Appendix H
Habitat Assessment Reports

LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

Woodinville, Washington

Prepared for:

THE CITY OF WOODINVILLE
17301 133rd Avenue NE
Woodinville, Washington 98072-8534

WOOD0000-0010

Prepared by:

DAVID EVANS AND ASSOCIATES, INC.
415 – 118th Avenue SE
Bellevue, Washington 98005-3518

DAVID EVANS AND ASSOCIATES INC.

July 2002

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EXECUTIVE SUMMARY

The City of Woodinville is bisected by several creeks, the largest of which is Little Bear Creek. Little Bear Creek is recognized as an important salmon-bearing stream within the Lake Washington – Cedar – Sammamish Basin (Water Resource Inventory Area 8). With the listing of chinook salmon as a threatened species under the Endangered Species Act (ESA), numerous cities, including the City of Woodinville, have undergone stream inventories to document existing habitat conditions in streams within their jurisdiction. The City of Woodinville contracted with David Evans and Associates, Inc. (DEA) to prepare this Little Bear Creek Corridor Habitat Assessment. The project goals were to document existing fish and wildlife habitat conditions and utilization, and identify potential restoration opportunities along Little Bear Creek within the City of Woodinville. This assessment provides a detailed analysis of stream and riparian habitat conditions, fish and wildlife utilization, and includes data that assisted in the determination of limiting factors as they relate to ESA listed salmon.

Because of project specific goals, and a desire to have the results comparable to other on-going stream inventory efforts, DEA utilized the *Inventory Methods for Wadable Streams in King County* (King County, 2001a) as the primary methodology. Both the King County 1991 (Appendix B) and 2001a (Appendix C) protocols are based on the methods defined in the *USDA Forest Service Stream Habitat Classification and Inventory Procedures for Northern California* (McCain et al., 1990) as modified by King County staff. Additional data as outlined in the United States Forest Service (USFS) – *Stream Inventory Handbook for Region 6, Version 2.1* (USFS, 2001) was included.

Existing stream and watershed conditions were quantified by using watershed and habitat parameters as defined by the "Matrix of Pathways and Indicators" developed by the National Marine Fisheries Service (NMFS) (Table S-1). The "Matrix of Pathways and Indicators" summarizes important parameters for six major pathways that are vital for the continued survival of salmon including:

- Water Quality;
- Habitat Access;
- Habitat Elements;
- Channel Condition and Dynamics;
- Flow/Hydrology; and
- Watershed Conditions.

These six major pathways are further broken down into a total of 18 "indicators." As an example, the water quality pathway is composed of three indicators: temperature, sediment/turbidity, and chemical contamination/nutrients. Scientifically sound data was collected during this assessment to accurately assign the appropriate "condition" to each indicator as defined by the NMFS. The indicator conditions are classified as either: "properly functioning," "at risk," or "not properly functioning." Criteria for each condition is defined by a range or goal based on the best available scientific data available, but criteria are not absolute, and may be adjusted for unique watersheds (NMFS, 1996). Within this report, definitions and determinations of an indicators status are distinguishable by font. Definitions are italicized and determinations are in bold font. Existing conditions were documented to a level of detail that would allow for future trend analysis. Should

the criteria for the Matrix of Pathways and Indicators change, an appropriate condition for each indicator could be assigned based on the results presented in this report.

This report has also consolidated numerous supporting references such as salmon spawning survey data from the Washington Department of Fish and Wildlife (WDFW), and presents all the raw data for ease of record keeping and as an aid to future researchers. Furthermore, opportunities for restoration have been listed and prioritized based on the findings present within this report.

Little Bear Creek is currently utilized by at least nine species of fish including resident, adfluvial, and anadromous species. Resident fish spend their entire life in a specific stream. Adfluvial fish spawn and sometimes rear in a stream, but migrate to a lake to mature before returning to a stream to spawn. Anadromous fish spawn and rear in freshwater, but reach maturity at sea prior to returning to freshwater to start the process over again. Resident species documented in Little Bear Creek include coast range sculpins (*Cottus aleuticus*), western brook lampreys (*Lampretra richardsoni*), and cutthroat trout (*Oncorhynchus clarki*). Cutthroat trout are somewhat unique in that resident, adfluvial, and anadromous forms may utilize the same stream depending upon watershed conditions, life history type, and access to the ocean. Species that utilize the adfluvial life history include cutthroat trout and kokanee salmon (*O. nerka* [freshwater sockeye]). Anadromous species documented in Little Bear Creek include chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), and sockeye salmon (*O. nerka*). Some species such as pink (*O. gorbuscha*) and chum (*O. keta*) salmon have rarely been observed in Little Bear Creek. However, due to their scarcity, they are not part of an established population, rather, they are strays from another watershed. Undocumented species such as steelhead trout (*O. mykiss*) could potentially utilize Little Bear Creek.

The results of this assessment indicate that Little Bear Creek is very similar to most urbanized Puget Sound lowland streams in that it has been severely impacted by past and current land-use activities. The percentage of total impervious surface has increased to about 37 percent and road density to 5.9 kilometers per square kilometer (km/km^2) (2.28 mi/mi^2) in the past 12 years (Purser and Simmonds, Snohomish County Surface Water Management, unpublished data as reported by Kerwin, 2001). Out of the 18 indicators examined, one was found to be partially **properly functioning** (temperature). Three were found to range from **not properly functioning** to **at risk** (varied by reach), three were **at risk**, while the remaining 11 were **not properly functioning**. The results are summarized below.

Although the existing habitat conditions reflect those frequently associated with an urbanized basin, Little Bear Creek is still an important salmon-bearing stream. Little Bear Creek possess numerous opportunities for enhancement and restoration that could significantly improve conditions for salmonids. The City of Woodinville is currently undertaking several stream restoration projects along the Little Bear Creek Corridor. Appendix R outlines current habitat enhancement projects along the corridor.

Little Bear Creek was segmented into three reaches based on land use and permanent landmarks. Reach 1 is defined as extending from the mouth to the SR 202 culvert crossing. Reach 2 is defined as extending from the SR 202 culvert crossing to the SR 522 culvert crossing. Reach 3 is defined as extending from the SR 522 culvert crossing to the NE 205th Street culvert crossing.

The majority of Reach 1 is developed up to the banks. The banks are armored with riprap and there are signs of localized erosion. This riprap should be removed. It is recommended that the banks be restored and stabilized using bioengineering methods. Improvements to the mouth such as the installation of large woody debris and create scour pools would also improve existing habitat conditions.

The amount of bank armoring (riprap) in Reach 2 is significantly less than in Reach 1. However, there are opportunities for riprap removal, and bank restoration and stabilization using bioengineering methods. There are areas of riparian habitat between Little Bear Creek and SR 522 that are candidates for acquisition. Connectivity between these areas and Little Bear Creek could be improved. In this reach there are culverted outfalls from regional and private storm drainage systems, and tributaries that could be used to create off-channel habitat.

There are similar opportunities in Reach 3, especially in the lowermost section. Riprap removal, bank restoration and stabilization using bioengineering methods, installation of large woody debris, and improved connectivity between remaining riparian habitat would improve existing conditions in Reach 3.

The majority of the Little Bear Creek corridor is privately owned. The City has acquired four parcels along the corridor. The Washington State Department of Transportation owns one parcel, and the SR 522 right-of-way through which segments of Little Bear Creek flow. It is recommended that the City look for opportunities to partner with residents, property owners, business owners, and other agencies on habitat enhancement projects. As redevelopment occurs along this corridor, an evaluation of potential habitat improvement opportunities should be undertaken to determine what could be done to restore and enhance the habitat. Potential improvements are outlined later in this report.

The following properties are outside the Little Bear Creek corridor, but within the watershed, that the City should evaluate for possible acquisition to preserve undeveloped upland forest habitat:

- North of Woodinville High School and west of 136th Avenue NE
- Northeast of 144th Avenue NE and NE 195th Street
- Southwest of North Woodinville Way and NE Woodinville Duvall Road

Purchase of these properties would help to maintain the amount of impervious area within the watershed, provide areas for groundwater recharge, and provide water quality benefits.

Table S-1:
Matrix of Pathway and Indicators Summary

PATHWAY	INDICATORS	BASELINE CONDITIONS
Water Quality	Temperature	Juvenile Migration and Rearing = Not Properly Functioning to At Risk Adult Migration and Spawning = Properly Functioning
	Sediment	Not Properly Functioning
	Chemical Contamination & Nutrients	Not Properly Functioning
Habitat Access	Physical Barriers	At Risk
Habitat Elements	Substrate	At Risk
	Large Woody Debris	Not Properly Functioning
	Pool Frequency	Not Properly Functioning
	Pool Quality/Depth	At Risk (not properly functioning in Reach 1)
	Off-Channel Habitat	Not Properly Functioning
	Refugia	Not Properly Functioning
Channel Conditions and Dynamics	Width/Depth Ratio	Reach 1: Not Properly Functioning Reach 2 and 3: At Risk
	Streambank Condition	Not Properly Functioning
	Floodplain Connectivity	Not Properly Functioning
Flow/Hydrology	Change in Peak/Base Flows	At Risk
	Increase in Drainage Network	Not Properly Functioning
Watershed Conditions	Road Density and Location	Not Properly Functioning
	Disturbance History	Not Properly Functioning
	Riparian Reserve/Conservation Areas	Not Properly Functioning (at risk in Reach 3)

Based on the results of this assessment, several additional actions have been outlined that could potentially improve existing habitat conditions in Little Bear Creek. These recommended actions include:

1. Obtain, preserve, and enhance land along Little Bear Creek to minimize further habitat degradation from continued development along the Little Bear Creek corridor. Undeveloped properties along the corridor with quality riparian habitat should be high priority acquisitions, such as, the properties to the north of the City's "Lumpkin" property (east of 134th Avenue NE crossing). Another area to consider would be the properties to the west of 134th Avenue NE as described in item 7.
2. Immediately initiate a program to reestablish conifers within the riparian zone throughout the Little Bear Creek corridor.
3. Restore hardened rip/rap banks along Little Bear Creek. Include creation of pool, and addition of large woody debris as part of the restoration plan.
4. Retrofit potential pollution-generating sites such as large parking lots and roadways with pollution prevention and storm flow retention facilities where such facilities are presently absent.
5. Reforest upland areas dominated by introduced species such as reed canarygrass and Himalayan blackberry.

6. Create off-channel habitat at each culverted tributary confluence with Little Bear Creek. This can be accomplished by daylighting the maximum extent of culverted tributary possible at each confluence.
7. The City of Woodinville should investigate the feasibility of purchasing the wrecking yard on 134th Avenue NE along the west side of Little Bear Creek. If this lot could be purchased several stream enhancement opportunities could occur. The first goals would be to remove soil contaminants within the lot and remove all structures. The second goal would be to use this crossing for enhancement efforts between Little Bear Creek and Highway 522 within Reach 2. Once these actions were completed the 134th Avenue NE crossing could be permanently removed, or replaced with a bridge.
8. The newly purchased city property immediately upstream of NE 195th Street is an ideal site for intensive in-stream, riparian, and upland habitat restoration activities. Actions that would benefit Little Bear Creek at this site include removal of bank armoring, creation of pool habitat, removal of impervious surface (pavement) and non-native vegetation, and installation of large woody debris, and riparian and upland vegetation.
9. Maintain regular street sweeping, storm drainage system cleaning, and add sediment traps where feasible. This will reduce the amount of sediment entering Little Bear Creek.

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1.0 INTRODUCTION

At the request of the City of Woodinville, David Evans and Associates, Inc. (DEA) conducted a Corridor Habitat Assessment along Little Bear Creek in King County during 2001. This assessment was carried out by accomplishing several tasks including: existing data collection and review, habitat and presence surveys for fish and wildlife, and documentation of findings.

The project goals were to document existing fish and wildlife habitat conditions and utilization, and identify potential restoration opportunities along Little Bear Creek within the City of Woodinville (Figures 1 and 2). DEA initially focused on collecting existing data for review and determination of data gaps. Once all readily available information was obtained and reviewed, the specific parameters and methods to be documented by DEA biologists were finalized. Fieldwork began during the spring of 2001 and continued through October 2001.

DEA biologists surveyed the entire stretch of Little Bear Creek that occurs within the City of Woodinville from June 25, through August 1, 2001. A total of 3,484.1 meters (2.2 miles) of stream was surveyed from the mouth of Little Bear Creek at the Sammamish River to the crossing under NE 205th Street along the City of Woodinville and Snohomish County line. Little Bear Creek was segmented into three reaches based on current land use and location of permanent landmarks (Figures 2 and 3). Reach 1 began at the mouth of Little Bear Creek and extended to the downstream end of the culverts under State Route (SR) 202. Reach 1 is composed of primarily industrial and commercial development. Reach 2 began at the downstream side of the culverts under SR 202 and extended to the upstream side of the culverts under Highway 522. Reach 2 is composed of primarily commercial development and public park/open space. Reach 3 began at the upstream side of Highway 522 and ended at NE 205th Street, which follows the City of Woodinville and Snohomish County line. Reach 3 is composed primarily of residential development.

Because Endangered Species Act (ESA) considerations are an important facet of current stream-related surveys, DEA also focused on collecting data that would assist in the determination of limiting factors as they relate to ESA listed salmonids. This included data required to address the Matrix of Pathways and Indicators developed by the National Marine Fisheries Service (NMFS). DEA utilized two versions of the Matrix. The original version was developed by the NMFS in 1996 and encompasses the entire Pacific Northwest (Appendix L-1). The Mt. Baker – Snoqualmie National Forest modified several of the indicators as originally outlined by the NMFS (Appendix L-2). In each case where the modified NMFS version is used it is cited as "NMFS as modified by the Mt. Baker – Snoqualmie National Forest." If the original NMFS version is used it is cited as "NMFS, 1996." A definition of *properly functioning*, *at risk*, and *not properly functioning* is provided for each condition, and a copy of the modified version is provided as an appendix.

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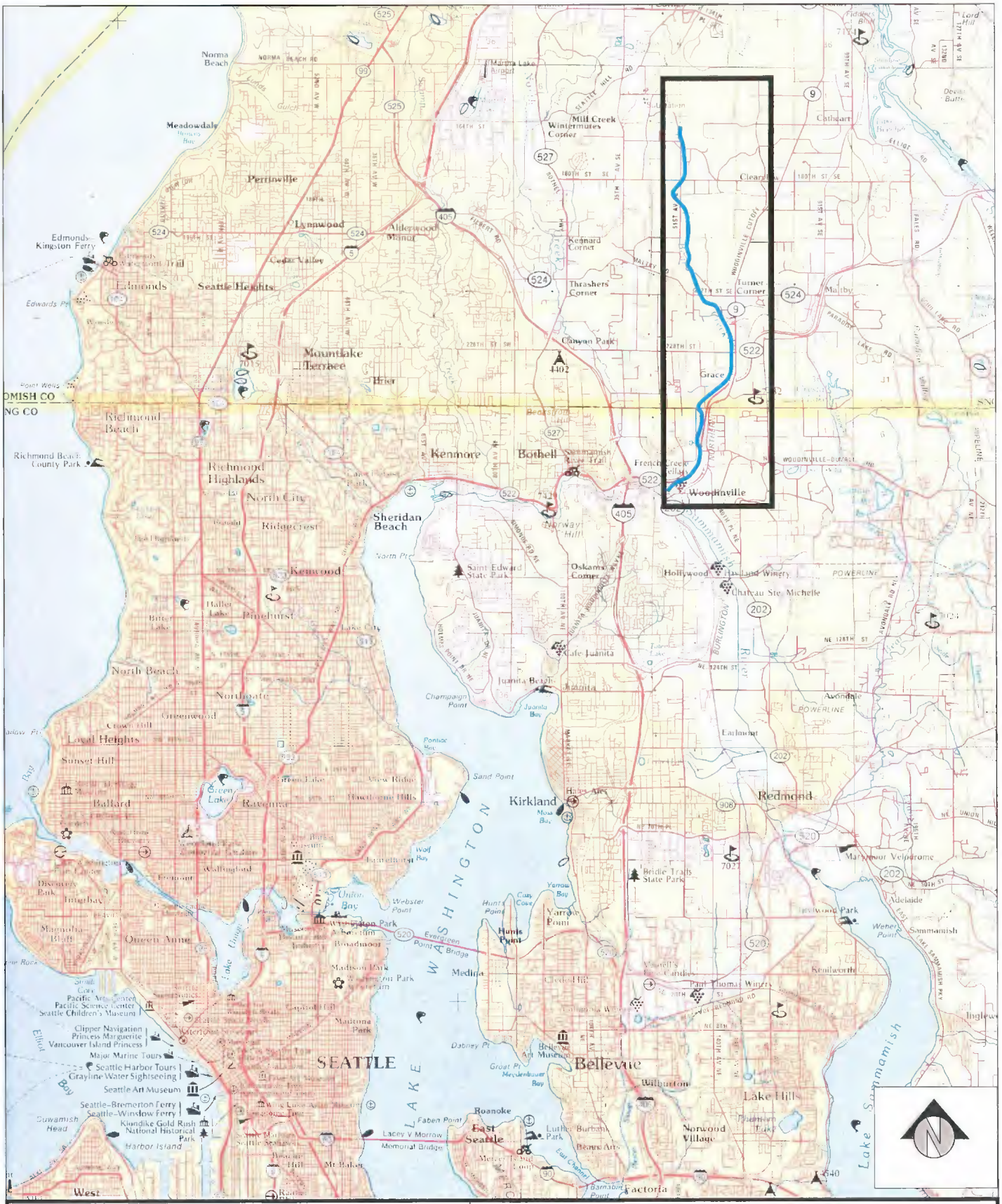

Vicinity Map

City of Woodinville - Little Bear Creek

WOOD0000-0010

September 2001

FIG. 1

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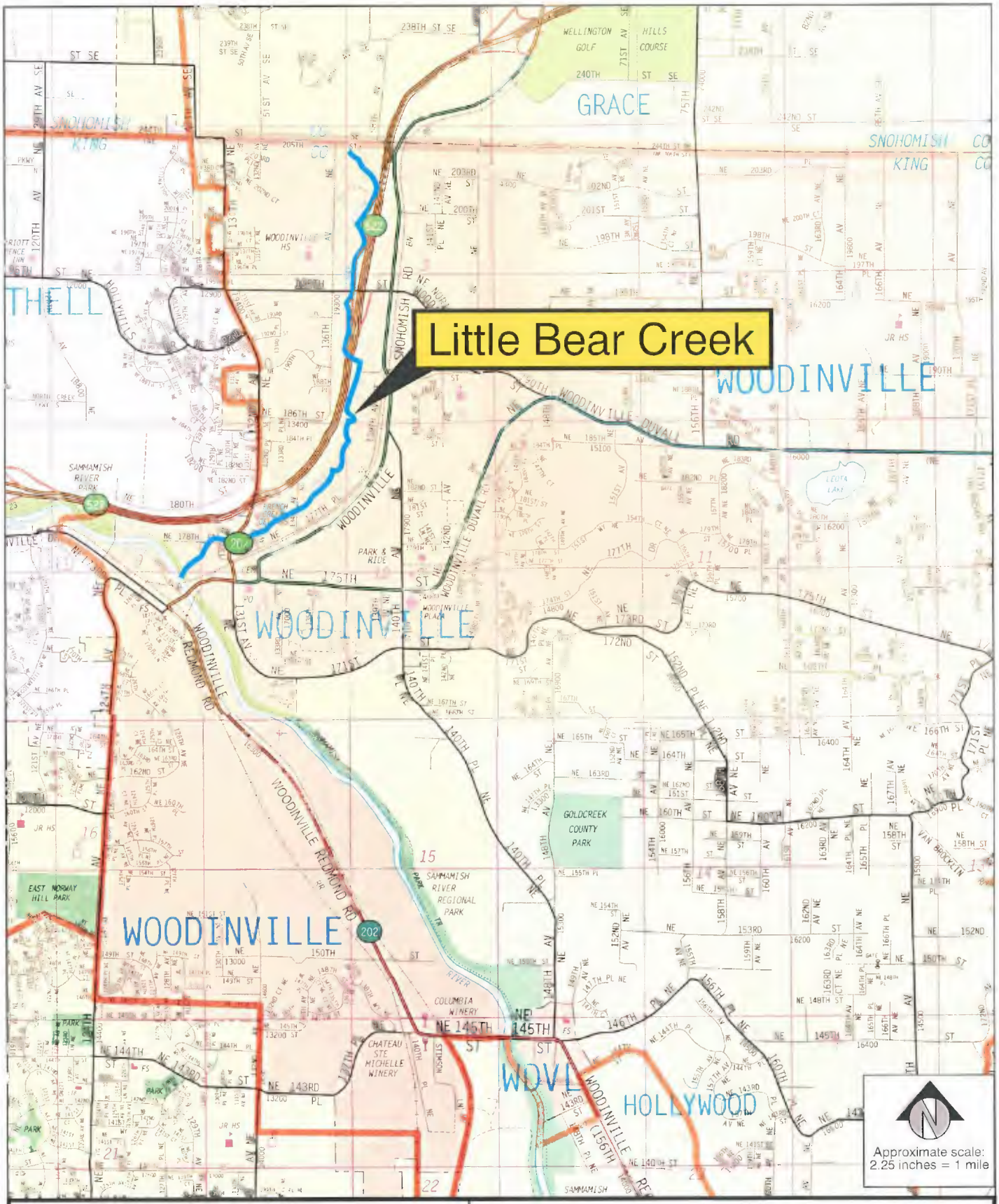
Gx0317



Site Map

City of Woodinville - Little Bear Creek

WOOD0000-0010

September 2001

FIG. 2

DAVID EVANS AND ASSOCIATES INC

Gx0317

SOURCE

Aerial photo provided by City of Woodinville, representing 1999 conditions.

Site Map
Little Bear Creek Corridor Habitat Assessment

City of Woodinville - Little Bear Creek

WOOD0000-0010

May 2002

FIG. 3

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Gx0471

2.0 METHODOLOGY

A Little Bear Creek Corridor Habitat Assessment was conducted between June 25, 2001, and September 1, 2001, to evaluate existing habitat conditions of Little Bear Creek within the City of Woodinville, King County, Washington. The methodology utilized was an enhanced combination of several protocols that results in collecting data for 16 general tasks. DEA used aspects of two King County protocols (1991 and 2001a), and the U.S. Forest Service (USFS) protocol (USFS, 2001). The combining of aspects from all three methodologies results in a comprehensive habitat analysis that is compatible and comparable with other data collected using any of these methodologies. The stream survey included the following tasks:

1. Measure temperature, dissolved oxygen, conductivity, turbidity, and pH at the beginning and end of each project stream utilizing a Horiba U-10 water quality meter.
2. Measure stream flow with a Swoffer flow meter.
3. Measure stream gradient in each reach.
4. Document condition, type, and size of every culvert encountered within each stream to include sediment accumulation, fish passage, and photo documentation.
5. Categorize each habitat type into one of the 22 channel geomorphic types as outlined by McCain et al., 1990.
6. Measure the length, average depth, and average width of each habitat type.
7. Measure the length, tailout depth, maximum depth, average depth, and width of each pool encountered.
8. Measure bankfull width at several representative riffles within each reach.
9. Document the length, diameter, species, decay class, and zone of influence for each piece of woody debris longer than 2 meters (6.6 feet) and wider than 10 centimeters (3.9 inches) encountered within the stream channel.
10. Conduct a Wolman Pebble count in at least two representative riffles per reach. Increase the number of measures as reach length and complexity increase.
11. Document substrate composition visually throughout the stream.
12. Document riparian species composition and age.
13. Document the species and location of any fish or wildlife observed during the survey.
14. Document the location of all side channels or tributaries encountered.
15. Document the degree of bank armoring and severe erosion along each stream reach.
16. Photo document representative stream reaches and features of note encountered during the survey.

2.1 EXISTING DATA

A listing of initial existing data collected on fish and wildlife habitat, species presence and abundance, water quality and hydrology, and land use along Little Bear Creek was previously presented to the City of Woodinville (Appendix A). Additional literature collected after the initial review of existing data is cited within the text and reference section as appropriate.

2.2 FISHERIES RELATED DATA

2.2.1 In-stream Habitat

DEA utilized the *Inventory Methods for Wadable Streams in King County* (King County, 2001a) as the primary methodology. Both the King County 1991 (Appendix B) and 2001a (Appendix C) protocols are based on the methods defined in the *USDA Forest Service Stream Habitat Classification and Inventory Procedures for Northern California* (McCain et al., 1990) as modified by King County staff. Habitat units are defined as one of 22 habitat types listed in Table 1 below. Additional data as outlined in the USFS – *Stream Inventory Handbook for Region 6, Version 2.1* (USFS, 2001) was included.

Table 1:
Stream Habitat Types

1.	Low gradient riffle	12.	Lateral scour pool - bedrock formed
2.	High gradient riffle	13.	Dammed pool
3.	Cascade	14.	Glide
4.	Secondary channel pool	15.	Run
5.	Backwater pool - boulder formed	16.	Step run
6.	Backwater pool – rootwad formed	17.	Mid-channel pool
7.	Backwater pool – log formed	18.	Edgewater
8.	Trench/chute	19.	Channel confluence pool
9.	Plunge pool	20.	Lateral scour pool - boulder formed
10.	Lateral scour pool - log formed	21.	Pocket water
11.	Lateral scour pool - rootwad formed	22.	Corner pool

Source: McCain et al., 1990.

King County surveyed most of the entire length of Little Bear Creek in 1999 (King County, 2001b). Because of variations in project goals and methodologies only select results from their previous survey were incorporated into this report. Specifically, DEA used their bankfull width to depth ratio, scour, and bank stability data.

A hip-chain was used to measure habitat lengths and create station numbers. The hip-chain was zeroed at the lowermost starting point at each stream reach and utilized to document the location of each feature or action taken along the stream reach. Each habitat unit was defined as occupying only the area actually wetted at the time of the survey. Habitat width was measured with a 22.9-meter (75-foot) tape, habitat length with a hip chain, and habitat depth with a 1.2-meter (4-foot) stick graduated in centimeters. DEA biologists used the U.S. Geological Survey (USGS) standard of defining "left bank" (LB) and "right bank" (RB) as when facing downstream.

2.2.2 Fish Abundance and Distribution

Data collected by the Washington State Department of Fish and Wildlife (WDFW) and King County was used to document the presence, abundance, and distribution of salmonids in Little Bear Creek (WDFW, 2001a). Additional data was collected through field investigations.

DEA biologists electrofished four locations along the mainstem of Little Bear Creek on August 24 and 31, 2001, prior to the arrival of returning adult salmon. Sites electrofished included

immediately upstream of the mouth, upstream of SR 202, downstream and upstream of 134th Avenue NE, upstream of NE 195th Street, downstream of NE 205th Street (Figure 2), and several sites in one unnamed tributary (Figure 3 – Unnamed Tributary D). DEA utilized a Smith-Root Model 12 electrofisher with a frequency setting of 60 Hz and output voltage of 500 volts. All fish captured were first placed in a bucket of water containing a "pinch" of Tricaine Methanesulfonate prior to species identification and measurement of total length. Tricaine Methanesulfonate relaxes the fish for ease of handling, and reduces injuries and oxygen consumption. After handling, all fish were placed in a second bucket with fresh water to recuperate prior to release.

All fish observed during the habitat survey from June 25, 2001, to September 1, 2001, were identified to the species level when possible. Additional surveys directed at encountering returning/spawning adult salmonids were conducted between September 20, and October 18, 2001. The number and location of redds, and whether spawning behavior was occurring was also noted. Accessible points such as trail and road crossings were surveyed. DEA biologists also surveyed extended sections of various reaches to document the upper extent of spawning and potential presence of barriers.

2.2.3 Riparian Habitat

DEA biologists used aerial photo interpretation and ground truthing to document riparian scale and composition. The width of potential riparian habitat analyzed incorporated 61 meters (200 feet) from the stream edge along each side of the stream for a total corridor width of 122 meters (400 feet). The amount of riparian habitat and impervious surface within the 122-meter (400-foot) corridor was then calculated. DEA used aerial photographs from 1999 that were expanded to a scale of 2.54-centimeter (1-inch) equaling 31.40 meters (103 feet). The amount of forest, shrub/grass, gravel, and impervious area within 60.96 meters (200 feet) of each side of the stream was then calculated with a PLANIX 7 – Tamaya digital planimeter. The species composition, age, and structure were then listed and documented by ground truthing. The stream side vegetation was also classified as coniferous, deciduous, or mixed. Plant species were identified according to Cooke (1997), Pojar and MacKinnon (1994), and Hitchcock and Cronquist (1973).

2.2.4 Water Quality and Hydrology

2.2.4.1 Water Quality

Existing water quality data for Little Bear Creek was obtained from both King and Snohomish counties. Published water quality data for Little Bear Creek as it flows through the City of Woodinville is available in *Water Quality of Small Streams – Western King County 1990 – 1993* (King County, 1994).

Published water quality data for Little Bear Creek in Snohomish County is available in *The State of the Waters: Water Quality in Snohomish County's Rivers, Streams, and Lakes – 2000 Assessment* (Snohomish County, 2000). Additional water quality data for Little Bear Creek in Snohomish County was obtained by contacting the Snohomish County Public Works – Surface Water Management (Thornburgh, personal communication, 2001).

Additional water quality data was collected by DEA. A Horiba U-10 water quality meter was used on several occasions to document temperature, pH, conductivity, dissolved oxygen, and turbidity.

Furthermore, two temperature monitors were deployed in Little Bear Creek between June 15, and October 18, 2001, to document stream temperature on an hourly basis. DEA utilized two 32K waterproof Stowaway Tidbit monitors set to collect hourly readings. One was installed in Little Bear Creek near its confluence with the Sammamish River, and the other was installed near the King and Snohomish county line immediately downstream of NE 205th Street.

2.2.4.2 Hydrology

Hydrology data for Little Bear Creek was obtained from King County (2001c). Hydrology data is collected in King County at the SR 202 crossing of Little Bear Creek in the City of Woodinville (Station #30). DEA biologists also used a Swoffer Model 2100 flow meter on two occasions to document site specific conditions. The first measurement was made on June 25, 2001, at the beginning of the in-stream habitat survey near the confluence of Little Bear Creek and the Sammamish River. The second event occurred on August 29, 2001, to document variation of flow at Little Bear Creek as it enters Woodinville at NE 205th Street, and near its confluence with the Sammamish River.

2.3 WILDLIFE RELATED DATA

2.3.1 Habitat Availability

DEA biologists mapped plant communities by interpreting aerial photographs and ground-truthing. DEA translated plant communities into habitat types. Biologists established 17 circular plots with a 10-meter (32.8-foot) radius in representative locations between the creek and the nearest development in all habitat types. DEA identified dominant, common, and infrequent plant species; estimated tree diameter at breast height (DBH); counted snags, stumps, and logs; observed trees for raptor nests; and assessed overall condition of each habitat area.

2.3.2 Wildlife Presence

2.3.2.1 Birds

DEA biologists surveyed birds on May 18, May 31, and June 18, 2001, using the variable circular-plot method (Reynolds et al., 1980). Surveys began at sunrise and ended by 9:15 AM (Robbins, 1981). DEA established 20-meter (65.6-foot) radius plots in all habitat types and surveyed for 10 minutes in each plot, recording species observed visually and aurally both in and outside of the plots. Biologists surveyed 16 plots on May 18, and 13 plots on subsequent survey days.

2.3.2.2 Bats and Owls

DEA biologists surveyed for owls at seven stations on June 19, and July 7, 2001, by soliciting birds with amplified taped recordings and listening for a response with the unaided ear. At each of 7 stations, located in each habitat type in the study area, biologists broadcast calls for approximately 1 minute and listened for a period of approximately 3 minutes. DEA repeated this procedure 3 times at each station. Although there was no standard distance between stations, we chose stations that were far enough apart to avoid double counting while still covering the entire study area. Biologists scanned each station and the surrounding areas with a 20 to 160 kHz bat detector at 1- to 2-minute intervals for approximately 10 minutes and recorded all frequencies of all detections.

2.3.2.3 Mammals

DEA biologists recorded all mammal species observed during all visits to the study area. Biologists searched for, examined, and recorded all mammal sign, including tracks, scats (wildlife excrement), and runways (animal trails). In addition to the site visits conducted for the wildlife and habitat analyses, DEA biologists also documented mammal observations while conducting the stream survey.

2.3.2.4 Reptiles and Amphibians

DEA biologists conducted reptile and amphibian surveys on May 31, and conducted searches during stream surveys. Biologists overturned logs and debris and searched at the bases of plants and along Little Bear Creek. DEA biologists identified and recorded all individuals observed. All captured specimens were returned to the point of capture unharmed and all overturned logs and debris were placed back in their original location.

3.0 HISTORIC CONDITIONS

To better understand existing conditions and possible future trends, historic conditions must be considered. The focus of this report is on fish, wildlife, habitat, and restoration potential along the Little Bear Creek corridor through the City of Woodinville. Although very little site-specific information on the historic conditions of Little Bear Creek as they relate to fish and wildlife is known, some data is available. The "historic conditions" defined as that time from the retreat of the Vashon Glacier approximately 14,000 years ago to the present can be segmented into pre European settlement and post European settlement time periods. The transition between pre and post European settlement time period near Woodinville occurred during the early 1870s. A brief overview is provided below.

3.1 PRE EUROPEAN SETTLEMENT

For the purposes of this report the pre European time period began approximately 14,000 years ago with the retreat of the glaciers and lasted until the arrival of the European settlers in 1870. The Sammamish River Valley was historically dominated primarily by giant western red cedar trees (*Thuja plicata*). Other conifers such as Douglas fir (*Pseudotsuga menziesii*) and Sitka spruce (*Picea sitchensis*) were also present. Several stumps of these remnant trees were observed along the banks of Little Bear Creek during the 2001 survey conducted by DEA. They often had burn marks and "spring board" notches where planks were used by loggers to reach the desired cut location above the tree buttress. Furthermore, old cedar tree stump fragments were also encountered during the in-stream habitat survey and classified as woody debris when they met or exceeded the length and width parameters.

Lake Washington was larger and deeper than at present, and the Sammamish River was longer, and contained numerous meanders and oxbows. The Sammamish River was about 30 miles long, heavily forested to its banks, and very difficult to navigate due to the abundance of fallen trees (King County, 2001d). Besides being lined with large trees, "swamp land" abutted both banks especially near its mouth. The Sammamish River was previously known as Squak Slough, and while the local Indians

were also known as the Squaks, they were really part of the Simump tribe (Stickney and McDonald, 1977). The native Americans lived primarily near Lake Sammamish, but traveled and camped along the Sammamish River. The Sammamish River corridor was also likely utilized by several other tribes as an east-west route.

3.2 ARRIVAL OF EUROPEAN SETTLERS

One of the first Europeans known to have traveled up the Sammamish River was Sam Hancock, who in 1850 explored for coal in the region (Stickney and McDonald, 1977). The earliest land claims in the Woodinville area were by George Wilson and Columbus Greenleaf in 1870 (King County, 2001d). In 1871 the Woodins became the first settlers after rowing across Lake Washington with all their goods and building a log cabin along the bank of the Sammamish River. They passed a couple other homesteads on their journey up the Sammamish River. Other families slowly moved into the area to log the local forests and establish homesteads. By 1897 four families owned most of the land along Little Bear Creek in Township 26 North, Range 5 East (Appendix E). Each of these landholders owned approximately one-quarter section along Little Bear Creek in what today is known as the City of Woodinville. The City of Woodinville was given its name in honor of the first pioneers, Ira and Susan Woodin sometime around 1887. The railway network grew rapidly in the area from 1877 through 1888 and was used extensively for both timber and coal transport. The railroad reached Woodinville in 1877 and Issaquah in 1888. By the 1890s several stores, hotels, saw mills, meat markets, and other enterprises became established.

Logging the old-growth forest was the primary occupation during this period. The local rivers played an important role in the transport of timber prior to the arrival of railroad. However, as the land was cleared and large first-growth trees became more distant, farming became more prevalent. The Sammamish River valley had been mostly cleared of giant western red cedar trees by the early 1920s. What was referred to as "stump farms" dotted the landscape during this time, but were gradually being cleared. Because heavy equipment was scarce and consisted primarily of horse drawn devices, the most common method of stump removal was by dynamiting and then burning the stump. As the stumps were removed, farming the rich river valley became the primary occupation in the area and the local population grew.

Other events related to logging and navigation that would result in changes to Little Bear Creek were occurring closer to Seattle during this same time period. In the 1880s a small channel and lock was built at Montlake to carry logs to mills. Lake Washington originally drained into the Black River that flowed into the Duwamish River prior to reaching Elliott Bay. In 1912 the Cedar River was diverted from the Black River into Lake Washington. This resulted in the replacement of the Black River as Lake Washington's outlet with the Cedar River as a new inlet. The Hiram M. Chittenden Locks and a fish ladder were completed by 1916 resulting in Lake Washington being lowered 2.7 meters (9 feet). In the early 1920's the historically slow and meandering Sammamish River was straightened, narrowed, and later dredged. By the 1930s stocks of chum and pink salmon had been extirpated, but three new stocks including Baker River sockeye, Green River coho and chinook salmon had been introduced (Goetz, proceedings from Conference, 2000).

Little is known about the composition and distribution of fish and wildlife during the early days of Little Bear Creek. Early accounts say the land was occupied by deer, cougar, bear, and migratory

waterfowl (Stickney and McDonald, 1977). Additional stories mention settlers being confined to their cabins during bad weather and hearing the howling of wolves, and others mention trapping bear, otter, raccoon, muskrat, and mink. Waterfowl were apparently abundant in the adjacent marshes since hunters would travel from Seattle to hunt the area, and Indians used the area extensively to hunt ducks. Duck clubs were present along the river that catered to wealthy Seattle residents. They hunted mallards, teal, and widgeon using decoys and feed to attract them within the marshy areas. Many of the adjacent marshes were drained as a result of the lowering of Lake Washington.

Settlers make no mention of salmon in the early accounts. Although it was noted that the local Indians hunted ducks along the marshy land adjacent to the Sammamish River, no reference to salmon is made. According to one resident, fishing in the Sammamish River during the early 1920s was not very good (Repman, personal communication, 2001). Mr. Repman recalled catching bullheads, chub, and an occasional chum salmon as a youth. It is likely that native populations of anadromous salmonids had drastically declined by this time. However, populations of resident kokanee (land-locked sockeye) were very abundant in the Lake Washington System during this time period (King County, 2000a). Mr. Repman was also an avid hunter who targeted grouse, quail, and pheasant (introduced). Between 1925 and 1970 he did not see any bear, cougar, or deer. According to Mr. Repman, deer showed-up later, after the surrounding uplands had been logged, and were more prevalent after the 1970s.

Based on a review of the first aerial photographs of Little Bear Creek during 1936 (Appendix F), riparian vegetation had been cleared from much of the stream by this time. The lower most reach downstream of what would become SR 202 was totally devoid of riparian vegetation by this time. Further upstream, thin segments of riparian vegetation lined some sections of the stream. The stream banks became more forested upstream of what would become NE 195th Street during 1936.

The local population around Woodinville began to expand rapidly after World War II. The City of Woodinville had been agricultural and very rural until a large influx of people began arriving from the 1950s through the 1970s. The creation of Interstate 405 in the 1960s and Highway 522 allowed for the exponential expansion of the area as developers began building and selling entire neighborhoods. By the 1980s, rural Woodinville had completely changed into its current suburban landscape. Woodinville was part of unincorporated King County until 1993.

4.0 EXISTING CONDITIONS

4.1 LITTLE BEAR CREEK WATERSHED

Little Bear Creek is a 12.4-kilometer (7.7-mile) long second order stream that drains a 3,885-hectare (9,600-acre) watershed in both Snohomish and King counties, Washington. Approximately 3,108 hectares (7,680 acres) (80 percent) of the upper watershed are located in Snohomish County while 777 hectares (1,920 acres) (20 percent) are in King County. While in King County, Little Bear Creek flows through the City of Woodinville for approximately 3.5 kilometers (2.2 miles) from NE 205th Street to its mouth on the Sammamish River at River Mile (RM) 5.4 (Figure 4). The headwaters of Little Bear

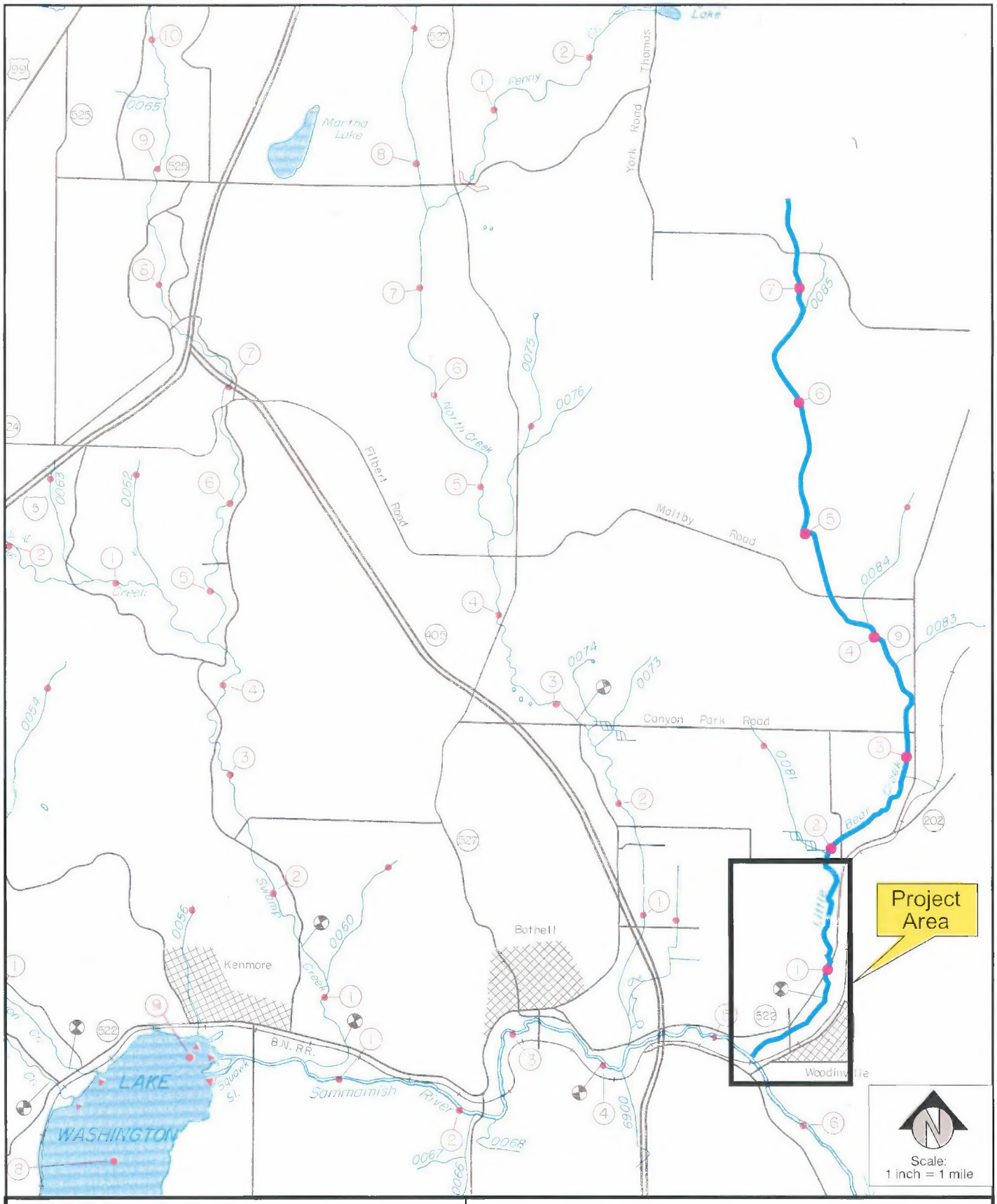
Creek are located in a peat bog 2.4 kilometers (1.5 miles) west of Clearview in Snohomish County. The elevation along Little Bear Creek varies from 76 meters (250 feet) near its headwaters to 6 meters (20 feet) at its confluence with the Sammamish River. Based on these elevations, the overall gradient of Little Bear Creek is about 0.6 percent. Other reports state the overall gradient is about 0.8 percent based on an elevation of 94.50 meters (310 feet) near Clearview (Kerwin, 2001).

4.2 CITY OF WOODINVILLE

The City of Woodinville currently covers 1,461 hectares (3,610 acres) and has a population of 9,294 people. The population is expected to reach 13,400 people by the year 2010 based on 1990 census data. Land use within the city is composed of residential (59.0 percent), commercial (9.2 percent), industrial (13.4 percent), park/open space (1.2 percent), public right-of-way (11.8 percent) and other (5.4 percent) designations.

4.3 FISHERIES

Little Bear Creek has been utilized by at least nine resident and anadromous species of fish. This includes anadromous, adfluvial, and resident salmonids, and sculpins and lampreys. Table 2 below lists the common name, scientific name, and documentation source for each species known to have utilized Little Bear Creek. Some species such as chum and pink salmon have been documented only once. Chinook salmon occur seasonally in low numbers, while other species such as sockeye and coho salmon, and cutthroat trout can be very abundant. Undocumented species could also occasionally utilize Little Bear Creek as well. An example of undocumented species that could be present includes steelhead trout (*Oncorhynchus mykiss*) and other species of sculpin (*Cottus* spp.). Native char (bull trout/Dolly varden) were not considered in this report due to a lack of documentation and absence of suitable habitat. Native char have never been documented in Little Bear Creek, and although it is theoretically possible that if they were to enter the Sammamish River they could investigate Little Bear Creek, the downstream limit of successful char spawning is always upstream of the winter snow line (WDFW, 1999). Because the headwaters of Little Bear Creek originate at an elevation of about 94.50 meters (310 feet), suitable char spawning habitat is not present in Little Bear Creek due to elevated stream temperatures throughout the basin. If bull trout were to ever be present in Little Bear Creek, it would likely be foraging adults or sub-adults, or possibly wayward adults searching for suitable spawning habitat.



SOURCE

Williams et al. 1975

WDFW - Lower Sammamish River Drainage

City of Woodinville - Little Bear Creek

WOOD0000-0010

November 2001

FIG. 4

DAVID EVANS AND ASSOCIATES INC.

Gx0317

Table 2:
Fish Species Documented in Little Bear Creek

#	Common Name	Scientific Name	Source
1.	Coast Range Sculpin	*Cottus aleuticus*	DEA
2.	Western Brook Lamprey	*Lampretra richardsoni*	DEA
3.	Cutthroat Trout	*Oncorhynchus clarki*	DEA
4.	Pink Salmon	*Oncorhynchus gorbuscha*	WDFW
5.	Chum Salmon	*Oncorhynchus keta*	WDFW
6.	Coho Salmon	*Oncorhynchus kisutch*	WDFW, King County, & DEA.
7.	Sockeye Salmon	*Oncorhynchus nerka*	WDFW & King County, & DEA
8.	Kokanee	*Oncorhynchus nerka*	WDFW & King County, & DEA
9.	Chinook Salmon	*Oncorhynchus tshawytscha*	WDFW, NMFS, & King County.

At least 40 different non-native species of fish have been introduced into the Lake Washington watershed since the arrival of the first European settlers. However, many of these introduced species did not survive and today approximately 24 species remain (Kerwin, 2001). A listing of 21 species of native and non-native fish that have been documented within the greater Lake Washington watershed are included in Table 3 below. Introduced species have become prevalent in both Lake Washington and Lake Sammamish, and continue to adversely impact native salmonids. Although the list presented in Table 3 below is not all-inclusive, it provides evidence of the shear abundance of non-native species of fish that still inhabit the Lake Washington watershed. Some of these species listed in Table 3 likely utilize the Sammamish River and therefore potentially the lowermost reach of Little Bear Creek. The likelihood of any of these additional undocumented species being present in Little Bear Creek varies by species.

Table 3:
Additional Fish Species Documented in the Greater Lake Washington Watershed

#	Common Name	Scientific Name	Native or Introduced	Resident or Anadromous	Status
1.	White sturgeon	*Acipenser transmontanus*	Locks created access	Anadromous	Rare visitor
2.	Largescale sucker	*Catostomus macrocheilus*	Native	Resident	Unknown
3.	Lake whitefish	*Coregonus clupeaformis*	Introduced in 1899	Resident	No longer present
4.	Prickly sculpin	*Cottus asper*	Native	Resident	Abundant
5.	Shorthead sculpin	*Cottus confusus*	Native	Resident	Abundant
6.	Carp	*Cyprinus carpio*	Introduced	Resident	Locally abundant
7.	Three-spine stickleback	*Gasterosteus aculeatus*	Native	Both	Unknown
8.	Brown bullhead	*Ictalurus nebulosus*	Introduced	Resident	Unknown
9.	Pumpkinseed	*Lepomis gibbosus*	Introduced	Resident	Sparse
10.	Pacific staghorn sculpin	*Leptocottus armatus*	Native	Both	Sparse
11.	Smallmouth bass	*Micropterus dolomieui*	Introduced	Resident	Abundant
12.	Largemouth bass	*Micropterus salmoides*	Introduced	Resident	Abundant
13.	Peamouth	*Mylocheilus caurinus*	Native	Resident	Unknown
14.	Olympic mudminnow	*Novumbra hubbsi*	Unknown	Resident	Rare: one siting
15.	Steelhead trout	*Oncorhynchus mykiss*	Native	Both	Stock depressed
16.	Yellow perch	*Perca flavescens*	Introduced	Resident	Abundant
17.	Black crappie	*Pomoxis nigromaculatus*	Introduced	Resident	Sparse
18.	Northern Squawfish	*Ptychocheilus oregonensis*	Native	Resident	Unknown
19.	Bull trout	*Salvelinus confluentus*	Native	Both	Rare
20.	Longfin smelt	*Spirinchus thaleichthys*	Native	Resident	Unknown
21.	Tench	*Tinca tinca*	Introduced	Resident	Unknown

4.3.1 Chinook Salmon

The Puget Sound chinook salmon evolutionarily significant unit (ESU) was designated as threatened on March 24, 1999 (64 FR 14308). This ESU includes all naturally spawned spring, summer, and fall runs of chinook salmon in the Puget Sound region. Puget Sound chinook salmon critical habitat was designated on February 16, 2000 (65 FR 7777). Critical habitat is designated to include all marine, estuarine and river reaches that could be utilized by chinook salmon in the Puget Sound region. This incorporates the riverbed, bank, and riparian zone in all rivers currently or historically utilized by Puget Sound chinook salmon. Based on the fact that fall run chinook salmon utilize Little Bear Creek, the stream and shoreline are designated critical habitat.

Salmon spawning ground survey data from the WDFW from 1952 through 2000 indicates that chinook salmon utilization of Little Bear Creek is typically limited to less than 8 individuals (Table 4). The maximum daily count was 28 chinook salmon on October 21, 1981, but was typically between 1 and 5 (Appendix J). The highest yearly count occurred in 1981 when a total of 62 chinook salmon were counted (Table 4). The majority of higher counts occurred between RM 4.4 and 5.5. Sightings were made as early as September 29, and live fish were observed as late as November 3. Although the WDFW has surveyed Little Bear Creek since 1952, the first documented adult chinook salmon did not occur in Little Bear Creek until 1971 when one carcass was found on November 11 between RM 4.4 and 5.4.

Table 4:
Chinook Salmon Summary for Little Bear Creek based on WDFW Salmon Spawning Ground Survey Data

Year	Live Count	Dead Count	Total Count
1971	0	1	1
1972	0	1	1
1973	0	1	1
1974	3	3	6
1975	4	1	5
1976	13	12	25
1977	2	16	18
1978	11	40	51
1979	0	1	1
1980	0	2	2
1981	20	42	62
1982	0	3	3
1983	0	3	3
1984	0	4	4
1985	11	4	15
1986	0	5	5
1987	7	3	10
1988	0	6	6
1989	1	3	4
1990	0	0	0
1991	0	0	0
1992	0	0	0

Table 4 continued

Year	Live Count	Dead Count	Total Count
1993	0	0	0
1994	0	7	7
1995	0	0	0
1996	1	4	5
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
Total	73	162	235
Average	2.4	5.4	7.8

During the King County surveys from 1996 to 1999, year to year sightings have varied from zero to 12 observations. These numbers represent the minimum number of fish present since the entire stream was not surveyed. However, it does further indicate that Little Bear Creek is not heavily utilized by chinook salmon.

The origin of chinook salmon in Little Bear Creek is uncertain. Straying from either Bear Creek and/or the Issaquah Creek Hatchery is highly probable. Plants of fry and fingerling chinook salmon directly into Little Bear Creek totaled 1,083,300 from 1983 through 1992 (Appendix H). These were all fall chinook from the Issaquah Hatchery. No more plants by the WDFW are currently planned for Little Bear Creek (Foley, personal communication, 2001). In May of 2001, the Issaquah Creek Hatchery released 2,194,773 juvenile chinook salmon into Issaquah Creek. Some of the juveniles from the Issaquah Creek Hatchery and from naturally produced spawners in Bear Creek may utilize the lower segment of Reach 1 during their outmigration through the Sammamish River.

Juvenile chinook salmon typically exhibit either ocean-type or stream-type life history strategies. The primary difference between these strategies is residence time and growth rates. For the purposes of this report, residence time is important. Juvenile chinook salmon within the Lake Washington watershed exhibit the ocean-type strategy which means they rapidly exit their natal stream after emergence from the gravel (Fresh, personal communication, 2000). Data collected and analyzed by the WDFW indicate that the majority of the total juvenile out-migration in Bear Creek (immediately east of Little Bear Creek) occurred after mid-April, but varied between years (Seiler, 2001). The overall out-migration period ranges from mid-January through late June, but spikes between March and June. These trends can be expected to be "similar" to what occurs in Little Bear Creek.

4.3.2 Coho Salmon

Puget Sound/Strait of Georgia coho salmon was designated as a candidate for listing under the ESA on July 25, 1995 (60 FR 38011). If its status is changed to either threatened or endangered in the future, critical habitat may be designated at that time.

Salmon spawning ground survey data from the WDFW from 1952 through 2000 indicates "fair" numbers of coho salmon consistently spawn in Little Bear Creek, but during some years they are very abundant. The average total number of coho salmon observed each year in Little Bear Creek is

approximately 380 (1952 through 2000 excluding 1962 and 1969 [no data]). However, from 1976 to 1978 when the WDFW conducted intensive salmon spawning surveys at Little Bear Creek an average of approximately 2,700 coho were observed per year (range = 1,448 to 4,852). The abundance of coho salmon in Little Bear Creek appears to have dropped in the late 1980s to early 1990s. Prior to 1991 the yearly average total number of observations was approximately 460, after 1991 the yearly average was 68 with a high of 168 in 1995.

The two highest single day counts included 197 on December 14, 1979, and 191 on December 11, 1987 (Appendix J). Both of these daily counts only represent the adults observed between RM 4.4 and 5.5 on a specific day, and therefore, do not represent the total number of spawning adults in Little Bear Creek. From 1988 through 2000, the highest daily counts have been 40, 45, 46, 36, 9, 26, 4, 48, 38, 68, 25, 12, and 36, respectively. As previously stated, these numbers are not absolute in that they can only be used as an indicator of abundance. Numerous factors such as time of year, observer bias, survey effort, survey timing, flow, water clarity, and weather can all play a role in the total number of observations.

Unlike chinook salmon, coho juveniles spend from 1 to 2 years in freshwater before heading to sea. Their extended period of rearing in freshwater makes them especially vulnerable to changes in habitat, water quality, and hydrology. Following this period of freshwater residence, the juveniles migrate downstream to Lake Washington and then the ocean. They then spend about 18 months at sea before returning to their stream of origin for spawning (Wydoski and Whitney, 1979). Returning adult coho salmon stray within a watershed, and between watersheds.

Low numbers of juvenile coho salmon were captured in Reach 1, 2, and 3 during our electrofishing survey on August 24, and 31, 2001 (Appendix K). The total coho catch in Reach 1 was three juveniles during 110 seconds of effort, or one per 36.7 seconds. Juvenile coho represented 8.3 percent of the catch in Reach 1. One of the three coho had a clipped adipose fin and was therefore likely from the Issaquah Hatchery. The hatchery coho was much larger than the others with a total length of 10.7 centimeters (4.2 inches) versus an average length of 8.6 centimeters (3.4 inches) for the naturally produced coho (range: 8.4 to 8.9 centimeters [3.3 to 3.5 inches]). Two coho were captured in Reach 2 during 320 seconds of effort.

Electrofishing in Reach 3 produced the most coho, except that all the captures occurred in the upper-most section downstream of NE 205th Street. A total of nine juvenile coho were captured in the upper section of Reach 3 during 141 seconds of effort. This equates to one coho per 15.7 seconds of effort. Juvenile coho represented 20.4 percent of the salmonid catch in the upper section of Reach 3. Juvenile coho in the upper section of Reach 3 were smaller than those captured in Reach 1 with an average length of 7.8 centimeters (3.08 inches) ranging from 7.6 to 8.3 centimeters (3 to 3.25 inches). Overall, juvenile coho represented 7.7 percent of the total catch in Little Bear Creek. No coho were captured immediately upstream of NE 195th Street although 29 cutthroat trout and six sculpins were caught. No hatchery coho were captured in any section of Reach 2 or Reach 3.

The WDFW has planted 2,927,707 emergent, fingerling, fry, pre-smolt, and smolt coho salmon into Little Bear Creek between 1952 and 1978, and 1,161,763 between 1984 and 1997 (Appendix H). This does not include additional plants by the tribes, schools, or other organizations. During March of 2001, the Issaquah Creek Hatchery released two different size classes into Issaquah Creek totaling

2,250,549 (Appendix I). One of these juvenile coho was captured in Reach 1 of Little Bear Creek on August 24, 2001.

4.3.3 Sockeye Salmon

Sockeye salmon differ from other species of salmon in that juveniles require a lake environment to exist, where they spend 12 to 15 months maturing prior to going to sea (Wydoski and Whitney, 1979). Returning adult sockeye enter Lake Washington in late June and July, reside in Lake Washington until late August, and then spawn in numerous tributaries between September through early December (peaking in mid-October). An average female will produce approximately 4,000 eggs that hatch in 6 to 9 weeks, and then reside within the substrate for another 2 to 3 weeks. The newly hatched juveniles migrate from the tributaries into Lake Washington between January and April, but typically peak during March. These fish are the progeny of transplants from Baker River around the 1930s.

Kokanee are sockeye salmon that spend their entire life in freshwater. They are segmented into early-run and late-run races. Early-run kokanee spawn from August through September while the late-run spawns from October through December (King County, 2000a). The early-run variance is native to the Lake Washington system and has received much notice lately due to a decline in abundance. The late-run are the progeny of hatchery fish from Lake Whatcom planted in Big Bear Creek in the 1930s and 3.5 million planted in Lake Sammamish between 1976 and 1979 (King County, 2000a). However, the total number of kokanee planted in the Lake Washington system was approximately 35 million fry and fingerlings.

Several organizations have petitioned the United States Fish and Wildlife Service (USFWS) to list the early-run kokanee as an endangered species. To date, the USFWS has not responded to these petitions despite the population crash that occurred in the 1980s. During 2000, efforts were initiated to capture, rear, and then release early-run kokanee in order to increase the egg-to-fry survival rate. As of yet, these efforts have failed due to a lack of captured adult spawners.

Kokanee have been documented in Little Bear Creek (King County, 2000a). According to King County, up to 221 kokanee spawned in the lower most section of Reach 1 between September 27, through November 8, 1999. Kokanee were observed spawning in Little Bear Creek by DEA biologists during a water quality-monitoring event on September 20, 2001. Between 6 and 10 kokanee ranging from 17.8 to 35.6 centimeters (7 to 14 inches) long were observed immediately below the NE 178th Street culvert. The exact number is uncertain due to a lack of visibility under the overhanging cluster of Japanese knotweed where several more were hiding. One female between 17.8 to 20.3 centimeters (7 and 8 inches) long was observed digging a redd immediately under the downstream culvert edge in the center of a low-gradient riffle. Several others, suspected to be males, would occasionally be by her side, but dart between the redd and the cluster of Japanese knotweed along the left-bank. A minimum of four were observed, and several others were under the overhanging cluster of Japanese knotweed, and "thrashing/splashing noises" were emanating from under the cluster of knotweed. One additional redd was identified immediately downstream of the railroad crossing near the mouth (upstream of the Sammamish River trail crossing). The timing of these observations does not conclusively categorize them as either early or late-run kokanee, but leads to the possibility that they could be either. Some researchers have stated that during 1996, the timing of the early-run in Issaquah Creek extended from August 14, through September 16 (Ostergaard 1988 as reported by King County, 2000). Due to yearly

variations in water temperature and run timing, these dates are not absolute. However, due to the closeness between the observed spawning of kokanee in Little Bear Creek on September 20th, it is possible that these fish were a component of the early-run race.

Sockeye salmon are occasionally the most abundant spawning anadromous salmonid in Little Bear Creek. Based on salmon spawning ground data from the WDFW, adult sockeye salmon were first observed in Little Bear Creek in 1970 (WDFW, 2001). Low numbers (n) were observed in 1970 (n = 14), 1975 (n = 1), 1976 (n = 8), 1977 (n = 2), 1978 (n = 34), 1979 (n = 91), but began to increase substantially during 1987 when over 2,000 spawning adults were observed (Appendix J). Exceptionally large numbers of sockeye salmon spawned in Little Bear Creek in 1996 when 4,716 were recorded. Based on observations during field visits this year, 2001 will be another productive year for sockeye in Little Bear Creek.

4.3.4 Chum Salmon

Chum salmon often spawn near tidewater and begin to migrate back to the ocean soon after emergence. Spawning primarily occurs between October through December, and outmigration between March and June (Wydoski and Whitney, 1979). Chum salmon were considered extirpated from Lake Washington by the early 1930s (Goetz, proceedings from Conference, 2000). However, they are occasionally observed in tributaries to both Lake Washington and Lake Sammamish. Only two chum salmon have been observed in Little Bear Creek during the WDFW annual salmon spawning ground surveys from 1952 through 2000. These two adults were observed between RM 4.4 and 5.5 on November 6, 1976 (Appendix J). Based on the low number of observations of chum salmon in Little Bear Creek, these adults likely strayed from either the Cedar River or other Puget Sound watersheds.

4.3.5 Pink Salmon

Pink and chum salmon are similar in that they have a short residence time in freshwater as both adults and juveniles. Spawning occurs primarily between August and September (Wydoski and Whitney, 1979). Pink salmon were also considered extirpated from Lake Washington by the early 1930s (Goetz, proceedings from Conference, 2000). Only one adult pink salmon has been observed in Little Bear Creek (WDFW, 2001). The single adult was observed dead between RM 0.0 and 1.1 on November 1, 1977 (Appendix J). Based on the single observation of a pink salmon in Little Bear Creek, this adult was likely a strayed from a different Puget Sound watershed.

4.3.6 Cutthroat Trout

The life history of cutthroat trout is very diverse. Sea-run, adfluvial, and resident forms utilize the Lake Washington system. The resident form is likely the most abundant trout and the only resident salmonid in Little Bear Creek. During our electrofishing survey on August 24 and 31, 2001, cutthroat trout increased in abundance as we progressed upstream. They represented 8.6 percent of the catch in Reach 1 (n = 3), 50.8 percent in Reach 2 (n = 32), and 76.2 percent in Reach 3 (n = 64). Overall, cutthroat trout represented 54.4 percent of the total catch in Little Bear Creek. The largest specimen captured was in Reach 3 and was 21.6 centimeters (8.5 inches) long (Appendix K).

4.3.7 Western Brook Lamprey

Three species of lamprey have been documented in the State of Washington including the western brook lamprey (*Lampetra richardsoni*), Pacific lamprey (*Entosphenus tridentatus*), and river lamprey (*Lampetra ayresi*). Of these, only the western brook lamprey was documented in Little Bear Creek by DEA.

Adult western brook lampreys are the smallest of the lamprey family by being usually less than 17.8 centimeters (7 inches) in length (Wydoski and Whitney, 1979). They are slender, have dull/ nonfunctional teeth, may live for up to 6 years, and spend their entire life in freshwater. Unlike other species of lampreys, the brook lamprey does not attach themselves to other fish. Spawning occurs in small-excavated "nests" from April to July. Up to 12 adults may use a single nest and die soon after spawning. Juveniles are called ammocoetes and are non-parasitic filter feeders that consume primarily microscopic plant and animal matter such as diatoms, algae, and detritus.

Western brook lampreys were observed in Reaches 2 and 3, and in Tributary D as depicted on Figure 3 immediately downstream of 140th Place NE. Spawning behavior in the form of nest building and quivering was noted in the large pool immediately downstream of NE 205th Street and in a low-gradient riffle in Reach 2. In Reach 3 approximately 12 spawning lampreys were observed on June 15, 2001, at the NE 205th Street site. It is interesting to note that the same site along the edge (RB) of the pool near the tailout was later used by sockeye salmon for spawning. Numerous other sightings of lampreys occurred throughout Reaches 2 and 3 during the survey.

4.3.8 Coastrange Sculpin

The coastrange sculpin inhabits medium to large streams along the West Coast from California to Alaska. They grow to 7.6 to 10.2 centimeters (3 to 4 inches) long depending on geographic location, and spawn from mid-February to June (Wydoski and Whitney, 1979). They feed primarily on aquatic insects but will eat stray salmonid eggs when available. Large adult sculpins may feed on salmonid fry but are in-turn eaten by larger salmon and trout.

Sculpins are the most difficult fish in Washington to identify to species because of their morphological variations and small size (Wydoski and Whitney, 1979). At least 11 species occur in Washington State, some of which may hybridize and result in similar characteristics that further complicates species identification. Some of the characteristics that distinguish the coastrange sculpin from other species include its non-contiguous dorsal fin (separated to base), distinct tubular nostril, lack of palatine teeth, and absence of prickles and dark vertical bars (Wydoski and Whitney, 1979).

DEA documented coastrange sculpins throughout Little Bear Creek (Appendix K). Sculpins represented 82.9 percent of the catch in Reach 1 (n = 29), 46 percent in Reach 2 (n = 29), and 13.1 percent in Reach 3 (n = 23). The overall catch in Little Bear Creek was 37.9 percent. Although the majority of specimens captured were coastrange sculpins, some differed and may have been reticulated sculpins. The variation included the presence of a slightly contiguous dorsal fin on larger specimens.

4.3.9 Mollusks and Crawfish

Other aquatic species observed in Little Bear Creek include mollusks, crawfish, and macroinvertebrates. The western pearlshell (*Margaritifera falcata*) has been documented within

upper Little Bear Creek within Snohomish County. Several shells were observed in Little Bear Creek within King County, but no live specimens were documented during the DEA stream survey. These shells likely floated downstream during flood events. Another mollusk referred to as the Asian clam (*Coricula fluminea*) was observed in the Sammamish River near the mouth of Little Bear Creek during the DEA stream survey. The Asian clam is an introduced species known to be present in the Colombia River, but never previously documented in the Sammamish River. Crawfish are also present in the Sammamish River and Little Bear Creek. However, their presence in Little Bear Creek appears to be limited to the lowermost section of Reach 1.

4.4 STREAM HABITAT

DEA biologists surveyed the entire section of Little Bear Creek within the City of Woodinville between its mouth to NE 205th Street from June 25, through August 1, 2001. A total of 3,484.1 meters (2.2 miles) of stream was surveyed from the mouth of Little Bear Creek at the Sammamish River to the crossing under NE 205th Street along the City of Woodinville and Snohomish County line (Table 5). Little Bear Creek was segmented into three reaches. Reach 1 began at the mouth of Little Bear Creek and extended to the downstream end of the culverts under SR 202. Reach 2 started at the downstream side of the culverts under SR 202 and extended to the upstream side of the culverts under Highway 522. Reach 3 began at the upstream side of Highway 522 and ended at NE 205th Street, which follows the City of Woodinville and Snohomish County line.

Table 5:
Survey Summary for Reach 1, 2, and 3 of Little Bear Creek in Woodinville, Washington (WDFW Stream Number 08-0080)

	Reach 1	Reach 2	Reach 3
Date Surveyed	6/25/01	6/26/01 – 7/6/01	7/19/01 – 8/1/01
Total Length Surveyed	388.2 meters (0.24 mile)	1,725.7 meters (1.07 miles)	1,370.2 meters (0.85 mile)
Bank Full Width	4.5 – 6.6, x[1] = 5.8 meters	3.1 – 8.8, x = 6.2 meters	5.6 – 8.2, x = 6.9 meters
Total # of Habitat Units (NSOs)	14	105	94
Total Habitat Area	1,773.58 m^2	9,267.05 m^2	7,379.52 m^2
Percent Pool by Area	13.74%	34.01%	36.57%
Percent Glide by Area	15.04%	20.48%	21.34%
Percent Riffle by Area	71.22%	47.67%	42.09%
# Hardened Crossings	3	4	3
Percent Armoring	98.3%	13.7%	15.5%
Placed Structures	6 log weirs	0	5 rip/rap weirs
Gradient	0.25 – 1.25%	0.56 – 1.2%	0.31 - 0.87%
Sinuosity	1.01	1.15	1.08
Number Wolman Measurements	2	5	4
% Fines < 6 mm	19 – 40%, x = 29.5%	15 – 41%, x = 27%	13 – 31%, x = 21.5%
Wolman Pebble Count D-50	x = 20.6 mm	x = 21.9 mm	x = 29.6 mm
Dominant Substrate Type	Coarse gravel	Coarse gravel	Coarse gravel
Flow Measurement (8/24/01)	15.02 cfs	Not measured	13.77 cfs

Note #1: X = mean measurement.

4.4.1 Pool/Riffle Habitat

Pools and riffles are the basic components of stream habitat. The percentage and quality of these basic components help define the overall health of a stream. They are also key parameters that help

support both resident and anadromous populations of salmonids as well as other aquatic species that depend on a "healthy" stream.

Pool Habitat: Pools are used by adult salmonids for cover and resting, and pool tailouts are key spawning sites for many species. Juveniles depend on pools for cover, feeding, and refuge during extremes in stream flow. As the quantity and quality of pool habitat decreases, so does the abundance of aquatic life (salmonids, insects, mollusks, etc.). The importance of pool habitat and their associated tailouts can not be overstated. All spawning sockeye in Little Bear Creek observed during our studies were spawning in pool tailouts or the transition between the pool and their associated tailout. Although riffle habitat is also used in streams such as Little Bear Creek, riffles tend to be too shallow to be used consistently by most salmonids.

Pools are typically formed by stationary features such as large woody debris and boulders, abrupt changes in elevation, and changes in the direction of flow and substrate. The loss of large conifers within the riparian zone that contribute to in-stream woody debris and removal of in-stream wood has reduced the abundance and quality of pool habitat. Additional factors such as reduction in sinuosity, increased sedimentation, and changes in hydroperiod have further reduced habitat complexity.

In order to rate a stream within an urbanized environment, comparisons are made to more natural streams that have not been as heavily impacted by anthropogenic factors. Several researchers as well as state and federal agencies have suggested some basic standards upon which to rate a stream. Because of the wide variation in streams, bankfull width (BFW) and gradient are typically used as the parameters to which the standards are based. This is done so that comparisons are made to similar sized streams. Regardless of size, the overall area of pool habitat in a stream is typically expected to be about 40 percent to 60 percent to be considered optimum (Peterson et al., 1992).

Pool Frequency: The NMFS (1996) utilizes channel width (BFW) to develop a desired pool frequency (# pools/mile). Since the average BFW varied by reach, the desired pool frequency also varies. A stream is considered *properly functioning* if it meets the desired pool frequency and the large woody debris standards for properly functioning is also met (NMFS, 1996). A stream is considered *at risk* if it meets the desired pool frequency but large woody debris recruitment is inadequate to maintain pools overtime. A stream is considered to be *not properly functioning* if it does not meet the pool frequency standards. A comparison of the NMFS pool frequency standards and results of the DEA survey are presented below in Table 6.

Table 6:
Pool Frequency Data for Little Bear Creek, Woodinville

Reach	BFW	NMFS Match	NMFS Goal	Actual
Reach 1	19.0 ft.	20 ft.	56 pools/mile	21 pools/mile
Reach 2	20.3 ft.	20 ft.	56 pools/mile	43 pools/mile
Reach 3	22.6 ft.	25 ft.	47 pools/mile	41 pools/mile
Average	20.7 ft.	20 ft.	56 pools/mile	40 pools/mile

Based on the results presented in Table 6, pool frequency in Little Bear Creek is **not properly functioning**. This conclusion is strengthened by the fact that large woody debris recruitment is not sufficient to maintain existing pools over time due to the absence of large mature conifers within most of the riparian zone. Furthermore, the overall number of pools per kilometer in Little Bear Creek as it

flows through the City of Woodinville is 24.7 (40/mile), and the overall percentage of pool habitat is 33.1 percent. This further indicates that the frequency of pool habitat is below optimum levels.

Pool Quality: Although the number of pools is very important, another important factor is the residual depth, which is defined as the maximum depth minus tailout depth. The premise of residual depth is that deeper pools provide more cover, are more stable, and can be utilized by larger salmonids such as chinook. Shallow pools provide less cover, can be rapidly filled by sediment, and do not provide good refugia for salmonids.

The NMFS (1996) considers that pool quality is *properly functioning* when they contain pools >1 meter (3.3 feet) deep with good cover and cool water, and minor reduction of pool volume by fine sediment. Pool quality is *at risk* when few pools >1 meter (3.3 feet) are present or have inadequate cover/temperature, and only a moderate reduction in pool volume by fine sediment. Pool quality is *not properly functioning* when no pools are >1 meter (3.3 feet) deep and have inadequate cover/temperature, and there is a major reduction of pool volume by fine sediment. The NMFS Matrix of Pathways and Indicators does not mention "residual depth," therefore maximum depth will be used.

Within Reach 1, none of the five pools had a maximum depth >0.90 meter (2.9 feet). The maximum pool depth was 0.90 meter (2.9 feet), average pool depth was 0.60 meter (2 feet), average maximum depth was 0.85 meter (2.8 feet), average residual depth was 0.55 meter (1.8 feet), and maximum residual depth was 0.70 meter (2.3 feet). These pools also lacked "good" cover and "cool" water. Therefore, pool quality in Reach 1 is **not properly functioning**.

Reach 2 contained 46 pools, but only eight (17.4 percent) had a maximum depth equal to or >1 meter (3.3 feet). The maximum pool depth was 1.1 meter (3.6 feet), average pool depth was 0.43 meter (1.4 feet), average maximum depth was 0.73 meter (2.4 feet), average residual depth was 0.55 meter (1.8 feet), and maximum residual depth was 0.90 meter (2.9 feet). Although some of the pools contained good cover, most did not. Therefore, pool quality in Reach 2 is considered **at risk**.

Pool quality increased in Reach 3 due to the presence of deeper pools. Reach 3 contained 35 pools, nine (25.7 percent) of which had a maximum depth equal to or greater than 1 meter (3.3 feet). The maximum pool depth was 1.71 meter (5.6 feet), average pool depth was 0.39 meter (1.3 feet), average maximum depth was 0.75 meter (2.5 feet), average residual depth was 0.54 meter (1.8 feet), and maximum residual depth was 1.51 meter (4.9 feet). Compared to Reaches 1 and 2, the percentage of deeper pools increased and overall water temperature decreased, but few pools were considered to provide adequate cover. A reduction in pool volume due to fines was observed. Although conditions improved in Reach 3, pool quality is considered **at risk**. The overall pool quality in Little Bear Creek as it flows through the City of Woodinville is considered also **at risk** because few pools are greater than 1 meter (3.3 feet) deep.

Riffle Habitat: Riffles are also important spawning areas in many streams, and support a myriad of macroinvertebrates that provide the primary food source for juvenile salmonids as well as other species of fish. Gradient and water depth dictates the suitability for salmonid spawning while embeddedness and overall abundance of fines influence productivity. The NMFS (1996) states that gravel or cobble should be the dominant substrate, with embeddedness being less than 20 percent to be *properly functioning*. In other words, the interstitial spaces between the gravel or cobble should not be filled with more than 20 percent fines, and the gravel should not be compacted. Although

salmonids can and do spawn in gravel containing excess fines, the egg-to-fry ratio may be low. This could result in few, if any eggs surviving to the fry stage due to suffocation and entrapment.

Table 7 below summarizes the pool, riffle, and glide habitat parameters quantified by this survey. The raw data are provided in Appendix M. Table 7 is segmented by reach in order to capture trends as Little Bear Creek flows through the City of Woodinville. Overall, Reach 1 near the mouth of Little Bear Creek has been severely degraded while Reach 2 and 3 still contain "fair" habitat. Although pool habitat is **not properly functioning** based on NMFS standards, Reaches 2 and 3 of Little Bear Creek do contain a fair amount of suitable habitat (although somewhat degraded). The primary factors that have degraded pool habitat in Little Bear Creek are the lack of in-stream large woody debris, and relatively heavy sediment load.

Table 7:
Pool, Riffle, and Glide Habitat Summary for Reach 1, 2, and 3 of Little Bear Creek

	Reach 1	Reach 2	Reach 3
Total Habitat Area	1,773.58 m^2	9,267.05 m^2	7,379.52 m^2
Total Pool Area	243.66 m^2	3,151.51 m^2	2,698.64 m^2
Total Glide Area	266.81 m^2	1,898.24 m^2	1,574.86 m^2
Total Riffle Area	1,263.11 m^2	4,417.305 m^2	3,106.02 m^2
Percent Pool by Area	13.74%	34.01%	36.57%
Percent Glide by Area	15.04%	20.48%	21.34%
Percent Riffle by Area	71.22%	47.67%	42.09%
Number of Pools	5 (4 of 5 man made)	46	35
Pools per Kilometer	12.88	26.66	25.54
Total Length of Pool Habitat	74.8 meters	548.2 meters	421.9 meters
Dominant Pool Type	Plunge	Scour	Scour
Average Length of Pools	14.96 meters	11.92 meters	12.05 meters
Average Residual Pool Depth	0.55 meter	0.55 meter	0.54 meter
Maximum Residual Depth	0.70 meter	0.90 meter	1.51 meter
Maximum Pool Depth	0.90 meter	1.1 meter	1.71 meter
Average Maximum Pool Depth	0.85 meter	0.73 meter	0.75 meter
Average Pool Depth	0.60 meter	0.43 meter	0.39 meter
Average Pool Width	4.02 meters	6.10 meters	6.19 meters
Number of Riffles	4	43	40
Total Length of Riffle Habitat	246.80 meters	841.4 meters	634.28 meters
Average Length of Riffles	61.70 meters	19.57 meters	15.86 meters
Average Width of Riffles	5.35 meters	4.80 meters	4.81 meters
Average Depth of Riffles	0.34 meter	0.20 meter	0.16 meter
Number of Glides	5	16	19
Total Length of Glides	66.60 meters	336.1 meters	313.98 meters
Average Length of Glide Habitat	13.32 meters	19.57 meters	16.53 meters
Average Width of Glides	4.1 meters	4.75 meters	5.09 meters
Average Depth of Glides	0.43 meter	0.34 meter	0.25 meter

4.4.2 Large Woody Debris

Large woody debris (LWD) is a critical component of stream habitat because it creates pools, structure, and habitat diversity. Large pieces of coniferous trees provide the best habitat since they

are long-lived and will not decay as rapidly as deciduous trees. Large pieces will also stay stationary during high flows and scour out pool habitat as water velocity is redirected around them.

The USFS protocol for LWD west of the Cascades segments wood into three size categories based on length and diameter (USFS, 2001). Small LWD must have a diameter >30.5 centimeters (12 inches) at a length of 7.62 meter (25 feet) from the large end. Medium LWD must have a diameter >61 centimeters (24 inches) at a length of 15.24 meter (50 feet) from the large end. Large LWD must have a diameter >0.91 meter (36 inches) at a length of 15.24 meter (50 feet) from the large end. The NMFS recommends that streams should have a minimum of 80 pieces of LWD per 1.61 km (1 mile) that are at least 15.24 meter (50 feet) long with a diameter of at least 61 centimeters (24 inches) to be *properly functioning*.

Both the USFS and NMFS standards are larger than what is now typically found in Puget Sound lowland streams. Although present in some streams in low numbers, LWD of this size are more appropriately categorized as remnant key pieces. Because of their scarcity, the new standard of measuring and categorizing pieces >2 meters (6.6 feet) long and wider than 10 centimeters (3.9 inches) has been adopted by several jurisdictions. Although these smaller pieces are not as influential as the key pieces, they do provide some function. By measuring and categorizing their size, abundance, and species, a more accurate account of existing habitat conditions can be obtained. Appendix N contains all the specific details of each piece of wood >2 meters (6.6 feet) long and 10 centimeters (4 inches) wide encountered in Little Bear Creek as it flows through the City of Woodinville.

Only 5 pieces large enough to meet the NMFS standard were recorded throughout the 3.48 kilometers (2.2 miles) of stream surveyed within the City of Woodinville. Researchers have documented that the occurrence of smaller pieces of wood such as those inventoried during this survey in natural streams occur at a rate of 150 to 460 pieces per kilometer (0.62 mile) (Peterson et al., 1992). The total number of pieces of LWD greater than 2 meters (6.6 feet) long per kilometer (0.62 mile) in Little Bear Creek is 110.5. Based on the NMFS criteria, large woody debris is **not properly functioning** in Little Bear Creek. Table 8 below summarizes our findings by reach, and the raw data are presented in Appendix N.

Table 8:
Woody Debris Summary for Reach 1, 2, and 3 of Little Bear Creek

	Reach 1	Reach 2	Reach 3
Total Wood Inventoried	16 pieces	217 pieces	152 pieces
# NMFS Woody Debris	0	4	1
Pieces (> 2 m long) per Meter	0.04	0.13	0.11
Pieces (> 2 m long) per kilometer	47.31	125.75	110.93
Distance between Pieces	24.26 meters	7.95 meters	9.01 meters
% Coniferous Woody Debris	66.7% (weirs)	23.6%	34.5%
% Deciduous Woody Debris	33.3%	76.4%	65.5%
Dominant Conifer Species	Cedar	Cedar	Cedar
Dominant Deciduous Species	Alder	Alder	Alder
Average Length	3.66 meters	3.31 meters	3.74 meters
Average Diameter	32.5 cm	29.2 cm	27 cm
# Stumps	0	18	10
# Log Jams	0	4	3

Note: The results for Reach 1 were skewed due to the presence of log weirs.

4.4.3 Sediment and Substrate

Stream substrate varies significantly on all scales, and no survey method is perfect at documenting substrate composition on the reach scale. DEA utilized the Wolman (1954) pebble count due to its ease of use, comparability with existing data, and acceptance by both King County and the USFS. However, the Wolman pebble count method focuses on riffle habitat and hence does document substrate composition in pool tailouts. Pool tailouts are often extensively used for spawning.

Variation in substrate occurs by watershed, stream, reach, and habitat type. The substrate also varies on the site-specific scale when analyzing either lateral or longitudinal change. This variation in conjunction with the numerous methods of assessing substrate composition has created difficulties in adequately documenting and interpreting the results of sampling efforts. However, the variation in substrate composition on the watershed scale is one of the many factors that allows for a diverse benthic community to exist such as macroinvertebrates, mollusks, and numerous species of fish that reside within the substrate during their larval stage. A few of the factors that influence substrate composition include flow, gradient, sediment load, and location within the watershed.

Sediment: The focus of most stream substrate assessments is to determine the percentage of fines in potential salmonid spawning habitat. The percentage of fines is then used to infer the quality of spawning habitat because too many fines can degrade in-stream habitat and adversely impact salmonid spawning success. Streams in urbanized watersheds "tend" to have a larger percentage of smaller particles (May, 1996). The NMFS Matrix, as modified by the Mt. Baker/Snoqualmie National Forest, uses percent fines as an indicator of the quality of potential spawning and rearing habitat. Percent fines is used for assessing both spawning and incubation habitat. However, the size range depends on if the field data is collected from the stream surface (<6 millimeters [0.24 inch]) or from within the substrate (<0.85 millimeter [0.03 inch]). The Wolman pebble count collects stream substrate surface data. Therefore, based on NMFS Matrix values as modified by the Mt. Baker/Snoqualmie National Forest that includes surface fines: ≤20 percent fines (<6 millimeters [0.24 inch]) and low turbidity is considered *properly functioning* in most watersheds, 12 percent to 20 percent fines and moderate turbidity is considered *at risk*, and >20 percent fines and high turbidity is considered *not properly functioning* (Appendix L-2).

The results of the Wolman pebble count data collected in Little Bear Creek highlights the variability of fines (Table 9). Data was collected at 11 riffles, the percent fines <6 millimeter (0.24 inch) ranged from 13 percent to 41 percent, with an overall average of 25.45 percent. Based on these results, the sediment indicator at the local level ranges from **properly functioning** to **not properly functioning**, but averages in the **at risk** range. Assuming this data is representative and enough samples were collected to identify possible trends, an overall general trend of fewer fines per reach occurred as sampling progressed upstream. The average percent fines in Reach 1 was 29.5 percent, Reach 2 was 27 percent, and Reach 3 was 21.5 percent. These reach averages are all greater than 20 percent, and therefore indicates that the overall sediment indicator for Little Bear Creek is **not properly functioning**.

Table 9:
Substrate Composition Based on Wolman Pebble Counts in Little Bear Creek, Woodinville

#	Reach #	NSO	Location	Fines <6 mm	D35	D50	D84	D95
1.	1	1	R1: Station 18.4	40%	1.9 mm	16.0 mm	175.8 mm	299.3 mm
2.	1	14	R8: Imm. D. stream SR 202	19%	14.2 mm	25.1 mm	132.4 mm	203.4 mm
3.	2	2	Imm. U. stream SR 202	21%	19.2 mm	29.6 mm	64.9 mm	99.5 mm
4.	2	15	R9	41%	1.9 mm	10.1 mm	30.7 mm	44.0 mm
5.	2	27	Station 558.9, UW Bug site	26%	9.6 mm	16.5 mm	35.0 mm	50.7 mm
6.	2	56	R26: Station 1015	32%	8.0 mm	17.9 mm	30.9 mm	43.2 mm
7.	2	76	NSO 76	15%	27.0 mm	35.5 mm	67.5 mm	93.8 mm
8.	3	3	R2	13%	22.9 mm	30.6 mm	57.1 mm	78.1 mm
9.	3	38	R23	24%	20.1 mm	48.7 mm	48.7 mm	61.1 mm
10.	3	50	R30	18%	16.1 mm	22.7 mm	58.4 mm	87.5 mm
11.	3	81	R49	31%	7.4 mm	16.2 mm	41.9 mm	63.9 mm

Wolman pebble count data also documents larger particle size distribution (D35 – D95). The "D" represents distribution, while the adjoining number represents the percentile of interest. The D35 equates to the distribution of the 35 percentile of the particle size distribution. Whereas the D50 is the median particle size of a distribution that divides the distribution in two equal parts (mid-point/median). Another way of expressing this concept is that a percentile is a sediment size indicated by the cumulative distribution curve for a particle "percent finer" value. Therefore, D35 means 35 percent of the sample was smaller than the cumulative particle size (diameter in millimeters) documented at the riffle. In the case of the first sample site, 35 percent of the pebbles measured were smaller than 1.9 millimeter (0.075 inch) in diameter. The data in the form of a cumulative distribution curve from each of the sample sites is provided in Appendix O.

Substrate: The NMFS utilizes both embeddedness and substrate composition as the indicators for substrate quality. The percentage embeddedness is obtained visually and is extremely subjective. The NMFS criteria for *properly functioning* is a dominance of gravel or cobble (interstitial spaces clear) and embeddedness <20 percent, *at risk* is gravel and cobble subdominant or if dominant embeddedness is between 20 percent and 30 percent, and *not properly functioning* if bedrock, sand, silt or small gravel dominant or if gravel and cobble dominant embeddedness is >30 percent.

Based on the D50 results, the median gravel size in riffles throughout Little Bear Creek in the City of Woodinville ranged from medium to very coarse gravel. The D50 in Reach 1 ranged from 16 to 25.1 millimeters (0.63 to 0.99 inch) with the average being 20.55 millimeters (0.81 inch) (coarse gravel). The D50 in Reach 2 ranged from 10.1 to 35.5 millimeters (0.40 to 1.4 inches) with the average being 21.92 millimeters (0.86 inch) (coarse gravel). The D50 in Reach 3 ranged from 16.2 to 48.7 millimeters (0.64 to 1.92 inches) with the average being 29.55 millimeters (1.16 inches) (coarse gravel). Although more samples should be taken to increase confidence levels, there appears to be a trend of increasing D50 results as the upstream distance from Reach 1 increases. Although coarse gravel was dominant, interstitial spaces were not clear, and embeddedness averaged from 20 percent to 30 percent (sometimes >30 percent). Based on these results, the Habitat Element Pathway – Substrate Indicator is **at risk**.

4.4.4 Off-Channel Habitat/Refugia

The availability of "adequate" off-channel habitat and refugia are indicators of a stream's ability to provide a safe haven for primarily juvenile fish during high flow events. These are generally areas of lower stream velocity that can be accessed during flood events, but also includes low energy areas during normal stream flows such as backwater areas with cover, ponds, and oxbows.

Few side-channels, oxbows, or other types of potential off-channel habitat/refugia exist along Little Bear Creek. Although a few potential off-channel habitat and refugia sites were noted, they were not adequately abundant or distributed in Little Bear Creek. It appears that hydromodifications in the form of rip/rap armoring throughout Reach 1, and sections of Reaches 2 and 3 in conjunction with the loss of adjacent wetlands and tributaries that are culverted into Little Bear Creek, the indicator for off-channel habitat and refugia are **not properly functioning**.

4.4.5 Channel Condition and Dynamics

The channel condition and dynamics pathway includes three primary indicators assessed by the NMFS. These include: (1) width/depth ratio, (2) streambank condition, and (3) floodplain connectivity. Additional parameters not included in the Matrix of Pathways and Indicators developed by the NMFS (1996) that also provide insight into channel conditions and dynamics of a stream include: channel sinuosity and percent armoring. Although no specific percentages have been defined by the federal agencies for these last two indicators, they provide insight into the degree of anthropogenic influences that have been placed upon a stream. Both channel sinuosity and percent armoring are often closely associated with each other in that as the percentage of armoring increases the overall sinuosity decreases.

Width/Depth Ratio: The width/depth ratio concept relies on the premise that a stream channel will incise when banks are armored. This channel down cutting is created as high-flows that would normally spill-out into and over the adjacent stream banks are forced to stay within the defined channel by the presence of armoring (typically large rip/rap). The hydrologic impacts of urbanization typically widen and/or deepen a stream channel when the banks are not armored, but streamside development will often have the opposite effect (May et al., 1997).

The NMFS (1996) states that a *properly functioning* stream has a width/depth ratio of <10, an *at risk* stream has a ratio between 10 to 12, and the ratio for a *not properly functioning* stream is >12 (Appendix L-1). Based on the results of King County (2001b), the width/depth ratio for Reaches 1 through 3 is 5.8, 5.3, and 8.0, respectively. Based on their data, this indicator is **properly functioning** throughout Reaches 1 through 3. Although this could possibly be true for Reaches 2 and 3, it does not seem possible that Reach 1 could be properly functioning given that 98.3 percent is armored close to the bankfull line. Based on this, and that May et al., (1997) found varying results, this indicator as currently defined does not appear to be suited for urbanized streams in Puget Sound. Considering these issues, the width/depth ratio in Reach 1 is considered by DEA to be **not properly functioning**, and **at risk** in Reaches 2 and 3.

Streambank Condition: Streambank condition refers to the percentage of the bank that is stable and the percentage that is actively eroding. The NMFS (1996) defines a *properly functioning* streambank as being >90 percent stable with <10 percent actively eroding, 80 percent to 90 percent stable when *at risk*, and <80 percent stable when *not properly functioning*. This indicator also appears at least

partially flawed since a streambank that is completely armored would be considered stable using this approach and would be categorized as properly functioning. If the banks contain a predominance of gravels and not fines, the addition of new gravels to a stream channel can be beneficial. King County (2001b) reported that Reach 1 was 32 percent armored, 32 percent full scour, 33 percent low scour, and zero percent stable. Reach 2 was 9 percent armored, 18 percent full scour, 46 percent low scour, and 27 percent stable (King County, 2001b). Reach 3 was 6 percent armored, 16 percent full scour, 26 percent low scour, and 52 percent stable (King County, 2001b).

DEA biologists documented 98.3 percent armoring in Reach 1 distributed equally between the left and right banks. The percent armoring in Reach 2 varied depending upon bank (Table 10). The right bank (RB) was armored for a distance of 185.6 meters (608.9 feet) or 10.7 percent, while the left bank (LB) was armored for 288.4 meters (946.2 feet) or 16.7 percent. This discrepancy is due to the abundance of businesses along the left bank, and the relatively long distance between the right bank and Highway 522. Several sites along the left bank were experiencing localized sloughing as a result of streambank encroachment and absence of riparian vegetation (Appendix D – Reach 2 Photo 7). The percent armoring in Reach 3 also varied depending upon bank. The right bank was armored for a distance of 225.6 meters (740.2 feet) or 16.5 percent, while the left bank was armored for a distance of 198.5 meters (651.2 feet) or 14.5 percent. Based on these results, the streambank condition indicator is **not properly functioning**.

Table 10:
Bank Armoring Along Little Bear Creek in Woodinville

#	Reach	Bank	Downstream Station (m)	Upstream Station (m)	Length	Comment
1.	1	RB	6.6	388.2	381.6 meters	Rip/rap +
2.	1	LB	6.6	388.2	381.6 meters	Rip/rap +
3.	2	RB	0.0	39.7	39.7 meters	SR 202 culvert
4.	2	LB	0.0	39.7	39.7 meters	SR 202 culvert
5.	2	LB	128.6	138.2	9.6 meters	Rip/rap
6.	2	RB	196.0	226.5	30.5 meters	132nd Ave culvert
7.	2	LB	196.0	226.5	30.5 meters	132nd Ave culvert
8.	2	LB	254.5	274	19.5 meters	Rip/rap
9.	2	LB	311.4	315.2	3.8 meters	Rip/rap
10.	2	RB	487.1	498.6	11.5 meters	134th Ave culvert
11.	2	LB	487.1	498.6	11.5 meters	134th Ave culvert
12.	2	LB	778.4	786.0	7.6 meters	Gabion weir
13.	2	LB	839	846.1	7.1 meters	Rip/rap
14.	2	LB	870.9	898.5	27.6 meters	Rip/rap
15.	2	LB	1262.7	1274.2	11.5 meters	Rip/rap
16.	2	LB	1281.2	1286.3	5.1 meters	Rip/rap
17.	2	LB	1380.7	1390.2	9.5 meters	CMP discharge
18.	2	RB	1595.7	1637.1	41.4 meters	Old crossing +
19.	2	LB	1595.7	1615.6	19.9 meters	Old crossing +
20.	2	LB	1651.7	1666.7	15.0 meters	Rip/rap
21.	2	RB	1666.7	1725.7	62.5 meters	Hwy 522 culvert
22.	2	LB	1666.7	1725.7	62.5 meters	Hwy 522 culvert
23.	3	RB	0.0	17.1	17.1 meters	Rip/rap deflector
24.	3	LB	135.3	155.4	20.1 meters	Rip/rap - On-ramp

Table 10 continued

#	Reach	Bank	Downstream Station (m)	Upstream Station (m)	Length	Comment
25.	3	LB	267.6	273.1	5.5 meters	Rip/rap - On-ramp
26.	3	RB	277.7	313.6	35.9 meters	Rip/rap - House
27.	3	LB	271.3	313.6	42.3 meters	Rip/Rap - On-ramp
28.	3	RB	313.6	350.2	36.6 meters	NE 195th Street culvert
29.	3	LB	313.6	350.2	36.6 meters	NE 195th Street culvert
30.	3	RB	350.2	396.0	45.8 meters	Old business
31.	3	LB	350.2	396.0	45.8 meters	Old business
32.	3	LB	616.9	634.9	18.0 meters	Hwy 522 edge
33.	3	RB	915.3	1005.5	90.2 meters	Old Bridge + yards
34.	3	LB	915.3	934.5	19.2 meters	Old Bridge
35.	3	LB	1297.5	1308.5	11.0 meters	House

Floodplain Connectivity: The floodplain indicator as defined by the NMFS (1996) includes hydrologic linkage between adjacent off-channel areas, wetlands, and riparian vegetation and succession. This indicator does not specify quantifiable measurements, but relies on subjective inferences of frequently linked, reduced linkage, and severe reduction in linkage. Based on the lack of off-channel habitat, adjacent wetlands, and greater than 10 percent armoring along all three reaches, this indicator is **not properly functioning**.

4.4.6 Riparian Habitat

Riparian habitat is defined as the land adjoining the stream that influences stream habitat and its processes. The composition and quantity of riparian habitat directly influences temperature, sedimentation, productivity, habitat complexity, and the streams disturbance regime. An "intact" riparian zone buffers the stream from outside elements. One issue today is how large does a buffer have to be to protect a stream from anthropogenic influences. A buffer of 30.5 meters (100 feet) is often used for salmonid-bearing streams. However, many researchers have documented that a 30.5-meter (100-foot) buffer is not sufficient in protecting a stream and its processes from all anthropogenic influences, especially when the quality of the existing buffer is low. Some researchers have suggested that if the goal is to truly protect a valuable resource, than buffer width should be at least 100 meters (328 feet). However, this width can be adjusted downward depending on the maturity and overall percentage of the existing riparian habitat. Furthermore, it is also recognized that the composition of the entire watershed plays a vital role in a stream's overall health. On the watershed scale, the percent or fraction of total impervious area has been found to have a direct correlation with a stream's productivity (May et al., 1997).

This report will focus on a linear corridor adjacent to the stream, 61 meters (200 feet) from each bank or 122 meters (400 feet) total width. Site specific conditions within the City of Woodinville based on aerial photographs from 1999 indicate the width of the Little Bear Creek vegetated riparian buffer varies considerably by reach (Appendix G).

The width of the vegetated riparian buffer in Reach 1 averages about 7.6 meters (25 feet) wide and is abutted by development along both banks. The overall 121.9-meter (400-foot) wide corridor

within Reach 1 was composed of 64.36 percent impervious surface, 27.97 percent shrub/grass habitat, 5.11 percent forest habitat, and 2.59 percent gravel area.

The width of the vegetated buffer in Reach 2 varied between the left and right banks. The left bank ranges from 7.6 to 22.9 meters (25 to 75 feet) wide (average width about 7.6 meters [25 feet]) and is abutted by businesses. The right bank ranges from 15.2 to >61 meters (50 to >200 feet) wide (average width about 45.7 meters [150 feet]) and is abutted by Highway 522. The overall 122-meter (400-foot) wide corridor within Reach 2 was composed of 19.38 percent impervious surface, 46.46 percent shrub/grass habitat, 21.63 percent forest habitat, and 12.52 percent gravel area.

The width of the vegetated riparian buffer along both banks of Reach 3 varies from 15.2 to >61 meters (50 to >200 feet). The right bank is relatively unconstrained while the left bank is defined by Highway 522. The overall 122-meter (400-foot) corridor in Reach 3 was composed of 17.12 percent impervious surface, 1.55 percent gravel area, 45.76 percent forested habitat, and 35.56 percent shrub/grass habitat (Table 11).

Table 11:
Land Use Based on 1999 Aerial Photograph
Along Little Bear Creek, Woodinville

Land Use	Reach 1	Reach 2	Reach 3	Total
Developed Impervious	64.36%	19.38%	17.12%	24.05%
Gravel - cleared impervious	2.59%	12.52%	1.55%	6.56%
Forested Habitat	5.11%	21.63%	45.76%	29.94%
Shrub/Grass Habitat	27.97%	46.46%	35.56%	39.45%

Based on the photo interpretation of the 1999 aerial photographs (Appendix G), two trends are apparent. The percentage of developed impervious (developed and gravel [cleared impervious]) surface is significantly higher along the lower reaches while the percentage of forested habitat significantly decreases. The high percentage (12.52 percent) of cleared gravel area along Reach 2 may be an indicator that more development is planned and that the percentage of developed impervious surface will continue to increase within potential buffer habitat.

The remaining riparian buffer and upland forest habitat is of vital importance to the continued functionality of Little Bear Creek. However, the composition of the buffer along Little Bear Creek is varied, and typically dominated by deciduous trees and non-native species of grasses and shrubs. Red alder (*Alnus rubra*), Himalayan blackberry (*Rubus procerus*), bittersweet nightshade (*Solanum dulcamara*), and reed canarygrass (*Phalaris arundinacea*) are abundant throughout Reaches 1 and 2, and the lowermost section of Reach 3. Japanese knotweed (*Polyonum cuspidatum*), another introduced species is also present and locally abundant, but not as widespread as the other aforementioned invasive species.

A continuous 61-meter (200-foot) riparian buffer along each bank composed of mature coniferous forest with numerous adjoining wetlands should be the goal along the Little Bear Creek corridor. Based on our survey results, these target conditions are absent, but scattered sections along the left bank of Reach 3 do possess some of the desired traits.

The remaining buffer is composed of primarily deciduous trees, shrubs, and grasses. A detailed list of the species observed along Little Bear Creek is contained in Tables 12, 13, 14, and 15 below. As mentioned previously, red alder is the most abundant tree species along Little Bear Creek, followed by black cottonwood (*Populus balsamifera*), big-leaf maple (*Acer macrophyllum*), and willow (*Salix* spp). Other species such as Douglas fir and western red-cedar become more prevalent in Reach 3. Two Pacific yew (*Taxus brevifolia*) trees were observed along Reach 2. These are long-lived small conifer trees that were used extensively by native Americans and are a source of the cancer fighting drug taxol. The two observed along Little Bear Creek are remnants from pre-settlement. Once gone, Pacific yews will likely not become reestablished because of the absence of mature coniferous forest.

Table 12:
Tree Composition Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	2, 3.	Vine maple	*Acer circinatum*	Native.
2.	1, 2, 3.	Big-leaf maple	*Acer macrophyllum*	Native.
3.	1, 2, 3.	Red alder	*Alnus rubra*	Native.
4.	2, 3.	Black hawthorne	*Crataegus douglasii*	Native.
5.	1, 3.	Oregon ash	*Fraxinus latifolia*	Native.
6.	1, 2, 3.	Sitka spruce	*Picea sitchensis*	Native.
7.	1	Shore pine	*Pinus contorta*	Native.
8.	1, 2, 3.	Black cottonwood	*Populas balsamifera*	Native.
9.	1, 2, 3.	Bitter cherry	*Prunus emarginata*	Native.
10.	1, 2, 3.	Douglas fir	*Pseudotsuga menziesii*	Native.
11.	2, 3.	Cascara buckthorn	*Rhamnus purshiana*	Native.
12.	1, 2, 3.	Pacific willow	*Salix lasiandra*	Native.
13.	2, 3.	Scouler willow	*Salix scouleriana*	Native.
14.	1, 2, 3.	Sitka willow	*Salix sitchensis*	Native.
15.	2.	Pacific yew	*Taxus brevifolia*	Native.
16.	2, 3.	Western red cedar	*Thuja plicata*	Native.
17.	2, 3.	Western hemlock	*Tsuga heterophylla*	Native.

Shrubs and vines are abundant along Little Bear Creek. The most common along the stream bank include Himalayan blackberry, bittersweet nightshade, and Pacific ninebark (*Physocarpus capitatus*). Others such as Scotch broom (*Cytisus scoparius*) are also abundant, but typically occur beyond the riparian zone, especially within the disturbed areas between Little Bear Creek and Highway 522 along Reaches 2 and 3.

Table 13:
Shrub and Vine Composition Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	1, 2, 3.	Red-twig dogwood	*Cornus sericea*	Native.
2.	2	Beaked hazelnut	*Corylus cornuta*	Native.
3.	1, 2, 3.	Scotch broom	*Cytisus scoparius*	Introduced, invasive.
4.	2	Salal	*Gaultheria shallon*	Native.
5.	3.	Black twinberry	*Lonicera involucrata*	Native.
6.	2, 3.	Indian plum	*Oemieria cerasiformis*	Native.
7.	3.	Devil's club	*Oplopanax horridus*	Native.
8.	1, 2, 3.	Pacific ninebark	*Physocarpus capitatus*	Native.
9.	2, 3.	Sword fern	*Polysticum munitum*	Native.
10.	3.	Stink currant	*Ribes bracteosum*	Native.
11.	2	Wild rose	*Rosa* spp.	Native.
12.	1, 2, 3.	Evergreen blackberry	*Rubus laciniatus*	Introduced, invasive.
13.	2, 3.	Thimble berry	*Rubus parviflorus*	Native.
14.	1, 2, 3.	Himalayan blackberry	*Rubus procera*	Introduced, invasive.
15.	1, 2	Salmonberry	*Rubus spectabilis*	Native.
16.	2, 3.	Trailing blackberry	*Rubus ursinus*	Native.
17.	2	Red elderberry	*Sambucus racemosa*	Native.
18.	2, 3.	Douglas spirea	*Spiraea douglasii*	Native.
19.	3.	Highbush-cranberry	*Viburnum edule*	Native.

