000,000				
S4	A	Trail to Approx NE 35th (12-inch conn.)					$2,200,000			
ST3	B	Replace Altitude Valve at Existing Reservoir					$25,000			
N4	C	SR 203 Crossing					$80,000			
O1	D	Telemetry Control and Reporting					$200,000			
O9		Water Modeling					$30,000			
R1	A	Spillman Avenue Replacement						$192,500		
R3	B	Morrison Street Replacement						$87,500		
R22	C	KC Trail						$472,500		
N3	D	SR 203 Crossing						$70,000		
O6		2016 Water Comprehensive Plan							$175,000	
N1		PAA/ SR203 New Main							$280,000	
R11		NE 55th Street Replacement							$385,000	
R13		320th Avenue Replacement							$227,500	

Improvement No.	Rank w/in Yr.	Improvement Description	Planned Improvement Schedule							
			2008	2009	2010	2011	2012	2013	2014-2017	2018-2027
R20		PAA/SR 203 Main Replacement							$264,000	
N5		Trail connections -3 conns							$417,025	
R6		McKinley Avenue Replacement							$140,000	
R12		318th Avenue Replacement							$87,500	
R15		322nd Avenue Replacement							$227,500	
ST2		New Reservoir - South Pr. Zone (100k gallons)							$250,000	
R17		NE 32nd Street Replacement							$472,500	
R18		Alley "E"							$99,000	
R19		NE 55th ST. - West Stub							$52,500	
R2		Alley J and Bagwell Street Replacement							$70,000	
R4		Various								$367,500
R10		Alley Between Myrtle and Blanche								$70,000
R21		Fall City Carn Rd.								$262,500
R5		Various								$385,000
R9		Myrtle Street Replacement								$70,000
R14		NE 60th Street Replacement								$122,500
R16		Stewart Avenue Replacement								$122,500
Totals			**$360,000**	**$373,250**	**$1,597,000**	**$2,572,000**	**$2,557,000**	**$824,500**	**$3,155,525**	**$1,400,000**

Grand Total 2008-2017	**$11,439,275**
Grand Total All Years	**$12,839,275**

(All entries are in 2007 dollars)

Alternatives										
O2		New PRV Station - Alternate Route								
S4A		Trail north to Entwistle (12-inch connection)								

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CHAPTER 9 FINANCIAL PROGRAM

The purpose of this financial chapter is to provide a financial program that allows the water utility to remain financially viable during execution of the Capital Improvement Program (CIP) identified in this Plan. This viability analysis considers the historical financial condition of the utility, the sufficiency of utility revenues to meet current and future financial and policy obligations, and the financial impact of executing the CIP. Furthermore, this chapter provides a review of the utility's current rate structure with respect to rate adequacy, equity, promotion of water conservation and customer affordability. Consistent with WAC 246-290-100 requirements, potential rate structure refinements are identified that could enhance water demand efficiency.

HISTORICAL FINANCIAL CONDITION

The City's enterprise funds operate on a cash basis, thus annual balance sheets and income statements are not prepared. **Table 9.1** summarizes the available level of financial detail for the previous six years (2001 through 2006). Noteworthy findings and trends are highlighted to demonstrate the historical performance and condition of the utility.

Table 9.1
Financial Detail for Water Funds 401 and 402

	Water 2001	Water 2002	Water 2003	Water/ Sewer 2004	Water/ Sewer 2005	Water/ Sewer 2006
Beginning Net Cash & Investments	210,770	271,422	302,168	73,050	295,045	785,580
Revenues and Other Financing Sources	432,026	476,444	473,805	452,410	469,118	512,169
Total Resources	$642,796	$747,866	$775,973	$525,460	$764,163	$1,297,749
Expenditures & Other Financing Uses	289,764	447,654	465,969	501,255	511,669	840,705
Excess (Deficit) of Resources Over Uses	353,032	300,212	310,004	24,205	252,494	457,044
Non Revenues	97,954	-	32,000	-	832,305	14,900
Non-Expenditures	177,500	-	-	-		
Ending Net Cash & Investments	$273,486	$300,212	$342,004	$24,205	$1,084,799	$471,944

***** 2004 through 2006 lists 401 as a Water/Sewer Fund
** No 402 Water Capital Replacement Fund reported in 2004

Findings and Trends

Through a combination of customer growth and periodic rate increases, revenues have been generally increasing over time, with the exception of lower revenue collections in 2004. A rate increase was implemented in 2004 to bring revenues more in line with expenditures.

While operating cash flow has remained relatively stable over the past six years (again with the 2004 exception), cash balance has been used in recent years to augment annual revenues in meeting annual expenditures. This trend indicates that current rates will likely be inadequate to meet future expenditures, as cash resources are drawn down. This is especially true in terms of meeting additional revenue bond debt service coverage requirements necessary to fund the CIP - which excludes the use of cash balance in the compliance test.

