

FACILITIES PLAN

Name

Carnation Wastewater Treatment Facility

Proponent/Lead Agency

King County Department of Natural Resources and Parks

Wastewater Treatment Division
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Seattle, WA 98014

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Prepared By

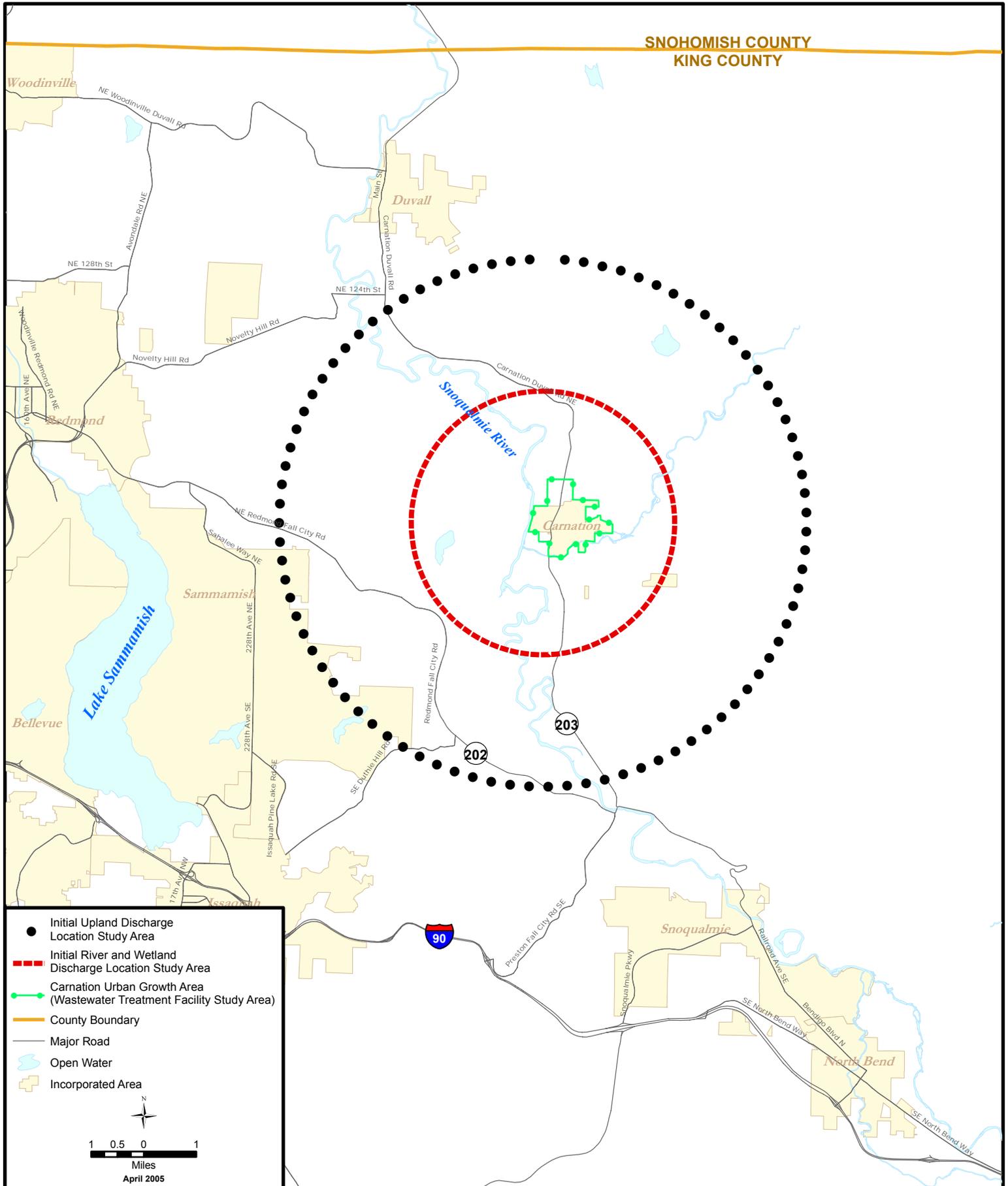
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1.0 EXECUTIVE SUMMARY

This Facilities Plan for the Carnation Wastewater Treatment Facility (CWWTF) has been prepared in accordance with the Submission of Plans and Reports for Construction of Wastewater Facilities (2000) Washington Administrative Code (WAC) 173-240 for submittal to the Washington Department of Ecology (Ecology). This plan is designed to demonstrate that the proposed project will meet the applicable guidelines, regulations, and approval requirements for issuance of a discharge permit. In addition, the Facilities Plan serves as a comprehensive guide to the project.

