Stillwater Natural Area
Site Management Guidelines

September 2003

Daryl Grigsby, Division Director

King County Water and Land Resources Division

King County
Department of Natural Resources and Parks
Water and Land Resources Division

Stillwater Natural Area
Site Management Guidelines

CONTENTS

LIST OF TABLES

FIGURES

Acknowledgements

Planning Team:

Michael D. Beevers, Natural Resource Planner, Natural Resource Lands Management Program, King County Department of Natural Resources and Parks (DNRP).

Kirk Anderson, Snoqualmie Basin Steward, Land and Water Stewardship Services, King County DNRP.

Mike Crandell, Resource Coordinator, Parks and Recreation Division, King County DNRP.

Tina Miller, Volunteer Coordinator, Program Project Manager, Natural Resource Lands Management Program, King County DNRP.

Report produced by:

Natural Resource Lands Management Program
Office of Rural and Resource Programs
King County Department of Natural Resources and Parks
201 South Jackson Street, Suite 600
Seattle, WA 98104-3855
(206) 263-3723

Suggested citation for this report:

King County. 2003. Stillwater Natural Area Site Management Guidelines. King County Department of Natural Resources and Parks, Water and Land Resources Division. Seattle, Washington.

Executive Summary

Stillwater Natural Area is a King County Department of Natural Resources and Parks Ecological Land managed for the protection of ecological values and where appropriate public access. The Stillwater Natural Area is located approximately four miles north of the City of Carnation and four miles south of the City of Duvall in unincorporated King County. The 44-acre property borders the Snoqualmie River and the Snoqualmie Valley Trail and lies within the Snoqualmie Agricultural Production District. The site is adjacent to 91-acres of privately owned land upon which King County holds a conservation easement as well as Washington State Department of Fish and Wildlife lands. Stillwater Natural Area contains predominantly pasturelands with smaller areas of forested wetlands and upland deciduous forest.

The Stillwater Natural Area and accompanying conservation easements were purchased in 1994 to protect and preserve the open space and agricultural characteristics of the site, to conserve the integrity of the Snoqualmie Valley Trail corridor and to provide public access to the Snoqualmie River. The site was purchased with funding from the 1993 Regional Conservation Futures Tax Levy.

Stillwater Natural Area contains significant habitat for a variety of fish and wildlife species. The Snoqualmie River just upstream from the Stillwater Natural Area sustains runs of chinook salmon, which are listed as threatened under the federal Endangered Species Act (ESA). The site is identified as a wildlife habitat corridor in the King County Comprehensive Plan and offers habitat for a variety of birds, mammals and amphibians.

Stillwater Natural Area supports a relatively low number of visitors engaged in recreational activities such as nature observation, fishing, swimming and boating. No formal public trails exist on the site, although pedestrians can access the site from the Snoqualmie Valley Trail. The level of public use appears to have no adverse effect on the ecological resources of the site. No vehicular access or parking area exists, although some visitors park along the shoulder of Carnation-Duvall Road NE.

The goals for the Stillwater Natural Area are: 1.) to conserve and enhance ecological value, and 2.) accommodate appropriate public uses that do not harm ecological resources. The following are planning and management recommendations that are designed to support these goals.

- Implement preserve and protect measures to limit inappropriate public use in rare and sensitive areas.
- Monitor public use, types of use and impacts on the ecological systems to inform management decisions.
- Complete comprehensive biological inventory to provide thorough baseline information.
- Plant native trees and shrubs and control noxious, invasive and non-native plant species to enhance natural floodplain conditions.
- Retain interior pasturelands in agriculture.
- Seek funding sources and grants for enhancement projects.
- Acquire adjacent properties to establish greater habitat connectivity while considering the impact on neighboring lands.

Stillwater Natural Area Site Management Guidelines

Introduction

Stillwater Natural Area is a King County Department of Natural Resources and Parks (DNRP) Ecological Land. Ecological Lands are a category of Water and Land Resources Division (WLRD) properties managed for the protection of their ecological value. Appropriate public access and educational opportunities are accommodated on these sites where they do not harm the ecological value of the site.

This document provides general property and acquisition information, a description of existing site conditions, a site analysis and a list of management objectives and recommendations for Stillwater Natural Area. These site management guidelines were developed using guidance established in the King County Ecological Lands Handbook (2003).

Part 1. General Property Information

Stillwater Natural Area is a narrow 44-acre corridor located approximately four miles north of the City of Carnation and four miles south of the City of Duvall in unincorporated King County along Carnation Duvall Rd NE. The site borders the Snoqualmie River over a discontinuous 1.4 mile stretch from River Mile (RM) 19.8 to RM 18.4 and lies within the Snoqualmie River's 100-year floodplain (King County Department of Parks, Planning and Resources, 1990). The Snoqualmie Valley Trail borders the Stillwater Natural Area to the north. The site contains a combination of pasturelands, wetlands and mature deciduous forest cover.

Stillwater Natural Area is primarily divided into three distinct sections bordered by privately owned parcels upon which King County holds conservation easements, the Snoqualmie Valley Trail and Washington State Department of Fish and Wildlife lands. The western section of the Stillwater Natural Area is primarily a forested wetland on a pronounced bend in the Snoqualmie River. The center section of the site is predominantly forested wetlands with lesser portions of upland forest and open water. The eastern section of the Stillwater Natural Area is pasturelands dominated by pasture grasses. Weiss Creek runs through the Stillwater Natural Area and a levee system extends for most of the site along the banks of the Snoqualmie River.

On 91-acres adjacent to the Stillwater Natural Area King County owns a conservation easement. The privately owned easement property is not included as part of the Stillwater Natural Area but is an integral component of the ecological land unit. The easement property contains a small house and is primarily pastureland used for grazing of horses and mules.

The Stillwater Natural Area is zoned A-35 in accordance with the 2000 King County Comprehensive Plan. The zoning designation refers to agricultural land use with a minimum lot size of 35-acres. The purpose of the agricultural zone (A) is to preserve and protect irreplaceable and limited supplies of farmland well suited for agricultural uses by their location, geological formation and chemical and organic composition and to encourage environmentally sound agricultural production. The Stillwater Natural Area lies within the Snoqualmie Agricultural Production District (APD).

The APD was designated under the requirements of the Washington Growth Management Act (GMA) as "agricultural lands that are not already characterized by urban growth and that have long-term significance for the commercial production of food or other agricultural purposes. Under the GMA "a county or a city may use a variety of innovative zoning techniques in areas designated as agricultural lands of long-term commercial significance to conserve agricultural lands and encourage the agricultural economy. The GMA also states that the non-agricultural uses should be encouraged in the APD on lands with poor soils or other wise no suitable for agricultural purposes.

