Final Environmental Impact Statement

Clark Springs Water Supply System Habitat Conservation Plan

April 2011

ACRONYMS

ADD	average day demand
BPA	Bonneville Power Administration
CAA	Clean Air Act
CAO	Critical Area Ordinance
ccf	hundred cubic feet of water
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CWA	Clean Water Act (Federal Water Pollution Control Act)
dbh	diameter at breast height
DNR	Washington State Department of Natural Resources
DOH	Department of Health
DPS	distinct population segment
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionary significant unit
fps	feet per second
FY	fiscal year
gpcd	gallons per capita per day
gpm	gallons per minute
HCM	Habitat Conservation Measure
HCP	Habitat Conservation Plan
IA	Implementation Agreement
ITP	Incidental Take Permit
MCL	maximum allowable contaminant levels
Metro	King County Metro
mgd	million gallons per day
mg/L	milligrams per liter
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetland Inventory
NOI	Notice of Intent
NRHP	National Register of Historical Places
O&M	Operation and Maintenance

PHS	Priority Habitats and Species database
PSCAA	Puget Sound Clean Air Agency
RM	River Mile
ROD	Record of Decision
RCNA	Rock Creek Natural Area
SEPA	State Environmental Policy Act
SIP	State Implementation Plan
SPU	Seattle Public Utilities
TMDL	total maximum daily load
TSSP	Tacoma Second Supply Project
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDFW	Washington State Department of Fish and Wildlife
WUA	Weight useable area
WHPP	Wellhead Protection Plan

FINAL ENVIRONMENTAL IMPACT STATEMENT
COVER SHEET

Title of Environmental Review:	Final Environmental Impact Statement Clark Springs Water Supply Habitat Conservation Plan	
Activity Considered:	NMFS' and USFWS' action of issuing incidental take permits to the City of Kent and implementation of the City of Kent Clark Springs Water Supply Habitat Conservation Plan	
Responsible Agencies and Officials:	Ms. Robyn Thorson Regional Director U.S. Fish and Wildlife Service Pacific Region 911 NE 11th Avenue Portland, Oregon 97232-4181	Mr. Barry Thom Acting Regional Administrator National Marine Fisheries Service Northwest Region 7600 Sand Point Way NE Seattle, Washington 98115-0070
Contacts:	Tim Romanski U.S. Fish and Wildlife Service 510 Desmond Drive, S.E., Suite 102 Lacey, Washington 98503-1263 (360) 753-5823	Matthew Longenbaugh National Marine Fisheries Service 510 Desmond Drive, S.E., Suite 103 Lacey, Washington 98503-1263 (360) 753-7761
Legal Mandate:	Endangered Species Act of 1973, as amended, section 10(a), as implemented by 50 CFR 17.22(b) and 17.32(b)	
Location of Proposed Action:	Clark Springs Water Supply Facility, Maple Valley, Washington	
Applicant:	City of Kent Washington 220 Fourth Avenue S Kent, Washington 98032	
Contact:	Kelly Peterson Environmental Conservation Supervisor (253) 856-5547	
Final EIS Preparer:	ICF International 317 SW Alder Street, Suite 800 Portland, Oregon 97204	

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THE FOLLOWING INFORMATION IS NEW SINCE THE DEIS WAS PUBLISHED AND REFLECTS CHANGES TO THE DEIS FROM THE PUBLIC COMMENT PERIOD

PREFACE

This Final Environmental Impact Statement (Final EIS) addresses the potential environmental effects that could result from implementing the *Clark Springs Water Supply Habitat Conservation Plan* (Clark Springs HCP) and reflects any modifications to the Draft Environmental Impact Statement (Draft EIS) based on public comments. The Final EIS has been prepared in accordance with the National Environmental Policy Act (NEPA). The National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Fish and Wildlife Service (USFWS) (the Services) are the Co-lead agencies under NEPA for issuance of the Incidental Take Permits (ITPs) described below.

The City of Kent, WA (City) has submitted an application to the Services for two ITPs in accordance with section 10(a)(1)(B) of the Federal Endangered Species Act (ESA), as amended. The City is seeking this authorization so that activities associated with implementing the Clark Springs HCP comply with the ESA, while providing protection for six species listed under the ESA.

Since the proposed issuance of the ITPs would be a Federal action that may affect the human environment, this issuance is subject to review under NEPA, which provides an interdisciplinary framework for Federal agencies to evaluate environmental consequences of programs and projects over which they have discretionary authority. The Draft EIS and Final EIS were prepared in compliance with NEPA regulations and the NEPA implementing regulations for NMFS (NOAA Administrative Order 216-6) and USFWS (73 Fed. Reg. 61292, October 15, 2008).

The Clark Springs HCP was prepared in support of the City's application for the ITPs to cover the continued operation and maintenance of the Clark Springs water supply system. The City requests coverage for the incidental take of listed covered species for a term of 50 years. The Clark Springs HCP would provide measures to minimize and mitigate impacts of the proposed incidental taking of listed covered species and the habitats upon which they depend for the full 50-year term.

Draft EIS Public Review Process

The Notice of Availability (NOA) was published in the (75 Fed. Reg. 78, April 23, 2010). The Draft EIS public comment period closed July 6, 2010. During the comment period, seven comment letters were received from Federal agencies, local agencies, and environmental organizations (Table 1). Comments on the Draft EIS and the Clark Springs HCP were responded to in the Final EIS and are included in Appendix B.

Table 1. Commenters on the Draft EIS.

Letter	Individual or Signatory	Affiliation	Letter Dated
1	Patrick Williams	The Center for Environmental Law and Policy (CELP)	August 1, 2006
2	Christine B. Reichgott	U.S. Environmental Protection Agency (EPA)	July 6,2010
3	Joan Burlingame	Friends of Rock Creek Valley (FRCV)	July 6,2010
4	David St. John	King County Department of Natural Resources and Parks	July 6,2010
5	Glen St Amant	Muckleshoot Indian Tribe	July 6,2010
6	Douglas Wood	Washington Department of Ecology	June 28, 2010
7	Hal A. Beecher	Washington Department of Fish and Wildlife	June 3, 2010

Final EIS Public Review Process

The Final EIS will be available for a 30-day public review period. During this review period, comments will be accepted on the Final EIS. Any comments received during this review period will be considered during the Services' decision-making process.

Environmentally Preferred Alternative

The environmentally preferred alternative (40 CFR 1505.2[b]) will promote the national environmental policy as expressed in Section 101 of NEPA. This is often characterized as the alternative that causes the least damage to the physical and biological environment and that best protects, preserves, and enhances historic, cultural, and natural resources. In this case, the Proposed Action is considered the environmentally preferred alternative because implementation of the Clark Springs HCP would provide greater environmental protection and the greatest degree of improvement in habitat conditions relative to what is expected to occur over time under the No-action Alternative. Table 2 provides a summary of the major changes made to the EIS as a result of comments received on the Draft EIS. Revisions to the Draft EIS are represented by ~~strike through~~ for deleted text and double underline for added text.

Table 2. Major Changes to the DEIS.

Description	Location
Clarified reasons for not carrying additional alternatives forward for detailed consideration	Subsection 2.5
Included information on the impact of fencing	Subsection 4.9
Precipitation data update to include data from 2005-2009	Subsection 4.6.1.2
Well locations added to Figure 2.3-1	Subsection 2.3
Land Cover map (Figure 3.2-1) of Rock Creek basin updated	Subsection 3.2

EXECUTIVE SUMMARY

INTRODUCTION

The City of Kent (City) is applying for Incidental Take Permits (ITPs) from the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) (collectively the "Services") under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (ESA). The ITPs will cover operations and maintenance activities relating to the City's Clark Springs Water Supply System (Clark Springs System) located east of Maple Valley on Rock Creek, in a 320-acre area of King County that was annexed in 1969 by the City (Figure ES-1). Species for which the City seeks ITP coverage include the Puget Sound (PS) Chinook salmon (*Oncorhynchus tshawytscha*), PS steelhead (*Oncorhynchus mykiss*), and bull trout (*Salvelinus confluentus*), which are currently listed as threatened, and six unlisted species that may be affected by the City's activities in the Rock Creek Watershed; these species are referred to as the "covered species." The USFWS has ESA jurisdiction over the bull trout, and NMFS has jurisdiction over PS Chinook salmon and PS steelhead (Table ES-1).

Table ES-1 Species Proposed for Coverage in the Clark Springs Water Supply Habitat Conservation Plan.

Species Name	Federal Status
Puget Sound (PS) Chinook salmon (*Oncorhynchus tshawytscha*)	Threatened 6/28/05 (70 FR 37160)
Puget Sound (PS) steelhead (*Oncorhynchus mykiss*)	Threatened 5/11/07 (72 FR 26722)
Bull Trout (*Salvelinus confluentus*)	Threatened 11/1/99 (64 FR 58910)
Sockeye salmon (*Oncorhynchus nerka*)	Not Listed
Puget Sound (PS)/Strait of Georgia coho salmon (*Oncorhynchus kisutch*)	Not Listed
Puget Sound (PS)/Strait of Georgia chum salmon (*Oncorhynchus keta*)	Not Listed
Coastal cutthroat trout (*Oncorhynchus clarki clarki*)	Not Listed
Pacific lamprey (*Lampetra tridentata*)	Not Listed
River lamprey (*Lampetra ayresi*)	Not Listed

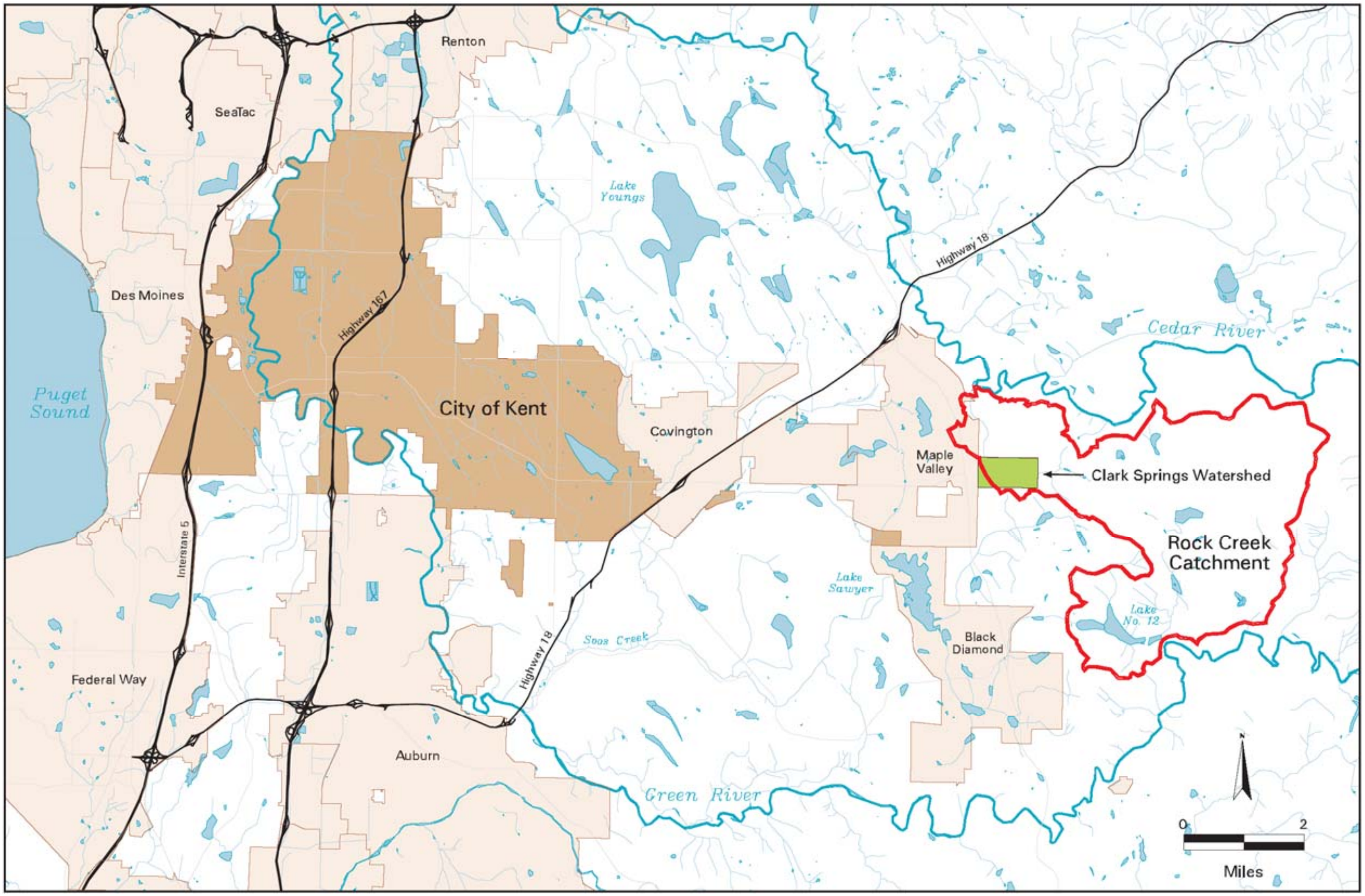

Figure ES-1   Vicinity map of the Rock Creek Basin relative to the City of Kent.

The City, a municipality with over 80,000 residents located in southern King County, Washington, owns and operates its own water supply system. The City's water supply system is comprised of both ground and surface water supplies, and provides water to meet domestic, commercial, irrigation, manufacturing, residential, fire, and life safety requirements of its residents and businesses. The Clark Springs System serves as the City's largest and primary water source, providing up to 60 percent of its total water supply needs.

The presence of listed fish species in the Rock Creek Watershed prompted concerns about the long-term reliability and certainty of the Clark Springs System to meet the City's water supply obligations.

To pursue certainty of its existing and future water supplies the City would like to formalize its water supply activities and conservation commitments under a habitat conservation plan (HCP), and obtain ITPs from the Services under section 10(a)(1)(B) of the ESA. To obtain the ITPs, the City must prepare an HCP that meets the issuance criteria in section 10(a)(2)(B) of the ESA, as described in Subsection 1.3.2, Decisions to be Made. Accordingly, the City has prepared a HCP in support of its ITP applications. The HCP is hereby incorporated by reference.

If the City's application meets the ITP issuance criteria under section 10(a)(2)(B) of the ESA, the USFWS and NMFS will issue separate ITPs for the species under their respective jurisdictions. Federal action on the City's ITP applications requires environmental review under the National Environmental Policy Act of 1969, as amended (NEPA). This Final Environmental Impact Statement (Final EIS) meets the Services' environmental documentation requirements under NEPA. The USFWS and NMFS (the Services) are co-leads on this Federal action and have jointly completed the Final EIS to evaluate the impacts of the proposed issuance of the ITPs through the implementation of the HCP, and a reasonable range of other alternatives.

PURPOSE AND NEED OF PROPOSED ACTION

Purpose of the Proposed Action

The purpose for this action (i.e., issuance of two ITPs) is for the Services to fulfill their responsibilities under section 10(a)(1)(B) of the ESA, and for the City to continue its water supply activities at the Clark Springs Water Supply Facility (Clark Springs Facility) while complying with the ESA. If granted, these proposed ITPs would authorize the incidental take of the three listed species identified in Table ES-1. Additionally, if these ITPs are granted, provisions for coverage of the six unlisted species would be made by the Services, and the City would then receive incidental take coverage if these species are listed in the future (Table ES-1). The purpose for unlisted species coverage is to provide assurance to the City that no additional water withdrawal limitations, land restrictions, or financial compensation would be required for species conservation if adequately covered by a properly functioning HCP.

To minimize and mitigate the incidental take and to adequately address the needs of the covered species, the City would implement the proposed HCP for the full 50-year term of the ITPs.

Implementation of the proposed HCP would include "effects and effectiveness monitoring" and "implementation monitoring." Effects and effectiveness monitoring evaluates the effects of the permitted action and determines whether the effectiveness of the operating conservation program of the HCP is consistent with the assumptions and predictions made when the HCP was developed and approved. Monitoring the effectiveness of the HCP measures is intended to determine if the proposed HCP achieves its biological goals and objectives and includes regular reporting to the Services. Implementation monitoring by the Services would include use of remote and on-site techniques to ensure the HCP is implemented in accordance with the terms of the HCP, the terms and conditions of the ITPs, and the Implementation Agreement (IA). Adaptive management, as specified in the proposed HCP and IA, could result in the modification and improvement of the Habitat Conservation Measures (HCMs) provided for in the proposed HCP in response to new information (HCP Chapter 7). Specific activities to be covered under the ITPs are detailed in Subsection 1.6 of the proposed HCP and include:

- Water supply withdrawals from the Clark Springs System pursuant to the City's water rights.
- Augmentation flows pumped from the Clark Springs Facility into Rock Creek.
- Operations, maintenance, replacement, monitoring, and improvements to the augmentation system. This includes relocating the augmentation system, and maintaining, adding to, and/or replacing all augmentation infrastructure as needed.
- Relocation of the augmentation discharge point downstream from its current location to a point near the Parshall Flume.
- Operations, maintenance, and improvements to the water-supply facilities located at the Clark Springs Facility such as buildings, wells, access roads, fences, and security infrastructure, infiltration galleries, and water-transmission main(s), except for portions within the ordinary high water boundaries of Rock Creek. This includes future replacement of the facilities and infrastructure as needed.
- Operations, improvements, and maintenance of the Clark Springs Facility and related infrastructure.
- Vegetation management on the Clark Springs property. This activity does not include vegetation management activities conducted by the Bonneville Power Administration to maintain its transmission line right-of-way and easement.
- Operation and maintenance of the Parshall Flume and U.S. Geological Survey (USGS) gaging station (No. 12118400).
- Wildlife management within the Clark Springs Facility for the purpose of protecting and enhancing the quality of the water supply. This includes trapping beavers to ensure a healthy municipal water source and removal of beaver dams to prevent stream relocation and damage to the City's infrastructure or the quality of the water supply.
- HCMs 2 through 6 described in Chapter 4 of the proposed HCP.

- Electrical, control, and telemetry operations, maintenance, improvements and replacement of equipment, conduit, cabling, and related infrastructure to meet the needs of the water supply facilities.
- The delivery and storage of chemicals, the chemical treatment processes and the operation, maintenance, replacement and improvement of equipment, conduit, piping, and sampling infrastructure required to monitor and treat the City's water supply.
- The maintenance and replacement of stormwater conveyance, control, and distribution facilities.
- Installation of monitoring wells along the eastern boundary of the Clark Springs property to monitor groundwater quality in order to detect contamination that might impact City water supplies.

ALTERNATIVES

Alternative A: No Action

Under Alternative A (No-action Alternative), the City would not implement the proposed HCP and would not receive incidental take coverage for the effects of its operations at the Clark Springs Facility on listed species of fish in Rock Creek. The City would be required to ensure that the Clark Springs System is in compliance with the take prohibitions under section 9 of the ESA, as well as all applicable local, State, and Federal laws and regulations. The City would continue operations at the Clark Springs Facility consistent with its water rights and, at its discretion, may continue its voluntary augmentation of Rock Creek. Under the No-action Alternative, the City would assume some potential liability for unauthorized take of listed species under section 9 of the ESA.

Alternative B: Proposed Action

Under Alternative B (Proposed Action), the City would receive ITPs from the Services for incidental take, and would implement the proposed HCP. Covered activities would include the operation and maintenance of facilities at the City's Clark Springs System, and the implementation of mitigation measures contained in the HCP. The ITPs and the HCP would run concurrently and would be in effect for 50 years.

The Proposed Action is described in detail in the proposed HCP. Under the Proposed Action, the Services would issue ITPs for nine species, including three species that are currently listed under the ESA as threatened (Table ES-1). The City would implement an HCP designed to minimize and mitigate the effects of any anticipated incidental take of the nine covered species. The City would receive incidental take coverage for the three listed species immediately upon issuance of the ITPs. For the six unlisted species, incidental take coverage would become effective only upon a future listing.

Anticipated Impacts

The potential environmental effects associated with the Proposed Action and the No-action Alternative are summarized in Table ES-2 and are described in detail in Section 4, Environmental Consequences.

Table ES-2 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
LAND USE AND OWNERSHIP		
Land use compatibility	Activities associated with the No-action Alternative would be consistent with applicable land use plans and policies.	As under the No-action Alternative activities associated with the Proposed Action would be consistent with applicable land use plans and policies.
GEOLOGY AND SOILS		
Sedimentation from Erosion Hazard Areas	The No-action alternative would result in minor erosion impacts if the City constructed new buildings in areas mapped as soil erosion areas. Soil erosion impacts would be minimized by the use of construction Best Management Practices (BMPs) required by the City's Critical Areas Ordinance.	The Proposed Action would result in the same minor sediment and erosion impacts at the Clark Springs Facility as described under the No-action Alternative. In addition, minor erosion impacts would occur at and near the mouth of Rock Creek during the construction of the HCMs required by the proposed HCP. The soil erosion impacts at the mouth would be minimized by the use of construction BMPs required by King County's Critical Areas Ordinance. Because of the additional minor impacts associated with the mitigation construction, the Proposed Action would have a slightly greater impact than the No-action Alternative.
AIR QUALITY		
Emissions from construction equipment	Construction of new buildings at the Clark Springs Facility would temporarily generate dust (including particulate matter [PM] 10) and carbon dioxide (CO^2).	Construction of new buildings at the Clark Springs Facility and the HCMs would result in a temporary increase in the emission of pollutants such as CO^2 and nitrogen oxides from vehicle and equipment exhaust, as well as PM10 from ground-disturbing activities. Because of the additional minor impacts associated with the mitigation construction, the Proposed Action would have a slightly greater impact than the No-action Alternative.
NOISE		
Noise level increase from construction equipment	There are no sensitive noise receptors close enough to the Clark Springs Facility to be affected by the temporary increase in noise levels from construction activities.	Construction activities at and near the mouth of Rock Creek would cause a temporary increase in noise levels at nearby residences. Impacts would be mitigated by the implementation of BMPs required through the King County permit process. The impacts under the Proposed Action would be greater than under the No-action Alternative.

Table ES-2 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
WATER QUANTITY AND WATER QUALITY		
Water withdrawal activities	Current operations at the Clark Springs Facility under The No-action Alternative may affect both the magnitude and timing of instream flows in Rock Creek downstream of the eastern boundary of the Clark Springs Facility. Since the groundwater and hydrology are connected, withdrawals from the aquifer would result in a reduction of streamflows in Rock Creek.	The Proposed Action would have surface water impacts similar to those described under the No-action Alternative for the period January through September. Impacts on surface water would be slightly different during October, November, and December due to the flow augmentation program (HCM-1) that would be implemented under the Proposed Action, in which some of the water withdrawn through the infiltration gallery would be used for augmentation instead of water supply. During years when the augmentation program is implemented, the impacts to surface water flows would be less than under the No-action Alternative.
Operations and maintenance	Minor water quality impacts would result from activities such as beaver dam removal and road building.	Impacts from the Proposed Action would be the same as under the No-action Alternative.
Habitat Conservation Measures	The City would not implement HCMs under the No-action Alternative.	Flow augmentation (HCM-1) would have a beneficial effect on instream flows downstream of the Clark Springs Facility during the months of October, November, and December due to an increase in flows of up to 2.5 cubic feet per second (cfs). Construction activities as part of implementing HCMs 1 through 6 may result in minor, short-term increases in turbidity and total suspended solids. These impacts would be minimized by implementation of BMPs during construction. These impacts would be greater than under the No-action Alternative.

Table ES-2 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
VEGETATION		
Wetlands	Existing wetlands at the Clark Springs Facility would not be impacted under the No-action Alternative because the City's construction activities necessary to maintain its existing facilities and to construct new buildings on the property would occur outside existing wetland areas.	Under the Proposed Action, impacts to wetlands at the Clark Springs Facility would be the same as under the No-action Alternative. The HCMs would increase the hydraulic connection to two wetlands located along Rock Creek near the mouth. These improvements would not reduce or increase the amount of wetland habitat at either site but would result in improved water quality along lower Rock Creek. These beneficial impacts would not occur under the No-action Alternative,
Special Status plants	No Federal- or State-listed plant species are known to occur within the action area.	No Federal- or State-listed plant species are known to occur within the action area.
Noxious weeds	For any new construction at the Clark Springs Facility, the City would implement weed management measures to reduce the opportunity for the introduction and spread of noxious weeds.	Under the Proposed Action, impacts from noxious weeds at the Clark Springs Facility would be the same as under the No-action Alternative. The City would implement the same mitigation measures for all construction activities associated with the HCMs.

Table ES-2 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
FISH AND AQUATIC HABITAT		
Covered Fish Species		
Puget Sound (PS) Chinook salmon	Water withdrawals would limit access to Rock Creek and available spawning and fry-rearing habitat that is considered critical habitat essential to the conservation and recovery of Puget Sound Chinook salmon.	Implementation of flow augmentation (HCM-1) would provide a beneficial effect on access and availability of habitat during the months of October, November, and December. Under the Proposed Action, passage improvements at the mouth of Rock Creek (HCM-2) and off-channel habitat enhancement (HCM-3 and HCM-4) would have beneficial effects on upstream migration and spawning and incubation habitat relative to the No-action Alternative. Replacement of the culverts at the Summit-Landsburg Road stream crossing (HCM-5) would benefit Chinook salmon through improved passage conditions relative to the No-action Alternative. These improvements would provide beneficial effects to PS Chinook salmon relative to the No-action Alternative.
Bull trout	Foraging opportunities, access during low-flow periods, and the availability of overwintering habitat would continue to be limited to bull trout because of water withdrawals.	Off-channel habitat enhancement and improvements to structural complexity in the wetlands adjacent to the lower reaches of Rock Creek (HCM-3 and HCM-4), and large wood enhancement (HCM-6), would provide positive effects to habitat that could be utilized by juveniles, sub-adults, and adults for foraging opportunities and overwintering. Access to Rock Creek during low-flow periods would be improved through construction of rock weirs at the mouth of Rock Creek (HCM-2). These improvements would provide beneficial effects to bull trout relative to the No-action Alternative,
Puget Sound (PS) steelhead	Steelhead rearing habitat is limited during summer low-flow periods.	Off-channel habitat enhancement (HCM-3 and HCM-4) and large wood enhancement (HCM-6) would provide beneficial impacts by improving the quality and quantity of rearing and overwintering steelhead habitat. HCM-5 would improve passage conditions at the Summit-Landsburg Road stream crossing, primarily for the juvenile life stage of PS steelhead. These improvements would provide beneficial effects to PS steelhead relative to the No-action Alternative,

Table ES-2 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
Other Covered Species		
Coho salmon	Water withdrawals result in a minor loss of juvenile rearing habitat.	Improvements in passage conditions (HCM-2, HCM-6) and in rearing and off-channel habitat (HCM-3, HCM-4) would provide minor beneficial effects to coho salmon relative to the No-action Alternative.
Sockeye salmon	Water withdrawals contribute to suboptimal access conditions to Rock Creek during the spawning season for sockeye.	Flow augmentation and passage improvements in Rock Creek under the Proposed Action are anticipated to maintain and improve the Cedar River sockeye salmon population relative to the No-action Alternative. Improved access to, and enhancement of, off-channel habitat (HCM-3 and HCM-4) would also provide positive effects to habitat that could be utilized by sockeye salmon fry; these effects would not occur under the No-action Alternative.
Puget Sound (PA)/Strait of Georgia chum salmon	Water withdrawals contribute to suboptimal access conditions to Rock Creek during the spawning season for chum.	If chum salmon were to colonize Rock Creek, HCMs under the Proposed Action would provide fish passage improvements (HCM-2) that would improve access and holding conditions at the mouth of Rock Creek. Improved access to, and enhancement of, off-channel habitat (HCM-3 and HCM-4) would also provide positive effects to habitat that could be utilized by chum salmon fry; these effects would not occur under the No-action Alternative.
Coastal cutthroat trout	Water withdrawals contribute to low levels of rearing habitat for juveniles during summer low-flow months.	Under low-flow conditions, improved passage at the mouth of Rock Creek (HCM-2) would provide a positive effect for cutthroat trout access to Rock Creek relative to the No-action Alternative. Improvements in access to, and the structural complexity of, off-channel habitat in the lower reaches of Rock Creek under HCM-3 and HCM-4 are expected to be a benefit to cutthroat trout fry, juveniles, or adults that would not occur under the No-action Alternative.
Pacific lamprey River lamprey	Some loss of habitat may occur due to reduction in wetted perimeter of the creek. However, the quality of the available habitat could improve from reduced water velocity.	The Proposed Action is anticipated to have no adverse effects to Pacific and river lamprey, and may provide slight benefits that would reduce the risk of ESA listing in the future.

Table ES-2 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
Other Resident Fish Species in Rock Creek	Some loss of habitat may occur due to reduction in wetted perimeter of the creek.	HCMs under the Proposed Action would improve aquatic habitats or the ability of other fish species to move up and downstream through the lower portions of Rock Creek. These improvements would provide beneficial effects to other resident fish species relative to the No-action Alternative,
Wildlife		
	The No-action Alternative would cause no impacts to existing wildlife habitats.	The Proposed Action would improve wildlife habitat by the construction of the wetland enhancement projects (HCM-3, HCM-4). These improvements would provide beneficial effects relative to the No-action Alternative,
Historic and Cultural Resources		
	The No-action Alternative includes some new construction at the Clark Springs Facility. Construction activities at the Clark Springs Facility under the No-action Alternative would occur in areas with undisturbed soils. These activities would have the potential to impact unknown cultural resources. Potential impacts to unknown cultural resources would be minimized by mitigation measures necessary to comply with all applicable regulations associated with cultural resources.	In addition to the construction activities at the Clark Springs Facility, the Proposed Action includes construction of HCMs along Rock Creek. Ground-disturbance activities along the shore of Rock Creek and its confluence with the Cedar River have the potential to impact unknown cultural resources. Potential impacts to unknown cultural resources would be minimized by mitigation measures necessary to comply with all applicable regulations associated with cultural resources.

Table ES-2 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
Socioeconomics and Environmental Justice		
	The No-action Alternative would not result in additional water rate increases to those the City may require to meet anticipated future demand.	The cost of implementing the mitigation requirements included in the proposed HCP would require the City to increase water rates an average of .65 percent annually over the 50-year permit period. This rate increase would be in addition to rate increases necessary to meet future demand.
	Because the City's water service area does not include minority or low-income populations significantly greater that those found in King County or the State of Washington, no disproportionate impacts, as defined by the Executive Order on Environmental Justice, to those populations would occur under the No-action Alternative.	Because the Proposed Action would require additional costs to implement mitigation required by the proposed HCP, the Proposed Action would have a slightly greater impact than the No-action Alternative.

GLOSSARY

Adaptive management	An approach that allows actions to be taken in the face of some uncertainty or lack of data, but provides for monitoring and the ability to change operations in response to new information to meet a particular objective.
Adfluvial	A life history type in which fish live in lakes but migrate into streams to spawn.
Ammocoete	A protracted larval stage of lamprey.
Anadromous	A life history type in which fish mature in marine waters but migrate into fresh water to spawn.
Aquifer	An underground bed or layer of earth, gravel, or porous stone that yields water.
Distinct Population Segment (DPS)	A subgroup of a vertebrate species that is treated as a species for purposes of listing under the Endangered Species Act (ESA). It is required that the subgroup be separable from the remainder of and significant to the species to which it belongs (61 FR 4722, Feb. 7, 1996). The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), collectively "the Services," adopted a joint policy for recognizing DPSs under the ESA (61 FR 4722, February 7, 1996) The Services apply the DPS policy in delineating species of West Coast *Oncorhynchus mykiss* for consideration under the ESA (71 FR 834, January 5, 2006) and apply the policy in defining the Puget Sound (PS) steelhead DPS (71 FR 15666, March 29, 2006).
Easement	A right-of-way giving specified individuals other than the property owner permission to use a property for a specific purpose.
Environmental Impact Statement (EIS)	A report that documents the information required to evaluate the environmental impact of a project under the National Environmental Policy Act (NEPA).
Escapement	The number of fish that avoid or escape all harvest and return to spawn at their home stream.
Evolutionarily Significant Unit (ESU)	A population that is substantially reproductively isolated from other population units of the same species, and that represents an important component in the evolutionary legacy of the species 56 Fed. Reg. 58,612 (Nov. 20, 1991).
Extirpation	The elimination of a species from a particular area.
Fluvial	A life history type in which fish mature in rivers but migrate into smaller tributaries to spawn.
Fry	A free-swimming, juvenile salmonid that has recently emerged from the gravel and fully absorbed its yolk sac.

Geomorphic processes	Landscape-modifying processes such as surface erosion, mass wasting, and stream flow.
Glacial outwash	Rocks ground into coarse and fine substrate materials by glaciers and delivered downstream by glacial melt water.
Habitat	The environmental conditions of a specific place occupied by a plant or animal species, or a population of a species. An individual may require or use more than one type of habitat to complete its life cycle.
Hydrogeology	A branch of geology that deals with the occurrence, distribution, and effect of groundwater.
Incidental take	Take that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by a Federal agency or applicant (50 CFR 402.02).
Incidental Take Permit (ITP)	A permit issued by NMFS or the USFWS that allows take of a listed species incidental to otherwise lawful activities in accordance with an approved Habitat Conservation Plan (HCP).
Juveniles	Salmonid life stage after emergence from gravel and prior to maturation or residence in marine waters; includes fry, parr, and smolts.
Large wood	Large pieces of wood in, or partially in, stream channels, including logs, pieces of logs, and root wads. Large wood provides streambed and bank stability and habitat complexity.
Outmigration	Process by which smolts leave freshwater habitat and enter saltwater habitat.
Rearing	Life stage during which juvenile fish find shelter and food prior to outmigration.
Redd	A salmonid fish nest, created by excavating a shallow pit in gravel where eggs are buried for incubation.
Riparian	Relating to, living, or located on the bank of a natural watercourse, such as a river, a lake, or a tidewater.
Salmonids	Fish species belonging to the family Salmonidae, which includes trout and salmon, among others.
Side channel	A secondary channel containing a portion of the stream flow from the main channel and separated from the main channel at bankfull discharge.
Spawning	The act of reproduction of fish, which includes egg laying and fertilization, and sometimes nest building (e.g., salmon).

Species A unit of the biological classification system below the level of genus; a group of individual plants or animals that have common attributes and that are capable of interbreeding. The Endangered Species Act (ESA) defines species to include subspecies and any Distinct Population Segment (DPS) or Evolutionarily Significant Unit (ESU) of any species.

Take To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a federally listed endangered species of fish or wildlife. Includes disturbance of species, nests, or habitat when disturbance is extensive enough to disrupt normal behavioral patterns and result in injury or death (Endangered Species Act, section 3[10]).3[1018]), 16 U.S.C. §1532(18).

Total Maximum Daily Load (TMDL) A written plan with an analysis that determines the total amount of a pollutant that can be present in a specific water body and still meet water quality standards according to section 303(d) of the Federal Clean Water Act.

Viable salmonid population (VSP) An independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation, random or directed, local environmental variation, and genetic diversity changes, random or directed, over a 100-year time frame.

Water Quality Limited A receiving stream that does not meet narrative or numeric water quality criteria during the entire year or defined season even after the implementation of standard technology. For more information see Water Quality Standards: Beneficial Uses, Policies, and Criteria For Oregon Department Of Environmental Quality Water Pollution Division 41 340-041-0002, Definitions, Part 70 a-c.

Watershed The land area from which surface runoff drains.

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1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 Introduction

The City of Kent (City) is applying for Incidental Take Permits (ITPs) from the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) (collectively the "Services") under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (ESA). The ITPs will cover operations and maintenance activities relating to the City's Clark Springs Water Supply System (Clark Springs System) located east of Maple Valley on Rock Creek, in a 320-acre area of King County that was annexed in 1969 by the City (Figure 1.1-1). Species for which the City seeks ITP coverage include the Puget Sound (PS) Chinook salmon (*Oncorhynchus tshawytscha*), Puget Sound (PS) steelhead (*Oncorhynchus mykiss*), and the bull trout (*Salvelinus confluentus*), which are currently listed as threatened, and six unlisted species that may be affected by the City's activities at the Clark Springs Water Supply Facility (Clark Springs Facility); these species are referred to as the "covered species." The USFWS has ESA jurisdiction over the bull trout, and NMFS has jurisdiction over the salmon and steelhead species (Table 1.1-1).

Table 1.1-1 Species Proposed for Coverage in the Clark Springs Water Supply HCP.

Species Name	**Federal Status**	**Federal Agency with Oversight**
Puget Sound (PS) Chinook salmon	Threatened 6/28/05 (70 FR 37160)	NMFS
Puget Sound (PS) steelhead	Threatened 5/11/07 (72 FR 26722)	NMFS
Bull trout	Threatened 11/1/99 (64 FR 58910)	USFWS
Sockeye salmon (*Oncorhynchus nerka*)	Not Listed	NMFS
Puget Sound (PS)/Strait of Georgia coho salmon (*Oncorhynchus kisutch*)	Not Listed	NMFS
Puget Sound (PS)/Strait of Georgia chum salmon (*Oncorhynchus keta*)	Not Listed	NMFS
Coastal cutthroat trout (*Oncorhynchus clarki clarki*)	Not Listed	USFWS
Pacific lamprey (*Lampetra tridentata*)	Not Listed	USFWS
River lamprey (*Lampetra ayresi*)	Not Listed	USFWS

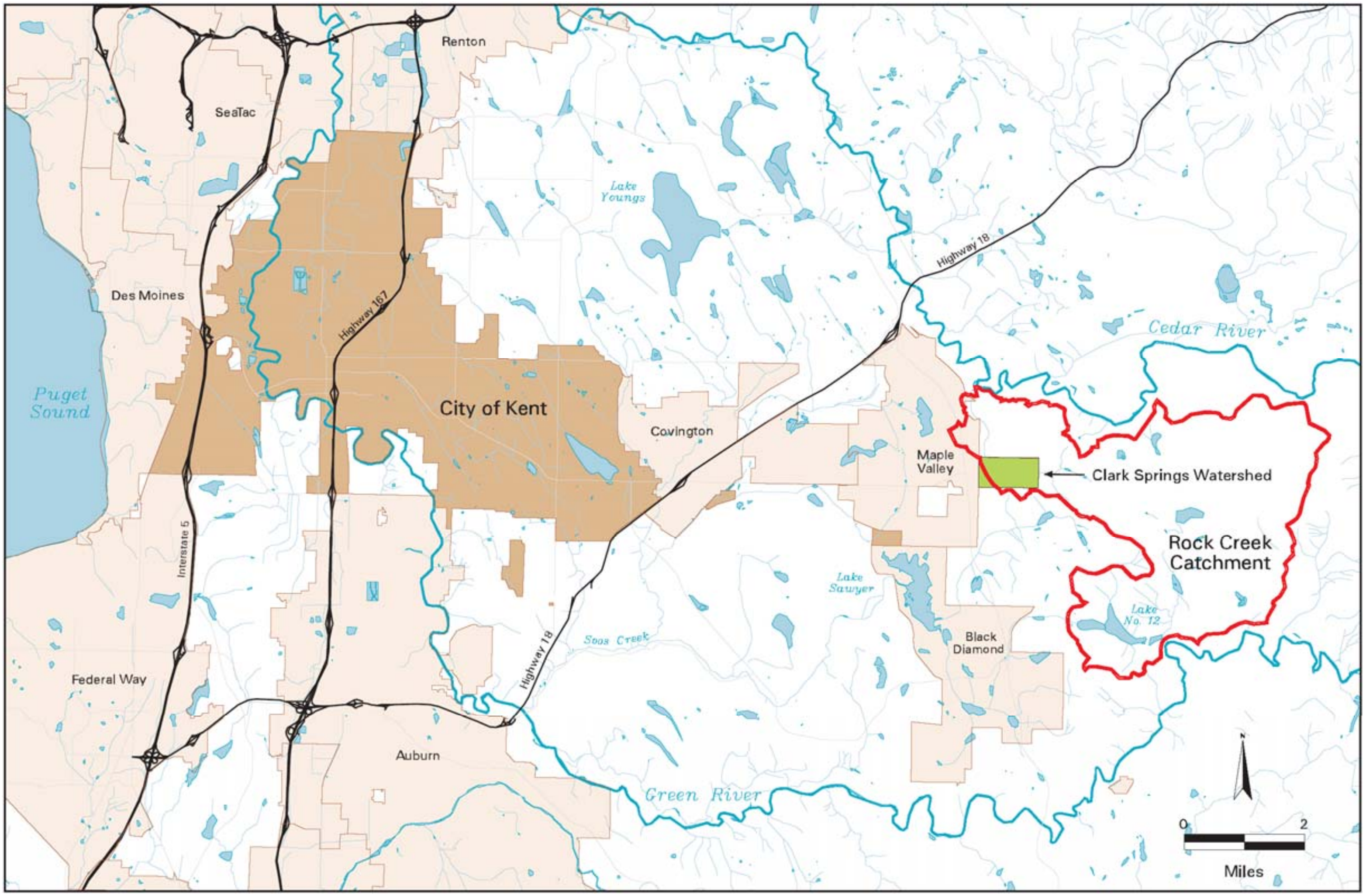

Figure 1.1-1 Vicinity map of the Rock Creek Basin relative to the City of Kent.

The City, a municipality with over 80,000 residents located in southern King County, Washington, owns and operates its own water supply system. The City's water supply system is comprised of both ground and surface water supplies, and provides water to meet domestic, commercial, irrigation, manufacturing, residential, fire, and life safety requirements of its residents and businesses. The Clark Springs System serves as the City's largest and primary water source, providing up to 60 percent of its total water supply needs.

The presence of listed fish species in the Rock Creek Watershed prompted concerns about the long-term reliability and certainty of the Clark Springs System to meet the City's water supply obligations. To begin to address these concerns, the City voluntarily installed a streamflow augmentation system at the Clark Springs Facility that could discharge groundwater from the Clark Springs Facility back into Rock Creek as a means of augmenting flows. In 1997, the City began voluntary stream augmentation when periods of low flow coincided with the spawning of listed salmonid species.

To pursue certainty of its existing and future water supplies the City would like to formalize its water supply activities and conservation commitments under a habitat conservation plan (HCP), and in so doing obtain ITPs from the Services under section 10(a)(1)(B) of the ESA. To obtain the ITPs, the City must prepare an HCP that meets the issuance criteria in section 10(a)(2)(B) of the ESA, as described in Subsection 1.3.2, Decisions to be Made. Accordingly, the City has prepared an HCP in support of its ITP applications. The HCP is hereby incorporated by reference

If the City's application meets the ITP issuance criteria under section 10(a)(2)(B) of the ESA, the USFWS and NMFS will issue separate ITPs for the listed species under their respective jurisdictions. Federal action on the City's ITP applications requires environmental review under the National Environmental Policy Act of 1969, as amended (NEPA). This Final Environmental Impact Statement (Final EIS) meets the Services' environmental documentation requirements under NEPA. The Services are co-leads on this Federal action and have jointly completed the Final EIS to evaluate the impacts of the proposed issuance of the ITPs through the implementation of the HCP, and a reasonable range of alternatives.

1.2 Purpose and Need for the Proposed Action

1.2.1 Purpose of the Proposed Action

The purpose for this action (i.e., issuance of two ITPs) is for the USFWS and NMFS to respond to the City's application to each agency for an ITP, and for the City to continue its water supply activities at the Clark Springs Facility while complying with the ESA. If granted, these proposed ITPs would authorize the incidental take of the three listed species identified in Table 1.1-1. Additionally, if these ITPs are granted, provisions for coverage of six unlisted species would be made by the Services; the City would then receive incidental take coverage if these species are listed in the future (Table 1.1-1), assuming the HCP provisions are still in force. The purpose for unlisted species coverage is to provide assurances to the City that no additional water withdrawal limitations, land restrictions, or financial compensation would be required for species conservation if adequately covered by a properly functioning HCP.

To minimize and mitigate the incidental take and to adequately address the needs of the covered species, the City would implement the proposed HCP for the full 50-year term of the ITPs. Implementation of the HCP would include "effects and effectiveness monitoring" and "implementation monitoring." Effects and effectiveness monitoring evaluates the effects of the permitted action and determines whether the effectiveness of the operating conservation program of the HCP is consistent with the assumptions and predictions made when the HCP was developed and approved. Monitoring the effectiveness of the HCP measures is intended to determine if the proposed HCP achieves its biological goals and objectives and includes regular reporting to the Services. Implementation monitoring by the Services would include use of remote and on-site techniques to ensure the HCP is implemented in accordance with the terms of the HCP, the terms and conditions of the ITPs, and the Implementation Agreement (IA). Adaptive management, as specified in the proposed HCP and Implementation Agreement (IA), could result in modification and improvement of Habitat Conservation Measures (HCMs) provided for in the proposed HCP in response to new information (HCP, Chapter 7). Specific activities to be covered under the ITPs are detailed in Subsection 1.6 of the proposed HCP and include:

- Water supply withdrawals from the Clark Springs System pursuant to the City's water rights.
- Augmentation flows pumped from the Clark Springs Facility into Rock Creek as described for HCM-1 in Chapter 4 of the proposed HCP (Habitat Conservation Measures to be implemented under the HCP).
- Operations, maintenance, replacement, monitoring, and improvements to the augmentation system. This includes relocating the augmentation system; maintaining, adding to, and/or replacing all augmentation infrastructure as needed.
- Relocation of the augmentation discharge point downstream from its current location to a point near the Parshall Flume.
- Operations, maintenance, and improvements to the water supply facilities located in the Clark Springs Facility such as the buildings, wells, access roads, fences and security infrastructure, infiltration galleries, and water transmission main(s), except for portions within the ordinary high water boundaries of Rock Creek. This includes replacement of the facilities and infrastructure as needed in the future.
- Operations, improvements, and maintenance of the Clark Springs Facility and related infrastructure.

- Vegetation management on the Clark Springs property. This activity does not include vegetation management activities conducted by the Bonneville Power Administration to maintain its transmission line right-of-way and easement.
- Operation and maintenance of the Parshall Flume and USGS gaging station (No. 12118400).
- Wildlife management within the Clark Springs Facility for the purpose of protecting and enhancing the quality of the water supply. This includes trapping beavers to ensure a healthy municipal water source and removal of beaver dams to prevent stream relocation and damage to the City's infrastructure or the quality of the water supply.
- HCMs 2 through 6 described in Chapter 4 of the proposed HCP.
- Electrical, control, and telemetry operations, maintenance, improvements and replacement of equipment, conduit, cabling, and related infrastructure to meet the needs of the water supply facilities.
- The delivery and storage of chemicals, the chemical treatment processes and the operation, maintenance, replacement and improvement of equipment, conduit, piping, and sampling infrastructure required to monitor and treat the City's water supply.
- The maintenance and replacement of stormwater conveyance, control, and distribution facilities.
- Installation of monitoring wells along the eastern boundary of the Clark Springs property to monitor groundwater quality in order to detect contamination that might impact City water supplies.

1.2.2 Need for the Proposed Action

The need for this action is to provide broader protection and conservation for listed and unlisted species than would be provided under section 9 of the ESA, while protecting the City's long-term municipal, commercial, and domestic water supply derived from the Clark Springs Facility. The needs and goals of the Services are to conserve listed species and their habitats and associated species during the City's implementation of the HCP and to ensure compliance with ESA, NEPA, and other applicable laws and regulations. The Services and the City consider the implementation of an HCP to be the most effective means of reconciling the City's proposed activities with prohibitions against take and other conservation mandates of the ESA.

1.2.3 Decisions to be Made

This subsection describes how the Services determine whether the City's need is met with respect to species protection and conservation. Discussions between the permit applicant and the Services during the development of the HCP and ITP proposal are conducted with the knowledge and understanding that specific criteria must ultimately be met before a permit issuance decision can be reached. The determination as to whether or not the ITP has met these criteria is made after the HCP and NEPA documents are developed and subsequently revised based on public input. The determination will be documented in the Services' decision documents consisting of the ESA section 10 findings documents, ESA section 7 biological opinions, and NEPA decision documents. These final decision documents are produced at the end of the ESA and NEPA processes.

1.2.3.1 ESA Section 10

Under §10(a)(1)(B) of the ESA, the Secretary of the Interior (through the USFWS) and the Secretary of Commerce (through the NMFS) may issue a permit for the incidental taking of a listed species if they find that the application conforms to the issuance criteria identified section 10(a)(2)(B) of the ESA. In order to issue a permit, ESA requires:

- The taking of any listed species will be incidental.
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking.
- The applicant will ensure that adequate funding for the conservation plan and procedures to deal with unforeseen circumstances will be provided.
- The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
- That measures required under section 10(a)(2)(A)(iv), if any, are met and such other assurances that may be required that the HCP will be implemented.

As a condition of receiving an ITP, an applicant must prepare and submit to the Services for approval an HCP containing the mandatory elements of section 10(a)(2)(A). An HCP must specify the following:

- The impact that will likely result from the taking of any listed species.
- What steps the applicant will take to minimize and mitigate such impacts, the funding available to implement such steps, and the procedures to be used to deal with unforeseen circumstances.
- What alternative actions to such taking the applicant considered, and the reasons why such alternatives are not proposed to be utilized.
- Such other measures that the Secretaries may require as being necessary or appropriate for the purposes of the plan.

The ESA section 10 assessment will be documented in the respective section 10 findings document produced by the Services at the end of the process. If the Services make the above findings, the Services will issue the ITPs. In such cases, the Services will decide whether to issue permits conditioned on implementation of the proposed HCP as submitted or to issue permits conditioned on implementation of the proposed HCP as submitted together with other measures specified by the Services. If the Services find that the above criteria are not satisfied, the permit request shall be denied.

1.2.3.2 ESA Section 7

Section 7(a)(2) requires all Federal agencies, in consultation with the Services, to ensure that any action "authorized, funded, or carried out" by any such agency "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification" of critical habitat. Because issuance of a section 10 ITP involves an agency authorization, it is subject to consultation under section 7 of the ESA. Although the provisions of section 7 and section 10 are similar, section 7 and its regulations introduce several considerations into the HCP process that are not explicitly required by section 10. Specifically included are indirect effects, effects on federally listed plants, and effects on critical habitat. The results of the ESA section 7 consultation are documented in a Biological Opinion produced at the end of the process.

1.2.3.3 NEPA

Issuance of an ITP is a Federal action subject to NEPA compliance. The purpose of NEPA is to promote analysis and disclosure of the environmental issues surrounding a proposed Federal action in order to reach decisions that reflect NEPA's mandate to strive for harmony between human activity and the natural world. Although ESA and NEPA requirements overlap considerably, the scope of NEPA goes beyond that of the ESA by considering the impacts of a Federal action on non-wildlife resources such as water quality, air quality, and cultural resources. Depending on the scope and impact of the HCP, NEPA requirements can be satisfied by one of the three following documents or actions:

- Categorical exclusion
- Environmental Assessment (EA)
- Environmental Impact Statement (EIS)

Activities that do not individually or cumulatively have a significant effect on the environment can be categorically excluded from NEPA. An EA is prepared when it is unclear whether an EIS is needed or when the project does not require an EIS but is not eligible for a categorical exclusion. An EA culminates in either a decision to prepare an EIS or a Finding of No Significant Impact. An EIS is required when the project or activity that would occur under the HCP is a major Federal action significantly affecting the quality of the environment, though an agency may produce an EIS at its discretion even in cases where significant effects are not likely to occur. An EIS culminates in a Record of Decision (ROD) that will be produced at the end of the process.

1.3 Environmental Review Process

Publication of this Final EIS is a key milestone in the environmental review process for the proposed HCP. Prior actions regarding this Final EIS have been related to the public/agency scoping process and the decision to prepare an EIS. A complete discussion of the scoping process is described in the Scoping Report for this project (on file with the Services).

In summary, a 45-day public scoping period, announced in the Federal Register on June 19, 2006 (71 FR 35286), was held from June 19, 2006, to August 3, 2006. A public scoping meeting was held on June 27, 2006, at the City of Kent City Hall to introduce the proposed HCP and the NEPA review process. Public, tribal, and agency comments were received in writing in subsequent letters. The Services also conducted internal scoping activities to address key components of alternative descriptions, to develop the level of detail for impact and cumulative impact analyses, and to prepare the Draft EIS framework and schedule. A Draft EIS was prepared in consideration of issues raised during the public and internal scoping process.

The Draft EIS analyzes the Services' actions of issuing their respective ITPs to the City for incidental take of the covered species over the 50-year term of the permits and HCP. A 60-day public comment period followed the publication of the Draft EIS, after which the Services reviewed all public and agency comments and developed responses. The Services' responses to all comments received on the Draft EIS are published with this Final EIS (Appendix B). Any changes to the Draft EIS that resulted from comments are published in this Final EIS. This Final EIS will be circulated for an additional 30-day public review period, after which the Services will prepare their respective RODs that will document their permit issuance decisions (i.e., whether or not to issue the ITPs). Any comments on the Final EIS will be considered in this final decision-making process, and be included with responses in the ROD.

1.3.1 Issues and Concerns

Issues and concerns regarding the Proposed Action were raised during the public and internal scoping process. Details of the issues raised are provided in the Scoping Report. Based on scoping comments, key issues and concerns considered in preparation of this Final EIS included the following:

- Consideration of flow augmentation alternatives that maintained flows in Rock Creek year round.
- Consideration of other methods and technologies for conserving, storing, or supplementing the water provided by Clark Springs for use by the City and to augment flows for fish use.
- Ensuring that the most recent data related to water flow and fish usage is included in the HCP and in the Final EIS.

1.4 Other Regulations, Laws, and Plans

Other Federal, State, and local statutes, regulations, and policies may govern the activities proposed for ITPs under the HCP. While some regulations may require issuance of environmental permits prior to project implementation, others may require agency consultation. A brief summary of other related regulations, laws, and plans or policies is provided below.

Permit/Consultation	Oversight Agency	Projects that Trigger Permit/Consultation Requirements
Clean Water Act Section 404 Permits	Washington State Department of Ecology U.S. Army Corps of Engineers	Several conservation measures could have removal/fill activity in the beds and banks of rivers.
National Historic Preservation Act Section 106 Consultation	United States Fish and Wildlife Service National Marine Fisheries Service	Cultural Resources Management Plan is required to protect historical properties and archaeological resources that may be impacted by the HCP conservation measures.
Clean Water Act Section 401 Water Quality Certification	Washington State Department of Ecology	Certification is required for individual activities subject to Section 404 Permits.
Clean Water Act 402 Construction Stormwater Permit	Washington State Department of Ecology	Compliance with statewide general permit (preparation of erosion control plan) required for all construction activities affecting one or more acres.
Magnuson-Stevens Fishery Conservation and Management Act	National Marine Fisheries Service	Conservation measures with the potential to affect Essential Fish Habitat.
State Shoreline Management Act	Washington State Department of Ecology	Conservation measures that impact riparian areas along the Cedar River, a river of statewide significance.
Hydraulic Project Approval	Washington Department of Fish and Wildlife	Any construction activity in or near State waters.
Critical Area Permit	City of Kent, WA King County	Construction activities in mapped and protected critical area.
State Environmental Policy Act (SEPA)	Washington State Department of Ecology City of Kent, WA	SEPA would be necessary for the adoption of the HCP and for the specific HCMs when they go through the permitting process.

1.5 Overview of EIS Sections

This EIS has been prepared in accordance with NEPA and with the NEPA guidelines adopted by the Services. The EIS is a stand-alone document; however, the EIS should be reviewed together with the proposed HCP, which contains detailed background information and justification for the HCMs contained in the Proposed Action.

In addition to this section, which describes the purpose of and need for the Proposed Action, other key sections of the EIS include the following:

Section 2.0 – Alternatives
This section describes the Proposed Action and alternatives to the Proposed Action. Alternative A is the No-action Alternative, or what activities would be expected to occur if the Proposed Action (i.e., issuance of an ITP) were not federally approved. Alternative B is management in accordance with the City's Proposed Action and is described as the Proposed Action.

Other options considered but not carried forward for detailed analysis as alternatives are described in Subsection 2.5 Alternatives Considered but Not Analyzed in Detail.

Section 3.0 – Affected Environment
This section describes the existing environmental conditions of the geographic area to be covered by the City's proposed HCP. The discussion of the affected environment is grouped into various subsections corresponding to the resources potentially affected by the Proposed Action (e.g., fisheries, vegetation).

Section 4.0 – Environmental Consequences
This section describes the potential impacts resulting from each of the alternatives to the resources described in Section 3, Affected Environment. The environmental consequences of each alternative are described relative to the environmental consequences of the No-action Alternative.

Section 5.0 – Cumulative Effects
This section will discuss cumulative impacts, or the impacts of the Proposed Action in consideration of other projects (i.e., past, present, and reasonably foreseeable future projects), that may affect fish and wildlife habitat and populations.

In addition, the following information is included in this EIS:

- **List of Acronyms**
- **Cover Sheet**
- **Glossary**
- **Summary**
- **Section 6.0, References**
- **Section 7.0, Distribution List**

Section 8.0, List of Preparers

Appendix A-List of Common Wildlife Species Reported to Occur in the Rock Creek Drainage

Appendix B-Public Comments and Services' Responses

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2.0 ALTERNATIVES

2.1 Introduction

The City has voluntarily prepared an HCP and submitted applications for ITPs to the Services that would address the City's operation and maintenance activities at the Clark Springs Facility in King County, Washington. This section provides a description of the two alternatives that were analyzed, the No-action Alternative and the Proposed Action. Under the No-action Alternative, the City would not receive incidental take coverage for its operation of the Clark Springs Facility and would not implement the HCP. Under this alternative, the City would assume some potential liability for unauthorized take of listed species under section 9 of the ESA. Under the Proposed Action, the City would continue the current operations and maintenance activities at the Clark Springs Facility in accordance with the implementation of the proposed HCP and issuance of ITPs.

Several alternatives to the Proposed Action were not considered for more detailed analysis. An explanation of why these alternatives were not considered for detailed environmental analysis in this EIS is provided in Subsection 2.5, Alternatives Considered but not Analyzed in Detail.

The information in Subsection 2.2, Background and Identification of Water Supply Alternatives, is provided as background and describes the City's various water conservation efforts that have been implemented since formally adopting its water conservation program in 1993. These efforts are ongoing and would continue regardless of the Services' decisions on this action.

2.2 Background and Identification of Water Supply Alternatives

The subsections below (i.e., 2.2.1 City of Kent Water Supply System through 2.2.4 Increase Capacity within the City of Kent System) describe the basis for forming the Proposed Action and alternatives to that action.

2.2.1 City of Kent Water Supply Systems

The City's water utility service area encompasses approximately 27 square miles, the majority of which is within the incorporated City (Figure 1.1-1). The City's principal source of water is Clark Springs. The Clark Springs Facility is located between the City of Maple Valley and the Ravensdale area of unincorporated King County along Kent-Kangley Road. The City also draws additional water from several other sources described below.

Kent Springs is located between Maple Valley and Black Diamond near the intersection of SE 288th Street and 216th Avenue SE, and is a water source that can reliably supply up to 1.5 million gallons per day (mgd) during the peak demand season. The Armstrong Springs Wells, located at approximately 179th Avenue SE and Kent-Kangley Road (SR 516), can reliably supply up to 1.4 mgd (City of Kent 2002). The East Hill Well, located at SE 246th Street and 104th Avenue SE, can supply up to 2.7 mgd at peak demand. The Seven Oaks Plat Well, located at 118th Avenue SE and Kent-Kangley Road (SR 516), can supply as much as 0.6 mgd at peak demand and 0.28 mgd on a yearly average, based on 120 days of operation per year; however, the reliability of this supply has been declining in recent years. The Garrison Well and the O'Brien Well, located near South 218th Street, can produce up to 0.5 mgd and 0.35 mgd, respectively, at peak demand, although they are both constrained by: 1) water quality conditions that exceed the maximum allowable contaminant levels (MCL), set by the Washington State Department of Health (DOH), for iron and manganese; and 2) local area customer complaints. The 212th/208th Street Wells, which pump to the iron/manganese filtration plant located at South 212th Street and SR 167, can yield up to 5 mgd at peak demand and 1.64 mgd on a yearly average, based on 120 days of operation per year (City of Kent 2002). Recent failures of the two 212th/208th Street Wells as a result of aquifer clogging have shown that this supply can be sensitive to overpumping, due to the artesian nature of the aquifer and the fine sand that makes up the aquifer strata.

These sources are adequate to meet the City's current and near-future peak day and peak season demands; however, they are insufficient to meet projected long-term peak season demands (City of Kent 2006) that typically occur in the months of July and August. In 2002, the City executed an agreement to participate as a partner with Tacoma Water, Covington Water District, and Lakehaven Utility District in the Tacoma Second Supply Project (TSSP) after planning for and participating in the development of the TSSP water supply and conveyance project for 25 years. However, the City expects water from the TSSP, coupled with the City's existing sources, will still be insufficient to meet the City's long-term peak season demand projections (City of Kent 2006). As a result, the City continues to explore additional sources of supply and storage to meet those anticipated future needs.

2.2.2 Future Water Demand Projections

Over the past 25 years, the City's population and land base have substantially expanded. Further growth is projected over the next 40 years as population density increases within the City's existing water system boundaries, resulting in an approximate doubling of the City's current water service area population. As a matter of law, the City has an ongoing responsibility to plan for and develop the water supplies necessary to meet its projected population growth, as well as to maintain and protect the viability of its existing water sources.

In recent years, meeting these responsibilities has become a significant challenge for the City due to a combination of factors that include: the seasonal and development-based impacts on source aquifers; the increasingly stringent and dynamic regulatory environment governing water supply; the need to maintain water quality; the increase in the number of water rights issues; and the ESA listing of salmonid species in the Puget Sound region. Washington State's Growth Management Act also requires cities to have adequate water supplies prior to allowing additional development. As part of its 2002 Water System Plan, the City calculated future peak day water demands utilizing three separate methods. Each was an accepted method for determining future peak water demand by the DOH. An explanation of the three methods and their results is provided in the following paragraphs.

In the first method of figuring ultimate peak day demand at saturated development, the number of people per connection was assumed to be 2.6 (Appendix G, City of Kent 2010). Dividing the projected saturation population of 96,323 by the number of people per connection (2.6) yielded 37,047 connections. When this was multiplied by the State-recommended value of 800 gallons per day per connection, the resulting ultimate peak day demand for water was 29.64 mgd.

In the second method, the 1996 peak day water consumption of 15.61 mgd was divided by the 1996 population of 48,129 to obtain a value of 324.34 gallons per capita per day (gpcd). This value, which includes the system demand for all customer classes on a per capita basis, was multiplied by the projected service area saturation population of 96,323 to yield an ultimate peak day demand of 30.86 mgd.

The service area saturation population was derived from vacant single-family zoned acres and re-developable land zoned Duplex Multi-family Residential District (MR-D), Garden Density Multi-family Residential District (MR-G), Medium Density Multi-family Residential District (MR-M), and High Density Multi-family Residential District (MR-H). In this analysis, the following assumptions were made:

- All existing single-family homes on land zoned for single families (SR-1, SR-2, SR-3, SR-4.5, SR-6, and SR-8) would remain and not be further subdivided.
- Of the existing structures/residences on land zoned for potential multi-family development (MR-D, MR-G, MR-M, and MR-H) 65 percent would redevelop to the maximum allowable number of multi-family units for that zoning classification. The 65 percent was established by the City Planning Department and provides discounts for critical areas, rights-of-way, public purpose lands, and market factors.
- Of the existing vacant single-family-zoned land, only 66 percent would be developed to the maximum allowable number of units for that respective zoning classification. The 66 percent was established by the City Planning Department and provides discounts for critical areas, rights-of-way, public purpose lands, and market factors.

The final population figure was determined by multiplying the saturated number of housing units, both single family and multi-family, by the average persons per household. This revealed a projected saturated population of 96,323 used in the second method described previously.

In the third method, the number of acres proposed for each type of land use was multiplied by the appropriate rate of water consumption at peak hour per acre to give a total flow. The calculations indicated a saturated peak day flow of 32.96 mgd. This projected amount was high since it is unlikely that peaks for commercial/industrial consumers would coincide with residential peaks. The peak hours of consumption for commercial/industrial users are during daytime hours, whereas residential consumption peaks are likely to be experienced in the early mornings and early evenings.

These three methods were used to estimate a low (29.64 mgd), medium (30.86 mgd) and high (32.96 mgd) peak day demand projection. The City has used the medium peak day demand estimate, rounded to 31.0 mgd, for saturated development peak day demand planning.

To determine average day demand (ADD) projections, the City performed an analysis comparing historical actual peak day demands and average day demands. This analysis showed the City's ADD to be 56.5 percent of the peak day demand. Based on this value, the projected ADD under saturated development conditions is 17.5 mgd.

2.2.3 Existing Water Conservation and Demand Management Programs

Water conservation practices began in the City in the late 1970s. In 1993, the City formalized a Water Conservation Program that includes Demand Management practices implemented to reduce water demand. In addition to its Water Conservation Program, in 2002 the City conducted a Water Conservation Potential Assessment. The goal of the Water Conservation Potential Assessment was to identify potential water savings and associated costs for conservation measures that could be undertaken between 2003 and 2010. Any water conservation savings realized by the City would be in addition to those that have occurred since the beginning of the ongoing conservation program. These two efforts are described below.