At the time of this writing, detailed financial reports were not available for 2007. Since the CIP identified in this Plan begins with 2008 projects, the associated financial program begins with 2008 as well. To void the gap between historical financial performance and the Financial Forecast developed for this Plan, 2007 actual rate revenue and year-end fund balances were used to form the basis of the 2008 forecast.

The financial program will address rate strategies to meet additional rate requirements to fund the CIP.

The following section summarizes the current financial structure used as the baseline for the Capital Financing Strategy and Financial Forecast developed for this Plan.

CURRENT FINANCIAL STRUCTURE

The City maintains a fund structure and implements financial policies that target management of a financially viable and fiscally responsible enterprise fund utility.

Funds

Separate accounting is provided for utility restricted and unrestricted cash reserves. Restricted reserves typically include funds set aside as part of revenue bond covenants and cannot be used for purposes other than final payment on outstanding revenue bond debt obligations. Unrestricted cash is maintained in the Water Operating Fund (401) and the Water Capital Fund (402). Restricted funds related to outstanding revenue bonds include Fund 404 Water Bond Redemption and 405 Water Bond Reserve.

The Operating Fund is where operating revenue deposits are made and operating expenses are withdrawn. The Financial Forecast developed for this Plan incorporates a minimum fund balance target of 60 days of O&M (discussed further under the Financial Policies Section).

The Capital Fund receives capital revenue deposits such as connection charges, grant funds, and debt proceeds, as well as interest earnings on the Fund balance. Capital reserves also include annual transfers from the Operating Fund for rate revenues designated for capital purposes and any operating cash balances in excess of the recommended target balance. Capital expenditures are paid from this Fund. The Fund balance at the end of 2007 had $266,764 in cash available for funding capital projects in 2008 and beyond.

Financial Policies

A brief summary of the key financial policies employed by the City, as well as those recommended and incorporated in the financial program are discussed below.

Minimum Fund Balances – Operating reserves are designed to provide a liquidity cushion to ensure that adequate cash working capital will be maintained to deal with significant cash balance fluctuations, such as seasonal fluctuations in billings and receipts, unanticipated cash expenses, or lower than expected revenue collections. As noted above, the Financial Plan incorporates a minimum balance target of 60 days of O&M. This target is prudent for a water utility, given the variability in revenue collections due to changing weather patterns that can significantly affect revenue collections during the summer season. The City should consider increasing this target to about 90 days of O&M if a more aggressive conservation-based rate structure is implemented in the future.

A capital contingency reserve is an amount of cash set aside in case of an emergency should a piece of equipment or a portion of the utility's infrastructure fail unexpectedly. Additionally, the reserve could be used for other unanticipated capital needs including capital project cost overruns. Industry practice ranges from maintaining a balance equal to 1 to 2% of fixed assets, an amount equal to a five-year rolling average of CIP costs, or an amount determined sufficient to fund an equipment failure (other than catastrophic failure). The forecast assumes a minimum balance target of $100,000 in the Capital Fund.

System Reinvestment - The purpose of system reinvestment funding is to provide for the replacement of aging system facilities to ensure sustainability of the system for ongoing operation. Each year, the utility's assets lose value, and as they lose value they are moving toward eventual replacement. That accumulating loss in value and future liability is

typically measured for reporting purposes through annual depreciation expense, which is based on the original cost of the asset over its anticipated useful life. While this expense reflects the consumption of the existing asset and its original investment, the replacement of that asset will likely cost much more, factoring in inflation and construction conditions. Therefore, the added annual replacement liability is even greater than the annual depreciation expense.

The City does not have a specific policy to fund system reinvestment through rates. Based on the City's available fixed asset information, depreciation expense is currently estimated at about $65,000, increasing to about $350,000 after incorporation of planned capital expenditures over the 10-year planning period. This forecast does not incorporate a formal policy to fund system replacement through rates; however, the City has budgeted for a $40,000 transfer from the Operating Fund to the Capital Fund in 2008. In addition to this level of funding, cash in excess of annual minimum Operating Fund balance targets are planned for transfer (due to debt coverage requirements exceeding cash requirements) to the Capital Fund at year end, and made available for capital spending in subsequent years. The forecast provides for a level of transfer commensurate with estimated annual depreciation expense.

Debt Management – The City has three years of debt service remaining on the outstanding 1999 Water Revenue Bond. The City issued a 2005 Water/Sewer Revenue Bond, which was subsequently paid off with a Public Works Trust Fund loan. The City is now making debt service payments toward the PWTF loan that paid off the 2005 Revenue Bond. The 1999 bond covenant requires a 1.25 debt coverage test (the bond covenant does not exclude GFC revenue as an eligible revenue, though, the forecast contained herein tests more conservatively for operating coverage at 1.25 which considers only operating revenues), and maintains the required bond reserves. The City actively pursues low cost loans, where appropriate, and issues revenue bonds to finance capital project costs in excess of available cash resources.