Herbs represent the most diverse subset of plants encountered along Little Bear Creek. The most common groups include the grasses and weeds. The herb category also contains the largest percentage of introduced species, many of which are invasive. They typically are the first group of species to colonize disturbed areas and once present are difficult to remove. Some of these species such as reed canarygrass and bittersweet nightshade can be extremely abundant, and have established extensive monocultures within the riparian zone. Others such as purple loosestrife and yellow flag iris are present but sparse.

Table 14:
Herb Composition Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	2	Creeping bentgrass	*Agrostis stolonifera*	Introduced.
2.	3.	Pearly everlasting	*Anaphalis margaritacea*	Native.
3.	1, 2, 3.	Lady fern	*Athyrium felix-femina*	Native.
4.	2, 3.	Canada thistle	*Cirsium arvense*	Introduced, invasive.
5.	3	Poison hemlock	*Conium maculatum*	Introduced.
6.	1, 2, 3.	Morning glory	*Convolvulus arvensis*	Introduced, invasive.
7.	2	Bristly hawksbeard	*Crepis setosa 'Haller'*	Introduced.
8.	2	Orchard grass	*Dactylis glomerata*	Introduced.
9.	2	Bleeding heart	*Dicentra formosa*	Native.
10.	1, 2	Fireweed	*Epilobium* sp.	Introduced.
11.	2	Field horsetail	*Equisetum arvense*	Native.
12.	1, 2	Giant horsetail	*Equisetum telmateia*	Native.

Table 14 continued

#	Reach #	Common Name	Scientific Name	Comment
13.	2	Tall fescue	*Festuca arundinacea*	Introduced.
14.	2, 3.	Bedstraw	*Galium aparine*	Native.
15.	2, 3.	Robert geranium	*Geranium robertianum*	Introduced, invasive.
16.	3.	Big-leaf avens	*Geum macrophyllum*	Native.
17.	1	St. John's-wort	*Hypericum perforatum*	Introduced, invasive, noxious.
18.	1, 2	Yellow touch-me-not	*Impatiens noli-tangere*	Introduced.
19.	1, 2	Yellow-flag iris	*Iris pseudacorus*	Introduced, invasive.
20.	1, 2,	Soft rush	*Juncus effusus*	Native.
21.	2	Daggerleaf rush	*Juncus ensifolius*	Native.
22.	3	Duck weed	*Lemna minor*	Native.
23.	2, 3.	Birdsfoot trefoil	*Lotus corniculatus*	Introduced, invasive.
24.	3	Skunk cabbage	*Lysichitum americanum*	Native.
25.	2, 3.	Purple loosestrife	*Lythrum salicaria*	Introduced, invasive.
26.	2	False lily-of-the-valley	*Maianthemum dilatatum*	Native.
27.	2, 3.	Small water forget-me-not	*Myosotis laxa*	Native.
28.	2	Common evening primrose	*Oenothera biennis*	Introduced – N.E. USA.
29.	1, 2, 3.	Reed canarygrass	*Phalaris arundinacea*	Introduced, invasive.
30.	1	English plantain	*Plantago major*	Introduced.
31.	1, 2, 3.	Japanese knotweed	*Polygonum cuspidatum*	Introduced, invasive.
32.	2, 3.	Bracken fern	*Pteridium aquilinum*	Native.
33.	2, 3.	Creeping buttercup	*Ranunculus repens*	Introduced, invasive.
34.	2	Water cress	*Rorippa nasturtium-aquaticum*	Introduced.
35.	2	Red sorrel	*Rumex acetosella*	Introduced.
36.	2, 3.	Curly dock	*Rumex crispus*	Introduced.
37.	2, 3.	Bitter dock	*Rumex obtusifolius*	Introduced.
38.	1, 2, 3.	Small-fruited bulrush	*Scirpus microcarpus*	Native.
39.	1, 2, 3.	Bittersweet nightshade	*Solanum dulcamara*	Introduced, invasive.
40.	2, 3.	Hedge nettle	*Stachys cooleyae*	Native.
41.	1	Tansy	*Tanacetum vulgare*	Introduced, invasive.
42.	1	Dandelion	*Taraxacum officinale*	Introduced, invasive.
43.	2, 3.	Piggy-back plant	*Tolmeia menziesii*	Native.
44.	2	White clover	*Trifolium repens*	Introduced.
45.	2, 3.	Stinging nettle	*Urtica dioica*	Introduced.

Ornamentals represent introduced species that were typically planted in private yards or businesses. They are usually not invasive, except for English ivy (*Hedera helix*), which can choke trees. Most do not represent a threat and are unable to naturally propagate. Others such as English holly (*Liex aquifolium*) are distributed by bird droppings, but are not problematic.

Table 15:
Ornamental Composition Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	3	Norway maple	*Acer platanoides*	Introduced.
2.	3	Red maple	*Acer rubrum*	Introduced.
3.	1	Butterfly bush	*Buddleia davidii*	Introduced.
4.	3	Parneyi cotoneaster	*Cotoneaster lacteus*	Introduced.
5.	3	Crocosmia	*Crocosmia* sp.	Introduced.
6.	1	Buning bush	*Euonymus alaalatus*	Introduced.
7.	1, 2	English ivy	*Hedera helix*	Introduced, invasive.
8.	3	Blue star juniper	*Juniperus squamata*	Introduced.
9.	2	English holly	*Liex aquifolium*	Introduced.
10.	1	Apple fruit tree	*Malus* sp.	Introduced.
11.	1	Scotch pine	*Pinus sylvestris*	Introduced.
12.	3	Thundercloud plum tree	*Prunus cerasifera*	Introduced.
13.	1	Otto-luyken laurel	*Prunus laurocerasus*	Introduced.
14.	1	Plum fruit tree	*Prunus* sp.	Introduced.
15.	3	Flowering cherry tree	*Prunus* sp.	Introduced.
16.	1	Rhododendron species	*Rhododendron* sp.	Introduced.
17.	1, 2, 3.	Locust tree	*Robinia* sp.	Introduced.
18.	1	Weeping willow	*Salix babylonica*	Introduced.
19.	2	European mountain ash	*Sorbus acuparia*	Introduced.

The NMFS (1996) indicator for riparian reserves includes several factors that must be assessed in order to determine its existing state. These factors include: adequate shade, large woody debris recruitment, habitat protection, connectivity, and percent similarity of riparian vegetation to the potential natural community/composition. The functionality of the riparian reserve decreases as loss and fragmentation increase, and as the percent similarity of the existing riparian vegetation to the potential natural community/composition drops from >50 percent (*properly functioning*), to 25 percent to 50 percent (*at risk*), and finally <25 percent (*not properly functioning*). The percent "intact" can also be quantified in that >80 percent is considered *properly functioning*, 70 percent to 80 percent is considered *at risk*, and <70 percent is considered *not properly functioning*. Based on the analysis of aerial photographs, ground truthing, and detailed stream survey, the results indicate the riparian reserves vary by reach.

The riparian reserve in Reach 1 is **not properly functioning** due to only 5.11 percent being forested habitat within the 122-meter (400-foot) wide corridor. Furthermore, the limited amount of riparian reserves along Reach 1 are dominated by deciduous trees and introduced invasive species.

The functionality of the riparian reserve in Reach 2 is not as clear as Reach 1. Although the percent forested increased to 21.63 percent, it is also composed of primarily deciduous trees, introduced invasive species are abundant, and shrubs and grasses (46.46 percent) dominate large tracts. The riparian reserve in this reach is also confined between Highway 522 to the west and commercial businesses to the east. Furthermore, the ability of the reserve to provide large woody debris and

adequate shading has been extremely compromised. Therefore, based on these facts, the riparian reserve in Reach 2 is also **not properly functioning**.

The functionality of the riparian reserve in Reach 3 increases as the percent forested habitat increased to 45.76 percent, and overall shading increased (except immediately upstream of NE 195th Street). Although the potential for future large woody debris recruitment is still unacceptably low, and much of the forest has a high deciduous component, conifers become much more prevalent. Because of these factors, the riparian reserve is considered **at risk** in Reach 3.

The overall rating for the riparian reserve in Little Bear Creek as it flows through the City of Woodinville is considered **not properly functioning**. Although conditions improve in the upper reaches, the overall dominance of deciduous trees, poor potential for future large woody debris recruitment and lack of shade in Reaches 1 and 2 indicate that overall the riparian reserve is **not properly functioning**.

4.4.7 Water Quality

The NMFS (1996) considers temperature, sediment, and chemical contamination/nutrients in their Matrix of Diagnostics/Pathways and Indicators criteria. Of these, sediment was previously discussed in Section 4.4.3, Substrate.

Temperature: Water temperature is a key factor controlling the ability of salmonids to survive in a stream. It will also influence species composition in that some species such as bull trout require exceptionally colder water to successfully reproduce. Water temperatures rising above a 7-day average maximum of 7.8°C (46°F) is reported to limit spawning and rearing success of bull trout.

The following temperatures are average 7-day maximums. The NMFS (1996) considers 10 to 13.9°C (50 to 57°F) or less to be *properly functioning*. At risk temperatures depend on time of year or life cycle (spawning or migration and rearing). Water temperature is considered *at risk* for spawning adults when between 13.9 to 15.6°C (57 to 60°F), and for migration and rearing when 13.9 to 17.8°C (57 to 64°F). Stream temperatures above 15.6°C (>60°F) for spawning and above 17.8°C (>64°F) for migration and rearing are considered *not properly functioning*. The Washington State Department of Ecology reported that temperatures from 21 to 22°C (69.8 to 71.6°F) are lethal to chinook salmon while temperatures from 20 to 21°C (68 to 69.8°F) create thermal barriers (Hicks, 2000 as reported by Kerwin, 2001).

DEA biologists monitored two Hobo temperature data loggers in Little Bear Creek between June 16 and October 17, 2001 (4 months). The lowermost data logger was installed near the mouth of Little Bear Creek while the uppermost was installed downstream of NE 205th Street crossing near the King/Snohomish County line. Each data logger was set to collect hourly readings. The City of Woodinville is continuing the monitoring effort beyond the period of analysis documented in this report (Monzaki, personal communication, 2001).

Table 16 below presents the consolidated stream temperature data in the NMFS 7-day average maximum temperature format for Little Bear Creek from June 16 through October 17, 2001. Juvenile

life cycle data is for chinook salmon as defined by Kerwin (2001) as adapted by Myers et al., 1998. The outmigration period lasts from early March through late July, peaking in June. Adult migration and spawning life cycle data was determined by reviewing the WDFW salmon spawning ground survey data from 1952 through 2000. The earliest observation of an adult chinook in Little Bear Creek occurred on September 29 while the latest live sighting occurred on November 5th, peaking in October. Although this analysis is focused on chinook salmon it is important to note that some species such as juvenile coho salmon, resident cutthroat trout, coastrange sculpins, and western brook lampreys are present in Little Bear Creek throughout the year.

Table 16:
7-day Average Maximum Stream Temperatures for Little Bear Creek, Woodinville

Week	Reach 1 Mouth	Reach 3 205th	Chinook Salmon Life Cycle	NMFS Indicator Status
6/16 – 6/22	15.3°C	14.9°C	Peak Juvenile Migration and Rearing	At Risk
6/23 – 6/29	14.8°C	14.5°C	Peak Juvenile Migration and Rearing	At Risk
6/30 – 7/6	16.4°C	16.1°C	Peak Juvenile Migration and Rearing	Not Properly Functioning
7/7 – 7/13	17.0°C	16.6°C	Juvenile Migration and Rearing	Not Properly Functioning
7/14 – 7/20	15.1°C	14.7°C	Juvenile Migration and Rearing – Adults in Lake Wa.	At Risk
7/21 – 7/27	16.1°C	15.6°C	Juvenile Migration and Rearing – Adults in Lake Wa.	Not Properly Functioning
7/28 – 8/3	15.0°C	14.7°C	Juvenile Migration and Rearing – Adults in Lake Wa.	At Risk
8/4 – 8/10	16.8°C	16.3°C	Juvenile Chinook now absent – Adults in Lake Wa.	Not Properly Functioning
8/11 – 8/17	17.2°C	16.5°C	Adults in Lake Washington	Not Properly Functioning
8/18 – 8/24	15.6°C	15.0°C	Adults in Lake Washington	Not Properly Functioning/At Risk
8/25 – 8/31	16.3°C	15.8°C	Adults in Lake Washington	Not Properly Functioning
9/1 – 9/7	14.8°C	14.4°C	Adults in Lake Washington	At Risk
9/8 – 9/14	14.7°C	14.2°C	Adults in Lake Washington	At Risk
9/15 – 9/21	13.7°C	13.3°C	Adults possibly present in Little Bear Creek	High-end of Properly Functioning
9/22 – 9/28	13.7°C	13.1°C	Adult Chinook likely present Little Bear Creek	High-end of Properly Functioning
9/29 – 10/5	12.0°C	11.6°C	Adult Chinook present – spawning in Little Bear Creek	Properly Functioning
10/6 – 10/12	11.1°C	10.6°C	Adult Chinook present – spawning in Little Bear Creek	Properly Functioning
10/13 – 10/17	11.0°C	10.6°C	Adult Chinook present – spawning in Little Bear Creek	Properly Functioning

Notes: *Properly Functioning* = 10 to 13.9° C.
At Risk = 13.9 to 15.6° C for migrating adults, and 13.9 to 17.8° C for migration and rearing.
Not Properly Functioning = >15.6° C for spawning, and >17.8° C for migration and rearing.

Based on the stream temperature data collected by DEA between June 16, through October 17, 2001, this parameter ranges from **at risk** to **not properly functioning** during juvenile migration and rearing, and **properly functioning** during adult migration and spawning. However, between September 15, 2001, through September 28, 2001, temperatures were at the upper end of **properly functioning** and will likely shift to **at risk** during warmer years.

The stream temperature data collected during this study is presented in Appendix P (Reach 1) and Appendix Q (Reach 3). It is interesting to note that daily stream temperatures fluctuated from 0.46 to 4.68 degrees and that on average, Reach 1 was approximately 0.4 degree warmer than Reach 3. The greatest daily fluctuations "typically" occurred on days when the maximum hourly temperature

was higher than average, and as stream temperature decreased so did the degree of fluctuation. Stream temperature was typically the coolest from 0700 to 0900 hours, and warmest from 1600 to 1800 hours. However, these "typical" time periods would shift substantially during cooling events. The highest hourly stream temperature reading occurred in Reach 1 measuring 18.16°C (64.69°F) for a 1-hour period between 1700 and 1800 hours on August 12, 2001.

Stream temperature data collected by Snohomish County Public Works – Surface Water Management (SWM) in the upper reaches of Little Bear Creek reported only one monthly measurement above 16°C (60.8°F) (SWM, 2000). However, these were spot checks during water quality sampling events utilizing hand held thermometers, and likely occurred prior to the daily peak. Snohomish County also reported that mean fecal coliform levels have violated Class AA standards, nitrate levels are some of the highest in the county, and dissolved oxygen levels violated standards about 8 percent of the time (SWM, 2000). Furthermore, the SWM reported that sediment samples collected near the mouth contained chromium, copper, lead, nickel, and zinc, although exact levels were not reported (SWM, 2000). Some of the peak water quality measurements during the year 2000 include 8,600 colonies/100 mL for fecal coliform, 0.00812 mg/L for copper, 0.000624 mg/L for lead, and 0.00691 mg/L for zinc collected on July 12, 2000 near the headwaters of Little Bear Creek (Thornburgh, personal communication, 2001).

Water quality data is collected by King County in Little Bear Creek at Station No. 0478 located in Reach 1 near the mouth. Stream temperature data collected by King County from 1990 through 1993 ranged from a low of 1.0°C (33.8°F) on February 16, 1993, to a high of 16.2°C (61.2°F) on July 20, 1992 (King County, 1994). Dissolved oxygen levels were generally good, with a low of 9.2 mg/L on August 19, 1991, when the stream temperature was 16.0°C (60.8°F), and a high of 14 mg/L on a couple of dates during the winter when stream temperatures were extremely low at 1.0 to 1.5°C (33.8 to 34.7°F). There is an inverse relationship of stream temperature and dissolved oxygen in that as stream temperature increases dissolved oxygen decreases.

Additional parameters analyzed by King County indicate turbidity fluctuates widely from 0.3 to 42 nephelometric turbidity units (NTU). The highest measurements recorded for various parameters were pH = 8.30, turbidity = 42.0 NTUs, suspended solids = 87.00 mg/L, fecal coliform = 1,700 organisms/100mL, nitrate + nitrite = 1.600 mg/L, ortho-phosphorus = 0.190 mg/L, and total phosphorus = 0.570 mg/L. Stormwater metal levels were below detection levels for cadmium, lead, and nickel, but averaged 0.006 mg/L copper, and 0.023 mg/L zinc (King County, 1994). Levels of copper and zinc in Little Bear Creek were higher than in Swamp, North, Bear-Evans, Issaquah, and Tibbetts creeks.

Chemical Contamination/Nutrients: The NMFS (1996) reports that for the chemical contamination/nutrients indicator, a *properly functioning* stream has low levels of chemical contamination from agricultural, industrial, and other sources, no excess nutrients, and no Clean Water Act (CWA) 303d designated reaches. An *at risk* stream has moderate levels of chemical contamination from agricultural, industrial, and other sources, some excess nutrients, and one CWA 303d designated reach. A *not properly functioning* stream contains high levels of chemical contamination, high levels of excess nutrients, and more than one Clean Water Act 303d designated reach. The Washington Department of Ecology has reported that Little Bear Creek does not support designated uses, and contains three 303(d) listed stream reaches due to elevated fecal

coliform levels (Kerwin, 2001). Furthermore, a recent King County small streams toxicity/pesticide study indicates a variety of pesticides are present in Little Bear Creek at levels high enough to be "toxic" to test species (Kerwin, 2001). Based on the data presented by Kerwin (2001), and reports by SWM (2000) and King County (1994), the water quality pathway and associated chemical contamination/nutrients are **not properly functioning** in Little Bear Creek.

Additional Water Quality Data: Water quality data was collected in the field with a Horiba U-10 water quality meter during this survey. The goal was to document change by reach, and compare Little Bear Creek with the Sammamish River utilizing data collected on the same day. Based on this effort, the following data in Table 17 is presented. On September 25, 2001, pH, turbidity, and dissolved oxygen levels were noticeably lower in the Sammamish River, while temperature was elevated (Table 17). Based on the results, water quality is generally better in Little Bear Creek than in the Sammamish River due to lower water temperature and higher dissolved oxygen levels in Little Bear Creek. Within Little Bear Creek, conductivity and turbidity increased, and temperature decreased from Reach 1 to 3. Dissolved oxygen and pH fluctuated little between reaches.

Table 17:
Water Quality Data on 9/25/01 for Little Bear Creek, Woodinville

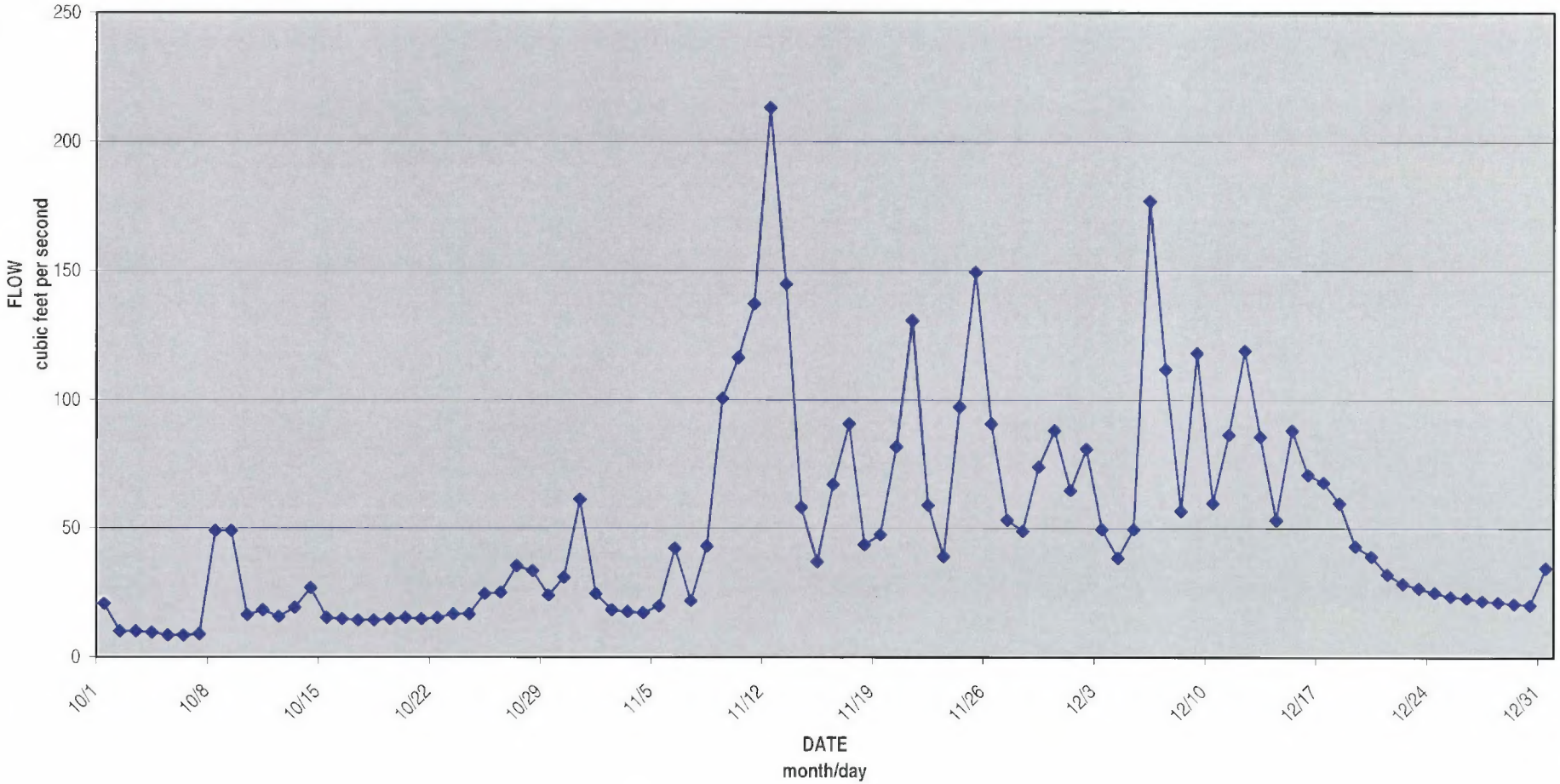
#	Parameter	Sammamish River	Reach 1 Mouth	Reach 2 134th	Reach 3 205th
1.	pH	6.85	7.70	7.89	7.72
2.	Conductivity (mS/cm)	0.145	0.144	0.147	0.148
3.	Temperature (C)	16.0	13.2	13.3	13.0
4.	Turbidity (NTU)	1	7	10	12
5.	Dissolved oxygen (mg/L)	6.90	9.40	8.65	8.95

4.4.8 Flow/Hydrology

The flow/hydrology pathway contains two indicators: change in peak/base flow and increase in drainage network. Increased urbanization results in increased flood frequency and streamflow variability (May et al., 1997). The result is that flow levels change frequently and extreme flow events occur more often. This condition is exasperated by an increase in the drainage network. Elements of the drainage network include ditches, road crossings, and stormwater outfalls. The overall result is that rainwater reaches the stream channel exponentially faster then what would occur naturally.

Peak/Base Flow: The NMFS (1996) Matrix of Diagnostics/Pathways and Indicators utilizes watershed hydrographs to document changes in peak/base flow. A *properly functioning* stream's hydrograph would indicate peak, base, and flow timing is comparable to a similar undisturbed watershed. An *at risk* stream shows some evidence of change. A *not properly functioning* stream's hydrograph indicates pronounced change in peak, base, and flow timing. Based on the following hydrographs (Figures 5a through 5c), the peak/base flow indicator is **at risk** due to evidence of change when compared with hydrographs from minimally disturbed watersheds.

Figure 5a: 1999 Hydrograph, October through December
Little Bear Creek



o:/project/w/wood0000-0010/0500 deliverables/Figure 5a 5b 5c.xls/5a, 1999

Figure 5b: 2000 Hydrograph, January through December
Little Bear Creek

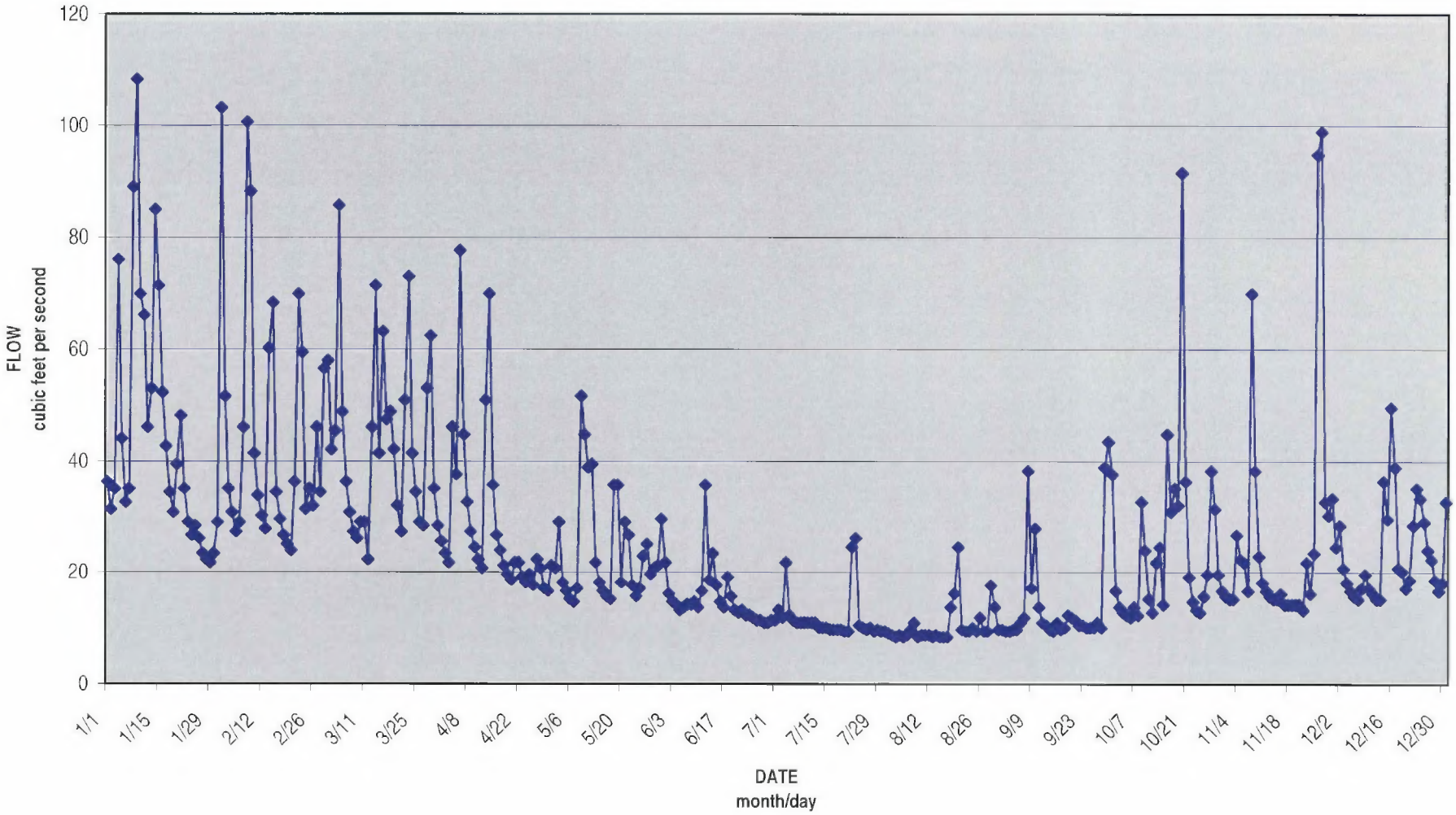
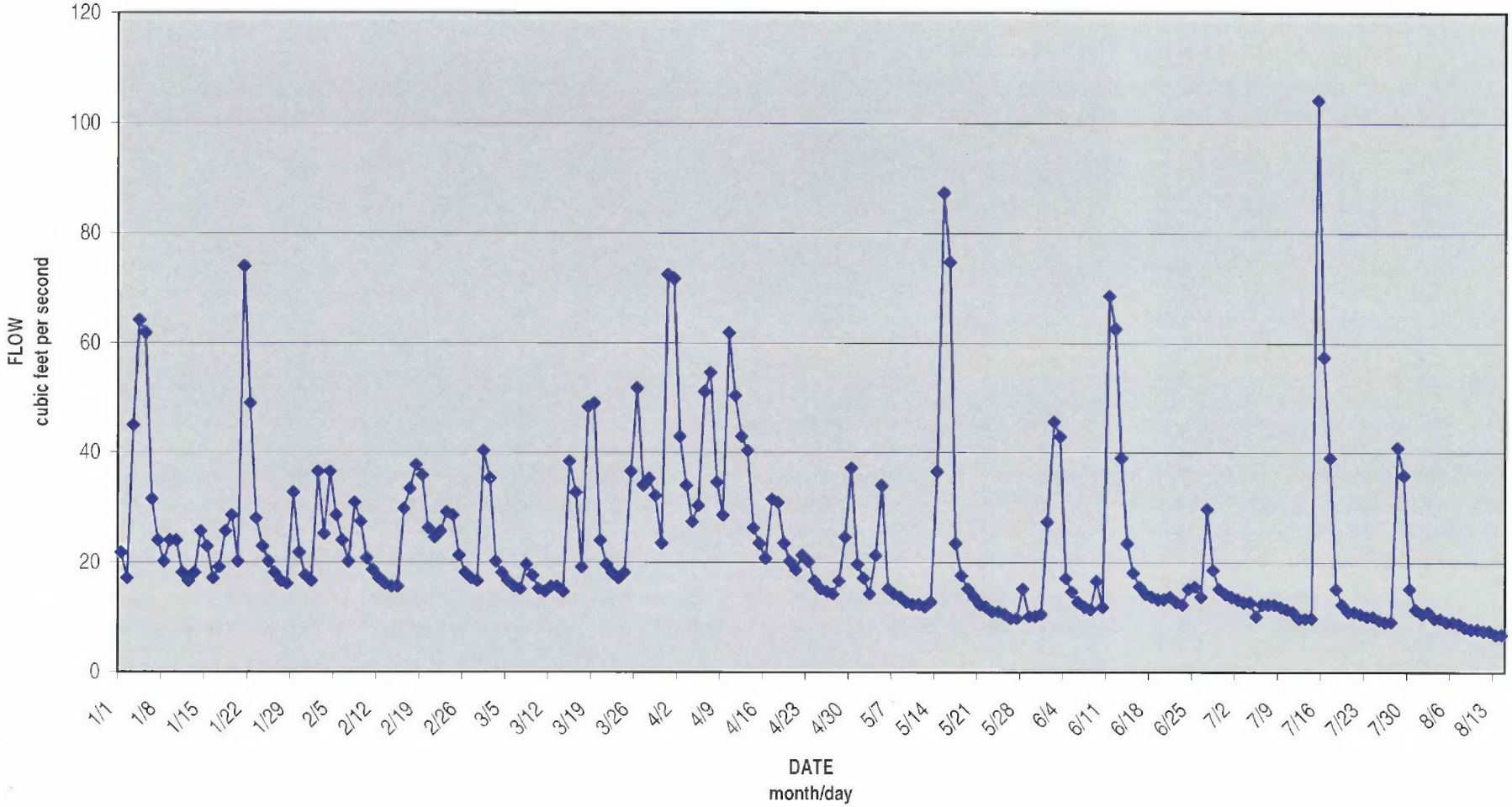


Figure 5c: 2001 Hydrograph, January through August
Little Bear Creek



Increase in Drainage Network: The NMFS (1996) Matrix of Diagnostics/Pathways and Indicators utilizes an increase in drainage network to document change. A *properly functioning* stream will have zero or minimum increases in drainage network due to roads. An *at risk* stream will have a moderate increase in drainage density due to roads (e.g., 5 percent). A *not properly functioning* stream will have a significant increase in the drainage network due to roads (e.g., 20 to 25 percent).

The percentage of total impervious surface has increased to about 37 percent and road density to 5.9 kilometers per square kilometer (km/km^2) (2.28 mi/mi^2) in the past 12 years (Purser and Simmonds, Snohomish County Surface Water Management, unpublished data as reported by Kerwin, 2001). Based on these changes, the increase in drainage network indicator is **not properly functioning**.

4.4.9 Watershed Conditions

The watershed conditions pathway is gauged by three indicators: road density and location, disturbance history, and riparian reserves. Riparian habitat was documented above in Section 4.4.6 – Riparian Habitat.

Road Density and Location: The NMFS (as modified by the Mt. Baker Snoqualmie National Forest) has quantified parameters to rank the degree of road density and location within their Matrix of Diagnostics/Pathways and Indicators (Appendix L-2). Based on their criteria, a *properly functioning* watershed contains less than 1.61 km/km^2 (<1 mi/mi^2) of roads and no valley bottom roads. An *at risk* watershed contains 1.61 to 3.86 km/km^2 (1 to 2.4 mi/mi^2) of roads with some valley bottom roads. A *not properly functioning* watershed contains >3.86 km/km^2 of roads (>2.4 mi/mi^2), and many valley bottom roads.

May et al. (1997) documented numerous watershed characteristics based on aerial photographs from 1989. At that time, the percent total impervious surface in the Little Bear Creek Basin was 13.8 percent and the road density was 4.9 km/km^2 (1.90 mi/mi^2). They reported that the basin was composed of 43 percent undeveloped forest, 12 percent undeveloped open land, 32 percent rural residential land, 6 percent suburban residential land, 2 percent urban residential land, and 7 percent commercial industrial land. This equates to a total of 57 percent of the land being developed to some degree at that time.

During the past 12 years, the percentage of total impervious surface has increased to about 37 percent and road density to 5.9 km/km^2 (2.28 mi/mi^2) (Purser and Simmonds, Snohomish County Surface Water Management, unpublished data – as reported by Kerwin, 2001). Based on these changes, the NMFS watershed condition indicators for road density is **not properly functioning**. During this period, the amount of undeveloped forest has only dropped to 40 percent. This indicates that the majority of new impervious surface since 1989 has been established in the previously undeveloped open land and rural residential land.

Disturbance History: The NMFS (1996) defines a *properly functioning* watershed as containing <15 percent equivalent clear-cut acres (ECA) within the entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian areas. Additional parameters specific for the Northwest Forest Plan do not apply. An *at risk* watershed

also contains <15 percent ECA within the watershed, but disturbance is concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian areas. A *not properly functioning* watershed contains >15 percent ECA and disturbance is concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian areas.

This indicator is difficult to judge based on the NMFS (1996) criteria and may be more applicable to watersheds outside the Puget Sound lowlands due to the extensive amount of development within this region. The ECA concept appears to be applicable in watersheds where logging is the dominant land use. Instead, DEA proposes to utilize the Urban Stream Rehabilitation guideline presented by May (1996) that ranks a stream based on percent total impervious area (percent TIA). This system results in a ranking of natural (percent TIA < 5 percent), impacted (percent TIA 10 to 30 percent), degraded (percent TIA 30 percent to 40 percent), and non-supporting (percent TIA >45 percent). Therefore, DEA equated natural to *properly functioning*, impacted to *at risk*, and degraded and non-supporting to *not properly functioning*. The location of the disturbance can also be factored into the formula.

Since about 37 percent of the watershed is impervious, and much of the riparian zone in the lower reaches has been developed, this watershed appears to be degraded. Therefore, the disturbance history indicator is **not properly functioning**. This is especially apparent when reviewing the rate of increase in new impervious area from 1989 to present.

4.4.10 Habitat Access

The Habitat Access Pathway includes the Physical Barriers Indicator. The NMFS (1996) states that a *properly functioning* stream with man-made barriers allows upstream and downstream fish passage during all flows. An *at risk* stream with man-made barriers does not allow upstream and/or downstream passage at base/low flow. A *not properly functioning* stream with man-made barriers does not allow upstream and/or downstream fish passage during a wide range of flows.

The Adopt-A-Stream Foundation conducted a Washington State Department of Transportation (WSDOT) Level A assessment of 88 culverts that posed potential fish passage barriers throughout the Little Bear Creek watershed (Adopt-A-Stream, unpublished data as reported by Kerwin, 2001). They concluded that only 8 of these culverts were fully passable during winter and spring flow conditions. The remaining 80 culverts posed at least partial barriers during this high flow period. The 8 culverts that were fully passable during high flows could also pose fish passage barriers during lower flows. Although this may seem dire, adult salmon are not usually present during peak flow periods in the early winter and spring time period, and "most" juvenile salmonids are migrating downstream during the spring. Therefore, this condition may primarily impact resident trout and juvenile coho salmon. This conclusion does not negate the need to continue basin wide removal of restrictive culverts, or the conversion of round culverts to larger bottomless culverts and bridges.

Habitat Access is not a major limiting factor along the mainstem of Little Bear Creek as it flows through the City of Woodinville. Potentially restrictive road crossings containing culverts within the City of Woodinville include SR 202, 132nd Avenue NE, 134th Avenue NE, Highway 522, NE 195th Street, and NE 205th Street. The crossing at NE 178th Street is considered passable to all life stages regardless of flow. All crossings within the City of Woodinville are passable to adult salmonids during the late summer and early fall. All of these crossings are also passable to juveniles with the possible exception of NE 205th Street which likely restricts upstream movement

by juveniles. It is likely that during peak flows that occur during the winter and spring, juvenile upstream passage is further restricted by all the aforementioned culverts. The primary issue is shear velocity due to the funneling effect of the culverts along the mainstem, and loss of three tributaries as the result of extensive culverting at their interface with Little Bear Creek in Reach 2 (Figure 3). Based on these conclusions, the physical barrier indicator within the City of Woodinville is **at risk**, but could become **properly functioning** as existing culverts are replaced with bridges, removed, or retrofitted to improve upstream passage for juvenile salmonids.

4.5 WILDLIFE

Biologists recorded bird, mammal, reptile, and amphibian species along Little Bear Creek both during surveys and incidentally during other site visits. Additional species to those observed likely use the area but remain undocumented by this study, as field visits were limited to spring and summer of a single year. A list of additional wildlife species that could potentially be present along the Little Bear Creek corridor but were not documented during these surveys is included in Appendix S.

4.5.1 Bird Observations

Thirty-nine bird species were observed along Little Bear Creek during site visits and surveys (Table 18). The majority of these species likely breed in the area, as most males were observed singing during the breeding season. One species, willow flycatcher (*Empidonax traillii*), is a federally designated species-of-concern. Five singing males were identified on three survey plots. The WDFW Priority Habitat and Species (PHS) program classifies great blue heron rookeries as vulnerable aggregations (Criterion 2) and are protected. Although no rookeries are documented within 2 miles of the corridor (WDFW, 2001b), suitable foraging habitat exists within the creek and adjacent wetlands, and biologists observed one individual during stream surveys.

Table 18:
Bird Observations Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	S Rank	Comment
1.	2, 3	Mallard	*Anas platyrhynchos*	S5B	
2.	2, 3	Great blue heron	*Ardea herodias*	S4S5	
3.	1, 2, 3	Cedar waxwing	*Bombycilla cedrorum*	S4N	NMBS*
4.	1, 2	Canada goose	*Branta canadensis*	S5B	
5.	2, 3	Red-tailed hawk	*Buteo jamaicensis*	S5B	
6.	3	Pine siskin	*Carduelis pinus*	S5B	
7.	1, 2, 3	American goldfinch	*Carduelis tristis*	S5B	
8.	1, 2, 3	House finch	*Carpodacus mexicanus*	S5	
9.	3	Swainson's thrush	*Catharus ustulatus*	S5B	NMBS
10.	1, 2, 3	Belted kingfisher	*Ceryle alcyon*	S5	NMBS
11.	1, 2	Killdeer	*Charadrius vociferus*	S5B	
12.	2, 3	Northern flicker	*Colaptes auratus*	S5	
13.	1, 2, 3	American crow	*Corvus brachyrhynchos*	S5	
14.	2, 3	Steller's jay	*Cyanocitta stelleri*	S5	
15.	2, 3	Willow flycatcher	*Empidonax traillii*	S5B	NMBS; Federal Species of Concern.
16.	3	Brewer's blackbird	*Euphagus cyanocephalus*	S5	
17.	3	Dark-eyed junco	*Junco hyemalis oreganus*	S5B	
18.	1	California gull	*Larus californicus*	S4B	Flying over creek.
19.	1, 2, 3	Song sparrow	*Melospiza melodia*	S5B	

Table 18 continued

#	Reach #	Common Name	Scientific Name	S Rank	Comment
20.	1, 2, 3	Brown-headed cowbird	*Molothrus ater*	S4N	
21.	1	House sparrow	*Passer domesticus*	SE	
22.	2, 3	Black-headed grosbeak	*Pheucticus melanocephalus*	S5B	NMBS
23.	1, 3	Downy woodpecker	*Picoides pubescens*	S5	
24.	3	Hairy woodpecker	*Picoides villosus*	S4S5	
25.	2, 3	Spotted towhee	*Pipilo erythrophthalmus*	S5B	Nest observed in Reach 3.
26.	1, 2, 3	Black-capped chickadee	*Poecile atricapilla*	S5	Nest observed in Reach 2.
27.	2, 3	Chestnut-backed chickadee	*Poecile rufescens*	S5	
28.	1, 2, 3	Bushtit	*Psaltriparus minimus*	S5	Nest observed in Reach 3.
29.	3	Golden-crowned kinglet	*Regulus satrapa*	S5B	NMBS
30.	3	Red-breasted sapsucker	*Sphyrapicus ruber*	S4S5	
31.	1, 2, 3	European starling	*Sturnus vulgaris*	SE	Nest observed in Reach 2.
32.	1, 2, 3	Violet-green swallow	*Tachycineta thalassina*	S5B	NMBS
33.	1, 2, 3	Bewick's wren	*Thryomanes bewickii*	S5	
34.	1, 2, 3	American robin	*Turdus migratorius*	S5B	
35.	3	Warbling vireo	*Vireo gilvus*	S5B	NMBS
36.	3	Hutton's vireo	*Vireo huttoni*	S5	
37.	2, 3	Wilson's warbler	*Wilsonia pusilla*	S5B	NMBS
38.	1	Mourning dove	*Zenaidura macroura*	S5B	NMBS
39.	1, 2, 3	White-crowned sparrow	*Zonotrichia leucophrys*	S5B	NMBS

*NMBS = neotropical migrant bird species

The WDFW PHS program maintains a list of species for which it has occurrence and status information. A global rank (GRank) describes the species' relative rarity or endangerment worldwide, and a state rank (SRank) describes the status within Washington State. Most bird species observed in the study area have a GRank of G5, which signifies that they are demonstrably secure globally. Most species have an SRank of S5 or S4 (Table 18), defining them as "demonstrably secure in state" or "apparently secure, with many occurrences", respectively. SRanks may include the qualifiers "B" and "N", which indicate breeding and nonbreeding status, respectively, of migrant species. The breeding status of these species may differ greatly from their nonbreeding status in the state. SE indicates an established exotic species. Two codes for any one species indicates an intermediate rank.

Eleven of the species recorded along Little Bear Creek are neotropical migrant bird species. Neotropical migrants breed in North America and winter in Mexico, Central America, the Caribbean, and South America. The publication of results from long-term survey programs confirms that populations of many neotropical migrants are declining, in some cases precipitously. Habitat loss and related problems are key issues in the causes of the declines. Therefore, these species may be of interest, particularly if they are breeding in the area. The area could potentially provide breeding habitat for several of these species, including Swainson's thrush, black-headed grosbeak, willow flycatcher, warbling vireo, Wilson's warbler, mourning dove, and white-crowned sparrow (Table 18). In addition, neotropical migrant species not detected during surveys and field visits may use the corridor (Appendix S).

4.5.2 Mammal Observations

Biologists documented ten mammal species in the Little Bear Creek corridor (Table 19). None of the species observed have federal or state special status. Other mammal species that may utilize the corridor include mink (*Mustela vison*), striped skunk (*Mephitis mephitis*), and coyote (*Canis latrans*). Appendix S contains a complete list of mammals that could potentially be present based on habitat types and historic range.

Table 19:
Mammal Observations Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	2	Beaver	*Castor canadensis*	Chewed shrubs and trails.
2.	3	Opossum	*Didelphis marsupialis*	Introduced, dead in stream.
3.	3	River otter	*Lutra canadensis*	Tracks, scat, and eaten salmon.
4.	2	Longtail weasel	*Mustela frenata*	Crossing stream on log.
5.	1, 2, 3	Myotis bat	*Myotis* spp.	
6.	2, 3	Black-tailed deer	*Odocoileus heminonus columbianus*	Tracks along stream bank; pellets.
7.	2, 3	Raccoon	*Procyon lotor*	Tracks along stream bank.
8.	2	Norway rat	*Rattus norvegicus*	Introduced.
9.	2, 3	Eastern gray squirrel	*Sciurus carolinensis*	Introduced.
10.	1, 2	Eastern cottontail	*Sylvilagus floridanus*	Introduced, dead young in nest (Reach 2).

4.5.3 Reptile and Amphibian Observations

Four reptile and amphibian species were observed in and along Little Bear Creek during field visits and surveys (Table 20). None of the species have state or federal special status. Other reptiles and amphibians not documented during this survey that could potentially be present along the Little Bear Creek corridor include: northern alligator lizard (*Elgaria coerulea*), painted turtle (*Chrysemys picta*), red eared slider (*Trachemys scripta*), common garter snake (*Thamnophis sirtalis*), western terrestrial garter snake (*Thamnophis elegans*), long-toed salamander (*Ambystoma macrodactylum*), rough-skinned newt (*Taricha granulosa*), western red-backed salamander (*Plethodon vehiculum*), ensatina (*Ensatina eschscholtzii*), western toad (*Bufo boreas*), and red-legged frog (*Rana aurora*). Both species of turtles were included due to the close proximity of several lakes to the study area.

Table 20:
Amphibian and Reptile Observations Along Little Bear Creek, Woodinville

#	Reach #	Common Name	Scientific Name	Comment
1.	3	Pacific Tree frog	*Hyla regilla*	3 in wetland near reach end.
2.	2	Bull frog	*Rana catesbeiana*	Introduced species captured next to stream.
3.	Tributary D	Northwestern salamander	*Ambystoma gracile*	Larva in small tributary.
4.	3	Northwestern garter snake	*Thamnophis ordinoides*	Near barricades at NE 195th.

4.5.4 Wildlife Habitat

Habitat in the Little Bear Creek corridor consists of wetlands, uplands, and a riparian zone. Vegetative composition in the riparian zone is discussed in detail in Section 4.4.6, Riparian Habitat. Wetland habitats include mixed forest, young deciduous, and scrub/shrub wetlands. Upland

habitats include second- and third-growth mixed forest, young alder, shrub, and open grassy areas. Exotic and invasive plant species occur both as infestations and in small, scattered clusters.

Most of the corridor in Reach 1 is disturbed shrub, dominated by Himalayan blackberry, red alder saplings, and Scotch broom. Approximately 5.1 percent of the corridor along Reach 1 consists of forested riparian habitat. An area of non-native planted species occurs in the developed area between 130th Avenue NE and NE 178th Street. The corridor is relatively narrow along this reach and provides limited wildlife habitat, although the mouth of the creek adjoins more heavily vegetated habitat along the Sammamish River and may be utilized by birds and other wildlife using the Sammamish River corridor. Red alder saplings, red-osier dogwood, and Himalayan blackberry were dominant in Reach 1 sampling plots. No snags, logs, or suitable raptor nesting or perching trees fell within sampling plots. Invasive species are common in all habitat types in the reach. The wildlife community in this reach is most likely made up of species habituated to human disturbance and able to utilize highly fragmented habitat (see Tables 18, 19, and 20 for wildlife species occurrence by reach).

Approximately 22 percent of Reach 2 is composed of young and mature deciduous forest. The remaining area is largely scrub/shrub, much of it disturbed and dominated by invasive weeds. One small area at the southeast junction of Highway 522 and SR 202 that fell within a sampling plot consisted of mature riparian vegetation, including red cedar of 61 to 76 centimeters (24 to 30 inches) DBH and several black cottonwoods and Douglas firs each approximately 61 centimeters (24 inches) DBH. Dominant species in this plot were hazelnut, big leaf maple, and Indian plum. Red alder, black cottonwood, and big-leaf maple dominate the deciduous forest in Reach 2. Common species include Himalayan blackberry, salmonberry, willow, Douglas fir, and giant horsetail. Few mature trees occurred outside of the mature forested sampling plot, although 2 snags were present on another plot. Sampling plots in disturbed riparian habitat, including young forest and scrub/shrub, were dominated by red alder, with infestations of Himalayan blackberry, Scotch broom, reed canarygrass, and other invasive species. Common native species included salmonberry, willow, and bitter cherry. The most extensive tracts of undeveloped land in Reach 2 are highly disturbed, while less disturbed areas tend to be small and highly fragmented. These areas support scattered mature trees, some red cedar along the creek, that may provide limited perching/nesting opportunities for raptors. The reach contains little breeding habitat for neotropical migrant bird species, which generally breed in forest interiors.

Reach 3 contains the highest proportion of mature trees and native species-dominated areas, as well as the most extensive tract of habitat. Deciduous and mixed forest makes up approximately 46 percent of the habitat in this reach, with the remainder in shrub and grass habitats. The reach supports potential raptor and neotropical migrant bird habitat, particularly in the northern region, where habitat is most extensive and large conifers occur more frequently. Sampling plots in Reach 3 fell into three general vegetative communities translated here into habitat types. Douglas fir, western red-cedar, big-leaf maple, and red alder dominated forested sampling plots. Common species were western hemlock, red-osier dogwood, salmonberry, trailing blackberry, willow, vine maple, red elderberry, skunk cabbage, and lady fern. Less frequent species included red huckleberry, piggyback, and Indian plum. DBH averaged approximately 71 centimeters (28 inches) for Douglas fir and western red-cedar, 41 centimeters (16 inches) for big-leaf maple, and 23 centimeters (9 inches) for red alder. Snags, stumps, and logs were more common than in the other reaches, averaging one of each per sampling plot. Young deciduous forest in Reach 3 was dominated by red alder, and western red-cedar, black cottonwood, vine maple, and salmonberry

were common. Invasive species, mainly reed canarygrass and giant horsetail, were encroaching on one sampling plot. Red alders averaged 13 centimeters (5 inches) DBH, and a few larger cottonwoods ranging from 15 to 38 centimeters (6 to 15 inches) DBH were recorded. One stump and little downed wood occurred on two plots. Shrub wetland sampled in Reach 3 consisted of alder saplings, Himalayan blackberry, reed canarygrass, evergreen blackberry, and bracken fern.

5.0 RESTORATION POTENTIAL

The Little Bear Creek watershed has changed significantly since the arrival of European settlers in the late 1800s. Although the Little Bear Creek corridor is still utilized by numerous species of fish and wildlife the quality of instream and riparian habitat has been impacted by changes in land use. Throughout this report the existing status of numerous pathways and indicators as defined by the NMFS (1996) have been documented. The determination of *properly functioning*, *at risk*, and *not properly functioning* for each "indicator" was used as a basis for the prioritization of restoration efforts. Baseline conditions determined to be *not properly functioning* are likely the most limiting conditions for salmonids and are therefore considered the highest priority for restoration followed by the conditions determined to be *at risk*. Table 21 represents a summary of the baseline conditions in Little Bear Creek as they pertain to listed salmonids. Other important considerations in prioritizing possible restoration opportunities are cost, feasibility, and probability of success.

Table 21:
Little Bear Creek Environmental Baseline Condition Summary

PATHWAY	INDICATORS	BASELINE CONDITIONS
Water Quality	Temperature	Juvenile Migration and Rearing = Not Properly Functioning to At Risk Adult Migration and Spawning = Properly Functioning
	Sediment	Not Properly Functioning
	Chemical Contamination & Nutrients	Not Properly Functioning
Habitat Access	Physical Barriers	At Risk
Habitat Elements	Substrate	At Risk
	Large Woody Debris	Not Properly Functioning
	Pool Frequency	Not Properly Functioning
	Pool Quality/Depth	At Risk (not properly functioning in Reach 1)
	Off-Channel Habitat	Not Properly Functioning
	Refugia	Not Properly Functioning
Channel Conditions and Dynamics	Width/Depth Ratio	Reach 1: Not Properly Functioning Reach 2 and 3: At Risk
	Streambank Condition	Not Properly Functioning
	Floodplain Connectivity	Not Properly Functioning
Flow/Hydrology	Change in Peak/Base Flows	At Risk
	Increase in Drainage Network	Not Properly Functioning
Watershed Conditions	Road Density and Location	Not Properly Functioning
	Disturbance History	Not Properly Functioning
	Riparian Reserve/Conservation Areas	Not Properly Functioning (at risk in Reach 3)

The NMFS matrix of pathways and indicators is divided into six major pathways each having several indicators. The following discussion on stream and riparian habitat restoration possibilities and prioritization follows this habitat component approach. Many of these indicators are interwoven in that correcting one will also improve another. An example of this is that large woody debris, riparian reserve, refugia, pool frequency and quality, streambank conditions, and substrate are all related. Another important consideration is that no single action will fully restore Little Bear Creek, and that improving existing conditions will be the result of a multitude of efforts taken over an extended period of time.

The City of Woodinville has already begun undertaking numerous restoration measures along the Little Bear Creek corridor (Appendix R). This includes land acquisition, culvert removal, fish passage improvements, and non-native plant removal. These measures, in addition to those outlined below, will help improve fish and wildlife habitat along the Little Bear Creek corridor.

5.1 WATER QUALITY

Temperature: The temperature indicator ranges from **properly functioning** to **not properly functioning** depending on time of year and life cycle of the species under consideration (see Section 4.4.7 and Table 16). Stream temperature increases as Little Bear Creek flows towards the Sammamish River. Based on the results of data collected from two hobo temperature data loggers installed at the downstream and upstream extremes of Little Bear Creek within the City of Woodinville, stream temperature typically increases by 0.4 degree Celsius within the city.

Additional data documenting the contribution tributaries and ambient air temperature makes to the overall increase of stream temperature would be beneficial in analyzing potential mitigating measures. However, increasing shade by planting conifer trees along the mainstem and tributaries to Little Bear Creek is the primary action the City of Woodinville could undertake to address this issue. The simplistic step of drastically increasing the abundance of conifers along both banks of Little Bear Creek would help increase shade and thereby reduce the rate of increase in stream temperature. Furthermore, planting conifer trees along both banks would help increase bank stability, reduce the abundance of invasive species such as reed canarygrass, provide wildlife habitat, reduce sedimentation, and eventually provide LWD and habitat complexity.

Sediment: The sediment indicator is **not properly functioning** due to a high percentage of fines within the substrate. Primary sources of sediment include stormwater runoff from upland sources such as roads and disturbed areas that directly enter Little Bear Creek or its tributaries, eroding and sloughing banks, and upstream sources. Remedies to reduce the percent of fines within the substrate include best management practices (BMPs) associated with construction projects, bank stabilization efforts, stormwater impact reduction measures, and isolated sediment removal measures from potential spawning areas or introduction of quality spawning gravel (typically not practicable). The most practicable measures the City of Woodinville could undertake to address this issue include bank stabilization efforts utilizing native vegetation, increasing the enforcement and use of BMPs, and working with Snohomish County to address upstream sources.

Chemical Contamination and Nutrients: The chemical contamination and nutrients indicator is **not properly functioning** (Table 21). This determination was based primarily on high fecal

coliform levels (a 1998 303[d] listing), the presence of pesticides, and the presence of metals in sediment samples collected in Reach 1.

The presence of high fecal coliform levels in Little Bear Creek is likely the result of failing septic tanks and runoff from fields with livestock. Both of these potential sources appear to be restricted to the upper portions of Little Bear Creek in Snohomish County and therefore not within the jurisdiction of the City of Woodinville to correct. The source of pesticides in Little Bear Creek may also be the result of actions occurring in the upper watershed.

The presence of metals is likely the result of road runoff entering Little Bear Creek through stormwater runoff in tributaries and direct discharge of stormwater from retention/detention facilities throughout the watershed. However, no existing data on metal concentrations from various potential sources exists. Therefore, identification of priority sites that contribute the highest metal concentrations to Little Bear Creek would need to be initiated prior to the initiation of corrective actions. Junk and construction yards located in Reach 2 and 3, and immediately north of King County may also contribute to the high metal concentrations in Little Bear Creek. An alternative to investing money and time into additional data collection is to insert catch-basin filters in high capacity parking lots that have the highest probability of contributing pollutants. Existing stormwater catch basins can be fitted with filter systems designed to capture priority pollutants such as soluble metals. The overall cost of installing and maintaining catch basin filters depends on the quantity of systems installed. The installation of catch basins would not eliminate existing contamination, but would reduce the rate of future accumulation.

5.2 HABITAT ACCESS

Habitat Access is **at risk**, and therefore not an imminent concern (Table 21). Both the City of Woodinville and Snohomish County are currently addressing habitat access concerns at 132nd Avenue NE and NE 205th Street (Appendix R). The predominance of the culverts identified as potential barriers to fish passage by the Adopt-A-Stream foundation are in Snohomish County and therefore outside of the jurisdiction of the City of Woodinville to correct.

Although the 134th Avenue NE crossing is not currently a fish passage barrier to migrating adult salmonids, they do stack-up immediately downstream of the crossing. The City of Woodinville should investigate the feasibility of purchasing the wrecking yard on the west side of Little Bear Creek serviced by this crossing. If this lot could be purchased several stream enhancement opportunities could occur. The first goals would be to remove soil contaminants within the lot and remove all structures. The second goal would be to use this crossing for enhancement efforts between Little Bear Creek and Highway 522 within Reach 2. Once these actions were completed the crossing could be permanently removed.

5.3 HABITAT ELEMENTS

Four of six indicators of the Habitat Elements pathway are **not properly functioning** (Table 21). Indicators that are **not properly functioning** include LWD, pool frequency, off-channel habitat, and refugia. Although the substrate indicator is **at risk** versus **not properly functioning**, the status of this indicator is also a concern due to its impact on salmonid reproduction.

The lack of LWD plays a major role in decreasing pool frequency and the availability of refugia. The importance of LWD in creating and maintaining pool frequency and refugia is so vital that this may be the single most important habitat element requiring immediate attention in Little Bear Creek. Furthermore, because the riparian zone along Little Bear Creek does not contain adequate numbers of large conifers for LWD recruitment, this indicator will remain **not properly functioning**. The addition of LWD by mechanical means in itself is simplistic and only moderately expensive. However, streamside access and uncertainty in obtaining desired results can create problems. These facts limit the applicability of installing LWD or creating pool habitat. However, some areas with good access are present, and careful design and implementation can increase the probability of success. Sites where access is good include most of Reach 1, within Reach 2 near 132nd Avenue NE and 134th Avenue NE, and within Reach 3 immediately upstream of NE 195th Street. Additional sections of stream could be accessed along Highway 522.

Another important issue is the availability of future recruitment of LWD. Large conifer trees that could potentially add to the presence of instream LWD are lacking along the Little Bear Creek corridor. The only way to address this issue is to plant thousands of conifers along the riparian corridor. Although the time-delay between planting conifer saplings and achieving LWD recruitment would be many decades, this action is necessary for the long-term interest of Little Bear Creek. Because of this time-delay, the planting of conifers is of the highest priority. Additional actions associated with this effort include the removal of non-native and invasive species to facilitate conifer establishment, and long-term monitoring. Additional value is created by this action since planting conifers along the riparian zone will increase bank stability, shade, and wildlife habitat. The entire remaining vegetated corridor along Little Bear Creek is in need of immediate and intensive planting of conifer saplings.

Restoring or improving pool frequency above what would result from the placement of LWD in accessible locations is problematic and costly. Two sites where stream restoration efforts could be undertaken include the lowermost section of Reach 1 and within Reach 3 immediately upstream of NE 195th Street (Appendix G). Both of these sites are fully armored, linear, lack LWD, and consist of low-gradient riffle habitat. Because these sites are degraded, owned by the city, and accessible, they are deemed the best candidates for intensive site specific restoration efforts that could address a multitude of the indicators for the Habitat Elements pathway that are not properly functioning. Primary actions that could occur at these sites include removal of bank armoring, creation of refugia and off-channel habitat, creation of pool habitat, revegetation, and installation of LWD.

Off-channel habitat can also be used as refugia by juvenile salmonids. Off-channel habitat could be created as part of the site specific restoration plan that would be developed for the two stream restoration sites mentioned above. Another simplistic and relatively inexpensive measure that would create additional off-channel habitat and refugia would be to reduce the length of two or three culverts that currently extend into the active stream channel located in Reach 2 (Appendix D – Reach 2 Photos 10, 12, 17, 20, and 21). These culverts drain the unnamed tributaries within the City of Woodinville as shown on Figure 3. The idea here is to cut each culvert back as far as possible into the adjacent uplands for a distance of at least 6 meters (>20 feet) so that new off-channel habitat (and wetlands) is created where culverts and their associated fill material currently exists. The newly exposed area would need to be graded to the stream's

base-flow level and planted with native hydrophytic vegetation. LWD could also be installed at these sites to increase their overall functionality.

5.4 CHANNEL CONDITIONS AND DYNAMICS

Two indicators of the Channel Conditions and Dynamics pathway that are **not properly functioning** include streambank condition and floodplain connectivity. Streambank conditions can be improved by replacing non-native and invasive species with conifers as mentioned previously. Extensive sections of the streambank, especially between Little Bear Creek and Highway 522 could be greatly improved. The removal of armoring in conjunction with revegetation in the lower section of Reach 1 near the mouth and immediately upstream of NE 195th Street will also help to improve streambank conditions.

Floodplain connectivity relates to hydrologic linkage between Little Bear Creek and adjacent off-channel areas, wetlands, riparian vegetation, and succession. No connectivity occurs where stream armoring is present or the stream is abutted by development. No other areas were identified where floodplain connectivity could be increased except as where previously mentioned.

5.5 FLOW/HYDROLOGY

The Flow/Hydrology pathway includes two indicators that were identified as **not properly functioning**. The percent impervious surface within the watershed and abundance of man-made drainage networks are the primary factors influencing this pathway. The two actions that can improve this pathway include reducing the percent of impervious surface, and improving or creating retention/detention facilities within the watershed. The preservation and restoration of existing habitat are critical in protecting against the continued degradation of this pathway. These issues are watershed-wide problems that extend far beyond the Little Bear Creek corridor. Because of the scale of this issue, it is most appropriately dealt with through the implementation of the Growth Management Act (GMA), Shoreline regulations, and city and county codes throughout the Little Bear Creek watershed. However, retrofitting of stormwater retention/detention facilities and elimination of impervious surface should be undertaken whenever the opportunity arises. Actions that reduce the speed at which stormwater travels through existing ditch networks to Little Bear Creek will further reduce the flashy conditions of the existing hydrographs (Figures 5a through 5c).

5.6 WATERSHED CONDITIONS

All indicators for the Watershed Conditions pathway including road density and location, disturbance history, and riparian reserve/conservation areas are **not properly functioning**. With the exception of the riparian reserve/conservation areas indicator (previously addressed), the remaining indicators are influenced primarily by the total amount of impervious surface within the watershed. As was the case with the Flow/Hydrology pathway, this issue is most appropriately dealt with through the implementation of the GMA, Shoreline regulations, and city and county codes throughout the watershed.

Table 22 below summarizes the pathway, indicator, priority, and action for each baseline condition identified as *not properly functioning*. Included in Table 22 are indicators that may have been partially *properly functioning* or *at risk* in one reach or for a specific life history (adult

migration/spawning) but otherwise *not properly functioning*. The priority of each indicator was determined based on time required to achieve desired results, degree of additional benefit, potential for success, and feasibility. Several of the indicators will benefit from the same basic action (e.g. installation of LWD and planting conifers). Although prioritized, the actions required to address these conditions in Little Bear Creek should occur simultaneously.

Table 22:
Not Properly Functioning Baseline Conditions Summary

PATHWAY	INDICATORS	Priority	Basic Action
Water Quality	Temperature	Medium	Plant conifers in riparian zone to increase shading.
	Sediment	Medium	Stabilize problem areas (e.g. LB of Reach 2), stabilize banks, reduce/eliminate upland sources, clean substrate (not practicable).
	Chemical contamination and nutrients	Medium	Identify key sources and implement corrective actions at sources.
Habitat Elements	Large Woody Debris	High	Install LWD and plant conifers for future recruitment.
	Pool Frequency	Medium	Will increase through installation of LWD
	Off-Channel Habitat	High	Create through LWD and retracting culverts
	Refugia	High	Create through LWD and retracting culverts
Channel Conditions and Dynamics	Width/Depth Ratio	Low	Remove armoring and taper back, and address incision resulting from changes in hydrology.
	Streambank Condition	High	Remove non-natives & plant > 10,000 conifers
	Floodplain Connectivity	Medium	Protect and restore corridor
Flow/Hydrology	Increase in Drainage Network	Medium	Reduce ditching and impervious area.
Watershed Conditions	Road Density and Location	Medium	Limit new roads and remove unnecessary ones
	Disturbance History	Medium	Protect and restore corridor
	Riparian Reserve/Conservation Areas	High	Remove non-natives, plant > 10,000 conifers, preserve existing habitat, and acquire more.

In summary, several key actions could potentially improve existing habitat conditions in Little Bear Creek. These recommended actions include:

1. Obtain, preserve, and enhance land along Little Bear Creek to minimize further habitat degradation from continued development along the Little Bear Creek corridor. Undeveloped properties along the corridor with quality riparian habitat should be high priority acquisitions, such as, the properties to the north of the City's "Lumpkin" property (east of 134th Avenue NE crossing). Another area to consider would be the properties to the west of 134th Avenue NE as described in item 7.
2. Immediately initiate a program to reestablish conifers within the riparian zone throughout the Little Bear Creek corridor.
3. Restore hardened rip/rap banks along Little Bear Creek. Include creation of pool habitat, and addition of large woody debris as part of the restoration plan.
4. Retrofit potential pollution-generating sites such as large parking lots and roadways with pollution prevention and storm flow retention facilities where such facilities are presently absent.

5. Reforest upland areas dominated by introduced species such as reed canarygrass and Himalayan blackberry.
6. Create off-channel habitat at each culverted tributary confluence with Little Bear Creek. This can be accomplished by daylighting the maximum extent of culverted tributary possible at each confluence.
7. The City of Woodinville should investigate the feasibility of purchasing the wrecking yard on 134th Avenue NE along the west side of Little Bear Creek. If this lot could be purchased several stream enhancement opportunities could occur. The first goals would be to remove soil contaminants within the lot and remove all structures. The second goal would be to use this crossing for enhancement efforts between Little Bear Creek and Highway 522 within Reach 2. Once these actions were completed the 134th Avenue NE crossing could be permanently removed, or converted to a bridged crossing.
8. The newly purchased city property immediately upstream of NE 195th Street is an ideal site for intensive in-stream, riparian, and upland habitat restoration activities. Actions that would benefit Little Bear Creek at this site include removal of bank armoring, creation of pool habitat, removal of impervious surface (pavement) and non-native vegetation, and installation of large woody debris, riparian vegetation, and upland vegetation.
9. Maintain regular street sweeping, storm drainage system cleaning, and add sediment traps where feasible. This will reduce the amount of sediment entering Little Bear Creek.

5.7 WILDLIFE HABITAT

The Little Bear Creek corridor was originally dominated by large expanses of old-growth forest composed of primarily conifers. These forests were extensively logged throughout the late 1800s and early 1900s and subsequently converted to agricultural land. More recently, agricultural land has rapidly been replaced with an urban landscape. Wetlands adjacent to the Sammamish River were historically extensive but were later filled to reduce flooding and create more developable land. Habitat features such as snags, downed wood, large conifers with a multi-canopy understory, and large wetland complexes are now uncommon or absent along the Little Bear Creek corridor.

Because the existing landscape has been significantly degraded from native conditions, numerous wildlife habitat enhancement opportunities exist. Based on our survey results, five primary actions that would improve wildlife habitat have been identified including:

1. Replacement of existing reed canarygrass, Himalayan blackberry, and scotch broom expanses with native vegetation.
2. Addition of conifers and mast (food) producing shrubs within existing deciduous dominated forest habitat.
3. Addition of downed woody debris to the forest floor.
4. Wetland creation within the corridor.
5. Installation of bird boxes for cavity nesting species.

The first four actions would help create more natural conditions conducive to native wildlife species. These four actions would benefit wildlife by creating suitable habitat, and Little Bear Creek by improving buffer functions. The installation of bird boxes is presented as a temporary measure to provide habitat for cavity nesters until other restoration efforts are able to reestablish suitable cavity nesting sites.

Numerous opportunities for wildlife habitat enhancement exist along the Little Bear Creek corridor in the City of Woodinville. Non-native plant removal opportunities exist along all reaches of the creek. The south end of Reach 1 is highly disturbed and in need of restoration. Little cover exists and non-native plants, which generally provide poor wildlife habitat, are common. The creek in the remainder of Reach 1 is closely bordered by development and would also benefit from restoration, as the existing vegetation provides little cover for wildlife.

The south end of Reach 2 in the vicinity of 132nd Avenue NE also has habitat enhancement opportunities. Shrub habitat on the left bank between 132nd Avenue NE and 134th Avenue NE is heavily infested with Himalayan blackberry, reed canarygrass, and other invasive species and is in need of weed removal and enhancement. Large areas of Himalayan blackberry and Scotch broom exist on the right bank beyond the riparian strip. The area from 134th Avenue NE to the north end of Reach 2 would benefit from the removal of reed canarygrass and other exotics, followed by restoration and enhancement. Although it is highly disturbed, the corridor is relatively wide in the middle stretch of Reach 2 and could potentially provide habitat for birds and mammals. Access to the right bank is difficult because of thick blackberry. The riparian zone becomes very narrow and shade and cover decrease from south to north. The north end of Reach 2 in particular would benefit from habitat restoration, as there is currently only sparse tree cover.

The portion of Reach 3 below NE 195th Street is bordered by private property on the right bank and Highway 522 on the left bank, and accessibility is poor. The area along Highway 522 is densely vegetated with Himalayan blackberry, and intensive clearing would be necessary to access and enhance this area. Private ownership along the left bank (east side) could hinder restoration attempts along this segment.

A shrub area accessed by a gravel lot off of 136th Avenue NE immediately north of NE 195th Street has good access and potential to provide wildlife habitat. The area is adjacent to a stand of mixed forest, which supports scattered large conifers and could provide a corridor for wildlife using the shrub area. Restoration of the gravel lot and adjacent areas would likely provide additional habitat for wildlife using the corridor north of this point.

Wildlife habitat improves with the increase of forest in the northern portion of Reach 3. Abundance of potential nesting and perching trees increases northward, and the corridor increases in width. The middle of Reach 3 is accessible from 136th Avenue NE, and this area provides opportunities for habitat improvement. Weed removal and the addition of native trees and shrubs to upland clearings outside of the riparian zone would enhance habitat in this area. While much of the forested area is young deciduous trees, larger trees increase in number to the north. This area might benefit most from the preservation of large conifers and tracts of forest.

6.0 REFERENCES

Cooke, Sarah Spear. 1997. *A Field Guide to the Common Wetland Plants of Western Washington & Northwestern Oregon*. Seattle Audubon Society. Seattle, Washington.

Foley, S. 2001. *Personal Communication.* Washington Department of Fish and Wildlife. Mill Creek, Washington.

Fresh, K. 2000. *Personal Communication*. Washington Department of Fish and Wildlife. Mill Creek, Washington.

Goetz, F. 2000. *Introduction to the Hiram M. Chittenden Locks – History and Issues*. Proceedings from: Selected recent and ongoing chinook salmon in the greater Lake Washington watershed. Fred Goetz, U.S. Army Corps of Engineers, Seattle District, Seattle, Washington.

Hitchcock, C.L., and A. Cronquist, 1973. *Flora of the Pacific Northwest.* University of Washington Press, Seattle, Washington.

Kerwin, J. 2001. *Salmon and Steelhead Habitat Limiting Factors Report for the Cedar – Sammamish Basin (Water Resource Inventory Area 8).* Washington Conservation Commission. Olympia, Washington.

King County. 2001a. *Draft Inventory Methods for Wadable Streams in King County, Version 3.0.* King County Water and Land Resources Division – Modeling, Assessment, and Analysis Unit. Seattle, Washington.

King County. 2001b. *Habitat Inventory and Assessment of Three Sammamish River Tributaries: North, Swamp and Little Bear Creeks*. King County Department of Natural Resources - Water and Land Resources Division. Seattle, Washington.

King County. 2001c. Web page at http://dnr.metrokc.gov/hydrodat/index.htm.

King County. 2001d. Web page at http://www.kcls.org/wood/history.html.

King County. 2001e. *1998 and 1999 Volunteer Salmon Watcher Program in the Lake Washington Watershed.* King County Department of Natural Resources. Seattle, Washington.

King County. 2000a. *Historic and Current Status of Kokanee in the Lake Washington Basin – Discussion Draft.* King County – Water and Land Resource Division. Seattle, Washington.

King County. 2000b. *1997 Volunteer Salmon Watcher Program in the Lake Washington Watershed.* King County Department of Natural Resources. Seattle, Washington.

King County. 2000c. 1999 *Chinook Spawner Survey Data Technical Report for the Lake Washington Watershed.* Prepared in cooperation with: Washington Department of Fish and Wildlife, Seattle Public Utilities, and Muckleshoot Indian Tribal Fisheries Department.

King County. 1999. 1998 *Chinook Spawner Survey Data Technical Report for the Lake Washington Watershed.* Prepared in cooperation with: Washington Department of Fish and Wildlife, Seattle Public Utilities, and Muckleshoot Indian Tribal Fisheries Department.

King County. 1998. *1996 Salmon Spawning Surveys in the Lake Washington Watershed.* King County Department of Natural Resources. Seattle, Washington.

King County. 1994. *Water Quality of Small Lakes and Streams – Western King County 1990 – 1993.* Publication 946. King County Department of Metropolitan Services. Seattle, Washington.

King County. 1991. *Stream Survey Report Criteria.* King County Building and Land Development Division. Seattle, Washington.

May, C. W., E. B. Welsh, R. R. Horner, J. R. Karr, and B. W. Mar. 1997. *Quality Indices for Urbanization Effects in Puget Sound Lowland Streams.* Final Report for the Washington Department of Ecology. Water Resources Series Technical Report No. 154. Olympia, Washington.

May, C. 1996. *Assessment of Cumulative Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion: Implications for Salmonid Resource Management.* Dissertation, University of Washington, Seattle, Washington, USA.

McCain, M., D. Fuller, L. Decker, and K. Overton. 1990. *Stream Habitat Classification and Inventory Procedures for Northern California.* USDA Forest Service, Pacific Southwest Region. Arcata, California.

Monzaki, Y. 2001. *Personal Communication.* City of Woodinville, Surface Water Engineer. Woodinville, Washington.

NMFS. 1996. *Matrix of Diagnostics/Pathways and Indicators.* National Marine Fisheries Service, Portland, Oregon.

Peterson, N. P., A. Hendry, and T.P. Quinn. 1992. *Assessment of Cumulative Effects on Salmonid Habitat: Some Suggested Parameters and Target Conditions.* TFW-F3-92-001, Washington Timber, Fish, and Wildlife.

Pojar, J., and A. MacKinnon. 1994. *Plants of the Pacific Northwest Coast.* B.C. Ministry of Forests and Lone Pine Publishing. Redmond, Washington.

Purser, M. and R. Simmonds. *Unpublished data on Snohomish County sub-basins total impervious area and vegetation class land cover.* Snohomish County Surface Water Management, Everett, WA.

Repman, L. 2001. *Personal Communication*. Early resident of the City of Woodinville currently residing in Edmonds, Washington.

Reynolds, R.T., J.M. Scott, and R.A. Nussbaum. 1980. *A Variable Circular Plot Method for Establishing Bird Numbers*. Condor 82: pages 309 – 313.

Robbins, C. 1981. *Effect of Time of Day on Bird Activity*. In: Ralph, C. John; Scott J. Michael, editors. Estimating Numbers of Terrestrial Birds. Studies in Avian Biology 6: pages 275 – 286.

Rosgen, D. and L. Silvey. 1998. *Field Guide For Stream Classification*. Wildland Hydrology. Pagosa Springs, Colorado.

Seiler, D. 2001. *Evaluation of Downstream Migrant Chinook Production in Two Lake Washington Tributaries, Cedar River and Bear Creek*. Washington Department of Fish and Wildlife. Olympia, Washington.

Stickney, A. E., and L. McDonald. 1977. *Squak Slough: 1870 – 1920 Early Days on the Sammamish River Woodinville – Bothell – Kenmore*. Evergreen Printing Company, Seattle, Washington.

Snohomish County. 2000. *The State of the Waters: Water Quality in Snohomish County's Rivers, Streams and Lakes*. Snohomish County Public Works, Surface Water Management. Everett, Washington.

U.S. Fish and Wildlife Service. 1986. *Recovery Plan for the Pacific Bald Eagle*. USFWS, Portland, Oregon.

U.S. Forest Service. 2001. *Stream Inventory Handbook – Level 1 & 2*. Version 2.1. Pacific Northwest Region. Region 6.

Thornburgh, K. 2001. *Personal Communication*. Snohomish County Public Works, Surface Water Management. Everett, Washington.

Washington Department of Fish and Wildlife. 2001a. *Salmon Spawning Ground Survey Data*. Letter response to data request by David Evans and Associates, Inc. from Carol Turcotte (WDFW), June 26, 2001.

Washington Department of Fish and Wildlife. 2001b. *Priority Habitat and Species data for the City of Woodinville*. Washington Department of Fish and Wildlife. Olympia, Washington.

Washington Department of Fish and Wildlife. 1999. *Bull Trout in the Stillaguamish River System*. WDFW Mill Creek, Washington.

Williams, R.W., R.M. Laramie and J.J. Ames. 1975. *A Catalog of Washington Streams and Salmon Utilization – Volume I, Puget Sound Region*. Washington Department of Fisheries.

Wolman, M. 1954. *A Method of Sampling Coarse River-bed Material.* Transactions of the American Geophysical Union. 35(6): pages 951 – 956.

Wydoski, R.S. and R.R. Whitney. 1979. *Inland Fishes of Washington.* University of Washington Press. Seattle, Washington.

APPENDICES

Appendix A

APPENDIX A:
Existing Literature Status Update Letter to the City of Woodinville

DAVID EVANS AND ASSOCIATES, INC.

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April 3, 2001

Yoshihiro Monzaki
City of Woodinville
13202 NE 175th Street
Woodinville, Washington 98072

SUBJECT: SUMMARY OF EXISTING LITERATURE TO BE USED IN THE LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

Dear Mr. Monzaki:

David Evans and Associates, Inc. (DEA) has completed the initial task (Task A) of the Little Bear Creek Corridor Habitat Assessment. Task A consisted of obtaining and reviewing relevant existing information on Little Bear Creek that will be utilized in our assessment of the creek corridor. This information will be used to identify data gaps, eliminate unnecessary duplication, and enhance the final report.

Three major modes of data obtainment were used to ensure all pertinent resources were collected. City, county, and state staff were contacted and asked if they were aware of existing information on Little Bear Creek. The Internet was used to search numerous servers that may contain existing information on Little Bear Creek. The reference sections of numerous reports were scanned for potential sources of additional information on Little Bear Creek. Contacting city, county, and state staff produced the majority of relevant documents and often led to obtaining pertinent information on forthcoming reports that will greatly enhance the final report.

Existing data can be categorized into fisheries, instream habitat, water quality and quantity, wildlife, and multiple topic data. The following discussion briefly summarizes the findings of Task A. Additional reports and relevant data will be collected and analyzed as the project progresses.

FISHERIES DATA

Existing fisheries data is available, but selective and spotty. Larger species such as spawning salmonids that are easily observed from the stream bank have been surveyed for in Little Bear Creek. These surveys appear to be spotty in that easily accessed sections near road crossings tend to be the primary area of focus versus surveying the entire reach. Documentation of less prominent species such as three-spine stickleback (*Gasterosteus aculeatus*), speckled dace (*Rhichthys osulus*), sculpins (*Cottus* spp.), large-scale sucker (*Catostomas macrocheilus*) cutthroat trout (*Oncorhynchus clarki*), and lampreys (*Lampetra* spp.) have received little focus.

The Volunteer Salmon Watcher Program conducted by King County provides good information on the presence and distribution of salmonids in Little Bear Creek. It also provides some indication on the minimum number of salmonids that utilize Little Bear Creek. DEA has obtained copies of these reports dating from 1996 through 1999 (King County, 1998, 1999, and 2001). The results from the year 2000 are forthcoming.

Additional chinook (*Oncorhynchus tshawytscha)* spawner survey data was obtained from King County. This includes the results of surveys conducted by several agencies from 1998 and 1999 (King County, 1999 and 2000). Although this data is helpful in establishing presence, it has limited value in establishing abundance and distribution in Little Bear Creek.

Results from recent studies in Bear Creek will also be used to infer emigration timing, fecundity, and survival ratios of chinook fry in Little Bear Creek (Seiler, 2001). The validity of inferring similar trends is based on proximity, genetics, and stream temperature.

INSTREAM HABITAT DATA

Existing instream habitat data is available, but not fully compatible with current City of Woodinville goals. King County accomplished the most recent instream habitat survey conducted in Little Bear Creek during 1999. The final draft report will be available by mid-April. King County surveyed most, but not all of Little Bear Creek within the City of Woodinville. The protocol used was a hybrid of the Timber-Fish-Wildlife (TFW) and May (1996) methodologies. Although this hybrid protocol was suitable in addressing King County's needs, it is not comparable with on-going efforts in the upper watershed being conducted by Snohomish County or the draft protocol for WRIA 8. The results of recent macroinvertebrate studies will also be incorporated into the final report (Morley, 2000).

Additional outdated data is also available in *Reconnaissance Report No. 17 – Little Bear Creek* (King County, 1987). This report is very subjective, and does not provide references for the information contained within. Of particular interest will be checking if potential fish blockage and erosion concerns highlighted in 1987 have been addressed.

The upper watershed in Snohomish County has not been surveyed. However, sections of Little Bear Creek in Snohomish County will be surveyed by Snohomish County (Purser, personal communication, 2001). This data will hopefully be available for incorporation into the City of Woodinville Little Bear Creek Habitat Corridor study.

WATER QUALITY AND QUANTITY DATA

Water quality and quantity data is available for Little Bear Creek. King County has collected water quality and quantity data in Woodinville for several years (King County, 1994). This data will be consolidated and analyzed in the final report. Water quality data for the upper watershed within Snohomish County is also available and will be consolidated and analyzed in the final report (Snohomish County, 2000). Both counties have provided recent unpublished water quality data to DEA for inclusion into the final report. DEA still proposes to monitor temperature at the upstream and downstream city boundary to determine if temperature is a limiting factor and if temperature increases within the lower section of Little Bear Creek. This data will allow city planners and policy makers to determine if current land use activities and riparian coverage within the City of Woodinville are influencing stream temperature.

WILDLIFE DATA

Limited recent site-specific wildlife data is available for lands within the City of Woodinville. Four primary sources of existing literature to be utilized include the *Priority Habitat and Species data* (WDFW, 2001), *Washington State Gap Analysis* (Cassidy et al., 1997), *Birding in Seattle and King County* (Hunn, 1982), and *King County Wetland-Breeding Amphibian Monitoring Program* (Richter et. al., 1999). Additional data has

been requested from King County. Reports that will document historic use include *Mammals of Washington* (Dalquest, 1948). These sources, plus personal communications with local area habitat biologists and city staff will augment field surveys.

MULTIPLE TOPIC REPORTS

Several reports were located that addressed instream habitat, riparian habitat, water quality, fisheries, percent impervious surface, and anthropogenic factors in Little Bear Creek. Two reports by May (1996) and May et. al., (1997) provide a wide range of information on Little Bear Creek. The latter report titled *Quality Indices for Urbanization Effects in Puget Sound Lowland Streams* will be especially valuable as a source of additional information and in comparing Little Bear Creek to other similar streams within the Puget Sound basin. It also provides a framework to rank parameters that will be calculated during this forthcoming survey season.

Additional reports such as the *Tributary 087 – Biological Resources Inventory* (Adlofson Associates, 1998), *North Creek Flood Hazard Reduction Plan – Technical Information* (Watershed Dynamics, 1995), *North Creek Flood Hazard Reduction Plan – Resources Assessment Report* (Watershed Dynamics, 1995), and *ESA Overview and Strategy and Little Bear Creek Corridor Plan* (CH2M Hill, 1999).

DEA is looking forward to working with the City of Woodinville, and providing the city with a detailed Little Bear Creek Corridor Habitat Assessment. DEA is available to meet with you and other city staff to discuss our findings at your convenience. Please do not hesitate to contact me either by phone (425-519-6593) or e-mail (sasw@deainc.com) should you have any questions or comments regarding our findings, fisheries, wildlife, wetlands, permitting, or the endangered species act.

Sincerely,

DAVID EVANS AND ASSOCIATES, INC.

Scott Swarts

Scott Swarts
Fish and Wildlife Biologist

Enclosure: Attachment A, References

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ATTACHMENT A
REFERENCES

Adolfson Associates. 1998. *Tributary 087 - Biological Resources Inventory.* Adolfson Associates, Inc. Seattle, Washington.

Cassidy, K. M., C. E. Grue, M. R. Smith, and K. M. Dvornich, eds. 1997. *Washington State Gap Analysis – Final Report.* Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, Volumes 1-5.

CH2M HILL. 1999. *ESA Overview and Strategy and Little Bear Creek Corridor Plan.* Prepared for the City of Woodinville. Woodinville, Washington.

Dalquest, W. 1948. *Mammals of Washington.* University of Kansas Publications, Museum of Natural History. University of Kansas. Lawrence, Kansas. Volume 2, pp. 1-444.

Hunn, E. 1982. Birding in Seattle and King County. *Seattle Audubon Society – Trailside Series.* Seattle, Washington.

King County. 2001. *1998 and 1999 Volunteer Salmon Watcher Program in the Lake Washington Watershed.* King County Department of Natural Resources. Seattle, Washington.

King County. 2000. 1999 *Chinook Spawner Survey Data Technical Report for the Lake Washington Watershed.* Prepared in cooperation with: Washington Department of Fish and Wildlife, Seattle Public Utilities, and Muckleshoot Indian Tribal Fisheries Department.

King County. 2000. *1997 Volunteer Salmon Watcher Program in the Lake Washington Watershed.* King County Department of Natural Resources. Seattle, Washington.

King County. 1999. 1998 *Chinook Spawner Survey Data Technical Report for the Lake Washington Watershed.* Prepared in cooperation with: Washington Department of Fish and Wildlife, Seattle Public Utilities, and Muckleshoot Indian Tribal Fisheries Department.

King County. 1994. *Water Quality of Small Lakes and Streams – Western King County 1990 – 1993.* Publication 946. King County Department of Metropolitan Services. Seattle, Washington.

King County. 1998. *1996 Salmon Spawning Surveys in the Lake Washington Watershed.* King County Department of Natural Resources. Seattle, Washington.

King County. 1987. *Reconnaissance Report No. 17 – Little Bear Creek.* King County Department of Natural Resources. Seattle, Washington.

May, C. W., E. B. Welsh, R. R. Horner, J. R. Karr, and B. W. Mar. 1997. *Quality Indices for Urbanization Effects in Puget Sound Lowland Streams.* Final Report for the Washington Department of Ecology. Water Resources Series Technical Report No. 154. Olympia, Washington.

May, C. 1996. *Assessment of Cumulative Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion: Implications for Salmonid Resource Management.* Dissertation, University of Washington, Seattle, Washington, USA.

Morley, S. 2000. *Effects of Urbanization on the Biological Integrity of Puget Sound Lowland Streams: Restoration with a Biological Focus.* University of Washington Thesis Submittal. School of Fisheries. Seattle, Washington.

Purser, M. 2001. *Personal communication.* Principal Habitat Specialist. Snohomish County, Public Works, Surface Water Management. Everett, Washington.

Richter, K.O. and E.C. Ostergaard. 1999. *King County Wetland-Breeding Amphibian Monitoring Program: 1993-1997 Summary Report.* King County Department of Natural Resources, Water and Land Resources Division, Seattle, Washington, USA.

Seiler, D. 2001. *Evaluation of Downstream Migrant Chinook Production in Two Lake Washington Tributaries, Cedar River and Bear Creek.* Washington Department of Fish and Wildlife. Olympia, Washington.

Snohomish County. 2000. *The State of the Waters: Water Quality in Snohomish County's Rivers, Streams and Lakes.* Snohomish County Public Works, Surface Water Management. Everett, Washington.

WDFW, 2001. *Priority Habitat and Species data for the City of Woodinville.* Washington Department of Fish and Wildlife. Olympia, Washington.

Watershed Dynamics. 1995. *North Creek Flood Hazard Reduction Plan – Resource Assessment Report.* Prepared for CH2M Hill. Watershed Dynamics, Inc. Auburn, Washington.

Appendix B

APPENDIX B:
King County 1991 Protocol

King County
Building & Land Development Division
Parks, Planning and Resources Department
3600 - 136th Place Southeast
Bellevue, Washington 98006-1400

July 1, 1991

STREAM SURVEY REPORT CRITERIA

The purpose of these guidelines is to improve the validity, consistency, and usefulness of fisheries information. The guidelines address the appropriate scope and methods of stream and fisheries studies, and recommend three progressive levels of detail based on stream system classification and fish utilization. This document is subject to change as more information becomes available or new methods are developed. Future efforts should be devoted toward a better understanding and evaluation of the interrelationships among elements of the environment and on improving impact predictions.

A. General Site Survey

1. Natural drainage system configuration and stream classification
2. Riparian zone land uses
3. Riparian vegetation (structure, species composition & density)
4. Description of adjacent wetlands
5. Animal habitat and utilization
6. Riparian soils, channel morphology, and bank stability.
7. Substrate composition
8. Large woody debris & pool quality
9. Benthos (invertebrates)
10. Fish habitat and utilization
11. Photographs taken at 25 foot intervals

B. Stream Survey Data

Level I - Basic:

A habitat and and stream channel stability survey is required for all Class 1 and 2 streams that traverse the site. The stream survey must be adhere to the methodology developed by King County Surface Water Management (SWM), as modified from the USDA Forest Service Stream Habitat Classification and Inventory Procedures for Northern California (McCain et al, 1990; attached). The survey shall encompass stream reaches one quarter mile upstream and downstream of the site, or to the next higher order stream (Strahler 1957) for Master Drainage Plans and Subdivisions. Stream survey requirements for Building Permits, Short Subdivisions, and Grading and Clearing Permits shall encompass stream reaches 500 feet upstream and downstream of the site. The habitat survey form, attached, was modified by SWM (Fuerstenburg and Luchetti, 1990) from methods developed by the USDA Forest Service. Pool quality indexing should conform to criteria developed by Platts (Platts, 1987; attached).

Level II - Intermediate

In addition to a Level I stream habitat survey, an Intermediate Survey must be performed to list all fish species known to use the stream. Habitat requirements and season of use must be documented. Use of the "two-pass removal electrofishing method" is recommended for a distance of 300 feet of each stream, or 10% of the stream length on the site (whichever is greater). Three sites per stream may be required. Record standard lengths for all salmonids or provide a sub-sample if certain species are particularly numerous. Presence and relative abundance of non-salmonids should be recorded.

In streams with spawning habitat: depending on species presence, survey every two weeks during spawning for chinook, coho, sockeye, steelhead, or other anadromous species. Survey once per month for resident species. Document numbers of redds, live fish, and carcasses.

Spawning or juvenile salmonid survey requirements may be modified or waived if determined unnecessary by SWM and/or BALD.

References

Strahler, A.N. , 1957. Quantitative analysis of watershed geomorphology. American Geophysical Union Transactions 38:913-920.

Fuerstenburg, R.B. and Lucchetti, G.L. 1990. pers. comm. King County Surface Water Management Div. Seattle, WA.

Platts, W.S., G. Armour, G.D. boot, M. Bryant, et al. 1987. Methods for Evaluating Riparian Habitats With Applications to Management. USDA Forest Service General Tech Rept INT-221.

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Level III - Detailed:

In addition to Level I and II requirements, produce a habitat map of scale 1" = 100' (1:1,200) showing:

a) habitat types (as determined by Level I stream habitat survey)
b) spawning areas by species (salmonids only)
c) locations, estimated volumes, and species of large woody debris (any wood at least 10" in diameter and 10' long) within the channel or associated flood plain/riparian area.

Using SWM methodology, establish cross sections for each 300 feet of every Class 1 and 2 stream traversing the site and up to 1/4 mile downstream of the site. If the stream length is less than 300 feet, establish at least three equidistant cross sections. Number and location of transects may be modified by SWM depending on site conditions. For each section document the following:

a) bed cross section elevation at 1 foot intervals from the OHWM
b) substrate composition along the cross section utilizing a leadline methodology (Bain and Finnen, 1985)
c) representative macroinvertebrate species and numbers along the cross section
d) stream habitat types within 5 channel widths upstream and downstream of the cross section
e) position, species, and size of all trees at least 10" average diameter that lie within 10 feet upstream and downstream of the cross section and within a distance of 100 feet of the OHWMs.

Minimum standards of acceptability:

All studies shall include the following:

a) Map of habitat types and sampling locations
b) Inventory of observed and expected species
c) Detailed description of methodology used and identification of researchers and their qualifications
d) Attachment of copies of field data sheets, labeled with consultants name, date, location, and activity.

References

Strahler, A.N., 1957. Quantitative analysis of watershed geomorphology. American Geophysical Union Transactions 38:913-920.

Fuerstenberg, R.B. and Lucchetti, G.L. 1990. pers. comm. King County Surface Water Management Div. Seattle, WA.

Bain, M.B., J.T. Finn, L.J. Gerarde, Jr., M.R. Ross, and W.P. Saunders, Jr. 1982. An evaluation of methodologies for assessing the effects of flow fluctuations on stream fish. FWS/OBS-82/63. U.S. Fish and Wildlife Service, Newton Corner, Massachusetts, USA.

Management Briefs, 1985. Quantifying Stream Substrate For Habitat Studies. North American Journal of Fisheries Management. 5:499-506.

McCain, M., D. Fuller, L. Decker and K. Overton, 1990. Stream Habitat Classification Inventory Procedures For Northern California. USDA Forest Service FHR R-5's Fish Habitat Relationships Technical Bulletin No. 1. 15 pp.

Platts, W.S., G. Armour, G.D. Booth, M. Bryant, et al. 1987. Methods for Evaluating Riparian Habitats With Applications to Management. USDA Forest Service General Tech Rept INT-221.

Appendix C

APPENDIX C:
King County 2001 Protocol

TLH

Inventory Methods for Wadable Streams in King County

v 3.0 5/21/2001

DRAFT

Introduction

In the interest of consistency among stream surveys across the County, and in the interest of combining field data with information from other sources --aerial photographs, maps, GIS, and field data from Federal, state, and tribal agencies-- the following methods are being proposed as the standard to be used by King County employees when conducting instream surveys of fish habitat. Standard methods, while they will not accommodate all inquiries for all needs, will allow King County WLRD to combine data sets collected by different programs for different purposes. It will allow the County to collect data that are most useful to the broadest audience of scientists and policy makers. It makes use of data that are most easily collected and of the highest utility in assessment (Scholtz and Booth 2000). It will allow data storage, retrieval, use, and access by a wider spectrum of scientists and technicians than is currently possible. It will foster more efficient use of field data sets when they can be incorporated in widely-accessible databases and GIS layers. Finally, it will provide a set of standard data types for anticipated use in long-term monitoring and assessment.

No survey protocol can accommodate every foreseeable data need, thus the King County protocol must be flexible if it is to be used for studies with different objectives. Any standardization of stream data sets deserves a note of caution. Multiple studies of observer bias have found a direct positive correlation between the number of habitat types in a classification scheme and the observer disagreement between habitat types (Platts 1983, Ralph et al. 1991, Pleus 1995, Roper and Scarnecchia 1995, Wang et al. 1996). However, despite the questionable assumptions of classifying individual habitat units, with the proper classification system-- and ample training of field personnel-- habitat surveys may be dependably reduced to *reach level* variables such as pool-riffle ratios, average widths, and LWD loading (Frissel et al. 1986, Roper and Scarnecchia 1995, Montgomery et al. 1995).

Reach level variables should, with sufficient amounts of high-quality field data, yield general stream characteristics that can be averaged and applied on a watershed scale (Frissel et al. 1986). Reach-level average values should also provide a context for comparing each new stream survey to streams of similar type and character (Paustian et al. 1992, R2 Resource Consultants 2000). At the very least these assessments will create and use a dynamic library of on-the-ground environmental data. Such a library will by itself clarify what is known about King County streams, and where data is lacking.

No single habitat survey protocol can meet all of King County's modeling and assessment needs. Other protocols are or will be developed separately for discharge measurements, fish distribution, water temperatures, macroinvertebrate abundance, nearshore habitat, and geomorphological characteristics.

Office Preparation

Unless the particular study design requires otherwise, stream survey reaches should always be defined before setting out into the field. Property access, riparian continuity, and the streams' geomorphic context are all more manageable if approached beforehand using a combination of maps, databases, aerial photographs, and geographic information systems (GIS). The segment identification procedures outlined in the TFW Ambient Monitoring Methods manual (Schuett-Hames et al. 1994) are useful for delineating stream reaches for field investigation. Most streams in the county have already been typed (according to the TFW method) by gradient, confinement, and general habitat type. This typing is available in the database compiled by the Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP) and can be accessed from the MAA data server (\\wlrnt4\data\gis\shapes\SSH_NS4.shp). The SSHIAP maps, while not perfect, are consistent with both the TFW protocol and those used by state, tribal, and industry biologists conducting watershed analysis according to Washington State Department of Natural Resources methods (WFPB 1997). The SSHIAP points are revised frequently, so check the shapefile for updates before beginning a survey. The Washington Department of Wildlife has compiled a catalog of stream features (Williams et al. 1975) that, while outdated in many suburban districts, is still of immense value in determining fish access, species distribution, and habitat suitability. The Washington Department of Fish and Wildlife database of spawner survey observations can often supplement the stream catalog in terms of fish abundance. The SSHIAP and spawner databases are currently available on the MAA data directory (\\WLRNT4\data\…).

The entire length of a stream does not have to be sampled in the field. Property access problems often prevent extensive surveys, but even in the case of perfect access many researchers sub-sample streams to increase their efficiency. Montgomery et al. (1995) surveyed reaches from 8 to 24 bankfull channel widths, and their repeated surveys differed by no more than one pool per reach. McHenry et al. (1998) surveyed LWD over 100 meter stream reaches on the Olympic Peninsula and were able to calibrate results with surveys of the same reaches done in 1982 (Grette 1985). Hankin and Reeves (1988) measured one out of every 10 habitat units and visually estimated the dimensions of the other nine, achieving an r^2 of 0.93 between the measured and the estimated habitat areas. May et al. (1997) sampled a minimum of 25 percent of over 100 reaches in 22 Puget Sound Lowland streams, but results on the adequacy of the sample size have yet to be determined. The DNR standard methods for watershed analysis (WFPB 1997) suggest field measurements encompass 15-25 percent of the stream segments in each basin.

Field Methods

Establishing the reach location

Habitat unit surveys will begin at the downstream end of the reach and proceed upstream, even though labeling of the left-bank and right-bank features should be done as if the

observer were looking downstream. The downstream and upstream end points for the survey need to be described in a way that can be clearly interpreted by someone who has not visited the site. Taking GPS points is the preferred way of identifying the upstream and downstream end points. The habitat unit survey form has blanks in the top portion (the header) for GPS readings downstream (D/S) and upstream (U/S). All GPS readings should be recorded in State Plane North HPGN coordinates. When taking GPS coordinates in State Plane North the appropriate measurement units are feet, not meters. Under heavy forest canopies the GPS receiver may not be capable of making accurate readings. In such cases the preferred solution is to shoot offsets with a laser rangefinder.

If GPS readings are not practical or feasible begin the survey where the stream crosses a road, at a confluence, or at some other landmark identifiable on a map or aerial photograph. If the sampling needs to begin upstream of an identifiable landmark (e.g. you don't want to start at a road crossing) then measure the stream distance from the landmark to the point where the survey begins, or simply start the survey elsewhere. An identifiable point (GPS reading, stream confluence, or road crossing) for upstream extent is necessary for accurately locating the stream reach. A downstream point is critical.

If the stream survey can not be located on a map then the usefulness and validity of the data is compromised. There may not be any purpose in conducting a survey if it isn't located so that others can find the site or use the data.

Defining Pools, Riffles, and Glides

Definitions of pools, riffles, and glides vary among habitat survey protocols, and the characteristics of each vary with changing stream flow. Pools typically have slow water velocities, concave bed shapes, and depths greater than that found in riffles and runs. The water surface slope in a pool is essentially zero. If streamflow were to cease pools would continue to hold water (disregarding gravel permeability). Pools often contain eddies with widely varying directions of flow, compared to riffles and glides where the flow is more uni-directional downstream. Riffles are portions of the stream where water velocity is fast, depths are relatively shallow, and the gradient is relatively steep (compared to pools). Riffles typically have boulders and cobble protruding above the water surface, creating a turbulent flow. Channel profile is usually straight to convex. Glides-- which have been likened to shallow canals-- are too shallow to be pools and too slow to be riffles (Platts 1983). Likewise a run, which is typically used in older survey protocols, especially those used in the intermountain West, is too deep to be a riffle and too swift to be a pool. Runs are particularly difficult to distinguish from glides, and the two terms are sometimes used interchangeably. A riffle at high flow often turns into a glide or run, causing confusion and imprecision in delineation. Many glides, such as agricultural ditches and floodplain sloughs, are of such low gradient that they do not become riffles at low flow, yet do not have the concave streambed of pools. Many survey protocols record several habitat types, as discussed below, and then combine classifications in order to calculate pool-riffle ratios, pool spacing, and other summary indices (Platts et al. 1983, USDA Forest Service 1998, Schuett-Hames et al. 1994).

Bisson et al. (1982) was one of the first papers to associate fish preferences with specific habitat types, and most current survey protocols are based on this work. The Bisson et al. (1982) paper divided riffles into three habitat types – low gradient riffles, rapids, and cascades—and pools into six habitat types – secondary channel pools, backwater pools, trench pools, plunge pools, lateral scour pools, and dammed pools. They classified glides as intermediate between pools and riffles.

Hawkins et al. (1993) used a hierarchical approach to break two categories (fast water and slow water) into 18 different habitat types typically found in wadable streams. Definition of these 18 habitat types (7 riffle/cascades, 6 scour pools, and 5 dam pools) was left to literature that is not widely available (Helm et al. 1985). Nevertheless, the Hawkins paper clearly demonstrates the utility and practicality of nesting multiple habitat types into two or three summary units, such as pools and riffles. The authors in Hawkins et al. (1993) equated fast and slow water with riffles and pools, respectively, using the terms interchangeably. The 18 habitat types in Hawkins et al. (1993) are a subset of the 24 habitat units defined in what is commonly referred to as the "FHR" methodology (McCain et al 1997) and an expansion of the 14 habitat types in Bisson et al. (1982).

Hankin and Reeves (1988) developed a sophisticated and statistically defensible habitat and fish abundance estimation technique on four habitat types – pools, riffles, glides, and side channels—based on the habitat classification in Bisson et al. (1982). They emphasized, however, that accurate estimation of habitat areas was contingent on a single experienced observer making all of the visual estimates. Reeves et al. (1989) used data collected using the Hankin and Reeves (1988) method to develop a limiting factors model for coho in the western Cascades. That model enjoys a wide acceptance among fisheries biologists and is often cited as the most reliable method of assessing limiting factors to salmonids.

Beechie et al. (1994) shortened the procedures in the Reeves limiting factors model – while expanding the habitat types to pools, riffles, ponds, lakes, mainstem, and side channel sloughs—and estimated the factors limiting coho in the Skagit watershed. The Beechie model was voted the best paper to appear in the North American Journal of Fisheries Management for the year it was published.

The Northwest Indian Fisheries Commission developed stream survey methods to be used by all cooperators in the Timber-Fish-Wildlife (TFW) Ambient Monitoring program. These methods were consistent with the watershed analysis procedures for use by the state departments of Natural Resources (WADNR) and Fish and Wildlife (WDFW). The original TFW stream survey methods included pools, riffles, cascades, and pool tailouts, but emphasized that tailouts (the way they were defined in that document) usually only occur in large, low-gradient rivers (Schuett-Hames et al. 1994). An updated TFW habitat unit survey protocol reduces the fluvial habitat units to only pools and riffles (Pleus et al. 1999). Reasons for the abbreviated habitat list include 1) problems with habitat unit identification, 2) inconsistent habitat boundary identification, and 3) fluctuation in habitat types at various stream discharges (Pleus 1995). The TFW Ambient Monitoring manual (Schuett-Hames et al. 1994) and the succeeding manuals

(Schuett-Hames et al. 1999, Pleus et al. 1999) provide ample guidance in delineating stream reaches, habitat types, and LWD characteristics.