The results of the Water Conservation Program demonstrated that the City's ongoing efforts to reduce demand, although successful, when considered individually or collectively, would not provide sufficient water savings to meet the City's future demands or to reduce demand from Clark Springs. The City will continue to make significant investments in its Water Conservation Program as part of its overall effort to meet future water demands. Because water conservation has been shown to be insufficient to meet the City's future water demands, the program is considered to be both part of the No-action Alternative and the Proposed Action considered in the EIS as well as part of each of the Alternatives Considered but Not Analyzed in Detail (Subsection 2.5). It is not considered as a stand-alone alternative for purpose of this analysis.

2.2.3.1 City of Kent Water Conservation Program

The City's Water Conservation Program includes conservation and demand management measures such as: rate incentives for summertime conservation; an emergency water shortage regulation implemented during drought conditions; distribution of public education materials and household conservation kits; and distribution of water-efficient plumbing fixtures, water-efficient irrigation technology, and drought-tolerant landscaping publications. The City adopted and implemented these comprehensive conservation programs to prolong supply and to mitigate annual and peaking demands that place stress on available water sources.

From 1993 to 1999, the City estimates that water use per connection dropped 12 percent (City of Kent 2002). Though a detailed analysis was not conducted to determine the Water Conservation Program's contributions to this reduction, some portion of the decrease was attributed to the conservation measures implemented. During this period, residential water use per connection dropped by 9 gallons per day (GPD) (4 percent). Table 2.2-1 summarizes the City's conservation efforts and its future plans.

One of the primary elements of the Water Conservation Program has been public education. To support public information and outreach, from 1997 through 2007 the City allocated between $11,600 and $170,000 in its annual budget, which includes funding for a 50 percent full-time equivalent (FTE) staff person. Additional public education efforts related to water conservation are included in Table 2.2-1. The City allocated $115,000 in the 2007 budget and $150,000 in 2008 for the Water Conservation Plan/Program.

2.2.3.2 Conservation Potential Assessment

In 2002, the City conducted a Water Conservation Potential Assessment in order to fulfill the terms of a Memorandum of Agreement (MOA) signed in 2001 between the TSSP partners, the DOH, and the Washington State Department of Ecology (Ecology). The purpose of the Water Conservation Potential Assessment was to evaluate the potential water savings and associated costs for both existing and proposed conservation measures that could be implemented or continued between 2003 and 2010. These savings include continuing ongoing efforts the City started as early as 1993, as well as other efforts that would be in addition to the City's existing water conservation program. A summary of the potential water savings by 2010 is presented in Table 2.2-2.

Water Conservation Measures

The Water Conservation Potential Assessment examined 72 existing, expanded, and new water conservation measures to determine if additional means of reducing demand could be implemented. Of the 72 measures reviewed, the Water Conservation Potential Assessment identified 28 that had the most potential for achieving the greatest water savings. A measure was determined to be most promising if the potential water savings was greater than 5,000 GPD during the summer months and the cost of implementing the measure was less than $6 per 5,000 gallons saved. The $6 cost was determined by estimating the "avoided cost" of both water production and wastewater disposal to the King County Metro system.

The 28 most promising conservation measures, taken collectively, had the potential to conserve an average of 614,000 GPD on a year-round basis and an average of 834,000 GPD during the summer months. Based on the City's estimates that the average daily demand during the summer season in 2010 would be 14.48 mgd, the 28 conservation measures considered in the evaluation could provide a potential water savings of approximately 5.8 percent by 2010. Of the 28 measures, 27 are currently in place, many of which have been ongoing since 1993.

Table 2.2-1 City of Kent Water Conservation Measures.

Measures	1990-2000	2001	2002-2003	2004-2008
Public Education/Information				
Newsletter	four times a year	three times a year	occasional	occasional
Water hotline-status of water supply/restrictions		ongoing	ongoing	ongoing
Consumption history on bill	implemented 1998	ongoing	ongoing	ongoing
Water bill inserts-conservation programs/incentives, etc.	ongoing	ongoing	ongoing	ongoing
Demonstration garden (2)				
Native plant demonstration	constructed 2000	ongoing	ongoing	ongoing
Low water use plants/drip irrigation demonstration site		construction 2001	ongoing	ongoing
Media advertising	run newspaper ads	ongoing	ongoing	ongoing
Public events/library displays	numerous events	ongoing	ongoing	ongoing
School education programs	"In Concert with the Environment" includes classroom presentation to approx 1,000 students annually	ongoing	ongoing	ongoing
Newspaper articles	provide to newspapers	ongoing	ongoing	ongoing
Informational brochures	produced/distributed numerous brochures	ongoing	ongoing	ongoing
Landscape/irrigation system guidelines	1998 revised landscape code to include native vegetation and low water use vegetation	ongoing	ongoing	
School Water Festival	began 2000 - 1278 students	ongoing -1473 students	ongoing - 3107 students	ongoing - 7,500 students
Landscape seminars	held for customers	promotion of County	promotions of County	promotions of County

Table 2.2-1 City of Kent Water Conservation Measures.

Measures	1990-2000	2001	2002-2003	2004-2008
Rate Structure				
Seasonal water rates	began 1999	ongoing	ongoing	ongoing
SF Residential – Indoor				
Toilet tank displacement device		distributed 2,000	distributed 3,000	distributed 5,000
Low-flow showerheads		distributed 2,500	distributed 600	distributed 850
High-efficiency toilets	147 rebates @ $50	46 rebates @ $50	206 rebates @ $50	388 rebates @ $50
Low-flow faucet aerators		distributed 3,000	distributed 1,500	distributed 1,700
Horizontal-axis clothes washers	116 rebates @ $50	68 rebates @ $50	90 rebates @ $50 in 2002 36 rebates @ $75 in 2003	241 rebates @ $75 100 rebates yearly est.
SF Residential – Outdoor				
Irrigation – rain sensors/shut off		distributed 350	done	
Rain barrels/rain pails		distributed 385	distributed 400 in 2002 and 2003	distributed 2,000
Landscape audits			10 per year as requested	
Rainwater harvesting				passage of ordinance by City Council, install rainwater harvesting in new construction '05 plans and detains for rainwater harvesting system for City Hall remodel, 2006
MF Residential - Indoor/Outdoor				
Low-flow showerheads		distributed 750	distributed 800	distributed 1000
Low-flow faucet aerators		distributed 800	distributed 800	distributed 550
High-efficiency toilets			500 per year replacement offer $100 rebate	500 per year replacement offer $100 rebate

Table 2.2-1 City of Kent Water Conservation Measures.

Measures	1990-2000	2001	2002-2003	2004-2008
Non-Residential – Indoor				
Kent schools toilet replacement	12 rebates for waterless urinals @$50 each		7 urinals/toilet rebates $100 rebate per item	as requested
Miscellaneous replacements in commercial			utility financed retrofit (up to 50% of cost) to replace low-flow toilets, urinals, faucets, refrigeration cooling, laundry, ice machines, etc.	utility financed retrofit (up to 50% of cost) to replace low-flow toilets, urinals, faucets, refrigeration cooling, laundry, ice machines, etc.
Non-Residential – Outdoor				
Irrigation reduction-Kent School District	Year 2000 cutback on irrigation, and plan to reduce areas irrigated	ongoing	ongoing	ongoing
Irrigation meters - schools	most schools have meters	ongoing	ongoing	ongoing
Rain sensors/shut off valve	distributed 50	ongoing	ongoing	ongoing
Water System Measures				
Water main leak detection	survey in 1991 of oldest part of town minimal leakage, repaired, leak detection/repair of Kent Springs water main	leak detection program and leaking fire hydrant replacement program	leak detection program and leaking fire hydrant replacement program	leak detection program and leaking fire hydrant replacement program
Hydrant use	required some non-emergency use to be metered	required all non-emergency use to be metered	ongoing	ongoing
Improved tracking of non-revenue water	ongoing	ongoing	ongoing	ongoing

Table 2.2-1 City of Kent Water Conservation Measures.

Measures	1990-2000	2001	2002-2003	2004-2008
Preventive maintenance programs	Infrastructure Management System implemented/track component inventory record maintenance history, preventive maintenance work	ongoing	ongoing	ongoing
Meter testing - 3-inches and larger	bi-annual testing	bi-annual testing with annual testing for meters larger than 4"	bi-annual testing with annual testing for meters larger than 4"	bi-annual testing with annual testing for meters larger than 4"
Water mains/dead end mains	400 dead end mains flushed yearly or more frequently as required	ongoing	ongoing	ongoing
Pump stations	water sources and pump stations visited daily while in operation	ongoing	ongoing	ongoing
Storage reservoirs	weekly visits to check security and overall conditions	ongoing	ongoing	ongoing
Pressure reducing valves	City-owned inspected monthly, complete maintenance yearly	ongoing	ongoing	ongoing
Watershed inspection	inspected on semi-annual basis to protect water quality	ongoing	ongoing	ongoing
Main flushing program	avoid summer flushing	non-summer flushing	non-summer flushing	non-summer flushing
Intertie meter calibration	annual or as needed	annual or as needed	annual or as needed	annual as needed
Source meter calibration	annual	annual	annual	annual

Table 2.2-2 Summary of Estimated Total Water Savings 2003- 2010 with Existing and Proposed Measures evaluated in the Conservation Potential Assessment.

Category	**Est. Year-Round Savings**		**Est. Summer-Season Savings***	
	Savings in GPD	**Percent total production (%)**	**Savings in GPD**	**Percent total production (%)**
Water conservation measures in residential and commercial sectors	614,000	5.3	834,000	5.8
Industrial Process Water	72,500	0.6	90,000	0.6
Water-Efficient Fixtures	200,000	1.7	200,000	1.4
Estimated Total Savings	**886,500**	**7.6**	**1,124,000**	**7.8**

Source: City of Kent 2002

*Estimated total savings includes some new and ongoing water conservation measures. Actual figures may vary depending on demand and weather.

<u>Industrial Process Water</u>

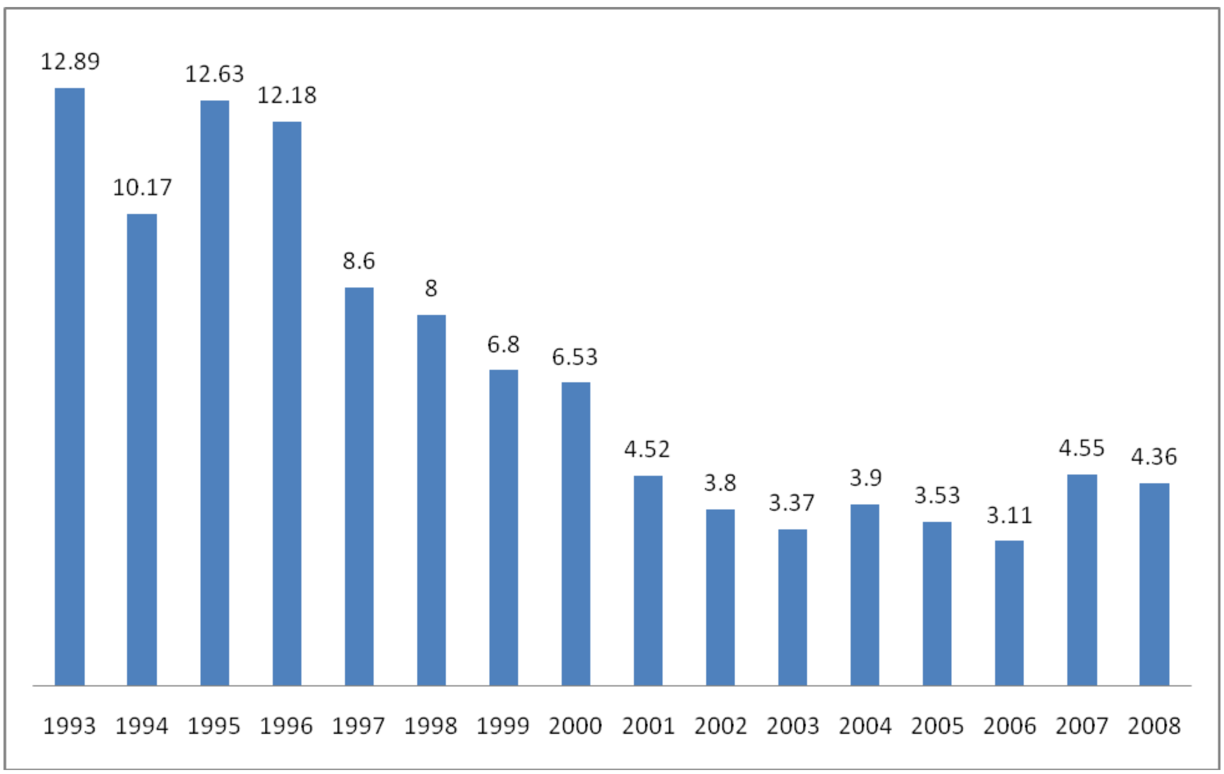
The City identified the top 20 industrial water users and offered free water usage audits to identify potential water conservation measures. Nine of the top 20 water users have been audited to date. Through the conservation of industrial process water the Water Conservation Potential Assessment used a general estimation procedure that identified a very approximate value in annual reduction of 72,500 GPD (10 percent) in total water sold to industrial users, and an estimate of 90,000 GPD reduction during the summer months, which is equivalent to approximately 0.6 percent savings by 2010.

<u>Water-Efficient Fixtures</u>

The Water Conservation Potential Assessment also looked at the potential water conservation that could be realized from the City's implementation of the 1993 plumbing code through new construction and remodels. The 1993 Washington State Plumbing Code included a section related to Water-Conserving Fixtures and Fittings (WAC 51-56-0402). The code requires that all new construction and all remodeling involving replacement of plumbing fixtures and fittings use toilets, faucets, and showerheads that meet water efficiency standards specified in the code. The Water Conservation Potential Assessment estimated that the City's implementation of 1993 plumbing code would result in 80 percent of the City's toilets being converted to water-efficient fixtures and would result in a savings of 200,000 GPD (1.7 percent) on a year-round basis by 2010.

Unaccounted-for Water Reductions

The City is required under the Municipal Water Law of Washington to track all water produced that is non-revenue generating. Non-revenue water is water that is produced but is not billed to customers, and includes beneficial uses such as flushing water mains, firefighting, reservoir maintenance, and treatment plant use, as well as system losses due to leakage or unauthorized uses (unaccounted-for water). The City's Water Conservation Plan has focused on reducing the amount of unaccounted-for water lost in the system through leaks. Before 1997 the City's unaccounted-for water was more than 10 percent of all water produced. In 2008, unaccounted-for water was 4.36 percent of all water produced and the 3-year average was 4 percent (Table 2.2-3). The City's percentage of unaccounted-for water is well below the State's water efficiency standard of 10 percent and is equal to or below the percentage of unaccounted-for water for other municipal water purveyors in the Puget Sound region (Figure 2.2-1).



Source: Appendix G, City of Kent 2010

Figure 2.2-1 Percent of Unaccounted-for Water 1993-2008.

Table 2.2-3 Unaccounted-for Water at Puget Sound Water Suppliers.

Jurisdiction	Unaccounted-for Water (%)	Source
Covington Water District	12 --Average non-revenue water between 2001-2006	Covington Water System Plan Update (2007)
City of Fife	20.3 in 2006	City of Fife Comprehensive Water System Plan (2009)
City of Tacoma	9--Average losses between 2001-2005	City of Tacoma Water System Plan Update (2006)
City of Olympia	8.84 in 2007	City of Olympia Water System Plan (2008)
Seattle Public Utility	5-7 in 2005	Seattle Public Utility Water System Plan (2006)
City of Auburn	4.3--Average unaccounted-for water between 2005-2007	City of Auburn Water Supply Plan (2009)

2.2.4 Increase Capacity within the City of Kent System

The City has explored expanding some of its existing well sites so they may provide additional water to meet future water demands. Three sites have been shown to have the potential for increases in supply but the potential increases would not be enough to offset the City’s reliance on the Clark Springs System. The three existing well sites that offer potential for increased water supply are the City wells at Blue Boy Reservoir, Armstrong Springs, and Earthworks Park. Each of these potential sites is discussed below.

Wells at Blue Boy Reservoir: Water rights from smaller wells that are believed to tap the same aquifer may be transferred to the Blue Boy Well. The City believes the Blue Boy Well may be capable of producing up to 350 gallons per minute (gpm). The well’s capacity must first be determined by an aquifer analysis that would determine its potential long-term yield and then the potential for the transfer of water rights for the site.

Wells at Armstrong Springs: The Armstrong Springs Site and the Kent Springs Site are believed to share the same aquifer. The City may pursue the transfer of water rights from the Kent Springs site to the Armstrong Springs site, which would allow the City to add an additional well; however, the estimated supply would only increase by approximately 100 gpm. The City is evaluating the feasibility of an additional well at the Armstrong Springs site and the volume of water that it would produce.

Wells at Earthworks Park: The City owns a small well located at Earthworks Park that may be capable of producing as much as 200 gpm. The City is currently evaluating the potential annual yield for the well to determine the reliability of the quality and also the quantity of water that can be withdrawn.

2.3 Existing Clark Springs Water Supply Facilities

The City's Clark Springs System is located adjacent to Rock Creek at river mile (RM) 1.94. This system is comprised of three separate, but conjunctively managed, primary sources and/or water rights that provide water from the shallow unconfined aquifer: Clark Springs Infiltration Gallery, Rock Creek, and Clark Springs Wells. Each of these sources draws upon the shallow aquifer and, at times, is in hydraulic continuity with the others.

Because closing the Clark Springs Facility would result in the City being unable to meet its future municipal water supply obligations, the analysis of the alternatives in this EIS is based on the City's continued operation of the Clark Springs System in a matter consistent with its water rights, regardless of the implementation of the proposed HCP (City of Kent 2002). The City's primary instantaneous and annual water rights are for 5,400 gpm and 8,710 acre-feet per year, respectively. Because of their close hydraulic connection, the operation of the infiltration gallery and the wells is conjunctively managed to comply with the quantities allowed under the combined water rights for the Clark Springs System.

The following is a description of the facilities that will be operated by the City at the Clark Springs Facility regardless of the implementation of the HCP. Figure 2.3.1 is a map of the Clark Springs Facility that shows the location of individual elements of the water withdrawal system.

Infiltration Gallery: The infiltration gallery (Figure 2.3-1) consists of 273 feet of 16-inch-diameter perforated pipe and 500 feet of 12-inch-diameter perforated pipe buried 18 feet underground. The two sections of perforated pipe collect groundwater from the shallow aquifer located beneath the Clark Springs Facility, as well as groundwater that is gravity-fed to a settling chamber called the clear well.

Surface Water Diversion: The surface water diversion does not take water from the surface water of Rock Creek, but is a 12-inch-diameter steel pipe that extends under the Rock Creek channel and is an extension of the 16-inch perforated pipe described as part of the infiltration gallery. As with the infiltration gallery, the surface water diversion collects groundwater that is gravity-fed to the clear well.

Clark Springs Wells: In 1968, three water supply wells were added to the Clark Springs Facility to meet demand. The wells extend 51 to 60 feet deep and pump water through a control valve and metering system. Unlike water from the infiltration gallery or the surface water diversion, water that is withdrawn from the wells is sent directly to the transmission main pipeline that delivers water to the City.

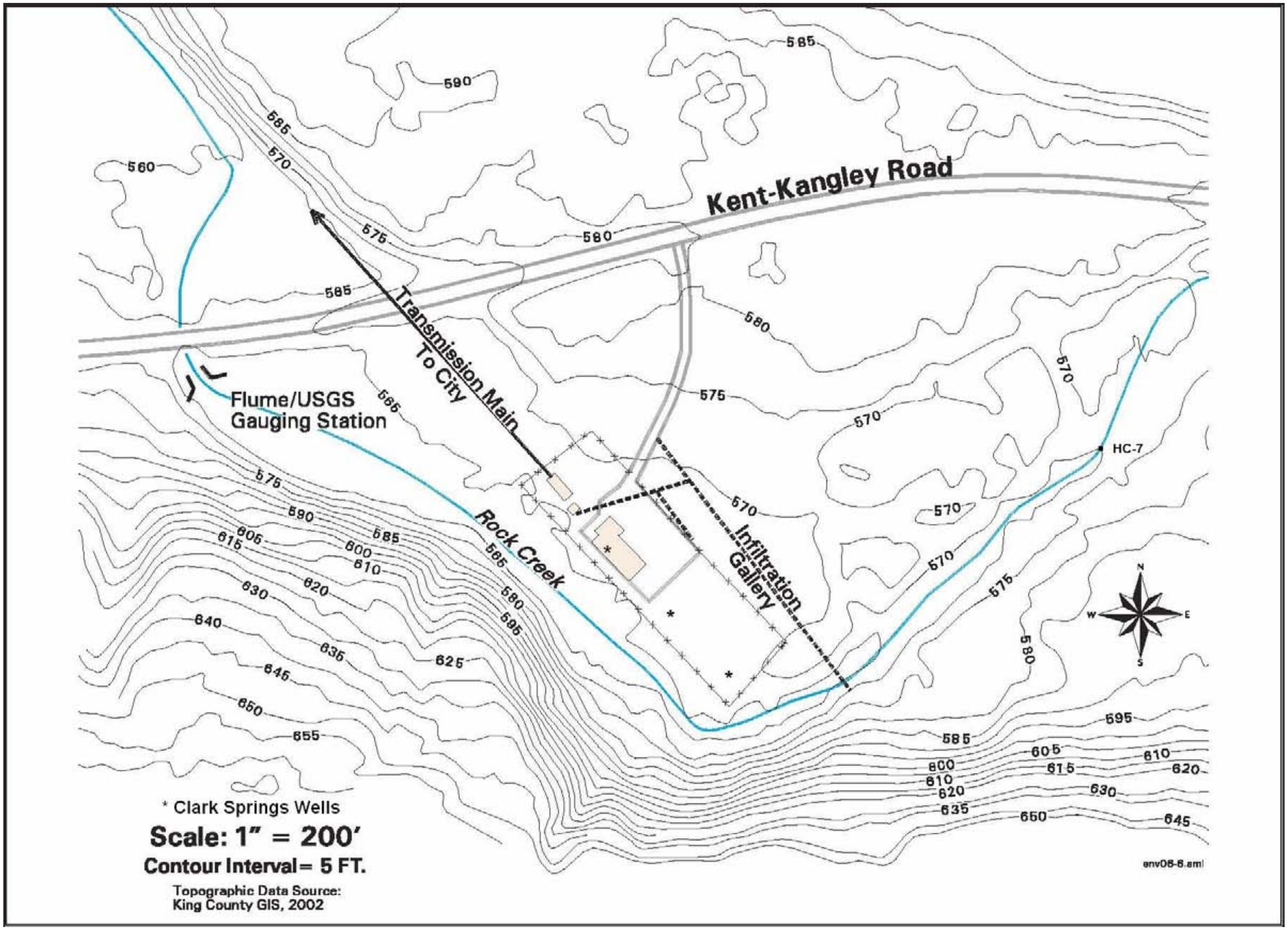


Figure 2.3-1 Map of the Clark Springs Water Supply Facility.

When the City uses the wells, its existing water right requires that a minimum instream flow be maintained in Rock Creek while the pumps are in use. The amount of the instream flow that must be ensured while the City utilizes its wells varies based on the time of year: from November 1 to April 30 the City must ensure a minimum flow of 15 cubic feet per second (cfs), and between July 1 and October 31 the City must ensure a minimum flow of 2 cfs. From May 1 to June 30 the minimum instream flow requirement declines arithmetically between 15 cfs and 2 cfs.

Clear Well and Transmission Main: Water that is withdrawn using the infiltration gallery and surface water diversion is gravity-fed to a settling chamber called the clear well. Water passes through the clear well and is then treated to maintain DOH water quality standards prior to entering the transmission main. The transmission main consists of 12 miles of 24-inch-diameter transmission pipeline (reducing to 18-inch diameter in some locations) that delivers water from Clark Springs, as well as water from other City water sources, to the City's reservoir storage and pumping facilities. The amount of gravity-fed water from the infiltration gallery and surface water withdrawals that can be delivered by the transmission main is primarily determined by the groundwater level. The difference in elevation between the groundwater and the entrance to the transmission main is called the hydraulic head. When the difference in hydraulic head is maximized, the transmission main can deliver up to 8.2 cfs (URS Corporation 1985). During the drier periods the groundwater level lowers and reduces the hydraulic head and the transmission main delivers between 4.9 to 6.2 cfs (City of Kent 2006).

2.4 Alternatives

2.4.1 Alternative A: No Action

Summary Description: Under Alternative A (the No-action Alternative), the City would not receive incidental take coverage for its operation of the Clark Springs System and for its effects of water withdrawal on listed species of fish in Rock Creek. The City would not implement the HCP. The City would be required to ensure that the Clark Springs System is in compliance with the take prohibitions under section 9 of the ESA, as well as all applicable local, State, and Federal laws and regulations. The City would continue operations at the Clark Springs Facility consistent with its water rights and, at its discretion, may continue its voluntary augmentation of Rock Creek.

2.4.1.1 Water Withdrawals

Under the No-action Alternative, the City would continue to operate the Clark Springs System as it has during the baseline period, except during high-flow winter months. The City is permitted to withdraw up to 12 cfs based on its existing water rights; however, the typical amount of water withdrawn is between 4.9 and 7.6 cfs, with an average of 6.2 cfs (data from 1986 to 1997). Under the No-action Alternative, during high-flow winter months the City may increase withdrawal amounts if an additional storage facility becomes available by withdrawing water in excess of the amount of water needed to meet municipal demand and diverting that amount to storage. If the well pumps are used to withdraw additional water for storage, the City's water rights would ensure a minimum instream flow of 15 cfs between November 1 to April 30 and a minimum instream flow of 2 cfs between July 1 and October

31. Between May 1 and June 30 minimum instream flows would decline arithmetically between 15 cfs and 2 cfs when the well pumps are in use. When the wells are not used, no minimum flow applies. The maximum withdrawal capacity in the transmission main under gravity flow is 8.2 cfs (URS Corporation 1985). During the baseline period this capacity has usually been reduced to between 4.9 to 6.2 cfs because of seasonal reduction in groundwater head at Clark Springs from declines in the water table as the summer progresses (Appendix G, City of Kent 2010). Additional inputs to the transmission main from other City sources can also decrease the amount of withdrawals from the infiltration gallery (Appendix G, City of Kent 2010).

For a complete discussion of the City's water operations see Chapter 1.3.3.2 of the proposed HCP.

2.4.1.2 Clark Springs Facility Maintenance and Improvements

Under the No-action Alternative the City would continue to conduct all of the activities necessary to maintain the conveyance systems, buildings, wells, and access roads to ensure the efficient operation of the facility. These activities include:

- Water supply withdrawals from the Clark Springs System pursuant to the City's water rights.
- Operations, improvements, and maintenance of the Clark Springs Facility and related infrastructure.
- Vegetation management on the Clark Springs property except within the Bonneville Power Administration (BPA) transmission line right-of-way and easement.
- Operation and maintenance of the Parshall Flume and USGS gaging station (No. 12118400).
- Wildlife management within the Clark Springs Facility for the purpose of protecting and enhancing the quality of the water supply.
- Maintenance, improvement, and replacement of the electrical, control, and telemetry equipment.
- The delivery and storage of chemicals, the chemical treatment processes and the operation, maintenance, replacement and improvement of equipment, conduit, piping, and sampling infrastructure required to monitor and treat the City's water supply.
- The maintenance and replacement of stormwater conveyance, control, and distribution facilities.
- Installation of monitoring wells along the eastern boundary of the Clark Springs property to monitor groundwater quality in order to detect contamination that might impact City water supplies.

2.4.1.3 Mitigation Measures Under the No-action Alternative

Under the No-action Alternative the City would not implement the proposed HCMs, though its existing voluntary augmentation program could be continued at the City's discretion.

To minimize the potential for take of listed species from water supply activities, the City may continue its conservation and demand management programs, and continue to identify existing water rights that could be put to beneficial use without affecting listed species.

2.4.2 Alternative B: Proposed Action

Summary Description: Under Water Withdrawal Alternative B (the Proposed Action), the City would receive ITPs from the Services authorizing incidental take of listed species, and would implement the proposed HCP. Covered activities would include the operation and maintenance of facilities at the City's Clark Springs System, and the implementation of conservation measures contained in the HCP. The ITPs and the HCP would run concurrently and be in effect for 50 years.

The Proposed Action is described in detail in the proposed HCP, which is hereby incorporated in its entirety by reference. Under the Proposed Action, the Services would issue ITPs for nine species, including three species currently listed under the ESA as threatened (Table 1.1-1). The City would implement an HCP designed to minimize and mitigate the effects of any anticipated incidental take of the nine covered species. The City would receive incidental take coverage for the three listed species immediately upon issuance of the ITPs. For the six unlisted species, the ITPs would have a delayed effective date and would become effective only upon future listing.

2.4.2.1 Water Supply and Operations Under the Proposed Action

The water withdrawal operations under the Proposed Action would be the same as described under the No-action Alternative except for augmentation flows pumped from the Clark Springs Facility into Rock Creek as described in Chapter 4 of the proposed HCP.

2.4.2.2 Clark Springs Facility Maintenance and Improvements

In addition to the facility maintenance and improvement activities described under the No-action Alternative, the City would also conduct the following activities:

- Operations, maintenance, replacement, monitoring, and improvements to the augmentation system. This includes relocating the augmentation system; maintaining, adding to, and/or replacing all augmentation infrastructure as needed.

- Relocation of the augmentation discharge point downstream from its current location to a point near the Parshall Flume.

2.4.2.3 Fish Mitigation Measures under the Proposed Action

The City would implement eight specific HCMs as part of the Proposed Action that are intended to enhance habitat conditions for fish affected by the operation of the Clark Springs System. A summary of the HCMs is provided below. A full description of the City's HCMs is included in Chapter 4 of the proposed HCP.

HCM-1 Flow Augmentation Plan: The City would augment flows in Rock Creek downstream of the Clark Springs System from October 1 through December 31, with variations in the amount of augmentation required based on a wet, normal, dry, or drought year. Under the City's adaptive management program, the 3-month augmentation period may be adjusted by up to 2 weeks if a substantial shift in Chinook salmon spawning timing in the Cedar River occurs. The amount of water diverted from water supply to augment surface flows under HCM-1 would vary depending on the deviation of the 2-month antecedent precipitation period from normal hydroclimate conditions as shown in Table 2.4-1. Augmentation would occur by pumping water from the clear well located at the Clark Springs System into Rock Creek. Augmentation pumping reduces water withdrawals to the water supply transmission pipe by approximately the same amount as the amount pumped for augmentation to the stream.

Table 2.4-1 Augmentation levels and target instream flows for HCM-1.

Hydroclimate Type	Maximum Augmentation (cfs)	Minimum Target Flow Level (cfs)
Wet	2.5	3.5
Normal	2.0	3.0
Dry	1.75	2.75
Drought	1.5	2.5

Source: City of Kent, 2006

HCM-2 Passage Improvements at Mouth of Rock Creek – Reach 1: The City would construct a fish passage improvement project by modifying the Rock Creek channel at the mouth of Rock Creek where it enters the Cedar River. The project would provide increased water depth during low flows, and overcome perching created by the lower flows in the Cedar River.

HCM-3 Wetland Improvement and Juvenile Salmonid Habitat Enhancement – Reach 1: The City would construct a habitat enhancement project intended to connect a small wetland-pond complex located immediately west of Reach 1 of Rock Creek to the main creek channel. The connection of the wetland complex with Rock Creek would create and make available off-channel rearing and flood refuge habitat that can be used by juvenile salmonid species covered under the ITPs.

HCM-4 Wetland Improvement and Juvenile Salmonid Habitat Enhancement – Reach 2: The City would construct a habitat enhancement project intended to enhance the quality of the existing wetland habitat and create additional off-channel habitat within a small wetland-pond complex adjacent to Reach 2. The wetland-pond complex would be improved by excavating the organic material to a depth of around 2 to 4 feet, constructing an island in the center of the pond that would support trees and shrubs and provide increased shade, and by placing pieces of large wood in the excavated pond to provide cover for juvenile salmonids.

HCM-5 Summit-Landsburg Road Culvert Replacement – Reach 8/9: The City would upgrade the existing Summit-Landsburg Road stream-crossing structure to a condition that meets Washington Department of Fish and Wildlife (WDFW) fish passage criteria as described in WAC 220-110-070. The existing culverts at the Summit-Landsburg Road do not meet current WDFW fish passage criteria, which are intended to provide free and unimpeded passage for adult and juvenile fishes (Washington Department of Fish and Wildlife 2003). Within 10 years of issuance of the ITP, the City would upgrade these culverts to meet WDFW fish passage criteria. Construction activities under HCM-5 may require additional consultation under ESA if other Federal permits are required.

HCM-6 Large Wood Placement – Reach 10 and 12: The City would fund a habitat enhancement project intended to increase the quantity of salmonid holding, rearing, and spawning habitat in the upper segments of Rock Creek via selective placement of large wood. The large wood would be placed in Reaches 10 and 12 of Rock Creek, which are both located within the Clark Springs Facility. The large wood would be placed in a manner that concentrates moderate to high flows, enhancing local scour of fine sediment from the channel bed, thereby promoting pool formation and spawning gravel deposition in proximal areas.

HCM-7 Water Conservation Program: A complete description of the City's Water Conservation Program is provided in Subsection 2.2.3.1, City of Kent Water Conservation Program. HCM-7 is not a covered activity under the ITPs.

HCM-8 Riparian Acquisition, Easement, and Enhancement Fund in Rock Creek Basin: The City would establish a habitat fund that would be used on mitigation/restoration projects to benefit the covered species in the HCP and improve water quality within the Rock Creek basin. The Habitat Fund would dedicate $600,000 in years 6 through 15 of the HCP with a minimum annual payment of $210,000 per year. The remaining balance shall be adjusted 3 percent per year from the year in which the ITPs are signed. The balance of the Habitat Fund, if any, shall be paid in year 15.

2.5 Alternatives Considered but not Analyzed in Detail

THE INFORMATION IN SECTION 2.5 AND ITS SUBSECTIONS WAS REVISED EXTENSIVELY SINCE THE DEIS WAS PUBLISHED AND REFLECTS CHANGES TO THE DEIS FROM THE PUBLIC COMMENT PERIOD

Five alternatives to the Proposed Action were raised during scoping, and were re-addressed following the Draft EIS comment period, in addition to the programs previously considered by the City (Subsection 2.2.3, Existing Water Conservation and Demand Management Programs). Four of these alternatives suggested other means by which the City could meet its future water demand needs and reduce its water withdrawals from Rock Creek to meet the requirements of the ESA. Two of the alternatives suggested during public scoping focused on identifying additional water sources that could augment the City's water supply. The first of these alternatives suggested acquiring water supplied by other regional water purveyors. The second suggested the City could identify available surface and groundwater rights in the area that could be purchased by the City to augment its supply. A third alternative identified during public scoping considered the potential for the City to acquire sufficient water from other sources to allow the Clark Springs Facility to be closed completely. A fourth alternative identified during public scoping suggested reusing water to replace or augment water supplies in specific applications. A fifth alternative identified during public scoping suggested limiting the term of the ITPs to no more than 20 years. These alternatives are discussed in Subsections 2.5.1 through 2.5.5, (Regional Water Supply Purchases through Shorter Permit Term).

In summary, four of the five alternatives were not analyzed in detail in this EIS because they do not meet the purpose and need. They would not produce reliable water sources with sufficient excess capacity to augment or replace withdrawals at the Clark Springs Facility during the low-flow periods between October 1 and December 31 to a level that would meet the City's current and future water demands. The period of October 1 to December 31 is the time period shown to be when the lowest flow in Rock Creek occurs (Figure 3.6-3) and is the peak spawning period for anadromous fish (Figure 3.8-1). For the fifth alternative, which considered a shorter permit term, the Services determined that the environmental impacts between a 20-year and 50-year term would not differ, and that an analysis of a shorter permit term in this EIS would not garner additional information to make an informed decision regarding impacts to the listed species or surrounding environment.

The City's Water Conservation Program is discussed in Subsection 2.2.3, Existing Water Conservation and Demand Management Programs. The City's Water Conservation Potential Assessment showed that water conservation alone would not conserve enough water to allow the City to augment or replace withdrawals at the Clark Springs Facility to a level that would meet the City's current and future water demands. Therefore, the City's Water Conservation Program is not listed as an Alternative Considered but Not Analyzed in Detail because it is considered to be an integral part of the No-action Alternative and the Proposed Action as well as part of each of the Alternatives Considered but Not Analyzed in Detail (Subsection 2.5).

The City's recent water demand has declined due to conservation, water use efficiency, and poor economic conditions. Demands will increase during the ITPs permit term as a result of growth and higher densities due in part to goals and requirements of the Washington State Growth Management Act. An improved economy will lead to a decrease in building vacancies and an increase in demand. Water system plans must be prepared every 6 years and will continue to update the City's short- and long-term demand projections (i.e., minimum 6 and 20 years, respectively) based on evolving land use trends, economic conditions, Growth Management Act requirements, and other appropriate factors required by law (RCW 43.20, WAC 246-290-100). Under any circumstance, the City intends in future years to meet its legal obligations and operational needs to effectively plan for and meet the long-term water demands of its commercial, residential, and industrial customers.

2.5.1 Regional Water Supply Purchases

Assessing the viability of acquiring water supply from adjacent and regional supply systems has been a constant feature of the City's water supply planning and system operations. As noted in the City's 1992 water system plan, it has in the past acquired firm annual supply, via existing water supply infrastructure, from the cities of Tukwila and Renton, and from the Highline Water District (Water District 75). Water supply from these purveyors is no longer available to the City as firm annual supply, as described in the HCP, Appendix G, Clark Springs Water Supply System Habitat Conservation Plan Operational Constraints White Paper. Many municipal suppliers in the Seattle area are seeking long-term reliable water supplies for purchase rather than developing and permitting new supplies, which have become increasingly difficult, if not impossible, to develop. This is due in part to environmental constraints, regulatory obstacles, and source limitations.

Aside from the systems described above, the City has examined opportunities with other regional purveyors to acquire new, firm, annual supplies. That investigation has focused on three adjacent and regional water purveyors that serve municipal water supply in southern King County: City of Tacoma, City of Seattle, and the Cascade Water Alliance. Each of these candidate sources was evaluated for yield, potential development costs, and regulatory feasibility. The City of Seattle and the Cascade Water Alliance been eliminated from future consideration because water from these sources is available only when authorized by the respective purveyor during short-term emergency situations, or, in the case of the Cascade Water Alliance, water rights have not yet been issued and any treatment/conveyance systems are only conceptual. These outside sources are not considered to be dependable or "firm" water supplies that the City could rely upon to meet its water demand needs and to reduce its water withdrawals from the Clark Springs Facility.

The term "firm water supply" means reliable, uninterrupted water in perpetuity or for as long as the water system and the contractual obligation to the customer base exist. The necessity of having long-term, reliable water supplies is critical to the viability and the future of any water purveyor, including the City, because of the ramifications on municipal and business planning. A key element of the City's municipal water system is the necessity of providing water to the City's business customers, who often develop substantial long-term business plans and investments based on the certainty that the City is obligated to provide water to them in perpetuity or for so long as the City water system is in existence. In addition, municipal water systems such as the City's must engage in planning for water supplies for future development needs and often must obtain capital funding through long-term bond sales (conditioned on the certainty of the water supplies) for mandated system replacements and improvements, which are all planned for and fully dependent upon water supplies that are reliable for 100 years and beyond. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.1.1 City of Tacoma: Second Supply Pipeline Project (TSSP)

The TSSP project provides the City of Tacoma, Lakehaven, Covington Water District, and the City of Kent with a second water supply pipeline by diverting water from the Green River. The TSSP is regulated by strict instream flow limitations set through negotiations with the State and the Muckleshoot Indian Tribe. The City completed the necessary infrastructure improvements to receive TSSP water in 2008.

In 1985, the City contracted with the City of Tacoma to acquire a capacity share of the storage, treatment, and conveyance project of up to 7.2 mgd for approximately 90 days (2,200 acre-feet) as available each year between June and August from the proposed TSSP project. This volume was increased to 12.64 mgd (3,850 acre-feet) in 2002 when the City and the other remaining project participants equally split the City of Seattle's share after the City of Seattle was no longer a participant in the project.

Although the City's share of the TSSP water has increased, this source remains subject to intermittent seasonal precipitation, flow inputs, and flood management constraints that affect the quantity and quality of water available for storage behind the Howard Hanson Dam. These limitations contribute to variability in the time of delivery to the City and other partners, except for the City of Tacoma, which in turn affects the reliability of this source. For the City of Tacoma's water supply only, the North Fork Wellfield water supply system is used to begin to dilute highly turbid surface water from the Howard Hanson storage reservoir when it exceeds 3.5 Nephelometric Turbidity Units (NTUs), and ramps up to fully dilute the turbid surface water to avoid exceeding the Washington Department of Health's (DOH) Maximum Contaminant Level (MCL) threshold for turbidity of 5 NTUs. The City, and the other two junior project partners, do not have access to groundwater from the North Fork Wellfield and so will not receive the water used for dilution; therefore, during periods of fall, winter, and spring turbidity, the TSSP becomes unavailable to the City and the other two project partners.

An analysis of more than 20 years of historical turbidity levels in the Green River system shows that turbidity levels during the months of June, July, and August have been reliably below MCL levels, with occasional exceedances following precipitation events. Turbidity levels in the Green River during the months of September through May have been shown to be more likely to be above MCL thresholds. Based on these historical turbidity levels, the City would not reliably expect to receive water supplied by the TSSP other than during the months of June through August, with some potential for interruption even during these months.

Although the City of Tacoma is now proposing to construct a facility to filter its TSSP surface water source to remove cryptosporidium and reduce algae, manganese, and turbidity, the proposed facility has yet to be designed, permitted, or constructed. Once constructed, in an effort to reduce costs, TSSP yield will be constrained by a filtration system capable of filtering only a portion of the system capacity during turbidity events. As a result, the City's TSSP supply will still be subject to intermittent and/or variable flows, particularly during fall and winter months. Under any circumstance, filtration of the TSSP surface water will have little effect on the variability of the TSSP water that can be predictably stored and released by the Howard Hanson Dam for use by the City and other TSSP partners.

For these reasons, water supplied to the City by the TSSP would not be able to meet the City's water demand needs for the months of September through May, thereby allowing the City to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.1.2 City of Seattle/Seattle Public Utilities

The City of Seattle, as represented by Seattle Public Utilities (SPU), and the City have discussed potential opportunities for the City to secure additional water during the summer months until the TSSP project is constructed. The City funded and constructed an emergency intertie with Soos Creek Water and Sewer District that provides the opportunity to receive emergency SPU water via bridging across Soos Creek's distribution system. However, SPU does not have sufficient firm, long-term surplus capacity to meet the City's water demand needs and to allow the City to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December, while continuing to meet the needs of SPU's retail and wholesale customers, the Cascade Water Alliance (Subsection 2.5.1.3, Cascade Water Alliance), and to also comply with the conditions of its HCP that regulates its diversions from the Cedar River.

On June 12, 2006, SPU's Cedar River supply was further constrained when the Seattle City Council unanimously approved a Settlement Agreement with the Muckleshoot Indian Tribe. One element of this agreement was the establishment of a water trust for the Cedar River. SPU agreed to transfer the portion of its perfected water right claim that exceeded 124 mgd (annual average) to the State Water Trust for the purpose of providing instream flows. Combined, SPUs obligations constrain the use of SPU's sources and system capacity to serve new customers such as the City. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.1.3 Cascade Water Alliance

The Cascade Water Alliance is a consortium of King County cities and water districts. Its members include the cities of Bellevue, Issaquah, Kirkland, Redmond, Tukwila, the Covington Water District, the Sammamish Plateau Water and Sewer District, and the Skyway Water and Sewer District. Their mission is to meet the current and future water needs of their members by purchasing wholesale water from other regional suppliers, coordinating conservation and supply management, and acquiring, constructing, and managing water supply infrastructure.

With the exception of relatively small independent supplies developed by some of its members, to meet its immediate and long-term needs the Cascade Water Alliance is largely dependent on purchasing water from such large regional wholesale providers as the cities of Seattle and Tacoma. Consequently, the Cascade Water Alliance has insufficient independent water supplies to make available on a wholesale basis to other purveyors. The Cascade Water Alliance's plans are to assume responsibility for the distribution of SPU water to its members beginning in 2012.

Over the past 10 years, the Cascade Water Alliance has worked to secure approval from Ecology to develop Lake Tapps as a water supply source. In September, 2010, Ecology issued final Reports of Examination (ROE) recommending approval to storage and water supply permits that will enable the development of Lake Tapps as a municipal water supply source (Department of Ecology 2010). The ROEs were issued based in large part on an Ecology finding that although the proposed diversions and storage project would affect a surface water closed by administrative rule (WAC 173-510-030(4), "overriding considerations of public interest" would be served because the project was unlikely to impair existing flows, would improve prior instream flow and fishery conditions, and would preserve Lake Tapps recreational uses, among other substantial environmental and regional benefits. Determinations of overriding considerations of public interest, which occur only in rare circumstances, authorize Ecology to approve new appropriations to surface waters that are closed and/or not meeting minimum flows set by administrative rule (RCW 90.54.020(3)).

Upon the successful completion of the ROE appeal period, the Cascade Water Alliance will be issued new storage and municipal water right permits. Although the Cascade Water Alliance is expected to secure such permits by the end of 2010, the facility development schedule established by Ecology in the ROE does not require the project's treatment and delivery facilities to be completed until 2040 at the earliest. Further, the ROE does not anticipate that actual beneficial use of the water will occur prior to the period from 2050 to 2055 based on the Cascade Water Alliance's own demand projections and wholesale supply agreements.

As a consequence of the Cascade Water Alliance's prolonged project development schedule, its impending transactions with the Cities of Seattle and Tacoma to secure an additional 30 mgd of wholesale water supply, and its financial interest in delaying capital project costs, it appears improbable that Lake Tapps water supply will be available for beneficial use prior to 2050. Because of these circumstances, timelines, and supply uncertainties, the Cascade Water Alliance would not be considered a reliable source of water that the City could rely upon to meet water demand needs and to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.1.4 City of Auburn

The City of Auburn is located directly south of the City and has sufficient water supplies to meet its projected demands until 2015 (City of Auburn 2009). Unfortunately, Auburn has been unsuccessful in acquiring new primary water rights from its Valley Production Aquifer. Because of this, Auburn's ability to meet future water demands beyond 2015 is in jeopardy and thus is not considered to be a dependable water supply that the City could rely upon to meet its water demand needs and to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.2 Water Right Changes

Changes to water rights include changes in place of use, purpose of use, and points of diversion or withdrawal. Changes to water rights also include establishing additional points of water diversion or withdrawal.

2.5.2.1 Transfer of Other Existing Water Rights

Washington State water law allows the transfer of existing rights as long as such transfer does not cause detriment or injury to other existing water bodies, including minimum flows established by rule. The City considered obtaining additional water by acquiring and transferring existing water rights to either existing sources or new sources in the vicinity of the City's service area. To this end, the City has identified and investigated irrigation and other water rights located within and outside its service area to determine opportunity for purchase, quantities available for transfer, and the underlying legal viability of the water rights. The City also evaluated opportunities to secure municipal supply via interties from neighboring systems holding independent water supplies.

In the course of this effort, the City was unable to identify any existing active water rights within a reasonable distance of the City's service area that would provide a sufficient quality and quantity of water to be of value to the system. As a result of these findings, the acquisition and transfer of existing water rights as a means of supplementing the City's water supply was not considered a reasonable or practicable alternative that the City could rely upon to meet its water demand needs and reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.2.2 Acquiring Additional Surface Water Rights

The City considered acquiring additional surface water rights from the Green River and the Cedar River but has been deterred from securing such rights due to environmental and regulatory obstacles. Both the Green River (173-509 WAC) and the Cedar River (173-508 WAC) are subject to minimum instream flow rules that effectively preclude all new surface water withdrawals, unless related effects can be fully mitigated or occur during high flows in winter months that exceed prescribed minimum flows. Further, virtually all tributaries to the Green and Cedar Rivers are closed to new appropriations by Washington administrative rule (173-509 WAC/173-508 WAC). In addition, HCPs have been developed for the Green and Cedar Rivers by the Cities of Seattle and Tacoma, respectively, which prescribe instream flow, fishery habitat, and water quality conditions that are vigorously enforced to meet ESA requirements.

In addition to evaluating the prospect of securing new surface water rights, the City has investigated the viability of developing new primary/additive groundwater rights in the Green and Cedar River Basins. The City, however, has been unable to successfully pursue such rights. This is because the same instream flow rules governing surface water diversions from the Green and Cedar Rivers also effectively prohibit new groundwater appropriations that are in hydraulic continuity with these river systems, as well as their closed tributaries (WAC 173-509/WAC 173-508).

Due to regulatory limitations on securing new water rights to the Green River, the Cedar River, and their tributaries, and the potential impairment risk of City of Seattle and City of Tacoma water rights and HCP conditions, the development of new surface and/or groundwater rights was not considered a viable alternative that the City could rely upon to meet its water demand needs and to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.2.3 Construct an Additional Storage Facility

An alternative was suggested whereby the City would construct a water storage facility that could store water from the Clark Springs System during high-flow months (winter) that could then be drawn on during low-flow months (summer), allowing the City to reduce withdrawals from the Clark Springs System during the summer.

In order to divert water to an additional storage facility, the City would have to rely on adequate rainfall during the winter months to produce high flow volumes. The flows would have to be high enough to allow the City to 1) provide enough water to meet its municipal water obligations during the winter months; and 2) divert enough water to the storage facility to compensate for the amount of water provided by the Clark Springs Facility during the summer months. In the course of investigating this option, the City evaluated the feasibility of locating a storage facility on City-owned property. This effort, which included conducting detailed hydrologic, hydrogeologic, seepage, and other analyses, determined that seasonal variations in precipitation could not ensure sufficient flow from the City's existing water rights to achieve the desired storage volumes. Consequently, it was found that this alternative was an unreliable source of supply option.

This finding led to a determination that the City could not rely upon the proposed storage facility to meet its water demand needs and to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.3 Acquire Water from Other Sources and Close the Clark Springs Facility

Because the City could not identify and/or acquire a reliable ground, surface, or storage water source with enough excess capacity to augment withdrawals at the Clark Springs Facility to a level that would ensure adequate water supplies, let alone replace it completely, this alternative was determined to be unable to reliably meet the City's water demands. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.4 Reuse of Water

Water reuse is an option that is increasingly being evaluated as a water supply alternative to replace or augment water supplies in specific applications. The City has considered various means of utilizing water reuse to meet future demand needs. Subsections 2.5.4.1, Wastewater Reuse, and 2.5.4.2, Stormwater Reuse, provide an explanation of why water reuse is not seen as a reliable source of water that would allow the City to meet its water demand needs and to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, none of the options described below would meet the purpose and need for the action (Subsection 1.2., Purpose and Need for the Proposed Action).

2.5.4.1 Wastewater Reuse

The concept of wastewater reuse is still in its infancy in the Puget Sound region. While a great deal of discussion has occurred among State and local agencies, actual implementation of wastewater reuse on a large regional scale is uncertain to occur. Such uncertainty is due to the high cost of wastewater reuse facilities, the unavailability of reclaimed water during high demand periods, and new regulations proposed by Ecology relating to the reclamation and reuse of both inland and marine wastewater discharges (173-219 WAC: Reclaimed Water Permitting and Use). As discussed below, a further limiting factor affecting this option is that King County has interpreted its METRO sewer disposal contract with the City as precluding the City from intercepting effluent generated within its corporate boundaries for purposes of reclamation and use within the City or elsewhere.

Any reclaimed wastewater used by the City would constitute a water withdrawal from either the Green or the Cedar Rivers. Because the Green River and its tributaries (173-509 WAC) and the Cedar River and its tributaries (173-508 WAC) are subject to minimum instream flow rules that effectively preclude all new surface water withdrawals, unless related effects can be fully mitigated or occur during high flows in winter months that exceed prescribed minimum flows, obtaining such a new surface water withdrawal is not possible at this time.

The City, as well as other local jurisdictions in King County, has investigated the feasibility of constructing scalping plants (small sewage treatment plants) within close proximity of the intended place of use to intercept and treat effluent that would otherwise be conveyed to a King County/METRO Treatment plant. Because effluent from the City and other METRO systems is discharged to marine waters, the reclamation of such water may not be subject to the impairment obstacles that are likely to impact wastewater reclamation. Further, such scalping plants could potentially reduce infrastructure costs to acceptable levels, subject to the availability of effluent flow on an annual basis. Thus far, however, King County/METRO officials have stated that scalping plants are not allowed under current contract conditions. Consequently, the City has been unable to develop this non-potable source of reclaimed water.

In addition to the obstacles cited above, historical concerns and constraints are inherent in the use of reclaimed wastewater (sewage) from the public and other entities. Ongoing concerns about the contaminant effects of treated wastewater on groundwater, the effects of contact with potentially disease-causing organisms and substances on human and environmental health, and long-term effects of pharmaceuticals and other substances in the reclaimed wastewater have not been resolved sufficiently to make reuse a long-term, reliable supply of potable or non-potable water.

King County has advocated for additional infrastructure that would allow reclaimed water from King County regional wastewater facilities to be sold back to cities for use in industrial areas, golf courses, and parks for irrigation. Potential costs and funding sources for the design and installation of the necessary infrastructure have not been identified. King County proposed some years ago that the City purchase treated Class A effluent from its Renton Wastewater Treatment Plant. The Renton Wastewater Treatment Plant, however, has yet to be upgraded to produce Class A effluent, which would be required in order to serve most non-potable uses. Under any circumstance, the City was recently advised by King County that the reclaimed water that King County may produce by upgrading the Renton facility will be used to serve the adjacent Cities of Renton and Tukwila.

King County issued a Reclaimed Water Planning Process Project Update on September 16, 2010, wherein the number of proposed strategies was narrowed from seven to three. The remaining strategies to be explored include reclaimed water treatment using small preassembled reclaimed water treatment facilities, but the strategies which included specific centralized and decentralized treatment plants or distribution in the City or in the Rock Creek Watershed have been removed from further consideration.

Because the region must still resolve many of the legal and logistical issues related to wastewater reuse, the City considers wastewater reuse an unreliable water source and unable to meet the City's water demand needs and to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.4.2 Stormwater Reuse

In the Green River Valley, the City operates a large stormwater treatment system, known as the Green River Natural Resources Area, which collects runoff from approximately 830 acres of developed area within the City and overflow from Mill Creek to control flooding and provide treatment. The City's stormwater treatment system consists of constructed wetlands designed to remove urban pollutants, followed by development of a retention lagoon. Treated runoff and overflow are then discharged back to Mill Creek under controlled release rates. The volume of stormwater that is discharged and potentially available for reclamation is highly variable and uncertain during the months of August, September, and October due to high ambient temperatures and low precipitation, leading to reduced and variable stormwater collection volumes.

The City currently has no water right to divert this stormwater, once biofiltrated, for any form of beneficial use, and the prospect of securing such a water right for reclamation purposes is highly unlikely because Mill Creek, as a tributary to the Cedar River, is closed by administrative rule to new appropriations (173-509 WAC).

Because of the fluctuations in the amount of water available during the months of August, September, and October, the lack of water rights for stormwater, and impacts to streamflows and wetland hydro-periods, this alternative would not allow the City to meet its water demand needs and to reduce its water withdrawals from Rock Creek during low-flow periods of October, November, and December. Consequently, this option would not meet the purpose and need for the action (Subsection 1.2, Purpose and Need for the Proposed Action).

2.5.5 Shorter Permit Term

Limiting the term of the ITPs to no more than 20 years was suggested as a potential alternative during the public scoping process. Operations at the Clark Springs Facility and the conservation measures implemented by the City would not differ from those during the proposed 50-year permit term under a shorter permit term. As such, the environmental effects of a reduced permit term would not differ, in a meaningful way, from the effects analyzed for the 50-year term of the Proposed Action. Such an analysis would not demonstrate measurable differences in impacts and, therefore, would not further inform the Services' decision makers about this Proposed Action.

Long-term, reliable water supplies are critical for the viability and the future of the City's water system. A key element of municipal water systems is the necessity of providing water to business customers who often develop long-term business plans and investments based on the certainty that the purveyor is obligated to provide water in perpetuity, or so long as the water system is in existence. In addition, municipal water systems must engage in planning for water supplies for future development needs and often must obtain capital funding through the issuance of long-term bond sales (conditioned on the utility's ability to provide a certain revenue stream for repayment, which is predicated on the utility's ability to supply water) for mandated system replacements and improvements. Such mandated system replacements and improvements are based upon future plans and are fully dependent upon reliable long-term (a minimum of 50 years) water supplies. The development of new or replacement water supplies has taken 30 to 40 years in the past, and with current regulatory, financial, and environmental constraints, that timeline is likely to extend. As such, a shorter permit term would not provide the certainty that the City needs for the reliability of the Clark Springs water supply.

Furthermore, a shorter permit term would assure conservation benefits for less time and with less certainty of being extended after the 20-year ITP term ends. Although the Services have not yet prepared Biological Opinions or ESA findings to support their ITP issuance decisions, the EIS and HCP analyses of potential impacts on the aquatic environment indicate there is low potential for serious adverse effects on covered species. Based on analyses in the EIS and HCP, the proposed set of conservation measures would provide substantial local environmental benefits for covered species and aquatic biota. Therefore, a longer permit term, which allows conservation benefits to accrue for more years, is favored over a shorter term. Against this expected accrual of conservation benefits, the potential for unforeseen circumstances should be considered, and the degree to which future management of the conservation measures may need to be changed to address seriously adverse unforeseen circumstances.

Because the EIS analyses and supporting documents indicate that proposed conservation measures generally have a high likelihood of effectiveness, there is little need to develop a comprehensive and detailed plan for adaptive management. The proposed responses by the City to changed circumstances (Subsection 2.1.2.3 of the HCP), the relatively small geographic area of the HCP, and the absence of identified potential unforeseen circumstances, aside from geologic calamity, suggest there is low potential for serious adverse effects from unforeseen circumstances. An analysis of differences in effects expected under a 20-year term versus a 50-year term based on unforeseen circumstances is not provided in this EIS since this analysis would be speculative. Additionally, the risk of unforeseen circumstances is balanced by the need for a sufficient period to implement the HCMs for species conservation benefits.

Before issuing the ITPs to the City, the Services must conclude that the proposed HCP meets ESA section 10 criteria under the proposed 50-year permit term and includes an analysis of expected effects over the full permit period. If the ESA determination concludes that all section 10 criteria are met with a 50-year permit term under the proposed HCP, greater conservation benefits would accrue over a longer permit term. Since the environmental impacts would not differ between a 20-year and 50-year term, an analysis of a shorter permit term in this EIS would not garner additional information to make an informed decision regarding impacts to the listed species or surrounding environment.

3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This section describes current conditions of resources that may be potentially affected by implementation of the alternatives. Eleven environmental resources are described:

- Land Use and Ownership (Subsection 3.2)
- Geology and Soils (Subsection 3.3)
- Air Quality (Subsection 3.4)
- Noise (Subsection 3.5)
- Water Quantity and Water Quality (Subsection 3.6)
- Vegetation (Subsection 3.7)
- Fish and Aquatic Habitat (Subsection 3.8)
- Wildlife (Subsection 3.9)
- Historic and Cultural Resources (Subsection 3.10)
- Socioeconomics (Subsection 3.11)
- Environmental Justice (Subsection 3.12)

For the purpose of clarity, the description of the affected environment for several of the resources is divided into two separate subsections as follows:

- The City's 320-acre Clark Springs Facility.
- The lower 2.6 miles of Rock Creek to its confluence with the Cedar River, as well as the adjoining properties downstream of the Clark Springs Facility to its confluence with the Cedar River.

3.1.1 Environmental Setting

The proposed ITP and HCP coverage area (action area) consists of: 1) the 320 acres of land that is owned by the City and collectively called the Clark Springs Facility; 2) Rock Creek, from the Clark Springs Facility to the confluence with the Cedar River; and 3) areas along Rock Creek where mitigation and restoration activities described in Chapter 4 of the proposed HCP would occur.

3.2 Land Use and Ownership

The land uses within the Rock Creek basin consist of mostly undeveloped forested areas with some low-density rural residential and commercial developments (Figure 3.2-1).

3.2.1 Clark Springs Facility

The Clark Springs Facility is located in the Rock Creek basin between RM 1.94 and RM 2.60. The Clark Springs Facility is comprised of three wells and a spring-fed infiltration gallery. The Clark Springs property was annexed to the City in 1958 for municipal water supply purposes and is bisected by Kent-Kangley Road. The Clark Springs Facility is 320 acres in size and is geographically separate from the City proper.

3.2.2 Lower Rock Creek

The King County Comprehensive Plan land-use designations along lower Rock Creek are for rural, residential, and forestry activities. The lower portion of Rock Creek flows through the Rock Creek Natural Area (RCNA) (RM 0.25 to RM 1.10), which has been owned by King County since 1995. The area below the RCNA was dedicated permanent open space through the King County 4:1 open space program with the development of the Maple Ridge Highlands subdivision located just south of the Clark Springs Facility (Figure 3.2-2). Several residential properties exist just downstream of the stream crossing of Summit-Landsburg Road and also at the mouth of Rock Creek.

Because the Cedar River is designated as a water body of statewide significance, the King County Shoreline Management Master Program regulates lands within 200 feet of the Cedar River Ordinary High Water Mark.

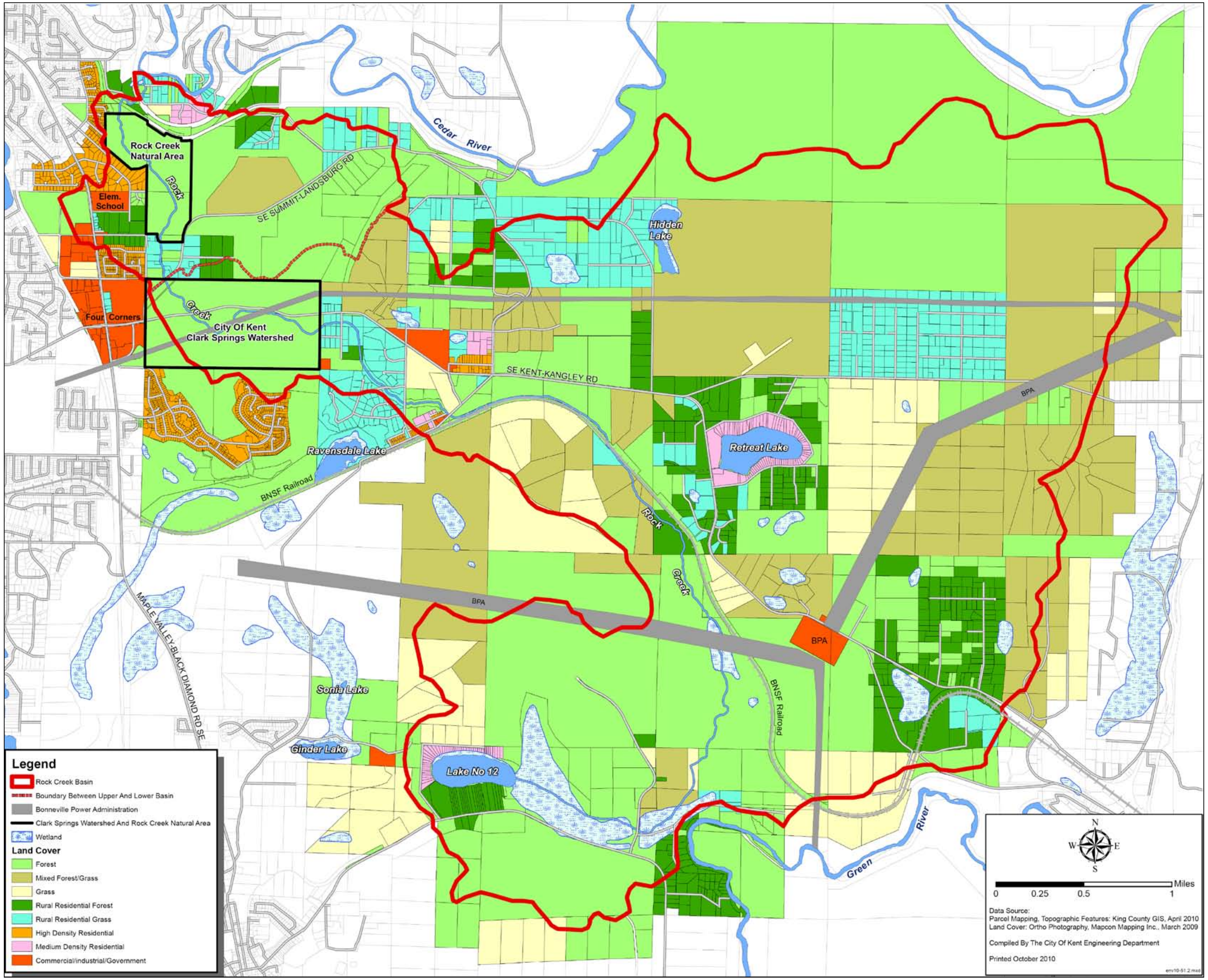


Figure 3.2-1 Land uses in the Rock Creek Basin.