The City of Carnation (City) is located on the Snoqualmie River within the Snoqualmie Valley (see Figure 1.1) and is an incorporated city within King County (County). At the request of the City, the County proposes to build and operate a new local wastewater treatment facility and associated river outfall to meet the needs of the City's designated Urban Growth Area (UGA) for a 2030 facility design year. The City will construct and operate a vacuum sewer collection system for the conveyance of sewage from residences and businesses within the City to the treatment facility. An agreement between the County and the City, attached as Appendix C of this plan, requires the facility to be operational by December 2007.

Historically, the City has relied on a system of individual septic tanks and drain fields. In 1987, Public Health – Seattle & King County (Public Health) declared the City a public health hazard area based on the number of inadequate septic systems and the likely contamination of the unprotected aquifer from which drinking water is derived.¹ Public Health made this declaration based on the soil conditions within the City, documented illegal sewage disposal repairs, and informal surveys confirming inadequate systems. Due to the costs associated with a lot-to-lot survey and comprehensive ground water studies, Public Health has been unable to determine the full extent of the health threat. Since then, Public Health has taken the step of restricting property use or prohibiting remodeling projects in cases where the long-term protection of public health is at risk. Legal repairs to existing septic systems on inadequately sized lots may require a notice of nonconforming repair on the property deed of records.² Attached as Appendix D, Public Health issued a letter on September 28, 2005 that indicates that due to continued public exposure to surfacing sewage and untreated sewage entering the groundwater aquifer, current on-site sewage disposal practices in the City are clearly inadequate and present a Severe Public Health Hazard to the community.³ As a result, Public Health supports the development of a sewer system for the City. Public Health views the system remains the “most viable solution for the long-term protection of the public's health.” Replacing on-site septic systems with a wastewater treatment facility is important to address public health concerns, achieve the City's comprehensive plan goals, and enhance community livability.



SNOHOMISH COUNTY
KING COUNTY

Woodinville

Duvall

Carnation

Snoqualmie

North Bend

- Initial Upland Discharge Location Study Area
- Initial River and Wetland Discharge Location Study Area
- Carnation Urban Growth Area (Wastewater Treatment Facility Study Area)
- County Boundary
- Major Road
- Open Water
- Incorporated Area

1 0.5 0 1
Miles
April 2005

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Data Source: King County GIS

Figure 1.1

**Project Study Areas
in Carnation and Vicinity**
CARNATION WASTEWATER
TREATMENT FACILITY

1.1 Future Flows and Loads

From the spring of 2003 through the summer of 2004, the City and County developed an approach to estimate populations and wastewater flows, as well as specific loads to a proposed treatment facility, for future years. Population development is documented in the City of Carnation 2004 Sewer Comprehensive Plan.⁴ Table 1.1 summarizes the design flows and load projections for the CWWTF. The City's population is expected to increase from 1,893 residents in 2000 to residential saturation (3,871 residents) by the year 2017.