Land use in the Upper Snoqualmie Basin above Snoqualmie Falls is varied. Much of the upper watershed area contains National Forest lands, land managed by Washington State Department of Natural Resources and land that is primarily managed for timber by private companies. A majority of the watershed has been logged since the turn of the 20th century with little or no old growth forest remaining except in those areas set aside as reserves such as the Alpine Lakes Wilderness. As King County continues to grow, several cities in the upper basin will have expanding commercial and residential development.

The lower Snoqualmie River below the falls is largely dominated by agricultural land use (70.4%) and rural residential land use (22.2%) (Solomon and Boles, 2002). The valley floodplain passes through the communities of Fall City, Carnation and Duvall. While these communities have historically supported rural land use activities such as agriculture, both urban land use and population are increasing. Between 1980 and 2000, the population in the Snoqualmie Basin nearly doubled, from just under 20,000 to approximately 40,000 residents. The Puget Sound Regional Council (2001) predicts that the population will further increase to over 70,000 residents by 2020. Private timber companies also intensively harvest trees in the Raging River, Tolt River, Griffin Creek and Tokul Creek watersheds (King County Department of Natural Resources, 2001).

Table 1. Stillwater Natural Area General Information.

Best Available Address	Carnation-Duvall Rd NE and NE Stillwater Hill Rd, Carnation
Thomas Guide Map Location	Pages 538 and 539
Legal Description	Section 31, Township 26 N, Range 7 E
Acreage	44.19-acres
Drainage Basin	Snoqualmie River
WRIA	7
Council District	3
King County Sensitive Areas	100-year floodplain, wetlands, erosion hazard, channel migration zone

Table 2. Stillwater Natural Area and Conservation Easement Parcel Information.

Parcel Number	Acreage*	Recording Number	Purchase Date	Ownership type/price	Previous Names	Zoning	Funding Source
3126079010	6.31	9410121535	10/07/1994	Owned in Fee $12,000	Weiss - bend	A-35 APD	1993 Regional Conservation Futures Snoqualmie / Stillwater Project
3126079017	18.18	9402182065	1/25/1994	Owned in Fee $102,000	Weiss	A-35 APD	1993 Regional Conservation Futures
3126079015	19.70	9402182065	1/25/1994			A-35 APD	Snoqualmie / Stillwater Project

Parcel Number	Acreage*	Recording Number	Purchase Date	Ownership type/price	Previous Names	Zoning	Funding Source
3126079014 3126079019 3226079031	91.83	9402182066	1/25/1994	Conservation Easement $136,000	Weiss Easement	A-35 APD	1993 Regional Conservation Futures Snoqualmie / Stillwater Project

*Acreage taken from King County Assessor's data.

Part 2. Acquisition, Funding Source and Deed Restrictions

King County's Parks, Planning and Resources Department initiated the acquisition of the Stillwater Natural Area and the accompanying conservation easements in 1993 for the combination of its prominent location along the Snoqualmie River corridor and its proximity to the highly used Snoqualmie Valley Trail.

The original move to acquire the Stillwater Natural Area (then called the Snoqualmie River / Stillwater Project) envisioned the project scope as:

> The "Snoqualmie River / Stillwater is a 140-acre project that includes 45-acres of fee simple acquisition and 95-acres of less than fee development rights. This project includes obtaining public access to the beach at the large river bend in the Northwest corner of the property" (King County Ordinance No. 11068, 1993).

Initially the property owner agreed to sell King County the fee simple interest in the portion of the property located between the Snoqualmie Valley Trail and the Snoqualmie River. In addition, the property owner agreed to sell a conservation easement on the property between Carnation-Duvall Road NE and the Snoqualmie Valley Trail as well as on the property known as the "good hay field." Although King County made an offer to acquire a public access easement from the trail to the beach in the river bend, the owner declined such offers citing potential use conflicts. Therefore, the original project scope and ordinance were adjusted and the requirement to obtain the public access to the beach was deleted. On February 18, 1994 the final settlement was reached resulting in King County acquiring approximately 35.04 acres of fee simple interest, a 101.53-acre conservation easement but no public access easement. The property was tentatively named the Stillwater Site.

After the initial acquisition, the property owner decided to sell King County the fee simple interest to the wooded westerly portion of the "good hay field" at the bend in the river. This is the original beach access that was desired by the County in the initial Snoqualmie River / Stillwater Project scope but was denied. Since the property was previously under a conservation easement as part of the "good hay field" in the original settlement, the County purchased the remaining fee interest of the 6.71 acres. On October 12, 1994 the County acquired the final 6.71 acres that would make up the Stillwater Site.

The funding for the acquisition of Stillwater Natural Area and the corresponding conservation easements were generated by revenues from the King County Conservation Futures Tax levy (CFT). The levy is addressed in King County Code 26.12, stating that "It shall be the goal of the county to maintain, preserve, conserve, and otherwise continue in existence adequate open space lands and to achieve an equitable geographic distribution of funds from conservation futures over the long term." It also states that there should be "demonstrable regional visibility, use, ecological, cultural, historical or other natural resource significance in CFT funded projects." King County Ordinance 10750 (March 8,1993)

authorized a $60,000,000 bond issuance against future CFT levy revenues to fund a CFT acquisition program called the Conservation Futures 1993 Bond Acquisition Program.

Conservation Futures acquisition criteria include: wildlife, salmonid, or rare plant habitat value; scenic resource, community separator, greenbelt, or general park and open space value; or historic and cultural resources. Additional consideration is given to passive recreation opportunity, interpretive opportunity, threat of loss, complexity of acquisition, public-private partnership, regional significance, relationship of proposed acquisition to existing parks, trails, or greenway systems or plans, and short-term and long-term stewardship commitment at the site (KCC 26.12.025).

Acquisitions made with Conservation Futures funds are to be used for low-impact, passive-use recreation. Motorized use is limited to parking/staging/maintenance areas. "Non-vegetative impervious surfaces" should cover less than 15% of the site. Conservation futures interests shall not be transferred except with agreement that land interests shall be preserved in accordance with the intent and language of RCW 84.34.230; uses of lands shall not be altered unless equivalent lands within the geographic jurisdiction are provided (King County Ordinance No. 10750, 1993).

The conservation easements were purchased by King County for its "natural, scenic, open space, educational and recreational value" and preserves and protects the easement property in perpetuity. Use of the property is permanently restricted to agricultural and open space uses. Agricultural uses permitted include the "growing, raising and production of horticultural and agricultural crops, all forms of domesticated animal husbandry and laying the land fallow. Open space use includes non-agricultural uses that preserve the land in its existing state. The easement prohibits hunting, the cutting of standing trees and the alteration of the agricultural soils. The full conditions of the conservation easement are included in the appendix.

Part 3. Ecological Resources

This section describes the existing natural resources and ecological processes present at Stillwater Natural Area. Further analysis will be provided in Part 6 below.