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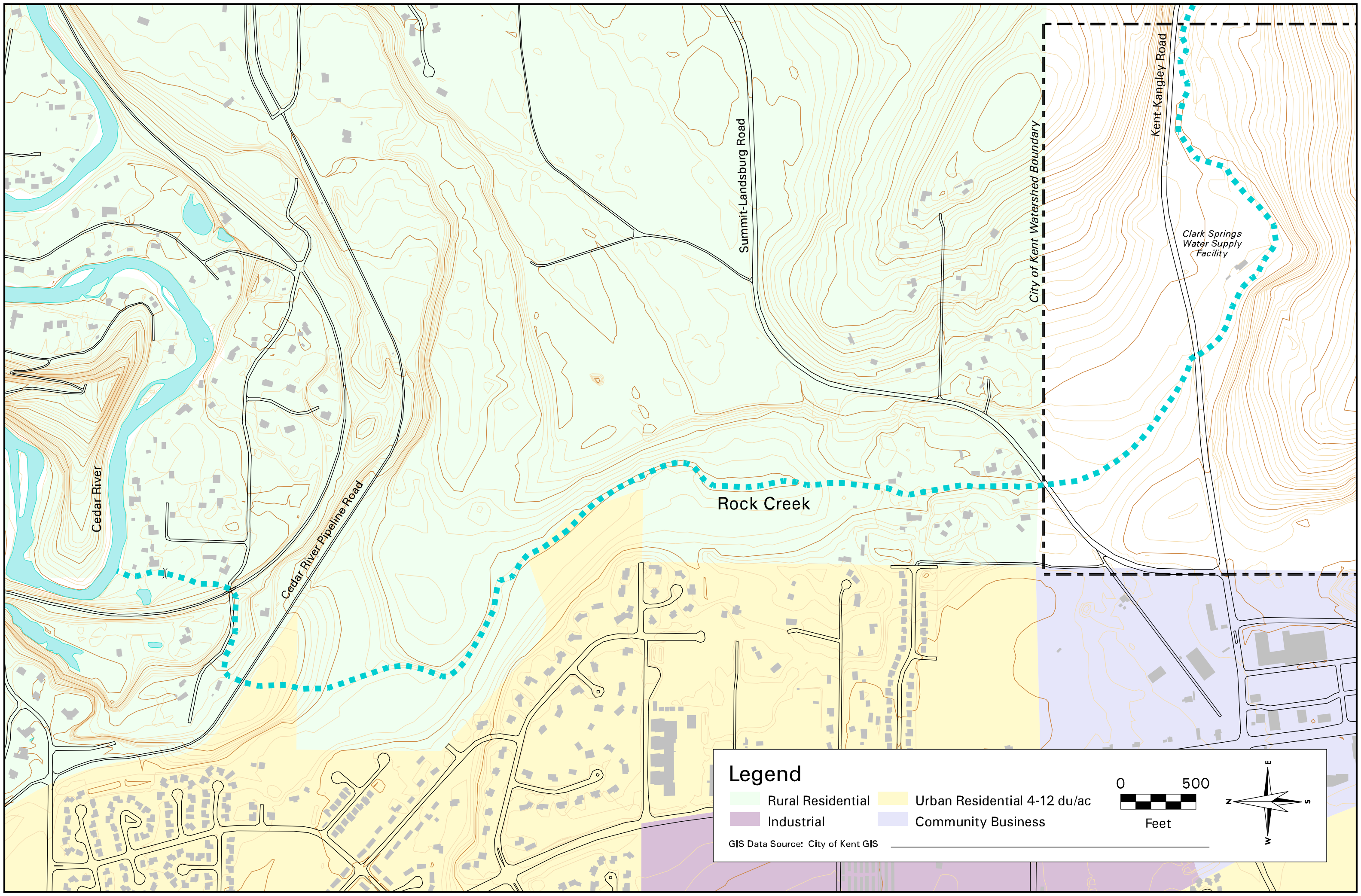

Figure 3.2-2 King County comprehensive plan map for Lower Rock Creek.

3.3 Geology and Soils

This subsection includes a discussion of the geology and soils found within the action area. Geology and soils are of particular concern because of potential impacts to the quality of drinking water and to fish habitat.

The action area falls within lands that are regulated by both the City's Critical Areas Ordinance and King County Critical Areas Ordinance (CAO). Both ordinances are in place to protect sensitive ecologic areas such as wetlands, shorelines, and streams, as well as geologic hazards including landslide, seismic, and erosion-susceptible areas. The Clark Springs Facility is regulated by the City with the remainder of the action area being regulated by King County.

The City designates erosion-hazard areas as areas with soils delineated in the "Soil Survey, King County Area, Washington" (USDA 1973) as having a moderate-to-severe, severe, or very severe erosion-hazard potential (Kent City Code, Chapter 11.06). King County code defines erosion-hazard areas as areas underlain by soils that include, but are not limited to, those classified as having a severe-to-very severe erosion hazard according to the King County Soils survey and any of the following soil types when they occur on slopes inclined at 15 percent or more:

- Alderwood gravelly sandy loam
- Alderwood and Kitsap soils
- Beausite gravelly sandy loam
- Kitsap silt loam
- Oval gravelly loam
- Ragnar fine sandy loam
- Ragnar-Indianola Association

3.3.1 Geology

The Rock Creek basin is located in the southeastern part of the Puget Sound Lowland, where it transitions into the foothills of the Cascade Range. The geology consists of Tertiary bedrock belonging to the Puget Group and dating from the Eocene to the Oligocene (between 24 million and 37 million years old). Sedimentary rocks in the Puget Group consist of sandstones and mudstones, a series of soft and relatively easily eroded rock that breaks into fines. The bedrock layer provided the base layer onto which depositions of unconsolidated sediments and glacial activity occurred. Bedrock in the Rock Creek basin is largely covered by Pleistocene~~Holocene~~ aged (approximately 12,000 years ago) glacial outwash deposits, and outcrops only sporadically throughout the basin, primarily in the vicinity of Sugarloaf Mountain to the southeast and Ravensdale Ridge to the southwest (Hart Crowser 2003a).

Episodes of glaciations in the Puget Sound Lowland began around 750,000 years ago, with glaciers up to 5,000 feet thick moving south from Canada over the underlying bedrock. Repeated glacial advances and retreats alternately deposited and then compressed sediments on top of the bedrock. The topography of the Rock Creek basin is largely a result of the Vashon Glacier. At its farthest extent, the Puget ~~Sound~~ Lobe of the Cordilleran Ice Sheet ~~lobe of the Vashon Glacier~~ extended just east of Sugarloaf Mountain, covering the upper Rock Creek basin and extending up the historic Cedar River to the north and the Green River to the south. Repeated surges of glacial meltwater and runoff during the glacial recession coursed through the Rock Creek basin, creating large outwash channels and re-depositing additional sediments to the area. These deposits have been found to comprise the majority of the northern Rock Creek valley plain; historic outwash channels are still visible in the surface morphology of the current landforms (Hart Crowser 2003a).

Lastly, topsoil and peat have accumulated on the glacial sediments. The peat in the action area is found near depressional wetlands and in the fully to partially saturated soils associated with marshes and perennial segments of Rock Creek. Figure 3.3-1 shows the geology of the Rock Creek basin.

3.3.2 Soils

Soil mapping materials used for analysis of the Rock Creek basin include the Soil Survey of King County Area (USDA 1973) and the Soil Survey of the Snoqualmie Pass Area, Parts of King and Pierce Counties (Goldin 1992). Table 3.3-1 lists the soil unit types found in the action area. The table provides the soil type, slope gradient, and soil erodibility. Erodibility (K) is based on the susceptibility of the soil to sheet erosion by water, and is shown as a factor between 0.02 and 0.69. The higher the value for K, the more susceptible the soil is to sheet or rill erosion by water.

Table 3.3-1 Soil unit types found in the action area.

Soil Type (Unit Name)	Slope Gradient (%)	Soil Erodibility
Alderwood gravelly sandy loam (AgC)	6 to 15	0.15
Alderwood gravelly sandy loam (AgD)	15 to 30	0.15
Everett gravelly sandy loam (EvB)	0 to 5	0.17
Everett gravelly sandy loam (EvC)	5 to 15	0.17
Everett gravelly sandy loam (EvD)	15 to 30	0.17
Seattle muck (Sk)	NA	0.02

Hills within the action area are composed of soils in the Alderwood series, moderately well-drained soils formed on dense glacial till or soils in foothill or valleys. These soils have a slow infiltration rate when thoroughly wet, but are not subject to flooding or ponding. Of the units found within the action area only Seattle muck is classified as hydric (USDA 1973). Alderwood gravelly sandy loam (6 to 15 percent) does have mapped hydric inclusions within the action area. The erosion hazard for these soils ranges from slight to severe, with slopes ranging from 5 to 30 percent (USDA 1973).

The Everett series is found mostly on terraces and formed in very gravelly glacial outwash deposits. This series is classified as having a high infiltration rate (low runoff potential) when thoroughly wet, consisting mainly of deep, well-drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission and are not subject to flooding or ponding. None of the included units is classified as hydric (USDA 1973). Erosion hazard can be slight to moderate with areas having steep slopes of 5 to 15 percent (USDA 1973).

Within the action area, the City has designated erosion-hazard areas within the Clark Springs Facility and King County has designated erosion-hazard areas at the mouth of Rock Creek.

Wetland areas such as Crow Marsh in the southwest portion of the basin and around other small lakes or wetland areas are mapped as Seattle muck, which is a very deep, poorly drained soil found in depressions in glacial outwash plains, and also in river and stream valleys. These soils are subject to ponding, but flooding is unlikely. This soil unit is classified as hydric (USDA 1973).

3.4 Air Quality

Air pollution control in Washington State is based on Federal, State, and local laws and regulations. The Clean Air Act (CAA), including the amendments of 1977 and 1980 (42 U.S.C. 7401, et seq.), is the Federal law designed to preserve air resources. Under the CAA's provisions, Congress requires implementation of various methods to accomplish national air-quality goals. Such methods include State Implementation Plans, deterioration prevention programs, and implementation of National Ambient Air Quality Standards.

The Puget Sound Clean Air Agency (PSCAA) is the regional agency chartered by Washington State law (RCW 70.94) to implement and enforce air-quality regulations for King, Kitsap, Pierce, and Snohomish Counties (the region).

According to the PSCAA, with the exception of fine particulate matter (PM2.5) (particulate matter less than 2.5 microns in size) and ozone, criteria air pollutant concentrations have fallen well below levels of concern within these counties. The region has been in attainment for all criteria air pollutants for almost a decade.

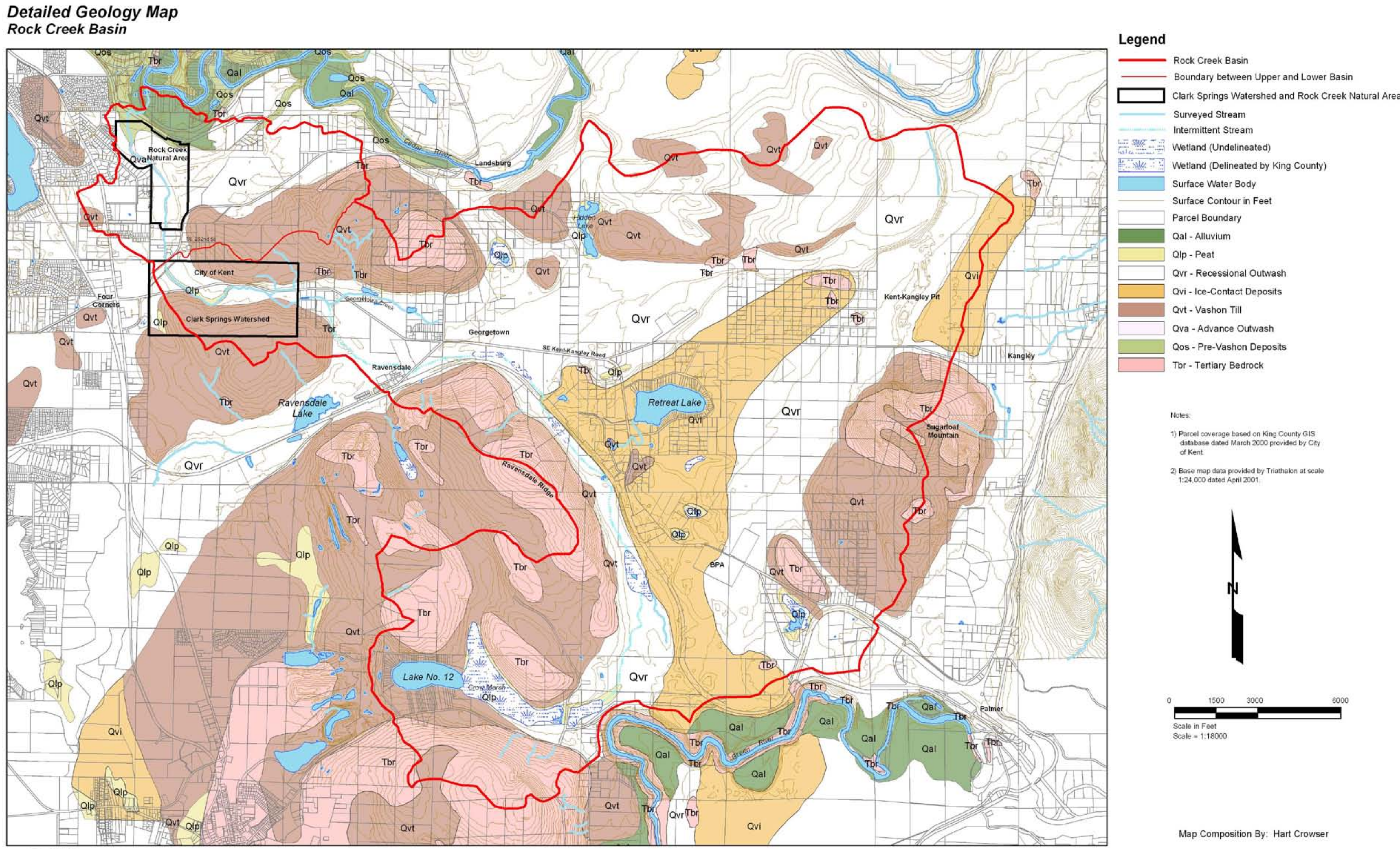

Figure 3.3-1 Geology of the Rock Creek Basin.

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The region has never violated the Federal standard for PM2.5, a main pollutant of concern in the Puget Sound area. Because of the adverse health effects of PM2.5, the PSCAA has established a health goal for PM2.5 and established monitoring sites in Snohomish, King, and Pierce Counties. These three counties continue to exceed the PM2.5 goal.

Vehicular traffic continues to be the greatest contributor to pollutant emissions in the region. The major contributors to PM2.5 emissions are outdoor and indoor burning.

3.5 Noise

Because no change to the City's daily operation of the Clark Springs System under the proposed HCP is expected, no change to noise levels is expected. Accordingly, a discussion of existing operational noise levels is not provided.

Construction activities within King County that have the potential to temporarily increase ambient noise levels are regulated by King County Code (K.C.C.). The K.C.C. states that construction activities may not exceed the maximum permissible sound levels based on the zoning district where the sound originates and on the zoning district of the noise receiver (K.C.C. 12.88.020).

3.6 Water Quantity and Water Quality

3.6.1 Surface and Groundwater Hydrology

The Rock Creek basin has a surface catchment area of 10,035 acres (approximately 15.7 square miles). Surface water bodies in the Rock Creek basin include Rock Creek and its tributaries as well as a number of small lakes (Figure 3.6-1). The following discussion is focused on Rock Creek because it is the only surface water in the Rock Creek basin expected to be potentially affected by the proposed alternatives; however, additional information is provided on other surface waters in the basin to provide context for the reader. The Rock Creek basin can be divided into the upper basin, which is characterized by intermittent surface flow, and the lower basin, which has year-round surface water flow. The upper basin comprises approximately 86 percent of the watershed. Several small tributaries drain into Rock Creek from the upper basin. Flow in these tributaries is intermittent, occurring only during wet periods.

Perennial flow in Rock Creek generally begins east of the Clark Springs Facility near RM 2.80 (near the 262nd Avenue SE Bridge), just downstream of the confluence with Georgetown Creek, and represents the upper end of the lower basin. Georgetown Creek is the largest tributary to Rock Creek. Flow in Georgetown Creek appears to originate 0.7 miles east of the confluence with Rock Creek, and is intermittent, occurring only under wet conditions. Downstream of RM 2.80, Rock Creek generally flows west then north, joining the Cedar River at RM 18.15.

Although it is located outside of the surface catchment of Rock Creek, Ravensdale Lake merits mention because of its critical role in interbasin groundwater loss, an important aspect of the hydrology of the

Rock Creek system. Ravensdale Lake is a groundwater-fed lake with a surface area of 18 acres and currently no direct connection to Rock Creek. The surface level of Ravensdale Lake is determined by the level of the water table.

An understanding of the significant hydrogeologic characteristics of the Rock Creek basin is needed to understand the potential effects of the Clark Springs Facility on the surrounding hydrogeology. The Rock Creek basin consists of unconsolidated glacial deposits on underlying bedrock (Figure 3.3-1). The underlying bedrock is generally of low permeability while the overlying glacial deposits are generally of high permeability. Since the surface soils are highly permeable, surface runoff rarely contributes to streamflow, but rather infiltrates and recharges the underlying groundwater. Percolating precipitation and runoff from the surrounding hills supply the recessional aquifer with the majority of its water. Interflow (subsurface flow that moves laterally through upper soil layers) reaching the valley floor from neighboring hillsides generally infiltrates to recharge the groundwater, except when the water table is already high, which results in interflow contributing directly to surface flow and runoff.

Groundwater in the Rock Creek basin flows from the surrounding hills over the underlying bedrock surface and into the shallow aquifer that underlies the valley floor. The aquifer has a high transmissivity with groundwater flow occurring across the sloping bedrock surface in a manner that is similar to surface runoff. At the eastern end of the valley, the aquifer picks up large quantities of recharge from outflow from Lake Twelve, runoff and interflow from the eastern flank of Ravensdale Ridge, outflow from Retreat Lake, and seepage from the perched groundwater system in the ice-contact deposits around Retreat Lake. From the available hydrogeologic information, Hart Crowser (2003a) concluded that a substantial amount of groundwater flows down the Ravensdale outwash channel, out of the Rock Creek catchment, and into the Green River basin. Groundwater remaining in the aquifer continues to flow westward into the narrow valley occupied by the Clark Springs Facility. In addition, there is an indication of a shallow bedrock ledge or a till-mantled saddle present beneath the surface of the watershed, up-gradient of the Clark Springs Facility and near the eastern edge of the City's property (Hart Crowser 2003a) (RM2.8 near the 262nd Avenue SE bridge).

The unique geologic features of the Rock Creek basin, primarily the large amount of glacial outwash above bedrock, have a major influence on the surface water hydrology of Rock Creek. The highly permeable recessional outwash channels extending across the basin in a generally east to southeast direction form shallow surficial aquifers and serve as preferential groundwater flow paths. Rainfall and surface runoff that deposit across the permeable recessional outwash rapidly infiltrate and recharge the aquifer. The less-permeable underlying bedrock forms an effective base for the shallow aquifer system, providing a boundary that prevents deeper absorption of groundwater.

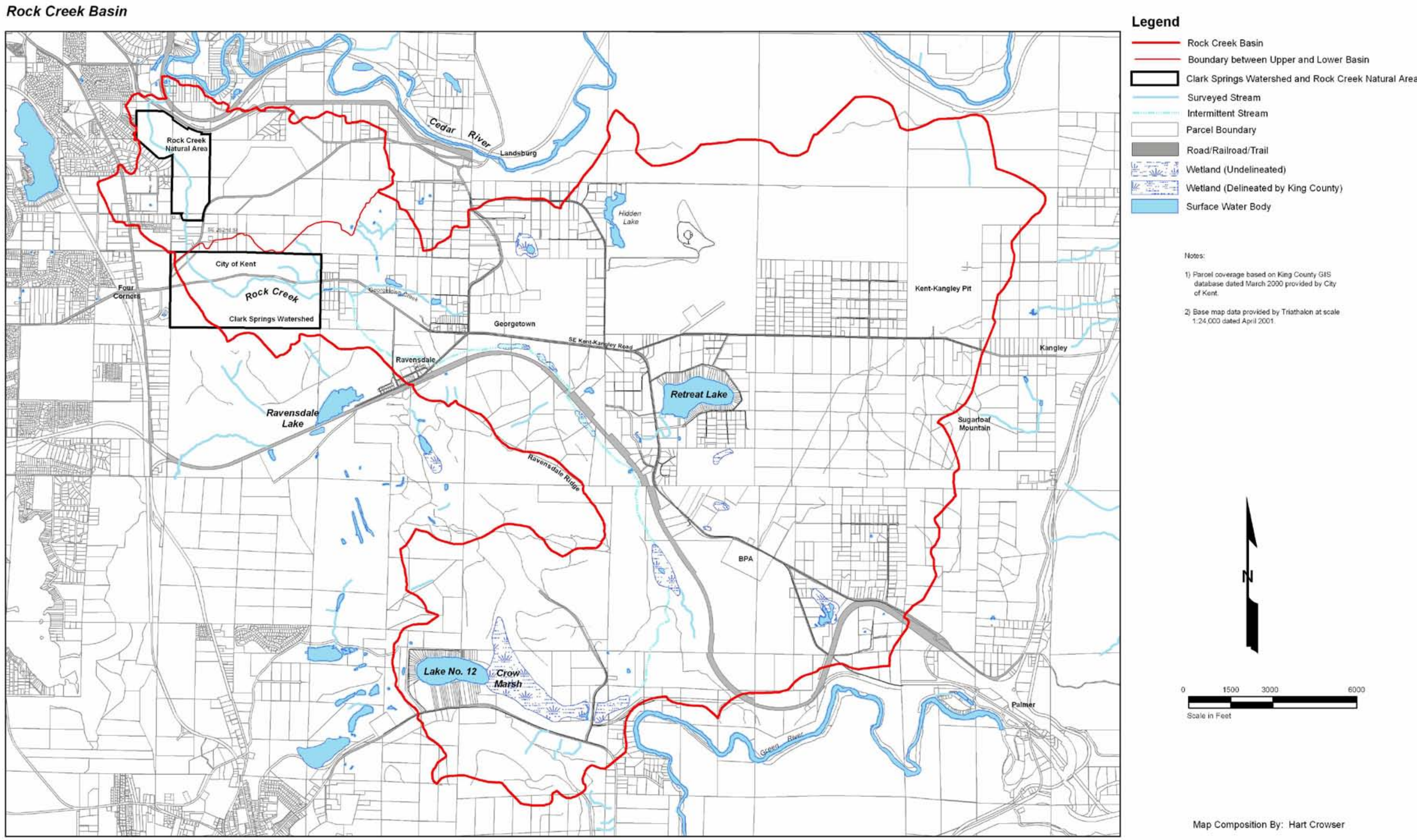

Figure 3.6-1 Surface water bodies.

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Groundwater generally flows north from the Crow Marsh area and southeastern portion of the basin, eventually combining with groundwater flows from the east in the larger outwash channel that runs through the Ravensdale area (Figure 3.6-2). A substantial amount of groundwater flows (approximately 44 to 48 percent; Appendix D, City of Kent 2010) down the Ravensdale outwash channel and out of the Rock Creek basin. Much of the remaining groundwater continues to flow north then westward into the lower Rock Creek valley. The proportion of groundwater flowing into the lower Rock Creek valley varies seasonally with approximately 49 percent flowing that direction during the winter months and approximately 44 to 46 percent flowing that direction during the summer months (Appendix D, City of Kent 2010). A small proportion of groundwater, only 6 to 8 percent, enters the Landsburg Channel (Appendix D, City of Kent 2010).

Groundwater levels in local wells clearly reflect seasonal recharge. Recharge in the fall is fairly rapid, followed by a long period of recession as water stored in the fall and winter is released through the spring and summer. The general pattern of groundwater levels is similar to seasonal variations in stream flow, and seasonal groundwater levels reflect antecedent rainfall amounts. That is, wet winters result in particularly high groundwater levels and dry winters result in reduced rates of groundwater recharge.

In stream systems associated with unconfined surficial aquifers (i.e., aquifers where surface water can percolate directly into the groundwater), two types of flow conditions are often observed. When the groundwater surface is equal to or higher than the streambed elevation, groundwater flows into the channel and the stream is said to be “gaining.” When groundwater levels are lower than the streambed elevation, water from the streams soaks into the ground, and the stream is considered to be “losing.” Surface and groundwater interactions may change spatially (varying between stream reaches) as well as seasonally (varying over time).

Rock Creek exhibits three distinct hydrologic regimes that are the result of groundwater-surface water interactions. The first regime is stream flows in the intermittent upper Rock Creek that depend primarily on groundwater levels. Overall, this section of Rock Creek is generally a “losing” stream, serving as a source of recharge to the underlying groundwater. However, there are areas that have perennial wetlands (e.g., Crow Marsh). In the winter, groundwater levels rise rapidly in response to heavy fall rains. If precipitation is sufficient to raise groundwater levels to the level of the streambed, surface flows occur. Wetlands and other low areas are the first to exhibit surface flows, which may not be continuous along the stream course.

Near the eastern end of the Clark Springs Facility, the glacial outwash deposits are narrower and thinner due to the underlying bedrock geology and act as a “pinch point.” This inferred geologic condition appears to force much of the groundwater flow to the surface, where it forms the headwaters of the perennial flow of Rock Creek. The pinch point also provides a buffer to the transmission of any flow effects upstream from below Clark Springs. The most understandable analogy is that of a weir; any amount of flow changes occurring below the weir cannot affect or change the amount of flow coming over the weir. That flow is governed by upstream conditions, not downstream conditions. Although not as visible as a weir, the narrow throat provided by the aquifer channel that passes through Clark Springs Facility acts as a weir that in part controls the subsurface flow from the upper catchment, while preventing the effect of downstream withdrawals from propagating upstream. The presence of this feature suggests that the operations of the Clark Springs Facility do not significantly affect groundwater levels upstream of the pinch point. Modeling of the groundwater system (Hart Crowser 2003a) also supported this conclusion.

Modeling analysis did show that withdrawals of the Clark Springs Facility produced some local drawdown effect at the western end of the basin. However, due to the nature of the characteristics of unconfined aquifers, this drawdown is not expected to propagate far. In unconfined aquifers, pumping causes dewatering of the formerly saturated space between grains, in cracks, and in solution holes. This dewatering results in significant volumes of water being released from storage (Alley et al. 1999). As a result, unconfined aquifers may fluctuate depending on the recharge/discharge rate. The aquifer supplying the Clark Springs Facility is recharged across its entire surface by infiltrating rain water, and by lakes and streams leading into the subterranean system. As a result, the aquifer is replenished annually from rainfall during the wet season, thereby minimizing any long-term impacts from pumping or water withdrawals.

The pinch point forces groundwater flow to the surface and creates the natural springs east of the Clark Springs Facility that represent the headwaters of perennial flow in Rock Creek (Figure 3.6-2). Consequently the second hydrologic regime occurs in the section below RM 2.8 where Rock Creek is typically a “gaining” stream reach year-round. It is important to note that only a portion of the groundwater flow in the aquifer becomes baseflow in Rock Creek; the remainder continues to flow subsurface through the aquifer. In summer, when groundwater levels in the aquifer are low, perennial flow originates at the “pinch point” approximately 1 mile upstream (east) of the Clark Springs System. In winter, when groundwater levels are higher, perennial flow in Rock Creek begins farther east.

From the Clark Springs Facility, groundwater flows north along the lower Rock Creek valley and west towards Lake Wilderness, a small 67-acre lake located outside of and to the west of the Rock Creek basin, as shown on Figure 3.6-2. Downstream of the Clark Springs Facility near RM 1.95, Rock Creek flows north through a slightly incised valley. Low-gradient wetland reaches appear to be underlain by glacial till, which in turn lies above a layer of advance glacial outwash. Well logs from this area suggest that the aquifer is contained within the advance outwash and separated from Rock Creek by a layer of glacial till. As a result, the third hydrologic regime occurs in the lower section of Rock Creek, where it neither gains nor loses substantial amounts of flow, although small seasonal gains or losses may occur as a result of local geologic variations.

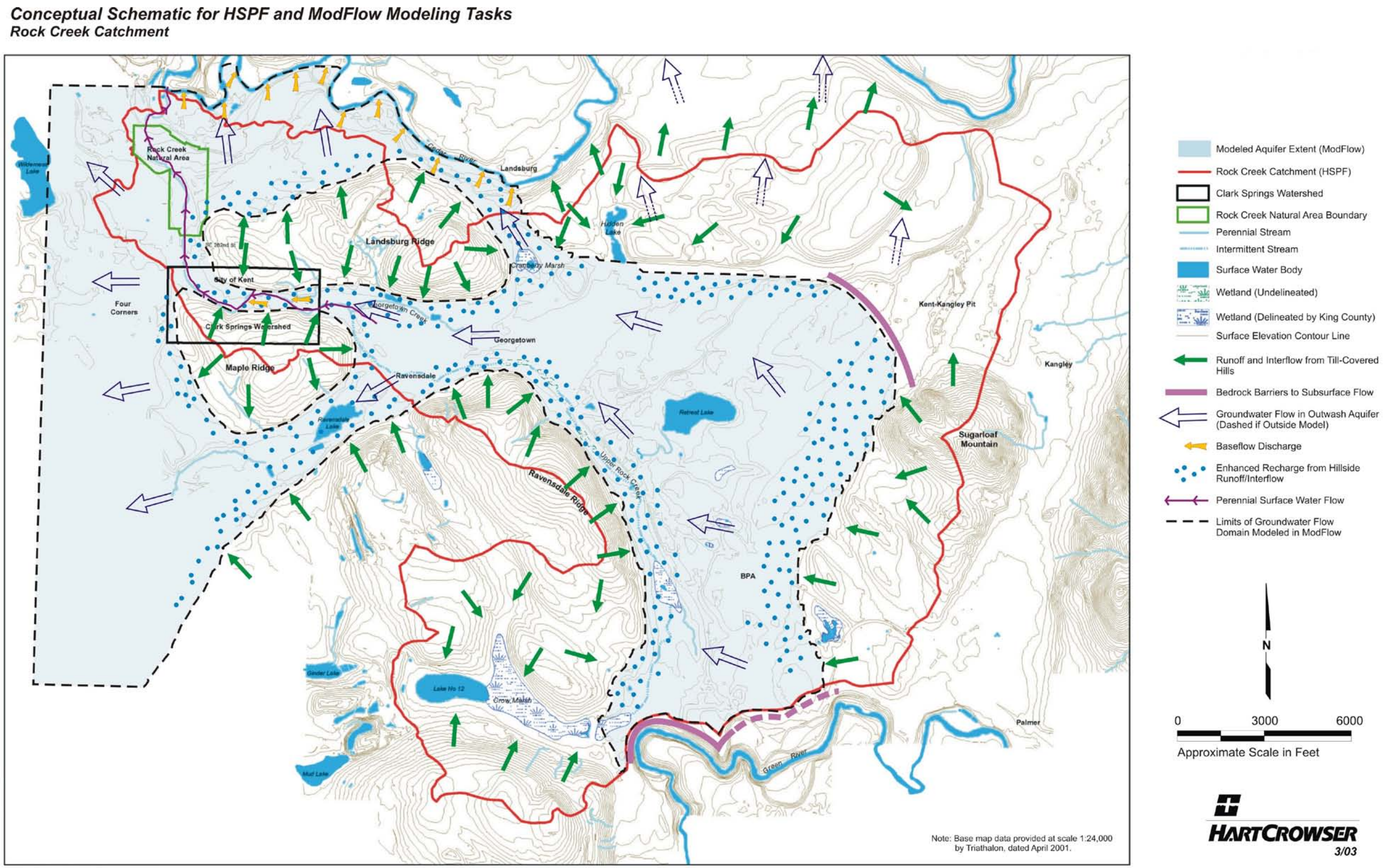

Figure 3.6-2 Groundwater flows.

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3.6.2 Water Quantity

Stream flow data for lower Rock Creek are available from a number of gage locations (Table 3.6-1). Stream flows in Rock Creek follow the same general pattern as other streams in Puget Sound Lowland. Flows are highest in the late fall and winter (November through March), gradually decline through the spring and summer, and reach their lowest levels in September and October (Figure 3.6-3). High flows in Rock Creek are generally the result of heavy rainstorms during the period from October through February. The highest peak flow recorded in Rock Creek to date was 221 cfs on March 6, 1972. Floods with recurrence intervals of 50 and 100 years were estimated to be 244 cfs and 276 cfs respectively (Sumioka et al. 1997). The mean annual flow of Rock Creek at USGS gage No. 12118500 is reported as 19.0 cfs based on available data collected for water years 1956 to 1972 and 2002 (U.S. Geological Survey 2005). The USGS gage No. 12118500 was not in operation from October 1, 1973, to April 30, 2001. Analyses of the flow record indicated a reduction in mean annual flow occurring around 1965 or 1966, from 21.0 cfs to 16.4 cfs; a similar reduction in basin water yield of around 6.0 cfs was also noted (Appendix C, City of Kent 2010). The analysis concluded that the apparent reduction was not attributable to a reduction in precipitation. Instead, the reduction occurred concurrently with construction of a diversion channel that routed flow from Crow Marsh to the Green River (circa early 1960s), as well as the start of water withdrawals at the Clark Springs Facility by the City. The diversion channel from Crow Marsh to the Green River was blocked off by King County in 1997. The City continues to withdraw water from the Clark Springs Facility per its water rights.

Table 3.6-1 Summary of gage stations and a description of the data available for Rock Creek.[1]

Gage Name	Location	Period of Record	Gage Type
USGS No. 12118500 Rock Creek near Maple Valley	RM 0.15	1945-1973 May 2001-present	Stage recorder Continuous recorder
King County gage 31L	RM 0.15 RM 0.28	1994-1997 1997-present	Stage recorder
USGS No. 12118300 Rock Creek near Ravensdale	RM 1.58	1956-1958	Continuous recorder
USGS No. 12118400 Rock Creek at Kent-Kangley Road near Ravensdale	RM 1.82	1956-1962	Continuous recorder
USGS No. 12118400 Rock Creek at Kent-Kangley Road near Ravensdale	RM 1.82	May 2001-present	Continuous recorder at Parshall Flume
Clark Springs Flume	RM 1.82	1969-April 2001	Parshall Flume

[1]Note that USGS gage No. 12118000 Rock Creek diversion near Landsburg was located on a different Rock Creek located on the north side of the Cedar River.

The lowest flows of the year typically occur from mid-September to early November just prior to the onset of the fall rains. The mean daily flow of approximately 6.0 cfs (median 5.7 cfs) in September and October is relatively stable based on 28 years of record (water years 1946 to 1965 and 1966 to 1973 from USGS gage 12118500). An analysis of low flows estimated that prior to 1966, a period when withdrawals at Clark Springs were 0.0 to 0.5 cfs, the mean annual 7-day low was 4.7 cfs (median 4.5 cfs), and ranged from 1.5 to 6.7 cfs. The 1966 to 1973 data, a period when withdrawals ranged from 3.6 to 8.0 cfs, exhibit a mean annual 7-day low of 1.6 cfs (median 1.3 cfs) and ranged from 0.8 to 3.2 cfs. During the 1986 to 1997 period at the Clark Springs Flume, when mean monthly withdrawals ranged from 5.7 to 7.0 cfs, the mean annual 7-day low flow was 1.0 cfs (median 1.0 cfs) and ranged from 0.5 to 1.4 cfs). Since augmentation began in September 1998, the more-recent low-flow data are not representative of unaugmented conditions and therefore are not presented.

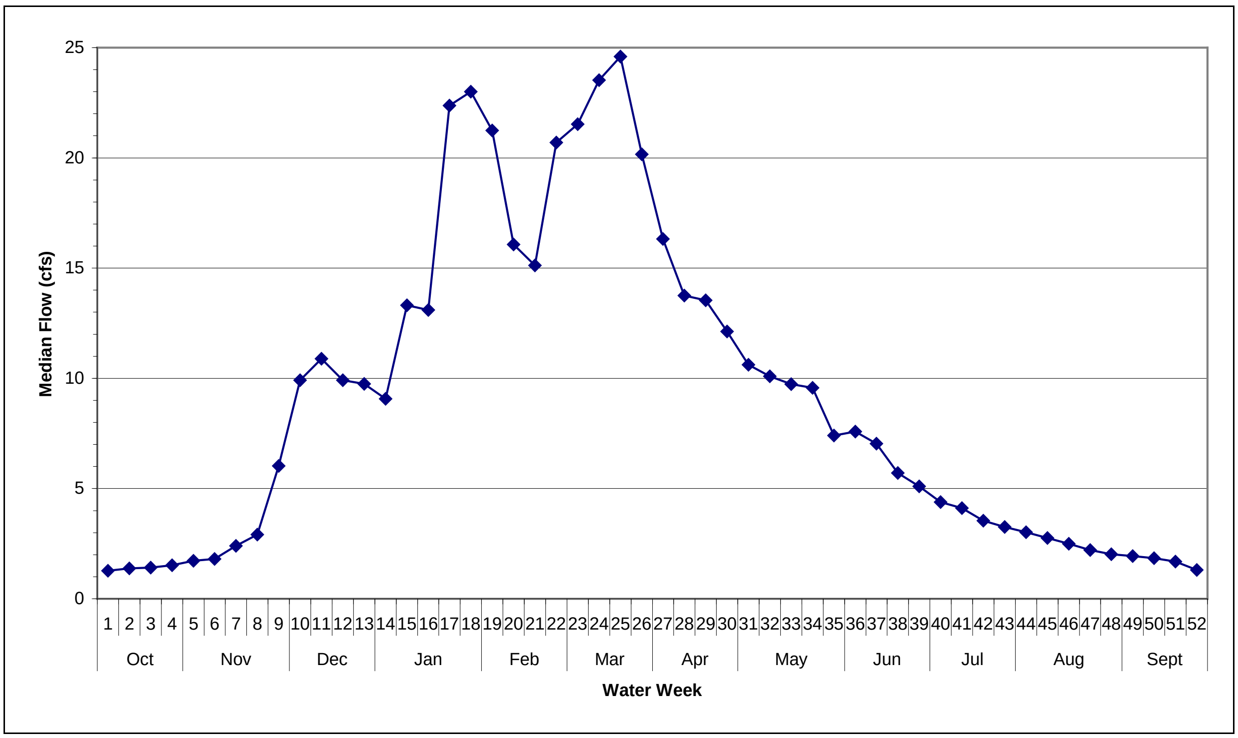


Figure 3.6-3 Median daily flow by water week at the Parshall Flume based upon data from 1986 to 1998.

3.6.3 Water Quality Standards and Criteria

Ecology has established surface water quality standards pursuant to Chapter 90.48 (Water Pollution Control Act) and Chapter 90.54 RCW (Water Resources Act of 1971). The Federal Clean Water Act (CWA) stipulates the water quality standards to protect beneficial uses of water, such as swimming, fishing, aquatic habitat, agriculture, and drinking water.

In 2006, Ecology adopted new surface water quality standards. These standards have not yet been approved by the Environmental Protection Agency (EPA), but approval is expected and Ecology has begun implementation of the new standards. These standards follow a use-based system with four types of uses recognized: Aquatic Life Uses, Recreational Uses, Water Supply Uses, and Miscellaneous Uses. These standards allow consideration and protection of only those uses that actually can be attained in those waters (Washington State Department of Ecology 2006a). Under standards adopted in 2006, designated uses for the Cedar River and tributaries from RM 4.1 to the Landsburg diversion (including Rock Creek) are: 1) core summer habitat; 2) extraordinary primary contact recreation; and 3) domestic, industrial, agriculture, and stock water supply. Miscellaneous designated uses include wildlife habitat, harvesting, boating, aesthetics, commerce, and navigation. The core summer habitat uses include salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and sub-adult native char (Washington State Department of Ecology 2006a). Table 3.6-2 summarizes the criteria that apply to Rock Creek, as established by the 2006 standards.

In addition to the use standards described above, Ecology also identified specific waters that require supplemental spawning and incubation protection for salmonid species (Washington State Department of Ecology 2006b). Rock Creek has been identified as a salmonid spawning area and is required to meet salmon and trout spawning criteria. This criteria applies a 55.4°F (13°C) 7-Day Average Daily Maximum (7-DADMax) temperature standard to Rock Creek between September 15 through June 15 to protect spawning and incubation. Table 3.6-2 summarizes the criteria that apply to Rock Creek, as established by the 2006 standards.

Section 303(d) of the CWA requires states to identify and list threatened and impaired water bodies. The purpose of the 303(d) listing is to identify water body segments that are not expected to meet State surface water quality standards after implementation of technology-based pollution controls. Every 2 years, Ecology prepares a list of these “water quality limited” water bodies and submits them to the EPA for its review and approval. The 2002/2004 303(d) list was approved by the EPA and no portions of Rock Creek were listed as impaired.

Table 3.6-2 Water quality standards intended to protect aquatic life uses that are applicable to Rock Creek under the 2006 Ecology-implemented Water Quality Standards.

	2006 Ecology Water Quality Standards (WAC 173-201A)
Temperature	Shall not exceed 60.8ºF (16ºC) 7-day average of the daily maximum temperatures (7-DADMax) for Core Summer Salmonid Habitat. Shall not exceed 55.4ºF (13ºC) 7-DADMax between September 15 to June 15 for supplemental spawning and incubation protection.
Dissolved Oxygen	Shall exceed 9.5 mg/L.
Turbidity	Shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTU.
Total Dissolved Gas	Total dissolved gas shall not exceed 110% of saturation at any point of sample collection.
Ph	Shall be within the range of 6.5 to 8.5 with a human-caused variation within a range of less than 0.2 units.
Bacteria (fecal coliform)	Not to exceed a geometric mean value of 50 colonies/100 ml and not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100 ml.

3.6.4 Temperature

As a general rule, water temperatures above 60ºF (16°C) are limiting for coldwater fish, such as salmon and steelhead, and also contribute to low dissolved oxygen, another potentially limiting water quality parameter. High water temperatures can affect the movement of migrating adult salmonids, particularly during August and early September, and may reduce salmon egg viability and survival (Caldwell 1994), as well as juvenile growth and survival (Bjornn and Reiser 1991).

Stream temperature is influenced by many factors including flow; depth; interactions with groundwater; energy transfer from solar radiation; convection between the stream and air; evaporation; and conduction between the stream and streambed (Adams and Sullivan 1989). Stream depth is the most important parameter that characterizes stream size for energy transfer purposes (Adams and Sullivan 1989). A change in stream depth will affect both the magnitude of the stream temperature fluctuations and the response time of the stream to changes in environmental conditions (Adams and Sullivan 1989). Stream temperatures are influenced by physical characteristics of the stream, including water source, elevation, aspect, and canopy cover. The latter three factors have a strong effect on ambient air temperature, which in turn affects surface water temperature. In the absence of groundwater, lake, or wetland surface water inputs, streams tend to gradually warm from higher to lower elevations (Sullivan et al. 1990). Large wetlands that have shallow water depth and lack overhead cover may have a warming effect on downstream waters if they have a direct surface connection. The influence of wetland inflows is related to the size of the wetland and the path to the stream. If wetlands have only subsurface connections to streams, the increase in water temperature would be very low since the warming effect is offset by groundwater or subsurface (hyporheic) flows that generally tend to cool surface water temperatures (Sullivan et al. 1990).

Although there are numerous wetlands in the headwaters of the Rock Creek basin, most are not directly connected to the stream during the late summer. Instead, the perennial portion of Rock Creek is fed primarily by groundwater, which, unlike wetlands, has a low temperature and tends to have a cooling effect on instream water temperature during the warm summer months.

Under the standards adopted by Ecology in 2006, currently being considered by the EPA, Ecology identified a 7-day period for measuring stream temperature. As outlined in Table 3.6-1, these criteria state that the annual 7-DADMax shall not exceed 60.8ºF (16ºC) for Core Summer Habitat and 55.4ºF (13ºC) between September 15 to June 15 for spawning and incubation. These criteria should also be met 9 out of every 10 years on average.

Measurements taken at Rock Creek near the Clark Springs Facility on an approximately monthly basis between June 1997 and December 2001 documented no instances of water temperatures in excess of 55.4ºF (13ºC). Continuously recording temperature monitors were used to periodically monitor water temperature in Rock Creek at the flume just upstream of Kent-Kangley Road (RM 1.83) in 1999, 2001, and 2002 (City of Kent, unpublished data). No exceedances of the 2006 Ecology standards were documented in these data (Figure 3.6-4). Between October 7 and December 2, 1999, the maximum water temperature recorded was 49.6ºF (9.8ºC) on October 7, October 13, and December 2. Between June 1 and November 19, 2001, the maximum temperature at Kent-Kangley Road was 53.2ºF (11.8ºC) on August 12. Between April 24 and October 10, 2002, the maximum temperature recorded was 54.6ºF (10.2ºC) on August 2.

In the summer of 2004, between May through July, continuous temperature recorders were installed at four locations in Rock Creek: upstream of the augmentation pipe, at the Kent-Kangley Road, in the middle reach, and at the mouth. Two continuous recorders were also installed in the Cedar River, 80 feet upstream and 130 feet downstream of the confluence with Rock Creek. Maximum daily water temperatures in Rock Creek were less than 60.8ºF (16ºC) throughout the measurement period at all Rock Creek stations (Figure 3.6-5). The highest 7-DADMax recorded at any station in Rock Creek was 59ºF (14.9ºC) (July 27) near the confluence with the Cedar River. Water temperatures tended to increase moving downstream (Figure 3.6-5); the maximum temperature recorded at Kent-Kangley Road was 55.2ºF (12.9ºC), while the maximum temperature recorded in Rock Creek near the confluence was 60.8ºF (16ºC).

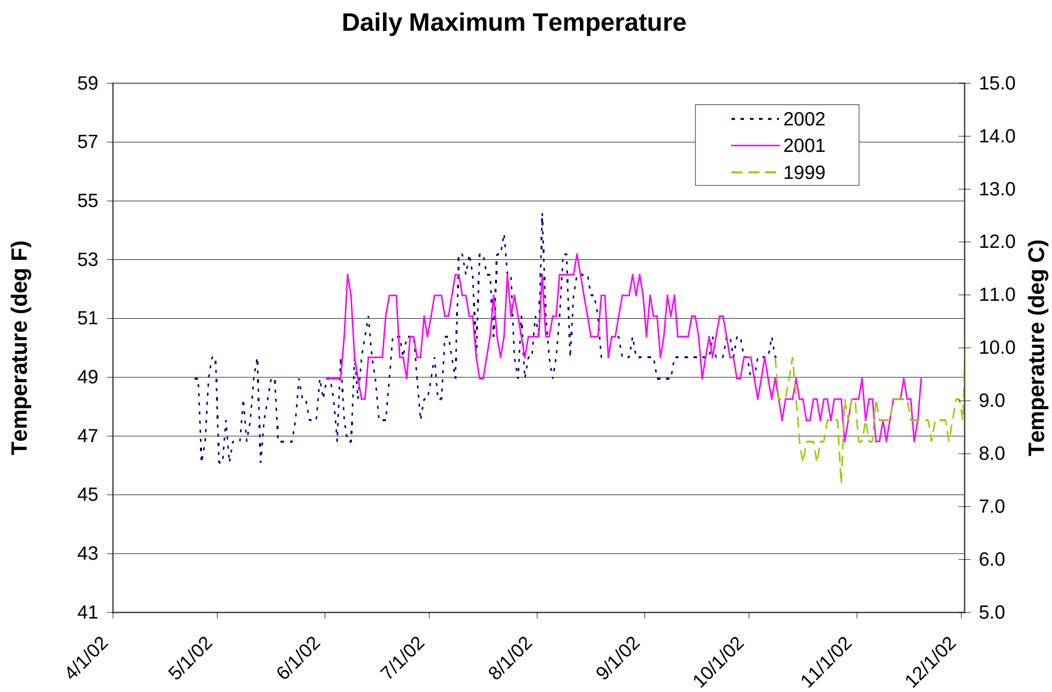


Figure 3.6-4 ..Maximum daily water temperature in Rock Creek during 1999, 2001, and 2002.

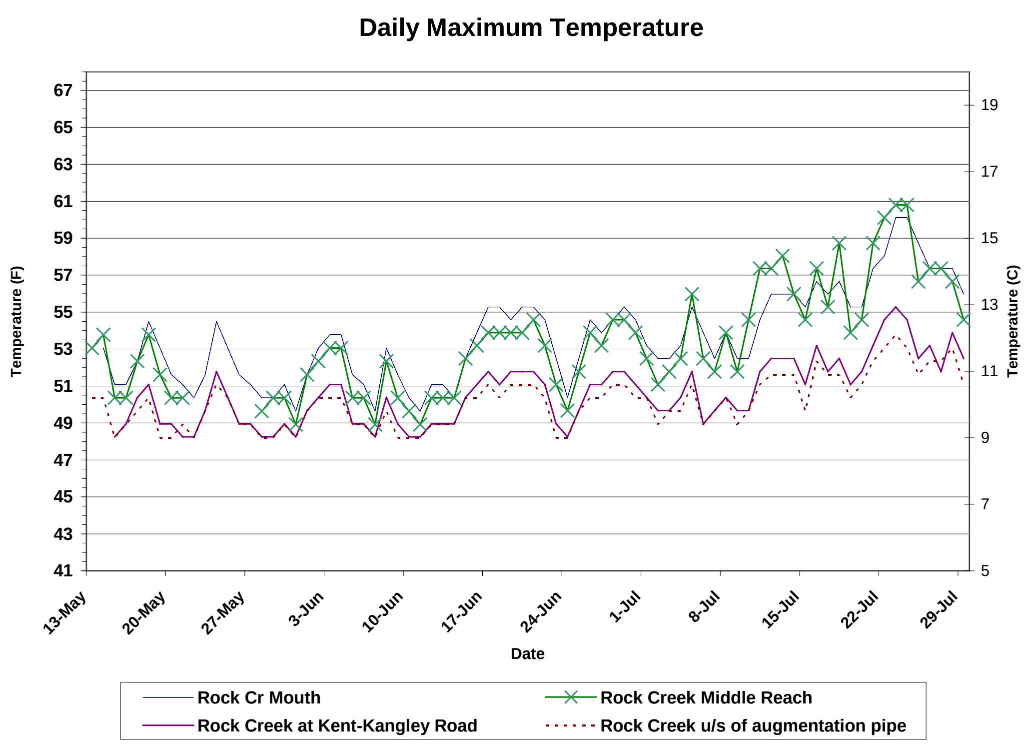


Figure 3.6-5 Maximum daily water temperature at three locations in Rock Creek during 2004.

At times, Rock Creek appears to have a slight localized cooling effect on temperatures in the Cedar River. During the early summer, the mean daily water temperatures at the downstream location were up to 0.9ºF (0.5ºC) cooler than those recorded at the upstream location. However, by the end of July, temperatures at the same recorder downstream of Rock Creek were slightly higher, despite the fact that Rock Creek inflows were typically 1.8ºF (1ºC) to 5.4ºF (3ºC) cooler than the Cedar River. During the summer, Rock Creek inflows typically represent a small percentage of the Cedar River flow; consequently, the cooling effect of Rock Creek is likely to be localized around the mouth of the creek and may explain why a cooling effect was not observable at the temperature recorder downstream of the confluence.

Weekly temperature measurements were also collected in Rock Creek at the Parshall Flume and are available for the period between February 2005 and February 2007. Temperature measurements were generally collected between the hours of 10 a.m. and 2 p.m. These data are presented in Figure 3.6-6 with summary statistics provided in Table 3.6-3. Temperature data during this time period ranged between 41.2ºF (5.1°C) and 55ºF (12.8°C) with low temperatures occurring between November and April and high temperatures occurring between April and September. None of the weekly temperatures recorded between 2005 and 2007 exceeded the new 2006 Washington State water quality standards. However, it is important to note that the water temperature measurements were not collected at the time of day when peak values are expected.

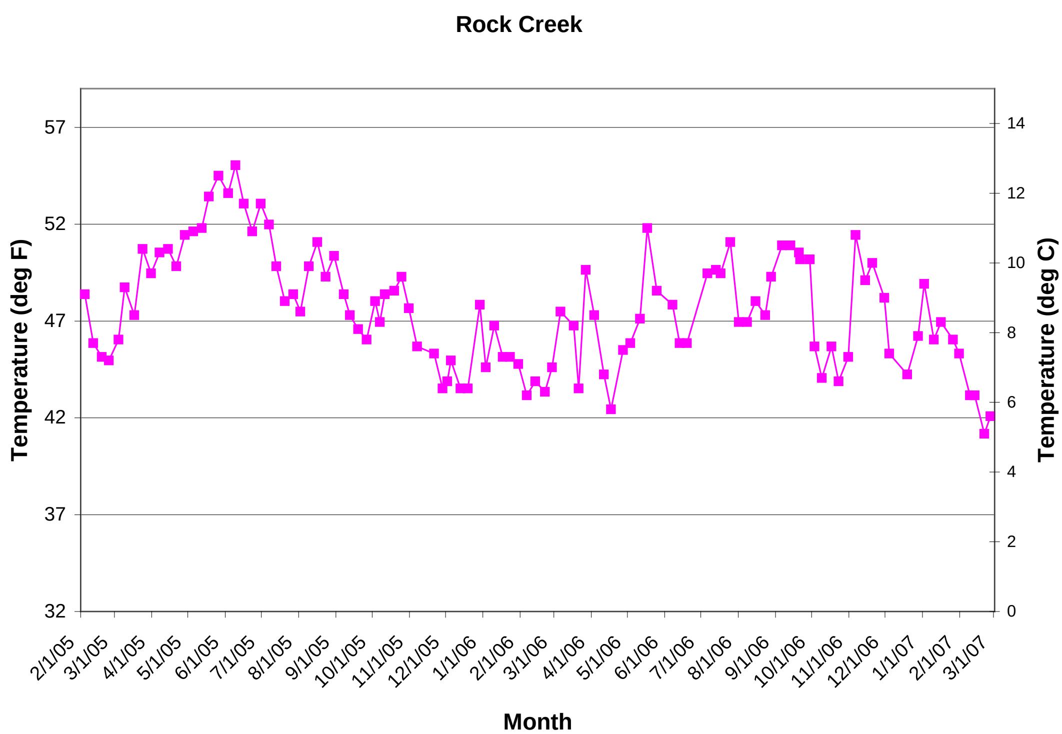


Figure 3.6-6 Weekly water temperature data in Rock Creek February 2005 through February 2007.

Table 3.6-3 Rock Creek temperature summary statistics for 2005-2006 weekly spot measurement data.

Statistic	Temperature
Mean	48ºF (8.9ºC)
Median	48ºF (8.9ºC)
Standard Deviation	34.9ºF (1.6ºC)
Minimum	42.4ºF (5.8ºC)
Maximum	55ºF (12.8ºC)

3.6.5 Dissolved Oxygen

Dissolved oxygen levels in streams are not generally a concern due to high re-aeration rates in turbulent flowing water. However, dissolved oxygen levels of groundwater sources tend to be lower than for surface water sources (Edwards 1998). Dissolved oxygen concentrations in streams may also be adversely influenced under special cases where the decomposition of high levels of organic matter results in high oxygen demand, for example: in areas supporting very warm stream temperatures, in shallow, slow-moving stream environments (less than 1 percent gradient), or at the location a wetland discharges to a stream. Because Rock Creek is fed by a combination of groundwater and wetland sources, and dissolved oxygen levels in groundwater tend to be lower than for surface water, dissolved oxygen levels in Rock Creek might be expected to be lower than in other tributary streams not affected by these factors.

Dissolved oxygen data are limited for Rock Creek, but periodic measurement data were collected weekly along with the temperature measurements at the Parshall Flume between February 2005 and February 2007. The dissolved oxygen measurements were generally collected between the hours of 10 a.m. and 2 p.m. These data are presented in Figure 3.6-7 with summary statistics shown in Table 3.6-4. Dissolved oxygen ranged from a low of 8.8 milligrams per liter (mg/L) to a high of 12.1 mg/L. Figure 3.6-7 also presents the temperature and dissolved oxygen saturation concentration. Dissolved oxygen saturation was estimated using a temperature-dependent equation (Chapra 1997). The weekly measurements show that the Rock Creek dissolved oxygen is frequently close to saturation, with saturation ranging between 77 and 107 percent and averaging 87 percent. Several measurements were taken that showed concentrations greater than the estimated saturation. Some streams can become supersaturated as a result of photosynthesis during daylight hours from extreme plant, algae, or periphyton growth. Significant aquatic vegetation growth occurs just upstream of the Parshall Flume and could be the source of the supersaturation. Supersaturated conditions were also documented in weekly dissolved oxygen measurements collected in 1994 and 1995 (May 1996). The 2005 through 2007 measurements recorded seven exceedances of water quality standards as shown in Table 3.6-5, with the lowest measurement of 8.8 mg/L.

Dissolved oxygen can be severely limiting to aquatic organisms; species differ in their abilities to tolerate low dissolved oxygen levels. Since dissolved oxygen levels in clean waters are inversely related to temperature, low dissolved oxygen levels have the highest potential to occur during periods of high temperatures. Low dissolved oxygen can impair successful migration of fish and may affect reproductive success, especially during periods when eggs and alevins are within the gravel strata. The State standard for dissolved oxygen for core summer salmonid habitat use is 9.5 mg/L. Given the relatively cold year-round water temperatures that occur in Rock Creek resulting largely from groundwater influence and the increased capacity of cold water to store dissolved oxygen, it is likely that dissolved oxygen levels would largely remain at or above the State standards.

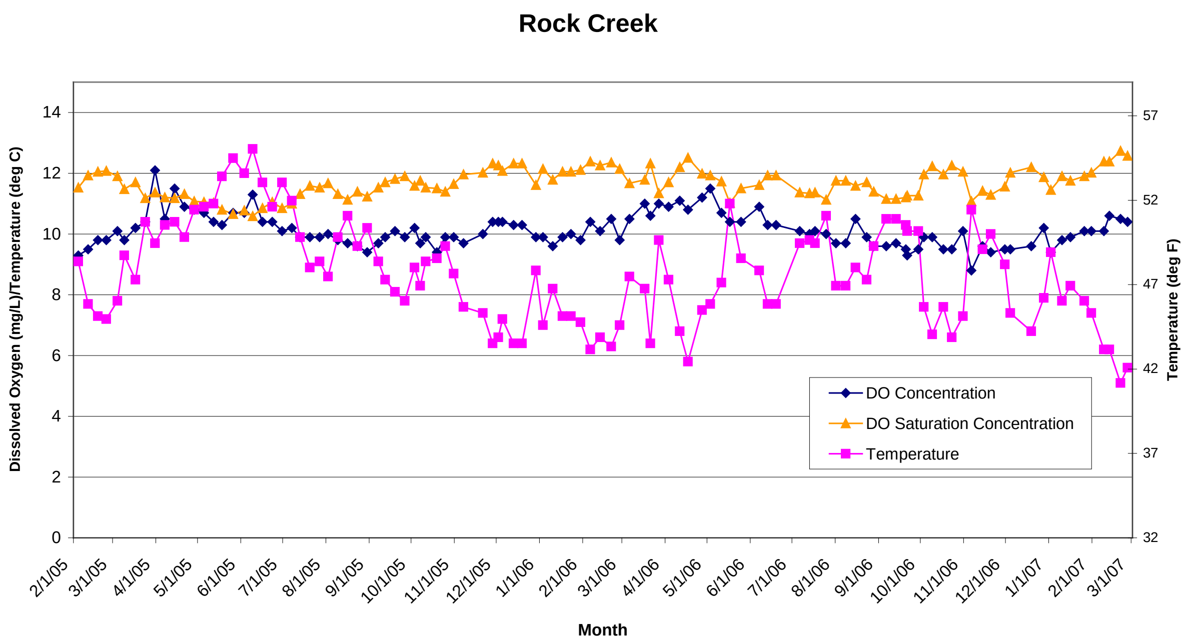


Figure 3.6-7 Rock Creek dissolved oxygen, dissolved oxygen saturation, and temperature in February 2005 through February 2007.

Table 3.6-4 Rock Creek dissolved oxygen statistics for 2005-2006 weekly measurement data.

Statistic	Dissolved Oxygen (mg/L)
Mean	10.1
Median	10.1
Standard Deviation	0.54
Minimum	8.8
Maximum	12.1

Table 3.6-5 Washington State dissolved oxygen exceedances in Rock Creek.

Date	Dissolved Oxygen Exceedances (mg/L)	Temperature on Date of Dissolved Oxygen Exceedance °F (°C)
2/4/2005	9.3	48.4 (9.1)
8/30/2005	9.4	50.4 (10.2)
10/19/2005	9.4	48.6 (9.2)
9/21/2006	9.3	50.2 (10.1)
11/6/2006	8.8	51.4 (10.8)
11/20/2006	9.4	50.0 (10.0)
1/2/2007	9.4	48.9 (9.4)

3.6.6 Turbidity and Total Suspended Solids

Total suspended solids (TSS) concentration and turbidity both indicate the amount of solids suspended in water. Total suspended solids are measured as the actual weight of material per volume of water, while turbidity is a measure of the amount of light scattered from a sample. Both turbidity and TSS vary naturally in response to stream flows and sediment inputs. Similarly turbidity and TSS levels are generally highest during storm events when surface runoff contributes water to the stream channel. The effects may be most pronounced during the first storms of the season as fine sediments that have accumulated during low flows are flushed downstream. State water quality standards for turbidity are generally focused on preventing increases relative to natural background conditions and do not include specific numeric thresholds. There are no State water quality standards for TSS.

Periodic measurements of turbidity were collected from Rock Creek within the Clark Springs Facility on an approximately monthly basis between June 1997 and December 2001; the highest turbidity level documented by those measurements was 1.36 NTUs. The median measured turbidity (of 57 samples) was 0.47 NTUs over a range of flows from 1.8 to over 36.0 cfs (the flow at which the Parshall Flume overflows). Examination of a plot of turbidity versus flow suggested no relationship between these variables. The results of those measurements suggest that turbidity levels in the creek are generally low, which is likely related to the strong influence of groundwater in the creek's flow. No TSS measurements are available for Rock Creek. Turbidity and TSS generally have a direct correlation, but this correlation can be dependent on particle size, shape, and color and is therefore specific to a stream. Concentrations of TSS in Rock Creek are assumed to be low given the low turbidity measurements.

3.6.7 pH

The City measured the pH in Rock Creek on a monthly basis from June 1997 to August 2002. These periodic measurements of pH at the Clark Springs Facility indicated a range from 5.3 to 7.9, with a median value of 6.9. Of the 56 samples taken, eight had a pH of less than 6.5, the water quality standard. Six of the eight occurred between December 1997 and July 1998. The pH level is important because even moderately acidic waters may reduce the hatching success of fish eggs, irritate the gills of fish and aquatic insects, and damage membranes.

3.6.8 Fecal Coliform

Fecal coliform are not generally considered to adversely affect aquatic biota. State water quality standards for fecal coliform are aimed at preventing adverse effects to recreation or water supply beneficial uses. Few data on fecal coliform are available for Rock Creek. The City collected and tested five samples between October 9, 2001, and September 18, 2002, as part of the Wellhead Protection Program (WHPP). The highest fecal coliform concentration measured in those samples was 16 colonies per 100 milliliters (ml), and the geometric mean of the five samples was 7.6 colonies per 100 ml. These values are well below the existing 2006 Ecology standards (Table 3.6-1).

3.6.9 Metals and Toxics

Rock Creek was not listed on Washington State's 1998 303(d) list or the 2002/2004 303(d) list for metals or toxics. The 2002/2004 303(d) list included all water bodies for which data were available, and categorized those water bodies as: 1) meeting State standards; 2) water of concern (some evidence of water quality problem, but not sufficient to require a Total Maximum Daily Load (TMDL) determination; 3) no data; 4) polluted, but no TMDL required; and 5) polluted with TMDL required. If no data are available, the water body is not listed individually. If the water body is not on the list, it is assumed to be Category 3. As Rock Creek is not listed on the 2002/2004 list, it is therefore assumed to be a Category 3 water body.

The Landsburg Mine, a coal mine that operated from 1959 to 1975, is located within the Rock Creek basin just upstream of the Clark Springs Facility. The collapsed trench of the mine was used to dispose of 4,500 55-gallon drums in addition to 200,000 gallons of unknown industrial waste and oily sludge from 1969 to 1978. Wastes disposed of in the trench include, but are not limited to: paint, solvents, heavy metals, oily water, and sludge. Landsburg Mine was ranked as the highest potential contaminant source to the Clark Springs System in the WHPP adopted by the Kent City Council on February 15, 2000.

From 1997 through 2002, as part of the WHPP, the City periodically tested Rock Creek at the Clark Springs Facility for metals and toxics. The 21 samples analyzed during that period documented no exceedances of State water quality standards for metals and toxics in Rock Creek (City of Kent 2010, unpublished data). Parameters monitored included antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, and zinc. Of these parameters, only three measurements taken during the 21 sampling dates had values higher than the detection limits. These measurements include cadmium at 0.004 micrograms/L (mg/L) on March 9, 2000, iron at 0.06 mg/L on July 18, 1998, and manganese at 0.022 mg/L on December 11, 2001. None of these measurements exceed water quality standards. However, the March 9 measurement of cadmium exceeds the surface water quality standard at the measured level of water hardness (Washington State Department of Ecology 2006a).