Table 1.1 Population, Flow, and Load Projections Carnation Wastewater Treatment Facility King County Department of Natural Resources and Parks				
Parameter	Projections by Major Milestone and Year			
	Startup 2007	Full Sewer^a 2012	Residential Saturation^b 2017	Design Year 2030
Planning forecasts ^c				
Population	2,185	3,816	3,871	3,871
Households	733	1,281	1,300	1,300
Employees	634	809	1,254	2,175
Flow (mgd)				
Average annual	0.21	0.32	0.34	0.37
Maximum monthly	0.27	0.42	0.44	0.48
Maximum daily	0.43	0.67	0.71	0.77
Peak hourly	0.63	0.72	1.29	1.4 ^d
BOD (lb/day)				
Average annual	538	923	954	991
Maximum monthly	700	1,200	1,240	1,288
Maximum daily	915	1,570	1,622	1,684
TSS (lb/day)				
Average annual	538	923	954	991
Maximum monthly	700	1,200	1,240	1,288
Maximum daily	915	1,570	1,622	1,684
Notes:				
mgd = million gallons per day lb/day = pounds per day				
a. End of the anticipated rapid increase in population (5% annual growth rate until the buildout density is reached) after the vacuum sewers are available.				
b. The residential saturation was determined based on the buildout density of the residentially zoned land within the UGA.				
c. Source: Roth Hill Engineering Partners, LLC, <i>City of Carnation 2004 Sewer Facilities Plan, City Review Draft</i> , September 2004.				
d. Allows for wet well equalization.				

In accordance with the countywide planning policies presented in the King County Comprehensive Plan⁵ and to satisfy the requirements of the Revised Code of Washington (90.48 RCW),⁶ the County commissioned a study in 2004 to review and determine the cost implications of initiating a water demand management program (to promote conservation through retrofitting equipment and/or establishing new plumbing codes) in conjunction with the design of the CWWTF. The study determined that conservation practices will have little to no effect on the design of the CWWTF or the collection system but may impact associated operations and maintenance (O&M) costs.

1.2 Water Quality and Regulatory Approvals

In 2003, the County made a commitment to the citizens of the City that the CWWTF design would provide highly treated effluent, herein referred to as highly treated water, to meet the stringent water quality requirements for the selected discharge alternative. For the river outfall discharge alternative, the anticipated National Pollutant Discharge Elimination System (NPDES) requirements would be set based on technology, water quality, and the 1994 total maximum daily load (TMDL) study for the Snoqualmie River.⁷ This commitment will allow the facility to be capable of meeting the Class A reclaimed water standards, as regulated by the Washington Departments of Health and Ecology, should either the County or the City desire to use the water in the future. Class A reclaimed water would allow for unrestricted non-potable contact applications as well as use for the restoration or enhancement of wetlands. Class A standards require the highly treated water from the CWWTF to meet additional water quality criteria for parameters such as total coliform and turbidity. Ecology also reserves the right to regulate nutrients such as nitrate and total phosphorus for specific reuse applications.

The County will treat and discharge wastewater from the City in accordance with the applicable permit standards. Permits related to the construction of the facility and discharge from the CWWTF to the river are expected to include NPDES construction and municipal discharge permits, Washington Department of Natural Resources Aquatic Lands Lease permit, and local clearing and grading, right-of-way, and building/construction permits. The CWWTF will be designed to meet all permit requirements and water quality standards in effect at the time of permit issuance. Table 1.2 summarizes the anticipated requirements for the discharge of treated wastewater from the CWWTF to the Snoqualmie River. Table 4.2 of this document lists the minute quantities of other constituents such as metals, which are also regulated by the Surface Water Standards.⁸

