King County Reclaimed Water Comprehensive Plan

# Reclaimed Water Strategy Effects on the Built Environment

**WORKING DRAFT**

**March 2012**

King County

Department of
Natural Resources and Parks
**Wastewater Treatment Division**

***For comments or questions, contact:***
Steve Tolzman
King County Wastewater Treatment Division
201 South Jackson Street
KSC-NR-0512
Seattle, WA 98104-3856
206-263-6185
steve.tolzman@kingcounty.gov

This information is available in alternative formats on request at 206-684-1280 (voice) or 711 (TTY).

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# Effects on the Built Environment

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March 2012

## Prepared for:

King County Wastewater Treatment Division
Department of Natural Resources and Parks

## Prepared by:

Brown and Caldwell and Associated Firms

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

# Table of Contents

Executive Summary ..... 1

1.0. Introduction ..... 7

1.1 Background ..... 7

1.2 Description and Location of Strategies ..... 8

1.3 Objectives of this Evaluation ..... 9

1.4 Content and Organization of this Report ..... 9

2.0. Reclaimed Water Standards and the Built Environment ..... 11

2.1 Reclaimed Water Quality and Proposed Nonpotable Consumptive Uses ..... 11

2.1.1 Agricultural Irrigation ..... 13

2.1.2 Non-agricultural Irrigation ..... 14

2.1.3 Groundwater ..... 15

2.2 Regional Plans ..... 15

2.2.1 King County Strategic Plan ..... 15

2.2.2 King County Comprehensive Plan ..... 16

2.2.3 Waterways 2000 ..... 17

2.2.4 Watershed Resource Inventory Areas ..... 18

2.3 Greenhouse Gas Emissions ..... 19

2.3.1 Background Information ..... 19

2.3.2 Greenhouse Gas Emissions from Reclaimed Water Strategies ..... 20

2.3.3 Significance Thresholds for GHG Emissions ..... 21

3.0. Methodology ..... 23

3.1 Effects on Public Health ..... 23

3.2 Effects on Parks and Recreation ..... 23

3.3 Effects on Groundwater ..... 24

3.4 Effects on Public Services and Utilities ..... 24

3.5 Compatibility with Regional Plans ..... 24

3.6 Greenhouse Gas Emission Estimates ..... 25

3.6.1 Tailpipe Emissions During Construction of New Wastewater Treatment Processes and Reclaimed Water Distribution Piping ..... 25

3.6.2 N20 Emissions from Nitrification-Denitrification Treatment Processes ..... 25

3.6.3 Indirect GHG Emissions from Purchase of Electricity from Puget Sound Energy ..... 25

4.0. Redmond/Bear Creek Brightwater Centralized Strategy ..... 27

4.1 Potential Effects on Public Health ..... 27

4.2 Potential Effects on Parks and Recreation ..... 27

4.3 Potential Effects on Groundwater Resources ..... 28

4.3.1 Replacement of Withdrawals ..... 28

4.3.2 Protection of Groundwater ..... 29

4.4 Compatibility with Public Services and Utilities ..... 30

4.4.1 Water Supply Plans ..... 30

4.4.2 Sewer System Plans ..... 30

4.5 Compatibility with Regional Planning ..... 30

4.5.1 King County Strategic Plan ..... 30

4.5.2 King County Comprehensive Plan ..... 31

4.5.3 Waterways 2000 ..... 31

4.5.4 Watershed Resource Inventory Area 8 ..... 32

4.6 Forecast GHG Emission Rates for Reclaimed Water Strategies ..... 32

5.0. Renton/Tukwila South Plant Centralized Strategy ..... 35

5.1 Potential Effects on Public Health ..... 35

5.2 Potential Effects on Parks and Recreation ..... 35

5.3 Potential Effects on Groundwater Resources ..... 36
5.3.1 Replacement of Withdrawals ..... 37
5.3.2 Protection of Groundwater ..... 37
5.4 Compatibility with Public Services and Utilities ..... 37
5.4.1 Water Supply Plans ..... 37
5.4.2 Sewer System Plans ..... 38
5.5 Compatibility with Regional Planning ..... 38
5.5.1 King County Strategic Plan ..... 38
5.5.2 King County Comprehensive Plan ..... 38
5.5.3 Waterways 2000 ..... 39
5.5.4 Watershed Resource Inventory Area 8 ..... 39
5.6 Forecast GHG Emission Rates for Reclaimed Water Strategies ..... 39
6.0. Interbay Skimming Decentralized Strategy ..... 41
6.1 Potential Effects on Public Health ..... 41
6.2 Potential Effects on Parks and Recreation ..... 41
6.3 Potential Effects on Groundwater Resources ..... 42
6.3.1 Replacement of Withdrawals ..... 42
6.3.2 Protection of Groundwater ..... 42
6.4 Compatibility with Public Services and Utilities ..... 42
6.4.1 Water Supply Plans ..... 42
6.4.2 Sewer System Plans ..... 42
6.5 Compatibility with Regional Planning ..... 43
6.5.1 King County Strategic Plan ..... 43
6.5.2 King County Comprehensive Plan ..... 43
6.5.3 Waterways 2000 ..... 43

6.5.4 Watershed Resource Inventory Area 8 ..... 43
6.6 Forecast GHG Emission Rates for Reclaimed Water Strategies ..... 43
7.0. Duwamish Polishing Decentralized Strategy ..... 45
7.1 Potential Effects on Public Health ..... 45
7.2 Potential Effects on Parks and Recreation ..... 45
7.3 Potential Effects on Groundwater Resources ..... 45
7.3.1 Replacement of Withdrawals ..... 45
7.3.2 Protection of Groundwater ..... 46
7.4 Compatibility with Public Services and Utilities ..... 46
7.4.1 Water Supply Plans ..... 46
7.4.2 Sewer System Plans ..... 46
7.5 Compatibility with Regional Planning ..... 46
7.5.1 King County Strategic Plan ..... 46
7.5.2 King County Comprehensive Plan ..... 47
7.5.3 Waterways 2000 ..... 47
7.5.4 Watershed Resource Inventory Area 9 ..... 47
7.6 Forecast GHG Emission Rates for Reclaimed Water Strategies ..... 47
8.0. Lower Green River Valley Skimming Decentralized Strategy ..... 49
8.1 Potential Effects on Public Health ..... 49
8.2 Potential Effects on Parks and Recreation ..... 49
8.3 Potential Effects on Groundwater Resources ..... 49
8.3.1 Replacement of Withdrawals ..... 49
8.3.2 Protection of Groundwater ..... 50
8.4 Compatibility with Public Services and Utilities ..... 50
8.5 Compatibility with Regional Planning ..... 50

8.5.1 King County Strategic Plan ..... 50

8.5.2 King County Comprehensive Plan..... 50

8.5.3 Waterways 2000..... 51

8.5.4 Watershed Resource Inventory Area 9 ..... 51

8.6 Forecast GHG Emission Rates for Reclaimed Water Strategies ..... 51

9.0. References..... 53

Figures..... 57

# Tables

Table 2-1. Reclaimed Water Use Categories..... 13

Table 2-2. River Basins and Reaches Selected for the Waterways 2000 Program..... 17

Table 4-1. Parks in the Redmond/Bear Creek Basin Brightwater Centralized Strategy Where Reclaimed Water is Proposed for Non-Agricultural Irrigation..... 28

Table 4-2. Greenhouse Gas Emissions for Reclaimed Water Strategies..... 33

Table 5-1. Parks in the Renton/Tukwila South Plant Centralized Strategy Where Reclaimed Water is Proposed for Non-Agricultural Irrigation..... 36

Table 5-2. Greenhouse Gas Emissions for Reclaimed Water Strategies..... 40

Table 6-1. Parks in the Interbay Skimming Decentralized Strategy Where Reclaimed Water is Proposed for Non-Agricultural Irrigation ..... 41

Table 6-2. Greenhouse Gas Emissions for Reclaimed Water Strategies..... 44

Table 7-1. Greenhouse Gas Emissions for Reclaimed Water Strategies..... 48

Table 8-1. Greenhouse Gas Emissions for Reclaimed Water Strategies..... 52

# Figures

**Figures are at the back of the document, with the exception of Figure 2-1.**

Figure 1-1. Reclaimed Water Strategies Recommended for Analysis

Figure 2-1. 1997 Water Reclamation and Reuse Standards (Washington State Departments of Health and Ecology)

Figure 4-1. Parks and Recreation—Brightwater

Figure 4-2. Wellhead Protection Areas—Brightwater

Figure 4-3. Critical Aquifer Recharge Areas—Brightwater

Figure 5-1. Parks and Recreation—South Plant

Figure 5-2. Wellhead Protection Areas—South Plant

Figure 5-3. Critical Aquifer Recharge Areas—South Plant

Figure 5-4. Sole Source Aquifer—South Plant

Figure 6-1. Parks and Recreation—Interbay

Figure 7-1. Parks and Recreation—Duwamish

Figure 7-2. Wellhead Protection Areas—Duwamish

Figure 7-3. Critical Aquifer Recharge Areas—Duwamish

Figure 8-1. Parks and Recreation—Lower Green River Valley

Figure 8-2. Wellhead Protection Areas—Lower Green River Valley

Figure 8-3. Critical Aquifer Recharge Areas—Lower Green River Valley

# Acronyms and Abbreviations

| | |
|---|---|
| BAAQMD | Bay Area Air Quality Management District |
| CEQA | California Environmental Quality Act |
| CH4 | methane |
| CO2 | carbon dioxide |
| COC | Citizens Oversight Committee |
| EPA | U.S. Environmental Protection Agency |
| ETS | Effluent Transfer System |
| GHG | greenhouse gas |
| GIS | Geographic Information Systems |
| GMA | Growth Management Act |
| GWP | global warming potential |
| IPCC | Intergovernmental Panel on Climate Change |
| LGRV | Lower Green River Valley |
| LOTT | LOTT Clean Water Alliance |
| MBR | membrane bioreactor |
| mgd | million gallons per day |
| MW-hr | megawatt-hours |
| N2O | nitrous oxide |
| PSE | Puget Sound Energy |
| RCW | Revised Code of Washington |
| SEPA | State Environmental Policy Act |
| SPU | Seattle Public Utilities |
| SSP | Section Supply Pipeline Project |

| | |
|---|---|
| TIN | Total inorganic nitrogen |
| TMDL | Total Daily Maximum Daily Load |
| TPU | Tacoma Public Utilities |
| WRIA | Watershed Resource Inventory Area |
| WTD | Wastewater Treatment Division |

# EXECUTIVE SUMMARY

This document reports on the potential effects of King County reclaimed water strategies pertaining to (1) the use of reclaimed water for nonpotable consumptive purposes, (2) the effect of the reclaimed water strategies on groundwater, (3) the compatibility of the reclaimed water strategies, and the associated uses of reclaimed water, with existing local and regional plans, and (4) the emission of greenhouse gases from construction and operation of facilities to produce reclaimed water.

This evaluation was done to support the development of a Reclaimed Water Comprehensive Plan for King County's Wastewater Treatment Division (WTD). The purpose of the Reclaimed Water Comprehensive Plan is to determine if, how, when, where, and by what funding mechanisms King County's existing reclaimed water program should expand over the next 30 years, through 2040 and beyond.

This report is part of a series of reports that document efforts to further define and evaluate three reclaimed water strategies developed and approved earlier in the reclaimed water planning process.

Each reclaimed water strategy represents a concept for producing and supplying reclaimed water to serve potential uses identified during the reclaimed water planning process. The uses include both nonpotable consumptive uses (irrigation, commercial, industrial) and environmental enhancement uses (wetland enhancement and associated indirect groundwater recharge and/or streamflow augmentation). The following are brief descriptions of the strategies.

- **Redmond/Bear Creek Basin Brightwater Centralized Strategy.** Reclaimed water would be produced through the membrane bioreactor (MBR) process at the Brightwater Treatment Plant for distribution to two areas—one in the immediate vicinity of the plant and one farther south above Lake Sammamish—via new pipelines connected to the South Segment of the Brightwater reclaimed water pipeline.
- **Renton/Tukwila South Plant Centralized Strategy**. Reclaimed water would be produced through expansion of the South Treatment Plant's tertiary sand filtration system for distribution to an area just south of Lake Washington via extension of an existing pipeline that delivers reclaimed water to the City of Tukwila.
- **Reclaimed Water Skimming or Polishing Decentralized Strategy.**[1] This strategy represents opportunities for smaller-scale reclaimed water implementation. Infrastructure was constrained to a single treatment plant of up to 0.5 million gallons per day (mgd) capacity and up to 1 mile of reclaimed water pipeline. Three potential areas and configurations—two in Seattle and one in the Green River Valley—were identified to help define the decentralized strategy.

[1] A skimming plant removes some of the raw wastewater from pipelines that carry the wastewater to regional plants for treatment and then treats the wastewater to reclaimed water quality for local distribution. A polishing plant removes some secondary-treated effluent from pipelines exiting regional treatment plants and treats the effluent to reclaimed water quality standards.

- An MBR skimming plant located in the Interbay area of Seattle would produce reclaimed water from untreated wastewater in adjacent conveyance pipelines for distribution near the plant via a new pipeline.
- A sand filtration polishing plant located in Seattle on the west side of the Duwamish River would produce reclaimed water from flows in the Effluent Transfer System (ETS) pipeline that carries South Treatment Plant secondary effluent for discharge at Alki Point in West Seattle. The reclaimed water would be distributed to nearby uses via a new pipeline.
- An MBR skimming plant located in the lower Green River Valley in south King County would produce reclaimed water from untreated wastewater in adjacent conveyance pipelines for distribution near the plant via a new pipeline.

All of the strategies propose supplying Class A reclaimed water for nonpotable consumptive uses; the Brightwater and South plant strategies also propose supplying Class A reclaimed water for environmental enhancement of wetlands. Class A reclaimed water is the highest standard of reclaimed water in Washington state. According to the Revised Code of Washington (RCW) 90.46, wastewater that has been cleaned to Washington State Departments of Ecology and Health Class A standards can be used for many purposes and is thereafter considered reclaimed water and not wastewater.

The tables below provide synopses, for each strategy location, of the evaluations that are addressed in this report, specifically the effects of nonpotable consumptive uses of reclaimed water, the compatability of the strategies with local and regional plans, and the impact of the strategies on green house gas emissions.

**Table ES-1. Summary for Redmond/Bear Creek Basin Brightwater Centralized Strategy**

| | |
|---|---|
| Public Health | A potential exists for human contact with reclaimed water through agricultural and non-agricultural irrigation. The uses proposed are consistent with current Washington state standards, which ensure reclaimed water is safe for human contact. |
| Recreation | Strategy would include irrigation of Basset Pond Natural Area, Cold Creek Natural Area, Cottage Lake Park, and Marymoor Park. Irrigation of parks with Class A reclaimed water is consistent with current Washington state standards. |
| Groundwater | Three agricultural irrigation, non-agricultural irrigation, and commercial/industrial uses are found in the 1-year, 5-year, and 10-year wellhead protection areas. Reclaimed water would not come into contact with the ground surface from the commercial/industrial use. Irrigation water would be applied at agronomic rates and infiltration to ground water is not anticipated.<br>Reclaimed water used for non-agricultural irrigation and environmental enhancement in the northern portion of this strategy area overlap with critical aquifer recharge areas. There is a potential for reclaimed water used for wetland enhancement to percolate into groundwater; a hydrogeologic study would be required before proceeding with this use.<br>To the extent that reclaimed water could be used to replace nonpotable water uses within the Redmond-Bear Creek Valley Groundwater Management Area, more groundwater could contribute to increasing stream base flows. |
| Public Services and Utilities | The City of Redmond and City of Woodinville water supply plans identify reclaimed water as a potential water source. According to RCW 90.46.120(3) and RCW 90.48, the cities of Redmond and Woodinville both are required to coordinate their water supply plans or water system plans with the reclaimed water available and/or proposed for use from the Brightwater plant. |
| Regional Planning | The Redmond/Bear Creek Basin Brightwater Centralized Strategy is consistent with the King County Strategic Plan and King County Comprehensive Plan. The Bear Creek basin is identified in the King County Waterways 2000 program; uses within the Cold Creek Natural Area would require additional environmental review. To the extent that this strategy could help increase water available to support base flows within Bear Creek and Sammamish River, as well as enhance flows in streams, it would be beneficial to aquatic resources and support salmon recovery efforts consistently with the WRIA 8 plan. |
| Energy | The forecasted carbon dioxide equivalent (CO2e) emission rate is 2,259 tons per year, related to secondary emissions from purchase of electricity from the utility grid. The GHG emission rate is less than levels that are considered significant and require reporting as a major industrial source. Some of the electricity purchases might be offset if the reclaimed water system reduces the need to pump groundwater as a water supply source. |

**Table ES-2. Summary for Renton/Tukwila South Plant Centralized Strategy**

| | |
|---|---|
| Public Health | A potential exists for human contact with reclaimed water through agricultural and non-agricultural irrigation. The uses proposed are consistent with current Washington state standards, which ensure reclaimed water is safe for human contact. |
| Recreation | Strategy would include irrigation of the following parks: Black River Riparian Forest, Cedar River Park, Joseph Foster Memorial Park, Liberty Park, Maplewood Greens, Riverview Park, and Tukwila Park. Irrigation of parks with Class A reclaimed water is consistent with current Washington state standards. |
| Groundwater | Three commercial/industrial uses are found in a 5-year wellhead protection area and the proposed environmental enhancement site is located in a 1-year wellhead protection area. None of the reclaimed water uses proposed for the Renton/Tukwila South Plant Centralized Strategy appear to overlap with critical aquifer recharge areas. However, several potential irrigation, commercial/industrial uses, and the wetland enhancement project are located above the Cedar Valley Aquifer. Reclaimed water would not come into contact with the ground surface from the commercial/industrial use. Irrigation water would be applied at agronomic rates and infiltration to ground water is not anticipated. There is a potential for reclaimed water used for wetland enhancement to percolate into groundwater; a hydrogeologic study would be required before proceeding with this use.<br>To the extent that reclaimed water could be used to replace nonpotable water uses within the Redmond-Bear Creek Valley Groundwater Management Area, this would be of particular benefit to the City of Renton because it relies on groundwater for drinking water. |
| Public Services and Utilities | The City of Renton and City of Tukwila water supply plans identify reclaimed water as a potential water source. According to RCW 90.46.120(3) and RCW 90.48, both cities are required to coordinate their water supply plans or water system plans with the reclaimed water available and/or proposed for use from the Brightwater plant. |
| Regional Planning | The Renton/Tukwila South Plant Centralized Strategy is consistent with the King County Strategic Plan and King County Comprehensive Plan. None of the reaches identified in the Waterways 2000 plans are within the strategy area. The strategy is consistent with the WRIA 8 plan but its effects are not expected to be significant in terms of overall watershed health. |
| Energy | The forecasted CO2e emission rate is 776 tons per year, related to secondary emissions from purchase of electricity from the utility grid. The GHG emission rate is less than levels that are considered significant and require reporting as a major industrial source. Some of the electricity purchases might be offset if the reclaimed water system reduces the need to pump groundwater as a water supply source. |

**Table ES-3. Summary for Interbay Skimming Decentralized Strategy**

| | |
|---|---|
| Public Health | A potential exists for human contact with reclaimed water through non-agricultural irrigation. The uses proposed are consistent with current Washington state standards, which ensure reclaimed water is safe for human contact. |
| Recreation | Strategy would include irrigation of the following parks: Interbay Athletic Field/Complex and Interbay P-Patch. Irrigation of parks with Class A reclaimed water is consistent with current Washington state standards. |
| Groundwater | No wellhead protection or aquifer recharge areas are located within the vicinity of this strategy. To the extent that reclaimed water could be used to replace nonpotable water uses during peak seasons, it could offset groundwater withdrawals. |
| Public Services and Utilities | The Seattle Public Utility (SPU) water supply plans identify reclaimed water as a potential water source. According to RCW 90.46.120(3) and RCW 90.48, SPU is required to coordinate their water supply plans or water system plans with the reclaimed water available and/or proposed for use. |
| Regional Planning | The Interbay Skimming Decentralized Strategy is consistent with the King County Strategic Plan and King County Comprehensive Plan. The strategy area is not within any areas proposed for the Waterways 2000 plan and is not expected to affect or support the WRIA plan. |
| Energy | The forecasted CO2e emission rate is 17 tons per year related to secondary emissions from purchase of electricity from the utility grid. The GHG emission rate is less than levels that are considered significant and require reporting as a major industrial source. Some of the electricity purchases might be offset if the reclaimed water system reduces the need to pump groundwater as a water supply source. |

**Table ES-4. Summary for Duwamish Polishing Decentralized Strategy**

| | |
|---|---|
| Public Health | A potential exists for human contact with reclaimed water through non-agricultural irrigation. The uses proposed are consistent with current Washington state standards, which ensure reclaimed water is safe for human contact. |
| Recreation | Strategy would include irrigation of the following parks: Delridge Playfield, Highland Park Playground, Puget Creek Greenspace, Puget Park, Riverview Playfield, and South Park Playground. Irrigation of parks with Class A reclaimed water is consistent with current Washington state standards. |
| Groundwater | No wellhead protection or aquifer recharge areas are located within the vicinity of this strategy. To the extent that reclaimed water could be used to replace nonpotable water uses during peak seasons, it could offset groundwater withdrawals. |
| Public Services and Utilities | The Seattle Public Utility (SPU) water supply plans identify reclaimed water as a potential water source. According to RCW 90.46.120(3) and RCW 90.48, SPU is required to coordinate their water supply plans or water system plans with the reclaimed water available and/or proposed for use. |
| Regional Planning | The Duwamish Polishing Decentralized Strategy is consistent with the King County Strategic Plan and King County Comprehensive Plan. The strategy area is not within any areas proposed for the Waterways 2000 plan and is not expected to affect or support the WRIA plan. |
| Energy | The forecasted CO2e emission rate is 25 tons per year, related to secondary emissions from purchase of electricity from the utility grid. The GHG emission rate is less than levels that are considered significant and require reporting as a major industrial source. Some of the electricity purchases might be offset if the reclaimed water system reduces the need to pump |

groundwater as a water supply source.