Topography and Soils

Stillwater Natural Area is predominantly flat and lies within the Snoqualmie River's 100-year floodplain. The maximum elevation is approximately 47 feet above sea level and the minimum is 35 feet above sea level.

The soil survey, King County Area, Washington indicates that soils within the property boundaries are Oridia silt loam, Nooksack silt loam, Puget silty clay loam and riverwash (Snyder et al, 1973). All soils are listed as hydric soils. These soils were developed under conditions representative of floodplain landforms sufficiently wet to support the growth and regeneration of hydrophytic vegetation. Hydric soils such as those underlying Stillwater are thought to be saturated, flooded or ponded at times of heavy run-off.

The soils in the pastureland area do not meet the criteria for hydric soils. Most likely this is due to the mixing and filling related to the site's agricultural use.

Along the sharp bend in the Snoqualmie River adjacent to the pasturelands, unstable riverbanks are being scoured and eroded.

The site is recognized as a seismic and erosion hazard according to the King County Sensitive Area Ordinance, King County Code 21.54 (King County Department of Parks, Planning and Resources, 1990).

Snoqualmie River Basin Hydrology

The Snoqualmie River originates in the Cascade Mountains and flows a total of 85 miles to the confluence with the Skykomish River. The Snoqualmie River Basin comprises 692 square miles and

nearly half of the Snohomish River Basin (Watershed Resource Inventory Area [WRIA] 7). Approximately 75% of the Snoqualmie Watershed lies within the Forest Production District (Solomon and Boles, 2002). A system of levees and revetments has fundamentally altered the dynamic flooding processes of the Snoqualmie River in terms of its in-channel and riparian habitat, sediment load, channel migration and interaction with its floodplain.

The upper basin above Snoqualmie Falls has three principle tributaries, the Middle, North and South forks of the Snoqualmie River. These tributaries are characterized by moderate to steep channel gradients and relatively broad river channels; some confined by valley walls. Emerging from mountainous terrain the three tributaries converge just upstream of the city of Snoqualmie where channel gradients begin to decline. The decline continues as the river approaches Snoqualmie Falls. Slack-water conditions caused by geologic features just above Snoqualmie Falls form an effective coarse sediment trap for most of the material transported from the upper basin. Snoqualmie Falls, which plunges 267 feet over the bedrock ledge, is an upstream fish-passage barrier (King County Department of Natural Resources, 2001).

In the lower basin below Snoqualmie Falls the river only drops 100 feet in 40 river miles. The channel follows a strongly meandering course through the lower Snoqualmie Valley. The Tokul River, the Raging River and the Tolt River are the major contributors of coarse sediment to the Snoqualmie River. Minimal coarse sediment is carried all the way to the Snohomish River and is instead distributed as substantial gravel and cobble bars below each of the respective confluences (King County Department of Natural Resources, 2001). Harris Creek (RM 21.3) and Weiss Creek (RM 19.1) which are in close proximity to the Stillwater Natural Area, are important contributors of hydrologic inputs to the system.

River Morphology within the Stillwater Reach

The Snoqualmie River meanders for most of its course across a broad alluvial floodplain through the lower Snoqualmie Valley. At the confluence of the Raging River and Snoqualmie River (RM 35) the broad lower valley floodplain commences and loses much of its gradient, virtually eliminating its capacity to move sediment. Although the river gradient is steeper between the Tolt River (RM 24.3) and Harris Creek (RM 21), the Stillwater reach is relatively flat.

The upper meandering reach that encompasses the Stillwater Natural Area is well developed and includes the presence of numerous oxbow lakes, relict channels and wetlands. This suggests that historically (prior to active flood control and channel stabilization) the Stillwater reach of the river was actively depositing sediment and that the channel itself was actively migrating in response to this deposition (King County Department of Natural Resources, 2001). These features are evidence of greater habitat diversity in the past (Collins and Sheikh, 2002).

At the Stillwater Natural Area, the main channel of the Snoqualmie River is mostly single thread suggesting that the width of the active stream channel has declined (Collins and Sheikh, 2002). This is largely due to the effectiveness of the extensive flood management and bank stabilization projects along the reach.

Wetlands

The Stillwater Natural Area property contains one large inventoried depressional wetland (31), which is present in a majority of the western section of property adjacent to the Snoqualmie River, Snoqualmie Valley Trail and the conservation easement property (King County Department of Parks, Planning and Resources, 1990). The wetland follows the edge of a meander of the Snoqualmie River and is adjacent to pasturelands. The hydrologic inputs are likely from infiltration and seepage from the Snoqualmie River through the berms. Portions of the wetlands exhibit what is characteristic of standing flows (King County Department of Parks, Planning and Resources, 1991).

The wetland component of the Stillwater Natural Area is approximately 13 acres in size or roughly 30% of the total natural area. About 9 acres of the wetland is permanently flooded or open water, with lesser amounts of deciduous forest and scrub-shrub vegetation. This portion of the wetland has characteristics of large water level fluctuations likely due to the variability of flows on the Snoqualmie River. The remaining portion of the wetland, about 4 acres, are seasonably flooded and distinguished by inland deciduous wetland forest vegetation (U.S. Fish and Wildlife, 2003 and King County Department of Parks, Planning and Resources, 1991).

The wetland is considered class 1 according to the King County Wetland Classification System (KCC 21A.06.1415). Class 1 wetlands are distinguished by: the presence of endangered or threatened species or their potential habitat; wetlands having 40 to 60 percent open water with two or more classes of vegetation; wetlands greater than ten acres in size or plant associations of infrequent occurrence (King County Department of Parks, Planning and Resources, 1991). A buffer width of 100-feet is required for all class 1 wetlands according to KCC 21A.24.320.

The eastern portion of the property contains no delineated wetlands. However, the absence of consistent agricultural drainage practices has left evidence of increased standing water.

Vegetation

Since the Stillwater Natural Area contains a mix of pasturelands, wetlands and forested areas a variety of vegetation is present on site. A majority of the property, approximately 22 acres, consists of pasturelands predominantly on the eastern section of the natural area adjacent to the Snoqualmie River, Snoqualmie Valley Trail and Washington State Department of Fish and Wildlife lands. The pasture is vegetated with pasture grasses, including a combination of orchardgrass (*Dactylis glomerata*), bentgrass (*Agrostis sp*), timothy (*Phleum pratense*), velvetgrass (*Holcus lanatus*) or tall fescue *(Festuca arundinacea*). Approximately 10% of the pasturelands support invasive weeds, including Canada thistle (*Cirsium arvense*), common tansy (*Tanacetum vulgare*), common burdock (*Artium minus*), bull thistle (*Cirsium vulgare*) and tansy ragwort (*Senecio jacobaeo*). A hedge of Himalayan blackberries (*Rubus procerus*) virtually surrounds the pasture and is intruding into the pasturelands. Due to the absence of sustained agricultural use since 1994, a scrub-shrub component is emerging.

