CHAPTER 1
WATER SYSTEM OVERVIEW

This 2011 Water System Plan update for the City of Kent has been developed pursuant to the guidelines and standards promulgated by the Washington State Department of Health (DOH). It represents the conclusions of planning and engineering analyses undertaken by PACE Engineers, Inc. in 2008 and 2011. The Water System Plan (Plan) offers an overview of the Kent Water System facilities and of the physical, economic, and political demands for water in the service area. Kent will select the most cost-effective approach, and summarize a plan to finance the necessary capital improvements to meet existing and future demands. The Plan overrides and supersedes previous planning efforts including a Comprehensive Water Report developed for the City in 1972, a Water System Plan developed in 1979, a Water System Plan Amendment prepared in 1982, a 1984 Water System Plan update that was based on information from the 1979 plan; a 1988 update completed in conjunction with the Critical Water Supply Plan for the South King County area; and, a 2002 Water System Plan update, later amended with additional information in 2004.

This Chapter of the Plan provides a general description of the City's water service area and existing water system. It also identifies the physical and demographic characteristics of the water service area for the purpose of determining existing and future system characteristics and needs. Figure 1-1 indicates the general location of the City of Kent and its water service area described in this Plan. Figure 1-2 shows the relationship between the City's corporate boundary and water service area.

1.1 SYSTEM OWNERSHIP AND MANAGEMENT

The City of Kent (City) is an incorporated municipality organized with an elected mayor/council type of government. The Chief Administrative Officer, who acts under the direction of the Mayor, is responsible for managing all City operations including Public Works. The Public Works Director is responsible for the management of all Public Works engineering, operations and maintenance, which includes water, sewer, stormwater, and streets. Public Works has separate divisions for Maintenance & Operations and Engineering; these divisions work together to support the existing infrastructure as well as engineering future infrastructure needs.

The City owns and operates a franchised municipal water supply and delivery system that treats and provides potable water supply to the residents of the retail water service area for municipal purposes. The water system operates under the name of "City of Kent Water Department" and the State Department of Health public water system identification number 381501. Appendix A includes the most current copy of the Water Facilities Inventory (WFI) report and the operating license(s). The Water Department is a section of the Public Works Department, but it operates as a self-funded utility supported by water service fees.

The Public Works Operations Manager is responsible for the Public Works Maintenance & Operations Division, which includes the Water Department. The Water Superintendent is responsible for the daily operations of the Water Department and is certified as a Water Distribution Manager as required by the Washington State Department of Health (DOH).

The Water Superintendent and Public Works Operations Manager handle the routine management decisions for the Water Department. The Public Works Director is involved with all decisions of a significant nature, including the planning for future needs. All major policy decisions and capital requests are reviewed and approved by the Mayor/City Council and Chief Administrative Officer. An organizational chart has been included in Chapter 8.

1.2 SYSTEM BACKGROUND AND HISTORY

The City incorporated in 1890 and adopted its first water system Plan in 1955. Over the years, the system has undergone numerous improvements and additions which are detailed in Appendix C. The following is a summary of key events in the history of the public water system.

In the latter part of the 19th century, a spring was tapped on the East Hill, in the back of what was known as Crow farm, which became the source of water for the Kent Water and Light Company. The company was organized by the Guiberson brothers, Captain J.J. Crow, and Will J. Shinn.

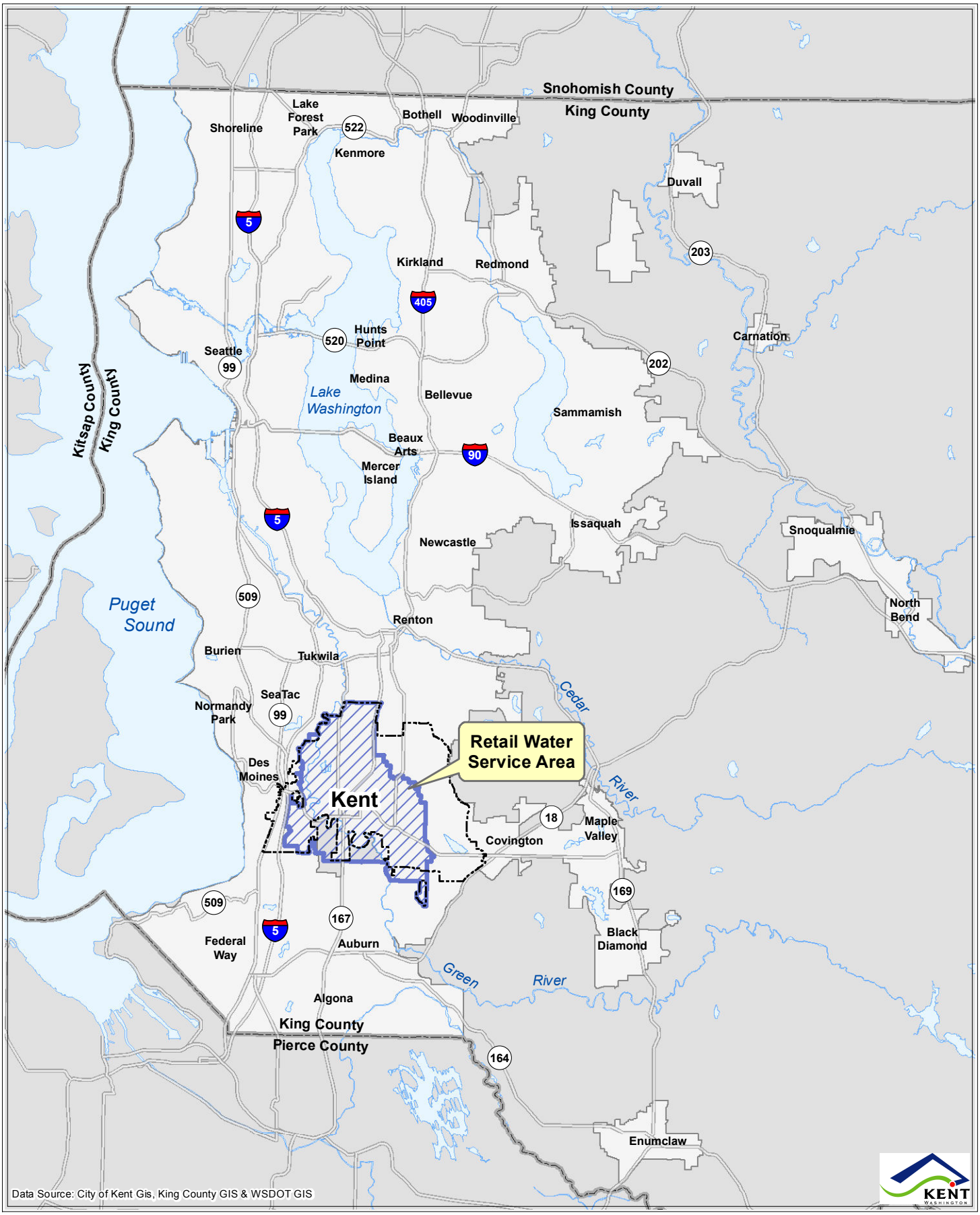
The water system worked by gravity flow, carrying water through wooden pipes into the yards of its customers. A tap on the porch was the source of supply for the family. It was many years later that interior plumbing was added to homes.