King County habitat types

Several systems have been developed to classify habitats (HabType), and can be referred to for guidance. The FHR system (McCain et al. 1990) has been adopted as the King County standard and is used by DDES for critical area surveys. Habitat units collected according to the FHR system will be stored in tables separate from current habitat survey data, therefore some habitat units in the database may not appear in the list below. Other nomenclature systems by Bisson et al. (1982), Helm et al. (1985), Hawkins et al. (1993), Rosgen (1994, 1996), and the NWIFC (Schuett-Hames et al. 1999) provide useful definitions, diagrams, and instructions for measuring various reach and habitat parameters. A sampling of sub-habitat types are listed below. Habitat type definitions are from Bisson et al. (1982) unless otherwise noted.

Riffles (aka low-gradient riffles) are defined as having slopes less than 0.04 (4 percent) and shallow depths (less than 20 cm). Current velocities range between 20 and 50 cm/sec, with moderate turbulence. Substrate is typically gravel and cobble from 2 to 256 mm.

Cascades are steeper than riffles and rapids, or, put another way, cascades are the steepest type of riffle (McCain et al. 1990). Unlike riffles and rapids, which have a generally even gradient, cascades alternate between short waterfalls and small pocket pools. Montgomery and Buffington (1993) classify this as a step-pool morphology. Typical substrate in cascades is bedrock or boulders. The TFW Ambient Monitoring manual distinguishes cascades as greater than 3.5 percent (gradient > 0.0350) and riffles as less than 3.5 percent.

Backwater pools usually occur in eddies on the margins of the main stream, typically behind obstructions of LWD, boulders, or rootwads of riparian trees. They are often quite shallow (less than 30 cm) and tend to have fine-grained substrates and low water velocities. Backwater pools are highly preferred summer and winter habitat for coho. McCain et al. (1990) further subdivide backwater pools into those formed by root wads, logs, and boulders.

Plunge pools occur where the stream passes over a channel-spanning obstruction (typically a log berm) and drops vertically into a pool scoured out below. These pools are often large and deep. A complex flow pattern in the pools radiates outward from the point of water entry. Substrates vary considerably from the center of the pool to the slackwater extremities. Plunge pool habitat can be highly complex, and often includes cover in the cavity under the log, behind the bubble curtain, and in the depths of the pool below.

Scour pools are the most common pools in wadable streams, and differ from plunge pools in that the flow is usually directed to one side of a stream by a partial channel obstruction. Often lateral scour pools are associated with undercut banks. Pools occurring on the outside of a meander bend (Montgomery and Buffington 1993, Montgomery et al.

1995) will be classified in King County surveys as lateral scour pools. McCain et al. (1990) specify that lateral scour pools are confined to less than 60 percent of the channel width, and should be sub-divided into those formed by logs, boulders, root wads, and bedrock. Habitats otherwise classified as lateral scour pools, trench pools, mid-channel pools, and convergence pools will be stored in the database as scour pools.

Dammed pools occur upstream of a complete or nearly complete channel obstruction. Typical obstructions include debris jams, landslides, and beaver dams. Water velocity is typically low and substrate sizes tend toward small gravels and sand.

Glides are wide, shallow "pools" flowing smoothly and gently, with low to moderate velocities and little or no surface turbulence. Substrates usually consist of cobble, gravel, and sand. The TFW protocols specify "tailouts" where many biologists would identify a glide (Schuett-Hames et al. 1994). Habitats formerly or otherwise classified as runs will be stored in the database as glides.

The following habitat types are usually not described in habitat survey protocols designed for forested watersheds. However these habitats are common in King County and will be included as available habitat types in the King County database.

Ditches are man-made channels (glides) created to carry runoff from fields and roadways. Some ditches may have once been small streams but have since been straightened, cleaned, or otherwise modified and are now artificially maintained. Ditches are typically straight, and are similar to glides in that they often have low velocities but do not have pool-like channel dimensions. They are typically found in agricultural zones and along road and railroads rights of way.

Debris complex habitat units are low-gradient stream segments with an overabundance of LWD, swirling flow, and indistinct pool or riffle morphology. The dominant feature is a conglomeration of woody debris. Flow is typically chaotic, with varying proportions of fast and slow water (% slow water should be noted). Number of LWD pieces should be counted and, depending on the purpose of the survey, measured.

Culverts are not favorable habitat for fish, but are encountered in many King County surveys and can not be ignored. Culvert survey protocols, which address passage problems, are considered separately from stream survey protocols. However, quantifying culvert length (and number) as a proportion of stream length may be an important factor in assessing habitat characteristics. Including pipes and culverts explicitly will avoid having to interrupt and re-start otherwise continuous habitat surveys.

Braids are a type of riffle that occur where the sediment load is exceeding the transport capacity of the stream under the current hydrologic regime (Leopold and Wolman 1957, Kellerhals et al. 1976). Braids result from an over abundance of sediment, which often originates from forest roads, washouts, or landsliding, and thus indicate a stream that has been impacted by watershed activities such as timber harvest. Either an increase in discharge or a decrease in sediment supply can return a braided channel to a single-thread

channel (Montgomery and Buffington 1993). Braids usually have very high width-to-depth ratios. Riffle habitats that consist of at least three channels separated by highly mobile cobble or sand bars (and bare of vegetation) should be considered braids .

Wetlands (jurisdictional wetlands) have a very specific definition codified in law and are delineated according to soil type, hydrologic regime, and plant community. For the purpose of stream surveys wetlands (in a non-jurisdictional context) are flat, marshy areas where the stream channel becomes indistinct, but where there is a channel entering and exiting the wetland (i.e. the stream being surveyed). For small wetlands the field measurements of length (as a pond centerline from outlet to inlet) and approximate width can be used to calculate habitat area, or for large marshes the area can be measured from aerial photographs back in the office.

Beaver dams provide excellent winter rearing habitat for salmonids, particularly coho, and are highly stable and productive habitats for macroinvertebrates and other organisms (Naiman et al. 1988). Beaver dams have significantly more coho in winter than other pools types (Nickelson et al. 1992) and so should be differentiated in habitat surveys. While dammed pools usually fill in with sediment over time, beavers maintain the depth of their ponds, and by doing so maintain the thermal refugia important to fish in the summer (Pollock et al. 1994). As with wetlands, beaver ponds should be measured in area rather than lineal meters. If field measurements of length and width are questionable it may be possible to measure habitat areas from maps or aerial photographs back in the office.

Habitat Unit Field Techniques

Habitat units will be measured one at a time working in an upstream direction. Left bank and right bank are denoted according to the Mormon method—looking down stream (LDS). The preferred method for measuring linear distance along the stream is a hip chain (also known as a string box) incremented in meters. A fiberglass tape measure may also be used if time permits and accuracy dictates, but a hip chain facilitates the upstream and downstream stationing required on the field form. Hip chain string should be removed from the stream whenever practicable. The suggested method for measuring stream width and depth is a surveyor's stadia rod, incremented in meters. Other instruments are acceptable if time and accuracy dictate.

Working upstream each habitat unit will be classified first as a pool, riffle, or side-channel and noted in the HabID column as P1, R1, P2, R2, S1…P*n*, R*n*, S*n* (see Form 1). Each habitat unit will get a new line on the habitat unit survey form. The cumulative distance (stationing) will be noted in two columns, STA D/S and STA U/S. The downstream distance (STA D/S) and upstream distance (STA U/S) will be used to calculate downstream and upstream measures for each habitat unit and plot them in GIS using routed hydrography layers when accurate hydrography becomes available. The separation of upstream and downstream measures also allows habitat units to exist, in tables, side-by-side where that reflects field conditions. This is especially relevant with side-channels, and also where pools and riffles do not extend across the entire channel.

The downstream and upstream end of each habitat unit will be noted in the STA columns of the survey form. In most cases the STA U/S of one habitat unit will be the same as the STA D/S of the next habitat unit. The habitat form will be clearer if both columns are filled in for each habitat unit (it doesn't take much time and avoids confusion). Habitat sub-unit categories (for example, those listed in Hawkins et al. 1993 or Bisson 1982) can be applied to each habitat in the HabType column of the survey form. This two-column method ensures a consistent accounting of pool-riffle ratios while allowing flexibility in deciding which habitat variables are most important for the survey and it's intended purpose. It also allows the concurrent delineation of side channels without interrupting the mainstem habitat survey. Each habitat unit should extend at least half way across the channel width to qualify as a new habitat unit (WFPB 1997, USDA Forest Service 1998). In cases where a pool occurs in part of a riffle but does not qualify as a new habitat unit, the column %POOL should be used to note the percentage of that riffle that is actually pool habitat (USDA Forest Service 1998). Using the %POOL column in combination with the HabID column allows an accurate and consistent tally of both pool-riffle ratios and the amount of pool habitat in a given reach. The %POOL column is also useful for eliminating observer doubt in steeper cascade reaches where pocket pools comprise a substantial amount of otherwise turbulent habitat.

Stream Width

Habitat width should be measured at least three times on longer habitats and noted in each of the width columns (W1, W2, W3), with an average width computed back in the office. Units of measurement on the field form will be in meters unless otherwise noted. For shorter or simpler habitats a single width measurement is sufficient. See Schuett-Hames et al. (1994) for useful diagrams of where to limit the width measurement on partially-inundated boulders and large cobbles.

Bankfull width should be measured only on habitat units where an accurate assessment of the bankfull flow is possible (Williams 1978, Dunne and Leopold 1978). Typically this occurs on long, straight riffles with a clearly-definable floodplain, distinct terraces, abrupt streambanks at the ordinary high water mark, or ample cobble bars topped with flattened areas of pea gravel or fine sediments (Leopold and Wolman 1957). A detailed discussion of various bankfull indicators can be found in Harrelson et al. (1994). A bankfull elevation that is consistent over several channel widths requires that the water surface slope be essentially the same as the floodplain slope (Leopold and Maddock 1953, Emmett 1975). The water surface slope at a pool is essentially zero. Bankfull *depth* is often irrelevant (or misleading) at pools and, according to some survey protocols, bankfull *width* should not be measured there (USDA Forest Service 1998).

Riffle and Pool Depth

Depth is measured differently in pools and riffles. Pools require two depth measurements, one at the deepest and one at the shallowest points. The pool maximum depth is self-explanatory. The pool crest measurement (or tailout depth) is taken at the deepest point

along the line dividing the pool from the riffle. This is the point at which the last trickle would flow out of the pool if stream flows were to cease. The difference between the maximum depth and the pool crest depth is the residual depth, and represents the pool depth at zero discharge. Pool maximum depth and tailout depth should be recorded on the field form. The residual depths will be calculated in the database. To qualify as a pool the habitat unit should comply with the criteria in Table __. Units of measurement on the field form will be in meters and centimeters unless otherwise noted.

Table__. Minimum residual depth criteria for pools (Schuett-Hames et al 1994).

Channel Bankfull Width (m)	Minimum Residual Depth (m)
0-2.5	0.10
2.5-5	0.20
5-10	0.25
10-15	0.30
15-20	0.35
>20	0.40

Depth in riffles is highly flow dependent so surveys that collect this characteristic should commence with a discharge measurement for the entire stream. (Methods for taking discharge measurements will be included in the next version of the survey protocol.) The average depth in riffles is taken in a representative section of the habitat unit. One way to think of average depth is to mentally note the depth at every point in the habitat, and then measure the depth at what would be an average over the entire habitat unit. If the average depth is in doubt the preferred method is to take measurements from three points along a transect perpendicular to the flow direction. Depths should be taken at one-fourth, one-half-, and three-fourths the distance across the stream, and then divided by 4, to account for the zero depths at the shore (USDA Forest Service 1998, Platts 1983).

Large Woody Debris (LWD)-

The effect of LWD on a stream generally depends on the size of the LWD relative to the width of the stream, the position of the LWD in the stream corridor, and the gradient of the stream reach (Beechie and Sibley 1997, Montgomery and Buffington 1993, Bilby and Ward 1991). Although many ecologists stress flexibility in interpretation, target conditions for LWD loading have nevertheless been set by various agencies and organizations, and in a variety of units. The National Marine Fisheries Service has set "properly functioning" LWD criteria for West Coast rivers at around 80 pieces per mile, greater than 24" diameter, and 50 ft in length (NMFS 1996). The Washington State Department of Fish and Wildlife (WDFW) set a minimum of two pieces of LWD per stream bankfull width on streams less than 20 meters wide, with a minimum of 0.3 key pieces for streams less than 10 meters wide and 0.5 key pieces for streams between 10 and 20 meters wide (WDFW 1996). The WDFW targets are identical to, and were adopted from, channel and fish habitat indicators defined in the Washington DNR watershed analysis methodology (WFPB 1997). Minimum LWD size thresholds in most Washington State standards are 10 cm diameter and 2 m length, and minimum key piece

diameters vary according to stream width, as in Table __ (Schuett-Hames et al. 1999, WFPB 1997).

Table __. Minimum size to qualify LWD as a key piece.

Bankfull Width		Diameter		Length	
meters	feet	meters	feet	meters	feet
0 – 5	0 – 15	0.40	1.3	8	26
6 – 10	15 – 30	0.55	1.8	10	33
11 – 15	30 – 45	0.65	2.1	18	60
16 – 20	45 – 60	0.70	2.3	24	79

Depending on the use of the survey some observers may need to measure each piece of LWD while for others a quick tally of LWD in different size classes may be sufficient. King County surveys will follow either a Level I or Level II assessment protocol depending on the needs of the party conducting the survey and the time and effort available for LWD counts.

For King County Level I surveys the size of LWD will be lumped into three size classes. Only LWD lying wholly or partially within the area inundated by bankfull flow (zone 2, Robison and Beschta 1990) will be counted. All LWD pieces on the division between two habitat units should be tallied on the same line as the habitat unit most affected, or by default with the downstream unit (since this unit will most likely be affected by any flow directed over or around the LWD). Minimum length of LWD will be two meters (6 feet). Root wads can be of any size that has an effect on stream morphology or habitat, but should generally not be less than about 25 centimetes in (bole) diameter. Units of measurement on the field form will be meters and centimeters unless otherwise noted. The LWD pieces for a Level I survey will be grouped into the three diameter classes in Table 1. These diameter classes coincide with those used in the King County and WADNR riparian analyses, but unfortunately do not coincide with either TFW or Mount Baker Snoqualmie National Forest protocols for LWD surveys (Schuett-Hames et al.. 1999, USDA Forest Service 1998, WFPB 1997).

Table1. LWD diameter classes.

Diameter Class	Diameter (inches)	Diameter (cm)
Small	4-12	10-30
Medium	12-20	30-50
Large	20+	Greater than 50

Each row on the habitat unit survey form will have four columns for tallying LWD. Hash marks ( ) will be entered for LWD pieces in each diameter class, with root wads in the fourth column. In many instances it may be useful to note the measured diameter of pool forming LWD pieces, particularly when those pieces are the smallest pieces forming pools in that reach (minimum pool-forming diameter for the reach). Minimum pool-forming diameter measurements can be entered in the column MIN in the LWD section (back) of the field form.

(WFPB 1997) for details on delineating RCUs from stereo photographs and verifying RCUs in the field.

Stream Gradient

Stream gradient is often used as a surrogate for stream energy, the dominant control on channel morphology (Richards 1982). An accurate gradient measurement that characterizes the entire reach is the most useful. Gradient measurements should be taken in a representative section if the reach is homogenous, or stretched over several bankfull widths if the reach is not. The most accurate method of determining stream gradient is to use an autolevel and stadia rod. This method, however, is relatively time consuming and requires more training than that normally given to stream survey personnel. In streams with gradients greater than about four percent it may be possible to achieve acceptable results with a clinometer, but clinometers and most other hand-held devices are not acceptable for flatter stream reaches (Isaak 1999, WFPB 1997, Harrelson 1994).

Laser rangefinders, although relatively expensive, are generally available to many King County personnel and give results nearly as accurate as an autolevel. Laser rangefinders are the preferred instrument for measuring stream gradient when an autolevel is unavailable or impractical. For best results the laser should be mounted on a staff and fired at a red reflector mounted on a second staff. Both the laser and the reflector must be the same height above the water surface (i.e. the staffs should be the same length). Gradient measurements should encompass a stream profile of at least 10 bankfull widths on all wadable streams and should be measured away from the influence of roads, bridges, berms, bank armoring, and other human impacts. Gradient measurements should be reported unitless and to at least three decimal places (i.e. not 0.2 percent but 0.002).

Substrate

The composition of streambed substrate is an crucial factor in how streams behave and can provide important information about how a channel will respond to changes in the watershed (Montgomery and Buffington 1993, Harrelson et al. 1994). Unfortunately, accurate and repeatable measurement of bed substrate can be both tedious and time consuming. Platts et al. (1983) visually classified substrate into six categories and listed a dominant and subdominant substrate in each habitat unit. Comparing these visual estimates to values acquired with sieves yielded disappointing results. Confidence intervals about the mean for the (visual) boulder category was ± 40.9 percent, for the rubble category ± 35.9 percent, and for the fines category was ± 27 percent (Platts et al. 1983). Year-to-year precision between observations was also low. A separate visual estimate of embeddedness fared better, with a 95 percent confidence interval of only ± 5.4 percent. In a similar study in Wisconsin, the accuracy and precision of substrate estimates was better, but still varied with the heterogeneity of the substrates. That is, the more homogenous the substrate mixture the narrower the variation in observer estimates (Wang et al. 1996). Visual estimates, preferred by fisheries biologists, may not be precise enough to serve the needs of fluvial geomorphologists and other river scientists.

Table 2. Riparian vegetation types for King County stream surveys

Type	Code	Description
Conifer dominated	C	Forested, more than 70% of trees are conifer
Hardwood dominated	H	Forested, more than 70% of the trees are hardwood
Mixed	M	Forested, no dominance greater than 70%
Shrub	S	Dominated by woody stemmed vegetation that does not reach > 40' at maturity, e.g., willows (salix), dogwood (cornus), and salmonberry (rubus).
Grass or Cleared	G	Pasture, row crops, maintained right-of-ways, orchards, parkland, landscaped areas, vacant fields, marshes and wetlands not in open water.
Urban	U	Greater than 70% of RCU is paved or built-up. Includes roads, levees, railroads, and bridges.

Table 3. Size classifications for riparian trees.

Type	Code	Description
Small	S	Dominant trees in the RCU: 3" ≤ DBH < 12"
Medium	M	Dominant trees in the RCU: 12" ≤ DBH < 20"
Large	L	Dominant trees in the RCU: 20" ≤ DBH
Not applicable	X	Value applied to the shrub, grass and urban classes

Table 4. Density classes for riparian trees.

Type	Code	Description
Dense	D	More than 1/3 of the RCU is covered by trees
Sparse	S	Less than 1/3 of the RCU is covered by trees
Not applicable	X	Value applied to the shrub, grass, and urban classes

Some studies may require a finer-scale approach to riparian condition than that available in the WADNR method, and some stream inventories may choose not to look at riparian composition at all. In the cases where riparian zone data *are* collected it will be most useful if the RCUs in Tables 2-4 are used to fill in the blanks for LBrip and RBrip on the habitat unit survey form.

The three categories in tables 2-4 are combined and listed in the appropriate columns on the field form. For example a riparian zone on the left bank with a typical stand of 20-year-old alder would get HMD (for hardwood, medium, dense) in the LBrip column. If the right bank was a mature, mixed-deciduous forest with at least 30% conifer understory beginning to accede to the canopy it would probably get MLD (for mixed large dense) in the RBrip column. Observers should interpret the riparian canopy as it would appear from an aerial photograph. Before going out in the field at least one observer should practice delineating riparian condition units using aerial photographs and a stereoscope. Before making riparian calls in the field each observer should also practice visually estimating the diameter classes of trees (at breast height, or 4.5 feet from the ground) and checking the visual estimates with a diameter tape. Refer to the watershed analysis methodology

Level II LWD surveys will use a separate form but will cross-reference to instream habitats by referencing the HabID column on both the habitat survey form and the LWD Level II form. The stationing for each piece may be recorded in the STA column, particularly if the LWD survey is conducted separately from the habitat unit survey. If conducted separately a Level II LWD survey should be located with upstream and downstream GPS points.

Each LWD piece above the minimum threshold (10 cm diameter and 2 m length) will be measured and entered on a separate line of the field form. The BANK column will record if the LWD piece is associated with the left bank (LB), right bank (RB), or mid stream (MS) portion of the channel. The diameter of each piece will be measured with calipers or a diameter tape. Laser rangefinders may be useful in measuring the length of large pieces of wood, but length is probably most easily measured with a stadia rod or fiberglass tape. Field measurements of LWD are acceptable in either metric or standard units, but must be converted to metric units for entry in the database. Each piece should be mentally broken into the four channel interaction zones (Figure __) as specified in Robison and Beschta (1990). Four columns (for zones 1 through 4) will record percentages for the volume of each LWD piece in the respective zones. If the LWD piece is responsible for forming a pool it will recieve an X in the POOL column. The ORIGIN column will record whether the LWD piece was placed during a restoration effort or was naturally recruited ("a" for artificial; "n" for natural). The field SRC_DST (for source distance) will record the distance from the formerly standing tree to the to the (bankfull) streambank, where it is obvious that the tree was recruited in place (laser rangefinders are particularly useful for this measurement). The species or composition (conifer or deciduous) may be recorded in the SP column, if known. A column for comments will also be provided.

Riparian Vegetation

Riparian vegetation has an enormous influence on the productivity and habitat characteristics of a stream reach, but without training and practice it is difficult to summarize from a single point on the ground. Accuracy and precision among different observers and over time are low for streamside cover and bank vegetation, but not for riparian trees (Wang et al. 1996, Platts et al. 1983, Lindsey et al. 1958). The Washington Department of Natural Resources (WADNR) has developed a standard methodology for assessing riparian vegetation along streams using aerial photographs combined with field verification (WFPB 1997). The WADNR method examines a riparian zone 100' on each side of the stream, and classifies the riparian condition units (RCUs) into categories depending on the trunk diameter, canopy density, and vegetational composition of the trees in the zone. King County has adopted a very similar method to classify RCUs in the Agricultural Production Districts and elsewhere, which uses the RCU categories listed in Tables 2-4.

Instead of visual estimates, many state, tribal, and Federal fisheries agencies in the Northwest use pebble counts to classify substrate (Wolman 1954, Booth et al. 1991, Ralph et al. 1991, Harrelson et al. 1994, WFPB 1997, USDA Forest Service 1998). Pebble counting consists of measuring the intermediate axis of 100 stones chosen from the river bed along a transect or from a grid (Wolman 1954). From the pebble sample a cumulative frequency distribution is plotted from which grain sizes may be read. The median diameter (D_{50}) and the diameter of the 84th percentile (D_{84}) are values used by many fluvial geomorphologists to characterize bedload transport in gravel bedded streams (Booth 1991, Kondolf and Li 1992).

Field techniques for the pebble count usually require an observer and a note taker. The reach in question may include both pools and riffles, pools only (usually tailouts, for spawning gravel surveys), or riffles only, depending on the needs of the survey. The reach location and character should be noted on the pebble count field form (Form 2). The observer paces across the bankfull channel width on a transect perpendicular to the flow. For multiple-habitat-unit pebble counts multiple transects are chosen, but typically the count is taken in a single "representative" riffle (USDA Forest Service 1998, Ralph et al. 1991). At each step the observer chooses a stone from under the tip of his or her boot. The tendency is to choose larger rocks, so the "first blind touch" technique is employed to minimize bias (Rosgen 1996). Observers should avoid looking down when choosing stones and try to select the first stone touched by the tip of a finger (Wolman 1954, USDA Forest Service 1998). Large boulders can be measured with a stadia rod. Each stone is measured on the intermediate axis, in millimeters, using a pocket ruler. The longest axis is the length, the shortest axis is the thickness, and the intermediate axis is the width. The intermediate axis determines whether or not a pebble would pass through a soil sieve. See Harrelson et al. (1994) for a good discussion of pebble count techniques that includes a useful diagram of the intermediate axis.

Each pebble is tallied according to a modified Wentworth scale (Form 2). The observer tells the note taker the measurement of each pebble, who tallies them in the appropriate category. If no note taker is available a voice activated pocket tape recorder is useful for recording the measurement (as long as the background noise of the stream isn't too loud). The recording can be played back as the 100 stones tallied on the field form. The note taker and observer can swap duties halfway through (or more often) to alleviate chilled hands. Cumulative frequencies can be totaled and plotted in the field, or saved for data entry in the office. The resulting frequency distribution represents the proportion of each gravel size class as it is found on the stream bed.

Data QA/QC

The most convenient, flexible, and widely-used data entry techniques usually involve spreadsheets. However, the flexibility afforded by spreadsheets often results in stream data that is inconsistent between streams, or even between habitat units in the same reaches of the same stream. To avoid inconsistency and streamline data interpretation, King County employees will enter habitat survey data into a database constructed for that purpose. The data entry screens will be arranged to mimic the field forms, and stream

summary parameters (average bankfull width, pool/riffle ratio, pool spacing, LWD counts, etc.) will be computed automatically. Output from the database will be used to construct GIS tables of stream inventory data.

Data should be entered into the database as soon as possible after the reach survey, preferably at the end of the day. Details of complex habitat configurations are quickly forgotten and can often make a difference in how data is entered or resolved in the database. Timely data entry is an important component of quality assurance.

After the data are entered they should be checked by at least one other person who was present when the data were collected. Both the data entry person and the QA/QC person should enter initials and dates in the appropriate boxes of the database entry forms. The third check of data quality (for character formatting, consistency, etc.) will be made by a database administrator, and the data will be posted for widespread access. Summary tables of survey data will be calculated and exported to standard report formats. The database itself will be posted on a read-only basis. Further manipulation of the survey data, for specific individual analyses and graphing, will occur on downloaded copies of the data, or by arrangement with the database administrators. ArcView event tables and shapefiles depicting the surveyed reaches will be set up by the database administrators and posted in freely-accessible ArcView projects. As with the data, the event tables and shapefiles will be available for copying and individual manipulation.

References

Beechie, T., E. Beamer, and L.Wasserman. 1994. Estimating coho salmon rearing habitat and smolt production losses in a large river basin, and implications for habitat restoration. North American Journal of Fisheries Management 14:797-811.

Beechie, T.J., and T.H. Sibley. 1997. Relationships between channel characteristics, woody debris, and fish habitat in northwestern Washington streams. Transactions of the American Fisheries Society **126**: 217-229.

Bilby, R.E., and J.W. Ward. 1991. Characteristics and function of large woody debris in streams draining old-growth, clear-cut, and second-growth forests in southwestern Washington. Canadian Journal of Fisheries and Aquatic Sciences 48: 2499-2508.

Bisson, P.A., J.L. Nielsen, R.A. Palmason, and L.E. Grove. 1982. A system of naming habitat types in small streams, with examples of habitat utilization by salmonids during low streamflow. *In* N.B. Armantrout [ed.] Acquisition and Utilization of Aquatic Habitat Inventory Information: Proceedings of the Symposium. [Portland, OR, October 1981].

Booth, D.B., K. Bell, and K.X. Whipple. 1991. Sediment transport along the South Fork and mainstem of the Snoqualmie River. King County Surface Water Management. Seattle, Washington.

Dunne, T. and L.B. Leopold. 1978. Water in environmental planning. W.H. Freeman and Co. New York.

Emmett, W.W. 1975. The channels and waters of the upper Salmon River area, Idaho. U.S. Geological Survey Professional Paper 870-A. Washington, D.C.

Frissel, C.A., W. J. Liss, C.E. Warren, M.D. Hurley. 1986. A hierarchical framework for stream habitat classification: viewing streams in a watershed context. Environmental Management 10(2): 199-214.

Grette, G.B. 1985. The role of large organic debris in juvenile salmonid rearing habitat in small streams. Masters thesis, University of Washington.

Hankin, D.G., and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. *Can. J. Fish. Aquat. Sci.* 45: 834-844.

Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field technique. Gen. Tech.Rep. RM-245. Fort Collins, CO: U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Hawkins, C.P., J.L. Kershner, P.A. Bisson, M.D. Bryant, L.M. Decker, S.V. Gregory, D.A. McCullough, C.K. Overton, G.H. Reeves, R.J. Steedman, and M.K. Young. 1993. A hierarchical approach to classifying stream habitat features. Fisheries **18**: 3-6.

Helm, W.T., P. Brouha, M. Aceituno, C. Armour, P. Bisson, J. Hall, G. Holton, and M. Shaw. 1985. Glossary of stream habitat terms. Habitat Inventory Committee, American Fisheries Society, Western Division.

Isaak, D.J., W.A. Hubert, and K.L. Krueger. 1999. Accuracy and precision of stream reach water surface slopes estimated in the field and from maps. North American Journal of Fisheries Management 19:141-148.

Kellerhalls, R., and M. Church, 1989. The morphology of large rivers: characterization and management. Pages 13-30 *in* Dodge, D.P. (ed) Proceedings of the International Large River Symposium (LARS). Can. Spec. Publ. Fish. Aquat. Sci. 106: 629 p.

Kondolf, G.M., and S. Li. 1992. The pebble count technique for quantifying surface bed material size in instream flow studies. Rivers 3(2): 80-87.

Leopold, L.B. and T. Maddock. 1953. The hydraulic geometry of stream channels and some physiographic implications. U. S. Geological Survey Professional Paper 252.

Leopold, L.B., and M.G. Wolman. 1957. River channel patterns: braided, meandering and straight. Geological Survey Professional Paper 282-B. U.S. Government Printing Office, Washington D.C.

Lindsey, A.A., J.D. Barton Jr., and S.R. Miles. 1958. Field efficiencies of forest sampling methods. Ecology 39(3): 428-444.

Lisle, T.E. and S. Hilton. 1992. The volume of fine sediment in pools: an index of sediment supply in gravel-bed streams. Water Resources Bulletin 28(2): 371-383

May, C.W., E.B. Welch, R.R. Horner, J.R. Karr, and B.W. Mar. 1997. Quality indices for urbanization effects in Puget Lowland streams. Report prepared for Washington Department of Ecology. Water Resources Series Technical Reprot No 154.

McCain, M. D. Fuller, L.Decker, and K. Overton. 1990. Stream habitat classification and inventory procedures for Northen California. USDA Forest Service, Pacific Southwest Region.

McHenry, M.L., E. Shott, R.H. Conrad, and G.B. Grette. 1998. Changes in the quantity and characteristics of large woody debris in streams of the Olympic Peninsula, Washington, USA. (1982-1993). Canadian Journal of Fisheries and Aquatic Sciences **55**: 1395-1407.

Montgomery, D.R., and J.M. Buffington. 1993. Channel classification, prediction of channel response, and assessment of channel condition. Report TFW-SH10-93-002. Washington Department of Ecology, Olympia WA.

Montgomery, D.R., J.M. Buffington, R.D. Smith, K.M. Schmidt, and G. Pess. 1995. Pool spacing in forest channels. Water Resources Research 31(4): 1097-1105.

Naiman, R.J., C.A. Johnston, and J.C. Kelley. 1988. Alteration of North American streams by beaver. BioScience 38(11): 753-762

Nickelson, T.E., J.D. Rodgers, S.L. Johnson, and M.F. Solazzi. 1992. Seasonal changes in habitat use by juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon coastal streams. Canadian Journal of Fisheries and Aquatic Sciences **49**: 783-789.

NMFS (National Marine Fisheries Service). 1996. Coastal salmon conservation: working guidance for comprehensive salmon restoration initiatives on the Pacific Coast. National Oceanic and Atmospheric Administration. September 15, 1996

Paustian, S.J. and thirteen coauthors. 1992. A channel type users guide for the Tongass National Forest, Southeast Alaska. USDA Forest Service, Alaska Region. R10 Technical Paper 26.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. USDA Forest Service General Technical Report INT-GTR-188.

Pleus A.E. 1995. Variability associated with salmon habitat identification and water surface area measurements. Masters thesis. Evergreen State College, Olympia, Washington.

Pleus, A.E., D. Schuett-Hames, and L. Bullchild. 1999. TFW Monitoring Program method manual for the habitat unit survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-003. DNR #105.

Pollock, M.M., R.J. Naiman, H.E. Erickson, C.A. Johnston, J. Pastor, and G. Pinay. 1994. Beavers as engineers: influences on biotic and abiotic characteristics of drainage basins. pp. 117-126 *in* Linking Species to Ecosystems. C.G. Jones and J.H. Lawton eds. Chapman & Hall, New York.

R2 Resource Consultants. 2000. Tri-county urban issues ESA study. Prepared for the Tri-County Urban Issues Advisory Committee by R2 Resource Consultants in association with CH2MHill and Shapiro & Associates. Seattle, WA.

Ralph, S.C., T. Cardoso, G.C. Poole, L. L. Conquest, and R.J. Naiman. 1991. Ambient monitoring project biennial progress report; 1989-91 biennial period. Center for Streamside Studies, University of Washington, Seattle.

Reeves, G.H., F.H. Everest, and T.E. Nickelson. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. USDA Forest Service General Technical Report PNW-GTR-245. 18p.

Richards, K. 1982. Rivers, form and process in alluvial channels. Methuen & Co. Ltd. London. 361pp.

Robison, G.E., and R.L. Beschta. 1990. Characteristics of coarse woody debris for several coastal streams of Southeast Alaska, USA. Canadian Journal of Fisheries and Aquatic Sciences 47: 1684-1693.

Roper, B.B. and D.L. Scarnecchia. 1995. Observer variability in classifying habitat types in stream surveys. North American Journal of Fisheries Management **15**: 49-53.

Rosgen, D.L. 1994. A classification of natural rivers. Catena 22: 169-199.

Rosgen, D.L. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.

Scholtz, J. G., and D. B. Booth. 2000. Monitoring urban streams: strategies and protocols for humid-region lowland systems. Prepared for King Count WLRD. University of Washington Center for Urban Water Resources Management and University of Washington Center for Streamside Studies, Seattle.

Schuett-Hames, D. A. Pleus, L. Bullchild, and S. Hall. 1994. Timber-Fish-Wildlife Ambient Monitoring Program Manual. TFW-AM9-94-001 Northwest Indian Fisheries Commission. Olympia WA.

Schuett-Hames, D., A.E. Pleus, J. Ward, M. Fox, and J. Light. 1999. TFW Monitoring Program method manual for the large woody debris survey. Prepared for the Washington State Dept of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-004. DNR #106.

USDA Forest Service. 1998. Stream inventory handbook, version 9.8. Region VI, USDA Forest Service, Portland, Oregon.

Wang, L. T.D. Simonson, and J. Lyons. 1996. Accuracy and precision of selected stream habitat estimates. North American Journal of Fisheries Management 16:340-347

Washington Department of Fish and Wildlife. 1996. 21st Century Wild: Washington State's Fish and Habitat Policy for Salmonid Protection and Recovery. Internal WDFW Review Draft (Wild Salmonid Policy). August 15, 1996. Olympia WA.

Washington Forest Practices Board (WFPB). 1997. Standard Methodology for Conducting Watershed Analysis under Chapter 222-22 WAC. Version 4.0, November 1997. Washington Department of Natural Resources, Olympia, Washington.

Williams, G.P. 1978. Bank-full discharge of rivers. Water Resources Research 14(6): 1141-1154

Williams, R.W., R.M. Laramie and J.J. Ames. 1975. A catalog of Washington streams and salmon utilization. Vol. 1, Puget Sound Region; Washington Department of Fisheries. Olympia.

Wolman, M.G. 1954. A method of sampling coarse river-bed material. Transactions of the American Geophysical Union 35: 951-956

Wolman Pebble Count field data form

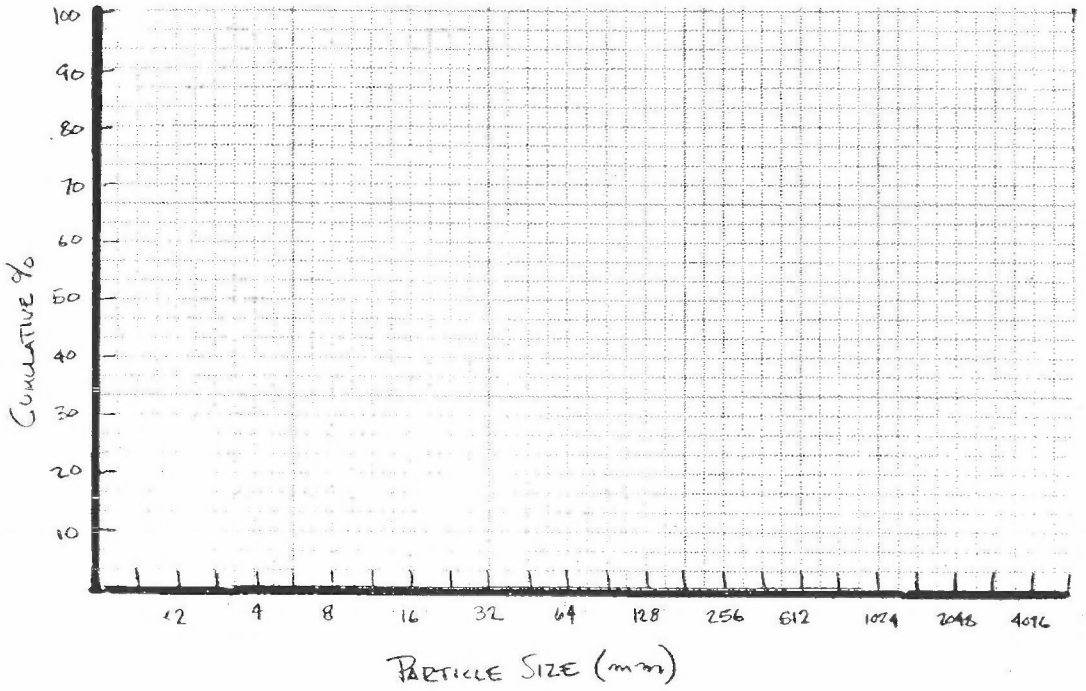
Date: _____ Observer: _____

Stream: _____ Recorder: _____

Habitat Unit: _____ Reach Description: _____

Particle	category	millimeters	count	total#	particle%	cumulative%
<= sand	fines	<2				
very fine	gravels	2-4				
fine	gravels	4-6				
fine	gravels	6-8				
medium	gravels	8-12				
medium	gravels	12-16				
coarse	gravels	16-24				
coarse	gravels	24-32				
very coarse	gravels	32-48				
very coarse	gravels	48-64				
small	cobbles	64-96				
small	cobbles	96-128				
large	cobbles	128-192				
large	cobbles	192-256				
small	boulders	256-384				
small	boulders	384-512				
medium	boulders	512-1024				
large	boulders	1024-2048				
very large	boulders	2048-4096				

BEDROCK



Stream Name	Date	Temp Air	Site Notes:
Reach Name/Num	Time In	Temp Water	
GPS D/S	Time Out	Weather	
GPS U/S	Crew		

						Width				Depth				Riparian		
Hab ID	STA D/S	STA U/S	Len	Hab Type	% pool	W1	W2	W3	BKF	Avg	Max	Tail	BKF	RB	LB	COMMENTS

LWD LEVEL II

Stream: _____

Date: _____

Crew: _____

HabID	STA	Bank	Length	Dia	Z1	Z2	Z3	Z4	Origin	Pool	MM	SP	Origin	SP	Comments

References

Beechie, T., E. Beamer, and L.Wasserman. 1994. Estimating coho salmon rearing habitat and smolt production losses in a large river basin, and implications for habitat restoration. North American Journal of Fisheries Management 14:797-811.

Beechie, T.J., and T.H. Sibley. 1997. Relationships between channel characteristics, woody debris, and fish habitat in northwestern Washington streams. Transactions of the American Fisheries Society 126: 217-229.

Bilby, R.E., and J.W. Ward. 1991. Characteristics and function of large woody debris in streams draining old-growth, clear-cut, and second-growth forests in southwestern Washington. Canadian Journal of Fisheries and Aquatic Sciences 48: 2499-2508.

Bisson, P.A., J.L. Nielsen, R.A. Palmason, and L.E. Grove. 1982. A system of naming habitat types in small streams, with examples of habitat utilization by salmonids during low streamflow. *In* N.B. Armantrout [ed.] Acquisition and Utilization of Aquatic Habitat Inventory Information: Proceedings of the Symposium. [Portland, OR, October 1981].

Booth, D.B., K. Bell, and K.X. Whipple. 1991. Sediment transport along the South Fork and mainstem of the Snoqualmie River. King County Surface Water Management. Seattle, Washington.

Dunne, T. and L.B. Leopold. 1978. Water in environmental planning. W.H. Freeman and Co. New York.

Emmett, W.W. 1975. The channels and waters of the upper Salmon River area, Idaho. U.S. Geological Survey Professional Paper 870-A. Washington, D.C.

Frissel, C.A., W. J. Liss, C.E. Warren, M.D. Hurley. 1986. A hierarchical framework for stream habitat classification: viewing streams in a watershed context. Environmental Management 10(2): 199-214.

Grette, G.B. 1985. The role of large organic debris in juvenile salmonid rearing habitat in small streams. Masters thesis, University of Washington.

Hankin, D.G., and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. *Can. J. Fish. Aquat. Sci.* 45: 834-844.

Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field technique. Gen. Tech.Rep. RM-245. Fort Collins, CO: U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Hawkins, C.P., J.L. Kershner, P.A. Bisson, M.D. Bryant, L.M. Decker, S.V. Gregory, D.A. McCullough, C.K. Overton, G.H. Reeves, R.J. Steedman, and M.K. Young. 1993. A hierarchical approach to classifying stream habitat features. Fisheries 18: 3-6.

Helm, W.T., P. Brouha, M. Aceituno, C. Armour, P. Bisson, J. Hall, G. Holton, and M. Shaw. 1985. Glossary of stream habitat terms. Habitat Inventory Committee, American Fisheries Society, Western Division.

Isaak, D.J., W.A. Hubert, and K.L. Krueger. 1999. Accuracy and precision of stream reach water surface slopes estimated in the field and from maps. North American Journal of Fisheries Management 19:141-148.

Kellerhalls, R., and M. Church, 1989. The morphology of large rivers: characterization and management. Pages 13-30 *in* Dodge, D.P. (ed) Proceedings of the International Large River Symposium (LARS). Can. Spec. Publ. Fish. Aquat. Sci. 106: 629 p.

Kondolf, G.M., and S. Li. 1992. The pebble count technique for quantifying surface bed material size in instream flow studies. Rivers 3(2): 80-87.

Leopold, L.B. and T. Maddock. 1953. The hydraulic geometry of stream channels and some physiographic implications. U. S. Geological Survey Professional Paper 252.

Leopold, L.B., and M.G. Wolman. 1957. River channel patterns: braided, meandering and straight. Geological Survey Professional Paper 282-B. U.S. Government Printing Office, Washington D.C.

Lindsey, A.A., J.D. Barton Jr., and S.R. Miles. 1958. Field efficiencies of forest sampling methods. Ecology 39(3): 428-444.

Lisle, T.E. and S. Hilton. 1992. The volume of fine sediment in pools: an index of sediment supply in gravel-bed streams. Water Resources Bulletin 28(2): 371-383

May, C.W., E.B. Welch, R.R. Horner, J.R. Karr, and B.W. Mar. 1997. Quality indices for urbanization effects in Puget Lowland streams. Report prepared for Washington Department of Ecology. Water Resources Series Technical Reprot No 154.

McCain, M. D. Fuller, L.Decker, and K. Overton. 1990. Stream habitat classification and inventory procedures for Northen California. USDA Forest Service, Pacific Southwest Region.

McHenry, M.L., E. Shott, R.H. Conrad, and G.B. Grette. 1998. Changes in the quantity and characteristics of large woody debris in streams of the Olympic Peninsula, Washington, USA. (1982-1993). Canadian Journal of Fisheries and Aquatic Sciences **55**: 1395-1407.

Montgomery, D.R., and J.M. Buffington. 1993. Channel classification, prediction of channel response, and assessment of channel condition. Report TFW-SH10-93-002. Washington Department of Ecology, Olympia WA.

Montgomery, D.R., J.M. Buffington, R.D. Smith, K.M. Schmidt, and G. Pess. 1995. Pool spacing in forest channels. Water Resources Research 31(4): 1097-1105.

Naiman, R.J., C.A. Johnston, and J.C. Kelley. 1988. Alteration of North American streams by beaver. BioScience 38(11): 753-762

Nickelson, T.E., J.D. Rodgers, S.L. Johnson, and M.F. Solazzi. 1992. Seasonal changes in habitat use by juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon coastal streams. Canadian Journal of Fisheries and Aquatic Sciences **49**: 783-789.

NMFS (National Marine Fisheries Service). 1996. Coastal salmon conservation: working guidance for comprehensive salmon restoration initiatives on the Pacific Coast. National Oceanic and Atmospheric Administration. September 15, 1996

Paustian, S.J. and thirteen coauthors. 1992. A channel type users guide for the Tongass National Forest, Southeast Alaska. USDA Forest Service, Alaska Region. R10 Technical Paper 26.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. USDA Forest Service General Technical Report INT-GTR-188.

Pleus A.E. 1995. Variability associated with salmon habitat identification and water surface area measurements. Masters thesis. Evergreen State College, Olympia, Washington.

Pleus, A.E., D. Schuett-Hames, and L. Bullchild. 1999. TFW Monitoring Program method manual for the habitat unit survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-003. DNR #105.

Pollock, M.M., R.J. Naiman, H.E. Erickson, C.A. Johnston, J. Pastor, and G. Pinay. 1994. Beavers as engineers: influences on biotic and abiotic characteristics of drainage basins. pp. 117-126 *in* Linking Species to Ecosystems. C.G. Jones and J.H. Lawton eds. Chapman & Hall, New York.

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Ralph, S.C., T. Cardoso, G.C. Poole, L. L. Conquest, and R.J. Naiman. 1991. Ambient monitoring project biennial progress report; 1989-91 biennial period. Center for Streamside Studies, University of Washington, Seattle.

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Schuett-Hames, D. A. Pleus, L. Bullchild, and S. Hall. 1994. Timber-Fish-Wildlife Ambient Monitoring Program Manual. TFW-AM9-94-001 Northwest Indian Fisheries Commission. Olympia WA.

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USDA Forest Service. 1998. Stream inventory handbook, version 9.8. Region VI, USDA Forest Service, Portland, Oregon.

Wang, L. T.D. Simonson, and J. Lyons. 1996. Accuracy and precision of selected stream habitat estimates. North American Journal of Fisheries Management 16:340-347

Washington Department of Fish and Wildlife. 1996. 21st Century Wild: Washington State's Fish and Habitat Policy for Salmonid Protection and Recovery. Internal WDFW Review Draft (Wild Salmonid Policy). August 15, 1996. Olympia WA.

Washington Forest Practices Board (WFPB). 1997. Standard Methodology for Conducting Watershed Analysis under Chapter 222-22 WAC. Version 4.0, November 1997. Washington Department of Natural Resources, Olympia, Washington.

Williams, G.P. 1978. Bank-full discharge of rivers. Water Resources Research 14(6): 1141-1154

Williams, R.W., R.M. Laramie and J.J. Ames. 1975. A catalog of Washington streams and salmon utilization. Vol. 1, Puget Sound Region; Washington Department of Fisheries. Olympia.

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Wolman Pebble Count field data form

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Stream: _____ Recorder: _____

Habitat Unit: _____ Reach Description: _____

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very coarse	gravels	48-64				
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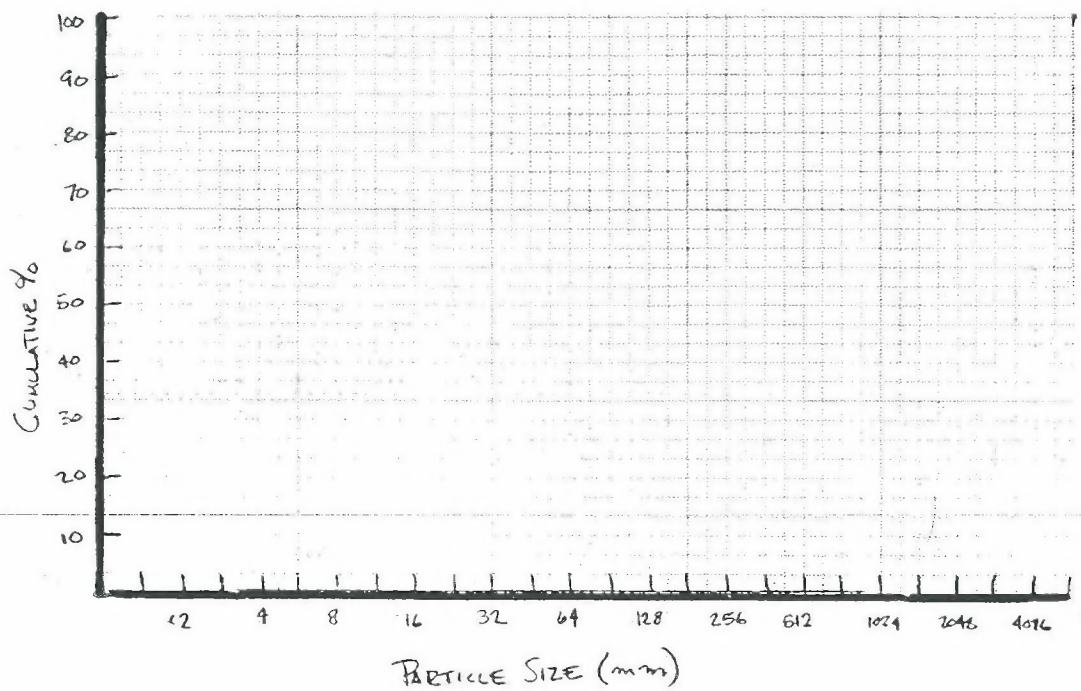
small	cobbles	96-128				
large	cobbles	128-192				
large	cobbles	192-256				
small	boulders	256-384				
small	boulders	384-512				
medium	boulders	512-1024				
large	boulders	1024-2048				
very large	boulders	2048-4096				

BEDROCK



Appendix D

APPENDIX D:
Stream Photos;
Reach 1, Reach 2, and Reach 3

Reach 1

PHOTO 1

PHOTO 2

DAVID EVANS AND ASSOCIATES INC.	City of Woodinville	REACH 1 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	1 Start of Reach 1 at mouth of Little Bear Creek.
	September 2001	2 First riffle in Little Bear Creek.

GX0315

PHOTO 3

PHOTO 4

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 1 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	3 *View Looking downstream towards the Sammamish River Trail crossing over Little Bear Creek.*
September 2001	4 *View looking upstream from the downstream side old railroad crossing over Little Bear Creek.*

Gx0315

PHOTO 5

PHOTO 6

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville

WOOD0000-0010

September 2001

REACH 1 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

5 *View looking upstream at long linear riffle habitat downstream of the NE 178th street crossing.*

6 *View looking upstream at long linear riffle habitat downstream of the NE 178th street crossing*

Gx0315

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 1 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	7 View looking downstream at the NE 178th Street crossing over Little Bear Creek.
September 2001	8 View looking upstream immediately above the NE 178th Street crossing

Gx0315

PHOTO 9

PHOTO 10

DAVID EVANS AND ASSOCIATES INC.	City of Woodinville	REACH 1 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	9 View of series of weirs previously installed by King County.
	September 2001	10 View of Reach 1 endpoint at the Hwy 202 crossing over Little Bear Creek

GX0315

Reach 2

PHOTO 1

PHOTO 2

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	1 View of the Reach 2 start point at the Hwy 202 crossing over Little Bear Creek.
September 2001	2 View of riffle/pool habitat immediately upstream of the Hwy 202 crossing

GX0315

PHOTO 3

PHOTO 4

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	3 View looking upstream at a water deflection device and scour pool.
September 2001	4 View of downstream side of culvert crossing under 132nd Ave. NE.

Gx0315

PHOTO 5

PHOTO 6

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	5 Close-up of failing deflector and erosion at 132nd Ave. NE culvert crossing.
September 2001	6 View of stream bank lacking shrub and/or tree cover.

Gx0315

PHOTO 7

PHOTO 8

DAVID EVANS AND ASSOCIATES INC	City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	7 *View of bank sluffing, and source of debris and sediment at Crane Company.*
	September 2001	8 *View of downstream side of culverts under the 134th Ave. NE crossing*

Gx0315

PHOTO 9

PHOTO 10

DAVID EVANS AND ASSOCIATES INC	City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	9 Typical riffle and riparian condition in Reach 2 upstream of 134th Ave. NE.
	September 2001	10 Mystery culvert that likely only flows during rain events

GX0315

PHOTO 11

PHOTO 12

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	11 Shrubby section of reach dominated by silt and sand
September 2001	12 Culverted outlet of unnamed tributary

GX0315

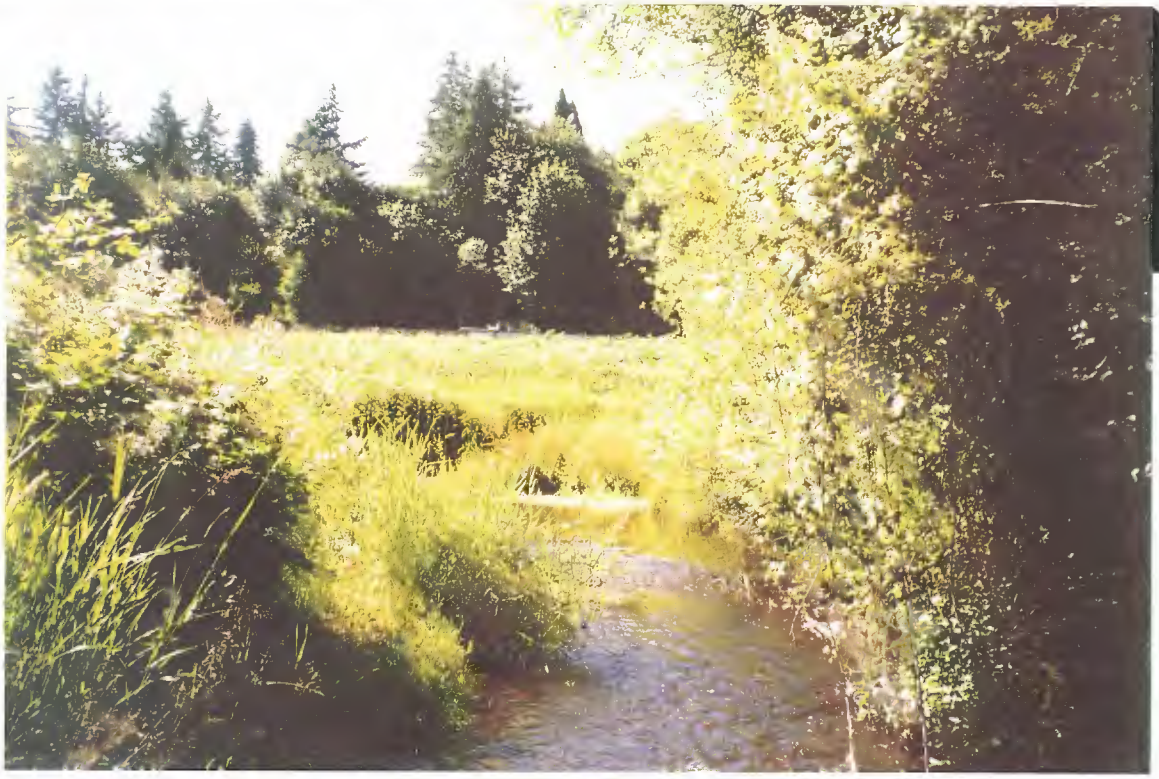


PHOTO 13

PHOTO 14

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	**13** View looking upstream towards opening dominated by reed canary grass and Himalayan blackberry between stream and HWY 522.
September 2001	**14** Large pipe crossing over Little Bear creek.

Gx0315

PHOTO 15

PHOTO 16

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville

WOOD0000-0010

September 2001

REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

15 *Typical riffle habitat and dominant non-native species along left bank.*

16 *Additional view of riffle and riparian condition.*

GX0315

PHOTO 17

PHOTO 18

DAVID EVANS AND ASSOCIATES INC	City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	17 Stormwater/detention pond outlet.
	September 2001	18 Long and wide riffle potentially suitable for spawning.

GX0315

PHOTO 19

PHOTO 20

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	19 Right-bank (RB) unnamed tributary between creek and HWY 522.
September 2001	20 Downstream side of culvert under HWY 522. Note smaller culvert along right side of photo.

Gx0315

PHOTO 21

PHOTO 22

DAVID EVANS AND ASSOCIATES INC	City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	21 Close-up of culvert opening of unnamed tributary.
	September 2001	22 Inside of downstream side of culvert under HWY 522

Gx0315

PHOTO 23

PHOTO 24

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville	REACH 2 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	23 Upstream side of culverts under HWY 522 at Reach 2 endpoint.
September 2001	24 Inside upstream side of culvert under HWY 522

GX0315

Reach 3

PHOTO 1

PHOTO 2

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	1 Upstream side of culverts under HWY 522 at Reach 3 starting point.
September 2001	2 Small unnamed tributary immediately upstream of HWY 522.

GX0315

PHOTO 3

PHOTO 4

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	3 Riffle habitat upstream of HWY 522.
September 2001	4 Cleared lawn along RB immediately downstream of 195th Street.

GX0315

PHOTO 5

PHOTO 6

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	5 Sluffing bank between creek and HWY 522 on-ramp from 195th Street southbound.
September 2001	6 View of stream bank armoring and rip/rap weirs near Reach 3 starting point.

GX0315

PHOTO 7

PHOTO 8

DAVID EVANS AND ASSOCIATES INC.	City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	7 Additional armoring and weirs immediately downstream of 195th Street.
	September 2001	8 Garter snakes at 195th Street.

Gx0315

PHOTO 9

PHOTO 10

DAVID EVANS AND ASSOCIATES INC.	City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	9 View looking upstream.
	September 2001	10 View looking downstream at 195th Street.

GX0315

PHOTO 11

PHOTO 12

DAVID EVANS AND ASSOCIATES INC.	City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	11 View looking upstream from 195th Street.
	September 2001	12 Riffle habitat near upstream end of long-linear-armored section.

Gx0315

PHOTO 13

PHOTO 14

DAVID EVANS AND ASSOCIATES INC.	City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	13 Raw bank around first large pool upstream of 195th Street
	September 2001	14 View of left bank of pool dominated by introduced species.

GX0315

PHOTO 15

PHOTO 16

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville

WOOD0000-0010

September 2001

REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

15 Debris with signs of beaver chew markings.

16 Beaver path into and out of Little Bear Creek

Gx0315

PHOTO 17

PHOTO 18

DAVID EVANS AND ASSOCIATES INC

City of Woodinville

WOOD0000-0010

September 2001

REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

17 *View of increasing upstream canopy cover.*

18 *Armoring and introduced species as creek nears HWY 522.*

GX0315

PHOTO 19

PHOTO 20

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville

WOOD0000-0010

September 2001

REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

19 *View of dominant reed canary grass.*

20 *Close-up of small, unnamed right-bank tributary.*

GX0315

PHOTO 21

PHOTO 22

DAVID EVANS AND ASSOCIATES INC	City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	21 *View of old cedar stump near small, unnamed right-bank tributary.*
	September 2001	22 *Old, abandoned bridge over Little Bear Creek.*

GX0315

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	23 Debris cuttings discarded into stream.
September 2001	24 One of few adjacent wetlands able to provide refuge during storm events

GX0315

PHOTO 25

PHOTO 26

DAVID EVANS AND ASSOCIATES INC	City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	**25** *Increasing abundance of conifers in upper section of Reach 3.*
	September 2001	**26** *Big-leaf maple providing in-stream structure.*

Gx0315

PHOTO 27

PHOTO 28

DAVID EVANS AND ASSOCIATES INC.

City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	27 Riffle habitat and hose crossing near Reach 3 endpoint
September 2001	28 View of last house along Reach 3.

Gx0315

PHOTO 29

PHOTO 30

DAVID EVANS AND ASSOCIATES INC

City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
WOOD0000-0010	29 View of Reach 3 endpoint at downstream side of 205th Street.
September 2001	30 View of last pool from endpoint at 205th Street.

Gx0315

PHOTO 31

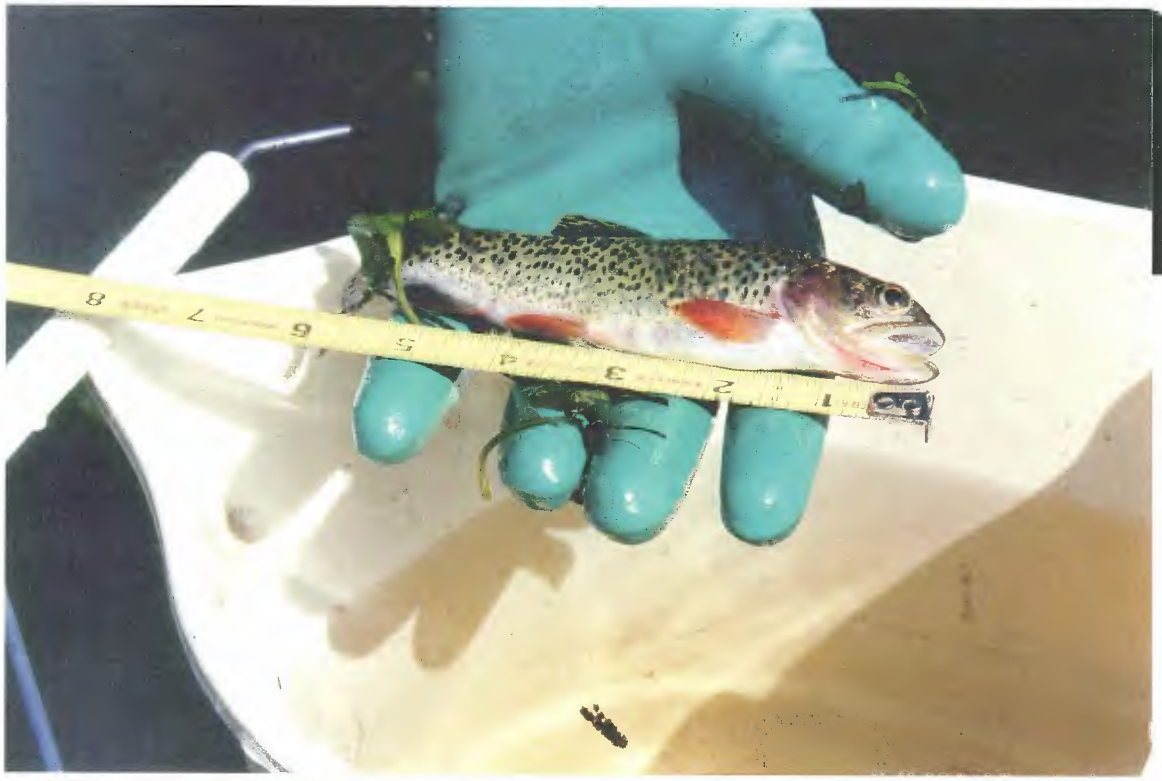


PHOTO 32

DAVID EVANS AND ASSOCIATES INC

City of Woodinville

WOOD0000-0010

September 2001

REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT

31 *Total fish sample captured near Reach 3 endpoint.*

32 *Close-up of cutthroat trout from Reach 3.*

Gx0315

PHOTO 33

PHOTO 34

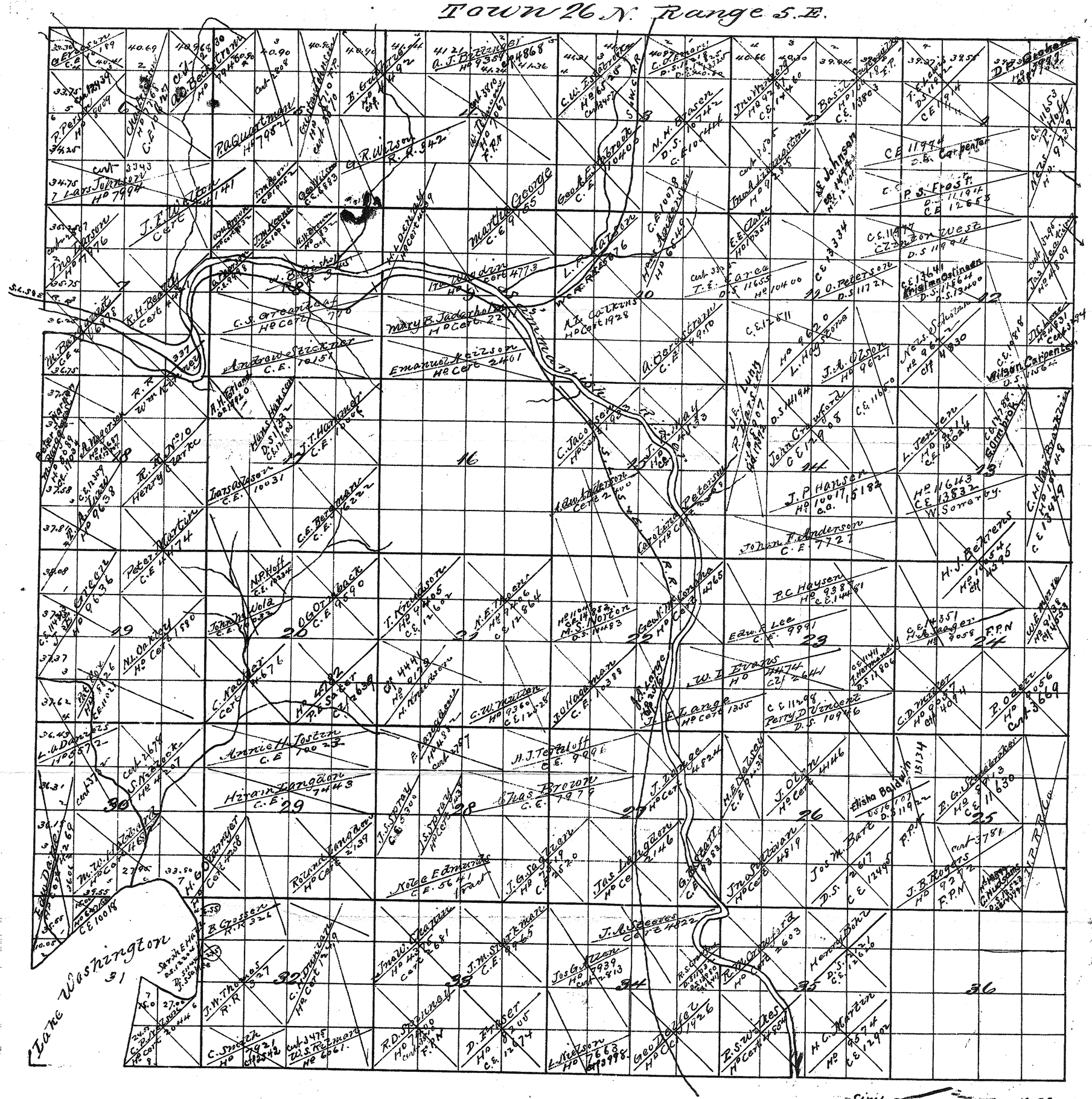
DAVID EVANS AND ASSOCIATES INC.	City of Woodinville	REACH 3 - LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT
	WOOD0000-0010	33 Spawning sockeye in pool tailout immediately downstream of 205th Street.
	September 2001	34 Spawning sockeye in pool tailout immediately downstream of 134th Avenue NE.

Gx0315

Appendix E

APPENDIX E:
Plat Map

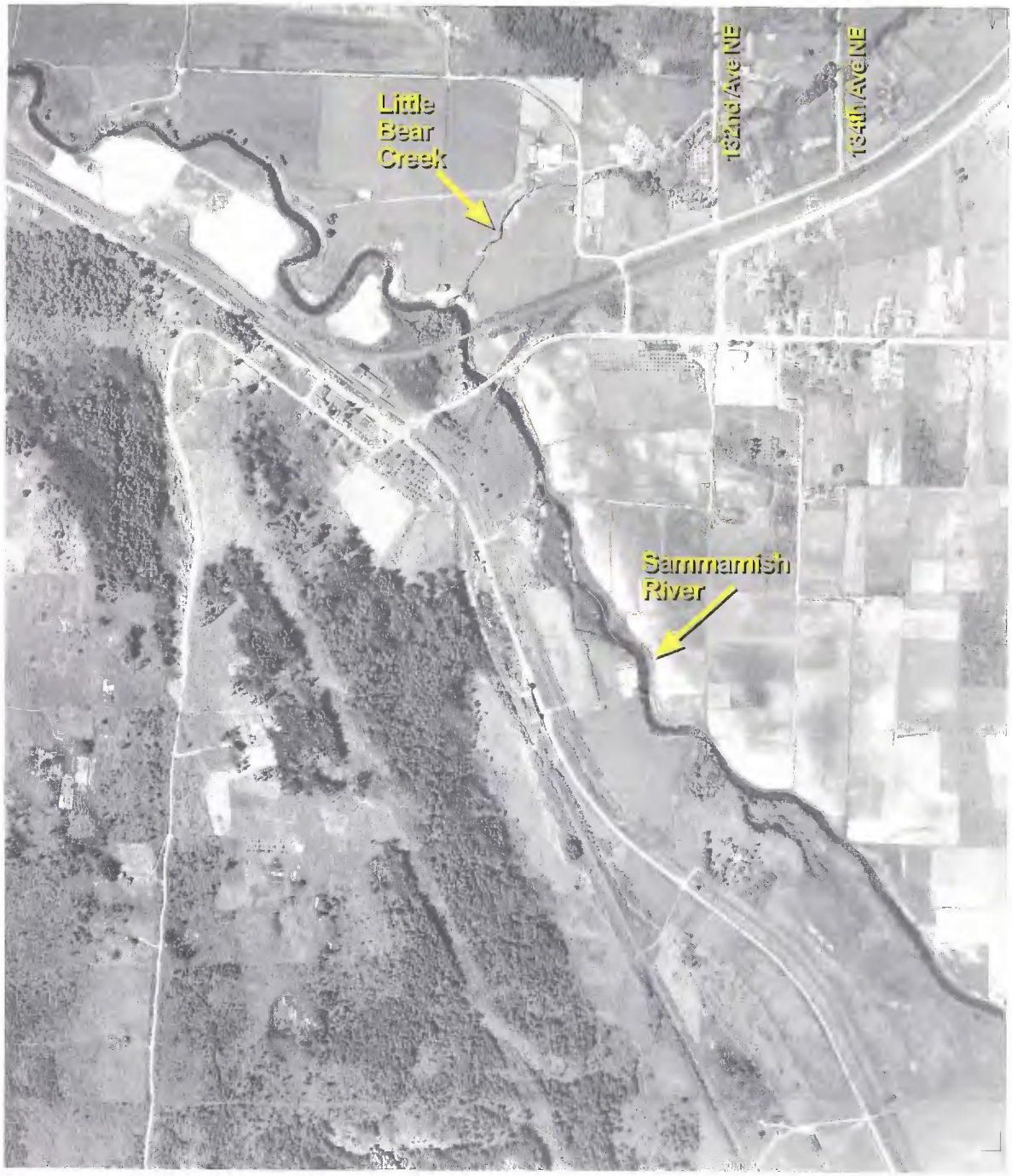
Town 26 N. Range 5 E.



Civil Engineers & Surveyors
Seattle Wash.

Appendix F

APPENDIX F:
1936 Aerial Photos



Approx Scale
1 inch = 800 feet

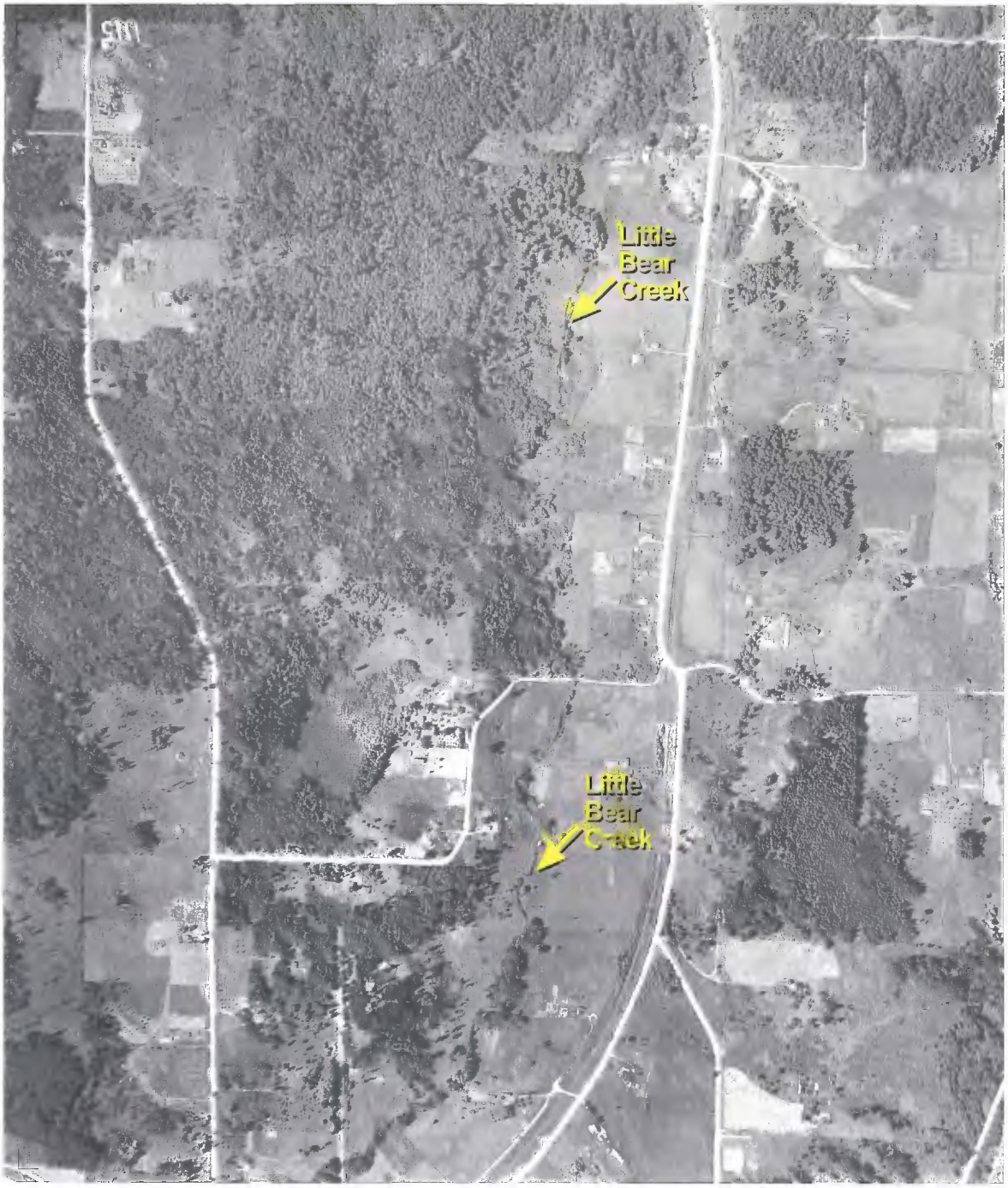
Gx:0321 Project # WOOD0000-0010.004

LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT	Appendix F Sheet 1 of 4	DAVID EVANS AND ASSOCIATES INC.
	City of Woodinville	
Aerial Photo: Year 1936 Source: Walker and Associates	Project Number: WOOD0000-0010.004	

Approx Scale
1 inch = 800 feet

Gx:0321 Project # WOOD0000-0010.004

LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT	Appendix F Sheet 2 of 4	DAVID EVANS AND ASSOCIATES INC.
	City of Woodinville	
Aerial Photo: Year 1936 Source: Walker and Associates	Project Number: WOOD0000-0010.004	



Approx Scale
1 inch = 800 feet

Gx:0321 Project # WOOD0000-0010.004

LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT	Appendix F Sheet 3 of 4	DAVID EVANS AND ASSOCIATES INC.
	City of Woodinville	
Aerial Photo: Year 1936 Source: Walker and Associates	Project Number: WOOD0000-0010.004	

Approx Scale
1 inch = 800 feet

Gx:0321 Project # WOOD0000-0010.004

LITTLE BEAR CREEK CORRIDOR HABITAT ASSESSMENT	Appendix F Sheet 4 of 4	DAVID EVANS AND ASSOCIATES INC.
	City of Woodinville	
Aerial Photo: Year 1936 Source: Walker and Associates	Project Number: WOOD0000-0010.004	

Appendix G

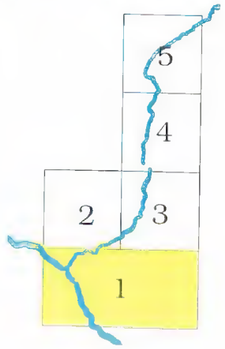
APPENDIX G:
1999 Aerial Photos

End Reach 1
Start Reach 2

Intensive Bank Restoration

Start Reach 1

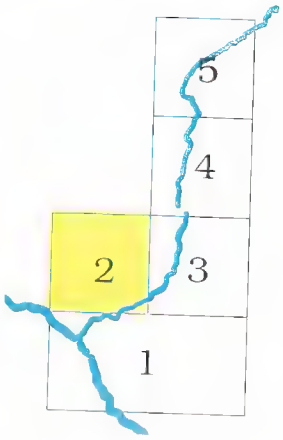
SAMMAMISH RIVER



61-meter Stream Buffer
Intensive Revegetation

100 0 100 200 Meters
250 0 250 500 750 Feet
N

Little Bear Creek
Reach 1
August, 1999



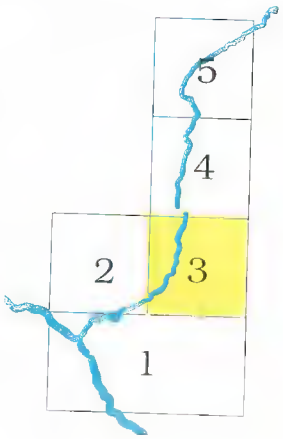
100 0 100 200 Meters

250 0 250 500 750 Feet

N

61-meter Stream Buffer
Intensive Revegetation

Little Bear Creek
Reach 2
August, 1999



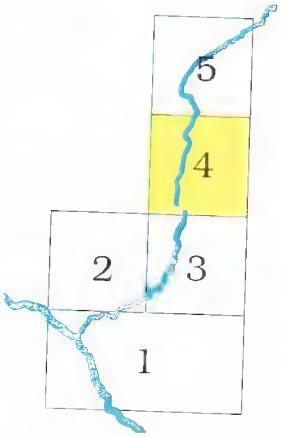
100 0 100 200 Meters

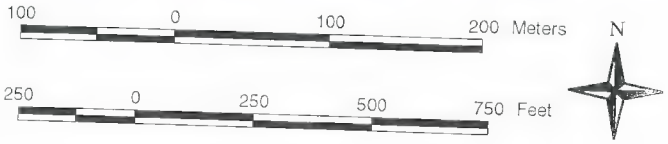
250 0 250 500 750 Feet

N

61-meter Stream Buffer
Intensive Revegetation

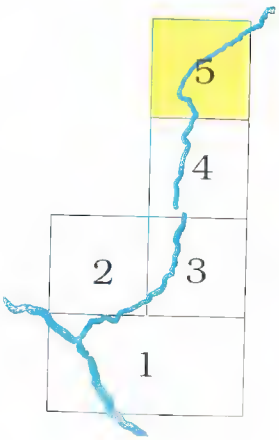
Little Bear Creek
Reach 2
August, 1999

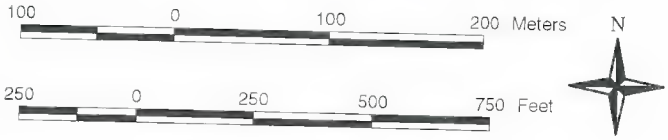




61-meter Stream Buffer
Intensive Revegetation

Little Bear Creek
Reach 3
August, 1999





61-meter Stream Buffer
Intensive Revegetation

Little Bear Creek
Reach 3
August, 1999

Appendix H

APPENDIX H:
Hatchery Plant Data for Little Bear Creek

LAKE WASHINGTON SYSTEM OFF-STATION COHO FINGERLING RELEASES

STREAM NAME	WRIA NO	NUMBER PLANTED	NO/LB	LBS PLNTD	DATE	STOCK	HATCHERY
LITTLE BEAR CR	08.0080	91098	482	189	4/24/97	ISSAQUAH	ISSAQUAH
		91728	504	182	4/10/96	ISSAQUAH	ISSAQUAH
		69625	557	125	4/13/95	ISSAQUAH	ISSAQUAH
		115900	666	174	4/06/94	ISSAQUAH	ISSAQUAH
		102300	598	171	5/03/93	ISSAQUAH	ISSAQUAH
		79000	1026	77	3/18/92	ISSAQUAH	ISSAQUAH
		54000	1400	39	3/13/91	ISSAQUAH	ISSAQUAH
		75000	798	94	4/12/89	ISSAQUAH	ISSAQUAH
		60600	830	73	3/11/88	ISSAQUAH	ISSAQUAH
		100000	1250	80	3/11/87	ISSAQUAH	ISSAQUAH
		55900	307	182	5/04/87	ISSAQUAH	ISSAQUAH
		130476	996	131	4/08/86	ISSAQUAH	ISSAQUAH
		75000	1250	60	3/19/84	ISSAQUAH	ISSAQUAH
UNNAMED Trib.	08.0083	7712	482	16	4/24/97	ISSAQUAH	ISSAQUAH
		7056	504	14	4/10/96	ISSAQUAH	ISSAQUAH
		5500	220	25	5/12/95	ISSAQUAH	ISSAQUAH
		10300	1026	10	3/18/92	ISSAQUAH	ISSAQUAH
UNNAMED Trib.	08.0084	7712	482	16	4/24/97	ISSAQUAH	ISSAQUAH
		7056	504	14	4/10/96	ISSAQUAH	ISSAQUAH
		5500	220	25	5/12/95	ISSAQUAH	ISSAQUAH
		10300	1026	10	3/18/92	ISSAQUAH	ISSAQUAH
UNNAMED	08.0102 ?	4500	447	10	4/15/92	ISSAQUAH	ISSAQUAH
UNNAMED	08.0104 ?	9620	481	20	4/25/97	ISSAQUAH	ISSAQUAH
		10665	395	27	4/16/96	ISSAQUAH	ISSAQUAH
		11697	557	21	4/12/95	ISSAQUAH	ISSAQUAH
		4900	405	12	4/26/94	ISSAQUAH	ISSAQUAH
		5400	598	9	5/03/93	ISSAQUAH	ISSAQUAH
		5700	710	8	3/24/92	ISSAQUAH	ISSAQUAH
		2500	248	10	5/20/91	ISSAQUAH	ISSAQUAH
		4800	798	6	4/13/89	ISSAQUAH	ISSAQUAH
		10000	770	13	3/14/88	ISSAQUAH	ISSAQUAH

Rel Site	Species/race name	Brood YR	Agency	DAT1	DAT2	Rel Stage	Rel Type	Tagged	AD Clipped	Unmarked	Total	Tag Loss Da	Weight (g)	Exp Survival	Hatchery
LTL BEAR CR 08.0080	COHO	1950	WDFW	19520306	19520306	Pre-smolt	H	0	0	15200	15200		11.9399996		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1951	WDFW	19530120	19530120	Fingerling	H	0	0	25200	25200		6.48000002		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1952	WDFW	19530319	19530319	Fed Fry	H	0	0	35435	35435		0.40000001		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1952	WDFW	19540315	19540315	Fingerling	H	0	0	5405	5405		9.64999962		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1953	WDFW	19550112	19550112	Fingerling	H	0	0	10416	10416		9.44999981		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1954	WDFW	19560308	19560308	Fingerling	H	0	0	9126	9126		8.39999962		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1955	WDFW	19570204	19570204	Fingerling	H	0	0	11520	11520		7.09000015		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1956	WDFW	19580205	19580205	Fingerling	H	0	0	19950	19950		7.96000004		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1957	WDFW	19590114	19590114	Fingerling	H	0	0	5040	5040		7.55999994		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1958	WDFW	19600113	19600113	Fingerling	H	0	0	19703	19703		7.44000006		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1959	WDFW	19610130	19610130	Fingerling	H	0	0	26961	26961		7.96000004		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1960	WDFW	19610330	19610330	Emergent	H	0	0	50600	50600		0.36000001		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1964	WDFW	19660119	19660119	Pre-smolt	H	0	0	4900	4900		16.2000008		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1967	WDFW	19680324	19680324	Fed Fry	H	0	0	161200	161200		0.37		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1968	WDFW	19700216	19700216	Smolt	H	0	0	4242	4242		21.6000004		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1981	COOP	19820312	19820312	Emergent	H	0	0	130000	130000		0.31		STEPS
LTL BEAR CR 08.0080	COHO	1982	COOP	19830308	19830308	Fed Fry	H	0	0	250000	250000		0.38		STEPS
LTL BEAR CR 08.0080	CHIN FALL	1983	WDFW	19840306	19840306	Fingerling	H	0	0	54000	54000		0.85000002		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	CHIN FALL	1983	WDFW	19840227	19840227	Fingerling	H	0	0	310000	310000		1.02999997		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1983	WDFW	19840319	19840319	Emergent	H	0	0	75000	75000		0.36000001		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1983	COOP	19840503	19840503	Fed Fry	H	0	0	470	470		0.47999999		BOTHELL HS FISH TEAM
LTL BEAR CR 08.0080	CHIN FALL	1983	WDFW	19840224	19840224	Fingerling	H	0	0	100000	100000		0.94		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1983	COOP	19840510	19840510	Fed Fry	H	0	0	470	470		0.47999999		BOTHELL HS FISH TEAM
LTL BEAR CR 08.0080	COHO	1984	COOP	19850404	19850404	Fed Fry	H	0	0	8523	8523		0.47999999		BOTHELL HS FISH TEAM
LTL BEAR CR 08.0080	CHIN FALL	1985	WDFW	19860327	19860327	Fed Fry	H	0	0	77800	77800		0.58999997		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1985	WDFW	19860408	19860408	Fed Fry	H	0	0	130500	130500		0.46000001		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1985	COOP	19860501	19860501	Fingerling	H	0	0	1500	1500		1.70000005		BOTHELL HS FISH TEAM
LTL BEAR CR 08.0080	CHIN FALL	1986	WDFW	19870304	19870304	Fingerling	H	0	0	27000	27000		0.97000003		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	CHIN FALL	1986	WDFW	19870304	19870304	Fingerling	H	0	0	111300	111300		1.02999997		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1986	WDFW	19870311	19870311	Emergent	H	0	0	100000	100000		0.36000001		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1986	WDFW	19870504	19870504	Fingerling	H	0	0	55900	55900		1.48000002		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1987	WDFW	19880311	19880311	Fed Fry	H	0	0	60600	60600		0.55000001		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	CHIN FALL	1987	WDFW	19880406	19880406	Fingerling	H	0	0	134700	134700		1		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1988	WDFW	19890412	19890412	Fed Fry	H	0	0	75000	75000		0.56999999		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	CHIN FALL	1988	WDFW	19890320	19890320	Fingerling	H	0	0	198800	198800		0.63		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1989	WDFW	19900312	19900312	Fingerling	H	0	0	128400	128400		1.13		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1990	COOP	19910115	19910115	Emergent	H	0	0	300000	300000		0.30000001		STEPS
LTL BEAR CR 08.0080	COHO	1990	COOP	19910315	19910315	Emergent	H	0	0	200000	200000		0.30000001		STEPS
LTL BEAR CR 08.0080	CHIN FALL	1991	WDFW	19920220	19920220	Fed Fry	H	0	0	69700	69700		0.47		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1991	WDFW	19920318	19920318	Fed Fry	H	0	0	78900	78900		0.44		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1991	COOP	19920228	19920228	Emergent	H	0	0	110000	110000		0.30000001		STEPS
LTL BEAR CR 08.0080	COHO	1992	COOP	19930115	19930115	Fed Fry	H	0	0	200000	200000		0.44999999		STEPS
LTL BEAR CR 08.0080	COHO	1992	WDFW	19930503	19930503	Fed Fry	H	0	0	102300	102300		0.75999999		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1993	WDFW	19940406	19940406	Fed Fry	H	0	0	115900	115900	0	0.68000001		ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1994	WDFW	19950413	19950413	Fed Fry	H	0	0	69625	69625		0.81	N	ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1995	WDFW	19960410	19960410	Fed Fry	H	0	0	91600	91600		0.89999998	N	ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1996	WDFW	19970424	19970424	Fed Fry	H	0	0	91098	91098		0.94	N	ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1997	WDFW	19980421	19980421	Fed Fry	H	0	0	44000	44000		0.82999998	N	ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1997	WDFW	19980421	19980421	Fed Fry	H	0	0	46410	46410		0.82999998	N	ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1997	WDFW	19980421	19980421	Fed Fry	H	0	0	30030	30030		0.82999998	N	ISSAQUAH HATCHERY
LTL BEAR CR 08.0080	COHO	1974	WDFW	197604	197605	Smolt	W	12575	0	0	12575		22.6800003	N	
LTL BEAR CR 08.0080	COHO	1975	WDFW	197705	197705	Pre-smolt	W	10660	0	0	10660		15.1199999	N	
LTL BEAR CR 08.0080	COHO	1976	WDFW	197806	197806	Pre-smolt	W	3013	30	305	3348	1	15.1199999	N	
											4011007				

Stock	COMMENTS	RepAGY	CWTmarkID	NonCWTmar	FishPerPoun	Pounds	MARKS	%CWT	TagLoss%	RelYear	RiverMile	Pond	AGE
ISSAQUAH CR 08.0178		WDFW		0000	38	400		0		1952			2
ISSAQUAH CR 08.0178		WDFW		0000	70	360		0		1953			2
ISSAQUAH CR 08.0178		WDFW		0000	1145	30.9475983		0		1953			1
ISSAQUAH CR 08.0178		WDFW		0000	47	115		0		1954			2
BIG SOOS CR 09.0072		WDFW		0000	48	217		0		1955			2
ISSAQUAH CR 08.0178		WDFW		0000	54	169		0		1956			2
SAMISH (FRIDAY CR)		WDFW		0000	64	180		0		1957			2
ISSAQUAH CR 08.0178		WDFW		0000	57	350		0		1958			2
ISSAQUAH CR 08.0178		WDFW		0000	60	84		0		1959			2
MAY CR 07.0943		WDFW		0000	61	323		0		1960			2
MAY CR 07.0943		WDFW		0000	57	473		0		1961			2
ISSAQUAH CR 08.0178		WDFW		0000	1265	40		0		1961			1
ISSAQUAH CR 08.0178		WDFW		0000	28	175		0		1966			2
ISSAQUAH CR 08.0178		WDFW		0000	1240	130		0		1968			1
ISSAQUAH CR 08.0178		WDFW		0000	21	202		0		1970			2
ISSAQUAH CR 08.0178		WDFW		0000	1445	89.9653979		0		1982			1
ISSAQUAH CR 08.0178		WDFW		0000	1200	208.333333		0		1983			1
ISSAQUAH CR 08.0178		WDFW		0000	533	101.313321		0		1984			1
ISSAQUAH CR 08.0178		WDFW		0000	440	704.545455		0		1984			1
ISSAQUAH CR 08.0178		WDFW		0000	1250	60		0		1984			1
ISSAQUAH CR 08.0178		WDFW		0000	940	0.5		0		1984			1
ISSAQUAH CR 08.0178		WDFW		0000	480	208.333333		0		1984			1
ISSAQUAH CR 08.0178		WDFW		0000	940	0.5		0		1984			1
ISSAQUAH CR 08.0178		WDFW		0000	947	9		0		1985			1
ISSAQUAH CR 08.0178		WDFW		0000	770	101.038961		0		1986			1
ISSAQUAH CR 08.0178		WDFW		0000	996	131.024096		0		1986			1
ISSAQUAH CR 08.0178		WDFW		0000	267	5.61797753		0		1986			1
ISSAQUAH CR 08.0178		WDFW		0000	466	57.9399142		0		1987			1
ISSAQUAH CR 08.0178		WDFW		0000	440	252.954545		0		1987			1
ISSAQUAH CR 08.0178		WDFW		0000	1250	80		0		1987			1
ISSAQUAH CR 08.0178		WDFW		0000	307	182.084691		0		1987			1
ISSAQUAH CR 08.0178		WDFW		0000	830	73.0120482		0		1988			1
BIG SOOS CR 09.0072		WDFW		0000	452	298.00885		0		1988			1
ISSAQUAH CR 08.0178		WDFW		0000	798	93.9849624		0		1989			1
ISSAQUAH CR 08.0178		WDFW		0000	723	274.965422		0		1989			1
ISSAQUAH CR 08.0178		WDFW		0000	400	321		0		1990			1
MINTER CR 15.0048		WDFW		0000	1500	200		0		1991			1
ISSAQUAH CR 08.0178		WDFW		0000	1500	133.333333		0		1991			1
ISSAQUAH CR 08.0178		WDFW		0000	968	72.0041322		0		1992			1
ISSAQUAH CR 08.0178		WDFW		0000	1026	76.9005848		0		1992			1
ISSAQUAH CR 08.0178		WDFW		0000	1500	73.3333333		0		1992			1
ISSAQUAH CR 08.0178		WDFW		0000	1000	200		0		1993			1
ISSAQUAH CR 08.0178		WDFW		0000	598	171.070234		0		1993			1
ISSAQUAH CR 08.0178	(RECORD FROM HHP DB)	WDFW		0000	666	174.024024		0		1994			1
ISSAQUAH CR 08.0178		WDFW		0000	557	125				1995		8	1
ISSAQUAH CR 08.0178		WDFW		0000	504	182				1996		9	1
ISSAQUAH CR 08.0178	NO SPECFIC R.M. LISTED-SCATTE	WDFW		0000	482	189				1997		2	1
ISSAQUAH CR 08.0178		WDFW		0000	546	29.3				1998	1	6	1
ISSAQUAH CR 08.0178		WDFW		0000	546	85				1998	4.3	6	1
ISSAQUAH CR 08.0178		WDFW		0000	546	55				1998	6.5	6	1
LTL BEAR CR 08.0080		WDFW	5000		20	628.75	AD+CWT	100	0	1976			2
LTL BEAR CR 08.0080		WDFW	5000		30	355.333333	AD+CWT	100	0	1977			2
LTL BEAR CR 08.0080		WDFW	5000	0000	30	111.6	AD+CWT	89.9940262	0.00986	1978			2

Appendix I

APPENDIX I:
Hatchery Plant Data for Issaquah Creek

ANTS REPORT

Washington Department of Fish and Wildlife
Hatcheries Program

AGENCY: WDFW--HATCHERIES
FACILITY: ISSAQUAH
MONTH / YEAR March 2001 /

	ID CODE (Appendix A) (Spc:Ru:Stk:BY:DO)	POND NO	START / END DAY	WATER NAME	WATER CODE	RIVER MILE	NUMBER	# PER POUND	POUNDS	MEAN LENGTH IN MM	CV OF LENGTH	Number Identified (grn sheet)	Total Rep. Pop. (at tagging)	Unidentifiable Marks (+CWT) (grn sheet)	AD&CWT (grn sheet)	AD Only (grn sheet)	CWT CODE	MARK CODE	?
1	CO:NA:ISSA:99:H	11	28/28	Issaquah Creek	8.0178	3	252,800	18	14,044		6.9					x			
2	CO:NA:ISSA:99:H	12	28/28	Issaquah Creek	8.0178	3	252800	18	14044		6.9					x			
3			/																
4			/																
5			/																
6			/																
7			/																
8			/																
9			/																
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14			/																
15			/																
16			/																
17			/																
18			/																
19			/																
20			/																

NOTES:

For Lake Plants: County Section Township Range

Send to Olympia Monthly

PLANTS REPORT

Washington Department of Fish and Wildlife
Hatcheries Program

AGENCY: WDFW-HATCHERIES
FACILITY: ISSAQUAH
MONTH / YEAR March / 2001

	ID CODE (Appendix A) (Spc:Rc:Stk:BY:BO)	POND NO.	START / END DAY	WATER NAME	WATER CODE	RIVER MILE	NUMBER	# PER POUND	POUNDS	MEAN LENGTH IN MM	CV OF LENGTH	Number Identified (grn sheet)	Total Rep. Pop. (at tagging)	Unidentifiable Marks(+CWT) (grn sheet)	AD+CWT (grn sheet)	AD Only (grn sheet)	CWT CODE	MARK CODE	?
1	CO:NA:ISSA:00:H	hat.	01/01	Issaquah Creek	8.0178	3	450,000	1269	354.6										
2	CO:NA:ISSA:00:H	hat.	07/07	Issaquah Creek	8.0178	3	450,000	1411	318.92										
3	CO:NA:ISSA:00:H	hat.	07/07	Issaquah Creek	8.0178	3	225,000	1317	170.84										
4	CO:NA:ISSA:00:H	hat.	12/12	Issaquah Creek	8.0178	3	30,261	1441	21										
5	CO:NA:ISSA:00:H	hat.	12/12	Issaquah Creek	8.0178	3	262,026	1293	202.65										
6	CO:NA:ISSA:00:H	hat.	12/12	Issaquah Creek	8.0178	3	100,262	1492	67.2										
7	CO:NA:ISSA:00:H	hat.	12/12	Issaquah Creek	8.0178	3	227,400	1441	157.81										
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			
										For Lake Plants:		County	Township	Section	Range			

NOTES:

Send to Olympia Monthly

PLANT REPORT

Washington Department of Fish and Wildlife
Hatcheries Program

AGENCY: WDFW
FACILITY: ISSAQUAH
MONTH / YEAR MAY / 2001

ID CODE (Appendix A) (Spc:Rc:Stk:BY:BO)	POND NO.	START / END DAY	WATER NAME	WATER CODE	RIVER MILE	NUMBER	# PER POUND	POUNDS	MEAN LENGTH IN MM	CV OF LENGTH	Number Identified (grn sheet)	Total Rep. Pop. (at tagging)	Unidentifiable Marks(+CWT) (grn sheet)	AD+CWT (grn sheet)	AD Only (grn sheet)	CWT CODE	MARK CODE	?
CK:FA:ISSA:00:H	11	15/15	Issaquah Creek	8.0178	3	339,212	69	4,916	83.6	7.16					AD			
CK:FA:ISSA:00:H	12	15/15	Issaquah Creek	8.0178	3	267,321	66	4,050	84.9	6.483					AD			
CK:FA:ISSA:00H	1	22/22	Issaquah Creek	8.0178	3	322,700	75.66	4,265	81.9	5.502					AD			
CK:FA:ISSA:00:H	2	22/22	Issaquah Creek	8.0178	3	344,900	75.66	4,559	81.9	5.502					AD			
CK:FA:ISSA:00:H	3	22/22	Issaquah Creek	8.0178	3	143,250	70.96	2,019	83.6	5.589					AD			
CK:FA:ISSA:00:H	4	22/22	Issaquah Creek	8.0178	3	125,000	70.96	1,762	83.6	5.589					AD			
CK:FA:ISSA:00:H	5	22/22	Issaquah Creek	8.0178	3	125,000	70.96	1,762	83.6	5.589					AD			
CK:FA:ISSA:00:H	6	22/22	Issaquah Creek	8.0178	3	125,000	70.96	1762	83.6	5.589					AD			
CK:FA:ISSA:00:H	8	22/22	Issaquah Creek	8.0178	3	139540	70.96	1966	83.6	5.589					AD			
CK:FA:ISSA:00:H	9	22/22	Issaquah Creek	8.0178	3	137,350	70.96	1936	83.6	5.589					AD			
CK:FA:ISSA:00:H	10	22/22	Issaquah Creek	8.0178	3	125500	70.96	1769	83.6	5.589					AD			
		/																
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NOTES:

For Lake Plants: County Section Township Range

Send to Olympia Monthly

Appendix J

APPENDIX J:
WDFW Salmon Spawning Ground Survey Data

CODED COMMENTS FOR USE ON STREAM SURVEY CARDS

AREA SURVEYED

00 Partial index survey
01 Intertidal
02 Includes tributary in index
03 Holes not surveyed
04 Right bank side channel
05 Left bank side channel
06 Includes area above index
07 Includes area below index
08 Right bank survey
09 Left bank survey

SURVEY TIMING

10 Peak survey
11 Survey too early - before peak
12 Survey too late - after peak
13 Early run
14 Late run
15 Middle run
16 Redds observed - after peak
17
18
19

WATER CONDITIONS

20 Low - clear
21 Low - medium color
22 Low - muddy
23 Medium - clear
24 Medium - medium color
25 Medium - muddy
26 High - clear
27 High - medium color
28 High - muddy
29 Flooding

VIEWING CONDITIONS

30 Dark
31 Dark in pools
32 High glare
33 Some glare
34 Raining
35 Snowing
36 Frozen
37 Partly frozen
38 Water turbid
39

STREAM CONDITIONS

40 Needs SI work
41 Impassable log jam
42 Passable log jam
43 Man-made block
44 Damaging channel work
45 Damaging bank work
46 Damaging diversion
47 Passable beaver dam
48 Impassable beaver dam
49 Evidence of scouring

FACTORS AFFECTING FISH ABUNDANCE

50 Heavy Poaching
51 Light Poaching
52 Heavy predation
53 Light predation
54 Stream dry
55 Stream frozen
56 Fish kill
57 Stream too low
58 Illegal set netting
59 Recent habitat alteration

CARD INFORMATION

60 See card for additional comments
61 Count breakdown available on card
62 Summary card
63 Escapement estimate survey
64 Area surveyed unknown
65 Spot observation (F/M count not applicable)
66 Live tagged fish observed
67 Dead tagged fish observed
68 Tag recovered
69

MISCELLANEOUS

70 Most carcasses have been washed out
71 Heavy siltation
72 Count in holes estimated
73 Partial count
74 Exposed redds due to low flow
75 Actual dead count higher than show
76 Carcass count only
77 Tag recovery survey. Tails cut, these will be recounted on successive surveys.