**Table ES-5. Summary for Lower Green River Valley Skimming Decentralized Strategy**

| | |
|---|---|
| Public Health | A potential exists for human contact with reclaimed water through agricultural irrigation. The use proposed is consistent with current Washington state standards, which ensure reclaimed water is safe for human contact. |
| Recreation | This strategy would not include reclaimed water use in park or recreation areas. |
| Groundwater | This strategy includes one agricultural irrigation use. Irrigation water would be applied at agronomic rates and infiltration to ground water is not anticipated. |
| Public Services and Utilities | The City of Kent and City of Auburn water supply plans identify reclaimed water as a potential water source. Auburn projects water demands will exceed water supply through 2028; a supply of reclaimed water could help to address that shortfall. According to RCW 90.46.120(3) and RCW 90.48, both cities are required to coordinate their water supply plans or water system plans with the reclaimed water available and/or proposed for use. |
| Regional Planning | The Lower Green River Valley Skimming Decentralized Strategy is consistent with the King County Strategic Plan and King County Comprehensive Plan. Middle Green River Basin is identified in the Waterways 2000 plan, but none of the reaches proposed are within the strategy area. Potential benefit to Green River from reduced surface water withdrawals would be consistent with the WRIA 9 salmon habitat management plan but this effect is not expected to be significant in terms of overall watershed health. |
| Energy | The forecasted CO2e emission rate is 25 tons per year, related to secondary emissions from purchase of electricity from the utility grid. The GHG emission rate is less than levels that are considered significant and require reporting as a major industrial source. Some of the electricity purchases might be offset if the reclaimed water system reduces the need to pump groundwater as a water supply source. |

# 1.0. INTRODUCTION

This document reports on the potential effects of King County reclaimed water strategies pertaining to (1) the use of reclaimed water for nonpotable consumptive purposes, (2) the effect of the reclaimed water strategies on groundwater, (3) the compatibility of the reclaimed water strategies, and the associated uses of reclaimed water, with existing local and regional plans, and (4) the emission of greenhouse gases from construction and operation of facilities to produce reclaimed water.

This evaluation was done as part of a comprehensive planning effort to better understand the potential for expanding King County's reclaimed water program through implementation of three reclaimed water strategies.

This chapter provides background information on the comprehensive planning process and reasons for analyzing the strategies. It then briefly describes the reclaimed water strategies and outlines the objectives of this evaluation.

## 1.1 Background

This report was prepared to support the development of a Reclaimed Water Comprehensive Plan for King County's Wastewater Treatment Division (WTD). The purpose of the Reclaimed Water Comprehensive Plan is to determine if, how, when, where, and by what funding mechanisms King County's existing reclaimed water program should expand over the next 30 years, through 2040 and beyond.

The work documented in this report was conducted as part of Step 4 of the reclaimed water planning process as amended and approved by the King County Council in May 2011. It is one of a series of reports that document efforts to define and analyze three reclaimed water strategies developed and approved earlier, during Step 3.[2] The results of these analyses will provide information on the following topics:

- Potential for use of reclaimed water to reduce reliance on Puget Sound for discharge of treated effluent.
- How reclaimed water strategies could fit into regional wastewater system planning and operations, including their effect on planned improvements and future operation of the regional wastewater system.
- The ability to use small prepackaged or preassembled reclaimed water facilities to produce and distribute reclaimed water.
- The potential effects of reclaimed water strategies on the environment, including the following:
    - Potential for reclaimed water to enhance watershed basin flows

[2] More information on the reclaimed water comprehensive planning process is available at http://www.kingcounty.gov/environment/wastewater/RWCompPlan.aspx. More information on prior reclaimed water strategy development and identification is available at http://your.kingcounty.gov/dnrp/library/wastewater/rw/CompPlan/1012_RWCPStrategyReport.pdf.

- Effects of reclaimed water use on groundwater and surface water quality
- Effects of reclaimed water use on the built environment, including energy demands and greenhouse gas emissions

- Changes in existing laws and policies that may be needed in order to allow expanded use of reclaimed water.
- The full range of benefits and costs associated with providing additional reclaimed water to serve both nonpotable consumptive and environmental enhancement uses.

Throughout the development, definition, and analysis of the strategies, WTD applied County Council−approved evaluation criteria to assess how each strategy addresses the three drivers for the Reclaimed Water Comprehensive Plan—regional wastewater system planning, creating resources from wastewater, and protecting Puget Sound water quality.

The strategies were developed for planning and evaluation purposes only; they are not intended to necessarily represent any future reclaimed water improvement projects or any implied preference or commitment on the part of any interested parties or potential end users.

## 1.2 Description and Location of Strategies

Each reclaimed water strategy represents a concept for producing and supplying reclaimed water to serve potential uses identified during the reclaimed water planning process. The uses include both nonpotable consumptive uses (irrigation, commercial, industrial) and environmental enhancement uses (wetland enhancement and associated indirect groundwater recharge and/or streamflow augmentation). The following are brief descriptions of the strategies:

- **Redmond/Bear Creek Basin Brightwater Centralized Strategy.** Reclaimed water would be produced through the membrane bioreactor (MBR) process at the Brightwater Treatment Plant for distribution to two areas—one in the immediate vicinity of the plant and one farther south above Lake Sammamish—via new pipelines connected to the South Segment of the Brightwater reclaimed water pipeline.
- **Renton/Tukwila South Plant Centralized Strategy**. Reclaimed water would be produced through expansion of the South Treatment Plant's tertiary sand filtration system for distribution to an area just south of Lake Washington via extension of an existing pipeline that delivers reclaimed water to the City of Tukwila.
- **Reclaimed Water Skimming or Polishing Decentralized Strategy.**[3] This strategy represents opportunities for smaller-scale reclaimed water implementation. Infrastructure was constrained to a single treatment plant of up to 0.5 million gallons per day (mgd) capacity and up to 1 mile of reclaimed water pipeline. Three potential areas and configurations were identified to help define the decentralized strategy:

[3] A skimming plant removes some of the raw wastewater from pipelines that carry the wastewater to regional plants for treatment and then treats the wastewater to reclaimed water quality for local distribution. A polishing plant removes some secondary-treated effluent from pipelines exiting regional treatment plants and treats the effluent to reclaimed water quality standards.

— An MBR skimming plant located in the Interbay area of Seattle would produce reclaimed water from untreated wastewater in adjacent conveyance pipelines for distribution near the plant via a new pipeline.

— A sand filtration polishing plant located in Seattle on the west side of the Duwamish River would produce reclaimed water from flows in the Effluent Transfer System (ETS) pipeline that carries South plant secondary effluent for discharge at Alki Point in West Seattle. The reclaimed water would be distributed to nearby uses via a new pipeline.

— An MBR skimming plant located in the lower Green River Valley in south King County would produce reclaimed water from untreated wastewater in adjacent conveyance pipelines for distribution near the plant via a new pipeline.

The locations of the strategies are shown in Figure 1-1, located at the back of this report.

## 1.3 Objectives of this Evaluation

King County's reclaimed water strategies propose supplying Class A reclaimed water for nonpotable consumptive uses from all five strategy locations; two of the strategies—Brightwater and South plant—also propose supplying Class A reclaimed water for environmental enhancement of wetlands. This document reports on evaluations of the potential effects of nonpotable consumptive uses of reclaimed water on public health, recreation, and groundwater, as well as the potential impact of the reclaimed water strategies on public services and utilities, regional planning, and energy use. The effects of applying reclaimed water for environmental enhancement, specifically, are analyzed in a separate document, titled Reclaimed Water Strategy Effects on Wetlands (King County 2012b).

This evaluation addressed the following questions:

- Does the strategy include use of reclaimed water in areas with potential for human contact and, if so, could the uses affect public health?
- Does the strategy include use of reclaimed water in recreational areas and, if so, how could the uses affect recreation?
- Does the strategy include use of reclaimed water inside a public water system wellhead protection area and, if so, how could the uses affect groundwater?
- Does the strategy support or enhance local and regional plans and initiatives, such as local water and wastewater comprehensive plans, the King County Strategic Plan, the King County Comprehensive Plan, and Waterways 2000?
- Based on predicted energy use for each strategy, what increases or decreases in the types and volumes of greenhouse gas (GHG) emissions could be expected?

## 1.4 Content and Organization of this Report

The next two chapters describe Washington state standards for water reclamation and reuse, review regional plans that the reclaimed water strategies may support or enhance, discuss potential impacts of constructing and operating reclaimed-water facilities on green house gas

emissions, and present the criteria used in this evaluation. These chapters are followed by chapters that report on the analyses and findings for each area; local public services and utility plans relevant to each strategy are presented and reviewed in these later chapters.

# 2.0. RECLAIMED WATER STANDARDS AND THE BUILT ENVIRONMENT

Reclaimed water is an important wastewater management tool that can also be used as a beneficial resource. King County's reclaimed water strategies propose to use Class A reclaimed water for nonpotable consumptive and environmental enhancement uses.

This chapter describes Washington state standards for water reclamation and reuse, identifies the reclaimed water uses proposed by King County's reclaimed water strategies, and provides background information on the aspects of the built environment considered in this evaluation. In order to identify ways in which the reclaimed water strategies could affect the built environment, this effort reviewed (1) research on the effect of non-potable consumptives uses of reclaimed water on public health and recreation, (2) information on how reclaimed water may infiltrate groundwater, (3) existing regional plans potentially relevant to the reclaimed water strategies, and (4) the emission of greenhouse gases from construction and operation of reclaimed water facilities. The effects of applying reclaimed water for environmental enhancement are outside the scope of this document and are analyzed in a separate report (King County 2012b).

## 2.1 Reclaimed Water Quality and Proposed Nonpotable Consumptive Uses

The Water Reclamation and Reuse Standards (1997) prepared by the Washington State Department of Health (Health) and the Washington State Department of Ecology (Ecology) define the standards for nonpotable consumptive and environmental enhancement uses of reclaimed water. Figure 2-1 below shows the criteria in the standards applicable to the nonpotable consumptive uses considered in this evaluation and to protecting potable water supplies from infiltration by reclaimed water. These criteria specify the class of reclaimed water required for particular consumptive uses as well as minimum setback distances where reclaimed water is used, transported, or stored.

Agricultural Irrigation (Article 1, Section 3, Food Crops):

- (a) Except as authorized by Health and Ecology under Section 3e, reclaimed water used for spray irrigation of food crops shall be at all times Class A reclaimed water or better.
- (b) Except as noted in Section 3c, 3d, and 3e, reclaimed water used for surface irrigation of food crops, where there is no contact between the reclaimed water and edible portion of the crop, shall be at all times Class B reclaimed water or better.
- (c) Except as noted in Section 3e, reclaimed water used for surface irrigation of root crops shall be at all times Class A reclaimed water or better.
- (d) Reclaimed water used for surface irrigation of orchards and vineyards shall be at all times Class D reclaimed water or better. No orchard or vineyard fruit may be harvested that has come in contact with the irrigating water or the ground.
- (e) As authorized by Health and Ecology, food crops that undergo physical or chemical processing sufficient to destroy all pathogenic agents prior to distribution or sale may be spray or surface irrigated with Class D reclaimed water or better.

Non-agricultural Irrigation (Article 1, Section 4, Landscape Irrigation):

- (a) Reclaimed water used for the irrigation of restricted access areas (e.g., freeway landscapes, or other areas where the public has similar access or exposure to the reclaimed water) shall be at all times Class C reclaimed water or better.
- (b) Reclaimed water used for the irrigation of open access areas (e.g., golf courses, parks, playgrounds, schoolyards, residential landscapes, or other areas where the public has similar access or exposure to the reclaimed water) shall be at all times Class A reclaimed water or better.

Impoundments (Article 2, Section 3, Nonrestricted Recreational Impoundments):

- (a) Reclaimed water used as a source of supply for a nonrestricted recreational impoundment shall be at all times Class A reclaimed water or better.
- (c) Nutrient removal to reduce levels of phosphorus and/or nitrogen is recommended for reclaimed water used as a source of supply for recreational impoundments to minimize algal growths and maintain acceptable aesthetic conditions.

General Requirements (Article 13, Section 3, Setback Distances):

- Minimum distance between any reclaimed water pipeline and potable water supply: 50 feet .
- Where reclaimed water is used for spray or surface irrigation, minimum distance between the area subject to irrigation, and any potable water supply well: 50 feet.
- Where reclaimed water is used for spray irrigation, minimum distance between the area subject to irrigation and areas accessible to the public and the use area property line: 0 feet.
- Where reclaimed water is used for an impoundment that is not lined or sealed to prevent measurable seepage, minimum distance between the perimeter of the impoundment and any potable water supply well: 500 feet.
- Where reclaimed water is used for an impoundment that is lined or sealed to prevent measurable seepage, minimum distance between the perimeter of the impoundment and any potable water supply well: 100 feet.

**Figure 2-1. 1997 Water Reclamation and Reuse Standards (Washington State Departments of Health and Ecology)**

King County's reclaimed water strategies all call for production of Class A reclaimed water. Class A is the highest standard of reclaimed water specified under Washington state standards (Ecology and Health, 1997). It is defined as reclaimed water that, at a minimum, is at all times an oxidized, coagulated, filtered, disinfected wastewater.

King County is proposing to use Class A reclaimed water for agricultural irrigation, non-agricultural irrigation (i.e., landscape irrigation), commercial and industrial uses, and environmental enhancement. Potential uses of reclaimed water are documented according to category, use type, estimated annual reclaimed water usage volume, and seasonality of use. The use categories and types for King County's reclaimed water strategies are listed in Table 2-1.

**Table 2-1. Reclaimed Water Use Categories**

| Categories | Use Type | Seasonal |
|---|---|---|
| Agricultural | Irrigation | Yes |
| Athletic Field | Irrigation | Yes |
| Cemetery | Irrigation | Yes |
| Commercial | Varies | Varies[a] |
| Golf Course | Irrigation | Yes |
| Industrial | Varies | Varies[a] |
| Nursery | Irrigation | No[b] |
| Other | Varies | Varies[a] |
| Park | Irrigation | Yes |
| School | Irrigation | Yes |
| Wetland Enhancement | Environmental | Potentially[c] |

Source: King County 2008

a. A portion of the use type for the commercial, industrial, and "other" categories may be seasonal irrigation use.

b. Irrigation use is treated as seasonal for all categories, except nursery.

c. Two application scenarios were evaluated for potential wetland enhancement flows: year-round application, and 7-8 month/year flow application during the spring, summer, and fall. Daily application rates would be consistent for both scenarios, and would be expected to coincide with all other use periods to form one component of peak demand. In terms of conceptual infrastructure sizing the two application scenarios thus become functionally equivalent and do not drive differing infrastructure capacity needs.

### 2.1.1 Agricultural Irrigation

In general, all agricultural irrigation proposed by King County for the reclaimed water strategies would use Class A reclaimed water, therefore meeting the reclaimed-water class standards set by Health and Ecology. Health and Ecology setback distance requirements would apply for water lines and any impoundments in relation to potable water supplies, as outlined in Figure 2-1.

Supporting the use of reclaimed water to irrigate food crops, studies conducted by the University of Washington have confirmed that Class A reclaimed water uses are safe for people and the environment (King County 2011a). The goals and results of these studies are summarized below.

University of Washington researchers conducted a two-year study beginning in 2008 to determine the food safety and nutrient value of food crops irrigated with reclaimed water. The study concluded that food crops irrigated with reclaimed water are safe for human consumption based on federal standards. The study also concluded that no significant difference exists between reclaimed water and conventional potable water in terms of the presence of microbial pathogens or metals in the plant tissues or water leached through the soils. For more information on this study, refer to Devin-Clarke et al. (2008).

Scientists from the University of Washington conducted a separate two-year study beginning in 2008 to determine the safety of vegetables irrigated with reclaimed water in the King County area. The study also examined the growth, physiology, and aesthetics of ornamental and vegetable plants irrigated with reclaimed water. The study concluded that plants irrigated with reclaimed water performed fairly well and all growth and physiological measures showed equal or better results with reclaimed water when compared to tap water. This finding indicates there is some nutritive benefit to reclaimed water, though where growth is not substantial compared to plants irrigated with tap water, additional fertilizer may be desired. This study also determined that salinity in the soils, which is a concern for many growers, does not appear to be a problem with reclaimed water. For more information on this study, refer to Kim et al. (2008).

### 2.1.2 Non-agricultural Irrigation

In general, all non-agricultural (i.e., landscape) irrigation proposed by King County for the reclaimed water strategies would use Class A reclaimed water, therefore meeting the reclaimed-water class standards set by Health and Ecology. Health and Ecology setback distance requirements would apply for water lines and any impoundments in relation to potable water supplies, as outlined in Figure 2-1.

The largest potential non-agricultural irrigation use for Class A reclaimed water in King County is turf grass irrigation. Supporting the use of reclaimed water to irrigate landscapes, a study conducted by the University of Washington has confirmed that Class A reclaimed water is safe for irrigating turf grass. The goals and results of this study are summarized below.

Researchers at the University of Washington conducted a six-month greenhouse comparison study to address concerns from potential customers regarding turf growth response, salinity, and the fate and transport of personal care products and pharmaceuticals. This study focused on the fate and transport of ibuprofen (a commonly used pain killer), triclosan (a widely used antibacterial chemical), and three types of estrogen (hormones) in turf grass and soil samples collected from a publicly-owned golf course in Tukwila. The Class A reclaimed water used in this study was produced by a sand-filter process at the South Treatment Plant in Renton; MBR treatment would be equal to or exceed the quality of sand filtration.

The results of the study point to the safety of irrigating turf grass with reclaimed water. Ibuprofen, triclosan, and estrogens did not persist in the soils and were not detected in the plant tissue or the water that drained through the soil, indicating that applying reclaimed water to turf and soil systems does not result in any accumulation of the hormones and personal care product chemicals studied. Due to the low salinity of the reclaimed water produced at the South Treatment Plant, no changes to the salinity of the soils were observed. Irrigation with reclaimed water has resulted in increased salinity in other areas of the county. Finally, the study also demonstrated that reclaimed water does not negatively affect the growth of turf grass or the

nutrient quality of the soil. Rather, since sand-filtered Class A reclaimed water retains nutrients essential for plant growth, this study suggests that turf growers may consider decreased fertilizer use as an additional benefit with reclaimed water irrigation. For more information on this study, refer to Devin-Clarke et al. (2008).

### 2.1.3 Groundwater

Reclaimed water could potentially infiltrate groundwater, affecting potable water supplies. Health and Ecology setback requirements, outlined in Figure 2-1, are intended to protect potable water resources.

Irrigation and commercial/industrial reclaimed water uses are unlikely to result in infiltration of reclaimed water into groundwater. Irrigation uses, including agricultural and non-agricultural irrigation are required to apply reclaimed water at agronomic rates to prevent infiltration, and commercial/industrial uses are not applied to the ground surface.

A literature review to characterize fate and transport of reclaimed water prepared in 2008 (ICF Jones & Stokes 2008) found that fate processes, such as soil adsorption and biodegradation, and variables such as infiltration depth play an important role in the attenuation of potential constituents of concern in reclaimed water (Ying et al. 2004). Furthermore, most of the water quality improvements occur in the vadose zone (the unsaturated zone between the soil surface and the groundwater table) when reclaimed water is applied to land or infiltrated through surface or near surface application (Pescod 1992).

As a result of partial or full failure of reclaimed water lines, reclaimed water could percolate to groundwater resources that are used as local drinking water supplies. As water percolates through soils and underlying sediments, many micro-constituents contained in reclaimed water would be attenuated through soil adsorption and biodegradation. As specified by Health and Ecology (1997), hydrogeological investigation would be required to show hydrogeologic conditions are adequate to prevent degradation of groundwater.

## 2.2 Regional Plans

Preparation of this report included reviewing regional plans that encompass the reclaimed water strategy areas in order to identify aspects of the plans that are relevant to the reclaimed water strategies. This section reviews the King County Strategic Plan, the King County Comprehensive Plan, the Waterways 2000 program, and plans developed for Watershed Resource Inventory Area 8 and Area 9.

### 2.2.1 King County Strategic Plan

On July 26, 2010, the King County Council unanimously approved legislation adopting the *King County Strategic Plan, 2010–2014: Working Together for One King County* (King County 2010). The plan was created with input from thousands of residents and county employees over a period of 18 months and was developed in collaboration with the Council and the County's separately elected officials. It lays out an ambitious set of goals, objectives, and strategies for King County from 2010 through 2014 and is a key tool in the King County Executive's work to reform county government by focusing on customer service, partnerships, and ways to bring down the cost of government.