The dry season could cause a problem for the City, as reflected in the rates charged to farming customers. Livestock was assessed at the rate of 10 cents per head for water during the months from June to November and 5 cents per head for the balance of the year. Family rates in 1902 were 90 cents per household.

The City granted a 25-year franchise to the Farmers Water Company and the Kent Water and Light Company to furnish water to the City in 1891 but held an option to purchase the system which it did in 1892. At that time, the Kent Water and Light Company was valued at $3,000. Subsequently the City relinquished its municipal light plant to the Seattle-Tacoma Interurban Railway but maintained the water system.

Purchase of the old companies and construction of a new City system, including a reservoir at the top of Kennebeck Street, was financed in 1892 by the sale of $23,500 worth of revenue bonds.

Further improvements to the water system were made in 1910. In 1926, the City purchased the Kent Springs water source near Lake Sawyer. Four years later an additional expenditure of $125,000 was made to lay the original Kent Springs Transmission Main.



Legend

- Kent City Limits
- Kent Retail Water Service Area
- King County Urban Growth Area

City of Kent

2011 Water System Plan

Vicinity / Location

N W E S

0 2.5 5 Miles

Figure 1-1

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Development of the Clarks Springs source began in the 1930's and Kent Springs was initially developed in the 1920's. In the 1930's, at a cost of $88,000, the Guiberson Reservoir was constructed to serve the Valley system. This facility is still in operation today.

In the 1950's, service to the West Hill system was developing. This was the first area to be provided water service outside of the Valley. Pump Station Nos. 3 and 4 were constructed to pump water to the Cambridge Tank and Reith Road Standpipe that were constructed during this time to provide storage for the area. A 125,000 gallon tank was also constructed near 98th Avenue South/South 239th Place.

In the 1960's, the 6 Million Gallon #2 Reservoir was constructed to provide additional storage in the Valley service area. Service to the East Hill system was developing and the James Street Reservoir and the Blue Boy Standpipe were constructed during this time to provide storage for the area. The Clarks Springs Transmission Main was also completed, giving the City two main water sources and transmission mains.

In the 1970's, the development of service to the East Hill system continued and Pump Station No. 5 was constructed to serve the expanding population. A 3.5 million gallon standpipe was constructed to provide additional storage in the East Hill system. East Hill Wells were developed and interties with the cities of Tukwila and Renton were constructed for additional supply during peak demands. A chlorination facility was constructed at Kent Springs for disinfection of water supply. Drilling of the South 212th Street and South 208th Street wells was completed and the new supply sources were intended to provide additional source capacity for the Valley service area as growth continued.

In the 1980's, the West Hill service area was improved. Pump Station Nos. 6, 7 and 8 were constructed to provide additional supply and improve pressures in the area. Pump Station No. 8 allowed for an intertie with Highline Water District (previously known as Water District No. 75). In addition, the Garrison, Armstrong, and Seven Oaks groundwater wells were developed. King County Water District No. 87 was divided and transferred to the cities of Kent and Auburn. The City of Kent initiated the process of obtaining additional supply from Tacoma and added a fluoridation water treatment facility at Clarks Springs. The City became a member of the South King County Critical Water Supply Service Area (SKCCWSSA) which was formed to coordinate water planning efforts.

In the 1990's, the S. 212th Street Iron and Manganese Treatment Facility was completed. The City's first Water Conservation Plan was adopted. As a member of the SKCCWSSA, the City participated in the development and adoption of the South King County Coordinated Water System Plan. In addition, major transmission and distribution pipeline improvements were completed and the Infrastructure Maintenance Management and Inventory System (Hansen IMS) was brought on-line to assist with planned maintenance. Lead and Copper Rule Treatment and Siting Studies were accomplished in accordance with Safe Drinking Water Act requirements and seismic evaluation and upgrades were completed at the reservoirs and distribution system infrastructure.

In the 2000's, Tacoma Second Supply Pipeline No. 5 became the City's third primary water source. The City partnered with Tacoma, Covington Water District, and Lakehaven Utility District on this project and in doing so, added 12.64 MGD to the City's available supply during the peak season (3.45 MGD annual average). The City is participating in a national American Waterworks Association Research Foundation "Water Distribution System Optimization Study" to determine common industry methods and practices used by water suppliers to improve a water distribution system's function and water quality. A water supply reliability analysis for most of Kent's water sources and also a pressure zone study for the Kent East Hill service area are currently underway.