Washington State Department of Fisheries Tue Sep 4 14:00:32 2001

Salmon Spawning Ground Survey Data

Species - All Species
Chinook Races - All Races
Stream Numbers - 080080
Date Range - 40/ 6/30 to 99/12/31
River Miles - All River Miles
Type Count - All Types of Counts
Type Survey - All Types of Surveys
Agency - All Agencies

Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
Lake Washington Basin																	
LITTLE BEAR Creek																	
080080	52/12/12	0.0	4.4	4.4	COHO	161	36	197	44.8	4	0		SUPP	FOOT			0
080080	53/11/29	4.4	6.2	1.8	COHO	55	1	56	31.1	4	0		INDX	FOOT			0
080080	53/12/15	4.4	6.2	1.8	COHO	75	21	96	53.3	4	0		INDX	FOOT		61	0
080080	54/11/22	4.4	6.2	1.8	COHO	70	19	89	49.4	4	0		INDX	FOOT		20	0
080080	55/11/17	4.8	6.2	1.4	COHO	27	6	33	23.6	4	0		SUPP	FOOT		20 37	0
080080	55/12/02	4.4	6.2	1.8	COHO	45	7	52	28.9	4	0		INDX	FOOT		26	0
080080	56/11/30	4.4	6.2	1.8	COHO	20	2	22	12.2	4	0		INDX	FOOT			0
080080	56/12/13	4.4	6.2	1.8	COHO	75	8	83	46.1	4	0		INDX	FOOT		20	0
080080	57/12/09	4.4	6.2	1.8	COHO	124	26	150	83.3	4	0		INDX	FOOT		20	0
080080	58/12/03	4.4	6.2	1.8	COHO	235	56	291	161.7	4	0		INDX	FOOT		20	0
080080	58/12/22	4.4	6.2	1.8	COHO	118	68	186	103.3	4	0		INDX	FOOT		21	0
080080	59/12/02	4.4	6.2	1.8	COHO	114	20	134	74.4	4	0		INDX	FOOT		24	0
080080	59/12/18	4.4	6.2	1.8	COHO	84	20	104	57.8	4	0		INDX	FOOT		26	0
080080	60/11/28	4.4	6.2	1.8	COHO	107	19	126	70.0	4	0		INDX	FOOT		20 60	0
080080	60/12/20	4.4	6.2	1.8	COHO	27	34	61	33.9	4	0		INDX	FOOT		21	0
080080	61/12/11	4.4	6.2	1.8	COHO	145	136	281	156.1	4	0		INDX	FOOT		20	0
080080	63/12/30	4.8	6.2	1.4	COHO	27	75	102	72.9	4	0		SUPP	FOOT		21	0
080080	64/11/20	4.4	6.2	1.8	COHO	121	72	193	107.2	4	0		INDX	FOOT		20	0
080080	65/12/01	4.8	6.2	1.4	COHO	104	53	157	112.1	4	0	34	SUPP	FOOT		24	0
080080	66/11/29	4.4	6.2	1.8	COHO	364	52	416	231.1	4	0		INDX	FOOT		21	0
080080	67/11/29	4.4	5.4	1.0	COHO	52	27	79	79.0	4	0		INDX	FOOT		24	0
080080	68/12/11	4.4	5.4	1.0	COHO	74	49	123	123.0	4	0		INDX	FOOT		20	0
080080	70/11/06	4.4	4.6	0.2	COHO	0	2	2	10.0	4	0		SUPP	FOOT			0

Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	70/11/06	4.4	4.6	0.2	SOCK	11	3	14	70.0	5	0		SUPP	FOOT	4		0
080080	70/11/17	4.4	5.4	1.0	COHO	266	17	283	283.0	4	75		INDX	FOOT		20	0
080080	70/12/04	4.4	4.8	0.4	COHO	140	65	205	512.5	4	80		SUPP	FOOT		25	0
080080	70/12/08	5.2	5.4	0.2	COHO	11	4	15	75.0	4	99		SUPP	FOOT		20	0
080080	71/11/23	4.4	5.4	1.0	FALL	0	1	1	1.0	1	85		SUPP	FOOT	4	20	0
080080	71/11/23	4.4	5.4	1.0	COHO	53	90	143	143.0	4	85		SUPP	FOOT	1	20	0
080080	71/12/21	4.4	5.4	1.0	COHO	95	105	200	200.0	4	85		INDX	FOOT		24	0
080080	72/09/28	0.0	0.0	0.0	COHO	0	0	0		4	99		SPOT	FOOT		20 65	0
080080	72/11/21	4.4	5.4	1.0	COHO	52	32	84	84.0	4	90		INDX	FOOT	1	20	0
080080	72/11/21	5.4	6.2	0.8	FALL	0	1	1	1.3	1	0		SUPP	FOOT	4	20	0
080080	72/12/14	4.4	5.4	1.0	COHO	22	15	37	37.0	4	90		INDX	FOOT		20	0
080080	73/10/29	0.0	0.0	0.0	COHO	2	0	2		4	80		SPOT	FOOT		20 65	0
080080	73/11/19	4.4	6.2	1.8	FALL	0	1	1	0.6	1	75		SUPP	FOOT	2		0
080080	73/11/19	4.4	4.8	0.4	COHO	68	11	79	197.5	4	75		SUPP	FOOT	1	20	0
080080	73/11/19	4.4	5.4	1.0	COHO	133	18	151	151.0	4	0		INDX	FOOT	1	20 62	0
080080	73/11/19	4.8	5.4	0.6	COHO	65	7	72	120.0	4	75		SUPP	FOOT	1	20	0
080080	73/12/06	4.4	4.8	0.4	COHO	18	57	75	187.5	4	0		SUPP	FOOT		20	0
080080	73/12/06	4.4	5.4	1.0	COHO	44	68	112	112.0	4	0		INDX	FOOT		20 62	0
080080	73/12/06	4.8	5.4	0.6	COHO	26	11	37	61.7	4	0		SUPP	FOOT		20	0
080080	74/10/24	4.4	4.7	0.3	COHO	0	0	0		4	99		INDX	FOOT		20 13	0
080080	74/10/31	3.2	4.4	1.2	FALL	3	1	4	3.3	1	0		SUPP	FOOT	4	21 31 60	0
080080	74/10/31	3.2	4.4	1.2	COHO	25	0	25	20.8	4	50	20	SUPP	FOOT	1	21 31 60	0
080080	74/10/31	4.4	6.2	1.8	FALL	0	2	2	1.1	1	60		SUPP	FOOT	4	21	0
080080	74/10/31	4.4	5.5	1.1	COHO	17	0	17	15.5	4	60		INDX	FOOT	1	21 61	0
080080	74/10/31	6.6	7.4	0.8	COHO	3	0	3	3.7	4	80		SUPP	FOOT		21 60	0
080080	74/11/14	4.4	5.5	1.1	COHO	83	9	92	83.6	4	60		INDX	FOOT	3		0
080080	74/11/26	4.4	5.5	1.1	COHO	97	22	119	108.2	4	85		INDX	FOOT		21 61	0
080080	74/12/09	4.4	5.5	1.1	COHO	36	58	94	85.5	4	85		INDX	FOOT		21 31 61	0
080080	74/12/26	4.4	5.5	1.1	COHO	9	46	55	50.0	4	80		INDX	FOOT		24 60 61	0
080080	75/11/03	4.4	5.5	1.1	FALL	2	0	2	1.8	1	75		SUPP	FOOT	45	23 34 60	0
080080	75/11/03	4.4	5.5	1.1	COHO	68	3	71	64.5	4	75		INDX	FOOT	15	23 34 61	0
080080	75/11/03	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	75		SUPP	FOOT	14	23 34 60	0
080080	75/11/05	3.2	4.0	0.8	FALL	2	1	3	3.8	1	65		SUPP	FOOT	4	67	0
080080	75/11/05	3.2	4.0	0.8	COHO	72	3	75	93.8	4	65		SUPP	FOOT	1	24 31 34	0
080080	75/11/05	5.5	5.8	0.3	COHO	24	1	25	83.3	4	65		SUPP	FOOT		24 60	0
080080	75/11/18	4.4	5.5	1.1	COHO	33	10	43	39.1	4	70		INDX	FOOT		24 31 68	0
080080	75/12/09	3.2	4.0	0.8	COHO	4	10	14	17.5	4	45		SUPP	FOOT		27 60	0
080080	75/12/09	4.4	5.5	1.1	COHO	15	17	32	29.1	4	60		INDX	FOOT		27 40 60	0
080080	75/12/15	4.4	0.0	0.0	COHO	0	0	0		4	60		SPOT	FOOT		24 60	0
080080	75/12/15	4.4	5.5	1.1	COHO	6	29	35	31.8	4	95		INDX	FOOT		20 60	0
080080	75/12/15	6.2	0.0	0.0	COHO	0	0	0		4	75		SPOT	FOOT		21 60	0
080080	75/12/15	6.5	0.0	0.0	COHO	0	0	0		4	75		SPOT	FOOT		21 60	0
080080	76/09/23	0.0	0.3	0.3	FALL	0	0	0		1	90		SUPP	FOOT	5	20 44	FW
080080	76/09/23	0.0	0.3	0.3	SOCK	0	0	0		5	90		SUPP	FOOT	1	20 44	FW
080080	76/09/29	2.2	3.2	1.0	FALL	0	0	0		1	60		SUPP	FOOT	5	25	FW

1

Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code

LITTLE BEAR Creek

080080	76/09/29	2.2	3.2	1.0	SOCK	0	0	0		5	60	SUPP	FOOT	1	25		FW
080080	76/09/29	3.2	4.5	1.3	FALL	2	0	2	1.5	1	50	SUPP	FOOT	5	21 31		FW
080080	76/09/29	3.2	4.5	1.3	SOCK	3	0	3	2.3	5	50	SUPP	FOOT	1	21 31		FW
080080	76/10/05	2.0	4.0	2.0	FALL	0	0	0		1	90	SUPP	FOOT		20		FW
080080	76/10/13	1.9	3.2	1.3	FALL	0	1	1	0.8	1	50	SUPP	FOOT		15 24 65		0
080080	76/10/13	3.2	4.4	1.2	FALL	1	3	4	3.3	1	30	SUPP	FOOT	45	22 30		0
080080	76/10/13	3.2	4.4	1.2	COHO	5	0	5	4.2	4	25	SUPP	FOOT	15	22 30		0
080080	76/10/13	3.2	4.4	1.2	SOCK	2	1	3	2.5	5	30	SUPP	FOOT	14	22 30		0
080080	76/10/14	0.0	1.3	1.3	FALL	2	2	4	3.1	1	90	SUPP	FOOT		21 31 60		0
080080	76/10/14	1.3	2.6	1.3	FALL	1	0	1	0.8	1	25	SUPP	FOOT		22 30		0
080080	76/10/15	4.4	5.1	0.7	FALL	1	0	1	1.4	1	90	SUPP	FOOT		20 43 60		0
080080	76/10/15	5.1	5.5	0.4	COHO	0	0	0		4	70	SUPP	FOOT		20		0
080080	76/10/20	0.0	1.3	1.3	FALL	1	1	2	1.5	1	80	SUPP	FOOT		21 31		0
080080	76/10/20	1.3	2.1	0.8	FALL	2	0	2	2.5	1	60	SUPP	FOOT	4	21 31		0
080080	76/10/20	1.3	2.1	0.8	COHO	1	0	1	1.2	4	50	SUPP	FOOT	1	21 31		0
080080	76/10/21	2.1	3.2	1.1	FALL	0	0	0		1	70	SUPP	FOOT		20 31		0
080080	76/10/21	3.2	4.4	1.2	COHO	3	1	4	3.3	4	80	SUPP	FOOT	1	21 31		0
080080	76/10/21	3.3	4.4	1.1	FALL	2	1	3	2.7	1	80	SUPP	FOOT	4	21 31		0
080080	76/10/21	4.4	4.8	0.4	SOCK	0	1	1	2.5	5	85	SUPP	FOOT		20		0
080080	76/10/21	4.8	6.1	1.3	COHO	4	1	5	3.8	4	80	SUPP	FOOT		20 60		0
080080	76/10/27	0.0	1.3	1.3	FALL	0	1	1	0.8	1	45	SUPP	FOOT	4	20 30		0
080080	76/10/27	0.0	1.3	1.3	COHO	3	1	4	3.1	4	40	SUPP	FOOT	1	20 30		0
080080	76/10/27	1.3	2.1	0.8	FALL	1	0	1	1.2	1	60	SUPP	FOOT		24 31		0
080080	76/10/28	2.8	4.0	1.2	COHO	4	1	5	4.2	4	15	SUPP	FOOT		24 34		0
080080	76/10/28	4.0	4.4	0.4	FALL	0	0	0		1	40	SUPP	FOOT		25 34		0
080080	76/10/28	4.4	5.5	1.1	COHO	3	0	3	2.7	4	60	INDX	FOOT	5	24 34 60		0
080080	76/10/28	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	60	INDX	FOOT	4	24 34 60		0
080080	76/10/28	5.5	6.2	0.7	COHO	5	0	5	7.1	4	20	SUPP	FOOT		24 34		0
080080	76/11/04	0.0	1.3	1.3	FALL	0	0	0		1	75	SUPP	FOOT		23 31		0
080080	76/11/04	1.3	2.1	0.8	COHO	0	0	0		4	70	SUPP	FOOT		20 31		0
080080	76/11/04	2.1	3.2	1.1	COHO	3	1	4	3.6	4	80	SUPP	FOOT		23 31		0
080080	76/11/04	3.2	4.4	1.2	FALL	0	1	1	0.8	1	75	SUPP	FOOT	4	20 31		0
080080	76/11/04	3.2	4.4	1.2	COHO	45	0	45	37.5	4	75	SUPP	FOOT	1	20 31		0
080080	76/11/04	4.4	5.5	1.1	FALL	0	1	1	0.9	1	90	INDX	FOOT	4	23 31		0
080080	76/11/04	4.4	5.5	1.1	COHO	59	5	64	58.2	4	90	INDX	FOOT	1	23 31		0
080080	76/11/11	0.0	1.3	1.3	COHO	1	0	1	0.8	4	70	SUPP	FOOT		20 31		0
080080	76/11/11	1.3	2.1	0.8	COHO	0	1	1	1.2	4	70	SUPP	FOOT		20 31		0
080080	76/11/11	2.1	3.2	1.1	COHO	11	1	12	10.9	4	65	SUPP	FOOT		20 31		0
080080	76/11/11	3.2	4.4	1.2	COHO	33	5	38	31.7	4	65	SUPP	FOOT		20 31		0
080080	76/11/11	4.4	5.5	1.1	FALL	0	1	1	0.9	1	80	INDX	FOOT	4	20 31		0
080080	76/11/11	4.4	5.5	1.1	COHO	45	20	65	59.1	4	80	INDX	FOOT	1	20 31		0
080080	76/11/11	5.5	6.2	0.7	COHO	28	3	31	44.3	4	60	SUPP	FOOT		20 60		0
080080	76/11/11	6.2	6.5	0.3	COHO	4	0	4	13.3	4	60	SUPP	FOOT		20 60		0
080080	76/11/11	6.5	6.7	0.2	COHO	5	0	5	25.0	4	95	SUPP	FOOT		60		0
080080	76/11/11	6.7	7.3	0.6	COHO	12	2	14	23.3	4	80	SUPP	FOOT		60		0
080080	76/11/11	7.3	7.9	0.6	COHO	14	10	24	40.0	4	90	SUPP	FOOT				0
080080	76/11/17	4.4	5.5	1.1	COHO	37	12	49	44.5	4	75	INDX	FOOT		24 30		0
080080	76/11/19	2.1	3.2	1.1	COHO	10	4	14	12.7	4	0	SUPP	FOOT		20 30		0
080080	76/11/19	3.2	4.0	0.8	COHO	67	6	73	91.3	4	75	SUPP	FOOT		23 30		0
080080	76/11/22	6.2	6.5	0.3	COHO	7	6	13	43.3	4	65	SUPP	FOOT		60		0
080080	76/11/22	6.5	6.7	0.2	COHO	6	1	7	35.0	4	60	SUPP	FOOT		60		0

Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	76/11/22	6.7	7.3	0.6	COHO	8	1	9	15.0	4	30		SUPP	FOOT		60	0
080080	76/11/22	7.3	7.9	0.6	COHO	19	13	32	53.3	4	80		SUPP	FOOT		60	0
080080	76/11/22	7.9	8.0	0.1	COHO	0	0	0		4	70		SUPP	FOOT		60	0
080080	76/11/24	2.1	3.2	1.1	COHO	2	3	5	4.5	4	50		SUPP	FOOT		21 30	0
080080	76/11/24	3.2	4.0	0.8	COHO	18	3	21	26.3	4	70		SUPP	FOOT		24 31	0

080080	76/11/24	4.4	5.5	1.1	COHO	55	15	70	63.6	4	85	INDX	FOOT		21 31	0
080080	76/11/29	0.0	1.3	1.3	COHO	0	0	0		4	40	SUPP	FOOT		24 31 60	0
080080	76/11/29	1.3	2.1	0.8	COHO	1	1	2	2.5	4	40	SUPP	FOOT		21 31	0
080080	76/11/29	2.1	3.2	1.1	COHO	1	1	2	1.8	4	55	SUPP	FOOT		24 30 31	0
080080	76/11/29	3.2	4.4	1.2	COHO	21	9	30	25.0	4	60	SUPP	FOOT		21 31	0
080080	76/11/29	4.4	5.5	1.1	COHO	16	3	19	17.3	4	80	INDX	FOOT		23 31	0
080080	76/11/29	5.5	6.2	0.7	COHO	19	5	24	34.3	4	85	SUPP	FOOT		20	0
080080	76/11/29	6.2	6.5	0.3	COHO	4	1	5	16.7	4	80	SUPP	FOOT		20 30	0
080080	76/11/29	6.5	7.7	1.2	COHO	17	9	26	21.7	4	60	SUPP	FOOT		21 31	0
080080	76/12/07	0.2	1.3	1.1	COHO	3	1	4	3.6	4	65	SUPP	FOOT		25 31	0
080080	76/12/07	1.3	2.1	0.8	COHO	0	1	1	1.2	4	20	SUPP	FOOT		24 34	0
080080	76/12/07	2.1	3.2	1.1	COHO	1	1	2	1.8	4	65	SUPP	FOOT		24 31	0
080080	76/12/07	3.2	4.0	0.8	COHO	15	4	19	23.8	4	60	SUPP	FOOT		24 30	0
080080	76/12/07	4.0	4.4	0.4	COHO	5	3	8	20.0	4	35	SUPP	FOOT		24 30	0
080080	76/12/07	5.5	6.5	1.0	COHO	33	8	41	41.0	4	70	SUPP	FOOT		24 31	0
080080	76/12/07	6.5	7.9	1.4	COHO	44	16	60	42.9	4	85	SUPP	FOOT		20 31	0
080080	76/12/08	4.4	5.5	1.1	COHO	81	27	108	98.2	4	75	INDX	FOOT		24 31 60	0
080080	76/12/14	0.2	1.3	1.1	COHO	1	2	3	2.7	4	60	SUPP	FOOT		24 31 60	0
080080	76/12/14	1.3	2.1	0.8	COHO	3	4	7	8.8	4	40	SUPP	FOOT		21 31	0
080080	76/12/14	2.1	3.2	1.1	COHO	3	7	10	9.1	4	45	SUPP	FOOT		21 31	0
080080	76/12/14	3.2	4.4	1.2	COHO	25	9	34	28.3	4	70	SUPP	FOOT		24 31	0
080080	76/12/14	4.4	5.5	1.1	COHO	66	37	103	93.6	4	75	INDX	FOOT		24 31 60	0
080080	76/12/14	5.5	6.5	1.0	COHO	43	11	54	54.0	4	65	SUPP	FOOT		24 31 60	0
080080	76/12/14	6.5	7.9	1.4	COHO	62	44	106	75.7	4	80	SUPP	FOOT		20	0
080080	76/12/21	3.2	4.4	1.2	COHO	26	10	36	30.0	4	70	SUPP	FOOT		24 31 60	0
080080	76/12/21	4.4	5.5	1.1	COHO	50	37	87	79.1	4	80	INDX	FOOT		20	0
080080	76/12/21	5.5	6.2	0.7	COHO	21	15	36	51.4	4	80	SUPP	FOOT		20	0
080080	76/12/21	6.2	6.5	0.3	COHO	3	9	12	40.0	4	80	SUPP	FOOT		20	0
080080	76/12/21	6.5	7.9	1.4	COHO	40	39	79	56.4	4	70	SUPP	FOOT		24 31 60	0
080080	76/12/27	4.4	5.5	1.1	COHO	70	58	128	116.4	4	75	INDX	FOOT		23	0
080080	76/12/27	5.5	6.2	0.7	COHO	57	16	73	104.3	4	75	SUPP	FOOT		23	0
080080	76/12/27	6.2	6.5	0.3	COHO	12	4	16	53.3	4	75	SUPP	FOOT		23	0
080080	76/12/27	6.5	7.9	1.4	COHO	95	41	136	97.1	4	80	SUPP	FOOT		21	0
080080	76/12/28	3.2	4.0	0.8	COHO	0	1	1	1.3	4	65	SUPP	FOOT		24 31	0
080080	76/12/28	4.0	4.4	0.4	COHO	7	2	9	22.5	4	50	SUPP	FOOT		24 31	0
080080	77/01/03	3.2	4.4	1.2	COHO	6	4	10	8.3	4	70	SUPP	FOOT		24 31 60	0
080080	77/01/03	4.4	5.5	1.1	COHO	27	43	70	63.6	4	80	INDX	FOOT		20	0
080080	77/01/03	5.5	6.2	0.7	COHO	16	9	25	35.7	4	80	SUPP	FOOT		20	0
080080	77/01/03	6.2	6.5	0.3	COHO	10	3	13	43.3	4	80	SUPP	FOOT		20	0
080080	77/01/03	6.5	7.9	1.4	COHO	33	34	67	47.9	4	70	SUPP	FOOT		24 31 60	0
080080	77/01/10	0.2	1.3	1.1	COHO	0	1	1	0.9	4	70	SUPP	FOOT		21 31	0
080080	77/01/10	1.3	2.1	0.8	COHO	0	0	0		4	60	SUPP	FOOT		21 31	0
080080	77/01/10	2.1	3.2	1.1	COHO	1	6	7	6.4	4	70	SUPP	FOOT		21 31	0
080080	77/01/10	3.2	4.4	1.2	COHO	11	2	13	10.8	4	70	SUPP	FOOT		21 31 60	0
080080	77/01/10	4.4	5.5	1.1	COHO	25	33	58	52.7	4	70	INDX	FOOT		21 31 60	0
080080	77/01/10	5.5	6.2	0.7	COHO	22	11	33	47.1	4	80	SUPP	FOOT		20	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	77/01/10	6.2	6.5	0.3	COHO	3	6	9	30.0	4	80		SUPP	FOOT		20	0
080080	77/01/10	6.5	7.9	1.4	COHO	22	42	64	45.7	4	70		SUPP	FOOT		21 31 60	0
080080	77/01/13	4.4	4.8	0.4	COHO	5	12	17	42.5	4	70		SUPP	FOOT		24 31 60	0
080080	77/01/17	3.2	4.4	1.2	COHO	2	2	4	3.3	4	65		SUPP	FOOT		38 60 31	0
080080	77/01/17	4.4	5.5	1.1	COHO	20	35	55	50.0	4	80		INDX	FOOT		20 31	0
080080	77/01/17	5.5	6.2	0.7	COHO	8	18	26	37.1	4	80		SUPP	FOOT		20	0
080080	77/01/17	6.2	6.5	0.3	COHO	0	5	5	16.7	4	80		SUPP	FOOT		20 31	0
080080	77/01/17	6.5	7.8	1.3	COHO	10	44	54	41.5	4	65		SUPP	FOOT		24 60	0
080080	77/01/24	2.1	3.2	1.1	COHO	1	1	2	1.8	4	65		SUPP	FOOT		20	0
080080	77/01/24	3.2	4.4	1.2	COHO	4	4	8	6.7	4	65		SUPP	FOOT		24 31 38	0
080080	77/01/24	4.4	5.5	1.1	COHO	11	33	44	40.0	4	70		INDX	FOOT		60	0

080080	77/01/24	5.5	6.2	0.7	COHO	2	6	8	11.4	4	80	SUPP	FOOT		20		0
080080	77/01/24	6.2	6.5	0.3	COHO	0	3	3	10.0	4	80	SUPP	FOOT		20		0
080080	77/01/24	6.5	7.9	1.4	COHO	6	37	43	30.7	4	65	SUPP	FOOT		60	24	0
080080	77/02/01	3.2	4.4	1.2	COHO	4	3	7	5.8	4	65	SUPP	FOOT		24	31 60	0
080080	77/02/01	4.4	5.5	1.1	COHO	2	26	28	25.5	4	70	INDX	FOOT		24	31 60	0
080080	77/02/01	5.5	6.2	0.7	COHO	1	2	3	4.3	4	80	SUPP	FOOT		20		0
080080	77/02/01	6.2	6.5	0.3	COHO	0	8	8	26.7	4	80	SUPP	FOOT		20		0
080080	77/02/01	6.5	7.9	1.4	COHO	4	15	19	13.6	4	70	SUPP	FOOT		24	31 60	0
080080	77/02/09	4.4	5.5	1.1	COHO	2	15	17	15.5	4	75	INDX	FOOT		23	60	0
080080	77/02/09	6.5	7.7	1.2	COHO	0	12	12	10.0	4	75	SUPP	FOOT		23	60	0
080080	77/10/27	4.4	5.5	1.1	COHO	4	2	6	5.5	4	75	INDX	FOOT	5	20	31 60	0
080080	77/10/27	4.4	5.5	1.1	SOCK	2	0	2	1.8	5	75	SUPP	FOOT	4	20	31 60	0
080080	77/10/27	5.5	6.0	0.5	COHO	1	0	1	2.0	4	75	SUPP	FOOT		6	20 60	0
080080	77/11/01	0.0	1.1	1.1	PINK	0	1	1	0.9	3	70	SUPP	FOOT		26	60	0
080080	77/11/01	0.0	1.1	1.1	COHO	0	0	0		4	50	SUPP	FOOT	3	26		0
080080	77/11/01	0.3	1.1	0.8	FALL	0	4	4	5.0	1	80	SUPP	FOOT		26	60	0
080080	77/11/01	1.1	3.2	2.1	FALL	2	4	6	2.9	1	50	SUPP	FOOT		26	60	0
080080	77/11/01	1.1	3.2	2.1	COHO	5	1	6	2.9	4	50	SUPP	FOOT	1	26	60	0
080080	77/11/01	3.2	4.4	1.2	COHO	2	0	2	1.7	4	60	SUPP	FOOT		26	31 60	0
080080	77/11/01	4.4	5.5	1.1	COHO	11	4	15	13.6	4	65	INDX	FOOT		24	30 60	0
080080	77/11/01	5.5	6.8	1.3	COHO	2	1	3	2.3	4	65	SUPP	FOOT		24	30 60	0
080080	77/11/07	0.2	1.3	1.1	FALL	0	1	1	0.9	1	60	SUPP	FOOT	4	27	30	0
080080	77/11/07	0.2	1.3	1.1	COHO	0	0	0		4	50	SUPP	FOOT	1	27	30	0
080080	77/11/07	1.3	2.1	0.8	FALL	0	4	4	5.0	1	60	SUPP	FOOT	4	27	60	0
080080	77/11/07	1.3	2.1	0.8	COHO	5	0	5	6.2	4	60	SUPP	FOOT	1	27	60	0
080080	77/11/07	3.2	4.4	1.2	COHO	11	1	12	10.0	4	70	SUPP	FOOT	6	24		0
080080	77/11/07	4.4	5.5	1.1	COHO	28	4	32	29.1	4	70	INDX	FOOT		23	60	0
080080	77/11/07	5.5	6.5	1.0	COHO	12	0	12	12.0	4	70	SUPP	FOOT		24		0
080080	77/11/07	6.5	7.3	0.8	COHO	6	0	6	7.5	4	90	SUPP	FOOT		20	60	0
080080	77/11/10	7.5	0.0	0.0	COHO	0	0	0		4	99	SPOT	FOOT		20	60	0
080080	77/11/14	4.4	5.5	1.1	COHO	12	8	20	18.2	4	70	INDX	FOOT		27	60 68	0
080080	77/11/14	5.5	6.5	1.0	COHO	12	0	12	12.0	4	70	SUPP	FOOT		26	60	0
080080	77/11/14	6.5	7.3	0.8	COHO	6	2	8	10.0	4	70	SUPP	FOOT		26	60	0
080080	77/11/14	7.3	7.9	0.6	COHO	2	0	2	3.3	4	85	SUPP	FOOT		21	60	0
080080	77/11/18	0.2	1.3	1.1	FALL	0	2	2	1.8	1	75	SUPP	FOOT	4	23	31	0
080080	77/11/18	0.2	1.3	1.1	COHO	0	0	0		4	75	SUPP	FOOT	1	23	31 60	0
080080	77/11/18	1.3	2.1	0.8	COHO	3	2	5	6.2	4	60	SUPP	FOOT		27	60	0
080080	77/11/18	2.1	2.9	0.8	COHO	2	1	3	3.8	4	80	SUPP	FOOT		23	33 60	0
080080	77/11/18	2.9	4.0	1.1	COHO	17	2	19	17.3	4	65	SUPP	FOOT		26	60	0

Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	77/11/18	4.0	4.4	0.4	COHO	3	1	4	10.0	4	85		SUPP	FOOT		23 31 60	0
080080	77/11/21	0.2	1.3	1.1	COHO	1	1	2	1.8	4	70		SUPP	FOOT		24 60	0
080080	77/11/21	1.3	2.1	0.8	COHO	4	4	8	10.0	4	80		SUPP	FOOT		20 31 60	0
080080	77/11/21	2.1	3.2	1.1	COHO	0	1	1	0.9	4	80		SUPP	FOOT		23 60	0
080080	77/11/21	3.2	4.4	1.2	COHO	7	7	14	11.7	4	80		SUPP	FOOT		20 31 60	0
080080	77/11/21	4.4	5.5	1.1	COHO	5	5	10	9.1	4	80		INDX	FOOT		23 60	0
080080	77/11/21	5.5	6.5	1.0	COHO	5	0	5	5.0	4	90		SUPP	FOOT		20 60	0
080080	77/11/21	6.5	7.3	0.8	COHO	1	2	3	3.8	4	60		SUPP	FOOT		27 60	0
080080	77/11/22	7.3	7.9	0.6	COHO	2	3	5	8.3	4	95		SUPP	FOOT		20 60	0
080080	77/11/28	0.2	1.3	1.1	COHO	1	3	4	3.6	4	60		SUPP	FOOT		28 60	0
080080	77/11/28	1.3	2.1	0.8	COHO	3	0	3	3.8	4	70		SUPP	FOOT		24 34	0
080080	77/11/28	2.1	3.2	1.1	COHO	0	2	2	1.8	4	70		SUPP	FOOT		24 60	0
080080	77/11/28	3.2	4.4	1.2	COHO	29	5	34	28.3	4	70		SUPP	FOOT		24 34 68	0
080080	77/11/28	4.4	5.5	1.1	COHO	38	6	44	40.0	4	80		INDX	FOOT		24 34 60	0
080080	77/11/28	5.5	6.5	1.0	COHO	60	3	63	63.0	4	65		SUPP	FOOT		24 34 60	0
080080	77/11/28	6.5	7.3	0.8	COHO	5	5	10	12.5	4	70		SUPP	FOOT		28 34 60	0
080080	77/11/29	7.3	7.9	0.6	COHO	6	2	8	13.3	4	65		SUPP	FOOT		21 39 60	0

080080	77/12/05	0.2	1.3	1.1	FALL	0	1	1	0.9	1	75	SUPP	FOOT	4	23	0
080080	77/12/05	0.2	1.3	1.1	COHO	2	4	6	5.5	4	70	SUPP	FOOT	1	23 60	0
080080	77/12/05	1.3	2.1	0.8	COHO	0	3	3	3.8	4	80	SUPP	FOOT		23 31 60	0
080080	77/12/05	2.1	3.2	1.1	COHO	0	1	1	0.9	4	70	SUPP	FOOT		23 60	0
080080	77/12/05	3.2	4.4	1.2	COHO	32	15	47	39.2	4	80	SUPP	FOOT		23 33 60	0
080080	77/12/05	4.4	5.5	1.1	COHO	42	13	55	50.0	4	80	INDX	FOOT		23 60	0
080080	77/12/05	5.5	6.5	1.0	COHO	37	7	44	44.0	4	90	SUPP	FOOT		23 60	0
080080	77/12/05	6.5	7.3	0.8	COHO	8	1	9	11.3	4	60	SUPP	FOOT		25 60	0
080080	77/12/05	7.3	7.9	0.6	COHO	4	1	5	8.3	4	90	SUPP	FOOT		20 60	0
080080	77/12/19	1.3	2.1	0.8	COHO	0	3	3	3.8	4	60	SUPP	FOOT		27 60	0
080080	77/12/19	2.1	3.2	1.1	COHO	0	6	6	5.5	4	40	SUPP	FOOT		23 31 60	0
080080	77/12/19	3.2	4.4	1.2	COHO	4	2	6	5.0	4	65	SUPP	FOOT		27 60	0
080080	77/12/19	4.4	5.5	1.1	COHO	10	11	21	19.1	4	85	INDX	FOOT		23 33 60	0
080080	77/12/19	5.5	6.5	1.0	COHO	25	3	28	28.0	4	75	SUPP	FOOT		24 60	0
080080	77/12/19	6.5	7.3	0.8	COHO	8	7	15	18.8	4	90	SUPP	FOOT		20 60	0
080080	77/12/19	7.3	7.9	0.6	COHO	28	2	30	50.0	4	85	SUPP	FOOT		23 60	0
080080	77/12/27	0.2	1.3	1.1	COHO	0	1	1	0.9	4	80	SUPP	FOOT		23 60	0
080080	77/12/27	1.3	2.1	0.8	COHO	2	2	4	5.0	4	75	SUPP	FOOT		20 31 60	0
080080	77/12/27	2.1	3.2	1.1	COHO	0	4	4	3.6	4	80	SUPP	FOOT		23 60	0
080080	77/12/27	3.2	4.4	1.2	COHO	3	3	6	5.0	4	60	SUPP	FOOT		23 31 60	0
080080	77/12/27	4.4	5.5	1.1	COHO	0	12	12	10.9	4	85	INDX	FOOT		20 60	0
080080	77/12/27	5.5	6.5	1.0	COHO	0	6	6	6.0	4	80	SUPP	FOOT		23 60	0
080080	77/12/27	6.5	7.3	0.8	COHO	0	1	1	1.3	4	70	SUPP	FOOT		24 60	0
080080	77/12/27	7.3	7.9	0.6	COHO	1	12	13	21.7	4	95	SUPP	FOOT		20 50 60	0
080080	78/01/03	1.3	2.1	0.8	COHO	0	0	0		4	15	SUPP	FOOT		28 60	0
080080	78/01/03	2.1	2.9	0.8	COHO	0	1	1	1.3	4	20	SUPP	FOOT		24 31 60	0
080080	78/01/03	4.4	5.5	1.1	COHO	0	7	7	6.4	4	75	INDX	FOOT		23 34 60	0
080080	78/01/03	5.5	6.5	1.0	COHO	0	0	0		4	70	SUPP	FOOT		24 60	0
080080	78/01/03	6.5	7.3	0.8	COHO	0	8	8	10.0	4	80	SUPP	FOOT		23 34 60	0
080080	78/01/03	7.3	7.9	0.6	COHO	0	5	5	8.3	4	70	SUPP	FOOT		24 60	0
080080	78/01/11	4.4	5.5	1.1	COHO	0	0	0		4	85	INDX	FOOT		23 60	0
080080	78/01/11	5.5	6.5	1.0	COHO	4	5	9	9.0	4	75	SUPP	FOOT		23 60	0
080080	78/01/11	6.5	7.3	0.8	COHO	0	0	0		4	85	SUPP	FOOT		23 60	0
080080	78/01/11	7.3	7.9	0.6	COHO	0	0	0		4	85	SUPP	FOOT		23 60	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	78/10/27	0.0	1.0	1.0	FALL	2	4	6	6.0	1	45		SUPP	FOOT	45	21	0
080080	78/10/27	0.0	1.0	1.0	COHO	3	4	7	7.0	4	45		SUPP	FOOT	15	21	0
080080	78/10/27	0.0	1.0	1.0	SOCK	21	2	23	23.0	5	45		SUPP	FOOT	14	21	0
080080	78/10/27	1.0	1.3	0.3	FALL	0	3	3	10.0	1	80		SUPP	FOOT	4	20	0
080080	78/10/27	1.0	1.3	0.3	COHO	1	0	1	3.3	4	80		SUPP	FOOT	1	20	0
080080	78/10/27	1.3	1.9	0.6	FALL	2	3	5	8.3	1	65		SUPP	FOOT	45	20	0
080080	78/10/27	1.3	1.9	0.6	COHO	5	0	5	8.3	4	65		SUPP	FOOT	15	20	0
080080	78/10/27	1.3	1.9	0.6	SOCK	2	0	2	3.3	5	65		SUPP	FOOT	14	20	0
080080	78/10/27	1.9	2.9	1.0	COHO	1	0	1	1.0	4	60		SUPP	FOOT		20	0
080080	78/10/27	2.9	4.0	1.1	FALL	3	2	5	4.5	1	60		SUPP	FOOT	45	20	0
080080	78/10/27	2.9	4.0	1.1	COHO	18	1	19	17.3	4	60		SUPP	FOOT	15	20 66	0
080080	78/10/27	2.9	4.0	1.1	SOCK	0	1	1	0.9	5	60		SUPP	FOOT	14	20	0
080080	78/10/27	4.0	4.4	0.4	COHO	0	1	1	2.5	4	70		SUPP	FOOT		20	0
080080	78/10/27	4.4	5.5	1.1	FALL	0	4	4	3.6	1	80		SUPP	FOOT	4	20 60	0
080080	78/10/27	4.4	5.5	1.1	COHO	5	4	9	8.2	4	80		INDX	FOOT	1	20 61	0
080080	78/10/27	5.5	6.2	0.7	COHO	1	0	1	1.4	4	70		SUPP	FOOT		20	0
080080	78/10/27	6.2	7.9	1.7	COHO	0	0	0		4	80		SUPP	FOOT		20	0
080080	78/10/27	6.5	6.7	0.2	FALL	0	1	1	5.0	1	80		SUPP	FOOT		20	0
080080	78/10/30	1.0	1.9	0.9	FALL	2	10	12	13.3	1	0		SUPP	FOOT	4	20	0
080080	78/10/30	1.0	1.9	0.9	COHO	1	0	1	1.1	4	70		SUPP	FOOT	1	20	0
080080	78/10/30	1.9	4.0	2.1	COHO	6	2	8	3.8	4	70		SUPP	FOOT	5	20	0
080080	78/10/30	1.9	4.0	2.1	SOCK	1	0	1	0.5	5	0		SUPP	FOOT	4	20	0

080080	78/10/30	4.0	4.4	0.4	COHO	1	0	1	2.5	4	70	SUPP	FOOT		20	0
080080	78/10/30	4.4	5.5	1.1	COHO	2	0	2	1.8	4	70	INDX	FOOT		20	0
080080	78/10/30	5.5	7.9	2.4	FALL	0	1	1	0.4	1	70	SUPP	FOOT	4	20	0
080080	78/10/30	5.5	7.9	2.4	COHO	0	0	0		4	70	SUPP	FOOT	1	20	0
080080	78/11/01	4.4	4.8	0.4	COHO	1	2	3	7.5	4	90	INDX	FOOT	1	20	0
080080	78/11/02	2.1	2.9	0.8	COHO	6	0	6	7.5	4	60	SUPP	FOOT	5	20 31	0
080080	78/11/02	2.1	2.9	0.8	SOCK	0	1	1	1.3	5	60	SUPP	FOOT	4	20 31	0
080080	78/11/02	2.9	3.2	0.3	COHO	1	1	2	6.7	4	75	SUPP	FOOT	5	20	0
080080	78/11/02	2.9	3.2	0.3	SOCK	1	1	2	6.7	5	75	SUPP	FOOT	4	20	0
080080	78/11/02	3.2	4.0	0.8	FALL	1	4	5	6.3	1	70	SUPP	FOOT	45	20 34	0
080080	78/11/02	3.2	4.0	0.8	COHO	3	1	4	5.0	4	70	SUPP	FOOT	15	20 34	0
080080	78/11/02	3.2	4.0	0.8	SOCK	0	1	1	1.3	5	70	SUPP	FOOT	14	20 34	0
080080	78/11/02	4.0	4.4	0.4	COHO	0	2	2	5.0	4	50	SUPP	FOOT		21 34 68	0
080080	78/11/02	4.4	5.5	1.1	FALL	0	2	2	1.8	1	80	INDX	FOOT	4	20	0
080080	78/11/02	4.4	5.5	1.1	COHO	3	3	6	5.5	4	80	INDX	FOOT	1	20	0
080080	78/11/02	5.5	6.2	0.7	COHO	1	0	1	1.4	4	70	SUPP	FOOT	1	21 60	0
080080	78/11/02	6.2	6.7	0.5	COHO	0	0	0		4	50	SUPP	FOOT		21 34	0
080080	78/11/02	6.7	7.3	0.6	COHO	0	0	0		4	65	SUPP	FOOT		21	0
080080	78/11/03	3.2	4.0	0.8	FALL	1	2	3	3.8	1	30	SUPP	FOOT	45	21 34	0
080080	78/11/03	3.2	4.0	0.8	COHO	3	0	3	3.8	4	30	SUPP	FOOT	15	21 34	0
080080	78/11/03	3.2	4.0	0.8	SOCK	1	3	4	5.0	5	30	SUPP	FOOT	14	21 34	0
080080	78/11/03	4.0	4.4	0.4	COHO	1	0	1	2.5	4	25	SUPP	FOOT		22 34	0
080080	78/11/03	4.4	5.5	1.1	FALL	0	2	2	1.8	1	75	SUPP	FOOT	4	31 34	0
080080	78/11/03	4.4	5.5	1.1	COHO	12	2	14	12.7	4	75	INDX	FOOT	1	31 34	0
080080	78/11/03	5.5	6.2	0.7	COHO	0	0	0		4	25	SUPP	FOOT		22 34	0
080080	78/11/03	6.2	6.7	0.5	COHO	2	0	2	4.0	4	45	SUPP	FOOT		25 30 34	0
080080	78/11/03	6.7	7.3	0.6	COHO	0	0	0		4	25	SUPP	FOOT		22 34	0
080080	78/11/03	7.3	7.9	0.6	COHO	0	0	0		4	55	SUPP	FOOT		24 31 34	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	78/11/05	4.4	5.5	1.1	COHO	8	0	8	7.3	4	60		INDX	FOOT		25 34	0
080080	78/11/05	5.5	6.2	0.7	COHO	8	0	8	11.4	4	60		SUPP	FOOT		24	0
080080	78/11/05	6.2	6.7	0.5	COHO	3	0	3	6.0	4	60		SUPP	FOOT		24	0
080080	78/11/07	3.2	4.0	0.8	COHO	53	1	54	67.5	4	65		SUPP	FOOT		20 66	0
080080	78/11/07	4.0	4.4	0.4	COHO	8	0	8	20.0	4	70		SUPP	FOOT		20 66	0
080080	78/11/07	4.4	5.5	1.1	COHO	69	1	70	63.6	4	90		INDX	FOOT		20 66	0
080080	78/11/07	5.5	6.2	0.7	COHO	26	0	26	37.1	4	80		SUPP	FOOT		20 60	0
080080	78/11/07	6.2	6.5	0.3	COHO	8	0	8	26.7	4	70		SUPP	FOOT		20	0
080080	78/11/07	6.5	6.7	0.2	COHO	2	0	2	10.0	4	70		SUPP	FOOT		20 66	0
080080	78/11/07	6.7	7.3	0.6	COHO	6	0	6	10.0	4	65		SUPP	FOOT		20 66	0
080080	78/11/07	7.3	7.7	0.4	COHO	4	0	4	10.0	4	70		SUPP	FOOT		20	0
080080	78/11/08	3.2	4.4	1.2	COHO	37	1	38	31.7	4	75		SUPP	FOOT		23 34	0
080080	78/11/08	4.4	5.5	1.1	COHO	37	0	37	33.6	4	75		INDX	FOOT		23 34	0
080080	78/11/08	5.5	6.2	0.7	COHO	15	0	15	21.4	4	75		SUPP	FOOT		26 34	0
080080	78/11/08	6.2	6.7	0.5	COHO	3	0	3	6.0	4	80		SUPP	FOOT		27 31 60	0
080080	78/11/08	6.7	7.3	0.6	COHO	1	0	1	1.7	4	70		SUPP	FOOT		23	0
080080	78/11/08	7.3	7.9	0.6	COHO	0	0	0		4	60		SUPP	FOOT		23	0
080080	78/11/09	3.2	4.4	1.2	COHO	11	0	11	9.2	4	30		SUPP	FOOT		28	0
080080	78/11/09	4.4	5.5	1.1	COHO	38	0	38	34.5	4	65		INDX	FOOT		24 31 60	0
080080	78/11/09	5.5	6.2	0.7	COHO	13	0	13	18.6	4	70		SUPP	FOOT		24	0
080080	78/11/09	6.2	6.7	0.5	COHO	4	0	4	8.0	4	60		SUPP	FOOT		24	0
080080	78/11/09	6.7	7.9	1.2	COHO	7	0	7	5.8	4	70		SUPP	FOOT		21	0
080080	78/11/10	3.2	4.4	1.2	FALL	0	1	1	0.8	1	55		SUPP	FOOT	4	24 31 33	0
080080	78/11/10	3.2	4.4	1.2	COHO	17	2	19	15.8	4	55		SUPP	FOOT	1	24 31 33	0
080080	78/11/10	4.4	5.5	1.1	COHO	27	1	28	25.5	4	70		INDX	FOOT		24 33	0
080080	78/11/10	5.5	6.2	0.7	COHO	10	0	10	14.3	4	85		SUPP	FOOT		20 33	0
080080	78/11/10	6.2	6.7	0.5	COHO	10	0	10	20.0	4	80		SUPP	FOOT		23	0
080080	78/11/10	6.7	7.3	0.6	COHO	4	0	4	6.7	4	80		SUPP	FOOT		20	0
080080	78/11/10	7.3	7.7	0.4	COHO	1	0	1	2.5	4	75		SUPP	FOOT		20	0

080080	78/11/11	3.2	4.4	1.2	COHO	5	1	6	5.0	4	65	SUPP	FOOT		24 31		0
080080	78/11/11	4.4	5.5	1.1	COHO	31	2	33	30.0	4	90	INDX	FOOT		20 60		0
080080	78/11/11	5.5	6.2	0.7	COHO	5	0	5	7.1	4	70	SUPP	FOOT		23 33		0
080080	78/11/11	6.2	6.7	0.5	COHO	6	0	6	12.0	4	75	SUPP	FOOT		20 33		0
080080	78/11/11	6.7	7.9	1.2	COHO	3	0	3	2.5	4	75	SUPP	FOOT		20 33		0
080080	78/11/12	3.2	4.4	1.2	COHO	9	3	12	10.0	4	65	SUPP	FOOT		24 31	68	0
080080	78/11/12	4.4	5.5	1.1	COHO	18	2	20	18.2	4	75	INDX	FOOT		20 31		0
080080	78/11/12	5.5	6.2	0.7	COHO	3	0	3	4.3	4	85	SUPP	FOOT		20 33		0
080080	78/11/12	6.2	6.7	0.5	COHO	5	0	5	10.0	4	80	SUPP	FOOT		20 60		0
080080	78/11/12	6.7	7.3	0.6	COHO	0	0	0		4	85	SUPP	FOOT		20		0
080080	78/11/12	7.3	7.7	0.4	COHO	0	0	0		4	85	SUPP	FOOT		20 60		0
080080	78/11/13	5.5	7.5	2.0	COHO	2	0	2	1.0	4	90	SUPP	FOOT				0
080080	78/11/14	3.2	4.0	0.8	COHO	16	4	20	25.0	4	50	SUPP	FOOT		20 60		0
080080	78/11/14	4.0	4.4	0.4	COHO	4	2	6	15.0	4	40	SUPP	FOOT		20		0
080080	78/11/14	4.4	5.5	1.1	COHO	17	3	20	18.2	4	70	INDX	FOOT		20		0
080080	78/11/14	5.5	6.2	0.7	COHO	1	0	1	1.4	4	90	SUPP	FOOT		20		0
080080	78/11/14	6.2	6.5	0.3	COHO	1	0	1	3.3	4	90	SUPP	FOOT		20		0
080080	78/11/14	6.5	6.7	0.2	COHO	1	0	1	5.0	4	90	SUPP	FOOT		20		0
080080	78/11/14	6.7	7.3	0.6	COHO	0	0	0		4	80	SUPP	FOOT		20		0
080080	78/11/14	7.3	7.7	0.4	COHO	1	0	1	2.5	4	95	SUPP	FOOT		20		0
080080	78/11/15	1.0	1.9	0.9	COHO	15	0	15	16.7	4	60	SUPP	FOOT	1	66		0
080080	78/11/15	1.9	3.2	1.3	COHO	5	7	12	9.2	4	80	SUPP	FOOT				0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	78/11/15	3.2	4.4	1.2	FALL	0	1	1	0.8	1	90		SUPP	FOOT	4	20	0
080080	78/11/15	3.2	4.4	1.2	COHO	8	5	13	10.8	4	90		SUPP	FOOT	1	20	0
080080	78/11/15	4.4	5.5	1.1	COHO	7	2	9	8.2	4	90		INDX	FOOT		20	0
080080	78/11/15	5.5	6.2	0.7	COHO	2	1	3	4.3	4	85		SUPP	FOOT		20	0
080080	78/11/15	6.2	6.7	0.5	COHO	0	2	2	4.0	4	80		SUPP	FOOT		20	0
080080	78/11/15	6.7	7.7	1.0	COHO	0	0	0		4	80		SUPP	FOOT		20 60	0
080080	78/11/16	3.2	4.4	1.2	COHO	13	4	17	14.2	4	60		SUPP	FOOT		27 31 34	0
080080	78/11/16	4.4	5.5	1.1	COHO	19	4	23	20.9	4	75		INDX	FOOT		24 34	0
080080	78/11/16	5.5	6.2	0.7	COHO	6	1	7	10.0	4	85		SUPP	FOOT		21 33	0
080080	78/11/16	6.2	6.7	0.5	COHO	2	1	3	6.0	4	75		SUPP	FOOT		24 31	0
080080	78/11/16	6.7	7.3	0.6	COHO	1	0	1	1.7	4	80		SUPP	FOOT		23 31	0
080080	78/11/16	7.3	7.7	0.4	COHO	1	0	1	2.5	4	80		SUPP	FOOT		21 34	0
080080	78/11/17	3.2	4.4	1.2	COHO	17	3	20	16.7	4	60		SUPP	FOOT		27 31	0
080080	78/11/17	4.4	5.5	1.1	COHO	41	5	46	41.8	4	80		INDX	FOOT		27 31	0
080080	78/11/17	5.5	6.2	0.7	COHO	18	1	19	27.1	4	75		SUPP	FOOT		24 31	0
080080	78/11/17	6.2	6.7	0.5	COHO	5	1	6	12.0	4	75		SUPP	FOOT		24 31	0
080080	78/11/17	6.7	7.7	1.0	COHO	6	1	7	7.0	4	80		SUPP	FOOT		24	0
080080	78/11/19	3.2	4.0	0.8	COHO	23	4	27	33.8	4	50		SUPP	FOOT		24	0
080080	78/11/19	4.0	4.4	0.4	COHO	6	4	10	25.0	4	25		SUPP	FOOT		24	0
080080	78/11/19	4.4	5.5	1.1	COHO	56	5	61	55.5	4	70		INDX	FOOT		24 61	0
080080	78/11/19	5.5	6.2	0.7	COHO	30	0	30	42.9	4	70		SUPP	FOOT		30 24 33	0
080080	78/11/19	6.2	6.7	0.5	COHO	1	1	2	4.0	4	65		SUPP	FOOT		25 31 33	0
080080	78/11/19	6.7	7.3	0.6	COHO	4	2	6	10.0	4	70		SUPP	FOOT		25 31	0
080080	78/11/19	7.3	7.7	0.4	COHO	8	0	8	20.0	4	80		SUPP	FOOT		25 31	0
080080	78/11/20	3.2	4.0	0.8	COHO	23	4	27	33.8	4	65		SUPP	FOOT		23 32	0
080080	78/11/20	4.0	4.4	0.4	COHO	4	6	10	25.0	4	70		SUPP	FOOT		23	0
080080	78/11/20	4.4	5.5	1.1	COHO	48	5	53	48.2	4	80		INDX	FOOT		23	0
080080	78/11/20	5.5	6.2	0.7	COHO	10	0	10	14.3	4	70		SUPP	FOOT		23	0
080080	78/11/20	6.2	6.5	0.3	COHO	4	0	4	13.3	4	70		SUPP	FOOT		23	0
080080	78/11/20	6.5	6.7	0.2	COHO	5	0	5	25.0	4	70		SUPP	FOOT		23	0
080080	78/11/20	6.7	7.3	0.6	COHO	5	0	5	8.3	4	70		SUPP	FOOT		23	0
080080	78/11/20	7.3	7.5	0.2	COHO	2	0	2	10.0	4	70		SUPP	FOOT		23 60	0
080080	78/11/21	3.2	4.4	1.2	COHO	29	1	30	25.0	4	80		SUPP	FOOT			0
080080	78/11/21	4.4	5.5	1.1	COHO	27	0	27	24.5	4	80		INDX	FOOT			0
080080	78/11/22	1.0	1.9	0.9	COHO	5	1	6	6.7	4	85		SUPP	FOOT			0

080080	78/11/22	1.9	3.2	1.3	COHO	7	2	9	6.9	4	60	SUPP	FOOT			0
080080	78/11/22	3.2	4.4	1.2	COHO	11	3	14	11.7	4	70	SUPP	FOOT	24 31 33		0
080080	78/11/22	4.4	5.5	1.1	COHO	21	4	25	22.7	4	75	INDX	FOOT	24 33		0
080080	78/11/22	5.5	6.2	0.7	COHO	11	0	11	15.7	4	60	SUPP	FOOT	20 32		0
080080	78/11/22	6.2	6.7	0.5	COHO	5	1	6	12.0	4	70	SUPP	FOOT	20		0
080080	78/11/22	6.7	7.3	0.6	COHO	1	1	2	3.3	4	60	SUPP	FOOT	22		0
080080	78/11/22	7.3	7.7	0.4	COHO	1	0	1	2.5	4	60	SUPP	FOOT	21		0
080080	78/11/23	3.2	4.4	1.2	COHO	14	3	17	14.2	4	65	SUPP	FOOT	24		0
080080	78/11/23	4.4	5.5	1.1	COHO	22	4	26	23.6	4	80	INDX	FOOT	20 31		0
080080	78/11/23	5.5	6.2	0.7	COHO	13	2	15	21.4	4	75	SUPP	FOOT	21		0
080080	78/11/23	6.2	6.7	0.5	COHO	5	3	8	16.0	4	80	SUPP	FOOT	20		0
080080	78/11/23	6.7	7.7	1.0	COHO	4	1	5	5.0	4	75	SUPP	FOOT	20		0
080080	78/11/25	3.2	4.4	1.2	COHO	23	8	31	25.8	4	85	SUPP	FOOT	21 33		0
080080	78/11/25	4.4	5.5	1.1	COHO	15	5	20	18.2	4	75	INDX	FOOT	21 34 60		0
080080	78/11/25	5.5	6.2	0.7	COHO	2	1	3	4.3	4	75	SUPP	FOOT	20		0
080080	78/11/25	6.2	6.7	0.5	COHO	7	2	9	18.0	4	90	SUPP	FOOT	20		0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	78/11/25	6.7	7.3	0.6	COHO	0	1	1	1.7	4	70		SUPP	FOOT		20	0
080080	78/11/25	7.3	7.7	0.4	COHO	1	0	1	2.5	4	80		SUPP	FOOT		20	0
080080	78/11/26	3.2	4.4	1.2	COHO	33	6	39	32.5	4	85		SUPP	FOOT		21 31	0
080080	78/11/26	4.4	5.5	1.1	COHO	15	10	25	22.7	4	85		INDX	FOOT		20 31	0
080080	78/11/26	5.5	6.5	1.0	COHO	15	7	22	22.0	4	80		SUPP	FOOT		20	0
080080	78/11/26	6.5	7.7	1.2	COHO	2	2	4	3.3	4	75		SUPP	FOOT		20 60	0
080080	78/11/27	3.2	4.4	1.2	COHO	15	5	20	16.7	4	80		SUPP	FOOT		20	0
080080	78/11/27	4.4	5.5	1.1	COHO	13	9	22	20.0	4	85		INDX	FOOT		20	0
080080	78/11/27	5.5	7.3	1.8	COHO	8	7	15	8.3	4	50		SUPP	FOOT		22	0
080080	78/11/29	1.9	3.2	1.3	COHO	5	0	5	3.8	4	70		SUPP	FOOT			0
080080	78/11/29	3.2	4.0	0.8	COHO	36	12	48	60.0	4	85		SUPP	FOOT		20	0
080080	78/11/29	4.0	4.4	0.4	COHO	10	2	12	30.0	4	75		SUPP	FOOT		21	0
080080	78/11/29	4.4	5.5	1.1	COHO	30	19	49	44.5	4	75		INDX	FOOT		21	0
080080	78/11/29	5.5	6.2	0.7	COHO	8	3	11	15.7	4	60		SUPP	FOOT		21	0
080080	78/11/29	6.2	6.7	0.5	COHO	2	6	8	16.0	4	85		SUPP	FOOT		20	0
080080	78/11/29	6.7	7.3	0.6	COHO	2	0	2	3.3	4	75		SUPP	FOOT		20 31	0
080080	78/11/29	7.3	7.7	0.4	COHO	1	0	1	2.5	4	80		SUPP	FOOT		20	0
080080	78/12/02	3.2	4.4	1.2	COHO	24	2	26	21.7	4	55		SUPP	FOOT		28	0
080080	78/12/02	4.4	5.5	1.1	COHO	61	6	67	60.9	4	60		INDX	FOOT		27	0
080080	78/12/02	5.5	6.2	0.7	COHO	38	5	43	61.4	4	70		SUPP	FOOT		27	0
080080	78/12/02	6.2	6.7	0.5	COHO	18	4	22	44.0	4	75		SUPP	FOOT		24 68	0
080080	78/12/02	6.7	7.7	1.0	COHO	34	3	37	37.0	4	80		SUPP	FOOT		24	0
080080	78/12/03	3.2	4.4	1.2	COHO	77	11	88	73.3	4	75		SUPP	FOOT		27 68	0
080080	78/12/03	4.4	5.5	1.1	COHO	81	13	94	85.5	4	80		INDX	FOOT		24	0
080080	78/12/03	5.5	6.2	0.7	COHO	43	5	48	68.6	4	70		SUPP	FOOT		27 31	0
080080	78/12/03	6.2	6.7	0.5	COHO	25	1	26	52.0	4	75		SUPP	FOOT		24 31	0
080080	78/12/03	6.7	7.3	0.6	COHO	10	0	10	16.7	4	70		SUPP	FOOT		25	0
080080	78/12/03	7.3	7.7	0.4	COHO	15	1	16	40.0	4	75		SUPP	FOOT		23	0
080080	78/12/04	3.2	4.0	0.8	COHO	31	1	32	40.0	4	60		SUPP	FOOT		24	0
080080	78/12/04	4.0	4.4	0.4	COHO	10	0	10	25.0	4	35		SUPP	FOOT		24	0
080080	78/12/04	4.4	5.5	1.1	COHO	97	13	110	100.0	4	75		INDX	FOOT		23	0
080080	78/12/04	5.5	6.7	1.2	COHO	39	5	44	36.7	4	80		SUPP	FOOT		23	0
080080	78/12/04	6.7	7.5	0.8	COHO	21	1	22	27.5	4	75		SUPP	FOOT			0
080080	78/12/05	4.5	5.5	1.0	COHO	79	1	80	80.0	4	75		INDX	FOOT		23	0
080080	78/12/06	1.0	1.9	0.9	COHO	2	1	3	3.3	4	85		SUPP	FOOT		24	0
080080	78/12/06	1.9	3.2	1.3	COHO	3	0	3	2.3	4	60		SUPP	FOOT		24	0
080080	78/12/06	3.2	4.4	1.2	COHO	31	2	33	27.5	4	65		SUPP	FOOT		25 31 33	0
080080	78/12/06	4.4	5.5	1.1	COHO	62	6	68	61.8	4	80		INDX	FOOT		24 31	0
080080	78/12/06	5.5	6.2	0.7	COHO	26	6	32	45.7	4	80		SUPP	FOOT		24 33	0
080080	78/12/06	6.2	6.7	0.5	COHO	6	0	6	12.0	4	80		SUPP	FOOT		24	0
080080	78/12/06	6.7	7.7	1.0	COHO	23	3	26	26.0	4	80		SUPP	FOOT		24 60	0

080080	78/12/07	3.2	4.0	0.8	COHO	23	8	31	38.8	4	65	SUPP	FOOT	24 31 33	0
080080	78/12/07	4.0	4.4	0.4	COHO	13	4	17	42.5	4	55	SUPP	FOOT	25 31 32	0
080080	78/12/07	4.4	5.5	1.1	COHO	55	15	70	63.6	4	75	INDX	FOOT	24 31 33	0
080080	78/12/07	5.5	6.2	0.7	COHO	18	4	22	31.4	4	65	SUPP	FOOT	20 32	0
080080	78/12/07	6.2	6.7	0.5	COHO	5	2	7	14.0	4	75	SUPP	FOOT	20 32	0
080080	78/12/07	6.7	7.3	0.6	COHO	8	0	8	13.3	4	70	SUPP	FOOT	21 31 32	0
080080	78/12/07	7.3	7.7	0.4	COHO	6	1	7	17.5	4	85	SUPP	FOOT	20 32	0
080080	78/12/08	3.2	4.4	1.2	COHO	34	7	41	34.2	4	80	SUPP	FOOT	20 31	0
080080	78/12/08	4.4	5.5	1.1	COHO	66	10	76	69.1	4	80	INDX	FOOT	20	0
080080	78/12/08	5.5	6.2	0.7	COHO	12	8	20	28.6	4	75	SUPP	FOOT	20	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	78/12/08	6.2	6.7	0.5	COHO	2	3	5	10.0	4	75		SUPP	FOOT		20	0
080080	78/12/08	6.7	7.7	1.0	COHO	9	8	17	17.0	4	75		SUPP	FOOT		20	0
080080	78/12/09	3.2	4.0	0.8	COHO	33	10	43	53.8	4	75		SUPP	FOOT		24 30 31	0
080080	78/12/09	4.0	4.4	0.4	COHO	10	4	14	35.0	4	65		SUPP	FOOT		24 31	0
080080	78/12/09	4.4	5.5	1.1	COHO	44	16	60	54.5	4	75		INDX	FOOT		24	0
080080	78/12/09	5.5	6.2	0.7	COHO	5	7	12	17.1	4	75		SUPP	FOOT		21	0
080080	78/12/09	6.2	6.7	0.5	COHO	0	4	4	8.0	4	80		SUPP	FOOT		20	0
080080	78/12/09	6.7	7.3	0.6	COHO	4	0	4	6.7	4	75		SUPP	FOOT		20	0
080080	78/12/09	7.3	7.7	0.4	COHO	6	1	7	17.5	4	85		SUPP	FOOT		20	0
080080	78/12/10	3.2	4.4	1.2	COHO	46	5	51	42.5	4	80		SUPP	FOOT		24 31	0
080080	78/12/10	4.4	5.5	1.1	COHO	41	12	53	48.2	4	85		INDX	FOOT		23	0
080080	78/12/10	5.5	6.2	0.7	COHO	12	6	18	25.7	4	35		SUPP	FOOT		21 30	0
080080	78/12/10	6.2	6.7	0.5	COHO	3	3	6	12.0	4	65		SUPP	FOOT		21 30	0
080080	78/12/10	6.7	7.7	1.0	COHO	14	4	18	18.0	4	70		SUPP	FOOT		21 31	0
080080	78/12/11	4.4	6.2	1.8	COHO	36	8	44	24.4	4	75		INDX	FOOT		6 20	0
080080	78/12/12	4.4	5.5	1.1	COHO	46	15	61	55.5	4	85		INDX	FOOT		20	0
080080	78/12/12	5.5	6.2	0.7	COHO	10	5	15	21.4	4	55		SUPP	FOOT		20	0
080080	78/12/12	6.5	7.9	1.4	COHO	14	5	19	13.6	4	75		SUPP	FOOT			0
080080	78/12/13	1.0	1.9	0.9	COHO	3	2	5	5.6	4	75		SUPP	FOOT		20	0
080080	78/12/13	1.9	3.2	1.3	COHO	1	11	12	9.2	4	80		SUPP	FOOT		20	0
080080	78/12/13	3.2	4.4	1.2	COHO	26	7	33	27.5	4	75		SUPP	FOOT		21 31	0
080080	78/12/13	4.4	5.5	1.1	COHO	37	18	55	50.0	4	80		INDX	FOOT		21 31	0
080080	78/12/13	5.5	6.2	0.7	COHO	9	5	14	20.0	4	75		SUPP	FOOT		20	0
080080	78/12/13	6.2	6.7	0.5	COHO	0	4	4	8.0	4	65		SUPP	FOOT		20	0
080080	78/12/13	6.7	7.3	0.6	COHO	10	2	12	20.0	4	80		SUPP	FOOT		20	0
080080	78/12/13	7.3	7.7	0.4	COHO	0	1	1	2.5	4	85		SUPP	FOOT		20	0
080080	78/12/14	3.2	4.4	1.2	COHO	24	2	26	21.7	4	55		SUPP	FOOT		28 34	0
080080	78/12/14	4.4	5.5	1.1	COHO	33	10	43	39.1	4	70		INDX	FOOT		27	0
080080	78/12/14	5.5	6.2	0.7	COHO	5	4	9	12.9	4	40		SUPP	FOOT		25 30 34	0
080080	78/12/14	6.2	6.7	0.5	COHO	2	4	6	12.0	4	50		SUPP	FOOT		25 34	0
080080	78/12/14	6.7	7.7	1.0	COHO	7	2	9	9.0	4	75		SUPP	FOOT		24	0
080080	78/12/15	3.2	4.0	0.8	COHO	16	6	22	27.5	4	70		SUPP	FOOT		27 31 33	0
080080	78/12/15	4.0	4.4	0.4	COHO	9	4	13	32.5	4	70		SUPP	FOOT		27 31	0
080080	78/12/15	4.4	5.5	1.1	COHO	51	12	63	57.3	4	80		INDX	FOOT		24	0
080080	78/12/15	5.5	6.2	0.7	COHO	15	3	18	25.7	4	70		SUPP	FOOT		24	0
080080	78/12/15	6.2	6.7	0.5	COHO	11	3	14	28.0	4	80		SUPP	FOOT		21	0
080080	78/12/15	6.7	7.3	0.6	COHO	8	1	9	15.0	4	85		SUPP	FOOT		20	0
080080	78/12/15	7.3	7.7	0.4	COHO	4	1	5	12.5	4	85		SUPP	FOOT		20	0
080080	78/12/16	3.2	4.4	1.2	COHO	28	7	35	29.2	4	65		SUPP	FOOT		25 33	0
080080	78/12/16	4.4	5.5	1.1	COHO	52	8	60	54.5	4	75		INDX	FOOT		24	0
080080	78/12/16	5.5	6.2	0.7	COHO	10	3	13	18.6	4	80		SUPP	FOOT		21 31	0
080080	78/12/16	6.2	6.7	0.5	COHO	3	4	7	14.0	4	80		SUPP	FOOT		21	0
080080	78/12/16	6.7	7.7	1.0	COHO	9	5	14	14.0	4	80		SUPP	FOOT		20	0
080080	78/12/17	3.2	4.0	0.8	COHO	30	10	40	50.0	4	75		SUPP	FOOT		24 31 34	0
080080	78/12/17	4.0	4.4	0.4	COHO	10	3	13	32.5	4	75		SUPP	FOOT		24 31 34	0
080080	78/12/17	4.4	5.5	1.1	COHO	52	13	65	59.1	4	80		INDX	FOOT		21 31 34	0
080080	78/12/17	5.5	6.2	0.7	COHO	17	2	19	27.1	4	80		SUPP	FOOT		20	0

080080	78/12/17	6.2	6.7	0.5	COHO	4	4	8	16.0	4	90	SUPP	FOOT		20	0
080080	78/12/17	6.7	7.3	0.6	COHO	7	1	8	13.3	4	85	SUPP	FOOT		20	0
080080	78/12/17	7.3	7.7	0.4	COHO	3	2	5	12.5	4	90	SUPP	FOOT		20	0
080080	78/12/18	3.2	4.4	1.2	COHO	35	5	40	33.3	4	80	SUPP	FOOT		20	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	78/12/18	4.4	5.5	1.1	COHO	36	9	45	40.9	4	80		INDX	FOOT		20	0
080080	78/12/18	5.5	7.9	2.4	COHO	14	1	15	6.2	4	80		SUPP	FOOT		20	0
080080	78/12/19	3.2	4.4	1.2	COHO	33	1	34	28.3	4	80		SUPP	FOOT		20	0
080080	78/12/19	4.4	5.5	1.1	COHO	29	13	42	38.2	4	85		INDX	FOOT		20 66 67	0
080080	78/12/19	5.5	7.9	2.4	COHO	24	15	39	16.2	4	90		SUPP	FOOT		20	0
080080	78/12/20	1.0	1.9	0.9	COHO	4	3	7	7.8	4	0		SUPP	FOOT		20	0
080080	78/12/20	1.9	3.2	1.3	COHO	3	1	4	3.1	4	75		SUPP	FOOT		20	0
080080	78/12/20	3.2	4.4	1.2	COHO	35	3	38	31.7	4	90		SUPP	FOOT		20	0
080080	78/12/20	4.4	5.5	1.1	COHO	17	18	35	31.8	4	90		INDX	FOOT		20	0
080080	78/12/20	5.5	6.2	0.7	COHO	10	6	16	22.9	4	75		SUPP	FOOT		21 31 33	0
080080	78/12/20	6.2	6.7	0.5	COHO	5	7	12	24.0	4	75		SUPP	FOOT		21 31	0
080080	78/12/20	6.7	7.7	1.0	COHO	8	5	13	13.0	4	80		SUPP	FOOT		20	0
080080	78/12/21	3.2	4.0	0.8	COHO	30	10	40	50.0	4	85		SUPP	FOOT		20 31 34	0
080080	78/12/21	4.0	4.4	0.4	COHO	6	3	9	22.5	4	75		SUPP	FOOT		21	0
080080	78/12/21	4.4	5.5	1.1	COHO	22	21	43	39.1	4	90		INDX	FOOT		20	0
080080	78/12/21	5.5	6.2	0.7	COHO	9	3	12	17.1	4	85		SUPP	FOOT		20 34	0
080080	78/12/21	6.2	6.7	0.5	COHO	5	3	8	16.0	4	85		SUPP	FOOT		20	0
080080	78/12/21	6.7	7.3	0.6	COHO	3	3	6	10.0	4	85		SUPP	FOOT		20	0
080080	78/12/21	7.3	7.7	0.4	COHO	5	1	6	15.0	4	90		SUPP	FOOT		26	0
080080	78/12/23	3.2	4.4	1.2	COHO	20	4	24	20.0	4	70		SUPP	FOOT		24	0
080080	78/12/23	4.4	5.5	1.1	COHO	21	12	23	20.9	4	80		INDX	FOOT		24	0
080080	78/12/23	5.5	6.2	0.7	COHO	7	7	14	20.0	4	70		SUPP	FOOT		24 30	0
080080	78/12/23	6.2	6.7	0.5	COHO	3	4	7	14.0	4	75		SUPP	FOOT		21 30	0
080080	78/12/23	6.7	7.7	1.0	COHO	3	4	7	7.0	4	80		SUPP	FOOT		20	0
080080	78/12/24	3.2	4.0	0.8	COHO	10	9	19	23.8	4	55		SUPP	FOOT		25	0
080080	78/12/24	4.0	4.4	0.4	COHO	3	1	4	10.0	4	55		SUPP	FOOT		25	0
080080	78/12/24	4.4	5.5	1.1	COHO	22	16	38	34.5	4	70		INDX	FOOT		24	0
080080	78/12/24	5.5	6.2	0.7	COHO	19	4	23	32.9	4	80		SUPP	FOOT		23	0
080080	78/12/24	6.2	6.7	0.5	COHO	0	3	3	6.0	4	85		SUPP	FOOT		23 32	0
080080	78/12/24	6.7	7.3	0.6	COHO	3	1	4	6.7	4	80		SUPP	FOOT		20 33	0
080080	78/12/24	7.3	7.7	0.4	COHO	0	0	0		4	90		SUPP	FOOT		20	0
080080	78/12/26	4.3	4.4	0.1	COHO	0	0	0		4	75		SUPP	FOOT			0
080080	78/12/26	4.4	5.5	1.1	COHO	5	11	16	14.5	4	75		INDX	FOOT			0
080080	78/12/27	1.9	3.2	1.3	COHO	0	2	2	1.5	4	70		SUPP	FOOT			0
080080	78/12/27	3.2	4.4	1.2	COHO	8	5	13	10.8	4	75		SUPP	FOOT		20	0
080080	78/12/27	4.4	5.5	1.1	COHO	2	11	13	11.8	4	80		INDX	FOOT		20 61	0
080080	78/12/27	5.5	6.2	0.7	COHO	7	7	14	20.0	4	75		SUPP	FOOT		20 33	0
080080	78/12/27	6.2	6.7	0.5	COHO	1	5	6	12.0	4	80		SUPP	FOOT		20 33	0
080080	78/12/27	6.7	7.7	1.0	COHO	3	5	8	8.0	4	80		SUPP	FOOT		20	0
080080	78/12/28	3.2	4.4	1.2	COHO	14	6	20	16.7	4	70		SUPP	FOOT		20	0
080080	78/12/28	4.4	5.5	1.1	COHO	3	8	11	10.0	4	75		INDX	FOOT		20	0
080080	78/12/28	5.5	6.2	0.7	COHO	1	6	7	10.0	4	75		SUPP	FOOT		20 32	0
080080	78/12/28	6.2	6.7	0.5	COHO	0	3	3	6.0	4	80		SUPP	FOOT		20 32	0
080080	78/12/28	6.7	7.7	1.0	COHO	4	5	9	9.0	4	80		SUPP	FOOT		20 32	0
080080	78/12/29	3.2	4.4	1.2	COHO	2	0	2	1.7	4	20		SUPP	FOOT		20 60 37	0
080080	78/12/29	4.4	5.5	1.1	COHO	2	1	3	2.7	4	30		INDX	FOOT		20 37 60	0
080080	78/12/29	5.5	6.2	0.7	COHO	2	3	5	7.1	4	75		SUPP	FOOT		20 60 37	0
080080	78/12/29	6.2	6.7	0.5	COHO	0	2	2	4.0	4	80		SUPP	FOOT		20 60	0
080080	78/12/29	6.7	7.3	0.6	COHO	4	3	7	11.7	4	85		SUPP	FOOT		20 60	0
080080	78/12/29	7.3	7.7	0.4	COHO	0	0	0		4	95		SUPP	FOOT		20 60	0
080080	79/09/28	4.6	0.0	0.0	SOCK	2	0	2		5	99		SPOT	FOOT		60	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	79/11/06	4.4	5.5	1.1	CHUM	2	0	2	1.8	2	75		SUPP	FOOT		21	0
080080	79/11/06	4.4	5.5	1.1	COHO	97	30	127	115.5	4	75		INDX	FOOT	5	21 60	0
080080	79/11/06	4.4	5.5	1.1	SOCK	39	19	58	52.7	5	75		SUPP	FOOT	2	21	0
080080	79/11/14	4.4	5.5	1.1	COHO	23	35	58	52.7	4	80		INDX	FOOT	5	20 61	0
080080	79/11/14	4.4	5.5	1.1	SOCK	8	13	21	19.1	5	80		SUPP	FOOT	4	20	0
080080	79/11/19	4.4	5.5	1.1	COHO	176	21	197	179.1	4	70		INDX	FOOT	5	23	0
080080	79/11/19	4.4	5.5	1.1	SOCK	0	7	7	6.4	5	70		SUPP	FOOT	4	23	0
080080	79/11/27	4.4	5.5	1.1	COHO	116	23	139	126.4	4	70		INDX	FOOT	5	20 31	0
080080	79/11/27	4.4	5.5	1.1	SOCK	0	3	3	2.7	5	70		SUPP	FOOT	4	20 31	0
080080	79/12/06	4.4	5.5	1.1	FALL	0	1	1	0.9	1	65		SUPP	FOOT	45	24 31	0
080080	79/12/06	4.4	5.5	1.1	COHO	126	48	174	158.2	4	65		INDX	FOOT	15	24 31	0
080080	79/12/06	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	65		SUPP	FOOT	14	24 31	0
080080	79/12/11	4.4	5.5	1.1	COHO	51	44	95	86.4	4	80		INDX	FOOT		60	0
080080	80/10/30	4.4	5.5	1.1	COHO	10	0	10	9.1	4	99		INDX	FOOT		20	0
080080	80/11/11	4.4	5.5	1.1	COHO	37	2	39	35.5	4	80		INDX	FOOT		20 31	0
080080	80/11/17	4.4	5.5	1.1	COHO	25	5	30	27.3	4	75		INDX	FOOT		20 31 60	0
080080	80/11/25	4.4	5.5	1.1	FALL	0	2	2	1.8	1	80		INDX	FOOT	4	24 31	0
080080	80/11/25	4.4	5.5	1.1	COHO	46	14	60	54.5	4	80		INDX	FOOT	1	24 31	0
080080	80/12/08	4.4	5.5	1.1	COHO	10	6	16	14.5	4	75		INDX	FOOT		21 31	0
080080	80/12/16	4.4	5.5	1.1	COHO	46	18	64	58.2	4	80		INDX	FOOT		21 31	0
080080	80/12/23	4.4	5.5	1.1	COHO	18	23	41	37.3	4	75		INDX	FOOT		24	0
080080	81/10/13	4.4	5.5	1.1	FALL	10	13	23	20.9	1	90		INDX	FOOT	45	51	0
080080	81/10/13	4.4	5.5	1.1	COHO	5	0	5	4.5	4	90		INDX	FOOT	15	20	0
080080	81/10/13	4.4	5.5	1.1	SOCK	10	7	17	15.5	5	90		INDX	FOOT	14	51	0
080080	81/10/15	0.0	4.4	4.4	FALL	8	3	11	2.5	1	70		SUPP	FOOT	45		0
080080	81/10/15	0.0	4.4	4.4	COHO	28	0	28	6.4	4	65		SUPP	FOOT	15		0
080080	81/10/15	0.0	4.4	4.4	SOCK	48	3	51	11.6	5	75		SUPP	FOOT	14		0
080080	81/10/21	4.4	5.5	1.1	FALL	1	13	14	12.7	1	85		SUPP	FOOT	45	21 31	0
080080	81/10/21	4.4	5.5	1.1	COHO	4	0	4	3.6	4	75		INDX	FOOT	15	21 31	0
080080	81/10/21	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	75		SUPP	FOOT	14	21 31	0
080080	81/10/27	4.4	5.5	1.1	FALL	0	10	10	9.1	1	65		SUPP	FOOT	4	24 31	0
080080	81/10/27	4.4	5.5	1.1	COHO	40	1	41	37.3	4	65		INDX	FOOT	1	24 31	0
080080	81/11/03	4.4	5.5	1.1	FALL	1	1	2	1.8	1	70		SUPP	FOOT	4	20 31 60	0
080080	81/11/03	4.4	5.5	1.1	COHO	34	2	36	32.7	4	70		INDX	FOOT	1	20 31 60	0
080080	81/11/10	4.4	5.5	1.1	FALL	0	1	1	0.9	1	80		SUPP	FOOT	4	20 31	0
080080	81/11/10	4.4	5.5	1.1	COHO	15	13	28	25.5	4	80		INDX	FOOT	1	20 31 33	0
080080	81/11/17	4.4	5.5	1.1	FALL	0	1	1	0.9	1	70		SUPP	FOOT	4	24 31	0
080080	81/11/17	4.4	5.5	1.1	COHO	49	4	53	48.2	4	70		INDX	FOOT	1	24 31	0
080080	81/11/24	4.4	5.5	1.1	COHO	57	4	61	55.5	4	65		INDX	FOOT		24 31 33	0
080080	81/12/01	4.4	5.5	1.1	COHO	20	16	36	32.7	4	75		INDX	FOOT		23 31	0
080080	81/12/08	4.4	5.5	1.1	COHO	15	9	24	21.8	4	60		INDX	FOOT		24 31 49	0
080080	81/12/17	4.4	5.5	1.1	COHO	4	3	7	6.4	4	70		INDX	FOOT		26 31 33	0
080080	82/11/01	4.4	5.5	1.1	FALL	0	2	2	1.8	1	90		INDX	FOOT	45	20 31	0
080080	82/11/01	4.4	5.5	1.1	COHO	67	3	70	63.6	4	90		INDX	FOOT	15	20 31	0
080080	82/11/01	4.4	5.5	1.1	SOCK	5	4	9	8.2	5	90		INDX	FOOT	14	20 31	0
080080	82/11/08	4.4	5.5	1.1	FALL	0	1	1	0.9	1	70		INDX	FOOT	45	20	0
080080	82/11/08	4.4	5.5	1.1	COHO	15	15	30	27.3	4	70		INDX	FOOT	15	20	0
080080	82/11/08	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	70		INDX	FOOT	14	20	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code

LITTLE BEAR Creek

080080	82/11/15	4.4	5.5	1.1	COHO	4	9	13	11.8	4	80	INDX	FOOT		20 31 61	0
080080	82/11/22	4.4	5.5	1.1	COHO	14	7	21	19.1	4	70	INDX	FOOT		20 30	0
080080	82/11/29	4.4	5.5	1.1	COHO	19	7	26	23.6	4	60	INDX	FOOT		24 30	0
080080	82/12/07	4.4	5.5	1.1	COHO	15	2	17	15.5	4	70	INDX	FOOT		23 30	0
080080	82/12/14	4.4	5.5	1.1	COHO	13	5	18	16.4	4	70	INDX	FOOT		23 30	0
080080	82/12/21	4.4	5.5	1.1	COHO	1	6	7	6.4	4	70	INDX	FOOT		24	0
080080	83/10/24	4.4	5.5	1.1	FALL	0	2	2	1.8	1	85	SUPP	FOOT	45	30 31 51	0
080080	83/10/24	4.4	5.5	1.1	COHO	31	0	31	28.2	4	85	INDX	FOOT	15	30 31 51	0
080080	83/10/24	4.4	5.5	1.1	SOCK	88	34	122	110.9	5	85	SUPP	FOOT	14	30 31 51	0
080080	83/10/27	3.0	3.7	0.7	COHO	4	0	4	5.7	4	70	SUPP	FOOT	5	23 31	0
080080	83/10/27	3.0	7.7	4.7	SOCK	296	278	574	122.1	5	80	SUPP	FOOT	4	20 60 61	0
080080	83/10/27	3.7	4.4	0.7	COHO	8	2	10	14.3	4	75	SUPP	FOOT	5	23 31	0
080080	83/10/27	4.4	5.5	1.1	COHO	22	1	23	20.9	4	80	INDX	FOOT	5	23 31	0
080080	83/10/27	5.5	7.7	2.2	COHO	39	2	41	18.6	4	80	SUPP	FOOT	5	20 61	0
080080	83/10/31	4.4	5.5	1.1	FALL	0	1	1	0.9	1	80	SUPP	FOOT	45	20 31	0
080080	83/10/31	4.4	5.5	1.1	COHO	29	5	34	30.9	4	80	INDX	FOOT	15	20 31	0
080080	83/10/31	4.4	5.5	1.1	SOCK	18	39	57	51.8	5	80	SUPP	FOOT	14	20 31	0
080080	83/11/07	4.4	5.5	1.1	SOCK	0	17	17	15.5	5	70	SUPP	FOOT	4	23 31	0
080080	83/11/08	4.4	5.5	1.1	COHO	26	9	35	31.8	4	70	INDX	FOOT	5	23	0
080080	83/11/15	4.4	5.5	1.1	COHO	23	3	26	23.6	4	30	INDX	FOOT		27 30 34	0
080080	83/11/23	4.4	5.5	1.1	COHO	34	11	45	40.9	4	60	INDX	FOOT		24 30 70	0
080080	83/12/02	4.4	5.5	1.1	COHO	5	20	25	22.7	4	85	INDX	FOOT		20	0
080080	83/12/09	4.4	5.5	1.1	COHO	2	9	11	10.0	4	60	INDX	FOOT		27	0
080080	83/12/16	4.4	5.5	1.1	COHO	4	8	12	10.9	4	80	INDX	FOOT		20	0
080080	83/12/23	4.4	0.0	0.0	COHO	0	0	0		4	25	SPOT	FOOT		36 60	0
080080	83/12/27	4.4	5.5	1.1	COHO	0	2	2	1.8	4	85	INDX	FOOT		20 37	0
080080	84/01/09	4.4	5.5	1.1	COHO	4	3	7	6.4	4	80	INDX	FOOT		20	0
080080	84/10/23	4.4	5.5	1.1	FALL	0	3	3	2.7	1	85	SUPP	FOOT	45	20 31	0
080080	84/10/23	4.4	5.5	1.1	COHO	2	1	3	2.7	4	85	INDX	FOOT	15	20 31	0
080080	84/10/23	4.4	5.5	1.1	SOCK	11	2	13	11.8	5	85	SUPP	FOOT	14	20 31	0
080080	84/10/30	4.4	5.5	1.1	FALL	0	1	1	0.9	1	75	SUPP	FOOT	45	20 31 33	0
080080	84/10/30	4.4	5.5	1.1	COHO	15	2	17	15.5	4	75	INDX	FOOT	15	20 31 33	0
080080	84/10/30	4.4	5.5	1.1	SOCK	6	1	7	6.4	5	75	SUPP	FOOT	14	20 31 33	0
080080	84/11/08	4.4	5.5	1.1	COHO	71	3	74	67.3	4	80	INDX	FOOT	5	20 31 33	0
080080	84/11/08	4.4	5.5	1.1	SOCK	5	0	5	4.5	5	80	INDX	FOOT	4	20 31 33	0
080080	84/11/16	4.4	5.5	1.1	COHO	86	9	95	86.4	4	90	INDX	FOOT		20 31 33	0
080080	84/11/16	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	90	SUPP	FOOT		20 31 33	0
080080	84/11/23	4.4	0.0	0.0	COHO	0	0	0		4	20	SPOT	FOOT		27 39	0
080080	84/11/29	4.4	5.5	1.1	COHO	31	21	52	47.3	4	60	INDX	FOOT		26 31 33	0
080080	84/12/03	4.4	5.5	1.1	COHO	18	8	26	23.6	4	85	INDX	FOOT		20 31 33	0
080080	84/12/10	4.4	5.5	1.1	COHO	11	19	30	27.3	4	80	INDX	FOOT		26 31	0
080080	84/12/19	4.4	5.5	1.1	COHO	2	14	16	14.5	4	80	INDX	FOOT		23 31 60	0
080080	84/12/28	4.4	5.5	1.1	COHO	2	11	13	11.8	4	85	INDX	FOOT		23 31	0
080080	85/10/18	4.4	5.5	1.1	FALL	10	1	11	10.0	1	85	SUPP	FOOT	45	20 31 33	0
080080	85/10/18	4.4	5.5	1.1	COHO	117	0	117	106.4	4	85	INDX	FOOT	15	20 31 33	0
080080	85/10/18	4.4	5.5	1.1	SOCK	119	30	149	135.5	5	85	SUPP	FOOT	14	20 31 33	0
080080	85/10/28	4.4	0.0	0.0	COHO	0	0	0		4	40	SPOT	FOOT		27 39	0
080080	85/10/31	4.4	5.5	1.1	FALL	1	1	2	1.8	1	75	SUPP	FOOT	45	23 30	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	85/10/31	4.4	5.5	1.1	COHO	58	11	69	62.7	4	75		INDX	FOOT	15	23 30	0
080080	85/10/31	4.4	5.5	1.1	SOCK	20	11	31	28.2	5	75		SUPP	FOOT	14	23 30	0
080080	85/11/08	4.4	5.5	1.1	FALL	0	2	2	1.8	1	60		SUPP	FOOT	45	23 30 33	0
080080	85/11/08	4.4	5.5	1.1	COHO	20	4	24	21.8	4	60		INDX	FOOT	15	23 30 33	0
080080	85/11/08	4.4	5.5	1.1	SOCK	6	12	18	16.4	5	60		SUPP	FOOT	14	23 30 33	0

080080	85/11/15	4.4	5.5	1.1	COHO	12	8	20	18.2	4	70	INDX	FOOT		23 31 33	0
080080	85/11/26	4.4	5.5	1.1	COHO	0	6	6	5.5	4	70	INDX	FOOT		20 37	0
080080	85/12/09	4.4	5.5	1.1	COHO	14	2	16	14.5	4	90	INDX	FOOT		23 33 60	0
080080	85/12/16	4.4	5.5	1.1	COHO	1	3	4	3.6	4	85	INDX	FOOT		20	0
080080	85/12/23	4.4	5.5	1.1	COHO	5	1	6	5.5	4	85	INDX	FOOT		20	0
080080	86/01/03	4.4	5.5	1.1	COHO	41	1	42	38.2	4	80	INDX	FOOT		23 30 60	0
080080	86/01/10	4.4	5.5	1.1	COHO	33	0	33	30.0	4	80	INDX	FOOT		23 31 33	0
080080	86/01/17	4.4	0.0	0.0	COHO	0	0	0		4	25	SPOT	FOOT		27 30 39	0
080080	86/01/24	4.4	5.5	1.1	COHO	6	1	7	6.4	4	75	INDX	FOOT		26 30 33	0
080080	86/10/15	1.2	1.9	0.7	FALL	0	0	0		1	0	SUPP	FOOT		21	0
080080	86/10/15	1.2	1.9	0.7	SOCK	7	6	13	18.6	5	0	SUPP	FOOT		21	0
080080	86/10/15	1.9	3.3	1.4	FALL	0	0	0		1	0	SUPP	FOOT		21	0
080080	86/10/15	1.9	3.3	1.4	SOCK	39	31	70	50.0	5	0	SUPP	FOOT		20	0
080080	86/10/15	3.3	4.4	1.1	FALL	0	0	0		1	0	SUPP	FOOT	5	21	0
080080	86/10/15	3.3	4.4	1.1	SOCK	82	44	126	114.5	5	0	SUPP	FOOT		21	0
080080	86/10/24	4.4	5.5	1.1	FALL	0	2	2	1.8	1	90	SUPP	FOOT	45	20	0
080080	86/10/24	4.4	5.5	1.1	COHO	1	1	2	1.8	4	90	INDX	FOOT	15	20	0
080080	86/10/24	4.4	5.5	1.1	SOCK	13	34	47	42.7	5	90	SUPP	FOOT	14	20	0
080080	86/11/03	4.4	5.5	1.1	COHO	12	0	12	10.9	4	85	INDX	FOOT	5	20	0
080080	86/11/03	4.4	5.5	1.1	SOCK	3	11	14	12.7	5	85	SUPP	FOOT	4	20	0
080080	86/11/10	4.4	5.5	1.1	FALL	0	3	3	2.7	1	85	SUPP	FOOT	45	20 31 33	0
080080	86/11/10	4.4	5.5	1.1	COHO	11	3	14	12.7	4	85	INDX	FOOT	15	20 31 33	0
080080	86/11/10	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	85	SUPP	FOOT	14	20 31 33	0
080080	86/11/18	4.4	0.0	0.0	COHO	0	0	0		4	25	SPOT	FOOT		28 39	0
080080	86/11/29	4.4	5.5	1.1	COHO	42	3	45	40.9	4	75	INDX	FOOT		23 30 33	0
080080	86/12/04	4.4	5.5	1.1	COHO	8	15	23	20.9	4	85	INDX	FOOT		20 31	0
080080	86/12/11	4.4	5.5	1.1	COHO	3	13	16	14.5	4	90	INDX	FOOT		20 31	0
080080	86/12/18	4.4	5.5	1.1	COHO	2	7	9	8.2	4	90	INDX	FOOT		20 31	0
080080	87/01/02	4.4	5.5	1.1	COHO	2	6	8	7.3	4	65	INDX	FOOT		26 30 33	0
080080	87/10/06	0.0	6.7	6.7	FALL	7	2	9	1.3	1	90	INDX	FOOT	5	20 57	0
080080	87/10/06	0.0	6.7	6.7	SOCK	1764	183	1947	290.6	5	90	SUPP	FOOT	1	20 57	0
080080	87/10/20	4.4	5.5	1.1	FALL	0	1	1	0.9	1	85	SUPP	FOOT	45	20 33	0
080080	87/10/20	4.4	5.5	1.1	COHO	4	1	5	4.5	4	85	INDX	FOOT	15	20 33	0
080080	87/10/20	4.4	5.5	1.1	SOCK	164	122	286	260.0	5	85	SUPP	FOOT	14	20 33 61	0
080080	87/10/27	4.4	5.5	1.1	FALL	0	0	0		1	90	SUPP	FOOT	45	20 33	0
080080	87/10/27	4.4	5.5	1.1	COHO	6	1	7	6.4	4	90	INDX	FOOT	5	20 33	0
080080	87/10/27	4.4	5.5	1.1	SOCK	101	158	259	235.5	5	90	SUPP	FOOT	4	20 33 61	0
080080	87/11/03	4.4	5.5	1.1	FALL	0	0	0		1	90	SUPP	FOOT	45	20 33	0
080080	87/11/03	4.4	5.5	1.1	COHO	52	2	54	49.1	4	90	INDX	FOOT	5	20 33	0
080080	87/11/03	4.4	5.5	1.1	SOCK	26	104	130	118.2	5	90	SUPP	FOOT	4	20 33	0
080080	87/11/10	4.4	5.5	1.1	COHO	36	2	38	34.5	4	80	INDX	FOOT	5	20 31 33	0
080080	87/11/10	4.4	5.5	1.1	SOCK	2	24	26	23.6	5	80	SUPP	FOOT	4	20 31 33	0
080080	87/11/17	4.4	5.5	1.1	COHO	184	7	191	173.6	4	75	INDX	FOOT	5	20 30 60	0
080080	87/11/17	4.4	5.5	1.1	SOCK	4	2	6	5.5	5	75	SUPP	FOOT	4	20 30 33	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	87/11/24	3.7	0.0	0.0	COHO	12	0	12		4	80		SPOT	FOOT		23 60	0
080080	87/11/24	4.1	0.0	0.0	COHO	10	0	10		4	75		SPOT	FOOT		23 30 60	0
080080	87/11/24	4.4	5.5	1.1	COHO	125	37	162	147.3	4	70		INDX	FOOT		23 30 61	0
080080	87/12/01	4.4	0.0	0.0	COHO	0	0	0		4	20		SPOT	FOOT		27 39	0
080080	87/12/05	4.4	5.5	1.1	COHO	39	31	70	63.6	4	55		INDX	FOOT		23 30	0
080080	87/12/08	4.4	5.5	1.1	COHO	28	16	44	40.0	4	80		INDX	FOOT		23 31 33	0
080080	87/12/15	4.4	5.5	1.1	COHO	14	21	35	31.8	4	80		INDX	FOOT		20 30	0
080080	87/12/22	4.4	0.0	0.0	COHO	0	0	0		4	40		SPOT	FOOT		27 30 39	0
080080	87/12/30	4.4	5.5	1.1	COHO	2	10	12	10.9	4	85		INDX	FOOT		20 31 33	0
080080	88/10/25	4.4	5.5	1.1	FALL	0	6	6	5.5	1	95		SUPP	FOOT	45	20	0

080080	88/10/25	4.4	5.5	1.1	COHO	21	19	40	36.4	4	95	INDX	FOOT	15		20 61	0
080080	88/10/25	4.4	5.5	1.1	SOCK	1	23	24	21.8	5	95	SUPP	FOOT	14		20	0
080080	88/11/01	4.4	5.5	1.1	COHO	41	9	50	45.5	4	85	INDX	FOOT		5	20 30 31	0
080080	88/11/01	4.4	5.5	1.1	SOCK	0	9	9	8.2	5	85	SUPP	FOOT	4		20 30 33	0
080080	88/11/08	4.4	5.5	1.1	COHO	24	0	24	21.8	4	70	INDX	FOOT			20 32 31	0
080080	88/11/15	4.4	5.5	1.1	COHO	32	8	40	36.4	4	85	INDX	FOOT			20 30	0
080080	88/11/22	4.9	0.0	0.0	COHO	0	0	0		4	0	SPOT	FOOT			28 39	0
080080	88/11/29	4.4	5.5	1.1	COHO	5	4	9	8.2	4	85	INDX	FOOT			20 31	0
080080	88/12/06	4.4	5.5	1.1	COHO	4	2	6	5.5	4	75	INDX	FOOT			21 30 31	0
080080	88/12/13	4.4	5.5	1.1	COHO	2	1	3	2.7	4	75	INDX	FOOT			21 30	0
080080	88/12/26	4.4	5.5	1.1	COHO	0	1	1	0.9	4	85	INDX	FOOT			20	0
080080	89/01/06	4.4	5.5	1.1	COHO	0	0	0		4	65	INDX	FOOT			24 33	0
080080	89/10/30	4.4	5.5	1.1	FALL	1	2	3	2.7	1	75	SUPP	FOOT	45		20 31	0
080080	89/10/30	4.4	5.5	1.1	COHO	6	1	7	6.4	4	75	INDX	FOOT	15		20 31	0
080080	89/10/30	4.4	5.5	1.1	SOCK	7	5	12	10.9	5	75	SUPP	FOOT	14		20 31	0
080080	89/11/06	4.4	5.5	1.1	COHO	32	1	33	30.0	4	85	INDX	FOOT	5		20 31 60	0
080080	89/11/06	4.4	5.5	1.1	SOCK	3	4	7	6.4	5	85	SUPP	FOOT	4		20 31 33	0
080080	89/11/15	4.4	5.5	1.1	FALL	0	1	1	0.9	1	80	SUPP	FOOT	45		20 31	0
080080	89/11/15	4.4	5.5	1.1	COHO	35	5	40	36.4	4	80	INDX	FOOT	15		20 31 60	0
080080	89/11/15	4.4	5.5	1.1	SOCK	1	0	1	0.9	5	80	SUPP	FOOT	14		20 31	0
080080	89/11/22	4.4	5.5	1.1	COHO	38	7	45	40.9	4	75	INDX	FOOT			20 31 60	0
080080	89/11/30	4.4	5.5	1.1	COHO	26	19	45	40.9	4	80	INDX	FOOT			20 31	0
080080	89/12/12	4.4	5.5	1.1	COHO	15	11	26	23.6	4	80	INDX	FOOT			20 31 60	0
080080	89/12/19	4.4	5.5	1.1	COHO	8	4	12	10.9	4	85	INDX	FOOT			20 33 60	0
080080	89/12/26	4.4	5.5	1.1	COHO	1	12	13	11.8	4	85	INDX	FOOT			20 60	0
080080	90/10/30	4.4	5.5	1.1	COHO	20	4	24	21.8	4	75	INDX	FOOT	5		20 31 60	0
080080	90/10/30	4.4	5.5	1.1	SOCK	17	47	64	58.2	5	75	SUPP	FOOT	4		20 31 60	0
080080	90/11/07	4.4	5.5	1.1	COHO	25	8	33	30.0	4	80	INDX	FOOT	5		20	0
080080	90/11/07	4.4	5.5	1.1	SOCK	2	0	0		5	80	SUPP	FOOT	4		20 60	0
080080	90/11/15	4.4	5.5	1.1	COHO	40	6	46	41.8	4	70	INDX	FOOT			20 31 60	0
080080	90/11/21	4.4	5.5	1.1	COHO	11	12	23	20.9	4	70	INDX	FOOT			23 30 60	0
080080	90/12/04	4.4	0.0	0.0	COHO	0	0	0		4	5	SPOT	FOOT			28 29 39	0
080080	90/12/10	4.4	0.0	0.0	COHO	0	0	0		4	30	SPOT	FOOT			27 29 39	0
080080	90/12/17	4.4	5.5	1.1	COHO	0	2	2	1.8	4	75	INDX	FOOT			23 31 60	0
080080	91/10/28	4.4	5.5	1.1	COHO	3	0	3	2.7	4	80	INDX	FOOT	5		20	0
080080	91/10/28	4.4	5.5	1.1	SOCK	72	49	121	110.0	5	80	SUPP	FOOT	4		20	0
080080	91/11/06	4.4	5.5	1.1	COHO	36	0	36	32.7	4	75	INDX	FOOT	5		20 30 61	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	91/11/06	4.4	5.5	1.1	SOCK	29	18	47	42.7	5	75		SUPP	FOOT	4	20 30	0
080080	91/11/13	4.4	5.5	1.1	COHO	5	0	5	4.5	4	75		INDX	FOOT	5	20	0
080080	91/11/21	4.4	5.5	1.1	COHO	5	2	7	6.4	4	60		INDX	FOOT		23 31 32	0
080080	91/12/03	4.4	5.5	1.1	COHO	0	4	4	3.6	4	80		INDX	FOOT		20 31 60	0
080080	91/12/03	4.4	5.5	1.1	SOCK	0	0	0		5	80		SUPP	FOOT	4	20 31	0
080080	91/12/11	4.4	5.5	1.1	COHO	1	0	1	0.9	4	80		INDX	FOOT		20 31	0
080080	91/12/26	4.4	5.5	1.1	COHO	0	0	0		4	80		INDX	FOOT		20 60	0
080080	92/10/29	4.4	5.5	1.1	COHO	0	0	0		4	85		INDX	FOOT	5	20	0
080080	92/10/29	4.4	5.5	1.1	SOCK	0	35	35	31.8	5	85		SUPP	FOOT		20 60	0
080080	92/11/09	4.4	5.5	1.1	COHO	8	0	8	7.3	4	70		INDX	FOOT		20 30 33	0
080080	92/11/16	4.4	5.5	1.1	COHO	1	0	1	0.9	4	70		INDX	FOOT		23 30 60	0
080080	92/11/24	4.4	5.5	1.1	COHO	3	2	5	4.5	4	80		INDX	FOOT		20 33 60	0
080080	92/12/03	4.4	5.5	1.1	COHO	3	2	5	4.5	4	80		INDX	FOOT		20 33 60	0
080080	92/12/14	4.4	5.5	1.1	COHO	3	0	3	2.7	4	70		INDX	FOOT		23 31 33	0
080080	92/12/22	4.4	5.5	1.1	COHO	3	1	4	3.6	4	75		INDX	FOOT		23 31 60	0
080080	92/12/28	4.4	5.5	1.1	COHO	4	5	9	8.2	4	85		INDX	FOOT		20 60	0

080080	93/01/05	4.4	5.5	1.1	COHO	0	2	2	1.8	4	75		INDX	FOOT		20 31 60	0
080080	93/11/03	4.4	5.5	1.1	COHO	14	5	19	17.3	4	75		INDX	FOOT	5	20 60	0
080080	93/11/03	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	75		SUPP	FOOT	4		0
080080	93/11/10	4.4	5.5	1.1	COHO	3	4	7	6.4	4	85		INDX	FOOT	5	20 31 60	0
080080	93/11/10	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	85		SUPP	FOOT	4	20 31 60	0
080080	93/11/18	4.4	5.5	1.1	COHO	6	2	8	7.3	4	80		INDX	FOOT		20 30 33	0
080080	93/11/29	4.4	0.0	0.0	COHO	0	0	0		4	40		SPOT	FOOT		24 30 39	0
080080	93/12/06	4.4	5.5	1.1	COHO	22	4	26	23.6	4	75		INDX	FOOT		20 31 60	0
080080	93/12/15	4.4	5.5	1.1	COHO	5	2	7	6.4	4	80	9	INDX	FOOT		20	0
080080	93/12/22	4.4	5.5	1.1	COHO	0	2	2	1.8	4	90		INDX	FOOT		20 60	0
080080	94/10/07	0.2	0.5	0.3	SOCK	31	14	45	150.0	5	0	17	SUPP	FOOT			KC
080080	94/10/07	1.3	1.8	0.5	SOCK	60	61	121	242.0	5	0	21	SUPP	FOOT			KC
080080	94/10/20	0.0	1.0	1.0	CHIN	0	1	1	1.0	1	0		SUPP	FOOT	5		KC
080080	94/10/20	0.0	1.0	1.0	SOCK	96	42	138	138.0	5	0		SUPP	FOOT	1		KC
080080	94/10/20	1.2	1.8	0.6	CHIN	0	1	1	1.7	1	0		SUPP	FOOT	5		KC
080080	94/10/20	1.2	1.8	0.6	SOCK	74	55	129	215.0	5	0		SUPP	FOOT	1		KC
080080	94/10/28	4.4	5.5	1.1	CHIN	0	5	5	4.5	1	75		SUPP	FOOT	45	21 31	0
080080	94/10/28	4.4	5.5	1.1	COHO	4	0	4	3.6	4	75		INDX	FOOT	15	21 31	0
080080	94/10/28	4.4	5.5	1.1	SOCK	89	99	188	170.9	5	75		SUPP	FOOT	14	21 31	0
080080	94/11/03	4.4	5.5	1.1	COHO	2	2	4	3.6	4	75		INDX	FOOT	5	20	0
080080	94/11/03	4.4	5.5	1.1	SOCK	36	77	113	102.7	5	75		SUPP	FOOT	4	20 31	0
080080	94/11/10	4.4	5.5	1.1	COHO	1	1	2	1.8	4	85		INDX	FOOT	5	20	0
080080	94/11/10	4.4	5.5	1.1	SOCK	7	63	70	63.6	5	85		INDX	FOOT	4	20	0
080080	94/11/17	4.4	5.5	1.1	COHO	4	0	4	3.6	4	75		INDX	FOOT		23 31	0
080080	94/11/25	4.4	5.5	1.1	COHO	1	0	1	0.9	4	85		INDX	FOOT		20	0
080080	94/12/07	4.4	5.5	1.1	COHO	2	1	3	2.7	4	90		INDX	FOOT		20	0
080080	94/12/14	4.4	5.5	1.1	COHO	0	2	2	1.8	4	90		INDX	FOOT		20	0
080080	95/10/18	4.4	5.5	1.1	COHO	16	0	16	14.5	4	75		INDX	FOOT	5	20	0
080080	95/10/18	4.4	5.5	1.1	SOCK	16	4	20	18.2	5	75		SUPP	FOOT	4	20	0
080080	95/10/26	4.4	5.5	1.1	COHO	4	1	5	4.5	4	60		INDX	FOOT	5	21 31 33	0
080080	95/10/26	4.4	5.5	1.1	SOCK	0	3	3	2.7	5	60		INDX	FOOT	4	21 31 33	0

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Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	95/11/02	4.4	5.5	1.1	COHO	6	0	6	5.5	4	85		INDX	FOOT	5	20	0
080080	95/11/02	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	85		SUPP	FOOT	4	20	0
080080	95/11/13	4.4	5.5	1.1	COHO	48	0	48	43.6	4	80		INDX	FOOT		20 31	0
080080	95/11/21	4.4	5.5	1.1	COHO	38	3	41	37.3	4	85		INDX	FOOT		20 60	0
080080	95/12/01	4.4	0.0	0.0	COHO	0	0	0		4	0		SPOT	FOOT		27 39 60	0
080080	95/12/03	4.4	5.5	1.1	COHO	30	10	40	36.4	4	85		INDX	FOOT		20 60	0
080080	95/12/11	4.4	0.0	0.0	COHO	0	0	0		4	5		SPOT	FOOT		28 39	0
080080	95/12/19	4.4	5.5	1.1	COHO	1	7	8	7.3	4	85		INDX	FOOT		20 60	0
080080	95/12/27	4.4	5.5	1.1	COHO	1	3	4	3.6	4	90		INDX	FOOT		20 60	0
080080	96/10/09	0.0	4.4	4.4	SOCK	2782	1245	4027	915.2	5	85		SUPP	FOOT		60	11
080080	96/10/23	4.4	5.5	1.1	CHIN	0	1	1	0.9	1	75		SUPP	FOOT	45	20 30	0
080080	96/10/23	4.4	5.5	1.1	COHO	18	0	18	16.4	4	75		INDX	FOOT	15	20 30	0
080080	96/10/23	4.4	5.5	1.1	SOCK	68	108	176	160.0	5	75		SUPP	FOOT	14	20 30	0
080080	96/10/30	1.3	4.4	3.1	SOCK	93	316	409	131.9	5	70		SUPP	FOOT		60	11
080080	96/10/30	4.4	5.5	1.1	CHIN	1	1	2	1.8	1	75		SUPP	FOOT	45	20 30	0
080080	96/10/30	4.4	5.5	1.1	COHO	34	2	36	32.7	4	75		INDX	FOOT	15	20 30 60	0
080080	96/10/30	4.4	5.5	1.1	SOCK	29	66	95	86.4	5	75		SUPP	FOOT	14	20 30	0
080080	96/11/06	4.4	5.5	1.1	CHIN	0	2	2	1.8	1	85		SUPP	FOOT	45	20	0
080080	96/11/06	4.4	5.5	1.1	COHO	34	4	38	34.5	4	85		INDX	FOOT	15	20 60	0
080080	96/11/06	4.4	5.5	1.1	SOCK	1	7	8	7.3	5	85		SUPP	FOOT	14	20	0
080080	96/11/13	4.8	0.0	0.0	COHO	0	0	0		4	5		SPOT	FOOT		25 39	0
080080	96/11/20	4.4	5.5	1.1	COHO	11	3	14	12.7	4	75		INDX	FOOT		20 31 60	0

080080	96/11/20	4.4	5.5	1.1	SOCK	0	1	1	0.9	5	75	SUPP	FOOT	4	20 31		0
080080	96/11/27	4.4	0.0	0.0	COHO	0	0	0		4	20	SPOT	FOOT		25 39		0
080080	96/12/04	4.4	5.5	1.1	COHO	8	1	9	8.2	4	60	INDX	FOOT		24 31 60		0
080080	96/12/11	4.4	5.5	1.1	COHO	3	5	8	7.3	4	80	INDX	FOOT		23		0
080080	96/12/18	4.4	5.5	1.1	COHO	0	8	8	7.3	4	90	INDX	FOOT		20 60		0
080080	97/11/05	4.4	5.5	1.1	COHO	61	7	68	61.8	4	80	INDX	FOOT		23 30		0
080080	97/11/24	4.4	5.5	1.1	COHO	9	9	18	16.4	4	85	INDX	FOOT		20		0
080080	97/12/02	4.4	5.5	1.1	COHO	5	2	7	6.4	4	75	INDX	FOOT		20		0
080080	97/12/09	4.4	5.5	1.1	COHO	0	3	3	2.7	4	90	INDX	FOOT		20		0
080080	97/12/20	4.4	5.5	1.1	COHO	0	2	2	1.8	4	55	INDX	FOOT		25		0
080080	98/10/21	4.4	5.5	1.1	COHO	0	0	0		4	90	INDX	FOOT	5	21		0
080080	98/10/21	4.4	5.5	1.1	SOCK	3	31	34	30.9	5	90	INDX	FOOT	4	21		0
080080	98/10/29	4.4	5.5	1.1	COHO	3	0	3	2.7	4	80	INDX	FOOT	5	24 60		0
080080	98/10/29	4.4	5.5	1.1	SOCK	0	25	25	22.7	5	80	INDX	FOOT	4	24		0
080080	98/11/10	4.4	5.5	1.1	COHO	0	0	0		4	90	INDX	FOOT		20		0
080080	98/11/18	4.4	5.5	1.1	COHO	0	0	0		4	85	INDX	FOOT		24		0
080080	98/11/24	4.4	5.5	1.1	COHO	6	0	6	5.5	4	80	INDX	FOOT		24 60		0
080080	98/12/03	4.4	5.5	1.1	COHO	4	3	7	6.4	4	75	INDX	FOOT		24 60		0
080080	98/12/10	4.4	5.5	1.1	COHO	1	0	1	0.9	4	85	INDX	FOOT		24 60		0
080080	98/12/16	4.4	5.5	1.1	COHO	0	0	0		4	85	INDX	FOOT		24		0
080080	99/11/03	4.4	5.5	1.1	COHO	9	0	9	8.2	4	80	INDX	FOOT		23		0
080080	99/11/10	4.4	5.5	1.1	COHO	10	2	12	10.9	4	70	INDX	FOOT		24		0
080080	99/11/15	4.4	5.5	1.1	COHO	12	0	12	10.9	4	75	INDX	FOOT		24		0
080080	99/11/23	4.4	5.5	1.1	COHO	4	1	5	4.5	4	75	INDX	FOOT		24		0
080080	99/12/02	4.4	5.5	1.1	COHO	1	2	3	2.7	4	70	INDX	FOOT		24		0

1

Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
LITTLE BEAR Creek																	
080080	99/12/09	4.4	5.5	1.1	COHO	0	0	0		4	70		INDX	FOOT		24	0
080080	99/12/22	4.4	5.5	1.1	COHO	0	0	0		4	80		INDX	FOOT		23	0

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Salmon Spawning Ground Survey Data

Species - All Species
Chinook Races - All Races
Stream Numbers - 080080
Date Range - 0/ 1/ 1 to 1/ 6/30
River Miles - All River Miles
Type Count - All Types of Counts
Type Survey - All Types of Surveys
Agency - All Agencies

Wria-Stream Number	Date Yr Mo Dy	Start Mile	End Mile	Length	Spec	Live Count	Dead Count	Total	Fish/ Mile	Spec Code	Pct. Seen	Redd Count	Type Count	Type Survey	Other Spec	Comment Codes	Agency Code
Lake Washington Basin																	
LITTLE BEAR Creek																	
080080	0/10/27	4.4	5.5	1.1	COHO	1	0	1	0.9	4	75		INDX	FOOT	5	24	0
080080	0/10/27	4.4	5.5	1.1	SOCK	17	245	262	238.2	5	75		SUPP	FOOT	4	24	0
080080	0/11/06	4.4	5.5	1.1	COHO	33	3	36	32.7	4	75		INDX	FOOT	5	24	0
080080	0/11/06	4.4	5.5	1.1	SOCK	2	169	171	155.5	5	75		SUPP	FOOT	4	24	0
080080	0/11/16	4.4	5.5	1.1	COHO	4	1	5	4.5	4	85		INDX	FOOT		20	0
080080	0/11/22	4.4	5.5	1.1	COHO	0	2	2	1.8	4	90		INDX	FOOT		20	0

Appendix K

APPENDIX K:
Electrofish Data

Stream: Little Bear Creek					ELECTROFISH DATA		
Reach: 1					sculpin = coastrange		
Date: August 24, 2001					length = total length in inches		
Seconds: 110							
Setting: 60 Hz at 500 V							
number	species	length	note				
1	coho	3.5	wild				
2	coho	3.3	wild				
3	coho	4.2	hatchery				
1	cutthroat	3.25					
2	cutthroat	2.5					
3	cutthroat	2.5					
1	sculpin	5					
2	sculpin	4.75					
3	sculpin	4.3					
4	sculpin	4.25					
5	sculpin	3.75					
6	sculpin	3.5					
7	sculpin	3.5					
8	sculpin	3.1					
9	sculpin	3					
10	sculpin	3					
11	sculpin	2.8					
12	sculpin	2.75					
13	sculpin	2.7					
14	sculpin	2.6					
15	sculpin	2.5					
16	sculpin	2.4					
17	sculpin	2.25					
18	sculpin	2.2					
19	sculpin	2.2					
20	sculpin	2.2					
21	sculpin	2					
22	sculpin	2					
23	sculpin	2					
24	sculpin	2					
25	sculpin	2					
26	sculpin	1.9					
27	sculpin	1.9					
28	sculpin	1.75					
29	sculpin	1.5					

Stream: Little Bear Creek					ELECTROFISH DATA		
Reach: 2 #1					sculpin = coastrange		
Date: August 31, 2001					length = total length in inches		
Seconds: 107							
Setting: 60 Hz at 600 V							
Site: Upstream 132nd Ave. NE							
No.	species	length	note				
1	cutthroat	7.5					
2	cutthroat	6.5					
3	cutthroat	5.6					
4	cutthroat	5.5					
5	cutthroat	5.25					
6	cutthroat	5					
7	cutthroat	5					
8	cutthroat	3.3					
1	sculpin	4.5					
2	sculpin	4.1					
3	sculpin	3.8					
4	sculpin	3.7					
5	sculpin	3.6					
6	sculpin	3.3					
7	sculpin	3.3					
8	sculpin	2.7					

Stream: Little Bear Creek					ELECTROFISH DATA		
Reach: 2 #2					sculpin = coastrange		
Date: August 31, 2001					length = total length in inches		
Seconds: 74							
Setting: 90 Hz at 700 V							
Site: Downstream 134th Ave NE							
No.	species	length	note				
1	cutthroat	4.5					
2	cutthroat	5.5					
3	cutthroat	4.4					
4	cutthroat	5.5					
5	cutthroat	3.2					
6	cutthroat	5.7					
7	cutthroat	3.5					
1	sculpin	3.1					
2	sculpin	2.7					
3	sculpin	2.3					
4	sculpin	1.6					
5	sculpin	4.7					
6	sculpin	4.5					
7	sculpin	2.5					
8	sculpin	2.5					
9	sculpin	1.3					

Stream: Little Bear Creek					ELECTROFISH DATA		
Reach: 2 #3					sculpin = coastrange		
Date: August 31, 2001					length = total length in inches		
Seconds: 139							
Setting: 60 Hz at 600 V							
Site: Upstream 134th Ave NE							
No.	species	length	note				
1	coho	3.4	wild				
2	coho	3.2	wild				
1	cutthroat	8.2					
2	cutthroat	6.8					
3	cutthroat	6.7					
4	cutthroat	6					
5	cutthroat	5.7					
6	cutthroat	5.4					
7	cutthroat	5.4					
8	cutthroat	5.3					
9	cutthroat	5.3					
10	cutthroat	5.2					
11	cutthroat	4.8					
12	cutthroat	4.6					
13	cutthroat	4.3					
14	cutthroat	2.7					
15	cutthroat	2.7					
16	cutthroat	2.7					
17	cutthroat	2.3					
1	sculpin	4.4					
2	sculpin	5.2					
3	sculpin	3.7					
4	sculpin	3.6					
5	sculpin	3.2					
6	sculpin	2.8					
7	sculpin	2.5					
8	sculpin	2.6					
9	sculpin	1.5					
10	sculpin	2.3					
11	sculpin	2.7					
12	sculpin	2.4					

Stream: Little Bear Creek					ELECTROFISH DATA		
Reach: 3 #1					sculpin = coastrange		
Date: August 31, 2001					length = total length in inches		
Seconds: 112							
Setting: 60 Hz at 600 V							
Site: Upstream 195th Street							
No.	species	length	note				
1	cutthroat	8					
2	cutthroat	7.5					
3	cutthroat	7					
4	cutthroat	7					
5	cutthroat	6					
6	cutthroat	5.75					
7	cutthroat	5.75					
8	cutthroat	5.5					
9	cutthroat	5.25					
10	cutthroat	5.25					
11	cutthroat	5.1					
12	cutthroat	5					
13	cutthroat	4.9					
14	cutthroat	4.5					
15	cutthroat	4.5					
16	cutthroat	4.25					
17	cutthroat	4.25					
18	cutthroat	3.5					
19	cutthroat	3					
20	cutthroat	2.9					
21	cutthroat	2.75					
22	cutthroat	2.5					
23	cutthroat	2.5					
24	cutthroat	2.5					
25	cutthroat	2.5					
26	cutthroat	2.5					
27	cutthroat	2.5					
28	cutthroat	2.25					
29	cutthroat	2.25					
1	sculpin	3					
2	sculpin	2.75					
3	sculpin	2.5					
4	sculpin	2.5					
5	sculpin	1.5					
6	sculpin	1					

Stream: Little Bear Creek					ELECTROFISH DATA			
Reach: 3 #2					sculpin = coastrange			
Date: August 31, 2001					length = total length in inches			
Seconds: 141								
Setting: 60 Hz at 600 V								
Site: Downstream 205th Street								
No.	Species	Length	Note		No.	Species	Length	Note
1	coho	3.25	wild		27	cutthroat	3.5	
2	coho	3.25	wild		28	cutthroat	3.5	
3	coho	3.25	wild		29	cutthroat	3	
4	coho	3	wild		30	cutthroat	2.75	
5	coho	3	wild		31	cutthroat	2.5	
6	coho	3	wild		32	cutthroat	2.5	
7	coho	3	wild		33	cutthroat	2.5	
8	coho	3	wild		34	cutthroat	2.5	
9	coho	3	wild		35	cutthroat	2.25	
1	cutthroat	8.5			1	sculpin	2.75	
2	cutthroat	8			2	sculpin	2.25	
3	cutthroat	6.5			3	sculpin	2	
4	cutthroat	6			4	sculpin	2	
5	cutthroat	5.75			5	sculpin	1	
6	cutthroat	5.5						
7	cutthroat	5.25						
8	cutthroat	5						
9	cutthroat	5						
10	cutthroat	5						
11	cutthroat	5						
12	cutthroat	4.75						
13	cutthroat	4.75						
14	cutthroat	4.5						
15	cutthroat	4.5						
16	cutthroat	4.25						
17	cutthroat	4.25						
18	cutthroat	4						
19	cutthroat	4						
20	cutthroat	4						
21	cutthroat	4						
22	cutthroat	3.75						
23	cutthroat	3.5						
24	cutthroat	3.5						
25	cutthroat	3.5						
26	cutthroat	3.5						

Appendix L-1

Appendix L-1:
NMFS Matrix (1996)

Description of the Matrix:

The "Matrix of Pathways and Indicators" (Table 1) is designed to summarize important environmental parameters and levels of condition for each. This matrix is divided into six overall pathways (major rows in the matrix):

-- Water Quality -- Channel Condition and Dynamics
-- Habitat Access -- Flow/Hydrology
-- Habitat Elements -- Watershed Conditions

Each of the above represents a significant pathway by which actions can have potential effects on anadromous salmonids and their habitats. The pathways are further broken down into "indicators." Indicators are generally of two types: (1) Metrics that have associated numeric values (e.g. "six pools per mile"); and (2) descriptions (e.g. "adequate habitat refugia do not exist"). The purpose of having both types of indicators in the matrix is that numeric data are not always readily available for making determinations (or there are no reliable numeric indicators of the factor under consideration). In this case, a description of overall condition may be the only appropriate method available.