FUNDING AND FINANCING THE CIP

The CIP developed for this Plan identifies $12.8 million ($16.5 million inflated at about 4% annually) in project costs over the 20-year planning horizon. Costs are stated in 2007 dollars and are escalated to the year of planned spending for financing projections.

Table 9.2 summarizes the annual costs associated with the 20-year CIP

Table 9.2 20-Year CIP		
CIP Summary Capital Expenditures	**2007 Dollars**	**Escalated Planned to Construction Year**
2008	360,000	373,491
2009	373,250	402,289
2010	1,597,000	1,790,553
2011	2,572,000	3,003,861
2012	2,527,000	3,078,381
2013	824,500	1,049,053
2014	745,131	991,539
2015	745,131	1,038,389
2016	920,131	1,344,643
2017	745,131	1,143,401
2018-2027	1,400,000	2,258,817
Total	$12,809,275	$16,474,415

Available Funding Assistance and Financing Resources

Feasible long-term capital funding strategies must be defined to ensure adequate resources are available to fund the CIP identified in this Plan. In addition to the Utility's resources such as accumulated cash reserves, capital revenues, and rate revenues designated for capital purposes, capital needs can be met from outside sources such as grants, low-interest loans, and bond financing. The following is a summary of Utility Resources and Outside Resources.

Utility Resources

Utility resources appropriate for funding capital needs include accumulated cash in the Capital Fund, rate revenues designated for capital spending purposes, and capital-related charges, such as general facilities charges and other connection fees. The first two resources have been discussed in the Financial Policies section. Capital-related charges are discussed below.

General Facilities Charges

A general facilities charge (GFC), also called a "connection charge" as provided for by RCW 35.92.025, refers to a one-time charge imposed on new customers as a condition of connection to the utility system. The purpose of the GFC is two-fold: (1) to promote equity between new and existing customers; and (2) to provide a source of revenue to fund capital projects. Equity is served by providing a vehicle for new customers to share in the capital costs incurred to support their addition to the system. GFC revenues provide a source of cash flow used to support utility capital needs; revenue can only be used to fund utility capital projects or to pay debt service incurred to finance those projects. In the absence of a GFC, growth-related capital costs would be borne in large part by existing customers. In addition, the net investment in the utility already collected from existing customers, whether through rates, charges and/or assessments, would be diluted by the addition of new customers, effectively subsidizing new customers with prior customers' payments. To establish equity, a GFC should recover a proportionate share of the existing and future infrastructure costs from a new customer. From a financial perspective, a new customer should become financially equivalent to an existing customer by paying the GFC. **Table 9.3** summarizes the GFC calculation.

Table 9.3
GFC Calculation Summary

	Dollars
EXISTING FACILITIES	
Plant-In-Service	
Water Utility Capital Assets	3,508,965
less: Contributed Capital	-
plus: Cumulative Interest on Non-Contributed Capital	1,647,732
less: Net Debt Principal Outstanding	(35,514)
Total Allocable Existing Facilities	**$5,121,183**
FUTURE FACILITIES	
Capital Facilities Plan	
Total Future Projects	12,809,275
less: Identified Repair & Replacements	(5,576,350)
less: Contributed Capital	-
Total Allocable Future Facilities	**$7,232,925**
CALCULATION	**TOTAL**
Allocable Existing Facilities Costs	5,121,183
Allocable Future Facilities Costs	7,232,925
Total Allocable Costs	12,354,108
Total Customer Base (20 year planning period)	2,042
TOTAL CHARGE PER EQUIVALENT METER	**$6,050**
Current Charge	*$2,245*

The updated GFC is $6,050, about 170% higher than the current charge of $2,245 adopted in 2004. A schedule of GFCs by meter size is shown in **Table 9.4**.

Table 9.4
Schedule of GFCs by Meter Size

Meter Size	Meter Capacity Factor	Charge	Fee Basis
5/8" Meter	1.0	$6,050	per meter
3/4" Meter	1.0	$6,050	per meter
1" Meter	2.5	$15,125	per meter
1 1/2" Meter	5.0	$30,250	per meter
2" Meter	8.0	$48,400	per meter
3" Meter	16.0	$96,800	per meter
4" Meter	25.0	$151,250	per meter
6" Meter	50.0	$302,500	per meter
8" Meter	80.0	$484,000	per meter

Local Facilities Charges

While a GFC is the manner in which new customers pay their share of general facilities costs, local facilities funding is used to pay the costs of local facilities that connect each property to the system's infrastructure. Local facilities funding is often overlooked in a rate forecast since it is funded upfront by either connecting customers, developers, or through an assessment to properties - but never from rates. Although these funding mechanisms do not provide a capital revenue source toward funding CIP costs, the discussion of these charges is included in this chapter, as they are an impact to the new customer of the system.