Nine acres of the site is characterized by inland forested or scrub-shrub wetlands. These wetlands are concentrated on the western portion of the property adjacent to the Snoqualmie River, Snoqualmie Valley Trail and the conservation easement property (King County Department of Parks, Planning and Resources, 1990). The dominant vegetation in the inland-forested wetlands consists of mostly deciduous species including big leaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), willow (*Salix spp*.), black cottonwood (*Populus trichocarpa*) and red-twig dogwood (*Cornus stolonifera*). Thick Himalayan blackberry, salmonberry (*Rubus spectabilis*), red-twig dogwood, willow and hardhack (*Spirea douglassii*) dominate the understory. To a lesser extent cherry (*Prunus spp*.) and evergreen blackberry (*Rubus laciniatus)* are present. Along the buffer, common rush (*Juncus effusus*), sedge (*Carex spp*.) and reed canary grass (*Phalaris arundinacea*) are present. Several small submerged snags also exist in the wetland areas.

Another nine acres of the site are upland forest and located primarily along the riparian buffer and adjacent to the Snoqualmie Valley Trail (outside delineated wetlands and pastureland areas). The vegetation is mostly deciduous and dominated by mature black cottonwoods, willow and big leaf maple. A few infrequent conifer species including western red cedar (*Thuja plicata*) and Sitka spruce (*Picea sitchensis*) are also present. Ages of the trees vary, with the average age between 30 and 50 years. However, several of the deciduous species are extremely large and may be well over 100 years old. These forested areas are relatively open with a variety of pastureland grasses on the forest floor, likely the result of past grazing practices. The understory vegetation includes snowberry (*Symphoricarpos albus*), red twig dogwood, red alderberry (*Sambucus racemosa*) and Indian plum (*Oemleria cerasiformis*). Japanese

knotweed (*Polygonum cuspidatum*) and Himalayan blackberries are also growing in abundance on the edge of the riparian areas.

Noxious, invasive and non-native plant species infest portions of the Stillwater Natural Area. Tansy ragwort, a Class B weed according to the King County Noxious Weed List (2003), exists in small patches and its control is required by law (WAC 16-750). Japanese knotweed, common tansy, bull thistle, Canada thistle and reed canary grass all occur on the site and are weeds of concern according to the King County Noxious Weed List. Evergreen blackberry, Himalayan blackberry and common burdock (*Artium minus*) are not listed but are non-native plant species that impact the site.

Fish and Wildlife

The Snohomish River system sustains two genetically distinct runs of chinook salmon (*Oncoryhnchus tshawytscha*); the fall run uses the Snoqualmie River system (Washington State Department of Fisheries, 1993). The Snohomish River fall chinook salmon are part of the larger Puget Sound chinook salmon Evolutionary Significant Unit (ESU) that is listed as threatened under the federal Endangered Species Act (Snohomish Basin Salmonid Recovery Technical Committee, 1999). Adults generally start to enter the Snoqualmie River system in August and the spawning period lasts from the second half of August through October. The Washington State Salmon and Steelhead Stock Assessment (1993) describes the stock as native with wild production.

The annual escapement from 1965 to 1976 averaged 1,187 fish while the annual escapement from 1987 to 1998 averaged 1,778, a nearly 50% increase over the base period (Snohomish Basin Salmonid Recovery Technical Committee, 1999). Between 1987 and 1998, the escapements have ranged from a low of 908 to a high of 2,725 fish (Snohomish Basin Salmonid Recovery Technical Committee, 1999). Other numbers show average escapement from 1996 to present as 2,005 fish (K. Anderson, Personal Comm., 2003). This positive trend is somewhat surprising considering the frequent flooding episodes and habitat problems in the Snohomish River system. However, recent data provided by the Puget Sound Salmon Forum (2001) indicates that annual escapement from 1996 to 2000 averaged only 1,200 fish.

Stillwater Natural Area is just downstream from a chinook spawning "core area" identified by the King County Department of Natural Resources (King County Department of Natural Resources, 2001). A core area is defined as part of the watershed that directly supports high levels of salmonid use for one or more of four basic functions: 1) spawning, 2) juvenile rearing and outmigration, 3) adult migration and holding, and 4) refuge from disturbance. To sustain healthy populations of chinook salmon a watershed needs to provide habitat for these basic functions.

Likewise, Stillwater Natural Area is closely connected to a "focus area" in the Snohomish River Basin Chinook Salmon Near Term Action Agenda (2001). Focus areas are regarded as important links to the recovery of chinook salmon evolutionary significant units and are determined from biological data on the level of habitat use. Stillwater lies just downstream of Focus Area IV, a three-mile reach on the Snoqualmie River that extends from Harris Creek to the Tolt River. About 20 % of chinook salmon that return to the Snoqualmie River watershed spawn in this reach (Snohomish Basin Salmon Recovery Forum, 2001).

The Snohomish River Basin Salmonid Habitat Conditions Review (2002) evaluated the Snoqualmie River's mid-mainstem habitat conditions (RM 23.9 – RM 9.8) in the vicinity of the Stillwater Natural Area reach. The review indicates that habitat conditions are "moderately degraded" or "degraded" in terms of the basin processes and habitat structure essential for the natural productivity of salmonids.

Approximately four miles upstream of Stillwater Natural Area at RM 22.4 is the first notable high-use spawning area employed by chinook salmon as they migrate upstream (King County Department of Natural Resources, 2001). The lowermost limit of chinook salmon spawning is recognized as approximately RM 20.5, about a mile and a half upstream of the Stillwater Natural Area boundaries.

Several other salmonid species may use areas around Stillwater Natural Area for spawning and/or rearing purposes. These species include coho salmon (*O. kisutch*), chum salmon (*O. keta*), odd-year pink salmon (*O. gorbuscha*), anadromous (steelhead) and resident forms of rainbow trout (*O. mykiss*), anadromous (sea-run) and resident forms of cutthroat trout (*O. clarki*) and possibly bull trout (*Salvelinus confluentis*). Harris Creek just south of the Stillwater Natural Area at RM 21.3 is utilized by coho salmon (Washington State Department of Fisheries, 1975).

The Snoqualmie River corridor at the Stillwater Natural Area is identified as a wildlife habitat corridor in the King County Comprehensive Plan (2000). The existence of several habitat types, including wetlands, pasture and forest provides high quality habitat for a variety of resident and migratory bird species. The site provides habitat for red-tailed hawks, great blue heron and a variety of waterfowl. In addition the existence of partially submerged snags indicates habitat for cavity nesting bird species, tree swallows, woodpeckers and osprey. The site also provides potential bald eagle habitat although none have been observed on site. Bald eagles are listed as threatened under the federal Endangered Species Act.