The reclaimed water strategies specifically support the objective of minimizing King County's operational environmental footprint (Objective 4) by creating resources from wastewater (Strategy d). This objective and strategy are included under the general goal of safeguarding and enhancing King County's natural resources and environment.

The reclaimed water strategies may also indirectly support the additional objective, under the same general goal, of reducing climate pollution and preparing for the effects of climate change on the environment, human health, and the economy (Objective 3).

### 2.2.2 King County Comprehensive Plan

King County's comprehensive land use planning dates back to 1964. Its first comprehensive plan under the State Growth Management Act (GMA) was adopted in 1994. The GMA, passed by the Washington State Legislature in 1990, seeks to protect the quality of life in the Pacific Northwest and directs the state's most populous and fastest growing counties and their cities to prepare comprehensive land use plans that anticipate growth for a 20-year horizon. Comprehensive plans adopted in accordance with GMA must manage growth so that development is directed to designated urban areas and away from rural areas and resource lands. The GMA also requires jurisdictions to designate and protect critical areas and commercially significant forestry, agriculture, and mining areas. The GMA requires each comprehensive plan to adhere to a set of 14 goals and to include the following elements: land use, housing, capital facilities, utilities, rural areas, shorelines, and transportation. The King County Comprehensive Plan 2000 represented the first major review and the first set of substantive changes since the county's first comprehensive plan under GMA was adopted in 1994. The 2012 update is the fourth major review of the comprehensive plan (King County 2011b).

The Proposed 2012 King County Comprehensive Plan Amendments provides a framework for guiding regional growth and making decisions about land use and unincorporated King County. In particular, the Comprehensive Plan acknowledges that water is becoming an increasingly scarce resource, which calls for commitments to improved planning, more efficient water use, and better water management. The following chapters specifically mention reclaimed water.

Chapter 2, Urban Communities, states that King County should work with residential and commercial developers to incorporate state-of-the art stormwater management techniques including low impact development practices that protect native vegetation and soils, facilitate reuse of resources, such as reclaimed water, reduce the carbon footprint of the project, and reduce impervious surface (Policy U-406).

Chapter 3, Rural Legacy and Natural Resource Lands, identifies how alternative water supplies, such as reclaimed water, can help to mitigate the impacts of climate change and help support local and sustainable agriculture (pages 3-72 and 3-76).

Chapter 4, Environment, states that King County can increase resiliency and adapt to climate change through actions such as collaborative planning with water suppliers and development of reclaimed water sources (pages 4-20 and 4-29).

Additionally, Chapter 4 discusses how the development of reclaimed water supplies can help make significant contributions to protecting and restoring Puget Sound. As stated in Chapter 4, King County, through its land use decisions, management of stormwater and wastewater discharges, development of reclaimed water supplies, cooperative habitat protection and

restoration projects, and ongoing monitoring is actively involved in the conservation and recovery of Puget Sound (Policies E-434 and Policy E-436).

Chapter 8, Services, Facilities, and Utilities, states how King County supports the coordination of reuse and reclaimed water programs (Policy F-225) and that regional water planning will include provisions for the efficient use of water, including reclaimed water (Policy F-235 and F-236). Additionally, King County will partner with utilities to publicize water conservation and encourage best management practices that conserve potable water supply through measures that include use of alternative supplies, such as reclaimed water (Policies F-239a, F-239b, and F-239c).

### 2.2.3 Waterways 2000

The Waterways 2000 program was initiated in 1993 by the King County Executive and Council, who asked the King County Open Space Citizens Oversight Committee (COC) to develop the program. The vision for Waterways was to conserve a system of interconnected greenways along King County's extensive network of streams and rivers for the protection of salmon and wildlife habitat. The Waterways 2000 program would accomplish the following goals (King County 1996):

- Preserve, protect and restore natural systems for fish and wildlife habitat
- Preserve the rural nature of the site in keeping with surrounding community
- Eliminate incompatible uses which degrade sensitive site resources
- Provide site improvements to direct public use in appropriate areas
- Provide interpretive experiences to the community and foster public involvement in site stewardship
- Comply with restrictions resulting from the listings of salmonids and other species under the Federal Endangered Species Act
- Implement recommendations in phases according to priority order and available funding

River basins and reaches selected for the Waterways 2000 program are listed in Table 2-2.

**Table 2-2. River Basins and Reaches Selected for the Waterways 2000 Program**

| River Basin | River Reaches |
|---|---|
| Bear Creek Basin | Upper Bear Creek – Paradise Lake to Woodinville – Duvall Road Reach<br>Upper Bear Creek – Woodinville-Duvall Road to Tolt Pipeline Reach<br>Cottage Lake Creek Headwaters Reach<br>Mid-Bear Creek – Tolt Pipeline to NE 116th Reach<br>Mid-Cottage Lake Creek Reach |
| Lower Cedar River Basin | Rock Creek<br>Shaw/Landsburg Reach<br>Peterson Creek Reach |
| Griffin Creek Basin | Middle Zone Reach east of Carnation/Fall City Road<br>Forest Zone Reach |
| Patterson Creek Basin | Tributary 0383 |

| River Basin | River Reaches |
|---|---|
| | Main Stem Reach 3B |
| | Main Stem Reach 3A |
| | Canyon Creek Reach |
| Middle Green River Basin | O'Grady Reach |
| | Newaukum Creek Confluence Reach |
| | Auburn Narrows Reach |
| Middle Fork Snoqualmie River | Oxbox Reach |
| | South of Three Forks Reach |

Source: King County 1996

Two of King County's three proposed reclaimed water strategies are located in river basins that are addressed by the Waterways 2000 program.

- Bear Creek Basin, located in the Redmond/Bear Creek Brightwater Centralized Strategy area
- Lower Cedar River Basin, located in the South Plant Renton/Tukwila Centralized Strategy area

### 2.2.4 Watershed Resource Inventory Areas

The areas served by the three strategies are within Watershed Resource Inventory Area (WRIA) 8 and Area 9, with the Duwamish Polishing and the Lower Green River Valley Skimming decentralized strategies in WRIA 9 and all of the other strategies in WRIA 8. WRIAs are defined by natural watershed boundaries and provide logical planning units for environmental management; they are used to organize and coordinate surface and groundwater management and salmon recovery planning and implementation.

WRIA 8 includes Lake Washington, Cedar River, and Sammamish River and is the most densely populated watershed in Washington (WRIA 8 Steering Committee 2005). A WRIA 8 Chinook Salmon Conservation Plan was developed in 2005 for three populations of chinook salmon (the Cedar River, North Lake Washington, and Issaquah populations). It has a 10-year planning horizon for implementation activities, with the primary focus of the conservation plan being habitat. The plan identified current habitat conditions and limiting factors to salmon abundance/productivity, which include the following (WRIA 8 Steering Committee 2005):

- Altered hydrology (e.g., low base flows, higher peak flows following storms, and increased "flashiness," which means more frequent and rapid responses when it rains)
- Loss of floodplain connectivity (e.g., reduced access to side-channels or off-channel areas due to bank armoring and development close to shorelines)
- Lack of riparian vegetation (e.g., from clearing and development), disrupted sediment processes (e.g., too much fine sediment deposited in urban streams, or sources of spawning gravel disconnected from the river channel)

WRIA 9 includes the Green and Duwamish rivers and is also highly developed. The WRIA 9 Salmon Habitat Management Plan for chinook salmon and bull trout was developed in 2005 (Green/Duwamish and Central Puget Sound WRIA 9 Steering Committee 2005). It also includes a 10-year planning horizon, in addition to long-range plans and management directions to

recover endangered populations within the watershed. The plan identifies target-limiting habitat areas, which are prioritized for habitat restoration and watershed-wide needs. The limiting habitats include the Duwamish Estuary transition habitat and the Lower Green River spawning habitat. The Duwamish Polishing and the Lower Green River Valley Skimming decentralized strategies are located within the subbasins that are targets for restoration or where these limiting habitats occur. As described in the plan, watershed-wide needs include the following (Green/Duwamish and Central Puget Sound WRIA 9 Steering Committee 2005):

- Prevent and reduce armoring of stream banks and shorelines
- Promote low impact development such as porous pavement, bioswales, and clustered development
- Replace culverts that block fish passage on tributary streams
- Protect and improve water quality by focusing on "nonpoint" pollution that comes from stormwater runoff from streets, highways, parking lots, roofs, yards, and cleared lands
- Allow natural river flows in an unconstrained river channel where possible
- Maintain adequate stream flows

## 2.3 Greenhouse Gas Emissions

Green house gases (GHGs) are gases that trap heat in the atmosphere; they are both naturally occurring and artificial. The primary GHGs that would be generated by the proposed reclaimed water strategies are carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). This section discusses the global, regional, and county efforts to understand and to limit anthropogenic (i.e., human-made) GHG emissions that form the context for evaluating GHGs with respect to the reclaimed water strategies, identifies the potential sources of GHGs from the reclaimed water strategies, and presents available information on thresholds for GHGs applicable to this evaluation.

### 2.3.1 Background Information

The Intergovernmental Panel on Climate Change (IPCC) estimates that CO2 accounts for more than 75 percent of all anthropogenic GHG emissions. Approximately one quarter of anthropogenic CO2 emissions result from land use changes and three-quarters are produced by a variety of other activities, including fossil fuel burning (Intergovernmental Panel on Climate Change 2007). CH4 is the second largest contributor of anthropogenic GHG emissions and is the result of growing rice, raising cattle, fossil fuel combustion, and mining coal. N2O, while not as abundant as CO2 or CH4, is a powerful GHG and sources of N2O include wastewater treatment processes, agricultural processes, nylon production, fuel-fired power plants, nitric acid production, and vehicle emissions.

In order to simplify reporting and analysis, methods have been set forth to describe emissions of mixtures of various GHG constituents in terms of the "equivalent carbon dioxide" or CO2e, by accounting for the global warming potential (GWP) of each constituent in the mixture. GWP is a measure of a gas's heat-absorbing capacity and lifespan relative to a reference gas, CO2—CO2 has a GWP of 1 by definition, while N2O has a GWP of 310.

Global climate change is a cumulative issue related to worldwide GHG emissions rather than emissions from any individual facility. No single project emits enough GHG to influence global

climate change by itself. GHG emitted anywhere on the planet remains active for roughly 100 years and eventually disperses throughout the world. Therefore, future climate change in Washington state is as likely to be influenced by, for example, new industrial activity in China as by future reclaimed water use in King County.

In response to growing worldwide concerns, Washington State Governor Christine Gregoire issued Executive Order 07-02, committing the state to reducing its GHG emissions under a staged schedule: (1) reduce emissions to 1990 levels by 2020 and (2) reduce emissions to 50 percent below 1990 levels by 2050. In 2011 Ecology published its *Guidance for Ecology Including Greenhouse Gas Emissions in SEPA Review* (Washington State Department of Ecology 2011), which stipulates that all State Environmental Policy Act (SEPA) environmental reviews should include an assessment of GHG emissions. The guidance does not specify what levels of GHG emissions would constitute a significant impact, nor does it specify how lead agencies should mitigate GHG emissions. The guidance concludes that the significance determination and mitigation requirements for GHG emissions are to be conducted at the discretion of the SEPA lead agency on a case-by-case basis.

In addition, King County has developed a Climate Action Plan (King County 2007) mandating significant reductions in countywide GHG emissions. King County recently developed proposed Motion No. 2011-0208.1, reiterating its commitment to identify ways to reduce GHG emissions. One of the key steps would be to "evaluate alternatives for production and use of reclaimed water for industrial, irrigation, and environmental restoration purposes to determine if it is a reasonable means of mitigating the climate change impacts projected to decrease summer stream flows and affect water supplies."

### 2.3.2 Greenhouse Gas Emissions from Reclaimed Water Strategies

As a result of the reclaimed water strategies, GHGs could be emitted from the following source categories:

- Tailpipe emissions from off-road construction equipment, on-road delivery trucks, and on-road commute vehicles associated with construction of new wastewater treatment operations.
- Tailpipe emissions from off-road construction equipment, on-road delivery trucks, and on-road commute vehicles associated with construction of new distribution piping and pump stations for reclaimed water.
- N2O emissions generated by nitirification-denitrification treatment of ammonia nitrogen in advanced wastewater treatment operations used to produce Class A wastewater suitable for reclaimed water usage. Conventional wastewater treatment operations also produce CO2 and CH4 during biological treatment processes, and biosolids management generates CH4 emissions. However, the proposed reclaimed water strategies would not increase the intensity of conventional wastewater treatment operations, and the proposed project would not increase the production of biosolids. For these reasons, increased N20 emissions during nitrification-denitrification treatment, when necessitated by end uses, are the only GHG emission source that was considered for the wastewater treatment operations.

- Additional electricity used by the wastewater treatment operations and the reclaimed water distribution system would be purchased from Puget Sound Energy (PSE). Some of PSE's electricity is generated by regional fossil-fuel power plants, which emit GHGs. Therefore, purchase of electricity for the proposed water reclaimed water strategy would result in indirect emissions of GHGs.

### 2.3.3 Significance Thresholds for GHG Emissions

Neither King County nor any other agency in Washington state has enacted numerical SEPA significance thresholds for GHG emissions. The most recent SEPA guidance issued by Ecology indicates that each SEPA lead agency is responsible for defining its own significance thresholds on a case-by-case basis (Washington State Department of Ecology 2011). For perspective, the forecast annual GHG emission rates derived for this study can be compared to a range of example numerical thresholds that have been established by other jurisdictions:

- Some regulatory agencies in California have established GHG significance thresholds under the California Environmental Quality Act (CEQA). For example, the Bay Area Air Quality Management District (BAAQMD) has set a significance threshold of 10,000 metric tons per year of CO2 equivalent (CO2e) from stationary industrial sources and 1,100 metric tons per year of CO2e from land use development projects (Bay Area Air Quality Management District 2010).
- The U.S. Environmental Protection Agency (EPA) has established monitoring and reporting requirements for "major sources" that emit more than 25,000 tons per year of GHG (U.S. Environmental Protection Agency 2009).

# 3.0. METHODOLOGY

Established reclaimed water standards, current regional and land use plans, and other published information formed the basis for this evaluation of the potential effects of the reclaimed water strategies on the built environment. This chapter presents the various aspects on which each strategy was evaluated: its effects on public health, its effects on parks and recreation, its effect on public services and utilities, its compatibility with regional plans, its impact on groundwater, and the GHG emissions that are anticipated to result from implementing the strategy. The sections below identify the criteria for evaluating each of these aspects.

## 3.1 Effects on Public Health

The primary pathways of concern where public health could be affected by the use of reclaimed water are as follows:

- Consuming food crops that have been irrigated with reclaimed water (i.e., agricultural irrigation)
- Coming in contact with landscapes that have been irrigated with reclaimed water (i.e., non-agricultural irrigation, primarily at parks and recreation facilities)
- Reclaimed water used for wetland enhancement or reclaimed water leaked because of failure or partial failure of a pipe conveying reclaimed water incidentally percolating into groundwater resources, especially those resources that could be used for drinking water

Proposed reclaimed water non-potable consumptive uses were reviewed relative to criteria specified in the Health and Ecology (1997) water reclamation and reuse standards as well as the findings of recent studies on reclaimed water and public health. These studies, as well as the Health and Ecology standards, are presented in Chapter 2.

## 3.2 Effects on Parks and Recreation

Geographic Information Systems (GIS) data, along with information from the corresponding parks departments' websites, were used to identify which parks and recreation areas could be affected by the reclaimed water strategies. Specifically, GIS "park area" feature class data were used to identify park locations and names from the King County geodatabase KingCounty_931GDB. Distinguishing information about each park was obtained through the following websites:

- City of Seattle parks page: http://www.seattle.gov/parks/listall.asp
- King County parks page: http://www.kingcounty.gov/recreation/parks/inventory.aspx
- King County trails page: http://www.kingcounty.gov/recreation/parks/trails.aspx
- City of Redmond parks page: http://www.redmond.gov/cms/One.aspx?portalId=169&pageId=676
- City of Renton parks directory page: http://rentonwa.gov/living/default.aspx?id=2328
- City of Kent parks page: http://www.ci.kent.wa.us/maps/park.aspx?id=13453

- City of Tukwila parks page: http://www.tukwilawa.gov/recreation/parks.html
- Port of Seattle parks page: http://www.portseattle.org/community/resources/parks/index.shtml

Proposed reclaimed water non-potable consumptive uses were reviewed relative to criteria specified in the Health and Ecology (1997) water reclamation and reuse standards as well as research findings on the effect of irrigating turf with reclaimed water. This study, as well as the Health and Ecology standards, are presented in Chapter 2.

## 3.3 Effects on Groundwater

In order to identify and assess the potential effects of the reclaimed water strategies on groundwater, GIS data were used to identify the locations of wellhead protection areas and critical aquifer recharge areas, as well as the location of the sole source aquifer in the South plant area. The following shapefiles were used:

- Wellhead protection areas: kcwhpa_6mo_area, kcwhpa_1yr_area, kcwhpa_5yr_area, kcwhpa_10yr_area
- Critical aquifer recharge areas: cara_area from King County geodatabase KingCounty_931GDB
- Sole source aquifer: nep_sole_source

Local groundwater protection plans and critical area requirements were also reviewed to identify requirements relevant to the reclaimed water strategies.

Figures located at the back of this document depict wellhead protection areas found within the reclaimed water strategy areas. A wellhead protection area is the area delineated as providing recharge to a drinking water well. These figures also show the time anticipated for constituents in the groundwater to travel to a production well.

Additional figures located at the back of this document identify critical aquifer recharge areas within the reclaimed water strategy areas. Critical aquifer recharge areas are the geographic areas that have “critical recharging effects on aquifers used for potable water” (RCW 36.70A.030[5]). Recharge areas serve to replenish the groundwater supplies but also allow for introduction of contaminants into the uppermost unconfined aquifer. (King County 2004)

## 3.4 Effects on Public Services and Utilities

Water supply, water system, and sewer plans within the footprint of each strategy were reviewed to determine the compatability of the reclaimed water strategies with these local plans.

## 3.5 Compatibility with Regional Plans

Regional plans within the footprint of each strategy were reviewed to determine the compatibility of potential reclaimed water uses with these plans.

## 3.6 Greenhouse Gas Emission Estimates

GHG emissions from each of the key source categories identified for the reclaimed water strategies were calculated using the methods described below.

### 3.6.1 Tailpipe Emissions During Construction of New Wastewater Treatment Processes and Reclaimed Water Distribution Piping

Construction equipment used to construct new or expanded wastewater treatment facilities would emit GHGs. For this study, the GHG emissions during construction were derived from the GHG emission forecasts developed for the Visalia, California, reclaimed water project (City of Visalia 2011). The Visalia project included construction of a 22-mgd MBR treatment system and construction of 6.8 miles of new reclaimed water distribution piping. The project used the URBEMIS2007 emission model to forecast construction equipment tailpipe emissions. The derived construction-phase GHG emissions were as follows:

- Reclaimed water pipelines: 1,500 tons CO2e for the 6.8-mile pipeline construction, or 220 tons CO2e per mile of pipeline
- Wastewater treatment plant: 1,026 tons CO2 to construct the 22 mgd treatment plant upgrade

### 3.6.2 N20 Emissions from Nitrification-Denitrification Treatment Processes

Nitrification-denitrification treatment processes used to produce Class A reclaimed water generate small amounts of N2O, which is a potent GHG. The N2O-emission factor for nitrification-denitrification wastewater treatment was derived from the Local Government Operations Protocol (ICLEI 2010). The derived N2O-emission factor is 50 tons/year of CO2e per annualized mgd of wastewater treated by nitrification-denitrification. For each reclaimed water strategy, King County estimated the annualized wastewater flow rates subject to nitrification-denitrification treatment. The N2O emissions were then calculated by multiplying the wastewater flow rate times the N2O emission factor.

### 3.6.3 Indirect GHG Emissions from Purchase of Electricity from Puget Sound Energy

For each reclaimed water strategy, King County provided forecasts of required electricity purchases for wastewater treatment and reclaimed water pumping. The amount of the electricity purchases were expressed as megawatt-hours (MW-hr) per year.

The amount of GHG emitted as a result of utility electricity purchases depends on the electricity supplier. Seattle City Light has fully offset its GHG emissions (Seattle City Light 2011), so it is assumed purchase of electricity from Seattle City Light causes zero emissions of GHG.

A portion of PSE's electricity is generated by regional fossil-fuel power plants. PSE reports that its GHG emission factor for electricity sales is 1,040 pounds of CO2e per MW-hr of electricity

sales (Puget Sound Energy 2011). Therefore, the indirect GHG emissions for each strategy were calculated by multiplying the forecast electricity purchases (MW-hr per year) times PSE's GHG emission factor (1,040 pounds CO2e per MW-hr). Some of the purchased electricity used to power new treatment systems and pumping systems might be offset if the reclaimed water strategy could reduce the amount of groundwater that would have to be pumped to supply water.