The columns in the matrix correspond to levels of condition of the indicator. There are three condition levels: "properly functioning," "at risk," and "not properly functioning." For each indicator, there is either a numeric value or range for a metric that describes the condition, a description of the condition, or both. When a numeric value and a description are combined in the same cell in the matrix, it is because accurate assessment of the indicator requires attention to both.

TABLE 1. MATRIX of PATHWAYS AND INDICATORS

(Remember, the ranges of criteria presented here are not absolute, they may be adjusted for unique watersheds. See p. 3)

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Water Quality:	Temperature	50-57• F[1]	57-60• (spawning) 57-64• (migration &rearing)[2]	> 60• (spawning) > 64• (migration & rearing)[2]
	Sediment/Turbidity	< 12% fines (<0.85mm) in gravel[3], turbidity low	12-17% (west-side)[3], 12-20% (east-side)[2], turbidity moderate	>17% (west-side)[3], >20% (east side)[2] fines at surface or depth in spawning habitat[2], turbidity high
	Chemical Contamination/ Nutrients	low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches[5]	moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach[5]	high levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one CWA 303d designated reach[5]
Habitat Access:	Physical Barriers	any man-made barriers present in watershed allow upstream and downstream fish passage at all flows	any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Habitat Elements:	Substrate	dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20%[3]	gravel and cobble is subdominant, or if dominant, embeddedness 20-30%[3]	bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant, embeddedness >30%[2]
	Large Woody Debris	Coast: >80 pieces/mile >24"diameter >50 ft. length[4]; East-side: >20 pieces/ mile >12"diameter >35 ft. length[2]; and adequate sources of woody debris recruitment in riparian areas	currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	does not meet standards for properly functioning and lacks potential large woody debris recruitment

	Pool Frequency channel width # pools/mile[6] 5 feet 184 10 " 96 15 " 70 20 " 56 25 " 47 50 " 26 75 " 23 100 " 18	meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above)	meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	does not meet pool frequency standards
	Pool Quality	pools >1 meter deep (holding pools) with good cover and cool water[3], minor reduction of pool volume by fine sediment	few deeper pools (>1 meter) present or inadequate cover/temperature[3], moderate reduction of pool volume by fine sediment	no deep pools (>1 meter) and inadequate cover/temperature[3], major reduction of pool volume by fine sediment
	Off-channel Habitat	backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)[3]	some backwaters and high energy side channels[3]	few or no backwaters, no off-channel ponds[3]
	Refugia (important remnant habitat for sensitive aquatic species)	habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[7]	habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations[7]	adequate habitat refugia do not exist[7]
Channel Condition & Dynamics:	Width/Depth Ratio	<10[2,4]	10-12 (we are unaware of any criteria to reference)	>12 (we are unaware of any criteria to reference)
	Streambank Condition	>90% stable; i.e., on average, less than 10% of banks are actively eroding[2]	80-90% stable	<80% stable
	Floodplain Connectivity	off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly

Flow/Hydrology:	Change in Peak/ Base Flows	watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in Drainage Network	zero or minimum increases in drainage network density due to roads[8,9]	moderate increases in drainage network density due to roads (e.g., • 5%)[8,9]	significant increases in drainage network density due to roads (e.g., • 20-25%)[8,9]
Watershed Conditions:	Road Density & Location	<2 mi/mi²[11], no valley bottom roads	2-3 mi/mi², some valley bottom roads	>3 mi/mi², many valley bottom roads
	Disturbance History	<15% ECA (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), • 15% retention of LSOG in watershed[10]	<15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), • 15% retention of LSOG in watershed[10]	>15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG retention
	Riparian Reserves	the riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact),and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/ composition >50%[12]	moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species (• 70-80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better[12]	riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition <25%[12]

[1] Bjornn, T.C. and D.W. Reiser, 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. Meehan, W.R., ed.
[2] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.
[3] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.
[4] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of Calfornia (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.
[5] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.
[6] USDA Forest Service, 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

[7] Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.

[8] Wemple, B.C., 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis, Geosciences Department, Oregon State University.

[9] e.g., see Elk River Watershed Analysis Report, 1995. Siskiyou National Forest, Oregon.

[10] Northwest Forest Plan, 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.

[11] USDA Forest Service, 1993. Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities.

[12] Winward, A.H., 1989 Ecological Status of Vegatation as a base for Multiple Product Management. Abstaracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Managem nt: p277.

Appendix L-2

Appendix L-2:
NMFS Matrix as modified by the Mt. Baker Snoqualmie National Forest

Recommended Revisions to the Matrix of Diagnostics / Pathways and Indicators for Salmonids
(J.E. Doyle 1/12/99)

The following recommendations to NMFS and F&WS's Matrix of Diagnostics / Pathways and Indicators for Chinook Salmon and Bull Trout is based on the Mt. Baker Snoqualmie National Forest aquatic staff's 18 years knowledge and experience gained from managing river and stream habitats within and adjacent to the national forest boundaries. These recommendations are consistent with the guidance and direction found within the Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions for Chinook Salmon and Bull Trout Watershed Scale documents.

The revisions or additions to the matrix are as follows:

(1) Pathway - Habitat, Indicator – Sediment

Of the seven major river basins found within the Mt. Baker Snoqualmie NF boundaries, three contain river sub-basins that are glacial (Nooksack, Skagit, White). This natural background sediment delivery and transport in these sub-basins needs to be acknowledged and accounted for in the baseline condition determinations for sediment. In these systems, snow and glacial melt usually enters the rivers in late spring/early summer (late May-June) and continues to late summer (late September-early October). During this time chinook salmon (spring) enter these systems to migrate to their native spawning areas. Bull trout also are in these systems, spawning in early fall.

Little or no known data/information exist describing the additional volume or degree of sediment generated by glacial melt over the ambient sediment levels in these sub-basins. Determinations of the sediment indicator will probably have to be based on professional judgement and experience for these systems.

When assessing the sediment indicator, consideration needs to be given to the preferred channel types used by spawning chinook and bull trout as well as knowledge of the preferred substrate size for each species.

(2) Pathway – Water Quality, Indicator – Chemical Contamination/Nutrients

When assessing this indicator include areas such as mine sites, Water Quality Restoration Plans, and fecal coliform sites.

(3) Pathway – Habitat Access

Consider all life stages for these two species

(4) Pathway - Habitat Elements, Indicator – Large Woody Debris

The value of LWD as a fish habitat element in channels is not only the number and size of this wood but the location and wood complexity. LWD size, frequency, location, and distribution requirements also varies with the size and type of channel. Adult chinook when in Puget Sound river systems holding and waiting to spawn require big, deep pools formed and maintained by large concentrations/complexes of large wood (log jams); the number of pieces per length of stream is of little or no value to spawning chinook. Frequency of LWD in a river or stream system is more meaningful habitat indicator for bull trout. Also the frequency and distribution of large woody debris is important component of the stream channel integrity and stability in the steep first and second order streams that connect to the lower gradient fish-bearing channels in all the Forest's watersheds. Consider these three situations when rating LWD.

In addition, the existing criteria separating the 3 functioning categories in the matrix will need to be changed based on collected Forest data/information. Over the past 10 years, stream inventories

have been conducted on managed and unmanaged Forest stream systems. This has not been completely analyzed and summarize, but will be in the near future. Once this is done, the Forest will advocate for changing the criteria for this indicator.

(5) **Pathway – Habitat Elements, Indicator – Pool Frequency and Quality**

This is another matrix indicator subject to change once the Forest completes the analysis and interpretation of its stream inventory data.

There is also a need to consider desired pool frequencies by channel type and channel gradients based on some published channel classification system (e.g. Rosgen, Montgomery & Buffington)

(6) **Pathway – Habitat Elements, Indicator – Large Pools**

Large pools should be the primary pools and the size of these types of pools will need to be tailored various sizes and types of channels. Also consider the needs of these two species and the freshwater life history stage when determining the size, frequency, and distribution of large (primary) pools (e.g. spawning chinook salmon).

(7) **Pathway – Channel Condition & Dynamics, Indicator – Average wetted width/max depth ratio and streambank condition**

These indicators and the associated criteria values need to be based on the geomorphic and hydrology features of a watershed. A simple watershed classification based on these three indicators needs to be developed and functioning criteria identified for watershed types. We suggest that average bankfull measurement be made and not wetted.

The numeric values for this baseline may require modification after Forest stream survey data is analyzed and evaluated for the different channel types found within the Forest boundaries.

(8) **Pathway – Flow/Hydrology, Indicator – Change in Peak and Base Flows**

This indicator needs to be linked to the disturbance history of the watershed. Flows can be dramatically altered by the management and natural disturbance within a fifth field watershed.

(9) **Pathway – Flow/Hydrology, Indicator – Increase in Drainage Network**

This indicator needs to be linked to the road density indicator. Increases in road density in many watersheds has been shown to increase the drainage network.

(10) **Pathway – Watershed Conditions, Indicator – Road Density, and Disturbance History, and Disturbance Regime**

The MBS NF developed and implemented a hydrologic cumulative effects assessment for all of the Forest's fifth field watersheds back in 1990 as a component of the old Forest Land Management Plan. Each watershed was assessed for upslope and in-channel conditions. Management induced disturbance (road building and timber harvesting) as well as natural disturbance events (floods) were used to generate these assessments. Based on this assessment, watersheds were rated into one of three conditions (acceptable, partially acceptable, and unacceptable). The recommendation is to use the road and other disturbance history indicators from this assessment supplemented by current watershed conditions to derive the current baseline condition for these three indicators (a copy of this hydrologic cumulative assessment and the ratings for each fifth field watershed is available from Jim Doyle).

(11) **Pathway – Integration of Species and Habitat Conditions**

This integration also needs to link to other fifth field watersheds in the river basin, if a similar environmental baseline has been done for that watershed which would help facilitate species and habitat integration at the 4th field level.

TABLE 1. MATRIX of DIAGNOSTICS / PATHWAYS AND INDICATORS

(Remember, the values of criteria presented here are NOT absolute, they may be adjusted for local watersheds given supportive documentation. See p. 7)

DIAGNOSTIC OR PATHWAY	INDICATORS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK
SPECIES:				
Subpopulation Characteristics within subpopulation watersheds	Subpopulation Size	Mean total subpopulation size or local habitat capacity more than several thousand individuals. All life stages evenly represented in the subpopulation.[1]	Adults in subpopulation are less than 500 but >50.[1]	Adults in subpopulation has less than 50.[1]
	Growth and Survival	Subpopulation has the resilience to recover from short term disturbances (e.g. catastrophic events, etc) or subpopulation declines within one to two generations (5 to 10 years).[1] The subpopulation is characterized as increasing or stable. At least 10+ years of data support this estimate.[2]	When disturbed, the subpopulation will not recover to predisturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend.[1]. At least 10+ years of data support this characterization.[2] If less data is available and a trend can not be confirmed, a subpopulation will be considered at risk until enough data is available to accurately determine its trend.	The subpopulation is characterized as in rapid decline or is maintaining at alarmingly low numbers. Under current management, the subpopulation condition will not improve within two generations (5 to 10 years).[1] This is supported by a minimum of 5+ years of data.
	Life History Diversity and Isolation	The migratory form is present and the subpopulation exists in close proximity to other spawning and rearing groups. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring subpopulations are large with high likelihood of producing surplus individuals or straying adults that will mix with other subpopulation groups.	The migratory form is present but the subpopulation is not close to other subpopulations or habitat disruption has produced a strong correlation among subpopulations that do exist in proximity to each other.[1]	The migratory form is absent and the subpopulation is isolated to the local stream or a small watershed not likely to support more than 2,000 fish.[1]

	Persistence and Genetic Integrity	Connectivity is high among multiple (5 or more) subpopulations with at least several thousand fish each. Each of the relevant subpopulations has a low risk of extinction. [1] The probability of hybridization or displacement by competitive species is low to nonexistent.	Connectivity among multiple subpopulations does occur, but habitats are more fragmented. Only one or two of the subpopulations represent most of the fish production. [1] The probability of hybridization or displacement by competitive species is imminent, although few documented cases have occurred.	Little or no connectivity remains for refounding subpopulations in low numbers, in decline, or nearing extinction. Only a single subpopulation or several local populations that are very small or that otherwise are at high risk remain.[1] Competitive species readily displace bull trout. The probability of hybridization is high and documented cases have occurred.
HABITAT:				
Water Quality:	Temperature	7 day average maximum temperature in a reach during the following life history stages: [1, 3] incubation 2 - 5?C rearing 4 - 12 ?C spawning 4 - 9?C also temperatures do not exceed 15?C **in areas used by adults during migration (no thermal barriers)**	7 day average maximum temperature in a reach during the following life history stages:[1, 3] incubation <2?C **or 6?C** rearing <4?C **or 13 - 15 ?C** spawning <4 ?C **or 10?C** also temperatures in areas used by adults during migration sometimes exceeds 15?C	7 day average maximum temperature in a reach during the following life history stages:[1, 3] incubation <1?C **or >6?C** rearing >15 ?C spawning <4 ?C or > **10?C** also temperatures in areas used by adults during migration regularly exceed 15?C **(thermal barriers present)**
	Sediment (in areas of spawning and incubation; rearing areas will be addressed under ''substrate embeddedness'')	Similar to chinook salmon [1]: for example (e.g.): < 12% fines (<0.85mm) in gravel[4]; e.g. ≤20% surface fines of ≤6mm[5, 6]	Similar to chinook salmon [1]: e.g. 12-17% fines (<0.85mm) in gravel[4]; e.g. 12-20% surface fines	Similar to chinook salmon [1]; e.g. >17% fines (<0.85mm) in gravel[4]; e.g. >20% fines at surface or depth in spawning habitat[7]
	Chemical Contamination/ Nutrients	low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches[8]	moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach[8]	high levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one CWA 303d designated reach[8]
Habitat Access:	Physical Barriers (address subsurface flows impeding fish passage under the pathway ''flow/hydrology'')	man-made barriers present in watershed allow upstream and downstream fish passage at all flows	man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Habitat Elements:	Substrate Embeddedness in rearing areas (spawning anld incubation areas were addressed under the indicator ''sediment'')	reach embeddedness <20%[9, 10]	reach embeddedness 20-30%	reach embeddedness >30%[4, 10]

Large Woody Debris	current values are being maintained at greater than 80 pieces/mile that are >24"diameter and >50 ft length on the Coast', or >20 pieces/ mile >12"diameter >35 ft length on the Eastside[11] ; also adequate sources of woody debris are available for both long and short-term recruitment	current levels are being maintained at minimum levels desired for ''functioning appropriately'', but potential sources for long term woody debris recruitment are lacking to maintain these minimum values	current levels are not at those desired values for ''functioning appropriately'', and potential sources of woody debris for short and/or long term recruitment are lacking
Pool Frequency and Quality	pool frequency in a reach closely approximates [5]: Wetted width (ft) #pools/mile 0-5 39 5-10 60 10-15 48 15-20 39 20-30 23 30-35 18 35-40 10 40-65 9 65-100 4 (can use formula: pools/mi = 5,280/wetted channel width #channel widths per pool); also, pools have good cover and cool water', and only minor reduction of pool volume by fine sediment	pool frequency is similar to values in ''functioning appropriately'', but pools have inadequate cover/temperature', and/or there has been a moderate reduction of pool volume by fine sediment	pool frequency is considerably lower than values desired for ''functioning appropriately''; also cover/temperature is inadequate', and there has been a major reduction of pool volume by fine sediment
Large Pools (in adult holding, juvenile rearing, and overwintering reaches where streams are >3m in wetted width at baseflow)	each reach has many large pools >1 meter deep'	reaches have few large pools (>1 meter) present'	reaches have no deep pools (>1 meter)'
Off-channel Habitat (see reference 18 for identification of these characteristics)	watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; and side-channels are low energy areas'	watershed has some ponds, oxbows, backwaters, and other off-channel areas with cover; but side-channels are generally high energy areas'	watershed has few or no ponds, oxbows, backwaters, or other off-channel areas'
Refugia (see Checklist footnotes for definition of this indicator)	habitats capable of supporting strong and significant populations are protected and are well distributed and connected for all life stages and forms of the species [12, 13]	habitats capable of supporting strong and significant populations are insufficient in size, number and connectivity to maintain all life stages and forms of the species[12, 13]	adequate habitat refugia do not exist[12]

Channel Condition & Dynamics:	Average Wetted Width/ Maximum Depth Ratio in scour pools in a reach	≤10[7, 5]	11 - 20[5]	>20[5]
	Streambank Condition	>80% of any stream reach has ≥90% stability[5]	50 - 80% of any stream reach has ≥90% stability[5]	<50% of any stream reach has ≥90% stability[5]
	Floodplain Connectivity	off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly
Flow/Hydrology:	Change in Peak/ Base Flows	watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in Drainage Network	zero or minimum increases in active channel length correlated with human caused disturbance	low to moderate increase in active channel length correlated with human caused disturbance	greater than moderate increase in active channel length correlated with human caused disturbance
Watershed Conditions:	Road Density & Location	<1mi/mi² [13]; no valley bottom roads	1 - 2.4 mi/mi² [13]; some valley bottom roads	>2.4 mi/mi² [13]; many valley bottom roads
	Disturbance History	<15% ECA of entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area there is an additional criteria of ≥15% LSOG in watersheds[14]	<15% ECA of entire watershed but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area there is an additional criteria of ≥15% LSOG in watersheds[14]	>15% ECA of entire watershed and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG
	Riparian Conservation Areas (RHCA - PACFISH and INFISH) (Riparian Reserves - Northwest Forest Plan)	the riparian conservation areas provide adequate shade, large woody debris recruitment, and habitat protection and connectivity in subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact), and adequately buffer impacts on rangelands: percent similarity of riparian vegetation to the potential natural community/ composition >50%[15]	moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian conservation areas, or incomplete protection of habitats and refugia for sensitive aquatic species (≈70-80% intact), and adequately buffer impacts on rangelands : percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better[15]	riparian conservation areas are fragmented, poorly connected, or provides inadequate protection of habitats for sensitive aquatic species (<70% intact, refugia does not occur), and adequately buffer impacts on rangelands : percent similarity of riparian vegetation to the potential natural community/composition <25%[15]

Disturbance Regime	Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life-history forms. [1] Natural processes are stable.	Scour events, debris torrents, or catastrophic fire are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from environmental disturbances is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. [1] Natural processes are unstable.

SPECIES AND HABITAT:			
Integration of Species and Habitat Conditions	Habitat quality and connectivity among subpopulations is high. The migratory form is present. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival or growth are consistent with pristine habitat. The subpopulation has the resilience to recover from short-term disturbance within one to two generations (5 to 10 years). The subpopulation is fluctuating around an equilibrium or is growing.[1]	Fine sediments, stream temperatures, or the availability of suitable habitats have been altered and will not recover to predisturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend. The subpopulation is stable or fluctuating in a downward trend. Connectivity among subpopulations occurs but habitats are more fragmented.[1]	Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will not improve within two generations (5 to 10 years). Little or no connectivity remains among subpopulations. The subpopulation survival and recruitment responds sharply to normal environmental events. [1]

[1] Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S.D.A. Forest Service, Intermountain Research Station, Boise, ID.
[2] Rieman, B.E. and D.L. Meyers. 1997. Use of redd counts to detect trends in bull trout (*Salvelinus confluentus*) populations. Conservation Biology 11(4): 1015-1018.
[3] Buchanan, D.V. and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. *In* W.C. Mackay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings. P8.
[4] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.
[5] Overton, C.K., J.D. McIntyre, R. Armstrong, S.L. Whitewell, and K.A. Duncan. 1995. User's guide to fish habitat: descriptions that represent natural conditions in the Salmon River Basin, Idaho. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-322.
[6] Overton, C.K., S.P. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermoutain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-346.
[7] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.
[8] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.

[9] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of Calfornia (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.
[10] Shepard, B.B., K.L. Pratt, and P.J. Graham. 1984. Life histories of westslope cutthroat and bull trout in the Upper Flathead River Basin, MT. Environmental Protection AgencyRep. Contract No. R008224-01-5.
[11] Interior Columbia Basin Ecosystem Management Project Draft Environmental Impact Statement and Appendices.
[12] Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.
[13] Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. *In* T.M. Quigley and S. J. Arbelbide eds ''An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III''. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405.
[14] Northwest Forest Plan, 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.
[15] Winward, A.H., 1989 Ecological Status of Vegetation as a base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p277.

Appendix M

APPENDIX M:
DEA Stream Habitat Survey Data

Stream Name: Little Bear Creek
Reach: 1 Habitat Survey
GPS D/S: Mouth
GPS U/S: Downstream Side SR 202

Date: 6/25/01
Time In: 10 am
Time out: 5:15 pm
Crew: Scott & Joe

Temp air: 21° C
Temp Water: 14° C
Weather: Overcast

								Width (meters)				Depth (meters)				
NSO	Hab ID	Sta D/S	Sta U/S	Length (m)	Hab Type	% Pool	Area m^2	W1	W2	W3	BKF	Avg	Max	Tail	Resid.	Comments
1	R1	0	192.7	192.7	Riffle		948.084	5.2	4.5	5.05	6.6	0.38				long-linear-rip/rap
2	R2	192.7	205.1	12.4	Glide		55.8	4.5	4.5	4.5		0.26				under first road
3	P1	205.1	218.8	13.7	RB Scour		57.54	4.2				0.60	0.90	0.28	0.62	
4	R3	218.8	225.8	7.0	Riffle		29.4	4.2			4.50	0.40				rip/rap in-stream
5	P2	225.8	245.7	19.9	Plunge Pool		83.58	4.2				0.55	0.90	0.38	0.52	walled in, created.
6	P3	245.7	260.5	14.8	Plunge Pool		50.32	3.4				0.70	0.90	0.28	0.62	walled in. V- weir
7	R4	260.5	277.1	16.6	Glide		44.82	2.7				0.50				
8	P4	277.1	288.3	11.2	Plunge Pool		45.92	4.1				0.55	0.67	0.40	0.27	walled in.
9	P5	288.3	303.5	15.2	Plunge Pool		63.84	4.2				0.60	0.90	0.20	0.70	walled in
10	R5	303.5	317.5	14.0	Glide		56	4.0				0.60	0.77			
11	R6	317.5	354.5	37.0	Riffle		222	6.0				0.30	0.60			sand still dominates
12	R7	354.5	370.8	16.3	Glide		76.61	4.7			5.80	0.45	0.60			
13	R8	370.8	380.9	10.1	Riffle		63.63	6.3				0.30	0.40			
14	R9	380.9	388.2	7.3	Glide		33.58	4.6				0.35	0.40			end reach
				388.2			1831.124									

Stream Name: Little Bear Creek
Reach: 2 Habitat
GPS D/S: Downstream side of Hwy 202
GPS U/S:

Temp air: 19° C
Temp Water: 13° C
Weather: Nice

								Width (Meter)			Depth (Meter)				
NSO	Hab ID	STA D/S	STA U/S	Length (meter)	Hab Type	Area (m^2)	% Pool	W1	W2	BKF	Avg	Max	Tail	Resid.	Comments
1	R1	0.0	39.7	39.7	Glide	123.07	0	3.1		3.1	0.41	0.5			Under Hwy 202
2	R2	39.7	54.7	15.0	Riffle	52.5	0	3.5		8.65	0.25	0.4			Pebble count site
3	P1	54.7	64.0	9.3	Scour	76.539		8.23			0.5	0.8	0.21	0.59	Sandy
4	R3	64.0	117.1	53.1	Riffle	288.067	10	4.75	6.1	5.6	0.27	0.4			Gravel nice, but sandy
5	P2	117.1	126.0	8.9	Scour	45.39		5.1			0.3	0.85	0.29	0.56	
6	R4	126.0	142.4	16.4	Riffle	73.8	0	4.5			0.2	0.3			LB armor 128.6-138.2.
7	P3	142.4	154.0	11.6	Scour	83.52		7.2			0.4	0.92	0.18	0.74	LB cleared, RB J. Knotweed.
8	R5	154.0	188.5	34.5	Riffle	144.9	0	4.2		7.3	0.3	0.4			
9	P4	188.5	196.1	7.6	Scour	60.8		8			0.6	1.0	0.25	0.75	Ended day at 132nd Ave.
				196.1		948.586									

Stream Name: Little Bear Creek
Reach: 2, day 2. Habitat
GPS D/S: 196.1 meters upstream of Hwy 202
GPS U/S: 132nd Ave NE

Temp air: 21 C
Temp Water: 14.5
Weather: Overcast, rained hard yesterday

								Width (Meter)			Depth (Meter)				
NSO	Hab ID	Sta D/S	Sta U/S	Length (Meter)	Hab Type	Area (m2)	% Pool	W1	W2	BKF	Avg	Max	Tail	Resid.	Comments
10	R6	196.1	231.0	34.9	riffle	171.01	5	4.9	-	5.8	0.4	0.7	-	-	Culvert (3) 26.5M long.
11	P5	231.0	242.2	11.2	l. scour	60.48	-	5.4	-	-	0.5	0.6	0.32	0.28	LB scour
12	R7	242.2	255.5	13.3	glide	53.2	30	4.0	-	-	0.6	0.8	0.2	0.6	deep trench/ riffle-turbulent
13	R8	255.5	301.1	45.6	riffle	241.68	-	5.3	-	-	0.3	0.4	-	-	
14	P6	301.1	313.3	12.2	l. scour	73.2	-	6.0	-	-	0.7	1.0	0.25	0.75	lateral scour & trench
15	R9	313.3	390.0	76.7	riffle	373.913	-	4.4	5.35	6.7	0.35	0.5	-		getting wider
16	P7	390.0	400.8	10.8	scour	113.4	-	10.5	-	-	0.4	0.7	0.22	0.48	most wood - lots of sand.
17	R10	400.8	408.8	8.0	riffle	22.4	-	2.8	-	-	0.15	0.3	-	-	
18	P8	408.8	419.8	11.0	scour	52.8	-	4.8	-	-	0.4	0.7	0.2	0.6	unstable LB 419.8-426.5.
19	R11	419.8	439.0	19.2	riffle	80.64	-	4.2	-	-	0.3	0.5	-	-	
20	P9	439.0	446.5	7.5	scour	51	-	6.8	-	-	0.4	0.6	0.3	0.3	
21	R12	446.5	469.4	22.9	riffle	87.02	-	3.8	-	-	0.35	0.5	-	-	first old growth cedar stump, LB
22	P10	469.4	478.1	8.7	scour	98.31	-	11.3	-	-	0.6	1.1	0.25	0.85	3 culverts 134th 11.5m long.
23	R13	478.1	503.0	24.9	riffle	119.52	-	4.8	-	-	0.3	0.6	-	-	starts downstream end culverts
24	P11	503.0	517.2	14.2	s. debris	110.76	-	7.8	-	-	0.5	0.8	0.15	0.65	part scour, part debris
25	R14	517.2	521.3	4.1	riffle	23.37	-	5.7	-	-	0.15	0.3	-	-	
26	P12	521.3	530.3	9.0	scour	51.3	-	5.7	-	-	0.4	0.8	0.15	0.65	several small fry; end day.
				334.2		1784.003									

Stream Name: Little Bear Creek
Reach 2. Habitat
GPS D/S: ~100 feet upstream of 134th Ave.
GPS U/S:

Temp air: 19° C
Temp Water:14° C
Weather: Sunny

								Width (Meter)			Depth (Meter)				
NSO	Hab ID	Sta D/S	Sta U/S	Length (Meter)	Hab Type	Area (m^2)	% Pool	W1	W2	BKF	Avg	Max	Tail	Resid.	Comments
27	R15	530.3	600.0	69.7	riffle	369.925	-	5.1	5.4	5.8	0.35	0.4			Small side channel (2nd)
28	P13	600.0	612.0	12.0	scour	55.2	-	4.6	-	-	0.4	0.6	0.23	0.37	
29	R16	612.0	625.3	13.3	riffle	49.21	-	3.7	-	5.5	0.2	0.3	-		
30	P14	625.3	642.0	16.7	scour	78.49	-	4.7	-	-	0.4	0.65	0.2	0.45	trench/scour
31	R17	642.0	662.0	20.0	glide	130	-	6.5	-	-	0.4	0.65	-		jungle dogwwod & ninebark
32	R18	662.0	685.9	23.9	riffle	109.94	20	4.6	-	-	0.2	0.5	-		photo 10
33	P15	685.9	694.0	8.1	plunge	48.6	-	~6	-	-	0.7	1	0.2	0.8	photo 11,12,13. Small fry.
34	P16	694.0	715.7	21.7	l. scour	104.16	-	4.8	-	-	0.3	0.65	0.23	0.42	scour-lateral, fallen fence LB,
35	R19	715.7	729.1	13.4	riffle	58.96	-	4.4	-	-	0.25	0.3	-		see discharge pipe LB
36	P17	729.1	742.0	12.9	scour	67.08	-	5.2	-	-	0.3	0.7	0.17	0.53	
37	P18	742.0	755.3	13.3	scour	62.51	-	4.7	-	-	0.35	0.63	0.2	0.43	
38	R20	755.3	759.3	4.0	riffle	20	-	5	-	-	0.1	0.2	-		
39	P19	759.3	771.6	12.3	scour	209.1	-	~17			0.3	1.1	0.2	0.9	wide area flooded
40	P20	771.6	786.0	14.4	l. scour	57.6	-	4			0.3	0.5	0.2	0.3	yellow iris
41	P21	786.0	808.7	22.7	b. water	86.26	-	3.8			0.45	0.8	0.24	0.56	backwater 70%, scour 70%
42	R21	808.7	826.9	18.2	glide	182	10	3.7			0.35	0.5	-		row of large cedars RB
43	R22	826.9	839.0	12.1	riffle	53.24	-	4.4		7.2	0.3	0.35	-		kingfisher, beaver sign
44	P22	839.0	852.0	13.0	l. scour	65	-	5		-	0.4	0.8	0.25	0.55	classic pool
45	R23	852.0	858.3	6.3	riffle	30.24	-	4.8			0.15	0.25	-		
46	R24	858.3	884.4	26.1	glide	122.67	-	4.7			0.3	0.45	-		
47	P23	884.4	892.4	8.0	scour	46.4	-	5.8			0.5	0.75	0.2	0.55	CMP- .47M dia.- LB, sta 890.2
48	R25	892.4	895.7	3.3	riffle	9.9	-	3		6.2	0.2	0.27	-		
49	P24	895.7	905.5	9.8	l. scour	43.12	-	4.4			0.45	0.6	0.2	0.4	
50	P25	905.5	913.2	7.7	l. scour	40.04	-	5.2			0.3	0.75	0.23	0.52	plunge 50%, scour 50%,
				382.9		2099.645									

Riparian: shrubs can be thick both sides. LB tends to have sections with a wall of Himalayen blackberry. Few if any conifers. When deciduous trees present, dominated by meduim and small alders. Some mature cottenwood, but usually set back. Large willows (pacific) present. Salmonberry co-dominates shrub later. Hazelnut also present. RCG present.

Stream Name: Little Bear Creek
Reach: 2. Habitat
GPS D/S:
GPS U/S:

Temp air: 22° C
Temp Water: 16° C
Weather: Sunny & Hot

								Width (m)		Depth (m)				
NSO	Hab ID	Sta D/S	Sta U/S	Length (meter)	Hab Type	Area (m2)	% Pool	W1	BKF	Avg	Max	Tail	Resid.	Comments
51	R26	913.2	936.9	23.7	riffle	111.39	-	4.7	6	0.23	0.3	-		Racoon tracks, clawfish claw. Clearing with new plants LB.
52	R27	936.9	955.4	18.5	glide	92.5	20	5	-	0.35	0.5	-		lots of salmonids 1-3 ", >12
53	P26	955.4	970.1	14.7	scour	108.78	-	7.4	-	0.45	0.79	0.4	0.39	
54	R28	970.1	978.2	8.1	riffle	36.45	-	4.5	-	0.15	0.25	-		
55	P27	978.2	1007.0	28.8	scour	210.24	-	7.3	5.9	0.5	1	0.2	0.8	shallow area LB-wide log-jam.
56	R29	1007.0	1028.6	21.6	riffle	118.8	-	5.5	-	0.1	0.3	-		narrow riparian
57	P28	1028.6	1046.7	18.1	scour	114.03	-	6.3	-	0.4	0.8	0.15	0.65	
58	P29	1046.7	1065.0	18.3	trench	78.69	-	4.3	-	0.6	0.8	0.2	0.6	ditch LB
59	R30	1065.0	1079.3	14.3	riffle	67.21	-	4.7	6.4	0.2	0.35	-		ditch LB
60	P30	1079.3	1091.7	12.4	scour	80.6	-	6.5	-	0.45	0.7	0.15	0.55	6" salmonid (trout?)
61	R31	1091.7	1103.0	11.3	riffle	58.76	-	5.2	-	0.15	0.2	-		SR522 close by RB
62	R32	1103.0	1116.8	13.8	glide	55.2	-	4	-	0.35	0.52	-		
63	R33	1116.8	1133.3	16.5	riffle	75.9	15	4.6	-	0.25	0.45	-		
64	P31	1133.3	1140.8	7.5	plunge	64.5	-	8.6	-	0.4	0.78	0.18	0.6	lamprey & juvenile salmonid
65	P32	1140.8	1158.5	17.7	b.water	56.64	-	3.2	-	0.4	0.7	0.15	0.55	backwater/trench
66	R34	1158.5	1161.3	2.8	riffle	14	-	5	-	0.1	0.2	-		
67	P33	1161.3	1168.0	6.7	scour	46.9	-	7	-	0.4	0.65	0.12	0.53	narrow band of trees
68	R35	1168.0	1169.9	1.9	glide	12.16	-	6.4	-	0.2	0.34	-		
69	P34	1169.9	1183	13.1	scour	52.4	-	4	-	0.35	0.64	0.25	0.39	
				269.8		1455.15								

Stream Name: Little Bear Creek
Reach 2. Habitat
GPS D/S:
GPS U/S: Upstream side of SR 522 crossing.

Temp air:16 C
Temp Water:14 C
Weather: Nice

								Width (m)		Depth (Meter)				
NSO	Hab ID	Sta D/S	Sta U/S	Length (Meter)	Hab Type	Area (m2)	% Pool	W1	BKF	Avg	Max	Tail	Resid.	Comments
70	R36	1183.0	1187.0	4.0	riffle	23.6	-	5.9	-	0.1	0.25	-		photo 1 & 2 of roll 3
71	R37	1187.0	1195.6	8.6	glide	51.6	-	6	-	0.25	0.45	-		
72	R38	1195.6	1204.9	9.3	riffle	93	10	5.3	-	0.15	0.3	-		
73	P35	1204.9	1218.7	13.8	l. scour	59.34	-	4.3	-	0.3	0.7	0.2	0.5	
74	R39	1218.7	1220.2	1.5	riffle	6.9	-	4.6	5.6	0.15	0.18	-		
75	R40	1220.2	1239.7	19.5	glide	62.4	-	3.2	-	0.3	0.5	0.15	0.35	glide like
76	R41	1239.7	1262.2	22.5	riffle	135	-	6	-	0.2	0.3	-		sloughing
77	P36	1262.2	1271.4	9.2	scour	35.88	-	3.9	-	0.35	0.7	0.3	0.4	LB rip/rap.
78	R42	1271.4	1275.7	4.3	riffle	22.36	-	5.2	-	0.1	0.2	-		LB unstable
79	P37	1275.7	1290.9	15.2	scour	69.92	-	4.6	-	0.45	0.98	0.2	0.78	LB rip/rap
80	R43	1290.9	1299.9	9.0	riffle	56.7	5	6.3	-	0.15	0.5	-		LB unstable
81	P38	1299.9	1309.2	9.3	scour	53.01	-	5.7	-	0.6	1	0.17	0.83	
82	P39	1309.2	1315.6	6.4	scour	46.08	-	7.2	-	0.5	0.85	0.2	0.65	RB unstable
83	P40	1315.6	1322.7	7.1	scour	36.21	-	5.1	-	0.3	0.5	0.15	0.35	
84	R44	1322.7	1337.3	14.6	riffle	87.6	-	6	-	0.2	0.4	-		
85	P41	1337.3	1346.1	8.8	scour	50.16	-	5.7	-	0.5	0.8	0.22	0.58	
86	R45	1346.1	1355.2	9.1	glide	47.32	-	5.2	-	0.3	0.55	-		
87	R46	1355.2	1360.0	4.8	riffle	28.8	-	6	8.8	0.1	0.2	-		
88	P42	1360.0	1370.8	10.8	scour	56.16	-	5.2	-	0.45	0.75	0.13	0.62	
89	P43	1370.8	1379.7	8.9	scour	50.73	-	5.7	-	0.4	0.7	0.3	0.4	
90	R47	1379.7	1391.2	11.5	riffle	47.15	-	4.1	-	0.25	0.5	-		Rip/rap 1380.7-1390.2
91	P44	1391.2	1403.3	12.1	scour	72.6	-	6	-	0.45	1.0	0.18	0.82	pipe LB sta. 1382
92	R48	1403.3	1408.7	5.4	riffle	24.84	-	4.6	-	0.15	0.22	-		
93	P45	1408.7	1416.2	7.5	scour	45	-	6	-	0.35	0.85	0.18	0.67	fish
94	R49	1416.2	1462.0	45.8	riffle	233.58	5	5.1	-	0.2	0.4	-		photo 17 & 18 of roll 3
95	R50	1462.0	1499.3	37.3	glide	208.88	-	5.6	-	0.3	0.5	-		banks ~ undercut good.
96	R51	1499.3	1514.1	14.8	riffle	76.96	-	5.2	-	0.2	0.25	-		

								Width (m)		Depth (Meter)				
NSO	Hab ID	Sta D/S	Sta U/S	Length (Meter)	Hab Type	Area (m2)	% Pool	W1	BKF	Avg	Max	Tail	Resid.	Comments
97	R52	1514.1	1554.8	40.7	glide	179.08	-	4.4	-	0.3	0.4			
98	R53	1554.8	1563.8	9.0	riffle	47.7	-	5.3	-	0.2	0.25			
99	R54	1563.8	1570.9	7.1	glide	32.66	-	4.6	-	0.3	0.45			
100	R55	1570.9	1583.2	12.3	riffle	70.11	-	5.7	-	0.2	0.3			
101	R56	1583.2	1630.0	46.8	glide	468	10	4.6	-	0.4	0.7			4 lampreys spawning
102	R57	1630.0	1640.5	10.5	riffle	57.75	-	5.5	-	0.2	0.25			pipe overhead.
103	R58	1640.5	1656.0	15.5	glide	77.5	-	5	-	0.4	0.6			
104	P46	1656.0	1663.2	7.2	pool	33.84	-	4.7	-	0.5	0.7	0.3		
105	R59	1663.2	1725.7	62.5	riffle	231.25		3.7		0.2				Within 2 CMP - SR-522
				542.7		2979.67								

Culvert 7.1m wide downstream side opening

Lots of deadly nightshade, Himalayan blackberry, and reed canarygrass.

Stream Name: Little Bear Creek
Reach: 3. Habitat
GPS D/S: Upstream side of SR 522.
GPS U/S: Downstream end of culverts under 195th Street

Temp air:21°C
Temp Water:16°C
Weather:cloudy
Date: 7/19/01

								Width (meter)			Depth (meter)				
NSO	Hab ID	Sta D/S	Sta U/S	Length (meter)	Hab Type	Area (m^2)	% Pool	W1	W2	BKF	Avg	Max	Tail	Resid.	Comments
1	R1	0.0	3.05	3.05	riffle	16.3462	-	5.36	-	-	.25	.3	-		Ditch/trib entering LB at culverts
2	P1	3.05	17.07	14.02	l. scour	60.8945	-	4.34	-	-	.3	.6	0.2	0.4	RB. Small alders
3	R2	17.07	45.4	28.33	riffle	130.247	0	3.531	5.664	7.82	.15	.2	-		Photo 5
4	R3	45.4	63.1	17.7	glide	114.643	5	6.477	-	-	.2	.45	-		Part pool, run/glide~shallow, flat
5	R4	63.1	84.1	21	riffle	128.549	-	6.121	-	-	.1	.15	-		Water/trib RB
6	R5	84.1	100.3	16.2	glide	98.755	0	6.096	-	-	.25	.4	-		Run/glide, like R3
7	R6	100.3	130.8	30.5	riffle	146.418	0	4.801	-	-	.12	.2	-		Blackberry thick RB
8	P2	130.8	149.7	18.9	l. scour	108.01	0	5.715	-	-	.25	.48	0.15	0.33	LB. Rip/rap LB, freeway close
9	R7	149.7	170.4	20.7	riffle	100.416		4.851	-	5.92	.15	.20	-		blackberry + Japanese knotweed
10	R8	170.4	177.7	7.3	glide	38.938	0	5.334	-	-	.2	.25	-		
11	P3	177.7	189.0	11.3	scour	46.928	0	4.547	3.759		.25	.5	0.2	0.3	%pool in glide.
12	R9	189.0	199.0	10	riffle	37.084	-	3.708	-	-	.15	.25	-		
13	P4	199.0	216.4	17.4	scour	90.602	-	5.207	-	-	.4	.71	0.19	0.52	Nice pool, old cedar stump
14	R10	216.4	236.8	20.4	riffle	97.414	-	4.775	-	-	.15	.3	-		Photo 6
15	P5	236.8	251.1	14.3	scour	67.559	-	4.724	-	-	.3	.70	0.15	0.55	Yards now present RB
16	R11	251.1	260.3	9.2	riffle	43.932	-	4.775	-	-	.15	.25	-		Photo 9 & 10
17	R12	260.3	271.2	10.9	glide	60.355	-	5.537	-	-	.3	.4	-		Run/glide
18	P10	271.2	277.7	6.5	plunge	39.624	-	6.096	-	-	.45	.70	0.25	0.45	Scour/plunge, rip/rap
19	P11	277.7	290.0	12.3	plunge	76.23	-	6.198	-	-	.45	.80	0.25	0.55	Foot Bridge 278.9
20	P12	290.0	296.6	6.6	plunge	22.128	-	3.353	-	-	.30	.65	0.25	0.4	
21	P13	296.6	303.9	7.3	plunge	35.601	-	4.877	-	-	.65	.80	0.2	0.6	Photo 11 & 12 = cascade
22	P14	303.9	313.6	9.7	plunge	59.427	-	6.126	-	-	.4	.7	0.4	0.3	Downstream end under 195th.
				313.6		1620.1									

*3 garter snakes on bank of stream, next to on ramp. 9 scales on 1/2 labia.

* Roll #1: P1 = both culverts; P2= LB culvert inside; P3= RB culvert inside; P4= LB trib.
*culverts round CMP 2M diameter each.
*LB trib is 1.4M wide-too small for adults, but could be used by juveniles.

Stream Name:Little Bear Creek
Reach: 3. Habitat.
GPS D/S: Upstream side of culverts under 195th St.
GPS U/S:

Temp air: 22°C
Temp Water: 15°C
Weather:partly coudy/sunny
Date: 7/20/01

								Width (meter)			Depth (meter)				
NSO	Hab ID	Sta. D/S	Sta. U/S	Length (meter)	Hab Type	Area (m^2)	% Pool	W1	W2	BKF	Avg	Max	Tail	Resid.	Comments
23	R13	313.9	330.7	53.38	glide	210.157		3.937			.28	.30			Shallow run/glide, plus 36.58 m in culvert
24	R14	330.7	338.0	7.3	riffle	33.93		4.648			.15	.20			~ at foot/old bridge
25	R15	338.0	345.3	7.3	glide	24.661		3.378			.25	.35			
26	R16	345.3	360.0	14.7	riffle	57.127		3.886			.17	.28			
27	R17	360.0	372.8	12.8	glide	55.921		4.369			.25	.4			
28	R18	372.8	375.5	2.7	riffle	14.813		5.486			.1	.2			
29	P15	375.5	380.7	5.2	s. pool	24.435		4.699			.35	.7	.15	0.55	Nice pool with cover
30	R19	380.7	385.6	4.9	riffle	21.656		4.42			.15	.26			
31	P16	385.6	402.3	16.7	d/s pool	180.701		10.82			.5	.9	.20	0.7	Two giant pools, debris/scour
32	P17	402.3	413.3	11	s. pool	109.525		9.957			.6	1.0	.22	0.78	Mink~brown, black tip on tail
33	R20	413.3	420.6	7.3	riffle	13.35		1.829			.2	.3			Red-tailed hawk. Photo 5-8
34	P18	420.6	424.2	3.6	plunge	16.276		4.521			.4	.65	.20	0.45	Photo 9
35	R21	424.4	450.5	26.1	glide	155.791		5.969			.3	.5	.20	0.3	Tough backwater/debris- glide
36	R22	450.5	455.7	5.2	riffle	26.152		5.029			.2	.3			Good cover, few large conifers
37	P19	455.7	473.0	17.3	scour	146.327		8.458			.65	1.1	.15	0.95	
38	R23	473.0	544.0	71	riffle	316.5		3.988	4.93	5.639	.16	.3			
39	P20	544.0	552.9	8.9	scour	37.3		4.191			.25	.6	.20	0.4	
40	R24	552.9	558.7	5.8	riffle	28.58		4.928			.15	.2			School of juvenile salmonids
41	R25	558.7	568.8	10.1	glide	55.669		5.512			.2	.35			School of juvenile salmonids
42	R26	568.8	593.8	25	riffle	112.395		4.496		6.17	.18	.3			
43	P21	593.8	603.1	9.3	scour	48.66		5.23			.35	.67	.10	0.57	Real close to SR 522
44	R27	603.1	615.4	12.3	riffle	67.636		7.264	3.73		.15	.2			
45	P22	615.4	634.9	19.5	l. scour	87.75		4.5			.30	1.1	.25	0.85	Invasives thick
				357.38		1845.312									

Stream Name:Little Bear Creek
Reach 3: Habitat
GPS D/S:
GPS U/S:

Temp air:18°C
Temp Water:14°C
Weather:cloudy
Date: 7/31/01

								Width		Depth				
NSO	Hab ID	Sta. D/S	Sta. U/S	Length (meter)	Hab Type	Area (m^2)	% Pool	W1	BKF	Avg	Max	Tail	Resid.	Comments
46	R28	634.9	664.8	29.9	riffle	146.576		4.902		0.15	0.3			Area near SR522-robin's nest
47	P23	664.8	679.7	14.9	l. scour	71.529		4.801		0.3	0.55	0.1	0.45	Lateral scour, nice cut bank
48	R29	679.7	690.7	11	riffle	43.586	5	3.962		0.2	0.4			
49	P24	690.7	705.3	14.6	s. pool	157.236		10.77		0.6	1.7	0.19	1.51	Scour pool, best so far
50	R30	705.3	714.4	9.1	riffle	47.615		5.23		0.1	0.2			
51	R31	714.4	734.6	20.2	run/glide	98.511		4.877		0.3	0.45	0.2	0.25	
52	R32	734.6	741.2	6.6	riffle	40.234		6.096		0.1	0.15			
53	P25	741.2	756.2	15	l. scour	72.39		4.826		0.3	0.6	0.19	0.41	RB trib (see photo) sta 750.
54	R33	756.2	783.3	27.1	riffle	128.03	20	4.724		0.15	0.16			
55	P26	783.3	792.4	9.1	l. scour	47.153		5.182		0.25	0.5	0.2	0.3	
56	R34	792.4	803.8	11.4	riffle	63.124		5.54		0.1	0.2			1998 UW B-IBI site
57	P27	803.8	809	5.2	scour	34.87		6.706		0.25	0.66	0.25	0.41	
58	R35	809	818.7	9.7	riffle	92.639		9.55		0.2	0.4			
59	R36	818.7	827.5	8.8	glide	50.963		5.79		0.25	0.4			
60	P28	827.5	847.6	20.1	scour	178.18		8.865		0.5	0.8	0.27	0.53	Clearing RB, big segment
61	R37	847.6	859.5	11.9	riffle	63.17		5.309		0.2	0.25			
62	R38	859.5	869.9	10.4	glide	47.55		4.572		0.27	0.4			
63	P29	869.9	876.6	6.7	pool	27.91		4.166		0.5	0.7	0.27	0.43	
64	R39	876.6	900.3	23.7	riffle	98.725		4.166		0.2	0.3			
65	R40	900.3	908.6	8.3	glide/run	39.845		4.801		0.25	0.35			
66	R41	908.6	934.5	25.9	riffle	169.728		6.55		0.15	0.18			
67	P30	915.3	934.5	19.2	s. pool	112.166		5.842		0.6	1.1	0.2	0.9	House RB-pool under old bridge.
				318.8		1831.73								

Stream Name: Little Bear Creek
Reach:3 Habitat
GPS D/S: Immediately upstream of old bridge, house RB.
GPS U/S: Immediately downstream of 205th Street.

Temp air:17°C
Temp Water:14°C
Weather:overcast
Date: 8/01/01

								Width (meter)		Depth (meter)				
NSO	Hab. ID	Sta. D/S	Sta. U/S	Length (meter)	Hab. Type	Area (m^2)	% Pool	W1	BKF	Avg	Max	Tail	Resid.	Comments
68	R42	934.5	954.6	20.1	riffle	108.745		5.41		0.15	0.25			Large riffle. LB trib, sta 948.2
69	R43	954.6	973.2	18.6	glide	87.874		4.72		0.25	0.55	0.2	0.35	Sta. 973.2, large cobble placed across stream by landowner.
70	P31	973.2	979.6	6.4	l. scour	29.7485		4.648		0.35	0.6	0.2	0.4	Yard RB. 1/2 width functioning
71	R44	979.6	1013.2	33.6	riffle	172.395		5.131		0.2	0.28			Not much spawning gravel.
72	P32	1013.2	1020.1	6.9	l/s pool	28.042		4.064		0.3	0.5	0.25	0.25	Freeway noise, raccoon tracks.
73	R45	1020.1	1029.3	9.2	riffle	28.976		3.15		0.15	0.25			Clay substrate prevalent.
74	R46	1029.3	1039	9.7	glide	53.711		5.537		0.35	0.45	0.24	0.21	Large doug firs and cedar LB.
75	P33	1039	1054	15	p. pool	135.636		9.04		0.6	1.4	0.25	1.15	Big simple plunge pool, less clay.
76	P34	1054	1060.7	6.7	l. scour	40.843		6.096		0.3	0.6	0.25	0.35	
77	R47	1060.7	1075	14.3	riffle	83.177		5.817		0.1	0.2			
78	P35	1075	1089.7	14.7	s. pool	91.85		6.248		0.4	0.5	0.2	0.3	Nice Wetland RB
79	R48	1089.7	1098.1	8.4	riffle	35.204		4.19		0.1	0.2			
80	P36	1098.1	1111.9	13.8	scour	76.413		5.537		0.25	0.5	0.2	0.3	Not much of a pool.
81	R49	1111.9	1116.5	4.6	riffle	25.588		5.563	8.2	0.05	1			
82	P37	1116.5	1138.1	21.6	s. pool	121.249		5.613		0.3	0.6	0.15	0.45	
83	R50	1138.1	1151.5	13.4	riffle	64.668		4.826		0.2	0.3			Some large cobble, clay gone
84	R51	1151.5	1180.8	29.3	glide	150.33	20	5.1308	7.39	0.2	0.5	0.2	0.3	
85	R52	1180.8	1186.9	6.1	riffle	35.791		5.867		0.1	0.15			
86	P38	1186.9	1199.7	12.8	scour	61.448		4.801		0.25	0.4	0.15	0.25	Not much of a pool.
87	R53	1199.7	1237.1	37.4	riffle	172.893	5	4.623		0.2	0.4			Steep, sandy, bedrock, black clay gravel. House RB
88	R54	1237.1	1258.8	21.7	glide	109.134		5.029		0.2	0.4			Run - Flat. 85% hard clay bottom.
89	R55	1258.8	1267.4	8.6	riffle	44.125		5.131		0.2	0.3			Steep. Sandy gravel
90	R56	1267.4	1279.2	11.8	glide	48.854		4.14		0.2	0.35			Flat, run.
91	R57	1279.2	1284.1	4.9	riffle	22.901		4.674		0.2	0.3			Steep.
92	R58	1284.1	1297.5	13.4	glide	73.177		5.461		0.25	0.3			Flat. LB rip/rap length of unit.
93	R59	1297.5	1305.5	8	riffle	25.6		3.2		0.2	0.3			and 10 feet into this unit
94	P39	1305.5	1314.9	9.4	plunge	154		16.38		0.5	1.2	0.25	0.95	End, 0.6 M vertical jump distant
				380.4		2082.373								Added 36.58 meters for 195th Street in NSO 23 not reflected in station #s.

Appendix N

APPENDIX N:
DEA Large Woody Debris Survey Data

Stream: Little Bear Creek **Reach: 1 WOOD**
Date: 6/25/01
Crew: Scott & Joe

						Zone %								Decay	
NSO	Hab ID	STA	Bank	Length (M)	Dia (CM)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Class	Comments
1	R1	9.1	LB	3.2	22	90	10	-	-	N	N	N	Decid.	4	Under walk bridge
1	R1	11.1	LB	2.6	21	5	95	-	-	A	N	Y	Doug Fir	4	Fractured beam?
1	R1	100.8	LB	3	13	5	95	-	-	N	N	N	Decid.	3	
1	R1	102	RB	5.9	20	0	100	-	-	N	N	N	Decid.	3	Beaver chewed
6	P3	245.7	Cross	4.3 +	48	100	0	-	-	A	Y	Y	Doug Fir	3	Placed-created plunge pool
6	P3	245.7	RB	5.5	13	70	30	-	-	N	N	N	?	3	
7	R4	260.5	RB	3.5	50	100	-	-	-	A	Y	Y	Conif.	3	V-weir connected to next
7	R4	260.5	LB	3.5	50	100	-	-	-	A	Y	Y	Conif.	3	V-weir connected to previous
8	P4	288.3	Cross	4.9	50	100	-	-	-	A	Y	Y	Conif.	3	Weir
9	P5	303.5	RB	4.3	47	100	-	-	-	A	Y	Y	Conif.	3	V-weir
9	P5	303.5	LB	3.7	50	100	-	-	-	A	Y	Y	Conif.	3	V-weir
11	R6	331.4	LB	1.7	40	100	-	-	-	A	N	Y	Conif.	3	Embedded V-weir
11	R6	331.4	RB	1.7	38	100	-	-	-	A	N	Y	Conif.	3	Embedded V-weir
11	R6	354.5	Cross	5	30	100	-	-	-	A	N	Y	Conif.	3	
12	R7	370.8	RB	5	15	20	80	-	-	N	N	N	Alder	1	Recently fell into stream
12	R7	370.8	RB	5	13	20	80	-	-	N	N	N	Alder	1	Recently fell into stream
				58.5	520										

Stream: Little Bear Creek **Reach: 2. Wood**
Date: 6/26/01
Crew: Scott & Joe

				Length	Dia.	Zone %									
NSO	Hab ID	STA	Bank	(m)	(cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
3	P1	57.5	Cross	12.5	46	5	80	15	0	N	N	N	BLM	4	Crosses center of pool
3	P1	57.5	LB	2.6	22	5	95	0	0	A	N	Y		NA	Railroad Tie- on top of other LWD
4	R3	94.3	RB	6	15	3	87	10	0	N	N	N	Decid.	3	Tips in water
4	R3	94.3	RB	5.5	12	4	86	10	0	N	N	N	Decid.	3	Tips in water
4	R3	105.6	RB	5.7	15	30	70	0	0	N	N	N	Decid.	3	
5	P2	122.4	LB	13	35	5	15	40	40	N	N	N	BLM	3	Fallen Tree Cluster
5	P2	122.5	LB	13	30	5	15	40	40	N	N	N	BLM	3	Roots 1/2 in water
5	P2	122.6	LB	13	30	5	15	40	40	N	N	N	BLM	2	BLM = big-leaf maple
5	P2	122.7	LB	20	55	5	15	40	40	N	N	N	BLM	2	
7	P3	150.7	RB	15	90	30	40	30	0	N	Y	N	Cedar	2	Stump-nice-pool ~70yrs old.
9	P4	194.2	RB	3.6	37	10	20	20	50	N	N	N	Decid.	4	
				109.9	387										

Stream: Little Bear Creek
Date: 6/28/01
Crew: Scott & Joe

Reach: 2, day 2 Habitat.

				Length	Dia	Zone %									
NSO	Hab. ID	Sta.	Bank	(meter)	(cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
10	R6	231	RB	2.0	23	60	40	0	0	N	Y	N	?	3	partly visible, formed 5% Pool
11	P5	243	RB	4.0	30	100	0	0	0	N	Y+/-	N	?	4	
12	R7	248.2	LB	1.2	22	0	100	0	0	A	N	Y	?	NA	~ 1/2 length exposed railroad tie
13	R7	250.5	cross	5.5	32	90	10	0	0	N	N	N	Decid.	4	
14	R8	277	LB	1.3	22	40	60	0	0	A	N	Y	-	-	Railroad Tie fallen-part of fence.
15	P6	309.9	cross	5.5	30	95	5	0	0	N	Y	N	Decid.	4	
15	P6	315.4	middle	4	30	50	50	0	0	N	N	N	Alder	2	
15	R9	350.5	LB	4	33	5	20	50	25	N	N	N	Alder	4	Part of fallen snag
15	R9	358.9	RB	2.4	30	30	70	0	0	N	N	N	Conifer	4	Slice of stump
15	R9	377.7	LB	4	20	2	68	30	0	N	N	N	Alder	3	
16	R9	383.7	LB	4	25	5	90	5	0	N	N	N	Alder	3	
16	R9	393.9	LB	4.5	27	10	10	60	20	N	N	N	Alder	2	Fry ~ 1inch
16	P7	393.9	LB	~10	28	5	10	75	10	N	N	N	Willow	1	Still alive but fallen into pool
16	P7	395.4	LB	~10	15	10	80	10	0	N	N	N	Decid.	2	3 small stumps also
16	P7	395.4	LB	2	13	5	95	0	0	N	N	N	Decid.	3	
16	P7	395.4	LB	2	15	50	50	0	0	N	N	N	Decid.	4	
16	P7	398.7	LB	5	30	10	85	5	0	N	N	N	Decid.	3	
16	P7	398.7	LB	4	35	30	70	0	0	N	N	N	Decid.	3	
16	P7	399.6	LB	3.6	13	90	10	0	0	N	N	N	Decid.	3	
16	P7	399.6	middle	~9.5	35	40	60	0	0	N	N	N	Decid.	3	
16	P7	399.6	LB	3.5	25	10	20	70	0	N	N	N	Decid.	2	
19	R11	419.5	LB	2.1	35	5	20	75	0	A	N	Y	Decid.	-	Part of beam
21	R12	466	RB	4.5	16	20	20	60	0	N	N	N	Decid.	3	
24	P11	505.8	center	~10	17	30	70	0	0	N	N	N	Decid.	2	Rootwad persist
24	P11	505.8	center	3	12	50	50	0	0	N	N	N	Decid.	2	
24	P11	508.4	center	2+	43	50	50	0	0	N	N	N	Cedar	5	Cedar slab
24	P11	510.4	LB	6.8	15	10	80	10	0	N	N	N	Willow	1	Log-jam this station/area
24	P11	510.4	LB	6.5	12	5	75	20	0	N	N	N	Willow	1	Cluster

				Length	Dia	Zone %									
NSO	Hab. ID	Sta.	Bank	(meter)	(cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
24	P11	510.4	LB	6.8	15	5	65	30	0	N	N	N	Willow	1	Cluster
24	P11	510.4	LB	~5	11	5	95	0	0	N	N	N	Willow	1	Cluster
24	P11	510.4	LB	4	13	0	5	95	0	N	N	N	Willow	1	Cluster
24	P11	510.4	LB	~7	13	0	50	50	0	N	N	N	Willow	1	Cluster
24	P11	510.5	LB	2.5	70	30	60	10	0	N	N	N	Cedar	5	Old part of stump
24	P11	511.5	cross	~4	20	50	50	0	0	N	N	N	Conifer	5	
24	P11	511.5	cross	2.5	60	80	20	0	0	N	N	N	Conifer	4	Stump
24	P11	511.5	cross	~4.5	14	10	5	85	0	N	N	N	Willow	1	
25	R14	518	LB	~3	30	0	80	20	0	N	N	N	-		Plank 6 x 12"
25	R14	518	LB	2.6	40	20	80	0	0	N	N	N	Decid.	5	
25	R14	519	LB	2.5	35	5	10	85	0	N	N	N	Decid.	5	
26	P12	518	cross	~3	~25	10	60	30	0	N	N	N	?	4	cluster upstream of channel
26	P12	525.9	cross	6+	14	5	90	5	0	N	N	N	Decid.	3	buried one end
26	P12	525.9	cross	5.5	13	0	95	5	0	N	N	N	Alder	3	
26	P12	525.9	cross	3	13	20	70	10	0	N	N	N	Alder	3	
26	P12	525.9	cross	2+	12	100	0	0	0	N	N	N	Decid.	3	
26	P12	525.9	LB	~6	18	40	5	55	0	N	N	N	Alder	3	
26	P12	525.9	LB	2.5	25	0	40	60	0	N	N	N	Decid.	4	
26	P12	525.9	LB	~3	14	0	25	75	0	N	N	N	Alder	3	
26	P12	525.9	LB	~6	23	0	40	60	0	N	N	N	Alder	3	
26	P12	526	LB	~4	26	20	5	75	0	N	N	N	?	5	End Day.
				117.3	1162										

Stream: Little Bear Creek **Reach: 2 Wood**
Date: 06/29/01
Crew: Scott & Joe

						Zone %									
NSO	**Hab ID**	**STA**	**Bank**	**Length**	**Dia**	**Z1**	**Z2**	**Z3**	**Z4**	**Origin**	**Pool**	**MM**	**Species**	**Decay Class**	**Comments**
27	R15	543	LB	3+	35	80	20	0	0	N	N	N	?	5	Embedded
27	R15	547.4	LB	4.4	32	5	90	5	0	N	N	N	?	5	
27	R15	556.5	LB	2.3	30	70	30	0	0	N	N	N	Conifer	5	
27	R15	556.5	LB	3.8	18	5	30	65	0	N	N	N	Alder	3	
27	R15	568	LB	2.3	14	50	50	0	0	N	N	N	?	4	
27	R15	572.3	LB	2.4	10	10	90	0	0	N	N	N	?	3	
27	R15	575.1	LB	2.4	70	5	45	50	0	N	N	N	Cedar	5	Stump
27	R15	594.8	cross	15.5	39	2	18	80	0	N	N	N	Alder	4	
27	R15	594.8	cross	4.5	12	0	100	0	0	N	N	N	Alder	2	
28	P13	608	cross	9.3	19	30	40	30	0	N	N	N	Alder	3	Rootwad attatched
28	P13	608.5	RB	2	75	20	60	20	0	N	N	N	Decid.	5	Stump
30	P14	631.4	LB	2.3	100	95	5	0	0	N	N	N	Conifer	5	Stump
30	P14	634.2	in strm	1	20	80	20	0	0	N	N	N	?	5	Stump
30	P14	634.2	in strm	0.8	40	90	10	0	0	N	N	N	?	5	Stump
30	P14	636.4	in strm	3+	15	100	0	0	0	N	N	N	?	5	
30	P14	636.4	LB	1.3	100	30	40	30	0	N	N	N	?	5	Stump
31	R17	661.8	LB	3.6	35	60	40	0	0	N	N	N	?	5	
31	R17	671	RB	4.2	13	5	45	50	0	N	N	N	Alder	2	Beaver dropped-in past
31	R17	671	RB	3.8	18	40	60	0	0	N	N	N	Alder	4	
31	R17	662	RB	4.5	24	5	95	0	0	N	N	N	Alder	2	
32	R18	663	RB	2	19	5	90	5	0	N	N	N	Alder	2	
32	P15	663	RB	4.8	41	0	60	40	0	N	N	N	Decid.	5	
33	P15	686.1	2/3cross	~20	38	40	30	30	0	N	N	N	Cedar	1	
33	P15	686.1	LB	~25	70	5	20	70	5	N	N	N	Cedar	1	
33	P15	688.4	middle	4.3	20	50	50	0	0	N	N	N	?	4	
33	P15	688.4	middle	2+	15	100	0	0	0	N	N	N	?	3	
33	P15	690.9	middle	1.5+	110	30	60	10	0	N	N	N		5	Stump- cedar
33	P15	692.6	cross	~25	80	20	60	20	0	N	N	N	Cedar	1	fell same time last year?

						Zone %									
NSO	Hab ID	STA	Bank	Length	Dia	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
33	P15	692.6	middle	2	15	100	0	0	0	N	N	N	?	4	
33	P15	693	middle	2+	20	75	25	0	0	N	N	N	?	4	
33	P15	693	middle	2+	20	80	20	0	0	N	N	N	?	4	
33	P15	694	cross	~20	60	95	5	0	0	N	Y	N	Cedar	3	Created plunge
34	P16	710	middle	2.5	25	100	0	0	0	N	N	N	dogwood	4	Pacific Dogwood
36	P17	736.7	RB	2	12	60	40	0	0	N	N	N	?	2	Recent beaver activity
36	P17	738.1	RB	7.3	28	50	30	20	0	N	Y	N	Alder	3	Burned
39	P19	768.2	cross	~20	55	10	60	30	0	N	Y	N	Cedar	2	
39	P19	769	cross	5	130	10	90	0	0	N	Y	N	Cedar	5	
40	P20	770	RB	3.5	13	15	85	0	0	N	N	N	Alder	2	
39	P19	767	RB	~3	11	50	50	0	0	N	N	N	Decid.	4	
41	P21	788.7	LB	~15	80	20	40	40	0	N	Y	N	BLM	3	BLM = Big-leaf Maple
41	P21	788.7	LB	~10	26	10	10	80	0	N	Y	N	Alder	4	
41	P21	794	center	1.7+	50	30	70	0	0	N	N	N	?	4	Beaver using Japanese Knotweed
44	P22	845.1	cross	10	44	0	30	50	20	N	N	N	Cotton	1	
44	P2	846	LB	1.9+	30	100	0	0	0	N	N	N	?	4	
46	R24	872	RB	6.1	15	10	50	40	0	N	N	N	Alder	2	
46	R24	873	LB	2.9	29	95	5	0	0	N	N	N	?	5	
46	R24	875.6	LB	5.1	12	5	90	5	0	N	N	N	Alder	2	
46	R24	878.1	RB	2.7	17	5	95	0	0	N	N	N	Alder	3	
47	P23	889.1	LB	6	45	0	30	70	0	N	N	N	Conifer	4	On top of CMP
47	P23	890.2	LB	3.8	24	70	30	0	0	N	N	N	Conifer	5	
49	P24	897.5	LB	4.6	15	90	10	0	0	N	N	N	Decid.	4	
49	P24	898.2	LB	3.5	21	0	100	0	0	N	N	N	Decid.	4	
49	P24	898.5	RB	8	24	50	50	0	0	N	N	N	Decid.	4	
49	P24	898.5	RB	7.6	21	5	90	5	0	N	N	N	Alder	3	
49	P24	905.3	RB	3.8	23	20	70	10	0	N	N	N	DEC	4	
49	P24	905.3	RB	~6.5	14	5	30	40	25	N	N	N	ALD	3	
49	P24	910.1	CROSS	9.3	70	60	40	0	0	N	Y	N	CON	5	
49	P24	913.2	1/2 CROSS	4	30	70	30	0	0	N	Y	N	conifer	5	
49	P24	913.2	RB	3.3	20	90	10	0	0	N	N	N	conifer	5	
				184.5	2111										

Stream: Little Bear Creek
Date: 7/02/01
Crew: Scott and Joe

Reach: 2. Wood

				Length	Dia.	Zone %									
NSO	Hab ID	STA	Bank	(m)	(cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
51	R26	915	RB	3.8	18	60	40	0	0	N	N	N	?	5	
51	R26	929.2	RB	1.4	60	10	40	50	0	N	N	N	Conifer	3	Stump
53	P26	964.8	cross	4.7	80	30	60	10	0	N	N	N	Cedar	5	Burned
53	P26	965	middle	2	20	100	0	0	0	N	N	N	?	4	
55	P27	978	RB	12.7	70	5	15	80	0	N	N	N	?	5	Log-jam
55	P27	979	RB	~7	28	5	15	30	40	N	N	N	Alder	2	"
55	P27	978	RB	2.5	20	15	85	0	0	N	N	N	?	4	"
55	P27	979	RB	3.5	13	0	20	80	0	N	N	N	Alder	3	"
55	P27	979.5	RB	3	15	10	30	60	0	N	N	N	Alder	3	"
55	P27	986	LB	2.4	14	10	90	0	0	N	N	N	Decid.	4	Spread out - shallow area
55	P27	986	LB	~7	18	60	40	0	0	N	N	N	Decid.	4	"
55	P27	986	LB	3	26	30	70	0	0	N	N	N	Cedar	5	Stump
55	P27	986	LB	4.5	22	40	60	0	0	N	N	N	Decid.	3	"
55	P27	986	LB	3	11	10	90	0	0	N	N	N	Decid.	3	"
55	P27	988.9	cross	~25	70	10	10	40	40	N	Y	N	Cedar	1	At bend in stream
55	P27	988.9	RB	~4	50	10	40	50	0	N	N	N	Conifer	4	In previous log-jam
55	P27	989	RB	~7.5	20	5	10	85	0	N	N	N	Alder	3	In previous log-jam
56	R29	1007	RB	6.1	60	40	55	5	0	N	N	N	Decid.	5	burn marks
56	R29	1013.9	RB	~5	13	10	30	30	30	N	N	N	Alder	3	
57	P28	1042.6	LB	2+	16	0	95	5	0	N	N	N	Willow	3	Embedded
57	P28	1045.2	LB	2.9	24	40	40	20	0	N	N	N	Conifer	5	Burned
57	P28	1045.2	LB+	6.5	60	60	40	0	0	N	N	N	Conifer	5	Burned
57	P28	1046.7	CROSS	6.3	50	100	0	0	0	N	~Y	N	Conifer	5	
57	P28	1050.8	MID	3.5	24	100	0	0	0	N	N	N	Conifer	5	
58	P29	1057.2	MID	2.4	15	20	70	10	0	N	N	N	?	4	
58	P29	1064	MID	3	20	100	0	0	0	N	N	N	?	5	
59	R30	1068.2	LB	4.5+	20	20	80	0	0	N	N	N	?	4	
59	R30	1069	LB	2.4	20	90	10	0	0	N	N	N	?	4	

				Length	Dia.	Zone %									
NSO	Hab ID	STA	Bank	(m)	(cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
59	R30	1071	LB	4.5	29	95	5	0	0	N	N	N	?	5	
60	R30	1079.3	LB	3.8	30	20	80	0	0	N	N	N	?	4	
60	P30	1087.4	RB	2.7+	60	100	0	0	0	N	N	N	?	5	
62	R32	1111.2	RB	3.5	13	40	60	0	0	N	N	N	Alder	3	Lots reed canary grass
62	R32	1111.2	RB	3+	25	100	0	0	0	N	N	N	?	5	RB
63	R33	1117	LB	9.1	37	5	95	0	0	N	N	N	Alder	3	
63	R33	1120	LB	7+	17	5	90	5	0	N	N	N	?	4	Beaver Chew
63	R33	1125	LB	7.5	12	5	10	85	0	N	N	N	Alder	3	
63	R33	1125	LB	8	17	10	80	10	0	N	N	N	Alder	2	
63	R33	1125	LB	2+	25	0	10	90	0	N	N	N	Decid.	4	
63	R33	1125	RB	2.3	10	100	0	0	0	N	N	N	Conifer	5	
63	R33	1125	LB	2.2	20	0	50	50	0	N	N	N	Decid.	3	
63	R33	1126.4	LB	1.6+	40	95	5	0	0	N	Y	N	Conifer	5	Pocket pool
63	R33	1127	cross	4.5+	13	40	40	20	0	N	N	N	Decid.	4	
64	P31	1133.3	LB	2+	40	95	5	0	0	N	N	N	Conifer	5	Buried stump next to this
64	P31	1138.5	middle	4	15	90	5	5	0	N	N	N	Decid.	4	Nice pool
64	P31	1140.8	cross	12.5+	70	100	0	0	0	N	Y	N	Conifer	5	Embedded
65	P32	1148	LB	3.5+	27	65	25	10	0	N	N?	N	Conifer	5	Embedded
65	P32	1157	cross	5.8	16	50	45	5	0	N	N	N	Alder	3	
65	P32	1157	RB	2	35	10	85	5	0	N	N	N	Conifer	5	Raccoon tracks
65	P32	1158.5	cross	7.6	14	5	30	65	0	N	N	N	Alder	1	
67	P33	1165.5	cross	~30	70	5	10	30	55	N	N	N	Conifer	1	Cluster.
				139.9											

Stream: Little Bear Creek **Reach: 2 WOOD**
Date: 7/06/01
Crew: Scott & Joe

						Zone %								Decay	
NSO	Hab ID	STA	Bank	Length	Dia	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Class	Comments
70	R36	1184	LB	2	21	5	95	0	0	N	N	N		5	
71	R37	1187	RB	2.9	210	5	10	75	10	N	N	N	Conifer	4	Giant Stump
71	R37	1187	RB	2.4+	18	30	70	0	0	N	N	N		5	
71	R37	1189.3	LB	5.2	25	5	80	15	0	N	N	N	Decid.	4	
71	R37	1191.8	LB	3.1	19	0	95	5	0	N	N	N	Decid.	4	
71	R37	1191.8	cross	7	12	5	5	80	10	N	N	N	Alder	1	
71	R37	1191.8	LB	4.1	17	0	5	10	85	N	N	N	Alder	3	
75	P37	1235.6	LB	5.4	19	5	95	0	0	N	N	N	Alder	3	Photo 4, Roll 3
80	R43	1294.3	LB	3.5	33+	50	50	0	0	N	Y	N		4	Photo 3, Roll 3
80	R43	1296.8	LB	6.2	23	5	10	85	0	N	N	N	Alder	3	
81	P39	1302.7	cross	11.5	30	10	80	10	0	N	N	N	Alder	1	
81	P39	1303	LB	7.1	26	15	85	0	0	N	N	N	Alder	3	
81	P39	1302.7	RB	5.2+	13	0	20	80	0	N	N	N	Alder		
82	P40	1315.9	cross	3+	65+	100	0	0	0	N	N	N	Conifer	5	
84	R44	1322.7	LB	2.7	40	20	80	0	0	N	N	N	Conifer	5	
84	R44	1325.5	LB	4.7+	15+	5	45	50	0	N	N	N	Alder	3	Little salmonids
84	R44	1328.9	RB	6.5	20	90	10	0	0	N	N	N	Alder	3	
84	R44	1328.9	RB	3.2+	~40	10	90	0	0	N	N	N	Decid.	5	Embedded
85	P42	1346.1	cross	2.8	39	95	5	0	0	N	N	N	Decid.	4	Embedded
86	R45	1349	RB	6+	16	20	60	20	0	N	N	N	Alder	3	
88	P43	1361.3	cross	7.9	21	5	95	0	0	N	N	N	Alder	3	Lots of little fish~ 1.25"
88	P43	1362.3	RB	2.7	13	0	60	40	0	N	N	N	Alder	3	
88	P43	1363.6	center	2.5+	~26	90	10	0	0	N	N	N	Alder	3	
88	P43	1366.9	center	7.5	18	5	75	20	0	N	N	N	Alder	1	Beaver chew
88	P43	1370.6	RB	7.8	23	0	100	0	0	N	N	N	Alder	3	
88	P43	1370.6	RB	4.3	15	0	100	0	0	N	N	N	Alder	3	
89	P44	1373.2	LB	2+	45	100	0	0	0	N	N	N	Conifer	5	
89	P44	1373.2	LB	2+	~45	40	60	0	0	N	N	N	Conifer	5	Embedded

						Zone %								Decay	
NSO	Hab ID	STA	Bank	Length	Dia	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Class	Comments
89	P44	1373.2	LB	6.5	20	10	10	10	70	N	N	N	Alder	3	
89	P44	1373.2	LB	5	11	5	85	10	0	N	N	N	Alder	3	
91	P45	1391.2	LB	3	22	100	0	0	0	N	N	N	Alder	3	
91	P45	1395.2	cross	~12+	31	40	60	0	0	N	N	N	Alder	3	End in blackberries
91	P45	1398.1	cross	~10	33	10	70	20	0	N	N	N	Willow	1	Pacific willow
91	P45	1403.3	LB	6.4	16	5	80	15	0	N	N	N	Alder	3	
93	P46	1411.6	RB	2+	35	5	10	85	0	N	N	N	Alder	3	
93	P46	1413.3	CROSS	5.7	18	5	90	5	0	N	N	N	Alder	3	
93	P46	1413.3	RB	2+	18	30	40	30	0	N	N	N	Alder	3	
93	P46	1414	RB	3+	12	20	70	10	0	N	N	N	Alder	3	
94	P49	1417	center	5.2	60	0	100	0	0	N	N	N	Alder	3	Part of jam
94	P49	1417	LB	7	~25	80	20	0	0	N	Y	N	?	4	"
94	P49	1419.4	center	5.8	25	0	100	0	0	N	N	N	Alder	3	"
94	P49	1421	center	~4	32	40	50	10	0	N	N	N	Alder	4	"
94	R49	1421.9	cross	~5	14	95	5	0	0	N	N	N	Alder	3	"
95	R50	1470.8	center	2.6	16	0	100	0	0	N	N	N	Decid.	4	
95	R50	1771.1	center	7	20	40	60	0	0	N	N	N	Decid.	4	
95	R50	1488.2	LB	~7	25	10	10	80	0	N	N	N	Decid.	3	
96	R51	1507.9	LB	4+	13	40	60	0	0	N	N	N	Alder	3	
97	R52	1542.6	center	2.4	15	60	40	0	0	N	N	N	Decid.	4	
100	R55	1580.1	LB	5.1	22	50	50	0	0	N	N	N	Alder	3	4 spawning Lampreys digging a nest
103	R58	1642	RB	4.4	18	10	70	20	0	N	N	N	Alder	3	LB rip/rap 1651.7 - 1666.7
				166.3	1159										

Stream: Little Bear Creek **Reach: 3. Wood.**
Date: 7/19/01
Crew: Scott & Amy

						Zone %									
NSO	Hab ID	Station	Bank	Length (m)	Dia (cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
1	R1	0	middle	3.38	12	2	48	50	0	N	N	N	Alder	2	Jammed up against culvert
1	R1	0	middle	3.45	16	50	50	0	0	N	N	N	Alder	2	Jammed up against culvert
2	P1	5.5	RB	8.48	22	5	30	65	0	N	N	N	Alder	2	
2	P1	6.1	center	2.84	17	100	0	0	0	N	N	N	Alder	2	Embedded
2	P1	7.6	LB	9.3	17	0	15	20	65	N	N	N	Alder	2	Attached rootwad
2	P1	7.6	LB	13.64	26	2	38	20	40	N	N	N	Alder	2	Attached rootwad
2	P1	8.5	LB	2.92	19	100	0	0	0	N	N	N	Alder	3	Attached rootwad
3	R2	21.3	LB	1.9	17	0	100	0	0	N	N	N	Decid.	5	
3	R2	22.3	LB	2.2	16	80	20	0	0	N	N	N	Alder	3	
3	R2	23.8	RB	7.6	21	40	60	0	0	N	N	N	Alder	3	
3	R2	27.4	RB	4	20	10	80	10	0	N	N	N	Alder	1	Recently fell into stream
3	R2	34.4	LB	1.8	18	5	95	0	0	N	N	N	Alder	4	
3	R2	36.3	LB	6.1	19	0	100	0	0	N	N	N	Alder	2	
4	R3	53	RB	4.5	13	5	92	0	0	N	N	N	Alder	3	
4	R3	61.6	LB	3.8	18	80	20	0	0	N	N	N	Alder	3	
5	R4	67.7	middle	2.8	13	20	80	0	0	N	N	N	Decid.	4	Embedded
6	R5	85.5	center	5	20	90	10	0	0	N	N	N	Alder	3	Rootwad
6	R5	89.6	center	3.5	17	10	90	0	0	N	N	N	Alder	3	Rootwad
6	R5	95.4	LB	~3.7	13	5	20	75	0	N	N	N	Alder	2	
7	R6	100.3	RB	~15.2	~25	5	15	30	50	N	N	N	Alder	3	
7	R6	104.5	RB	7.6	26	50	50	0	0	N	N	N	Alder	3	
7	R6	121	LB	~5.2	16	5	20	50	25	N	N	N	Alder	2	
12	R9	194.4	cross	~6.1	28	0	5	65	30	N	N	N	Decid.	5	
12	R9	194.4	RB	4.5	30	0	100	0	0	N	N	N	Alder	3	
13	P4	210.3	RB	6.1	27	20	75	5	0	N	N	N	Decid.	4	
16	R11	252.1	LB	1.8	~75	75	25	0	0	N	N	N	Cedar	5	chunk of cedar stump
				107.21	461										

Stream:Little Bear Creek
Date:7/20/01

Reach: 3. Wood.
Crew:Scott & Amy

					Zone %										
NSO	Hab ID	STA	Bank	Length (m)	Dia. (cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
26	R16	349.3	cross	4.1	18	50	50	0	0	N	N	N	Alder	2	
26	R16	357.5	LB	4.7	20	40	60	0	0	N	N	N	Alder	2	
30	R19	383.4	RB	10.1	38	30	70	0	0	N	Y	N	Alder	3	Giant rootwad
30	R19	383.4	RB	9.0	32	0	20	70	10	N	Y	N	Alder	3	
31	P16	388.9	LB	7.6	33	20	60	20	0	N	Y	N	Alder	2	Giant rootwad
31	P16	390.8	LB	4.1	14	100	0	0	0	N	N	N	Alder	3	
31	P16	400.5	LB	8.3	25	20	80	0	0	N	Y	N	Alder	3	
31	P16	400.5	center	2.1	150	10	70	20	0	N	Y	N	Cedar	3	Giant cedar stump
32	P17	400.5	LB	3.6	33	80	20	0	0	N	Y	N	Alder	2	
32	P17	400.5	LB	4.8	24	10	90	0	0	N	Y	N	Alder	2	
32	P17	400.5	LB	7.2	22	0	100	0	0	N	N	N	Alder	3	
32	P17	400.5	LB	2.4	15	10	60	30	0	N	N	N	Decid.	4	
32	P17	400.5	LB	3.7	16	70	30	0	0	N	N	N	Decid.	4	
32	P17	400.5	RB	1.8	24	90	10	0	0	N	Y	N	Decid.	4	
32	P17	400.5	RB	4.6	14	5	75	20	0	N	N	N	Alder	3	
32	P17	400.5	RB	2.4	16	20	70	10	0	N	N	N	Alder	3	
32	P17	407.8	center	4.4	22	95	5	0	0	N	N	N	?	4	
32	P17	411.5	LB	4.5	14	100	0	0	0	N	N	N	Alder	3	
33	R20	413.3	RB	3.0	33	60	40	0	0	N	Y	N	Alder	4	
33	R20	413.3	RB	1.8	50	95	5	0	0	N	Y	N	Alder	5	
34	P18	424.3	cross	6.7	29	50	40	10	0	N	Y	N	Alder	1	
34	P18	424.3	cross	7.6	26	15	35	50	0	N	Y	N	Alder	2	
35	R21	429.8	LB	1.8	19	20	20	60	0	N	N	N	Alder	2	
35	R21	429.8	LB	2.1	24	10	30	60	0	N	N	N	Alder	2	
37	P19	459.6	LB	3.4	22	40	60	0	0	N	N	N	Decid.	4	
37	P19	459.6	LB	3.0	26	50	50	0	0	N	N	N	Decid.	4	
37	P19	463.9	center	4.7	16	100	10	0	0	N	N	N	Decid.	4	
37	P19	463.9	RB	5.5	25	20	30	50	0	N	N	N	Alder	3	
37	P19	463.9	RB	~3.7	~20	100	0	0	0	N	N	N	?	4	

					Zone %										
NSO	Hab ID	STA	Bank	Length (m)	Dia. (cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
37	P19	466	RB	~4.2	130	20	40	40	0	N	N	N	Conifer	4	Giant stump.
38	R23	500.8	LB	~4.6	19	40	60	0	0	N	N	N	Decid.	5	
38	R23	502.9	LB	2.6	15	5	25	70	0	N	N	N	Decid.	4	
38	R23	504.4	LB	2.8	45	40	60	0	0	N	N	N	Conifer	5	
38	R23	527.9	RB	2.4	29	50	50	0	0	N	N	N	Alder	3	
38	R23	542.8	LB	2.6	27	5	95	0	0	N	N	N	Alder	4	
38	R23	544.1	LB	3.0	17	60	40	0	0	N	N	N	Alder	3	
39	P20	545	LB	3.0	20	50	50	0	0	N	N	N	Decid.	3	
39	P20	546.5	LB	2.0	14	70	30	0	0	N	N	N	Decid.	2	
39	P20	549.6	RB	~4.6	12	5	95	0	0	N	N	N	Decid.	3	
39	P20	551.7	LB	~3.0	25	5	70	25	0	N	N	N	Decid.	4	
42	R26	584.6	LB	1.8	~80	40	60	0	0	N	N	N	Cedar	5	
42	R26	591	LB	3.1	31	70	30	0	0	N	N	N	Alder	2	
43	P21	598.6	RL	4.6	15	60	40	0	0	N	y	N	Willow	3	Rootwad attached plus
44	R27	604.4	LB	2.8	22	40	50	10	0	N	N	N	Decid.	4	
45	P22	604.4	center	3.0	25	20	40	40	0	N	N	N	Alder	2	
45	P22	625.1	center	~7.6	25	50	20	20	0	N	Y	N	Conifer	4	Jam, LWD from here down.
45	P22	630.6	center	~4.6	15	80	20	0	0	N	Y	N	Alder	2	
45	P22	630.6	center	~6.1	22	30	30	40	0	N	Y	N	Alder	3	
45	P22	630.6	center	~6.1	18	25	75	0	0	N	Y	N	Alder	2	
45	P22	630.6	center	~4.6	22	20	40	40	0	N	Y	N	Alder	2	Snags
45	P22	630.6	center	~4.6	17	20	40	40	0	N	Y	N	Alder	3	Snags
45	P22	630.6	center	~9.1	20	20	30	25	25	N	Y	N	Alder	3	Snags
45	P22	630.6	center	~6.1	15	25	25	25	25	N	Y	N	Alder	3	Snags
45	P22	630.6	center	~10.7	32	40	60	0	0	N	Y	N	Alder	2	
45	P23	630.6	center	~7.6	16	20	10	10	0	N	Y	N	Alder	2	
45	P24	630.6	center	~6.1	21	0	10	90	0	N	Y	N	Alder	2	
45	P25	630.6	center	~6.1	26	0	100	0	0	N	Y	N	Alder	3	
				162.7	1495										

Stream: Little Bear Creek
Date: 7/31/01

Reach: 3. Wood.
Crew:

					Zone %										
NSO	Hab ID	STA	Bank	Length (m)	Dia (cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
49	P24	694.3	LB	2.9	21	50	50	0	0	N	N	N	Alder	3	
49	P24	694.3	RB	6.3	15	5	30	65	0	N	N	N	Decid.	1	
49	P24	694.3	RB	5.8	28	50	25	25	0	N	N	N	Alder	2	
49	P24	694.3	cross	15.5	100	30	40	10	20	N	Y	N	FIR	2	Doug-fir
49	P24	694.3	RB	3.4	~30	50	40	10	0	N	N	N	?	2	
49	P24	694.3	RB	4.6	32	50	50	0	0	N	N	N	Cedar	2	
51	R31	706.8	RB	5.2	16	75	25	0	0	N	N	N	Alder	2	
54	R33	766.6	cross	~10.7	37	5	70	20	5	N	N	N	Cedar	1	
54	R33	768.1	cross	~6.1	20	5	70	20	5	N	N	N	Cedar	1	
54	R33	768.4	cross	~12.2	42	5	70	20	5	N	N	N	Cedar	1	
54	R33	780.3	LB	2.3	35	100	0	0	0	N	N	N	Cedar	4	
57	P27	806.8	center	7.3	40	20	80	0	0	N	Y	N	Alder	3	
57	P27	806.8	RB	4.0	30	30	70	0	0	N	N	N	Alder	3	
58	R35	811.1	LB	4.7	27	10	80	10	0	N	N	N	Alder	3	
58	R35	811.1	LB	1.7	24	40	60	0	0	N	N	N	Cherry?	3	
58	R35	811.1	LB	2.4	120	90	10	0	0	N	N	N	Cedar	5	Chunk of stump
59	R36	816.9	LB	10.9	35	0	100	0	0	N	N	N	Alder	2	
60	P28	827.5	LB	3.8	26	95	5	0	0	N	N	N	Alder	3	
60	P28	839.4	center	1.8+	34	99	1	0	0	N	N	N	Decid.	4	Embedded, raccoon tracks.
60	P28	839.4	center	1.8+	26	99	1	0	0	N	N	N	Decid.	4	Embedded, pileated woodpecker
60	P28	847.6	cross	5.8	25	60	40	0	0	N	Y	N	Alder?	4	
60	P28	847.6	cross	5.1	36	75	25	0	0	N	Y	N	Alder?	4	
64	R39	877.5	RB	6.4	21	80	20	0	0	N	N	N	Alder	2	
64	R39	892.8	RB	3.6	35	0	40	60	0	N	N	N	Alder	4	
64	R39	891.5	RB	4.8	17	5	95	0	0	N	N	N	Alder	2	
65	R40	905	RB	4.7	29	10	80	10	0	N	N	N	Alder	2	
65	R40	909.5	LB	4.7	28	10	90	0	0	N	N	N	Alder	3	
67	P30	915.9	LB	4.6	90	20	80	0	0	N	N	N	Cedar	5	
67	P30	919.6	cross	6.1	22	0	60	20	20	N	N	N	Cherry	1	House LB
67	P30	920.5	cross	6.1	28	0	60	20	20	N	N	N	Cherry	1	
67	P30	922.3	cross	6.1	22	5	20	75	0	N	N	N	Cherry	1	
				138.7											

Stream: Little Bear Creek
Date: 8/01/01

Reach: 3. Wood.
Crew: Scott & Dan

					Zone %										
NSO	Hab ID	STA	Bank	Length (m)	Dia (cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
71	R44	1008	RB	3.4	30	40	60	0	0	N	N	N	Alder	3	
72	P32	1015	LB	6.8	28	50	50	0	0	N	N	N	Alder	4	
75	P34	1054	cross	12.2	37	30	20	25	25	N	Y	N	Cedar	3	
75	P34	1055	cross	4.8	19	90	10	0	0	N	Y	N	Decid.	4	
75	P34	1054	cross	10.7+	32	25	25	25	25	N	Y	N	Cedar	3	
75	P34	1053	LB	2.4	40	10	90	0	0	N	N	N	Cedar	3	Broken, large alive cedar, not counted.
75	P34	1054	LB	2.4	30	5	95	0	0	N	N	N	Alder	3	Broken, see photo 8
76	P35	1059	center	6.6	20	5	80	15	0	N	N	N	Cedar	2	
76	P35	1142	LB	5.5	25	10	90	0	0	N	N	N	Cedar	3	
77	R47	1061	LB	5.5	42	15	85	0	0	N	N	N	Alder	2	
77	R47	1061	LB	4.7	15	40	60	0	0	N	N	N	Cedar	3	
78	P35	1076	cross	12.2+	50	10	30	30	30	N	Y	N	BLM	1	Giant big-leaf maple
80	P36	1109	RB	6.8	30	15	85	0	0	N	?Y	N	Cedar	3	
80	P36	1109	RB	7.0	25	10	90	0	0	N	?Y	N	Cedar	3	
82	P37	1125	cross	7.0	60	5	45	50	0	N	N	N	Alder	2	Old, big, rotten.
83	R50	1140	cross	7.6	29	5	55	40	0	N	N	N	Alder	3	
84	R51	1167	cross	6.1	20	10	90	0	0	N	N	N	Cedar	3	
84	R51	1167	LB+	4.6+	20	100	0	0	0	N	N	N	Cedar	3	
84	R51	1170	cross	5.5	19	5	95	0	0	N	N	N	Cedar	4	
84	R51	1170	LB+	1.8+	21	60	40	0	0	N	N	N	Cedar	4	
84	R51	1170	LB+	2.9	24	15	85	0	0	N	N	N	Cedar	4	
84	R51	1170	RB	3.7	30	5	95	0	0	N	N	N	Cedar	4	
84	R52	1181	RB	2.1	60	10	90	0	0	N	N	N	Cedar	5	
85	R52	1185	RB	4.9	18	40	60	0	0	N	N	N	Cedar	4	
86	P38	1187	LB	9.0	25	5	95	0	0	N	N	N	Cedar	1	
86	P38	1199	LB	2.1+	19	25	75	0	0	N	N	N	Decid.	4	
87	R53	1202	RB	6.7	20	5	45	30	20	N	N	N	Cedar	4	
87	R53	1202	RB	10.7+	40	0	5	45	50	N	N	N	Cedar	3	
87	R53	1204	LB	4.0	32	5	90	5	0	N	N	N	Fir	3	Doug-fir, broken.