Stillwater Natural Area offers significant habitat for a variety of mammalian wildlife, especially those species that thrive in clearings, in and around wetlands or in the forest edge. Blacktail deer are abundant on the site while bear, cougar and bobcat may also utilize the site. Beaver activity has formed small ponds where Weiss Creek enters the property. Raccoons, river otter, muskrat and mink are believed to frequent the river's edge. Small mammals such as shrews, mice, voles, squirrels and weasels most likely exist on the site.

A wide-variety of unidentified amphibians and reptiles are believed to inhabit the large, diverse wetland areas. However, no inventory has been undertaken.

Part 4. Site Use and Infrastructure

This section describes public use, access points, and site infrastructure such as trails and roads at Stillwater Natural Area.

Public Use

Currently public use of the Stillwater Natural Area is minimal due to its relatively limited access, general undeveloped character and lack of formal trails. However, its close proximity to the regional Snoqualmie Valley Trail and Snoqualmie River provides opportunities for the public to engage in informal passive recreational uses such as walking, nature observation, bird watching, boating, fishing or swimming. At one location adjacent to the river, several rope swings are present and small informal paths lead from the Snoqualmie Valley Trail to the Snoqualmie River. As people become more aware that the site is under public ownership and discover the site's possible recreational opportunities, visitation is likely to increase.

Public use from the adjacent Washington State Department of Fish and Wildlife lands, where hunting and fishing are common activities, likely spills onto the southeast portion of the Stillwater Natural Area. Hunting and shooting are not allowed on the site per King County Regulations (KCC 7.12). Mules, cows and horses also frequently encroach on the Stillwater Natural Area from adjacent pasturelands.

Access

Most visitors access to the Stillwater Natural Area via the Snoqualmie Valley Trail. No official vehicular access or parking area exists although some visitor's likely park along the shoulder of Carnation-Duvall Road NE where a primitive gravel pull-off area is located. King County staff can access the property via the gated Snoqualmie Valley Trail.

Trails and Roads

Stillwater Natural Area offers no formal trails that bisect the property, although the highly used regional Snoqualmie Valley Trail runs the length of the northern section of the site. Pedestrians do use a small network of informal trails and paths that have been created over time. These informal trails usually start at the Snoqualmie Valley Trail and lead to viewpoints or swimming / fishing holes on the Snoqualmie River.

A network of social trails, most likely resulting from deer or livestock also wind throughout the property. Most notably is a pronounced social trail leading from the conservation easement property on the south side of the Stillwater site (Weiss-Bend) to the Stillwater site itself.

King County Stewardship and Restoration Activities

On-going maintenance and stewardship of the Stillwater Natural Area is provided by the King County Parks Resource Program staff and documented in the annual Site Maintenance Plan (SMP). The SMP's document on-site tasks including but not limited to: site inventory, natural area monitoring, invasive non-native plant removal, conflict resolution and park inspections.

In March of 2003, Washington Trout, funded in part by a King County Drainage Habitat Improvement Grant, completed the Weiss Creek Restoration Project on the easement property adjacent to the Stillwater Natural Area. The restoration project at lower Weiss Creek re-routed the creek from an 800 ft. diked ditch back into its historical channel, recovering almost a mile of floodplain channel and about 20 acres of wetland (Brulle, 2003). The project replanted the riparian zone around the restored creek with over 12,000 native trees, shrubs, wetland plants and grasses and installed stock fencing to protect the channel from cattle and horse grazing (Brulle, 2003). The project is designed to provide a full range of natural stream functions and enhance juvenile coho salmon, winter steelhead and cuttroat trout rearing and spawning habitat.

King County is considering plans for a riparian planting and bank stabilization project (2004) along the pasturelands on the eastern section of the natural area adjacent to the Snoqualmie River Snoqualmie and just north of the Washington State Department of Fish and Wildlife lands. The proposed Small Habitat Restoration Program (SHRP) project proposes to plant the riparian buffer and lay back vertical portions of the riverbank.

Flood Reduction

Flooding on the Stillwater Natural Area occurs with relative frequency due to the Snoqualmie River's seasonally high flows, broad floodplain and migrating channel. The southern portion of the site, on the right-bank of the Snoqualmie River, contains two levees (Sinnera Qualle Lower and Barry) to prevent the river from migrating. While the primary function of the levee is to direct flows away from the site, some flooding still occurs. Water flows likely enter the site via a low spot between levee features and remnant side channel at RM 19.1. According to the King County Flood Hazard Reduction Plan (1993) no flood hazard problem sites or project recommendations are forthcoming.

Part 5. Analysis

This section is intended to integrate site-specific information, public access considerations, and the larger landscape considerations described in the conservation principles section of the King County Ecological Lands Handbook (2003). This section presents the analysis from which site management recommendations will be made.

Information Gaps

Precise information that documents the ecological processes, structures and functions at the Stillwater Natural Area and that ultimately guides management decisions has never been collected for the site. The

absence of this pertinent baseline information, including a comprehensive biological inventory and site analysis, creates difficulties in managing the site effectively. In the absence of more complete site information, management actions may inadvertently harm systems, damage rare and critical species / habitats, or negatively affect the ecological processes at the site.

To avoid this, it would be prudent to complete a biological inventory designed to gain a more thorough understanding of the site's ecological values and potential problems. This information can be used to evaluate the full spectrum of ecological impacts from the natural disturbances, proposed habitat enhancements projects, public use activities and proposed management recommendations.

Species of Concern

Due to the abundance of information gaps and the lack of a comprehensive biological inventory at the Stillwater Natural Area, the species identified in this document very likely do not account for all species that use the Stillwater Natural Area for one or more stages of their life cycle.

Although there is no documented evidence that threatened species utilize the Stillwater Natural Area, the presence of chinook salmon and bull trout spawning areas in close proximity (less than two miles) make habitat preservation and enhancement a priority. In addition, since the Stillwater Natural Area is adjacent to the Snoqualmie River and near Harris Creek, it is a landscape level contributor to basin processes and habitat structure essential for the natural productivity of salmonids. Activities that have the potential to harm these processes or habitat should be undertaken cautiously, if at all. Where appropriate habitat should be protected and enhanced to contribute to the protection of chinook salmon and bull trout.

Ecological Processes

Ecological processes must be maintained for ecosystems and habitats to be sustained. Current conservation theory suggests that where ecological processes are intact, systems are likely to recover – or be recovered – more easily from disturbances or inappropriate actions (if the actions themselves are not permanent). Conversely, the more interference there has been with the basic ecological processes the greater the severity and longevity of the effects (King County Department of Natural Resources and Parks, 2003). If systems are not functioning properly, management activities should focus on system-wide processes instead of affected elements. Ultimately, management actions that do not consider the processes are less sustainable.