Table 1.2 Anticipated Discharge Requirements to the Snoqualmie River Carnation Wastewater Treatment Facility King County Department of Natural Resources and Parks	
Parameter	Allowable Limit
Year-Round or Non-TMDL Permit Limitations	
Average monthly BOD ₅ ^a TSS ^a NH ₃ -N ^b Fecal coliform ^c Residual Cl ₂ ^b	30 mg/L, 155 lb/day 30 mg/L, 155 lb/day 38.3 mg/L 50 CFU per 100 mL 0.063 mg/L
Average weekly BOD ₅ ^a TSS ^a NH ₃ -N ^b Fecal coliform Residual Cl ₂ ^b	45 mg/L, 233 lb/day 45 mg/L, 233 lb/day 91.3 mg/L 400 CFU per 100 mL 0.165 mg/L
Maximum daily Temperature (7-day average) ^d pH ^e Turbidity ^f Total dissolved gas ^g	16 °C 6.5 - 8.5 5 ntu + river background 110 percent
Minimum daily DO ^h	9.5 mg/L
TMDL Permit Limitations (Aug - Oct)ⁱ	
Maximum daily BOD ₅ NH ₃ -N SRP	25 lb/day 8.4 lb/day 3 lb/day
BOD ₅ = biochemical oxygen demand °C = degrees Celsius CFU = colony forming units Cl ₂ = chlorine DO = dissolved oxygen	NH ₃ -N = ammonia-nitrogen ntu = nephelometric turbidity unit mg/L = milligrams per liter mL = milliliter TSS = total suspended solids
Notes:	
<p>a. Average monthly concentration cannot exceed 30 mg/L or 15 percent of the respective monthly average influent concentrations, whichever is more stringent.</p> <p>b. As reported by Cosmopolitan in Technical Memorandum (TM) No. 12 for these toxic substances and assuming limiting acute and chronic dilution factors of 8.7 and 116, respectively. The Surface Water Standards also list other regulated constituents such as heavy metals not listed in this table. Using updated potential dilution allowances; the allowable concentration would likely be greater than that reported in this table.</p> <p>c. Based on a geometric mean value, with not more than ten percent of all samples exceeding 100 colonies / 100 mL.</p> <p>d. No temperature increase can raise the receiving water temperature by greater than 0.3°C if natural temperature exceeds criteria.</p> <p>e. Human-caused variation within acceptable range, less than 0.2 unit.</p> <p>f. Results in less than a 10 percent increase when the background turbidity is more than 50 ntu.</p> <p>g. Criteria does not apply when the stream flow exceeds the 7-day, 10-year flood frequency.</p> <p>h. No DO decrease greater than 0.2 mg/L when the receiving water body is lower than the criteria due to natural conditions.</p> <p>i. Based on the 1994 TMDL study for mass discharge loading. For the months of August, September, and October, the water quality must meet both the NPDES and the year-round limitations.</p>	
Sources: Cosmopolitan Engineering Group, <i>Technical Memorandum No. 12 - River Outfall</i> , 2004.; <i>Water quality standards for surface waters of the state of Washington</i> , WAC 173-201A (2003).; Joy, J., <i>Snoqualmie River Total Maximum Daily Load Study</i> , Ecology Report #94-71, 1994.	

In addition, the County is continuing to prepare documentation to meet the other major regulatory approval processes.

- The final Environmental Impact Statement (EIS) analyzed the characteristics, probable impacts, and mitigation measures for the CWWTF alternatives. The final EIS was issued October 15, 2004, and addressed all comments submitted (eight government agencies and 20 individuals or groups) after a 30-day public comment period and public hearing.⁹
- A biological assessment (BA) has been prepared for the CWWTF in order to comply with Section 7 of the Endangered Species Act (ESA) and is required for the City to apply for federal funding. The BA has submitted to the Environmental Protection Agency (EPA) for review in September 2005 and forwarded to the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) for their concurrence shortly thereafter.
- A Joint Aquatic Resources Permit Application (JARPA) was submitted to the appropriate permitting agencies in April 2005. It is anticipated that the project will require a Hydraulic Project Approval (HPA) and a Shoreline Substantial Development permit.

1.3 Treatment Process

Treatment processes that would effectively provide the level of treatment to meet the anticipated discharge requirements for all of the discharge alternatives evaluated during preliminary design were evaluated. The evaluation examined a range of suspended, fixed-film, and hybrid processes for the following criteria: 1) risk, 2) capital and O&M costs, 3) facility space requirements, 4) process reliability, 5) operations familiarity, 6) maintenance requirements, and 7) odor control and enclosure costs. Based on the evaluation, activated sludge coupled with membrane bioreactor (MBR) technology was recommended for the CWWTF. This technology provides the highest water quality while requiring the smallest environmental footprint. In addition, the City would have state-of-the-art treatment at a cost similar to a more conventional treatment system.