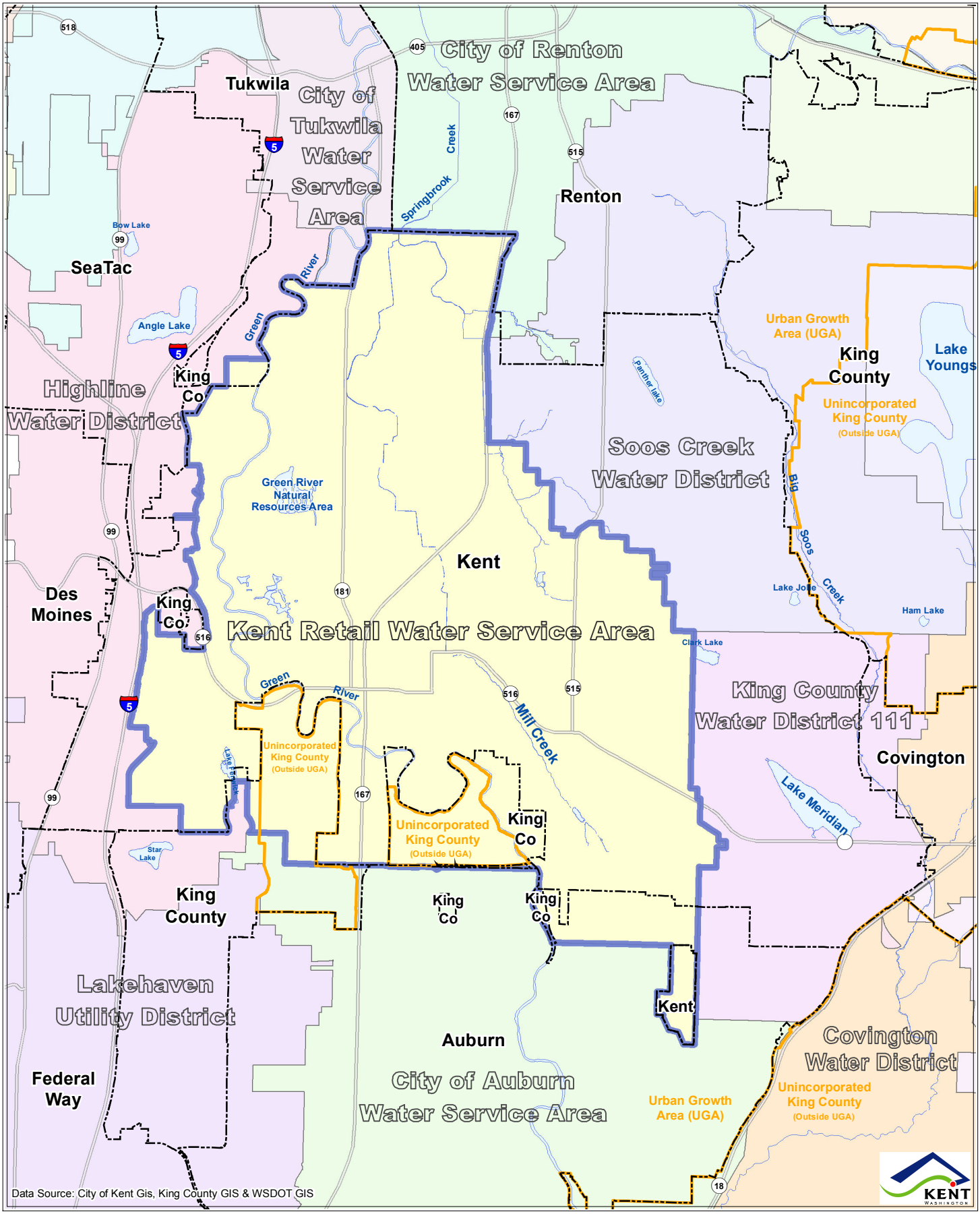
1.3 CHARACTERISTICS OF THE SERVICE AREA

The City of Kent's existing water service area (also referred to as "service area") is predominantly within the City's incorporated boundaries, with the exception of two small, non expanding areas that extend into unincorporated King County and a few small portions of the Cities of Tukwila and Auburn. Residential, commercial, and industrial uses of land are interspersed throughout the service area. Containing over 50,000 jobs, Kent is one of the largest employment centers in southern King County. Situated between Seattle and Tacoma, it is also well suited to commuter-oriented, residential development. Kent is close to the Ports of Seattle and Tacoma, and Sea-Tac International Airport, making its 40-million square feet warehouse/industrial area one of the major destinations in the state of Washington for freight. In addition, two major transcontinental rail lines, and two major freeways travel through the city. There are substantial amounts of flat, industrially-zoned land which continue to attract new industry to the city. Industrial growth has transformed the majority of agricultural uses to industrial along the Kent valley floor and continued economic and population growth is expected for the next several years.

At present, about 20.1 square miles in the service area are within the City of Kent. The principle topographic features are the Green River Valley and the upland plateaus, the East and West Hills rising from both sides of the valley. The valley itself extends from the adjoining City of Auburn to the south through Kent to the cities of Tukwila and Renton in the north. It is about 2.5 miles wide with an elevation ranging from 30 to 40 feet above sea level on the valley floor. The West Hill rises abruptly to about 400 feet, while the East Hill rises to a similar elevation with a gentler slope. Because of the favorable topography on the East Hill, more development has occurred there. The topography of the service area is generally indicated on Figure 1-3.

1.3.1 Geologic Setting

The Kent area is located in the Green River valley near the eastern boundary of the Puget Lowlands physiographic province. The province is bounded on the east by the Cascades North and Cascades South provinces and on the west by the Olympic Mountains and the Willapa Hills provinces. The San Juan Islands form the division between the Puget Lowlands and the Strait of Georgian British Columbia.



Legend

- City Limits
- Urban Growth Area (UGA) Boundary
- Kent Retail Water Service Area

City of Kent

2011 Water System Plan

Boundary / Service Area

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Figure 1-2

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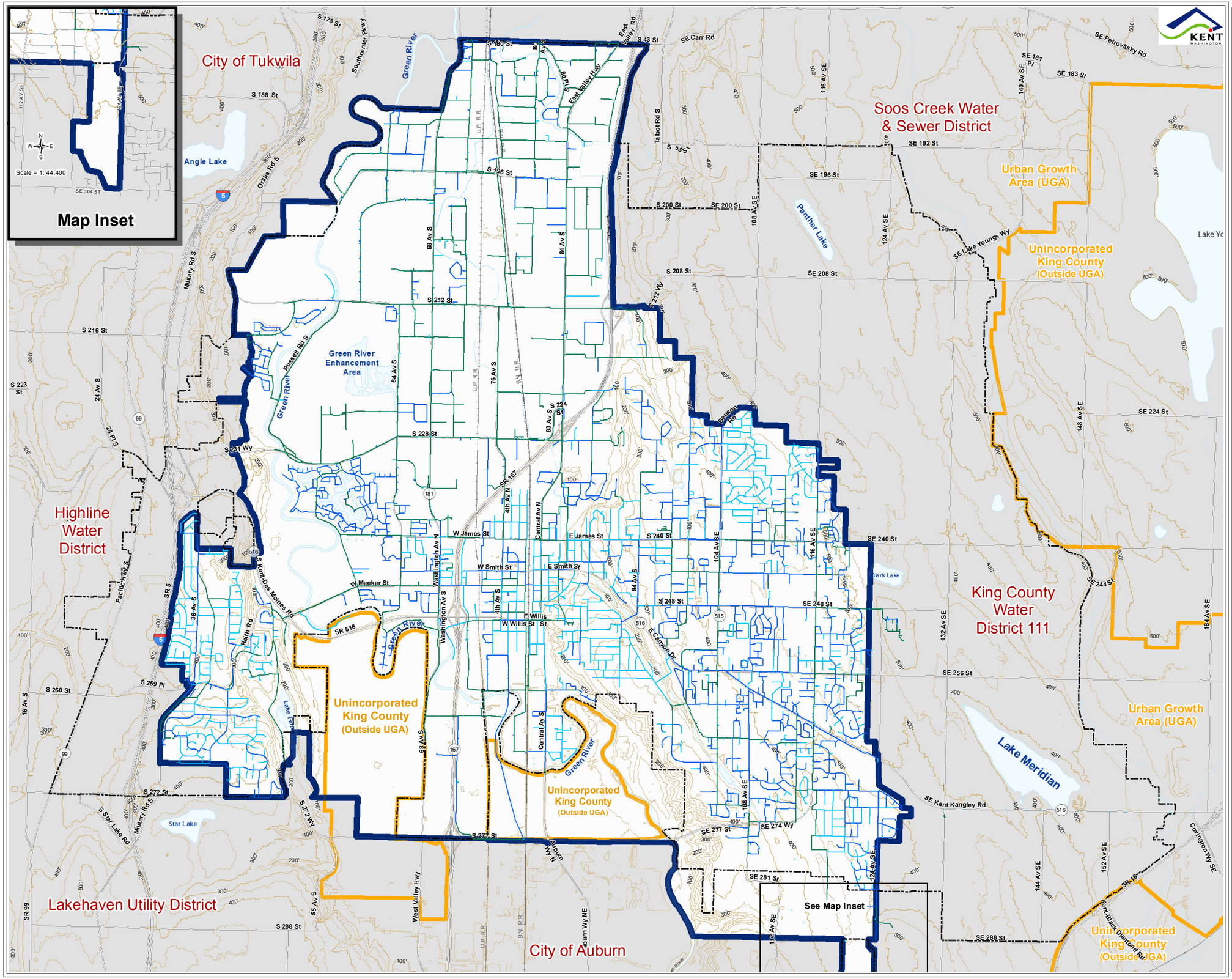