Bearing this concept in mind, management interventions within the Stillwater Natural Area should strive to maintain and enhance basic ecological processes. As a result of the levee construction that has constrained the river, floodplain processes and functions have been altered at the Stillwater site and the surrounding floodplain area. When a river is constrained, the river's natural processes, such as meandering and flooding are curtailed, thus diminishing riparian ecosystem complexity, diversity and function. Meandering, a natural response to sediment deposition and historically significant in the Stillwater Natural Area reach, allows for habitat complexity and the recruitment of large woody debris, both critical to creating the habitat features (log-jams, pools, and side channels) necessary for healthy salmon and trout habitat. Flooding carries nutrient-rich silt and seeds of plants onto the floodplain for the natural regeneration of riparian forests. Essentially, without the dynamic natural ecological processes associated with the natural floodplain conditions, sustainable enhancement will be difficult.

The Stillwater Natural Area itself contains limited opportunities to conduct floodplain reconnections and hence target enhancement of ecological processes. Any management interventions and alternatives to conduct floodplain reconnections (i.e. levee removal), while certainly beneficial from an ecological perspective, would likely impact adjacent roads, trails, properties and agricultural land. It is therefore unlikely that it would be possible to implement any large-scale floodplain reconnection project to reestablish or improve ecological processes at the Stillwater Natural Area. The site is too narrow and constrained and without adequate land area to allow a functional floodplain to establish. Floodplain reconnection alternatives may have undesirable effects in the short-term (i.e. flooding and loss of

agricultural lands) but are the best-suited strategies to help restore the hydrologic and ecological processes. However, at the Stillwater Natural Area, the constraints of any project may nullify the probable ecological benefits. With that in mind, any attempts to reconnect the river with its floodplain would need the support of the adjacent landowners as well as the cooperation of government agencies.

Several possible smaller-scale alternatives could be examined to increase the amount of flow to the floodplain including strategies to increase over-bank flooding or reconnecting historical flows to the riparian areas. These alternatives would likely improve habitat conditions for salmon and trout. An example is the Weiss Creek Project, carried out by Washington Trout, that restored the Weiss Creek floodplain and contributed to the enhancement of ecological processes (Brulle, 2003).

Ecological Structure and Function

Although addressing the ecological processes at the Stillwater Natural Area would be most beneficial to the site's natural systems the feasibility of doing so is limited. Therefore, the top management priority should be to enhance structure and function of the site's floodplain and riparian habitat.

A structurally diverse and functioning forested floodplain provides numerous ecological benefits such as shading the river, trapping sediment and detritus in the floodplain, preventing excessive erosion during flood events, delivering large woody debris and creating a canopy that shades out noxious and invasive plant species.

The Stillwater Natural Area offers significant opportunities for enhancing the floodplain structure and function through native tree and shrub plantings as well as the control of noxious, invasive and non-native plant species.

Although Washington Trout's Weiss Creek Restoration Project on the adjacent conservation easement property planted over 12,000 native trees, shrubs, wetland plants, and grasses to the floodplain no habitat enhancement projects to date have been implemented at the Stillwater Natural Area. An enhancement project at the Stillwater Natural Area would greatly benefit the riparian area habitats and reduce erosion along the banks of the Snoqualmie River. Any enhancement project should attempt to mimic natural succession and include plantings that represent a mixture of coniferous and deciduous species as well as shrub species, commonly associated with riparian areas in western Washington. Attempts to control noxious, invasive and non-native plant species also should be a vital feature of any enhancement project. Inherent in the restoration efforts are attempts to maintain structural complexity, plant diversity and multiple canopy layers in order to provide a variety of vegetative and physical features that would provide a number of niches for wildlife. Likewise, the plantings would provide large woody debris to the systems and reduce erosion.

It is important to note that restoring structure to the site through plantings provides benefits for some species (salmon, songbirds) while potentially degrading conditions for others (raptors, deer).

Monitoring

There are two types of monitoring: 1) monitoring of management actions to determine if they are succeeding in their objectives; and 2) monitoring the processes on lands where no management action is taking place to determine if the management action is needed (King County Department of Natural Resources and Parks, 2003). Since natural and social systems are uncertain, dynamic and in a constant state of flux, monitoring information is used to adaptively manage the site.

While a long-term monitoring regime of the Stillwater Natural Area would provide an early warning of ecological change on the site, it is not advisable at this time due to the intensive resources required. If future projects are initiated to enhance the ecological processes on site or if public use increases substantially, an appropriate monitoring framework should be administered. However, King County Department of Natural Resources and Parks staff should monitor public use and noticeable ecological

impacts to the site as much as possible. Photographic evidence should be kept in order to record short and long-term changes.

Compliance monitoring should also be conducted to ensure that the area covered under the conservation easement is in compliance with the convenants imposed by the easement.

Public Use

Aquatic and riparian habitats are especially vulnerable to recreational activities (Washington Department of Fish and Wildlife, 1997). Currently, Stillwater Natural Area supports low numbers of visitors engaged in recreational activities such as nature observation, swimming and fishing. Most visitation comes from users of the Snoqualmie Valley Trail and the Snoqualmie River, as well as adjacent landowners. Except for several short trails that lead to the river's edge, the current level of use appears to have no adverse effect on the ecological resources. At one location adjacent to the river, several rope swings are present. Future public use of the Stillwater Natural Area will likely increase as the population of the region increases, the Snoqualmie Valley Trail receives more use and the public becomes more aware of the site.

Regardless of the amount of public use on site, recreational use should remain confined to upland areas where possible and be kept away from rare and sensitive portions of the site. These riparian areas lack the capability to resist changes in environmental conditions and/or lack the resilience to recover from change. At this time, there appears to be no reason to install visitor infrastructure such as improved trails or parking facilities. Monitoring changes in public visitation, types of use and impacts on the ecological systems will alert land use managers to needed management adjustments.

Unauthorized encroachment by livestock such as mules, cattle and horses that graze nearby pasturelands is frequent at the Stillwater Natural Area. The livestock have created, over time, small impacted areas that resemble game trails and can foster the growth of unwanted weed species. In addition, the livestock have been observed along the Snoqualmie River shoreline. The unauthorized encroachment of livestock should be prohibited and access to the riparian areas eliminated through the construction and/or improvement of fencing.

Since the Stillwater Natural Area lies within the Agricultural Production District and contains potentially productive agricultural land it would be advantageous, given that farming is a disappearing resource in the region, to keep the interior pasturelands in agriculture. To prevent impacts to the Snoqualmie River, a riparian buffer would need to be established and fencing constructed. While for purposes of ecological processes, structure and function plantings and floodplain reconnection strategies would be most beneficial, the adverse impacts on the site's agricultural production potential and adjoining farmland must be considered. Maintaining agriculture on the site would entail finding a tenant to lease the area from King County. Stillwater Natural Area could potentially generate revenue for King County in the form of agricultural leases that permit animal grazing activities, small-scale farming or poplar plantations.