There are a number of mechanisms that can be considered toward funding local facilities. One of the following scenarios typically occurs: (a) the utility charges a connection fee based on the cost of the local facilities; (b) a developer funds extension of the system to their development and turns those facilities over to the utility; or (c) a local assessment is set up called a Utility Local Improvement District (ULID/LID) which collects tax revenue from benefited properties.

The Local Facilities Charge (LFC) is a City-imposed charge to recover the cost related to service extension to local properties. Often called a front-footage charge and imposed on the basis of footage of main "fronting" a particular property, it is a reimbursement to the City for the cost of a local facility that directly serves a property. It is a form of connection charge

and, as such, can accumulate up to 10 years of interest. It typically applies to instances where no developer-installed facilities are needed through developer extension due to the prior existence of available mains already serving the developing property.

The Developer Extension is a requirement that a developer install onsite and sometimes offsite improvements as a condition of extending service. These are in addition to the GFC required and must be built to City standards.

Part of the agreement between the City and the developer for the developer to extend service might include a late-comer agreement, resulting in a late-comer charge to new connections to the developer extension.

Latecomer Charges are a variation of developer extensions whereby a new customer connecting to a developer-installed improvement makes a payment to the City based on their share of the developers cost. The City passes this on to the developer who installed the facilities. This is part of the developer extension process, and defines the allocation of costs and records latecomer obligations on the title of affected properties. No interest is allowed, and the reimbursement agreement cannot exceed 15 years in duration.

LID/ULID is another mechanism for funding water infrastructure that assesses benefited properties based on the special benefit received by the construction of specific facilities. Most often used for local facilities, some ULIDs also recover related general facilities costs. Substantial legal and procedural requirements can make this a relatively expensive process, and there are mechanisms by which a ULID can be rejected.

Outside Resources

Grants and Low Cost Loans

Grants and low cost loans for Washington state water utilities are available from the Department of Ecology and the Department of Community Trade and Economic Development. Each includes water programs for which the City might be eligible, although some are primarily targeted at wastewater programs or low-income and/or rural communities.

Department of Ecology (from the FY 2008 Funding Guidelines)

The Department of Ecology Water Quality Program administers three major funding programs that provide low-interest loans, grants or loans and grant combinations for projects that protect, preserve and enhance

water quality in Washington State. These are primarily for wastewater projects and not applicable to the City's water CIP.

Further detail is available in the FY 2008 Funding Guidelines document found at http://www.ecy.wa.gov/pubs/0610062.pdf.

Department of Community Trade and Economic Development (from the CTED website)

The Department of Community Trade and Economic Development has four grant and loan programs that the City might be eligible for:

- Community Development Block Grants General Purpose Grant
- Community Economic Revitalization Board Grant and Loan Program
- Public Works Trust Fund Loan Program
- Drinking Water State Revolving Fund Loan Program

Community Development Block Grants General Purpose Grants – These grants are made available to Washington State small cities, towns and counties in carrying out significant community and economic development projects that principally benefit low and moderate income persons.

Eligible applicants are Washington State cities and towns with a population less than 50,000 and counties with a population less than 200,000 that are non-entitlement jurisdictions or are not participants in a HUD Urban County Entitlement Consortium.

Eligible projects include public facilities for water, wastewater, storm sewer and streets. Approximately $12 million is expected to be available in 2008 with a maximum single grant amount of $1 million.

The application period is September through November annually.

Community Economic Revitalization Board - CERB primarily offers low-cost loans; grants are made available only to the extent that a loan is not reasonably possible. The CERB targets public facility funding for economically disadvantaged communities, specifically targeting job creation and retention. Priority criteria include the unemployment rates, number of jobs created and/or retained, wage rates, projected private investment and estimated state and local revenues generated by the project. Traditional construction projects are offered at a maximum dollar limit per project of $1 million. Local match of 25% is targeted.

Eligible applicants include cities, towns, port districts, special purpose districts, federally recognized Indian tribes, and municipal corporations.

The Board's policy is that all loans made by the CERB will be secured by a general obligation pledge of the taxing power of the borrowing entity. Terms do not exceed 20 years including available payment deferral of interest and principal for up to five years. Interest rates match the most current rate of Washington State bonds (not to exceed 10%).

Public Works Trust Fund – Cities, towns, counties and special purpose districts are eligible to receive loans. Water, sewer, storm, roads, bridges and solid waste/recycling are eligible and funds may be used for repair, replacement, rehabilitation, reconstruction and improvements including reasonable growth (generally the 20-year growth projection in the comprehensive plan).

PWTF loans are available at interest rates of 0.5%, 1% and 2% with the lower interest rates given to applicants who pay a larger share of the total project costs. The loan applicant must provide a minimum local match of funds of 5% towards the project cost to qualify for a 2% loan, 10% for a 1% loan, and 15% for a 0.5% loan. The useful life of the project determines the loan term up to a maximum of 20 years.