					Zone %										
NSO	Hab ID	STA	Bank	Length (m)	Dia (cm)	Z1	Z2	Z3	Z4	Origin	Pool	MM	Species	Decay Class	Comments
87	R53	1205	LB	3.4	22	0	100	0	0	N	N	N	Decid.	4	
87	R54	1216	cross	12.2+	22	5	25	25	45	N	Y	N	Spruce	1	Pocket pool.
87	R54	1223	cross	6.1	29	50	50	0	0	N	Y	N	Cedar	4	
87	R54	1223	RB	3.0	35	0	100	0	0	N	N	N	Fir		
91	R57	1279	LB	5.2	22	10	90	0	0	N	N	N	Cedar	4	
92	R58	1288	center	4.2	32	0	95	5	0	N	N	N	BLM	4	
92	R58	1291	RB	4.9	35	10	65	10	15	N	N	N	Alder	1	
93	R59	1306	RB	2.1	35	40	60	0	0	N	N	N	Conifer	5	
94	P39	1310	RB	3.7	25	0	100	0	0	N	N	N	Alder	2	
				160.3	1117										

Appendix O

APPENDIX O:
DEA Wolman Pebble Count Data

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

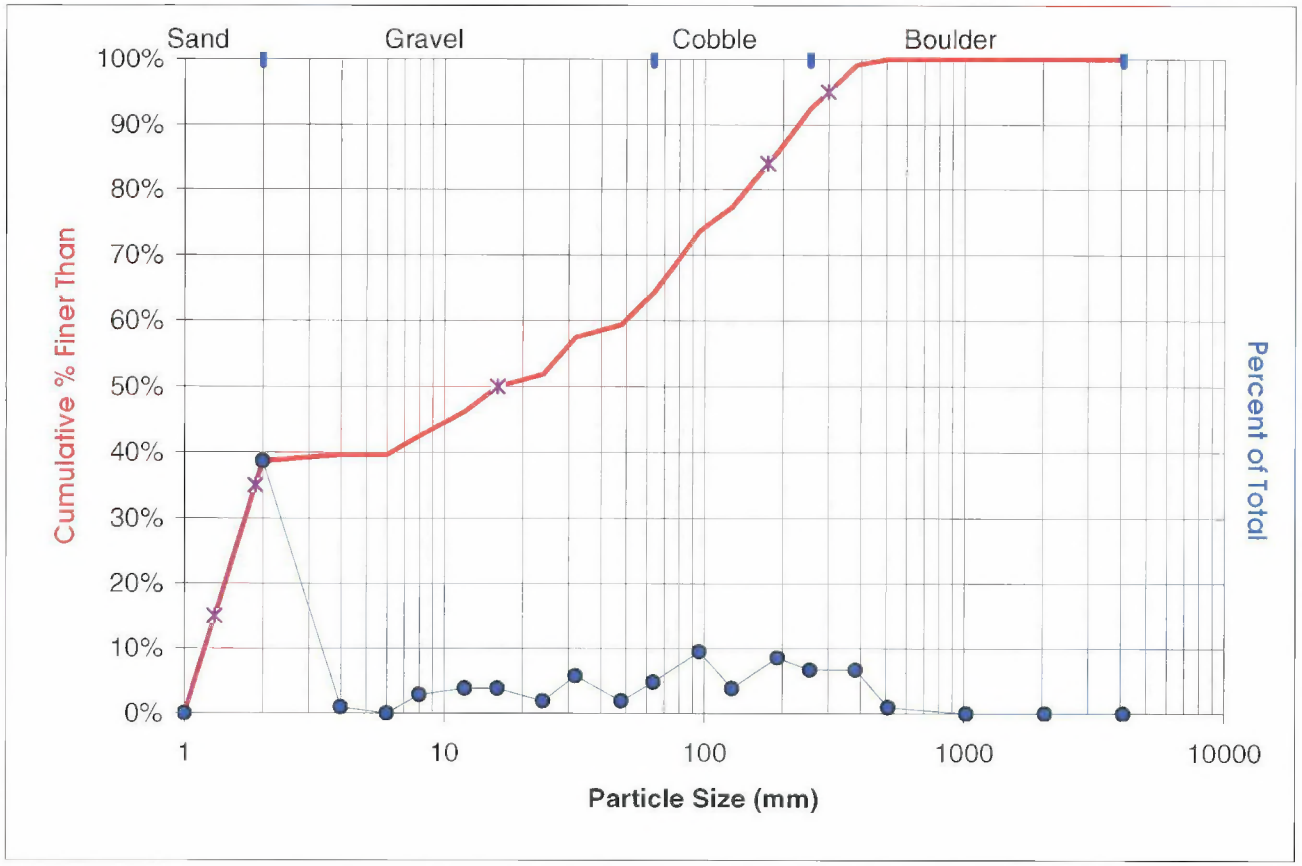
Pebble Count Worksheet

Comment: +/- 18.4M upstream of mouth (started immediately upstream of walk bridge)

Particle Size (mm)	% finer than	Total Count
< 2	39%	41
2 - 4	40%	1
4 - 6	40%	0
6 - 8	42%	3
8 - 12	46%	4
12 - 16	50%	4
16 - 24	52%	2
24 - 32	58%	6
32 - 48	59%	2
48 - 64	64%	5
64 - 96	74%	10
96 - 128	77%	4
128 - 192	86%	9
192 - 256	92%	7
256 - 384	99%	7
384 - 512	100%	1
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
	Total #	106

STREAM NAME: Little Bear Creek
ID NUMBER:
DATE: 6/25/01
CREW: Scott & Joe

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	40%	1.9	16.0	175.8	299.3



FILENAME: PebbleReach1_6-25-01a.xls ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

Pebble Count Worksheet

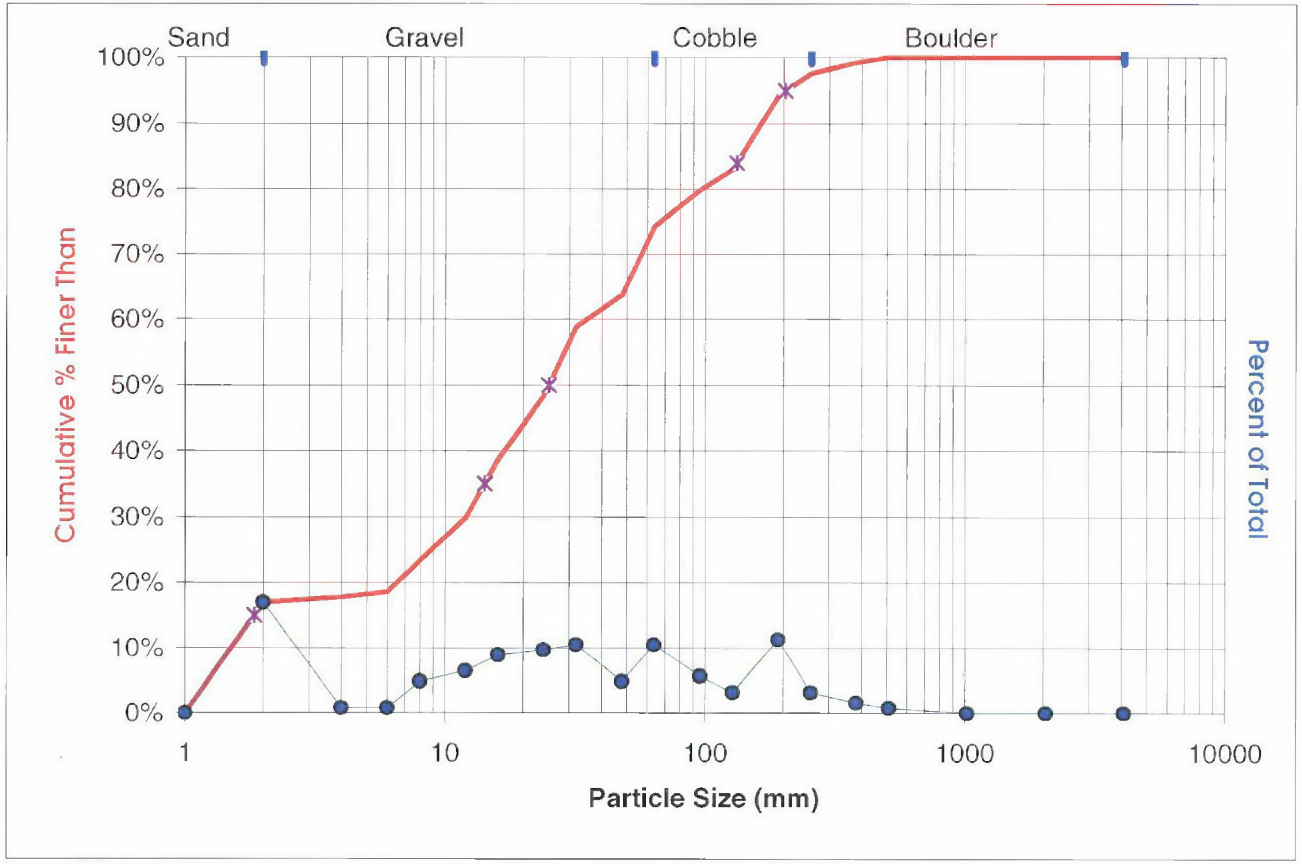
COMMENTS: immediately downstream of SR 202: very embedded

# of transects= 7

STREAM NAME: Little Bear Creek
ID NUMBER: NSO 14
DATE: 6/25/01
CREW: Scott &

Particle Size (mm)	% finer than	Total Count
< 2	17%	21
2 - 4	18%	1
4 - 6	19%	1
6 - 8	23%	6
8 - 12	30%	8
12 - 16	39%	11
16 - 24	48%	12
24 - 32	59%	13
32 - 48	64%	6
48 - 64	74%	13
64 - 96	80%	7
96 - 128	83%	4
128 - 192	94%	14
192 - 256	98%	4
256 - 384	99%	2
384 - 512	100%	1
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
	Total #	124

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	19%	14.2	25.1	132.4	203.4



FILENAME: PebbleReach1_06-25-01b.xls ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

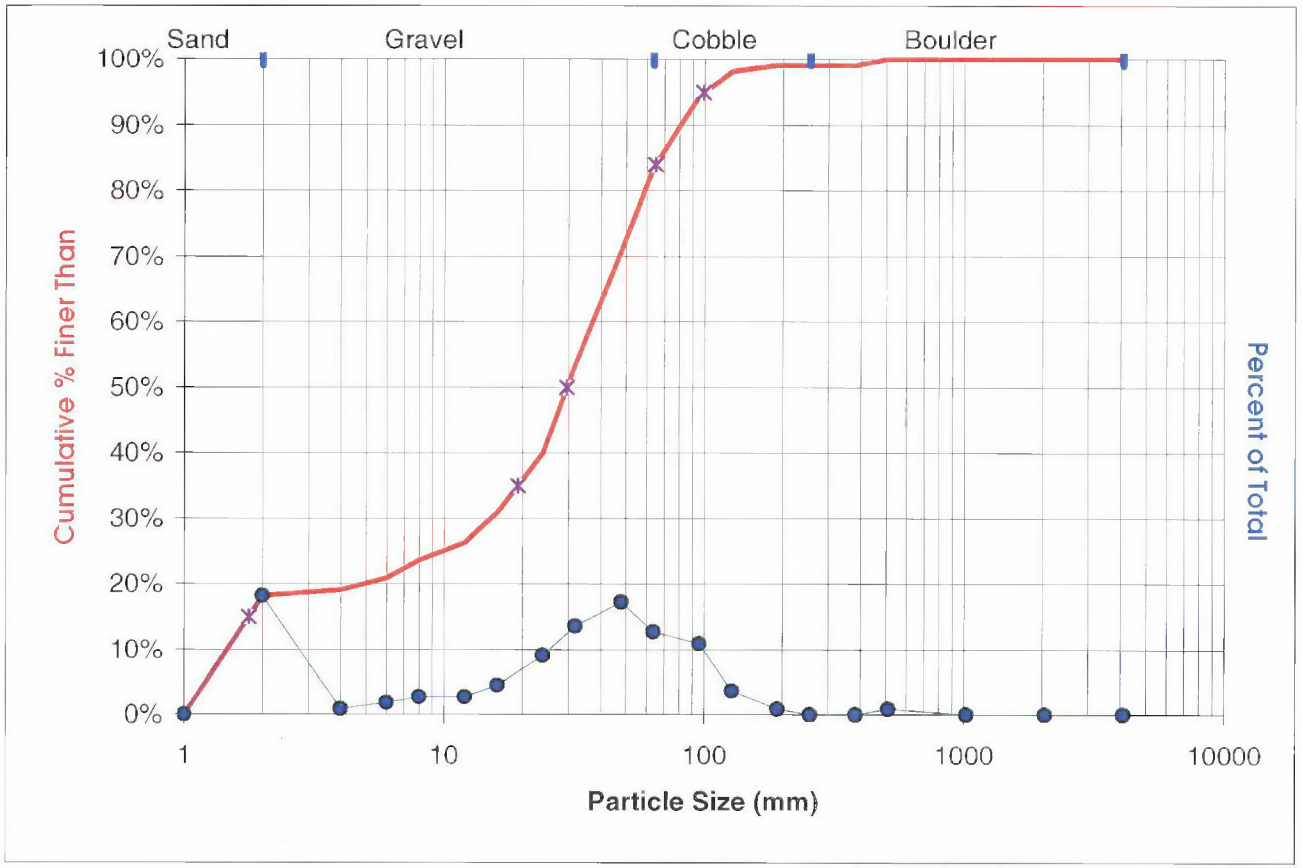
Pebble Count Worksheet

COMMENTS: Site: riffle immediately upstream of SR202 culvert

Particle Size (mm)	% finer than	Total Count
< 2	18%	20
2 - 4	19%	1
4 - 6	21%	2
6 - 8	24%	3
8 - 12	26%	3
12 - 16	31%	5
16 - 24	40%	10
24 - 32	54%	15
32 - 48	71%	19
48 - 64	84%	14
64 - 96	95%	12
96 - 128	98%	4
128 - 192	99%	1
192 - 256	99%	0
256 - 384	99%	0
384 - 512	100%	1
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
	Total #	110

STREAM NAME: Little Bear Creek
ID NUMBER: NSO 2
DATE: 6/25/01
CREW: Scott & Joe

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	21%	19.2	29.6	64.9	99.5



FILENAME: PebbleReach2_6-26-01.xls ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

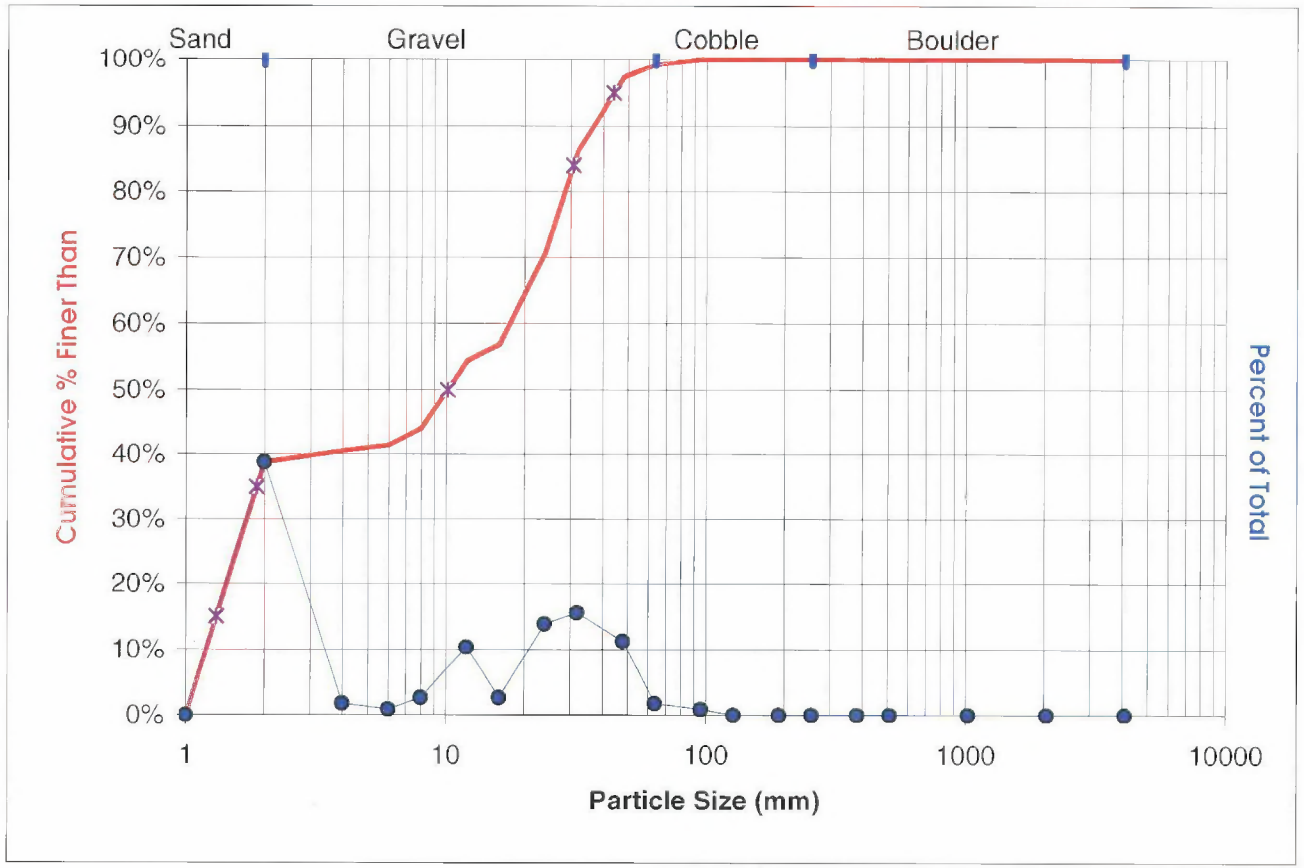
Pebble Count Worksheet

COMMENTS:# of transects 5

Particle Size (mm)	% finer than	Total Count
< 2	39%	45
2 - 4	41%	2
4 - 6	41%	1
6 - 8	44%	3
8 - 12	54%	12
12 - 16	57%	3
16 - 24	71%	16
24 - 32	86%	18
32 - 48	97%	13
48 - 64	99%	2
64 - 96	100%	1
96 - 128	100%	0
128 - 192	100%	0
192 - 256	100%	0
256 - 384	100%	0
384 - 512	100%	0
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
Total #		116

STREAM NAME: Little Bear Creek
ID NUMBER: NSO 15, R9
DATE: 6/28/01
CREW: Scott & Joe

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	41%	1.9	10.1	30.7	44.0



FILENAME: PebbleRreach2_6-28-01.xls1 ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

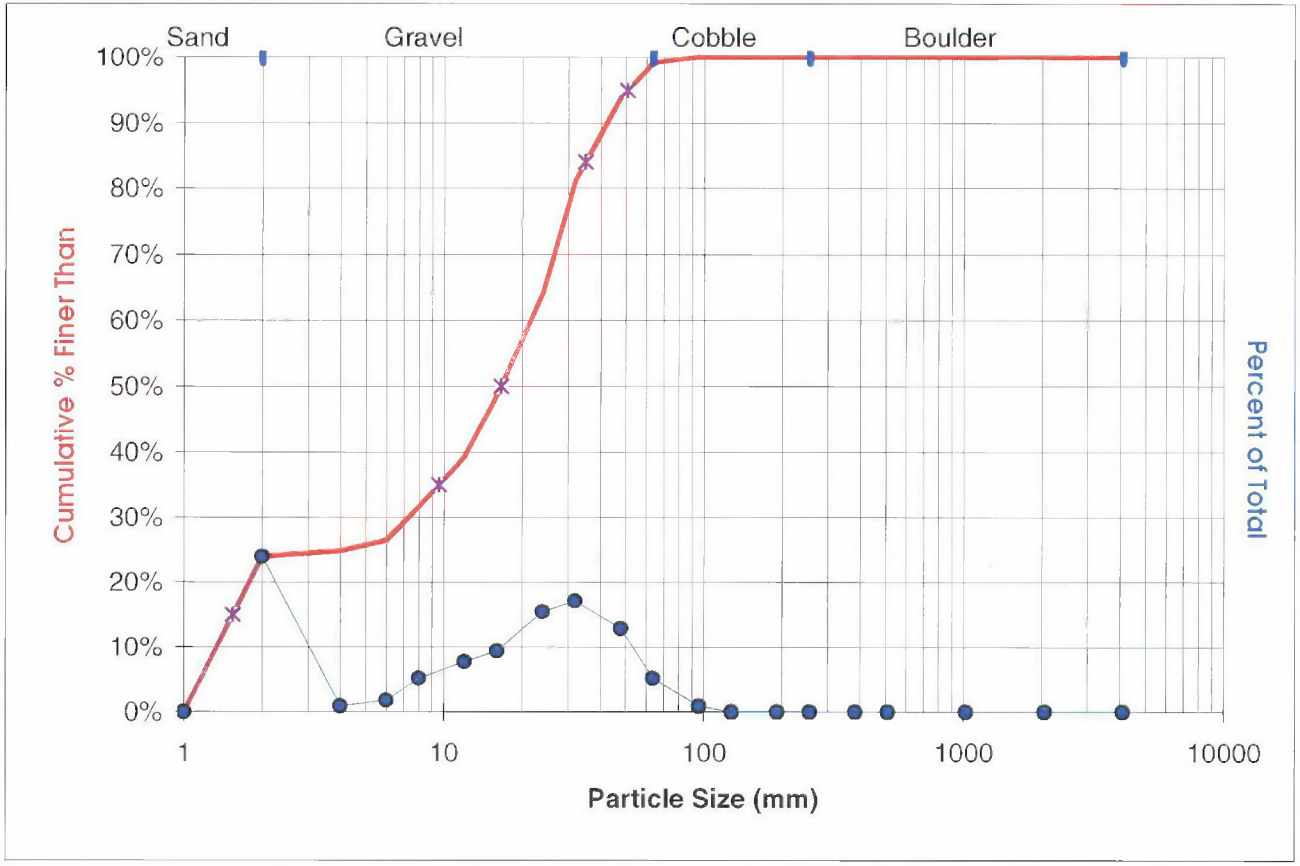
Pebble Count Worksheet

COMMENTS:sta. 558.9 at orange flag saying 1998 UW BJBI.

Particle Size (mm)	% finer than	Total Count
< 2	24%	28
2 - 4	25%	1
4 - 6	26%	2
6 - 8	32%	6
8 - 12	39%	9
12 - 16	49%	11
16 - 24	64%	18
24 - 32	81%	20
32 - 48	94%	15
48 - 64	99%	6
64 - 96	100%	1
96 - 128	100%	0
128 - 192	100%	0
192 - 256	100%	0
256 - 384	100%	0
384 - 512	100%	0
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
	Total #	117

STREAM NAME: Little Bear Creek
ID NUMBER:
DATE: 6/29/01
CREW: Scott & Joe

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	26%	9.6	16.5	35.0	50.7



FILENAME: PebbleReach2_6-29-01.xls1 ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

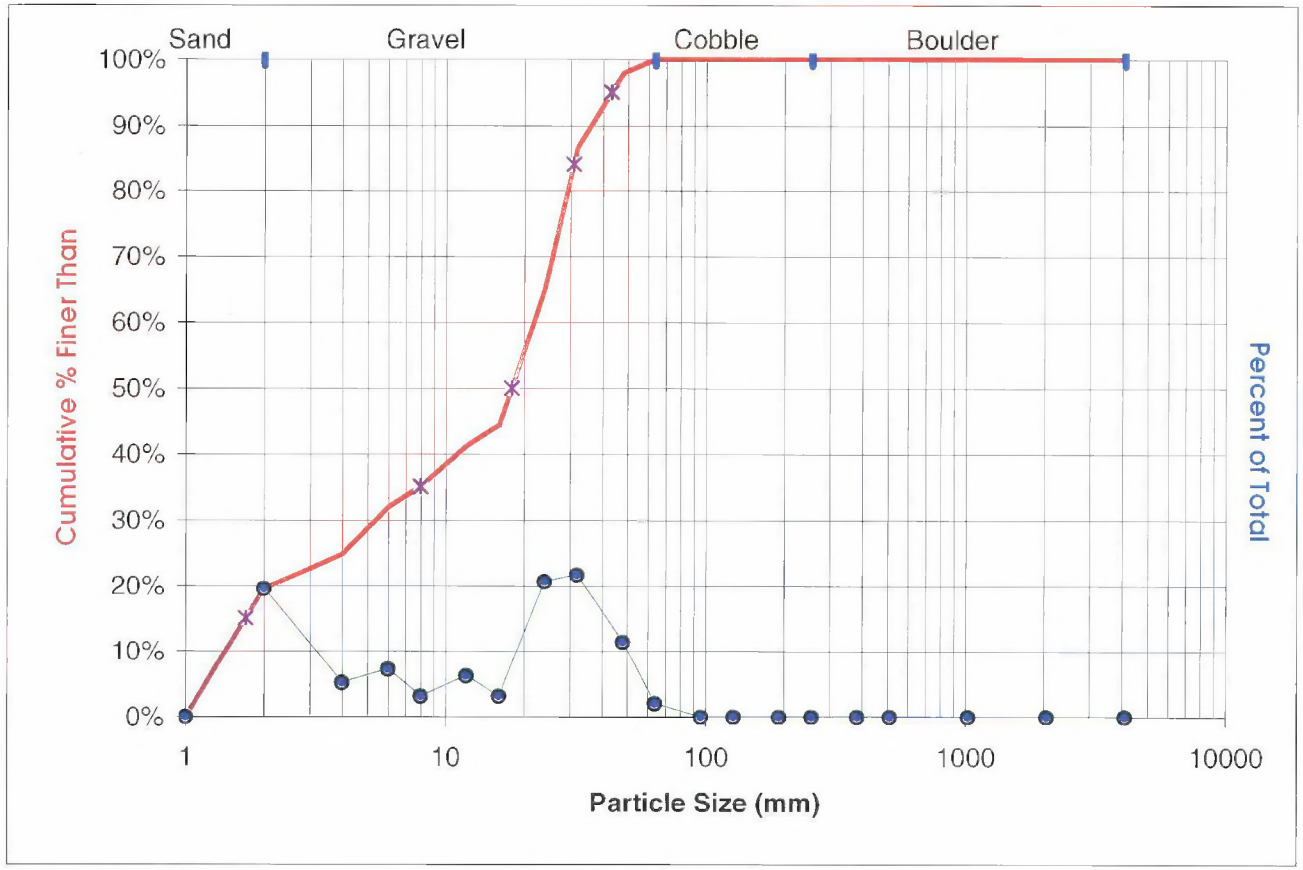
Pebble Count Worksheet

COMMENTS:just upstream of reach 27, sta. 1015, # of transects= 4

Particle Size (mm)	% finer than	Total Count
< 2	20%	19
2 - 4	25%	5
4 - 6	32%	7
6 - 8	35%	3
8 - 12	41%	6
12 - 16	44%	3
16 - 24	65%	20
24 - 32	87%	21
32 - 48	98%	11
48 - 64	100%	2
64 - 96	100%	0
96 - 128	100%	0
128 - 192	100%	0
192 - 256	100%	0
256 - 384	100%	0
384 - 512	100%	0
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
	Total #	97

STREAM NAME: Little Bear Creek
ID NUMBER: NSO 56, R29
DATE: 7/2/01
CREW: Scott & Joe

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	32%	8.0	17.9	30.9	43.2



FILENAME: PebbleReach2_7-2-011 ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

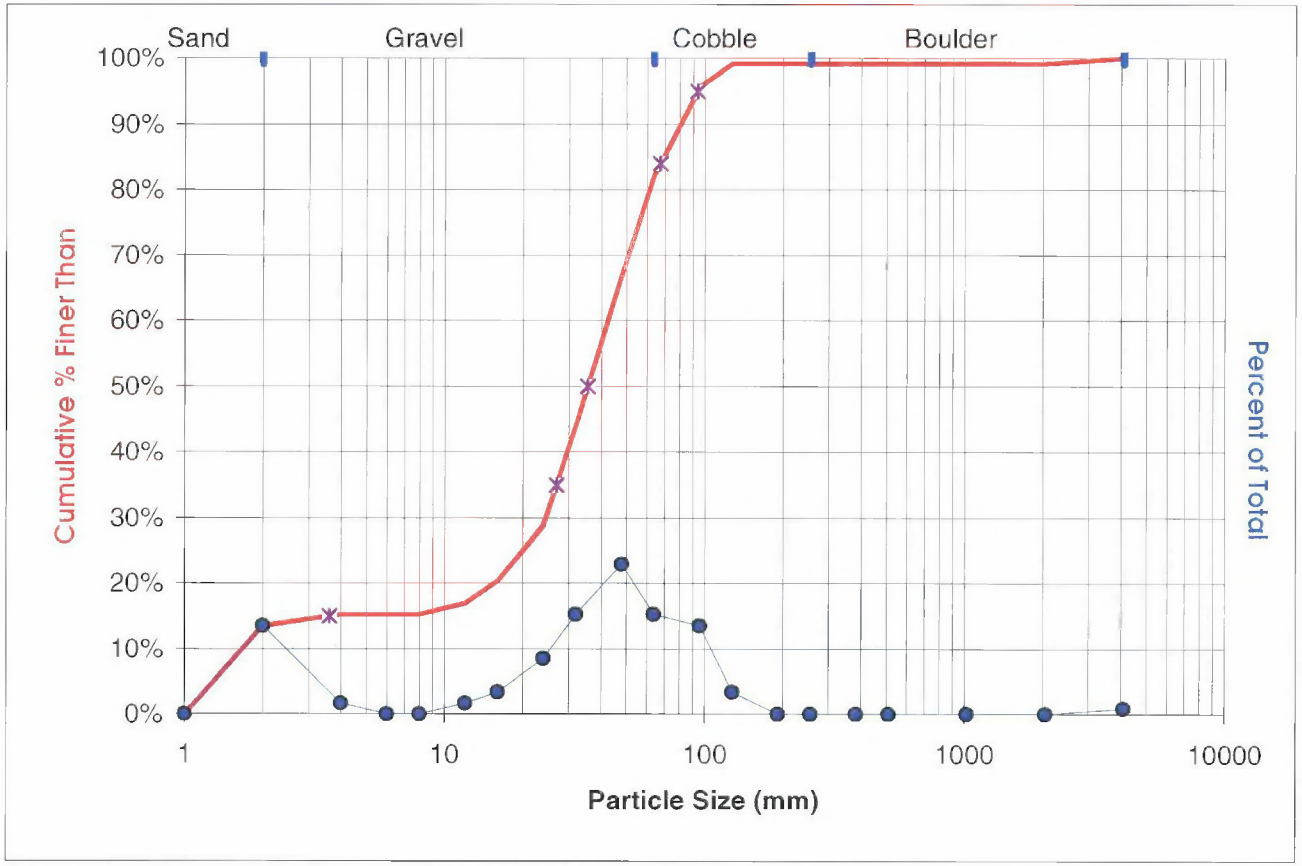
Pebble Count Worksheet

COMMENTS:# of transects=6, NSO= 76

Particle Size (mm)	% finer than	Total Count
< 2	14%	16
2 - 4	15%	2
4 - 6	15%	0
6 - 8	15%	0
8 - 12	17%	2
12 - 16	20%	4
16 - 24	29%	10
24 - 32	44%	18
32 - 48	67%	27
48 - 64	82%	18
64 - 96	96%	16
96 - 128	99%	4
128 - 192	99%	0
192 - 256	99%	0
256 - 384	99%	0
384 - 512	99%	0
512 - 1024	99%	0
1024-2048	99%	0
2048-4096	100%	1
Total #		118

STREAM NAME: Litle Bear Creek
ID NUMBER:
DATE: 7/6/01
CREW: Scott & Joe

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	15%	27.0	35.5	67.5	93.8



FILENAME: PebbleReach2_7-6-011 ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

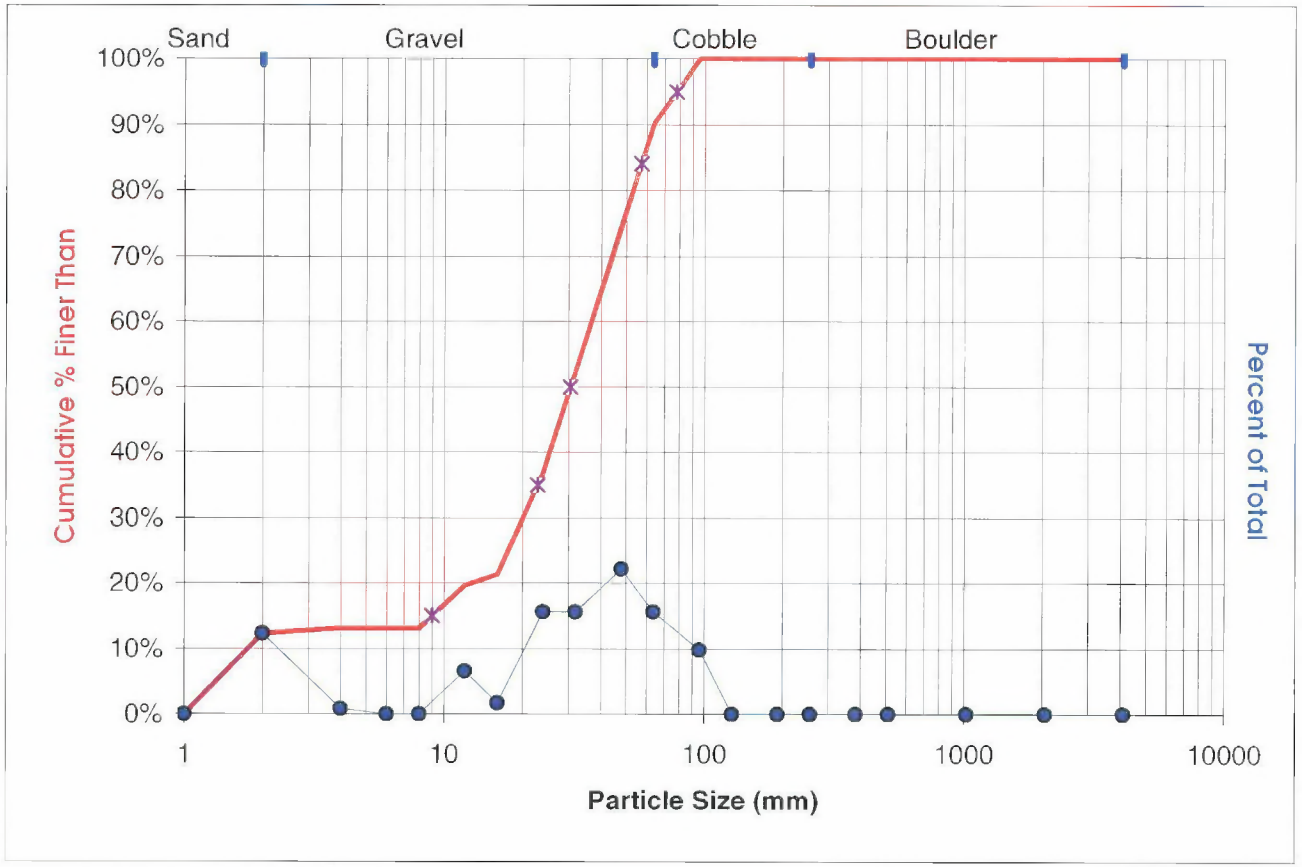
Pebble Count Worksheet

Particle Size (mm)	% finer than	Total Count
< 2	12%	15
2 - 4	13%	1
4 - 6	13%	0
6 - 8	13%	0
8 - 12	20%	8
12 - 16	21%	2
16 - 24	37%	19
24 - 32	52%	19
32 - 48	75%	27
48 - 64	90%	19
64 - 96	100%	12
96 - 128	100%	0
128 - 192	100%	0
192 - 256	100%	0
256 - 384	100%	0
384 - 512	100%	0
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
	Total #	122

COMMENTS:

STREAM NAME: Little Bear Creek
ID NUMBER: R2
DATE: 7/19/01
CREW: Scott & Amy

Particle Size Distribution (mm)	**Fines <6 mm**	**D35**	**D50**	**D84**	**D95**
	13%	**22.9**	**30.6**	**57.1**	**78.1**



FILENAME: PebbleReach3_7-19-01.xls ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

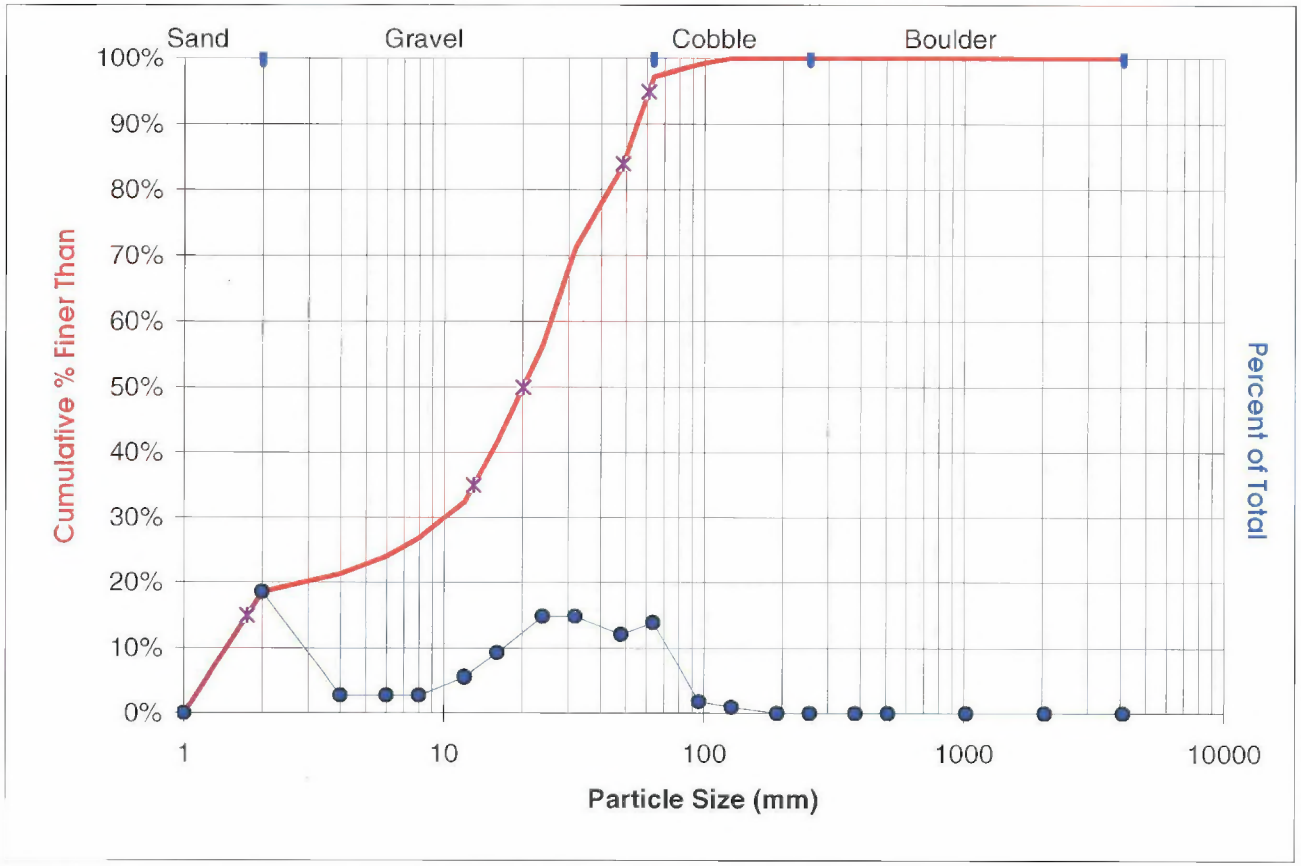
Pebble Count Worksheet

Particle Size (mm)	% finer than	Total Count
< 2	19%	20
2 - 4	21%	3
4 - 6	24%	3
6 - 8	27%	3
8 - 12	32%	6
12 - 16	42%	10
16 - 24	56%	16
24 - 32	71%	16
32 - 48	83%	13
48 - 64	97%	15
64 - 96	99%	2
96 - 128	100%	1
128 - 192	100%	0
192 - 256	100%	0
256 - 384	100%	0
384 - 512	100%	0
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
	Total #	108

COMMENTS:

STREAM NAME: Little Bear Creek
ID NUMBER: R23
DATE: 7/20/01
CREW: Scott & Amy

Particle Size Distribution (mm)	**Fines <6 mm**	**D35**	**D50**	**D84**	**D95**
	24%	**13.0**	**20.1**	**48.7**	**61.1**



FILENAME: PebbleReach3_7-20-01.xls ENTERED: 7/10/02

Check Cell Notes (See online help to access cell notes) for specific information. If spreadsheet is slow on data entry you may want to use man

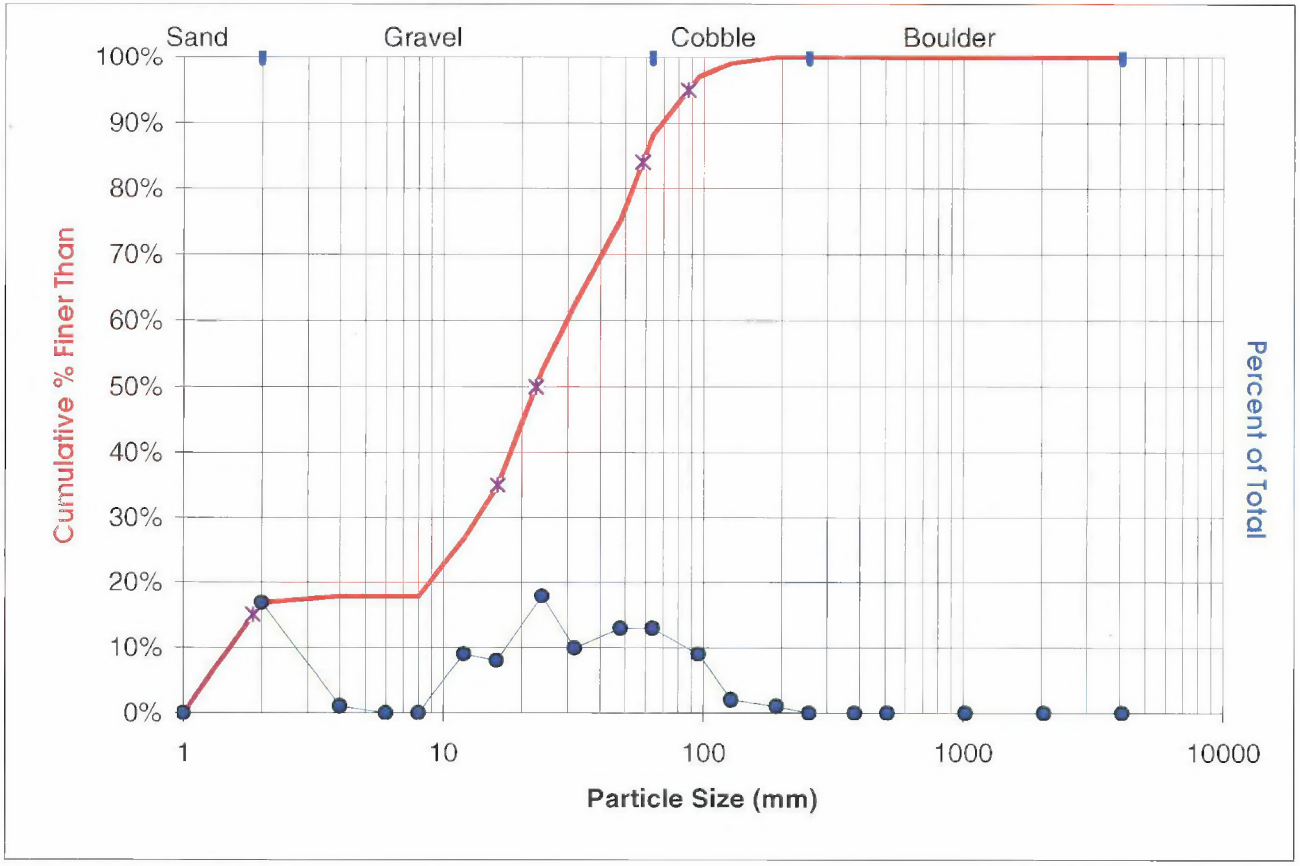
Pebble Count Worksheet

Particle Size (mm)	% finer than	Total Count
< 2	17%	17
2 - 4	18%	1
4 - 6	18%	0
6 - 8	18%	0
8 - 12	27%	9
12 - 16	35%	8
16 - 24	52%	18
24 - 32	62%	10
32 - 48	75%	13
48 - 64	88%	13
64 - 96	97%	9
96 - 128	99%	2
128 - 192	100%	1
192 - 256	100%	0
256 - 384	100%	0
384 - 512	100%	0
512 - 1024	100%	0
1024-2048	100%	0
2048-4096	100%	0
	Total #	101

COMMENTS:

STREAM NAME: Little Bear Creek
ID NUMBER: R30
DATE: 7/31/01
CREW: Scott & amy

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	18%	16.1	22.7	58.4	87.5



FILENAME: PebbleReach3_7-31-01.xls ENTERED: 7/10/02

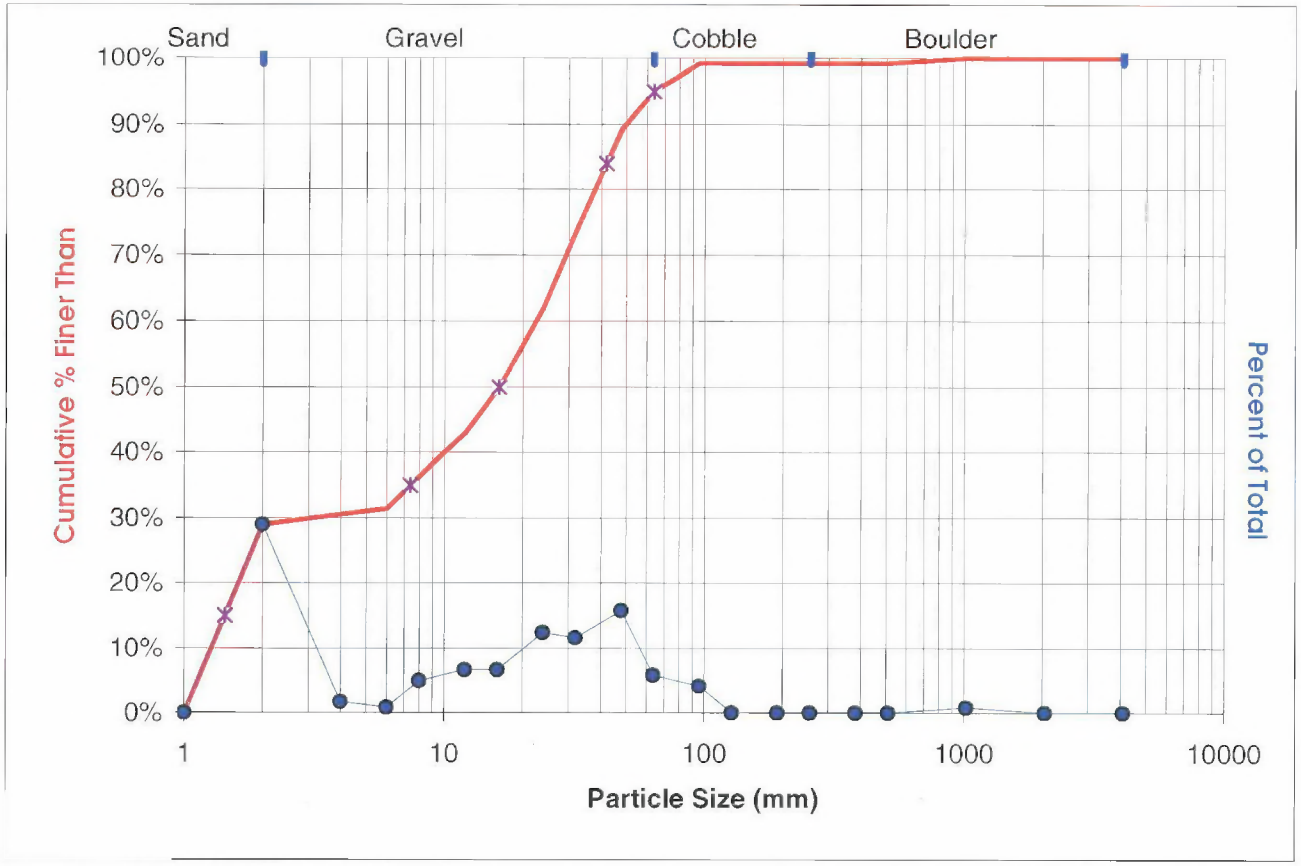
Pebble Count Worksheet

Particle Size (mm)	% finer than	Total Count
< 2	29%	35
2 - 4	31%	2
4 - 6	31%	1
6 - 8	36%	6
8 - 12	43%	8
12 - 16	50%	8
16 - 24	62%	15
24 - 32	74%	14
32 - 48	89%	19
48 - 64	95%	7
64 - 96	99%	5
96 - 128	99%	
128 - 192	99%	
192 - 256	99%	
256 - 384	99%	
384 - 512	99%	
512 - 1024	100%	1
1024-2048	100%	
2048-4096	100%	
	Total #	121

COMMENTS:

STREAM NAME: Little Bear Creek
ID NUMBER: Reach 3, NSO 81
DATE: 9/25/01
CREW: Matt and Scott

Particle Size Distribution (mm)	Fines <6 mm	D35	D50	D84	D95
	31%	7.4	16.2	41.9	63.9