# 4.0. REDMOND/BEAR CREEK BRIGHTWATER CENTRALIZED STRATEGY

The Redmond/Bear Creek Basin Brightwater Centralized Strategy focuses on expanding reclaimed water service in the vicinity of Brightwater Treatment Plan, including areas in and around the Cities of Woodinville and Redmond (Figure 1-1).

WTD has identified 31 potential sources of demand for reclaimed water produced from this strategy. Nonpotable consumptive uses include agricultural irrigation, non-agricultural irrigation, and industrial cooling, process, and wash water uses. The 31 potential sources of demand also include three wetland environmental enhancement uses.

Reclaimed water produced by Brightwater MBR treatment processes satisfies Class A reclaimed water requirements and can be directly applied for nonpotable consumptive uses. Because this strategy includes potential wetlands enhancement uses, additional tertiary nutrient removal treatment processes for phosphorus and possibly nitrogen may be required for reclaimed water flows delivered to areas where environmental wetland enhancements are proposed.

## 4.1 Potential Effects on Public Health

The Brightwater strategy proposes to use Class A reclaimed water for agricultural irrigation at one location, bounded by Avondale Road NE and NE 95th Street to the north, NE Union Hill Road to the south, and 196th Avenue NE to the east and for non-agricultural irrigation (i.e., landscape irrigation) at several locations throughout the strategy area, especially at parks and recreation facilities. In addition, three wetland enhancement opportunities are being evaluated.

No negative public health effects are anticipated with the reclaimed water nonpotable consumptive uses given that the reclaimed water produced in this strategy would meet the water reclamation and reuse standards set by Health and Ecology. This conclusion is supported by recent studies confirming that food crops irrigated with Class A reclaimed water are safe for people to consume and that landscapes irrigated with Class A reclaimed water are safe for incidental human contact (King County 2011a, RCW 90.46).

There may be potential for reclaimed water used for wetland enhancement to percolate into groundwater. An additional site-specific analysis would be needed to ensure local drinking water sources would not be degraded. A more detailed discussion of groundwater is included in Section 4.3 below.

## 4.2 Potential Effects on Parks and Recreation

Several parks and recreation facilities are located in the Brightwater strategy area (Figure 4-1). Parks where King County proposes to use Class A reclaimed water for non-agricultural irrigation are listed in Table 4-1.

**Table 4-1. Parks in the Redmond/Bear Creek Basin Brightwater Centralized Strategy Where Reclaimed Water is Proposed for Non-Agricultural Irrigation**

| Park Name | Recreational Opportunities |
|---|---|
| Bassett Pond Natural Area | See Cold Creek Natural Area |
| Cold Creek Natural Area | Cold Creek Natural Area and adjacent Bassett Pond Natural Area managed together under the Cold Creek Natural Area Plan; covers about 250 acres that contain extensive wetland systems, numerous springs, and one of the highest quality salmon-bearing streams in the Big Bear Creek drainage basin (King County 2011d) |
| Cottage Lake Park | Boating, fishing, walking trails, picnic tables and barbeques, picnic shelter, play area, free outdoor summer community concerts (King County Parks 2011a) |
| Marymoor Park | Off-leash dog park, pet garden, bird watching, Clise Mansion, summer outdoor movies and concerts, community garden, climbing rock, picnic areas, trails, tennis courts, ball fields, cycling—Velodrome (King County Parks 2011b) |

Table 4-1 identifies several recreational opportunities where the public could potentially come in contact with reclaimed water, should reclaimed water be used for non-agricultural irrigation at these parks as proposed by the Brightwater strategy. No negative recreation effects are anticipated with the reclaimed water nonpotable consumptive uses given that the reclaimed water produced in this strategy would meet the water reclamation and reuse standards set by Health and Ecology. This conclusion is supported by recent studies confirming that Class A reclaimed water nonpotable consumptive uses are safe for the environment and incidental human contact (King County 2011a, RCW 90.46).

## 4.3 Potential Effects on Groundwater Resources

The City of Redmond obtains approximately 35 percent of its drinking water from a shallow unconfined[4] aquifer located beneath the city. In some locations, groundwater is less than 5 feet below the surface. To protect the aquifer, the City of Redmond implemented a well-head protection program in 2003 to ensure risks to groundwater are identified and mitigated (City of Redmond 2011a).

### 4.3.1 Replacement of Withdrawals

Base stream flows in the Bear-Evans Creek watershed and Sammamish River are closely connected to groundwater inputs (Washington State Department of Ecology 2003, 2008). Hartley (2001, as cited by Washington State Department of Ecology 2008) determined that decreases in base flows could not be attributed to increased impervious area alone. In 2003 Ecology conducted an analysis of Groundwater and Surface Water Interactions (Washington State Department of Ecology 2003), which concluded that additional withdrawals from shallow aquifers in the Sammamish River Valley are inadvisable due to the cooling influence of shallow

[4] There is no impermeable layer above the aquifer to prevent percolation of water from the surface from reaching groundwater.

groundwater that flows into the river during the summer. In 2008, the Bear-Evans Temperature and Dissolved Oxygen Total Daily Maximum Daily Load (TMDL) Implementation Plan recommended measures to reduce groundwater withdrawals and identified water conservation and use of reclaimed water as potential methods to reduce use of ground water withdrawals for nonpotable water uses. Figure 4-2 depicts the water right point of diversions in the basin.

To the extent that reclaimed water could be used to replace nonpotable water uses within the Redmond-Bear Creek Valley Groundwater Management Area, more groundwater could contribute to stream base flows. This could make a positive contribution toward improving base flows (see habitat-limiting factors identified in Section 2.2.4).

### 4.3.2 Protection of Groundwater

Figure 4-2 identifies wellhead protection areas that demarcate recharge areas to drinking water wells found in and near the Brightwater strategy area. Figure 4-2 also shows the time anticipated for constituents in the groundwater to travel to a production well. Figure 4-3 identifies the critical aquifer recharge areas in or near the Brightwater strategy area. Water that falls within recharge areas serves to replenish the groundwater supplies but can also introduce contaminants into the uppermost unconfined aquifer.

Figure 4-2 shows that reclaimed water used for agricultural irrigation, non-agricultural irrigation, and commercial/industrial uses in the southern portion of the Brightwater strategy are found in the 1-year, 5-year, and 10-year wellhead protection areas. No wellhead protection areas are found in the northern portion of the Brightwater strategy. Two potential reclaimed water uses are within a public water system wellhead protection area (10-year travel zone). Irrigation and commercial/industrial reclaimed water uses are unlikely to result in infiltration of reclaimed water into groundwater. Reclaimed water used in agricultural and non-agricultural irrigation must be applied at agronomic rates to prevent infiltration, and commercial/industrial uses are not applied to the ground surface.

Figure 4-3 shows that reclaimed water used for non-agricultural irrigation and environmental enhancement in the northern portion of the Brightwater strategy area overlap with critical aquifer recharge areas. No reclaimed water uses appear to overlap with critical aquifer recharge areas in the southern portion of the Brightwater strategy area.

Irrigation and commercial/industrial reclaimed water uses are unlikely to result in infiltration of reclaimed water into groundwater. Irrigation uses, including agricultural and non-agricultural irrigation are required to apply reclaimed water at agronomic rates to prevent infiltration, and commercial/industrial uses are not applied to the ground surface. Reclaimed water used for environmental enhancement as a part of the Brightwater strategy and reclaimed water leaks as a result of partial or full failure of reclaimed water lines could percolate to groundwater resources that are used as local drinking water supplies. As water percolated through soils and underlying sediments many micro-constituents contained in reclaimed water would be attenuated through soil adsorption and biodegradation. As specified by Health and Ecology (1997), hydrogeological investigation would be required to show hydrogeologic conditions are adequate to prevent degradation of groundwater.

## 4.4 Compatibility with Public Services and Utilities

This section evaluates the compatibility of the Brightwater strategy with local water supply and sewer system plans.

### 4.4.1 Water Supply Plans

The cities of Redmond and Woodinville have distinct water supply approaches. According to RCW 90.46.120(3), both cities are required to coordinate their water supply plans with the reclaimed water available and/or proposed for use, which applies to reclaimed water that will be produced at the Brightwater plant.

The City of Redmond is a member of the Cascade Water Alliance and purchases more than 65 percent of its drinking water from the Seattle-Tolt water supply (City of Redmond 2011b). Since 2004, members have been working together on conservation planning as a part of long-term water supply planning. The 2004 long-range plan identified reclaimed water from King County as a potential approach to offset peak season supply requirements. The long-range forecast in the 2004 long-range water supply plan identified potential use of approximately 2.6 mgd of reclaimed water by 2023, assuming implementation issues are addressed (Cascade Water Alliance 2005). Work is under way on the 2012 update to this plan (Cascade Water Alliance 2011).

Woodinville Water District purchases all of its drinking water from the City of Seattle and receives water primarily from the Tolt water supply. SPU revised its water supply plan in 2007. SPU's resource selection policy explicitly includes reclaimed water as an alternative source option; exploring reclaimed water projects would be consistent with this policy and would require a "triple-bottom-line analysis" in comparison to other source options (Seattle Public Utilities 2006).

### 4.4.2 Sewer System Plans

At this time, it does not appear that any of the reclaimed water strategies would affect sewer system plans. In the event of further planning and design of the Brightwater strategy, coordination with local utilities is recommended. According to RCW 90.48112., the cities of Redmond and Woodinville both are required to coordinate their sewer system plans with the reclaimed water available and/or proposed for use from the Brightwater plant.

## 4.5 Compatibility with Regional Planning

This section evaluates the compatibility of the Brightwater strategy with relevant regional plans: the King County Strategic Plan, the King County Comprehensive Plan, the Waterways 2000 program, and the WRIA 8 plan.

### 4.5.1 King County Strategic Plan

The proposed use of reclaimed water for the Brightwater strategy would meet Objective 4 of King County's Strategic Plan goal to safeguard and enhance King County's natural resources and environment, which would minimize King County's operational environmental footprint by creating resources from wastewater and solid waste disposal.

### 4.5.2 King County Comprehensive Plan

The Brightwater strategy addresses several actions identified in the Proposed 2012 King County Comprehensive Plan Amendments (King County 2011b). In particular, expanding the use of reclaimed water for nonpotable uses throughout the county would help with water conservation efforts and prepare the county for potential climate change impacts. Additionally, the use of reclaimed water is an important mechanism for improving water quality and reducing discharge of treated wastewater into Puget Sound and other sensitive areas, which in turn would help with salmon recovery efforts.

### 4.5.3 Waterways 2000

The Bear Creek Basin is one of the river basins selected for the Waterways 2000 program. Within the Bear Creek Basin, through the Waterways 2000 program, the County acquired almost 300 acres and negotiated more than 430 acres in current-use taxation agreements, for a total of 730 acres. Cottage Lake Creek, a major tributary to Bear Creek, is part of the Sammamish River watershed and was targeted by the program for the habitat it provides to chinook, coho and cutthroat trout, as well as numerous terrestrial and aquatic mammals and amphibians. In the future, the Sammamish River system as a whole and the Cold Creek Natural Area in particular will play an important role in the region's effort to protect, restore, and increase public awareness of threatened salmon runs and the watershed habitats that sustain them (King County 2001).

Cold Creek Natural Area management will focus on the protection and enhancement of the natural systems on site: fish and wildlife habitats, corridors, and scenic character. Where public use does not compromise these systems, the Cold Creek Natural Area will provide low-impact passive recreational, interpretive, and educational opportunities in keeping with the Waterways 2000 program goals outlined in Chapter 2, Section 2.2.3.

Significant resources at the Cold Creek Natural Area include (King County 2001):

- A large portion of the Big Bear Creek #10 wetland, a King County Class 1 wetland rating for size, diversity of vegetation, and open water component
- Wetlands, streams, and biotic communities within the upper reaches of the Cottage Lake Creek and Bear Creek basin, which play a critical role in the health and vitality of the downstream system
- Cold Creek (WRIA # 08.0126), a King County Class 2 stream which provides essential cool waters to the Cottage Lake Creek and Bear Creek system, especially in the critical summer and fall months
- Cottage Lake Creek/Daniels Creek (WRIA # 08.0122), a King County Class 2 stream that supports significant populations of chinook, sockeye, coho, kokanee, steelhead, and cutthroat
- High quality, diverse habitat for a variety of resident and migratory bird species as well as habitat for numerous terrestrial and aquatic wildlife, including river otter, beaver, coyote, black bear, and native amphibian species
- A peat deposit of state significance

As a component of the Brightwater strategy, King County is proposing to use reclaimed water to irrigate lands within the vicinity of the Cold Creek Natural Area (Figure 4-1 and Table 4-1). Use of reclaimed water at the Cold Creek Natural Area should not interfere with the site management plan goals, but project specific planning will need to confirm full alignment with the management plans. In addition, if application of reclaimed water for irrigation offsets (i.e., replaces) existing well use for irrigation water, it could help increase groundwater base flows into the Cold Creek Natural Area and the Bear-Evans Creek watershed.

### 4.5.4 Watershed Resource Inventory Area 8

The Brightwater strategy would include use of reclaimed water for environmental enhancements in the Bear Creek Basin and Sammamish Slough, which are part of the WRIA 8 Lake Washington/ Cedar/ Sammamish Watershed. A study of the potential effects on the quality and quantity of water in lakes, streams, and rivers from using reclaimed water for these environmental enhancement wetland projects (King County 2012a) indicates that the strategy would support the WRIA 8 plan. The study found that wetland enhancement with reclaimed water has the potential to improve summer flow and aquatic habitat in Daniels, Cottage Lake, and Bear creeks. The additional water provided to the stream would have the potential to reduce daily maximum temperatures under critical summer conditions on the order of 0.5 to almost 1.8 °C. The study showed an expected increase in typical summer flows in the Sammamish River below the confluence with Bear Creek. A reduction in maximum summer river temperatures would be expected as well, primarily as a result of reduced maximum temperatures in Bear Creek. Due to the potential effects of the input of additional nutrients, however, the study also found that uses of lakes, streams, and rivers by aquatic life may be affected by a decrease in dissolved oxygen.

To the extent that the Brightwater strategy could help increase water available to support base flows within Bear Creek and Sammamish River, and to the extent that the use of reclaimed water to replace withdrawals from groundwater in WRIA 8 would also help enhance flows in streams, the strategy would be consistent with the Final WRIA 8 Chinook Salmon Conservation Plan (WRIA Steering Committee 2005).

## 4.6 Forecast GHG Emission Rates for Reclaimed Water Strategies

Table 4-2 shows the engineering assumptions, GHG emission factors, and forecast GHG emission rates associated with the long-term operation of the Brightwater strategy. All calculated GHG emission rates are expressed as CO2e. The forecast emission rate is 2,259 tons per year of CO2e, all of which would be generated as secondary emissions from purchased electricity. Some of the electricity purchases might be offset if the reclaimed water system reduces the need to pump groundwater as a water supply source. The forecast GHG emission rate is less than the BAAQMD's significance threshold under CEQA (10,000 tons per year) or the EPA reporting threshold for major industrial sources (25,000 tons per year).

**Table 4-2. Greenhouse Gas Emissions for Reclaimed Water Strategies**

| Parameter | Brightwater Strategy |
|---|---|
| Potential reclaimed water flow | 12.98 mgd |
| Wastewater supply | Brightwater treatment flows |
| Distribution piping for reclaimed water | 15.4 miles |
| New treatment requirement for nitrification-denitrification | None required at the Brightwater plant |
| Electricity purchases for new wastewater treatment | None required |
| Electricity purchases for reclaimed water pumping | 4,010 MW-hrs/yr |
| **GHG Emission Factors and Data Sources** | |
| Electricity purchases from Puget Sound Energy | 1,040 lbs CO2e per MW-hr of purchased electricity2 |
| Nitrous oxide (N20) emissions from nitrification-denitrification wastewater treatment | None required |
| Total annualized GHG emissions (tons/year CO2e) | 2,259 |

# 5.0. RENTON/TUKWILA SOUTH PLANT CENTRALIZED STRATEGY

The Renton/Tukwila South Plant Centralized Strategy focuses on expanding reclaimed water service in the vicinity of South Treatment Plant, including areas in and around the Cities of Renton and Tukwila (Figure 1-1).

WTD has identified 43 potential sources of demand for reclaimed water produced from this strategy. Nonpotable consumptive uses include non-agricultural irrigation as well as industrial cooling, process, and wash water uses. The 43 potential uses also include one wetland environmental enhancement use.

Reclaimed water produced by South plant's existing activated sludge wastewater treatment and tertiary reclaimed water sand filter processes satisfies Class A reclaimed water requirements and can be applied for nonpotable consumptive uses directly. However, the sand filter has limited capacity to produce reclaimed water, and the system would require expansion or replacement to meet demands identified in the strategy area. Although one small wetland enhancement use has been identified within the strategy area, no additional nutrient removal tertiary treatment beyond Class A standards is currently assumed for the South plant strategy.

## 5.1 Potential Effects on Public Health

The South plant strategy proposes to use Class A reclaimed water for non-agricultural irrigation (i.e., landscape irrigation) at several locations throughout the strategy area, especially at parks and recreation facilities. The South plant strategy does not propose to use reclaimed water for agricultural irrigation.

No negative public health effects are anticipated with the reclaimed water nonpotable consumptive uses given that the reclaimed water produced in this strategy would meet the water reclamation and reuse standards set by Health and Ecology. This conclusion is supported by recent studies confirming that landscapes irrigated with Class A reclaimed water are safe for incidental human contact (King County 2011a, RCW 90.46).

There may be a potential for reclaimed water used for wetland enhancement to percolate into groundwater. An additional site-specific analysis would be needed to ensure local drinking water sources would not be degraded. A more detailed discussion of groundwater is included in Section 5.3 below.

## 5.2 Potential Effects on Parks and Recreation

Several parks and recreation facilities are located in the South plant strategy area (Figure 5-1). Parks where King County proposes to use Class A reclaimed water for non-agricultural irrigation are listed in Table 5-1.

**Table 5-1. Parks in the Renton/Tukwila South Plant Centralized Strategy Where Reclaimed Water is Proposed for Non-Agricultural Irrigation**

| Park Name | Recreational Opportunities |
|---|---|
| Black River Riparian Forest | Complex ecosystem with abundant wildlife habitat; provides year-round bird watching and is home to more than 50 species of birds, including one of the largest great blue heron colonies in the region (City of Renton 2011) |
| Cedar River Park | Multi-use fields, Renton Community Center, Carco Theater, picnic area, trail access, dog park (City of Renton 2011) |
| Joseph Foster Memorial Park | Basketball courts, tennis courts, picnic shelter, children's play area, Lee Phillips Athletic Field—youth soccer/baseball (Tukwila Parks and Recreation 2011) |
| Liberty Park | Basketball courts, tennis practice wall, tennis courts, Giannini's Stadium Field, Wilcoxen Field, picnic areas, picnic shelters, play equipment, skate park, tables and benches, Cedar River Trail access (City of Renton 2011) |
| Maplewood Greens | Golf and country club (Maplewood Greens 2011) |
| Riverview Park | Cedar River Trail access, soft surface trail to Cedar River for launching canoes and kayaks, picnic shelter, picnic and barbecue areas, interpretive salmon lifecycle displays and wildlife viewing, open meadows (City of Renton 2011) |
| Tukwila Park | Basketball courts, tennis courts, children's play area, gazebo, trails (Tukwila Parks and Recreation 2011) |

Table 5-1 identifies several recreational opportunities where the public could potentially come in contact with reclaimed water, should reclaimed water be used for non-agricultural irrigation at these parks as proposed by the South plant strategy. No negative recreation effects are anticipated with the reclaimed water nonpotable consumptive uses given that the reclaimed water produced in this strategy would meet the water reclamation and reuse standards set by Health and Ecology. This conclusion is supported by recent studies confirming that Class A reclaimed water nonpotable consumptive uses are safe for the environment and incidental human contact (King County 2011a, RCW 90.46).

## 5.3 Potential Effects on Groundwater Resources

The City of Renton relies on the Cedar Valley Aquifer for the majority of its drinking water (approximately 87 percent). The remainder of the city's drinking water is from Spring Brook Springs. The Cedar Valley Aquifer has been designated a "sole source" by EPA, which means that no federal funding can be provided for projects that could contaminate the aquifer. In some locations, the aquifer is only 23 feet below the surface and the overlaying layers are permeable. Figure 5-4 shows the location of the Cedar Valley Aquifer, which overlaps with the South plant strategy area.

### 5.3.1 Replacement of Withdrawals

To the extent that reclaimed water could be used to replace existing nonpotable water uses within the Renton/Tukwila area, application of reclaimed water could replace existing groundwater withdrawals. This would likely be of greater benefit to the City of Renton given their reliance on groundwater for drinking water.

### 5.3.2 Protection of Groundwater

Figure 5-2 identifies wellhead protection areas that provide recharge to drinking water wells found in and near the South plant strategy area. Figure 5-2 also shows the time anticipated for constituents in the groundwater to travel to a production well. Figure 5-3 identifies the critical aquifer recharge areas in or near the South plant strategy area. Recharge areas serve to replenish groundwater supplies but can also allow contaminants to be introduced to the uppermost unconfined aquifer.