Drinking Water State Revolving Loan Program (DWSRF) – The DWSRF is jointly administered by the Public Works Board and the Department of Health. The program is intended to improve drinking water systems and protect public health for both publicly and privately owned systems.

There is no match required, terms are not to exceed 20 years and project completion time is 36 months after loan execution. The loan limit is $4 million, the loan fee is 1% and interest rates range from 0% to 1.5%. Applications are accepted annually in May.

Bond Financing

General Obligation Bonds – General obligation (G.O.) bonds are bonds secured by the full faith and credit of the issuing agency, committing all available tax and revenue resources to debt repayment. With this high level of commitment, G.O. bonds have relatively low interest rates and few financial restrictions. However, the authority to issue G.O. bonds is restricted in terms of the amount and use of the funds, as defined by Washington constitution and statute. Specifically, the amount of debt that can be issued is linked to assessed valuation.

RCW 39.36.020 states:

"(ii) Counties, cities, and towns are limited to an indebtedness amount not exceeding one and one-half percent of the value of the taxable property in such counties, cities, or towns without the assent of three-fifths of the voters therein voting at an election held for that purpose.

(b) In cases requiring such assent counties, cities, towns, and public hospital districts are limited to a total indebtedness of two and one-half percent of the value of the taxable property therein."

While bonding capacity can limit availability of G.O. bonds for utility purposes, these can sometimes play a valuable role in project financing. A rate savings may be realized through two avenues: the lower interest rate and related bond costs; and the extension of repayment obligation to all tax-paying properties (not just developed properties) through the authorization of an ad valorem property tax levy.

Revenue Bonds – Revenue bonds are commonly used to fund utility capital improvements. The debt is secured by the revenues of the issuing utility and the debt obligation does not extend to the City's other revenue sources. With this limited commitment, revenue bonds typically bear higher interest rates than G.O. bonds and also require security conditions related to the maintenance of dedicated reserves (a bond reserve) and financial performance (added bond debt service coverage). The City agrees to satisfy these requirements by ordinance as a condition of bond sale.

Revenue bonds can be issued in Washington without a public vote. There is no bonding limit, except perhaps the practical limit of the utility's ability to generate sufficient revenue to repay the debt and provide coverage. In some cases, poor credit might make issuing bonds problematic.

Capital Financing Strategy

An ideal funding strategy would include the use of grants and low-cost loans when debt issuance is required. However, these resources are very limited and competitive in nature and do not provide a reliable source of funding for planning purposes. It is recommended that the City pursue these funding avenues but assume bond financing to meet needs above the utility's available cash resources. G.O bonds may be useful for special circumstances, but due to the bonding capacity limits are most often reserved for other City (non-utility) purposes. Revenue bonds are a more secure financing mechanism for utility needs. The Capital Financing Strategy developed to fund the CIP identified in this Plan assumes the following funding priority:

1. Accumulated capital cash reserves
2. Annual revenue collections from general facilities charges (GFCs)
3. Annual transfers of rate-funded capital or excess cash (over minimum balance targets) from the Operating Fund, if any

4. Interest earning on Capital Replacement Fund balances and other miscellaneous capital resources

5. Revenue bond financing

The Capital Fund begins 2008 with $266,764 in cash reserves. The City has budgeted for a $40,000 transfer in 2008 from the Operating Fund to the Capital Fund. GFC revenue collections are budgeted at $22,450 in 2008, increasing to about $377,000 a year thereafter based on an increased level of GFC (conservatively set at $5,000 for the forecast) and the annual growth assumptions used in this Plan. Should the City adopt a lower GFC, additional debt issuance would be required to fund the capital program.

The above cash resources, coupled with additional transfers from the Operating Fund and interest earnings are forecasted to fund about 31% of the 20-year CIP. Revenue bond proceeds of $11.4 million are assumed to fund remaining needs.

Table 9.5 presents the 20-year Capital Financing Strategy.

Table 9.5
20-year Capital Financing Strategy

			Financing Resources		
	Capital Expenditures 2007 Dollars	**Capital Expenditures Escalated**	**Cash Reserves**	**Revenue Bond Proceeds**	**Total Financing Resources**
2008	$360,000	$373,491	$373,491	$-	$373,491
2009	373,250	402,289	402,289	-	402,289
2010	1,597,000	1,790,553	745,671	1,044,883	1,790,553
2011	2,572,000	3,003,861	637,580	2,366,280	3,003,861
2012	2,527,000	3,078,381	700,479	2,377,902	3,078,381
2013	824,500	1,049,053	609,507	439,546	1,049,053
2014	745,131	991,539	440,035	551,504	991,539
2015	745,131	1,038,389	470,348	568,041	1,038,389
2016	920,131	1,344,643	208,666	1,135,977	1,344,643
2017	745,131	1,143,401	199,613	943,788	1,143,401
2018-2027	1,400,000	2,258,817	326,551	1,932,266	2,258,817
Total	$12,809,275	$16,474,415	$5,114,230	$11,360,185	$16,474,415