3.7 Vegetation

3.7.1 Lower Rock Creek Wetlands

The WDFW Priority Habitats and Species (PHS) database, the National Wetlands Inventory (NWI) database, and the King County sensitive areas database were reviewed for the occurrence of priority habitats in the action area (Washington Department of Fish and Wildlife 2006b). The NWI database and the King County sensitive areas database were reviewed for the occurrence of wetlands in the action area. In addition, City staff provided information regarding the presence of other wetlands on the Clark Springs property and along lower Rock Creek. The location of each wetland described in Subsections 3.7.1.1 and 3.7.1.2 is shown in Figure 3.7-1.

3.7.1.1 Clark Springs Facility

Neither the NWI (U.S. Fish and Wildlife Service 2006a) nor the King County sensitive areas database (King County GIS Center 2006a) documented the presence of wetlands on the Clark Springs property. However, field reconnaissance and review of aerial photos determined the presence of a number of wetlands on the site.

A depressional wetland is located in the southwest corner of the Clark Springs property, beneath the BPA transmission line. A forested riverine wetland of about 1 acre in size is present along Rock Creek in the central portion of the Clark Springs property (Reach 12), just east of the dike and north of the BPA transmission line. Riparian forested wetland habitat is present along Rock Creek in Reaches 9 and 9b, extending from just below the USGS gaging station to the northern boundary of the property along Summit-Landsburg Road (Figure 3.7-1).

3.7.1.2 Lower Rock Creek

North of the Summit-Landsburg Road, Rock Creek passes through a residential area for a distance of about 1,000 feet and then enters the RCNA. Within the RCNA portion of Reach 8, a well-developed forested riparian wetland is associated with the creek and its multiple side channels. Based on the Rock Creek Site Management Plan (King County Department of Natural Resources 2006), two small wetlands are located adjacent to the creek in the northwestern portion of the RCNA; one of these is forested primarily with red alder and the other is dominated by salmonberry. Two small wetlands are present near the confluence of Rock Creek and the Cedar River. One of these wetlands is associated with a small pond on the left bank of Rock Creek in Reach 1, and is shown on the King County sensitive areas database (King County GIS Center 2006a). The wetland and pond, in total, are estimated at about 0.5 acres. A second wetland is located adjacent to Rock Creek on the right bank in

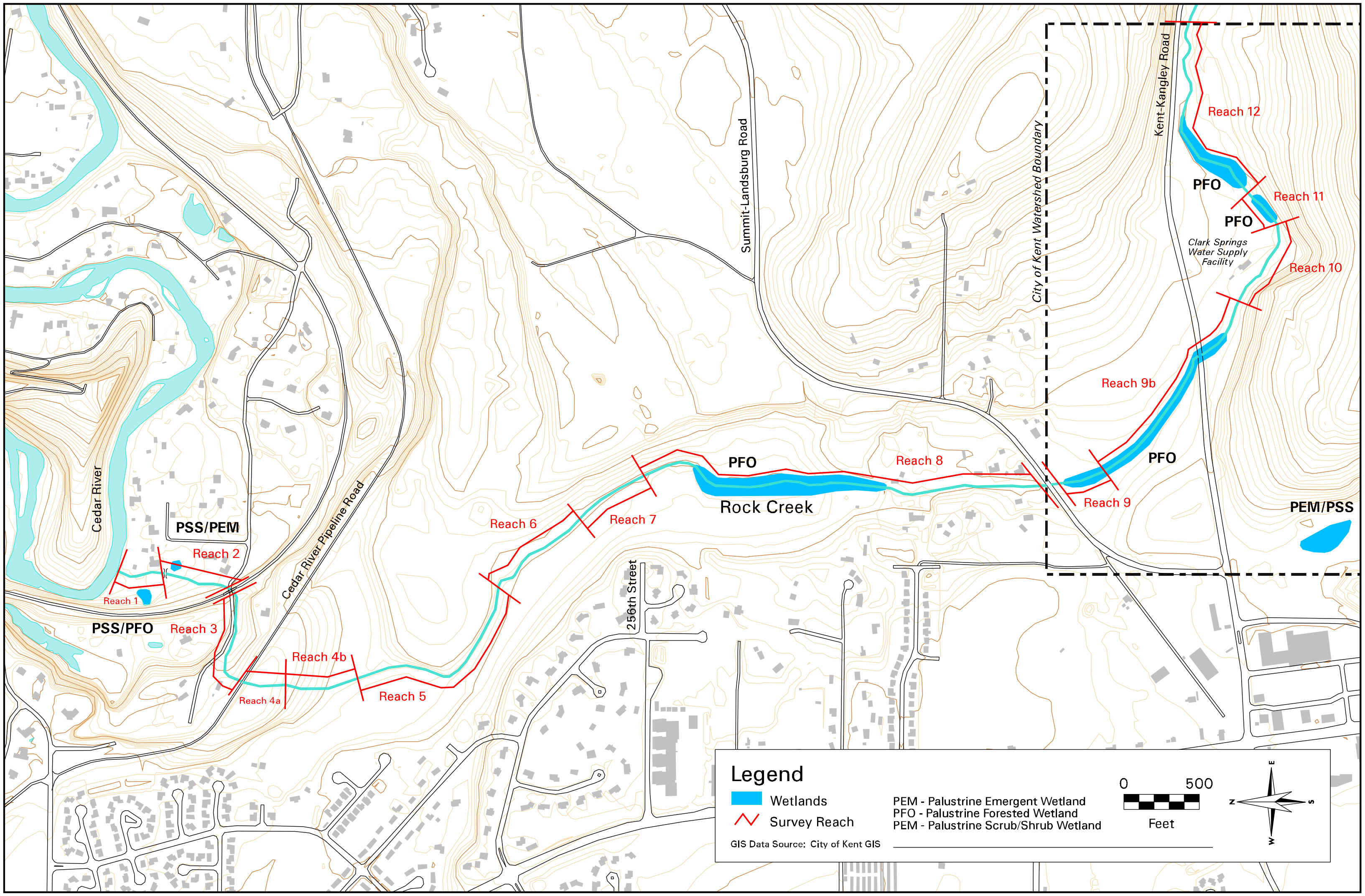


Figure 3.7.1 Clark Springs wetland.

Reach 2, and consists primarily of palustrine scrub/shrub and palustrine emergent vegetation. The second wetland is not documented on any of the three referenced wetland databases but is discussed in the proposed HCP (City of Kent 2010).

3.7.2 Plant Species of Special Interest

Two federally listed plant species may occur within King County (U.S. Fish and Wildlife Service 2006b). Golden paintbrush (*Castilleja levisecta*) is a federally threatened and State endangered species. The species occurs in open prairie grasslands of the Puget Trough on glacial outwash or depositional substrates up to elevations of about 300 feet (Washington Natural Heritage Program 2006a). It is most commonly found in association with Idaho fescue (*Festuca idahoensis*) or red fescue (*Festuca rubra*). Grass-dominated habitat is present at the Clark Springs Facility; however, this human-created habitat is located at elevations above 400 feet, is dominated by non-native species, and is not true prairie. Although golden paintbrush has historically occurred in King County, it has not been reported within the action area, and is unlikely to occur there.

Marsh sandwort (*Arenaria paludicola*) is a federally endangered species that is thought to be extirpated in the State. It occurs in coastal swamps, freshwater wetlands and marshes, and has been reported in acidic bog soils and sandy soils with high organic content (Washington Natural Heritage Program 2006a). It has not been reported from King County historically, and is very unlikely to be present in the action area.

Review of the Washington Natural Heritage Program database indicates that no special status plants or plant communities have been recorded within the Rock Creek Watershed (Washington Natural Heritage Program 2006b). The closest recorded rare plant sightings are several miles from the Clark Springs Facility.

3.7.3 Noxious Weeds

Washington Weed Law (Chapter 17.10 RCW) requires that noxious weeds be controlled to limit adverse economic effects on agricultural, natural, and human resources of the State. Noxious weeds are plants that, when established, are highly destructive, competitive, or difficult to control by cultural or chemical practices. The State Noxious Weed Control Board updates its list of noxious weeds annually and categorizes the species into three classes (WAC 16-750). Federal noxious weed lists are incorporated in the State list. The King County Noxious Weed Control Board administers State weed laws at the local level on private, county, and State lands. The County Weed Board also adopts rules and regulations as necessary to administer King County's noxious weed control program.

A review of the King County digital data shows the occurrence of one noxious weed species in the project vicinity (King County GIS Center 2006b). Tansy ragwort (*Senecio jacobaea*) was reported at one location along the BPA transmission line right-of-way that passes through the Clark Springs Facility. It was also reported from several locations near the confluence of Rock Creek and the Cedar

River. This species is a Class B designate in King County, for which control (prevention of all seed production) is required (King County Noxious Weed Control Board 2006). Tansy ragwort is known to be toxic to livestock and humans (King County Noxious Weed Control Board 2005).

Two species of non-designated noxious weeds were observed in the project vicinity during field reviews in preparation of this EIS. Scot's broom (*Cytisus scoparius*) is present in scattered locations at the Clark Springs Facility along the transmission line right-of-way and in the meadow adjacent to the water supply facilities. One or more species of invasive knotweeds (*Polygonum* spp.) is present as very small infestations along the lowermost reach of Rock Creek. Both of these weeds are Class B and C species from the State Weed List that are not designated for control due to their widespread occurrence in the county. Control of these species is recommended but not required.

3.8 Fish and Aquatic Habitat

As described previously, perennial flow in Rock Creek starts approximately 0.2 miles upstream of the eastern boundary of the Clark Springs Facility and continues to its confluence with the Cedar River at RM 18.2 (Subsection 3.6.1, Surface and Groundwater Hydrology). The historical fisheries habitat within the lower 2.8 miles of Rock Creek is presumed to have been excellent for anadromous salmon and trout, resident trout, and other coldwater species native to the area because current conditions, as described below, are relatively good. However, specific documentation of historic conditions and the presence of fish and fauna is limited. Recent surveys have documented the presence of sockeye salmon, PS Chinook salmon, PS/Strait of Georgia coho salmon, PS/Strait of Georgia chum salmon, PS steelhead, cutthroat trout, and lamprey (MCS Environmental, Inc., unpublished data; MCS Environmental, Inc. 2003; R2 Resource Consultants, Inc. 2005a). Based upon their presence elsewhere in the Cedar River Watershed (City of Seattle et al. 1999; King County 1993), other fish species potentially present in the lower reaches of Rock Creek include bull trout, rainbow trout, western brook lamprey, mountain whitefish, and various species of minnows and sculpins.

3.8.1 Covered Fish Species

The City is seeking ITP coverage for nine fish species that have the potential to be present in Rock Creek at some time during their life cycles (Table 1.1-1). These species are PS Chinook salmon, sockeye salmon, PS/Strait of Georgia coho salmon, PS/Strait of Georgia chum salmon, bull trout, PS steelhead, cutthroat trout, Pacific lamprey, and river lamprey. Puget Sound Chinook salmon were listed as threatened in the Puget Sound evolutionarily significant unit (ESU) by NMFS on March 9, 1998 (63 FR 11482). Puget Sound steelhead were listed as threatened on May 8, 2007 (72 FR 26722). On April 15, 2004, NMFS designated PS/Strait of Georgia coho salmon as a species of concern (69 FR 19975). The USFWS listed bull trout in Puget Sound as threatened on November 1, 1999 (64 FR 58909). Bull trout have not been observed in Rock Creek, but are present in the upper Cedar River and Lake Washington and could potentially utilize Rock Creek. The following discussion will be focused on species to be covered under the proposed HCP, but will also include discussion of other fish species that could potentially occur in Rock Creek as well as the potentially affected benthic macroinvertebrates community that is an important source of forage for these species and an indicator of watershed conditions.

All nine species proposed for coverage are anadromous, two of which, cutthroat trout and bull trout, can also exhibit resident freshwater life-history phases in the Cedar River. More-detailed information on the life history characteristics and stock status of each of the nine species is discussed in Appendix A, *Life Histories of Species of Concern*, of the proposed HCP.

3.8.1.1 Species Listed as Threatened Under the ESA

Puget Sound Chinook Salmon

Chinook salmon, also referred to as king salmon, are the largest of the Pacific salmon species (Wydoski and Whitney 2003). This species is differentiated into two juvenile behavioral forms, ocean-type and stream-type, based on their pattern of freshwater rearing. Juvenile ocean-type Chinook salmon migrate to the marine environment during the first year of life, generally within 3 to 4 months of emergence (Lister and Genoe 1970). Juvenile, stream-type Chinook salmon rear in fresh water for a year or more before outmigrating to the ocean (Figure 3.8-1). Within these two migrant designations many subtype variations have been described (Reimers 1973). Chinook salmon classification is further divided by the timing of upstream migration (e.g., spring or fall/summer runs) (Beauchamp et al. 1983).

The principal population of PS Chinook salmon present in the Cedar River has a summer/fall ocean-type life history pattern (Washington Department of Fisheries et al. 1994). Adult summer/fall PS Chinook salmon enter fresh water at the Chittenden Locks between June and September with peak migration in mid-August (Warner and Fresh 1999). Adult Chinook salmon typically enter the Cedar River in late September, but in some years Chinook salmon have been observed in the river as early as late August (Berge et al. 2006). Spawning surveys in tributaries to the Cedar River have occurred since 1998 with most Chinook salmon being observed in October and November (Carrasco et al. 1998; Mavros et al. 1999; Priest and Berge 2002; MCS Environmental 2003; Burton et al. 2004; R2 Resource Consultants, Inc. 2004; R2 Resource Consultants, Inc. 2005a). The earliest observation of Chinook salmon in a Cedar River tributary from these surveys was September 20 in Rock Creek, a fish that presumably returned to the Cedar River because it was not observed during a survey the following week (R2 Resource Consultants, Inc. 2005a). Spawning in the Cedar River occurs from early to mid-September through mid- to late-November. Peak spawning occurs during early- to mid-October (City of Seattle et al. 1999; Washington Department of Fisheries et al. 1994). Chinook salmon fry in the Cedar River typically begin emergence from the gravel as soon as late January. Chinook salmon fry have generally completed outmigration from the Cedar River by early June.

On March 24, 1999, NMFS formalized the listing of PS Chinook salmon as threatened under the ESA (64 FR 14308). Cedar River (including Rock Creek) Chinook salmon are considered part of the Puget Sound ESU. The Cedar River and three of its tributaries (Rock Creek, Webster Creek, and Taylor

Figure 3.8-1 Likely freshwater life history periodicity of sockeye salmon, Puget Sound/Strait of Georgia coho salmon, and Puget Sound Chinook salmon, in the Cedar River Watershed, Washington. Source: City of Seattle et al. (1999); Wydoski and Whitney (2003).

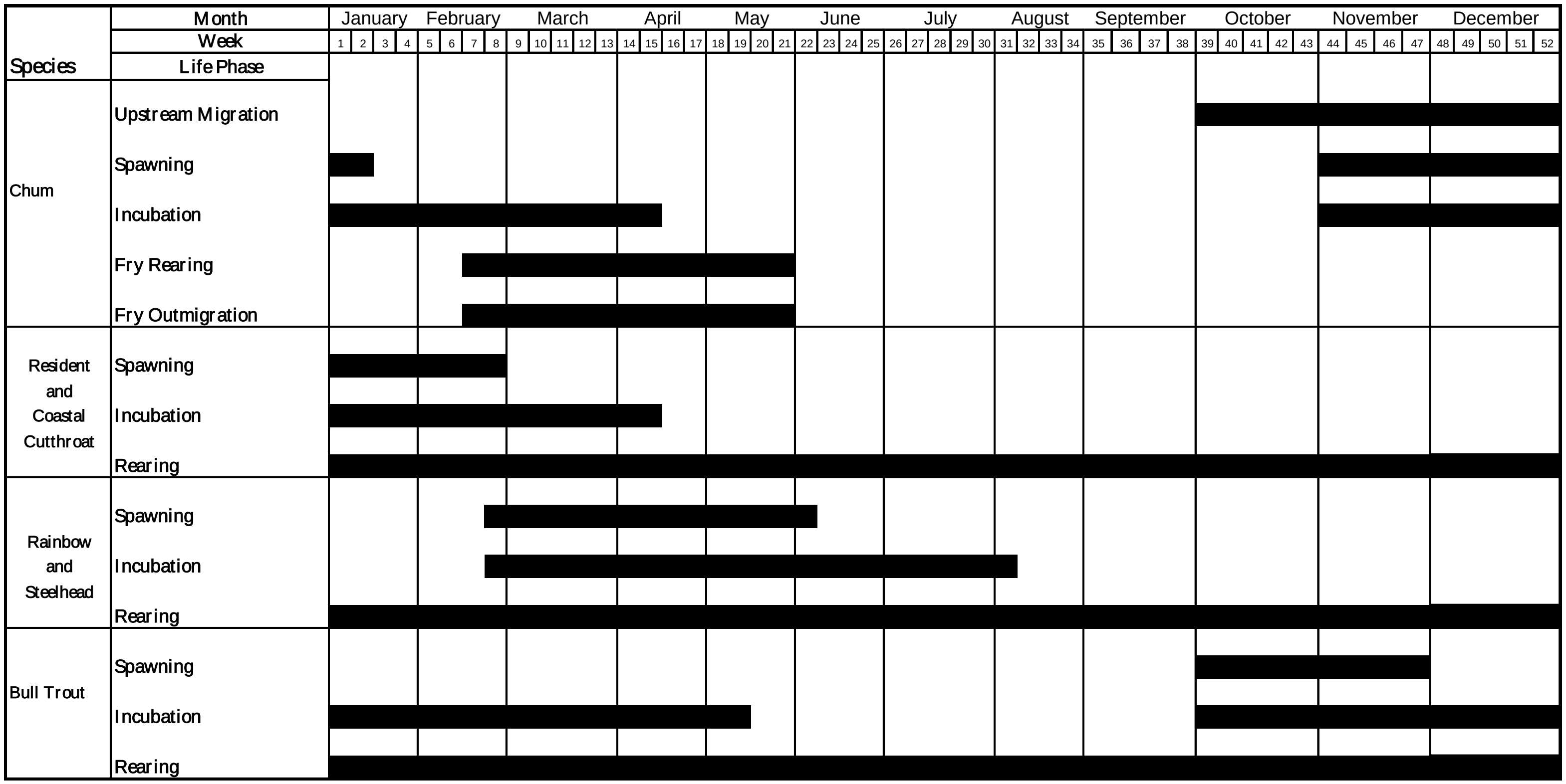


Figure 3.8-1 (cont.) Likely freshwater life history periodicity of Puget Sound/Strait of Georgia chum salmon, cutthroat trout, rainbow and Puget Sound steelhead, and bull trout in the Cedar River Watershed, Washington. Source: City of Seattle et al. (1999); Wydoski and Whitney (2003).

Creek) have been designated by NMFS as critical habitat (70 FR 52630). Overall, abundance of Chinook salmon in the Puget Sound ESU has declined substantially, and both long- and short-term abundance exhibit predominantly downward trends. One factor negatively affecting the PS Chinook salmon population in the Cedar River basin is land use practices. Lack of pool habitat, bank hardening features, loss of floodplain connectivity, and a reduction in forest cover are all examples of factors affecting PS Chinook salmon populations (Kerwin 2001).

Based upon data provided by WDFW (personal communication with Foley 2006), the Cedar River escapement run size averaged approximately 449 fish from 1988 through 2005, while from 1964 to 1987 it averaged approximately 920 fish (Figure 3.8-2). According to Burton et al. (2004) the majority of Cedar River Chinook salmon use mainstem habitats for spawning with a small proportion using tributaries.

The historic distribution of Chinook salmon in Rock Creek is uncertain. Different sources (primarily geographic information system based) have placed the upper extent of Chinook salmon spawning at RM 1.3, RM 0.65, RM 0.27, and RM 0.20. Documentation of the rationale for these locations is limited (Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes 1994; Salmon and Steelhead Habitat Inventory and Assessment Program 2005; Streamnet 2005; WRIA 8 Steering Committee 2005). The latter two locations (RM 0.27 and RM 0.20) are in the approximate locations of the SE 248th Street culvert (end of Reach 2) and the Seattle Pipeline culverts (end of Reach 3). Both culverts have been cited as partial barriers to anadromous fish (Chinook Engineering 2002; King County et al. 1999), but were replaced and should improve the ability of resident and anadromous fish to move through the lower reaches of Rock Creek. The RM 1.3 location was based upon the upper extent of the WDFW spawning survey index reach (Summit-Landsburg Road; end of Reach 8; primarily surveyed for coho salmon) and not necessarily observations of Chinook salmon at that location. The Ecosystem Diagnosis and Treatment model used in the WRIA 8 Conservation Plan evaluated the creek up to RM 0.65 (approximately the end of Reach 5). Reach designations for Rock Creek utilized for analysis of the HCP are provided in Figure 3.8-3.

Six adult Chinook salmon have been observed in the lower reaches of Rock Creek during recent years, one live fish in September 2004, two carcasses (both male) in November 2004, one live fish in October 2003, one carcass in November 2002, and one carcass in October 2001 (MCS Environmental, Inc. 2003; R2 Resource Consultants, Inc. 2004; R2 Resource Consultants, Inc. 2005a; Burton et al. 2004; Berge et al. 2006). The WDFW has conducted spawning surveys in Rock Creek since 1960; however, the WDFW surveys targeted the coho salmon run and usually did not begin surveying until late October or early November (Table 3.8-1). The last recorded Chinook salmon observation in Rock Creek during WDFW spawning surveys was 1985 (one fish). Anecdotal information (Washington Department of Fisheries and Washington Department of Game 1969) suggested the historical numbers of adult Chinook salmon in Rock Creek may have averaged 40 fish per year, but this level of use cannot be verified from the available WDFW spawning survey data (Table 3.8-1) or from any other available literature source or data sets. Consequently, there is substantial uncertainty regarding the magnitude of historical Chinook salmon utilization in Rock Creek.

Puget Sound Steelhead

Steelhead are rainbow trout that display an anadromous life history pattern. Their historic native distribution extended from northern Mexico to the Alaska Peninsula. Currently, spawning steelhead are found along the Pacific Coast from as far south as Malibu Creek, California (Busby et al. 1996). As with Chinook salmon, runs of steelhead are generally named for the season in which they occur or peak. There are two types of runs of Pacific Northwest steelhead. Winter-run fish migrate into fresh water during the fall and winter, while summer-run fish enter fresh water during the spring and summer (Pauley et al. 1986). Steelhead are further divided based on the state of sexual maturity when they enter fresh water. Summer-run fish, also known as stream-maturing steelhead, enter fresh water in an immature life stage, while winter-run steelhead enter fresh water with well-developed reproductive tissues (Busby et al. 1996). In the Lake Washington system, there are no summer steelhead stocks and only one winter steelhead stock has been identified (Washington Department of Fisheries et al. 1994). Winter steelhead return to the Lake Washington drainage from mid-December to mid-May and spawn generally from early March to mid-June (Washington Department of Fisheries et al. 1994) (Figure 3.8-1).

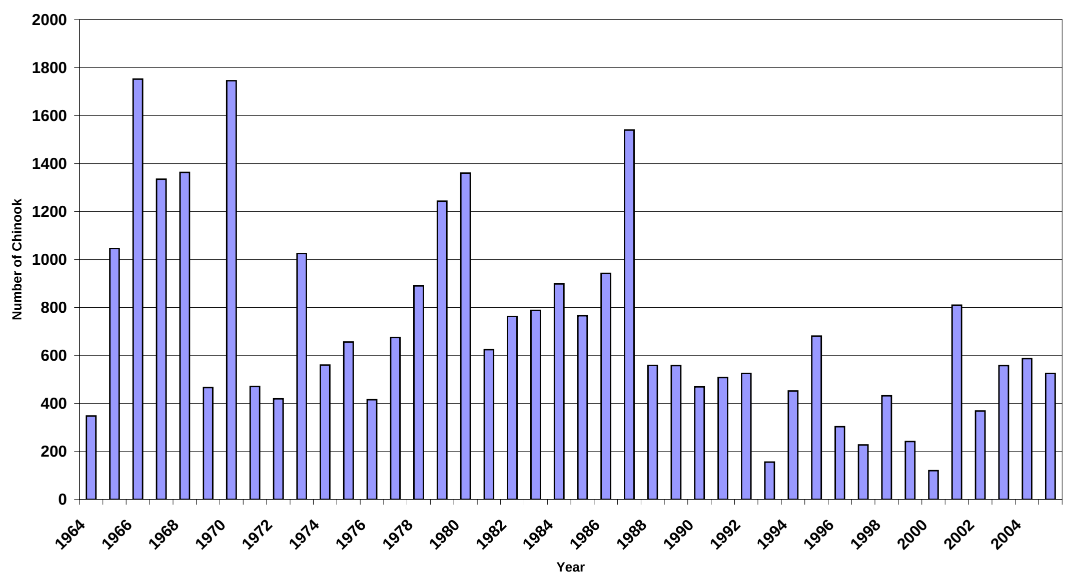
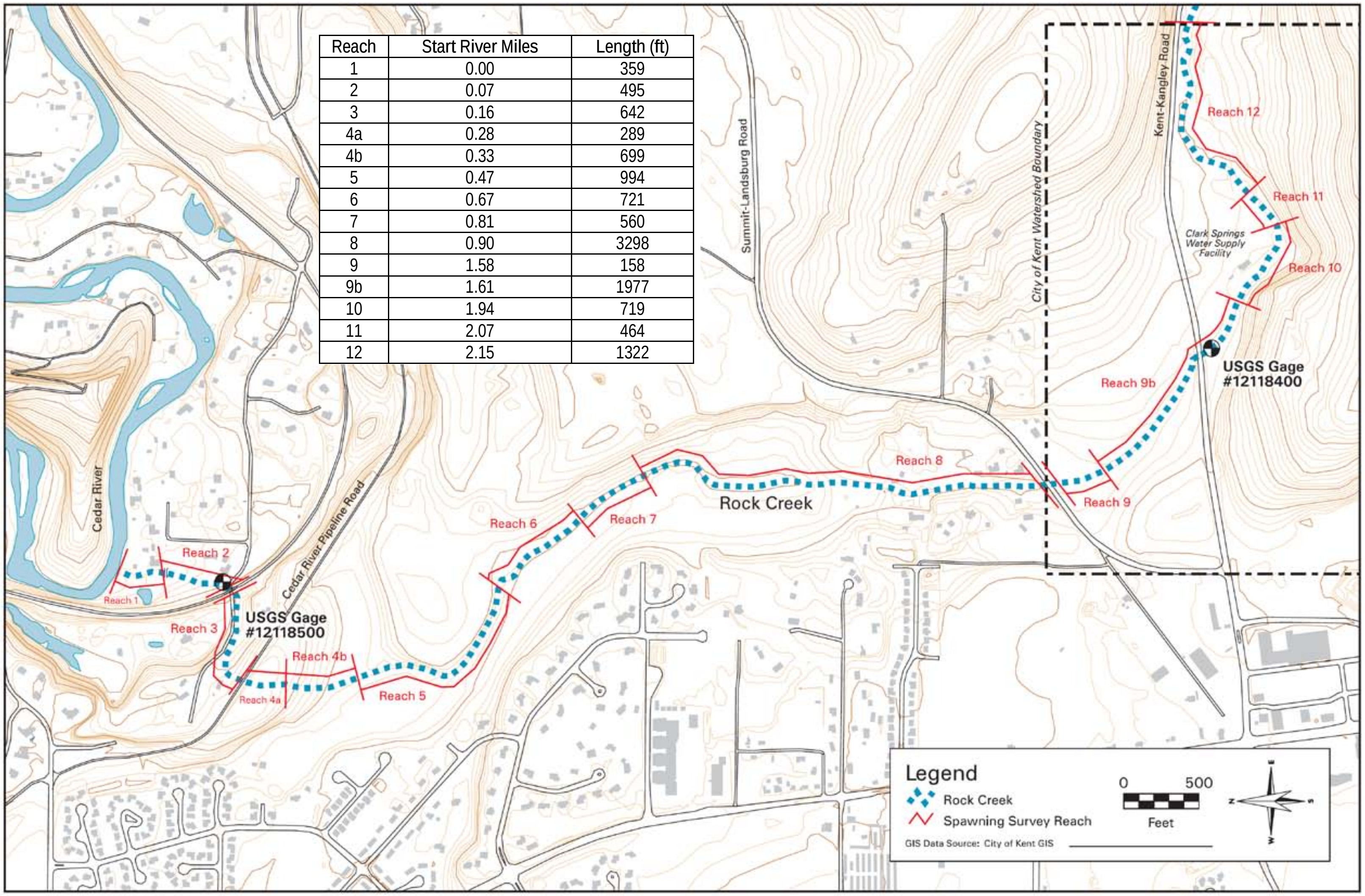


Figure 3.8-2 Estimated Chinook salmon escapement to the Cedar River 1964 to 2005. Data Source: Foley 2006, personal communication.



Reach	Start River Miles	Length (ft)
1	0.00	359
2	0.07	495
3	0.16	642
4a	0.28	289
4b	0.33	699
5	0.47	994
6	0.67	721
7	0.81	560
8	0.90	3298
9	1.58	158
9b	1.61	1977
10	1.94	719
11	2.07	464
12	2.15	1322

Figure 3.8-3 Map Rock Creek from its confluence with the Cedar River through the City of Kent Watershed at Clark Springs.

Table 3.8-1 WDFW salmon surveys on Rock Creek: 1960-2001.

Survey Date			No. of Surveys	River Miles		Length	Coho Salmon		Chinook Salmon		Chum Salmon		Sockeye Salmon		Steelhead	
Year(s)	**From**	**To**		**From**	**To**	**(mile)**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**
1960	6-Dec	6-Dec	1	1.5	2.1	0.6	111	6								
1961	11-Dec	11-Dec	1	0.0	1.5	1.5	14	26								
1962	30-Nov	30-Nov	1	0.0	1.5	1.5	78	9								
1966	9-Dec	15-Dec	2	0.0	2.6	2.6	251	146	3			1				
1967	20-Dec	20-Dec	1	0.0	1.5	1.5	30	35								
1968	4-Dec	12-Dec	2	0.0	0.5	0.5	23	22		7						
1969	8-Dec	17-Dec	2	0.0	0.2	0.2	7	6								
1970	25-Nov	25-Nov	1	0.0	0.7	0.7	68	28								
1971	21-Oct	16-Dec	2	0.0	1.3	1.3	84	14	7							
1972	No Data															
1973	28-Nov	28-Nov	1	0.0	0.2	0.2	25	7								
1974	20-Nov	20-Dec	3	0.0	1.4	1.4	323	200								
1975	18-Nov	16-Dec	3	0.0	1.4	1.4	96	8		1	1		10	4		
1976-1977	29-Sep	23-Feb	13	0.0	2.5	2.5	175	508								
1977-1978	2-Nov	16-Feb	18	0.0	2.6	2.6	1945	1385					18	2		
1978	12-Oct	20-Dec	6	0.0	2.5	2.5	454	308					1			
1979	5-Nov	17-Dec	4	0.0	1.3	1.3	299	12					20	11		
1980-1981	7-Nov	8-Jan	7	0.0	1.3	1.3	616	213	1				331	125		

Table 3.8-1 WDFW salmon surveys on Rock Creek: 1960-2001.

Survey Date			No. of Surveys	River Miles		Length	Coho Salmon		Chinook Salmon		Chum Salmon		Sockeye Salmon		Steelhead	
Year(s)	**From**	**To**		**From**	**To**	**(mile)**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**
1981-1982	2-Nov	2-Feb	13	0.0	1.3	1.3	515	241					29	212	1	
1982-1983	1-Nov	31-Jan	13	0.0	1.3	1.3	567	244	2	1			1049	381		
1983-1984	21-Oct	9-Feb	15	0.0	1.3	1.3	342	57	3				7472	5281	4	
1984-1985	31 -Oct	29-Jan	12	0.0	1.3	1.3	349	96					2904	2598	7	
1985-1986	1-Nov	6-Feb	12	0.0	1.3	1.3	600	154	1				2280	1265	5	
1986-1987	29-Oct	12-Feb	15	0.0	1.3	1.3	413	121					369	55	2	
1987-1988	6-Nov	25-Feb	17	0.0	1.3	1.3	1107	356					6195	1687	3	
1988-1989	24-Oct	31 -Jan	14	0.0	1.3	1.3	356	83					3113	2127	11	
1989-1990	31-Oct	25-Jan	11	0.0	1.3	1.3	322	97					490	183	2	
1990-1991	5-Nov	30-Jan	12	0.0	1.3	1.3	310	52					266	13		
1991-1992	29-Oct	4-Feb	13	0.0	1.3	1.3	103	88					254	295	6	
1992-1993	3-Nov	12-Feb	13	0.0	1.3	1.3	140	55					1033	416	1	1
1993-1994	27-Oct	20-Jan	12	0.0	1.3	1.3	177	33					156	140	23	
1994-1995	26-Oct	13-Jan	10	0.0	1.3	1.3	15	3					950	278	1	
1995-1996	20-Oct	18-Jan	11	0.0	1.3	1.3	216	63					97	9		
1996-1997	25-Oct	22-Jan	11	0.0	1.3	1.3	160	31					1162	308		
1997-1998	4-Nov	5-Feb	8	0.0	1.3	1.3	111	58					175	70		
1998-1999	5-Nov	26-Jan	13	0.0	1.3	1.3	9	14					212	18		
1999-2000	1-Nov	20-Jan	10	0.0	1.3	1.3	25	7					333	93		
2000-2001	3-Nov	19-Mar	15	0.0	2.3	2.3	142	231					3491	5790		

The Cedar River may be the only stream in the Lake Washington basin that is contributing natural steelhead production to the basin (City of Seattle et al. 1999). Cedar River steelhead spawn and rear in the mainstem and tributaries below Landsburg Dam. More recently, steelhead have regained access to 17 miles of mainstem and tributary spawning and rearing habitat above Landsburg Dam via a fish ladder constructed by the City of Seattle. In general, small perennial streams, such as Rock Creek, contain good steelhead spawning habitat (City of Seattle et al. 1999). Steelhead were historically present in Rock Creek, but the current level of utilization is uncertain. Based upon the distribution of cutthroat trout, sockeye salmon, and coho salmon, steelhead could potentially spawn at least through Reach 12 and juveniles could also rear in those reaches if spawning occurred. Stream-rearing occurs for 2 to 3 years before smoltification and outmigration to the ocean (City of Seattle et al. 1999). Passage conditions at culverts upstream of the Clark Springs Facility during high-flow periods are unknown. However, most culverts upstream of the watershed pass little to no water during the summer and early fall. No adult steelhead have been observed during recent fall and winter spawning surveys (R2 Resource Consultants, Inc. 2005a) and there have been no spawning surveys conducted during the spring months to document their use of Rock Creek. Between 1984 and 1992, steelhead spawner escapement for the Lake Washington basin met the WDFW goal of 1,600 in only 1 year, 1985. Surveys conducted during a similar period recorded steelhead in Rock Creek (Table 3.8 1). Escapement has ranged from 20 to 1,816 wild steelhead in the Lake Washington basin from 1986 to 2004 and escapements of fewer than 50 fish between 2000 and 2004 (Washington Department of Fish and Wildlife 2002).

Cedar River steelhead have been classified by NMFS as part of the Puget Sound ESU (1 of 15 West Coast steelhead ESUs). Total run size for the major stocks of this ESU was estimated at 45,000; natural escapement was estimated at 22,000 steelhead (Busby et al. 1996). On March 29, 2006, NMFS proposed steelhead in the Puget Sound ESU for listing as threatened (69 FR 19975). Subsequently, the final rule listing the Puget Sound ESU was published on May 8, 2007 (72 FR 26722). The WDFW has classified the stock as “critical” (Washington Department of Fish and Wildlife 2002). This classification was made based on the short-term severe decline in spawner escapement and run size. Many other regional stream systems have also displayed a steady decrease in winter steelhead populations since the mid-1980s (Kerwin 2001).

Bull Trout

Bull trout, along with Dolly Varden (*Salvelinus malma*), are members of the char family. These two species are similar in coloration, morphology, and life history, making distinction between the two species difficult without DNA analysis (Washington Department of Fish and Wildlife 1997). The State of Washington has established identical protective measures and management for the two species. Within the Puget Sound region bull trout exhibit resident, anadromous, and adfluvial life history strategies (U.S. Fish and Wildlife Service 2004, 64 FR 58910). Bull trout spawn in cold, clear streams with complex channel characteristics. Juvenile rearing in streams occurs for 1 to 4 years. The two migratory forms then begin to move downstream to take up residence in lakes (adfluvial) or nearshore marine areas (anadromous). Maturity occurs at age 4 to 7 years with spawning migrations to the natal stream. Unlike Pacific salmon, bull trout are iteroparous and repeat spawn annually or in alternate years.

A self-sustaining population of bull trout exists in the upper Cedar River Watershed upstream of Chester Morse Lake and Masonry Pool. Dolly Varden char are not known to be present in the watershed and will not be discussed further. Bull trout have rarely been observed in Cedar River reaches downstream of Masonry Pool. Recent observations include:

- One bull trout documented near the powerhouse at Cedar Falls during 1997 (City of Seattle et al. 1999)
- Three adult bull trout observed in the tailrace to the Cedar Falls powerhouse during July 2000 (U.S. Fish and Wildlife Service 2004)
- Three adult bull trout observed in the tailrace to the Cedar Falls powerhouse during August 2003 (U.S. Fish and Wildlife Service 2004)
- Occasional bull trout observed in Lake Washington and the Ballard Locks fish ladder (R2 Resource Consultants, Inc. 2000).

Bull trout were listed as threatened under the ESA by the USFWS on October 28, 1999. The WDFW includes bull trout as a State candidate species. Candidate species include fish and wildlife species that the WDFW will review for possible listing as State endangered, threatened, or sensitive.

Although bull trout have been observed in the Cedar River and Lake Washington, there have been no reported observations of bull trout in Rock Creek. However, the USFWS believes conditions "may come close to suitable spawning temperatures and that may provide thermal refuge for rearing or foraging during warm summer periods" (U.S. Fish and Wildlife Service 2004). Water temperatures in Rock Creek are generally within the suitable range for bull trout (less than 59ºF [15ºC]) (Goetz 1989), but daily maximum temperatures have been occasionally recorded that slightly (i.e., up to 60.8ºF [16ºC]) exceeds this temperature in the lower part of the creek (Subsection 3.6, Water Quantity and Water Quality). Lake Washington, Lake Union, the lower Cedar River (downstream of Cedar Falls), and their associated tributaries are considered to be foraging, migration, and overwintering habitat by the USFWS as part of the Lake Washington subunit (70 FR 56212). Core population areas such as the Stillaguamish, Snohomish, and Skykomish Rivers are considered to be the most likely source of bull trout to utilize the Lake Washington critical habitat subunit. Bull trout have been captured and observed within and below the Ballard Locks and within the associated fish ladder (Goetz et al. 2004).

Bull trout in the Chester Morse critical habitat subunit utilize an adfluvial life history strategy, meaning that the majority of rearing occurs in a lake with annual spawning migrations by mature fish to associated upstream rivers and streams. In the upper Cedar River, bull trout spawn during October and

November and rearing occurs year-round. There are no upstream passage facilities at Chester Morse or Masonry Dams, and Cedar Falls is considered a natural barrier to bull trout. Consequently, bull trout that actively migrate or are inadvertently washed downstream from the dams are considered lost to the Chester Morse population. In contrast to the Chester Morse population, bull trout that enter the Lake Washington Watershed by passing through the Ballard Locks utilize an amphidromous life-history strategy. Amphidromous bull trout spawn in natal freshwater streams and rivers, but migrate between freshwater and estuarine and nearshore marine areas throughout their life cycle. Amphidromous bull trout may also enter non-natal freshwater systems, such as Lake Washington, to overwinter and rear. Reproducing populations of bull trout have not been confirmed in the lower Cedar River (Kerwin 2001).

3.8.1.2 Other Covered Species

Puget Sound/Strait of Georgia Coho Salmon

Coho salmon populations exist as far south as the San Lorenzo River, California, and north to Norton Sound, Alaska (Sandercock 1991). Coho salmon are one of the most popular and widespread sport fishes found in Pacific Northwest waters. Rock Creek coho salmon appear to be typical of Puget Sound stocks with regard to their life history, which includes approximately 18 months spent in fresh water followed by up to 18 months in salt water (Weitkamp et al. 1995).

Adult coho salmon enter fresh water at the Ballard Locks during late August to mid-November (City of Seattle et al. 1999); migration up the Cedar River occurs from early September through late January (Figure 3.8-1). River flow and temperature have been found to be important factors in the timing of river entry (Weitkamp et al. 1995). Coho salmon are present in Rock Creek throughout the year. Adult salmon may enter Rock Creek in late October, but more generally the spawning migration begins in mid- to late November with peak spawning from the second week in December through mid-January (R2 Resource Consultants, Inc. 2004) (Appendix A of the HCP). Spawning generally occurs in Rock Creek from late October to early March (Washington Department of Fisheries et al. 1994; R2 Resource Consultants, Inc. 2004). Juvenile coho salmon may rear in Rock Creek for about a year, migrating as smolts during the spring following their emergence from the gravel. Some coho salmon juveniles may also emigrate over the year and undergo smoltification within the Cedar River.

Rock Creek coho salmon are identified by the WDFW as part of the Lake Washington-Cedar coho salmon stock. Although the status of Cedar River coho salmon was determined to be healthy in 1992 (Washington Department of Fisheries et al. 1994), as a result of recent downward population trends it is now classified as depressed (Washington Department of Fish and Wildlife 2002). Rock Creek coho salmon are included by NMFS in the Puget Sound/Strait of Georgia ESU. Continued loss of habitat, extremely high harvest rates, and a severe recent decline in average spawner size are considered substantial threats to remaining native coho salmon populations in the Puget Sound/Strait of Georgia ESU. Currently this ESU is not listed as threatened or endangered under the ESA, but is considered a species of concern. Consequently, upon reevaluation, NMFS may reconsider and propose to list the Puget Sound/Strait of Georgia population as threatened or endangered in the future (60 FR 38011).

Sockeye Salmon

Sockeye salmon exhibit a variety of life history habits and characteristically use lacustrine (lake) habitat more than other salmon species. The Cedar River, one of the most productive sockeye salmon streams in the Puget Sound region, is home to the largest wild sockeye salmon run south of British Columbia. There is debate whether sockeye salmon were historically present in Lake Washington prior to introduction of the Baker River stock in 1935. A "temporary interim hatchery" has been operated at the base of the Landsburg Dam on the Cedar River since 1991 and the City of Seattle has plans to build a permanent hatchery facility as part of its Cedar River Watershed HCP. Sockeye salmon fry releases from the temporary hatchery have averaged 9.7 million fish annually from 1995 to 2001 (Washington Department of Fish and Wildlife 2003).

Sockeye salmon begin to enter the Cedar River during late August or early September, continuing into January (Figure 3.8-1). Spawning takes place in mid-September to late December and occasionally through January (Gustafson et al. 1997). A few sockeye salmon may begin to enter Rock Creek during the last week of September, but more typically the run begins in early October with peak spawning occurring from mid-October to mid-November (MCS Environmental, Inc. 2003; R2 Resource Consultants, Inc. 2004, 2005a). Sockeye salmon spawning has been observed up through Reach 12, but the majority occurs in Reaches 1 through 4. Spawning escapement estimates for a set of reaches consistently surveyed between the 2001/2002 and 2004/2005 spawning seasons ranged from 502 to 3,346 sockeye salmon (R2 Resource Consultants, Inc. 2005a). Fry emergence begins in late January and continues through May. Sockeye salmon fry begin their downstream movement to Lake Washington shortly after emergence.

The sockeye salmon in Rock Creek are considered by the WDFW to be part of the Cedar River sockeye salmon run, a component of Lake Washington sockeye salmon. The Lake Washington sockeye salmon escapement goal has been met four times since 2000, allowing sport fishery during 2000, 2002, 2004, and 2006. The Cedar River sockeye salmon stock is not considered by NMFS to constitute an ESU under the ESA; therefore, it is not listed as threatened or endangered at this time.

Puget Sound/Strait of Georgia Chum Salmon

Adult chum salmon typically return to fresh water in October and November and spawn in the lower reaches of rivers from mid-November through December (Washington Department of Fish and Wildlife et al. 2002) (Figure 3.8-1). Preferred spawning areas are in groundwater-fed streams or at the head of riffles (Grette and Salo 1986). In general, chum salmon are reported to spawn in shallower, low-velocity streams and side channels more frequently than other salmon species (Johnson et al. 1997).

Juvenile chum salmon, like ocean-type Chinook salmon, have a short freshwater residence and an extended period of estuarine residence, which is the most critical phase of their life history and often determines the size of subsequent adult returns (Johnson et al. 1997; Grette and Salo 1986). Chum salmon fry in the middle Green River, a nearby watershed, were found to be present starting from the middle of March and continuing through the end of the study in June (Jeanes and Hilgert 2000). Peak abundance was likely influenced by large hatchery releases and occurred during May. Chum salmon populations are often limited in Puget Sound river systems by the quantity or quality of available estuarine habitat because of their dependency on estuaries as rearing habitat. Little suitable estuarine habitat remains in the Lake Washington drainage for rearing juvenile chum salmon (Kerwin 2001). Chum salmon mature at 2 to 6 years of age, most commonly at 3 or 4 (Salo 1991).

Chum salmon that are likely strays from established populations or hatcheries have occasionally been observed in the Cedar River drainage; however, native populations were virtually extirpated in 1917 by the diversion of the river into Lake Washington. During the 2004 season, seven chum salmon fry were captured in the Cedar River screw trap (Seiler et al. 2005). Adult chum salmon have been recently observed in Rock Creek (one fish) and Mercer Slough, and possibly in Bear Creek and other tributaries; however, the extent of any spawning is unknown (R2 Resource Consultants, Inc. 2005a; King County Water and Land Division 2004). Cedar River (including Rock Creek) chum salmon are considered by NMFS as part of the Puget Sound/Strait of Georgia ESU. Although chum are rarely seen in the Cedar River drainage, NMFS concluded that this ESU, as a whole, is not currently at risk of extinction, and is not likely to become endangered in the near future (63 FR 11778).

Coastal Cutthroat Trout

Natural coastal cutthroat trout habitat ranges from the Eel River of northern California to Prince William Sound in southern Alaska, rarely penetrating more than 100 miles inland (Behnke 2002; Johnston 1982). It is a common native species in western Washington, often referred to as sea-run cutthroat. The coastal cutthroat trout exhibits four life history variations: sea-run (anadromous or amphidromous) populations, resident stream populations, fluvial populations, and lake-adapted (adfluvial) populations (Behnke 2002). All variations may be exhibited within the same stream. While it is likely anadromous populations once existed historically in the Cedar River they are most likely not present in the Lake Washington Watershed today. The coastal cutthroat trout in Rock Creek are considered adfluvial fish from Lake Washington, as there are no records of sea-run cutthroat use at the Ballard Locks (City of Seattle et al. 1999). These adfluvial coastal cutthroat trout reside in Lake Washington and migrate in late winter into tributaries, including the Cedar River and Rock Creek, to spawn (Figure 3.8-1). Adult adfluvial coastal cutthroat trout have been observed in Rock Creek as early as the third week in November through mid-February (R2 Resource Consultants, Inc. 2005a); however, most observations tend to occur in late-December and into January. Spawning surveys conducted from 2002 through 2005 observed adult coastal cutthroat trout in Reaches 3 to 12 (R2 Resource Consultants, Inc. 2005a). MCS Environmental, Inc. (2003) observed the highest total over that period with 78 live coastal cutthroat trout and 8 carcasses observed during the 2002/2003 surveys.

Nowak et al. (2004) reported that coastal cutthroat trout usually enter Lake Washington at 2 years of age and Wydoski and Whitney (2003) reported juveniles generally rear in headwater streams for about a year before moving downstream to larger streams. Consequently, juvenile rearing habitat is likely important for at least a year for the offspring of adfluvial coastal cutthroat trout spawning in Rock Creek.

Considerable information exists for PS cutthroat trout, though little of that has been collected in a standardized manner and over a long-enough time period to establish trends in populations (Leider 1997). However, the Lake Washington cutthroat trout is not considered by USFWS to warrant listing under the ESA at this time (64 FR 16397). Based primarily upon anecdotal information Nowak et al. (2004) concluded the adfluvial population of cutthroat trout that resides in Lake Washington is relatively robust and is a significant predator on sockeye salmon juveniles, longfin smelt (*Spirinchus thaleichthys*), and three-spine stickleback (*Gasterosteus aculeatus*).

Pacific Lamprey

Pacific lamprey *(Lampetra tridentatus)* inhabit coastal streams from southern California north to Alaska (Wydoski and Whitney 2003). Pacific lamprey have been documented in the Cedar River below Landsburg Dam (City of Seattle et al. 1999). One lamprey was captured during electrofishing surveys in Rock Creek during August 2002, but its species was not identified (MCS Environmental, Inc., unpublished data).

In the Pacific Northwest, adult Pacific lamprey enter fresh water in July to October, and overwinter to spawn in May when water temperatures are between 50°F and 59°F (10°/15°C (Close et al. 1995; Wydoski and Whitney 2003). Pacific lamprey are relatively weak swimmers (Close et al. 1995) and utilize their sucker-like mouths to cling to substrate when passing through areas of high velocity (Moser et al. 2002). They do not feed during the spawning migration, and die shortly after spawning. The spawned-out carcasses provide important nutrients to the stream system, as well as dietary items for other fish, such as white sturgeon (Close et al. 1995). Pacific lamprey may reach a size of over 2 feet long at maturity (Hart 1973). Larval Pacific lamprey, called ammocoetes, rear in slow-moving waters with high levels of fine organic materials for 4 to 6 years (Close et al. 2002). The ammocoetes burrow into the substrate and feed on suspended materials, such as diatoms and desmids (Torgersen and Close 2004), and algae (Moyle 1976) filtered from the water. Pacific lamprey are considered a species of concern by the USFWS and a monitor species by WDFW. A Washington State monitor species is not a species of concern, but is monitored and managed as needed to prevent its listing as an endangered, threatened, or sensitive species. No information is available on the population size or trends in the Cedar River Watershed or Rock Creek.

River Lamprey

River lamprey *(Lampetra ayresi)* exhibit life-history characteristics similar to that of the Pacific lamprey. Furthermore, river lamprey juveniles are morphologically similar to Pacific lamprey, making positive distinction between the two species difficult (Wang 1986). The adult river lamprey is smaller than the Pacific lamprey, with a body length of only 30 cm, or slightly less than 1 foot (Hart 1973). River lamprey remain in the ocean for only about 10 weeks (Kostow 2002). They remain very close to shore, near their natal rivers. The life span of river lamprey from metamorphosis to death after spawning is shorter than that of the Pacific lamprey, lasting approximately 2 years (Beamish 1980). No specific documentation has been found concerning river lamprey in the action area. However, similar to Pacific lamprey, it is possible the species may be present because of the capture of an unidentified lamprey during surveys in August 2002. River lamprey are considered a species of concern by the USFWS and a candidate species for listing as a State endangered, threatened, or sensitive species by WDFW. No information is available on the population size or trends in the Cedar River Watershed or Rock Creek.

3.8.2 Other Resident Fish Species in Rock Creek

Little direct information is available regarding other resident fish species that may be present in Rock Creek. Electrofishing surveys conducted during August 2002 collected unspecified sculpins (*Cottus* spp.) in addition to coho salmon, cutthroat trout, and unspecified cutthroat/rainbow trout. Jones and Stokes (1993) reported that surveys between 1976 and 1983 predominantly collected salmonids, including subyearling coho salmon, subyearling trout, yearling or older cutthroat trout, and yearling or older steelhead. They also noted that three crappie (*Pomoxis* spp.) were captured, which they hypothesized were either flushed out from marshes located in the headwaters of the creek or released by anglers who captured them elsewhere. Crappie are an introduced warm-water fish native to central and eastern North America that would not be expected to survive in the habitat types or water temperatures present in Rock Creek downstream of Clark Springs.

Fish collections from elsewhere in the Cedar River basin may provide an indication of species that may also be present in Rock Creek. As part of an ongoing annual class project, University of Washington Professor Tom Quinn and his students have conducted surveys from 2003 to 2006 in upper Rock Creek[1], which drains into the Cedar River at RM 23.9 (Quinn 2008). In addition to the salmonids and lamprey mentioned above, Quinn's class has collected torrent sculpin (*Cottus rhotheus*), reticulate sculpin (*C. perplexus*), and speckled dace (*Rhinichthys osculus*). The City of Seattle (1999) reported the presence of western brook lamprey (*L. richardsoni*) and redside shiner (*Richardsonius balteatus*) in the Walsh Lake Diversion, which drains into the Cedar River at RM 19.3. King County (1993) identified three-spine stickleback in the Cedar River basin. Additionally, mountain whitefish (*Prosopium williamsoni*) are present in the Cedar River basin, but Wydoski and Whitney (2003) note that mountain whitefish generally inhabit larger streams, which suggests they are more likely to be present in the mainstem Cedar River than in its smaller tributaries.

1 Upper Rock Creek is distinct from lower Rock Creek, which is the focus of this HCP EIS.

The following life history information is derived from Wydoski and Whitney (2003). All of the fish species discussed below may be utilized as food by larger trout.

Sculpins are in the cottid family, which is a rather large family with marine, estuarine, and freshwater species. The 10 freshwater sculpin species native to Washington are all in the *Cottus* genus and are generally difficult to identify in the field because of their small size, similarity in basic form, and variable mottled coloration. The torrent sculpin can be found in both lakes and streams. In streams it is usually found among coarse substrate (gravel, cobble, small boulders) with fast water velocities between 1.4 to 4.0 feet per second (fps). The reticulate sculpin is found in both pools and riffles of streams, but is often restricted to pools if torrent sculpins are also present in the stream. Both of these sculpins primarily forage on benthic macroinvertebrates, but may also feed on salmon and trout eggs or fry when available.

Speckled dace and redside shiner are both small fish in the Cyprinidae family native to Washington. Speckled dace are a bottom-oriented species having a maximum length of about 4 inches and are usually found in streams, but are occasionally found in lakes as well. Most redside shiners are less than 5 inches in length and can be found in a variety of freshwater habitats (lakes, ponds, streams, and irrigation ditches). Fry for these species eat plankton and algae while larger fish primarily forage on aquatic insects.

The three-spined stickleback is common in many places around the world and inhabits both streams and lakes. Three-spine sticklebacks are a relatively small fish usually less than 3 inches in length that forages on zooplankton and aquatic insect larvae. In streams and lakes, three-spine sticklebacks generally live close to the bottom and are often utilize aquatic vegetation as cover.

3.8.3 Fish Habitat Conditions

3.8.3.1 Historic Influences on Fish Habitat Conditions

There have been extensive changes in the Rock Creek basin, the Cedar River, Lake Washington, and adjoining ecosystems since Euro-American settlement began more than a century ago. Land and water use activities such as logging, urban and residential development, agriculture, transportation, and municipal and industrial water supply have all influenced the processes regulating the flow of water, sediment, and nutrients throughout the basin. These processes govern the underlying productivity of a system, and directly influence fish and other species that rely on aquatic habitats for some or all of their life cycles. Manipulation of fishery resources that utilize the Cedar River and Rock Creek systems, including the establishment and operation of hatcheries and commercial, sport, and tribal fishing, have directly influenced the sizes of spawning population. Indirect activities that alter habitat also impact fish populations. This subsection reviews historic influences on fish and their environment in the Rock Creek basin, and thus sets the framework for understanding the context of the City's Clark Springs System water withdrawals, and the overall effects of associated conservation and monitoring activities proposed in the HCP.

Fish populations in Rock Creek are controlled, in part, by basin-scale characteristics of sediment sources, transport and deposition, surface and groundwater hydrology, and nutrient supply. Habitat conditions in the Rock Creek basin are naturally constrained by ongoing geomorphic processes (sediment transport, hydrology, and wood recruitment) as well as anthropogenic disturbances (development, logging, agriculture, and water withdrawal).

Aquatic habitat characteristics are typically a function of channel type, which is a function of gradient and confinement. In the absence of anthropogenic influences, pool-riffle habitat sequences with a gravelly bed would be expected to predominate in the lower reaches of Rock Creek, where the channel crosses the Cedar River floodplain. Beginning in Reach 3 at around RM 0.2 the channel becomes steeper and more confined as it cuts across the valley wall formed by the Cedar River. The higher gradient and confinement increase the stream energy and constrain lateral channel migration, resulting in the formation of step-pool sequences and generally coarser substrates; with abundant wood, this portion of the channel would be expected to exhibit forced pool-riffle morphology. Upstream of RM 1.5 in Reach 9, Rock Creek flows across a wide valley consisting of coarse sediments deposited by much larger glacial outwash streams under a very different climatic regime (Appendix C of the HCP).

Under the current climatic regime, sediment inputs from headwater areas via mass wasting and surface erosion are naturally low (Appendix C of the HCP). Erosion of glacial outwash deposits in the valley bottom is the primary mechanism for recruitment of gravels to Rock Creek. The largest particles within the glacial outwash deposit may be too big for Rock Creek to move under the current hydrologic regime, particularly in headwater reaches, thus the bed would be expected to consist of a heterogeneous mixture of sediment sizes with a pool-riffle to braided morphology.

The flow regime of Rock Creek is dominated by either surface flow or groundwater flow, depending on the season, as described in Subsection 3.6.1, Surface and Groundwater Hydrology. The contributing area and dominant water source determine the amount and quality of available aquatic habitat. Although groundwater flow may maintain higher summer base flows per unit area in the lower reaches of Rock Creek in comparison with other nearby non-groundwater-fed tributaries, the relatively small contributing area of Rock Creek (groundwater and surface water) limits the overall amount of available aquatic habitat even under unregulated conditions.

In small streams such as Rock Creek, large wood can be a primary factor controlling the quality of aquatic habitat (Bjornn and Reiser 1991). Under unregulated conditions, most of the Rock Creek basin would be expected to support forest vegetation. Forest communities on the Cedar River floodplain would be influenced by floods and channel migration of the Cedar River, and would thus be expected to consist of a mosaic of tree species and ages. Wood would be recruited to lower Rock Creek through mortality, bank erosion, and potentially by overbank flows in the Cedar River. Where Rock Creek crosses the Cedar River valley wall, riparian stands would have naturally consisted primarily of coniferous forest. Wood recruitment would occur from bank erosion and mass wasting. Upstream of RM 0.2 in Reach 3, vegetation would most likely have consisted of conifer forests as it does currently, except in naturally occurring wetlands where trees would have been less common. Typical of unregulated forests, windthrow and natural mortality would have been the primary large wood recruitment mechanisms (Spence et al. 1996). Trees and organic material falling into the stream provide habitat structure and food for aquatic insects, which in turn are eaten by fishes (Marcus et al. 1990). During December 2005 an extreme windstorm added substantial amounts of large wood to Reaches 2 and 3 and initiated changes in the channel morphology and movement of channel substrate.

Anthropogenic activities over the past 150 years have also combined to influence current habitat conditions in Rock Creek (Kerwin 2001). Many physical changes to the hydrologic regime, sediment supply and transport, and stream channel have both directly and indirectly affected fish and their habitat. The changes are briefly described below, in no particular order of importance.

Transportation

The first road in King County was constructed around 1854; railroad construction in the general area of Rock Creek began in 1867. Settlement in Maple Valley began in 1879, while the Black Diamond Mine began operations in 1882 and the town of Ravensdale began settlement in 1900 (Sisler 1939). Since then, construction of roads and railroads has affected aquatic habitats throughout the Rock Creek basin. Major roads in the Rock Creek basin include Kent-Kangley Road, Summit-Landsburg Road, Ravensdale Way, and Retreat-Kanaskat Road. In addition, a number of other county, local, and private roads are located within the basin. Road crossings downstream of the Clark Springs Facility are Kent-Kangley Road, Summit-Landsburg Road, and SE 248th Street. Based upon recent spawning surveys (MCS Environmental, Inc. 2003, R2 Resource Consultants, Inc. 2004, 2005a) anadromous fish are known to pass these three road crossings, but little information is available regarding fish passage at road crossings upstream of Clark Springs. Many of the road crossings upstream of Clark Springs do not actively pass water except during the rainy season.

Historically, an old railroad generally followed the Cedar River, crossing Rock Creek approximately 800 feet from its mouth. That railroad was abandoned, and the right-of-way has since been converted to a trail. The Burlington Northern Railroad continues to maintain an active rail line that crosses the center of the basin near Ravensdale, running generally parallel to Rock Creek for about a mile.

Other infrastructure located in the Rock Creek basin includes the City of Seattle’s aqueduct, a water supply pipeline that runs east from the Landsburg diversion, crossing Rock Creek approximately 0.25 mile upstream of the confluence with the Cedar River. This crossing has been considered as at least a partial barrier or impediment to upstream passage of adult salmonids under some flow conditions and, as a result, Seattle Public Utilities reviewed options to repair this structure (Chinook Engineering 2002) and, in the summer of 2007, repaired the partial blockage (personal communication with J. Herold, Seattle Public Utilities, June 21, 2007). The replacement culvert was designed as a box culvert 26 feet wide with roughness structures that extend approximately 1 foot from the sides. A low-flow channel approximately 5 feet wide would be built with a step-pool configuration using 18- to 36-inch boulders for the major features of the channel and smaller cobble and gravel materials for the streambed. Post-construction monitoring is planned to include comparison of juvenile salmonid densities upstream and downstream of the new structure.

Logging

The earliest widespread human activity affecting the Rock Creek basin was timber harvest. In general, logging activities have been documented to result in increased fine sediment inputs and sediment loading, altered streamflows, and removal of riparian vegetation that provides shade, bank stability, leaf litter, and large wood to the stream (Spence et al. 1996). Large-scale logging in the vicinity of the Rock Creek basin began circa 1880 to 1910 (Kerwin 2001). Past logging has affected conditions throughout the basin; although the majority of the area is currently forested, those forests consist primarily of second-growth timber stands. If harvested areas are allowed to become revegetated, the sediment inputs eventually return to natural levels (Spence et al. 1996). However, permanent conversion of forest to urban, residential, or agricultural land uses may result in more permanent changes in sediment delivery and flow regime (Spence et al. 1996).

Urban and Residential Development

Urbanization involves conversion of land and wetlands into residential, commercial, and industrial uses. Primary effects of urbanization on river ecosystems, in addition to the related water withdrawal and land uses described in previous and successive paragraphs, include: water quality degradation through sewage discharge and septic tank leakage, spills of pollutants, runoff over contaminated and fertilized surfaces, groundwater contamination and subsequent non-point source inflow to the stream channel, and point source discharge; increased peak flows and reduced summer flows in association with increased impervious area and reduced floodplain storage; increased fishing pressure as the human population expands; filling of wetlands and drainage channels for development; and removal of riparian vegetation and increased summer water temperatures (Spence et al. 1996; May 1998). Pollutants associated with urbanization that influence water quality include, but are not limited to, heavy metals; petrochemicals and related byproducts, herbicides, and pesticides; other organic compounds; and nutrients (Spence et al. 1996).

As of 2004, approximately 72 percent of the Rock Creek Watershed was forested (Radford 2004). The remainder of the area has been cleared, primarily for urban/rural development and limited, small-scale agriculture and animal husbandry. Although there are some developed and densely populated areas in the Rock Creek basin, the estimated total impervious area (3.2 percent) is below the threshold (5 percent) at which significant effects on the hydrologic regime and impacts on the overall biological integrity are observed (May et al. 1997).

There has been some residential development immediately downstream of the Summit-Landsburg Road and from the Cedar River pipeline to the mouth of the creek. Stream crossings occur at four locations within the perennial section of the stream: SE 248th Street, the Cedar River Pipeline, Summit–Landsburg Road, and Kent-Kangley Road. These types of activities have resulted in some modifications to the stream channel (riprap and straightening) and localized loss of riparian trees. Modification of channel banks through placement of riprap or other materials reduces the quality of lateral margin habitat that has been shown to be important for juvenile salmonids (Washington Department of Fish and Wildlife and Inter-Fluve 2003). A number of roads cross Rock Creek upstream of Clark Springs and utilize culverts to pass stream flow when it is present. No detailed culvert surveys have been conducted to determine their condition or ability to meet State fish passage requirements.

Consumptive Water Use

Water use in the Rock Creek basin is described in detail in Appendix C of the proposed HCP. Unless specifically noted, the information presented below is derived from that document. Consumptive water use in the Rock Creek basin consists primarily of groundwater withdrawal. Groundwater withdrawals generally fall into four categories:

- Municipal water supply
- Private multi-dwelling water supply
- Other wells with water rights
- Domestic wells (exempt from the water rights permitting process)

The City holds the largest water right in the Rock Creek basin. Available records indicate that the City began withdrawing water from the shallow aquifer at Clark Springs in 1957. The Clark Springs System is used on a continuous basis throughout the year.

The combined Clark Springs surface water, wells, and trench rights total 12 cfs/5,400 gpm (instantaneous withdrawal) and 8,710 acre-feet per year (annual). Over the period from 1986 to 1998, annual withdrawals averaged 6.2 cfs/2,693 gpm. Water withdrawal records from 1968 through 1985 are available only as monthly totals and records are incomplete prior to 1968. Withdrawals from 1957 to 1965 are believed to be relatively low at levels under 0.5 cfs. Between 1968 and 1973, monthly withdrawals ranged from 1.2 to 5.9 cfs and averaged 3.4 cfs. The available records indicate the period from 1974 to 1985 had somewhat higher monthly withdrawals compared to the earlier periods with a range of 3.4 to 8.1 cfs and an average of 5.7 cfs.