Given the environmental sensitivity of the Snoqualmie River and surrounding areas, the CWWTF will include state-of-the art biological treatment and separation facilities that include:

- Fine-screening, solids storage, and odor control facilities
- Liquid treatment facilities
 - Activated sludge with anoxic, anaerobic, and aerobic zones
 - MBR tanks
 - Ultraviolet (UV) disinfection facilities

- Aerated solids holding/thickening basin
- Odor control equipment
- Chemical feed and storage tanks and appurtenances
- Laboratory and staff office and support facilities

In general, the facility will be designed to provide constant, reliable treatment; have on-line automated alarms; and possess redundancy or standby equipment for each unit treatment process. Mechanical treatment devices such as screens, pumps, and blowers will be provided with one standby unit. The facility processes will be designed to continue to fully treat the flow while any single process unit is removed from service for maintenance or repair. For the river outfall discharge alternative, the CWWTF is required by Ecology to meet a minimum Class II level of reliability and redundancy. Reliability Class II pertains to “works whose discharge, or potential discharge, as a result of its volume and/or character, would not permanently or unacceptably damage or affect the receiving waters or public health during periods of short-term operations interruptions, but could be damaging if continued interruption of normal operations were to occur.”¹⁰ In the event that the County or the City would be interested in beneficial reuse in the future (wetlands restoration or urban use), the CWWTF design has the flexibility to meet the Class A reclaimed water standards and the reclaimed water standards for discharging to wetlands.¹¹

1.4 Wastewater Treatment Facility Siting

Alternative sites for the CWWTF were investigated by a systematic process of screening for favorable site characteristics. Figure 1.1 illustrates the different study areas investigated in this project. The study area for the CWWTF was restricted to the City’s UGA boundary lines, consistent with the City of Carnation 1996 General Comprehensive Plan.¹² A coarse-screening of sites within the study area narrowed the search to 15 land parcels that met the minimal critical land use, geographic, technical, and environmental criteria. Using the geographic information system (GIS), visual observation, and other County data, the County further screened the identified land parcels based on land use compatibility and acquisition requirements, geographic location, technical feasibility, and regulatory environmental impacts.

As a result of the screening process, two sites were selected for further evaluation, as shown in Figure 1.2. The City-owned site is zoned for light industrial and manufacturing use and is the planned location of the City's Vacuum Station No. 1. The site is generally flat and undeveloped with the exception of a single-family residence located on the northeast corner of the property. The Weckwerth site is also located in a light industrial/manufacturing area, adjacent to a middle school and the City fire station. The King County Executive (Executive), in consultation with the City, used environmental, cost, engineering, community impact, and County policy considerations to select the City-owned site as the preferred location for the proposed CWWTF.