FINANCIAL FORECAST

The Financial Forecast, or revenue requirement analysis, forecasts the amount of annual revenue that needs to be generated by water rates. The analysis incorporates operating revenues, O&M expenses, debt service payments, rate funded capital needs, and any other identified revenues or expenses related to utility operations, and determines the sufficiency of the current level of rates. Revenue needs are also impacted by debt covenants (typically applicable to revenue bonds) and specific fiscal policies and financial goals of the utility.

The analysis determines the amount of revenue needed in a given year to meet that year's expected financial obligations. For this analysis, two revenue sufficiency criteria have been developed to reflect the financial goals and constraints of the utility: (1) cash needs must be met; and (2) debt coverage requirements must be realized. In order to operate successfully with respect to these goals, both tests of revenue sufficiency must be met.

Cash Test

The cash flow test identifies all known cash requirements for the utility in each year of the planning period. Capital needs are identified and a capital funding strategy is established. This may include the use of debt, cash reserves, outside assistance, and rate funding. Cash requirements to be funded from rates are determined. Typically, these include O&M expenses, debt service payments, system reinvestment funding or directly funded capital outlays, and any additions to specified reserve balances. The total annual cash needs of the utility are then compared to projected cash revenues using the current rate structure. Any projected revenue shortfalls are identified and the rate increases necessary to make up the shortfall are estimated.

Coverage Test

The coverage test is based on a commitment made by the City when issuing revenue bonds and some other forms of long-term debt. For purposes of this analysis, revenue bond debt is assumed for any needed debt issuance. As a security condition of issuance, the City is required per covenant to agree that the revenue bond debt would have a higher priority for payment (a senior lien) compared to most other utility expenditures; the only outlays with a higher lien are O&M expenses. Debt service coverage is expressed as a multiplier of the annual revenue bond debt service payment. For example, a 1.0 coverage factor would imply no additional cushion is required. A 1.25 coverage factor means revenues must be sufficient to pay O&M expenses, annual revenue bond debt service payments, plus an additional 25% of annual revenue bond debt

service payments. The excess cash flow derived from the added coverage, if any, can be used for any utility purpose, including funding capital projects.

The City's 1999 Water Revenue Bond remains outstanding for another three years, and it is forecasted that the City will incur additional revenue bond debt to finance the capital program. The forecast tests a coverage factor of 1.25 excluding GFC revenue. Though the City's bond covenant does not exclude GFC revenue as eligible revenue, it is more conservative, consistent with industry practice, and better positions the City for projected future bond issuances.

In determining the annual revenue requirement, both the cash and coverage sufficiency tests must be met – the test with the greatest deficiency drives the level of needed rate increase in any given year.

The City's 2008 budget (with noted adjustments) forms the basis for the operating revenues and expenditures forecast.

Revenue – The City has two general revenue sources: water sales revenue (rate revenue) and miscellaneous (non-rate) revenue. In the event of a forecasted annual shortfall, rate revenue can be increased to meet the annual revenue requirement. The 2008 budget of rate revenues was adjusted to incorporate 2007 actual revenue collections, plus one year of 1% customer growth. Future year rate revenues (prior to additional rate increases) are directly tied to the customer growth forecast used in this Plan.

Non rate revenues are based on the 2008 budget, and are forecasted to increase with inflation or growth depending on the nature of the revenue.

Expenses – O&M expense projections are based on the 2008 budget, and are forecasted to increase with inflation, inflation plus growth, and/or anticipated cost changes. State taxes are calculated based on annual revenues and prevailing tax rates.

Transfers to Capital – The 2008 budget identifies a $40,000 transfer from the Operating Fund to the Capital Fund. Additional annual transfers result in the Financial Forecast, representing coverage-driven cash in excess of minimum balance targets. Any Operating Fund balance above the minimum requirement is assumed available to fund capital projects and is projected to be transferred to the Capital Fund to do so.

Debt – As noted in the Capital Financing section, debt is required to fund CIP costs beginning in 2010. Debt service for each issue is planned to begin in the year following issuance. **Table 9.6** summarizes the annual revenue requirement based on the forecast of revenues, expenditures, fund balances, and fiscal policies.