Figure 5-2 shows that three locations where reclaimed water is proposed for commercial/industrial uses in the central portion of the South plant strategy are found in the same 5-year wellhead protection area. Additionally, the proposed environmental enhancement site is located in a 1-year wellhead protection area. No other locations of reclaimed water uses proposed for the South plant strategy area appear to overlap with wellhead protection areas. Figure 5-3 shows that none of the reclaimed water uses proposed for the South plant strategy appear to overlap with critical aquifer recharge areas.

As shown in Figure 5-4, several potential irrigation, commercial/industrial uses, and the wetland enhancement use are located above the Cedar Valley Aquifer. Irrigation and commercial/industrial reclaimed water uses are unlikely to result in infiltration of reclaimed water into groundwater. Reclaimed water used in agricultural and non-agricultural irrigation must be applied at agronomic rates to prevent infiltration, and commercial/industrial uses are not applied to the ground surface.

Reclaimed water used for environmental enhancement as a part of the South plant strategy and reclaimed water leaks as a result of partial or full failure of reclaimed water lines could percolate to groundwater resources that are used as local drinking water supplies. However, as water percolates through soils and underlying sediments many micro-constituents contained in reclaimed water would be attenuated through soil adsorption and biodegradation. As specified in the Health and Ecology standards (1997), hydrogeological investigation would be required to show that hydrogeologic conditions are adequate to prevent degradation of groundwater.

## 5.4 Compatibility with Public Services and Utilities

This section evaluates the compatibility of the South plant strategy with local water supply and sewer system plans.

### 5.4.1 Water Supply Plans

Both the City of Renton and the City of Tukwila are required to coordinate their water supply plans with reclaimed water available and/or proposed for use as specified by RCW 90.46.120(3).

South plant provides Class A reclaimed water; therefore, both cities are subject to this requirement.

According to the City of Renton 2005 Water Supply Plan, the city has sufficient annual water rights to meet its projected 20-year (2025) annual and 2025 peak daily demands but does not have sufficient water to meet peek hourly demands. The city plans to satisfy future demands that exceed existing water rights by establishing agreements with nearby water purveyors, creating water storage reservoirs, and implementing conservation programs. The City of Renton has identified aquifer recharge and reclaimed water use as potential approaches to ensure a reliable long-term water supply (City of Renton 2005). The city's first attempts at reclaimed water use have had limited success to date (City of Renton 2005). Use of reclaimed water is consistent with the City of Renton water system plan.

In contrast, 100 percent of the City of Tukwila drinking water is supplied by the City of Seattle's water system through a long-term contract through Cascade Water Alliance (City of Tukwila 2005). Nearly all of the potable water supplied to Tukwila comes from the Cedar River Watershed. The city also has a contract with King County to receive reclaimed water for irrigation purposes and has a surface water right from the Green River currently used for watering a golf course. The 2005 water system plan anticipates expanding current uses of reclaimed water; at the time the plan was written, reclaimed water was used exclusively for watering baseball fields (City of Tukwila 2005).

### 5.4.2 Sewer System Plans

At this time, it does not appear that any of the reclaimed water strategies would affect sewer system plans. In the event of further planning and design of the South plant strategy, coordination with local utilities is recommended. According to RCW 90.46.120(3) and RCW 90.48, the City of Renton and the City of Tukwila are required to coordinate their water supply plans or water system plans with the reclaimed water available and/or proposed for use from the South plant.

## 5.5 Compatibility with Regional Planning

This section evaluates the compatibility of the South plant strategy with relevant regional plans: the King County Strategic Plan, the King County Comprehensive Plan, and the WRIA 8 plan. This strategy would not directly affect or support the Waterways 2000 program.

### 5.5.1 King County Strategic Plan

King County's proposed use of reclaimed water for the South plant strategy would meet Objective 4 under King County's Strategic Plan goal to safeguard and enhance King County's natural resources and environment, which would minimize King County's operational environmental footprint by creating resources from wastewater and solid waste disposal.

### 5.5.2 King County Comprehensive Plan

The South plant strategy addresses several actions identified in the Proposed 2012 King County Comprehensive Plan Amendments (King County 2011b). In particular, expanding the use of reclaimed water for nonpotable uses throughout the county would help with water conservation

efforts and prepare the county for potential climate change impacts. Additionally, the use of reclaimed water is an important mechanism for improving water quality and reducing discharge of treated wastewater into Puget Sound and other sensitive areas, which in turn would help with salmon recovery efforts.

### 5.5.3 Waterways 2000

While the Lower Cedar River Basin is one of the river basins selected for the Waterways 2000 program, none of the reaches proposed for the Waterways 2000 program are within the South plant strategy area (Table 2-2). Therefore, this strategy would not directly affect or support the Waterways 2000 program.

### 5.5.4 Watershed Resource Inventory Area 8

The South plant strategy includes use of reclaimed water for environmental enhancement adjacent to the Cedar River, which is part of the WRIA 8 Lake Washington/Cedar/ Sammamish Watershed. The strategy includes the concept of an approximately 16 acre wetland enhancement, which would displace some water withdrawals from the basin, restore riparian vegetation, and potentially add 0.8 cfs to the Cedar River basin. While these actions are beneficial to the watershed and consistent with the Final WRIA 8 Chinook Salmon Conservation Plan (WRIA 8 Steering Committee 2005), the effects are not expected to be significant in terms of overall watershed health.

## 5.6 Forecast GHG Emission Rates for Reclaimed Water Strategies

Table 5-2 shows the engineering assumptions, GHG emission factors, and forecast GHG emission rates associated with the long-term operation of the South plant strategy. All calculated GHG emission rates are expressed as CO2e. The forecast emission rate is 776 tons per year of CO2e, most of which would be generated as secondary emissions from purchased electricity. Some of the electricity purchases might be offset if the reclaimed water system reduces the need to pump groundwater as a water supply source. The forecast GHG emission rate is less than the BAAQMD's significance threshold under CEQA (10,000 tons per year) or the EPA reporting threshold for major industrial sources (25,000 tons per year).

**Table 5-2. Greenhouse Gas Emissions for Reclaimed Water Strategies**

| Parameter | South Plant Strategy |
|---|---|
| Potential reclaimed water flow | 4.75 mgd |
| Wastewater supply | South Plant treatment flows |
| Distribution piping for reclaimed water | 16.3 miles |
| New treatment requirement for nitrification-denitrification | 4.75 mgd |
| Electricity purchases for new wastewater treatment | 85 MW-hrs/yr |
| Electricity purchases for reclaimed water pumping | 950 MW-hrs/yr |
| **GHG Emission Factors and Data Sources** | |
| Electricity purchases from PSE | 1,040 lbs CO2e per MW-hr of purchased electricity[2] |
| N20 emissions from nitrification-denitrification wastewater treatment | 50 tons/yr CO2e per mgd treated using nitrification-denitrification[3] |
| **GHG Emissions (tons CO2e)** | |
| GHG emissions from wastewater treatment | 238 |
| GHG emissions from purchase of electricity | 538 |
| Total annualized GHG emissions (tons/year CO2e) | 776 |

[1] Source: Draft Environmental Impact Report for City of Visalia Water Conservation Plant Upgrades Project. (City of Visalia 2011).
[2] Source: Puget Sound Energy Customer Handbook for Climate Change (Puget Sound Energy 2011).
[3] Source: Local Government Operations Protocol for the quantification and reporting of GHG emissions inventories (ICLEI 2010).

# 6.0. INTERBAY SKIMMING DECENTRALIZED STRATEGY

The Interbay Skimming Decentralized Strategy focuses on implementing reclaimed water service in the Interbay area of Seattle, between the Queen Anne and Magnolia neighborhoods (Figure 1-1). The service area for this strategy area is a 1 mile radius surrounding a conceptual treatment plant with a single distribution main. The Interbay strategy and other decentralized strategy areas are intended to represent opportunities for implementing smaller scale reclaimed water efforts subject to certain infrastructure limitations.

WTD has identified three potential sources of demand for reclaimed water produced in this strategy. All of these would be nonpotable consumptive uses and include non-agricultural irrigation and industrial cooling.

Reclaimed water produced by the Interbay skimming treatment plant would satisfy Class A reclaimed water requirements and could be applied for nonpotable consumptive uses directly.

## 6.1 Potential Effects on Public Health

The Interbay strategy proposes to use Class A reclaimed water for non-agricultural irrigation (i.e., landscape irrigation) at several locations throughout the strategy area, especially at parks and recreation facilities. The Interbay strategy does not propose to use reclaimed water for agricultural irrigation. No negative public health effects are anticipated with the reclaimed water nonpotable consumptive uses given that the reclaimed water produced in this strategy would meet the water reclamation and reuse standards set by Health and Ecology. This conclusion is supported by recent studies confirming that landscapes irrigated with Class A reclaimed water are safe for incidental human contact (King County 2011a, RCW 90.46).

## 6.2 Potential Effects on Parks and Recreation

Several parks and recreation facilities are located in the Interbay strategy area (Figure 6-1). Parks where King County proposes to use Class A reclaimed water for non-agricultural irrigation are listed in Table 6-1.

**Table 6-1. Parks in the Interbay Skimming Decentralized Strategy Where Reclaimed Water is Proposed for Non-Agricultural Irrigation**

| Park Name | Recreational Opportunities |
|---|---|
| Interbay Athletic Field/Complex | Play fields, 9-hole golf course, driving range |
| Interbay P-Patch | Community garden |

Source: Seattle Parks and Recreation 2011

Table 6-1 identifies several recreational opportunities where the public could potentially come in contact with reclaimed water, should reclaimed water be used for non-agricultural irrigation at these parks as proposed by the Interbay strategy. No negative recreation effects are anticipated with the reclaimed water nonpotable consumptive uses given that the reclaimed water produced

in this strategy would meet the water reclamation and reuse standards set by Health and Ecology. This conclusion is supported by recent studies confirming that Class A reclaimed water nonpotable consumptive uses are safe for the environment and incidental human contact (King County 2011a, RCW 90.46).

## 6.3 Potential Effects on Groundwater Resources

The Interbay strategy includes using Class A reclaimed water for non-agricultural irrigation and for commercial/industrial purposes. Irrigation would be at agronomic rates—with no application of reclaimed water for irrigation purposes when the ground is saturated—to prevent infiltration of reclaimed water to groundwater. Commercial/industrial use of reclaimed water would be within piping and have no ground surface contact.

### 6.3.1 Replacement of Withdrawals

SPU has two well fields in the City of SeaTac to provide peak season and emergency water supply (Seattle Public Utilities 2006). To the extent that reclaimed water could be used to replace existing nonpotable water uses during peak seasons, application of reclaimed water could replace existing groundwater withdrawals.

### 6.3.2 Protection of Groundwater

There are no wellhead protection areas or critical aquifer recharge areas in the geographic vicinity of the Interbay strategy area.

## 6.4 Compatibility with Public Services and Utilities

This section evaluates the compatibility of the Interbay strategy with local water supply and sewer system plans.

### 6.4.1 Water Supply Plans

SPU is the water purveyor for the City of Seattle. The City's water supply includes the Cedar and South Fork Tolt Rivers and two well fields to provide additional peak season capacity and emergency water supply. SPU revised its water supply plan in 2007. The city is required to coordinate their water supply plans with the reclaimed water available and/or proposed for use as specified by RCW 90.46.120(3). Consistent with this requirement, SPU's resource selection policy explicitly includes reclaimed water as an alternative source option. Exploring reclaimed water projects would be consistent with this policy and would require a "triple-bottom-line analysis" in comparison to other source options (Seattle Public Utilities 2006).

### 6.4.2 Sewer System Plans

At this time it does not appear that any of the reclaimed water strategies would affect sewer system plans. In the event of further planning and design of the Interbay strategy, coordination with local utilities is recommended. According to RCW 90.48112, the City of Seattle is required to coordinate their water supply plans or water system plans with the reclaimed water available and/or proposed for use.

## 6.5 Compatibility with Regional Planning

This section evaluates the compatibility of the Interbay strategy with relevant regional plans: the King County Strategic Plan and the King County Comprehensive Plan. This strategy would not directly affect or support the Waterways 2000 program or the WRIA plan.

### 6.5.1 King County Strategic Plan

King County's proposed use of reclaimed water for the Interbay strategy would meet Objective 4 under King County's Strategic Plan goal to safeguard and enhance King County's natural resources and environment, which would minimize King County's operational environmental footprint by creating resources from wastewater and solid waste disposal.

### 6.5.2 King County Comprehensive Plan

The Interbay strategy addresses several actions identified in the Proposed 2012 King County Comprehensive Plan Amendments (King County 2011b). In particular, expanding the use of reclaimed water for nonpotable uses throughout the county would help with water conservation efforts and prepare the county for potential climate change impacts. Additionally, the use of reclaimed water is an important mechanism for improving water quality and reducing discharge of treated wastewater into Puget Sound and other sensitive areas, which in turn would help with salmon recovery efforts.

### 6.5.3 Waterways 2000

Since the Interbay strategy area does not include any river basins that are addressed by the Waterways 2000 program, this strategy would not directly affect or support the Waterways 2000 program.

### 6.5.4 Watershed Resource Inventory Area 8

The Interbay strategy is in WRIA 8, which includes Cedar River and Sammamish River. Since the strategy is small in scale and does not include environmental enhancement uses, it is not expected to affect or support the WRIA plan.

## 6.6 Forecast GHG Emission Rates for Reclaimed Water Strategies

Table 6-2 shows the engineering assumptions, GHG emission factors, and forecast GHG emission rates associated with the long-term operation of the Interbay strategy. All calculated GHG emission rates are expressed as CO2e. The forecast GHG emission rate is 17 tons per year of CO2e, which is less than the BAAQMD's significance threshold under CEQA (10,000 tons per year) or the EPA reporting threshold for major industrial sources (25,000 tons per year).

**Table 6-2. Greenhouse Gas Emissions for Reclaimed Water Strategies**

| Parameter | Interbay Skimming Decentralized Strategy |
|---|---|
| Potential reclaimed water flow | 0.33 mgd |
| Wastewater supply | Regional wastewater conveyance flows |
| Distribution piping for reclaimed water | 0.8 mile |
| New treatment requirement for nitrification-denitrification | 0.33 mgd |
| Electricity purchases for new wastewater treatment | 75 MW-hrs/yr |
| Electricity purchases for reclaimed water pumping | 50 MW-hrs/yr |
| **GHG Emission Factors and Data Sources** | |
| Electricity purchases from Seattle City Light | Zero CO2e per MW-hr of purchased electricity[2] |
| N20 emissions from nitrification-denitrification wastewater treatment | 50 tons/yr CO2e per mgd treated using nitrification-denitrification[3] |
| **GHG Emissions (tons CO2e)** | |
| GHG emissions from wastewater treatment | 17 |
| GHG emissions from purchase of electricity | 0 |
| Total annualized GHG emissions (tons/year CO2e) | 17 |

[1] Source: Draft Environmental Impact Report for City of Visalia Water Conservation Plant Upgrades Project. (City of Visalia 2011).
[2] Source: Seattle city Light, Global Warming. http://www.seattle.gov/light/conserve/globalwarming/.
[3] Source: Local Government Operations Protocol for the quantification and reporting of GHG emissions inventories (ICLEI 2010).

# 7.0. DUWAMISH POLISHING DECENTRALIZED STRATEGY

The Duwamish Polishing Decentralized Strategy would produce and distribute reclaimed water on the west side of the Duwamish River in Seattle (Figure 1-1). The service area for this strategy is a 1 mile radius surrounding a conceptual treatment plant with a single distribution main. The Duwamish strategy and other decentralized strategy areas are intended to represent opportunities for implementing smaller scale reclaimed water efforts subject to certain infrastructure limitations.

WTD has identified two potential sources of demand for reclaimed water produced in this strategy. Both of these are nonpotable consumptive uses and include non-agricultural irrigation and industrial cooling.

Reclaimed water produced by the Duwamish polishing treatment plant would satisfy Class A reclaimed water requirements and could be directly applied for nonpotable consumptive uses.

## 7.1 Potential Effects on Public Health

The Duwamish strategy proposes to use Class A reclaimed water for non-agricultural irrigation (i.e., landscape irrigation) in the strategy area. The Duwamish strategy does not propose to use reclaimed water for agricultural irrigation. No negative public health effects are anticipated with the reclaimed water nonpotable consumptive uses given that the reclaimed water produced in this strategy would meet the water reclamation and reuse standards set by Health and Ecology. This conclusion is supported by recent studies confirming that landscapes irrigated with Class A reclaimed water are safe for incidental human contact (King County 2011a, RCW 90.46).

## 7.2 Potential Effects on Parks and Recreation

The Duwamish strategy does not include use of reclaimed water at parks and recreation areas. Several parks and recreation facilities are located in the vicinity of the Duwamish strategy (Figure 7-1). Since no use of reclaimed water is proposed for these parks, the strategy will not affect parks and recreation facilities.

## 7.3 Potential Effects on Groundwater Resources

The Duwamish strategy includes using Class A reclaimed water for non-agricultural irrigation and for commercial/industrial purposes. Irrigation would be at agronomic rates—with no application of reclaimed water for irrigation purposes when the ground is saturated—to prevent infiltration of reclaimed water to groundwater. The commercial/industrial uses of reclaimed water would be within piping and no ground surface contact would be expected.

### 7.3.1 Replacement of Withdrawals

SPU has two well fields in the City of SeaTac to provide peak season and emergency water supply (Seattle Public Utilities 2006). To the extent that reclaimed water could be used to replace

existing nonpotable water uses during peak seasons, application of reclaimed water could replace existing groundwater withdrawals.

### 7.3.2 Protection of Groundwater

There are no wellhead protection areas or critical aquifer recharge areas in the geographic vicinity of the Duwamish strategy (Figures 7-2 and 7-3).

## 7.4 Compatibility with Public Services and Utilities

This section evaluates the compatibility of the Duwamish strategy with local water supply and sewer system plans.

### 7.4.1 Water Supply Plans

SPU is the water purveyor for the City of Seattle. The City's water supply includes the Cedar River and South Fork Tolt River and two well fields that provide additional peak season capacity and emergency water supply. SPU revised its water supply plan in 2007, and the agency is required to coordinate its water supply plans with the reclaimed water available and/or proposed for use as specified by RCW 90.46.120(3). Consistent with this requirement, SPU's resource selection policy explicitly includes reclaimed water as an alternative source option; exploring reclaimed water projects would be consistent with this policy and would require a "triple-bottom-line analysis" in comparison to other source options (Seattle Public Utilities 2006).

### 7.4.2 Sewer System Plans

At this time, it does not appear that any of the reclaimed water strategies would affect sewer system plans. In the event of further planning and design of the Duwamish strategy, coordination with local utilities is recommended. According to RCW 90.48.112, the City of Seattle is required to coordinate their water supply plans or water system plans with the reclaimed water available and/or proposed for use.

## 7.5 Compatibility with Regional Planning

This section evaluates the compatibility of the Duwamish strategy with relevant regional plans: the King County Strategic Plan and the King County Comprehensive Plan. This strategy would not directly affect or support the Waterways 2000 program or the WRIA plan.

### 7.5.1 King County Strategic Plan

King County's proposed use of reclaimed water for the Duwamish strategy would meet Objective 4 under King County's Strategic Plan goal to safeguard and enhance King County's natural resources and environment, which would minimize King County's operational environmental footprint by creating resources from wastewater and solid waste disposal.

### 7.5.2 King County Comprehensive Plan

The Duwamish strategy addresses several actions identified in the Proposed 2012 King County Comprehensive Plan Amendments (King County 2011b). In particular, expanding the use of reclaimed water for nonpotable uses throughout the county would help with water conservation efforts and prepare the county for potential climate change impacts. Additionally, the use of reclaimed water is an important mechanism for improving water quality and reducing discharge of treated wastewater into Puget Sound and other sensitive areas, which in turn would help with salmon recovery efforts.

### 7.5.3 Waterways 2000

Since the Duwamish strategy area does not include any river basins that are addressed by the Waterways 2000 program, this strategy would not directly affect or support the Waterways 2000 program or the WRIA plan.

### 7.5.4 Watershed Resource Inventory Area 9

The Duwamish strategy is in WRIA 9, the Green/Duwamish and Central Puget Sound Watershed. Since the strategy is small in scale and does not include environmental enhancement uses, it is not expected to affect or support the WRIA plan.

## 7.6 Forecast GHG Emission Rates for Reclaimed Water Strategies

Table 7-1 shows the engineering assumptions, GHG emission factors, and forecast GHG emission rates associated with the long-term operation of the Duwamish strategy. All calculated GHG emission rates are expressed as CO2e. The forecast GHG emission rate is 25 tons per year of CO2e, which is less than the BAAQMD's significance threshold under CEQA (10,000 tons per year) or the EPA reporting threshold for major industrial sources (25,000 tons per year).