City of Kent

2011 Water System Plan

Topographic Map

Legend

Water Main (Diameter)

- 1" - 6"
- 8"
- 10" - 24"
- Kent City Limits
- Kent Retail Water Service Area
- Urban Growth Area (UGA)
- 100ft Contours
- 50ft Contours

Data source: City Of Kent GIS & King County GIS

N W E S

Scale 1:44,400

0 0.5 1 Mile

Figure 1-3

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The surficial geology of the Puget Lowlands is primarily the result of a continental glacier which advanced from British Columbia approximately 18,000 years ago and covered the entire Puget Sound area as far south as Olympia until approximately 13,000 years ago.

1.3.2 Geologic Structure

The Green River valley is a north-trending topographic feature that defines the service area. The valley is characterized by a relatively flat floor and moderate slopes. Downtown Kent is located on the eastern perimeter of the valley floor, where the Green River crosses from the east to the west side of the valley floor.

The hills east and west of the Kent valley are comprised almost entirely of glacial till and other glacial deposits overlying bedrock principally consisting of Tertiary sedimentary rocks. The youngest of the glacial materials were deposited approximately 13,000 to 15,000 years ago with the recession of the last continental glacier. The floor of the Green River valley is underlain by post-glacial alluvial deposits generally derived from erosion of the glacial deposits in the surrounding hillsides.

There are few faults with surface expression in the Green River valley. Mapped faults generally consist of northeast trending features of limited length. The Seattle fault is located approximately 15 miles north of Kent, and is considered the most significant fault which could affect the City. Kent is located above the subsurface projection of the Cascadia Subduction Zone, where the Juan de Fuca tectonic plate is being forced under the North American continental plate.

1.3.3 Near-Surface Geology

The Green River valley is an eroded trough of glacial origin which is partially filled by more than 400 feet of post-glacial alluvial deposits in the Kent area. Three main depositional units have been identified in the subsurface: younger alluvium, the Osceola mudflow which originated on Mt. Rainier, and older alluvium. Silty sand and gravel deposited along the margin of the Vashon stade glacier are present along the western valley margin.

1.3.4 Subsurface Geology and Groundwater Flow – Clark Springs Area

The Clark Springs are situated in a narrow, sediment-filled channel bounded by till-capped bedrock knobs to the north and south. The infilled materials are very coarse-grained recessional outwash sand and gravel deposited as the last glacier retreated from this area. These coarse-grained glacial deposits extend due east of the Clarks Springs property, then fan out to the north and south just beyond the Georgetown area. The coarse-grained glacial deposits comprise the aquifer which provides groundwater flow to Clark Springs.

Bedrock confinement of the permeable outwash deposits to a narrow channel at the Clark Springs property which is the starting point of the perennial flow of Rock Creek. Bedrock surfaces again east, southeast, and southwest of Lake Retreat over 2 miles east of Clark Springs. In the area by Lake Retreat and southwestward, shallowing bedrock causes the coarse-grained glacial deposits to rise in elevation. This rise distinguishes a northwest-southeast trending trough of recessional outwash that occurs along the east side of the bedrock knobs north and south of Georgetown and west to Lake Retreat. This trough represents former meltwater discharge pathways to the Cedar and Green Rivers and remains a preferred pathway for groundwater flow through this area today.

Groundwater flow through the glacial deposits east of Clark Springs appears to be predominantly east to west. However, within the trough of recessional deposits along the east side of the bedrock knobs north and south of Georgetown, a northward and southward flow pattern is indicated.

1.3.5 Subsurface Geology and Groundwater Flow – Kent Springs

The Kent Springs property lies just north of Lake Sawyer within the glacial drift plain in the western portion of the study area. In this area the bedrock dives steeply beneath a thick sequence of glacial and interglacial sediments. These surficial deposits are predominately Vashon recessional outwash, the permeable recessional outwash deposits seen further east. Till-capped knobs are interspersed within the flatter outwash channels. In this area the subsurface stratigraphy becomes more complex with a thicker sequence of variable material types.

The Kent Springs aquifer appears to be made up of two coarse-grained glacial sequences, the Vashon recessional outwash and the older coarse-grained deposits. At the Kent Springs property these glacial sequences appear to be in direct contact with each other, while to the north, east, and south, till typically separates these units. Till appears to occur beneath the depth of the nearby Covington Water District wells along the north side of Lake Sawyer, parts of Lake Sawyer, and stretches beneath the ground surface between till-capped knobs to the northeast. However, as you near the Kent Springs property, the till deposits are thin or absent. Limited data suggest that the till may also be absent for some distance west-southwest of the Kent Springs site.

Geologic materials and seasonal behavior suggest the Kent Springs are derived from the shallower recessional outwash and the wells are completed in the older coarse-grained deposits. Use of the Springs occurs primarily in the wetter months of the year and this would correlate with renewed recharge of the shallower Vashon recessional outwash deposits. In the drier summer and early fall months the deeper and more continuous older coarse-grained deposits provide a more reliable source.

Groundwater flow through the Kent Springs vicinity is a continuation of the east to

west flow pattern discussed for the Clark Springs property. Moving westward from the Georgetown area toward the Kent Springs property, groundwater passes through the bedrock-bounded recessional outwash channel around Ravensdale Lake into the drift plain in the western portion of the study area. Water level and well log data suggest that much of the groundwater supplying the Kent Springs flows through the Ravensdale channel west toward Lake Sawyer.

1.3.6 Subsurface Geology and Groundwater Flow – Armstrong Springs

The geology around the Armstrong Springs property is similar to the Kent Springs property. The property lies within the recessional outwash plain and the wells appear to tap into the deeper older coarse-grained deposits, lying below the Vashon recessional outwash, in an area where the till seems to be thin or absent. Till occurs toward the southeast and northwest of the property. Till-like material appears to extend beneath the Vashon recessional outwash in these same directions away from the Armstrong Springs property. The till also appears to have eroded away in the area 1-1/2 miles to the northeast of the property within the recessional outwash channel.