Table 9.6
Annual Revenue Requirements Summary

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
EXPENSES										
Cash Operating Expenses	$306,699	$323,098	$335,602	$348,024	$360,821	$374,004	$387,590	$397,552	$410,771	$424,424
Transfers to Other Funds	2,400	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Existing Debt Service	113,766	110,841	112,860	49,569	49,339	49,108	48,878	48,647	48,417	48,186
New Debt Service	-	-	-	92,161	300,872	550,266	595,816	652,755	647,924	642,804
Budgeted Capital Transfer	40,000	-	-	-	-	-	-	-	-	-
Total Expenses	$462,866	$443,938	$458,462	$499,755	$721,031	$983,379	$1,042,283	$1,108,954	$1,117,112	$1,125,414
REVENUES										
Water Sales	$494,505	$531,063	$567,621	$604,179	$640,737	$677,295	$713,853	$732,051	$750,249	$768,448
Other Revenue	12,550	12,866	13,202	13,507	13,818	14,136	14,460	14,780	15,106	15,439
Operating Fund Interest Earnings	31,397	6,499	6,681	10,967	20,497	30,077	31,968	30,007	32,268	41,328
Total Revenue	$538,452	$550,428	$587,504	$628,653	$675,052	$721,508	$760,281	$776,838	$797,623	$825,215
CASH TEST REVENUE DEFICIENCY (SURPLUS)	**$ (75,587)**	**$(106,490)**	**$(129,042)**	**$(128,898)**	**$45,979**	**$261,871**	**$282,002**	**$332,116**	**$319,489**	**$300,199**
ADJUSTMENTS FOR COVERAGE										
Total Allowable Revenue	$550,456	$577,276	$621,059	$657,344	$706,574	$748,936	$780,083	$798,004	$807,013	$834,198
Cash Operating Expenses	(306,699)	(323,098)	(335,602)	(348,024)	(360,821)	(374,004)	(387,590)	(397,552)	(410,771)	(424,424)
Revenue Bond Debt Service	(63,505)	(60,810)	(63,060)	(92,161)	(300,872)	(550,266)	(595,816)	(652,755)	(647,924)	(642,804)
Revenue Bond Coverage Requirement	(15,876)	(15,203)	(15,765)	(23,040)	(75,218)	(137,567)	(148,954)	(163,189)	(161,981)	(160,701)
COVERAGE DEFICIENCY (SURPLUS)	**$164,376**	**$178,165**	**$206,632**	**$194,119**	**$ (30,337)**	**$ (312,901)**	**$ (352,276)**	**$ (415,492)**	**$ (413,663)**	**$(393,731)**
ANNUAL RATE INCREASE	**0.00%**	**9.00%**	**9.00%**	**9.00%**	**9.00%**	**4.00%**	**4.00%**	**4.00%**	**0.00%**	**0.00%**
CUMULATIVE RATE INCREASE	**0.00%**	**9.00%**	**18.81%**	**29.50%**	**41.16%**	**46.80%**	**52.68%**	**58.78%**	**58.78%**	**58.78%**
Net Cash Flow After Rate Increase	$75,587	$151,882	$230,442	$298,185	$204,474	$39,191	$77,229	$80,980	$103,877	$133,436
Coverage After Rate Increase	3.84	4.93	6.13	5.19	1.98	1.23	1.26	1.25	1.26	1.31
Annual Borrowing	$-	$-	$1,044,883	$2,366,280	$2,377,902	$439,546	$ 551,504	$568,041	$1,135,977	$943,788

As shown in the table, revenues and expenditures are in balance until the new debt service levels in 2012. Without rate increases before 2012, the analysis indicates the need for 9.6%, 42.4%, 3.5% and 4.5% rate increases in years 2012 through 2015. The Financial Forecast developed for this Plan presents a rate strategy to smooth needed rate increases over time, to avoid rate spikes due to CIP financing, and to mitigate longer term impacts. This strategy includes a series of annual 9% rate increases in years 2009 through 2012, followed by three years of 4% from 2013 through 2015.

EVALUATION OF CURRENT RATES AND POTENTIAL CONSERVATION FEATURES

The City's current rate structure consists of a monthly fixed charge applicable to all customer classes (increasing with meter size); a two-block increasing volume charge for residential customers (block one: 0-20 ccf; block two: > 20 ccf); and a class-specific single-block volume charge for multi-family and commercial customers. Indicated rate increases are applied "across-the-board" to the existing rate structure.

While the current rate structure might appropriately address rate equity among the customer classes, and provide some incentive for conservation, the City might consider introducing more aggressive conservation features into the structure. Examples include additional increasing block rates (3 or 4 blocks) and higher block rate differentials for the residential class and seasonal rates for all other classes.

Table 9.7 presents a comparison of current and proposed rates and **Table 9.8** presents associated sample residential water bills.