The Ravensdale well, operated by the Covington Water District, is another source of municipal water that withdraws groundwater within the Rock Creek basin. Groundwater pumping from that well increased steadily between 1996 and 2000, but repairs and/or replacement of leaky pipes during mid-2000 resulted in decreases between 2001 and 2004; in 2001 pumpage was approximately 0.08 cfs/35 gpm (Appendix C of the proposed HCP).

In addition, several independent, privately operated water supply systems provide water to subdivisions at Evergreen Acres, Retreat Lake, Lake Twelve, and a number of other locations throughout the basin. Total capacity for these systems within the Rock Creek basin is 9.4 cfs/4,231 gpm; information on actual water usage is lacking.

Other water rights that are all or partly within the Rock Creek basin total 1,230 acre-feet per year, which is equivalent to 1.7 cfs. In addition, a large number of wells that withdraw less than 5,000 GPD are exempt from the water rights permitting process and provide water to individual landowners. The overall impact of private and individual water supply withdrawals is likely less than the stated water right amount because a portion of the water returns to the aquifer as infiltration or septic flow from drainfields.

One additional water diversion has been documented in the Rock Creek basin. For an unknown period of time, there was a 6-to-8-foot-wide diversion channel that cut through from Crow Marsh to the Green River. Flow in this channel was observed to be approximately 5 cfs in 1993 (King County 1993). This diversion channel was eventually blocked off by King County in 1997.

Hatchery and Supplementation Practices

Hatchery and supplementation practices, often referred to as artificial propagation, have historically been used as partial or complete mitigation for urbanization, hydropower, municipal and agricultural water supply, highway construction, or other projects that affect stream habitats. Artificial propagation has also been used to sustain or increase available numbers of fish for recreational and commercial harvest. Under the ESA, artificial propagation can be a potential recovery mechanism for some stocks of Pacific salmon (Hard et al. 1992). For instance, artificial propagation appears to have reversed the decline in abundance of spring-run Chinook salmon in the White River in western Washington (Washington Department of Fish and Wildlife et al. 1996). However, artificial propagation appears to entail risks as well as opportunities for recovery of Pacific salmon populations. Steward and Bjornn (1990) noted that interactions between hatchery fish and natural fish may result in greater competition for food, habitat, or mates; an increase in predation or harvest pressure on natural fish and amphibian populations; potential transmission of disease; and deleterious genetic interaction between populations. In its status review of Chinook salmon, NMFS also noted among other things that hatchery production may mask trends in natural populations and hinder determination of whether runs are self-sustaining (Myers et al. 1998).

Three hatcheries are operated in the Lake Washington/Cedar River Watershed: the Landsburg sockeye salmon hatchery on the Cedar River, the Issaquah hatchery on Issaquah Creek, and the University of Washington hatchery, located along the north side of the Lake Washington Ship Canal. The City of Seattle has been operating an interim sockeye salmon hatchery near Landsburg since 1991; it has the capacity to produce up to 17 million fry annually. Releases from this hatchery averaged 9.7 million fish annually from 1995 to 2001 (Washington Department of Fish and Wildlife 2003). A permanent hatchery as part of the Cedar River Watershed HCP is scheduled for completion in 2008. The planned capacity of this facility is 34 million sockeye salmon fry annually (Seattle Public Utilities 2005). Actual releases would vary based on criteria in an adaptive management plan. The WDFW operates a Chinook salmon and coho salmon hatchery in Issaquah that has an annual production of 2 million Chinook salmon fingerlings and 450,000 coho salmon yearlings (Washington Department of Fish and Wildlife 2002, 2003). Beginning in 1996 for coho salmon and 2000 for Chinook salmon, all fish released from the Issaquah hatchery were marked with an adipose fin clip. The University of Washington's hatchery is a research and educational facility that releases approximately 90,000 yearling coho salmon and 180,000 fingerling Chinook salmon (Washington Department of Fish and Wildlife 2002, 2003). All released fish are marked with either a coded wire tag and/or an adipose fin clip.

Recent observations since 2003 of adipose-clipped Chinook salmon and identification of code wire tags from hatchery fish in Cedar River and its tributaries have led to concern about the straying of Issaquah hatchery fish into the Cedar River and elsewhere (WRIA 8 Steering Committee 2005). While other hatcheries, including the University of Washington, Grover's Creek (located on the Kitsap Peninsula), and Soos Creek, may also contribute to Chinook salmon hatchery strays into the Cedar River, most of the hatchery strays are believed to derive from the Issaquah hatchery (WRIA 8 Steering Committee 2005). It is also possible that straying could occur from naturally reproducing Chinook salmon elsewhere in the Lake Washington Watershed, such as Issaquah Creek, Bear Creek, North Creek, and Kelsey Creek. A large number of strays relative to wild Chinook salmon spawning in the Cedar River could potentially result in a dilution of the Cedar River gene pool.

Fishing Harvest

Salmon originating from the Cedar River basin, including Rock Creek, are caught in both the United States and Canada sport and commercial saltwater fisheries. Hatchery production facilitates a higher harvest rate than wild-spawning populations are able to sustain. Sport angling and tribal gill-net fisheries for Chinook salmon and coho salmon and steelhead have been active within the densely populated Elliott Bay area, near the mouth of the Duwamish River. In addition, limited sport fishing seasons for Lake Washington sockeye salmon have occurred in recent years when escapement is deemed high enough to sustain a fishery. Until recently, the Cedar River has generally been closed to fishing. However, during 2004, portions of the Cedar River were open for catch-and-release fishing of gamefish. Rock Creek continues to be closed to fishing.

3.8.3.2 Current Fish Habitat Conditions

The current conditions of aquatic populations, habitat, and channel morphology in Rock Creek have been characterized based on eight surveys of the creek conducted since 1993 (Jones and Stokes 1993; May 1996; Pentec Environmental 2001a, 2001b; MCS Environmental, Inc. 2003; Priest and Berge 2002; R2 Resource Consultants, Inc. 2004, 2005a, 2005b). In particular, physical habitat surveys provide a basic understanding of the channel characteristics present that affect aquatic populations, including salmon. Based upon data collected by Pentec (2001a) in Reaches 1 through 10, Rock Creek is a small stream with an average bankfull width of 28.3 feet (range 16.7 to 49.2 feet). Pentec (2001b) estimated that bankfull flows at three transects would range from 124 to 176 cfs.

The habitat conditions in lower Rock Creek are in part a product of topographic features within the watershed. Jones and Stokes (1993) reported that stream gradients downstream of the proposed Wilderness Retreat/Wilderness 50 development adjacent to Reach 4 averaged 3.3 percent, those within the development reach averaged 2.5 percent, and those above the proposed development were 0.7 percent. This proposed development was subsequently purchased by King County and protected as the RCNA described in Subsection 1.2, Purpose and Need for the Proposed Action (see also Figure 3.2-1). In addition, much of the stream between Reaches 3 and 7 was moderately to highly confined on one or both sides of the stream (Figure 3.7-1). This type of topography would tend to promote riffles if no instream structures were present (Montgomery and Buffington 1993). However, Pentec (2001a) and Jones and Stokes (1993) both concluded that instream large wood amounts are generally good in the perennial portion of the stream and contain a mixture of primarily pool and riffle habitat types.

A number of events may have resulted in changes in channel morphology of Rock Creek between the surveys described above, including flooding that occurred in November 1995 and a windstorm in December 2005 that added substantial amounts of large wood to Reaches 2 and 3 and initiated changes in the channel morphology and movement of channel substrate. In addition, mitigation measures for the replacement of the box culvert at SE 248th Street also resulted in the addition of large wood to Reach 2. The relatively high levels of large wood found in much of Rock Creek provide structure to the stream and have promoted the development of frequent, but small, pools.

The available habitat survey information indicates there is high quality gravel suitable for salmonid spawning and incubation habitat downstream of the wetlands below Summit-Landsburg Road, and excellent coho salmon-rearing habitat within and upstream of the Summit-Landsburg Road. These high quality conditions are maintained in part by the presence of forested riparian zones in Rock Creek, and their subsequent input of large organic debris, providing habitat and cover for salmonid species. In contrast, the surveys suggest that adult holding, juvenile rearing, and overwintering habitat are in short supply from Reaches 1 through 7 because of the general lack of large, deep pools (Figure 3.8-4) and little off-channel habitat.

Lack of suitable water depth in Rock Creek appears to be a critical limiting factor for the spawning of large-bodied fish such as Chinook salmon. A model based on a geographic information system (GIS) concluded that Rock Creek has a very low potential for Chinook salmon spawning habitat because it is too small (Sanderson et al. 2004; Personal communication with J. Davies, National Marine Fisheries Service, January 20, 2005). A Physical Habitat Simulation (PHABSIM) model analysis conducted during preparation of the proposed HCP supports this conclusion, suggesting that approximately 10 percent or less of the creek area downstream of the Parshall Flume would be suitable for Chinook salmon spawning under a hypothetical no-withdrawal scenario (Appendix F of the proposed HCP). Mean water depth along PHABSIM transects at a modeled flow of 7.0 cfs (approximating typical

October flows under a no-withdrawal scenario) was 0.6 feet, which has a habitat suitability index (HSI) of about 0.1 under the Washington fallback HSI depth curves and about 0.4 under the Douglas County HSI depth curve (1.0 is optimal). In contrast, the depth suitability at 0.6 feet is 0.8 under the fallback HSI curve for sockeye salmon spawning. Taken together, the PHABSIM analysis, depth analysis at PHABSIM transects, and the depth HSI curves suggest that much of Rock Creek has low suitability for Chinook salmon spawning because it is too shallow.

Figure 3.8-4 A typical pool in Reach 5 on May 5, 2004 during flows of 6.5 cfs with a mean depth of 0.52 feet and maximum depth of 0.97 feet along the Physical Habitat Simulation (PHABSIM) transect.

Access to the stream by adult Chinook salmon and sockeye salmon has been identified as a concern during public scoping, particularly during the low-flow period of late September through October (Figure 3.8-5). The mouth of Rock Creek drops off quickly as it enters the Cedar River at a run-channel feature lacking suitable adult holding habitat. In addition, the mouth of Rock Creek widens near the Cedar River confluence, resulting in shallower depths that make it more difficult for adult salmon to enter the creek. Flows in the Cedar River may also affect access into Rock Creek. At flows of about 200 cfs, the Cedar River begins to inundate the initial drop-off at the mouth of the creek (Figure 3.8-5). At lower Cedar River flows (Figure 3.8-6) the drop-off is more prominent and contributes to poor passage conditions at the mouth of the creek. The minimum instream flow for the Cedar River under normal conditions under the Cedar River Watershed HCP is 133 cfs from September 16 to September 22, 210 cfs from September 23 to October 7, and 330 cfs from October 8 to December 30 (City of Seattle 1999).

The majority of Rock Creek, from its perennial source above Clark Springs to the mouth of the creek, is currently protected from urban or residential development. This has resulted in a relatively pristine riparian corridor consisting of mature second-growth forest including Douglas-fir, western red cedar, western hemlock, big-leaf maple, red alder, and black cottonwood (Jones and Stokes 1993). The Clark Springs Facility is protected by the City as a water supply source. Although the proposed Wilderness Retreat/Wilderness 50 development was not implemented, King County purchased and converted these and other adjacent properties into the RCNA.

Figure 3.8-5 The mouth of Rock Creek on September 30, 2003. Rock Creek enters the Cedar at the right of the photo. Rock Creek flows were 2.4 cfs and Cedar River flows were 218 cfs.

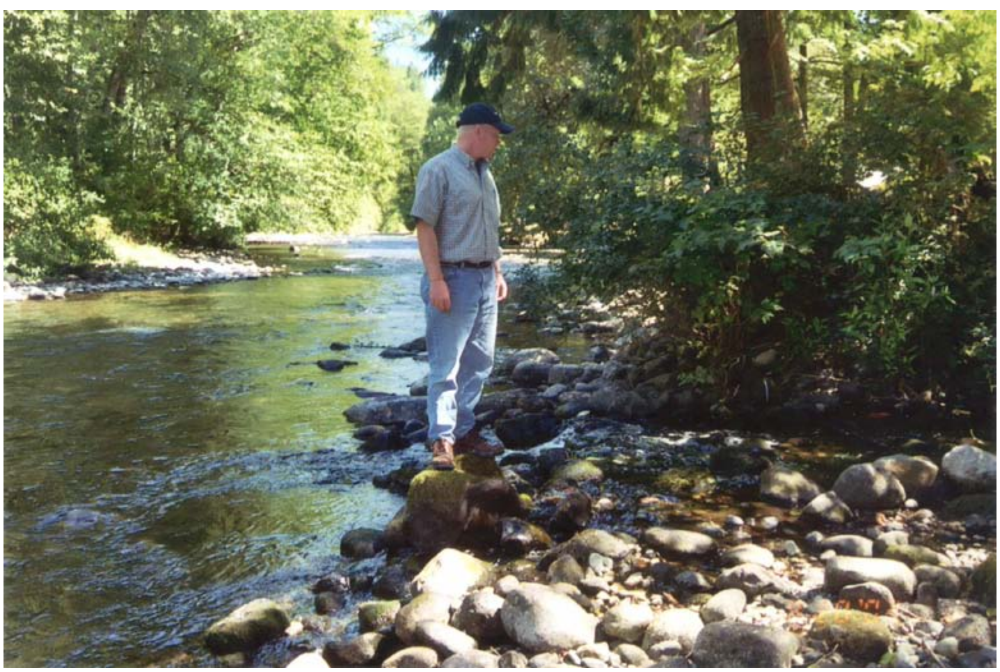


Figure 3.8-6 The mouth of Rock Creek on September 20, 2003. Rock Creek flows were 1.7 cfs and Cedar River flows were 118 cfs.

3.9 Wildlife

3.9.1 Wildlife Habitats and Communities within the Action Area

3.9.1.1 Clark Springs Facility

The Clark Springs Facility ranges in elevation from approximately 500 to 800 feet. The property can be divided into seven primary habitats, or cover types, relative to wildlife habitat:

- Stream
- Second-growth forest (the most prominent habitat type)
- Shrub (primarily under maintained electrical transmission line right-of-way)
- Grass/forb (periodically mowed)
- Palustrine forested wetland
- Palustrine emergent-palustrine scrub/shrub wetland
- Facility (maintained lawn, gravel areas, and buildings)

Rock Creek runs through the Clark Springs Facility through forest and shrub habitats. The stream habitat through forested areas is relatively undisturbed (no current active management) and well shaded. Maintenance of the transmission line right-of-way perpetuates dense shrub habitat along portions of the creek, preventing forest development in the adjacent riparian area.

The most prominent habitat type found in the 320-acre Clark Springs Facility is second-growth forest consisting of a mix of conifer and deciduous tree species, primarily Douglas-fir, western hemlock, western red cedar, big-leaf maple, and red alder (approximately 300 acres). The stand is relatively uniform in age and structure and dominated by trees with diameters at breast height (dbh) of 12 to 20 inches, with scattered conifer up to approximately 30 inches dbh. Forested areas generally have a well-developed and dense understory of mixed shrubs and young trees. Small forested wetlands with well-developed shrub understories are present along the creek in areas where the channel is not confined and where multiple side channels have developed. The forested wetlands and a second wetland in the southwest corner of the Clark Springs Facility are described in Subsection 3.7, Vegetation. The continuity of the forest is broken up by the City’s water supply facilities, the electrical transmission line right-of-way, and the Kent-Kangley and Summit-Landsburg Roads.

Of the remaining 17 acres of the Clark Springs property the City maintains approximately 2 acres over the infiltration gallery in a grass/forb habitat condition by periodic mowing; another 2 acres are occupied by the facility buildings, lawns, gravel parking and roadways, and facility buildings. There are also 13 acres of shrub habitat in the BPA right-of way. The BPA maintains the right-of-way mechanically to preclude the development of trees that could interfere with the overhead transmission lines. No herbicides are used for vegetation maintenance at the Clark Springs Facility. The vegetation in the right-of-way is very dense, consisting of a variety of deciduous trees and shrubs with heights dependent on when the last mechanical maintenance was conducted. Plant species within the right-of-way include red alder (*Alnus rubra*), red elderberry (*Sambucus racemosa*), Himalayan blackberry (*Rubus discolor*), evergreen blackberry (*Rubus laciniatus*), Scot's broom, salmonberry (*Rubus spectabilis*), willow (*Salix* spp.), and Pacific ninebark (*Physocarpus capitatus*).

3.9.1.2 Lower Rock Creek

Between the Clark Springs Facility and its confluence with the Cedar River, Rock Creek passes through the 143-acre RCNA. The RCNA consists of a large parcel (approximately 140 acres) located roughly between the Summit-Landsburg Road and the Cedar River Trail and a smaller parcel (approximately 3 acres) extending upstream from the confluence of Rock Creek with the Cedar River. The main portion of the RCNA supports second-growth conifer of varying size classes from young (5- to 10-inch dbh) to mature forest (average dbh of 20 to 25 inches) or mixed conifer-deciduous forest and deciduous forest, which shades the stream and contributes to a forested corridor from the Clark Springs Facility to the Cedar River (King County Department of Natural Recourses Parks and Recreation Department 1996). Between the Clark Springs Facility and the RCNA the forest habitat is fragmented by residential development. The smaller portion of the RCNA is located at the mouth of Rock Creek. This area, and the surrounding area, consists of stream, wetland, second-growth forest, and residential landscaping cover types. Small forested wetlands are present along the creek and two small open-water wetlands are present near the mouth of Rock Creek within the RCNA property; these wetlands are described in detail in Subsection 3.7, Vegetation.

Second-growth forests along these stream segments are dominated by deciduous trees and scattered conifers. Tree sizes are similar to those within the upstream reaches of the action area. Along the west side of Rock Creek, the forest consists of a relatively small but intact stand with moderate forest structure. The understory is patchy and often dominated by sword fern (*Polystichum munitum*) (King County Department of Natural Resources and Parks and Recreation Department 1996). Along the east side of the creek, the forest is broken by residential development. Understory vegetation in the developed areas is dominated by artificially maintained lawns and landscaping.

3.9.2 Special Status Wildlife Species

The USFWS, under the authority of the ESA, has identified species considered threatened or endangered because of low population numbers or other significant threats to their survival, as well as candidate species being considered for formal listing. The USFWS has identified 11 wildlife species that are currently considered as threatened or endangered, as candidates for listing, or as proposed for listing in or near the action area. Eight of the 11 species (Pacific tailed frog [*Ascaphus truei*], Cascades frog [*Rana cascadae*], Oregon spotted frog [*Rana pretiosa*], Larch Mountain salamander [*Plethodon larselli*], Northwestern pond turtle [*Emys marmorata*], marbled murrelet [*Brachyramphus marmoratus*], northern spotted owl [*Strix occidentalis caurina*], and Pacific fisher [*Martes pennant*]) are not likely present in the action area. This determination is based on the known habitat use and range for these species, the lack of supporting habitat in the study area, and other information collected for the preparation of this EIS. Consequently these species are not included for detailed analysis. This subsection provides a description of the status, habitat requirements, threats, and known occurrences of the other three special status species (western toad [*Bufo boreas*], bald eagle [*Haliaeetus leucocephalus*], and gray wolf [*Canis lupus*]). None of the special status wildlife species described in this subsection is proposed for incidental take coverage by the proposed HCP. Even though the special status species are not proposed for coverage under the HCP, the project may have the potential to affect these species or their habitats. Therefore, these three special status species are analyzed in detail for this EIS.

Western Toad

The western toad is a Federal species of concern and a Washington State candidate species (Washington Department of Fish and Wildlife 2006a). Its population has declined in the lowlands of western Washington and it is sensitive to the loss of wetland habitats (Leonard et al. 1993). Other possible threats include fungal infections and other pathogens (Carey 1993) and increased ultraviolet radiation (Kiesecker and Blaustein 1995). The western toad ranges throughout Washington with the exception of the Columbia basin (Dvornich et al. 1997) at elevations up to 6,520 feet (Leonard et al. 1993).

The western toad breeds in a variety of aquatic habitats, including ditches, stream edges, ponds, and shallow lake edges, regardless of the presence of a shrub or canopy cover, coarse woody debris, or emergent vegetation. It lays eggs in water less than 1.6 feet deep (Leonard et al. 1993; Corkran and Thoms 1996; Wind and Dupuis 2002).

Although the western toad reproduces in aquatic habitat, all its other life requisites can be met in terrestrial habitat (O'Connell et al. 1993). It utilizes a wide range of habitats, including forests, wetlands, clearcuts, open meadows, marshes, and grasslands, and does not appear to be dependent on old-growth forest (Davis 2002; Wind and Dupuis 2002). Adults can range at least 0.6 miles from breeding habitat (Davis 2000) and upland habitats can be used up to 90 percent of the time (Bartelt and Peterson 1994 cited in Wind and Dupuis 2002).

A review of the PHS database did not find any evidence of western toads in the vicinity of the action area (Washington Department of Fish and Wildlife 2006b). However, it is possible they inhabit the area, particularly outside the breeding season. The Friends of Rock Creek Valley (2004) reference Eastside Consultants (2000) as evidence of western toads occurring within the Rock Creek Valley.

Bald Eagle

The bald eagle is a State-listed threatened species (Washington Department of Fish and Wildlife 2006a). Recently the bald eagle was removed from the Federal list of threatened and endangered species (U.S. Fish and Wildlife Service 2007). The population decline that prompted the original

Federal listing was caused by habitat loss, organochlorine contamination, and mortality from shooting. Since its listing, regulations have reduced the level of organochlorine pesticides in the environment and increased the protection of nest sites, communal roosts, and communal foraging areas, allowing bald eagle reproduction to increase and the population to expand. Bald eagles are found throughout Washington in areas supporting forests and are common year-round along rivers, lakes, and reservoirs in western Washington, but are most abundant along marine shorelines (Stinson et al. 2001). In Washington, the bald eagle population increased 427 percent from 1981 to 1998, and continues to increase (Stinson et al. 2001).

Bald eagles usually nest in large, super-dominant trees within 1 mile of forested shorelines in Washington (Anthony et al. 1982; Anthony and Isaacs 1989; Watson and Pierce 1998; Stinson et al. 2001). Nest trees can be located in contiguous stands or small clumps (Stinson et al. 2001). Bald eagle territories are often associated with a number of alternate nest trees, which are, on average, about 1,000 feet from the active nest (Grubb 1976 cited in Stalmaster 1987); Stalmaster 1987; Stinson et al. 2001).

Bald eagles forage primarily on large areas of open water for fish and waterfowl (Buehler 2000). During the winter, bald eagles congregating to forage on large salmon runs can establish communal night roosts located on average 1,400 feet from water (Watson and Pierce 1998; Stinson et al. 2001). Communal winter roosts often provide a more favorable microclimate than is generally available (Stalmaster 1981 cited in Stinson et al. 2001); Knight and Knight 1983; Keister et al. 1985; Stellini 1987 cited in Stinson et al. 2001); however, communal roost use is primarily influenced by food availability (Watson and Pierce 1998).

There are no known bald eagle nests on or directly adjacent to the action area (Washington Department of Fish and Wildlife 2006b). The closest known bald eagle nest site is approximately 1.75 miles from the action area, with only one other known nest site within 5 miles of the action area. There are no known communal winter roosts in the vicinity of the action area. The lack of nest trees and an abundant food source within or near the action area makes it unlikely bald eagles reside there, but they could occasionally forage along Rock Creek.

Gray Wolf

The gray wolf is a Federal endangered species in western parts of Washington and a State endangered species (Washington Department of Fish and Wildlife 2006b). The gray wolf once ranged over much of North America, and was common in the forested areas of Washington State (Johnson and Cassidy 1997), but modification of suitable habitat and human persecution caused the population to decline (U.S. Fish and Wildlife Service 1978). Current core habitat is limited to the most remote areas of the North Cascades and northeastern Washington.

Wolf den sites are usually burrows dug in sandy soil in elevated areas near water (Mech 1970; Trapp 2004); however, dens have been reported in the bases of trees, hollow logs, and rock caves (Joslin

1967; Mech 1974; Trapp 2004). Human disturbance around a den can cause the den to be abandoned, but the relationship between disturbance and abandonment may involve the nature of the disturbance, the past history of encounters with humans, and the availability of alternate dens (Mech 1970). Wolves have been documented living in relatively close proximity to human activity (Fuller and Keith 1980; Thiel et al. 1998), but in some areas road density is linked to the ability of an area to support wolves (Thiel 1985).

Unconfirmed sightings of a gray wolf in the Rock Creek Valley have been made on a number of occasions since 1997 (Friends of the Rock Creek Valley 2004), though the origin of the animal (wild, hybrid, or escaped captive) is not known. A review of the PHS database did not find any confirmed gray wolf sightings within 6 miles of the action area (Washington Department of Fish and Wildlife 2006b).

3.9.3 Other Common Wildlife Species

In addition to the species of special status there are 134 other, more common, species of wildlife reported to occur in the Rock Creek basin, including the western red-backed salamander (*Plethodon cinereus*), Pacific chorus frog (*Pseudacris regilla)*, common garter snake (*Thamnophis sirtalis*), sharp-shinned hawk (*Accipiter striatus*), white crown sparrow (*Zonotrichia leucophrys)*, black-tailed deer (*Odocoileus hemionus columbianus*), and coyote (*Canis latrans*) (Appendix A Common Species List). Friends of Rock Creek Valley (2004) collected information from a variety of sources that confirm 9 amphibian, 4 reptile, 89 birds, and 32 mammal species occurring in the Rock Creek Drainage, though two of the mammal species on the list do not occur in Washington (Johnson and O'Neil 2001). It is not anticipated that all of these species utilize the action area, but all are assumed to have the potential to occur there. Appendix A lists these species and describes their association with the habitats and vegetation communities described in Subsection 3.9.1, Wildlife Habitats and Communities within the Action Area.

3.9.4 Other Priority Habitats

The WDFW maintains a priority habitats and species list of those species identified within the State of Washington because of population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance (Washington Department of Fish and Wildlife 2006b). The WDFW's PHS database is used by agency and private cooperators as a central repository for distribution and abundance records of Federal and State species of concern. Information from a search of the database was used along with habitat coverage for the action area to indicate occurrence potential for terrestrial species in the action area.

A review of the PHS database indicates the presence of two priority riparian habitats within the action area (Washington Department of Fish and Wildlife 2006b). The palustrine wetland is described and assessed in the Vegetation subsections of the EIS (Subsections 3.7 and 4.7). Riparian habitat along the Cedar River, including the lowest reaches of Rock Creek from the Cedar River upstream to the Kent-

Kangley Road, is designated as priority habitat. Riparian areas are considered priority habitats due to their potential to support high densities of fish and wildlife, high species diversity, important fish and wildlife breeding habitat, important wildlife seasonal ranges, unique and/or habitat dependent species, and important fish and wildlife movement corridors. These areas may also be especially vulnerable to habitat alteration.

3.10 Historic and Cultural Resources

Scoping under NEPA identified no significant cultural resources issues associated with the implementation of the proposed HCP. Cultural resources that were considered during the NEPA scoping process include archaeological sites, places of Native American traditional cultural value, historic districts and buildings, community heritage values, cultural landscapes, and cultural uses of the natural environment.

Results of background research identified no previously recorded cultural or historic resources in the action area. Data were collected from cultural resource survey reports, archaeological and historic site forms on file with the Washington State Department of Archaeology and Historic Preservation, listings in the National Register of Historic Places, the Washington Heritage Register, and the King County Heritage Registry, and historic maps on file at the University of Washington libraries and other repositories. The RCNA Management Plan (King County 1996) and aerial photos of Rock Creek were also examined for evidence of potential historic resources.

No previous cultural resources surveys have been conducted within 1 mile of the action area. Within 2 miles of the action area, two transportation-related surveys identified three historic structures and two historic-period archaeological sites (Earley and Ray 2005; Sharley 2005). The historic structures are two residences built around 1940 and a 1939 gas station. The two archaeological sites are a remnant of the historic Columbia and Puget Sound/Pacific Coast Railroad in use from 1884 to circa 1925, and a ditch that appeared to be associated with a saw mill in operation from 1940 to circa 1960. All of these resources are located outside of the action area and would not be impacted by implementation of any alternatives considered in this EIS.

There are no recorded Native American traditional cultural properties in the action area. In 2002, a study for Seattle Public Utilities mapped several Native American place names within the Cedar River Watershed, all but one of which are located in the lower Cedar River Basin northeast of the action area (Dugas and Robbins 2002). Salmon with historic presence in the action area have cultural value for the Muckleshoot Indian Tribe.

3.11 Socioeconomics

Because the Clark Springs Facility provides up to 60 percent of the water supplied to the City, this subsection assesses the socioeconomic conditions within the action area, the City, and the City's Potential Annexation Area (PAA).

The City's economic base has changed dramatically since the mid 1900s. Historically the City was a relatively small agricultural community of truck and dairy farms; in 2006, the City had the ninth largest residential population in the State. Many factors contribute to the City's economic success, including the large expanse of flat land within the Kent Valley, its location midway between the cities of Seattle and Tacoma, and its proximity to the Interstate 5 corridor. Just northwest of the City is the Seattle-Tacoma International Airport, which allows easy access to domestic and international markets for local goods and services. Approximately 45 percent of the City is currently designated for industrial and commercial uses. The proposed HCP is one element of the City's commitment to providing the infrastructure and public services necessary to sustain current and future development, while providing a high quality of life for its residents (City of Kent Comprehensive Plan 2006, Economic Development Element).

The 320-acre Clark Springs Facility area, which is geographically separate from the City, was annexed to the City in 1969 for municipal water supply purposes. The watershed is undeveloped with no residents.

3.11.1 Population

Between 1990 and 2000, the City's population grew by 109 percent. This rapid growth was largely the result of several annexations of surrounding unincorporated areas. In 2006, the City's population was estimated to be 85,650 people (Washington State Department of Office Financial Management 2006), a 7.2 percent increase since 2000. This increase includes population added as a result of annexations between 2000 and 2006. The City is approximately 30 square miles in area with a population density of 2,867 people per square mile (Washington State Department of Office Financial Management 2006). By 2020, the City's population is expected to reach 93,937 (Washington State Department of Office Financial Management 2006), an 18 percent increase from 2006. In the next decade, the combined population for the City and the PAA is expected to increase by 19.4 percent, from an estimated 104,581 people in 2000 to 124, 903 people in 2020 (City of Kent Comprehensive Plan 2006 Community Profile).

3.11.1.1 Household Income

In 2000, the median income in the City was $46,046, an increase of 42 percent from 1990. However, median income in the City has not increased along with other household expenses. Between 1990 and 2000, median rents in the City increased by 39 percent and the cost of homeownership rose by 66 percent.

3.11.1.2 Income and Poverty

In 2000, 10.6 percent of the population in Washington State was below the poverty rate. The percent of the population below the poverty rate was 8.4 percent in King County and 11.6 percent in the City.

3.11.1.3 Race and Ethnicity

Approximately 85 percent of Washington's population identified as white in the 2000 Census, compared to 79 percent in King County and 75 percent in the City. Compared to the State and county averages, the City's Black or African-American populations comprise a slightly higher percentage of the total population than do persons of Hispanic or Latino origin.

Asian populations in the City comprise a slightly lower percentage of the population than existed in King County but slightly larger percentage than that found throughout the State. The City's American Indian population comprises a similar percentage of the population than is found in King County and Washington State (U.S. Census Bureau 2000).

3.11.2 Employment

Employment growth in the City over the past 20 years has outpaced population growth. In 1970, just under 15,000 people were employed there, compared to over 46,000 people in 1990, an increase of more than 300 percent. In 2000, employment was at 59,331 jobs, an increase of 29 percent from 1990. Most of this growth was attributed to manufacturing and warehouse employment. The City is expected to continue to grow as an employment center but at a slower growth of approximately 17.6 percent by 2020 (City of Kent, Comprehensive Plan 2006 Community Profile).

In 1970, over 60 percent of the jobs in the City were in the manufacturing sector. By 1990 this percentage had declined to 41 percent, with wholesale/warehouse employment 22 percent of the total. Looking ahead to 2020, the manufacturing sector is expected to decline to 26 percent of the total employment and the retail and service sectors together are expected to increase to 39 percent of the total jobs (City of Kent, Comprehensive Plan 2006 Community Profile).

The City is required by law to plan for and develop the water supplies necessary to meet its projected population growth, as well as to maintain and protect the viability of its existing sources. This has become increasingly difficult in recent years due to several factors, such as seasonal impacts on the source aquifers; the increasingly stringent and dynamic regulatory environment governing water supply, water quality and water rights; and the ESA listing of species in an urbanized setting. Not all of the City is served by the City's Water Division; other water services are provided through Soos Creek Water & Sewer District, Highline Water District, and by Water District 111.

In 2005, the City's Water Division provided water to a population of more than 59,300 people. The Water Division delivered 2.8 billion gallons of water to 13,089 service connections through 263 miles of pipeline. The City's water is classified as groundwater, meaning it does not come from a lake or stream, but comes instead from either a spring or well drilled into an underground aquifer (a natural underground water reservoir).

The Clark Springs System is the City's primary water source, providing up to 60 percent of the City's total water supply. Population growth over the next 40 years within the City's existing water system boundaries will result in an approximate doubling of the City's current water service area population. During periods of high demand the capacity of the Clark Springs System is exceeded and supplemental well facilities are activated. These sources are adequate to meet current and near-future peak demands; however, they are insufficient to meet long-term demands.

To provide for future growth and system demands the City has partnered with the City of Tacoma, Covington Water District, and Lakehaven Utility District to obtain water from the TSSP project (formerly known as Pipeline 5). There are also several connections linking the City's water system with neighboring purveyors, which in the case of emergencies allow water service to be provided between water purveyors. Purveyors include the cities of Auburn, Renton, Tacoma, and Tukwila, as well as Water District #111, Highline Water District, and Soos Creek Water & Sewer District.

Water consumption is measured in units with 1 unit of water equaling 100 cubic feet (748 gallons). The City rates for water usage are provided in Table 3.11-1. The City charges different rates to its users based on:

- Time of year
- Amount of water used
- Inside/Outside City Users

The City offers utility rate reductions for eligible senior citizens and disabled persons based on income and place of residence. The eligibility criteria for the Lifeline rate are established by the City Council. In addition to water rates based on the volume of water used, the City also charges a flat water access rate that is based on metric size and is billed monthly (Table 3.11-2).

Table 3.11-1 City of Kent Monthly Current Water Rates.

Inside the City			
# 700 ft^3		> 700 ft^3	
10/1-4/30	5/1-9-30	10/1-4/30	5/1-9/30
$1.44	$1.95	$1.95	$2.43
Outside the City			
$1.90	2.42	$2.32	2.85

Table 3.11-2 City of Kent Water Monthly Access Rates (Effective January 1, 2007).

Meter Size (inches)	
5/8 x 3/4	$3.76
1	$4.19
1 1/2	$5.64
2	$6.84
3	$23.85
4	$28.72
5	$48.03
8	$64.25
10	$84.53

3.12 Environmental Justice

The EPA Office of Civil Rights and Environmental Justice developed guidance for all Federal agencies conducting environmental justice analyses. This environmental justice analysis follows the EPA guidelines. The EPA environmental justice guidelines offer a range of categories to indicate the presence or absence of environmental justice effects (Environmental Protection Agency 1998). Consequently, this indicator-based assessment draws topically from the range of indicator categories that the EPA (1998) outlined. These categories correspond to effects described in Subsection 3.11.1.2, Income and Poverty, and Subsection 3.11.1.3, Race and Ethnicity, of this EIS. The EPA environmental justice guidelines also indicate that impacts on human health should be considered in environmental justice analyses.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

The descriptions in this subsection contain comparative analyses of the consequences associated with each component discussed in Section 3, Affected Environment. Consequently, Subsections 4.2, Land Use and Ownership, through 4.11, Socioeconomics and Environmental Justice, of this section directly correspond to Subsections 3.2, Land Use and Ownership, through 3.12, Environmental Justice in Section 3, Affected Environment. Included in each subsection is a comparison of the anticipated consequences associated with the Proposed Action to the affected environment effects associated with the No-action Alternative. For purposes of this discussion, the terms "effects" and "impacts" will be considered to be synonymous with consequences, and consequences may be positive or negative.

The analyses in this section also include potential impacts that may result from specific activities covered under the ITPs, which are described in Subsection 1.2.1, Purpose of the Proposed Action. The Services reviewed the potential for impacts to occur to each resource of the affected environment; those resources that may receive either a positive or negative impact were further discussed within the text of this section.

4.2 Land Use and Ownership

4.2.1 Alternative A: No Action

Under the No-action Alternative, there would be no change in how the City operates the three wells, gravity-fed infiltration gallery, and surface water diversion system at the Clark Springs Facility. The City would continue its maintenance operations and improvements to the buildings and systems necessary for the water withdrawal operations at the Clark Springs Facility in a manner consistent with the municipal designation of the property. The City would not conduct mitigation activities along Rock Creek downstream of the Clark Springs Facility. Therefore, there would not be an effect on land use or ownership under the No-action Alternative.

Under the No-action Alternative, the City would not conduct any activities adjacent to the Cedar River, a water body of statewide significance.

4.2.2 Alternative B: Proposed Action

Under the Proposed Action, the City would continue to own and operate the three wells, gravity-fed infiltration gallery, and surface water diversion system at the Clark Springs Facility for municipal water supply purposes. In addition, the City would place and maintain large wood along Reaches 10 and 12 (HCM-6), which are located within the Clark Springs Facility. The City would consider this activity an allowable use for the property (personal communication with Kelly Peterson, City of Kent, August 15, 2007). As with the No-action Alternative, the Proposed Action would result in no effect on land ownership or use at the Clark Springs Facility.

The City would also construct fish passage improvements at the mouth of Rock Creek (HCM-2) and off-channel habitat enhancements (HCM-3 and HCM-4) on land owned by King County. Prior to the construction of these HCMs, an inter-governmental agreement (IGA) would be implemented to formally acknowledge the use of county land for mitigation purposes and to define conditions for the long-term maintenance of the HCMs concurrent with the permit term. The implementation of the IGA would not affect the ownership of the property and the proposed use of the land would be consistent with the existing land use designation (King County 2008). As with the No-action Alternative, the Proposed Action would result in no effect on land ownership or use downstream of the Clark Springs Facility.

Construction of habitat mitigation measures at the mouth of Rock Creek would occur adjacent to the Cedar River, a water body of statewide significance. Approval of construction activities that impact water bodies of statewide significance would require a shoreline development permit from King County.

4.3 Geology and Soils

This subsection qualitatively evaluates the potential impacts that may result from the two alternatives. Each alternative was evaluated using the descriptions of physical properties of the soil units (U.S. Department of Agriculture Soil Conservation Service 1973), with consideration given to the erosion-hazard areas discussed in Subsection 3.3, Geology and Soils.

4.3.1 Alternative A: No Action

4.3.1.1 Geology

As discussed in Chapter 3.3, Geology and Soils, there are no geologic hazard areas within the action area. Therefore, no geologic impacts would occur under the No-action Alternative.

4.3.1.2 Soils

Under the No-action Alternative, ground-disturbance activities would occur only within the Clark Springs Facility where there are mapped erosion-hazard areas. The City's CAO regulates any activities with erosion-hazard areas so such activities that would be conducted using construction Best Management Practices (BMPs) would include, but not be limited to, timing constraints; erosion control devices; hydroseeding and planting specifications; stormwater detention, treatment, and discharge facilities; designation of washing, refueling, staging, and laydown areas(used for the storage of equipment and materials); maintenance of buffers around sensitive areas; and the use of emergency response protocols. All disturbed soils would also be replanted immediately following construction activities. By implementing construction BMPs in accordance with the City's CAO, activities involving ground disturbance would not have an adverse effect on existing erosion-hazard areas.

Under the No-action Alternative there would not be impacts to erosion-hazard areas mapped by King County at the mouth of Rock Creek.

The potential effects of the No-action Alternative on wetland soils are discussed in Subsection 4.7.1.1, Wetlands.

4.3.2 Alternative B: Proposed Action

4.3.2.1 Geology

As discussed in Subsection 3.3, Geology and Soils, there are no geologic hazard areas within the action area. Therefore, as under the No-action Alternative, no geologic impacts would occur under the Proposed Action.

4.3.2.2 Soils

Under the Proposed Action, the City would conduct the same ground-disturbance activities as described under the No-action Alternative. Consequently, the effects to erosion-hazard areas within the Clark Springs Facility under the Proposed Action would be the same as under the No-action Alternative.

The Proposed Action would also include ground-disturbance activities associated with the construction of fish mitigation measures in areas designated as erosion-hazard areas by King County at the mouth of Rock Creek. Because they would occur in designated erosion-hazard areas, these ground-disturbance activities would result in some temporary erosion impacts, The potential impacts of ground disturbance on identified erosion-hazard areas would be minimized through the implementation of construction BMPs required by the Federal, State, county, and/or local agencies as part of the permitting process. Construction BMPs to minimize soil and erosion impacts to erosion-hazard areas would include, but not be limited to, timing constraints; erosion control devices; hydroseeding and planting specifications; stormwater detention, treatment, and discharge facilities; designation of washing, refueling, staging, and laydown areas (used for the storage of equipment and materials); maintenance of buffers around sensitive areas; and the use of emergency response protocols. All disturbed soils would also be replanted immediately following construction activities. By implementing soil erosion and other construction BMPs, the City would minimize the potential for adverse effects to soils. Because of the implementation of construction BMPs, the construction of the HCMs would result in minimal impacts to mapped erosion-hazard areas. The minimal impacts to erosion-hazard areas at the mouth of Rock Creek would be greater under the Proposed Action than under the No-action Alternative, which would have no impacts.

The potential effects of the Proposed Action on wetland soils are discussed in Subsection 4.7.2.1, Wetlands.

4.4 Air Quality

4.4.1 Alternative: A: No Action

Under the No-action Alternative, there would be no new sources of air pollutants associated with the City's water withdrawal operations at the Clark Springs Facility. Because there are no new sources of air pollutants, there would not be an effect on air quality.

However, the City would likely require the use of various types of construction equipment in order to maintain its existing facilities, and, if necessary, to construct new buildings. These vehicles would represent new sources of air pollutants within the action area. Effects on air quality within the action area could include dust generation caused by construction and by use of temporary access roads, clearing, and site-grading activities. In addition to dust, air pollutants from construction equipment would be generated during facilities construction, but any effects would be localized and temporary in nature. Because these effects would be temporary and localized, they would not result in long-term or widespread adverse effects to air quality nor would they affect the region's ability to remain in attainment for all air pollutant criteria.

Emissions from construction equipment would include PM2.5 and so would contribute to the levels of PM2.5 within King County, but because these construction emissions would be localized and temporary, their effect on PM2.5 levels within King County would not be significant.

The temporary increase of emissions from construction activities under the No-action Alternative would also contribute to the atmospheric levels of CO_2 that contribute to global climate change. Because the new emissions would be temporary, the increase would not cause a measurable increase in atmospheric levels of CO_2 or measurably contribute to global climate change.

4.4.2 Alternative B: Proposed Action

Under the Proposed Action, there would be no new sources of air pollutants associated with the City's water withdrawal operations at the Clark Springs Facility. Because there are no new sources in air pollutants there would not be an effect on air quality.

The City would likely require the use of various types of construction equipment in order to maintain its existing facilities, and, if necessary, to construct new buildings as described under the No-action Alternative. Under the Proposed Action, the City would conduct the same construction activities described under the No-action Alternative. Therefore, under the Proposed Action the same types of localized and temporary impacts to air quality described under the No-action Alternative would occur, but would not result in long-term or widespread adverse effects.

Construction equipment used to implement fish mitigation measures under the Proposed Action would represent new sources of air pollutants within the action area. Effects on air quality within the action area could include dust generation caused by construction and by use of temporary access roads, clearing, and site-grading activities. In addition to dust, air pollutants from construction equipment emissions would be generated during construction. Because these new sources of air pollutants would be temporary and on a small scale, the effects of these activities on air quality would be localized and temporary in nature. As with the No-action Alternative, these effects would be localized and temporary and would not result in long-term or widespread adverse effects to air quality, nor would they affect the region's ability to remain in attainment for all air pollutants criteria.

Emissions from construction equipment would include PM2.5 and so would contribute to the levels of PM2.5 within King County, but because these construction emissions would be localized and temporary, their effect on PM2.5 levels within King County would not be significant.

The temporary increase of emissions from construction activities would also contribute to the atmospheric levels of CO_2 that contribute to climate change. Because the new emissions would be temporary, the increase would not cause a measurably increase atmospheric levels of CO_2 or measurably contribute to global climate change. This is the same as under the No-action Alternative.

4.5 Noise

4.5.1 Alternative A: No Action

Under the No-action Alternative, there would be no change in how the City operates the three wells, gravity-fed infiltration gallery, and surface water diversion system at the Clark Springs Facility. As a result, the City's continued operation of the water withdrawal operations under the No-action Alternative would not create any new additional sources of noise.

However, the City's continued operation of the Clark Springs Facility would likely require the City to utilize construction equipment to maintain its existing facilities and, if necessary, to construct new buildings on the property. During future construction there would be temporary increases in sound levels near active construction areas due to the use of heavy equipment and along roadways used for hauling construction materials. The increases in noise levels would depend on the type of equipment being used, and the amount of time it is in use.

The closest sensitive noise receptors to the Clark Springs Facility are residences approximately 2,000 feet to the south. The restriction of construction activities to daytime hours when other ambient noise levels are greatest and the distance between most of the construction and the nearest residential locations would minimize or eliminate noise impacts resulting from construction.

4.5.2 Alternative B: Proposed Action

Because the water withdrawal, maintenance and operations activities under the Proposed Action would be the same as under the No-action Alternative, effects on noise would be similarly localized and temporary and would not result in long-term or widespread adverse effects from these activities.

In addition to construction activities at the Clark Springs Facility, under the Proposed Action construction would occur at the mouth the Rock Creek in order to implement fish mitigation measures. These activities would represent new sources of noise within this area. The closest sensitive noise receptor is a residential home located over 200 feet from the proposed mitigation sites. As with the No-action Alternative, by restricting construction activities to daytime hours when other ambient noise levels are greatest, noise impacts would be minimized.

4.6 Water Quantity and Water Quality

4.6.1 Water Quantity

Current operations at the Clark Springs Facility have the potential to adversely affect both upstream and downstream hydrology and hydrogeology over the long term. The short-term (hours to days) effects would diminish a short distance upstream of the withdrawal point. This subsection evaluates how the No-action Alternative and the Proposed Action may potentially affect instream flows and groundwater levels. In the process, evaluation tools developed as part of the proposed HCP (City of Kent 2010) were used to make quantitative assessments, and available information was used for qualitative assessments.

4.6.1.1 Alternative A: No Action

Water Withdrawal Activities

Operations at the Clark Springs Facility under the No-action Alternative may affect both the magnitude and timing of instream flows in Rock Creek downstream of the pinch point (Subsection 3.6.1, Surface and Groundwater Hydrology, or glossary for description of the pinch point) near the eastern boundary of the Clark Springs Facility. Since the groundwater and hydrology are connected, withdrawals from the aquifer result in a reduction of streamflows in Rock Creek over time (Subsection 3.6.1, Surface and Groundwater Hydrology, for a description of the Rock Creek surface and groundwater hydrology). This effect is demonstrated in both low and peak flows. Withdrawals act to decrease low flows as well as to reduce the magnitude of flood events downstream of Clark Springs. The magnitude of the reduction varies depending on the season and aquifer level relative to the stream bed. During high flows and high aquifer levels, most of the withdrawal amount is manifested as a reduction in surface flow. During low flows and low aquifer levels, the proportion of the withdrawal expressed as surface flow decreases. Withdrawals are manifested as a combination of a reduction in surface flow and a reduction in aquifer levels. In addition to affecting the surface flow magnitude, the City's water withdrawals may delay the seasonal rise of instream flows during the fall because more water and hence more time would be necessary to first replenish the aquifer before increasing instream flows could be realized. It is anticipated that operations under the No-action Alternative would affect only downstream flows; upstream flows would remain unaffected because of the geology at the pinch point near the eastern boundary of the Clark Springs Facility. The effects of withdrawals on instream flows downstream of the Clark Springs Facility would not be instantaneous. Instead, a change in withdrawal rate may take hours, weeks, or months to become fully realized in the stream, depending upon the groundwater level in the aquifer. In general, a reduction in withdrawal takes longer to increase streamflow than an increase in withdrawal does to decrease streamflow (Figure 4.6-1; Hart Crowser 2003b). The effects of operations under the No-action Alternative and the technical details supporting the conclusions are described below.

Under the No-action Alternative, the Clark Springs Facility would continue to be operated in a manner similar to the 1986 to 1997 operational conditions. The City would continue to rely primarily on the gravity-fed infiltration gallery for water withdrawals from July through October. The amount of water withdrawn by the gravity-fed infiltration gallery would depend on groundwater levels. As groundwater levels drop so does the maximum potential withdrawal rate. If the City uses the wells at the Clark Springs Facility during this period, a minimum instream flow of 2 cfs would be required by the City's existing water rights from July 1 to October 31, and a 15 cfs minimum flow would be required from November 1 to April 30, then declining to 2 cfs by June. The City's water right for the infiltration gallery does not have a minimum instream flow requirement. The City could voluntarily implement flow augmentation of some form under the No-action Alternative. However, for the purpose of the analysis it is assumed that no augmentation would occur.

Limited pre-project information is available for comparison, but short-term operation testing demonstrates that withdrawals reduce instream flows. Historical data show that median flows at Rock Creek during project operation range from 1 to 25 cfs and generally peak between January and March; the lowest flows would occur from July through October, assuming that average withdrawals remain at 5.9 cfs during this time. The annual 7-day low-flow period for a stream is determined by calculating the average flow measured during the 7 consecutive days of lowest flow during a year. The average annual 7-day low flow from 1986 to 1997 was 1.3 cfs (median 1.1 cfs) measured at the Parshall Flume. When stream flows under the No-action Alternative were modeled using the Hydrological Simulation Program-Fortran (HSPF), results indicated an average 7-day low flow of 1.1 cfs over the 1955 to 1997 period of record. Additional data from 1998 through 2004 suggest the 1986 to 1997 operational period may have included a higher proportion of extreme low flows than compared to a longer time series. Following adjustment for augmentation (i.e., subtraction of the augmentation amount that reached the flume) during some periods after 1998, the mean annual 7-day low-flow level for 1998 to 2004 was 2.2 cfs and for all years (1986 to 2004) was 1.6 cfs. During the 1986 to 1997 period the annual 7-day low flow usually occurred during October (9 of 12 years). Annual 7-day low flows also occurred during November (2 years) and September (1 year). While there is some uncertainty regarding the level of future 7-day low-flow levels under the No-action Alternative, taken together the available information described above suggests 7-day low flows in the 1.0 to 2.0 cfs range could commonly occur and the average annual 7-day low-flow period would occur primarily during October, but could occur between July and November depending upon the annual precipitation pattern.

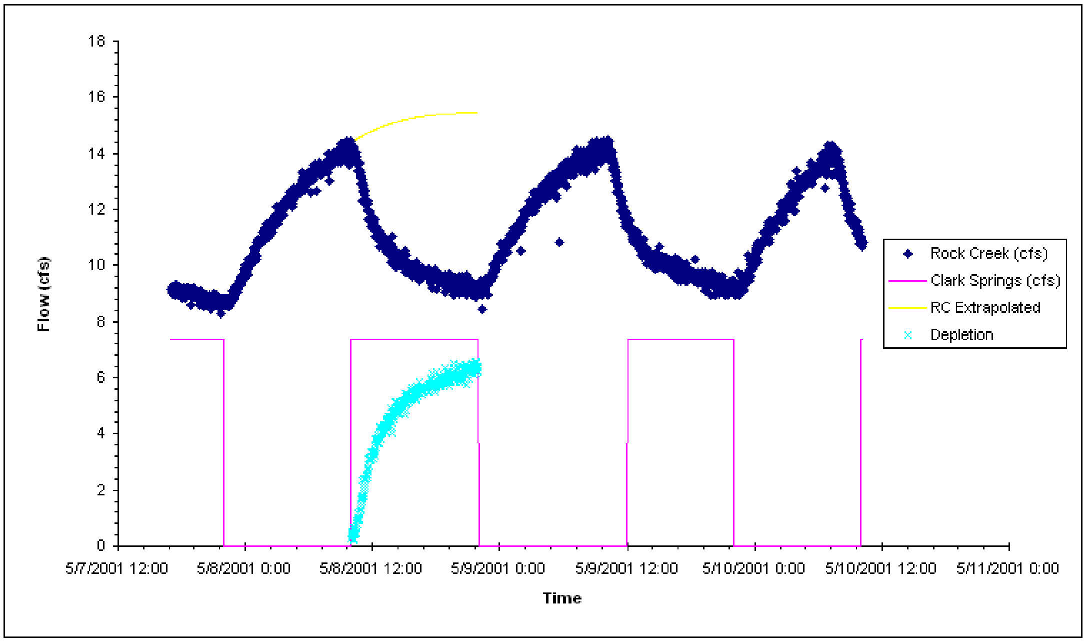


Figure 4.6-1 Results of the operations test during May 2001. Withdrawals (7.5 cfs) via the infiltration gallery were cycled on a 12-hour sequence.

Water supply withdrawals at the Clark Springs Facility also decrease the magnitude of high-flow events. Flood frequencies calculated from flow records at USGS gage 12118500 between 1945 and 1979 indicated a 2-year flood event of 82 cfs, a 10-year flood event of 167 cfs, and a 50-year flood event of 244 cfs (Pentec 2001b). At maximum withdrawal levels allowed under the Clark Springs water rights of 12 cfs, the magnitude of these flood events would decrease by about 15 percent, 9 percent, and 5 percent, respectively. Channel-forming processes are generally affected by flows greater than bankfull flows. Bankfull flow levels calculated at three transects in Reaches 3, 6, and 7 were 156 cfs, 124 cfs, and 176 cfs, respectively (Pentec 2001b). Consequently, if maximum withdrawals were to occur under the No-action Alternative during peak flow periods, a slight decrease in the frequency of channel-forming flows might occur. However, this effect is anticipated to be minor because maximum withdrawal rates, which generally occur during the summer, would not be expected to coincide with periods of peak flows, which are expected to occur during the fall or winter.

Effects of withdrawals under the No-action Alternative on surface flows vary depending on the overall flow rate of the creek and corresponding water levels in the aquifer. At high streamflow conditions, when the water table in the aquifer is also high, the degree of streamflow depletion would be expected to approach 100 percent because the aquifer would be at full to capacity, with all diverted flow coming from baseflow capture that would otherwise discharge to the creek. These results likely would not apply to low-flow conditions because lower groundwater levels in the aquifer mean that a smaller portion of the groundwater flow is discharged as baseflow. During seasonal declines in the water table, withdrawals from private wells in the upper Rock Creek basin and withdrawals by the infiltration gallery could combine to lower aquifer levels to the point where groundwater flow passes below the bed of the creek (Hart Crowser 2003b).

It is possible that one effect of water withdrawals would be an increase in the amount of precipitation needed to complete the recharge of the local Clark Springs groundwater aquifer below the pinch point, delaying the seasonal rise in the hydrograph in the fall. Direct evidence of this possible effect is not available because of an insufficient hydrologic record (i.e., the available periods of record for surface flows pre- and post-water withdrawals are too short for analysis). However, some indication of this effect is available from HSPF modeling using the results from two modeling scenarios (MGS Engineering Consultants 2005). In one scenario, the HSPF model was run under the assumption that no water supply withdrawals occurred at the Clark Springs Facility. In the second scenario, the model was run under the assumption that the 1986 to 1997 average monthly water withdrawal pattern (Figure 1.6, City of Kent 2010) occurred over the entire 43-year model duration. A graphic examination of the median (i.e., 50 percent exceedance) values (Figure 4.6-2) and the difference between the two scenarios suggests there could be an approximate 3-week delay (mid-November to early December) in the ascending hydrograph as a result of water withdrawals under typical median conditions.

It is important to note that the preceding analysis should not be construed to mean that a 3-week delay in aquifer recharge occurs every year. The timing of the autumnal rise in the hydrograph is affected by the amount of withdrawals in the upper catchment (above the pinch point) and the local Clark Springs aquifer over the late summer and autumn period, and by the amount of precipitation during that period. All of these variables fluctuate on an annual basis. Withdrawals from the aquifer above the pinch point in the upper catchment by other wells in the area also affect the amount of recharge needed, but detailed withdrawal information is not available to quantify these potential effects; in addition, the calibrated HSPF model did not vary well withdrawals by non-city entities under the different scenarios. Nevertheless, the HSPF modeling analysis suggests that water withdrawals can delay the recharge of the local aquifer.

Several operations tests, which have involved sequentially turning on and off water withdrawals via the wells or infiltration gallery, have demonstrated that the shallow aquifer at Clark Springs influences the amount of surface flow discharge in Rock Creek. The first operations test occurred from December 9 to 11, 1997. During this test, withdrawals via the wells went from 0 to 10 cfs, but then declined slightly to 9.5 cfs over the 2-day test. Over this period, the flow in Rock Creek was reduced by approximately 7 cfs (Figure 4.6-3) with approximately 50 percent of the reduction occurring over the first 4.5 hours of the test.

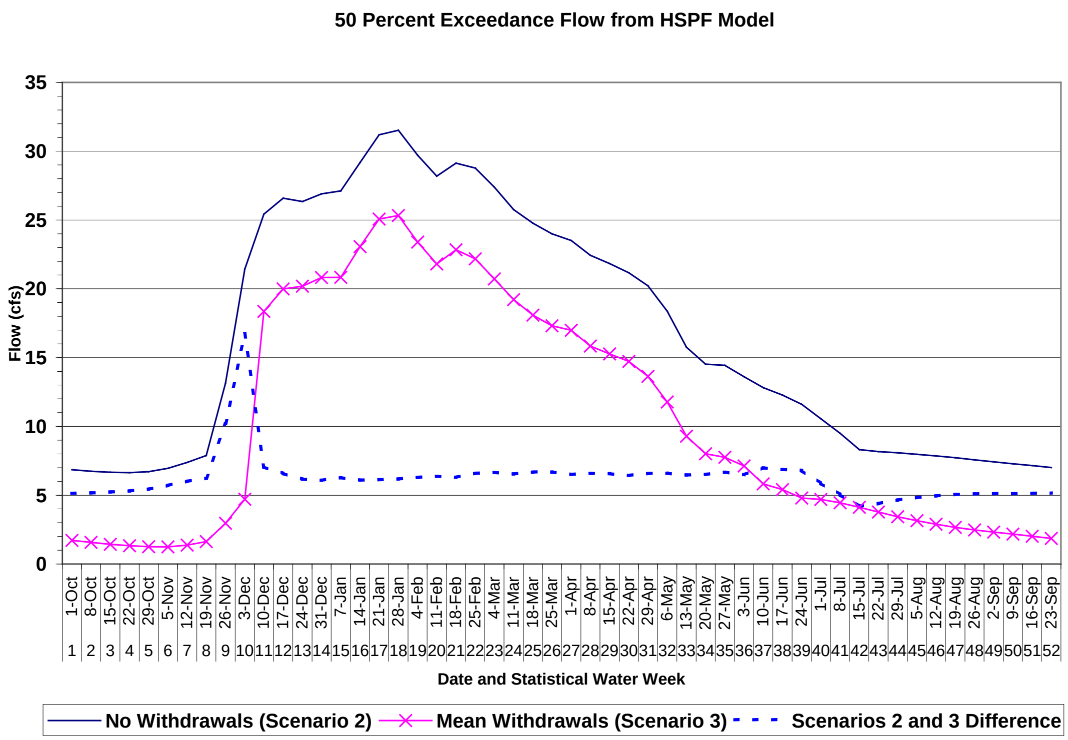


Figure 4.6-2 Median (50%) flow exceedance values calculated using simulated flows from the HSPF under no-withdrawal and mean monthly withdrawal scenarios.

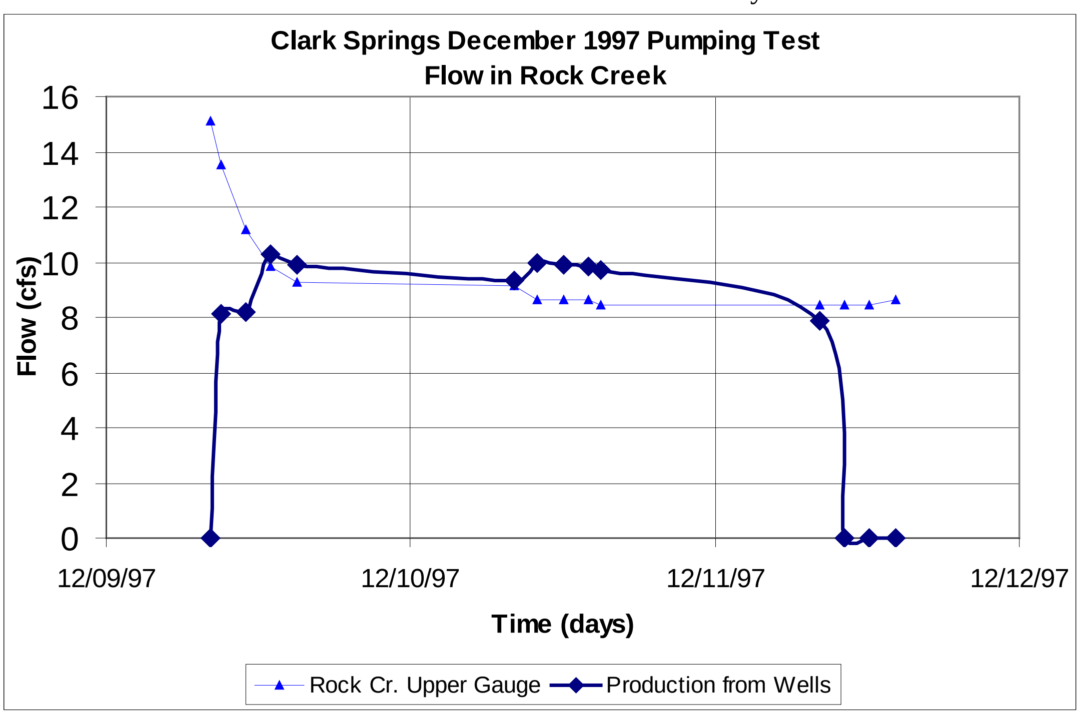


Figure 4.6-3 Results of the December 1997 operations test. Production via the wells was increased from 0 to 10 cfs for a period of 2 days.

The operations tests also included several tests of the infiltration gallery. The first occurred from May 7 to 10, 2001, and tested a 12-hour sequence of cycling withdrawals via the infiltration gallery between 0 and 7.5 cfs without any use of the wells. At that time Rock Creek surface flows at the start of the test were approximately 8.5 cfs with withdrawals. After 12 hours of no withdrawals, surface flows increased in Rock Creek by approximately 5.9 cfs (Figure 4.6-1). Another test occurred during a low-flow period from July 30 to 31, 2004. Under these conditions surface flows in Rock Creek were approximately 2.8 cfs at the beginning of the test and withdrawals via the infiltration gallery were approximately 5.5 cfs. During the test, withdrawals were reduced by 1.8 cfs for 24.75 hours and surface flows increased by approximately 0.7 cfs, changing from 3.0 to 3.7 cfs (Figure 4.6-4). This test was repeated in August with similar results.

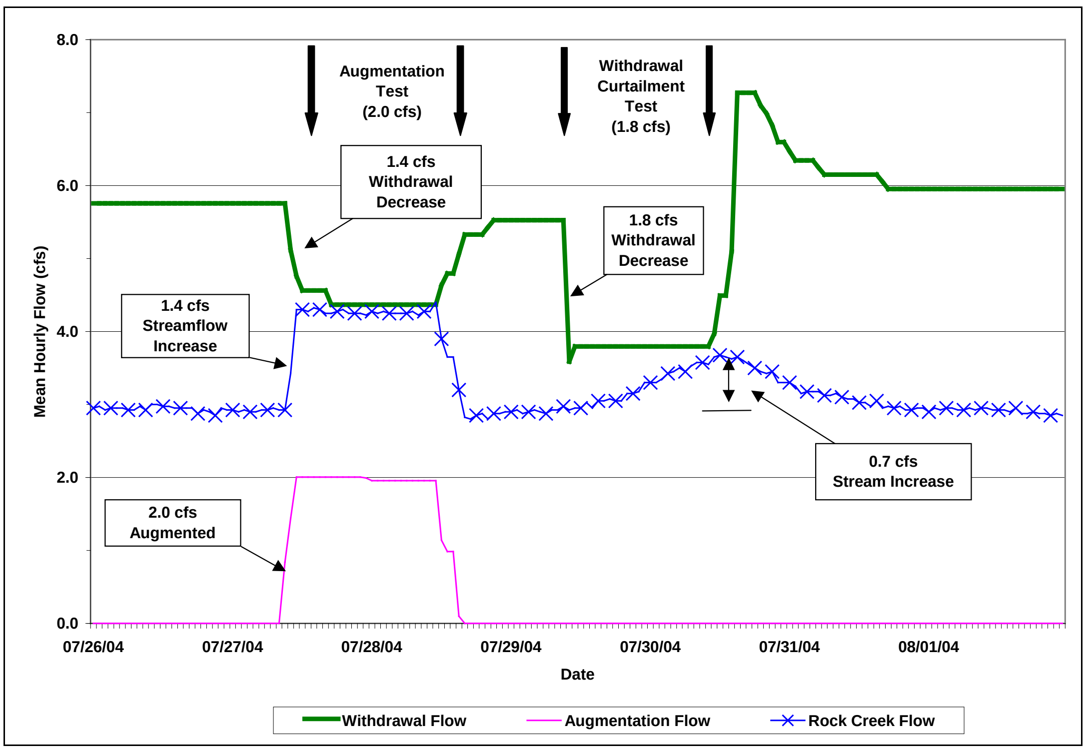


Figure 4.6-4 Results of the withdrawal curtailment and augmentation test during July 2004.