**Table 7-1. Greenhouse Gas Emissions for Reclaimed Water Strategies**

| Parameter | Duwamish Strategy |
|---|---|
| Potential reclaimed water flow | 0.50 mgd |
| Wastewater supply | South Plant effluent flows |
| Distribution piping for reclaimed water | 0.74 miles |
| New treatment requirement for nitrification-denitrification | 0.50 mgd |
| Electricity purchases for new wastewater treatment | 12 MW-hrs/yr |
| Electricity purchases for reclaimed water pumping | 81 MW-hrs/yr |
| **GHG Emission Factors and Data Sources** | |
| Electricity purchases from Seattle City Light | Zero lbs CO2e per MW-hr of purchased electricity for Seattle City Light2 |
| Nitrous oxide (N20) emissions from nitrification-denitrification wastewater treatment | 50 tons/yr CO2e per mgd treated using nitrification-denitrification3 |
| **GHG Emissions (tons CO2e)** | |
| GHG emissions from wastewater treatment | 25 |
| GHG emissions from purchase of electricity | 0 |
| Total annualized GHG emissions (tons/year CO2e) | 25 |

[1] Source: Draft Environmental Impact Report for City of Visalia Water Conservation Plant Upgrades Project. (City of Visalia 2011).
[2] Source: Seattle city Light, Global Warming. http://www.seattle.gov/light/conserve/globalwarming/.
[3] Source: Local Government Operations Protocol for the quantification and reporting of GHG emissions inventories (ICLEI 2010).

# 8.0. LOWER GREEN RIVER VALLEY SKIMMING DECENTRALIZED STRATEGY

The Lower Green River Valley (LGRV) Skimming Decentralized Strategy would produce and distribute reclaimed water along the floor of the LGRV, including areas in and around the Cities of Kent and Auburn (Figure 1-1). The service area for this strategy area is a 1 mile radius surrounding a conceptual treatment plant site with a single distribution main.

WTD has identified one potential source of demand for reclaimed water produced from this strategy. This is a large nonpotable consumptive agricultural irrigation use. During irrigation season, the identified use could demand the entire supply of reclaimed water from the treatment plant. Outside of irrigation season, the plant would be idle.

Reclaimed water produced at the LGRV skimming treatment plant would satisfy Class A reclaimed water requirements and could be directly applied for nonpotable consumptive uses.

## 8.1 Potential Effects on Public Health

The LGRV strategy proposes to use Class A reclaimed water for agricultural irrigation in the Lower Green River Valley. No negative public health effects are anticipated with the reclaimed water nonpotable consumptive uses given that the reclaimed water produced in this strategy would meet the water reclamation and reuse standards set by Health and Ecology. This conclusion is supported by recent studies confirming that food crops irrigated with Class A reclaimed water are safe for people to consume and that landscapes irrigated with Class A reclaimed water are safe for incidental human contact (King County 2011a, RCW 90.46).

## 8.2 Potential Effects on Parks and Recreation

The LGRV strategy does not include use of reclaimed water at parks and recreation areas. Several parks and recreation facilities are located in the vicinity of the LGRV strategy (Figure 8-1). Since no use of reclaimed water is proposed for these parks, the strategy will not affect parks and recreation facilities.

## 8.3 Potential Effects on Groundwater Resources

The LGRV strategy includes using Class A reclaimed water for agricultural irrigation. Irrigation would be at agronomic rates—with no application of reclaimed water for irrigation purposes when the ground is saturated—to prevent infiltration of reclaimed water to groundwater.

### 8.3.1 Replacement of Withdrawals

The agricultural use served by the LGRV Strategy is currently supplied by groundwater or surface water withdrawals from the Green River. To the extent that reclaimed water could be used to replace existing nonpotable water uses within the LGRV area, application of reclaimed

water could replace some existing groundwater withdrawals. This would likely benefit the Green River because of the reduction in the amount of water diverted from the river.

### 8.3.2 Protection of Groundwater

Figure 8-2 identifies wellhead protection areas that provide recharge to drinking water wells found in and near the LGRV strategy area. Figure 8-2 also shows the time anticipated for constituents in the groundwater to travel to a production well. Figure 8-3 identifies the critical aquifer recharge areas in or near the South plant strategy area. Recharge areas serve to replenish groundwater supplies but can also allow contaminants to be introduced to the uppermost unconfined aquifer.

Agricultural irrigation is unlikely to result in infiltration of reclaimed water into groundwater. Reclaimed water used in agricultural irrigation must be applied at agronomic rates to prevent infiltration.

## 8.4 Compatibility with Public Services and Utilities

Compatibility with public services and utilities does not apply to the LGRV strategy. The LGRV strategy would provide reclaimed water to a self supplied user; self supplied users do not maintain water plans. Additionally, no public sewer service exists in the strategy area, which is located in unincorporated King County.

## 8.5 Compatibility with Regional Planning

This section evaluates the compatibility of the LGRV strategy with relevant regional plans: the King County Strategic Plan, the King County Comprehensive Plan, and the WRIA 9 plan. This strategy would not directly affect or support the Waterways 2000 program.

### 8.5.1 King County Strategic Plan

King County's proposed use of reclaimed water for the LGRV strategy would meet Objective 4 under King County's Strategic Plan goal to safeguard and enhance King County's natural resources and environment, which would minimize King County's operational environmental footprint by creating resources from wastewater and solid waste disposal.

### 8.5.2 King County Comprehensive Plan

The LGRV strategy addresses several actions identified in the Proposed 2012 King County Comprehensive Plan Amendments (King County 2011b). In particular, providing reclaimed water for agriculture supports King County's recognition of the importance of maintaining viable agriculture areas in an urban landscape. In addition, expanding the use of reclaimed water for nonpotable uses throughout the county would help with water conservation efforts and prepare the county for potential climate change impacts. Additionally, the use of reclaimed water is an important mechanism for improving water quality and reducing discharge of treated wastewater into Puget Sound and other sensitive areas, which in turn would help with salmon recovery efforts.

### 8.5.3 Waterways 2000

While the Middle Green River Basin is one of the river basins selected for the Waterways 2000 program, none of the reaches proposed for the Waterways 2000 program are within the LGRV strategy (Table 2-2). Therefore, this strategy would not directly affect or support the Waterways 2000 program.

### 8.5.4 Watershed Resource Inventory Area 9

Potential benefit to the Green River from reduced surface water withdrawals would be consistent with the WRIA 9 Green/Duwamish and Central Puget Sound Watershed salmon habitat management plan (WRIA Steering Committee 2005). Because the LGRV strategy is small in scale and is only considered to have the potential to displace one use of water in the watershed, its effects are not expected to be significant in terms of overall watershed health.

## 8.6 Forecast GHG Emission Rates for Reclaimed Water Strategies

Table 8-1 shows the engineering assumptions, GHG emission factors, and forecast GHG emission rates associated with the long-term operation of the LGRV strategy. All calculated GHG emission rates are expressed as CO2e. The forecast annualized GHG emission rate is 25 tons CO2e per year, which is less than the BAAQMD's significance threshold under CEQA (10,000 tons per year) or the EPA reporting threshold for major industrial sources (25,000 tons per year).

**Table 8-1. Greenhouse Gas Emissions for Reclaimed Water Strategies**

| Parameter | Lower Green River Valley Decentralized Strategy |
|---|---|
| Potential reclaimed water flow | 0.50 mgd |
| Wastewater supply | Regional wastewater conveyance flows |
| Distribution piping for reclaimed water | 0.17 mile |
| New treatment requirement for nitrification-denitrification | 0.50 mgd |
| Electricity purchases for new wastewater treatment (Seattle City Light) | 138 MW-hrs/yr |
| Electricity purchases for reclaimed water pumping | 82 MW-hrs/yr |
| **GHG Emission Factors and Data Sources** | |
| Electricity purchases from Seattle City Light | Zero lbs CO2e per MW-hr of purchased electricity from Seattle city Light2 |
| N20 emissions from nitrification-denitrification wastewater treatment | 50 tons/yr CO2e per mgd treated using nitrification-denitrification3 |
| **GHG Emissions (tons CO2e)** | |
| GHG emissions from wastewater treatment | 25 |
| GHG emissions from purchase of electricity | 0 |
| Total annualized GHG emissions (tons/year CO2e) | 25 |

1 Source: Draft Environmental Impact Report for City of Visalia Water Conservation Plant Upgrades Project. (City of Visalia 2011).
2 Source: Seattle city Light, Global Warming. http://www.seattle.gov/light/conserve/globalwarming/.
3 Source: Local Government Operations Protocol for the quantification and reporting of GHG emissions inventories (ICLEI 2010).

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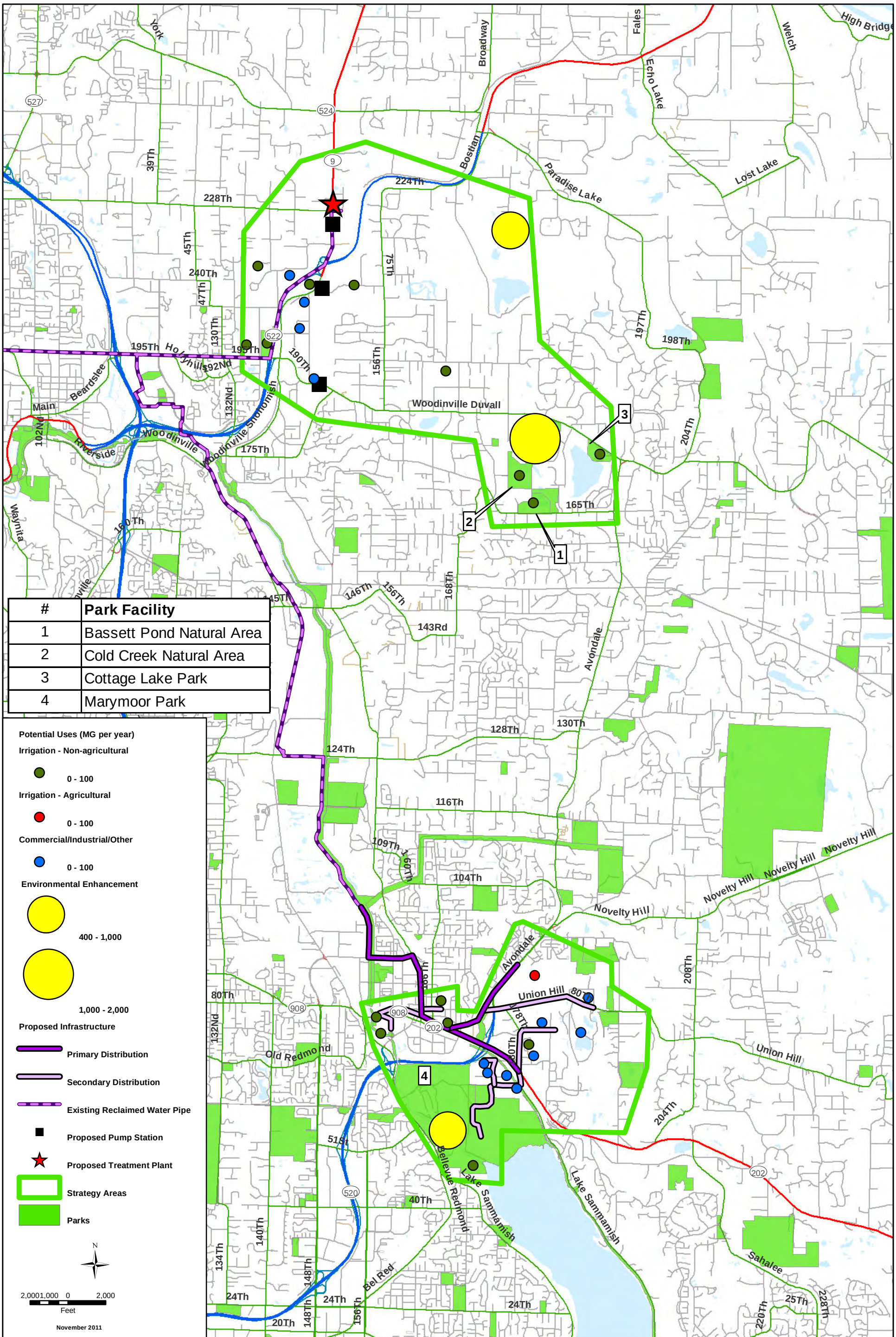
# FIGURES




| # | Park Facility |
|---|---|
| 1 | Bassett Pond Natural Area |
| 2 | Cold Creek Natural Area |
| 3 | Cottage Lake Park |
| 4 | Marymoor Park |

King County
Department of
Natural Resources and Parks
**Wastewater Treatment Division**

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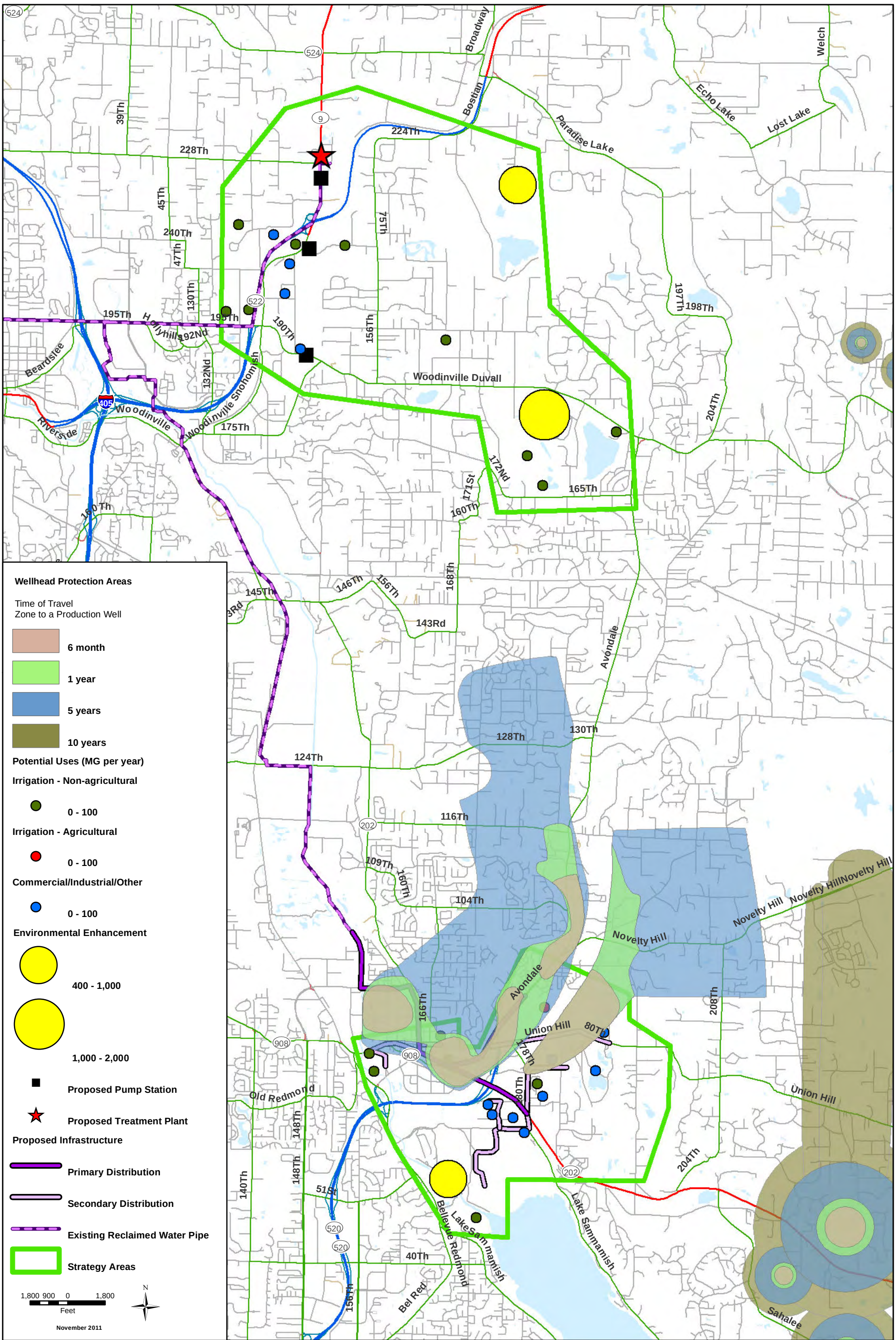
Figure 4-1

**Parks and Recreation- Brightwater**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

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**Wastewater Treatment Division**

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Figure 4-2

**Wellhead Protection Areas- Brightwater**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

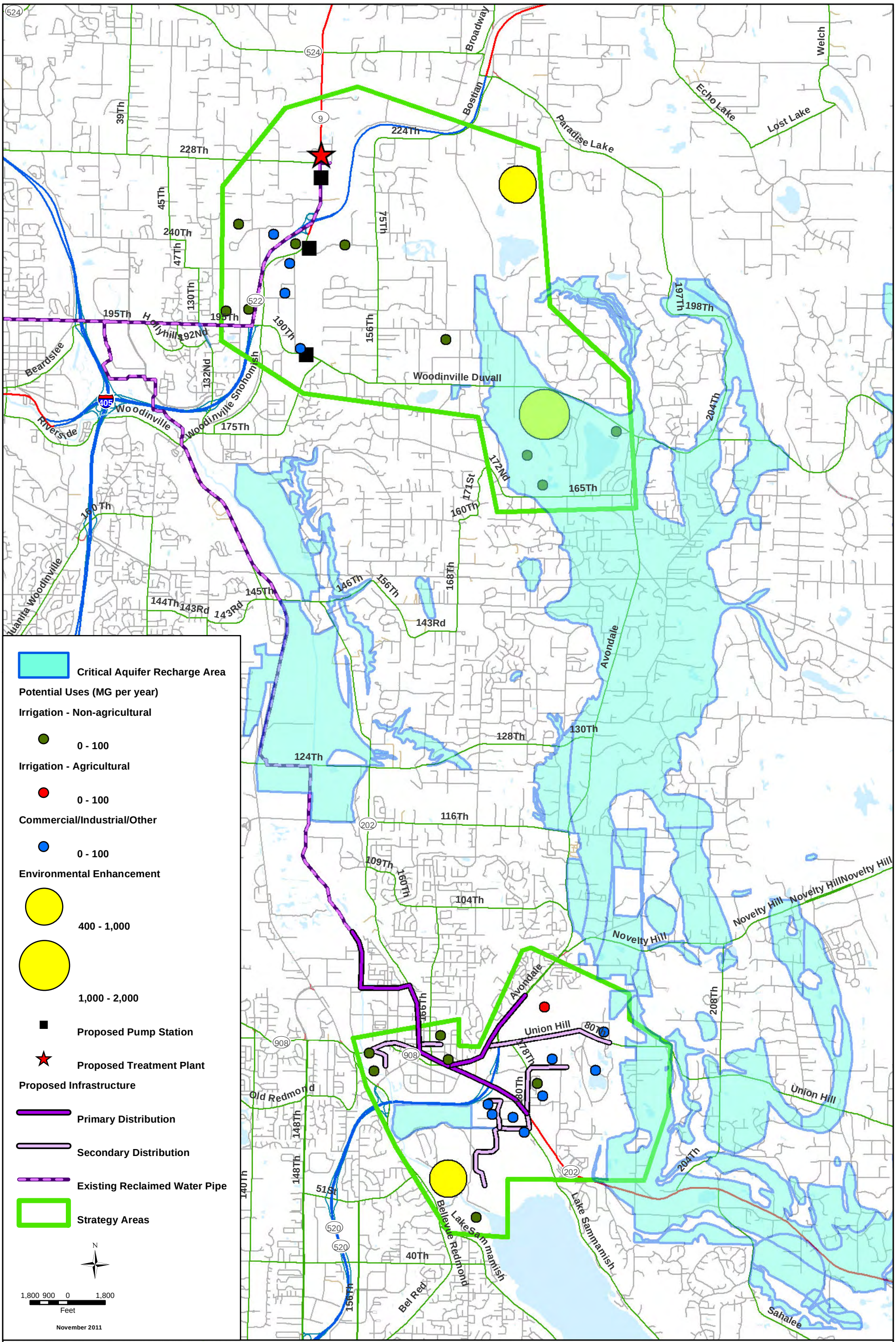


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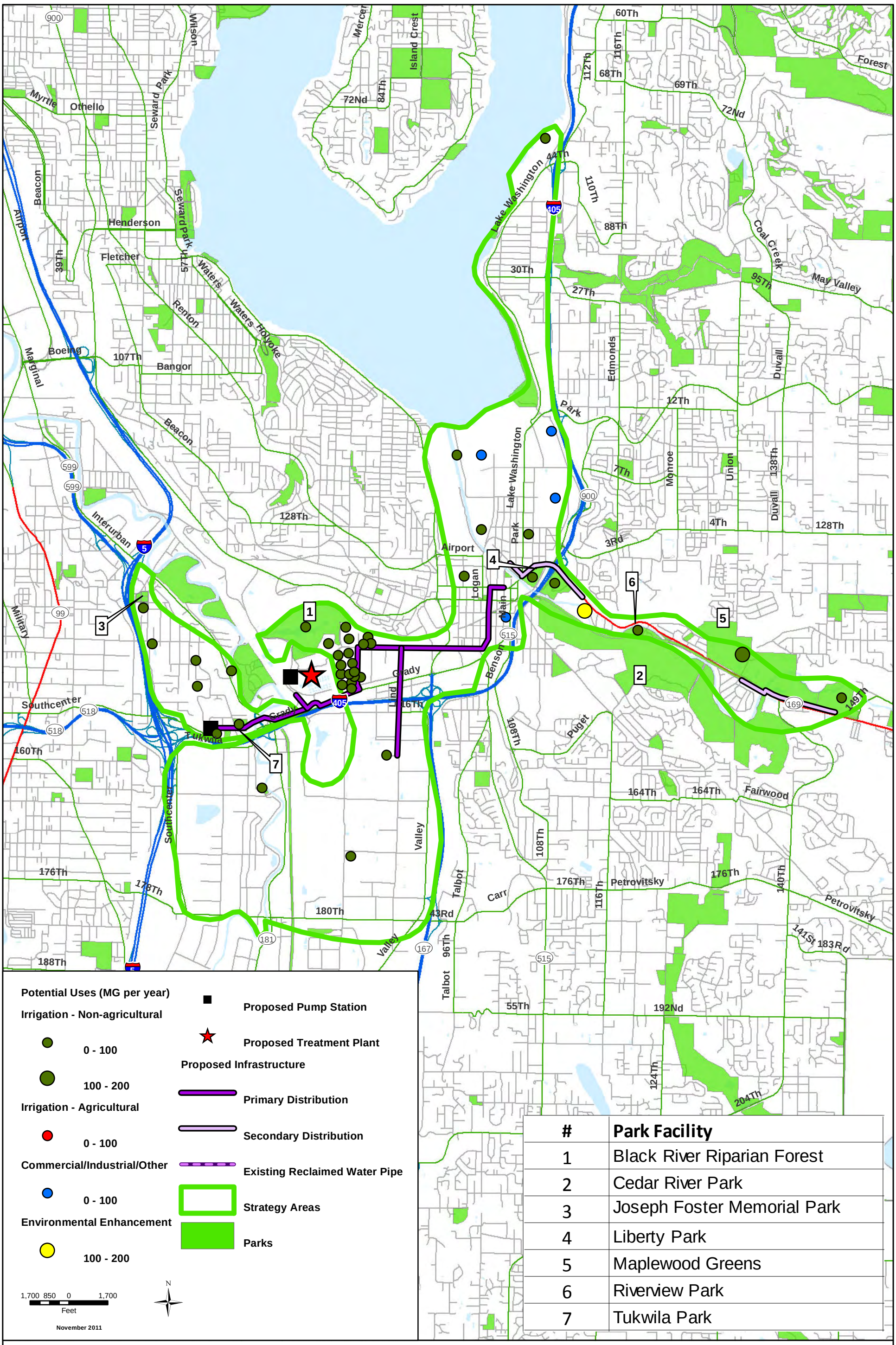
Figure 4-3