FILENAME: PebbleReach3__9-25-01.xls ENTERED: 7/10/02

Appendix P

APPENDIX P:
2001 Reach 1
Data Logger Stream Temperature Results

```
Date,Time,Temperature    (*C)
06/15/01,18:00,13.42
06/15/01,19:00,13.27
06/15/01,20:00,13.27
06/15/01,21:00,13.12
06/15/01,22:00,12.81
06/15/01,23:00,12.49
06/16/01,00:00,12.34
06/16/01,01:00,12.03
06/16/01,02:00,11.72
06/16/01,03:00,11.56
06/16/01,04:00,11.41
06/16/01,05:00,11.25
06/16/01,06:00,11.25
06/16/01,07:00,11.1
06/16/01,08:00,11.1
06/16/01,09:00,11.25
06/16/01,10:00,11.25
06/16/01,11:00,11.41
06/16/01,12:00,11.56
06/16/01,13:00,11.87
06/16/01,14:00,12.34
06/16/01,15:00,12.81
06/16/01,16:00,12.81
06/16/01,17:00,13.27
06/16/01,18:00,13.27
06/16/01,19:00,13.12
06/16/01,20:00,13.12
06/16/01,21:00,12.81
06/16/01,22:00,12.49
06/16/01,23:00,12.34
06/17/01,00:00,12.03
06/17/01,01:00,11.87
06/17/01,02:00,11.56
06/17/01,03:00,11.41
06/17/01,04:00,11.25
06/17/01,05:00,10.94
06/17/01,06:00,10.79
06/17/01,07:00,10.79
06/17/01,08:00,10.79
06/17/01,09:00,10.79
06/17/01,10:00,10.94
06/17/01,11:00,11.25
06/17/01,12:00,11.56
06/17/01,13:00,12.18
06/17/01,14:00,12.34
06/17/01,15:00,12.81
06/17/01,16:00,13.27
```

```
06/17/01,17:00,13.58
06/17/01,18:00,13.88
06/17/01,19:00,13.73
06/17/01,20:00,13.58
06/17/01,21:00,13.27
06/17/01,22:00,12.96
06/17/01,23:00,12.81
06/18/01,00:00,12.65
06/18/01,01:00,12.49
06/18/01,02:00,12.34
06/18/01,03:00,12.18
06/18/01,04:00,12.03
06/18/01,05:00,11.72
06/18/01,06:00,11.72
06/18/01,07:00,11.56
06/18/01,08:00,11.56
06/18/01,09:00,11.56
06/18/01,10:00,11.72
06/18/01,11:00,11.72
06/18/01,12:00,12.03
06/18/01,13:00,12.65
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06/18/01,23:00,13.58
06/19/01,00:00,13.27
06/19/01,01:00,12.96
06/19/01,02:00,12.65
06/19/01,03:00,12.34
06/19/01,04:00,12.03
06/19/01,05:00,11.72
06/19/01,06:00,11.56
06/19/01,07:00,11.41
06/19/01,08:00,11.41
06/19/01,09:00,11.56
06/19/01,10:00,11.87
06/19/01,11:00,12.34
06/19/01,12:00,12.96
06/19/01,13:00,13.73
06/19/01,14:00,14.35
06/19/01,15:00,15.13
06/19/01,16:00,15.61
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Appendix Q

APPENDIX Q:
2001 Reach 3
Data Logger Stream Temperature Results

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06/16/01,08:00,10.82
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Appendix R

APPENDIX R:
On-Going
City of Woodinville Restoration Projects

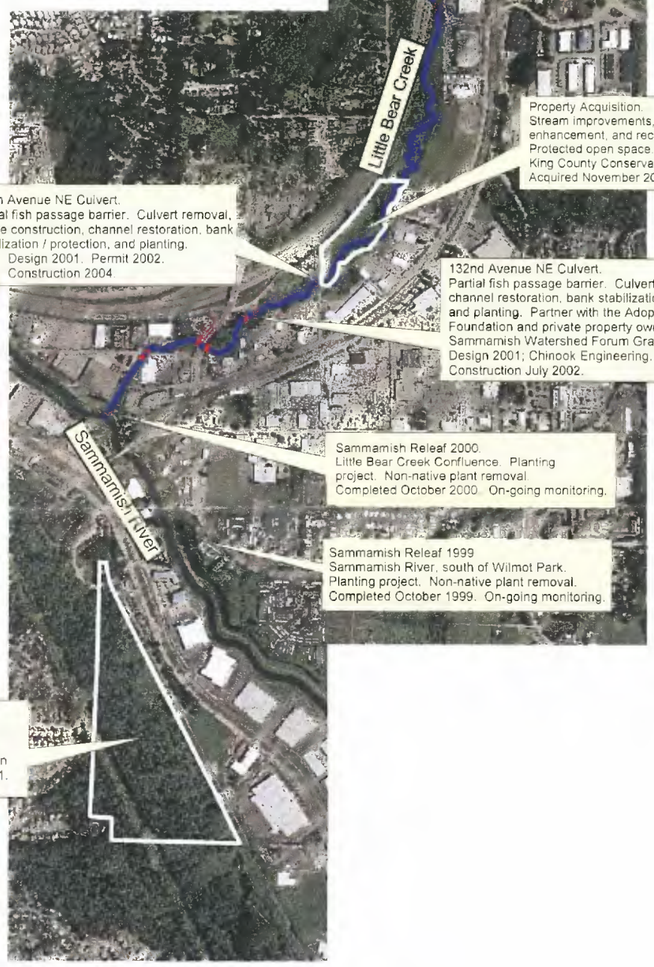
NE 205th Street Culvert. Baffle installed at outlet.
Partnered with Snohomish County.
Trans-Aid Grant Fund.
Completed September 2000.

NE 205th Street Reach.
Fish passage improvement. Weir installation, bank stabilization / protection, pool enhancement, and planting. Partner with Snohomish County and private property owner.
Design 2001. Permit 2001. Construction July 2002.

Property Acquisition.
Good habitat. Restoration, enhancement, and recreation opportunities. Protected open space.
Acquired June 2001.

Property Acquisition.
Restoration, enhancement, and recreation opportunities. Protected open space.
Acquired June 2001.

NE 195th Street Reach.
Fish passage improvement.
Weir repairs, and plantings. Partner with Snohomish County and Adopt-A-Stream Foundation.
Trans-Aid Grant Fund.
Design 2001. Permit 2002. Construction July 2004.



Property Acquisition.
Stream improvements, good habitat, enhancement, and recreation opportunities.
Protected open space.
King County Conservation Grant.
Acquired November 2000.

134th Avenue NE Culvert.
Partial fish passage barrier. Culvert removal, bridge construction, channel restoration, bank stabilization / protection, and planting.
Design 2001. Permit 2002.
Construction 2004

132nd Avenue NE Culvert.
Partial fish passage barrier. Culvert removal, channel restoration, bank stabilization / protection, and planting. Partner with the Adopt-A-Stream Foundation and private property owners.
Sammamish Watershed Forum Grant.
Design 2001; Chinook Engineering. Permit 2001.
Construction July 2002.

Sammamish Releaf 2000.
Little Bear Creek Confluence. Planting project. Non-native plant removal.
Completed October 2000. On-going monitoring.

Sammamish Releaf 1999
Sammamish River, south of Wilmot Park.
Planting project. Non-native plant removal.
Completed October 1999. On-going monitoring.

Property donated by
Lakeside Industries, Inc.
Good habitat and recreation opportunities. Protected open space. Donated August 2001.

Little Bear Creek Habitat Assessment Study. Field investigation. Begun June 2001.
Study completion March 2002.
David Evans and Associates, Inc.

Sammamish Releaf 2001
Planting project. Non-native plant removal.
Planting October 2001.

N

City of Woodinville
Habitat Enhancement Projects
July 2001

NTS

DRAFT

The city of WOODINVILLE

Drawn by Sean Baker July 5, 2001

Appendix S

APPENDIX S:
Potential Wildlife Species List

Common Name	Scientific Name	Habitat									
		Herbaceous	Shrub	Deciduous	Coniferous	Mixed C/D	Riparian	Wetland (Fo)	Wetland (S-S)	Wetland (Em)	Wetland (OW)
BIRDS											
Great blue heron	*Ardea herodias*	X					X			X	X
Green-backed heron	*Butorides striatus*						X			X	X
Canada goose	*Branta canadensis*	X								X	X
Green-winged teal	*Anas crecca*									X	X
Cinnamon teal	*Anas cyanoptera*									X	X
Blue-winged teal	*Anas discors*									X	X
Mallard	*Anas platyrhynchos*						X			X	X
Northern pintail	*Anas acuta*									X	X
Northern shoveler	*Anas clypeata*									X	X
American wigeon	*Anas americana*									X	X
Gadwall	*Anas strepera*									X	X
Wood duck	*Aix sponsa*						X			X	X
Hooded merganser	*Lophodytes cucullatus*						X			X	X
Red-tailed hawk	*Buteo jamaicensis*	X		X	X	X					
Sharp-shinned hawk	*Accipiter striatus*			X	X	X					
Cooper's hawk	*Accipiter cooperii*			X	X	X					
Bald eagle	*Haliaeetus leucocephalus*			X	X	X	X				X
American kestrel	*Falco sparverius*	X		X		X					
Ruffed grouse	*Bonasa umbellus*			X	X	X	X				
California quail	*Callipepla californica*	X	X								
Ring-necked pheasant	*Phasianus colchicus*	X	X								
Virginia rail	*Rallus limicola*								X	X	X
Sora	*Porzana carolina*								X	X	X
Killdeer	*Charadrius vociferus*	X									
Common snipe	*Gallinago gallinago*	X	X								
Spotted sandpiper	*Actitis macularia*						X				
California gull	*Larus californicus*	X									
Band-tailed pigeon	*Columba fasciata*			X	X	X					
Rock dove	*Columba livia*	X									
Mourning dove	*Zenaida macroura*		X	X	X	X	X				
Western screech owl	*Otus kennicottii*			X	X	X	X				
Great horned owl	*Bubo virginianus*			X	X	X	X				
Short-eared owl	*Asio flammeus*	X	X							X	
Northern pygmy owl	*Glaucidium gnoma*				X	X					
Barred owl	*Strix varia*			X	X	X					
Barn owl	*Tyto alba*	X		X		X					
Rufous hummingbird	*Selasphorus rufus*		X				X				
Anna's hummingbird	*Calypte anna*			X		X					
Belted kingfisher	*Ceryle alcyon*						X				X
Northern flicker	*Colaptes auratus*		X	X	X	X	X				
Pileated woodpecker	*Dryocopus pileatus*			X	X	X					
Red-breasted sapsucker	*Sphyrapicus ruber*		X	X	X	X					
Downy woodpecker	*Picoides pubescens*			X	X	X	X				
Hairy woodpecker	*Picoides villosus*			X	X	X	X				
Olive-sided flycatcher	*Contopus borealis*			X	X	X	X				
Western wood-pewee	*Contopus sordidulus*			X	X	X	X				

Common Name	Scientific Name	Habitat									
		Herbaceous	Shrub	Deciduous	Coniferous	Mixed C/D	Riparian	Wetland (Fo)	Wetland (S-S)	Wetland (Em)	Wetland (OW)
Willow flycatcher	*Empidonax traillii*		X	X			X				
Pacific-slope flycatcher	*Empidonax difficilis*			X	X	X	X				
Tree swallow	*Tachycineta bicolor*	X	X		X	X	X	X	X	X	X
Violet-green swallow	*Tachycineta thalassina*	X	X	X	X	X	X	X	X	X	X
Barn swallow	*Hirundo rustica*	X	X						X	X	X
Steller's jay	*Cyanocitta stelleri*		X	X	X	X					
American crow	*Corvus brachyrhynchos*	X	X	X	X	X	X	X	X	X	
Black-capped chickadee	*Parus atricapillus*		X	X	X	X	X	X	X		
Chestnut-backed chickadee	*Parus rufescens*		X	X	X	X	X	X	X		
Common bushtit	*Psaltriparus minimus*		X	X		X	X	X	X		
Red-breasted nuthatch	*Sitta canadensis*			X	X	X	X				
Brown creeper	*Certhia americana*			X	X	X	X				
American dipper	*Cinclus mexicanus*						X				
Bewick's wren	*Thryomanes bewickii*		X	X	X	X	X		X		
Winter wren	*Troglodytes troglodytes*		X	X	X	X	X	X			
Marsh wren	*Cistothorus palustris*								X	X	
American robin	*Turdus migratorius*	X	X	X	X	X	X	X	X	X	
Varied thrush	*Ixoreus naevius*		X	X	X	X	X	X	X		
Swainson's thrush	*Catharus ustulatus*		X	X	X	X	X	X	X		
Northern shrike	*Lanius excubitor*	X	X						X	X	
Golden-crowned kinglet	*Regulus satrapa*			X	X	X	X	X			
Ruby-crowned kinglet	*Regulus calendula*			X	X	X	X	X			
Cedar waxwing	*Bombycilla cedrorum*		X	X	X	X	X	X	X		
European starling	*Sturnus vulgaris*	X	X	X	X	X	X	X	X	X	
Solitary vireo	*Vireo solitarius*		X	X	X	X	X	X	X		
Hutton's vireo	*Vireo huttoni*		X	X	X	X	X	X	X		
Warbling vireo	*Vireo gilvus*		X	X	X	X	X	X	X		
Red-eyed vireo	*Vireo olivaceus*			X			X				
MacGillivray's warbler	*Oporonis tolmiei*		X	X		X	X	X	X		
Orange-crowned warbler	*Vermivora celata*		X	X			X	X	X		
Yellow-rumped warbler	*Dendroica coronata*		X	X	X	X	X	X	X		
Yellow warbler	*Dendroica petechia*		X	X		X	X	X	X		
Townsend's warbler	*Dendroica townsendi*				X	X	X	X			
Black-throated gray warbler	*Dendroica nigrescens*			X	X	X	X	X			
Common yellowthroat	*Geothlypis trichas*	X	X				X		X	X	
Wilson's warbler	*Wilsonia pusilla*		X	X		X	X	X	X		
House sparrow	*Passser domesticus*	X	X								
Red-winged blackbird	*Agelaius phoeniceus*		X						X	X	X
Brewer's blackbird	*Euphagus cyanocephalus*	X							X	X	X
Bullock's oriole	*Icterus galbula bullockii*		X	X		X	X	X	X		
Brown-headed cowbird	*Molothrus ater*	X	X	X	X	X	X	X	X	X	
Western tanager	*Piranga ludoviciana*		X	X	X	X	X	X	X		
Black-headed grosbeak	*Pheucticus melanocephalus*			X	X	X	X	X			
Evening grosbeak	*Hesperiphona vespertina*		X	X	X	X	X				
Purple finch	*Carpodacus purpureus*			X	X	X	X				
House finch	*Carpodacus mexicanus*		X						X		
Pine siskin	*Carduelis pinus*			X	X	X	X	X			

Common Name	Scientific Name	Habitat									
		Herbaceous	Shrub	Deciduous	Coniferous	Mixed C/D	Riparian	Wetland (Fo)	Wetland (S-S)	Wetland (Em)	Wetland (OW)
American goldfinch	*Carduelis tristis*	X	X								
Red crossbill	*Loxia curvirostra*				X	X	X				
Rufous-sided towhee	*Pipilo erythrophthalmus*		X	X	X	X	X	X	X		
Dark-eyed junco	*Junco hyemalis*	X	X	X	X	X	X	X	X		
White-crowned sparrow	*Zonotrichia leucophrys*	X	X						X		
Golden-crowned sparrow	*Zonotrichia atricapilla*						X				
Chipping sparrow	*Spizella passerina*	X	X	X					X		
Savannah sparrow	*Passerculus sandwichensis*	X								X	
Fox sparrow	*Passerella iliaca*		X	X	X	X	X	X	X		
Song sparrow	*Melospiza melodia*		X	X	X	X	X	X	X		
MAMMALS											
Opossum	*Didelphis marsupialis*	X	X	X	X	X	X	X	X	X	
Vagrant shrew	*Sorex vagrans*	X	X				X		X	X	
Marsh shrew	*Sorex bendirii*						X		X	X	
Shrew-mole	*Neurotrichus gibbsii*			X	X	X	X	X			
Coast mole	*Scapanus orarius*	X	X	X		X					
Townsend's mole	*Scapanus townsendi*	X	X								
Little brown bat	*Myotis lucifugus*			X	X	X	X	X	X	X	X
California myotis	*Myotis californicus*			X	X	X	X	X	X	X	X
Yuma myotis	*Myotis yumanensis*		X	X	X	X	X	X	X	X	X
Silvery-haired bat	*Lasionycteris noctivagans*			X	X	X	X	X	X	X	X
Big brown bat	*Eptesicus fuscus*			X	X	X	X	X	X	X	X
Porcupine	*Erethizon dorsatum*		X	X	X	X					
Deer mouse	*Peromyscus maniculatus*	X	X	X	X	X	X	X	X	X	
Townsend's meadow mouse	*Microtus townsendii*	X	X							X	
Norway rat	*Rattus norvegicus*	X	X				X		X		
Black rat	*Rattus rattus*	X	X				X		X		
House mouse	*Mus musculus*	X	X								
Mountain beaver	*Aplodontia rufa*			X	X	X	X	X			
Muskrat	*Ondatra zibethicus*		X				X		X	X	X
Beaver	*Castor canadensis*						X	X	X	X	X
Townsend's chipmunk	*Eutamias townsendi*			X	X	X					
Douglas' squirrel	*Tamiasciurus douglasii*				X	X					
Eastern gray squirrel	*Sciurus carolinensis*			X	X	X					
Eastern cottontail	*Sylvilagus floridanus*	X	X								
Mink	*Mustela vison*						X	X	X	X	
Long-tailed weasel	*Mustela frenata*		X	X	X	X	X	X			
River otter	*Lutra canadensis*						X				X
Striped skunk	*Mephitis mephitis*		X	X		X	X		X		
Spotted skunk	*Spilogale putoris*			X	X	X	X	X			
Raccoon	*Procyon lotor*			X	X	X	X	X	X	X	
Bobcat	*Felis rufus*			X	X	X					
Mountain lion	*Felis concolor*			X	X	X					
Coyote	*Canis latrans*	X	X	X	X	X	X				
Black bear	*Ursus americanus*		X	X	X	X	X				
Black-tailed deer	*Odocoileus hemionus columbianus*		X	X	X	X	X				
AMPHIBIANS											

Common Name	Scientific Name	Habitat									
		Herbaceous	Shrub	Deciduous	Coniferous	Mixed C/D	Riparian	Wetland (Fo)	Wetland (S-S)	Wetland (Em)	Wetland (OW)
Rough-skinned newt	*Taricha granulosa*			X	X	X	X	X	X		X
W. red-backed salamander	*Plethodon vehiculum*				X	X	X				
Northwestern salamander	*Ambystoma gracile*				X	X	X	X			X
Long-toed salamander	*Ambystoma macrodactylum*			X	X	X	X	X			
Ensatina	*Ensatina eschscholtzi*			X	X	X	X	X			
Pacific treefrog	*Hyla regilla*		X	X	X	X	X	X	X	X	X
Red-legged frog	*Rana aurora*			X	X	X	X	X			X
Bullfrog	*Rana catesbeiana*										X
Western toad	*Bufo boreas*			X	X	X	X	X	X	X	X
REPTILES											
N. alligator lizard	*Elgaria coerulea*		X		X						
Common garter snake	*Thamnophis sirtalis*	X	X	X	X	X	X	X			
N.W. garter snake	*Thamnophis ordinoides*	X	X	X	X	X					
Source: Brown 1985, Guenther and Kucera 1978, Hunn 1982, Ingles 1965, Nussbaum et al. 1983, and Wahl and Paulson 1977.											

WOODIN CREEK BASIN
HABITAT ASSESSMENT
FINAL REPORT
SEPTEMBER 2004

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EXECUTIVE SUMMARY

The City of Woodinville has retained Adolfson Associates, Inc. (Adolfson) to conduct a habitat assessment of Woodin Creek Basin. The study area for the Woodin Creek Basin Habitat Assessment includes all wetted habitat areas within the City of Woodinville that occur within the Woodin Creek Basin from its headwaters to its mouth at the Sammamish River. The primary purpose of the Woodin Creek Basin Habitat Assessment is to provide baseline information on habitat conditions affecting fish and wildlife in the study area. Other goals of the study are to identify potential limiting factors that support City-wide planning efforts aimed at the conservation and restoration of salmonid habitat within the City of Woodinville and to provide information that may be used by both the City and its citizens to assist in obtaining grants or other outside support to implement habitat conservation and restoration projects within the Woodin Creek Basin.

Methods

The field inventory method used for this study followed King County's stream habitat assessment methodology (King County, 1991). This is a semi-qualitative method used to document channel characteristics, in-water habitat conditions, riparian habitat conditions, substrate, and large woody debris. This study also addresses stream habitat and watershed criteria in relation to a hypothetical "properly functioning" stream system as currently defined by National Oceanic and Atmospheric Administration (NOAA) and United States Department of the Interior Fish and Wildlife Service (USFWS).

Summary of Findings

Watershed Conditions, Flow, and Hydrology

Woodin Creek has a high level of impervious surface. Approximately 41 percent of the total basin area of approximately 400 acres is covered by some type of impervious surface (roads, buildings, parking lots). The highest level of impervious surface within the basin was associated with road rights-of-way. The second highest level of impervious surface was associated with large parking lots for commercial, retail, and multifamily residential development. These two sources account for over half of the total impervious surface with the basin. Roadways and parking lots also impact flow and hydrology in Woodin Creek as a result of culverts. Approximately 20 percent of the total length of stream within the Woodin Creek basin is enclosed in culverts or pipes under roadways and parking lots. The most significant amount of alternation is the piping of the entirety of Reaches 2a and 2b (approximately 3,200 feet). In addition to these pipes, flow and hydrology within the basin are affected by the use of much of Reach 1 for conveyance of stormwater from developed areas. Flow enters the stream through a series of pipes and is conveyed downstream until it reaches a high flow bypass upstream of NE 171st Street where flow re-enters the piped storm conveyance network near station 9+25

Habitat Access

The scope of the Woodin Creek Habitat Assessment included a fall and winter in 2003 survey to identify use by adult salmon and to identify potential migration barriers based on fish-use. One adult Chinook salmon (carcass) was observed during the first day of the fall spawning survey upstream from NE 171st Street. No other adult salmon were observed at any other time during the spawning survey. Local neighborhood groups have reported observations of occasional large fish (unidentified species) within the stream during the fall and winter. King County relocated approximately 250 juvenile cutthroat trout and two sub yearling coho salmon from Reach 1 in November 2003 prior to conducting in-water work in the stream. Juvenile salmonid fish (unidentified species) were observed throughout the entire length of Reach 1 during the summer habitat inventory. Two adult cutthroat trout were observed downstream of NE 171st Street within Reach 1. In addition to salmonid fish, larval lamprey (unidentified species) and sculpin (unidentified species) were also seen in the stream. No adult or juvenile fish of any species were noted in Reaches 3, 4, or 5.

Water Quality

Woodin Creek did not meet all required State of Washington water quality parameters for Class AA waters during the study period. Temperature, dissolved oxygen, and pH are the water quality parameters included in the data provided to Adolfson for this study that were most often exceeded that relate to fish and wildlife habitat support. Temperature and dissolved oxygen values were most limiting during the summer; pH readings were lowest during the fall and winter. Woodin Creek also does not provide “properly functioning” water quality parameters considered necessary to support healthy self-sustaining populations of salmonid fish per NOAA Fisheries and USFWS parameters (NOAA Fisheries, 1996; USFWS, 1998). Summer temperatures recorded in Woodin Creek indicate that the primary concern is in relation to supporting rearing and migration habitat for salmonid fish.

Habitat Elements and Channel Conditions and Dynamics

Woodin Creek is limited in relation to the following habitat elements: Substrate, Large Woody Debris, Pool Frequency, Pool Quality, Off-Channel Rearing Habitat, and Refugia. Small gravel was the dominant substrate type in Reaches 1, 3, and 4. The only reach where cobble or large gravel was a significant component of the substrate was in Reach 5. Substrates in Reach 1 where fish are present were small gravel or finer (sand, silt, or organic materials). No naturally occurring large woody debris was observed in Reach 1. The large woody debris that was observed was associated with constructed log weirs or root wads installed and secured to the streambed and/or bank with cables. Pool frequency within Reach 1 was approximately a third of that which NOAA Fisheries (1996) and USFWS (1998) identify as “properly functioning.” Pool quantity was generally low or moderate. There were few deep pools (over 3 feet deep) and dense woody cover was generally lacking in association with pools.

Riparian habitat widths in Reach 1 were commonly 100 feet or less and few habitats were adjacent to riparian areas that had a mature forest component. The narrow riparian area constrained by roads and development limits the abundance of off-channel rearing opportunities and significant areas for refugia. The few off-channel wetlands or side channels that are present have largely been impacted by conversion to landscape amenities (ponds).

Wildlife Habitat

Seven habitat types occur in the study area. These include in order of abundance: High Density Commercial and Residential; Medium Density Residential; Upland Forest; Riparian-Wetlands; Upland Grassland; Herbaceous Wetland; and Open Water Pond. In addition, Agricultural areas occur in King County just south of the study area.

Songbirds were the most abundant wildlife identified by the study both in numbers of individuals and numbers of species. The most abundant species of birds were those generally adapted to habitats located within urban environments. The study attempted to identify species that might not be commonly observed by residents, as a result night surveys were conducted and identified the presence of significant numbers of bats and one group of western screech owls. Bats and owls were observed in the forested areas of the watershed, generally adjacent to Reaches 3, 4, and 5. Other wildlife observations recorded during the habitat surveys included waterfowl (mallard), pileated woodpecker excavations, eastern gray squirrel, Pacific chorus frog, mole tunnels, and Virginia opossum.

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INTRODUCTION

The City of Woodinville has retained Adolfson Associates, Inc. (Adolfson) to conduct a habitat assessment of Woodin Creek Basin. This work will encompass all of 2003 and was designed to occur in two phases. The first phase included the gathering of existing baseline information regarding Woodin Creek and the completion of a reconnaissance-level review of habitat conditions within the basin. The second phase included site-specific field studies to document fish and wildlife use and habitat conditions in the basin. This report discusses the findings of the second phase of the Woodin Creek Basin Habitat Assessment.

Study Area and Purpose

The mouth of Woodin Creek is located on the left bank of the Sammamish River south of the center of the City of Woodinville, Washington (Figure 1). The Woodin Creek Basin drains a significant portion of the City of Woodinville east of the Sammamish River. Woodin Creek originates from groundwater seeps in residential areas in the eastern portion of the City and then flows generally west through the heavily developed floor of the Sammamish River Valley within the City (Figure 2). One tributary with two distinct branches originates from groundwater seeps and enters Woodin Creek from the north (Figure 2).

The study area for the Woodin Creek Basin Habitat Assessment includes all areas within the City of Woodinville that occur within the Woodin Creek Basin from its headwaters to its mouth at the Sammamish River (Photos 1 and 2). For the purpose of this study, the Woodin Creek Basin is defined as all parcels that contribute flow, either directly or indirectly to Woodin Creek (Figure 2).

The primary purpose of the Woodin Creek Basin Habitat Assessment is to provide baseline information on habitat conditions affecting fish and wildlife in the study area. This included identifying and summarizing existing sources of information to determine the applicability of existing resources in regard to Woodin Creek. These data will support the City of Woodinville's efforts to develop regulations and policies to comply with the GMA and implement their CIP program. Because of the emphasis on fisheries in both GMA guidelines and the ESA listings, much of this report focuses on habitat in the context of supporting anadromous fisheries, including Chinook salmon and bull trout; however, information on wildlife habitat conditions are also included in this report to address other regulatory and policy needs.

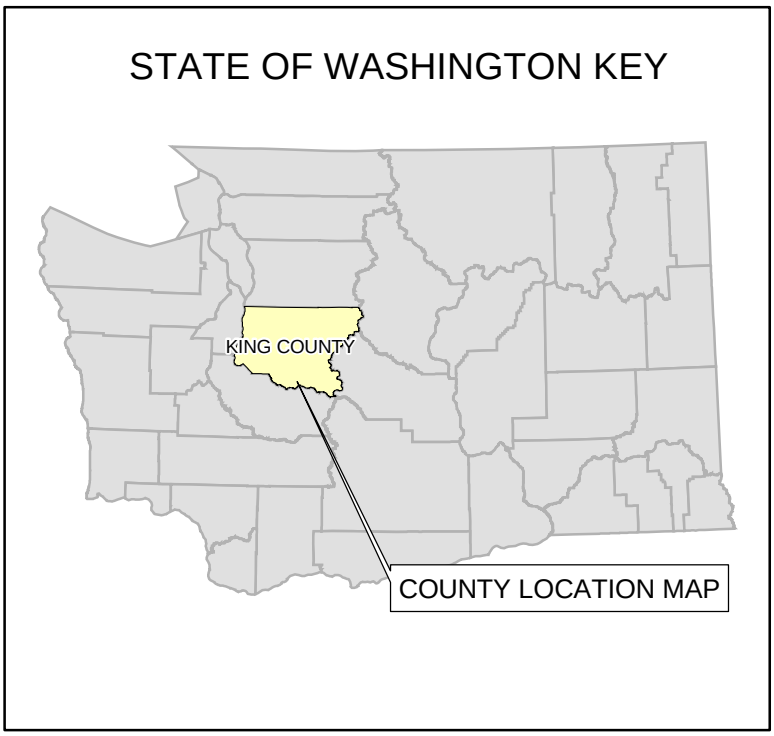
This study also has two secondary goals. The first is to identify potential limiting factors that support City-wide planning efforts aimed at the conservation and restoration of salmonid habitat within the City of Woodinville. The second and related goal is to provide information that may be used by both the City and its citizens to assist in obtaining grants or other outside support to implement habitat conservation and restoration projects within the Woodin Creek Basin.

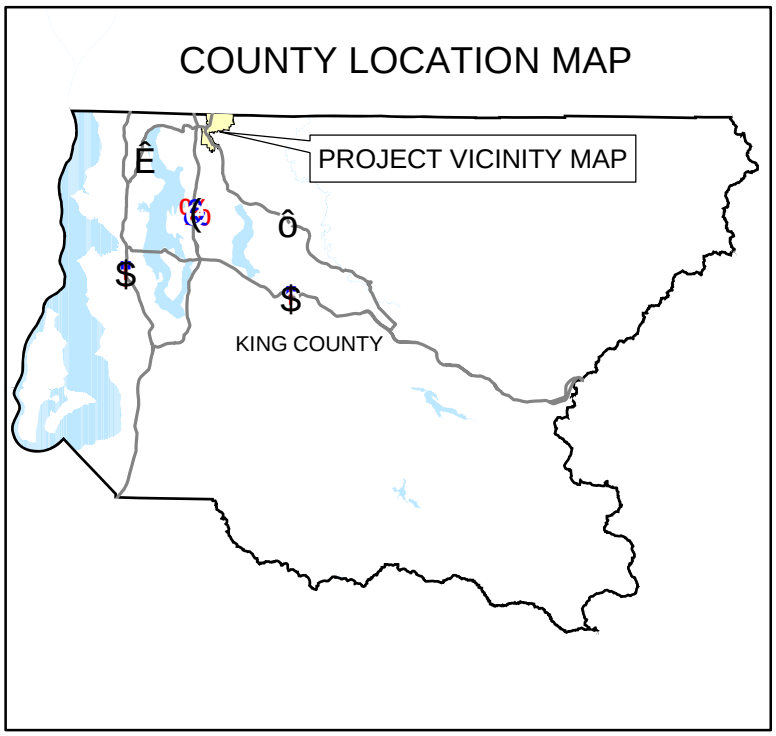
Regulatory Background

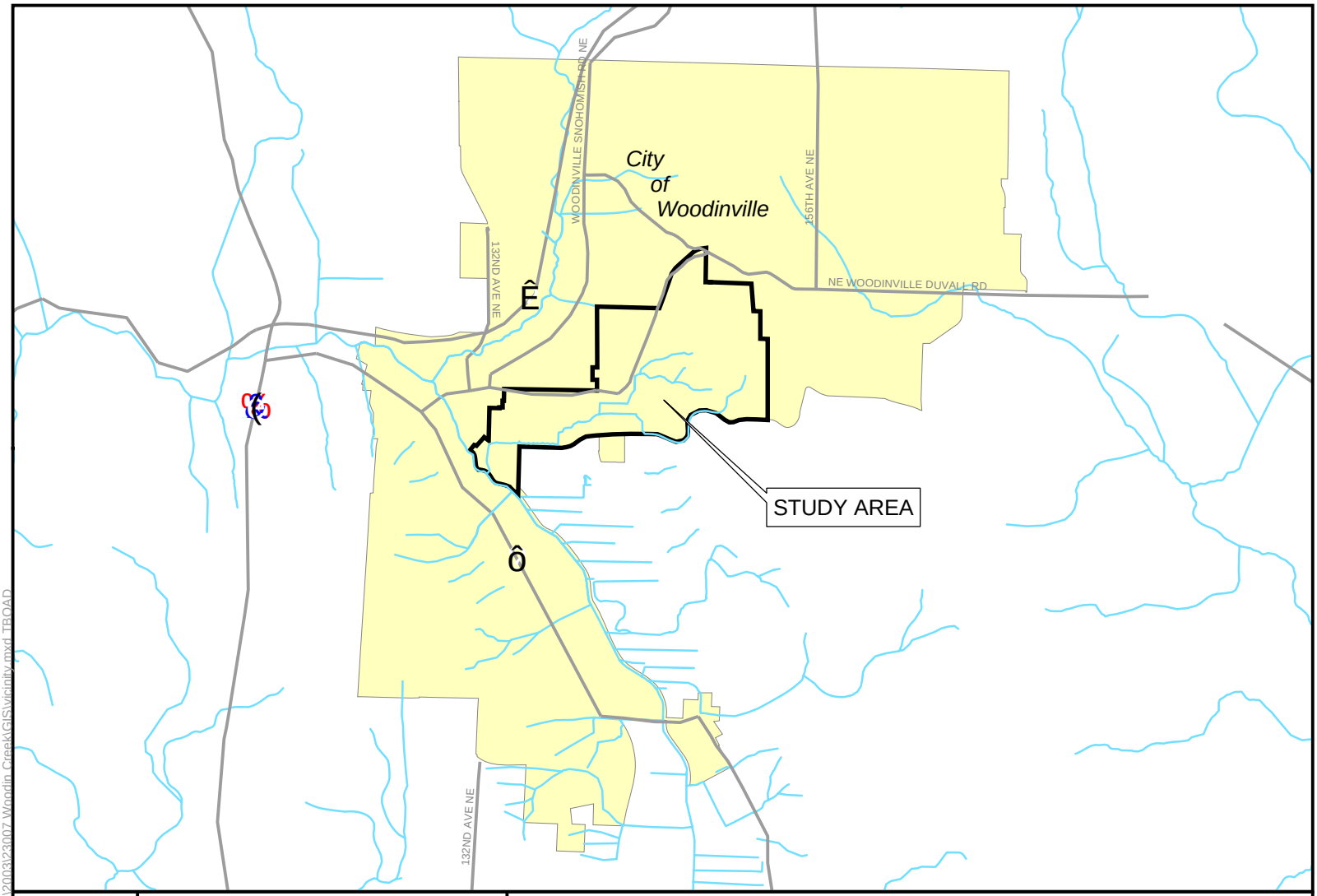
Due to the cultural and economic importance of anadromous fisheries in the Pacific Northwest, fish populations and habitat requirements in many of the regions larger stream systems are well studied. For example, The State of Washington, federal government, tribal governments, and regional water resource agencies such as METRO (now part of King County) all have been involved in the study of the regions rivers and streams over the past half century. Ideally, reliable scientific information would be known for all of the region's watercourses; however, most work has occurred to determine habitat requirements and species presence and abundance in the regions larger rivers and streams. It is only since the late 1990's that smaller urban tributaries became more of a research priority. This has been driven, in large part, by the requirements of the state's Growth Management Act (GMA) and the listings of Chinook salmon and bull trout under the federal Endangered Species Act (ESA).

The Washington State's legislature added a new section to the state's GMA in 1995 to ensure that cities consider reliable scientific information when adopting policies and regulations to designate and manage critical areas (RCW 36.70A.172). In 2002, the state adopted procedural criteria to implement these regulations. The regulations require that cities consider "best available science" in developing land use management policies and codes and that these policies and regulations give special consideration to the preservation or enhancement of anadromous fisheries. Although the state has specifically emphasized fisheries resources, the regulations also mandate that policies and land use decisions regarding other critical areas, including wetlands and wildlife habitat areas, similarly are based on the best scientific information available.

The National Marine Fisheries Service, a branch of the National Oceanic and Atmospheric Administration (NOAA Fisheries) proposed the Puget Sound Chinook salmon as "threatened" under the ESA in 1998. The following year, the US Fish and Wildlife Service (USFWS) listed Costal/Puget Sound bull trout stocks as "threatened." These listings brought with them the requirement that all projects that have a federal nexus (most commonly federal funding or the requirement for a federal permit) must comply with section 7(c) of the ESA. Many of the City's planned and proposed Capital Improvement Projects (CIPs) in the Woodin Creek Basin are anticipated to have a federal nexus, either as a result of a federal grant or as the result of the need to acquire a federal permit. A Corps of Engineers Section 404 permit is required for most work affecting in wetlands and streams and is one of the more common federal permit required by CIPs. The Section 7(c) consultation process administered by both NOAA Fisheries and USFWS require the evaluation of habitat conditions in relation to their ability to support populations of these listed fish species







Map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.

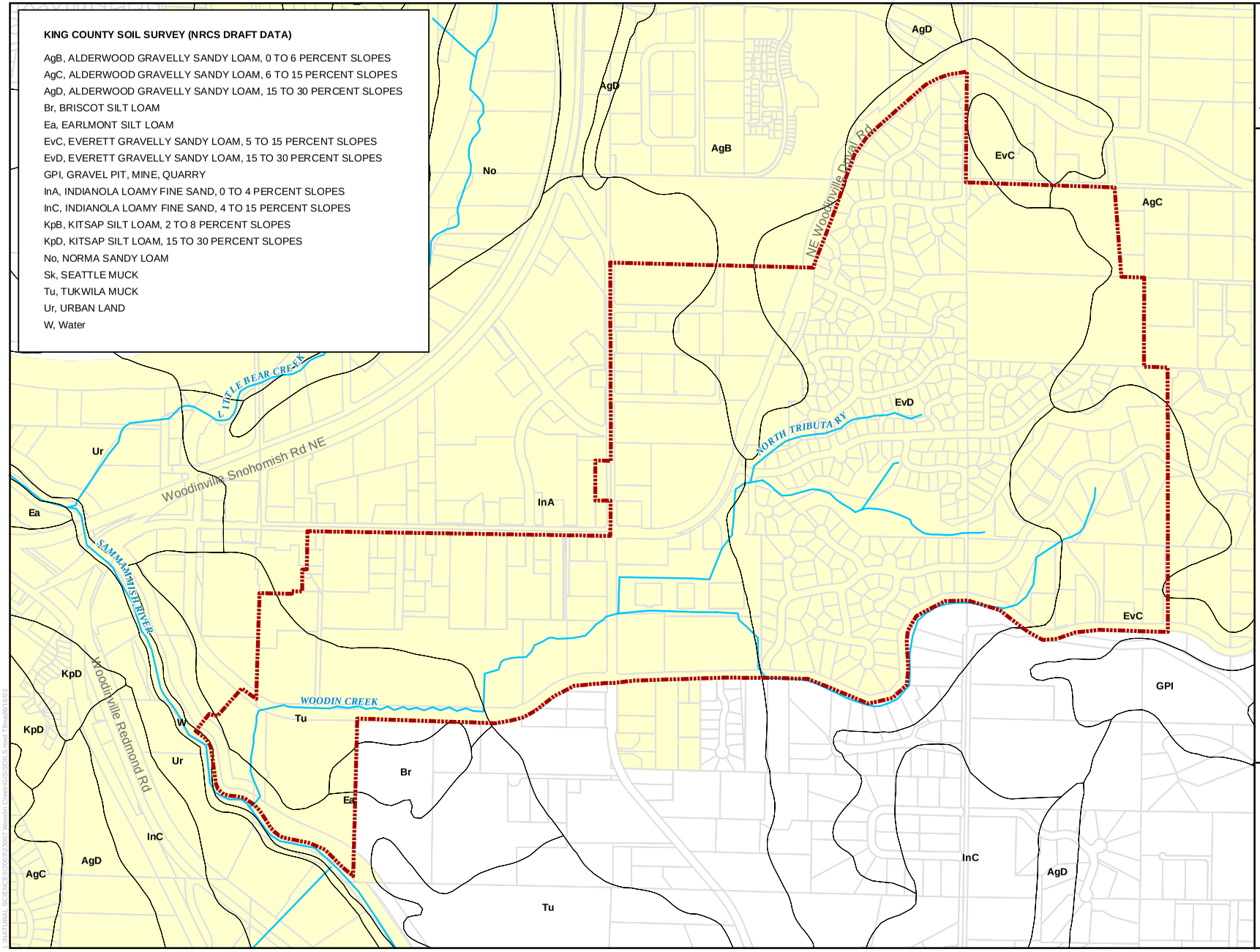
Source: Woodinville GIS 2002; King County GIS 2002; ESRI 2000

NO SCALE

FIGURE 1

VICINITY MAP
WOODIN CREEK BASIN
HABITAT ASSESSMENT
WOODINVILLE, WASHINGTON

\NATURAL_SCIENCES\2003\23007 Woodin Creek\GIS\vicinity.mxd TBOAD


KING COUNTY SOIL SURVEY (NRCS DRAFT DATA)
AgB, ALDERWOOD GRAVELLY SANDY LOAM, 0 TO 6 PERCENT SLOPES
AgC, ALDERWOOD GRAVELLY SANDY LOAM, 6 TO 15 PERCENT SLOPES
AgD, ALDERWOOD GRAVELLY SANDY LOAM, 15 TO 30 PERCENT SLOPES
Br, BRISCOT SILT LOAM
Ea, EARLMONT SILT LOAM
EvC, EVERETT GRAVELLY SANDY LOAM, 5 TO 15 PERCENT SLOPES
EvD, EVERETT GRAVELLY SANDY LOAM, 15 TO 30 PERCENT SLOPES
GPI, GRAVEL PIT, MINE, QUARRY
InA, INDIANOLA LOAMY FINE SAND, 0 TO 4 PERCENT SLOPES
InC, INDIANOLA LOAMY FINE SAND, 4 TO 15 PERCENT SLOPES
KpB, KITSAP SILT LOAM, 2 TO 8 PERCENT SLOPES
KpD, KITSAP SILT LOAM, 15 TO 30 PERCENT SLOPES
No, NORMA SANDY LOAM
Sk, SEATTLE MUCK
Tu, TUKWILA MUCK
Ur, URBAN LAND
W, Water
AgD
AgB
AgC
EvC
EvD
No
Ur
Ea
InA
KpD
W
Tu
Br
InC
GPI
LITTLE BEAR CREEK
Woodinville Snohomish Rd NE
SAMMAMISH RIVER
Woodinville Redmond Rd
WOODIN CREEK
NORTH TRIBUTARY
NE Woodinville Duvall Rd
FIGURE 3
SOILS
WOODIN CREEK BASIN
HABITAT ASSESSMENT
WOODINVILLE, WASHINGTON
Study Area
Soils
Parcels
Woodinville City Limits
Streams
0
500
1,000
Feet
Map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.
Source: Woodinville GIS 2002;
King County GIS 2002; NRCS 2002

METHODOLOGY

The reconnaissance-level investigation included a review of existing background information to determine the type and relevancy of habitat data available for Woodin Creek and a general qualitative field review of the basin as observable from public rights-of-way and publicly owned properties. To assist with the assessment of fish habitat, Woodin Creek and its tributaries were divided into five primary reaches. These include:

- Reach 1: Mouth to 140th Avenue NE
- Reach 2: 140th Avenue NE to Woodinville City limits (includes Reach 2A and 2B)
- Reach 2A: Piped section under Woodinville Plaza connects to Reach 3 at NE 171st Street/143rd Place NE
- Reach 2B: Piped section under north end of Woodinville Plaza connects to Reach 4 and 5 at NE 178th Street/143rd Avenue NE
- Reach 3: Woodinville City Limits at 143rd Place NE to headwaters
- Reach 4: North Tributary Branch A 143rd Avenue NE to 151st Way NE
- Reach 5: North Tributary Branch B 143rd Avenue NE to 148th Avenue NE

These reaches are identified in Figure 2.

Impervious Surface Area

The approximate area of impervious surface was calculated using GIS information to characterize the Woodin Creek basin. GIS data provided street right-of-way (ROW) from the parcel data and building footprints along with aerial photos of Woodinville (City of Woodinville GIS data, 2003). This data was clipped to the study area (Woodin Creek Basin).

The acreage of the building footprints in low density residential (R-1, R-4, and R-6) was subtracted from the total acreage. A parcel sample of approximately 10 % (or at least 10, whichever was greater) was taken from each of the previously mentioned residential areas. On those sample parcels, additional impervious areas were measured (driveways, other buildings, etc) to the extent that the aerials would visually allow, excluding street ROW. This measurement was added to the building footprint acreage and an average for the total impervious area was taken for each of the sample sets. This was then multiplied by the number of existing parcels in each of the low residential zoning groups to derive the approximate impervious area for R-1, R-4 and R-6.

The parking lots and other visible impervious areas were then measured in the commercial and higher density residential areas. Street ROW area was calculated. The combination of these numbers gave us an approximate existing impervious surface area for the study area.

Water Quality and Hydrology

Existing water quality data for Woodin Creek was obtained from the City of Woodinville. Water quality parameters including: conductivity, dissolved oxygen, oxidation/reduction potential, pH,

salinity, total dissolved solids (TDS), temperature, and turbidity were measured by the City of Woodinville at two sites within Woodin Creek from January 2003 to October 2003. Additional water quality monitoring was performed by the City of Woodinville to assess contaminant levels within Woodin Creek at Woodin Park (Reach 1) from October 2000 to July 2003. Samples were collected and analyzed for fecal coliforms, metals, nitrate/nitrite, total phosphorous, total suspended solids (TSS), and other parameters. (See Table 6.)

Adolfson collected limited water quality data from four sites (Figure 2) within Woodin Creek. Portable water quality meters were used to document temperature, pH, conductivity, and turbidity. Samples were also collected and analyzed for dissolved oxygen (DO) at North Creek Laboratories in Bothell, Washington.

In addition, Adolfson collected stream temperature data from four sites using HOBO temperature data loggers that were placed directly in the stream. One temperature logger also monitored ambient air temperatures. Data was recorded at a rate of one reading every five minutes from June 6, 2003 to August 27, 2003. Site 1 was located approximately 200 feet upstream of the mouth in Reach 1. Site 2 was located immediately west of 140th Avenue NE (end of Reach 1). Site 3 was located at the NE Woodinville-Duvall Road/178th Way NE intersection (Reach 4). Site 4 was located at the NE 171st Street/143rd Place NE intersection (Reach 3).

Fish Habitat Assessment

The assessment of stream habitat generally followed the King County stream habitat assessment, General Site Survey methodology (King County, 1991). The General Site Survey is a qualitative review of stream characteristics, habitat conditions, riparian habitat, and fish use. There are 11 primary habitat elements evaluated during the General Site Survey (Table 1). The King County 1991 protocol is based on the methods defined in the *USDA Forest Service Stream Habitat Classification and Inventory Procedures for Northern California* (McCain et al., 1990). Habitat units are defined as one of 23 habitat types listed in Table 2 below.

Table 1. Elements of the General Site Survey

ID	Description
1	Natural drainage system configuration and stream classification
2	Riparian soils, channel morphology, and bank stability
3	Substrate composition
4	Riparian zone land uses
5	Riparian vegetation
6	Description of adjacent wetlands
7	Large woody debris and pool quality
8	Animal habitat and utilization
9	Benthos
10	Fish habitat and utilization
11	Photographs of stream features

Source: King County, 1991

While the inventory methods followed King County General Site Survey protocols, the

assessment of those inventory elements has been expanded to consider ESA evaluation guidelines. NOAA Fisheries and USFWS guidance for conducting ESA reviews requires that habitat assessments used in support of section 7(c) consultations define the biological requirements of a listed fish species in terms of properly functioning conditions (PFC) (NOAA Fisheries, 1996; USFWS, 1998). PFC is the sustained presence of natural habitat-forming processes necessary for the long-term survival of the species through the full range of environmental variation. Indicators of PFC vary between different landscapes based on unique physiographic and geologic features. Since aquatic habitats are inherently dynamic, PFC is defined by the persistence of natural processes that maintain habitat productivity at a level sufficient to ensure long-term survival (NOAA Fisheries, 1996). An overview of these elements is included below in Table 2.

Table 2. Stream Habitat Types

ID	Description	ID	Description
1.	Low-gradient riffle	12.	Lateral scour pool-bedrock formed
2.	High gradient riffle	13.	Damned pool
3.	Cascade	14.	Glide
4.	Secondary channel pool	15.	Run
5.	Backwater pool-boulder formed	16.	Step run
6.	Backwater pool-rootwad formed	17.	Mid-channel pool
7.	Backwater pool-log formed	18.	Edgewater
8.	Trench/Chute	19.	Channel confluence pool
9.	Plunge pool	20.	Lateral scour pool-boulder formed
10.	Lateral scour pool-log formed	21.	Pocket water
11.	Lateral scour pool-rootwad formed	22.	Corner pool
		23.	Culvert

Source: McCain et al., 1990

A hip chain was used to measure habitat lengths and create station numbers. The hip chain was zeroed at the lowermost starting point for each habitat reach, and used to document the location of specific features including: seeps, erosion areas, and other actions taken along each reach. Habitats were limited to the actual wetted width of the stream channel at the time of the survey. Habitat widths and depths were measured using a six-foot staff graduated in inches. Adolfson biologists defined “left bank” (LB) and “right bank” (RB) as when facing upstream.

Stream Stationing

To assist with the identification of the location of habitats and the approximate location of features described in the text, Adolfson calculated stream stationing for features based on the measurements taken with a hip chain as stated above. Stationing as is stated in this report is the cumulative total of the habitat lengths for each habitat type. Stationing starts at 0+00 at the downstream limit of each reach. The station for the habitat type is identified as the last station within that habitat type. It should be noted that stream stationing as identified in this report is approximate in nature and is for the purpose of aiding discussion in relation to this study. The location of features as described in this study should be verified by a civil survey prior to any engineering design, permitting, or other quantitative analysis. The approximate station of each

habitat area is identified on the summary tables in Appendix B prior to the field data collected for each reach.

Fish Use

During the preliminary investigation, information pertaining to fish-use in Woodin Creek is based on existing data, where available, and incidental observations of fish use occurring during the reconnaissance-level habitat assessment from May 13, 2003 to July 8, 2003. More detailed analysis of fish use, including adult salmon spawning surveys were conducted in the fall of 2003 during the second phase of the study.

The adult salmon spawning surveys were conducted from September 23, 2003 through November 24, 2003. Since Woodin Creek is a small stream and typical spawner surveys require wading the stream, several observation points and 200-foot reaches were observed from the bank to prevent the disturbance of spawning substrates. Survey locations are shown in Figure 2. Observation points and reaches were observed for adult salmon spawners, salmon carcasses, and redds.

Wildlife

Habitat Evaluation

Wildlife habitat was evaluated in the field from public rights-of-way, on public land, and on private land with permission from the City. Field surveys also included observations of opportunities for improving habitat. Habitat assessment methods described in *Wildlife–Habitat Relationships in Oregon and Washington* (Johnson and O'Neil, 2001) were used to describe and evaluate common habitat types in the City. These methods were developed by the WDFW with input from a panel of regional wildlife experts and with information collected from more than 12,000 pertinent publications. Using this methodology, habitats were assessed at three levels of detail: wildlife habitat types, structural conditions, and habitat elements. Opportunities for habitat protection and restoration were also explored.

The term "wildlife habitat type" as referred to in this inventory and in Johnson and O'Neil (2001) generally describes vegetation cover types or land use/land cover types. Geographic distribution and physical setting-- including climate, elevation, soils, hydrology, geology, and topography-- determine vegetation cover types. Human activities determine other land use cover types such as urban and agricultural habitat types. Habitat types can also include areas of disturbance where grasses, forbs, shrubs, or tree saplings are the primary vegetation cover type. Wildlife habitat types, in turn, are directly related to wildlife species abundance and distribution.

The habitat types in this report do not use the exact naming conventions found in Johnson and O'Neil (2001). Rather they are modified to further define habitat structural conditions and land cover conditions. Specific references to regional habitat types are not needed for this study that occurs only within Western Washington. Westside lowland conifer-hardwood forest as described by Johnson and O'Neil (2001) is divided into upland forest and grassland habitat types, and urban and mixed environs is divided into high density commercial and residential and medium density residential to further define habitat structural types on project maps and in this report.

Structural conditions refer to vegetation structure and are based on the characteristics of trees and shrubs including tree size, number of canopy layers, and canopy closure. Structural conditions in urban areas are shaped by land use cover type as indicated by variables such as the percent impervious surface in a watershed.

Habitat elements are described on a site-specific basis and include biological, physical, and anthropogenic features that influence wildlife species distribution, abundance, fitness, and viability. Common habitat elements in the Woodin Creek basin include downed wood, tree snags, moss, leaf litter, trails, hedgerows, street trees, ornamental landscaping, and roads. Habitat elements can have positive or negative effects on wildlife species.

Opportunities can include the protection and conservation of a particular habitat, removal of invasive or non-native vegetation or wildlife species, or the reduction of noise and encroachment from surrounding developments. The presence of non-native vegetation and wildlife is identified in the Findings section.

Bird and Mammal Surveys

Two types of wildlife survey were conducted in each daylighted reach of Woodin Creek: general observations, and specific studies. The specific studies included early morning bird surveys and evening bat and owl surveys. Bird and other wildlife observations were also made in the basin during general habitat and stream surveys in 2003.

Six survey stations within the Woodin Creek basin, mostly in riparian areas, were established for the specific studies using aerial photographs and field reconnaissance. The six stations were located in order to represent different habitat types within the different stream reaches. The bird surveys were conducted on April 29, May 23, and June 12, 2003. The bat and owl surveys were conducted on July 7 and 17, 2003. The locations of the survey stations are shown on Figure 5. Table 17 identifies the location of each survey station within different areas of the basin and habitat types found in these areas.

Early morning bird surveys were conducted once per month from April through June, and evening bird and mammal surveys were conducted in June and July. Bird and other wildlife observations were also made throughout the Woodin Creek basin during general habitat and stream surveys from March through June. A total of six survey stations ranging from near the mouth of Woodin Creek to the upper portion of the basin were established for these surveys. For the early morning surveys, birds were observed (by direct visual observation and by their calls) during a 15-minute period at each station. These surveys were conducted during the two hours following sunrise (approximately). Methodology for the bird survey protocols was taken from *Monitoring Wetlands* (Miller et al., 1996).

Evening surveys were conducted during the two hours following sunset at each of the six survey stations. A Peterson D-100 bat detector was used at each station to detect high-frequency bat calls (10 to 120 Hz) for the first five minutes of the survey and later during the owl surveys. The bat survey documented only presence or absence of bats.

After five minutes of bat and other general observations, a tape of owl calls was used to attract and detect owls in the vicinity. Owl calls were played for one minute per species, followed by a one-minute silent break for listening. Owl species calls were played in order of bird size, from smallest to largest, and call type. This was done because large owls are known to prey on

smaller owl species (i.e., the calls of the large owls may scare away small owls before they can be surveyed). The owl species included northern saw-whet owl, western screech owl, barn owl, barred owl, and great horned owl. The five owl species surveyed were chosen because they may occur in the City. Owl survey techniques from *How to Spot an Owl* (Sutton, 1994) and recommendations from members of the Seattle Audubon Society were used to develop protocols for owl surveys.

PROPERLY FUNCTIONING CONDITIONS

Ideally, reliable scientific information would exist for all populations of listed species that would allow the effects of an action to be quantified in terms of population impacts (NOAA Fisheries, 1999). As stated in the Habitat Approach, an August 1999 supplement to the NOAA Fisheries guidance document: Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale, in the absence of population-specific information, an assessment must define the biological requirements of a listed fish species in terms of PFC. PFC elements are typically identified as being either:

1. "Properly functioning" meaning that the element can support healthy populations of fish;
2. "At risk," meaning that functionality is maintained but there is a likelihood that further degradation would result in a negative response by fish populations; or
3. "Not properly functioning," meaning that there are known limitations to those parameters necessary to support healthy salmonid populations.

NOAA (1996) and USFWS (1998) have developed guidelines to assist in conducting a limiting factors analysis in relation to several specific PFC elements using a matrix approach following specific environmental pathways to evaluate indicators of habitat quality (Table 3). The King County stream habitat assessment methodology used for this inventory does not include all of the same parameters used by NOAA Fisheries and USFWS relative to a "properly functioning" stream system. Because of this, it is necessary to consider indirect factors related to the overall condition of the drainage basin in combination with best professional opinion and make judgments on whether or not Woodin Creek meets "properly functioning" criteria. The following describes the habitat quality indicators used to assess PFC. Actual PFC for Woodin Creek are discussed further in the "Findings" section of this document.

Water Quality

Temperature

In-stream water temperatures are important indicators of stream health. Smaller streams such as Woodin Creek, usually have much lower temperatures than larger mainstem streams, such as the Sammamish River, unless adversely affected by development. Small cooler tributaries can provide higher quality rearing habitat and/or refuge from higher temperatures and may be important to maintaining healthy fish populations throughout the basin. However, elevated water temperatures in smaller tributaries such as Woodin Creek reduce the area of usable rearing habitat during the summer and can render these small streams, potentially some of the most productive and structurally complex habitats, unusable (NOAA Fisheries, 1996).

NOAA Fisheries (1996) considers temperatures ranging from 10 to 13°C (50 to 57°F) or less to be a properly functioning conditions. Temperatures from 13°C to 15°C (57 to 60°F) are considered an at risk condition for adult spawning salmonids and temperatures ranging from 10 to 17°C (57 to 64°F) are considered an at risk condition for migrating and rearing salmonids. Temperatures above 15°C are considered not properly functioning for spawning salmonids and temperatures above 17°C are not properly functioning for migration and rearing salmonids (Table 3).

Sediment/Turbidity

Salmonid habitat is produced and maintained by substrate recruited from upstream streambanks and deposited in downstream reaches of the river. This natural process can be affected by development so that sediment inputs and turbidity exceed norms anticipated under natural conditions. Excessive sedimentation, caused by landslides, dam construction, the conversion of historic forests to urban environments, or bank erosion, can cause fish habitat degradation (Kerwin, 2001). The rearing capacity of salmon habitat is decreased as embeddedness, the degree to which fine sediments surround coarse substrates on the surface of a streambed (Stylte and Fischenich, 2002), levels increase in spawning substrates. Along with habitat degradation, increased fine sediment entombs incubating salmon in redds, reduces egg survival by reducing oxygen flow, alters the food web, reduces pool volumes for adult and juvenile salmon, and reduces the availability of rearing space for juveniles rendering them more susceptible to predation (NOAA Fisheries, 1996).

Table 3. Matrix of Pathways and Indicators

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Water Quality:	Temperature	50-57°F[1]	57-60° (spawning) 57-64° (migration & rearing)[2]	>60° (spawning) >64° (migration & rearing)[2]
	Sediment/Turbidity	<12% fines (<0.85 mm) in gravel, turbidity low	12-17% (westside)[3] 12-20% (eastside)[2] turbidity moderate	>17% (westside)[3] >20% (eastside)[2] fines at surface or depth in spawning habitat[2], turbidity high
	Chemical Contamination/Nutrients	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches[5]	Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach[5]	high levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one CWA 303d designated reach[5]
Habitat Access:	Physical Barriers	Any man-made barriers present in watershed allow upstream and downstream fish passage at all flows	Any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	Any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Habit Elements:	Substrate	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20%[3]	Gravel and cobble is subdominant, or if dominant, embeddedness 20-30%[3]	Bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant embeddedness >30%[2]
	Large Woody Debris	>80 pieces/mile >24" diameter >50 ft. length[4]; >20 pieces/mile >12" diameter >35 ft. length[2]; and adequate sources of woody debris recruitment in riparian areas.	Currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	Does not meet standards for properly functioning and lacks potential large woody debris recruitment

Table 3. Matrix of Pathways and Indicators (cont.)

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Habit Elements (cont.):	Pool Frequency Channel width / # pools/mile[6] 5 feet: 184 10 feet: 96 15 feet: 70 20 feet: 56 25 feet: 47 50 feet: 26 75 feet: 23 100 feet: 18	Meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above)	Meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	Does not meet pool frequency standards
	Pool Quality	Pools >1 meter deep (holding pools) with good cover and cool water[3], minor reduction of pool volume by fine sediment	Few deeper pools (>1 meter) present or inadequate cover/temperature[3], moderate reduction of pool volume by fine sediment	No deep pools (>1 meter) and inadequate cover/temperature[3], major reduction of pool volume by fine sediment
	Off channel Habitat	Backwaters with cover, and low energy off channel areas (ponds, oxbows, etc.)[3]	Some backwaters and high energy side channels[3]	Few or no backwaters, no off-channel ponds[3]
	Refugia (important remnant habitat for sensitive aquatic species)	Habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[7]	Habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations[7]	Adequate habitat refugia do not exist[7]
Channel Condition & Dynamics:	Width/Depth Ratio	<10[2,4]	10-12 (we are unaware of any criteria to reference)	>12 (we are unaware of any criteria to reference

Table 3. Matrix of Pathways and Indicators (cont.)

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Channel Condition & Dynamics: (cont.)	Streambank Condition	>90% stable; i.e. on average, less than 10% of banks are actively eroding[2]	80-90% stable	<80% stable
Channel Dynamics (cont.):	Floodplain Connectivity	Off channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly
Flow/Hydrology:	Change in Peak/Base Flows	Watershed hydrograph indicates peak flow, base flow and how timing characteristics comparable to any undisturbed watershed of similar size, geology and geography	Some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	Pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in Drainage Network	Zero or minimum increases in drainage network density due to roads [8,9]	Moderate increases in drainage network density due to roads (e.g., ~5%)[8,9]	Significant increases in drainage network density due to roads (e.g., ~20-25%)[8,9]
Watershed Conditions: (AMA-ECA-LSOG-Late Successional and Old Growth NWFP-NW Forest Plan) AMA: Adaptive Management Area ECA: Equivalent Clearcut Area	Road Density & Location	<2 ml/ml[2,11], no valley bottom roads	2-3 ml/ml[2], some valley bottom roads	>3 ml/ml[2], many valley bottom roads
	Disturbance History	<15% ECA (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), ≥15% retention of LSOG in watershed[10]	<15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), ≥15% retention of LSOG in watershed[10]	>15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG retention

Table 3. Matrix of Pathways and Indicators (cont.)

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Watershed Conditions (cont.):	Riparian Reserves	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatershed, and buffers or includes known refugia for sensitive aquatic species (>80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition >50%[12]	Moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species (~70-80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better[12]	Riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition <25%[12]

1 Bjornn, T.C. and D.W. Reiser, 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. Meehan, W.R., ed.

2 Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995

3 Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.

4 Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.

5 A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.

6 USDA Forest Service. 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

7 Frissell, C.A., Liss, W.J., and David Bayles. 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on changing roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.

8 Wemple, B.C. 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis, Geosciences Department, Oregon State University.

9 E.g., see Elk River Watershed Analysis Report, 1995. Siskiyou National Forest, Oregon.

10 Northwest forest Plan. 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern spotted Owl. USDA Forest Service and USDI Bureau of land Management.

11 USDA Forest Service. 1993. Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities.

12 Winward, A.H. 1989. Ecology Status of Vegetation as a base for Multiple Produce Management. Abstracts 42nd annual meeting, society for Range Management, Billings MT, Denver Co; Society for Range Management, p. 277.

NOAA Fisheries (1996) has determined that water quality within western Washington streams becomes not properly functioning when sediment fines have greater than 17 percent of coverage. Streams on the west-side have at risk water quality conditions when sediment fines are at a level of 12-17 percent and turbidity within the stream is moderate. Properly functioning conditions exist when sediment fines are less than 12 percent in the gravel substrate and turbidity is low (NOAA Fisheries, 1996) (Table 3).

Chemical Contamination

Urbanization of salmonid streams can have multiple impacts. Urbanized streams generally have elevated levels of many contaminants; however, the most consistent problems include oxygen demand, conductivity, suspended solids, ammonium, hydrocarbons, and metals. These increases may be attributed to both point and non-point sources (Paul and Meyer, 2001). The increase of impervious surface area within a stream basin creates higher volumes of non-point source pollution from runoff. Because of restrictions placed on the direct discharge of materials into tributary streams under state water quality regulations, non-point pollution often contributes the highest level of chemical contamination found in small urban streams such as Woodin Creek.

In addition to runoff from roads and other impervious surfaces, chemical contaminants widely used within urbanized areas may affect fish both directly and indirectly. Some pesticides are capable of killing salmon directly and within a short period of time. Indirect effects of pesticides on salmon include interfering with their food supply or altering the aquatic habitat (Lind, 2002). Some studies have suggested that suppressed immune systems in young salmon from chemical contamination could make the fish more susceptible to disease as they move further into the marine environment (Arkoosh, 1991,1998 as seen in Kerwin, 2001).

NOAA Fisheries (1996) considers properly functioning conditions to be present for the chemical contamination indicator when there are low levels of chemical contamination from agricultural, industrial, and other sources. An at risk stream contains moderate levels of chemical contamination from agricultural, industrial, and other sources. If there are some excess nutrients and the stream contains one Clean Water Act (CWA) designated reach the stream is also considered at risk. A not properly functioning stream contains high levels of chemical contamination from agricultural, industrial, and other sources and has high levels of excess nutrients and more than one CWA 303(d) designated reach (Table 3).

The CWA requires Washington State to prepare a list of all surface waters that serve beneficial uses such as drinking water, recreation, aquatic habitat, and industrial use, and that are impaired by pollutants. A 303(d) listed reach would be a portion of a stream that falls short of state surface water quality standards and is not expected to improve over the next two years following listing. Waters that are placed on the 303(d) list require the preparation of Total Maximum Daily Loads (TMDL's), which will identify the total allowable maximum amount of pollutant to be released so as not to impair the waterbody. The Washington State Department of Ecology assessment of which waters are to be placed on the list is guided by federal laws, state surface water quality standards, and 303(d) policy. Pollutants and water quality standards that are of primary concern include temperature, fecal coliform, toxic substances, excess nutrients, organic waste, and erosion (DOE, 2004)

Habitat Access

Physical Barriers

Physical barriers are defined as natural or anthropogenic features, features made by people or resulting from human activities, that prevent or inhibit the movement of salmon and steelhead, these include: falls, cascades, dikes/levees, ditches, culverts, weirs, flood/tide gates, dams, or other human structures (WDFW, 1999). Culvert blockage appears to be the main physical barrier within Woodin Creek. Washington Department of Fish and Wildlife (WDFW) (1999) identifies five common conditions at culverts that create migration barriers:

- Excess drop at culvert outlet;
- High velocity within culvert barrel;
- Inadequate depth within culvert barrel;
- Turbulence within the culvert; and
- Debris accumulation at culvert inlet.

Adequate migration corridors are vital to maintaining anadromous fish populations. Physical barriers may reduce the quantity of available habitat that can be utilized by anadromous fish for spawning and rearing. Even where adult fish can bypass a potential barrier and gain access to spawning areas, habitat barriers can result in impacts to anadromous fish populations. Studies have shown that the majority of salmonid movement is upstream even during fry stages (Kahler and Quinn, 1998). Any type of physical barrier to this upstream movement precludes the use of vital upstream habitat for migration, spawning, and rearing life stages.

NOAA Fisheries (1996) considers streams with any man-made barriers present in the watershed that allow upstream and downstream fish passage at all flows is considered to be "properly functioning" for habitat access. A stream is at risk when any man-made barriers are present in the watershed and do not allow upstream and/or downstream fish passage at base/low flows. Not properly functioning conditions exist when any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows (Table 3).

Habitat Elements

Instream Habitat (Pool Frequency and Pool Quality)

Riffles and pools are often the dominant habitats in smaller tributary streams. Pools are created by erosion processes in the channel and below in-stream obstructions. Riffles are associated with straight, often higher-gradient, areas and are characterized by shallow, faster flow. The spacing between pools and riffles is indicative of the slope and condition of the stream channel. Pool habitat is important for all stages of salmonid development. Adult salmon need deep pools for resting and for shelter from predators (Kerwin, 2001). Pools are important rearing habitat for juvenile salmonids.

NOAA Fisheries' (1996) indicators for pool habitat are divided into pool frequency and pool quality. Habitat elements are properly functioning for pool indicators when pool frequency standards of 184 pools per mile are present within a stream with five foot of width and large woody debris recruitment standards are properly functioning. Pools also must be greater than

one meter deep with good cover and cool water, along with minor reduction of pool volume by fine sediment (NOAA Fisheries, 1996) (Table 3).

Substrate

Substrate is vitally important to most salmonid fish, particularly the trout and salmon species that occur in the Pacific Northwest. Studies have shown that in a healthy stream young salmon and trout hide in the interstitial spaces between cobbles and boulders to avoid predation (Mendocino website, 2002). Suitably sized substrate is also required for most species of salmon and trout to successfully spawn.

NOAA Fisheries has determined that properly functioning conditions for the substrate indicator exist when dominant substrate is gravel or cobble with clear interstitial spaces in between and embeddedness is less than 20 percent. If gravel and cobble is subdominant or is dominant and contains an embeddedness of 20 to 30 percent then the habitat element is at risk. Not properly functioning conditions exist when bedrock, sand, silt or small gravel is the dominant substrate, or if gravel and cobble are dominant, embeddedness is greater than 30 percent (NOAA Fisheries, 1996) (Table 3).

Large Woody Debris

Large woody debris (LWD) is an important part of functioning stream habitat and plays many roles in a healthy stream environment. Large woody debris is defined as large woody material, usually at least 20 inches in diameter, which has fallen to the ground or into a stream (Kerwin, 2001). Large woody debris helps to contribute nutrients to instream habitat through invertebrates, vegetated material, and indirectly by holding salmon carcasses. Structurally, LWD provides potential roosting, nesting, refuge, and foraging opportunities for wildlife; foraging, refuge, and spawning substrate for fishes; and foraging, refuge, spawning, and attachment substrate for aquatic invertebrates and plants (Brennan and Culverwell in prep, as seen in Kerwin, 2001).

NOAA Fisheries' (1996) standards for properly functioning LWD within western Washington streams are greater than 80 pieces of LWD per mile with diameters of greater than 24 inches and greater than 50–feet in length. Habitat elements at risk meet standards for properly functioning, but lack potential sources from riparian areas of woody debris recruitment to maintain that standard. Not properly functioning conditions do not meet standards for properly functioning and lack potential large woody debris recruitment (Table 3).

Off Channel Habitat

Off channel habitat such as ponds, connected wetland areas, side channel stream, and backwater pools are important habitat areas for juvenile salmonids. These off channel areas not only provide refuge areas for juvenile salmonids during high stream flows, but also provide protection from predators. In small tributary systems such as Woodin Creek, off channel habitat may not be common even under natural conditions; however, these streams themselves provide necessary off channel habitat and refuge for fish when associated with larger mainstem waterbodies such as the Sammamish River.

NOAA Fisheries (1996) standards for off channel habitat describe properly functioning conditions containing backwaters with cover, and low energy off channel areas (such as ponds, and oxbows etc). Conditions are at risk when the habitat contains some backwaters and high-

energy side channels. Not properly functioning habitat exists when few or no backwaters and no off channel ponds exist (Table 3).

Channel Condition and Dynamics

Width/Depth Ratio

Comparisons of bankfull width to depth ratios can indicate shifts in channel stability in response to disturbance (Rosgen, 1996 as seen in Kerwin, 2001). Increased discharge increases erosion rates of the streambanks and causes channel widening and increased width to depth ratios (Kerwin, 2001). NOAA Fisheries (1996) describes properly functioning conditions existing when the bankfull width to depth ratio is 10. At risk conditions exist when the width to depth ratio is 10 to 12. A not properly functioning condition occurs when the ratio is above 12 (Table 3).

Streambank Condition

Streambanks provide important sources of gravel recruitment necessary to maintain natural stream functions; however, where banks become unstable due to the lack of vegetation or increased scour within the channel, the input of sediment may exceed the system's natural capacity. As a result, some habitats can be impacted by excessive bed load scour while others can be lost to sedimentation.

NOAA Fisheries (1996) describes properly functioning conditions as having greater than 90 percent stable banks or on average less than 10 percent of streambanks are actively eroding. Conditions are at risk when streambanks are 80 to 90 percent stable. A not properly functioning condition exists when less than 80 percent of the streambanks are eroding (Table 3).

Floodplain Connectivity

Natural floodplains provide an area for dissipation of energy during flood events. Many natural streams and rivers floodplains are connected directly to the river at many points, allowing the floodplains to store flood water and later discharge this storage back to the river during lower flows. NOAA Fisheries (1996) describes properly functioning conditions existing when off channel areas are frequently linked hydrologically to the mainstream channel, overbank flows occur and maintain wetland functions, riparian vegetation, and succession. Conditions become at risk when linkage of wetland, floodplains, and riparian areas to the mainstream channel are reduced. This causes overbank flows to be reduced relative to historic frequency, as evidenced by a moderate degradation of wetland function, riparian vegetation, and riparian succession. Not properly functioning conditions exist when hydrologic connectivity between off channel, wetland, floodplain, and riparian areas are severely reduced. During not properly functioning conditions, the wetland extent is drastically reduced and riparian vegetation/succession is altered significantly (Table 3).

Flow/ Hydrology

Change in Peak/Base Flows

The change in peak/base flows is linked to a number of human activities such as changes in land cover, including the clearing of forests and the creation of impervious surfaces. The combination of activities increase storm flows and reduces base flows (Kerwin, 2001). Flood impacts may be

exacerbated by human activities that lead to increased sediment loads, point and non-point source pollutants, and the removal of instream LWD. However, floods can also be beneficial as they also produce and maintain habitats where they provide the necessary energy to scour deep pools, connect off channel habitats, and create side channels (Kerwin, 2001). Low flows typically limit salmon production for stocks that rear during summer within the stream (Kerwin, 2001).

NOAA Fisheries (1996) describes properly functioning conditions as having conditions indicated for change in peak/base flows by watershed hydrographs that indicate peak flow, base flow, and comparable timing characteristics to any undisturbed watershed of similar size, geology, and geography. At risk conditions are indicated by the evidence of altered peak flow, baseflows, and/or flow timing is relative to an undisturbed watershed of similar size, geology, and geography. Not properly functioning conditions exist when there are pronounced changes in peak flow, baseflow, and/or flow timing is shown relative to an undisturbed watershed of similar size, geology, and geography (Table 3).

Increase in Drainage Network

All the tributaries of Lake Washington and Lake Sammamish utilized by salmonid species have been intensively urbanized with a myriad of human-caused habitat impacts, which for the most part mask the natural population limiting factors of low summer stream flows and poor spawning gravel quality.

NOAA Fisheries (1996) describe properly functioning conditions for flow/hydrology drainage network indicator existing when zero or minimum increases in the drainage network density due to roads are present. Conditions are at risk when moderate increases in drainage network density due to roads exist, for example, approximately 5 percent increase. Not properly functioning conditions exist when there are significant increases in drainage network density due to roads, for example, an increase of 20 to 25 percent (Table 3).

Watershed Condition and Dynamics

Road Density and Location

NOAA Fisheries (1996) describe properly functioning conditions existing within a watershed environment when the watershed contains no valley bottom roads and has less than two miles of roads. Conditions are at risk when some valley bottom roads exist and there are 2 to 3 miles of road per square mile within the watershed. Not properly functioning conditions exist when there are many valley bottom roads with greater than 3 miles of roadway within the watershed (Table 3).

Disturbance History

NOAA Fisheries (1996) describes disturbance history within a watershed based upon conditions that exist in a forested environment and not an urban environment and thus is not applicable as criteria for Woodin Creek. Much work has been done in the urban environment in relation to disturbance history (Booth et al., 2001; Horner and May, 2000; May et al., 1997), and much of the disturbance history is correlated with increases in impervious surface area. Studies in Puget Sound lowland streams show that alteration can occur in basins with as little as 10 percent total impervious surface. However, dramatic effects can be seen relative to discharge in basins where

impervious surface exceeds 40 percent (May et al., 1997). The amount of impervious surface area within the Woodin Creek basin will be used to assess the disturbance history.

Riparian Zone and Vegetation

Riparian zones are transitional areas between aquatic and upland habitats. These usually lie within an area between 100 or 200 feet from the water's edge (Raedeke, 1988 in Johnson and Ryba, 1992). A number of wildlife species depend heavily on the functions of riparian zones including the life history of Pacific Northwest fish (Johnson and Ryba, 1992). This habitat assessment will concentrate on the influences of riparian systems on salmonids that include:

- The contribution of organic matter (leaves, needles, cones, twigs, wood, and bark) and many terrestrial insects vital to the diet of juvenile salmonids.
- The contribution of large woody debris, logs and branches, that shape channel morphology, retain organic matter, and provide essential cover for juvenile salmonids.
- The stabilization of streambanks with roots that also contribute to the formation of juvenile salmonid habitat.
- Protective cover from overhanging vegetation that helps maintain cool stream temperatures in small stream systems during the summer (Johnson and Ryba, 1992).

If a riparian buffer is to be able to meet all of these functions, it must have a properly functioning riparian reserve. A properly functioning riparian reserve provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subbasins, and buffers or includes known refugia for sensitive aquatic species (greater than 80 percent intact) (NOAA Fisheries, 1996) (Table 3).

FINDINGS

Review of Existing Background Data

A primary goal of this study was to identify and summarize existing sources of information to determine the applicability of existing resources in regard to Woodin Creek. Background sources used specifically in this assessment include:

- *Salmon and Steelhead Habitat Limiting Factors* Report for the Cedar-Sammamish Basin (Water Resource Inventory Area 8) (Kerwin, 2001)
- 1992 Washington State Salmon and Steelhead Stock Inventory (SASSI) Appendix One: North Puget Sound Volume (WDFW and WWTIT, 1994)
- 1998 Washington Salmonid Stock Inventory Bull Trout and Dolly Varden Appendix (WDFW, 1998)
- *Catalog of Washington Streams and Salmon Utilization*, Washington State Department of Fisheries (Williams et al., 1975)
- Draft Coastal Cutthroat SASSI Data (Unpublished)
- *Tributary 87 Biological Resources Inventory* (Unpublished)
- *Sensitive Areas Map Folio*, King County, Washington (King County, 1990)
- *Soil Survey of King County Area, Washington* (Natural Resource Conservation Service, 1973)
- *US Geological Survey (USGS) Water Resources for Washington State: Historical Data* (USGS, 2001).

Existing resources indicate that little information specific to Woodin Creek is available. Woodin Creek is only specifically identified in one of these resources (*Salmon and Steelhead Habitat Limiting Factors* Report for the Cedar-Sammamish Basin (Water Resource Inventory Area 8) and is not even shown on many of the existing inventories. Although there was limited information specific to Woodin Creek in these sources, they do provide overview information on general fish-use and basin-wide characteristics that can be applied generally to Woodin Creek and other tributaries in the Sammamish River drainage (Figures 3 and 4).

Properly Functioning Conditions

Site-specific habitat data is provided for each of the five identified reaches in the following section and is based upon information gathered during the stream habitat assessment (Summer 2003), and water quality data collected by Adolfson and the City of Woodinville. This section describes the findings of the site-specific and reconnaissance-level investigations and discusses general conditions at the basin-level. Table 4 summarizes the PFC conditions for Woodin Creek.

Table 4. Summary of Woodin Creek Baseline Conditions

Pathways: Indicators	Environmental Baseline	Comments
Water Quality		
Temperature	"at risk" to "not properly functioning"	During summer months only.
Sediment	"at risk"	TSS levels low, however erosive nature of soils in upper reaches likely contribute to high turbidity during storm events.
Chemical	"not properly functioning"	Reach 1 does not meet state surface water quality standards for fecal coliform on a regular basis, elevated nitrtates/nitrites, pH low in winter months, DO low in summer months, elevated stream temperatures during summer months.
Habitat Access		
Physical Barriers	"not properly functioning"	Culverted Reach 2 acts as a complete fish passage barrier to upstream Reaches 3, 4, and 5. Other barriers exist during high and low flow conditions.
Habitat Elements		
Substrate	"not properly functioning"	High degree of embedment of spawning substrates in Reach 1, which is the only accessible spawning reach.
LWD	"not properly functioning"	LWD is absent from much of Reach 1, all of Reach 2, and is limited in the upper reaches as well.
Pool Frequency	"not properly functioning"	27 pools per mile of stream.
Pool Quality	"not properly functioning"	Pools that do exist lack adequate cover and depth.
Refugia	"not properly functioning"	
Off-Channel Habitat	"not properly functioning"	Reaches 3, 4, and 5 are high gradient, Reach 2 is culverted, and Reach 1 is primarily channelized and offers no off-channel habitat.
Channel Condition and Dynamics		
Width/Depth Ratio	"properly functioning"	Overall width/depth ratios are <10.
Streambank Condition	"at risk"	Conditions in Reach 1 are fairly stable due to armoring and low bank height and Reaches 3, 4, and 5 contain steeper gradients and more erosive soils and are less stable.
Floodplain Connectivity	"not properly functioning"	Development of valley floor, diking of Sammamish River, channelization, armoring, and culverting have all severely reduced floodplain connectivity.
Flow/Hydrology		
Peak/ Base Flows	"not properly functioning"	Over 40% impervious surface within the basin.
Drainage Network	"not properly functioning"	Over 30% of impervious surface within the basin is within road rights-of-way.
Watershed Conditions		
Road density and location	"not properly functioning"	Many roads cross Woodin Creek and almost all of Reach 1 is confined to roadside conveyance ditches.
Disturbance History	"not properly functioning"	Highly disturbed by urban development.
Riparian reserves	"not properly functioning"	Reaches 1 and 2 have been significantly modified and much of the riparian vegetation is gone. Upper Reaches are intact to some extent, but are fragmented.

Impervious Surface Area

The Woodin Creek basin is approximately 408 acres in size. The total impervious area within the basin was calculated at 168.37 acres or 41.3% of the Woodin Creek Basin. Table 5 summarizes the impervious area within the basin. Stream degradation has been associated with the quantity of impervious surface in a basin (Booth, 2000; May et al., 1997; Horner and May, 2000). Urbanization changes the volume, rate, and timing of water flowing through stream systems, which can impact the physical characteristics of the stream channel (Booth, 1991). Dramatic effects can be seen relative to discharge in basins where impervious surface exceeds 40 percent (May et al., 1997). The percent impervious surface area within the Woodin Creek basin suggests that it has a large impact on the overall degradation of stream conditions and likely has a negative impact upon salmonid populations within the basin.

Table 5. Summary of Impervious Surface Area in The Woodin Creek Basin

Measured Parameters	Acres	% of Study Area	% of Total Impervious Area
Street ROW	53.50	13.1%	31.8%
Commercial/Multi-family Building footprints	37.70	9.2%	22.4%
SFR R-1, R-4, R-6	25.99	6.4%	15.4%
Large visible parking lots	51.18	12.5%	30.4%
SUM Impervious	168.37	41.3%	100.0%
Study Area	408.00	100.0%	

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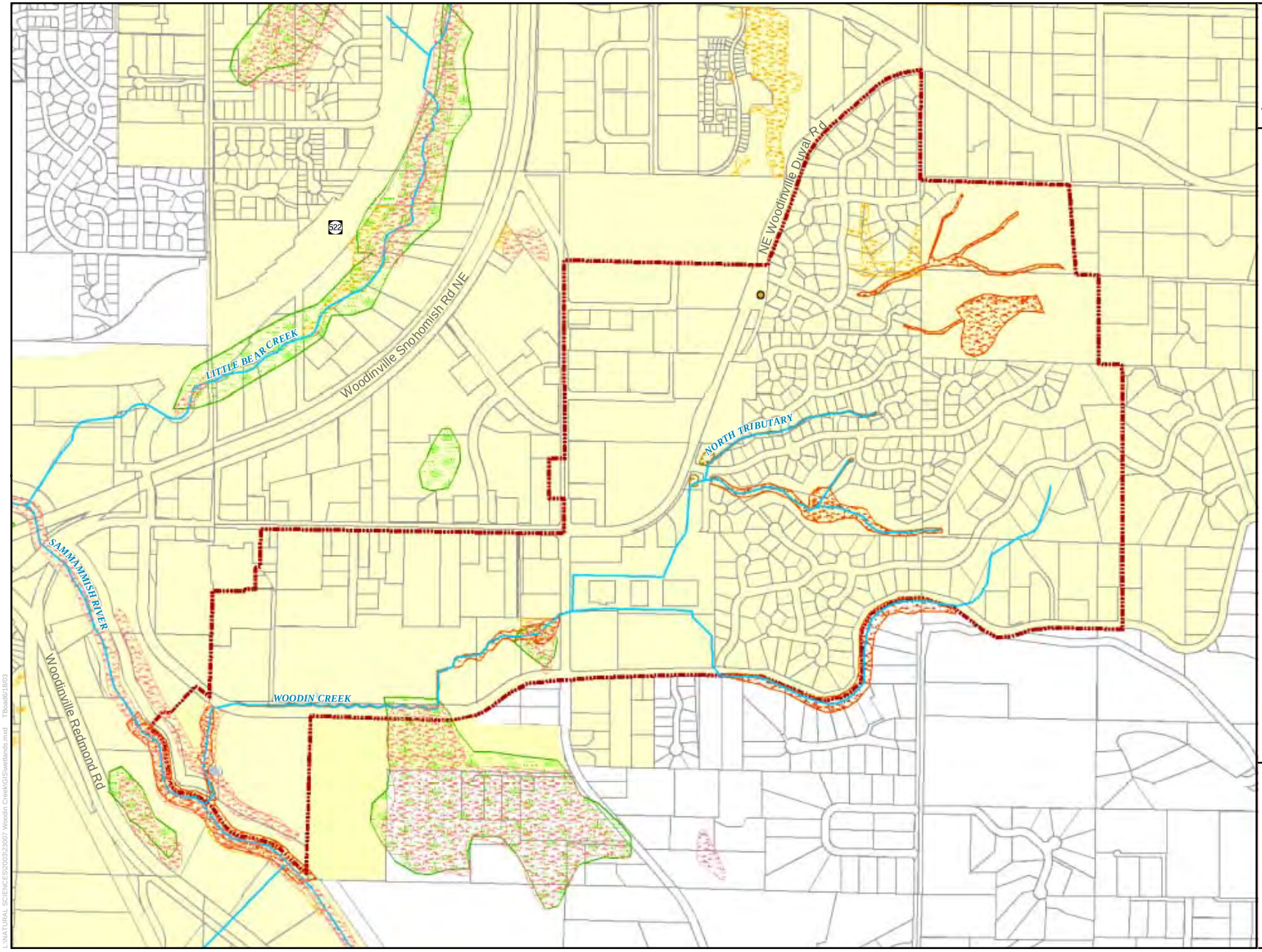

FIGURE 4

WETLANDS

WOODIN CREEK BASIN
HABITAT ASSESSMENT

WOODINVILLE, WASHINGTON

N

NWI Wetlands
NWI Wetlands
King County Wetlands

Habitat Types

Agricultural
Upland Grassland
Open Water Pond
Riparian Wetland
Herbaceous Wetland
NWI Modified
Study Area
Parcels
Woodinville City Limits
Streams

0 500 1,000
Feet

Map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.

Source: Woodinville GIS 2002; King County GIS 2002; NWI 1987

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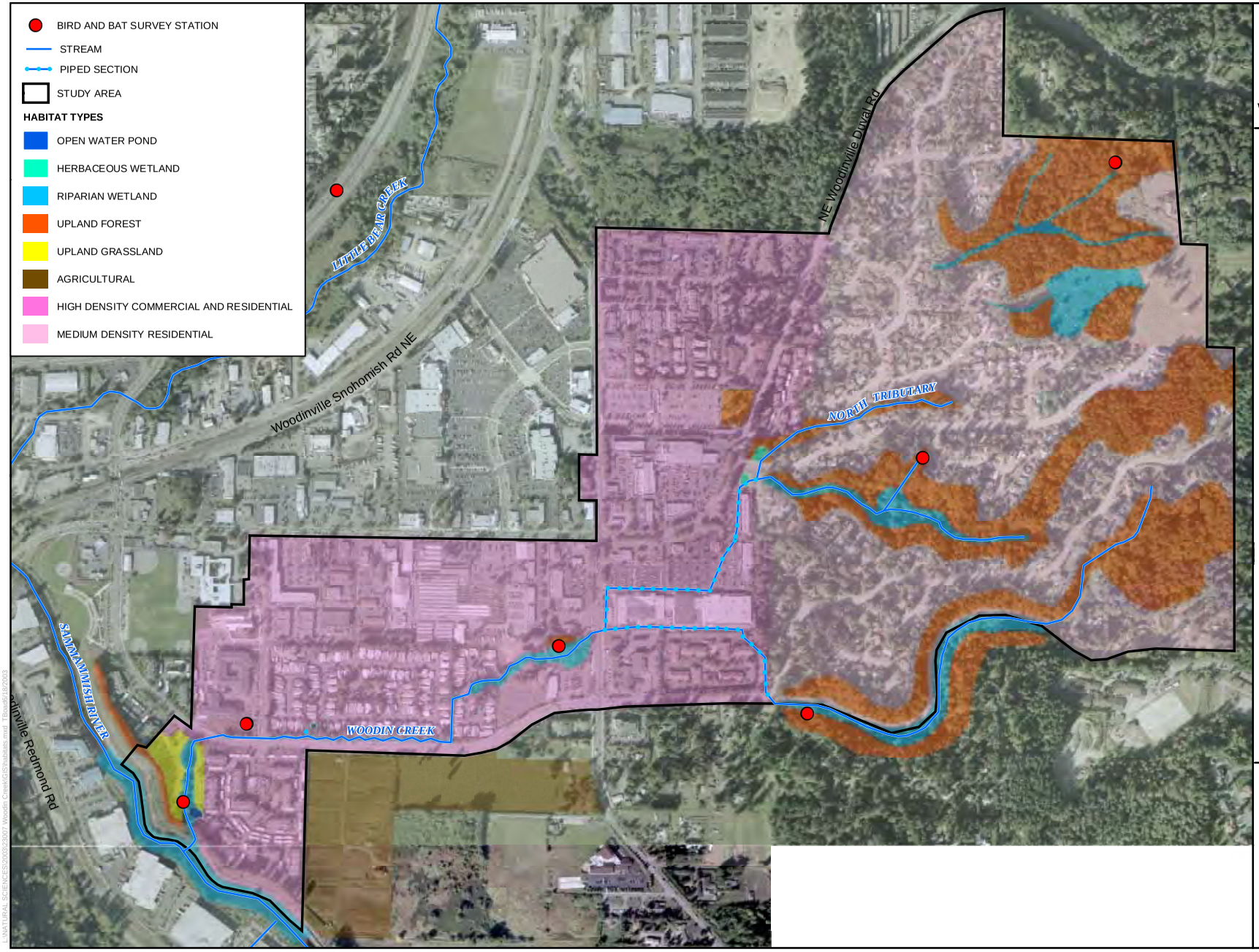

FIGURE 5

HABITATS

WOODIN CREEK BASIN
HABITAT ASSESSMENT

WOODINVILLE, WASHINGTON

0 500 1,000
Feet

Map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.

Source: Woodinville GIS 2002; King County GIS 2002

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Water Quality

Table 6 shows the range in which the measured parameters occurred. Appendix A contains the water quality data collected by both Adolfson and the City of Woodinville. Figure 2 shows the Adolfson's sample site locations. The pH standards set by the State of Washington Department of Ecology in the Washington Administrative Code (WAC) 173-201A for class "AA" waters including all waters in the Lake Washington and Sammamish Basins states that pH shall be within the range of 6.5 to 8.5. The pH data collected by Adolfson only accounted for three days in 2003, but the City's data was more comprehensive and was used to assess the pH of Woodin Creek (Table 6 and Appendix A). Approximately 71 percent of samples collected by the City at the upstream site (171st Place) were below a pH of 6.5. Approximately 10.5 percent of the downstream samples in Reach 1 (Woodin Park) were below a pH of 6.5. According to State water quality standards Woodin Creek exceeded pH criteria standards on several occasions.

Table 6. Range of Water Quality Parameters Measured Within Woodin Creek

Sample Site	Parameter	Maximum	Minimum
NE 171st Place	pH	7.53 (5/8/03)	5.00 (2/13/03)
Woodin Park		7.63 (5/1/03)	5.80 (1/16/03)
Site 1		7.40 (8/29/03)	7.20 (5/30/03)
Site 2		7.10 (5/30/03)	6.90 (8/29/03)
Site 3		7.10 (*)	7.10
Site 4		7.20 (10/31/03)	7.10 (5/30/03)
NE 171st Place	***Conductivity***	**21.7 (8/14/03)	**5.7 (3/13/03)
Woodin Park	(uOhms)**	**20.4 (9/27/03)	**6.3 (3/6/03)
Site 1	uS	298 (5/30/03)	228 (10/31/03)
Site 2		277 (10/31/03)	235 (5/30/03)
Site 3		241 (5/30/03)	255 (10/31/03)
Site 4		302 (8/29/03)	219 (10/31/03)
NE 171st Place	***Turbidity***	372 (9/11/03)	31.8 (3/6/03)
Woodin Park	(NTU)	272 (8/21/03)	20.7 (1/23/03)
Site 1		3.35 (8/29/03)	1.5 (5/30/03)
Site 2		4.34 (8/29/03)	2.32 (5/30/03)
Site 3		5.42 (8/29/03)	2.64 (10/31/03)
Site 4		4.93 (8/29/03)	2.98 (5/30/03)
NE 171st Place	***Dissolved Oxy.***	7.3 (10/16/03)	9.9
Woodin Park	(mg/L)	7.7 (10/16/03)	6.7
Site 1		12.04 (10/31/03)	5.91 (8/29/03)
Site 2		11.72 (10/31/03)	4.97 (8/29/03)
Site 3		11.88 (10/31/03)	5.51 (8/29/03)
Site 4		12.06 (10/31/03)	9.58 (8/29/03)

Temperature

Temperature data was collected by Adolfson and the City of Woodinville to assess Woodin Creeks ability to support aquatic life and in particular those of salmonids. Data collected by the City of Woodinville from two sites (Woodin Park and at NE 171st Place) within Woodin Creek from January 2003 to October 2003 indicates that temperatures at the park in lower Reach 1 ranged from 6.0 ºC (43 ºF) in February to 18 ºC (64 ºF) in July. Temperatures in the upper section (Reach 3) ranged from 4.7 ºC (40.5 ºF) in February to 21.3 ºC (70.3 ºF) in June.

Table 7 shows the average weekly daytime temperatures collected by Adolfson for each water quality monitoring site, which were those temperatures recorded between 6:00 A.M. to 7:00 P.M. over the seven day period, as well as the highest and lowest temperature recorded at each site. Temperatures within Woodin Creek appear to be "not properly functioning" for the lower reach (Sites 1 and 2) and "at risk" for the upper reaches (Sites 3 and 4) based on NOAA Fisheries standards. Temperature standards set by the State of Washington Department of Ecology in the Washington Administrative Code (WAC) 173-201A for class "AA" waters including all waters in the Lake Washington and Sammamish Basins states that temperatures shall not exceed 16 ºC (60.8 ºF). According to State water quality standards Woodin Creek exceeds criteria standards during the summer months.

Dissolved oxygen (DO) levels were also measured in Woodin Creek (Table 6). DO levels ranged from poor to good, with a minimum of 4.97 mg/L recorded in Reach 1 on August 29, 2003, when the stream temperature was 15º C (59 ºF), and a maximum of 12.06 mg/L in Reach 3 on October 31, 2003, when the stream temperature was 6.5º C (43.7 ºF). There is an inverse relationship between stream temperature and DO in that as stream temperature increases, the DO decreases. DO standards set by the State of Washington Department of Ecology in the Washington Administrative Code (WAC) 173-201A for class "AA" waters including all waters in the Lake Washington and Sammamish Basins states that DO levels shall exceed 9.5 mg/L. It appears that DO levels in Woodin Creek do not meet State standards during the summer months.

Table 7. Summary of Temperature Data for Woodin Creek.

Weekly Average Daytime Temperatures (ºC)					
Week	**Air**	**Site1**	**Site 2**	**Site 3**	**Site 4**
6/6/03-6/12/03	17.8	15.1	14.3	13.3	13.6
6/13/03-6/19/03	16.7	14.5	14.1	13.5	12.9
6/20/03-6/26/03	15.1	13.9	13.7	12.9	11.9
6/27/03-7/3/03	18.4	15.2	14.7	15.1	13.3
7/4/03-7/10/03	18.9	15.8	15.0	15.6	13.4
7/11/03-7/17/03	20.0	16.8	15.8	13.8	14.4
7/18/03-7/24/03	21.1	17.6	15.6	14.0	14.8
7/25/03-7/31/03	21.6	17.8	16.7	14.3	15.2
8/1/03-8/6/03	19.3	16.7	16.4	13.6	14.7
8/7/03-8/13/03	18.9	16.7	16.5	13.5	14.5
8/14/03-8/20/03	20.5	18.1	16.6	13.8	14.9
8/21/03-8/27/03	15.1	13.3	13.5	10.9	11.9
Minimum	7.6	11.7	12.6	9.5	11.0
Maximum	32.8	21.5	19.9	22.4	17

Sediment/Turbidity

Turbidity data was collected by both Adolfson and the City of Woodinville (See Table 3 and Appendix A). Turbidity measurements within Woodin Creek ranged from 1.5 NTU's to 372 NTU's. The USFWS recommends a maximum TSS level of 80 mg/L to protect salmonids (Kuttel, 2001). The highest reported TSS level for Woodin Creek was 63 mg/L in November 2000 (Table 8 and Appendix A). TSS data provided by the City was fairly low and appears to be protective of salmonids; however, certain turbidity levels measured by the City were much higher.

To a large degree, sediment and turbidity are related to the erosive character of the adjacent streambanks and surrounding soils types (Figure 3). Most of the erosion and sediment deposition in Reach 1 can be attributed to the soils and slopes that exist within the upper reaches of Woodin Creek (Reaches 3, 4, and 5). Soils in Reaches 4 and 5 and the upper most portion of Reach 3 consist of Everett Gravelly Sandy Loam with 15-30 percent slopes. The lower portion of Reach 3 is Everett Gravelly Sandy Loam with 5-15 percent slopes. However, these conditions result in sediment deposition within the lower reaches of Woodin Creek. The grain size is sufficient enough to cause the sediments to drop out of the water column quickly once they reach the lower gradient portions of the stream. This limits the amount of total suspended solids within the system. It appears that Woodin Creek is "at risk" based upon NOAA Fisheries standards for this element.

Chemical Contamination/Nutrients

Woodin Creek is not specifically listed on the state's CWA 303(d) list; however, the list does not often include small tributaries such as Woodin Creek. Data collected to date indicate higher than normal level of some contaminants within Woodin Creek. Data collected by the City over a three year period (Appendix A) has shown high amounts of fecal coliform organisms along with high amounts of nitrate/nitrite, particularly within Reach 1. Reach 1 was the only site analyzed for contaminants.

Fecal Coliform standards set by the State of Washington Department of Ecology in the Washington Administrative Code (WAC) 173-201A for class "AA" waters including all waters in the Lake Washington and Sammamish Basins states that fecal coliform levels shall not exceed a geometric mean value of 50 colonies/100ml and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100ml. The geometric mean for all samples collected by the City (Appendix A) is 403 colonies/100ml with 66.7 percent of the samples exceeding 100 colonies/100ml. Reach 1 does not meet current State water quality standards.

Table 8 shows the contaminants that were measured by the City and the range of concentrations reported over the three-year period. Due to elevated stream temperatures and higher than normal contaminants, it is likely that Woodin Creek is "not properly functioning" based on NOAA Fisheries standards for this element.

Table 8. Reported Concentration Ranges for Analyses Assessed

Sample Site	Parameter	Maximum	Minimum
Woodin Park	Fecal Coliforms (organisms/100ml)	2800 (June 01)	0.5 (Jan. 01)
Woodin Park	Nitrate/Nitrite (µg/l)	1460 (March 02)	0.731 (July 03)
Woodin Park	Total Phosphorous (mg/l)	0.1450 (Aug. 01)	0.0025 (Nov. 00)
Woodin Park	Total Suspended Solids (mg/l)	63 (Nov. 00)	2 (Jan. 01)
Woodin Park	Lead (mg/l)	0.00295 (Nov. 00)	0.00050 (Jan. 01)
Woodin Park	Zinc (mg/l)	0.0712 (Jan. 01)	0.0050 (Feb. 01)
Woodin Park	Copper (mg/l)	0.06460 (March 01)	0.00050 (Sept. 01)

Source: City of Woodinville, unpublished data (Appendix A)

Habitat Access

Physical Barriers

Physical barriers to fish passage were noted in the field and described below.

Reach 1. The culvert at NE 171st Street appears to be a fish barrier during high flow events (Figure 2). Sedimentation has reduced the volume of the culvert and may result in increased velocities that could preclude fish use during some times of the year. No other man-made barriers were noted within Reach 1 that would prohibit the access of salmonids to the upstream reaches, although the stream is crossed by several roads via culverts. Many of these appear to be newer culverts and were designed with fish passage as a consideration or allowed fish passage as a result of the need to provide adequate conveyance.

Reach 2. From 140th Avenue NE to NE 174th Street, Woodin Creek is culverted (Figure 2). The length of culvert is approximately 1,350 feet. This length of culvert is a blockage to upstream fish passage to Reach 3 and Reaches 4 and 5.

Reach 3. There are no known man-made habitat blockages within Reach 3. The culvert under 146th Place NE is likely a fish passage barrier during low-flow periods (Figure 2).

Reach 4. Much of the lower section of the North Tributary is culverted under the same development as Reach 2. This length of culvert is a blockage to upstream fish passage and likely precludes anadromous fish from upstream sections of this reach and from Reach 5.

Reach 5. There are two culverts crossings under roads within Reach 5. One culvert is under NE 178th Street and one is under 146th Avenue NE. The culvert under 178th Street has a grate covering the culvert and is a barrier to upstream fish passage. The culvert at 146th Avenue NE is elevated several feet above the streambed and is a barrier to upstream migration.

It is evident that the Woodin Creek Basin is not properly functioning for this habitat element. The long expanses of culverts in Reaches 2 and 4 preclude anadromous or migratory resident fish from accessing available upstream habitats.

Habitat Elements

Substrate

Sand and silts substrates were most evident within Reach 1 of Woodin Creek (Photos 3 and 4, Appendix C). Sand flows from Reaches 3, 4, and 5 and is deposited in Reach 1 due to lower stream gradients. The majority of sediment deposition from erosion areas in Reaches 4 and 5 collect at the stormwater facilities at NE 178th Street/NE Woodinville-Duvall Road. Catch basins along the culverted Reach 2A collect sediment as well. Erosion areas for Reach 3 generally included areas in the vicinity of stations 49+00 to 51+00. Erosion areas were common in Reach 4 and included areas in the vicinity of stations: 1+00 to 11+00. Erosion areas in Reach 5 occurred in the vicinity of stations 1+00 to3+30. In some areas, small gravel is present, but where it occurs it is highly embedded. Substrates were not evaluated in Reach 2 and lower sections of Reach 4 because these areas are culverted. Upstream of these piped segments, substrates in Reaches 3 and 4 are dominated by small gravel (Photo 5, Appendix C). Cobble was the dominant substrate in Reach 5. Subdominant substrates range from large gravels (Reaches 3 and 5) in areas with higher sloped streambeds to organic matter where the stream crosses areas of riparian wetlands (Figure 4). Sand was a subdominant substrate in Reaches 1 and 4. Table 9 documents substrate composition in Reaches 1, 2, 4, and 5.

Although sand was not a dominant substrate based on surface area coverage, the overall dominant coverage was 25 percent with a subdominant coverage of 52 percent. This causes a high degree of imbedment for the larger grained substrates such as gravels and cobble, and ultimately reduces stream velocities necessary to flush fine sediments from spawning substrates. Substrates within Woodin Creek are “not properly functioning” due to the high levels of sedimentation in Reach 1 and the loss of habitat area in Reach 2 due to culverts.

Large Woody Debris

Large woody debris does not appear to meet the requirements for properly functioning conditions throughout the entire basin. Large woody debris is largely absent from Reach 1. The only large woody debris that was observed occurred in one location where it appears to have been placed during restoration efforts (Photo 6, Appendix C). Potential for LWD recruitment in Reach 1 is lacking due to the lack of available mature trees in the riparian areas older trees. No large woody debris occurs in Reach 2 because that section is culverted.

Large woody debris pieces are present, but do not meet the standards for properly functioning due to the size and lack of number of pieces available within the streambed. Large woody debris within Reaches 3, 4, and 5 is generally small, approximately 10-inch to 20-inch in diameter and is short (less than 20 feet). The total number of LWD pieces, that meet standards for properly functioning, was 20 pieces for the 7,469 feet of stream surveyed. This equates to 14.1 pieces of LWD per mile of stream. Woodin Creek is “not properly functioning” for the LWD element. Appendix B contains stream survey data sheets, which document LWD within Woodin Creek.

Table 9. Substrate Summary

Substrate	Dominant Coverage (ft)	Secondary Coverage (ft)	Dominant Coverage (%)	Sub-dominant Coverage (%)
		Reach 1		
Silt/Organic	40	18	1%	1%
Sand	1,019	2,023	29%	57%
Small Gravel	2,048	846	58%	24%
Large Gravel	96	300	3%	9%
Cobble	80	96	2%	3%
Totals	3,283	3,283	93%	93%
		Reach 3		
Silt/Organic	6	6	0%	0%
Sand	718	577	37%	30%
Small Gravel	769	575	39%	29%
Large Gravel	460	787	24%	40%
Cobble	-	8	-	0%
Totals	1,953	1,953	100%	100%
		Reach 4		
Sand	131	1,173	10%	88%
Small Gravel	1,200	131	90%	10%
Large Gravel	-	27	-	2%
Totals	1,331	1,331	100%	100%
		Reach 5		
Silt/Organic	75	-	11%	-
Sand	-	75	-	11%
Small Gravel	-	20	-	3%
Large Gravel	-	481	-	72%
Cobble	310	-	47%	-
Boulder	191	-	29%	-
Totals	576	576	86%	86%
		Summary for Reaches 1, 3, 4, and 5		
Silt/Organic	121	24	2%	0%
Sand	1,868	3,848	25%	52%
Small Gravel	4,017	1,572	54%	21%
Large Gravel	556	1,595	7%	21%
Cobble	390	104	5%	1%
Boulder	191	-	3%	-
Totals	7,143	7,143	96%	96%

Instream Habitat Types (Pool Frequency and Pool Quality)

Woodin Creek contains 113 habitat types in the portions surveyed of which 55 are riffle habitats and 39 are pool habitats. This number excludes habitat within culverts. Tables 10 through 13 summarize the habitat data collected in the field (Appendix B) for each Reach. Table 14 summarizes habitat data for the entire portion of stream surveyed. Instream habitat within Reach 1 consists of low-gradient riffle and glide habitat. Pools within Reach 1 are few and are largely limited to those created by stream enhancement activities including the construction of log weirs

across the stream and root wads (Photos 7 and 8, Appendix C). Most of Reach 1 is contained within roadside conveyance ditches and/or has been channelized and straightened by past development activities. Instream habitat in Reach 2 and lower sections of Reach 4 is absent as a result of culverting. Instream habitat within open channel portions of Reaches 3, 4, and 5 are dominated by riffles with few pools (Photo 9, Appendix C). Cascades are present in areas with high streambed gradients. This occurs primarily within the Northern Tributary (Reaches 4 and 5). Woodin Creek contains a total of 39 pools in the 1.4 miles surveyed (Appendix B). This translates into 27 pools per mile of stream. Woodin Creek contains no pools with depths greater than three feet and lacks the large woody debris necessary for creating quality pool habitat. Woodin Creek is not properly functioning based on NOAA Fisheries standards for pool frequency and pool quality (Table 3).

Off Channel Habitat

Off channel habitat throughout the Woodin Creek system has been degraded by the channelization of Reach 1 and the culverting of Reach 2 and parts of Reach 4. Off stream habitat is limited in Reaches 3, 4, and 5 due to higher streambed gradients and residential development. The most significant area of off-channel habitat is associated with a small pond in Reach 1 approximately 250 feet upstream of the stream mouth (Figure 2; Photo 10, Appendix C); however, this pond is elevated above Woodin Creek and is not accessible as off channel habitat and only receives flow during storm events. A second open water pond is located adjacent to Woodin Creek north of NE 171st Street within the Canterbury Estates community (Figure 2). This pond is elevated above Woodin Creek and is not accessible as off channel habitat. Woodin Creek is likely to be “not properly functioning” based on NOAA Fisheries standards for off channel habitat.

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Table 10. Habitat Summary for Reach 1

Habitat	Frequency	Total Length (feet)	Average Width (feet)	Average Depth (inches)	Average Length (feet)	Total Area (feet^2)	Percent of Total Reach (Area)	Percent of Total Reach (Length)
Low Gradient Riffle	26	1,808	4.5	2.9	69.5	8,066.5	49.5%	51.4%
High Gradient Riffle	2	80	5.0	3.0	40.0	400.0	2.5%	2.3%
Plunge Pool	6	72	6.8	10.0	12.0	492.0	3.0%	2.0%
Glide	14	946	4.1	5.6	67.6	3,919.1	24.1%	26.9%
Step Run	1	32	6.0	5.0	32.0	192.0	1.2%	0.9%
Mid-Channel Pool	7	140	7.0	9.3	20.0	980.0	6.0%	4.0%
Corner Pool	12	176	6.2	8.9	14.7	1,085.3	6.7%	5.0%
Culverted Reach	5	236	4.2		47.2	991.2	6.1%	6.7%
Other	2	29	5.5	9.0	14.5	159.5	1.0%	0.8%
Totals	75	3,519				16,285.6	100%	100%

Table 11. Habitat Summary for Reach 3

Habitat	Frequency	Total Length (feet)	Average Width (feet)	Average Depth (inches)	Average Length (feet)	Total Area (feet^2)	Percent of Total Reach (Area)	Percent of Total Reach (Length)
Low Gradient Riffle	19	1,839	3.7	1.2	96.8	6,872.1	94.0%	94.2%
High Gradient Riffle	1	50	3.0	1.0	50.0	150.0	2.1%	2.6%
Cascade	1	10	4.0	1.0	10.0	40.0	0.5%	0.5%
Backwater Pool - Log Formed	2	7	5.5	3.0	3.5	38.5	0.5%	0.4%
Plunge Pool	6	28	4.0	4.8	4.7	112.0	1.5%	1.4%
Dammed Pool	4	17	5.3	4.8	4.3	89.3	1.2%	0.9%
Mid-Channel Pool	1	2	4.0	8.0	2.0	8.0	0.1%	0.1%
Totals	34	1,953				7,309.8	100%	100%

Table 12. Habitat Summary for Reach 4

Habitat	Frequency	Total Length (feet)	Average Width (feet)	Average Depth (inches)	Average Length (feet)	Total Area (feet^2)	Percent of Total Reach (Area)	Percent of Total Reach (Length)
Low Gradient Riffle	3	1,298	4.7	2.0	432.7	6,057.3	98.5%	97.5%
High Gradient Riffle	1	27	3.0	1.0	27.0	81.0	1.3%	2.0%
Plunge Pool	1	6	2.0	3.0	6.0	12.0	0.2%	0.5%
Totals	5	1,331				6,150.3	100%	100%

Table 13. Habitat Summary for Reach 5

Habitat	Frequency	Total Length (feet)	Average Width (feet)	Average Depth (inches)	Average Length (feet)	Total Area (feet^2)	Percent of Total Reach (Area)	Percent of Total Reach (Length)
Low Gradient Riffle	3	556	2.7	2.3	185.3	1,482.7	86.1%	83.5%
Cascade	1	20	3.0	2.0	20.0	60.0	3.5%	3.0%
Culverted Reach	1	90	2.0		45.0	180.0	10.4%	13.5%
Totals	5	666				1,722.7	100%	100%

Table 14. Overall Habitat Summary for Woodin Creek

Habitat	Frequency	Total Length (feet)	Average Width (feet)	Average Depth (inches)	Average Length (feet)	Total Area (feet^2)	Percent of Total Reach (Area)	Percent of Total Reach (Length)
Low Gradient Riffle	51	5,501	4.1	2.2	107.9	22,543.3	71.6%	73.7%
High Gradient Riffle	4	157	4.0	2.0	39.3	628.0	2.0%	2.1%
Cascade	2	30	3.5	1.5	15.0	105.0	0.3%	0.4%
Backwater Pool - Log Formed	2	7	5.5	3.0	3.5	38.5	0.1%	0.1%
Plunge Pool	13	106	5.2	7.1	8.2	546.3	1.7%	1.4%
Dammed Pool	4	17	5.3	4.8	4.3	89.3	0.3%	0.2%
Glide	14	946	4.1	5.6	67.6	3,919.1	12.4%	12.7%
Step Run	1	32	6.0	5.0	32.0	192.0	0.6%	0.4%
Mid-Channel Pool	8	142	6.6	9.1	17.8	940.8	3.0%	1.9%
Corner Pool	12	176	6.2	8.9	14.7	1,085.3	3.4%	2.4%
Culverted Reach	6	326	3.8		54.3	1,249.7	4.0%	4.4%
Other	2	29	5.5	9.0	14.5	159.5	0.5%	0.4%
Totals	119	7,469				31,496.8	100%	100%

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Refugia

Refugia throughout the entire Woodin Creek basin has been degraded by development that has either resulted in the loss of mainstream habitat or riparian vegetation. This degradation has reduced the amount of vegetation and appropriate substrate and other remnant habitat available for refugia. Although some refugia does occur along the stream, primarily as a result of off channel wetlands in Reach 1, these areas are relatively small and have been impacted by adjacent land uses. In several instances, off channel wetlands have been converted into landscape amenities as decorative ponds that do not provide as high a level of refugia function as would undisturbed riparian wetlands. Woodin Creek is likely to be "not properly functioning" based on NOAA Fisheries standards for refugia.

Channel Condition and Dynamics

Width/Depth Ratio

Width/Depth ratios were calculated using channel width and depth data (Appendix B) collected during stream surveys. Data shows that values ranged widely between reaches with Reaches 1 and 3 showing the widest variability. Reach 1 values ranged from 1.3:1 to 32:1. Reach 3 values ranged from 1.4:1 to 40:1. Reach 4 values ranged from 1.5:1 to 8:1. Reach 5 values ranged from 3:1 to 8:1. Average width/depth ratios for all reaches are less than 10:1, which would indicate that Woodin Creek is "properly functioning" for this element. Low width/depth ratios are typical for incised channels such as those encountered in Woodin Creek.

Streambank Condition

Streambank conditions within Reach 1 of Woodin Creek are generally stable due to the lack of bank height and armoring within the reach. Armoring stationing areas include the angular rip-rap beneath the footbridge (0+18). Bank stability is compromised to some degree in Reaches 3, 4, and 5 because of the erosive nature of soils and the slope of streambanks in these reaches. Reaches 4 and 5 are the most susceptible to erosion due to 15-30 percent slopes. Reach 3 contains some 15-30 percent slopes in the uppermost section, but the majority is 5-15 percent slopes. Reaches 3-5 all contain erosion problem areas and much of this sediment is deposited in the lower gradient Reach 1. Streambank conditions within Woodin Creek appear to be "at risk" based on NOAA Fisheries standards.

Floodplain Connectivity

Floodplain connectivity within Woodin Creek has been affected by past channelization, culverting, and bank armoring. The overall floodplain area has been severely degraded by diking of the Sammamish River and development of the valley floor. It is evident that Woodin Creek is not properly functioning for floodplain connectivity based on NOAA Fisheries standards.

Flow/Hydrology

Change in Peak/Base Flows

Much of the basin is comprised of impervious surfaces (Figure 2). Runoffs from impervious surfaces appear to have altered peak and base flows within the basin. The stream appears to commonly breach the streambanks along the main channel of Reach 1. The level of development within the basin and the documented problems with sedimentation support this

assessment. It is evident that the Woodin Creek Basin is not properly functioning for flow/hydrology based on NOAA Fisheries standards.

Drainage Network

Approximately 31 percent of the impervious surface within the Woodin Creek basin occurs in road rights-of-way. Many roads have drainage networks that predate current water quality detention and treatment standards. The Woodin Creek Basin is not properly functioning for flow/hydrology based on NOAA Fisheries standards.

Watershed Conditions

Road Density and Location

Many roadways cross Woodin Creek. Most of Reach 1 is confined to roadside conveyance ditches. It is evident that the Woodin Creek Basin is not properly functioning for road density and location based on NOAA Fisheries standards.

Disturbance History

The Woodin Creek Basin is 41.3% impervious surface area. The valley floor is heavily developed and the original stream channel in this area has been historically altered to allow for development. Best available science indicates that basins with greater than 40 percent impervious surface area are known to severely degrade streams in the Lowland Puget Sound region (May et al., 1997). Based upon this information, it is likely that Woodin Creek is not properly functioning for this element.

Riparian Zone and Vegetation

The width of the vegetated riparian zone within the basin varies considerably by location. In Reach 1, the riparian zone varies from approximately 100-feet along the east banks to five feet or less as it parallels NE 171st Street. The riparian zone is completely lacking in Reach 2 and lower sections of Reach 4. In Reaches 3 and 5, and in Reach 4 upstream of 143rd Avenue NE, the riparian corridor is more consistent and ranges from 50 to 100 feet in width. Steep slopes and development under more current land use guidelines appear to have allowed riparian conditions in these areas to be maintained to a higher degree than in other portions of the basin. Although riparian areas have been maintained in some areas, the significant modification in Reaches 1 and 2 and the fragmentation of other riparian areas indicates that the Woodin Creek basin is not properly functioning for riparian reserve based on NOAA Fisheries standards.

Fish Use in the Woodin Creek Basin

Woodin Creek is a small tributary to the Sammamish River. Limited site-specific data was found that describes fish use in Woodin Creek. The Washington Department of Fish and Wildlife Priority Habitat and Species map does not identify Woodin Creek or identify fish presence within Woodin Creek. On the other hand, King County Water Resources Inventory Area 8 data contains some information on fish presence within Woodin Creek. The King County Salmon Watcher's Program evaluated Woodin Creek in 1999 and 2002 and did not identify any spawning salmonids within Woodin Creek during those years. There is also

sufficient data available related to the larger Sammamish River Basin that allows information on fish use within the area, or potential fish use, within Woodin Creek to be assessed. In addition, Adolfson performed spawner surveys within Woodin Creek. Surveys were performed from September 2003 through November 2003 (Figure 2). Table 15 shows the dates the surveys took place and the number of spawning adults, carcasses, and redds observed for the indicated sites.

Table 15. Spawner Survey Results for Woodin Creek

Date	Number and Species of Spawning Adults, Carcasses, and Redds Observed							
	*OP-1	OP-2	OP-3	OP-4	**OR-1	OR-2	OR-3	OR-4
9/23/03	None	1 Chinook Carcass	None	None	None	None	None	None
10/6/03	None	None	None	None	None	None	None	None
10/15/03	None	None	None	None	None	None	None	None
10/23/03	None	None	None	None	None	None	None	None
10/31/03	None	None	None	None	None	None	None	None
11/14/03	None	None	None	None	None	None	None	None
11/24/03	None	None	None	None	None	None	None	None

*OP = Observation Point **OR = Observation Reach

ESA-listed and Candidate Fish Species

Chinook Salmon and Bull Trout

Under ESA-enabling legislation, two anadromous fish species have been listed as threatened in Puget Sound: Chinook salmon and bull trout. In the Lake Washington Basin, Chinook salmon spawn mainly in the Cedar River and Bear Creek in Redmond. Chinook spawning in north Lake Washington tributaries utilize North, Swamp, Bear, Little Bear, Thornton, McAleer, and Cottage Lake Creeks as well as the Sammamish River. Spawning occurs from September through October with the spawning peak occurring in October (WDFW and WWTIT, 1994). Smaller tributaries have some documented Chinook spawning activity although it is not known if these streams represent reproducing runs of Chinook or if spawners are mainly strays from other basins. One Chinook carcass (Photo 11, Appendix C) was discovered during the September 2003 spawner survey at the upstream end of the culvert beneath NE 171st Street in Reach 1. The carcass was out of the stream and approximately five feet up the left bank in a patch of reed canarygrass. Water levels at the time were extremely low in this lower reach, and the Chinook was likely stranded and removed by a streamside predator (raccoon). No other Chinook were observed during the spawner surveys.