The three operations tests of the infiltration gallery and the well pump test suggest that changes in withdrawal levels result in changes to surface flows that may be gradual and take several hours or days to complete. The rate of change is dependent upon the height of the groundwater level, withdrawals, and the elapsed time since the change in withdrawals. For example, under high groundwater levels typically present during the winter and spring, a 2 cfs reduction in withdrawals would result in a 1 cfs increase of stream flows over approximately 0.1 days or about 2.4 hours. In contrast, a 2 cfs reduction in withdrawals under low groundwater levels typically present during the late summer and fall would result in a 1 cfs increase of stream flows over approximately 3 days; it would require approximately 90 days (i.e., the entire augmentation period) to observe an approximate 1.75 cfs increase, assuming groundwater levels remained static (Figure 6-5, City of Kent 2010). The source of the withdrawals, whether via wells or infiltration gallery, also appears to affect the rate of change in surface flows relative to changes in withdrawal level. These tests suggest that the Clark Springs operations affect downstream hydrology, but that the magnitude of the effect varies depending on several factors, including the withdrawal rate and the source of the withdrawals, as well as the groundwater level. In addition, the tests suggest that streamflow response to changes in operations at the facility is gradual over several hours or days depending on water level conditions. Additional details about the effect of withdrawal curtailment on surface flows are available in the proposed HCP (City of Kent 2010).

The 2001 operations test of the infiltration gallery also demonstrated that the short-term (hours to days) effect of water withdrawals at Clark Springs declines relatively rapidly in an upstream direction. During the test, Rock Creek stream flows were measured approximately 500 feet upstream of the infiltration gallery. Flows at this site ranged from 5.2 to 5.4 cfs (Figure 4.6-5) even though withdrawal rates ranged from zero to approximately 7.5 cfs. These measurements provide evidence that, beyond a relatively short distance (i.e., less than 1,000 feet), operation of the infiltration gallery likely has a small and insignificant effect on flows upstream of the facility. The finding is consistent with the understanding of a water table depression surrounding the infiltration gallery and/or wells when they are operating. In addition to the decreasing effect of the local water table depression at greater distances from the facility, the hydrogeologic conditions that created Clark Springs (i.e., the pinch point that functions analogously to flow occurring over a weir) effectively isolate the upper reaches of Rock Creek from any changes in streamflow that may occur due to operation of the Clark Springs Facility (Figure 4.6-5). See Subsection 3.6.1, Surface and Groundwater Hydrology, for a complete description of the Rock Creek hydrology and groundwater interaction and the pinch point.

Based on information presented above, the Clark Springs water withdrawals under the No-action Alternative would primarily affect the surface hydrology and groundwater downstream of the facility. Upstream effects appear to be localized and unlikely to propagate beyond the pinch point up-gradient from the Clark Springs Facility. Review of historical streamflow data, operational testing data, and HSPF modeling indicates that withdrawals have reduced average streamflows and may also delay the normal increase in flows during the winter. These conditions would remain the same under the No-action Alternative.

Operations and Maintenance Activities

All of the operational and maintenance activities conducted by the City within the Clark Springs Facility and covered under the No-action Alternative would also occur under the Proposed Action. Most of these operational and maintenance activities would not affect the instream flows of Rock Creek. A maintenance activity that could cause effects to instream flows is wildlife management. The City's wildlife management program includes the trapping and removal of beavers and the destruction of beaver dams. The removal of a beaver dam could cause minor pulse flow increases though the dams would generally be removed before substantial backwaters can develop. Potential effects would be minimized through the implementation of mitigation measures identified in the Hydraulic Project Approval (HPA) issued by WDFW for this activity; these measures include restricting the rate at which water can be released from behind a beaver dam. Because any increase in flows would be short term and low in magnitude, the long-term effects would be negligible.

Stormwater conveyance systems and new roads have the potential for affecting flow regimes, but these effects would be minor for maintenance of stormwater conveyance and minor to low for any new roads. Stormwater conveyance from the facility would not affect Rock Creek flows because the City has no stormwater outfalls. Stormwater conveyance from the facility occurs only by dispersed infiltration.

If the City were to construct new roads for access to develop, maintain, and operate new groundwater monitoring wells along the eastern and northeastern boundary of the watershed, the range of potential adverse effects to Rock Creek flows would be minor to low depending upon the number of roads built. The effects would be minor to low because access roads would be short gravel spur roads branching off existing roads near the watershed boundaries, would be constructed at least 50 feet from wetlands or streams, and would avoid crossing any streams. Precipitation that falls on access roads is expected to infiltrate through the road surface or forest floor adjacent to the road.

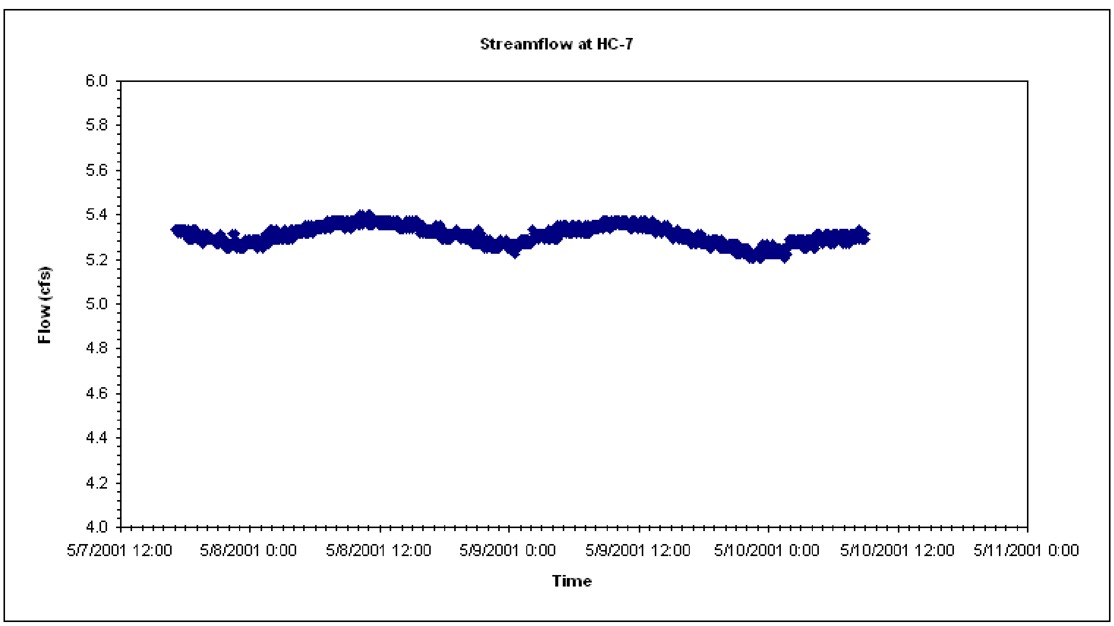


Figure 4.6-5 Rock Creek stream flow at Site HCM-7 during operations test of the infiltration gallery during May 2001.

4.6.1.2 Alternative B: Proposed Action

Water Withdrawal Activities

Water withdrawal activities under the Proposed Action would also affect the groundwater and hydrology of Rock Creek within the Clark Springs Facility and the lower reaches of Rock Creek. The impacts on groundwater would be the same as under the No-action Alternative because the same amount of water would be withdrawn (Subsection 4.6.1.1, Water Quantity, Alternative A – No Action). For the period January through September, the surface water impacts described under the No-action Alternative would be similar under the Proposed Action. Impacts on surface water would be slightly different during October, November, and December due to the flow augmentation program (HCM-1) that would be implemented under the Proposed Action, as described below.

Operations and Maintenance Activities

Under the Proposed Action, the City would conduct the same operations and maintenance activities as described under the No-action Alternative. Consequently, the effects to water quantity from operation and maintenance activities would be the same as under the No-action Alternative.

Habitat Conservation Measures

With the exception of the flow augmentation program (HCM-1), none of the conservation measures would affect the water flow regime in Rock Creek. The implementation of the flow augmentation program (HCM-1) under the Proposed Action would have a beneficial effect on instream flows downstream of the Clark Springs Facility during the months of October, November, and December. The 3-month period when augmentation could occur may be adjusted by up to 2 weeks (i.e., begin as early as September 17 or as late as October 15) if substantial shifts in Chinook salmon spawn timing occurs in the Cedar River. The following analysis only covers the October 1 to December 31 proposed augmentation period. From October through December, flow augmentation (HCM-1) under the Proposed Action would increase instream flows by up to 2.5 cfs. Relative to the No-action Alternative, flows would be substantially higher (more than 0.25 cfs higher), almost half of the time (approximately 45.6 percent) with the majority of the increases occurring under dry or drought conditions. Because of the increase of flows during the augmentation period, the timing of the low-flow period is expected to shift from October to late September under the Proposed Action with the result that the average 7-day low flow is expected to increase 0.5 cfs between the No-action Alternative and the Proposed Action. Because of limits on the amount of water the City can access for augmenting Rock Creek, instream flows may not always meet the targets from October through December. However, the Proposed Action would have a beneficial effect on instream flows compared to the No-action Alternative. The effects of the Proposed Action on surface waters during the months of October, November, and December and the technical details supporting the conclusions are described below.

Precipitation, augmentation, and instream flow data from 1986 through ~~2004~~ 2009 were analyzed to provide an indication of how the flow augmentation program (HCM-1) might have affected instream flow levels under the different precipitation year types that occurred during that period. The analysis of historical data was performed using an accounting system developed in a spreadsheet. The analysis utilized the 2-month antecedent precipitation data to assign climate types (wet, normal, dry, or drought) for each 2-week period from October through December as described in Appendix H of the HCP, which explains how the augmentation program would be implemented under the HCP. The precipitation type determined the maximum augmentation and instream flow target as outlined by the criteria in the augmentation program. When instream flows met or exceeded the target flows at the Parshall Flume during October, November, and December, then no augmentation occurred. When instream flows were below the target flows, water up to the maximum augmentation amount would be allocated from the water supply withdrawals to increase instream flows up to the target flow level. Using the historical discharge information, the spreadsheet was able to calculate the amount of flow in Rock Creek without augmentation and the amount of augmentation flow that would have been needed to meet the criteria outlined in the augmentation program. Details of the analysis and an example of the calculations used are provided in Subsection 6.1 of the HCP (City of Kent 2010).

One major difference between this analysis and actual implementation of augmentation is that to simplify calculations the analysis utilized daily adjustments in augmentation to meet the flow targets. Consequently, the analysis estimated the minimum amount of augmentation flow needed to meet the target flow. In practice, augmentation would likely include adjustments less frequently, such as once per week or every other week, and leave an adequate buffer to maintain surface water flows at or above the target flow. Because of this simplification, the analysis may slightly underestimate actual augmentation and instream flow levels that would be implemented under HCM-1.

Within the analysis period, the ~~19~~24 fall seasons from 1986 to ~~2004~~2009 tended to be relatively dry compared to the long-term average of the 43-year precipitation data from Landsburg (Western Regional Climate Center 2004). During this period, ~~53~~54 of ~~114~~144 augmentation periods (2-week intervals between October 1 and December 31) were drier than normal compared to ~~18~~31 augmentation periods that were wetter than normal (Table 4.6-1). Consequently, the results of the analysis may be more representative of what could be expected during normal, dry, and drought years, but less representative of what might happen during wet periods. This is particularly true for October in which only ~~2~~4 of the ~~38~~48 2-week augmentation periods occurring in October were considered wet (Table 4.6-2).

To determine the effects on the surface waters of Rock Creek, average instream flows for October, November, and December were analyzed for the ~~19~~24-year period, with and without implementation of the flow augmentation program (HCM-1). For the analysis, changes in flow greater than 0.25 cfs were considered substantive because smaller changes would fall close to or below the measurement error of the USGS gage at the Parshall Flume (typically 10 to 15 percent). During ~~52~~63 of ~~114~~144 augmentation periods (~~45.6~~43.8 percent), average instream flows were more than 0.25 cfs higher than they would be under the No-action Alternative. Table 4.6-2 shows the amount of increase in instream flow that would result under the Proposed Action, as compared to the No-action Alternative.

Table 4.6-1 Frequency that a 2-week augmentation period would have been categorized as wet, normal, dry, or drought between 1986 and ~~2004~~2009.

	Number of 2-Week Augmentation Periods			
	Oct	**Nov**	**Dec**	**Total**
Wet	~~2~~4	~~6~~13	~~10~~14	~~18~~31
Normal	~~14~~21	~~11~~14	~~18~~24	~~43~~59
Dry	~~10~~11	11	3	~~24~~25
Drought	12	10	7	29
Total	~~38~~48	~~38~~48	~~38~~48	~~114~~144

Based upon the analysis of the available data, the majority of the improvements to instream flow would occur when they are most needed, i.e., under drought (19 of 29 drought augmentation periods, 65.5 percent) or under dry conditions (~~14~~15 of ~~24~~25 dry augmentation periods, ~~58.3~~60.0 percent). In contrast to dry and drought conditions, augmentation would provide improvements in instream flow less frequently under normal (~~17~~24 of ~~43~~59 normal augmentation periods, ~~39.5~~40.7 percent) and wet conditions (~~2~~5 of ~~18~~31 wet augmentation periods, ~~11.1~~16.1 percent) because instream flows that meet flow targets without the need for augmentation would occur more frequently.

Using the 1986 to ~~2004~~2009 data, average annual augmentation levels needed to meet instream flow targets would range from 0.0 cfs (1997) to 1.0 cfs (1992) and average ~~0.5~~0.4 cfs per year. However, under the Proposed Action, conditions could occur that require the City to provide instream flows of as much as 2.5 cfs (i.e., the maximum augmentation level under wet conditions for 3 months). Under the No-action Alternative, the annual 7-day low flows would typically occur in October and range from August through November, but under the Proposed Action low flows would occur primarily during September and occasionally during August. This shift in the seasonal timing of the annual 7-day low-flow event would on average decrease the severity of the event relative to the No-action Alternative. For example, under the No-action Alternative the average 7-day annual low flow would be approximately 1.1 cfs, but under the Proposed Action the average annual 7-day low flow would be approximately 1.6 cfs.

Table 4.6-2 Summary of Rock Creek estimated augmentation and flow by period with and without augmentation based upon data from 1986 to ~~2004~~2009.

Period	Alternative A – No Action			Alternative B – Proposed Action		
	Average Augmentation (cfs)	**Average Instream Flow (cfs)**	**Range of Flows (cfs)**	**Average Augmentation (cfs)**	**Average Instream Flow (cfs)**	**Range of Flows (cfs)**
1: October 1-15	NA	~~1.9~~2.0	0.5-6.4	1.0	~~2.9~~3.0	2.2-6.4
2: October 16-31	NA	~~2.0~~2.2	0.5-6.8	~~0.9~~0.8	3.0	2.2-6.8
3: November 1-15	NA	~~3.1~~4.0	0.8-38~~6~~	~~0.6~~0.5	~~3.7~~4.5	2.4-~~36~~38
4: November 16-30	NA	~~8.1~~9.0	1.3-36	0.2	~~8.4~~9.2	2.5-36
5: December 1-15	NA	~~14.8~~13.9	1.3-36	0.1	~~14.9~~14.0	2.5-36
6: December 16-31	NA	~~16.8~~16.0	1.9-42	~~0.02~~0.01	~~16.8~~16.1	2.5-42

Note: Flows recorded at the flume were capped at 36 cfs from 1986 to 2000 while the City operated the flume. During subsequent years the USGS expanded the rating curve beyond the capacity of the flume; however, flow estimates above 36 cfs are rated as poor by the USGS.

The 1986 to ~~2004~~2009 data, under the assumption of implementing the flow augmentation program (HCM-1), shows average augmentation levels generally declining from October through December (Period 1 to Period 6, Table 4.6-2) and from drought to wet conditions (Table 4.6-3). Table 4.6-2 also provides a comparison of the average, and the range of, instream flows that would likely occur under the No-action Alternative and the Proposed Action. Based on this analysis, both the minimum and average instream flow in Rock Creek would increase during October and early November under the Proposed Action compared to the No-action Alternative, but on average flows would tend to be similar during late November and December under both alternatives because augmentation would rarely be needed to meet instream flow targets. Table 4.6-3 shows that the average augmentation level is higher in dry periods than it is in drought periods. This apparent paradox is the result of the difference in maximum augmentation amounts allowed under the different year types; under dry conditions, augmentation can occur up to 1.75 cfs while under drought conditions, it is capped at 1.50 cfs.

The analysis also suggests that the implementation of the flow augmentation program under the Proposed Action may not always meet the instream flow targets identified in the proposed HCP. From 1986 to ~~2004~~2009, in 77 out of ~~1,748~~3,208 days (~~4.5~~3.5 percent), instream flows were below flow targets. The shortfall ranged from 0.02 cfs to 0.52 cfs with an average of 0.17 cfs. Under most circumstances, the target shortfalls would be relatively minor, with 71 percent (55 out of 77) less than 0.25 cfs below the target, or of short duration (less than 1 week). One notable exception is October to early November 1992, which would have had a 31-out-of-37-day period with target shortfalls. During this period, instream flows would have ranged from 2.2 to 2.7 cfs with an average of 2.4 cfs.

Table 4.6-3 Summary of Rock Creek estimated augmentation and flow by climate type under the Proposed Action.

Climate Type	Average Augmentation (cfs)	Average Flow (cfs)	Minimum Flow Target (cfs)
Drought	0.6	2.8	2.5
Dry	0.7	~~4.0~~4.1	2.75
Normal	0.4	~~9.9~~8.7	3.0
Wet	0.1	~~15.1~~16.2	3.5

The amount of water diverted from the water supply to augment surface flows would vary depending on the deviation of the 2-month antecedent precipitation period from normal hydroclimate conditions and the amount of surface flow already existing in the stream. Compared to the No-action Alternative, average flows in Rock Creek during the October, November, and December flow augmentation period under the Proposed Action would increase up to 1 cfs and minimum flows would increase up to 1.7 cfs. Average augmentation amounts would be highest during October and lowest during December. Average augmentation amounts would be highest during dry and drought periods, moderate during normal periods, and low during wet periods.

4.6.2 Water Quality

This subsection will evaluate how the alternatives may potentially impact the water quality in Rock Creek based on surface water quality standards as defined in the Washington Administrative Code (Washington State Department of Ecology 2006a). The subsection includes an analysis of water quality impacts based on changes to temperature, dissolved oxygen, and turbidity. Other water quality constituents such as pH, bacteria, and metals or toxics would not be expected to be affected by implementation of the Proposed Action because there are no additional sources or sinks of these constituents that would result from project operations and concentrations would not be expected to change as a result of groundwater removal or changes in flow magnitude. Because there would be no effects, these constituents are not analyzed in detail.

Based on the results of operations tests described in Subsection 4.6.1, Water Quantity, the City's water withdrawals have an insignificant effect on instream flows upstream of the Clark Springs Facility. In addition, no covered activity would occur upstream of the Clark Springs Facility. As such, neither the No-action Alternative nor the Proposed Action is expected to impact upstream water quality; therefore, the alternatives will be evaluated only for downstream conditions.

4.6.2.1 Alternative A: No Action

Water Withdrawal Activities

Under the No-action Alternative, the City would continue to operate the Clark Springs Facility within the requirements of its water rights. Future water withdrawals and standard operational and maintenance activities would likely occur regardless of ITP coverage, and may have some effect on water quality. Because the Clark Springs Facility is used to supply drinking water, the City has a strong self-interest in maintaining a high level of ground and surface water quality. As part of the Cedar River basin, Rock Creek is currently designated for core summer habitat and supplemental spawning and incubation and has not been identified as impaired for these purposes (Subsection 3.6.3, Water Quality Standards and Criteria, for a description of designated uses and standards). In order to maintain high water quality and protect the designated uses for water in Rock Creek, the City utilizes BMPs during the implementation of operational and maintenance activities within the Clark Springs Facility to minimize or avoid adverse effects to water quality. Typical facility activities are described below along with applicable BMPs and a corresponding description of the effect on water quality.

Operations and Maintenance Activities

Operations and maintenance activities, including future replacement, applies to buildings, wells, access roads, fences and security infrastructure, infiltration gallery, and the water transmission main. It is assumed that any construction activities within Rock Creek or within other parts of the watershed would require the appropriate permits from local, State, and Federal entities, which have built-in processes for identifying and implementing BMPs and mitigation measures to reduce the effects of construction activities on water quality. In addition, Federal permits would require ESA section 7 consultation designed to ensure that adverse effects to ESA-listed species would be minimized or avoided during implementation of the permitted activity. Consequently, it is anticipated that construction and maintenance activities likely to occur under the No-action Alternative that require a local, State, or Federal permit would have minimal effect on water quality in Rock Creek.

Current water quality conditions and applicable surface water standards are summarized in Subsection 3.6, Water Quantity and Water Quality. Operations and changes in the instream flow of Rock Creek as a result of the Clark Springs Facility have the most potential to impact temperature, dissolved oxygen, and turbidity. The reduction of flow from water withdrawals is expected to increase maximum water temperature and the magnitude of the daily fluctuation in temperature, but this effect has not been documented to exceed State water quality standards and is not expected to in the future. Dissolved oxygen is temperature dependent and may be affected as a result of the change in the daily maximum water temperature; however, low saturation levels suggest any changes in temperature would not be realized as changes in dissolved oxygen. A review of available turbidity and flow data indicated that turbidity in Rock Creek (Subsection 3.6, Water Quantity and Water Quality) is well below State standards and that no obvious relationship between the two variables was apparent. Consequently, the reduction in flow as a result of the Clark Springs Facility is not anticipated to affect turbidity in Rock

Creek under the No-action Alternative. Other operation and maintenance activities also have the potential to affect water quality, but would affect only turbidity. The effects of the No-action Alternative on water quality and the technical details supporting the conclusions are described below.

One of the critical water quality parameters in Rock Creek is stream temperature. High water temperatures can affect the movement of migrating adult salmonids and may reduce both salmon egg viability and survival (Caldwell 1994), as well as juvenile growth and survival (Bjornn and Reiser 1991). As described in Subsection 3.6.4, Temperature, stream temperature is impacted by many factors, but stream depth is the most important parameter that characterizes stream size for energy transfer purposes (Adams and Sullivan 1989). A change in stream depth would affect both the magnitude of the stream temperature fluctuations and the response time of the stream to changes in environmental conditions (Adams and Sullivan 1989). As a result, any project impacts reducing stream flow, and hence reducing stream depth, also have the potential to impact stream temperature.

Under the No-action Alternative, despite the reduction in flow as a result of water withdrawals at the Clark Springs Facility, available water temperature data presented in Subsection 3.6.3, Water Quality Standards and Criteria, do not show any exceedance of the temperature standard. In addition, Rock Creek downstream of the Clark Springs Facility is well shaded and only about 2 miles long before entering the Cedar River. This portion of the creek is close to the groundwater source and has a limited distance in which to gain heat before entering the Cedar River. Based on the available information, it is assumed that the operations of the Clark Springs Facility increase maximum water temperature, but this effect has not been documented to exceed State water quality standards and would not be expected to in the future.

Dissolved oxygen levels may also be adversely affected by the operations of the Clark Springs Facility. Clark Springs operations under the No-action Alternative would not directly change groundwater or surface water concentrations of dissolved oxygen. However, changes in dissolved oxygen can be indirect as a result of changes in flow and temperature. Dissolved oxygen concentrations are inversely related to temperature since higher-temperature water has a lower oxygen saturation limit. As such, a decrease in flow such as that described in Subsection 4.6.1.1, Water Quantity Alternative A – No Action, with a corresponding increase in temperature may also tend to reduce dissolved oxygen concentrations.

Available dissolved oxygen data as presented in Subsection 3.6.4, Temperature, show seven exceedances of the dissolved oxygen surface water quality standard at the Parshall Flume with three occurring in the summer/early fall and the remaining in the late fall/winter. Using a temperature-dependent estimation of dissolved oxygen saturation (Chapra 1997), dissolved oxygen levels on the exceedance dates were only 80 percent of saturation and averaged only 86 percent of saturation over the period of record. Since the dissolved oxygen was not fully saturated, a decrease in the saturation limit as a result of a change in temperature would not have an effect on the dissolved oxygen level at this location. These data were collected near the Parshall Flume, which is located near the perennial groundwater source less than 600 feet downstream of the infiltration gallery and wells. Low dissolved oxygen concentrations are not unexpected given that groundwater often has lower dissolved oxygen levels than surface water (Quinn 2005; Edwards 1998).

As water travels downstream and becomes fully saturated, the change in temperature as a result of the change in flow may begin to adversely affect the dissolved oxygen concentration. Continuous temperature data collected in 2004 show a 0.4ºF (0.7ºC) to 4ºF (7.2ºC) increase in temperature between the Kent-Kangley Road and the mouth of Rock Creek. Assuming a maximum increase in temperature of 4ºF (7.2ºC) on the dates of the dissolved oxygen exceedances, the dissolved oxygen saturation would decrease by 0.9-1.0 mg/L from between 11.2-11.5 mg/L at the Kent-Kangley Road to 10.3-10.5 mg/L at the mouth. The change in temperature and dissolved oxygen from the Kent-Kangley Road to the mouth would be attributable to both natural heating that occurs in a stream as well as heating that may occur as a result of reduced flow. However, despite these changes in temperature and the decrease in dissolved oxygen saturation limit, the dissolved oxygen concentrations are still well above the dissolved oxygen standards. Dissolved oxygen concentrations may be affected by changes in temperature, but given the information available on observed dissolved oxygen levels and corresponding temperature and saturation limits, it would be unlikely the Clark Springs Facility either increases or exacerbates dissolved oxygen exceedances near the facility or toward the mouth of Rock Creek.

Turbidity levels in Rock Creek are excellent relative to water quality standards, with the highest measurement less than 1.5 NTU (Subsection 3.6.6, Turbidity and Total Suspended Solids). In addition, a review of available turbidity and flow information suggests no apparent relationship between the two variables within Rock Creek. Withdrawals for water supply would not affect turbidity.

Construction at the aforementioned facilities can increase soil disturbance resulting in increased potential for sediment delivery to the creek and an increase in turbidity. Under the No-action Alternative the City would install and use all appropriate and applicable BMPs required under City ordinances at the time of the activity such as erosion and sedimentation control devices as appropriate. The current BMPs required by the City can be found in Appendix K of the HCP (City of Kent 2010). As indicated above, it is assumed that any construction activities within the Rock Creek or within other parts of the watershed would require the appropriate permits from local, State, and Federal entities. These could include an HPA permit, a joint aquatic resource permit application (JARPA), and other city or county permits. All of these permits have built-in processes for identifying and implementing BMPs and mitigation measures to reduce the effects of construction activities on water quality. Consequently, it is anticipated that construction and maintenance activities likely to occur under the No-action Alternative that require a local, State, or Federal permit would have minimal effect on turbidity levels in Rock Creek.

The City would conduct vegetation management to maintain its facilities. All vegetation management conducted by the City on the Clark Springs property would be carried out via mechanical methods and would not include chemical applications so there is no threat of spill or transfer of pesticides or herbicides into the waterways. Furthermore, nearly all needed vegetation management occurs outside of riparian zones, or in areas already cleared for the existing facilities. As such, no water quality impacts as a result of vegetation management would be anticipated.

Activities at the facility also include operation and maintenance of the Parshall Flume. This activity could result in short-term and localized dispersion of algae and periphyton communities during cleaning and instream disturbance and redistribution of fine sediment as a result of movement of debris or small boulders. Both of these activities have the potential to increase turbidity. Given that the impacts would be short term, localized and occur infrequently, no significant impacts would be anticipated. In addition, BMPs described in Table 6-1 of the City's HCP (City of Kent 2010) would be implemented to minimize any of the short-term, localized effects.

The City is likely to periodically conduct wildlife management within the watershed that may include beaver trapping and beaver dam removal in order to maintain drinking water quality and prevent stream relocation and damage to the City's infrastructure. This activity could result in minor increases in suspended sediments during beaver dam removal, which may increase turbidity. However, these increases in suspended sediment would likely be short term and minor because dam removal usually occurs before a substantial backwater develops behind the dam. In addition, an HPA permit from the WDFW (Appendix M, City of Kent 2010) stipulates acceptable rates of water lowering during dam removal.

Facility operations also include electrical, control, and telemetry operations, maintenance, and improvements. These activities have the potential to increase turbidity as a result of localized soil disturbance and sediment delivery to the creek. However, these activities would primarily occur outside of the riparian zone and any of these activities would be carried out under BMPs, such as sediment control and reseeding and stabilization of disturbed soil, and would not be anticipated to substantially affect turbidity levels in Rock Creek.

The facility requires the delivery and storage of chemicals used to treat the City's water supply. Chemicals for existing treatment include chlorine and fluoride and may include other chemicals needed for potential future treatment as required by State and Federal drinking water regulations. The infrequent deliveries and storage of the chemicals inside the facility make accidental spillage or release of chemicals into Rock Creek unlikely. In addition, the City has an emergency hazardous materials containment and recovery plan in place that would help mitigate the effects of spills on water quality in the event of a chemical spill/release (Appendix N, City of Kent 2010). Prior to working with any hazardous material, all personnel are made familiar with material safety data sheets, the proper personal protective equipment, and accidental release measures. In addition, the facility has on-site monitoring and alarm systems. However, in the event of a spill, the adverse effects to water quality could be significant.

The City would continue to maintain and replace stormwater conveyance, control, and distribution facilities. These activities have the potential to result in short-term and localized soil disturbance and sediment delivery to Rock Creek. Increases in sediment would increase turbidity, but given the BMPs utilized by the City, such as sediment control and reseeding of disturbed soils, the anticipated effects to Rock Creek would be minimal.

The City may decide to install, operate, and maintain monitoring wells to detect contamination from Landsburg Mine or other sources in the watershed. The installation of these wells has the potential to increase turbidity as a result of soil disturbance during road construction for access and well drilling. However, access roads would likely be short gravel-surfaced spur roads off existing roads, would be placed at least 50 feet from riparian zones, and would avoid crossing streams. Best Management Practices such as sediment control and reseeding would minimize the potential for disturbed soils to reach Rock Creek.

As mentioned above, the important water quality parameters of interest include temperature, dissolved oxygen, turbidity, and TSS. These parameters are of importance because they have the highest likelihood of impacting aquatic species and their productivity. Cooler water temperatures are required for salmon survival during all life stages. In addition, salmon and other aquatic life need sufficient levels of dissolved oxygen to ensure the normal physiological functions are not impaired (Spence et al. 1996). Increases in turbidity and TSS have the potential to impact feeding efficiency or may also decrease primary productivity of algae or periphyton as a result of reduced light penetration, which can adversely impact macroinvertebrates and fish (Gregory et al. 1987). Under the No-action Alternative, operations of the project may potentially affect water temperature, dissolved oxygen, turbidity, and TSS. However, available water quality measurements do not show any exceedances of temperature or dissolved oxygen water quality standards and BMPs would be implemented to ensure effects from turbidity resulting from construction and maintenance activities associated with operation of the Clark Springs Facility would be minimized.

4.6.2.2 Alternative B: Proposed Action

Water Withdrawal Activities

Water withdrawal activities under the Proposed Action would be the same as under the No-action Alternative and therefore would have the same effects to water temperature, dissolved oxygen, turbidity, TSS, and designated uses as described under the No-action Alternative.

Operations and Maintenance Activities

Operations and maintenance activities under the Proposed Action would be the same as under the No-action Alternative and therefore would have the same effects to water temperature, dissolved oxygen, turbidity, TSS, and designated uses as described under the No-action Alternative.

Habitat Conservation Measures

Under the Proposed Action, there would be water quality effects during augmentation periods (HCM-1) and during the implementation of the following HCMs:

- Passage improvements at the mouth of Rock Creek (HCM-2)
- Off-channel habitat enhancement (HCM-3 and HCM-4)
- Summit-Landsburg Road culvert replacement (HCM-5)
- Large wood placement (HCM-6)

Overall, the Proposed Action would result in a net benefit to water quality conditions as compared to the No-action Alternative, primarily because of the flow augmentation program.

The flow augmentation program (HCM-1) under the Proposed Action would increase streamflow to maintain minimum flow targets in Rock Creek during October, November, and December. When augmentation occurs, this increase would dampen the daily fluctuation of water temperature and reduce maximum daily temperatures. Dissolved oxygen concentrations may also benefit from a reduction in maximum temperature because cooler water can hold more oxygen. However, this change is likely to be minimal since available data did not show dissolved oxygen concentrations near saturation limits and the change in temperature may not be large enough to result in a significant change in dissolved oxygen. Under the Proposed Action, dissolved oxygen concentrations would likely increase near the augmentation pipe outlet during October, November, and December as a result of aeration that occurs during the process of releasing water for augmentation.

Habitat Conservation Measures 2 through 6, which may involve active construction in the stream channel, would disturb soil and sediment and may temporarily increase the levels of turbidity in Rock Creek. However, specific BMPs would be developed as a part of the permitting process. As such, it is assumed these activities would have the necessary mitigation to ensure minimal effects on water quality. Once completed, these alterations would be stable within the channel and would not be expected to have any long-term effects to turbidity or TSS. However, maintenance or reconstruction of the rock weirs at the mouth of Rock Creek (HCM-2), maintenance of the off-channel wetlands in the lower reaches (HCM-3 and HCM-4), or large wood enhancement (HCM-6) could result in minor temporary and local increases in turbidity. Maintenance activities are anticipated to occur infrequently and would have only localized effects so no long-term impacts on turbidity would occur.

4.7 Vegetation

4.7.1 Alternative A: No Action

4.7.1.1 Wetlands

Wetlands, including undocumented wetlands, the wetland beneath the BPA transmission line, and riparian forested wetlands, would not be impacted under the No-action Alternative because the City's construction activities necessary to maintain its existing facilities and to construct new buildings on the property would occur outside existing wetland areas on the property; therefore, no effects to wetlands are expected. Wetlands downstream of the Clark Springs Facility that are currently hydrologically connected to Rock Creek would continue to experience stream flows similar to those that occurred during the period of record.

Under the No-action Alternative, there would be no change to the condition of the two wetlands located near the mouth of Rock Creek.

4.7.1.2 Special Status Plants

No federally listed, proposed, or candidate plant species or plant communities are known or suspected to occur within the action area. No State-tracked special status plant species are documented from the action area. As a result, no effects to special status plant species would be expected to occur as a result of the No-action Alternative.

4.7.1.3 Noxious Weeds

Under the No-action Alternative, the City would not change its operation of the three wells, gravity-fed infiltration gallery, and surface water diversion system at the Clark Springs Facility; therefore, weed occurrence, distribution, or management in the lower Rock Creek basin would remain unaltered. The City's continued operation of the Clark Springs Facility would entail construction activities to maintain its existing facilities and to construct new buildings on the property. Any construction activity that requires ground clearing provides an opportunity to introduce noxious weeds. However, the City will implement weed management measures for cleared and disturbed areas, including treatment of existing weed infestations and revegetation of disturbed soils. These measures will reduce the opportunity for the introduction and spread of noxious weeds. Weeds will be managed at the site in accordance with the King County Noxious Weed Control Board requirements.

4.7.2 Alternative B: Proposed Action

4.7.2.1 Wetlands

The Proposed Action is not expected to affect wetlands at the Clark Springs Facility site because construction activities necessary to maintain existing facilities and to construct new buildings on the property would occur outside of known wetland areas on the property.

Implementation of the flow augmentation plan (HCM-1) would increase instream flows to lower Rock Creek during October, November, and December. Wetland functions downstream of the Clark Springs Facility would not be affected by the proposed streamflow augmentation because flows would be expected to occur within the range of natural variability. Furthermore, the wetland plant community would not be expected to change because most wetland plant species are transitioning from active growth to dormancy at this time of year; therefore, the additional water supply would not be expected to affect the quality or quantity of wetland vegetation. The implementation of the flow augmentation plan would result in higher levels of streamflow during October, November, and December than would be expected to occur under the No-action Alternative.

Two wetlands located near the mouth of the Cedar River would be affected under the Proposed Action as a result of implementation of off-channel habitat improvements (HCM-3 and HCM-4). These improvements would not reduce or increase the amount of wetland habitat at either site but would result in improved water quality along lower Rock Creek as a result of restoring hydraulic connectivity. Wetland quality would also be enhanced at both sites through plantings of native wetland species. Under the No-action Alternative, the HCMs would not be implemented so none of the improvements to wetlands described above would occur.

4.7.2.2 Special Status Plants

No federally listed, proposed, or candidate plant species are known or suspected to occur within the action area. No State-tracked special status plant species or plant communities are documented from the action area. As with the No-action Alternative, no effects to special status plants would be expected to occur as a result of implementation of the Proposed Action.

4.7.2.3 Noxious Weeds

Implementation of the Proposed Action would have no direct effect on weed occurrence, distribution, or management in the lower Rock Creek basin. The implementation of passage improvements at the mouth of Rock Creek (HCM-2), off-channel habitat enhancements (HCM-3 and HCM-4), culvert replacement at Summit-Landsburg Road (HCM-5), and large wood placement (HCM-6) would have the potential for soil and vegetation disturbance, which could promote the distribution and establishment of weed species. However, the City would implement weed management measures for cleared and disturbed areas, including treatment of existing weed infestations and revegetation of disturbed soils. These measures would reduce the opportunity for the introduction and spread of noxious weeds. Weeds would be managed at the sites in accordance with King County Noxious Weed Control Board requirements. Funding of off-site habitat enhancement (HCM-8) also provides an opportunity for the City to support weed management activities in the Rock Creek basin, if such activities were determined to be consistent with the goal of protecting or enhancing existing riparian habitats and adjoining floodplain function and integrity (e.g., invasive knotweed removal from creek and wetland habitats).

Relative to the No-action Alternative, the Proposed Action would have the same or a slightly beneficial effect on the reduction of noxious weeds in the action area.

4.8 Fish and Aquatic Habitat

This subsection discusses the effects of the alternatives on fish species and their aquatic habitat. Additional information can be found in the HCP in Chapter 3, Existing Condition of the Rock Creek Basin, and Chapter 6, Effects of City of Kent Water Withdrawal and Conservation Measures.

Flow levels are an important component to fish holding, rearing, and spawning habitat and migration passage conditions (Bjornn and Reiser 1991). To better understand how flows might affect fish habitat under the No-action Alternative, the City commissioned a study to establish and assess the relationship of fish habitat versus flows in Rock Creek, so that the biological benefits of its flow proposal could be quantified and compared to current (baseline) conditions in which no supplementation occurs (City of Kent 2010). These studies utilized the PHABSIM analysis (Bovee and Milhous 1978; Bovee 1982) and involved the establishment of a series of 37 cross-channel transects at selected locations representative of different habitat types in Rock Creek, and the collection of depth, velocity, and substrate data under three different flows (Appendix F of the HCP). These data were used to develop a hydraulic model of the system that was linked to a habitat model used to derive species and life stage specific habitat versus flow relationships. The habitat parameter in this model exercise is termed "Weighted Usable Area" (WUA) since it is weighted by a fish's preference for certain depths, velocities, and substrates. With the exception of Chinook salmon, all salmonid life stages were modeled from the mouth of Rock Creek to the end of Reach 9b (Figure 3.9-3). The end of Reach 9b is at the location of the Parshall Flume near Kent-Kangley Road. To provide context to the range of WUA calculated from the PHABSIM/HSPF Linked Operations Analysis Tool (PHLOAT) analysis, the maximum amount of surface area of Reaches 1 through 9b using an average bankfull width of 29.1 feet is 282,183 square feet.

The PHABSIM output was then linked with an HSPF model that provided estimates of mean daily flow (Appendix C of the HCP; MGS Engineering Consultants 2005). The operations analysis tool PHLOAT provided an index of the amount of habitat (for different species and life stages) that would be available at different times of the year for seven of the nine species proposed for coverage under the HCP. The PHLOAT tool could not be used for the two lamprey species because no habitat suitability index information is available. A detailed description of the PHLOAT analysis completed on Rock Creek may be found in Appendix F of the HCP.

The transects used in the PHABSIM analysis also provided an opportunity to examine passage through riffles and holding conditions in pools at different flow levels. The main criterion for successful upstream passage at low flows is depth. Many minimum depth criteria can be found in the literature for salmonids, varying by species and investigation. Based upon a review of available scientific literature (Orsborn and Powers 1985; Thompson 1970; Thompson 1972; Weaver et al. 1976; Evans and

Johnston 1980; Bell 1991), the optimal passage conditions for Chinook salmon were assumed to occur at depths of 1.0 feet or more per the recommendations of Bell (1991). Few studies discuss the minimum width over which a depth criterion should be applied. The WDFW (2000) recommends a minimum orifice width of 1.5 feet for fish ladders in its draft fishway guidelines, but indicates that widths of 1.0 foot are occasionally used. The depth analysis in this subsection applied the WDFW recommendations and assumed that the minimum depth criteria over a contiguous minimum width of 1.0 foot to 1.5 feet would allow complete passage. The assessment of adult holding habitat was based on comparing pool depths across transects to the 3.3-foot criterion as specified by the Washington Forest Practices Board 1995).

4.8.1 Alternative A: No Action

Under the No-action Alternative, the City would continue to operate the Clark Springs Facility as it has during the baseline period, except during high-flow winter months. The most important aspects of the No-action Alternative that have the potential to adversely affect listed fish species are the water withdrawals that reduce the amount of water in Rock Creek. As described in Subsection 3.6, Water Quantity and Water Quality, the annual hydrograph for Rock Creek flows (Figure 3.6-3) is strongly influenced by precipitation that recharges the shallow aquifer, which is the source of perennial water for the creek. Surface flows in the creek increase shortly after the onset of fall rains, peak during the winter and early spring, then decline to their lowest levels during early fall (typically mid-September to early November). The annual 7-day low flow would usually occur in October under the No-action Alternative, but occasionally would occur in November or September. The average annual 7-day low flow during the 1986 to 1997 period at the Parshall Flume was 1.3 cfs. Additional data from 1998 through 2004 suggest the earlier period may have included a higher proportion of extreme low flows than a longer time series would provide. Following adjustment for augmentation (i.e., subtraction of the augmentation amount that reached the flume) during some periods after 1998, the mean annual 7-day low-flow level from 1998 to 2004 was 2.2 cfs and for all years (1986 to 2004) was 1.6 cfs.

4.8.1.1 Covered Fish Species

Puget Sound Chinook Salmon

The PHLOAT analysis for Chinook salmon spawning and fry rearing habitat considered four different distributions in Rock Creek described in Subsection 3.8.1.1, Species Listed as Threatened Under the ESA, because of uncertainty in the available information. Based upon these different potential distributions, Chinook salmon and fry habitat were modeled from the mouth through Reach 3 (RM 0.28), through Reach 5 (RM 0.67), through Reach 8 (RM 1.58), and through Reach 9b (1.85) (Figure 3.9-3).

The spawning habitat analysis for Chinook salmon also considered two alternative sets of habitat preference curves for depth and velocity. The first was a default set of curves based upon the WDFW and Ecology guidelines for conducting instream flow studies, and the second set of curves was derived from streams comparable in size to Rock Creek. The default curves were those recommended by the

WDFW and by Ecology for use in the absence of curves developed from site-specific microhabitat data. Because site-specific preference curves were not developed for Rock Creek, these curve sets (also known as the fallback curves) were used for this analysis (Washington Department of Fish and Wildlife and Washington Department of Ecology 2003). According to Caldwell et al. (1990), the Washington Department of Fish and Wildlife and Washington Department of Ecology (2003) fallback curves were based upon curves from the Yakima River, Washington, and the Sandy River, Oregon, which are much larger than Rock Creek; the curves were further adjusted based on professional judgment so that higher suitability was assigned to lower velocities and depths. The other set of preference curves, i.e., Douglas curves, was derived from a number of smaller streams of similar size to Rock Creek that had been applied to streams in Douglas County, Washington (R2 Resource Consultants, Inc., unpublished data). A comparison of the curves indicated a higher suitability for lower velocities and shallower depths and lower suitability for higher velocities under the Douglas curves relative to the fallback curves. For completeness, both sets of curves were used in the analysis for Chinook salmon spawning habitat, resulting in development of two alternative WUA-flow relationships.

The PHLOAT analysis indicated that under the No-action Alternative the median amount of Chinook salmon spawning habitat from the mouth of Rock Creek to the Parshall Flume would be approximately 168 square feet of WUA during October and 47 square feet of WUA during November based on the Washington fallback habitat preference curves (Table 4.8-1). The amount of WUA is lower during November compared to October because median flow levels under the No-action Alternative with typical withdrawal amounts would be slightly lower during November than October based upon the HSPF modeling. Under the Douglas curves, the median amount of habitat would be 2,977 square feet of WUA during October and 1,756 square feet during November. Based upon the fallback preference curves, Chinook salmon spawning habitat would be negligible at flows typically available during October and November under current operations present in the No-action Alternative regardless of the distribution assumption. Using the Douglas preference curves, a small amount of spawning habitat is available under the No-action Alternative. The analysis also suggests that depth would likely be a critical factor limiting Chinook salmon spawning habitat. Reaches 8 and 9b have a higher percentage of pools with water of a suitable depth for spawning than do other reaches below the Parshall Flume. However, it is notable that all Chinook salmon observed in Rock Creek during spawning surveys in recent years have been in Reaches 1 or 2, but that no Chinook salmon redds have been reported.

If the wells are used in October or November, a minimum instream flow of 2 cfs in October and 15 cfs in November would be required under the water rights for the facility and would ensure that the amount of WUA for spawning would be higher when compared to the median WUA amounts modeled using PHLOAT, though use of the wells would not likely be the typical operational strategy during the early fall.

Table 4.8-1 Median amounts of weighted usable area (square feet) (WUA) for spawning habitat and fry habitat under four different Chinook salmon distribution assumptions.

	Month	Reaches			
		1 - 9b	**1 - 8**	**1 – 5**	**1 - 3**
Spawning Habitat					
Fallback Curves	October	168	116	36	15
	November	47	32	10	4
Douglas Curves	October	2977	2587	1258	539
	November	1756	1546	767	329
Fry Habitat					
	February	75379	59335	22127	9533
	March	74719	58553	21435	9243
	April	72461	56560	20366	8792
	May	67024	51908	18089	7831

Under the No-action Alternative, the PHLOAT analysis indicated that median Chinook salmon fry habitat would range from approximately 67,024 square feet of WUA during May (low) to about 75,739 square feet of WUA during February (high) (Table 4.8-2). Similar to spawning habitat, the analysis suggests Reaches 8 and 9 would have a higher amount of suitable fry rearing habitat on a per unit of stream length basis than other reaches farther downstream. The higher amount of suitable fry rearing habitat is likely to be related to the higher percentage of pools and slower moving water in these upstream reaches.

As described in Section 2, Alternatives, if additional water storage facilities become available, future operations under the No-action Alternative may include higher withdrawals than have typically occurred in the past during high-flow months. Under these circumstances, the wells would likely be used to provide the additional withdrawal amounts. If the wells are used, the minimum instream flow of 15 cfs between February and April 30 would ensure at least 72,575 square feet of fry WUA area for Reaches 1 through 9b (Table 4.8-3). As the minimum flow requirements under the City's water right decrease during May, the amount of WUA would also decrease (assuming only the minimum flow was maintained). These WUA amounts would be only slightly different (within 8.5 percent) from the median amounts present without the minimum flow requirements during the February through April period (Table 4.8-2). Consequently, additional water withdrawals during the winter and spring for the purposes of diverting water to storage that would be higher than the 1986 to 1997 pattern of withdrawals would not be likely to substantially reduce the amount of fry habitat available in the lower reaches of Rock Creek.

As described above, the water depth along nine pool and riffle transects was calculated at low-flow levels of 1.5 cfs that would be typical of the No-action Alternative operations to assess passage conditions. Three depth statistics were also calculated for each transect at the four flow levels:

maximum depth, mean depth, and mean depth of the primary channel (the portion of the channel at least 1.0 foot wide with the greatest depth most likely to be utilized by an adult salmon). The mean depth of the primary channel met the 1.0-foot criterion at only one of the nine transects and the maximum depth met the criterion at only two transects. Mean depth along the entire wetted width did not meet the criterion at any of the transects (Table 4.8-4). The analysis suggests that passage for Chinook salmon in Rock Creek downstream of the Clark Springs Facility would be suboptimal under the No-action Alternative. These results should not be construed to indicate that Rock Creek would be totally impassable under the No-action Alternative operational conditions, but that passage would be sub-optimal under most conditions.

Observations at the mouth of Rock Creek during the Chinook salmon and sockeye salmon spawning period also suggest passage would be restricted during low-flow periods at that location. When flows in both the Cedar River and Rock Creek are low (i.e., Cedar River flows less than 200 cfs and Rock Creek flows less than 4 cfs), the mouth of Rock Creek becomes perched approximately 3 feet above the confluence with the Cedar River resulting in a 40-foot-long section composed of large cobble and boulders with a gradient of 7 percent. At its confluence with the Cedar River, the mouth of Rock Creek is over 20 feet wide. This creates a condition in which low flows become quite shallow and diffuse as they enter the Cedar River. Although the area is readily passable at moderate to high flows (flows greater than 6 to 7 cfs), as flows decline, they spread out so that water depths become increasingly shallower. Although successful adult salmonid passage has been documented at flows as low as 1.5 cfs as evidenced by spawning survey data (R2 Resource Consultants, Inc. 2004), the prevailing conditions at these low flows would clearly be suboptimal for adult Chinook salmon passage. Under the No-action Alternative, suboptimal passage conditions at the mouth of Rock Creek during low-flow periods would continue for the foreseeable future.

Table 4.8-2 Median monthly weighted usable area (in square feet) WUA) for covered salmonids under the No-action Alternative.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook Salmon Spawning (Fallback)										168	47	
Chinook Salmon Spawning (Douglas)										2977	1756	
Chinook Salmon Fry		75379	74719	72461	67024							
Bull Trout Spawning										27549	24825	
Bull Trout Juvenile and Adult Rearing	18597	19052	16446	13837	9420	5701	4207	3117	2479	1952	1674	15512
Steelhead Spawning				6937	3015	823						
Steelhead Juvenile Rearing	7325	7523	6407	5375	3631	2151	1651	1198	923	715	605	6034
Coho Salmon Spawning	21628	22207									1549	17917
Coho Salmon Juvenile Rearing	9915	9927	10019	10040	10152	10213	10040	9540	9407	9208	9104	9647
Sockeye Salmon Spawning										4042	2561	52333
Chum Salmon Spawning										5718	4985	41657
Coastal Cutthroat Trout Spawning	36384	37132										
Coastal Cutthroat Trout Juvenile and Adult Rearing	3722	3830	3279	2782	1972	1220	920	648	458	325	255	3096

Table 4.8-3 Total weighted usable area (in square feet) (WUA) at minimum flow levels required when wells are being used.

		Chinook Salmon			Bull Trout		Steelhead		Coho Salmon		Sockeye Salmon	Chum Salmon	Cutthroat Trout	
Period	Minimum Flow (cfs)	Spawn - Fallback Curve	Spawn - Douglas Curve	Fry	Spawn	Juv	Spawn	Juv	Spawn	Juv	Spawn	Spawn	Spawn	Juv
July – October	2	424	5545	-	33278	2536	-	946.2	-	9429	7157	7258	-	472
November – April	15	18344	36962	72575	77198	13942	7042	5416	16151	10044	49042	38371	41709	2801

Note: During May and June minimum instream flow requirements decrease arithmetically from 15 cfs to 2 cfs when the wells are in operation.

Table 4.8-4 Maximum, mean, and mean depth (inches) along the primary channel calculated at flow of 1.5 cfs (the No-action Alternative) at nine PHABSIM transects.

Site	**Transect**	**Maximum**	**Mean**	**Primary Channel Mean**
A	1 – Pool	8.2	5.3	5.9
	2 – Pool	16.1	7.2	8.4
	3 – Riffle	3.5	1.6	2.4
B	1 – Riffle	6.7	4.0	3.8
	2 – Riffle	4.4	1.6	2.9
	3 – Pool	20.1	11.0	14.3
C	1 – Pool	8.5	4.3	5.3
	2 – Pool	9.2	5.9	5.9
	3 – Riffle	5.1	2.5	2.8
	Minimum	3.5	1.6	2.4
	Maximum	20.1	11.0	14.3
	Mean	9.1	4.82	5.74

The calculated depths for the pools in Table 4.8-4 are far below the 3.3-foot (39.4 inches) criterion specified in Washington Forest Practices Board (1995) for holding habitat for adult Chinook salmon and other adult anadromous salmonids. The deepest pool evaluated, Site B Transect 3, had a maximum depth of 20.1 inches under the 1.5-cfs-flow scenario. Habitat mapping conducted for the PHABSIM analysis suggested this pool was representative of pools found in Rock Creek; about 31 percent of the pools (ten pools) had a greater residual depth over the 2.75 miles of stream surveyed. The deepest pool measured during the habitat survey had a residual depth of 2.5 feet (R2 Resource Consultants, Inc. 2004, unpublished data). Assuming this pool has a water surface elevation versus flow relationship similar to the measured pools, flows of slightly over 50 cfs, a flow that rarely occurs in October or November in Rock Creek, would be required for pool depth to be more than 3.3 feet deep at this location. The conclusion from this analysis is that under the No-action Alternative, adult holding habitat for Chinook salmon and other anadromous salmonids that meets the Washington Forest Practices Board (1995) criterion would be virtually absent downstream of the Clark Springs Facility except under peak flow conditions, and this condition would be present regardless of water supply withdrawals. Consequently, water withdrawal operations under the No-action Alternative would be unlikely to substantially affect the availability of high quality adult holding habitat in Rock Creek. While certainly at a lower level than historic conditions, high quality holding pool habitat is available in the Cedar River (WRIA 8 Steering Committee 2005); it is possible that Chinook salmon may preferentially utilize holding habitat in the Cedar River prior to entering Rock Creek to spawn.

Under the No-action Alternative, access to Rock Creek and available spawning and fry rearing habitat that is considered critical habitat essential to the conservation and recovery of PS Chinook salmon would continue to be adversely affected by low flows during the fall spawning period, particularly during dry and normal precipitation years, because of water withdrawals for the City's water supply. Similar to the recent past, adult Chinook salmon would likely be observed to periodically use the lower reaches of Rock Creek during the spawning season. If the overall population of Chinook salmon in the Cedar River basin increases in the future, use of Rock Creek by Chinook salmon could also increase.

Puget Sound Steelhead

Withdrawals under the No-action Alternative would not substantially affect access to Rock Creek by adult steelhead or upstream passage for spawning because of the timing of steelhead spawning in late spring when flows would typically be near their highest in Rock Creek. Steelhead spawning habitat was modeled during April, May, and June. During this period the amount of spawning habitat declines as flows decline. Under the No-action Alternative the median amount of WUA for spawning was estimated at 6,937 square feet for April, 3,015 square feet for May, and 823 square feet for June (Table 4.8-2). The risk of incubating eggs becoming dewatered as a result of water supply withdrawals would be low because of the channel morphology and time of year that steelhead spawn. Rock Creek is moderately confined over most of the length downstream of the Clark Springs Facility and too small to develop substantial mid-channel bars. Consequently, most salmonid spawning, including steelhead, is likely to occur in the stream's thalweg. At flows typical of March through June based upon the HSPF modeling, the maximum decrease in water depth would be about 4.9 inches under Alternative 1. Minimum spawning depth for steelhead under Washington fallback habitat suitability curves is 7.8 inches (Washington Department of Fish and Wildlife and Department of Ecology 2003), which is nearly twice the maximum change in water depth under Alternative I. Consequently, incubating eggs would be unlikely to become dewatered.

The availability of steelhead fry habitat in Rock Creek would likely be similar to that of Chinook salmon because of their similarity of size and habitat requirements. Median monthly WUA for steelhead juvenile habitat ranged from a high of 7,523 square feet during February, then declined to 605 square feet during November (Table 4.8-2).

Under typical operations that rely primarily on the infiltration gallery for withdrawals, the amount of juvenile WUA for steelhead during the mean annual 7-day low-flow period would be approximately 605 square feet under the No-action Alternative. If additional storage becomes available in the future and the wells are used to withdraw additional water for storage between July 1 and October 31, a minimum instream flow of 2 cfs would be required and would ensure at least 946 square feet of WUA for rearing. If the wells are used between November 1 and April 30, a minimum instream flow of 15 cfs would be required and would ensure at least 5,416 square feet of WUA for rearing and 7,042 square feet for spawning (Table 4.8-3). During the summer, the minimum flow amount of WUA when the wells are used for additional storage would be less than the median amount during July and August under current withdrawal operations, but the minimum flow amount of WUA would be slightly higher during September and October. The amount of WUA for rearing at the minimum flow level when the wells are used for additional storage would be higher than the median amounts modeled by PHLOAT during November and April, but less than December through March. During May and June minimum flow requirements when using the wells decline linearly from 15 cfs to 2 cfs. Consequently, during the period April through June, the amount of WUA for spawning under the minimum flow levels would transition from being higher than median levels modeled using PHLOAT during April to lower than the median levels during June.

In summary, under typical operating conditions at Clark Springs, low to moderate amounts of spawning habitat would be available to steelhead under the No-action Alternative. Rearing habitat for steelhead juveniles in Rock Creek is also present under the No-action Alternative, but at extremely low levels during the late summer and early fall when low-flow conditions occur. Water withdrawals at the Clark Springs Facility adversely affect flow levels in the stream and contributes to the low levels of juvenile rearing habitat during the summer and early fall. Similar to Chinook salmon, the No-action Alternative is unlikely to adversely affect the availability of high quality adult steelhead holding habitat because the channel morphology is not conducive to this habitat type even under natural conditions. Overwintering habitat in the form of deep pools, coarse substrate, and off-channel habitat would not be significantly affected by the No-action Alternative and would continue to be in short supply in Reaches 1 through 7 (Subsection 3.8.3.2, Current Fish Habitat Conditions). These rearing conditions would be similar to other salmonid species that might live year-round in Rock Creek. If the wells were used to increase withdrawals for storage during high-flow periods, minimum flow requirements associated with their use would protect the amount of spawning and rearing habitat available to steelhead.

From the available information, it is unclear to what extent the available amount of juvenile rearing habitat, or one or more factors external to Rock Creek, limits the number of spawning steelhead using the creek. However, it is unlikely that available spawning habitat currently limits steelhead production in Rock Creek given the low steelhead population size in the Lake Washington basin (Subsection 3.8.1.1, Species Listed as Threatened Under the ESA). Under the No-action Alternative, future spawning and rearing conditions for steelhead in Rock Creek would be similar to those in the recent past. Rock Creek would continue to provide for spawning habitat that could be used by a recovering PS steelhead population. However, limited summertime rearing habitat is likely to continue to adversely affect the number of juvenile steelhead that could potentially rear in Rock Creek and the overall ability of the creek to contribute to PS steelhead recovery.

Bull Trout

Although bull trout use of Rock Creek has not been documented, according to the USFWS there is the potential for bull trout to colonize the creek in the future, and for juvenile, sub-adult, and adult bull trout to utilize Rock Creek for foraging (U.S. Fish and Wildlife Service 2004) (Subsection 3.8.1.1, Species Listed as Threatened Under the ESA). The median amount of bull trout spawning WUA, if the wells were not used to withdraw additional water for storage, was estimated at 27,549 square feet during October and 24,825 square feet during November under the No-action Alternative (Table 4.8-2). Median monthly juvenile and adult bull trout rearing habitat over the year ranged from 1,674 square feet of WUA during November to 19,052 square feet during February (Table 4.8-2). Based upon the PHLOAT analysis, stream flows under the No-action Alternative would provide some spawning and rearing habitat with suitable depths, velocities, and substrates if bull trout were to colonize the creek. The amount of juvenile WUA for bull trout during the typical annual 7-day low-flow period would be approximately 1,674 square feet.

If the wells were used to withdraw additional water for storage between July 1 and October 31, a minimum instream flow of 2 cfs would be required and would ensure at least 2,536 square feet of WUA for rearing and 33,278 square feet of WUA for spawning (Table 4.8-3); however, use of the wells is not anticipated to be the typical operating strategy during the summer and early fall because it increases the risk of not meeting peak water demand by the City's water supply customers. If the wells were used to withdraw additional water for storage, minimum flow requirements would ensure more rearing WUA during September and October, and more spawning WUA during October than the median amounts modeled for the current operations. Between November 1 and April 30, a minimum instream flow of 15 cfs would be required and would ensure bull trout at least 13,942 square feet of WUA area for rearing and 77,198 square feet of WUA for spawning in Reaches 1 through 9b. The amount of WUA for rearing at 15 cfs would be lower than the median amounts modeled with PHLOAT during December through March, but substantially higher than the low levels that generally occur in November. Similarly, the amount of WUA for spawning habitat during November would be substantially higher under the 15 cfs minimum flow than the median amount modeled using PHLOAT.

In summary, under typical operating conditions at Clark Springs, rearing habitat that could be used for foraging and overwintering by bull trout juveniles and adults in Rock Creek is present under the No-action Alternative, but at fairly low levels during the late summer and early fall when low-flow conditions occur. These rearing conditions would be similar to other salmonid species that might live year-round in Rock Creek. If bull trout were to colonize Rock Creek, modest amounts of spawning habitat would also be available to them under the No-action Alternative between the mouth of the creek and the Clark Springs Facility (Reaches 1 through 9b). If the wells were used to increase withdrawals for storage during high-flow periods, minimum flow requirements associated with their use would protect the amount of spawning and rearing habitat available to bull trout. It is anticipated that under the No-action Alternative, Rock Creek would continue to have a minor influence on the conservation and recovery of bull trout in the Lake Washington critical habitat unit because current bull trout use of

Rock Creek is extremely low, if any, and there is no record of historical use of Rock Creek by bull trout.

4.8.1.2 Other Covered Species

Puget Sound/Strait of Georgia Coho Salmon

Because they are similar in size, the availability of coho salmon fry habitat and the effect of the No-action Alternative would likely be similar to the habitat availability and effects on Chinook salmon fry, which has habitat ranging from 67,024 to 75,379 square feet of median WUA amounts from February through May. However, while the effects to the habitat would be similar under the No-action Alternative, coho salmon fry would be more likely present or present in greater numbers in Rock Creek from Reaches 1 through Reach 12 compared to Chinook salmon fry because substantial levels of recent coho salmon spawning have been documented (Subsection 3.8.1.2, Other Covered Species). Furthermore, some coho fry may rear through smolt outmigration in Rock Creek while Chinook salmon fry would outmigrate within a few months of emergence. Consequently, the availability of fry habitat in Rock Creek is likely more important for coho salmon than for Chinook salmon.

Due to the later migration and spawning periodicity of coho salmon in Rock Creek (Figure 3.8-1), the overall adverse effects of water withdrawals under the No-action Alternative on upstream migration would be less for coho salmon than for Chinook salmon and sockeye salmon. As described in Subsection 3.8.1.2, Other Covered Species, increases in flow can trigger upstream movements by adult coho salmon. Typically, as a result of fall rains, stream flows have increased in Rock Creek by late November or early December to levels where water depths exceed the minimum depth criterion for optimal passage. However, for years when drought conditions continue through the late fall and early winter, the suboptimal passage conditions described for adult Chinook salmon could also affect adult coho salmon, though at a lower magnitude because coho salmon generally have a smaller body size than Chinook salmon.

The PHLOAT analysis indicated that, under the No-action Alternative, the median amounts of coho salmon spawning habitat would be 1,549 square feet of WUA during November and 17,917 to 21,628 square feet of WUA from December to February. The PHLOAT analysis indicated that the amount of rearing habitat for juvenile coho salmon would be relatively stable throughout the year (Table 4.8-2). The amount of juvenile rearing habitat would range from 9,104 square feet of WUA during November to 10,213 square feet of WUA during June. However, other studies suggest coho salmon population generally do better during years with higher flows. For example, Smoker 1953) demonstrated that Washington adult coho salmon productivity (commercial harvest) is positively correlated to annual flow levels 2 years prior, when coho salmon juveniles would be rearing in fresh water. Seiler et al. (2005) found that coho salmon smolt survival during outmigration is positively correlated to springtime flows in the Cedar River, and Seiler et al. (2004) found that coho salmon smolt production in Bingham Creek, Washington, is positively correlated with a regional summer low-flow index. Quinn and

Peterson (1994) reported the freshwater carrying capacity for coho salmon is affected by summer low flows.