Groundwater flow patterns around the Armstrong Springs property are more complex than at Kent and Clark Springs because of multiple hydrogeologic boundary conditions. That is, several regional recharge and discharge factors appear to affect groundwater flow in this area. Regional recharge from the Lake Youngs area creates a north to south flow pattern toward the Armstrong Springs property. This flow pattern converges with the regional east to west flow (dominating the Kent Springs property) in this same area. The Soos Creek valley, located less than one mile west of the Springs property, is a central discharge area for both of these regional groundwater flow systems. Further complicating the groundwater flow interpretation is the likely location of a groundwater divide two miles to the northeast of Armstrong Springs where groundwater flow may be directed toward the Cedar River.

1.3.7 Climate/Weather

The service area is influenced by the West Coast marine climate, which is characterized by mild, wet winters and cool, relatively dry summers. Most of the precipitation occurs as rainfall, although snow does occur almost every year. Approximately 75 percent of the rainfall occurs between October 1 and April 1, with an average annual precipitation of 35 to 40 inches in Kent.

Temperatures are moderated by the proximity of Puget Sound and the Pacific Ocean. The mean annual temperature in Kent is 51.7 degrees Fahrenheit, although extremes of 100 degrees Fahrenheit and minus 5 degrees Fahrenheit have been recorded. Winds from the South prevail in the fall and winter, gradually shifting to a northerly direction in late spring and summer.

Climate is the long term average of temperature and precipitation in a region,

whereas weather is a description of current conditions. In western Washington, latitude, terrain and close proximity to the Puget Sound and the Pacific Ocean influence both weather and climate. Climate change is the alteration of the precipitation and temperature patterns over a long period of time. Though global climates have changed several times in the past, scientists have determined that human activity is impacting current shifts in global climate patterns, including the Puget Sound Region, by the emission of greenhouse gases. Greenhouse gases in the earth's atmosphere trap heat similar to how glass traps heat in a greenhouse. The Washington State Department of Ecology (2007) has estimated the Pacific Northwest's average annual temperature has increased 1.5 degrees Fahrenheit during the 20th century and is expected to rise another 1.9 degrees Fahrenheit before 2030.

In the Spring of 2006, a Climate Change Technical Committee (Committee) was formed as a part of the regional water planning framework in the Puget Sound Basin, which focused on Snohomish, King and Pierce counties. The Committee collaborated with the Climate Impacts Group from the University of Washington to draft technical memoranda and a final report on climate change and the potential impacts to regional water supplies. The study found that large river systems (Sultan, South Fork of the Tolt, Cedar, Green and White Rivers) will have earlier spring peak flows in the future as a result of earlier spring snowmelt. This is an issue for municipal water systems which rely on the snowpack. However, for those municipal systems in the Puget Sound Lowlands, such as Kent, early runoff from melting snowpack is not an issue. The Committee's final report stated that the understanding of impacts of climate change are limited at this time (Palmer, 2007) suggesting that the scientific community is more confident in changes to temperature than in predicted changes to precipitation patterns. Climate change impacts on water supply resources is in its infancy, and, identifying impacts to municipal water supplies is difficult (Palmer, 2007). Potential impacts of climate change are even more difficult to predict in the Puget Lowlands where snowpack is not a factor in municipal water supply operations.

The City of Kent will continue to monitor the science of climate change as additional information and scientific processes improve the understanding of impacts on municipal water supplies in the Puget Sound Lowlands.

Sources:

Palmer, Rick (2007), *Final Report of the Climate Change Technical Committee*, University of Washington, 23 pp

Washington State Department of Ecology, (2007) *Facing the Challenge of Climate Change*, DOE Publication No. 07-01-023, 7 pp

1.4 SERVICE AREA AND NEIGHBORING PURVEYORS

The retail service area (service area) is located within the incorporated City of Kent, plus some additional unincorporated areas within the jurisdiction of King County. Figure 1-2 shows the City limits, and the service area boundaries of the City of Kent and neighboring purveyors. The boundaries were established under the adopted Coordinated Water System Plan for South King County and include approximately 24 square miles. The service area is generally bounded on the west by Interstate Highway 5, on the east by 124th Avenue SE, on

the north by SW 43rd Street, and on the south by S. 277th Street. The City's service area is adjacent to the water service area boundaries of the Cities of Tukwila and Renton on the north, Highline Water District on the West, the City of Auburn on the south, and King County Water District 111 and Soos Creek Water and Sewer District on the east/northeast.

Interties with neighboring water systems increase water system reliability between water purveyors and the City of Kent currently maintains 13 interties with 7 separate water purveyors. The primary function of the interties is to provide emergency service between purveyors, although in some cases they can provide firm supply for use under certain operational situations. Section 7 provides an inventory of all of the system interties and provides a complete analysis of the City's source of supply and system reliability, including the role of the identified interties.

1.5 INVENTORY OF EXISTING FACILITIES

The City of Kent's water distribution system consists of over 270 miles of water mains, 8 storage reservoirs with a total capacity of approximately 21 MG, and six pumping stations. The water system is presently divided into five primary pressure zones based on property elevation and Hydraulic Grade Line (HGL). Some of those primary zones have been divided into smaller sub-areas with the use of pressure reducing facilities to provide better management of the pressures in the zones. The primary water supply sources for the City are Clark Springs, Kent Springs, East Hill Well(s) and the Tacoma Second Supply Pipeline connections. Additional water supply sources are the 212th/208 Street wells with treatment provided by the Iron/Manganese Filtration Plant at 212th Street, Armstrong Springs, Seven Oaks, Garrison and O'Brien well. An overview of the system and primary pressure zones is provided on Figure 1-4.

1.5.1 Connections

Table 1-1 provides a general overview of the distribution of water service connections by customer type and the five primary pressure zones within the system. Smaller pressure zones, or sub-zones, where topography necessitates use of pressure reducing valves (PRVs) to regulate high pressures in isolated areas, have been consolidated into the primary pressure zones from which these areas receive source of supply and storage. The data presented are based on information provided by the City of Kent Utility Billing Department, population and employment data from the City's Planning Department, and the City's Geographical Information System (GIS). More detailed demographic and water use within the system is provided in Chapter 3 of this Plan and includes historical data and population, water service connections, equivalent residential units (ERUs) and water demand projections. A complete summary of methodology associated with demographic and water demand projections is included in Appendix D.

TABLE 1-1: CONNECTIONS AND ERUS
By Pressure Zone and Customer Type

	Pressure Zones					Total
Customer Type	**529**	**354.5**	**240**	**485**	**590**	
Residential Connections	1,784	213	1,727	1,411	4,878	10,013
Residential ERUs	1,953	213	1,412	1,403	5,031	10,013
Multi-Family Connections	21	20	783	102	522	1,448
Multi-Family ERUs	207	185	6,275	981	4,874	12,522
Commercial/Industrial Connections	25	2	1,457	38	337	1,859
Commercial/Industrial ERUs	39	1	9,639	270	1,343	11,292
Governmental/Education Connections	13	2	72	6	45	138
Governmental/Education ERUs	65	0	432	19	201	716
Irrigation Connections	9	2	197	10	44	262
Irrigation ERUs	26	7	3,621	88	516	4,257
Total Connections	*1,852*	*239*	*4,236*	*1,567*	*5,862*	*13,720*
Total ERUs	*2,289*	*407*	*21,379*	*2,761*	*11,964*	*38,801*

Note: All figures are estimates based on 2010 billing system data.