**Critical Aquifer Recharge Areas- Brightwater**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*


Potential Uses (MG per year)
Irrigation - Non-agricultural
0 - 100
100 - 200
Irrigation - Agricultural
0 - 100
Commercial/Industrial/Other
0 - 100
Environmental Enhancement
100 - 200
Proposed Pump Station
Proposed Treatment Plant
Proposed Infrastructure
Primary Distribution
Secondary Distribution
Existing Reclaimed Water Pipe
Strategy Areas
Parks
1,700 850 0 1,700
Feet
N
November 2011
1
2
3
4
5
6
7
Lake Washington
Seward Park
Renton
Waters
Waters Holyoke
Beacon
Airport
Boeing
Marginal
Interurban
Military
Southcenter
Tukwila
Grady
Lind
Valley
Talbot
Carr
Petrovitsky
Fairwood
Puget
Benson
Logan
Main
Park
Edmonds
Monroe
Union
Duvall
Coal Creek
May Valley
Forest
Mercer
Island Crest
Wilson
Myrtle
Othello
Henderson
Fletcher
Bangor
Lake Washington
Park
Airport
Southcenter
Petrovitsky
Talbot
Valley
Grady
Lind
Benson
Logan
Main
Park
Edmonds
Monroe
Union
Duvall
Coal Creek
May Valley
Forest
Mercer
Island Crest
Wilson
Seward Park
Myrtle
Othello
Beacon
Airport
Boeing
Marginal
Interurban
Military
Southcenter
Tukwila
Grady
Lind
Valley
Talbot
Carr
Petrovitsky
Fairwood
Puget

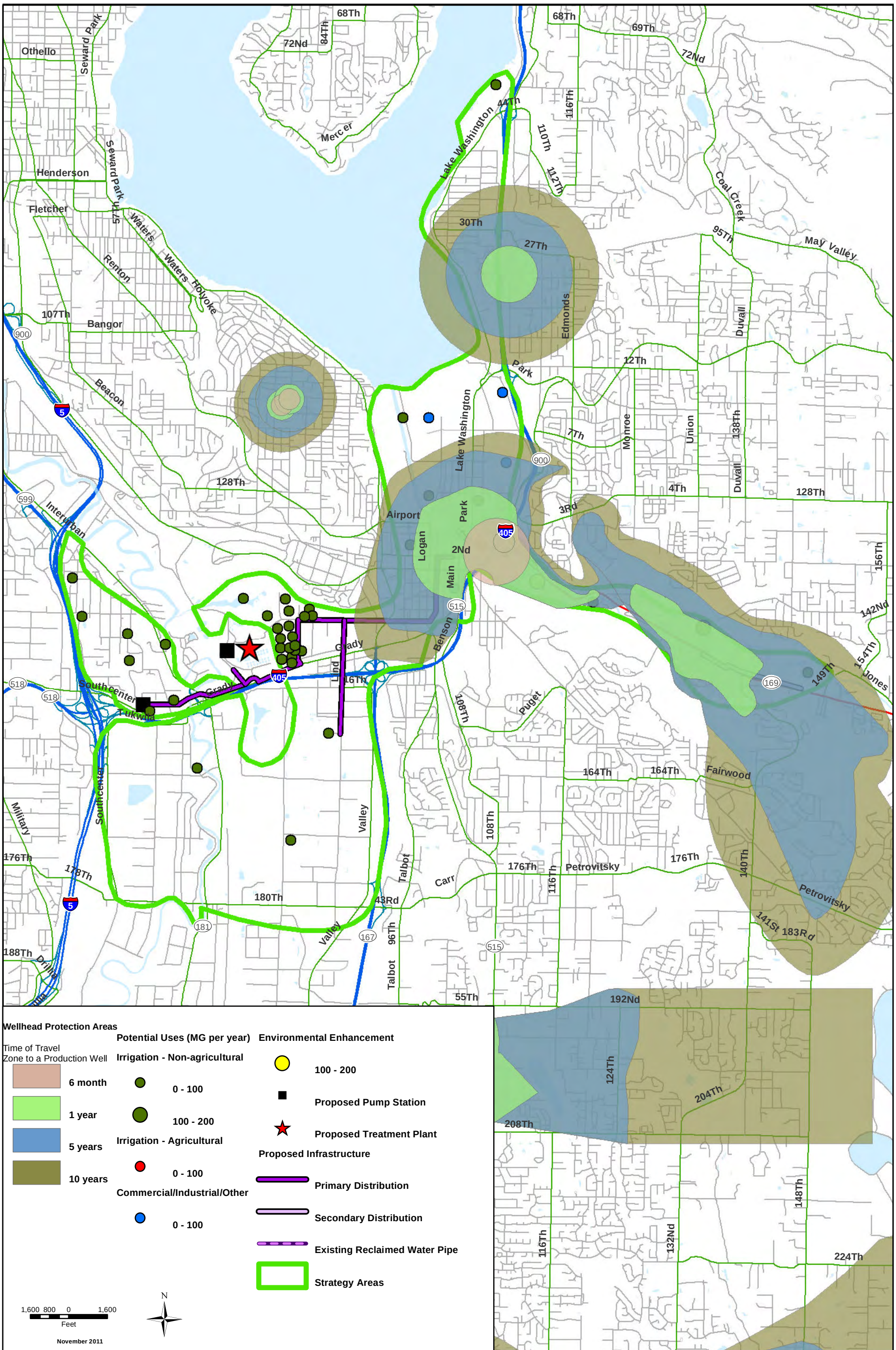



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Figure 5-2

**Wellhead Protection Areas- South Plant**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

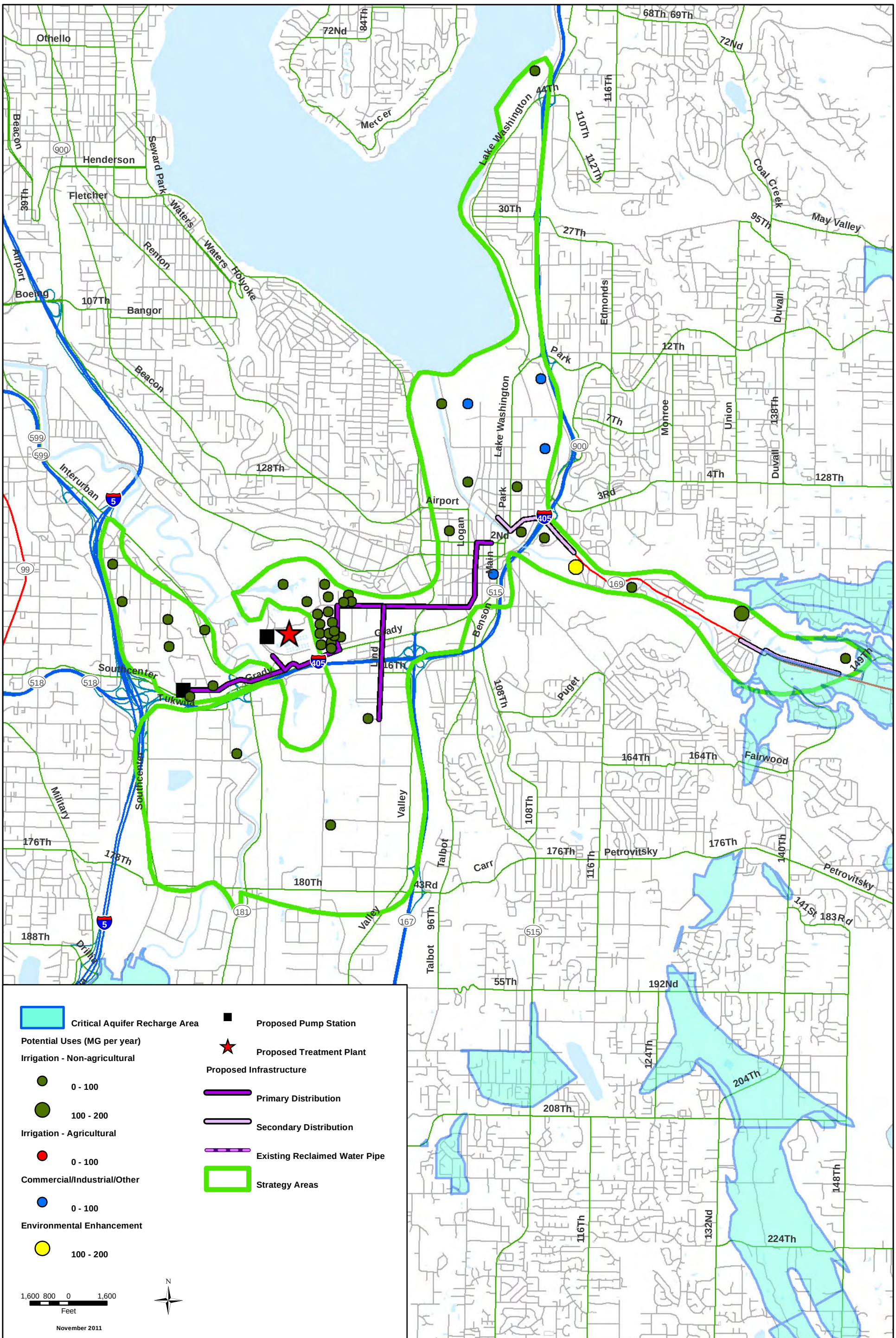


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Figure 5-3

**Critical Aquifer Recharge Area- South Plant**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

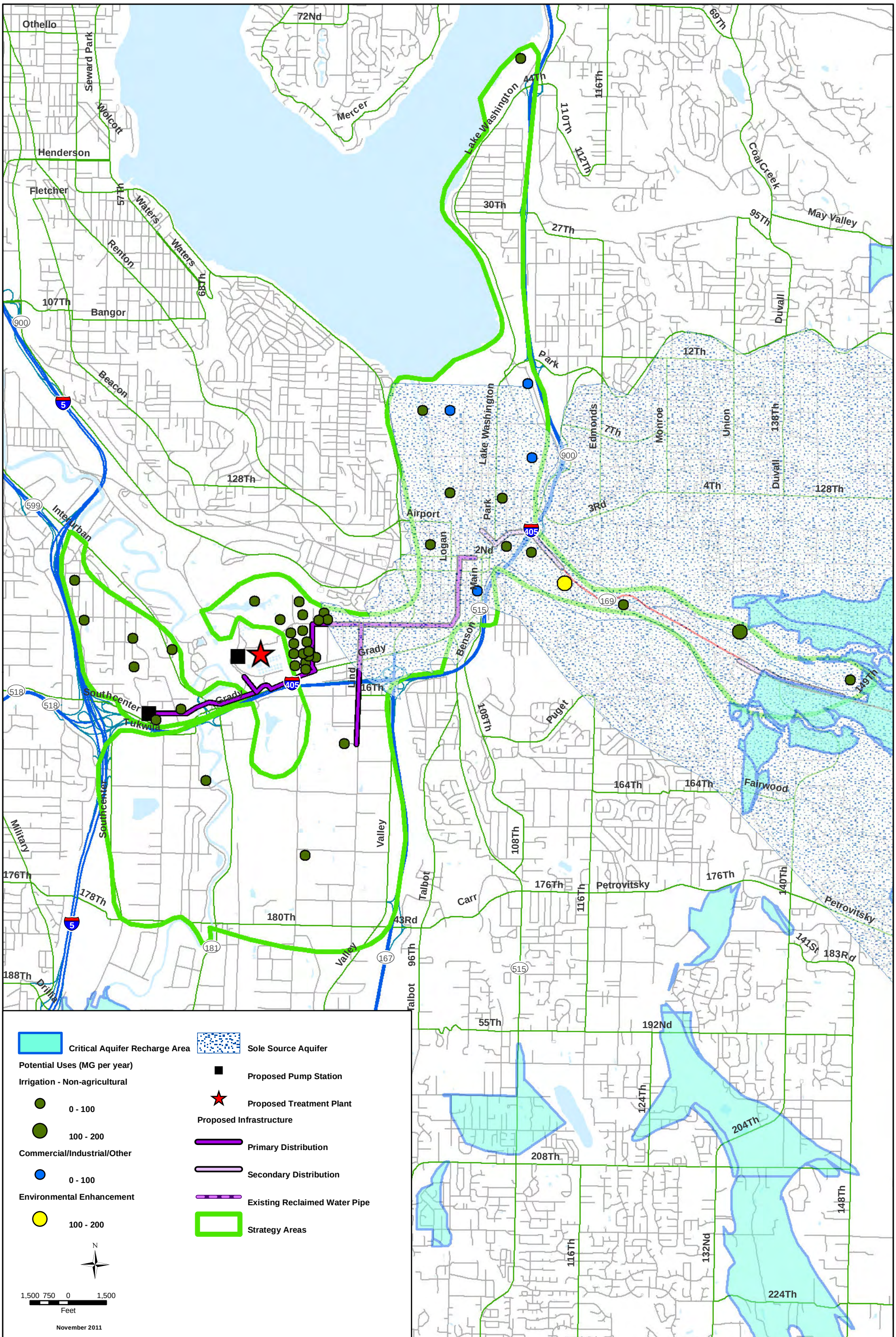


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Figure 5-4

**Sole Source Aquifer- South Plant**

*Technical Memorandum:*
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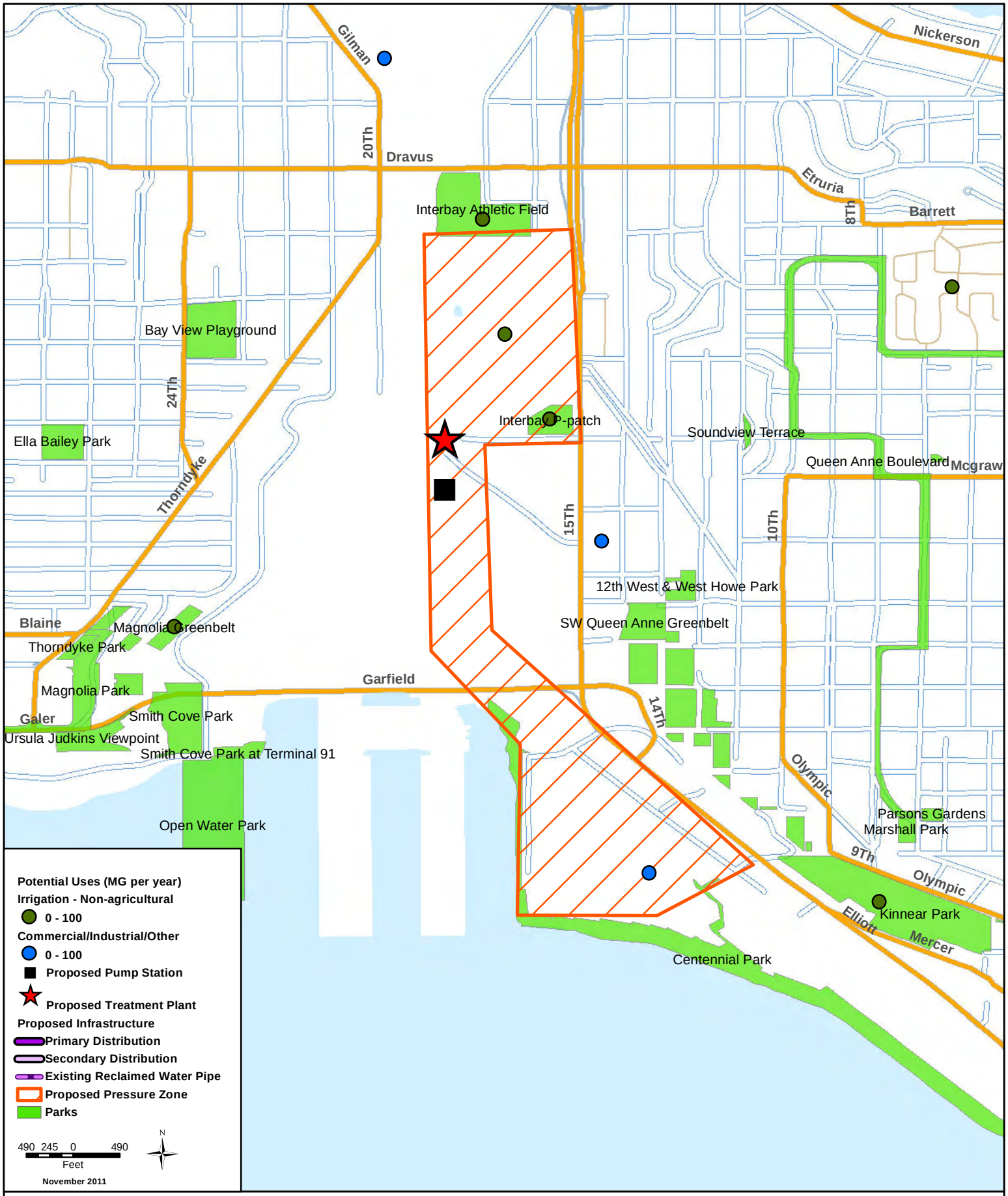


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**Data Source:**

Figure 6-1

**Parks and Recreation- Interbay**

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*Reclaimed Water Strategy Effects on the Built Environment*