Under typical operations that rely primarily on the infiltration gallery for withdrawals, the amount of juvenile WUA for coho salmon during the mean annual 7-day low-flow period would be approximately 9,104 square feet. If additional storage becomes available in the future and the wells were used to withdraw additional water for storage between July 1 and October 31, a minimum instream flow of 2 cfs would be required and would ensure at least 9,429 square feet of WUA for rearing, but this is unlikely to be the operational strategy during the summer and early fall. If the wells were used between November 1 and February 28, a minimum instream flow of 15 cfs would be required and would ensure at least 10,044 square feet of WUA for rearing and 16,151 square feet for spawning. The minimum flow amount of WUA for rearing if the wells were used to withdraw additional water for storage would be lower than the median amount modeled using PHLOAT during May through August, but higher during September through February; the amounts would be about the same during March and April. The minimum flow amount of WUA for spawning if the wells were used to withdraw additional water for storage would be higher during November compared to the median amount modeled using PHLOAT, but less during December through February.

In summary, under typical operating conditions at Clark Springs, rearing habitat for coho salmon juveniles in Rock Creek is present under the No-action Alternative at moderate levels throughout the year based upon the PHLOAT analysis. Moderate amounts of spawning habitat and relatively high amounts of fry habitat would be available to coho salmon under the No-action Alternative. Similar to Chinook salmon, the No-action Alternative is unlikely to adversely affect the availability of high quality adult coho salmon holding habitat because the channel morphology is not conducive to this habitat type even under natural conditions. Overwintering habitat in the form of deep pools, coarse substrate, and off-channel habitat would not be significantly affected by the No-action Alternative and would continue to be in short supply in Reaches 1 through 7 (Subsection 3.8.3.2, Current Fish Habitat Conditions. If the wells were used to increase withdrawals for storage during high-flow periods, minimum flow requirements associated with their use would protect the amount of spawning and rearing habitat available to coho salmon.

Two of the three major threats to the Puget Sound/Strait of Georgia coho salmon ESU, namely high harvest rates and a decline in size, would not likely be affected by the operation of the Clark Springs Facility under the No-action Alternative. Under the No-action Alternative, the third major threat, loss of habitat, would be affected by ongoing withdrawals for water supply, but the analysis presented above suggests these effects would be relatively minor for juvenile rearing because the amount of WUA would be relatively stable over a wide range of flows and low for coho salmon spawning habitat because coho spawning generally occurs after the fall increase in flows.

Sockeye Salmon

Similar to Chinook salmon, creek access passage and holding habitat conditions for sockeye salmon would likely be suboptimal in Rock Creek under the No-action Alternative because of shallow water depths, but would likely be less severe than for Chinook salmon because adult sockeye salmon generally have a smaller body size than Chinook salmon. The PHLOAT analysis indicated that under the No-action Alternative the median amount of sockeye spawning habitat downstream of the Parshall Flume during October would be 4,042 square feet of WUA, while November would have 2,561 square feet, and December would have 52,333 square feet (Table 4.8-2). Because sockeye salmon fry and Chinook salmon fry are similar in size, the effect of the No-action Alternative on the availability of sockeye salmon fry habitat, which ranges from 67,024 to 75,379 square feet of median WUA amounts from February through May, would likely be similar to the effects for Chinook salmon fry. However, while the effects upon habitat would be similar, sockeye salmon fry would more likely be present or present in greater numbers in Reach 1 through Reach 12, compared to Chinook salmon fry, because substantial levels of recent sockeye salmon spawning have been documented (Subsection 3.8.1.2, Other Covered Species).

If the wells were used to withdraw additional water for storage during October, a minimum instream flow of 2 cfs would be required and would ensure at least 7,157 square feet of WUA for spawning (Table 4.8-3). If the wells were used to withdraw additional water for storage during November or December, a minimum instream flow of 15 cfs would be required and would ensure at least 49,042 square feet of spawning habitat. This amount of WUA for spawning would be higher during October and November compared to the median amount modeled using PHLOAT, but lower during December.

In summary, under typical operating conditions at Clark Springs under the No-action Alternative, access to Rock Creek at its mouth and upstream passage would be suboptimal during low-flow periods usually present during the early spawning period. Low to moderate amounts of spawning habitat and relatively high amounts of fry habitat would be available to sockeye salmon under the No-action Alternative. Similar to Chinook salmon, the No-action Alternative is unlikely to adversely affect the availability of high quality adult sockeye salmon holding habitat because the channel morphology is not conducive to this habitat type even under natural conditions. If the wells were used to increase withdrawals for storage during high-flow periods, minimum flow requirements associated with their use would protect the amount of fry and spawning habitat available to sockeye salmon.

Under the No-action Alternative, moderate numbers of sockeye salmon would likely continue to use Rock Creek for spawning, incubation, and early fry rearing; in addition, water withdrawals at the Clark Springs Facility would adversely affect access to the creek and the amount of available spawning habitat during the early part of the spawning season. Nevertheless, it is unlikely the effects to habitat under the No-action Alternative would affect the listing status of sockeye salmon under ESA, unless NMFS redefines sockeye salmon ESUs to include the Cedar River population.

Puget Sound/Strait of Georgia Chum Salmon

The No-action Alternative is not anticipated to affect chum salmon unless their distribution expands into the Cedar River basin. Similar to Chinook salmon, creek access, passage, and holding habitat conditions for chum salmon would likely be suboptimal in Rock Creek under the No-action Alternative during the early part of the spawning period because of shallow water depths. The PHLOAT analysis suggests that under the No-action Alternative the median amount of chum salmon spawning habitat during October would be approximately 5,718 square feet of WUA, while November would have approximately 4,985 square feet, and December would have approximately 41,657 square feet (Table 4.8-2). Based upon the PHLOAT analysis, under the No-action Alternative, Rock Creek would provide some spawning habitat for chum salmon with suitable depths, velocities, and substrates if any were to colonize the creek. Because chum salmon fry and Chinook salmon fry are similar in size, the effect of the No-action Alternative on the availability of chum salmon fry habitat, which ranges from 67,024 to 75,379 square feet of median WUA amounts from February through May, would likely be similar to those for Chinook salmon fry.

If the wells were used to withdraw additional water for storage during October, a minimum instream flow of 2 cfs would be required and would ensure at least 7,258 square feet of WUA for spawning (Table 4.8-3). If the wells were used to withdraw additional water for storage during November and December, a minimum instream flow of 15 cfs would be required and would ensure at least 38,371 square feet of WAU for spawning. Compared to the median amount modeled using PHLOAT, the minimum flow amount of WUA for spawning if the wells were used to withdraw additional water for storage would be higher during October and November, but lower during December.

In summary, under typical operating conditions at Clark Springs under the No-action Alternative, access to Rock Creek at its mouth and upstream passage would be suboptimal during low-flow periods usually present during the early spawning period. Low to moderate amounts of spawning habitat and relatively high amounts of fry habitat would be available to chum salmon under the No-action Alternative. Similar to Chinook salmon, the No-action Alternative is unlikely to adversely affect the availability of high quality adult chum salmon holding habitat because the channel morphology is not conducive to this habitat type even under natural conditions. If the wells were used to increase withdrawals for storage during high-flow periods, minimum flow requirements associated with their use would protect the amount of fry and spawning habitat available to chum salmon.

The status of chum salmon in the Puget Sound/Strait of Georgia ESU is unlikely to be significantly affected by the No-action Alternative because their use of Rock Creek or the Cedar River as strays does not currently constitute a substantive portion of the population. However, if chum salmon use of the Cedar River and Rock Creek dramatically increases in the future, the importance of the Cedar Basin could be re-evaluated by NMFS.

Coastal Cutthroat Trout

Due to their migration and spawning periodicity in Rock Creek (Figure 3.8-1) the overall adverse effects of water withdrawals on upstream migration of coastal cutthroat trout would be similar to those for coho salmon and somewhat less than those for Chinook salmon and sockeye salmon. Typically, as a result of fall rains, stream flows have increased in Rock Creek by late November or early December to levels where water depths exceed the minimum depth criterion for optimal passage when adult coastal cutthroat trout enter the stream for spawning. However, if drought conditions continue through the early winter, the suboptimal passage conditions described for Chinook salmon could also affect coastal cutthroat trout, but these conditions would likely be rare (probability of monthly flows less than 3 cfs would be 7 percent for January and 4.5 percent during February based on HSPF modeling). The PHABSIM analysis estimated the median amount of coastal cutthroat spawning WUA would be 36,384 square feet during January and 37,132 square feet during February under the No-action Alternative operational conditions (Table 4.8-2). Like other year-round residing salmonids in Rock Creek, coastal cutthroat juvenile habitat was assessed for each month over the year. The PHLOAT analysis suggests that availability of rearing habitat for coastal cutthroat would be extremely limited during the fall months under the No-action Alternative. The median amount of coastal cutthroat juvenile and resident adult WUA would range from a high in February of 3,839 square feet to a low of 255 square feet in November.

Under typical operations that rely primarily on the infiltration gallery for withdrawals, the amount of juvenile WUA for coho salmon during the mean annual 7-day low-flow period would be approximately 255 square feet. As described previously, use of the wells imposes minimum instream flow levels, but they would not likely be the typical operational strategy during the summer and early fall. During high-flow periods, the wells may be used to extract additional water in excess of demand if storage becomes available in the future. If the wells were used to withdraw additional water for storage between July 1 and October 31, a minimum instream flow of 2 cfs would be required and would ensure at least 472 square feet of WUA for rearing (Table 4.8-3). If the wells were used between November 1 and April 30, a minimum instream flow of 15 cfs would be required and would ensure at least 2,801 square feet of WUA for rearing and 41,709 square feet for spawning. The amount of WUA for rearing under minimum flows if the wells were used would be lower than the median amount modeled using PHLOAT during January through March and June through August, but higher during September through November; the amounts would be about the same during April. The minimum flow amount of WUA for spawning would be higher during January and February compared to the median amount modeled using PHLOAT.

In summary, under typical operating conditions at Clark Springs, rearing habitat for coastal cutthroat juveniles in Rock Creek is present under the No-action Alternative, but at fairly low levels during the late summer and early fall when low-flow conditions occur. These would be similar rearing conditions as for other salmonid species that might live year-round in Rock Creek. Moderate amounts of spawning habitat would also be available to cutthroat trout under the No-action Alternative.

Overwintering habitat in the form of deep pools, coarse substrate, and off-channel habitat would not be significantly affected by the No-action Alternative and would continue to be in short supply in Reaches 1 through 7 (Subsection 3.8.3.2, Current Fish Habitat Conditions). If the wells were used to increase withdrawals for storage during high-flow periods, minimum flow requirements associated with their use would protect the amount of rearing and spawning habitat available to cutthroat trout.

The relative contribution of Rock Creek to the adfluvial coastal cutthroat population in Lake Washington is unknown; however, the Lake Washington population appears relatively robust (Nowak et al. 2004) and significant spawning appears to occur in Rock Creek (R2 Resource Consultants, Inc. 2005a). Consequently, the No-action Alternative is not expected to have a significant adverse effect on the overall Lake Washington adfluvial coastal cutthroat trout population.

Pacific Lamprey and River Lamprey

Habitat preference curves are not available for Pacific or river lamprey. Consequently, a PHLOAT analysis was not possible for these species. Because of their similarity in life history during their freshwater phase, the effects analysis for these species has been treated similarly. One major difference between the species is size. Pacific lamprey adults may reach a length of over 2 feet while river lamprey are generally less than 1 foot in length. Pacific lamprey and river lamprey enter fresh water during July to October and begin spawning during the following May.

Upstream passage requirements for lamprey are not fully understood. Water depth would not likely be an important factor because lamprey have a relatively small dorsal to ventral (top to bottom) length. Pacific lamprey are relatively weak swimmers (Close et al. 1995) and the smaller river lamprey presumably have an even lower swimming capacity. At hydroelectric dams, Moser et al. (2002) observed that lamprey utilize their sucker-like mouth to cling to substrate when passing through areas of high velocity, then utilize burst swimming speeds (approximately 6.9 feet per second; Bell 1990) to move forward and cling to the substrate once again. Water velocities of this magnitude would not likely be experienced by Pacific lamprey during the summer months when upstream migration occurs. Based upon the available information, it is not likely that the upstream migration of Pacific or river lamprey would be adversely affected under the No-action Alternative.

Pacific lamprey spawn during May in shallow gravel nests with stream velocities of 1.6 to 3.3 fps (Close et al. 1995). May is characterized by a declining hydrograph and median flows in Rock Creek of around 10 cfs. Although average channel velocities would generally be lower than the range observed by Close et al. (1995), these velocities would be present in some areas, and would likely provide sufficient suitable spawning areas for Pacific lamprey under the No-action Alternative.

Larval Pacific lamprey, called ammocoetes, rear in slow-moving waters with high levels of fine organic materials. The ammocoetes burrow into the substrate and feed on suspended materials, such as diatoms and desmids (Torgersen and Close 2004), and algae (Moyle 1976) filtered from the water. Water withdrawals for water supply could have two potentially offsetting effects. First, reduced flows could reduce a stream's wetted perimeter, particularly during low-flow periods, which consequently could result in reductions in the area of habitat available to larval lamprey. On the other hand, flow reductions could also reduce water velocities in some areas, which could increase the area where fine organic materials and sediment could settle out. Moore and Mallatt (1980) reported that larval lamprey have specific velocity requirements (0.16 to 0.49 fps) that are suitable for the settling of fine materials. Nine PHABSIM transects were analyzed for changes in mean channel velocity and wetted perimeter at four different flows (Table 4.8-5). A flow of 1.5 cfs was used to represent low-flow conditions under the No-action Alternative for analysis of the effects to lamprey. Notably, flows of about 5 cfs or less result in modeled mean channel velocities that would be within the optimal range reported by Moore and Mallatt (1980), suggesting that under some circumstances withdrawals that occur under the No-action Alternative may improve larval habitat rearing conditions for lamprey.

Table 4.8-5 Mean channel velocity and wetted perimeter from 9 PHABSIM transects located in Rock Creek.

Modeled Flow (cfs)	Mean Channel Velocity (fps)	Mean Wetted Perimeter (ft)	Percent of Habitat Available at 1.5 cfs (%)	
			Velocity	**Wetted Perimeter**
1.5	0.30	23.3	100.0	100.0
3.0	0.39	26.5	130.0	113.7
4.0	0.44	27.5	146.7	118.2
7.0	0.58	29.5	193.3	126.5

The downstream migration of juvenile lamprey occurs from March to July with a peak migratory period of April and June (Wydoski and Whitney 2003). The downstream migration is passive and, if similar to the passage of other lamprey species at dams, occurs primarily at night. Water supply withdrawals at the Clark Springs Facility would comprise a relatively small proportion of the surface streamflow during the period of outmigration. Consequently, operations at the Clark Springs Facility under the No-action Alternative would not likely impact the outmigration of Pacific or river lamprey.

Declines in population numbers of Pacific lamprey on the Columbia River and Oregon coast have led Close et al. (2002) to suggest that habitat disturbance is an important factor because similar declines have occurred to salmonids that live in sympatry with Pacific lamprey. However, the general lack of information regarding the abundance of Pacific and river lamprey populations in the Cedar River basin and Rock Creek makes it difficult to discern the importance of water withdrawals under the No-action Alternative on the lamprey populations. The analysis above suggests that effects of the No-action Alternative could have some adverse effects to the quantity of lamprey habitat because of a reduction in wetted perimeter, but the quality of the habitat for rearing ammocoetes could improve at lower water velocities.

4.8.1.3 Other Resident Fish Species in Rock Creek

A variety of resident fish species other than those discussed above, such as western brook lamprey, torrent sculpin, speckled dace, redside shiner, and three-spine stickleback, may be affected under the No-action Alternative. Unlike river lamprey and Pacific lamprey, western brook lamprey remain in fresh water their entire lives and are smaller (5 to 7 inches) (Wydoski and Whitney 2003). The effects upon western brook lamprey would be expected to be similar to those for other lamprey species. The torrent sculpin, redside shiner, and sticklebacks are often bottom oriented, but dace may be found in the water column. Similar to the salmonid species that are found year-round in Rock Creek, surface flow reductions resulting from water supply withdrawals likely decrease the amount of available habitat. These species are generally more tolerant of warmer water temperatures than are salmonids. Available information suggests water temperatures would remain suitable for these resident fish species under the No-action Alternative.

4.8.1.4 Other Activities Affecting Fish Habitat Conditions

As discussed above, water withdrawals at the Clark Springs Facility under the No-action Alternative would be the most important component of the City's operations that could have an effect on fishes and fish habitat in Rock Creek. A number of standard operational and maintenance activities would be performed by the City at the Clark Springs Facility under the No-action Alternative. More detailed descriptions of these activities are provided in Section 2, Alternatives, of this EIS and in Chapter 1 of the proposed HCP. In summary, these activities include:

- Operations, maintenance, improvements, and replacement of the water supply facilities located at the Clark Springs Facility, such as buildings, wells, access roads, fences and security infrastructure, infiltration gallery, and water transmission main, except for portions within the ordinary high water boundaries of Rock Creek
- Vegetation management
- Beaver management and beaver dam removal
- Operation and maintenance of the Parshall Flume and USGS gaging station (No. 12118400)
- Electrical, control, and telemetry infrastructure
- Delivery and storage of chemicals and fuel
- Stormwater conveyance, control, and distribution facilities

In addition to the operational and maintenance activities listed above, the City may install groundwater monitoring wells near the eastern and northeastern boundaries of the watershed. The City has concerns about the potential for hazardous materials from the Landsburg Mine, which is undergoing remediation, to adversely affect groundwater quality. To a lesser extent, the City is also concerned about the potential effects to groundwater from housing and commercial development within the Rock Creek basin east of the watershed. At this time, the number and location of potential monitoring wells is unknown. Installation, maintenance, and operation of monitoring wells may require the construction of short spur roads off existing roads for access.

The risk of adverse effects to listed fish species from the construction of spur roads and drilling of monitoring wells is considered minor to low, depending upon the number and location of the wells that would be installed. Established roads already exist near the watershed boundaries, so spur roads should be short. The City is committed to minimizing the potential adverse effects of spur roads by locating them at least 50 feet from the ordinary high water mark and outside wetland boundaries, avoiding new stream crossings, and using construction standards and BMPs consistent with City Code. Mitigation measures to control sediment erosion could include standard practices such as silt fencing, mulch or straw, and reseeding and stabilization of disturbed soils.

The types of adverse effects to fish habitat that could occur from the operations and maintenance activities listed above include increased potential for soil disturbance and delivery to Rock Creek; loss of riparian function from clearing areas for spur roads, monitoring wells, and vegetation management; increased sediment and runoff from road surfaces; temporary increases in flow resulting from beaver dam removal; and lethal or sub-lethal effects from chemical spills. The overall amount of large wood is generally good within the Clark Springs Facility and downstream to the mouth of Rock Creek, but portions of two reaches (Reaches 10 and 12) have been identified as having low amounts of large wood. Under the No-action Alternative, the amount of large wood would not be expected to change in the near future, but could eventually improve if new wood enters the stream from the nearby riparian forest as a result of high winds or channel migration.

Turbidity levels in Rock Creek are generally low (Subsection 3.6.6, Turbidity and Total Suspended Solids) and under the No-action Alternative levels of turbidity and TSS would remain similar to the past with the exception of minor short-term increases that would occur from operations and maintenance activities (Subsection 4.6.2.1, Water Quality Alternative A – No Action). The effects of suspended sediment and turbidity on salmonids are reported in the literature as ranging from beneficial to detrimental. Elevated levels of TSS have been reported to enhance cover conditions, reduce predation by piscivorous fishes and birds, and improve survival (Gregory and Levings 1998; Gregory 1993). Elevated levels of TSS have also been reported to cause physiological stress, reduce growth, and adversely affect survival (Newcombe and MacDonald 1991). Of key importance in considering the detrimental effects of TSS on salmonids are the season, frequency, and duration of the exposure, not only the TSS concentration.

Behavioral avoidance of turbid waters may be one of the more important effects of suspended sediments (DeVore et al. 1980; Birtwell et al. 1984; Scannell 1988). Salmonids have been observed to move laterally and downstream to avoid turbid plumes (McLeay et al. 1984, 1987; Sigler et al. 1984; Lloyd 1987; Scannell 1988; Servizi and Martens 1991). At moderate levels, turbidity and TSS have the potential to adversely affect primary and secondary productivity, and at high levels they have the potential to injure and kill adult and juvenile salmonids. Turbidity and TSS might also interfere with feeding (Spence et al. 1996). Newly emerged salmonid fry may be vulnerable to even moderate amounts of TSS (Bjornn and Reiser 1991). Other behavioral effects on salmonids, such as gill flaring and feeding changes, have been observed in response to pulses of suspended sediment (Berg and Northcote 1985). Deposition of fine sediments also have the potential to adversely affect primary and secondary productivity (Spence et al. 1996), to reduce incubation success (Bell 1991), and to reduce cover for juvenile salmonids (Bjornn and Reiser 1991).

Increases in runoff from spur roads constructed for monitoring wells would be minimal and undetectable in Rock Creek because of their short length and location away from streams. Changes in flow as a result of beaver dam removal would be slight because the dams would generally be removed early in their construction before substantial pond development occurs. Potential changes in flow as a result of stormwater management would be minimal because stormwater from the facility is controlled through dispersed infiltration rather than delivery to Rock Creek via stormwater ditches or pipes.

Accidental spills of chlorine or sodium phosphate that reach Rock Creek could have sub-lethal and lethal effects to fishes residing in the creek. However, the risk of this occurring is considered very low because deliveries of these chemicals to the facility would be infrequent and standard operating procedures and alarm systems are in place within the storage and water treatment areas of the facility. Sodium fluoride is stored in a stable powder form while chlorine is stored as a liquefied gas in containers meeting Federal and State requirements. Fuel for the on-site emergency generator is in the form of propane and is not considered a risk to fishes or fish habitat.

The level of risk to listed fish species from the activities described above is generally minor or low because they would primarily occur outside of the stream corridor and riparian zone. In addition, the implementation of BMPs, standard operating procedures, and other mitigation measures would further minimize the risk of adverse effects occurring to listed species. Consequently, under the No-action Alternative, the potential for adverse effects to listed fish species from the activities listed above would likely be minimal.

As described in Subsection 4.6 Water Quantity and Quality, flow reductions have the potential to adversely affect water temperatures by increasing temperature fluctuations and increasing maximum temperatures. Subsection 4.6 also concluded that under baseline conditions, water temperatures remained within current surface water quality standards. Although some dissolved oxygen exceedances of surface water quality standards were noted within the Clark Springs Facility, these were attributed to the low dissolved oxygen levels of groundwater flowing into the stream and not from operation of the Clark Springs Facility. Consequently, the effects of the No-action Alternative on fishes from degradation of water quality in Rock Creek would be minor.

4.8.2 Alternative B: Proposed Action

Under the Proposed Action, the City would withdraw water as under the No-action Alternative, but would implement eight HCMs that are intended to mitigate for the effects of the withdrawal and are designed for the protection and restoration of the covered species. Operations and maintenance activities under the Proposed Action would be the same as under the No-action Alternative and therefore would have the same effects to fish populations and fish and aquatic habitat as described under the No-action Alternative. The eight HCMs are:

- Flow augmentation plan during October through December (HCM-1)
- Passage improvements at the mouth of Rock Creek (HCM-2)
- Wetland improvements and juvenile habitat enhancement in Reach 1 (HCM-3) and Reach 2 (HCM-4)
- Summit-Landsburg Road culvert replacement (HCM-5)
- Large wood placement in Reaches 10 and 12 (HCM-6)
- Water conservation program (HCM-7)
- Riparian acquisition, easement, and enhancement fund (HCM-8)

Descriptions of these HCMs are provided in detail in Chapter 4 of the HCP and will not be repeated here. Because flow augmentation (HCM-1) would be implemented only during October through December, the effects of operations at the Clark Springs Facility on flows and fish habitat during other times of the year would be similar to the No-action Alternative. The following discusses the effects of the HCMs on covered species compared to conditions that would be present under the No-action Alternative. These effects are summarized in Table 4.8-6.

4.8.2.1 Covered Fish Species

Puget Sound Chinook Salmon

The proposed HCMs under the Proposed Action would benefit Chinook salmon that might utilize Rock Creek and contribute to the recovery of PS Chinook salmon. In particular, flow augmentation (HCM-1), passage improvements at the mouth of Rock Creek (HCM-2), and off-channel habitat enhancement (HCM-3 and HCM-4) would have the largest direct benefits to Chinook salmon upstream migration, spawning and incubation habitat, and fry rearing habitat.

HCM-1 would augment flows during October through December by up to 2.5 cfs to meet minimum flow targets determined according to the amount of precipitation that has occurred over the prior 2-month period. The proposed augmentation period begins after most of the Chinook salmon have entered the Cedar River and prior to the typical peak spawning period. The beginning of the augmentation period also corresponds to a minimum flow increase in the Cedar River from 95 to 210 cfs during normal years under the City of Seattle’s Cedar River Watershed HCP. As noted in

Subsection 3.6.2, Water Quality, Cedar River flows of approximately 200 cfs begin to inundate the drop-off at the mouth of Rock Creek that can affect access conditions for salmon into the creek. Flow augmentation (HCM-1) under the Proposed Action would be expected to increase water depths approximately 1.1 inches over water depths under the No-action Alternative, but upstream passage would likely remain suboptimal (assuming 1 foot depth is optimal) over most of Rock Creek.

Table 4.8-6 Qualitative assessment of effects of HCM-1 to HCM-6 on covered species at specific life history stages compared to the No-action Alternative.

Species and Life History Stage	HCM-1	HCM-2	HCM-3	HCM-4	HCM-5	HCM-6
Adult Chinook Salmon Passage	+	+	=	=	+	=
Chinook Salmon Spawning	+	=	=	=	=	=
Fry	=	=	+	+	=	=
Bull Trout Passage	+	+	=	=	+	=
Bull Trout Spawning	+	=	=	=	=	=
Bull Trout Juvenile and Adult Rearing	+	=	+	+	=	+
Steelhead Passage	=	+	=	=	+	=
Steelhead Spawning	=	=	=	=	=	=
Steelhead Juvenile Rearing	+	=	+	+	=	+
Coho Salmon Passage	+	+	=	=	+	=
Coho Salmon Spawning	=	=	=	=	=	=
Coho Salmon Juvenile Rearing	+	=	+	+	=	+
Sockeye Salmon Passage	+	+	=	=	+	=
Sockeye Salmon Spawning	+	+	=	=	=	=
Chum Salmon Passage	+	+	=	=	+	=
Chum Salmon Spawning	+	+	=	=	=	=
Chum Salmon Fry	=	=	+	+	=	=
Coastal Cutthroat Trout Passage	+	+	=	=	+	=
Coastal Cutthroat Trout Spawning	=	=	=	=	=	=
Coastal Cutthroat Trout Juvenile and Adult Rearing	+	=	+	+	=	+
Pacific and River Lamprey	+	=	+	+	=	+

Notes: "=" means neutral, or no effect anticipated; "+" means a positive effect anticipated. The effects of HCM 7 and HCM-8 to fishes and aquatic habitat are discussed in Subsection 4.8.2.3, Other Resident Fish Species in Rock Creek.

The PHLOAT analysis suggests that during years with normal precipitation levels, flow augmentation (HCM-1) would provide a 7.8-to-27.7-fold increase in suitable Chinook salmon spawning habitat availability downstream of the Parshall Flume based upon the fallback HSI curves and a 3.1-to-5.2-fold increase based upon the Douglas curves (Table 4.8-7). Although the analysis suggests flow augmentation would provide substantial increases in spawning and incubation habitat over the No-action Alternative, the amount of suitable Chinook salmon spawning habitat under the Proposed Action would be anticipated to be low relative to other salmon species that spawn in Rock Creek. Flow augmentation under HCM-1 would have no effect on the amount of Chinook salmon fry habitat because they would not be present during the augmentation period.

Table 4.8-7 Median amounts of weighted usable area (square feet) (WUA) for spawning habitat under the Proposed Action, and four different Chinook salmon distribution assumptions.

		Alternative Chinook Salmon Distribution Reaches			
	Month	**1 - 9b**	**1 - 8**	**1 - 5**	**1 - 3**
Fallback Curves	October	1,307	923	290	123
	November	1,307	923	290	123
Douglas Curves	October	9,139	7,729	3,587	1,537
	November	9,139	7,729	3,587	1,537

Passage improvements at the mouth of Rock Creek (HCM-2) would complement the flow augmentation that would occur under HCM-1 by improving access into the creek during Chinook salmon spawning periods. Passage improvements at the mouth of Rock Creek (HCM-2) would also improve passage outside of the flow augmentation period. At the design flow of 3 cfs, the weirs constructed at the mouth of Rock Creek would focus the available water during low-flow periods and increase water depths at each weir from about 4 inches to approximately 1 foot, or near the minimum depth needed for adequate passage conditions. The weirs would also provide resting areas for fish ascending the stream, but would not be deep enough to provide optimal holding conditions for adult salmon.

Replacement of the culverts at the Summit-Landsburg Road stream crossing (HCM-5) would benefit Chinook salmon through improved passage conditions if individual salmon began to utilize these higher elevation reaches. Based upon recent Chinook salmon observations within Rock Creek, this potential benefit to Chinook salmon has a low likelihood of realization.

HCM-3 and HCM-4 enhance wetlands and associated ponds located adjacent to Reaches 1 and 2 and either improve (HCM-3) or create (HCM-4) connections between the wetlands and Rock Creek. These wetlands and associated ponds are estimated to be about 0.5 and 0.25 acres in size. The proposed improvements would be anticipated to increase the amount of suitable Chinook salmon fry habitat available in Rock Creek, but may also increase habitat for predators such as sculpins; bull, cutthroat or rainbow trout; and wading birds. On balance, the wetland enhancements and improved connectivity would be anticipated to be a net benefit for Chinook salmon fry.

HCM-6 would place large wood enhancements in Reaches 10 and 12. Chinook salmon do not currently utilize these reaches and the likelihood that utilization would occur over the life of the HCP would be considered low. If Chinook salmon began to spawn in these reaches, or farther upstream, large wood enhancement might provide a positive effect for the fry-rearing life stage and possibly for upstream migration. However, for the purposes of this EIS the effect of large wood enhancement under HCM-6 on Chinook salmon would be considered to be neutral.

Puget Sound Steelhead

The upstream migration of steelhead in preparation for spawning occurs during the winter and spring, typically when Rock Creek flows would be at their highest. Consequently, typical upstream passage and adult holding conditions for steelhead under the Proposed Action would be expected to be optimal for Rock Creek and would not be expected to be different from the No-action Alternative because flow mitigation (under HCM-1) would not occur during the steelhead migratory season. Although optimal for Rock Creek, adult holding conditions would continue to be sub-optimal relative to Washington Forest Practices Board (1995) criteria because the stream morphology is not conducive to creating deep (greater than 3.3 ft) pools. Based upon HSPF modeling, flows would rarely (about one chance in 10 years) be less than 5 cfs between mid-January to early May and commonly (about one chance in 2 years) would be over 10 cfs. Consequently, under the Proposed Action, the weirs at the mouth of Rock Creek to be built under HCM-2, which are designed to improve passage for fall-run fish, would likely provide little to no improvements for the passage of steelhead. Under Alternative B, the amount of available spawning habitat and level of risk that incubating eggs would be dewatered would be the same as under the No-action Alternative.

The PHLOAT analysis suggests that during October and November, median monthly steelhead juvenile and adult rearing area would be 1,328 square feet of WUA with flow augmentation HCM-1 under the Proposed Action, an 86 percent (October) to 120 percent (November) increase over the No-action Alternative. During some low-flow years flow augmentation would also provide habitat benefits to rearing steelhead during December. If the wells were not used during the summer, the amount of WUA for juvenile steelhead during the mean annual 7-day low-flow period would be approximately 795 square feet (Table 4.8-8), an increase of about 31 percent over the No-action Alternative.

The steelhead population in the Cedar River has been in decline since the mid-1980s (Subsection 3.8.1.1, Species Listed as Threatened Under the ESA). Relative to the No-action Alternative, off-channel habitat enhancement (HCM-3 and HCM-4) and large wood enhancement (HCM-6) would also provide positive benefits to the quality and quantity of rearing and overwintering habitat that could be utilized by steelhead fry or juveniles by improving access to, and the structural complexity of, the off-channel habitat in the lower reaches of Rock Creek, while HCM-5 would improve passage conditions at the Summit-Landsburg Road stream crossing, primarily for the juvenile life stage. Consequently, the Proposed Action provides a small but positive contribution to the maintenance and recovery of the PS steelhead population relative to the No-action Alternative through improved passage conditions and rearing and off-channel habitat.

Table 4.8-8 Amount of weighted usable area (in square feet) (WUA) downstream of the Parshall Flume for juvenile life stages at the mean 7-day annual low-flow level based upon analysis of historical flow data from 1986 to 2004 and HSPF modeling.

Species	No-action Alternative (feet ^{2})	Proposed Action (feet^2)
Bull Trout	1,674	2,153
Steelhead	605	795
Coho Salmon	9,104	9,284
Cutthroat Trout	255	376

Bull Trout

Although bull trout have been observed in the Cedar River there are no documented observations of bull trout utilizing Rock Creek. This assessment is based upon the potential for bull trout to colonize Rock Creek or periodically utilize the creek for foraging, rather than known historical use. Adult bull trout have a similar spawning period to Chinook salmon; hence, if they were to utilize Rock Creek for spawning (assuming fluvial or adfluvial stocks of fish that would use tributaries for spawning), they would likely migrate upstream during October and November and encounter the same suboptimal passage conditions. However, since they are generally smaller than Chinook salmon, bull trout should be able to migrate through slightly shallower waters. Nevertheless, HCM-2 would provide improved access and holding conditions for bull trout at the mouth of Rock Creek if they were to colonize the creek. If bull trout were to utilize reaches of Rock Creek upstream of the Summit-Landsburg Road (RM 1.58), upstream passage would also be improved for bull trout by implementation of HCM-5, which would replace the culvert at this stream crossing with a bridge or box culvert that meets WDFW criteria.

The PHLOAT analysis suggests that during years with normal precipitation levels, flow augmentation would increase potential spawning habitat in Reaches 1 to 9a to 41,117 square feet of WUA during both October and November (Table 4.8-9), which represents approximately a 49 to 66 percent improvement over conditions under the No-action Alternative.

Table 4.8-9 Median monthly weighted usable area (in square feet) (WUA) downstream of the Parshall Flume for covered salmonids under the No-action Alternative and the Proposed Action during October November and December.

	No Action Alternative			**Proposed Action**		
	Oct	**Nov**	**Dec**	**Oct**	**Nov**	**Dec**
Chinook Salmon Spawning (Fallback)	168	47		1,307	1,307	
Chinook Salmon Spawning (Douglas)	2,977	1,756		9,139	9,139	
Bull Trout Spawning	27,549	24,825		41,117	41,117	
Bull Trout Juvenile and Adult Rearing	1,952	1,674	15,512	3,426	3,426	15,512
Steelhead Juvenile Rearing	715	605	6,034	1,328	1,328	6,034
Coho Salmon Spawning		1,549	17,917		3,417	17,917
Coho Salmon Juvenile Rearing	9,208	9,104	9,647	9,677	9,677	9,677
Sockeye Salmon Spawning	4,042	2,561	52,333	12,012	12,012	52,333
Chum Salmon Spawning	5,718	4,985	41,657	9,985	9,985	41,657
Coastal Cutthroat Trout Juvenile and Adult Rearing	325	255	3,096	728	728	3,096

The PHLOAT analysis was used to estimate juvenile and adult bull trout habitat under the minimum flow targets during the “normal” year type flow mitigation as it was for other salmonids that might reside year-round in Rock Creek. The WDFW fallback curves for juvenile and adult bull trout rearing habitat are the same. With the implementation of flow augmentation under the Proposed Action, an additional 1,474 square feet of median WUA (up 76 percent to 3,426 square feet) would be provided during October and an additional 1,752 square feet would be provided during November (up 120 percent to 3,426 square feet). Some benefits from flow augmentation would also occasionally occur during December if augmentation were needed to meet instream flow targets. During January through September, flow and habitat amounts under the Proposed Action would be similar to those for the No-action Alternative. If the wells were not used, the amount of WUA for rearing juvenile and adult bull trout during the annual low-flow period would be approximately 2,153 square feet under the Proposed Action, an increase of about 29 percent over the No-action Alternative (Table 4.8-8).

Similar to Chinook salmon and sockeye salmon, which also have their upstream migration periods during the low-flow period of the year, flow augmentation under HCM-1 and the construction of rock weirs at the mouth of Rock Creek under HCM-2 would improve upstream passage conditions for adult bull trout if they were to colonize Rock Creek or use Rock Creek for foraging during low-flow months. Off-channel habitat enhancement and improvements to structural complexity in the wetlands adjacent to the lower reaches of Rock Creek (HCM-3 and HCM-4), and large wood enhancement (HCM-6), would provide positive effects to habitat that could be utilized by bull trout fry, juveniles, or adults. Off-channel habitat and structural complexity such as large wood are important components to rearing habitat and overwintering habitat for bull trout and other salmonids (Bjornn and Reiser 1991).

In addition to the direct benefits of improved access and increased spawning, rearing, and overwintering habitat under the Proposed Action relative to the No-action Alternative, bull trout would benefit indirectly through improved foraging opportunities. Because bull trout are occasionally flushed downstream of Chester Morse Lake and also use the lower Cedar River and Lake Washington for foraging and overwintering (Subsection 3.8.1.1, Species Listed as Threatened Under the ESA), the most likely future scenario is that bull trout would use the lower reaches of Rock Creek or the Cedar River near its mouth for foraging. Consequently, the potential for increases in the production of fry and juvenile fish from Rock Creek that could be used as forage by bull trout would be an indirect benefit of the Proposed Action relative to the No-action Alternative. Taken together, the direct and indirect benefits of the Proposed Action relative to the No-action Alternative represent a small but positive contribution to maintaining and improving bull trout populations and critical habitat in the Coastal-Puget Sound DPS.

4.8.2.2 Other Covered Species

Puget Sound/Strait of Georgia Coho Salmon

The PHLOAT analysis suggests that under the Proposed Action during years with normal precipitation levels, flow augmentation under HCM-1 would increase the median amount of coho salmon spawning habitat by 1,868 square feet of WUA during November, but no changes would occur in the median amount of WUA during December through February. The increase in November represents an approximate 2.2-fold increase over the No-action Alternative. Only during years when flows were low (e.g., habitat duration value of 80 percent exceedance or greater) would flow augmentation (HCM-1) provide flows during December that would increase the amount of spawning habitat from approximately 1,549 square feet of WUA to about 3,417 square feet of WUA. Similarly, flow augmentation under the Proposed Action would improve adult holding conditions relative to the No-action Alternative for coho salmon during years when flows were low, but conditions would still be suboptimal compared to Washington Forest Practices Board (1995) criteria because the morphology of the stream is not conducive to the development of deep pools.

The PHLOAT analysis suggests the amount of habitat for juvenile coho salmon is relatively stable throughout the year, regardless of the Alternative. The PHLOAT analysis indicated that monthly total habitat WUA would range between about 9,151 to 9,988 square feet under drought conditions (greater than 80 percent WUA exceedance value) and 10,042 to 10,345 square feet under wet conditions (less than 20 percent WUA exceedance value). The flow augmentation measure (HCM-1) would provide a relatively small increase (e.g., about 469 square feet during October) in median amounts of rearing under the Proposed Action compared to the No-action Alternative. The WDFW (Appendix B; DEIS comment WDFW-6) suggested that WUA was a poor metric for juvenile coho salmon, but HCM-1 would nevertheless benefit them during October and possibly November and December. If the wells were not used during the summer, the amount of WUA for juvenile coho salmon during the annual 7-day low-flow period would be approximately 9,284 square feet, about 2 percent higher than under the No-action Alternative because the annual 7-day low-flow period would occur more frequently in September with a higher flow under the Proposed Action rather than during October with a lower flow under the No-action Alternative.

Under drought conditions, low flows could potentially persist during periods when the upstream migration of coho salmon adults occurs, usually from late November through the end of spawning in mid-January. Under these circumstances, the construction of rock weirs at the mouth of Rock Creek (HCM-2) under the Proposed Action would provide a positive effect for coho salmon access to Rock Creek relative to the No-action Alternative. Improvements in access to off-channel habitat and enhancement of the structural complexity of the wetlands under HCM-3 and HCM-4, and large wood enhancement under HCM-6, would also provide positive effects to habitat that could be utilized by coho salmon fry or juveniles. HCM-5 would improve passage conditions at the Summit-Landsburg Road stream crossing for both the adult and juvenile life stages.

Two of the three major threats to the Puget Sound/Strait of Georgia coho salmon ESU, namely high harvest rates and a decline in spawner size, would not likely be affected by the operation of the Clark Springs Facility under the Proposed Action. Under the Proposed Action, the third major threat, loss of habitat, would be affected by ongoing withdrawals for water supply, but the analysis presented above suggests these effects would be relatively minor for juvenile rearing because the amount of WUA would be relatively stable over a wide range of flows and low for coho salmon spawning habitat because coho spawning generally occurs after the fall increase in flows. However, the Proposed Action also provides improvements in passage conditions and rearing and off-channel habitat, which would benefit coho salmon relative to the No-action Alternative. Consequently, the Proposed Action provides a small but positive contribution to the maintenance and increase of the PS/Strait of Georgia coho salmon population relative to the No-action Alternative.

Sockeye Salmon

The PHLOAT analysis suggests that under flow augmentation HCM-1), the median amount of sockeye salmon spawning habitat would increase to about 12,012 square feet of WUA during October and November, but no changes compared to the No-action Alternative would occur in the median amount of WUA during December. These would represent a 3.0-fold increase over the No-action Alternative conditions during October and a 4.7-fold increase during November. Similar to coho salmon, during years with low-flow conditions (e.g., habitat duration value of 80 percent exceedance or greater), the proposed minimum flows during December under the flow augmentation measure would increase the amount of sockeye salmon spawning habitat from approximately 2,561 square feet of WUA to about 12,012 square feet of WUA or about a 4.7-fold increase over the No-action Alternative conditions.

Similar to Chinook salmon fry, emergence of sockeye salmon fry begins in late January and continues through May with the peak of the downstream migration to the Cedar River and Lake Washington occurring during late March and early April. The availability of sockeye salmon fry habitat in Rock Creek is assumed to be similar to that of Chinook salmon. Flow augmentation would not affect sockeye salmon fry because they would not be present during October, November, and December.

Similar to Chinook salmon and bull trout, which also have their upstream migration periods during the low-flow period of the year, construction of rock weirs at the mouth of Rock Creek under HCM-2 would provide improved access and holding conditions at the mouth of Rock Creek for sockeye salmon. Improvements in access to off-channel habitat and enhancement of the structural complexity of the wetlands under HCM-3 and HCM-4, and large wood enhancement under HCM-6, would provide positive effects to habitat that could be utilized by sockeye salmon fry, while HCM-5 would improve passage conditions at the Summit-Landsburg Road for adult sockeye salmon.

Under the Proposed Action, moderate numbers of sockeye salmon would likely continue to use Rock Creek for spawning, incubation, and early fry rearing. Flow augmentation and passage improvements in Rock Creek under the Proposed Action would maintain and improve the Cedar River sockeye salmon population relative to the No-action Alternative. Consequently, if NMFS redefines sockeye salmon ESUs to include the Cedar River population, the beneficial effects under the Proposed Action would reduce the risk that Cedar River sockeye salmon would be listed under ESA.

Puget Sound/Strait of Georgia Chum Salmon

The PHLOAT analysis suggests that with flow augmentation under HCM-1, the median amount of chum salmon habitat would increase to 9,985 square feet of WUA during November, approximately double the amount available under the No-action Alternative, but no changes would occur in the median amount of WUA during December. During years with low-flow conditions during December (e.g., habitat duration value of 80 percent exceedance or greater), the proposed minimum flows would increase the amount of chum salmon spawning habitat from approximately 4,496 square feet of WUA to about 9,985 square feet of WUA or about a 2.2-fold increase over the No-action Alternative.

Similar to Chinook salmon and sockeye salmon, which also have their upstream migration periods during the low-flow period of the year, construction of rock weirs at the mouth of Rock Creek under HCM-2 would provide improved access and holding conditions at the mouth of Rock Creek if chum salmon colonized the creek. Improved access to, and enhancement of, off-channel habitat (HCM-3 and HCM-4), would also provide positive effects to habitat that could be utilized by chum salmon fry. If chum salmon were to begin utilization of the upstream reaches, large wood enhancement (HCM-6) would provide some benefits to fry rearing, and HCM-5 would improve passage conditions at the Summit-Landsburg Road for adult chum salmon. However, the current intermittent observations of chum salmon in the creek suggest the likelihood of chum salmon using the reaches of Rock Creek above Summit-Landsburg Road over the duration of the HCP is low.

Similar to the No-action Alternative, the status of chum salmon in the Puget Sound/Strait of Georgia ESU is unlikely to be significantly affected by the Proposed Action because their use of Rock Creek or the Cedar River as strays does not currently constitute a substantive portion of the population. However, if chum salmon use of the Cedar River and Rock Creek dramatically increases in the future, the importance of the Cedar Basin could be re-evaluated by NMFS. Should that occur, improvements to spawning habitat and access to the stream under the Proposed Action would be a benefit to the chum salmon population relative to the No-action Alternative.

Coastal Cutthroat Trout

Based upon recent spawning surveys, the time of entry of adfluvial cutthroat trout into Rock Creek from the Cedar River is early December and could continue through the end of spawning in late February (R2 Resource Consultants, Inc. 2005a). Flow augmentation (HCM-1) would improve the ability of cutthroat trout to migrate upstream during October, November, and December by improving access and adult holding conditions, but cutthroat trout spawning usually does not occur until January or February so the flow augmentation measure would not be expected to affect the amount of available cutthroat trout spawning habitat.

During the proposed flow augmentation period (October, November, and December) under the Proposed Action, the median amount of available habitat for juvenile rearing would be more than double over what would be provided under the No-action Alternative during October and November (e.g., an additional 403 square feet of WUA during October). However, there would be no change in the median amount during December. If the wells were not used during the summer, the amount of WUA for cutthroat trout juvenile rearing would be approximately 376 square feet (Table 4.8-8), about 47 percent higher than the No-action Alternative. During years with low-flow conditions during December (e.g., habitat duration value of 80 percent exceedance or greater), flow augmentation would increase the amount of cutthroat spawning habitat from approximately 255 square feet of WUA to about 728 square feet of WUA or about a 2.9-fold increase over the No-action Alternative.

Under drought conditions, low flows could potentially persist during periods when the upstream migration of cutthroat trout adults occurs. Under these circumstances, construction of rock weirs under HCM-2 would provide a positive effect for cutthroat trout access to Rock Creek relative to the No-action Alternative. Improvements in access to, and the structural complexity of, off-channel habitat in the lower reaches of Rock Creek under HCM-3 and HCM-4 would be a benefit to cutthroat trout fry, juveniles, or adults under the Proposed Action. Large woody debris enhancement under the Proposed Action (HCM-6) would also provide positive effects to habitat that could be utilized by cutthroat trout in Reaches 10 and 12. Replacement of the culverts under HCM-5 would improve passage conditions at the Summit-Landsburg Road stream crossing for both the adult and juvenile life stages of cutthroat trout.

The relative contribution of Rock Creek to the adfluvial coastal cutthroat population in Lake Washington is unknown; however, the Lake Washington population appears relatively robust (Nowak et al. 2004) and significant spawning appears to occur in Rock Creek (R2 Resource Consultant, Inc. 2005a). Nevertheless, the Proposed Action is anticipated to improve passage conditions and rearing and overwintering habitat that would benefit the overall Lake Washington adfluvial coastal cutthroat trout population and reduces the likelihood that the population would be listed in the future.

Pacific Lamprey and River Lamprey

The degree of utilization of Rock Creek by Pacific and river lamprey and their specific life history traits are not well understood. As described in Subsection 4.8.1.2, Other Covered Species, for the No-action Alternative, declines in population numbers of Pacific lamprey on the Columbia River and Oregon coast has led Close et al. (2002) to suggest that habitat disturbance is an important factor because similar declines have occurred to salmonids living in sympatry with Pacific lamprey. Consequently, only general life history information is available to help discern the effects of water withdrawals at the Clark Springs Facility and the mitigation measures to be implemented under the HCP. As discussed previously, the available information suggests it is not likely that the upstream migration of Pacific lamprey would be adversely affected by water withdrawals at the Clark Springs Facility. Similarly, water augmentation during October, November, and December as a consequence of HCM-1 under the Proposed Action would be expected to provide no or little benefit to lamprey. However, given the benefit to salmonids described above, which are an important host species for lamprey, the Proposed Action may have indirect benefits to Pacific and river lamprey. Overall, the Proposed Action would have a minimum to no significant adverse effect to Pacific and river lamprey, and may provide slight benefits that would reduce the risk of ESA listing in the future.

4.8.2.3 Other Resident Fish Species in Rock Creek

Under the Proposed Action, flow augmentation (HCM-1), rock weirs at the mouth of Rock Creek (HCM-2), off-channel habitat enhancement (HCM-3 and HCM-4), culvert replacement at the Summit-Landsburg Road stream crossing (HCM-5), and large wood placement (HCM-6) would improve aquatic habitats or the ability of fish to move up and downstream through the lower portions of Rock Creek. None of the HCMs is likely to have an adverse effect on other resident fish species that utilize Rock Creek and most would be expected to have a beneficial effect. In particular, HCM-1 would improve low-flow conditions during October, November, and December relative to the No-action Alternative. HCM-3 and HCM-4 would improve off-channel wetland habitat that speckled dace, redside shiner, and three-spine stickleback could utilize. HCM-5 would improve passage at the Summit-Landsburg Road stream crossing and HCM-6 would improve habitat conditions in Reaches 10 and 12.

4.8.2.4 Other Activities Affecting Fish Habitat Conditions

All of the operational and maintenance activities described above for the No-action Alternative would also occur under the Proposed Action; therefore, the effects to fish habitat in Rock Creek would be similar. Under the Proposed Action, flow augmentation (HCM-1), rock weirs at the mouth of Rock Creek (HCM-2), off-channel habitat enhancement (HCM-3 and HCM-4), culvert replacement at the Summit-Landsburg Road stream crossing (HCM-5), and large wood placement (HCM-6) improve fish rearing and overwintering habitat conditions or access to habitat relative to the No-action Alternative. Although the overall amount of large wood within the Clark Springs Facility and farther downstream to the mouth of Rock Creek would continue to be good under the No-action Alternative, the Proposed Action would enhance large wood levels in two specific areas of Reaches 10 and 12 where large wood levels are low. As described above, depending upon the lifestage and species of interest, HCM-2 through HCM-6 would have neutral or positive effects relative to the No-action Alternative (Table 4.8-6). The effects of water conservation (HCM-7) and the Habitat Fund (HCM-8) would also be expected to be positive, but HCM-7 effects would be indirect and those of HCM-8 cannot be specified at this time. The effects of the latter two HCMs will be discussed in more detail later in this subsection.

While the net effects of HCM-3 and HCM-4, which enhance wetlands and their hydrologic connection to Reach 1, would be beneficial to salmonids compared to the No-action Alternative, by providing access and improvements to off-channel habitat used for fry rearing, juvenile rearing, and overwintering some confounding effects may potentially occur due to ecological relationships with other species, primarily through predation or scavenging of salmon or trout. Cederholm et al. (2000) reported that 9 of the 605 wildlife species they reviewed had a strong relationship to Pacific salmon, and 58 had a recurrent relationship. Of those with a strong relationship, seven could be found in western Washington riparian wetlands. Consequently, enhancement of the wetlands under HCM-3 and HCM-4 may benefit a variety of wildlife species (Subsection 4.9, Wildlife), some of which may interact with covered species that are the target of the mitigation measures. Enhancement of the wetlands may result in increased utilization by larger cutthroat trout, or possibly even bull trout that can feed on smaller salmon or trout. Furthermore, other piscivorous species, both native and non-native to the area, might be attracted to the enhanced wetlands, including birds such as mergansers, kingfishers, herons, or egrets; amphibians such as bullfrogs and salamanders; or mammals such as otter or water shrew. Despite these potential confounding effects, enhancement of the wetlands under the Proposed Action is considered an overall benefit to the covered species and to the general ecological function of the area as compared to the No-action Alternative.

The effects of water conservation (HCM-7) on covered species would be indirect, but considered beneficial. Water conservation planning is an integral part of the City's overall strategy to meet its current and future water demand in its service area and would likely occur under the No-action Alternative without the HCP. Continued water conservation and water conservation planning on the part of the City and its water customers help to reduce annual water demand that in turn allows the City to provide augmentation flows during October, November, and December under HCM-1 without unacceptable risk to the beneficial uses of the water supply. Without continued water conservation and water conservation planning, the City would be unable to guarantee augmentation flows under HCM-1. Compared to the No-action Alternative, HCM-7 under the Proposed Action secures indirect benefits to covered species that would otherwise be lost.

The specific effects of the Habitat Fund (HCM-8) on covered species would be unknown until specific projects are identified. However, the $1.6 million included in the Habitat Fund under the Proposed Action would be considered a significant contribution toward the conservation or restoration of habitat utilized by the covered species. In comparison, under the No-action Alternative the City would be unlikely to voluntarily implement any restoration or enhancement projects in Rock Creek unless direct benefits to its water supply would be accrued. Under the Proposed Action, annual contributions to the Habitat Fund are scheduled for years 6 through 15 of the HCP and all expenditures would be expected to occur by the end of that period. Selection of projects to be implemented would be made by a committee including members from the City, NMFS, and USFWS. The goal of the fund would be to implement mitigation/restoration projects that benefit covered species in the HCP and protect water quality within the Rock Creek basin. The types of projects could include, but would not be limited to, land acquisitions, conservation easements, and the purchase of water rights. Under some circumstances Habitat Fund monies could be used to leverage larger projects by selecting projects that utilize matching grants from other entities. Overall, the Proposed Action is considered to provide substantial benefits to covered species through habitat restoration and protection projects that would not be implemented under the No-action Alternative.

4.9 Wildlife

4.9.1 Alternative A: No Action

4.9.1.1 Wildlife Habitats and Communities

Under the No-action Alternative, the City would continue its vegetation management practices described in Section 3, Affected Environment, and would maintain the habitat cover types at roughly the current proportions within the Clark Springs Facility. The City plans to complete the fencing perimeter around the site to minimize public access and protect the water supply system.

Since there would be no change in how the City operates the three wells, gravity-fed infiltration gallery, and surface water diversion system at the Clark Springs Facility under the No-action Alternative, wetland habitats in the lower Rock Creek basin downstream of the Clark Springs Facility would be unaffected.

Under the No-action Alternative existing conditions in the uplands and in stream and wetland habitats above the Clark Springs Facility would remain unchanged. In the absence of augmented flows, stream flows and wetland habitat in lower Rock Creek would be expected to be consistent with conditions over the past several decades.

The BPA would continue to maintain the shrub habitat within its electrical transmission line right-of-way.

The planned fencing around the Clark Springs Facility could inhibit use and movement of some species, while reducing disturbance for others. Installing a fence to enclose the northern portion of the parcel, similar to that which exists in the southern portion of the parcel, could reduce the use of the property by larger mammals (e.g., deer, bear, elk). The loss of this habitat would likely not substantially impact these species. Small and medium-sized mammals, (i.e., coyotes and raccoons) would likely be able to navigate the fence, and birds would be relatively unaffected by the fence. The fence would also reduce human and domestic dog activity on the property, which would likely benefit some species.

4.9.1.2 Special Status Wildlife Species

Western Toad

Western toads have not been documented in the action area, but it is possible they inhabit the area because suitable habitat is present. The No-action Alternative would not change management at the Clark Springs Facility; therefore, it would not be expected to affect western toad habitat or indirectly affect western toads. Western toads could experience direct impacts from vehicular traffic in and out of the project facilities, operation of construction equipment, and during periodic mowing over the infiltration gallery. The impact of this direct effect would be expected to be relatively low as a result of the limited amount of facility-related road and the periodic nature of the mowing.

Bald Eagle

Bald eagles are not known to occur in the action area. The closest known bald eagle nest site is approximately 1.75 miles from the Clark Springs Facility and there is only one other known nest site within 5 miles of the action area. Suitable nesting habitat is limited, if present at all, in the action area. Bald eagles may forage along Rock Creek. Management under the No-action Alternative would not alter any potential bald eagle nesting, roosting, or foraging habitat, and continued operation of the Clark Springs Facility would not be expected to directly or indirectly affect bald eagles.

Gray Wolf

Gray wolves are not known to occur in the action area. Possible wolf sightings have been reported in the Rock Creek basin, but these have not been confirmed. Though the origin of the observed animal is not known at this time, reported wolf sightings in areas without a resident wolf population can be from observations of a hybrid or escaped captive wolf. Given the extreme unlikelihood that gray wolves exist in the action area, management under the No-action Alternative would not be expected to substantively change wolf habitat in the action area or to directly or indirectly affect wolves.

4.9.1.3 Other Wildlife Species

Habitat cover types within the action area are expected to support a wide variety of wildlife species, including the western red-backed salamander, Pacific chorus frog, common garter snake, sharp-shinned hawk, white crown sparrow, deer, and coyote (Appendix A, Common Species List). Management under the No-action Alternative would not be expected to substantively change the quality or quantity of habitat cover types in the action area (Subsection 4.9.1.1, Wildlife Habitat and Communities). Some of the less mobile species, primarily the amphibians, could experience direct impacts from vehicular traffic in and out of the project facilities, operation of construction equipment, and periodic mowing over the infiltration gallery. The impact of this direct effect would be expected to be relatively low as a result of the limited amount of facility-related road and the periodic nature of the mowing. Management would not be expected to directly or indirectly affect common wildlife species in the action area.

Public comments raised concern over the potential effects of bullfrogs on fish and aquatic amphibians in the action area. While the bullfrog is a well-documented predator of fish and amphibians, it is not currently known to be present in the action area. Suitable bullfrog habitat is likely present in the wetlands along lower Rock Creek. The potential for bullfrogs to become established in the lower Rock Creek basin is unknown. If bullfrogs are or become present in the action area, they would be expected to have a low to moderate effect on fish and amphibian species, depending on the number of bullfrogs.

4.9.1.4 Other Priority Habitats

The riparian area along the lower portion of Rock Creek between the Cedar River and the Kent-Kangley Road is identified as priority habitat (Washington Department of Fish and Wildlife 2006b). The No-action Alternative would not alter current priority riparian habitat conditions.

In addition to the riparian habitat, one palustrine wetland is identified as a priority habitat within the action area, while a number of other priority wetland habitats are identified within the Rock Creek basin (Washington Department of Fish and Wildlife 2006b). The effects upon wetland habitats are discussed in detail in Subsection 4.7, Vegetation.

4.9.2 Alternative B: Proposed Action

4.9.2.1 Wildlife Habitats and Communities

Vegetation management at the Clark Springs Facility would be the same under the Proposed Action as under the No-action Alternative. The planned completion of a fenced perimeter around the facility described under Alternative A would also occur under Alternative B with the same potential impacts.

Under the Proposed Action, the City would implement a flow augmentation plan (HCM-1) that would provide water augmentation to lower Rock Creek during October, November, and December. Wetlands downstream of the Clark Springs Facility would be only minimally affected by the flow augmentation plan (HCM-1) because most of the wetland plant species would be transitioning from active growth to dormancy at this time of year; therefore, the additional water supply would not be expected to affect the quality or quantity of wetland vegetation.

The Proposed Action also proposes a number of projects that would enhance off-channel habitat (HCM-3 and HCM-4), improve fish passage at the mouth of Rock Creek and at Summit-Landsburg Road (HCM-2 and HCM-5), and increase structural complexity by the placement of large wood (HCM-6). The effects of these projects on wetland and stream habitat are discussed in Subsections 4.7, Vegetation, and 4.8, Fish and Aquatic Habitat. The potential effects of these conservation measures on wildlife within the action area are discussed below in Subsections 4.9.2.2, Special Status Wildlife Species, and 4.9.2.3, Other Wildlife Species.

4.9.2.2 Special Status Wildlife Species

Western Toad

Effects on the western toad under the Proposed Action would be similar to those under the No-action Alternative. Terrestrial habitats used by adult western toads would remain unchanged under the Proposed Action, along with stream and wetland habitat above the project facilities. The proposal under the Proposed Action to deepen one of the wetlands along lower Rock Creek could reduce the amount of western toad breeding habitat. Western toads lay eggs in shallow water up to 1.6 feet deep (Leonard et al. 1993; Corkran and Thoms 1996; Wind and Dupuis 2002). If the wetland were dredged to a depth of 2 to 4 feet, as proposed (HCM-4), the amount of shallower habitat could be reduced, potentially impacting western toads. But since western toads are not known to use this wetland for breeding, the potential effect would be minimal. Under the No-action Alternative, this wetland would not be dredged; therefore, the potential adverse effect from dredging under the Proposed Action would not occur under the No-action Alternative. Other measures proposed under the Proposed Action (HCM-2, HCM-3, HCM-5, and HCM-6) to modify Rock Creek and a second associated wetland would not be expected to substantively affect western toad habitat.

Western toads could be directly affected by heavy equipment operation and active modification of habitat while stream and wetland projects are being conducted. These activities would be conducted only once, for a brief period during the term of the permit, however, limiting the potential effect. The potential direct effects to western toads from traffic along facility access roads and periodic mowing over the infiltration gallery would be similar to those under the No-action Alternative.

Bald Eagle

Management of potential bald eagle terrestrial habitat under the Proposed Action would be similar to that under the No-action Alternative. Potential increased salmon production in Rock Creek under the Proposed Action could improve the availability of bald eagle prey, relative to the No-action Alternative. The potential effects of the Proposed Action on bald eagles and bald eagle habitat would result in improved or similar habitat conditions to those under the No-action Alternative.

Gray Wolf

Management of potential gray wolf habitat under the Proposed Action would be similar to that under the No-action Alternative. The potential effects of the Proposed Action on gray wolves and gray wolf habitat would be the same as those under the No-action Alternative.

4.9.2.3 Other Wildlife Species

Under the Proposed Action, the effects to common wildlife species that may be expected to use these habitats (such as the rough-skinned newt, western red-backed salamander, common garter snake, white-crowned sparrow, sharp-shinned hawk, black-tailed deer, and coyote) would be the same as those under the No-action Alternative.

Under the Proposed Action, the City would implement instream and wetland modifications that would not occur under the No-action Alternative. Projects proposed under the Proposed Action that could potentially affect common wildlife species include enhancing off-channel habitat (HCM-4), improving fish passage at the mouth of Rock Creek and at Summit-Landsburg Road (HCM-2 and HCM-5), and increasing the structural complexity of Rock Creek by the placement of large wood (HCM-6). These conservation measures would alter existing habitat but they would not be expected to substantially change the amount of stream and wetland habitat available to common wildlife species. The enhancement of off-channel habitat (HCM-3 and HCM-4) would alter the character of an existing wetland by reducing the amount of emergent vegetation and by increasing the amount of coarse woody debris and shade. Such modifications could affect the amount of use by some species, but it is not expected to eliminate use by any species.

The off-channel enhancements (HCM-3) would involve the hydrologic connection of another existing wetland so that the wetland would receive water directly from Rock Creek throughout the year. Connecting the wetland to Rock Creek could introduce or increase the number and diversity of fish species in the wetland. This modification could affect amphibian use of the wetland, but would not be expected to eliminate use by any amphibian species.

Suitable bullfrog habitat is currently present in the action area and proposed modifications to stream and wetland habitat under the Proposed Action would not substantially alter the quality of the habitat or its accessibility to bullfrogs. The potential for bullfrogs to be present in the action area would be similar under both alternatives. If bullfrogs become established in the action area, the effects to fish and amphibians would be similar under both the No-action Alternative and the Proposed Action.

Passage improvements at the mouth of Rock Creek (HCM-2) and the culvert replacement at Summit-Landsburg Road (HCM-5) would improve anadromous fish access to Rock Creek. Anadromous fish currently access Rock Creek from the Cedar River and modifications to the channel would improve access at lower flows (HCM-2). Replacing a culvert at the Summit-Landsburg Road stream crossing (HCM-5) would improve current access farther up Rock Creek. Increasing anadromous fish access in

Rock Creek would increase the abundance of salmon carcasses in Rock Creek relative to the No-action Alternative. These carcasses would provide foraging opportunities and nutrients that could benefit a wide variety of wildlife species.

Large woody debris would be placed in selected reaches of Rock Creek to increase structural complexity to the stream habitat (HCM-6). Increased structural complexity would improve habitat conditions for aquatic and streamside amphibians and reptiles, such as the Pacific giant salamander and rubber boa.

Construction activities such as dredging wetlands, modifying the stream channel and bank, and replacing a culvert have the potential to directly affect common species, especially amphibians, for short periods of time. These effects would be minimized by conducting construction activities only during the permit term and would not present an ongoing impact. The result of potential direct impacts to common wildlife species under the Proposed Action would be expected to be low.

Relative to the No-action Alternative, the long-term effects to common wildlife species such as the rough-skinned newt, western red-backed salamander, common garter snake, white-crowned sparrow, sharp-shinned hawk, black-tailed deer, and coyote would be the same or better under the Proposed Action. Short-term effects on common species would be greater under the Proposed Action due to the construction activities related to the implementation of proposed conservation measures.