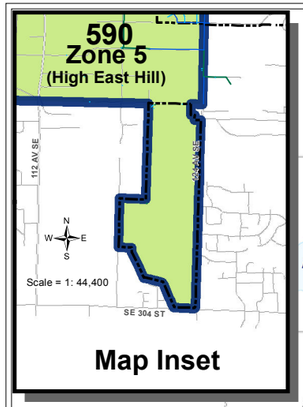
1.5.2 Sources of Supply

Clark Springs, Kent Springs, East Hill Well(s) are the primary water supply sources for the City. The supply from these sources is complemented by the multiple well sources as described below. Capacities of these sources are discussed in Chapter 7.

1.5.2.1 Clark Springs

The Clark Springs source is located several miles east of the City. The City owns 320± acres at this source. This property has been annexed into the City for municipal purposes. The site is segregated by Kent Kangley Road and by Rock Creek. Rock Creek flows through the property in a westerly-northwesterly direction. The Clark Springs water intake facilities consist of three wells and an infiltration gallery and other infrastructure, all of which are used conjunctively to meet water supply needs. They are located in the mid westerly part of the property.

City of Kent
2011 Water System Plan
System Overview



City of Tukwila

Soos Creek Water & Sewer District

Urban Growth Area (UGA)

Unincorporated King County (Outside UGA)

Highline Water District

Lakehaven Utility District

King County Water District 111

City of Auburn

240
Zone 3
(Valley)

485
Zone 4
(Low East Hill)

590
Zone 5
(High East Hill)

354.5
Zone 2
(Low West Hill)

529
Zone 1
(High West Hill)

Green River Enhancement Area

See Map Inset

Angle Lake · Panther Lake · Lake Meridian · Star Lake · Clark Lake · Lake Yc

Green River · Soos Creek

S 178 St · Southcenter Pkwy · S 180 St · 80 Av S · East Valley Rd · S 43 St · SE Carr Rd · SE Petrovitsky Rd · SE 181 Pl · SE 183 St · 140 Av SE · 116 Av SE · S 188 St · Orillia Rd S · I-5 · UP R.R. · East Valley Hwy · Talbot Rd S · S 192 St · SE 192 St · S 196 St · SE 196 St · S 200 St · SE 200 St · 124 Av SE · SE Lake Youngs Wy · S 208 St · SE 208 St · S 212 Wy · 108 Av SE · S 212 St · SR 99 · S 216 St · SR 5 · Russell Rd S · 64 Av S · 68 Av S · 76 Av S · B.N. R.R. · 84 Av S · SR 167 · S 223 St · 24 Av S · 24 Pl S · Military Rd S · S 224 St · 83 Av S · Benson Rd · S 228 St · S 231 Wy · 132 Av SE · 148 Av SE · SE 224 St · 4th Av N · Central Av N · W James St · E James St · S 240 St · SE 240 St · 104 Av SE · W Smith St · E Smith St · W Meeker St · Washington Av N · Washington Av S · 4th Av S · S 248 St · SE 248 St · E Willis St · W Willis St · Reith Rd · SR 516 · Green River · E Canyon Dr · 36 Av S · 16 Av S · S 260 St · S 259 Pl · Pacific Hwy S · Lake Fenwick · S 272 St · S 272 Wy · S Star Lake Rd · SR 5 · Military Rd S · S 277 St · SE 277 St · SE 274 Wy · 108 Av SE · Auburn Wy N · West Valley Hwy · 55 Av S · S 288 St · SR 99 · SE 281 St · 124 Av SE · 132 Av SE · 144 Av SE · 152 Av SE · SR 164 · Covington Wy SE · SE 240 St · SE 244 St · SE 256 St · 164 Av SE · SE 288 St · Kent-Black Diamond Rd

Data source: City Of Kent GIS & King County GIS

Printed: June 23, 2011

Legend

Water Main (Diameter)

- 1" - 6"
- 8"
- 10" - 24"
- Kent City Limits
- Urban Growth Area (UGA) Boundary
- Kent Retail Water Service Area
- 529 Pressure Zone
- 354.5 Pressure Zone
- 240 Pressure Zone
- 485 Pressure Zone
- 590 Pressure Zone

N
W E
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Scale 1:44,400

0 0.5 1 Mile

Figure 1-4

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1.5.2.2 Kent Springs

The Kent Springs source is located near Black Diamond. The City owns 75± acres at this source. This property has been annexed into the City for municipal purposes. The site is segregated by Cran-Mar Creek which flows through the property in a westerly direction. The water intake facilities consist of a wellfield and a spring fed infiltration gallery. The actual summer and winter production capacity is limited by the aquifer levels. Reliability of the wells has been significantly increased by the addition of variable speed drives on the well pumps, allowing them to pump at a rate commensurate with the available water supply.

1.5.2.3 East Hill Wells

Located in the East Hill area and pumping into the 590 zone 3.5 MG Reservoir and Blue Boy Standpipe, the East Hill Wells can provide 3.0 MGD during a peak period, and a yearly average supply of 1.2 MGD, based on 365 days per year of pumping.

1.5.2.4 Garrison Well

Located in the northeast part of the City, the Garrison Well can supply 0.92 MGD during peak demand and 0.81 MGD as a yearly average, based on 120 days of pumping per year. It is pumped directly into the 6 Million Gallon #2 reservoir, which supplies the 240 zone (Valley system).

1.5.2.5 Seven Oaks Well

Located near the top of East Hill, the Seven Oaks Well can supply 0.97 MGD at peak demand and 0.88 MGD on a yearly average, based on 120 days of operation per year. The Seven Oaks Well pumps directly into either the Clark Springs or Kent Springs Transmission Mains.

1.5.2.6 Armstrong Springs Wells

Located outside of Covington, Armstrong Springs Wells can yield 1.7 MGD at peak demand and 1.35 MGD on a yearly average, based on 120 days of operation per year. The Armstrong Spring Wells pump directly into either the Clark Springs Transmission Main or Kent Springs Transmission Main.

1.5.2.7 O'Brien Well

Located near the Valley floor, the O'Brien Well can yield 0.35 MGD during peak demand and serves the 240 pressure zone.

1.5.2.8 212th/208th Street Wells

Also located near the Valley floor, the 212th/208th Street Wells are pumped to the Iron/Manganese Filtration Plant that serves the Valley (240) zone. These wells can yield up to 6 MGD at peak demand and 5.4 MGD on a yearly average based on 120 days of operation per year.