The hunting that likely spills over onto the Stillwater Natural Area from the Washington State Department of Fish and Wildlife lands to the southeast must be addressed. Hunting and shooting on the site (and in the easement property) are illegal per King County Regulations and should be actively discouraged.

In the future King County may want to consider expanding the Stillwater Natural Area through more conservation easements on nearby lands and/or acquisition of adjacent lands to establish greater habitat connectivity and to better preserve the integrity of this reach of the Snoqualmie River. However, a key consideration in the acquisition process must be its impact on neighboring agricultural lands and regional agriculture. Since adjoining properties are within the designated APD it might be more beneficial if they are retained in private ownership to support agricultural uses.

Part 6. Management Goals, Objectives, and Recommendations

The objectives and recommendations in this section are derived from the analysis in the previous section. Office of Rural and Resource Programs staff will revise the recommendations for Stillwater Natural Area when new information from site monitoring programs and other initiatives indicate a need for a change in management strategies.

Goals for Stillwater Natural Area

The King County Department of Natural Resources and Parks staff will strive to

- conserve and enhance ecological value, and
- accommodate appropriate public use that does not harm the ecological resources on site

The objectives and recommendations that follow are designed to support these goals where practicable at the Stillwater Natural Area. The corresponding matrix (Table 3) designates the King County Department of Natural Resources and Parks staff involved in implementing the specific recommendations.

Objective: Fill data gaps

➢ *Recommendation: Complete comprehensive biological inventory*

The absence of complete information limits the scope and accuracy of management decisions. Department of Natural Resources and Parks staff should complete a comprehensive and thorough biological inventory to provide the essential baseline information.

Objective: Enhancement of natural floodplain conditions

➢ *Recommendation: Acquire adjacent lands*

King County Department of Natural Resources and Parks staff should expand the Stillwater Natural Area through conservation easements and/or the in fee acquisition of adjacent lands to establish greater habitat connectivity and to better preserve the areas natural floodplain conditions. However, a key consideration in the acquisition process must be its impact on neighboring agricultural lands and regional agriculture.

➢ *Recommendation: Seek funding sources and grants for enhancement projects*

To date, King County Department of Natural Resources and Parks have not implemented any projects targeted at enhancing natural floodplain conditions at the Stillwater Natural Area. Yet, the site is adjacent to a strategic portion of the Snoqualmie River and is an important landscape level contributor to basin processes and habitat structure essential for the natural productivity of salmonids in the region.

King County Department of Natural Resources and Parks staff should consider future long-term enhancement projects that seek to reestablish some of the site's natural floodplain conditions. Inherent in this recommendation is that funding sources and grants need to be established to cover expenses. Staff should explore the feasibility of CIP projects, funding by habitat restoration and salmon recovery grants, and other available sources to support enhancement projects.

➢ *Recommendation: Plant native trees and shrubs*

King County Department of Natural Resources and Parks staff should work to plant native trees and shrubs to facilitate the enhancement of the forested floodplain and begin to restore ecological structure to

the site. Staff should initiate opportunities such as volunteer tree planting events and soliciting donations of native tree starts.

Priority areas for the tree plantings should be in the riparian areas of the pasturelands that are currently devoid of a forest component. Plantings of native deciduous species and shrubs would provide numerous ecological benefits to the site such as shading the river, trapping sediment and detritus in the floodplain, preventing excessive erosion during flood events, delivering large woody debris and creating a canopy that shades out noxious and invasive plant species.

King County Department of Natural Resources and Parks staff should provide adequate protection for tree and shrub plantings until monitoring suggests that the trees will prosper without such protection measures. All plantings should be monitored often to estimate tree survival and health as well as to assess watering needs, disease, animal damage and competition.

➢ *Recommendation: Control noxious, invasive and non-native plant species*

King County Department of Natural Resources and Parks staff should manage the noxious, invasive and non-native plant species that infest portions of the Stillwater Natural Area. These efforts will aid in the enhancement of the natural floodplain conditions and in restoring ecological structure to the site.

Priority for the control of noxious, invasive and non-native plant species should be given when control of specific weeds is required and where infestations are impacting sensitive areas. The removal and control of the patches of tansy ragwort in the small pasture area should be a high priority because the control of this species is required by law. In addition, the isolated patches of common reed (observed on the riverbank of the large pasture) and Japanese knotweed (mostly in the large forested wetland) should be controlled as soon as possible to avoid full-scale infestation of the property. Other noxious, invasive and non-native plant species should be controlled when resources are available.

Until native tree and shrub plantings are established that shade out unwanted plant species various methods of control are possible. In some areas, cutting the plants where they are found and using weed fabric or similar materials to cover infested areas is advisable. In the pastureland areas, routine mowing to stop the spread of unwanted plant species (preferably several times in the summer months to prevent flowering) is recommended. If necessary, staff should explore and implement alternative methods of control as part of an Integrated Pest Management program. After several years successful tree plantings should begin to shade out noxious, invasive and non-native plant species.

Objective: Allow levels of public use that do not impact ecological resources

➢ *Recommendation: Implement preserve and protect measures*

Limited low-impact public use is compatible with the site goals provided that the ecological resources are not impacted. King County Park staff should recommend, install and maintain any necessary capital improvements to protect the site from inappropriate public uses. This should include bollards, fences, signs and boundary markers.

King County Park staff should ensure that unauthorized livestock are kept out of the Stillwater Natural Area. If King County leases the pasturelands to a tenant, a fence should be installed to protect riparian areas on the site.

Staff should also remove any rope swings on King County property.

King County Park staff should also install and maintain more visible signs along the length of the site and along its boundaries. Of particular concern is the possibility that hunting may be occurring on the southeast section of the Stillwater Natural Area that is adjacent to the Washington State Department of

Fish and Wildlife lands. Signs that mark the natural area boundary and explicitly state "No Hunting or Shooting" should be installed.

Signs should also put up along the Snoqualmie Valley Trail or Carnation-Duvall Road NE as a means for the public to identify the site. Staff should install "rules" signs if public use warrants.

➢ *Recommendation: Retain pasturelands in agriculture*

Since the Stillwater Natural Area is located in an APD the sites past agricultural legacy is an important attribute. King County Department of Natural Resources and Parks should work to retain the interior pasturelands on the eastern portion of the Stillwater Natural Area in agriculture (i.e. animal grazing, production of pasture grasses). The agricultural activities should be kept away from the riparian buffer. To protect the riparian area from the agricultural activities a fence should be erected.