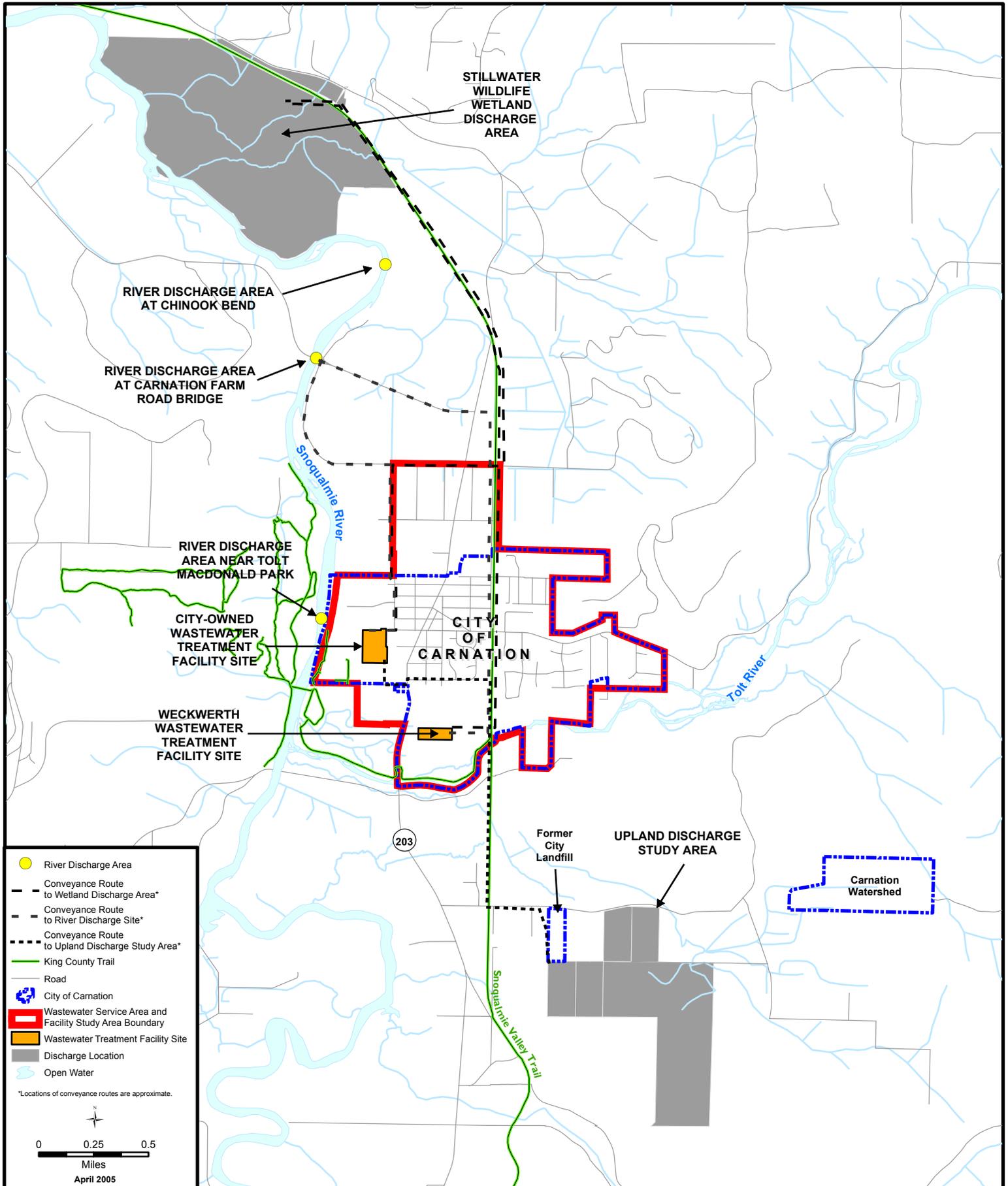
1.5 Discharge Alternatives

Five discharge alternatives were initially evaluated: 1) direct discharge to the Snoqualmie River, 2) wetlands discharge, 3) upland discharge, 4) conveyance to existing facilities, and 5) non-potable water reuse for irrigational and commercial purposes. Conveyance to existing facilities was eliminated from further study based on excessive cost and environmental impact.¹³ Reclaimed water use for irrigational and commercial purposes was determined to have a greater cost than other discharge alternatives, due in part to the limited number of users, and thus was deferred for consideration in the future.¹⁴ The three remaining discharge alternatives were evaluated further prior to preparation of the EIS.¹⁵ These were the:

- Conventional river outfall at the Carnation Farm Road Bridge (Bridge), near the Tolt MacDonald Park (Park), or at Chinook Bend^{16,17}
- Upland discharge through high-rate infiltration to groundwater^{18,19}
- Wetlands restoration in the Stillwater Wildlife Area (SWA)^{20,21}

Based on these reports, the EIS²² evaluated the following three alternatives:

- Conventional river outfall at the Bridge
- Upland discharge through high-rate infiltration to groundwater
- Wetlands restoration in the SWA



● River Discharge Area
 Conveyance Route to Wetland Discharge Area*
 Conveyance Route to River Discharge Site*
 Conveyance Route to Upland Discharge Study Area*
 King County Trail
 Road
 City of Carnation
 Wastewater Service Area and Facility Study Area Boundary
 Wastewater Treatment Facility Site
 Discharge Location
 Open Water

*Locations of conveyance routes are approximate.