1.5.2.9 Tacoma Second Supply Line

In June 1985, an agreement was executed with the City of Tacoma for Kent to share in both the capital costs and the operational and maintenance costs of Tacoma's Green River Pipe Line #5 project (also referred to as Second Supply Pipeline or SSP), to include portions of the water right and surface water storage behind the Howard Hansen Dam.

On December 16, 1997 a conceptual agreement was signed between City of Tacoma Public Utilities Water Division, Covington Water District, Lakehaven Utility District, and the City of Kent. In 2001, a partnership agreement was enacted among all agencies participating in the project. In 2002, after Seattle Public Utilities opted out of the project, the remaining participants divided Seattle's capacity share and remaining Seattle costs equally between the partners. This increased Kent's capacity in the project to 12.64 MGD (assuming a 100 day operating period). In October 2005, the pipeline began conveying water to the SSP partners and Tacoma wholesale customers. Tacoma manages and maintains the pipeline, water supply and treatment facilities for the partnership, and each partner has a capacity share in the project. Fixed operating costs are billed to each partner by Tacoma, and variable costs based on the quantities of water used are added to the assessment, with a "true up" of costs occurring at the end of each fiscal year.

The City has three Interties or "turnouts" with the SSP. The SSP #1 Connection is located at the Kent Springs source to provide water to the Kent Springs Transmission Main (KSTM). The SSP #3 Connection is near the 3.5 Million Gallon Tank and can provide water to both the 590 zone and the KSTM. SSP #3 will also be capable of supplying the future 640 Zone without pumping. The SSP #2 Connection has been left undeveloped for future use.

The Second Diversion water right associated with this source of water is constrained by minimum instream flows in the Green River year round. Tacoma executed a separate agreement with the United States Army Corps of Engineers which allows for the storage of Second Diversion water behind Howard Hansen Dam. The fill period is February 15th through June 30th. Assuming a full pool (20,000 acre-feet) is achieved during the fill period, Kent's proportionate share of 7/36th is equivalent to 3,889 acre-feet. This

volume of water must be utilized by Kent, or another project Partner, before the water is released by the Corps of Engineers. The timing of the release is dependent on the Corps of Engineers' interpretation of weather forecasts, however, it has normally been in early November.

The Second Diversion supply is also constrained by turbidity levels in the Green River. When turbidity levels reach 3.5 ntu's Tacoma begins utilizing water from ground water supplies under a different water right that is only available to Tacoma, and blends it with the Green River water to reduce turbidity. This blended water may be available to the Partner(s) (Tacoma Water, City of Kent, Covington Water District, and Lakehaven Utility District) under a wholesale purchase agreement with Tacoma. In an analysis conducted by Tacoma for the years 1984 through 1993, only the months of June through September had multiple reoccurring years in which turbidity levels would not have constrained the supply. Therefore, without filtration, Kent considers the Tacoma supply reliable during the months of June through September only; although the supply may be available during other periods of the year.

1.5.3 Water Treatment

The primary treatment of the water supplied to the Kent consumers is chlorination and fluoridation. Chlorination and fluoridation take place at all the springs and well sources. Pressure filters use potassium permanganate and greensand technology to remove iron, manganese and hydrogen sulfide at the 212th treatment plant. PH adjustment with the addition of sodium hydroxide takes place at the 212th Treatment Plant, Pump Station No. 5 (Clark Springs supply), and East Hill Wells to reduce the corrosivity of the finished water on household plumbing and to maintain compliance with the Lead and Copper Rule. Aeration at the Guiberson reservoir is the current pH adjustment technique for the Kent Springs supply. A new sodium hydroxide pH adjustment facility is under design to treat blended Kent Springs and Tacoma water near the Guiberson Reservoir site. Construction of this facility is anticipated in 2009. Additional water treatment information is provided in Chapter 7.

1.5.4 Transmission Mains

The Clark Springs Transmission Main (CSTM), originates at the Clark Springs source and terminates at the James Street reservoir on 98th Avenue S./S. 240th Street. It is approximately 12 miles long and the diameter varies from 18- to 24-inches. There are no service connections on this transmission main.

The Kent Springs Transmission Main (KSTM), which originates at the Kent Springs source and terminates at the Guiberson Street reservoir, was re-constructed in the 1980's and 1990's. The new main was constructed in phases and replaced the original concrete cylinder Kent Springs Transmission Main which was not capable of

conveying maximum flows from Kent Springs due to deteriorating conditions. The new main has been constructed and sized to accommodate additional flows from the Kent Springs and Clark Springs sources and the future flows from the Tacoma SSP project. It is approximately 10 miles long and the diameter varies from 18- to 36-inches and is constructed primarily of ductile iron pipe. There are no service connections on this transmission main.

The Clark Springs Transmission Main has an eighteen inch (18-inch) intertie with the Kent Springs Transmission Main at Kent Springs, a twelve inch (12-inch) intertie with the Kent Springs Transmission Main at Armstrong Springs and another between there and the City. From that point to the Tacoma SSP #3 Intertie, the Kent Springs Transmission Main is capable of accommodating the pumping flows from both Kent and Clark Springs (13.8 MGD). This requires the addition of a future surge control station at the Kent and Clark Springs Transmission Main intertie prior to conveying flows from the Clark Springs Transmission Main to the Kent Springs Transmission Main.

There are 1.7 miles of 16-inch transmission main between the James Street Reservoir and the 6 Million Gallon #2 Reservoir. There are a limited number of service connections on this transmission main that the City plans to remove in the future as the distribution piping in the area is constructed.

From the SSP connection near 3.5 Million Gallon reservoir to the Guiberson Street reservoir, the Kent Springs Transmission Main has a gravity flow capacity of 15.5 MGD. It consists of 14,030 feet of 36-inch main and 7,483 feet of 24-inch main.

Thus the combined capacity of the two transmission mains at gravity flow ranges from 8.25 MGD to 9.05 MGD. The combined capacity with both Kent Springs and Clark Springs under forced flow conditions is 13.8 MGD.

The 34-mile Tacoma Second Supply Pipeline is owned and maintained by the City of Tacoma. The pipeline has a capacity of 72 MGD. It conveys flows from the Tacoma Water Headworks diversion dam to Pipeline No. 4 near the Portland Avenue Reservoir. The pipeline diameter varies from 48-inches to 90-inches.

1.5.5 Pressure Zones

The total service area is divided into five primary pressure zones, each of which has a distinct hydraulic grade, as follows:

- High East Hill System at elevation 590 feet above sea level (590 zone)
- Low East Hill System at 485 feet (485 zone)
- Valley System at 240 feet (240 zone)
- Low West Hill System at 354.5 feet (354 zone)
- High West Hill System at 529 feet (529 zone)

1.5.5.1 High East Hill System

The primary supply sources for the High East Hill System (590 zone) are Clark Springs, the East Hill Wells, and the Tacoma intertie. A transmission main connects Clarks Springs directly to the 6 MG #1 reservoir (James Street Tank). Pump Station No. 5 boosts water from the 6 MG #1 reservoir to the 590 zone.