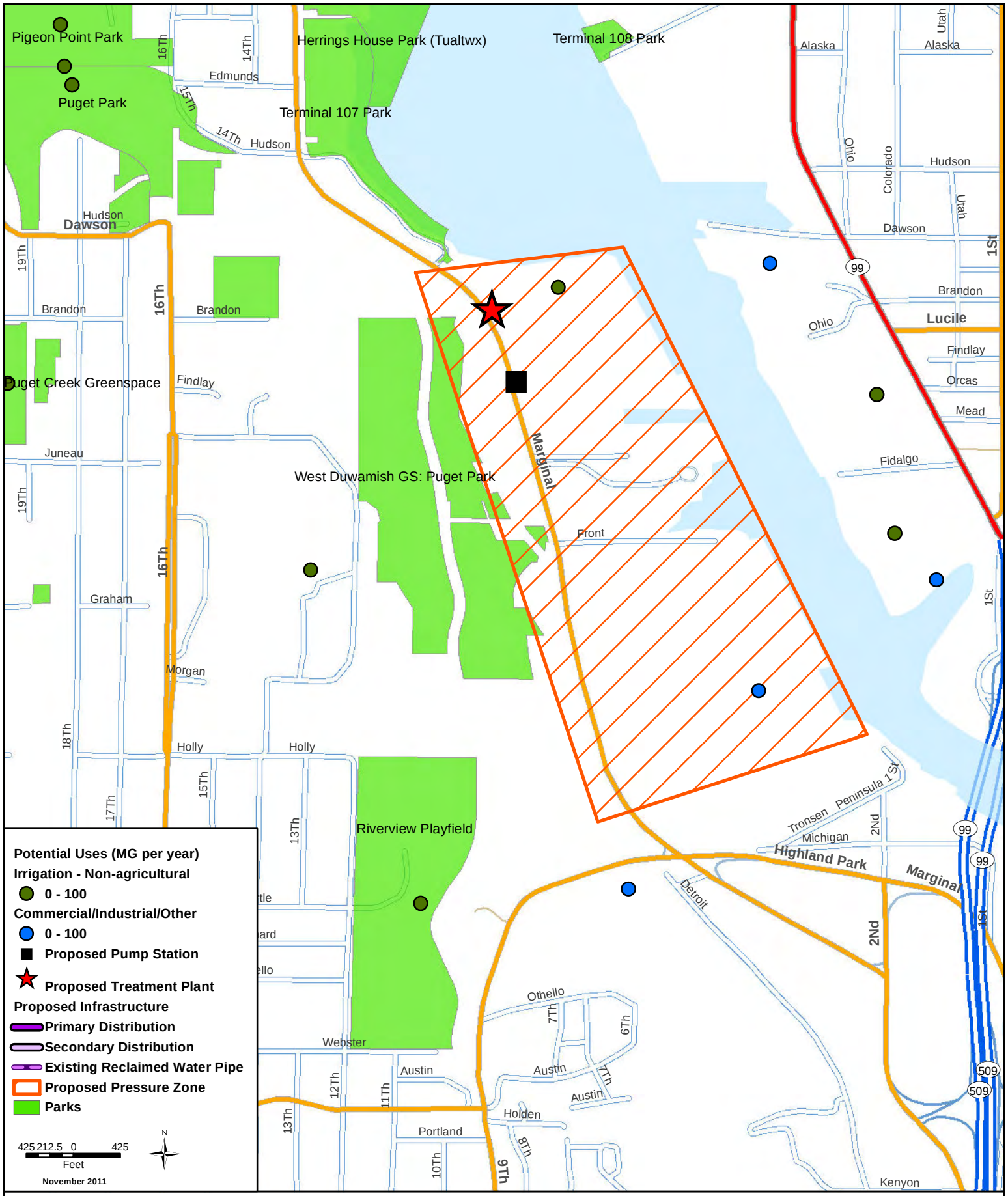


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Figure 7-1

**Parks and Recreation- Duwamish**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

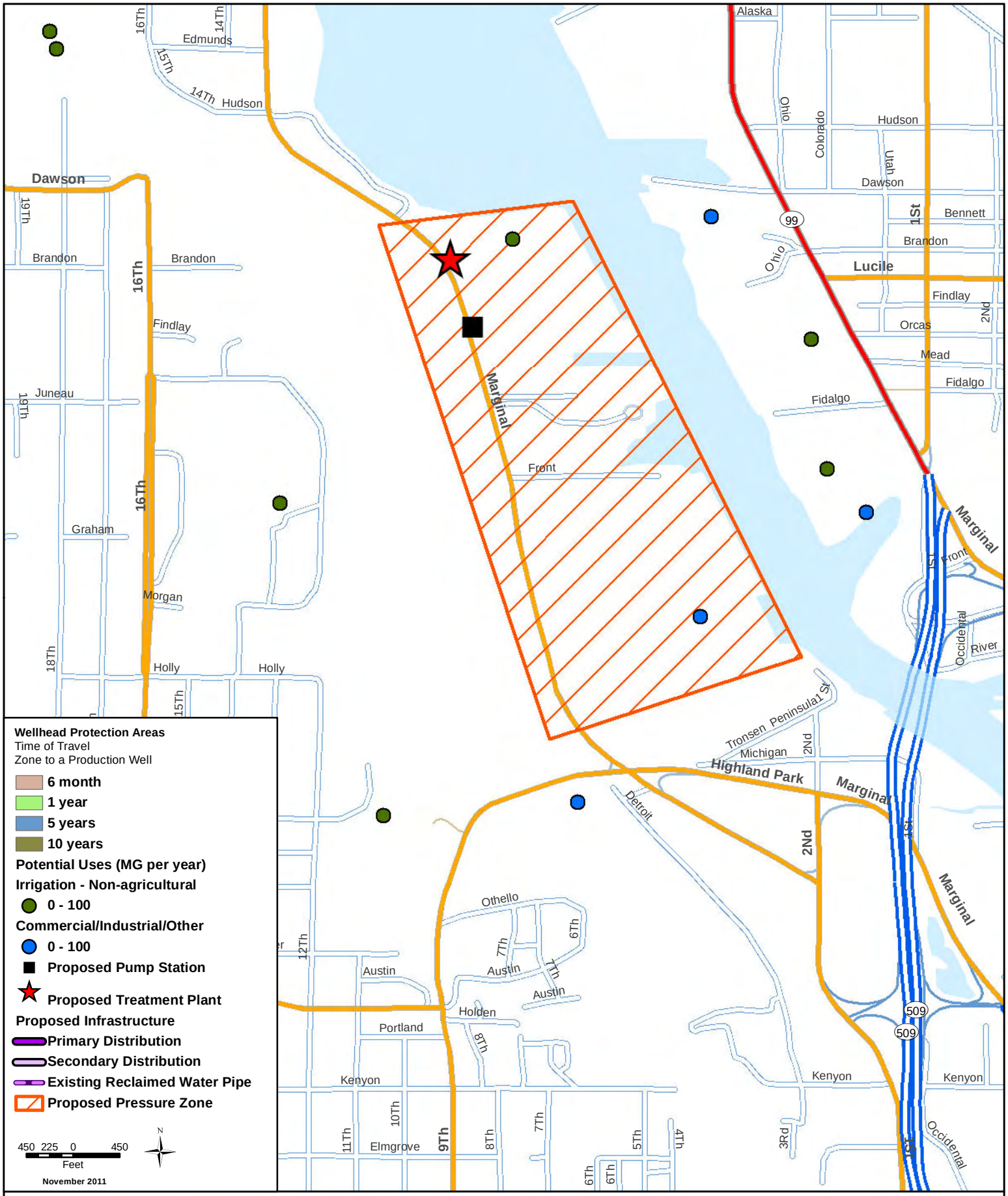


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Figure 7-2

**Wellhead Protection Areas- Duwamish**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

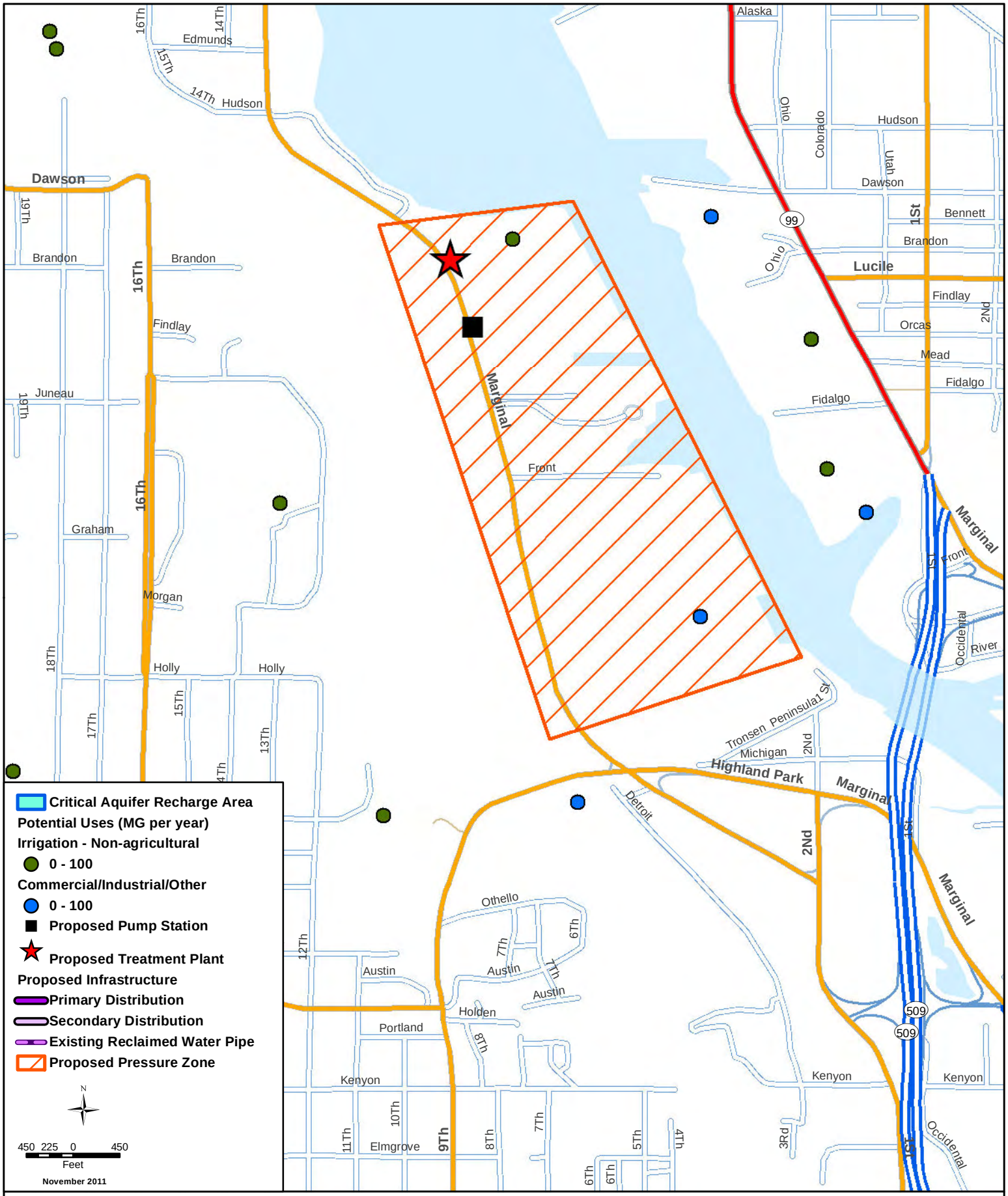


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Figure 7-3

**Critical Aquifer Recharge Areas- Duwamish**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

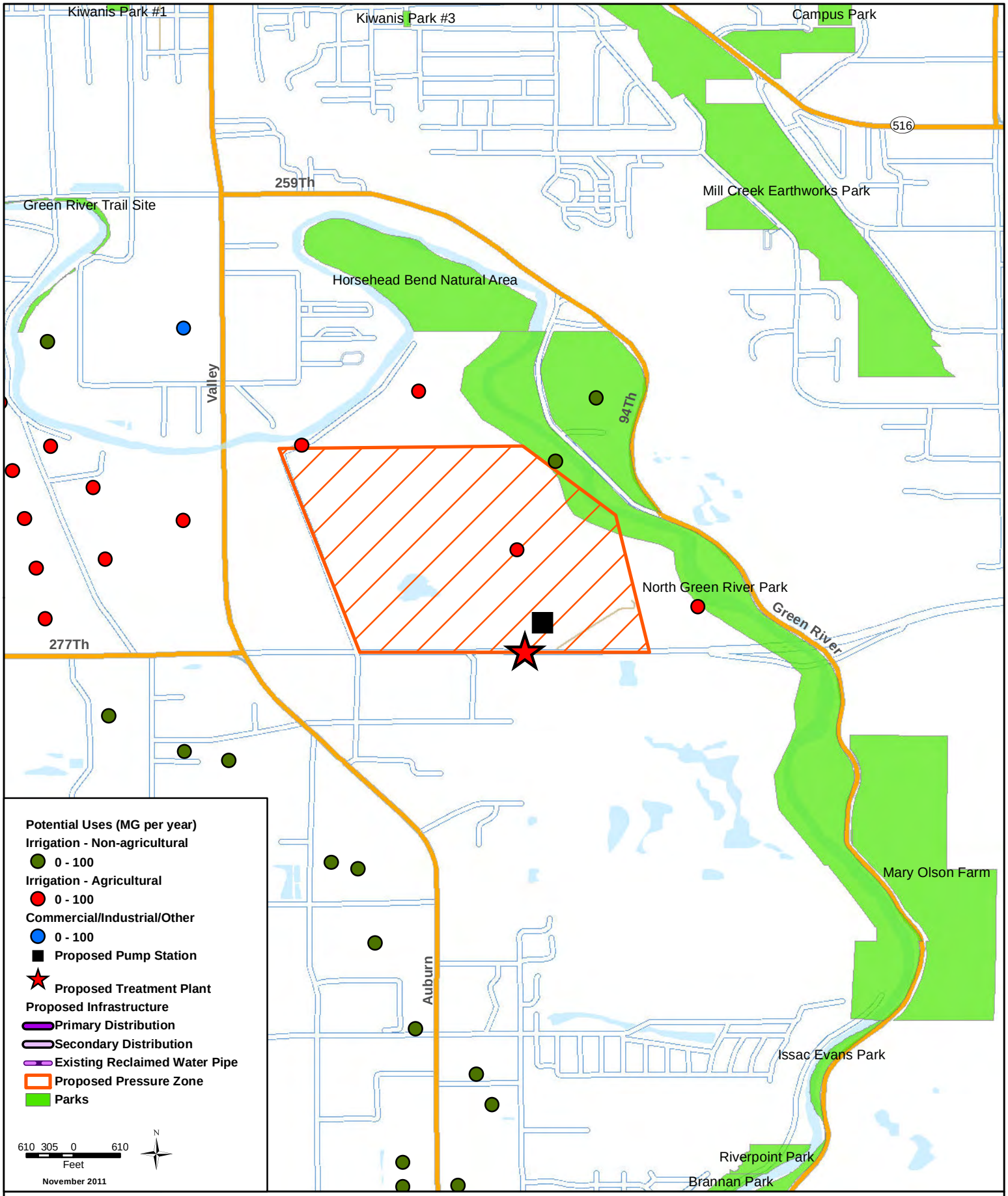


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Figure 8-1

**Parks and Recreation- Lower Green River Valley**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

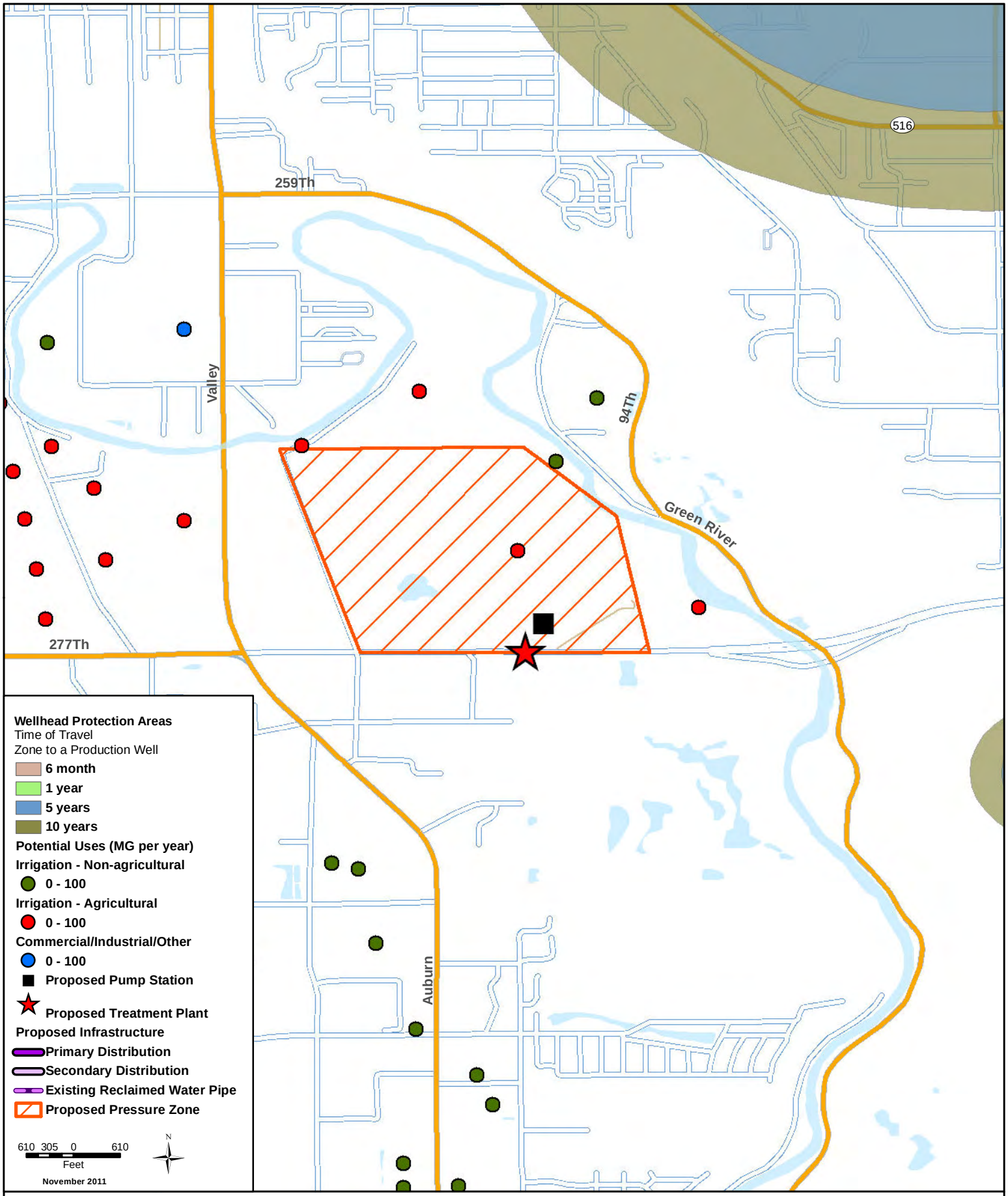


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Figure 8-2
**Wellhead Protection Areas-**
**Lower Green River Valley**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*

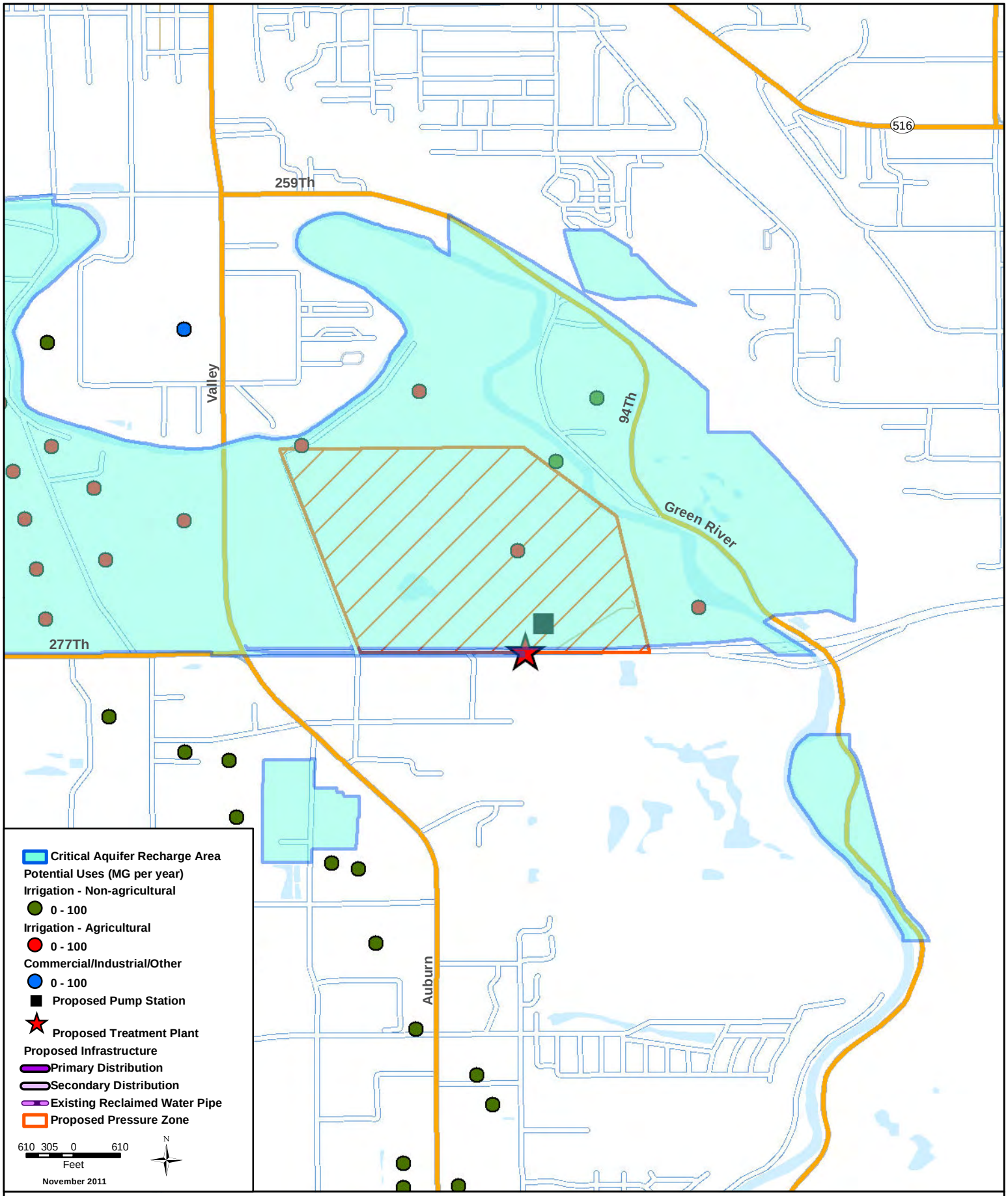


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Figure 8-3

**Critical Aquifer Recharge Areas-**
**Lower Green River Valley**

*Technical Memorandum:*
*Reclaimed Water Strategy Effects on the Built Environment*