0 0.25 0.5
 Miles
 April 2005

The Executive decided to carry forward the river outfall and wetlands discharge alternatives for further study. As documented in the EIS²³ and other previous reports, the upland discharge to groundwater alternative was eliminated as a viable option based on available hydrogeologic information, environmental review, and cost considerations. Wetland discharge to the SWA provides environmental benefits and has public support but requires \$2.2 million more in capital costs than a river outfall discharge at the Bridge. Design and permitting activities will proceed with the river outfall discharge alternative but the County continues to actively pursue potential partnerships and grants to make wetlands enhancement an environmental amenity and an economically viable future reuse opportunity for this project.

The County is currently working with the City and other partners to explore additional opportunities of water reuse for creating or enhancing wetlands as a second phase of the project in a cost conscious manner. The County understands that an impairment analysis, as well as other environmental and permitting requirements, must be completed before any reuse can occur. If the City wanted to use the reclaimed water from the treatment plant for another purpose, the interlocal agreement between the City and County would have to be amended. If the wetlands alternative becomes financially feasible, the County will also prepare an amendment to the Facilities Plan to include additional components associated with reclaimed water (at that time) such as chlorination and a river impairment analysis.

A review and confirmation of the recommended outfall location on the Snoqualmie River was completed in order to address public comments and refine project costs. This evaluation consisted of a review of previously available information, river cross-section profiles at the two locations, and detailed fisheries data on the Tolt Delta Reach (TDR) of the Snoqualmie River. The combination of technical, scheduling, public perception, and overall cost parameters evaluated demonstrated that the Bridge discharge location is preferred over the Park discharge location. Although the cost comparison of the two locations shows a \$1 million total capital savings for the Park, the comparison does not account for other potential increased impacts such as additional environmental review, and more difficult permitting requirements. In addition, the Bridge discharge location will allow the discharge pipeline to be supported across the bridge to the west pier. This construction alternative would minimize the amount and duration of in-water activities and thus minimize the impact to sensitive habitat by not disturbing the existing riverbed. In addition, discharging the highly treated water at the bridge will decrease the exposure risk in areas with documented Chinook and steelhead redds based on 2004 data.²⁴

A review and confirmation of the selected conveyance route to the Snoqualmie River was then completed in order to address public comments and refine project costs. Three conveyance routes to the Bridge were initially identified during preliminary design efforts, as detailed in Technical Memorandum (TM) No. 14.²⁵ Two routes were selected for further review. Both routes avoid traversing areas that serve as major city thoroughfares, attempt to provide the most direct conveyance route to the discharge location, and minimize

construction impacts to the community. Based on the discovery of sensitive areas between 60th Avenue NE and Carnation Farm Road, including jurisdictional wetlands and a stream crossing, one of the routes was eliminated

Therefore, the route recommended during preliminary design has been confirmed as the preferred route with a lower risk of unforeseen costs and schedule impacts. The route begins at the City-owned site and continues a short distance east on Entwistle Street. The route then heads due north along Stewart Street to the Bagwell Street intersection and continues north along the UGA boundary to 60th Avenue NE (which becomes 310th Avenue as the road turns northward). The route follows 310th Avenue NE to the outfall located at the bridge. Figure 1.2 illustrates the proposed CWWTF and discharge locations.

1.6 Recommendation and Costs

The recommended treatment system consists of a MBR treatment facility, conveyance pipeline, and discharge through an outfall to the Snoqualmie River at the north side of the Carnation Farm Road Bridge. Table 1.3 provides the preliminary present worth estimate of the total project costs for the CWWTF.

Table 1.3 Conceptual Level Cost Estimate Carnation Wastewater Treatment Facility King County Department of Natural Resources and Parks	
Cost Parameter	Cost (\$)
CWWTF	
Construction cost	9,377,000
Allied cost	3,092,000
Conveyance and discharge	
Construction cost	1,352,000
Easement allowance	38,000
Allied cost	<u>358,000</u>
Total Capital Cost^a	14,217,000
Annual O&M Costs	
Labor ^b	90,000
Energy	45,000
Maintenance	93,000
Chemicals	72,000
Solids Transportation	122,000
Miscellaneous	<u>20,000</u>
Annual O&M Cost	442,000
Notes:	
a. Cost does not include purchase or leasing of land for the CWWTF.	
b. Assumes one full-time employee equivalent during normal operation (50% operations duties, 50% maintenance duties).	