The East Hill Wells source pumps directly into the distribution system after treatment.

The Tacoma intertie is located at the southern end of the pressure zone. The connection has been sized to meet the future demands of both the 590 and 485 zones as well as a portion of the KSTM demands supplied to the 240 zone, via gravity flow.

The 590 zone can also be served in an emergency by the Soos Creek Sewer and Water District or Water District #111 interties.

Because Water District #111 and the City's system are at the same hydraulic elevation (590), they can operate as a single system. In fact, when Kent was the District's sole water source they were operated as one. Today, however, with the District supplying its own water, these interties are no longer used. The fourth intertie with the District was located at 150th Place SE and Kent Kangley Road. This intertie connected the Clark Springs Transmission Main directly to a pump station that delivered water to the District's reservoir. This intertie was capped during the reconstruction of Kent Kangley Road and may be relocated at some future date.

Storage for the 590 zone is provided by the Blue Boy Standpipe, the 3.5 MG Standpipe, and ¼ of the 6 MG #1 Reservoir. A future 3.5 MG standpipe has been proposed in the future 640 zone which will provide additional storage to both the 590 and 485 pressure zones.

In 2006 the City executed an agreement with Water District #111 and the City of Auburn stating the entire 150 acre former water impoundment site west of 124th Ave SE. and south of SE 288th St would be within the City of Kent's service area. This site is located within the 590 pressure zone.

In the fall of 2007, the City obtained the services of a consultant to study the 590 pressure zone. The purpose of the study was to propose solutions for areas with pressures below both City and DOH standards. The consultant has recommended the City create a new 640 pressure zone. A summary of this analysis is located in Appendix F.

The approximate boundaries for the High East System are:

North: SE 224th Street
East: 124th Avenue SE
South: SE 304th Street
West: 98th Avenue S.

1.5.5.2 Low East Hill System

Primary supply source for the Low East Hill System (485 zone) is Clark Springs. The Clark Springs Transmission Main (CSTM) is directly connected to the 6 MG #1 Reservoir. Pump Station No. 5 boosts water from the 6 MG #1 Reservoir to the 485 zone. Storage for the 485 zone is provided by a 125,000 gallon Elevated Tank and ¼ of the capacity of the 6 MG #1 reservoir.

A secondary source of supply is the Tacoma supply via wheeling water through the High East Hill System through a new pressure reducing station that was constructed in 2006 on Woodland Way. Additional PRV's are planned between these pressure zones in the future.

The 485 zone is connected to the 590 system in the vicinity of Pump Station No. 5 through a pressure reducing station. This pressure reducing station is only activated when the Elevated Tank is taken out of service or some other problem prohibits supplying water to the system via Pump Station No. 5.

The approximate boundaries for the Low East System are:

North: SE 218nd Street
East: 98th Avenue S.
South: S. 257th Street
West: Clearview Avenue S.

1.5.5.3 Valley System

Primary supply sources for the Valley System (240 zone) are the Clark Springs, Kent Springs, and Tacoma supply. Storage for the 240 zone is provided by the 6 Million Gallon #2 Reservoir, the Guiberson Reservoir, and part of the 6 MG #1 Reservoir.

The 6 Million Gallon #2 Reservoir serves the northern areas of the 240 zone and Guiberson Reservoir serves the southern. A transmission main connects Kent Springs directly to the Guiberson Reservoir. The 240 zone has multiple secondary supply sources:

- Garrison Well (pumped directly into 6 Million Gallon #2 Reservoir)
- 212th Street Wells
- 208th Street Well
- O'Brien Well

In 2005, the City executed a voluntary agreement with Highline Water District to adjust the parties' existing service area boundaries near the base of the West Hill relating to the Kentview Development. The agreement and related

service area maps are provided in Appendix J. The maps are used by both parties to ensure that service requests are referred to the proper water system. See related discussion in Chapter 2.

The approximate boundaries for the Valley System are:

North: S 180th Street	South: S 277th Street
East: 94th Avenue S	West: Base of West Hill slope

1.5.5.4 Low West Hill System

The primary supply source for the Low West Hill System (354 zone) is the 240 zone. Pump Station No. 3 boosts water from the 240 zone to the 354 zone. Storage for the 354 zone is provided by the Reith Road Standpipe.

The 354 zone is connected to the 529 zone (High West Hill System) through Pump Station No. 4.

The approximate boundaries for the Low West Hill System are:

North: W Meeker Street	South: S. 272nd Street
East: Lake Fenwick Rd S.	West: Reith Road

1.5.5.5 High West Hill System

Primary supply source for the High West Hill System (529 zone) is the 240 zone. Pump Station No. 4 boosts water from the 354 zone to the 529 zone. Storage for the 529 zone is provided by the Cambridge Tank. Additional storage is proposed in this zone at some time in the future, as well as an alternate supply pipeline and booster pump system. The 529 zone can also be served by the Highline Water District intertie (Pump Station No. 8).

The 529 zone serves two minor pressure zones, the 575 and 587 zones. Storage is not provided for these zones. Pump Station No. 6 boosts water from the 529 zone to the 587 zone. Pump Station No. 7 boosts water from the 529 zone to the 575 zone. Pressure reducing stations allow water to gravity flow from the 575 and 587 zones to the 529 zone.

The approximate boundaries for the High West system are:

North: S. 241st Street	South: S. 272nd Street
East: Reith Road	West: I-5

1.6 RELATIONSHIPS WITH OTHER PLANS

City of Kent Comprehensive Plan: The goals and policies identified in this Water System Plan complement and support those stated the 1995 City-wide Comprehensive Plan (2004 Update).

City of Kent Sewerage Plan: The Water System Plan is consistent with the City's Sewerage Plan. There are no areas scheduled for water service without accompanying sewerage service.

1.6.1 Previous Planning Studies

Development on this Plan has been coordinated with a variety of plans and studies which have previously been prepared by/for the City. The below listed documents were utilized as source material or are referenced herein as a source of additional information.

- City of Kent Aquifer Reliability Study, Robinson/Noble/Saltbush, 2008
- City of Kent Water Storage Calculations, HDR, Inc., September 2005
- Description of Kent's Hydraulic Modeling Analysis, HDR, Inc., October 2004
- Water System Plan for the City of Kent, City of Kent Department of Public Works, 2002.
- Earthquake Vulnerability Assessment Water, Waste Water and Storm Systems, Dames & Moore, December 1996.
- Corrosion Control Project Consolidated Treatment and Siting Report, Economic & Engineering Services, January 1997.
- City of Kent Comprehensive Plan, City of Kent Planning Department, April 1995 (Updated 2004).
- City of Kent Wellhead Protection Program Clark, Kent, and Armstrong Springs, 1996 (Updated 2008).
- City of Kent Wellhead Protection Plan Phase 2, Aspect, Inc., 2008.
- 640 Zone Creation Report, RH@ Engineering, Inc. 2008.