Table 9.7
Current and Proposed Rates

Current Carnation Water Rates

Fixed Monthly	Inside City	Outside City	
5/8" & 3/4"	$17.69	$26.54	
1"	$26.33	$39.50	
1.5"	$39.37	$59.05	
2"	$58.19	$87.28	
3"	$134.94	$202.41	
4"	$189.88	$284.82	
6"	$334.91	$502.37	
8"	$508.44	$762.60	

Table 9.7 Current and Proposed Rates			
Volume Inside	**0-2,000 cf**	**>2,000 cf**	**All Usage**
Residential	$2.51	$3.71	n/a
Multifamily	n/a	n/a	$2.46
Commercial	n/a	n/a	$3.00
Outside			
Residential	$3.77	$5.56	n/a
Multifamily	n/a	n/a	$3.69
Commercial	n/a	n/a	$4.51
Projected 2009 Carnation Water Rates with 9% Increase			
Fixed Monthly	**Inside City**	**Outside City**	
5/8" & 3/4"	$19.28	$28.93	
1"	$28.70	$43.06	
1.5"	$42.91	$64.36	
2"	$63.43	$95.14	
3"	$147.08	$220.63	
4"	$206.97	$310.45	
6"	$365.05	$547.58	
8"	$554.20	$831.23	
Volume Inside	**0-2,000 cf**	**>2,000 cf**	**All Usage**
Residential	$2.74	$4.04	n/a
Multifamily	n/a	n/a	$2.68
Commercial	n/a	n/a	$3.27
Outside			
Residential	$4.11	$6.06	n/a
Multifamily	n/a	n/a	$4.02
Commercial	n/a	n/a	$4.92
Projected 2017 Carnation Water Rates with 59% cumulative increase			
Fixed Monthly	**Inside City**	**Outside City**	
5/8" & 3/4"	$28.09	$42.14	
1"	$41.81	$62.72	
1.5"	$62.51	$93.76	
2"	$92.40	$138.59	
3"	$214.26	$321.39	
4"	$301.50	$452.25	
6"	$531.78	$797.68	
8"	$807.32	$1,210.88	
Volume Inside	**0-2,000 cf**	**>2,000 cf**	**All Usage**
Residential	$3.99	$5.89	n/a
Multifamily	n/a	n/a	$3.91
Commercial	n/a	n/a	$4.76

Table 9.7 Current and Proposed Rates			
Outside			
Residential	$5.99	$8.83	n/a
Multifamily	n/a	n/a	$5.86
Commercial	n/a	n/a	$7.16

Table 9.8 Sample Residential Bill *(assumes 7 ccf per month)*	
Rates in Year	**Sample Bill**
2008	$35.26
2009	$38.43
2010	$41.89
2011	$45.66
2012	$49.77
2013	$51.76
2014	$53.83
2015	$55.99
2016	$55.99
2017	$55.99

Operating and capital shares of the sample bill vary year to year. While the annual customer growth rate exceeds the annual inflation rate built into the forecast, the share of operating costs per customer goes down based on the resulting economies of scale. The operating share averages around 70% until the rate increases are complete in 2013 (all to fund additional debt-related costs) and settles in just under 40% of the sample customer bill.

Affordability

A common affordability index used by agencies to prioritize low cost loan awards is whether rates exceed 1.5% of the median household income for the demographic area. The median household income for Carnation, Washington in the 2000 census was $60,156. Median income is forecasted to include 3% annual escalation. **Table 9.9** presents the City's rates with the projected rate increases annually for the forecast period, tested against the 1.5% threshold.

Table 9.9 Affordability				
Year	Annual Median Income	Income Escalator	1.50% Monthly	Projected Bill (7 ccf)
2000	$60,156	3%	$75.20	
2001	$61,961	3%	$77.45	
2002	$63,820	3%	$79.77	
2003	$65,734	3%	$82.17	
2004	$67,706	3%	$84.63	
2005	$69,737	3%	$87.17	
2006	$71,829	3%	$89.79	
2007	$73,984	3%	$92.48	
2008	$76,204	3%	$95.25	$35.26
2009	$78,490	3%	$98.11	$38.43
2010	$80,845	3%	$101.06	$41.89
2011	$83,270	3%	$104.09	$45.66
2012	$85,768	3%	$107.21	$49.77
2013	$88,341	3%	$110.43	$51.76
2014	$90,991	3%	$113.74	$53.83
2015	$93,721	3%	$117.15	$55.99
2016	$96,533	3%	$120.67	$55.99
2017	$99,429	3%	$124.29	$55.99

Applying the 1.5% test, the City's rates are forecasted to remain within the indicated affordable range.

CONCLUSION

The results of this analysis indicate that rate increases are necessary to fund and finance the CIP, along with funding ongoing operating needs. Implementation of the proposed rate increases should provide for continued financial viability, while maintaining generally affordable rates. We recommend that proposed rates be implemented and become effective January 1 for each year 2009 through 2015, and that the updated GFC be implemented January 1, 2009.

Furthermore, we recommend that the City update the cost-of-service rate study (last performed in 2004) to update the rate structure for changes in utility costs, customer class demands, and the potential incorporation of additional conservation rate features.