Notes

- ¹ Kleeberg, C., Director, Environmental Health Division, Seattle-King County Department of Health, to Mayor Alan Morris, *Wastewater Treatment Compliance Schedule*, April 19, 1988.
- ² Bishop, G., Supervisor, Community Environmental Health, Public Health - Seattle & King County, to City Manager Bill Brandon, *Sewer Development in the City of Carnation*, September 9, 2003.
- ³ Teeter, D., Interim Director and Health Officer, Public Health - Seattle & King County, to City Manager Bill Brandon, **Severe Public Health Hazard in the City of Carnation**, September 28, 2005.
- ⁴ Roth Hill Engineering Partners, LLC, *City of Carnation 2004 Comprehensive Sewer Plan*, October 2004.
- ⁵ King County Department of Development and Environmental Services, *2004 King County Comprehensive Plan*, King County, <http://www.metrokc.gov/ddes/COMPPLAN/2004/index.htm>, (accessed March 10, 2005).
- ⁶ *Water Pollution Control*, 90.48 RCW, (2003)
- ⁷ Joy, J., *Snoqualmie River Total Maximum Daily Load Study*, Ecology Report #94-71, 1994.
- ⁸ *Water quality standards for surface waters of the state of Washington*, WAC 173-201A (2003).
- ⁹ King County Department of Natural Resources and Parks, Wastewater Treatment Division, *Final Environmental Impact Statement for the Carnation Treatment Facility*, October 2004.
- ¹⁰ Washington State Department of Ecology, *Criteria for Sewage Works Design*, 1998. G2-64.
- ¹¹ Washington Department of Ecology, *Washington Reclamation and Reuse Standards*, 1997.
- ¹² City of Carnation, *Carnation Comprehensive Plan - 1996*, City of Carnation, Washington, <http://www.ci.carnation.wa.us/library/COMPLAN.PDF> (accessed June 1, 2003).
- ¹³ Carollo Engineers, *Technical Memorandum No. 11 - Discharge Alternatives*, 2004.
- ¹⁴ Carollo Engineers, *Technical Memorandum No. 11 - Discharge Alternatives*, 2004.
- ¹⁵ King County Department of Natural Resources and Parks, Wastewater Treatment Division, *Final Environmental Impact Statement for the Carnation Treatment Facility*, October 2004.
- ¹⁶ Cosmopolitan Engineering Group, *Technical Memorandum No. 12 – River Outfall*, 2004.
- ¹⁷ Wilson, Dean, King County Water and Land Resources Division, *Alternatives for a Direct Discharge to the Snoqualmie River from the Proposed Carnation Wastewater Treatment Plant*, 2004.
- ¹⁸ Carollo Engineers, *Technical Memorandum No. 5 - Upland Disposal Alternatives*, 2004.
- ¹⁹ Carollo Engineers, *Technical Memorandum No. 5A – Upland Disposal Alternatives*, 2004.
- ²⁰ Carollo Engineers, *Technical Memorandum No. 5B – Hydrological Aspects of the Wetland Disposal Alternative*, 2004.
- ²¹ Wilson, Dean, King County Water and Land Resources Division, Memorandum to King County Wastewater Treatment Division Project Manager Regarding *Proposal for Habitat Enhancement Using Reclaimed Water from the Proposed Carnation Wastewater Treatment Plant Memorandum*, October 1, 2003.
- ²² King County Department of Natural Resources and Parks, Wastewater Treatment Division, *Final Environmental Impact Statement for the Carnation Treatment Facility*, October 2004.
- ²³ King County Department of Natural Resources and Parks, Wastewater Treatment Division, *Final Environmental Impact Statement for the Carnation Treatment Facility*, October 2004.
- ²⁴ Lucchetti, G., "Salmonid Use of the Snoqualmie River - Tolt Delta Reach", King County Department of Natural Resources and Parks, 2005.
- ²⁵ Carollo Engineers, *Technical Memorandum No. 14 - Plant Alternatives Development*, 2004.