4.9.2.4 Other Priority Habitats

The priority riparian habitat along the lower portion of Rock Creek between the Cedar River and the Kent-Kangley Road could be affected by instream mitigation measures. The Proposed Action would implement HCM-2, HCM-3, HCM-4, and HCM-5, which might require modification of the priority riparian habitat along Rock Creek during implementation. The extent to which riparian habitat may be modified to complete these measures is not known, but would be expected to be minimal and temporary. The Proposed Action also would establish a fund for riparian acquisition, easement, and enhancement in the Rock Creek Watershed (HCM-8) that would not be established under the No-action Alternative. To the extent projects are funded along Rock Creek between the Cedar River and the Kent-Kangley Road, habitat conditions in the priority riparian habitat would improve under the Proposed Action. The combined effect of the HCMs under the Proposed Action would result in improved riparian habitat conditions along Rock Creek, relative to the No-action Alternative.

The effects on priority wetland habitats are discussed in detail in Subsection 4.7, Vegetation.

4.10 Historic and Cultural Resources

Analysis of potential impacts to historic and cultural resources from the proposed HCP is undertaken with reference to the following Federal and State statutory and regulatory requirements:

Section 106-National Historic Preservation Act (36 Code of Federal Regulations 800) - Section 106 of the National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470 et seq.) requires Federal agencies to take into account the effects of their undertakings on properties included in or eligible for inclusion in the National Register of Historic Places. The NHPA also affords the Advisory Council on Historic Preservation a reasonable opportunity to comment if participating as a consulting party. The review process mandated by Section 106 is outlined in regulations issued by the Advisory Council on Historic Preservation (Protection of Historic Properties [36 CFR Part 800]). As defined in the regulations, "undertaking" means a project, activity, or program of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; or those requiring a Federal permit, license, or approval. In order to determine whether an action is an undertaking subject to Section 106 review, an agency should examine the nature of Federal involvement in the action, taking into consideration factors such as the degree of Federal agency control or discretion, and whether or not the action could move forward without the Federal action.

The Washington State Environmental Policy Act (SEPA) – This legislation requires that potential significant impacts on historic and cultural resources be considered in project planning during the environmental review process. Under SEPA, historic resources include sites and places listed on a historic register. Cultural resources include historic buildings and districts, archaeological sites, places of traditional cultural value to Native American groups, and resources or places of heritage value to a community.

Under both the No-action Alternative and the Proposed Action, historic and cultural resources would be considered under SEPA review with reference to the following Washington State cultural resources and historic preservation laws:

- Executive Order 05-05, Archaeological and Cultural Resources
- Archaeological Sites and Resources (RCW 27.53)

Analysis of environmental consequences focuses on those activities under the No-action Alternative and the Proposed Action that 1) may affect archaeological resources; and 2) may affect the management of salmon habitat, and therefore the availability of and/or access to salmon, a culturally and traditionally significant resource to the Muckleshoot Indian Tribe.

As discussed in Subsection 3.10, Historic and Cultural Resources, review of existing information, including records in the cultural resources GIS database maintained by the Washington Department of Archaeology and Historic Preservation, has determined that there are no historic buildings in the action area, and no previously recorded archaeological resources. Previous studies have documented Native American place names in the Cedar River Watershed and archaeological resources in the project vicinity and, based on the review of literature and other information reviewed for this analysis, the action area should be considered sensitive for archaeological resources, particularly the lower reaches of Rock Creek near its confluence with the Cedar River, where specific HCM measures would be implemented under the Proposed Action. There is general agreement among regional archaeologists that the confluence of two waterways, particularly if they support salmon, is a landform type that should be considered archaeologically sensitive because ethnographic evidence suggests that anadromous fish have been important to the economic and subsistence strategies of prehistoric and historic-era Native American populations in the Pacific Northwest (Ames and Maschner 1999). The archaeological sensitivity of any landform is determined by evaluating known historic land use, the distribution of cultural resources in the vicinity, and the nature and extent of previous disturbance in the area of interest.

4.10.1 Alternative A: No Action

Under the No-action Alternative, the HCP would not be implemented. Potential impacts to archaeological resources from activities necessary to maintain or modify existing facilities would be limited to ground disturbance from such actions as the construction of new facilities or new roads; previous disturbances from tree clearance, construction grading, and installation of wells and the infiltration gallery would be taken into consideration. Activities that would involve ground disturbance in areas that have not been disturbed by previous development may impact unknown archaeological resources. The City would be obligated to take the steps necessary to comply with Washington State law RCW 27.53 regarding the protection of archaeological resources on public and private lands. Compliance would be accomplished by completing an appropriate level of field investigations to identify archaeological resources prior to any activities that involve ground disturbance, and/or providing a specific plan for the unanticipated discovery of archaeological resources during ground disturbance. If unknown cultural resources are uncovered during construction activities, all work would be halted and the City would contact a certified archaeologist to evaluate the condition of the resources.

Ongoing management of salmon habitat under the No-action Alternative may result in the eventual reduced availability of and/or access to salmon, a natural resource with significant cultural and traditional value to the Muckleshoot Indian Tribe.

Under the No-action Alternative, potential impacts to unknown archaeological resources in undisturbed areas from future construction activities would be avoided through conducting appropriate archaeological investigations prior to ground disturbance. In the event that archaeological resources are discovered during construction, City personnel and contractors would be required to halt work in the vicinity of the find and to contact the Washington Department of Archaeology and Historic Preservation for direction on how to proceed.

4.10.2 Alternative B: Proposed Action

Under the Proposed Action, the City would implement the HCMs stipulated in the HCP and the operations and maintenance activities described under the No-action Alternative. Unlike the No-action

Alternative, because the Proposed Action involves a federal action the project must comply with Section 106 of the NHPA. Under the Proposed Action impacts to unknown archaeological resources may result from implementation of the following specific HCMs, which require some degree of ground disturbance to landforms that should be considered archaeologically sensitive based on the information presented in Subsection 3.10: flow augmentation program (HCM-1), passage improvements at the mouth of Rock Creek (HCM-2), off-channel habitat enhancements (HCM-3 and HCM-4), culvert replacement at Summit-Landsburg Road (HCM-5), and large wood placement (HCM-6).

Adverse impacts to archaeological resources under the Proposed Action could be avoided or minimized through compliance with Section 106 regulations at 36 CFR 800.4(b)(2), which provide for phased field investigations to identify archaeological resources and assess adverse impacts as HCMs are implemented. Similarly, compliance with Washington State laws under SEPA provides for avoidance or minimization of adverse impacts through identification of archaeological resources prior to ground disturbance following guidelines published by the Washington Department of Archaeology and Historic Preservation. Based on the outcome of field investigations, a plan for the unanticipated discovery of archaeological resources during implementation of HCMs may also be appropriate. If unknown cultural resources are uncovered during construction activities, all work would be halted and the City would contact a certified archaeologist to evaluate the condition of the resources.

The Proposed Action may result in beneficial impacts to Native American cultural resources through improvements to salmon habitat that would support the ongoing availability of and/or access to salmon for the Muckleshoot Indian Tribe. Because the improvements to salmon habitat would not occur under the No-action Alternative, these beneficial impacts would only occur with the Proposed Action.

4.11 Socioeconomics and Environmental Justice

As described in Subsection 3.11, Socioeconomics, the City’s service area was used as the study area for the socioeconomic and environmental justice analyses. The focus of the socioeconomic impact analysis is the change in water rates due to implementation of one of the project alternatives. A qualitative assessment of impacts on employment and economic growth is also discussed. For this analysis, the changes in rates for different customer classes are compared to typical retail rates (Table 3.11.1) based on analysis of each alternative’s capital and costs projected over the 50-year permit period. Because usage is based on a yearly rate, an average of the two seasonal rates was used to calculate monthly costs (Table 3.11.1).

This socioeconomic analysis used a qualitative assessment of the adverse effects that would result from the proposed alternatives. A determination of an environmental justice impact would occur if these adverse effects were to have a disproportionate effect on a minority and low-income population. A disproportionately high and adverse effect on minority and low-income populations means an adverse effect that would be 1) predominantly borne by a minority population and/or a low-income population; or 2) suffered by the minority population and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that would be suffered by the non-minority population and/or non-low-income population.

4.11.1 Alternative A: No Action

4.11.1.1 Socioeconomics

Based on population projections (Subsection 3.11.1, Population) the City expects substantial population growth and increased demand for water in the future. To meet this expected increase in demand, the City must expand its water supply infrastructure. The City would likely rely on increased water rates to generate a portion of the revenue necessary to construct major capital improvements.

Under the No-action Alternative, the City would continue to offer utility rate reductions for eligible senior citizens and disabled persons based on income through its Lifeline program. The City Council establishes the eligibility criteria for the Lifeline rate. The City's Lifeline rates for 2007 were $.51 per 100 cubic feet of water inside the City limits and $.56 per 100 cubic feet outside the City limits compared to non-Lifeline rates of $1.44 to $1.90 per 100 cubic feet inside the City limits and $1.90 to $2.42 per 100 cubic feet outside the City limits. Low-income populations that do not qualify for the Lifeline rates do not receive a reduction in water rates.

Under the No-action Alternative, the City would continue operations at the Clark Springs Facility consistent with its water rights and would not implement the proposed HCMs, though the existing voluntary augmentation program could be continued at the City's discretion. The City would continue its conservation and demand management programs, and continue to identify existing water rights that may be put to beneficial use. Therefore, while additional water rate increases under the No-action Alternative would occur to meet future demand, no additional rate increases would occur as a result of mitigation measures at the Clark Springs Facility.

Because the supply of water to City users is not expected to be impacted under the No-action Alternative, the City's projected employment growth of 17.6 percent by 2020 (City of Kent, Comprehensive Plan 2006 Community Profile) would not be impacted under the No-action Alternative.

4.11.2 Alternative B: Proposed Action

4.11.2.1 Socioeconomics

Under the Proposed Action the City would be committed to spending $2.9 million to comply with the mitigation agreed to in the proposed HCP. The City estimates that as a result of costs associated with the implementation of the HCP, ratepayers would have approximately a 1.3 percent increase for each $100,000 of annual mitigation required (based on the 2007 budget). Over the 50-year term of the ITPs, the City would spend an average of $50,000 per year for mitigation. Based on the City's estimates, annual rate increases necessary to meet future water demand would be increased an additional 0.65 percent per year to pay for the mitigation required by the proposed HCP. Because annual rate increases would not be affected by mitigation costs under the No-action Alternative, the additional impacts to rates under the Proposed Action would be greater than those under the No-action Alternative.

Under the Proposed Action, the increase in water rates would cause a disproportionate and adverse effect on low-income populations because the rate increase would have a greater impact on low-income populations than it would be to non-low-income populations. As under the No-action Alternative, mitigation for this impact would be offered by the City through its Lifeline Program. The Lifeline Program offers reduced water rates for eligible senior citizens and disabled persons. Eligibility criteria for the Lifeline Program are based on income and are set by City Council. In 2008, the Lifeline water rate was $.51 per unit inside the City limits and $.56 per unit outside the City limits. As under the No-action Alternative, low-income households that do not qualify for the Lifeline Program would not receive reduced rates.

As with the No-action Alternative, because the supply of water to City users is not expected to be impacted under the Proposed Action, the City's projected employment growth of 17.6 percent by 2020 (City of Kent, Comprehensive Plan 2006 Community Profile) would not be impacted under the Proposed Action.

4.12 Environmental Justice

4.12.1 Alternative A: No Action

Environmental justice impacts are those that would be disproportionately realized by minority or low-income populations as a result of the covered activities. However, this only applies if the percentage of minority, Hispanic, and low-income populations in the study area is meaningfully greater than the percentage of minority, Hispanic, and low-income populations in the general population (i.e., King County and the State of Washington). This is not the case in the City's service area (Subsections 3.11.1.1, Household Income, 3.11.1.2, Income and Poverty, and 3.11.1.3, Race and Ethnicity). Therefore, there would be no environmental justice impacts associated with the No-action Alternative.

Under the No-action Alternative there would not be an interruption of water service to public services, or any effect on the quality of drinking water. Therefore, there would be no impacts to human health under the No-action Alternative.

4.12.2 Alternative B: Proposed Action

As under the No-action Alternative, there would be no environmental justice impacts associated with the Proposed Action because the percentage of minority, Hispanic, and low-income populations in the study area is not meaningfully greater than the percentage of minority, Hispanic, and low-income populations in the general population (i.e., King County and the State of Washington).

Under the Proposed Action there would not be an interruption of water service to public services, or any effect on the quality of drinking water. Therefore, as with the No-action Alternative, there would be no impacts to human health under the Proposed Action.

4.13 Summary of Environmental Consequences

Table 4.12-1 summarizes the potential environmental consequences derived from the analyses of impacts presented in the previous Subsections 4.2 through 4.11.

Table 4.12-1 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
LAND USE AND OWNERSHIP		
Land use compatibility	Activities associated with the No-action Alternative would be consistent with applicable land use plans and policies.	As under the No-action Alternative, activities associated with the Proposed Action would be consistent with applicable land use plans and policies.
GEOLOGY AND SOILS		
Sedimentation from erosion hazard areas	The No-action alternative would result in minor erosion impacts if the City constructed new buildings in areas mapped as soil erosion areas. Soil erosion impacts would be minimized by the use of construction Best Management Practices (BMPs) require by the City's Critical Areas Ordinance (CAO).	The Proposed Action would result in the same minor sediment and erosion impacts at the Clark Springs Facility as described under the No-action Alternative. In addition, minor erosion impacts would occur at and near the mouth of Rock Creek during the construction of the HCMs required by the proposed HCP. The soil erosion impacts at the mouth would be minimized by the use of construction BMPs required by King County's CAO. Because of the additional minor impacts associated with the mitigation construction, the Proposed Action would have a slightly greater impact than the No-action Alternative.
AIR QUALITY		
Emissions from construction equipment	Construction of new buildings at the Clark Springs Facility would temporarily generate dust (including particulate matter [PM] 2.5 and carbon dioxide (CO^2).	Habitat Conservation Measures (HCMs) would result in a temporary increase in the emission of pollutants such as carbon monoxide and nitrogen oxides from vehicle and equipment exhaust, as well as PM2.5 from ground-disturbance activities. Because of the additional minor impacts associated with the mitigation construction, the Proposed Action would have a slightly greater impact than the No-action Alternative.
NOISE		
Noise level increase from construction equipment	There are no sensitive noise receptors close enough to the Clark Springs Facility to be affected by a temporary increase in noise levels from construction activities.	Construction activities at and near the mouth of Rock Creek would cause a temporary increase in noise levels at nearby residences. Impacts would be mitigated by the implementation of BMPs required through the King County permit process. The impacts would be greater under the Proposed Action than under the No-action Alternative.

Table 4.12-1 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
WATER QUANTITY AND WATER QUALITY		
Water withdrawal activities	Current operations at the Clark Springs Facility under the No-action Alternative may affect both the magnitude and timing of instream flows in Rock Creek downstream of the eastern boundary of the Clark Springs Facility. Since the groundwater and hydrology are connected, withdrawals from the aquifer would result in a reduction of streamflows in Rock Creek.	The Proposed Action would have surface water impacts similar to those described under the No-action Alternative for the period January through September. Impacts on surface water would be slightly different during October, November, and December due to the flow augmentation program (HCM-1) that would be implemented under the Proposed Action, in which some of the water withdrawn through the infiltration gallery would be used for augmentation instead of water supply. During years when the augmentation program is implemented, the impacts to surface water flows would be less under the Proposed Action than under the No-action Alternative.
Operations and maintenance	Minor water quality impacts would result from activities such as beaver dam removal and road building.	Impacts from the Proposed Action would be the same as under the No-action Alternative.
Habitat Conservation Measures	The City would not implement HCMs under the No-action Alternative.	Flow augmentation (HCM-1) would have a beneficial effect on instream flows downstream of the Clark Springs Facility during the months of October, November, and December due to an increase in flows of up to 2.5 cubic feet per second (cfs). Construction activities as part of implementing HCMs 1 through 6 may result in minor, short-term increases in turbidity and total suspended solids. These impacts would be minimized by implementation of BMPs during construction. The impacts under the Proposed Action would be greater than under the No-action Alternative.
VEGETATION		
Wetlands	Existing wetlands at the Clark Springs Facility would not be impacted under the No-action Alternative because the City's construction activities necessary to maintain its existing facilities and to construct new buildings on the property would occur outside existing wetland areas.	Under the Proposed Action, impacts to wetlands at the Clark Springs Facility would be the same as under the No-action Alternative. The HCMs would increase the hydraulic connection to two wetlands located along Rock Creek near the mouth. These improvements would not reduce or increase the amount of wetland habitat at either site but would result in improved water quality along lower Rock Creek. These beneficial impacts would not occur under the No-action Alternative,

Table 4.12-1 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
Special Status Plants	No Federal or State listed plant species are known to occur within the action area.	No Federal or State listed plant species are known to occur within the action area.
Noxious Weeds	For any new construction at the Clark Springs Facility, the City would implement weed management measures to reduce the opportunity for the introduction and spread of noxious weeds.	Under the Proposed Action, impacts from noxious weeds at the Clark Springs Facility would be the same as under the No-action Alternative. The City would implement the same mitigation measures for all construction activities associated with the HCMs.
FISH AND AQUATIC HABITAT		
Covered Fish Species		
Puget Sound (PS) Chinook salmon	Water withdrawals would limit access to Rock Creek and available spawning and fry rearing habitat that is considered critical habitat essential to the conservation and recovery of PS Chinook salmon.	Implementation of flow augmentation (HCM-1) would provide a beneficial effect on access and availability of habitat during the months of October, November, and December. Under the Proposed Action, passage improvements at the mouth of Rock Creek (HCM-2) and off-channel habitat enhancement (HCM-3 and HCM-4) would have beneficial effects on upstream migration and spawning and incubation habitat relative to the No-action Alternative. Replacement of the culverts at the Summit-Landsburg Road stream crossing (HCM-5) would benefit PS Chinook salmon through improved passage conditions relative to the No-action Alternative. These improvements would provide beneficial effects to PS Chinook salmon relative to the No-action Alternative.
Bull trout	Foraging opportunities, access during low-flow periods, and the availability of overwintering habitat would continue to be limited to bull trout because of water withdrawals.	Off-channel habitat enhancement and improvements to structural complexity in the wetlands adjacent to the lower reaches of Rock Creek (HCM-3 and HCM-4), and large wood enhancement (HCM-6), would provide positive effects to habitat that could be utilized by juveniles, sub-adults, and adults for foraging opportunities and overwintering. Access to Rock Creek during low-flow periods would be improved through construction of rock weirs at the mouth of Rock Creek (HCM-2). These improvements would provide beneficial effects to bull trout relative to the No-action Alternative,

Table 4.12-1 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
Puget Sound (PS) steelhead	Steelhead rearing habitat is limited during summer low-flow periods.	Off-channel habitat enhancement (HCM-3 and HCM-4) and LWD enhancement (HCM-6) would provide beneficial impacts by improving the quality and quantity of rearing and overwintering steelhead habitat. HCM-5 would improve passage conditions at the Summit-Landsburg Road stream crossing, primarily for the juvenile life stage of PS steelhead. These improvements would provide beneficial effects to PS steelhead relative to the No-action Alternative,
Other Covered Species		
Coho salmon	Water withdrawals result in a minor loss of juvenile rearing habitat.	Improvements in passage conditions (HCM-2, HCM-6) and rearing and off-channel habitat (HCM-3, HCM-4) under the Proposed Action would provide minor beneficial effects to coho salmon relative to the No-action Alternative.
Sockeye salmon	Water withdrawals contribute to suboptimal access conditions to Rock Creek during the spawning season for sockeye.	Flow augmentation and passage improvements in Rock Creek under the Proposed Action are anticipated to maintain and improve the Cedar River sockeye salmon population relative to the No-action Alternative. Improved access to, and enhancement of, off-channel habitat (HCM-3 and HCM-4), would also provide positive effects to habitat that could be utilized by sockeye salmon fry that would not occur under the No-action Alternative.
Puget Sound (PS)/Strait of Georgia chum salmon	Water withdrawals contribute to suboptimal access conditions to Rock Creek during the spawning season for chum.	If chum salmon were to colonize Rock Creek, HCMs under the Proposed Action would provide fish passage improvements (HCM-2) that would improve access and holding conditions at the mouth of Rock Creek. Improved access to, and enhancement of, off-channel habitat (HCM-3 and HCM-4), would also provide positive effects to habitat that could be utilized by chum salmon fry that would not occur under the No-action Alternative.
Coastal Cutthroat Trout	Water withdrawals contribute to low levels of rearing habitat for juveniles during summer low-flow months.	Under low-flow conditions improved passage at the mouth of Rock Creek(HCM-2) would provide a positive effect for cutthroat trout access to Rock Creek relative to the No-action Alternative. Improvements in access to, and the structural complexity of, off-channel habitat in the lower reaches of Rock Creek under HCM-3 and HCM-4 are expected to be a benefit to cutthroat trout fry, juveniles, or adults that would not occur under the No-action Alternative.

Table 4.12-1 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
Pacific lamprey River lamprey	Some loss of habitat may occur due to reduction in wetted perimeter of the creek. However, the quality of the available habitat could improve from reduced water velocity.	The Proposed Action is anticipated to have no adverse effects to Pacific and river lamprey, and may provide slight benefits that would reduce the risk of Endangered Species Act (ESA) listing in the future.
Other resident fish species in Rock Creek	Some loss of habitat may occur due to reduction in wetted perimeter of the creek.	HCMs under the Proposed Action would improve aquatic habitats or the ability of other fish species to move up and downstream through the lower portions of Rock Creek. These improvements would provide beneficial effects to other resident fish species relative to the No-action Alternative,
Wildlife		
	The No-action Alternative would cause no impacts to existing wildlife habitats.	The Proposed Action would improve wildlife habitat by the construction of the wetland enhancement projects (HCM-3, HCM-4). These improvements would provide beneficial effects relative to the No-action Alternative,
Historic and Cultural Resources		
	The No-action Alternative includes some new construction at the Clark Springs Facility. Construction activities at the Clark Springs Facility under the No-action Alternative would occur in areas with undisturbed soils. These activities would have the potential of impacting unknown cultural resources. Potential impacts to unknown cultural resources would be minimized by mitigation measures necessary to comply with all applicable regulations associated with cultural resources.	In addition to the construction activities at the Clark Springs Facility, the Proposed Action includes construction of HCMs along Rock Creek. Ground-disturbance activities along the shore of Rock Creek and its confluence with the Cedar River have the potential of impacting unknown cultural resources. Potential impacts to unknown cultural resources would be minimized by mitigation measures necessary to comply with all applicable regulations associated with cultural resources.

Table 4.12-1 Summary of potential impacts for each alternative.

Criteria	Alternative A: No Action	Alternative B: Proposed Action
Socioeconomics and Environmental Justice		
	The No-action Alternative would not result in additional water rate increases to those the City may require to meet anticipated future demand. Because the City's water service area does not include minority or low-income populations significantly greater that those found in King County or the State of Washington, no disproportionate impacts, as defined by the Executive Order on Environmental Justice, to those populations would occur under the No-action Alternative.	The cost of implementing the mitigation requirements included in the proposed HCP would require the City to increase water rates an average of 0.65 percent annually over the 50-year permit period. This rate increase would be in addition to rate increase necessary to meet future demand. Because the Proposed Action would require additional costs to implement mitigation required by the proposed HCP, the Proposed Action would have a slightly greater impact than the No-action Alternative.

5.0 CUMULATIVE EFFECTS

5.1 Introduction

Under NEPA, cumulative effects are defined as:

> *"the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions." (40 CFR 1508.7)*

This section presents an analysis of the cumulative effects (negative or beneficial) of the project alternatives on the resource areas evaluated in this EIS. This analysis is presented in the context of other local, State, and Federal management activities in the vicinity of the action area.

5.2 Approach and Methodology

This EIS uses a list approach to assess the cumulative effects of the proposed project alternatives. The analysis for the list approach involved identification of individual land use planning efforts or large-scale projects in the action area that could contribute to the cumulative effects of the project alternatives (Council on Environmental Quality 1997). Cumulative impacts occur at the landscape or regional level; therefore, for purposes of evaluating the cumulative effects of the proposed project alternatives, a regional scale action area was used that covers the Rock Creek and Cedar River Watersheds.

Current and reasonably foreseeable actions with the potential to result in impacts similar in kind or in location to those of the project alternatives were considered for this analysis. Past actions are assumed to have contributed to the existing conditions, as described in Section 3, Affected Environment. Refer to Section 3, Affected Environment, for a discussion of the existing conditions of each resource area.

Additional regional land management and large-scale development plans and activities that were evaluated as part of this cumulative effects analysis are listed below:

- Cedar River Watershed HCP
- WRIA-8 Chinook Recovery Plan
- Rock Creek Valley Vision
- King County Comprehensive Plan

5.2.1 Context for the Analysis

The following subsection describes the hydrology of Rock Creek, the types of consumptive water uses within the Rock Creek basin, and the salmon recovery strategy for the Puget Sound region. The hydrology and consumptive water use information is intended to provide an understanding of the other environmental conditions existing in the Rock Creek basin that affect surface water flow in Rock Creek. The description of the salmon recovery efforts for the Puget Sound region is intended to provide an understanding of how the proposed HCP supports the salmon recovery efforts going on throughout the region.

5.2.1.1 Hydrology of the Rock Creek Basin

For ~~most~~ substantial portions of the year in the upper basin, Rock Creek flows below ground along the valley floor. This subsurface flow originates in the upper basin where rainfall quickly infiltrates through permeable soils. During periods of heavy rainfall, when the soil becomes saturated and the water table rises, rainfall flows as surface runoff that remains above ground. Surface flow in the upper portions of Rock Creek varies according to the amount of precipitation in a given year.

Groundwater flows westward into a narrow valley just upstream from the Clark Springs Facility and reaches the surface near RM 2.8, the point of perennial flow in Rock Creek. The geology of this area suggests that there is a shallow bedrock ledge or similar geomorphic feature just beneath the surface (Hart Crowser 2003a) that forms a pinch point and pushes groundwater to the surface. The shallow depth of the bedrock ledge also prevents the operations of the Clark Springs Facility from affecting groundwater levels above this point. Downstream of this point, a portion of the groundwater flow becomes surface flow in Rock Creek while the remainder continues to flow subsurface below the Clark Springs Facility. A portion of this subsurface flow is withdrawn by the City's infiltration gallery.

5.2.1.2 Consumptive Water Use

Consumptive water use in the Rock Creek basin consists primarily of groundwater withdrawals made by municipalities, private wells that service multiple dwellings, domestic wells that are exempt from the water rights permitting process and service a single dwelling, and other wells with designated water rights.

The City's Clark Springs Facility began water withdrawals in 1957 and has the single largest water right in the Rock Creek basin. The City's withdrawals during the period of record defined for analysis in this EIS (1986 to 1998) averaged 6.2 cfs per year. The other municipal water supply system in the basin, Covington Water District, operates the Ravensdale Well. In 2001, the Ravensdale Well pumped water at a rate of approximately 35 gpm (Appendix C of the proposed HCP).

Several private water supply systems provide water to subdivisions such as those at Evergreen Acres, Retreat Lake, and Lake Twelve. It is not known how much water is actually withdrawn at these locations but the capacity of all of the private water supply systems in the basin is 4,231 gpm (Appendix C, City of Kent 2010).

The total amount of water allocated to other water rights for surface and groundwater withdrawals within the Rock Creek basin is 1,230 acre-feet per year for consumptive water uses (Appendix C, City of Kent 2010).

Throughout the basin, many private wells that provide water for individual landowners are exempt from the water rights permitting process. The number of wells in 1999 was estimated to be 250. The overall effect of water withdrawals from private and individual water supply withdrawals on groundwater levels is partially mitigated because a portion of the water returns to the ground as infiltration or septic flow from drain fields.

5.2.1.3 Puget Sound Salmon Recovery

In order to support the recovery of salmon populations throughout the Pacific Northwest, NMFS has delineated three recovery domains, or geographic recovery planning areas, for the salmon and steelhead populations listed under the ESA. The three domains are PS, Willamette/Lower Columbia, and Interior Columbia. The recovery plans developed for each domain are intended to meet ESA requirements and to adhere to consistent scientific principles but they will vary widely because the environmental conditions for each domain are substantially different and because the plans will be based on local initiatives.

The Clark Springs System is within the PS salmon recovery planning domain, which includes the western slopes of the Cascade Mountains, the San Juan Islands, Hood Canal, and a northern portion of the Olympic Peninsula. Recovery efforts in the PS domain address three ESA-listed ESUs of salmon: PS Chinook, Hood Canal summer chum, and Lake Ozette sockeye. Puget Sound steelhead were listed in May 2007 and recovery efforts for steelhead will be included in the Puget Sound domain.

Recovery planning in the Puget Sound domain is being conducted by NMFS in conjunction with a coalition of salmon management interests called the Shared Strategy for Puget Sound (Shared Strategy). It includes NMFS, USFWS, the Washington State Governor's Office, Puget Sound treaty tribes, Washington State natural resources agencies, local governments, and non-governmental organizations.

The Puget Sound Chinook Salmon Recovery Plan was adopted by NMFS in January 2007, and states its long-term goal as "to achieve self-sustaining levels of PS Chinook numbers, distribution and diversity (Shared Strategy for Puget Sound 2007)." A PS Chinook salmon recovery plan was then developed for the 12 major watersheds around Puget Sound, including the Lake Washington/Cedar/Sammamish Watershed. The Chinook Salmon Conservation Plan for the Lake Washington/Cedar/Sammamish Watershed (WRIA-8) was finalized in 2005 and is described in

Subsection 5.3, Land Management and Large-Scale Development Plans Considered in the Cumulative Effects Analysis.

5.3 Land Management and Large-Scale Development Plans Considered in the Cumulative Effects Analysis

This subsection presents a summary of the land use plans and activities that are currently being implemented within the analysis area, as well as those that are likely to be implemented in the future and are likely to result in impacts that are similar in kind or in location to those of the project alternatives.

5.3.1 Cedar River Watershed HCP

The Cedar River Watershed HCP was finalized in 2000 and covers City of Seattle operations in the Cedar River Watershed (cite plan [City of Seattle 1999]). The plan was designed to provide certainty for Seattle's drinking water supply and also to protect and restore habitats for 83 species of fish and wildlife that could be affected by City of Seattle operations. Operations covered by the Cedar River Watershed HCP include land management activities such as timber harvesting, water supply operations such as water withdrawals and management of reservoir levels, and the operation of hydroelectric facilities as long as the conservation measures in the HCP are implemented.

5.3.1.1 Anticipated Environmental Effects

The objectives of the Cedar River Watershed HCP are to implement a beneficial instream flow regime in order to provide high quality habitat for anadromous fish, while reducing the risks of stranding juvenile salmonids and dewatering salmonid redds, in order to assist in the recovery of salmon and steelhead populations in the Cedar River. When combined with the expected short- and long-term outcomes of the City's proposed HCP on salmonids habitat, it is expected that the cumulative effect of the Cedar River Watershed HCP and the City's proposed HCP would be an improvement in overall conditions for listed species of salmon and steelhead in the Cedar River Watershed. A more detailed discussion of potential cumulative effects by resource area is presented in Subsection 5.4, Analysis of Cumulative Effects by Resource Topic.

5.3.2 WRIA-8 Chinook Recovery Plan

Under the Washington Watershed Management Act (Revised Code of Washington [RCW] 90.82), local governments are authorized to participate in watershed planning programs to foster planning for water quantity, water quality, aquatic habitat, and instream flow. Rock Creek is part of the Lake Washington/Cedar/Sammamish Watershed (WRIA-8). The WRIA-8 Chinook Recovery Plan was developed as part of the larger recovery efforts led by NMFS for the Puget Sound region. The WRIA-8 Chinook Recovery Plan contains a list of actions that is based on a scientific framework and includes a proposed approach for implementing these actions over a 10-year period. The actions are intended to restore and protect salmon habitat for three populations of Chinook salmon: Cedar River, North Lake

Washington, and Issaquah. The focuses of the actions intended to improve habitat for PS Chinook salmon returning to the Cedar River are to:

- Protect water quality
- Protect/restore instream flows
- Protect/restore riparian habitat
- Remove/set back levees to restore connections with off-channel habitat
- Restore sources of large wood and add new large wood to restore pool habitat

5.3.2.1 Anticipated Environmental Effects

The actions identified in the WRIA-8 Chinook Recovery Plan are intended to protect and restore water quality, instream flows, and riparian habitat. As the actions identified in the plan are completed, the habitat conditions for PS Chinook salmon, as well as other salmon and steelhead species in the analysis area, are likely to improve. When combined with the expected short- and long-term outcomes of the proposed HCP on salmonids habitat, it is expected that the cumulative effect of the WRIA-8 Chinook Recovery Plan and the proposed HCP would improve conditions for listed species across the cumulative effects analysis area, as compared to historic conditions.

A detailed discussion of the potential cumulative effects of the above watershed management plans by resource area is presented in Subsection 5.4, Analysis of Cumulative Effects by Resource Topic.

5.3.3 Rock Creek Valley Vision

In April 2001, the King County Council adopted the Rock Creek Valley Vision (Vision) as established priorities for voluntary conservation efforts such as public outreach, transfer of development credits (TDC), and a public benefit rating system (PBRS). The Vision was developed by the Friends of Rock Creek, a community advocacy group, and is based on community priorities that were identified for the preservation of the Rock Creek Valley. The Vision relies on voluntary conservation strategies that can be used for the conservation of natural resource lands as a means of protecting wildlife habitat and recreation opportunities in the valley.

The key elements of the Vision are (in order of priority):

- Protection and enhancement of water, fish, and wildlife resources
- Maintenance of forest cover for water and wildlife protection, aesthetics, recreation, and commercial forestry opportunities
- Establishment of a working alliance between King County and private entities in the valley to implement the Vision
- Provision of recreational opportunities

- Preservation and promotion of local historic and cultural sites

By adopting the Vision, the King County Council:

- Endorses the use of TDC, PBRS, and public/private partnerships to voluntarily preserve forestry, salmon habitat, and open space in the Rock Creek Valley
- Directs the [King County] executive to complete a targeted public outreach program to encourage Rock Creek Valley landowners to participate in county incentive programs (e.g., TDC, PBRS)
- Authorizes the executive to seek and endorse grants to preserve forestry, salmon habitat, and open space by purchasing development rights or fee-simple interests from sellers in the Rock Creek Valley
- Authorizes the executive to submit funding applications to the King County conservation futures citizen oversight committee to assist in the acquisition of development rights or fee-simple interests of priority properties identified in the Vision
- Directs the executive to encourage and support city-sponsored applications to the King County conservation futures citizen oversight committee when a city accepts residential densities from the Rock Creek Valley through the TDC program

5.3.3.1 Anticipated Environmental Effects

Though implementation of the Vision is voluntary, it provides a guide for recovery efforts in the Rock Creek Watershed. As the opportunities to implement the Vision arise in the Rock Creek Watershed, there will be gradual improvement to habitat conditions that would benefit fish and wildlife species in the Rock Creek basin. If TDCs and property acquisition were pursued, new development in the watershed would be directed away from key habitat areas. When combined with the expected short- and long-term outcomes of the proposed HCP on salmonids habitat, it is expected that the cumulative effect of changes to land development patterns proposed in the Rock Creek Valley Vision and habitat improvement proposed in the proposed HCP would result in improved conditions for salmon in lower Rock Creek.

A detailed discussion of the potential cumulative effects of the Rock Creek Valley Vision by resource area is presented in Subsection 5.4, Analysis of Cumulative Effects by Resource Topic.

5.3.4 King County Comprehensive Plan

The Washington State Growth Management Act (GMA), passed in 1990, requires State and local governments to manage Washington's growth by identifying and protecting critical areas and natural resource lands, designating urban growth areas, preparing comprehensive plans, and implementing the plans through capital investments and development regulations.

The King County Comprehensive Plan (KCCP) is the guiding policy document for all land use and development regulations in unincorporated King County, and for regional services throughout the county, including transit, sewers, parks, trails, and open space. In 2007, King County began an update of the KCCP. The Public Review Draft of the 2008 KCCP Update was published in September 2007 and the Update was completed in late 2008.

The KCCP defines rural areas as lands in King County that are outside the Seattle Metro Urban Growth Area (UGA); therefore, the vast majority of the analysis area is considered as rural area. Chapter 3 of the KCCP, Rural Area and Natural Resource Lands, establishes the county policies directing development in Rural and Natural Resource Lands. The GMA, Countywide Planning Policies, and King County's policies and regulations call for protecting rural areas by limiting housing densities. The KCCP includes policies to protect other characteristics of rural areas such as streams, wetlands, and wildlife habitat; open vistas, wooded areas and scenic roadways; and a reliance on minimal public services.

The Draft 2008 KCCP Update includes several land use designation changes that would occur just outside the Rock Creek basin boundary but none that would alter the future development of the Rock Creek basin.

5.3.4.1 Anticipated Environmental Effects

The KCCP is intended to allow for planned development in the rural areas of the county and to balance development pressures in the analysis area with resource protection and land conservation. As discussed in Subsection 4.2, Land Use and Ownership, the implementation of the proposed HCP would include the construction of fish passage improvements at the mouth (HCM-1) and off-channel habitat enhancements (HCM-3 and HCM-4) on land owned by King County. The planned HCMs would be consistent with the land use designations for the property.

Although the KCCP and its associated zoning ordinances (Title 21A) require new development within the watershed to protect natural resource lands, new development or other changes from the existing land uses have the potential to affect resources considered in this EIS, including water quality, water quantity, and fish and aquatic habitats. When combined with the expected short- and long-term outcomes of the City's proposed HCP on salmonids habitat, it is expected that the cumulative effect of additional the King County Comprehensive Plan and the proposed HCP would result in a reduction in surface water flows in Rock Creek. A detailed discussion of potential cumulative effects by resource area is presented in Subsection 5.4, Analysis of Cumulative Effects by Resource Topic.

5.4 Analysis of Cumulative Effects by Resource Topic

5.4.1 Land Use and Ownership

As described in Subsection 4.2, Land Use and Ownership, implementation of the proposed HCP would not result in land use changes or create any land use compatibility impacts. Land uses present in the analysis area would not change as a result of the Proposed Action. Therefore, the proposed HCP would not contribute to any cumulative effects caused by changes in land use that may occur as a result of other past, present, or future projects in the analysis area.

5.4.2 Soils and Geology

As described in Subsection 4.3, Geology and Soils, the implementation of the proposed HCP would cause minimal soil disturbance during covered construction activities at the Clark Springs Facility and construction of fish mitigation measures at the mouth of Rock Creek. Any soil impacts would be minor and temporary and would not result in long-term impacts to the existing geologic and soil conditions in the Rock Creek Watershed. Therefore, the proposed HCP would not contribute to any cumulative effects to soil or geologic stability that may occur as a result of other past, present, or future projects in the analysis area.

5.4.3 Air Quality

As described in Subsection 4.4, Air Quality, the implementation of the proposed HCP would not result in the creation of additional permanent sources of regulated air quality contaminants. Air quality in the analysis area would not change as a result of the Proposed Action. Therefore, the proposed HCP would not contribute to any cumulative effects to air quality that may occur as a result of other past, present, or future projects in the analysis area.

5.4.4 Noise

As described in Subsection 4.5, Noise, the implementation of the proposed HCP would not result in the creation of additional permanent sources of noise. Baseline noise levels in the analysis area would not change as a result of the Proposed Action. Construction activities at the Clark Springs Facility and construction of fish mitigation measures at the mouth of Rock Creek would result in new temporary and localized sources of noise but they would not contribute to cumulative increases to baseline noise levels that may occur as a result of other past, present, or future projects in the analysis area.

5.4.5 Water Quantity and Water Quality

As described in Subsection 4.6, Water Quantity and Water Quality, the implementation of the proposed HCP would cause water quality conditions to improve or remain the same in Rock Creek downstream of the City's Clark Springs Facility. Increases in surface water flow during periods of augmentation (HCM-1) would help to moderate stream temperature fluctuations and reduce maximum daily temperatures. In addition, aeration of the water returning to Rock Creek would result in small localized increases in dissolved oxygen levels near the outlet of the augmentation pipe. The analysis of surface flows during the period of record suggested that flow augmentation activities under HCM-1 would result in a slight increase to the average annual 7-day low-flow level and shift the typical timing of the low-flow period to earlier in the year. Depending upon the precipitation year type, water quality and quantity in Rock Creek would either improve or remain the same as a result of the Proposed Action compared to the No-action Alternative.

Rural development in the upper Rock Creek Watershed would be governed by the KCCP. Most of the land in the upper watershed where development is allowed is designated by the KCCP as Rural Residential lands. Development on Rural Residential lands would occur at lower densities than on non-rural lands, ranging from one unit per 2.5 acres (RA-2.5) to one unit per 20 acres (RA-20). King County development code requires that all new development in rural areas be served by an adequate public or private water supply system (King County Code 21A.28.040). In the rural areas of the Rock Creek Watershed there are no existing public water supply systems; therefore, all new development would likely be served by private on-site water supply systems (wells). Consumptive water uses in the upper watershed reduce the amount of groundwater that reaches the shallow aquifer under the Clark Springs Facility, resulting in lower flows in Rock Creek and a delay in the annual fall recharge of the aquifer. Additional development in the upper watershed would further reduce the available groundwater reaching the shallow aquifer under the Clark Springs Facility. The City's withdrawals would contribute to cumulative effects on surface water flows in Rock Creek that could occur as a result of existing and future development in the rural areas of the upper Rock Creek basin.

5.4.6 Vegetation

As described in Subsection 4.7, Vegetation, the implementation of the proposed HCP would cause some changes to the existing vegetation from covered construction at the Clark Springs Facility and at the HCM sites between the Clark Springs Facility and the mouth of Rock Creek. Vegetation impacts would be minor and, in the cases of proposed off-channel enhancements near the mouth (HCM-3 and HCM-4), wetland vegetation would likely be enhanced. Overall the changes to vegetation in the action area would be minor and would not result in impacts to existing vegetation conditions in the Rock Creek Watershed. Therefore, the proposed HCP would not contribute to any cumulative effects to vegetation that may occur as a result of other past, present, or future projects in the analysis area.

5.4.7 Fish and Aquatic Habitat

As described in Subsection 3.8.3.1, Historic Influences on Fish Habitat Conditions, a wide variety of past activities have contributed to the habitat conditions and population status of ESA-listed salmonids and other fish species that could potentially use Rock Creek and the wider Cedar River Watershed. Some of these activities include ground and surface water withdrawals, logging, transportation networks, urban and residential development, fishing, and hatcheries. Subsection 3.8.3.2, Current Fish Habitat Conditions, describes the current fish habitat conditions in Rock Creek within and downstream of the Clark Springs Facility as being relatively good in terms of water quality, riparian and instream large wood conditions, and sediment composition, but limited in terms of passage conditions and the availability of off-channel and adult holding habitat. In Subsection 4.8, Fish and Aquatic Habitat, the City's water withdrawal operations at the Clark Springs Facility is described as having contributed to habitat conditions in Rock Creek during low-flow periods that affect the migration and rearing habitat for anadromous species. Other operations, infrastructure and maintenance activities on the Clark Springs Watershed under both the No-action Alternative and the Proposed Action have minor or no contribution to the historical and current activities affecting habitat conditions in Rock Creek within and downstream of the Clark Springs Facility. The HCMs included in the proposed HCP would partially mitigate impacts from water withdrawals at the Clark Springs Facility to salmon and steelhead habitat by improving habitat conditions in lower Rock Creek.

The Cedar River Watershed HCP is intended provide a beneficial instream flow regime in order to provide high quality fish habitat for anadromous fish, while reducing the risks of stranding juvenile salmonids and dewatering salmonid redds in order to assist in the recovery of salmon and steelhead populations in the Cedar River. The beneficial effects that will result from implementation of the Cedar River Watershed HCP will contribute to the cumulative effect of improved conditions for salmon and steelhead in the Cedar River Watershed that would occur with the implementation of the proposed HCP.

The WRIA-8 Chinook Recovery Plan identifies actions to protect and restore Chinook populations in the Lake Washington/Cedar/Sammamish Watershed. The goals of the plan identified for the Cedar River are listed above in Subsection 5.3.2, WRIA-8 Chinook Recovery Plan, and are similar, if not identical, to goals for the HCMs that would be implemented under the proposed HCP. Because the HCMs would support the goals of the WRIA-8 Chinook Recovery Plan, the proposed HCP would contribute to the cumulative effects of the WRIA-8 recovery efforts and to the Puget Sound recovery efforts discussed in Subsection 5.2.1, Context for the Analysis.

Rural development in the upper Rock Creek Watershed would be governed by the KCCP. Under both No-action Alternative and the Proposed Action, the Clark Springs Watershed is protected from future development. However, most of the land in the upper watershed, where development is allowed, is designated as Rural Residential in the KCCP. Development on these lands would have to occur at lower densities, ranging from one unit per 2.5 acres (RA-2.5) to one unit per 20 acres (RA-20). King County development code requires that all new development in rural areas be served by an adequate public or private water supply system (King County Code 21A.28.040). In the rural areas of the Rock Creek Watershed there are no existing public water supply systems; therefore, all new development would likely be served by private on-site water supply systems. As discussed in Subsection 5.2.1 Context for the Analysis, additional withdrawals in the upper watershed could reduce the amount of subsurface groundwater flow that provides water to the shallow aquifer under the Clark Springs Facility. If future development in the upper basin increases the consumptive uses of groundwater discussed in Subsection 5.2.1, Context for the Analysis, and reduces the amount of subsurface groundwater flow reaching the Clark Springs Facility, ongoing water withdrawals under both the No-action Alternative and the Proposed Action could contribute to the cumulative negative effect on surface water flows in Rock Creek resulting in impacts to fish and aquatic habitat in Rock Creek.

5.4.8 Wildlife

As described in Subsection 4.9, Wildlife, the implementation of the proposed HCP would cause some changes to existing wildlife habitat. The changes to wildlife habitat would mostly occur at the mouth of Rock Creek and would primarily benefit wildlife species that use the wetland and riparian areas. Therefore, the proposed HCP would not contribute to any cumulative effects to wildlife or wildlife habitat that may occur as a result of other past, present, or future projects in the analysis area.

5.4.9 Historic and Cultural Resources

Cultural resources in the Cedar River Watershed have experienced long-term cumulative losses as a result of urbanization, rural development, natural resource extraction operations, recreation, and other modern human activities. As described in Subsection 4.10, Historic and Cultural Resources, the implementation of the proposed HCP would include some ground-disturbance activities in areas identified as archaeologically sensitive.

Adverse impacts to archaeological resources under the Proposed Action would be avoided or minimized through compliance with Washington State laws under SEPA, which provides for avoidance or minimization of adverse impacts through identification of archaeological resources prior to ground disturbance following guidelines published by the Washington Department of Archaeology and Historic Preservation. Based on the outcome of field investigations, a plan for the unanticipated discovery of archaeological resources during implementation of HCMs may also be appropriate. Therefore, the proposed HCP is not expected to contribute to the cumulative impacts to cultural resources that may occur as a result of other past, present, or future projects in the analysis area.

5.4.10 Social and Economic Conditions

The implementation of the proposed HCP would require the City to invest $2.6 million in order to carry out the HCMs described in the proposed HCP. As described in Subsection 4.11, Socioeconomics and Environmental Justice, this investment would require the City to increase water rates 0.65 percent per year over the 50-year period for the ITPs. As part of the cumulative effects analysis, the City identified current and reasonably foreseeable capital improvement projects that are, either individually or collectively, also likely to require a water rate increase.

<u>Guiberson Corrosion Control ($1,210,000)</u>

The City plans to construct a new sodium hydroxide treatment facility near the existing Guiberson reservoir. The project will use sodium hydroxide to adjust the pH of blended Kent Springs and Tacoma Green River Supply water to maintain compliance with the Safe Drinking Water Act. The addition of sodium hydroxide will also raise the pH of the drinking water in order to reduce corrosion of the copper pipes that deliver water to end users. Construction is expected to begin in 2009.

Water Tank Mixing Systems ($305,000)

The City is planning to install three new mixing systems at the 3.5 MG Tank, Blue Boy Tank, and 98th Avenue Tank reservoirs. These above-ground storage tanks have common inlet/outlets with low cycling of water. Low cycling of water leads to a lower chlorine level that creates the potential of "re-growth" from disinfection byproducts with the introduction of surface water from the Tacoma Green River supply. The mixers are intended to maintain adequate chlorine levels in the tanks. The City expects the mixers to be installed by 2012.

Tacoma Intertie ($30,000,000)

The TSSP project will provide the City of Tacoma, Lakehaven, Covington Water District, and the City with a second water supply pipeline by diverting water from the Green River. The City completed the necessary infrastructure improvements to receive TSSP water in 2008.

Pump Station #3 ($721,572)

The City will replace Pump Station #3, which was found to be vulnerable to earthquake damage during a seismic study of the Kent Water System. Construction of the new pump station is anticipated to begin in 2011.

Storage Capacity Expansion ($6,000,000-$10,000,000)

In 2002, as part of the update to the City's Water System plan, the City conducted a storage analysis and determined that two new storage facilities would be needed. As a result the City is planning to construct two new reservoirs, one at East Hill and one at West Hill. The East Hill Reservoir will have a 7-million-gallon capacity, with construction beginning in 2013. The West Hill Reservoir project will include a 2-million-gallon reservoir, transmission main, and pump stations. Detailed planning for this project has not begun and no construction date has been established.

18" Water Main to East Hill Reservoir ($1,100,000)

The City plans to install an 18-inch-diameter pipeline from its existing distribution system to the site of the new East Hill Reservoir. The proposed alignment will be .5-mile long and follow SE 248th Street from 116th Avenue SE to approximately the 12500 block of SE 248th Street before heading south to the East Hill Reservoir site. Construction of this project is expected to begin in 2009.

East Hill Maintenance Facility ($11,000,000)

The City's existing Public Works Maintenance facility located at SE 240th Street and Russell Road is undersized and cannot accommodate the City's current and future maintenance operations. The City is planning to construct a new maintenance facility that will be used by all the City departments that conduct maintenance activities. The water department expects to contribute $11 million of the total project costs of $50 million. Construction is expected to begin in 2009 to 2010.

Update Water Comprehensive Plan ($500,000)

The DOH requires water purveyors to update their water comprehensive plans every 6 years. The City's updated plan was submitted to the DOH in 2008.

Earthworks Well ($250,000)

This project consists of multiple improvements to the City's earthworks well, including a structure, telemetry, and new transmission piping. A construction date has not been determined.

Groundwater Rule at East Hill Well ($150,000)

The Safe Drinking Water Act requires water purveyors to meet contact time requirements (the time between when a disinfectant is added to source water and when it reaches the first downstream customer tap). If it is determined that the City does not meet this requirement for its East Hill Well source, the budgeted money will be used for the improvements necessary to do so. If construction is needed, it is anticipated to be between 2011 and 2013.

East Hill Water Supply Assessment ($200,000)

This project is a study of sensitivity of the City's East Hill source aquifers. The study was completed in 2008.

Kent Springs Transmission Main Repair ($250,000)

This project consists of repairing a small leak on the City's Kent Springs Transmission Main. Construction is anticipated in 2009.

Seismic System Controls ($100,000)

This project is to study and construct improvements of a seismic isolation valve on one of the City's 240 pressure zone reservoirs. No date has been set for this study.

Miscellaneous Water ($340,000)

This is a project fund that is used by the City to replace distribution piping. Piping is replaced because of lack of fire flow and age. Construction is done every year.

Kent-Kangley Road Repair ($350,000)

This project was completed in 2007. It consisted of repairing and overlaying Kent-Kangley Road through the Clark Springs Watershed.

Kent-Kangley Bridge Replacement ($100,000)

The $100,000 budgeted in 2012 is to evaluate replacing the bridge. Within the last 2 years, significant repairs were made to the bridge. At this time, it is not known when the bridge will require replacement.

Based on the City's current cost estimates, the cost of current and future capital improvement projects related to maintain the City's water supply system totals $56,326,572. The total amount expected to be spent for the implementation of the proposed HCP over the 50-year duration of the ITPs is $2.6 million. Because the total cost related to the City's implementation of the proposed HCP is 5 percent of the expected capital improvements related to maintaining the City's water supply system the effect of the proposed project on water rates would not be significant.

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APPENDIX A

List of Common Wildlife Species
Reported to Occur in the Rock Creek Drainage

APPENDIX A

Other common wildlife species reported to occur in the Rock Creek Drainage (Friends of Rock Creek 2004) and their association with habitat cover types located in the analysis area. Habitat associations are classified for wildlife use for breeding (B) and feeding (F). Habitat associations are based on information in Johnson and O'Neil (2001) and Brown (1985).

Common Name	Scientific Name	Habitat Types					
		Stream	Second-growth Forest	Shrub	Grass/forb	Palustrine forested wetland	Palustrine emergent-palustrine scrub/shrub wetland
AMPHIBIANS							
Northwestern Salamander	*Ambystoma gracile*	B, F	F	F	F	B, F	B, F
Long-toed Salamander	*Ambystoma macrodactylum*	B, F	F	F	F	B, F	B, F
Pacific Giant Salamander	*Dicamptodon tenebrosus*	B, F	F	F	F	B, F	B, F
Rough-skinned Newt	*Taricha granulose*	B, F	F	F	F	B, F	B, F
Western Red-backed Salamander	*Plethodon vehiculum*	B, F	B, F	B, F		B, F	
Ensatina	*Ensatina eschscholtzii*	B, F	B, F	B, F	B, F	B, F	B, F
Pacific Chorus (Tree) Frog	*Pseudacris regilla*	B, F	F	F	F	B, F	B, F
Red-legged Frog	*Rana aurora*	B, F	F	F	F	B, F	B, F
Bullfrog	*Rana catesbeiana*	B, F	F	F	F	B, F	B, F
REPTILES							
Rubber Boa	*Charina bottae*		B, F	B, F	B, F	B, F	B, F
Western Terrestrial Garter Snake	*Thamnophis elegans*		B, F	B, F	B, F		B, F
Northwestern Garter Snake	*Thamnophis ordinoides*			B, F	B, F		B, F
Common Garter Snake	*Thamnophis sirtalis*		B, F	B, F	B, F		B, F

Common Name	Scientific Name	Habitat Types					
		Stream	**Second-growth Forest**	**Shrub**	**Grass/forb**	**Palustrine forested wetland**	**Palustrine emergent-palustrine scrub/shrub wetland**
BIRDS							
Great Blue Heron	*Ardea Herodias*	F	B			B	F
Turkey Vulture	*Cathartes aura*	F		B, F	B, F		B, F
Canada Goose	*Branta Canadensis*	F					B, F
Wood Duck	*Aix sponsa*	F	B, F			B, F	F
Mallard	*Anas platyrhynchos*	F					B, F
Osprey	*Pandion haliaetus*	F	B			B	F
Sharp-shinned Hawk	*Accipiter striatus*		B, F	F	F	B, F	
Red-tailed Hawk	*Buteo jamaicensis*		B	F	F	B	F
Golden Eagle	*Aquila chrysaetos*			F	F		F
American Kestrel	*Falco sparverius*		B	F	F	B	F
Ruffed Grouse	*Bonasa umbellus*		B, F	B, F	F	B, F	B, F
California Quail	*Callipepla californica*			B, F	B, F		B, F
Northern Bobwhite	*Colinus virginianus*			B, F	B, F		
American Coot	*Fulica Americana*	F					B, F
Killdeer	*Charadrius vociferous*						B, F
Spotted Sandpiper	*Actitis macularia*						B, F
Rock Dove	*Columba livia*				F		
Band-tailed Pigeon	*Columba fasciata*		B, F	F	F	B, F	F
Mourning Dove	*Zenaida macroura*		B	B, F	F	B	B, F
Great Horned Owl	*Bubo virginianus*		B, F	F	F	B, F	F

Common Name	Scientific Name	Habitat Types					
		Stream	Second-growth Forest	Shrub	Grass/forb	Palustrine forested wetland	Palustrine emergent-palustrine scrub/shrub wetland
Northern Saw-whet Owl	*Aegolius acadicus*		B, F	F	F	B, F	F
Common Nighthawk	*Chordeiles minor*	F	F	B, F	B, F	F	B, F
Vaux's Swift	*Chaetura vauxi*	F	B, F	F	F	B, F	F
Rufous Hummingbird	*Selasphorus rufus*		B, F	B, F	F	B, F	B, F
Belted Kingfisher	*Ceryle alcyon*	F				F	F
Red-breasted Sapsucker	*Sphyrapicus ruber*		B, F			B, F	
Downy Woodpecker	*Picoides pubescens*		B, F			B, F	
Hairy Woodpecker	*Picoides villosus*		B, F			B, F	
Northern Flicker	*Colaptes auratus*		B, F	F	F	B, F	F
Pileated Woodpecker	*Dryocopus pileatus*		B, F		F	B, F	
Olive-sided Flycatcher	*Contopus cooperi*		B, F			B, F	
Western Wood-pewee	*Contopus sordidulus*		B, F	F		B, F	B, F
Willow Flycatcher	*Empidonax traillii*			B, F	F	B, F	B, F
Hammond's Flycatcher	*Empidonax hammondii*		B, F			B, F	F
Pacific-slope Flycatcher	*Empidonax difficilis*		B, F			B, F	
Cassin's Vireo	*Vireo cassinii*		B, F			B, F	
Hutton's Vireo	*Vireo huttoni*		B, F	B, F		B, F	B, F
Warbling Vireo	*Vireo gilvus*		B, F	B, F		B, F	B, F
Red-eyed Vireo	*Vireo olivaceus*		B, F	B, F		B, F	
Steller's Jay	*Cyanocitta stelleri*		B, F	F		B, F	F
American Crow	*Corvus brachyrhynchos*		B, F	F	F	B, F	B, F

Common Name	Scientific Name	Habitat Types					
		Stream	Second-growth Forest	Shrub	Grass/forb	Palustrine forested wetland	Palustrine emergent-palustrine scrub/shrub wetland
Common Raven	*Corvus corax*		B, F	F	F	B, F	F
Tree Swallow	*Tachycineta bicolor*	F	B, F	F	F	B, F	F
Violet-green Swallow	*Tachycineta thalassina*	F	B, F	F	F	B, F	F
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	F				F	F
Bank Swallow	*Riparia riparia*	F				F	F
Cliff Swallow	*Petrochelidon pyrrhonota*	F			F	F	
Barn Swallow	*Hirundo rustica*	F		F	F		F
Black-capped Chickadee	*Poecile atricapilla*		B, F	F		B, F	F
Chestnut-backed Chickadee	*Poecile rufescens*		B, F	F		B, F	F
Bushtit	*Psaltriparus minimus*		B, F	B, F			
Red-breasted Nuthatch	*Sitta Canadensis*		B, F			B, F	
Brown Creeper	*Certhia Americana*		B, F			B, F	
Bewick's Wren	*Thryomanes bewickii*		B, F	B, F		B, F	B, F
Winter Wren	*Troglodytes troglodytes*		B, F			B, F	
Marsh Wren	*Cistothorus palustris*						B, F
American Dipper	*Cinclus mexicanus*	B, F					
Golden-crowned Kinglet	*Regulus satrapa*		B, F	F		B, F	F
Swainson's Thrush	*Catharus ustulatus*		B, F	B, F		B, F	B, F
American Robin	*Turdus migratorius*		B, F	B, F	F	B, F	B, F
Varied Thrush	*Ixoreus naevius*		B, F	F		B, F	F
European Starling	*Sturnus vulgaris*		B	F	F	B	F

Common Name	Scientific Name	Habitat Types					
		Stream	Second-growth Forest	Shrub	Grass/forb	Palustrine forested wetland	Palustrine emergent-palustrine scrub/shrub wetland
Cedar Waxwing	*Bombycilla cedrorum*		B, F	B, F		B, F	B, F
Orange-crowned Warbler	*Vermivora celata*			B, F		B, F	B, F
Yellow Warbler	*Dendroica petechia*		B, F	F	F	B, F	B, F
Yellow-rumped Warbler	*Dendroica coronate*		B, F	B, F		B, F	B, F
Black-throated Gray Warbler	*Dendroica nigrescens*		B, F	F		B, F	F
Townsend's Warbler	*Dendroica townsendi*		B, F			B, F	
Macgillivray's Warbler	*Oporornis tolmiei*		B, F	B, F		B, F	B, F
Common Yellowthroat	*Geothlypis trichas*						B, F
Wilson's Warbler	*Wilsonia pusilla*		B, F	B, F	F	B, F	B, F
Western Tanager	*Piranga ludoviciana*		B, F	F		B, F	F
Spotted Towhee	*Pipilo maculates*		B, F	B, F	F	B, F	B, F
Chipping Sparrow	*Spizella passerine*		B, F	B, F	F	B, F	B, F
Savannah Sparrow	*Passerculus sandwichensis*				B, F		B, F
Song Sparrow	*Melospiza melodia*			B, F	F		B, F
White-crowned Sparrow	*Zonotrichia leucophrys*			B, F	B, F		B, F
Dark-eyed Junco	*Junco hyemalis*		B, F	B, F	F	B, F	B, F
Black-headed Grosbeak	*Pheucticus melanocephalus*		B, F	B, F		B, F	B, F
Red-winged Blackbird	*Agelaius phoeniceus*						B, F
Western Meadowlark	*Sturnella neglecta*				B, F		
Brown-headed Cowbird	*Molothrus ater*		B	B, F	F	B	B, F
Purple Finch	*Carpodacus purpureus*		B, F	F	F	B, F	F

Common Name	Scientific Name	Habitat Types					
		Stream	Second-growth Forest	Shrub	Grass/forb	Palustrine forested wetland	Palustrine emergent-palustrine scrub/shrub wetland
House Finch	*Carpodacus mexicanus*		B	B, F	F	B	B, F
Red Crossbill	*Loxia curvirostra*		B, F			B, F	
Pine Siskin	*Carduelis pinus*		B, F	F	F	B, F	F
American Goldfinch	*Carduelis tristis*		B	B, F	F	B	B, F
Evening Grosbeak	*Coccothraustes vespertinus*		B, F	F		B, F	B, F
House Sparrow	*Passer domesticus*						
MAMMALS							
Virginia Opossum	*Didelphis virginiana*		B, F	B, F	B, F	B, F	B, F
Masked Shrew	*Sorex cinereus*		B, F	B, F	B, F	B, F	B, F
Pacific Shrew[2]	*Sorex pacificus*						
Vagrant Shrew	*Sorex vagrans*		B, F	B, F	B, F	B, F	B, F
Water Shrew	*Sorex palustris*	B, F				B, F	B, F
Trowbridge's Shrew	*Sorex trowbridgii*		B, F	B, F		B, F	
Shrew-mole	*Neurotrichus gibbsii*		B, F	B, F	B, F	B, F	B, F
Townsend's Mole	*Scapanus townsendii*			B, F	B, F		B, F
Coast Mole	*Scapanus orarius*		B, F	B, F	B, F	B, F	B, F
Mountain Beaver	*Aplodontia rufa*		B, F	B, F	B, F	B, F	B, F
Townsend's Chipmunk	*Tamias townsendii*		B, F	B, F	B, F	B, F	B, F
Eastern Gray Squirrel	*Sciurus carolinensis*						
Douglas' Squirrel	*Tamiasciurus douglasii*		B, F			B, F	
American Beaver	*Castor Canadensis*	B	F	F		B, F	B, F

Common Name	Scientific Name	Habitat Types					
		Stream	Second-growth Forest	Shrub	Grass/forb	Palustrine forested wetland	Palustrine emergent-palustrine scrub/shrub wetland
Deer Mouse	*Peromyscus maniculatus*		B, F	B, F	B, F	B, F	B, F
Bushy-tailed Woodrat	*Neotoma cinerea*		B, F	B, F	F	B, F	B, F
Townsend's Vole	*Microtus townsendii*			B, F	B, F		B, F
Red Tree Vole[2]	*Arborimus longicaudus*						
Long-tailed Vole	*Microtus longicaudus*			B, F	B, F		B, F
Common Porcupine	*Erethizon dorsatum*		B, F	B, F	F	B, F	B, F
Coyote	*Canis latrans*		B, F	B, F	B, F	B, F	B, F
Black Bear	*Ursus americanus*		B, F	F	F	B, F	F
Raccoon	*Procyon lotor*		B, F	B, F	B, F	B, F	B, F
Ermine	*Mustela ermine*		B, F	B, F	F	B, F	B, F
Long-tailed Weasel	*Mustela frenata*		B, F	B, F	B, F	B, F	B, F
Mink	*Mustela vison*	B, F	B, F	B, F	B, F	B, F	B, F
Striped Skunk	*Mephitis mephitis*			B, F	B, F		B, F
Northern River Otter	*Lutra Canadensis*	B, F	B, F	B, F	B, F	B, F	B, F
Mountain Lion	*Puma concolor*		B, F	B, F	F	F	F
Bobcat	*Lynx rufus*		B, F	B, F	F	B, F	B, F
Roosevelt Elk	*Cervus elaphus roosevelti*		B, F	B, F	F	F	B, F
Black-tailed Deer	*Odocoileus hemionus columbianus*		B, F	B, F	B, F	B, F	B, F

[1] B – species can use habitat type for breeding

F – species can use habitat type for feeding

[2] Species identified as being in the Rock Creek basin does not occur in Washington (Johnson and O'Neill (2001).

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