King County Department of Natural Resources and Parks staff should actively find tenants to lease the pasturelands. If the pasturelands are leased the impacts of the agriculture activities should be monitored to ensure they do not impact the ecological resources. Stillwater Natural Area could potentially generate revenue for King County in the form of agricultural leases.

➢ *Recommendation: Monitor public use*

King County Park staff should note and record changes in visitor numbers and types of public use activities during site inspections of the Stillwater Natural Area. Noticeable visitor impacts on the ecological resources of the site should be recorded.

King County Park staff should also monitor encroachment of unauthorized livestock and the impacts of authorized agricultural activities on the Stillwater Natural Area.

This information should be reported annually to the King County Natural Resource Lands Program for updating and adapting site management guidelines.

➢ *Recommendation: Monitor conservation easement*

King County owns a conservation easement totaling approximately ninety-one acres, which adjoins the Stillwater Natural Area. Although the easement property is not included as part of the Stillwater Natural Area it is an integral component of the larger ecological unit.

King County Department of Natural Resources and Parks staff should also routinely inspect and monitor the terms of the conservation easement property to ensure compliance with the obligations, convenants and conditions. The easement is intended to preserve and protect the properties opens space and agricultural characteristics.

➢ *Recommendation: Survey property boundary*

King County Department of Natural Resources and Parks staff should survey the perimeter of the Stillwater Natural Area to identify the property boundary. King County staff should plan on contracting an outside consultant to carry out the work. The survey is needed to assist with the placement of King County signs or fencing.

Objective: Implement site management guideline recommendations

➢ *Recommendation: Site maintenance plan creation*

King County Park staff should prepare a site maintenance plan for Stillwater Natural Area that incorporates these site management plan recommendations. King County Natural Resource Lands staff and the Snoqualmie River Basin Steward should collaborate on this effort.

- *Recommendation: Coordinate implementation of site management guideline recommendations*

King County Natural Resource Lands staff should monitor the recommendations in the site management guidelines and coordinate with the various programs responsible for implementing these recommendations to facilitate their timely accomplishment.

King County Natural Resource Lands staff should coordinate with Snoqualmie River Basin Steward and King County Park staff to revise the site management guidelines as needed.

Table 3. Matrix of Stillwater Natural Area Management Recommendations

Recommendations	Cost	Year	Park Resource Staff	Basin Steward	WRIA Project Coord.	CPOSA/ Contract	WEAT	Ag. staff	NRL staff
Priority One									
Implement preserve and protect measures		On-going	X						X
Monitor public use		On-going	X						X
Survey property boundary		2004 – 2005	X			X			X
Monitor conservation easement		On-going	X	X					X
Site maintenance plan creation		Annual	X	X					X
Priority Two									
Control noxious, invasive and non-native plant species		N/A	X	X		X			
Plant native trees and shrubs		N/A	X	X		X			
Retain pasturelands in agriculture		2004-2005						X	X
Complete comprehensive biological inventory		2003-2005	X	X		X	X		
Coordinate implementation of Site Management Guideline Recommendations		On-going	X	X					X
Seek funding sources and grants for natural area enhancement projects		On-going	X	X			X		

References

Brulle, Ramon Vanden. 2003. The Weiss Creek Project, Rebuilding a Salmon Stream. www.washingtontrout.org/weiss.shtml

Collins, Brian D. and Sheikh, Amir J. 2002. Mapping Historical Conditions in the Snoqualmie River Valley (RM 0 – RM 40). Prepared for the King County Department of Natural Resources.

King County Code, Chapter 26.12.

King County. 2000. King County Comprehensive Plan.

King County Department of Parks, Planning and Resources. 1990. Sensitive Areas Map Folio.

King County Department of Parks, Planning and Resources. 1991. King County Wetlands Inventory.

King County Ordinance 10750, 1993.

King County Ordinance 11068, 1993.

King County Surface Water Management. 1993. King County Flood Hazard Reduction Plan.

King County Annual Growth Report. 2001. www.metrokc.gov/budget/agr/

King County Department of Natural Resources. 2001.Chinook Bend Feasibility Study. Wastewater Treatment Division, Surface Water and Engineering and Environmental Services.

King County Department of Natural Resources and Parks. 2003. King County Ecological Lands Handbook. Water and Land Resources Division. Seattle, Washington.

Puget Sound Regional Council. 2001. King County Annual Growth Report.

Puget Sound Salmon Forum. 2001. Chinook Spawner Abundance Planning Targets and Ranges for Puget Sound Region.

Snohomish Basin Salmonid Recovery Technical Committee. 1999. Initial Snohomish River Basin Chinook Salmon Conservation/Recovery Technical Work Plan. Snohomish County Surface Water Management Division. Everett, Washington.

Snohomish Basin Salmonid Recovery Technical Committee. 2000. Snohomish River Basin Chinook Salmon Habitat Evaluation Matrix. Snohomish County Surface Water Management Division. Everett, Washington.

Snohomish Basin Salmon Recovery Forum. 2001. Snohomish River Basin Chinook Salmon Near Term Action Agenda. Snohomish County Surface Water Management Division. Everett, Washington.

Snohomish Basin Salmon Recovery Technical Committee. 2002. Snohomish River Basin Salmonid Habitat Conditions Review. Snohomish County Surface Water Management Division. Everett, Washington.

Snyder, D.E. et al. 1973. Soil Survey of King County Area, Washington. U.S. Department of Agriculture, Soil Conservation Service, Washington D.C.

Solomon, Fran and Boles, Melissa. 2002. Snoqualmie Watershed Aquatic Habitat Conditions Report: Summary of 1999 – 2001 Data. King County Department of Natural Resources and Parks, Water and Land Resources Division. Seattle, Washington.

U.S. Fish and Wildlife. 2003. National Wetlands Inventory. https://mapper.tat.fws.gov/mapper

Washington State Department of Fisheries. 1975. A Catalog of Washington Streams and Salmon Utilization, Vol. 1). Olympia, Washington.

Washington State Department of Fisheries. 1993. Salmon and Steelhead Stock Inventories. Olympia, Washington.

Washingon State Department of Fish and Wildlife. 1997. Management Recommendations for Washington's Priority Habitats. Olympia, Washington.

Personal Communications:

Anderson, Kirk. 2002-2003. Snoqualmie Basin Steward, Land and Water Stewardship Services, King County WLRD.

Blumen, Connie. 2003. Manager, Natural Resource Lands Program, King County DNRP.

Crandell, Mike. 2003. Resource Coordinator, Parks and Recreation Division, King County DNRP.

Miller, Tina. 2003. Volunteer Coordinator, Program Project Manager, Natural Resource Lands Management Program, King County DNRP.

Herring, Judy. 2004. Coordinator, Farmland Preservation Coordinator, King County DNRP.