Less than a dozen bull trout have been reported in the Lake Washington Basin; these individuals are thought to be strays from other Puget Sound basins. Although native char (bull trout and/or Dolly Varden trout) have been documented in the Snohomish River basin to the north and in Chester Morse Lake (headwaters of the Cedar River) (Snohomish County, 2000), no reproducing populations are known or thought to exist in the Sammamish River Basin. All known successful bull trout spawning in the region occurs below the winter snow line (ranges from 1,500 feet to 2,500 feet in the Western Cascades). It is unlikely that bull trout occur within Woodin Creek. No bull trout were observed during the stream or spawner surveys.

Coho Salmon

Puget Sound/Strait of Georgia coho salmon are currently candidates for listing under the ESA. Coho salmon utilize small streams for spawning and are found in virtually all of the accessible

reaches of smaller Lake Washington tributaries. Based on declining escapement numbers, however, Lake Washington coho runs are considered "depressed." Coho spawn timing occurs from late October to mid-December and is very similar to hatchery coho spawn timing (WDFW and WWTIT, 1994) (Table 16). Spawning surveys in 1996 identified adult coho salmon spawning activity within the lower reaches of Woodin Creek (King County, 2001). Juvenile salmonid fish, likely to be coho fry, were observed by Adolfson biologists during site visits in February 2003. In addition, King County personnel electrofished and dewatered a portion of lower Reach 1, prior to sediment blockage removal activities in early November 2003. Two subyearling coho were removed and released upstream of removal activities. No spawning coho were observed during surveys conducted from September through the end of November.

Table 16. Life History of Lake Washington Chinook and Coho Salmon (WDFW, 1994)

Month	J	F	M	A	M	J	J	A	S	O	N	D
adult spawning –Chinook												
adults spawning –coho												
intragravel development –Chinook												
intragravel development –coho												
rearing –Chinook												
rearing –coho												
smolting & migration –Chinook												
smolting & migration –coho												

Other Salmonids

Sockeye Salmon

Sockeye salmon stocks have been recognized as three distinct stocks according to the Washington State Salmon and Steelhead Stock Inventory or SASSI (WDFW and WWTIT 1994): (1) Cedar River; (2) tributary streams to Lakes Washington and the Sammamish River; and (3) Lake Washington beach spawners. These stocks are distinguished from other Puget Sound sockeye stocks by geographic and reproductive separation. Genetic studies suggest the current stocks in the Cedar River and Issaquah Creek are similar to the Baker River stock transferred from the Birdsview Hatchery and first released in 1935 into Lake Washington. Electrophoretic genetic analysis of fish taken from North Lake Washington tributaries indicates they are genetically different from the introduced stocks. As such, these fish may be of native origin (Kerwin, 2001). Lake Washington sockeye stocks are the largest sockeye run in the state (Kerwin, 2001). Spawn timing for Lake Washington sockeye occurs from early September through November with Cedar River and beach spawners spawning into January (WDFW and WWIT, 1994). Sockeye salmon have been observed spawning in the lower reaches of Woodin Creek in 1996 (King County, 2001). No Sockeye were observed spawning in Woodin Creek by Adolfson during the September through November 2003 spawner surveys.

Kokanee

Kokanee salmon is the freshwater resident form of sockeye salmon. The Lake Washington Basin is thought to support two distinct kokanee populations and a population of residualized sockeye that are managed as kokanee. A summer (early) and presumed native run that returns in August primarily to Issaquah Creek, and a native stock returning to East Lake Sammamish Tributaries in November through January. A third stock, that was recently determined to be more closely linked genetically to sockeye, is found in North, Little Bear, and Big Bear Creeks. In March 2000, the summer run kokanee stock that returns to Issaquah Creek was petitioned for listing as Endangered under the Endangered Species Act (Kerwin, 2001). Adult kokanee have been identified spawning within Reach 1 of Woodin Creek (King County, 2001). No kokanee were observed by Adolfson spawning in Woodin Creek during the September through November 2003 spawner surveys.

Cutthroat Trout

Coastal cutthroat trout, a subspecies of cutthroat trout are known to occur throughout the Lake Washington Basin (Kerwin, 2001). In 1997 juvenile cutthroat trout were identified within Woodin Creek by the Muckleshoot Indian Tribe Fisheries Department (King County, 2001). Adolfson also documented cutthroat trout use of Woodin Creek during spawner and stream habitat surveys in Reach 1. No cutthroats were documented using the upper reaches of Woodin Creek (Reaches 3-5). This is likely due to the culverted section (Reach 2 and lower portion of Reach 4) that acts as a fish passage barrier.

In addition, King County personnel electrofished and dewatered a portion of lower Reach 1, prior to sediment blockage removal activities in early November 2003. Approximately 250 cutthroat trout were removed and released upstream of the work area.

Steelhead Trout

Wild winter steelhead are present within the Lake Washington system and are a distinct native stock. No summer steelhead stock have been identified. Spawn timing for winter steelhead within the Lake Washington system is generally from early March to mid-June (WDFW and WWIT, 1994). While it is unlikely that adult steelhead spawn in Woodin Creek, juvenile steelhead may enter the system to rear. No spawner survey was performed by Adolfson during peak steelhead spawning, so no assessment can be made as to their presence or absence from the stream.

Other Fish

Along with salmonids, other species in Woodin Creek are typical of Lake Washington tributaries and include sculpins, three-spine stickleback, western brook lamprey, red-sided shiner, large-scale sucker, peamouth, small mouth bass, long nose dace, and speckled dace (Wydoski and Whitney, 1979). In addition King County personnel electrofished and dewatered a portion of lower Reach 1, prior to sediment blockage removal activities, in early November 2003. Lampreys (*Lampetra sp*.) and sculpin (*Cottus sp*.) were removed and released upstream of work area.

Aquatic Species

Aquatic species such as insects, leeches, slugs, and other species typical of Lake Washington tributaries are also present within Woodin Creek. During preliminary studies stonefly larvae, cadis fly larvae, and adult mayflies were observed by Adolfson staff during site surveys.

Wildlife Habitat

Woodin Creek basin habitat and wildlife surveys were conducted within five main stream reaches and the upper basin area. Habitat type descriptions and opportunities for habitat improvements are summarized in Table 17. Plant species observed in the stream reach areas are listed in Table 17. Bird survey findings are provided in Table 18.

Habitat Types

Eight primary habitat associations are identified in the basin and mapped on an aerial photograph. Seven habitat types occur in the study area. These include in order of abundance: High Density Commercial and Residential; Medium Density Residential; Upland Forest; Riparian-Wetlands; Upland Grassland; Herbaceous Wetland; and Open Water Pond. In addition, Agricultural areas occur in King County just south of the study area (Figure 5).

High Density Commercial and Residential

The dominant habitat type of the basin along Reaches 1 and 2 is high density commercial and residential (Photo 12). These areas consist of nearly 100 percent impervious surfaces. Native vegetation communities are lacking, and invasive, non-native plants and animals such as lawn grasses, Himalayan blackberry, European starling, house sparrow, house mouse, and raccoon are abundant.

Medium Density Residential

The dominant habitat type of the basin along Reaches 3, 4, and 5 is medium density residential (Photo 13). Single-family housing is located within 100 feet (horizontal distance) of the stream. This habitat type is covered by 30 to 59 percent impervious surfaces. Vegetation is mainly lawn grasses and ornamental trees and shrubs, with some remaining patches of native forest. A few native and non-native wildlife species are abundant in these areas including American robin, black-capped chickadee, house finch, domestic cat, and the species listed above for high density commercial and residential.

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Table 17. Summary of Terrestrial Habitats in Different Stream Reaches

Stream Reach	Survey Station	Habitat Types	Structural Conditions	Habitat Elements	Opportunities
Reach 1	1, 2, 4	Riparian-wetland, open water wetland, herbaceous wetland, upland grassland, high density commercial and residential	Shrub-sapling along stream with scattered small trees, maintained grass in park, windbreak poplars in rows	Sammamish River, dense shrub thickets along stream, large woody debris in stream, fruits and seeds, nest boxes	Conifers could be planted near stream to provide future structure and woody debris. Park maintenance activities could be reduced, especially near the stream. Invasive plant species could be removed/managed and native shrubs and trees could be planted in riparian and adjacent upland areas. Limit development near stream.
Reach 2a and 2b	Piped stream	High density commercial	No forested component is present.	Commercial buildings, dumpsters with food garbage	None
Reach 3	3	Riparian-wetland, upland forest, medium density residential	Medium trees (15-19” dbh) – single story – closed (>70% canopy cover), and smaller patches of large tree (20-29” dbh) – multi-story – closed (>70% canopy cover)	Small, deciduous snags, conifer trees, multiple-trunked maple trees, forested and scrub-shrub wetlands, mosses, large woody debris, leaf litter, herbaceous ground cover, fruits, seeds, and nuts, shrub thickets	Continue protection of existing riparian-wetland areas and native forest. Protect large trees and snags for nesting, roosting, and foraging habitat.
Reach 4 and 5	5	Riparian-wetland, upland forest, medium density residential, herbaceous wetland	Small and medium trees (10-19” dbh) – single story – moderate (40-69% canopy cover) in upland forest and riparian	Wetlands where the base of ravines widen, conifer trees, invasive vines with fruits (Himalayan blackberry and English ivy), leaf litter, herbaceous ground cover, fruits, seeds, and nuts, shrub thickets	Reduce the dumping of yard debris and garbage into forested ravines. Remove invasive vines and replant with native understory herbs and shrubs. Increase development set-backs from forested ravines. Encourage neighborhood wildlife watch programs to increase resident’s awareness of the native forest environment.
Upper basin	6	Upland forest, agricultural	Small and medium tree (15-19” dbh) – single story – closed (>70% canopy cover)	Understory shrubs, moss, large woody debris, leaf litter, conifer trees, fruits, seeds, and nuts	Retain native forest areas to prevent downstream flooding from new impervious surfaces, prevent erosion on steep slopes, and provide wildlife habitat. Ensure that any new developments in the upper basin provide adequate stormwater treatment and detention.

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Upland Forest

The largest areas of upland forest are found in the upper basin and in steep ravines bordering Reaches 3, 4, and 5. Dominant trees in upland forest areas include red alder, black cottonwood, Douglas fir, big leaf maple, and western red cedar (Photo 14). Common understory shrubs and herbs include trailing blackberry, salmonberry, Indian plum, red elderberry, hazelnut, sword fern. Non-native, invasive vines including Himalayan blackberry and English ivy are prevalent in some areas, especially near developed areas. Most forest areas consist of small and medium trees (10 to 19" dbh) with one tree canopy layer. The canopy layer is moderate (40 to 69 percent cover) near Reaches 4 and 5, and closed (more than 70 percent cover) in Reach 3 and the upper basin. Scattered large Douglas fir, big leaf maple and black cottonwood (20 to 36 inches diameter at breast height [dbh]) are found near Reach 3. Habitat elements include herbaceous ground cover, shrub thickets, fruits, seeds, nuts, leaf litter, moss, and small deciduous snags. Wildlife species observed in this habitat type include a number of bird, mammal, and amphibian species as described in the wildlife survey sections below.

Riparian Wetlands

Riparian wetland habitats are found along all of the reaches except for Reaches 2a and 2b that are piped and in the upper basin. This habitat type is dominated by shrubs in Reach 1 and by shrubs and trees in Reaches 3, 4, 5 and the upper basin. Dominant shrubs include willow species and salmonberry, dominant trees include red alder, black cottonwood, and western red cedar. In Reach 3, herbaceous cover includes skunk cabbage and youth-on-age (Photo 15). Structural forest conditions are mostly small tree (10 to 14 inches dbh) with moderate canopy (40 to 69 percent cover). One tree canopy layer is present, with dense shrub thickets present between the stream and upland forest in some places. Habitat elements include those listed above for upland forest and stream and herbaceous wetland habitats. Wildlife species observed in this habitat type include Pacific chorus frog, song sparrow, American robin, common yellowthroat, white-crowned sparrow, black-capped chickadee, myotis bats, and pileated woodpecker excavations in snags.

Upland Grassland

Most of the upland grassland habitat is maintained on a regular basis by mowing and is found in Woodin Creek Park along Reach 1 and in the upper basin in agricultural fields. Maintained grassland also includes residential lawns, too small to identify on the habitat map, in Reaches 4 and 5. Structures are limited to utility poles, buildings, and scattered trees. Wildlife species in this habitat type include mostly American robin, European starling, and house sparrow.

Herbaceous Wetland

Herbaceous wetland habitat occurs adjacent to the stream and associated ponds along Reach 1 and in storm drainage retention facilities at the downstream end of Reaches 4 and 5 (Photo 16). Dominant plants include reed canarygrass, bentgrass, creeping buttercup, and water cress. Willows and red alders provide woody structure in adjacent riparian-wetland areas. Habitat elements include seasonal and permanent open water, dense herbaceous cover, and adjacent shrubs and trees. Wildlife species observed in this habitat type include common yellowthroat, red-tailed hawk, marsh wren, and song sparrow.

Open Water Pond

Permanent open water ponds occur mainly in Reach 1 (Photo 17), while seasonally ponded areas occur throughout the riparian-wetland area of Reach 3. Ponds are situated adjacent to herbaceous wetland and riparian-wetland habitats and habitat structure and elements are similar to those listed for herbaceous wetland. Wildlife species observed in the study area and expected

use open water areas include gadwall, mallard, red-winged blackbird, violet-green swallow, marsh wren, Pacific chorus frog, and others.

Wildlife Surveys

Results of the early morning bird surveys are provided in Table 18. The most common species observed at most stations included American crow, American robin, Bewick's wren, black-capped chickadee, song sparrow, spotted towhee, and white-crowned sparrow. These species are generally adapted to vegetated habitats located within an urban matrix. Species closely associated with herbaceous wetland and open water wetland habitats were observed only at Station 1, and include red-winged blackbird, common yellowthroat, marsh wren, and gadwall.

During bat and owl surveys conducted in July, bat echolocations were detected at Stations 3, 5, and 6, and a family of western screech owls were observed perching and flying between trees and by their call at Station 5. It is interesting to note that bats and owls were only detected at the stations that were located near medium to large conifer trees. The owls were observed flying between conifer trees, between residential properties and the ravine. Structure for bat roosting could be limited where conifer trees or other large trees are not present. Smaller deciduous trees usually lack peeling bark and fissures that characterize medium to large conifer trees. Peeling bark and fissures provide potential roost sites for bats.

Other wildlife observations recorded during the habitat surveys included ruby-crowned kinglet, dark-eyed junco, mallard, pileated woodpecker excavations, eastern gray squirrel, Pacific chorus frog, mole and mountain beaver tunnels, raccoon, and Virginia opossum.

Special Status Species

Special status wildlife species include species designated by federal or state government agencies (USFWS, NMFS, and WDFW) as endangered, threatened, proposed, candidate, sensitive, and monitor species. The USFWS also designates species of concern. Habitat for several special status wildlife species occurs in the Woodin Creek basin. The foraging sign, excavations in live and dead trees, of pileated woodpecker, a state candidate species, was observed during habitat surveys in Reach 3. Foraging habitat for this species is especially prevalent in this reach. Potential nest sites for status species such as bald eagle, pileated woodpecker, and great blue heron are limited in the basin due to the lack of large trees within remaining forest habitats. However, foraging habitat is present for bald eagle and great blue heron, mostly along the Sammamish River. Olive-sided flycatcher, a federal species of concern, was heard in the distance at Station 6 during an early morning bird survey.

Table 18. Early Morning Bird Survey Results.

Bird Species	29-Apr-03						23-May-03						12-Jun-03					
	Stations						Stations						Stations					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
American crow	x	x	x	x	x			x	x				x	x	x	x	x	
American robin	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Bewick's wren				x	x	x				x	x				x	x	x	x
Black-capped chickadee	x	x				x						x	x	x		x	x	x
Bullock's oriole													x					
California quail												x						
Canada goose							x											
Cedar waxwing								x										
Chestnut-backed chickadee			x			x					x						x	
Common yellowthroat	x						x						x					
European starling							x						x	x			x	x
Gadwall							x											
Gull				x						x								
House finch	x												x			x		
House sparrow								x		x				x				
Marsh wren	x						x											
Northern Flicker							x										x	
Olive-sided flycatcher																		x
Red-breasted nuthatch			x		x													
Red-winged blackbird	x						x						x					
Song Sparrow	x	x	x		x	x	x	x	x	x			x	x	x	x	x	
Spotted towhee	x					x			x	x	x	x	x	x	x	x	x	x
Stellar's jay			x	x				x			x				x		x	x
Swainson's thrush																	x	
Violet-green swallow														x				
White-crowned sparrow	x	x	x	x		x							x	x		x		

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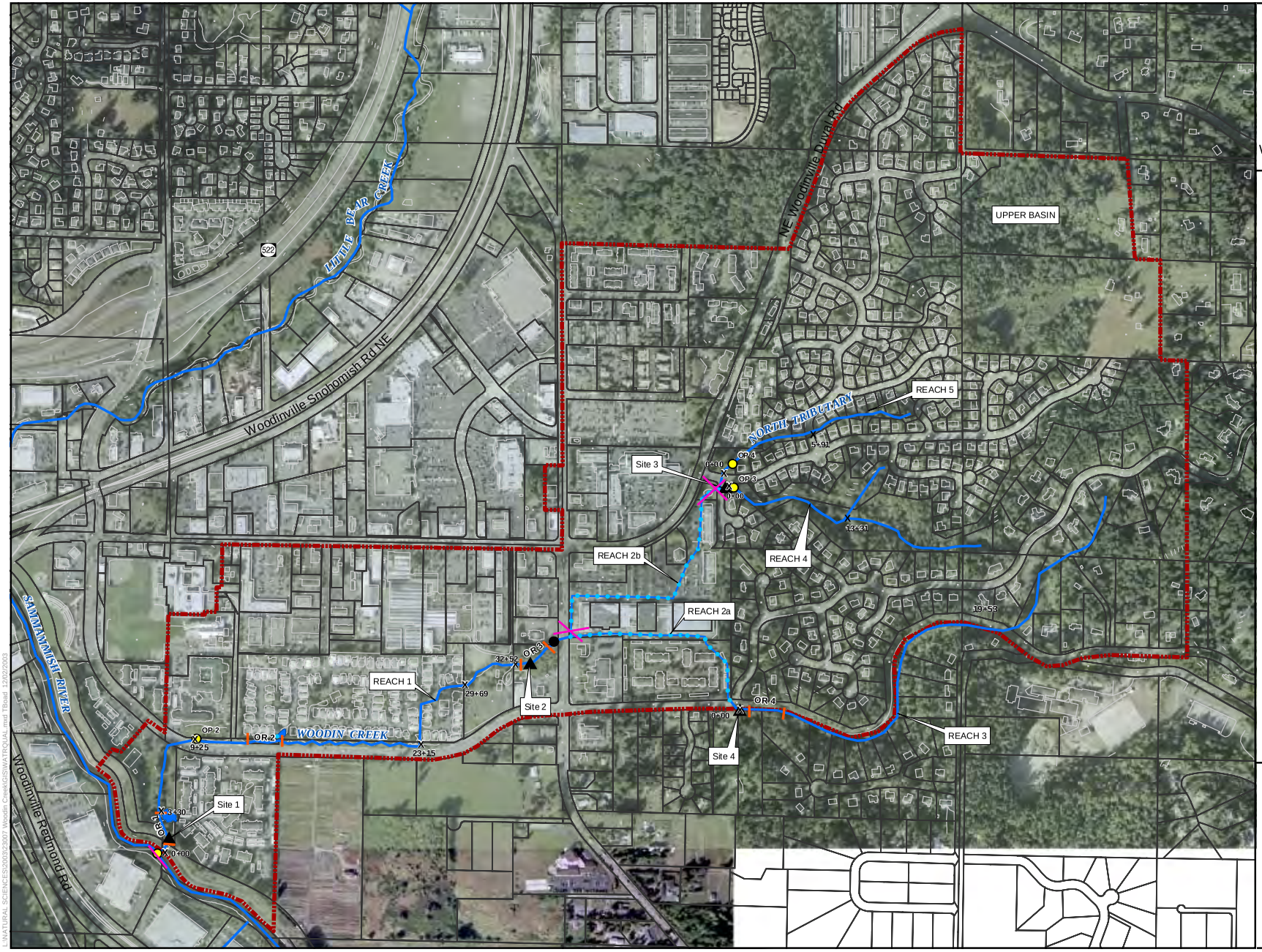

FIGURE 2

WATER QUALITY & SPAWNER SURVEY LOCATIONS

WOODIN CREEK BASIN HABITAT ASSESSMENT

WOODINVILLE, WASHINGTON

N
W E
S

- Study Area
- Parcels
- Locations of Ponds
- Streams
- Piped Sections
- Spawning Survey Observation Reaches
- Water Quality Monitoring Sites
- Spawner Survey Observation Points
- OP Observation Point
- OR Observation Reach
- Fish Barriers / Culverts
- X Stations
- Start of Reach

0 500 1,000
Feet

0 500
Feet

Map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.

Source: Woodinville GIS 2003; King County GIS 2002

L:\NATURAL SCIENCES\2003\23007 Woodin Creek\GIS\WATRQUAL.mxd TBeard 12/02/2003

LIMITATIONS

All rights-of-entry for the purpose of conducting this study was granted by the City of Woodinville. The boundaries of the study area were established based on maps provided by the City. It should be recognized that stream surveys are inexact sciences; fisheries professionals may disagree on the characterization of habitat types, the relative value of certain habitat features, and stream classifications. The final determination of stream classifications is the responsibility of the resource agencies that regulate activities in and around streams. Accordingly, all stream evaluations performed for this study, as well as the conclusions drawn in this report, should be reviewed by the appropriate regulatory agencies prior to any detailed site planning or construction activities. Further, streams are dynamic systems; habitat types and riparian vegetation may change with time.

Within the limitations of schedule, budget, and scope-of-work, we warrant that this study was conducted in accordance with generally accepted environmental science practices, including the technical guidelines and criteria in effect at the time this study was performed, as outlined in the Methods section. The results and conclusions of this report represent the authors' best professional judgment, based upon information provided by the project proponent in addition to that obtained during the course of this study. No other warranty, expressed or implied, is made.

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REFERENCES AND BIBLIOGRAPHY

Arkoosh, M. R., E. Casillas, P. Huffman, E. Clemons, J. Evered, J. E. Stein, and U. Varanasi. 1998. Increased susceptibility of juvenile chinook salmon from a contaminated estuary to *Vibrio anguillarum*. Transactions of the American Fisheries Society 127:360-374.

Arkoosh, S., E. Casillas, E. Clemons, B. McCain, and U. Varanasi. 1991. Suppression of immunologically memory in juvenile Chinook salmon (*Oncorhynchus tschawytscha*) from an estuary. Fish and Shellfish Immunology 1:261-277.

Booth, D.B. 1991. Urbanization and the Natural Drainage System—Impacts, Solutions, and Progress. *Northwest Environmental Journal* 7(1): 93-118.

Booth, D. B. 2000. Forest cover, impervious-surface area, and the mitigation of urbanization impacts in King County, Washington. Prepared for King County Water and Land Resources Division. Seattle, Washington.

Booth, D.B., J.R. Karr, S. Schauman, C.P. Konrad, S.A. Morley, M.G.Larson, P.C. Henshaw, E.J. Nelson, and S.J. Burgess. 2001. Urban Stream Rehabilitation in the Pacific Northwest. University of Washington, Seattle.

City of Woodinville. 2003. Geographic Information System (GIS) data.

Horner, R.R., and C.W. May. May. 2000. Watershed Urbanization and the Decline of Salmon in Puget Sound streams. Center for Urban Water Res. Management, University of Washington, Seattle.

Johnson, A.W., and D. Ryba. 1992. A Literature Review of Recommended Buffer Widths to Maintain Various Functions of Stream Riparian Areas. King County Surface Water Management Division, Seattle, WA.

Johnson, D.H. and T.A. O'Neil. 2001. *Wildlife-Habitat Relationships in Oregon and Washington*. Oregon State University Press. Corvallis, OR.

Kerwin, J. 2001. *Salmon and Steelhead Habitat Limiting Factors Report* for the Cedar-Sammamish Basin (Water Resource Inventory Area 8). Washington Conservation Commission. Olympia, Washington.

King County. 2001. Known Freshwater Distribution of Salmon and Trout for Water Resources Inventory Area (WRIA) 8. Website: http://dnr.metrokc.gov/Wrias/8/fish-maps/distmap.htm. February, 2003.

King County. 1991. Stream Survey Report Criteria. Department of Development and Environmental Services.

King County. 1990. Sensitive Areas Map Folio.

Kuttel, M. 2001. *Final Report: Salmonid Habitat Limiting Factors, Water Resource Inventory Area 32, Walla Walla Watershed*. Washington State Conservation Commission. Lacey, Washington.

Lind, P. 2002. Poisoned Waters: Pesticide Contamination of Waters and Solutions to Protect Pacific Salmon. Publication of the Clean Water For Salmon Campaign.

May, C. W., R. R. Horner, J. R. Karr, B. W. Mar, and E. B. Welch. 1997. Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion. Watershed Protection Techniques Vol. 2, No. 4.

May, C.W., E.B. Welch, R.R. Horner, J.R. Karr, and B.W. Mar. 1997. Quality Indices for Urbanization Effects in Puget Sound Lowland Streams. Wat. Res. Tech. Rep 154. Washington Department of Ecology, Olympia WA.

McCain, M., D. Fuller, L. Decker, K. Overton. 1990. Habitat Classification and Inventory Procedures for Northern California. U.S. Department of Agriculture Forest Service. Pacific Southwest Region.

Mendocino, K. 2002. Stream Conditions: Sediment (Measuring Sediment in Streams). Website: http://www.krisweb.com/stream/sediment.htm. Accessed February 2003.

Natural Resource Conservation Service. 1973. *Soil Survey of King County Area, Washington*.

NOAA Fisheries. 1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. August 1996.

Paul, M.J. and J.L. Meyer. 2001. Streams in the Urban Landscape. Annual Review of Ecological Systems. Annual Reviews. 32:333-65.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pogosa Springs.

Sylte, T. and C. Fischenich. 2002. Techniques for Measuring Substrate Embeddedness. ERDC TN-EMRRP-SR-36.

United States Department of the Interior Fish and Wildlife Service (USFWS). 1998. *A Framework to Assist in the Making of Endangered Species Act Determinations of Effect for Individual or Grouped action s at the Bull Trout Subpopulations Watershed Scale* (Draft). U.S. Fish and Wildlife Service.

Washington State Department of Ecology. 2004. Washington States Water Quality Assessment (303 (d)). Website: http://www.ecy.wa.gov/programs/wq/303d/index.html. Accessed February 2004.

Washington Department of Fish and Wildlife. 2001. Salmon and Steelhead Habitat Inventory and Assessment Program: Fish Passage Barriers. WDFW website: http://www.wa.gov/wdfw/hab/sshiap/fishbarr.htm. Accessed February, 2003.

Washington Department of Fish and Wildlife. 1999. Fish Passage Design at Road Culverts: A Design Manual for Fish Passage at Road Crossings. Habitat and Lands Program. Environmental Engineering Division. Olympia, Washington.

Washington Department of Fish and Wildlife (WDFW) and Western Washington Treaty Indian Tribes (WWTIT). 1994. *1992 Washington State Salmon and Steelhead Stock Inventory (SASSI) Appendix One: North Puget Sound Volume*.

Washington Department of Fish and Wildlife (WDFW). 1998. *1998 Washington Salmonid Stock Inventory Bull Trout and Dolly Varden Appendix.*

Washington Department of Fish and Wildlife (WDFW). Unpublished. Draft Coastal Cutthroat SASSI Data.

Washington State Forest Practices Board. 1988. Washington Forest Practices Rules and Regulations.

Williams, R. W., R. M. Laramie, and J. J. Ames. 1975. *A Catalog of Washington Streams and Salmon Utilization - Volume I, Puget Sound Region*. Washington Department of Fisheries (currently Washington Department of Fish and Wildlife).

Wydoski, R. S. and R.R. Whitney. 1979. *Inland Fishes of Washington*. University of Washington Press. Seattle, Washington.

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APPENDIX A: WATER QUALITY DATA

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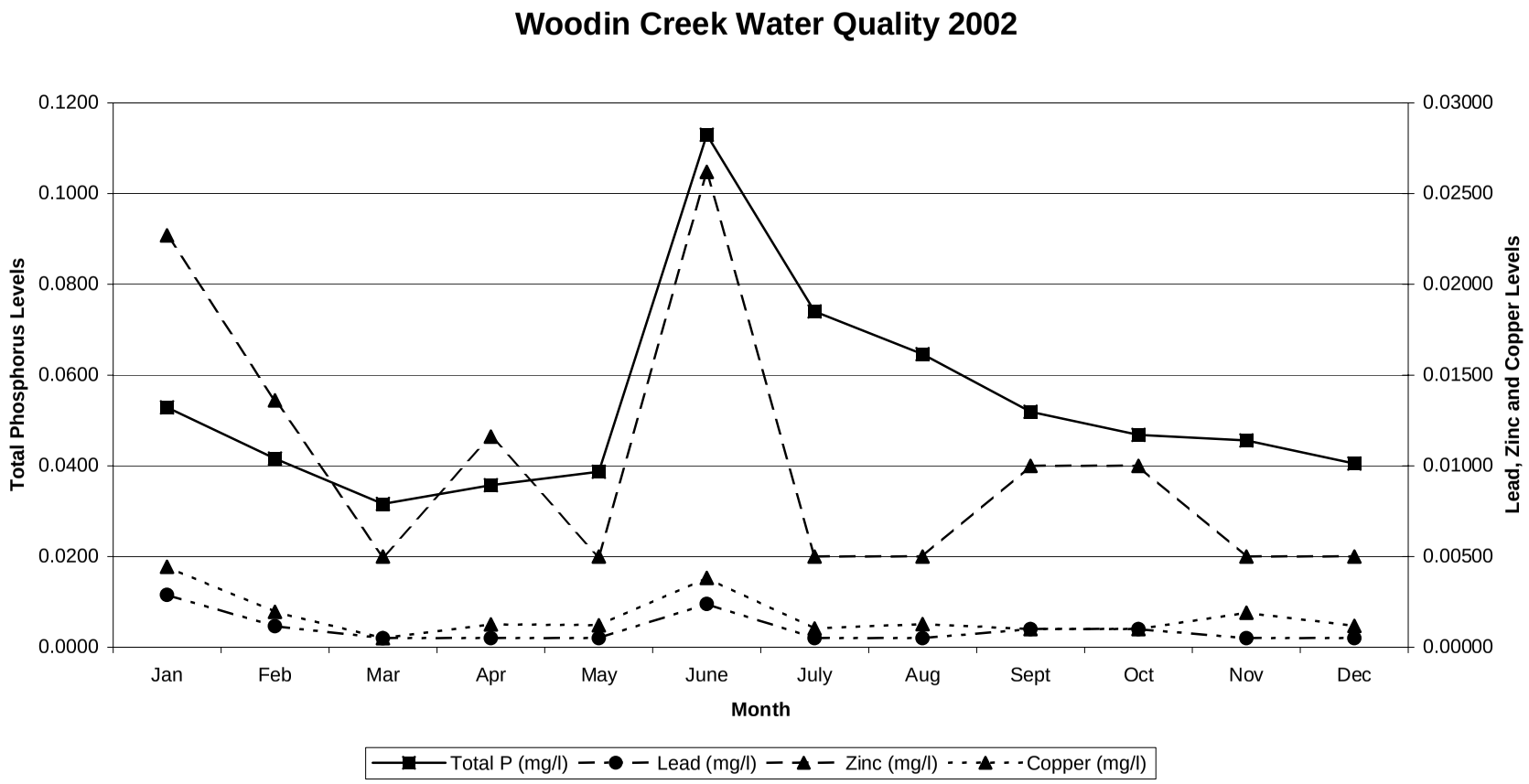
City of Woodinville

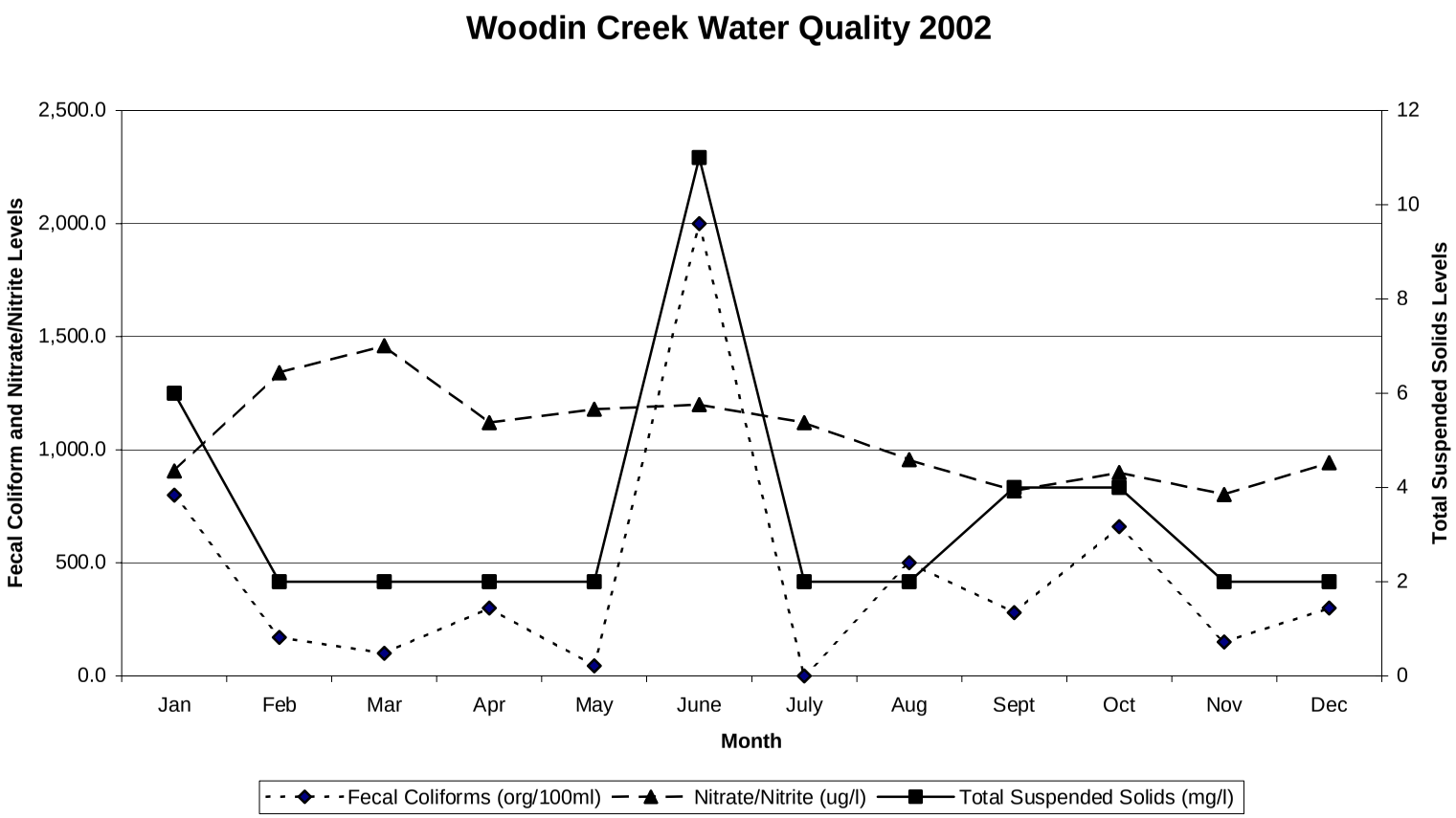
Woodin Creek Water Quality Data

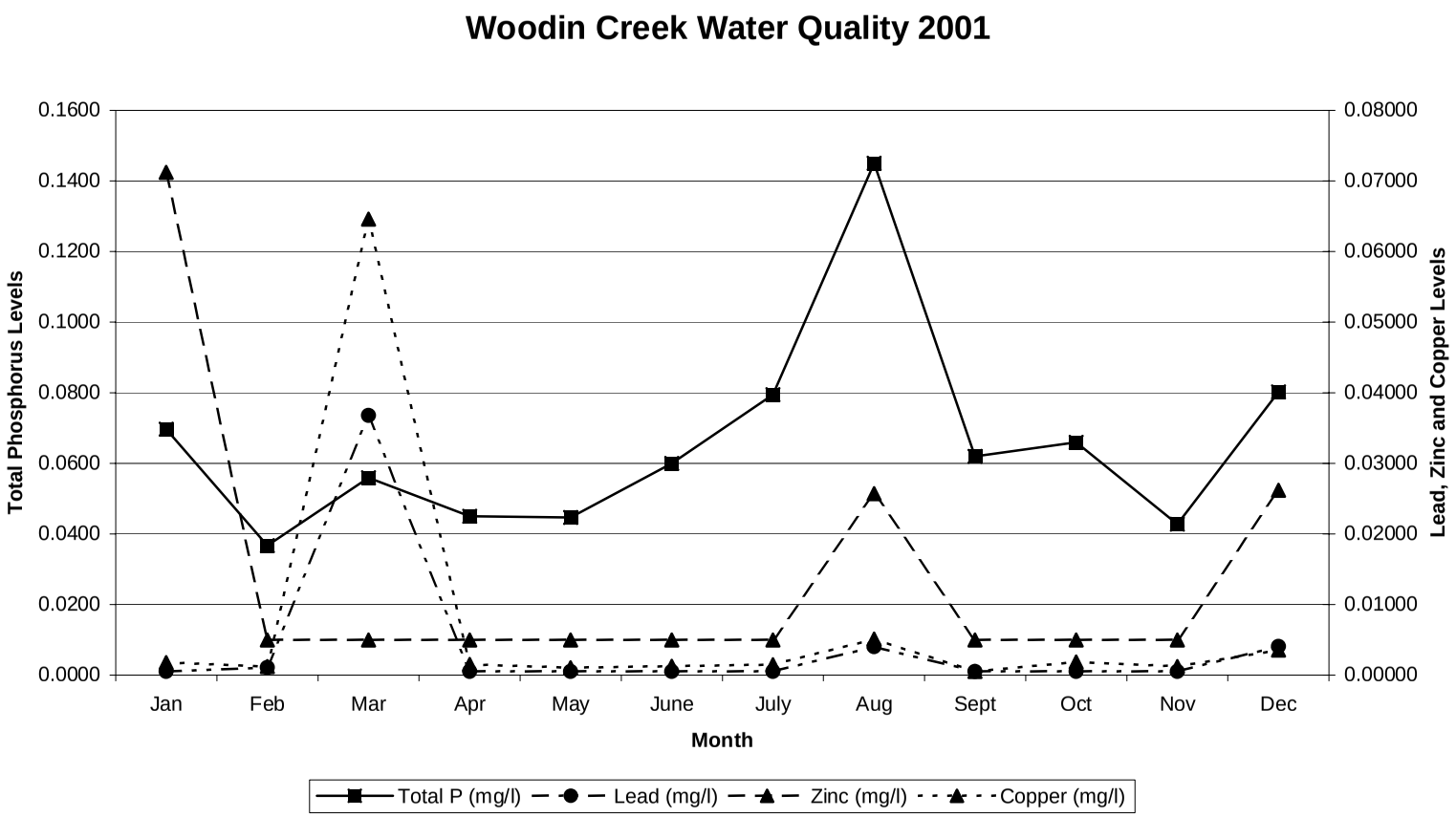
Collected by the City of Woodinville

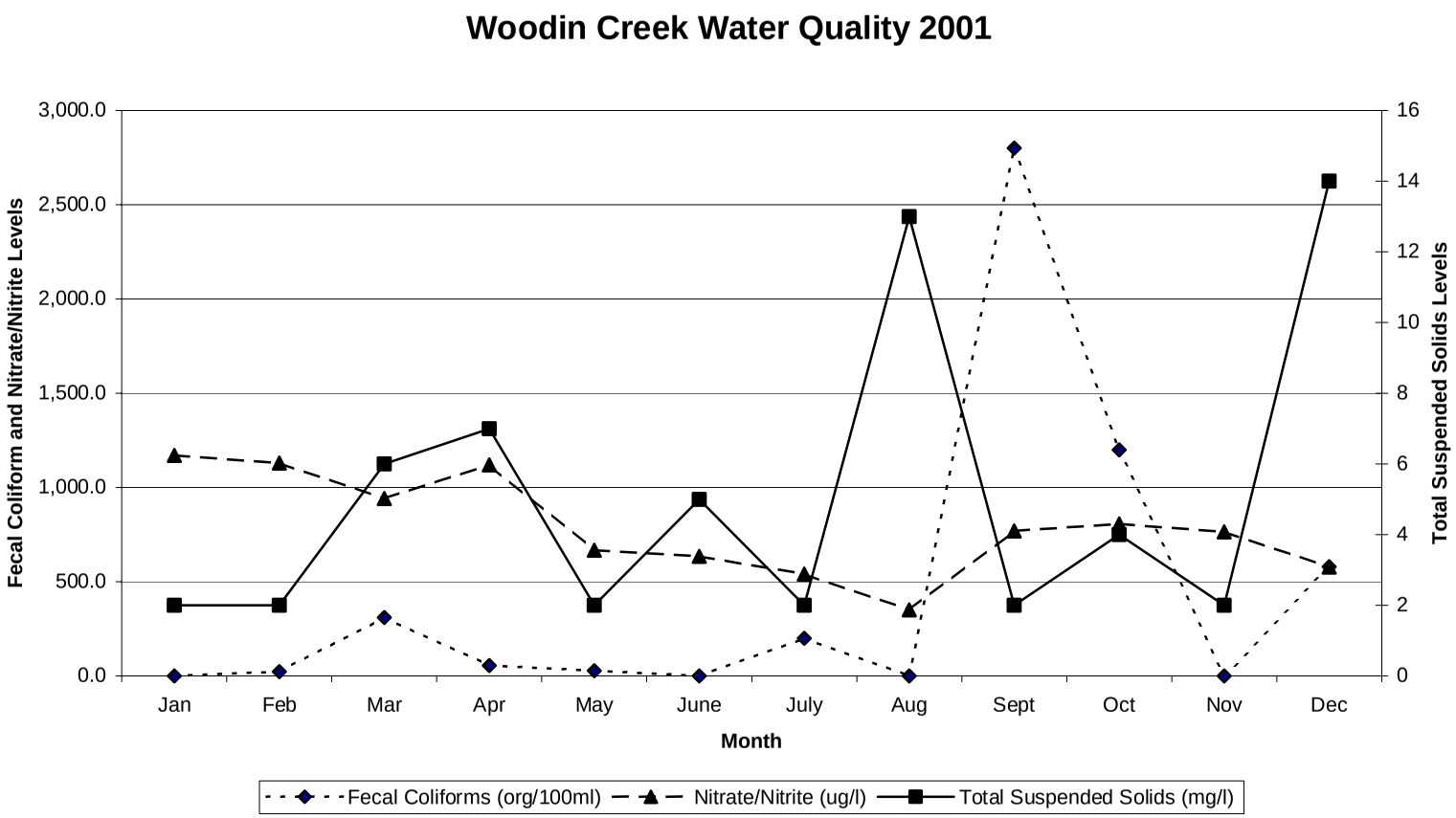
Date	Fecal Coliforms (org/100ml)	Nitrate/Nitrite (ug/l)	Total P (mg/l)	Total Suspended Solids (mg/l)	Lead (mg/l)	Zinc (mg/l)	Copper (mg/l)
Year 2000							
Oct	780.0	852	0.0849	19	0.00189	0.0158	0.00274
Nov	580.0	975	0.0025	63	0.00295	0.0230	0.00497
Year 2001							
Jan	0.5	1,170	0.0697	2	0.00050	0.0712	0.00176
Feb	23.0	1,130	0.0367	2	0.00108	0.0050	0.00120
Mar	310.0	941	0.0559	6	0.03680	0.0050	0.06460
Apr	55.0	1,120	0.0450	7	0.00050	0.0050	0.00151
May	27.0	668	0.0447	2	0.00050	0.0050	0.00106
June	0.5	634	0.0600	5	0.00050	0.0050	0.00124
July	200.0	540	0.0795	2	0.00050	0.0050	0.00149
Aug	0.5	351	0.1450	13	0.00402	0.0257	0.00512
Sept	2,800.0	769	0.0620	2	0.00050	0.0050	0.00050
Oct	1,200.0	807	0.0660	4	0.00050	0.0050	0.00184
Nov	0.5	764	0.0428	2	0.00050	0.0050	0.00120
Dec	580.0	578	0.0803	14	0.00405	0.0262	0.00356
Year 2002							
Jan	800.0	906	0.0529	6	0.00288	0.0227	0.00443
Feb	170.0	1,340	0.0416	2	0.00116	0.0136	0.00195
Mar	100.0	1,460	0.0316	2	0.00050	0.0050	0.00050
Apr	300.0	1,120	0.0357	2	0.00050	0.0116	0.00126
May	45.0	1,180	0.0387	2	0.00050	0.0050	0.00121
June	2,000.0	1,200	0.1130	11	0.00239	0.0262	0.00382
July	0.5	1,120	0.0740	2	0.00050	0.0050	0.00103
Aug	500.0	957	0.0646	2	0.00050	0.0050	0.00128
Sept	280.0	818	0.0519	4	0.00100	0.0100	0.00100
Oct	660.0	900	0.0468	4	0.00100	0.0100	0.00100
Nov	150.0	802	0.0456	2	0.00050	0.0050	0.00190
Dec	300.0	943	0.0405	2	0.00050	0.0050	0.00118

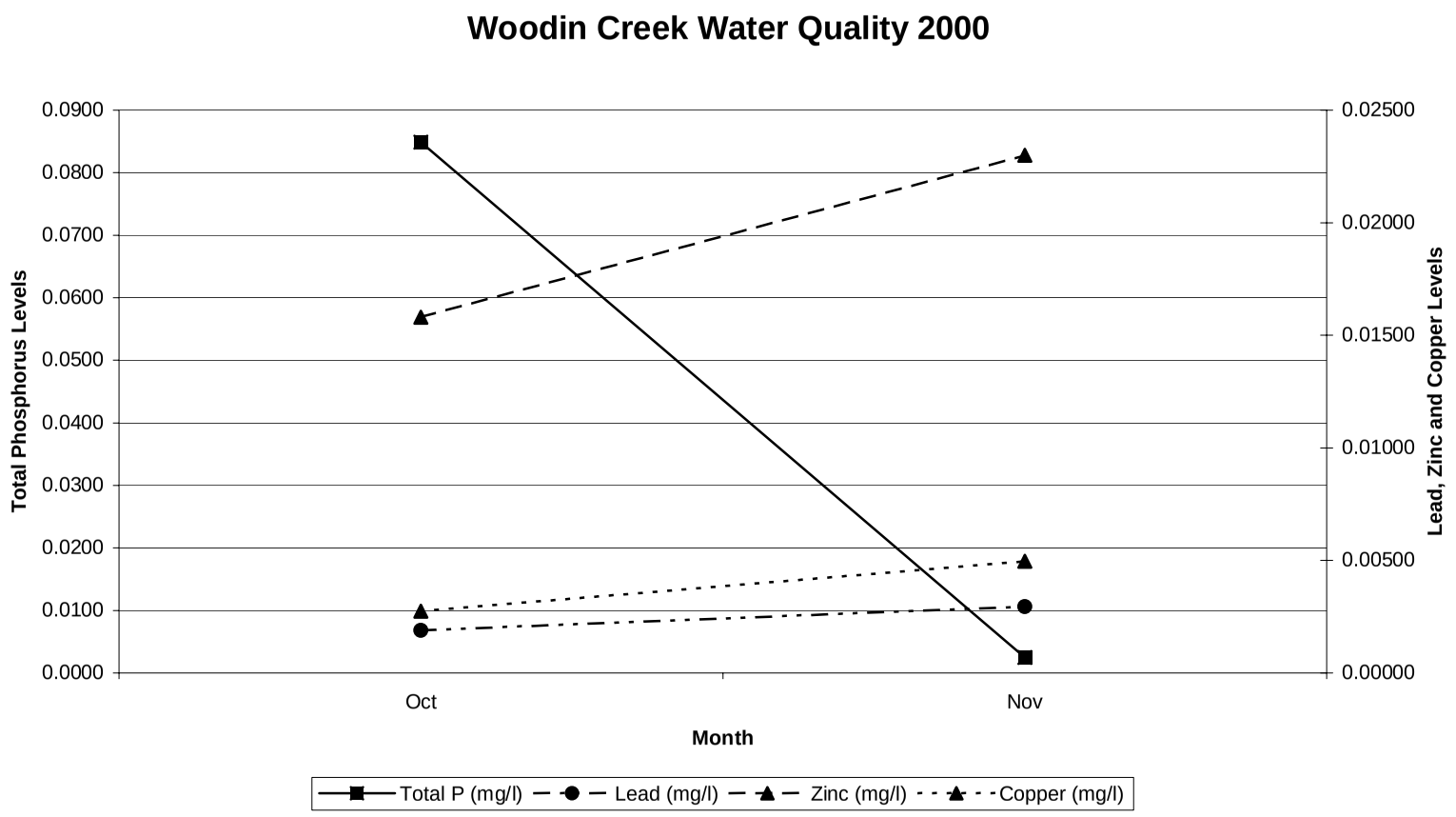
Year 2003							
Jan	430.0	1,230	0.0378	2	0.00050	0.0050	0.00050
Feb	160.0	1,130	0.0345	2	0.00050	0.0050	0.00050
Mar	55.0	1,160	0.0327	2	0.00050	0.0050	0.00050
Apr	140.0	879	0.0381	2	0.00050	0.0108	0.00200
May	91.0	922	0.0472	2	0.00050	0.0050	0.00050
June	350.0	0.926	0.0698	2	0.00050	0.0102	0.00050
July	220.0	0.731	0.1090	2	0.00050	0.0162	0.00160

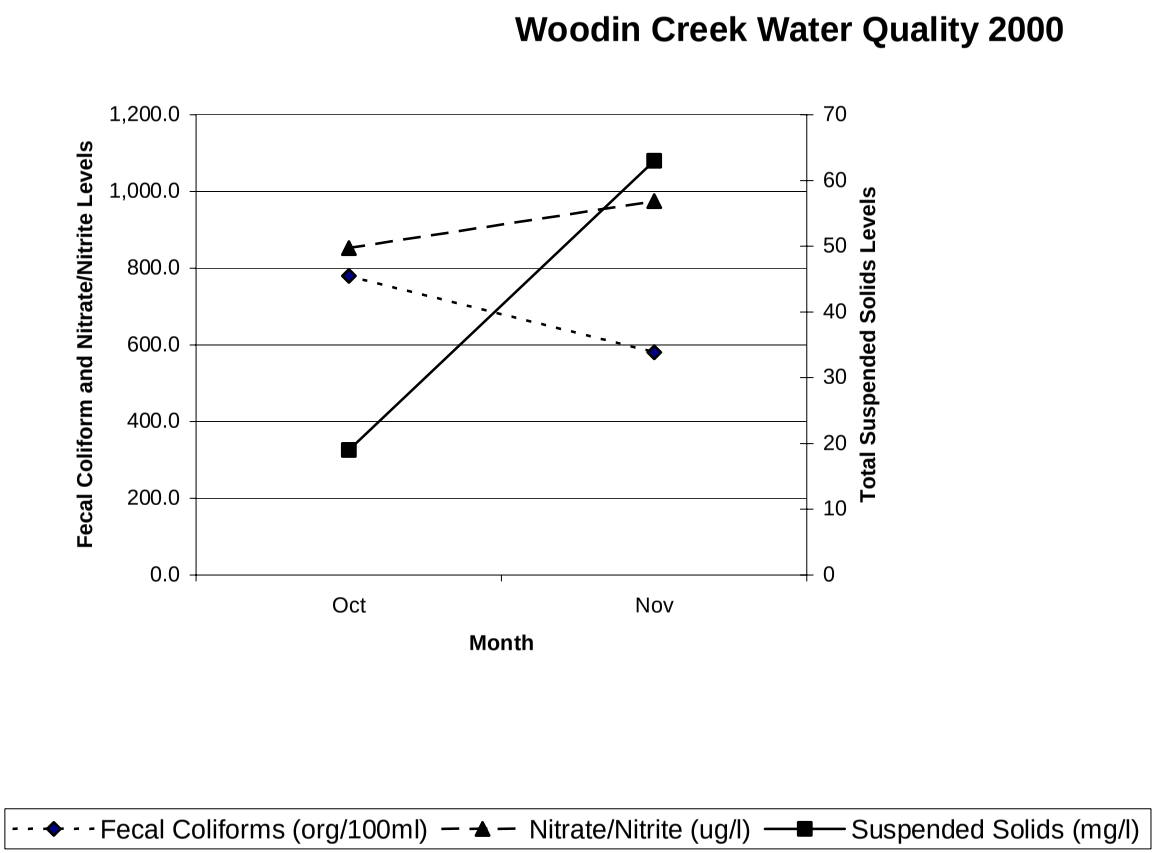

Woodin Creek Water Quality 2002
Total Phosphorus Levels
Lead, Zinc and Copper Levels
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
0.03000
0.02500
0.02000
0.01500
0.01000
0.00500
0.00000
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Month
Total P (mg/l)
Lead (mg/l)
Zinc (mg/l)
Copper (mg/l)


Woodin Creek Water Quality 2002
Fecal Coliform and Nitrate/Nitrite Levels
2,500.0
2,000.0
1,500.0
1,000.0
500.0
0.0
Total Suspended Solids Levels
12
10
8
6
4
2
0
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Month
Fecal Coliforms (org/100ml)
Nitrate/Nitrite (ug/l)
Total Suspended Solids (mg/l)


Woodin Creek Water Quality 2001
Total Phosphorus Levels
Lead, Zinc and Copper Levels
0.1600
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
0.08000
0.07000
0.06000
0.05000
0.04000
0.03000
0.02000
0.01000
0.00000
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Month
Total P (mg/l)
Lead (mg/l)
Zinc (mg/l)
Copper (mg/l)


Woodin Creek Water Quality 2001
Fecal Coliform and Nitrate/Nitrite Levels
Total Suspended Solids Levels
3,000.0
2,500.0
2,000.0
1,500.0
1,000.0
500.0
0.0
16
14
12
10
8
6
4
2
0
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Month
Fecal Coliforms (org/100ml)
Nitrate/Nitrite (ug/l)
Total Suspended Solids (mg/l)


Woodin Creek Water Quality 2000
Total Phosphorus Levels
0.0900
0.0800
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
Lead, Zinc and Copper Levels
0.02500
0.02000
0.01500
0.01000
0.00500
0.00000
Oct
Nov
Month
Total P (mg/l)
Lead (mg/l)
Zinc (mg/l)
Copper (mg/l)


Woodin Creek Water Quality 2000
Fecal Coliform and Nitrate/Nitrite Levels
1,200.0
1,000.0
800.0
600.0
400.0
200.0
0.0
Total Suspended Solids Levels
70
60
50
40
30
20
10
0
Oct
Nov
Month
Fecal Coliforms (org/100ml)
Nitrate/Nitrite (ug/l)
Suspended Solids (mg/l)

City of Woodinville
Woodin Creek at NE 171st Pl Water Quality Data

Collected by the City of Woodinville

Date	Time	pH	Conductivity	Turbidity	DO	Temp. (*C)	Salinity	Total Dissolved Solids (mg/l)	Specific Gravity	Oxidation Reduction Potential	Weather Conditions	Comments
1/30/03	11:10 AM	6.50	16.1	41.7		8.6	0	0.10	0	182		
2/6/03	3:45 PM	5.30	18.0	116.0		4.9	0	0.12	0	198	overcast, dry	
2/13/03	3:10 PM	5.00	23.0	108.0		4.7	0	0.10	0	167	sunny, dry	
2/20/03	1:00 PM	5.60	15.6	135.0		7.6	0	0.10	0	299	gray, drizzly	
2/27/03	8:50 AM	5.40	18.7	45.6		4.8	0	0.12	0	364	sunny, dry	
3/6/03	11:45 AM	6.40	18.7	31.8		6.5	0	0.12	0	306	sunny, dry	
3/13/03	7:55 AM	5.35	5.7	334.0		9.5	0	0.04	0	364	gray, rainy	
3/20/03	2:17 PM	5.33	15.3	56.6		10.7	0	0.10	0	348	slightly cloudy, dry	
3/27/03	1:31 PM	5.82	16.4	60.1		9.6	0	0.11	0	345	sunny, dry, cloud patches	
4/3/03	10:10 AM	5.65	14.9	137.0		7.2	0	0.1	0	339	sunny, wet, cloud patches	
4/10/03	10:07 AM	5.82	16.9	173.0		9.0	0	0.11	0	331	gray overcast, damp	
4/17/03	7:49 AM	5.66	17.9	97.2		9.3	0	0.12	0	400	light overcast, dry	
4/24/03	1:30 PM	5.63	10.5	190.0		8.9	0	0.07	0	392	overcast, damp	
5/1/03	12:46 PM	5.89	18.9	103.0		12.1	0	0.12	0	355	sunny, clear	
5/8/03	2:30 PM	7.53	18.9	170.0		9.8	0	0.12	0	205	slightly cloudy, dry	
5/15/03	8:45 AM	6.55	18.5	133.0		8.9	0	0.12	0	313	light overcast, dry	
5/22/03	8:15 AM	6.06	19.6	71.1		11.9	0	0.13	0	353	light overcast, dry	
5/31/03	1:33 PM	6.48	19.6	124.0		12.6	0	0.13	0	339	sunny, dry	
6/5/03	12:46 PM	6.44	19.8	157.0		14.3	0	0.13	0	275	sunny, dry	
6/12/03	2:08 PM	6.93	20.9	40.1		21.3	0	0.14	0	225	sunny, dry	
6/20/03	7:19 AM	6.39	19.0	133.0		11.1	0	0.12	0	185	light overcast, drizzly	
6/26/03	8:05 AM	6.35	20.4	121.0		12.4	0	0.13	0	295	sunny, dry	
7/3/03	7:43 AM	6.03	20.7	113.0		11.4	0	0.13	0	307	sunny, dry	
7/11/03	9:31 AM	7.48	20.8	115.0		14.2	0	0.13	0	226	sunny, dry	
7/17/03	11:07 AM	7.23	20.7	128.0		14.3	0	0.13	0	251	sunny, dry	
7/25/03	1:54 PM	6.83	21.1	109.0		15.4	0	0.14	0	278	sunny, dry	
8/4/03	9:21 AM	6.86	21.4	114.0		14.0	0	0.14	0	290	sunny, dry	
8/7/03	9:47 AM	6.43	21.3	166.0		14.1	0	0.14	0	336	sunny, dry	
8/14/03	8:36 AM	6.51	21.7	174.0		13.3	0	0.14	0	146	sunny, dry	

City of Woodinville
Woodin Creek at NE 171st Pl Water Quality Data

Date	Time	pH	Conductivity	Turbidity	DO	Temp. (*C)	Salinity	Total Dissolved Solids (mg/l)	Specific Gravity	Oxidation Reduction Potential	Weather Conditions	Comments
8/21/03	1:19 PM	6.41	21.7	185.0		15.7	0	0.14	0	315	sunny, dry	
8/29/03	9:15 AM	6.97	21.7	166.0		13.6	0	0.14	0	307	sunny, dry	
9/4/03	11:39 AM	5.27	21.6	84.5	9.9	15.9	0	0.14	0	285	sunny, dry	
9/11/03	1:35 PM	6.12	19.7	372.0	7.9	14.2	0	0.13	0	321	gray, light rain	
9/19/03	11:34 AM	5.93	19.5	120.0	9.4	13.1	0	0.13	0	376	sunny, dry	
9/26/03	10:58 PM	6.24	21.1	89.1	8.1	12.8	0	0.14	0	357	sunny, dry	
10/2/03	3:22 PM	5.85	21.4	85.8	7.6	13.2	0	0.14	0	354	slight overcast, low light, dry	
10/16/03	3:39 PM	5.73	17.0	101.0	7.3	12.0	0	0.11	0	335	slight overcast, low light, dry	heavy sedimentation
10/30/03	4:08 PM	6.50	20.2	148.0	7.7	8.2	0	0.13	0	402	slight overcast, low light, dry	

City of Woodinville
Woodin Creek at Park Water Quality Data

Date	Time	pH	Conductivity	Turbidity	DO	Temp. (*C)	Salinity	Total Dissolved Solids (mg/l)	Specific Gravity	Oxidation Reduction Potential	Weather Conditions	Comments
1/16/03	2:45 PM	5.8	18.4	64.6		7.4	0	1.20	0	232		
1/23/03		6.7	15.0	20.7		8.8	0	0.10	0	180		
1/30/03	12:00 PM	7.0	17.3	22.8		9.3	0	0.11	0	165		
2/6/03	12:20 PM	6.7	18.5	48.6		6.0	0	0.12	0	169	overcast, dry	
2/13/03	11:15 AM	7.2	18.3	22.3		6.1	0	0.12	0	148	sunny, dry	
2/20/03	2:55 PM	6.6	9.8	46.8		8.5	0	0.06	0	186	gray, drizzly	
2/27/03	1:16 PM	7.4	18.2	57.9		8.4	0	0.12	0	245	sunny, dry	
3/6/03	11:19 AM	6.1	18.3	91.9		7.2	0	0.12	0	308	sunny, dry	
3/13/03	9:27 AM	6.63	6.3	37.5		9.6	0	0.04	0	190	gray, rainy	
3/20/03	3:40 PM	7.53	15.0	42.4		11.4	0	0.10	0	216	slightly cloudy, dry	
3/27/03	3:01 PM	7.61	17.0	54.0		11.9	0	0.11	0	202	sunny, dry, cloud patches	
4/3/03	12:10 PM	7.04	15.1	54.5		9.4	0	0.10	0	208	sunny, damp, cloud patches	
4/10/03	11:38 AM	7.17	17.1	49.4		10.2	0	0.11	0	184	overcast, damp	
4/17/03	9:20 AM	6.76	17.7	60.8		10.1	0	0.12	0	195	light overcast, dry	
4/24/03	3:17 PM	6.44	9.9	108.0		10.0	0	0.06	0	236	overcast, damp	
5/1/03	2:21 PM	7.63	18.3	98.1		14.2	0	0.12	0	164	sunny, clear	
5/8/03	11:24 AM	7.41	18.4	53.4		10.4	0	0.12	0	180	light overcast, dry	
5/15/03	10:09 AM	7.17	16.6	74.9		10.7	0	0.11	0	166	light overcast, dry	
5/22/03	10:02 AM	6.98	18.5	55.3		12.5	0	0.12	0	215	light overcast, dry	
5/31/03	3:50 PM	7.34	18.7	107.0		15.3	0	0.12	0	190	sunny, dry	
6/5/03	2:45 PM	7.33	19.3	93.1		16.7	0	0.13	0	179	sunny, dry	
6/12/03	2:15 PM	7.46	19.0	60.1		14.6	0	0.12	0	240	sunny, dry	
6/20/03	8:50 AM	6.89	12.4	91.4		13.3	0	0.08	0	281	light overcast, drizzly	
6/26/03	12:18 PM	6.86	19.5	91.8		15.6	0	0.13	0	288	sunny, dry	
7/3/03	9:00 AM	7.08	16.7	92.4		15.1	0	0.11	0	191	sunny, dry	
7/11/03	9:21 AM	7.37	19.4	61.5		15.8	0	0.13	0	225	sunny, dry	
7/17/03	10:49 AM	7.23	19.3	142.0		15.3	0	0.13	0	246	sunny, dry	
7/25/03	3:47 PM	7.37	19.4	106.0		18.0	0	0.13	0	248	sunny, dry	
8/4/03	10:45 AM	7.09	19.5	96.0		15.9	0	0.13	0	302	sunny, dry	

City of Woodinville
Woodin Creek at Park Water Quality Data

Date	Time	pH	Conductivity	Turbidity	DO	Temp. (*C)	Salinity	Total Dissolved Solids (mg/l)	Specific Gravity	Oxidation Reduction Potential	Weather Conditions	Comments
8/7/03	12:47 PM	6.97	19.8	137.0		16.8	0	0.13	0	273	sunny, dry	
8/14/03	10:10 AM	7.37	19.7	168.0		15.4	0	0.13	0	270	sunny, dry	
8/21/03	3:01 PM	7.00	19.5	272.0		17.7	0	0.13	0	279	sunny, dry	
8/29/03	11:06 AM	7.12	19.6	190.0		15.9	0	0.13	0	283	sunny, dry	
9/4/03	1:26 PM	6.28	19.7	127.0	7.3	17.7	0	0.13	0	248	sunny, dry	
9/11/03	3:33 PM	6.61	17.7	103.0	7.4	14.5	0	0.12	0	278	sunny, dry	
9/22/03	10:07 AM	6.73	20.4	109.0	6.9	13.0	0	0.13	0	298	sunny, dry	
9/27/03	2:05 PM	6.87	20.4	168.0	7.3	15.7	0	0.13	0	284	sunny, dry	
10/2/03	5:16 PM	6.68	20.2	48.0	6.7	14.7	0	0.13	0	312	slight overcast, dark, dry	
10/16/03	5:36 PM	6.14	13.6	69.8	7.7	13.5	0	0.09	0	319	slight overcast, dark, dry	Sedimentation on stream
10/30/03	5:34 PM	7.00	19.5	51.9	7.7	10.0	0	0.13	0	319	slight overcast, dark, dry	bottom with light debris strewn along stream bottom

Project: **Woodin Creek Water Quality Monitoring (Project #23007)**

Monitor: **Deron Lozano; Adolfson Associates, Inc.**

Date: **May 30, 2003**

Weather: **Sunny with scattered clouds**

Table 1. Woodin Creek Water Quality Monitoring Results

Site / Location	Sample Time	Water Quality Parameters				
		Dissolved Oxygen (mg/l)	Turbidity (Nephelometric Turbidity Units (NTUs))	pH	Conductivity (µS/cm)	Temp. (°C)*
Site 1 Sammamish River Regional Park	9:53 a.m.	10.52	1.50	7.2	298	13.5
Site 2 Immediately west of 140th Ave. NE	10:30 a.m.	10.33	2.32	7.1	235	13
Site 3 NE Woodinville-Duvall Rd/178th Way NE intersection	10:58 a.m.	10.93	4.65	7.1	255	12
Site 4 NE 171st St./143rd Pl NE intersection	11:28 a.m.	10.80	2.98	7.1	286	13.5

*Temperature loggers were placed at each of the four sampling sites during the May 30 site visit. Data was retrieved from the temperature loggers on June 6, 2003. A graphical representation of the temperature in Woodin Creek and presented in the attached table.

Project: **Woodin Creek Water Quality Monitoring (Project #23007)**

Monitor: **Deron Lozano; Adolfson Associates, Inc.**

Date: **August 29, 2003**

Weather: **Sunny / Clear**

Table 1. Woodin Creek Water Quality Monitoring Results

Site / Location	Sample Time	Water Quality Parameters				
		Dissolved Oxygen (mg/l)	Turbidity (Nephelometric Turbidity Units (NTUs))	pH	Conductivity (µS/cm)	Temp. (°C)*
Site 1 Sammamish River Regional Park	8:53 a.m.	5.91	3.35	7.4	269	15
Site 2 Immediately west of 140th Ave. NE	9:17 a.m.	4.97	4.34	6.9	277	15
Site 3 NE Woodinville-Duvall Rd/178th Way NE intersection	9:32 a.m.	5.51	5.42	7.1	244	12.5
Site 4 NE 171st St./143rd Pl NE intersection	9:49 a.m.	9.58	4.93	7.1	302	13.5

*Temperature data was retrieved from the temperature loggers placed within the stream sites June 6, 2003 and is included in the attached table.

Project: **Woodin Creek Water Quality Monitoring (Project #23007)**

Monitor: **Deron Lozano; Adolfson Associates, Inc.**

Date: **October 31, 2003**

Weather: **Sunny / Clear**

Table 1. Woodin Creek Water Quality Monitoring Results

Site / Location	Sample Time	Water Quality Parameters				
		Dissolved Oxygen (mg/l)	Turbidity (Nephelometric Turbidity Units (NTUs))	pH	Conductivity (µS/cm)	Temp. (°C)
Site 1 Sammamish River Regional Park	11:04 a.m.	12.04	3.30	7.2	228	6.5
Site 2 Immediately west of 140th Ave. NE	11:43 a.m.	11.72	3.52	7.1	277	8
Site 3 NE Woodinville-Duvall Rd/178th Way NE intersection	12:15 p.m.	11.88	2.64	7.1	241	6.5
Site 4 NE 171st St./143rd Pl NE intersection	12:00 p.m.	12.06	3.05	7.2	219	6.5

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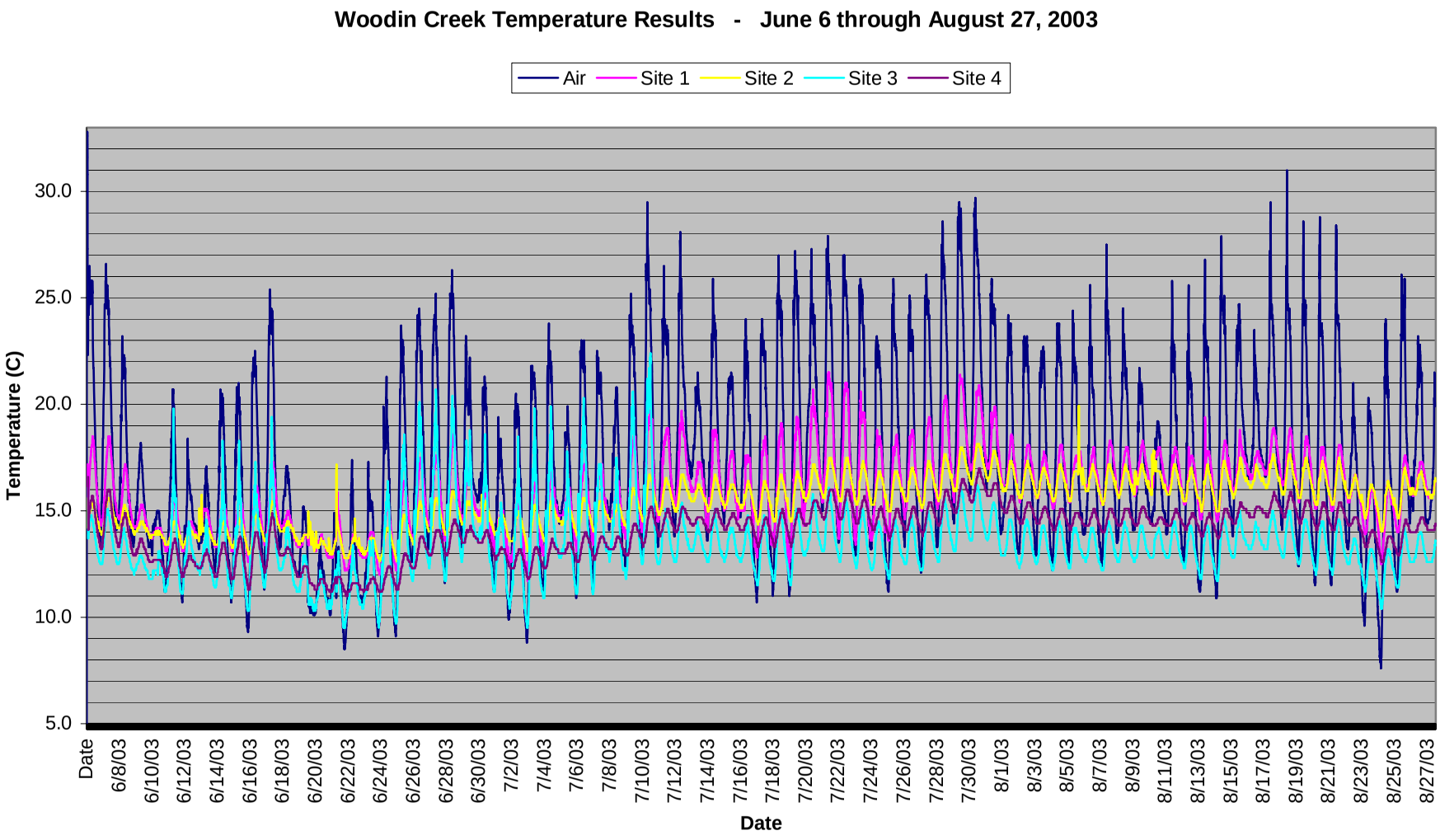
Woodin Creek Temperature Results - June 6 through August 27, 2003
Air
Site 1
Site 2
Site 3
Site 4
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
Date
6/8/03
6/10/03
6/12/03
6/14/03
6/16/03
6/18/03
6/20/03
6/22/03
6/24/03
6/26/03
6/28/03
6/30/03
7/2/03
7/4/03
7/6/03
7/8/03
7/10/03
7/12/03
7/14/03
7/16/03
7/18/03
7/20/03
7/22/03
7/24/03
7/26/03
7/28/03
7/30/03
8/1/03
8/3/03
8/5/03
8/7/03
8/9/03
8/11/03
8/13/03
8/15/03
8/17/03
8/19/03
8/21/03
8/23/03
8/25/03
8/27/03
Date

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APPENDIX B: STREAM SURVEY DATA SHEETS

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Habiat Inventory Summary

Woodin Creek - Reach 1

Reference Number (RF)	Stream Stationing	Habitat (HT)	Width (W)	Depth (D)	Length (L)	Channel Width (CW)	Channel Depth (CD)	Primary Substrate (SBST)	Secondary Substrate (SBST)
1	00+18	22	10	10	18	12	22	3	6
2	00+41	2	6	3	23	6	15	6	3
3	00+59	24	6	8	18	8	20	3	2
4	00+99	14	7	10	40	8	28	2	3
5	01+31	16	6	5	32	8	23	4	3
6	01+51	22	8	12	20	8	3	3	6
7	01+72	22	10	15	21	12	27	5	3
8	01+91	1	4	2	19	7	14	4	3
9	02+15	17	12	13	24	15	25	3	6
10	03+30	1	4	2	115	8	23	4	3
11	04+03	14	4	8	73	6	32	3	4
12	04+55	1	4	3	52	4	27	4	3
13	04+90	14	4	6	35	4	30	4	3
14	05+20	17	15	8	30	20	32	3	4
15	07+79	14	5	3	259	8	21	3	3
16	08+64	23	5		85				
17	09+25	1	5	4	61	6	19	3	4
18	09+61	14	5	5	36	6	26	3	4
19	09+75	17	5	8	14	10	26	3	4
20	10+00	1	4	2	25	6	14	4	3
21	10+16	17	4	6	16	6	21	4	3
22	10+32	1	4	3	16	6	15	4	3
23	10+60	22	6	8	28	8	23	4	3
24	10+91	1	4	3	31	6	27	3	3
25	11+36	23	5		45				
26	11+46	9	5	4	10	10	12	4	5
27	13+04	1	3	6	158	4	30	4	3
28	13+65	14	3	6	61	5	30	4	3
29	14+88	1	3	6	123	4	30	4	3
30	15+07	22	3	8	19	4	30	4	3
31	15+17	9	4	6	10	4	30	3	4
32	15+70	1	5	3	53	7	15	3	3
33	15+91	17	3	10	21	4	21	3	3
34	16+39	14	3	6	48	4	20	3	4
35	16+62	1	4	2	23	6	14	4	3
36	16+77	9	9	12	15	12	24	3	6
37	16+83	9	10	14	6	10	26	3	6
38	16+94	24	5	10	11	6	22	3	3
39	17+34	1	6	3	40	7	15	4	3
40	18+57	14	3	4	123	4	12	4	3
41	18+65	9	7	6	8	7	21	4	3
42	18+76	22	4	6	11	4	21	4	3
43	19+18	1	4	3	42	5	18	4	3
44	19+70	14	4	5	52	4	20	4	3
45	19+93	1	4	2	23	5	14	4	3
46	20+01	22	5	8	8	5	20	4	3
47	20+31	14	3	6	30	4	21	4	3
48	20+39	22	5	12	8	7	27	3	4

Woodin Creek - Reach 1

Reference Number (RF)	Stream Stationing	Habitat (HT)	Width (W)	Depth (D)	Length (L)	Channel Width (CW)	Channel Depth (CD)	Primary Substrate (SBST)	Secondary Substrate (SBST)
53	21+54	17	4	12	10	5	24	4	3
54	21+76	1	3	1	22	8	15	4	3
55	21+89	22	6	8	13	6	20	4	6
56	22+47	14	4	6	58	5	18	3	4
57	23+15	1	6	2	68	10	12	3	4
58	23+78	14	5	4	63	7	14	3	4
59	25+43	1	6	2	165	8	14	4	3
60	25+82	23	3		39				
61	26+80	1	4	2	98	6	14	4	5
62	27+22	23	3		42				
63	27+79	2	4	3	57	5	27	6	4
64	28+02	9	6	18	23	6	54	3	4
65	28+39	14	4	4	37	5	19	4	3
66	29+04	1	4	3	65	5	18	4	4
67	29+69	1	4	3	65	5	15	4	4
68	29+80	22	8	6	11	12	24	3	4
69	30+33	1	5	2	53	7	17	4	3
70	30+58	17	6	8	25	9	23	4	3
71	32+27	1	6	8	169	9	23	4	3
72	32+52	23	5		25				
73	33+17	1	6	2	65	12	14	5	4
74	33+27	22	5	6	10	12	18	5	4
75	35+19	1	5	2	192	10	14	4	5
76		23							

WOODIN CREEK

WRIA Basin # 8 Basin # Reach 1 Date 05/13/03 Time 10:00 am

Stream # Stream Order: Survey Length (RM) to 2:30 pm

Weather Conditions Sunny

Investigators Ben Burke, Alex Gittens

Habitat Characteristics | Riparian - RB | Riparian - LB | LWD

	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
	1	22	10'	20" 21" max 10" Avg	18'	12"	22"	3	25	M	3	25	M	3/6		NONE					
	75 Chinook Parr/P-Mouth/Stk																				
	2	12	16'	3"	23'	6"	15"	3	25	M	3	25	M	NO RIPRAP							
	Sculpin													6/3							
	Redd under footbridge Remove Avg/Riprap																				
	3	24	6'	8"	18'	8'	20"	3	25	M	3	50	M	3/2		None					
				13" max Depth																	
	4	14	7'	10"	40'	8'	28"	3	25	M	3	50	M	2/3		NO					
*	5	16	6'	5"	32'	8'	23"	3	25	M	3	50	M	4/3		30'	18"	A	C	O/R	L
																Installed					
																12'	15"	A	C	O	W/F
																12'	10"	A	C	O/R	L
	6	22	8'	12"	20'	8'	3	3	25	M	3	50	M	3/6	High	10'	18"	A	C	O	B/P
				21" max																	
	Juv. Cutthroat															8'	15"	A	C	O	B/P
																10'	15"	A	C	O	B/P
																4'	15"	A	C	O	L
	7	22	10'	15"	21'	12'	27'	3	25	M	3	50	M	5/3	High						
				24"																	
	P-mth/min/Coho Juv?																				
	CP (Corner Pool) include small gravel tailout										up to 10 ft					10'	10"	A	C	O	L
																10'	15"	A	C	O	B/P
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

RF=Reference # HT=Habitat Type W=Avg. Habitat Width D=Avg Habitat Depth CW=Avg Channel Width at OHWM
CD=Avg Channel Depth from OHWM L=Length of Habitat Type *(All Depths <> 5 measurements)*

SS=Streamside Structure *Options:* 0=No Riparian (Note Lawn, Road, Building, etc.) 1=Mature Complex Forest
2=Immature/Even-aged/Disturbed Forest 3=Shrub Dominated (Less than 20') 4=Grassland/Meadow/Pasture 5= Wetland
LB=Left Bank RB=Right Bank W=Width TY=Riparian Type *Options:* C=Coniferous D=Deciduous M=Mixed

SBST=Substrate (Dominant/Subdominant) *Options:* 1=Bedrock 2=Silt/Organic 3=Sand 4=Small Gravel (<25 mm)
5=Large Gravel (25 mm-100 mm) 6=Cobble (100mm-256mm) 7=Boulder (*Note Dominant and Subdominant* [Dom/Sub])

PQI=Pool Quality Index Value *(For all Pools, Record Maximum Depth and Cover)*

LWD=Large Woody Debris LE=Length DI=Mean Diameter ST=Stability *Options:* A=Anchored U=Unancored ?=Unknown
V=Variety *Options:* C=Coniferous D=Deciduous ?=Uncertain
CN=Conditions *Options:* S=Solid [Subtype (R)ecent/(O)ld] M=Moderate [Subtype (R)ecent/(O)ld]
R=Rotted [Subtype (R)ecent/(O)ld] TY=Type *Options:* J=Log Jam F=Floating Log S=Stranded Log
B=Bridge Log [Subtype (C)ollapsed/(P)artial] L= Lateral Log W=Weir [Subtype (F)ull/(P)artial]

* Habitat Restoration Area

WRIA Basin # 8 | Basin # WOOLIN CREEK Reach 1 | Date 5/13/03 | Time 10:00am to 2:30pm

Stream # | Stream Order: | Survey Length (RM)

Weather Conditions SUNNY

Investigators Ben Burke & ALEX BITTAY

CHG 50' R.P DARKS TO OTHER SIDE

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
*	8	1	4'	2"	19'	7'	14"	3	25	M	3	50	M	4/3		8'	12"	A	C	S/O	W
*	9	17	12'	13"	24'	15'	25"	3	25	M	3	25	M	3/6		18'	24"	A	C	S/O	B/C
			MAX 21"																		
														ANG/ROCK							
49	10	1	4'	2"		8'	23"	3	100'	M	3	50	M	4/3							
+ 47								ROND-													
19								1	NO OUTLET		TO CRK										
17 —	11	14	4'	8"		6'	32"	3	100'	D	3	25	D	3/4							
56	12	1	4'	3"	52	4'	27"	3	100'	D	3	25	D	4/3							
	13	14	4'	6"	35	4'	28"	3	100'	D	3	30	D	4/3							
	14	17	15'	8"	30'	20'	32"	3	100'	D	3	25	D	3/4	HIGH						
			MAX 18"																		
	TOP OF HABITAT OLD Beaver Dam/Debris, blockage under 1ow flow																				
	TRAPPING SUBSTRATE/SAND														71 STAKE						
	15	14	5'	3"	259'	8'	21"	3	25	D	3	25	D	3/3							
	8" Cut 15" Cut										CPARK/LAWN										
	Juvenile Cut Hgh #																				
ul- culvert	16	23			85'																
	DIAMETER 60" PIPE ARCH - PASSABLE - Stewed ANG CC under																				
	17	1	5'	4"	61	6'	19'	D-ROAD			3	100	D	3/4							
											Restoration										
	18	14	5'	5"	36'	6'	20"	3	10	D	3	75	D	3/4							
ADD AS	19	17	5'	9"	14'	10'	28"	3	10	D'	3	100'	D	3/4	LOW						
CK W FOR CLOSED			MAX 13"																		
	20	1	4'	2"	25'	6'	14"	3	<25	D	3	>100	D	4/3							
	21	17	4'	6"	16'	6'	21"	3	<25	D	3	>100	D	4/3							
			MAX 9"																		
	22	1	4'	3"	16'	6'	15"	3	<25	D	3	>100	D	4/3							
ACH STONE	23	22	6'	8"	38'	8'	23"	O-ROAD			3	100	D	4/3	HIGH	30'	18"	A	C	S/O	L
			MAX 21"																		
	24	1	4'	3"	31'	6'	27"	O-ROAD			3	100	D	3/3		(Juvenile Cutthroat)					
33 RP	25 - 23		— Get Length from CAD & WIDTH													12'	12"	A	C	S/O	W
: HAVE PARTIAL	26	9	5'	4"	10'	10'	8.5"	O-ROAD			3	100	D	4/5							
			MAX 10"																		
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

RF=Reference # HT=Habitat Type W=Avg. Habitat Width D=Avg Habitat Depth CW=Avg Channel Width at OHWM
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LB=Left Bank RB=Right Bank W=Width TY=Riparian Type *Options:* C=Coniferous D=Deciduous M=Mixed

SBST=Substrate (Dominant/Subdominant) *Options:* 1=Bedrock 2=Silt/Organic 3=Sand 4=Small Gravel (<25 mm)
5=Large Gravel (25 mm-100 mm) 6=Cobble (100mm-256mm) 7=Boulder (*Note Dominant and Subdominant* [Dom/Sub])

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R=Rotted [Subtype (R)ecent/(O)ld] TY=Type *Options:* J=Log Jam F=Floating Log S=Stranded Log
B=Bridge Log [Subtype (C)ollapsed/(P)artial] L= Lateral Log W=Weir [Subtype (F)ull/(P)artial]

WRIA Basin # 8 Basin # Reach 1 Date 5/13/03 Time

Stream # Stream Order: Survey Length (RM) to

Weather Conditions Sunny

Investigators Ben Burke & Alex Otley

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
1	27	1	3'	6"	158'	4'	30"	0-ROAD			3	25	D	4/3		4'	18"	A	C	S/O	W
2		Juvenile Cut																			
3	28	14	3'	6"	161'	5'	30"	0-ROAD			3	20	D	4/3							
4		Juvenile Cut																			
5	29	1	3'	6"	123'	4'	30"	3	25	M	3	25	M	4/3							
6	30	22	3'	8"	19'	4'	30"	0-ROAD						4/3	HIGH	30'	10"	A	C	S/O	L
7				15" MAX																	
8	31	9	4'	6"	10'	4'	30"	3	15	M	3	30	M	3/4	HIGH	8	20"	A	C	S/O	W
9				MAX 12'																	
10	32	1	5'	3"	53'	7'	15"	3	20	M	3	25	M	3/3							
11	33	17	3'	10"	21'	4'	21"	0-ROAD						3/3							
12				MAX 18"											MOD						
13	34	14	3'	6"	48'	4'	20"	0-ROAD			3	10	M	3/4							
14	35	1	4'	2"	23'	6'	14"	3	10	M	3	10	M	4/3							
15	36	9	9'	12"		12'	24"	3	10	M	3	25	M	3/6	MOD	6'	18"	A	C	S/O	W
16		LAMPREY/Juvenile CUT														12'	20"	A	C	S/O	W
17				MAX 21"												~~12'~~	~~20"~~	~~A~~	~~C~~	~~S/O~~	~~W~~
18	37	9	10'	14"	6'	10'	26"	3	5	M	3	50	M	3/6	MOD						
19				MAX 20"																	
20	38	24	5'	10"	11'	6'	22"	0-ROAD			3	50	M	3/3	LOW						
21				MAX 14"																	
22	39	1	6'	3"	40'	7'	15"	SS	5	M	3	50	M	4/3							
23	40	14	3'	4"	123'	4'	22"	SS	3'	M	3	25	M	4/3		ROOT WAD/ANCHORED					
24																					
25																					
26																					
27																					
28																					
29																					
30																					
31																					
32																					
33																					
34																					
35																					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

RF=Reference # HT=Habitat Type W=Avg. Habitat Width D=Avg Habitat Depth CW=Avg Channel Width at OHWM
CD=Avg Channel Depth from OHWM L=Length of Habitat Type *(All Depths <> 5 measurements)*

SS=Streamside Structure *Options:* 0=No Riparian (Note Lawn, Road, Building, etc.) 1=Mature Complex Forest
2=Immature/Even-aged/Disturbed Forest 3=Shrub Dominated (Less than 20') 4=Grassland/Meadow/Pasture 5= Wetland
LB=Left Bank RB=Right Bank W=Width TY=Riparian Type *Options:* C=Coniferous D=Deciduous M=Mixed

SBST=Substrate (Dominant/Subdominant) *Options:* 1=Bedrock 2=Silt/Organic 3=Sand 4=Small Gravel (<25 mm)
5=Large Gravel (25 mm-100 mm) 6=Cobble (100mm-256mm) 7=Boulder (*Note Dominant and Subdominant* [Dom/Sub])

PQI=Pool Quality Index Value *(For all Pools, Record Maximum Depth and Cover)*

LWD=Large Woody Debris LE=Length DI=Mean Diameter ST=Stability *Options:* A=Anchored U=Unancored ?=Unknown
V=Variety *Options:* C=Coniferous D=Deciduous ?=Uncertain
CN=Conditions *Options:* S=Solid [Subtype (R)ecent/(O)ld] M=Moderate [Subtype (R)ecent/(O)ld]
R=Rotted [Subtype (R)ecent/(O)ld] TY=Type *Options:* J=Log Jam F=Floating Log S=Stranded Log
B=Bridge Log [Subtype (C)ollapsed/(P)artial] L= Lateral Log W=Weir [Subtype (F)ull/(P)artial]

WRIA Basin # 8 Basin # Reach 1 Date 5/29/03 Time 8:45 am
Stream # Stream Order: Survey Length (RM) to 11:00 am
Weather Conditions Sunny
Investigators ALEX & BENN

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
1	41	9	7'	6" 18"	8	7	21"	0	25	M	3	25	M	4/3	MOD	8'	20"	A	C	S/D	W/F
2	SMALL JUV. SALMONIDS														COVER						
3	42	22	4	6"	11	4	+15"	0	25	M	3	25	M	4/3	LOW						
4				9"										4	COVER						
5	43	1	4'	3"	42'	5'	+15"	0	5	M	3	25	M	4/3							
6	44	14	4'	5"	52'	4'	+15"	0	25	M	3	40	M	4/3							
7	45	1	4'	2"	23'	5'	+12"	3	10	M	3	50	D	4/3							
8	46	22	5'	8"	8	5	+12"	0		M	3	50	D	4/3	HIGH						
9				15"											COVER						
10	47	14	3'	6"	30'	4'	+15"	0		M	3	50	D	4/3							
11	48	22	5'	12"	8'	7'	+15"	0		M	3	50	M	3/4	MOD						
12				18"											COVER						
13	49	14	4'	6"	31'	5'	+15"	0		M	3	30	D	3/4							
14	50	1	3'	3'	41'	6	+12"	0		M	3	25	M	4/3							
15	Number of small JUV. Salmonids																				
16	51	22	4'	8"	9'	5'	+15"	0		M	3	60	M	3/4	LOW						
17				15"				Next to							COVER						
18								sidewalk													
19	52	1	6'	1"	24'	8'	+12"	3	5	M	3	75	M	4/3							
20	JUV. SALMONIDS																				
21	53	17	4"	12"	9'	5'	+12"	3	10	M	3	60	M	4/3	LOW						
22				15"											COVER						
23	54	1	3	1	22'	8	+12	3	25	M	3	25	M	4/3							
24	JUV SALMONIDS																				
25	55	22	6	8	13'	6	+12							4/6	LOW	JUV. SALMONIDS					
26				10										ANG RR	COVER						
27	56	14	4	6	58	5	+12	3	5	M	0			3/4							
28	JUV SALMONIDS & COHO IDENTIFIED																				
29	57	1	6	2"	68	10	+10"	3	15	M	0			3/4							
30	POND ENTERS @ secondary channel / PHOTO @ 68 FT 2/3 PHOTOS																				
31	58	14	5'	4"	63	7	+18"	0			0			3/4	ENTERED MOBILE HOME AREA						
32	59	1	6	2"	165	8	+12	0			0			4/3							
33	60	23			39																
34	61	1	4	2	98	6	+12	0			0			4/5							
35	JUV SALMONIDS (SPOTTED)																				
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

PHOTO 53 — HOTES BENN

PHOTOS

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SS=Streamside Structure *Options:* 0=No Riparian (Note Lawn, Road, Building, etc.) 1=Mature Complex Forest 2=Immature/Even-aged/Disturbed Forest 3=Shrub Dominated (Less than 20') 4=Grassland/Meadow/Pasture 5= Wetland
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V=Variety *Options:* C=Coniferous D=Deciduous ?=Uncertain
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WATER ENTERS POND from unknown origin culvert @ 63 & 58

WRIA Basin # 8 Basin # Peach 1 Date 5/29/03 Time 8:45

Stream # Stream Order: Survey Length (RM) to 1.100

Weather Conditions SUNNY & CLEAR

Investigators ALEX OTTLEY & BENN BURKE

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
+10 1	62	23			42'			0			0					NEW					
33 2	63	2	4	3	57'	5	+24"	3	25	m	3	25	M	6/4							
3	6							LANDSCAPED						AND RR							
4	64	9	6	18"	23	6	+36"	0			0			3/4							
5				27"	MANY	JUVEN	ILE	SALMOND													
6	Rock	on	base	of	Plunge			which	may	be	fish	passage		barrier	/ PHOTO						
7	65	14	4	4	37'	5	+15	0			0			4/3							
8	66	1	4	3	65'	5	+15	0			0			4/4	STOPPED	@	FENCE				
9	67	1	4	3	65'	5	+15	3	50	D	3	50	D	4/4							
10	68	22	B'	6"	11	12'	+18	3	50	D	3	35	D	3/4	MODERATE						
11				10"	LOTS	OF	JUV.	SALMONIDS							COVER						
12	69	1	5	2"	53	7	+15	3	50	D	3	50	D	4/3							
13	70	17	6	8"	25	9		3	50	D	3	50	D	4/3	HIGH						
14				15"											COVER						
15	71	1	6	8	169	9	+15	3	50	D	3	50	D	4/3							
16	72	23			25				CULVERT		under		MCDONALD'S		DRIVE						
17	73	1	6	2	65	12	+12	3	50	D	3	100	D	5/4							
18	ADJACENT			TO	MCDONALD'S			3	50	D	-		D								
19	74	22	5	6	10	12	+12	3	50	D	3	100	D	5/4	MODERATE						
20				12																	
145 21	75	1	5	2	192	10	+12	3	100	D	3	75	D	4/5							
22	76	23		PIPED	SECTION			UNDER			WOODINVILLE			MALL							
23																					
24																					
25																					
26																					
27																					
28																					
29																					
30																					
31																					
32																					
33																					
34																					
35																					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

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Habiat Inventory Summary

Woodin Creek - Reach 3

Reference Number (RF)	Stream Stationing	Habitat (HT)	Width (W)	Depth (D)	Length (L)	Channel Width (CW)	Channel Depth (CD)	Primary Substrate (SBST)	Secondary Substrate (SBST)
78	00+08	1	4	2	8	4	24	4	6
79	00+12	7	6	2	4	9	36	3	4
80	00+34	1	3	3	22	6	24	4	3
81	00+40	9	7	2	6	7	48	3	3
82	01+58	1	3	1	118	10	60	3	4
83	01+61	7	5	4	3	9	72	3	3
84	01+97	1	7	1	36	7	48	3	4
85	02+02	9	5	10	5	7	60	3	3
86	02+82	1	4	1	80	15	48	4	3
87	03+32	2	3	1	50	10	48	4	3
88	04+27	1	3	1	95	18	60	5	3
89	04+32	9	2	2	5	18	72	3	3
90	05+97	1	4	2	165	20	84	5	3
91	06+27	1	7	1	30	30	84	3	4
92	06+65	1	3	1	38	10	12	5	3
93	06+68	9	4	3	3	20	24	3	3
94	08+24	1	3	1	156	15	36	3	4
95	08+26	17	4	8	2	15	36	3	3
96	09+96	1	3	1	170	10	36	3	5
97	09+99	9	3	2	3	6	24	3	4
98	13+49	1	3	1	350	10	48	4	5
99	13+75	1	3	1	26	20	6	5	4
100	13+78	13	4	5	3	10	8	3	4
101	14+21	1	3	1	43	6	16	5	4
102	14+25	13	3	4	4	5	10	3	5
103	15+58	1	3	1	133	10	10	3	4
104	15+68	3	4	1	10	4	24	3	3
105	15+85	1	4	1	17	6	24	3	4
106	15+91	9	3	10	6	5	26	3	4
107	16+84	1	4	1	93	4	20	5	3
108	16+88	13	6	6	4	6	26	3	5
109	17+15	1	4	1	27	5	12	4	5
110	17+21	13	8	4	6	8	18	2	2
111	19+53	1	3	1	232	5	28	4	5

WOODIN CREEK - UPPER REACH

WRIA Basin # _____ Basin # Reach 3 Date 6/5/07 Time 8:25

Stream # Stream Order: Survey Length (RM) to 10.30

Weather Conditions Sunny & Clear

Investigators ALEX O & LINDA K

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
1	77	23																			
2	78	1	4'	2"	8'	4'	2'	4	10	-	4	10	-	4/6	-						
3	79	7	6'	2"	4'	9'	3'	2	20	D	3	15	D	3/4	low	small log jam - limbs - longest piece 3'					
4			max	5"				12" dbh alder													
5	80	1	3	3	22'	6	2	2	20	D	2	25	D	4/3							
6	81	9	7	2"	5'	7'	4'	2	30	D	2	25	D	3/3	mod	7'	5"	A	C	SO	W
7			max	5"				2			2										
8	82	1	3	1"	118'	10'	5'	2	200+	D	2	100	D	3/4		35"	12"	U	C	SO	S
9																8'	10"	U	C	SO	S
10																6'	12"	U	C	SO	S
11																5.5'	12"	U	C	SO	S
12																5'	12"	A	C	SO	S
13	83	7	5'	4"	3'	9'	6"	2	200+	D	2	75'	D	3/3	low	7'	12"	A	C	SO	J
14			max	8"												6'	12"	A	C	SO	J
15	84	1	7	1"	36"	7'	4'	2	300+	D	2	50'	D	3/4							
16	85	9	5'	10"	5'	7'	5'	2	300	D	2	50'	D	3/3	mod	7'	12"	A	C	SO	W
17			max	12"																	
18	86	1	4	1"	80'	15'	4'	2	300'+	D	2	75'	D	4/3		14'	24"	A	C	SO	W
19																	Plus	Smaller	debris	combined	
20	87	2	3'	1"	50'	10'	4'	2	300'	D	2	75'	D	4/3		6'	12"	U	D	SO	S
21	88	1	3'	1"	95'	18'	5'	2	300+	D	2	25'	D	5/3		10'	4'	U	C	RO	S
22																10'	10"	A	C	SO	W
23																150'	12"	U	D	SO	S
24																3'	18"	U	C	SO	S
25	89	9	2'	2"	5'	18'	6'	2	300'	D	2	30'	D	3/3	low						
26			max	8"																	
27	90	1	4'	2"	165'	20'	7'	2	300+	D	2	50'	D	5/3		150'	10"	U	D	SR	B
28																6'	16"	U	D	SO	S
29																20'	10"	U	D	RO	L
30	91	1	7'	1"	30'	30'	7'	2	300	D	2	75'	D	3/4		10'	22"	U	U	RO	S
31																16'	24"	U	U	RO	S
32	92	1	3'	1"	38'	10'	12"	2	300'	D	2	75'	D	5/3		Large cedar root - stump					
33																200'	25"	A	D	RO	B
34	93	9	4'	3"	3'	20'	2'	2	300	D	2	80'	D	3/3	mod.	150'	10"	A	U	RO	U
35			max	8"																	
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

Notes: 1 large w/ root; 3 max 5"; 5 max 5"; 6 max 5"; 8 max 8"; 9 max 8"; 11 max 12"; 13 max 8"; 15 max 8"; 17 max 12"; 19 max 8"; 26 max 8"; 34 max 8"; 35 max 8"; 12 same tree; 18 these lost placed; 20 plus smaller debris combined; 34 old growth

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B=Bridge Log [Subtype (C)ollapsed/(P)artial] L= Lateral Log W=Weir [Subtype (F)ull/(P)artial]

WOODEN [illegible]

WRIA Basin # _____ Basin # Reach 5/3 Date 6-5-03 Time 10:30

Stream # Stream Order: Survey Length (RM) to ____

Weather Conditions 70°F, sunny

Investigators LK, AO

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
1	94	1	3'	1"	156'	15'	3'	2	300+	D	2	60'	D	3/4		150'	10"	U	U	SR	B
2									open canopy							11'	22"	U	U	SO	B
3																18'	12"	U	U	RO	S
4																100'	26"	U	U		S
5	95	17	4'	8"	2'	15'	3'	2	300+	D	2	80'	D	3/3	mod	4'	14"	A	U	RO	T
6			max	12"												100'	24"	A	U	RO	B
7	96	1	3'	1"	170'	10'	3'	2	300	D	2	50'	D	3/5		150'	36"	U	C	SR	B
8																20'	30"	U	U	SO	B
9																250	32"	A	C	SR	B
10																30'	36"	A	U	SO	B
11	97	9	3'	2"	3'	6'	2'	2	300	D	2	70'	D	3/4		4'	12"	A	C	SO	W
12			max	4"												200'	36"	U	C	SO	S
13	98	1	3	<1"	350'	10'	4'	2	200'	D	2	~50'	D	4/5		20'	18"	U	U	RO	S
14																75'	24"	A	U	SO	B
15																200'	14"	A	U	RO	L
16																8'	14"	A	C	SO	L,L
17																8'	12"	A	U	RO	L
18																200+	38"	A	D	SO	B
19																80'	18"	A	U	RO	L
20																7'	12"	U	U	RO	S
21	99	1	3'	<1"	260'	20'	6"	2	200'	D	2	50'	D	5/4		6'	16"	A	U	RO	L
22	100	13	4'	5"	3'	10'	8"	2	200'	D	2	50'	D	3/4	Low	1'	12"	A	U	RO	Root
23	101	1	3'	max 8"	43'	6'	16"	2	200'	D	2	50	D	5/4		30'	16"	A	U	RO	RW
24	WE1 = GPS coordinate; KS Groundwater seep erosion - photo w/stake # 1804															40'	10"	A	D	RO	B
25	WE2 = GPS coordinate for photo 1804															12'	12"	?	U	RO	L
26	102	13	3'	4'	4'	5'	10"	2	200'	D	2	75'	D	3/5		13'	12"	U	D	RO	L
27	103	1	3'	max 21"	133	10'	10"	2	300'	D	2	56'	D	3/4		10'	18"	U	U	RO	L
28																15'	10"	U	D	RO	B
29																30'	20"	A	C	RO	L
30																50	18"	A	D	RO	B
31																30'	30"	A	C	RO	B
32																100'	25"	A	C	SR	B
33																150'	30"	A	D	SR	B
34																75'	8"	A	D	SR	B
35																75'	10"	A	D	SR	B
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

Shotweed coming in

open canopy

another old growth stump

springs here

deep, incised

6/18/05

Erosion pt → photo of erosion

cavy under bank (RB)

log jam

Root wad

RF=Reference # HT=Habitat Type W=Avg. Habitat Width D=Avg Habitat Depth CW=Avg Channel Width at OHWM

SS=Streamside Structure *Options:* 0=No Riparian (Note Lawn, Road, Building, etc.) 1=Mature Complex Forest 2=Immature/Even-aged/Disturbed Forest 3=Shrub Dominated (Less than 20') 4=Grassland/Meadow/Pasture 5= Wetland

LB=Left Bank RB=Right Bank W=Width TY=Riparian Type *Options:* C=Coniferous D=Deciduous M=Mixed

SBST=Substrate (Dominant/Subdominant) *Options:* 1=Bedrock 2=Silt/Organic 3=Sand 4=Small Gravel (<25 mm) 5=Large Gravel (25 mm-100 mm) 6=Cobble (100mm-256mm) 7=Boulder (*Note Dominant and Subdominant* [Dom/Sub])

PQI=Pool Quality Index Value *(For all Pools, Record Maximum Depth and Cover)*

LWD=Large Woody Debris LE=Length DI=Mean Diameter ST=Stability *Options:* A=Anchored U=Unancored ?=Unknown

V=Variety *Options:* C=Coniferous D=Deciduous ?=Uncertain

CN=Conditions *Options:* S=Solid [Subtype (R)ecent/(O)ld] M=Moderate [Subtype (R)ecent/(O)ld]

R=Rotted [Subtype (R)ecent/(O)ld] TY=Type *Options:* J=Log Jam F=Floating Log S=Stranded Log

B=Bridge Log [Subtype (C)ollapsed/(P)artial] L= Lateral Log W=Weir [Subtype (F)ull/(P)artial]

WRIA Basin # 8 Basin # Reach 3 Date 6/13 Time 10:00

Stream # WOODIN CREEK Stream Order: Survey Length (RM) to

Weather Conditions Overcast 64°

Investigators Steve Krueger & Alex Ottley

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
1	103 cont															100'	10"	A	D	SR	B
2																100'	16"	A	D	SR	B
3																50'	24"	A	C	RO	B
4																30'	12"	A	C	RO	B
5 (root system substrate)	104	3	4'	<1"	10'	4'	24"	2	300'	D	2	50'	D	3		—	—	—	—	—	—
6	105	1	4'	<1"	17'	6'	24"	2	300'	D	2	50									
7	Left Bank & RB erosion																				
8	106	9	3'	10"	10'	5'	26	2	300	D	2	75	D	3/4							
9	107	1	4'	2" max 18"	93'	4'	20"	2	200'	D	2	100	D	5/3		40'	18	A	D	SR	B
10	2' undercut on LB @ 46'															80'	20"	A	D	SR	B
11																10'	12"	A	C	RO	B
12																10'	10"	A	U	RO	B
13																10'	10"	A	U	RO	B
14	108	13	6'	6"	4'	6'	26"	2	200'	D	2	100'	D	3/5	MOD	—	—	—	—	—	—
15	109	1	<1" max	11"	27'	5'	12"	2	200'	D	2	200'	D	4/5		50'	8"	A	U	RO	L
16	Island @ 21'					—		—	—		—	—		3	—	50'	30"	A	D	SR	B
17	110	13	8'	4" max 10"	10'	8'	18"	2	200	D	2	250	D	2							
18																					
19	111	1	3'	<1" to 0	232'	5'	28"	2	200	D	2	50	D	4/5		10'	12"	A	U	RO	L
20	NO Flow up above 110'															50'	8"	A	U	RO	B
21																6'	18"	A	U	RO	W
22	Headwaters																				
23																					
24	Start Reach 4																				
25	112	1	4'	2"	125'	4'	24"	2	25'	M	2	100'	M	(3)/4		5'	12"	A	D	MR	W
26	RB Erosion problem @ 11' (15 ft)															50'	10"	A	D	SR	B
27	LB Erosion problem @ 43' (20 ft)																				
28	Undercut bank (RB) ~ 3' @ 100'; ~10" @ 121'																				
29	113	2	3	1"	27'	3'	24"	2	50'	D	2	150'	D	4/5							
30	LB seep																				
31	GPS Coord for seep R45																				
32	114	1	6'	2"	692'	8'	24"	2	200'	M	2	200'	M	4/3		20'	10"	A	U	RO	L
33																5'	10"	A	U	RO	W
34																7'	14"	U	U	RO	F
35															(2)	6'	12	U	U	RO	F
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

Reach 4

RF=Reference # HT=Habitat Type W=Avg. Habitat Width D=Avg Habitat Depth CW=Avg Channel Width at OHWM

SS=Streamside Structure *Options:* 0=No Riparian (Note Lawn, Road, Building, etc.) 1=Mature Complex Forest 2=Immature/Even-aged/Disturbed Forest 3=Shrub Dominated (Less than 20') 4=Grassland/Meadow/Pasture 5= Wetland
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V=Variety *Options:* C=Coniferous D=Deciduous ?=Uncertain
CN=Conditions *Options:* S=Solid [Subtype (R)ecent/(O)ld] M=Moderate [Subtype (R)ecent/(O)ld]
R=Rotted [Subtype (R)ecent/(O)ld] TY=Type *Options:* J=Log Jam F=Floating Log S=Stranded Log
B=Bridge Log [Subtype (C)ollapsed/(P)artial] L= Lateral Log W=Weir [Subtype (F)ull/(P)artial]

Habiat Inventory Summary

Woodin Creek - Reach 4

Reference Number (RF)	Stream Stationing	Habitat (HT)	Width (W)	Depth (D)	Length (L)	Channel Width (CW)	Channel Depth (CD)	Primary Substrate (SBST)	Secondary Substrate (SBST)
112	01+25	1	4	2	125	4	24	3	4
113	01+52	2	3	1	27	3	24	4	5
114	08+44	1	6	2	692	8	24	4	3
115	08+50	9	2	3	6	4	6	3	4
116	13+31	1	4	2	481	5	14	4	3

WOODIN CREEK TRIBUTARY

WRIA Basin # ____ Basin # 8 Date 6/18/03 Time 11:30

Stream # REACH 4 Stream Order: Survey Length (RM) to ____

Weather Conditions Overcast 64°

Investigators Steve Kruegger + Alex Otteby

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
1	114 (cont)		Braided channel 148'-168'													30'	14"	U	D	MO	F
2			RB Erosion starts @ 428'-443' or (15')													60'	10"	U	D	MO	B
3			LB seep @ 501'; GPS coord: R452													75'	6"	A	D	RO	B
4																75'	10"	A	D	RO	B
5																5'	10"	A			B Root Stator
6			RB Erosion problem 562'-578 or (16')													100	30"	A	C	MO	B
7			LB seep small @ 595' (NO GPS)													22"	30"	U	U	RO	S
8			LB seep @ 634' (No GPS)													60'	30"	U	U	RO	S
9	115	9	2'	3"	6'	4'	6"	2	200	M	2	200	M	3/4	LOD	5'	10"	A	U	RO	D
10			Max 6'																		
11	116	1	4'	2"	481'	5'	14"	2	300	D	2	300	D	2/3							
12			Caddis fly & stonefly larvae observed													100'	10"	A	D	SR	B
13			mayfly adults observed													25"	10"	A	D	Living	B
14																40'	10"	A	D	RO	D
15			seep @ 80' on LB													8'	11"	A	U	RO	B
16			seep @ 101' on LB													60'	28"	A	C	RO	B
17			RB Erosion problem (slide) @ 135'-142' (R4E1 GPS coord)													75'	18"	A	C	RO	B
18			LB " " @ 152'-190' or (38')													75'	24"	A	C	RO	B
19																100'	24"	U	MO	RO	B
20																20'	24	U	C	RO	B
21																50'	36"	A	C	RO	B
22																100'	30"	A	C	RO	B
23																100'	20'	A	C	RO	B
24																20'	24"	A	U	RO	D
25																75'	38"	A	C	RO	B
26																5'	10"	A	U	RO	B
27																8'	12"	U	U	RO	S
28			RB seep @ 251'-292' (41')													100'	36"	A	C	RO	B
29		LB &	RB erosion problem GPS coord R4E2													50'	30"	A	D	MO	B
30																35'	8"	A	D	RO	B
31																10'	16"	A	U	RO	B
32																25'	12"	A	U	RO	B
33																40'	10"	A	D	MO	B
34														Heavy Undergrowth		60'	10"	A	D	RO	B
35	LB seep @ 481'; Stop Point GPS coord: Windfalls															20'	20"	A	U	RO	L
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

RF=Reference # HT=Habitat Type W=Avg. Habitat Width D=Avg Habitat Depth CW=Avg Channel Width at OHWM

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Habiat Inventory Summary

Woodin Creek - Reach 5

Reference Number (RF)	Stream Stationing	Habitat (HT)	Width (W)	Depth (D)	Length (L)	Channel Width (CW)	Channel Depth (CD)	Primary Substrate (SBST)	Secondary Substrate (SBST)
05_1		23	2						
05_2	03+10	1	4	4	310	7	12	6	5
05_3	03+30	3	3	2	20	6	24	7	4
05_4	05+01	1	2	2	171	4	6	7	5
05_5	05+91	23	2		90				
05_6	06+66	1	2	1	75	2	6	2	3

WRIA Basin # 8 Basin # Resch 5 Date 7/8/03 Time 1200 pm

Stream # Stream Order: Survey Length (RM) to

Weather Conditions Overcast 64°

5-1 Investigators STEVE KRUEGER & Alex Ottley

	Habitat Characteristics							Riparian - RB			Riparian - LB					LWD					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY
1	5-1 Culvert															4'	10"	U	D	RO	J
2	5-2	1	4'	4"	310'	7'	12"	2	75'	D	2	75'	D	6/5	–	9'	10"	U	D	RR	J
3		– Debris blockage @ 37' Photo #002													–	4"	12"	U	D	RO	J
4		– LB culvert 12" galvanized @ 127' – Photo #003													–	75'	14"	A	D	SR	J
5		– undercut bank (RB) 195'-228 (8-10")													–	8'	12"	U	D	RO	J
6		– Feeder creek (LB) @ 240' Photo #004													–						
7		Debris blockage @ 240-250'													–	12'	14"	U	D	RO	J
8		– 3 or 4 French drains observed in stretch from residential areas																			
9		– RB Erosion problem @ 275' Photo #005													–						
10		– Seep w/ Eroded Deposits @ 301' (RB)													–						
11	05-3	3	3'	1"	20'	6'	24"	2	75'	D	2	75'	D	7/4	–	50'	14"	A	C	SR	B
12		– Photos 006 & 007 - Cascade																			
13		– LB & RB Erosion 310'-320'																			
14	05-4	1	2'	2"	171'	4'	6"	2	30'	D	2	40'	D	7/5	–	–	–	–	–	–	–
15	05-5	Culvert		–	90'																
16		Passes under 146th Ave NE																			
17	05-6	1	2'	1"	75'	2'	6"	2	10'	D	2	10'	D	2/3		–	–	–	–	–	–
18		STREAM ENDS - dry up above –																			
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
27																					
28																					
29																					
30																					
31																					
32																					
33																					
34																					
35																					
	RF	HT	W	D	L	CW	CD	SS	W	TY	SS	W	TY	SBST	PQI	LE	DI	ST	V	CN	TY

RF=Reference # HT=Habitat Type W=Avg. Habitat Width D=Avg Habitat Depth CW=Avg Channel Width at OHWM

SS=Streamside Structure *Options:* 0=No Riparian (Note Lawn, Road, Building, etc.) 1=Mature Complex Forest 2=Immature/Even-aged/Disturbed Forest 3=Shrub Dominated (Less than 20') 4=Grassland/Meadow/Pasture 5= Wetland

LB=Left Bank RB=Right Bank W=Width TY=Riparian Type *Options:* C=Coniferous D=Deciduous M=Mixed

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B=Bridge Log [Subtype (C)ollapsed/(P)artial] L= Lateral Log W=Weir [Subtype (F)ull/(P)artial]

APPENDIX C: PHOTOS

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Photo 1. Mouth of Woodin Creek at the Sammamish River beginning of Reach 1 (0+00).

Photo 2. Sammamish River downstream of Woodin Creek below the beginning of Reach 1.

Photo 3. Sand substrate within the mainstem of Reach 1 of Woodin Creek below NE 171st Street adjacent to Woodin Creek Park (~7+00).

Photo 4. Sand substrate and visible sediment at depth within Reach 1 of Woodin Creek along the north side of NE 171st Street and south of Canterbury Square (~9+50).

Photo 5. Stream channel Reach 3 of Woodin Creek upstream from the culvert on NE 171st Street (~2+50).

Photo 6. Large woody debris within Reach 1 upstream from the mouth of Woodin Creek (~2+00).

Photo 7. Pools within Reach 1 of Woodin Creek created by log weirs (~16+50).

Photo 8. Root wad secured on the left bank of Reach 1 of Woodin Creek (~18+57).

Photo 9. Riffle habitats in Reach 3 (~5+97).

Photo 10. Off Channel Pond in Reach 1 (3+30).

Photo 11. Chinook Carcass on LB of Woodin Creek (9/23/03) (~9+50)

Photo 12. High density residential land use adjacent to Reach 1 (March 21, 2003).

Photo 13. Medium density residential land use between Reaches 4 and 5 (March 21, 2003).

Photo 14. Upland forest in Reach 5 (March 21, 2003).

Photo 15. Riparian-wetland forest in Reach 3 (March 21, 2003).

Photo 16. Herbaceous wetland habitat in a storm drainage retention area at the downstream end of Reaches 4 and 5 (~0+00) (March 21, 2003).

Photo 17. Open water pond habitat adjacent to Reach 1 and Woodin Creek Park (May 23, 2003) (~3+30).

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APPENDIX D: WOODIN CREEK HABITAT ASSESSMENT SUMMARY DISCUSSION, AND RECOMMENDATIONS

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MEMORANDUM

DATE: **April 12, 2004**

TO: **Yoshihiro Monzaki, P.E.**

FROM: **Benn Burke**

RE: **Woodin Creek Habitat Assessment**
Summary of Results, Discussion, and Recommendations

The discussion of the results, conclusions, and recommendations of the Woodin Creek Habitat Assessment (the study) prepared by Adolfson Associates, Inc. are summarized in the following technical memorandum. Specific results and findings are presented detail in the main body of the report.

RELATIONSHIP TO BEST AVAILABLE SCIENCE CRITERIA

Washington State has state adopted procedural criteria to assist with the implementation of the State's Growth Management Act (GMA). The State requires that cities consider "best available science" in developing land use management policies. As described in the study, the primary purpose of the Woodin Creek Basin Habitat Assessment is to provide baseline information on fish and wildlife habitat conditions and identify factors that may be limiting to fish and wildlife, with particular attention provided to anadromous fisheries as directed by the State criteria. These data could be used to support the City of Woodinville's efforts to develop regulations and policies to comply with the GMA as well as provide a baseline for ongoing management activities within the basin.

There are three levels of assessment presented in the study relative to "best available science." The first level of information is data collected in the field that is specific to Woodin Creek in 2003. The study followed King County's stream habitat assessment methodology (King County, 1991). This is a semi-qualitative method used to document channel characteristics, in-water habitat conditions, riparian habitat conditions, substrate, and large woody debris. The second level of evaluation discussed in the study is related to assessing the general condition of Woodin Creek by comparing it to a hypothetical "properly functioning" stream system as currently defined by National Oceanic and Atmospheric Administration (NOAA) Fisheries in the document titled: *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (NOAA Fisheries, 1996) and United States Department of the Interior Fish and Wildlife Service (USFWS) in a parallel document titled: *A Framework to Assist in the Making of Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulations Watershed Scale (Draft)* (USFWS, 1998). This level of assessment is comparable to what would be required in support of a Biological Assessment that might be prepared as part of a permit application or in support of a federal grant for a capital project. The King County stream habitat assessment methodology used for this inventory does not include all of the same parameters used by NOAA Fisheries and USFWS relative to a "properly functioning" stream system. Because of this, it is necessary to consider indirect factors related to the overall condition of the drainage basin in combination with best professional opinion and make judgments on whether or not Woodin Creek meets "properly functioning" criteria.

The third level of assessment is a discussion of the findings in an attempt to step beyond the empirical data and provide forward-looking observations and offer hypothesis for why a particular condition occurs in Woodin Creek. Where hypothesis serves as the basis for the discussion, we have recommended potential future studies or monitoring so that better information may become available.

It should be recognized that stream surveys are inexact sciences and fisheries professionals may interpret the conclusions and recommendations differently based on the same data. Therefore, the second and third levels of assessment are less objective than the simple reporting of results. To assist with the delineation between data types related to "best available science" the following summaries of these report findings are delineated into Summary of Findings and Discussion. These sections are followed by two sets of recommendations: 1) recommendations for continued or future monitoring and study and 2) recommendations for potential projects or programs to further assess or attempt to mitigate for a known or assumed limiting factor.

WATERSHED CONDITIONS AND FLOW AND HYDROLOGY

NOAA Fisheries (1996) and USFWS (1998) discuss Watershed Conditions and Flow and Hydrology as the last two factors relative to their parameters for a properly functioning stream. This is largely because these assessment methods were developed for watersheds within forests areas proposed for timber harvest. Following harvest these areas would generally be replanted and would continue to be used for forest production. Neither agency had developed assessment criteria at the time of the study that reflects urban stream conditions. Many authors that study urban systems argue that watershed conditions that affect flow and hydrology should be the primary factor considered when assessing the health of urban systems. As a result, these parameters are discussed first here because watershed conditions and flow and hydrology within the Woodin Creek basin appear to be closely related to many other parameters.

Summary of Findings

The study included an indirect assessment of conditions and past actions that have occurred in the basin that affect flow and hydrology. During the study, biologists reviewed drainage maps provided by the City and conducted an assessment of the level of impervious surface associated with the various land uses within the basin. These assessments found that Woodin Creek has a high level of impervious surface. Approximately 41 percent of the total basin area of approximately 400 acres is covered by some type of impervious surface (roads, buildings, parking lots). The highest level of impervious surface within the basin was associated with road rights-of-way. The second highest level of impervious surface was associated with large parking lots for commercial, retail, and multifamily residential development. These two sources account for over half of the total impervious surface with the basin. Roadways and parking lots also impact flow and hydrology in Woodin Creek as a result of culverts. Approximately 20 percent of the total length of stream within the Woodin Creek basin is enclosed in culverts or pipes under roadways and parking lots. The most significant amount of alternation is the piping of the entirety of Reaches 2a and 2b (approximately 3,200 feet). In addition to these pipes, flow and hydrology within the basin are affected by the use of much of Reach 1 for conveyance of stormwater from developed areas. Flow enters the stream through a series of pipes and is conveyed downstream until it reaches a high flow bypass upstream of NE 171st Street where flow re-enters the piped storm conveyance network near station 9+25.

Discussion

Impervious surface in urban stream basins is a concern for three primary reasons: 1) It can increase the quantity of water that flows into a stream by decreasing the amount of water absorbed and/or retained by the landscape; 2) It can decrease the quality of runoff as a result of oil, grease, metals, nutrients, and particulate material (and other items) that are deposited on roadways and parking areas, and 3) It decreases groundwater infiltration that might reduce the recharge of springs, wetlands, and seeps that provide base flows to the stream during the summer. In addition piping and culverts cause constrictions in the channel, that and

Photo 1: New culvert under 133rd Avenue NE

affect flow rates and discharge, particularly if a culvert is undersized.

There are five road culverts within Reach 1: 131st Avenue NE, 133rd Avenue NE, a private road at approximately station 25+82, a private road at approximately 27+22, and a private driveway at approximately 32+52 near Molbaks. Based on field observations, two culverts, the one at 131st Avenue NE and the one at approximately 32+52 appear to be undersized. This observation is based on the fact that they both appear to create large sediment deposits above the inlet and scour was observed below the outlet as might be expected if water was constructed by the culvert and a head developed that increased water velocities within downstream reaches. This appears to occur to the extent that water velocities may be creating scour in downstream habitats. The culvert at 133rd Avenue NE appears to be new and constructed to current standards (Photo 1). The two private road culverts appear to have been recently upgraded.

Open channel portions of Woodin Creek within Reach 1 and Reach 3 are also constrained by roadways. Approximately 1,500 feet of Reach 1 and 2,000 feet of Reach 3 parallels NE 171st Street. The portion of stream in Reach 1 north of NE 171st Street appears to have been relocated during the reconstruction and widening of the road. As a result, the stream corridor is artificially straight and confined relative to its position in the watershed. Given the location of this stream along the valley floor, a stream with a wide channel and broad meanders would be expected to be present under natural conditions.

Based on the high level of impervious surface within the basin, the fact that roads and parking areas account for over half of the impervious surface, and the fact that extensive portions of Woodin Creek are piped and/or are used to provide stormwater conveyance above normally expected base flows, the basin is “not properly functioning” for both watershed conditions and flow and hydrology criteria.

Recommendations

Study and Monitoring

The study calculated a gross area of impervious surface within the basin; however, the study did not separate out what amount of this is “effective impervious surface,” meaning what amount is not effectively treated by stormwater detention and water quality treatment facilities. To better ascertain the degree of impact from impervious surface, a study could be conducted that identifies those parcels or road segments that have stormwater control facilities and, if they do, what level of treatment they provide. It is likely that even those parcels that have stormwater facilities do not provide completely effective treatment based on current standards.

The City might consider a study to identify potential areas to retrofit existing development or roadways with stormwater management facilities. A priority could be those parcels that currently have no stormwater detention or treatment and that discharge directly to the stream. Other studies may be appropriate to address issues with the location and configuration of the channel. These are described below under the Habitat Elements and Channel Condition and Dynamics section.

Projects for Consideration

At this time, there does not appear to be sufficient information available to recommend a specific project that would result in significant improvements within the basin related to watershed condition or flow and hydrology issues. But as a general recommendation there appears to be opportunity for improvement through redevelopment in the basin. Based on the City’s comprehensive planning efforts, many of the properties along Woodin Creek adjacent to Reaches 1, 2a, and 2b are planned for redevelopment or could be redeveloped in the future. The redevelopment of parcels adjacent to Reaches 1, 2a, and 2b, should be viewed as significant opportunities to restore a measure of functionality to the stream corridor through the reduction of effective impervious surface and the removal or upgrade of piped streams and culverts. Specifically the culverts at 131st Avenue NE and the one at approximately 32+52 should be priorities for replacement.

HABITAT ACCESS

Summary of Findings

The scope of the Woodin Creek Habitat Assessment included a fall and winter survey to identify use by adult salmon and to identify potential migration barriers based on fish-use. One adult Chinook salmon (carcass) was observed during the first day of the fall spawning survey upstream from NE 171st Street. No other adult salmon were observed at any other time during the spawning survey. Local neighborhood groups have reported observations of occasional large fish (unidentified species) within the stream during the fall and winter. The study did not include sampling for fish use during other times of the year. King County relocated approximately 250 juvenile cutthroat trout and two sub yearling coho salmon from Reach 1 in November 2003 prior to conducting in-water work in the stream. Juvenile salmonid fish (unidentified species) were observed throughout the entire length of Reach 1 during the summer habitat inventory. Two adult cutthroat trout were observed downstream of NE 171st Street within Reach 1. In addition to salmonid fish, larval lamprey (unidentified species) and sculpin (unidentified species) were also seen in the stream. No adult or juvenile fish of any species were noted in Reaches 3, 4, or 5.

Discussion

It appears that the piping and modifications within Reaches 2a and 2b have resulted in the elimination of fish use from the upper sections of the stream (Reaches 3, 4, and 5). Based on the length of pipe within Reach 2a and 2B, it is assumed that fish are precluded from migrating up past Reaches 2a or 2b. Fish were only observed within Reach 1.

Photo 2: Ripraped channel near mouth.

Photo 3: Man-made waterfall.

In addition to the culverts discussed above, there were three habitat features in Reach 1 that biologists identified as potential partial blockages. These included a riprap section of channel underneath the Sammamish River Trail bridge immediately upstream of the mouth (Photo 2) that may block adult salmon during periods of low base flows. A debris jam within Woodin Creek Park near station 3+50 and a waterfall that is part of a stream beautification feature within the mobile home park at approximately station 28+02 (Photo 3) may also be barriers.

Based on the abundant numbers of juvenile fish throughout Reach 1 and the observed presence of juvenile and adult salmon within this reach, it does not appear that there are any absolute migration barriers within Reach 1; however, it does appear that one or more of these features could represent a migration barrier during certain flow levels. As a result Woodin Creek system is not likely “properly functioning” based on the stated criteria.

The assessment of potential barriers within the Woodin Creek system are based on incidental observations of juvenile fish during the habitat inventory, one adult salmon carcass observed during one spawning season, one fish salvage operation in Reach 1 by King County in November of 2003, and anecdotal observations of large unidentified fish in the stream by neighbors. This is not a definitive set of data. It is possible that a few other adult fish did access Woodin Creek but were not

observed. It is possible that because 2003 was a dry year and fall rains were delayed, the riprap below the Sammamish River Trail bridge (approximately station 0+18) was a more significant blockage than it would be under more normal circumstances. The few carcasses that have been observed in the stream could be a result of being drug up from the Sammamish River by a raccoon or other animal. The level of juvenile fish observed in the channel could be supported by resident cutthroat and/or could be a result of juvenile coho salmon out plants from local school groups, sportsman groups, or tribes.

Recommendations

Study and Monitoring

Because of the significant number of unknowns related to fish passage within the system, two courses of study and monitoring are recommended. The first is to augment the data set related to adult and juvenile salmon use. The City might choose to repeat the spawner surveys in a year with more normal rainfall patterns. The City is currently involved in the King County Salmon Waters Program. An alternate to a formal study would be coordinate with the King County program to additional training and organizational support for neighborhood groups to the extent that observations are conducted regularly and that any fish that are observed can be identified with a high degree of certainty. The City might also consider commissioning a study to attempt to trap out-migrating salmon smolts from various locations within Reach 1. Such a study would have to be closely coordinated to insure that the results were not compromised by juvenile out planting by third party groups. The second course of study could be to conduct specific evaluations of the potential habitat barriers identified herein based on State fish passage criteria.

Projects for Consideration

Assessment and potential correction of the passage barriers under the Sammamish River Trail bridge, the debris jam in Woodin Park, and the man-made waterfall within the mobile home community are all potential projects that could benefit fisheries within the basin. Even if these features are not absolute barriers, they could all impede migration of some fish under normal base flow conditions.

Several of the culverts within the basin appear to have been recently replaced or enlarged to improve water flow and improve fish passage. Culverts that should be considered priorities to assess as potential fish barriers include the culvert under 131st Avenue NE upstream of Woodin Creek Park and the culvert at the upstream extent of the Molbaks parcel at approximately station 32+52 (Photo 4). The capacity of the culvert at 131st Avenue NE appears have been decreased by sediment. Although this culvert appeared to be passable during the study, but additional decrease in capacity could create problems. The culvert at Molbaks appears to be undersized based on observations of sediment deposition upstream and scour downstream of the culvert. These conditions could result in high velocities within the culvert during high flows that could limit fish passibility.

Photo 4: Culvert inlet near station 32+52.

WATER QUALITY

Summary of Findings

Woodin Creek did not meet all required State of Washington water quality parameters for Class AA waters during the study period. Woodin Creek is characterized as a Class AA water per WAC 173-201A. Temperature, dissolved oxygen, and pH are the water quality parameters included in the data

provided to Adolfson for this study that were most often exceeded that relate to fish and wildlife habitat support. Temperature and dissolved oxygen values were most limiting during the summer; pH readings were lowest during the fall and winter. Woodin Creek also does not provide "properly functioning" water quality parameters considered necessary to support healthy self-sustaining populations of salmonid fish per NOAA Fisheries and USFWS parameters (NOAA Fisheries, 1996; USFWS, 1998). Summer temperatures recorded in Woodin Creek indicate that the primary concern is in relation to supporting rearing and migration habitat for salmonid fish.

Discussion

Woodin Creek is limited for many water quality parameters based on the current State water typing criteria; however, it should be noted that State water quality standards are not specifically intended to measure the ability of a water to support healthy populations of fish and wildlife. Water quality exceedances, while common, do not appear to preclude rearing for some salmonids, particular cutthroat trout. It is unknown if high temperatures result in an underutilization of some habitats or if temperatures result in limitations to other species of salmonids. None of the levels observed in the stream appear to indicate the presence of lethal conditions to fish. Low pH values during winter exceed state water quality standards, but further study would be needed to determine if this was a result of a particular point source or is a natural condition. Based on the level of wildlife use with the basin, water quality does not appear to limit many types of wildlife, particularly birds and small mammals habituated to urban environments. It is unknown if water quality is particularly limiting on other wildlife, such as reptiles or amphibians since the wildlife inventory did not specifically target those species.

Recommendations

Study and Monitoring

Ongoing water quality monitoring is recommended to insure that long-term deleterious conditions do not develop. It would be particularly beneficial to continue monitoring those parameters that might attribute to low dissolved oxygen levels (temperature, nutrients, and BOD). Although dissolved oxygen levels can often times be interpolated from temperature data (lowest during the day when temperatures are highest), night dissolved oxygen levels might be a concern for Woodin Creek because of occasional high levels of nutrients in the stream. High nutrient levels might increase the use of oxygen used by algae and bacteria during the night. The addition of occasional night sampling of dissolved oxygen levels could help determine the extreme lows of dissolved oxygen within the within the system. The lowest levels of dissolved oxygen commonly occur just before dawn in late summer.

The scope of the study did not include a statistical assessment of the City's water quality data. Further analysis of the data could show relationships to help pinpoint potential problems. For example, a leaking sanitary sewer might be indicated by a correlation between nutrients (nitrite and nitrate) and fecal levels. A high correlation between nutrients and metals could indicate that runoff from parking lots or roads are a concern.

Low levels of pH have been known to affect spawning success for some salmonid species. If continued monitoring indicates that pH levels continue to be low (6.5 or less), as observed in 2003, additional examination of the data could be warranted to determine if the condition were natural or a result of a specific source. Natural sources of low pH may be runoff from decomposing forest litter or discharge from some types of wetlands. In addition, basin soils may have low buffering capacity. If additional analysis of the data does not identify a situation that can be explained by a natural condition, the current sampling program could be extended to include additional stations or monitoring at outfalls to determine if there is a specific man-made source of the low pH values.

Water quality monitoring provides a quick assessment of potential acute issues with a stream's water. An alternative to extensive water quality monitoring could be to incorporate an evaluation of benthic macroinvertebrate into the sampling program. The addition of benthic monitoring would help identify if there were chronic water quality problems within a stream that might be missed by traditional event sampling.

Projects for Consideration

Temperature (and indirectly dissolved oxygen) has been identified as a potential limiting factor in Woodin Creek. Forested riparian areas with closed canopies provide shade to the stream that limit the potential increase in temperature as a result of direct sunlight. In natural systems, a dense, multilayered, riparian forest may create a cool, high humidity microclimate around the stream that reduces evaporation and might have an actual cool effect on the stream. The establishment of these conditions is likely to require significantly more riparian forest than is possible in Woodin Creek given the high levels of development and limited riparian corridor adjacent to the stream.

Although the establishment of a natural, functioning riparian forest adjacent to Woodin Creek is unlikely due to constraints of the landscape, riparian enhancement is a viable opportunity in the basin. Riparian plantings would benefit many habitats within Reach 1 and lower portions of Reaches 4 and 5. Even areas that are presently forested could be under-planted to help establish as much of a multi-layered forest canopy as possible.

Areas that would specifically benefit from riparian enhancement to provide shade include the reach from station 29+57 to station 32+52 adjacent to Molbaks (Photo 5) and areas within Woodin Creek Park between stations 4+03 and 7+79. In both these areas stream bank vegetation is primarily non-native invasive species (blackberry) and/or immature deciduous forest. Opportunities for shading could also be considered in lower portions of Reaches 4 and 5 adjacent to the existing stormwater facilities and in Reach 1 between station 9+25 and 23+15 where the stream parallels the roadway and there are many south-facing exposures and open canopies (Photo 6).

Photo 5: Dense blackberry in riparian corridor.

Photo 6: Open riparian areas in Reach 1.

HABITAT ELEMENTS AND CHANNEL CONDITION AND DYNAMICS

These parameters can be discussed separately, however habitat elements and channel condition and dynamics within Woodin Creek appear to be closely related so they are described here as a single topic.

Summary of Findings

Woodin Creek is limited in relation to the following habitat elements: Substrate, Large Woody Debris, Pool Frequency, Pool Quality, Off-Channel Rearing Habitat, and Refugia. Small gravel was the dominant substrate type in Reaches 1, 3, and 4. The only reach where cobble or large gravel were a significant component of the substrate was in Reach 5. Substrates in Reach 1 where fish are present were small gravel or finer (sand, silt, or organic materials). No naturally occurring large woody debris was observed in Reach 1. The large woody debris that was observed was associated with constructed log weirs or root wads installed and secured to the streambed and/or bank with cables. Pool frequency within Reach 1 was approximately a third of that which NOAA Fisheries (1996) and USFWS (1998) identify as “properly functioning.” Pool quantity was generally low or moderate. There

were few deep pools (over 3 feet deep) and dense woody cover was generally lacking in association with pools.

Riparian habitat widths in Reach 1 were commonly 100 feet or less and few habitats were adjacent to riparian areas that had a mature forest component. The narrow riparian area constrained by roads and development limits the abundance of off-channel rearing opportunities and significant areas for refugia. The few off-channel wetlands or side channels that are present have largely been impacted by conversion to landscape amenities (ponds)(Photos 7 and 8).

Photo 7: Pond near station 3+30.

Photo 8: Pond near station 23+15.

Discussion

Bank erosion, scour, and sedimentation are natural and necessary process in streams. These processes provide a continuous supply of spawning gravel and create habitat diversity, particularly when combined with the presence of large woody debris. However, when these processes are unbalanced the opposite can occur: spawning substrate and habitat diversity are degraded or lost entirely. The latter appears to be the current situation in Woodin Creek. The data collected during the study documents that most of Woodin Creek, and the entirety of fish accessible reaches, are dominated by deposits of small gravels or finer particles. Sand is largely a dominant substrate type in lower habitats of Reach 1 downstream of 131st Avenue NE to the extent that sand appears to have filled in most pools between stations 0+18 and 7+79 resulting in monotypic glide habitat.

The study did not identify one specific cause for these substrate conditions (such as a landslide, massive bank failure, or a man-made source). As a result, the data and observations point to a series of factors that may be contributing to excessive sedimentation in the lower reach of stream. The first factor is the geography of the basin with steep upper reaches draining valley slopes and a flat lower reach that flows through a remnant floodplain. The second factor is the erosive soil type along the valley slopes. The third factor is the extensive alteration of Reaches 2a and 2b and the creation of high levels of impervious surface within the basin. The fourth factor is that the reconstructed stream channel of Reach 1 relocated by the construction of NE 171st Street did not appear to be sufficient to accommodate the current sediment load. And the fifth factor is the high flow bypass with its inlet upstream of 131st Avenue NE at approximately station 9+25.

The most exacerbating factor appears to be the historic modification of Reaches 2a and 2b and the high level of impervious surface within the basin. Much of the development surrounding Woodin Creek and the piping of surface flows through Reaches 2a and 2b occurs at a location in the landscape where an active alluvial fan would normally occur. Sediments that would typically be deposited in the alluvial fan appear to be collected in man-made sediment traps or transported downstream into the lower, flatter Reach 1. The sediment traps appear to keep most of the larger gravels and cobble from migrating down the basin, but they do not appear to retain all the small gravel and sand. As a result of an artificially narrow and constrained stream channel and increased flow velocities and discharge from impervious surface, these finer materials appear to be carried downstream where they appear to settle out as flow velocities diminish. This appears to be particularly significant downstream of the high flow bypass at NE 171st Street. The deposition of

sediments decreases the conveyance capacity within the artificially narrow stream channel, resulting in flooding and degradation of in-stream habitats.

Similar factors appear to affect large woody debris within the basin. In natural streams of a similar configuration, upslope forests provide a source of debris for reaches lower in the basin. Large woody debris recruitment potential is limited from Reach 1 as a result of past development and the piping in Reaches 2a and 2b combined with other channel constrictions like culverts. Both the high sediment load and the lack of woody debris appear to be reflected in the quality of pools. A preponderance of the pools studied within Reach 1 appear to be a result of habitat enhancement features installed within the stream. Where installed habitat features are absent, the stream was primarily glide or low gradient riffle habitat. While the installation of these features appears to have increased level of habitat diversity, it does not appear to be a self-sustaining condition. Several of the log weirs appear to be failing and the liner used to construct the weirs was exposed in many areas.

Recommendations

Study and Monitoring

The current habitat conditions relative to substrate, large woody debris presence and recruitment, and pool frequency are largely a result of the level of historic modifications of both the channel of Woodin Creek and wider scale development within the basin.

These problems will not be easily solved; however, there does appear to be significant opportunities within the basin to correct or significantly improve these conditions. These opportunities include: The relatively undeveloped nature of the area south of NE 171st Street compared to areas north of the road within the City, the potential high cost and liability of managing flooding within the basin under the status quo, and the extent of planned redevelopment within the basin.

The most appropriate recommendation for additional study for this basin would be an assessment of the feasibility of reconstructing all or parts of Reaches 1, 2a, and 2b for the purpose of creating new stream habitats, improving sediment transport, addressing fish passage issues, and correcting or improving the condition of limited riparian corridor width. This study could include a wide range of alternatives ranging from an evaluation of the status quo to the full reconstruction of the stream channel downstream of Reach 3. Additional alternatives should also be evaluated to guide potential redevelopment in the event that the larger-scale solution is not feasible.

Projects for Consideration

The purpose of the level of study recommended in the previous section is to identify potential long-term solutions for known problems within the Woodin Creek basin. There are, however, several interim measures that should be considered that would build on past stream restoration actions or leverage existing features within the present land use setting of the basin to provide for more opportunities for off-channel rearing habitat and refugia. A measure for consideration would be to continue sediment removal from existing sediment ponds in Reaches 1, 4 and 5. In addition, a sediment trap might be considered for Reach 3. Although it would be more beneficial to return the system to balance related to sediment deposition and transport, the current condition of Reach 2 likely necessitates ongoing and future sediment management to retain balance in the system until longer-term solutions can be implemented.

There are four areas that appear to be good opportunities for this type of targeted enhancement. The first is the existing pond located at approximately station 3+30 in Reach 1. A similar off-channel pond occurs in Reach 1 at approximately station 15+25. Both of these ponds are currently adjacent to the stream, but both occur above the elevation of the stream channel and neither appears to have a fish passable connection to the stream. The potential may exist to provide fish access to these ponds for additional rearing. This should only be done with advanced planning and input from the Washington State Department of Fish and Wildlife who can provide technical expertise to accomplish this while minimizing potential negative effects from stranding or predation. A third off-channel pond is located at approximately station 23+15. This pond is currently accessible to fish but lacks significant cover to provide quality refugia or off channel rearing potential. Plantings of native vegetation and/or in water

enhancement thought the addition of woody debris might increase the functionality of this feature. The forth opportunity area is the segment of Woodin Creek within Woodin Creek Park. The proximity to the Sammamish River and quantity of available open space north and west of the stream channel between stations 3+30 and 7+79 make this an attractive area to create additional off-channel habitat refugia in addition to, or in conjunction with, opportunities related to the pond on the east side of the stream at station 3+30.

WILDLIFE HABITAT

Management of upland wildlife habitat is not a specifically mandated element for inclusion within a basin habitat assessment; however, the City desired to include an inventory of wildlife habitat and wildlife usage within the basin as part of this assessment to better understand the broad range of habitat conditions associated with Woodin Creek.

Summary of Findings

Seven habitat types occur in the study area. These include in order of abundance: High Density Commercial and Residential; Medium Density Residential; Upland Forest; Riparian-Wetlands; Upland Grassland; Herbaceous Wetland; and Open Water Pond. In addition, Agricultural areas occur in King County just south of the study area.

Songbirds were the most abundant wildlife identified by the study both in numbers of individuals and numbers of species. The most abundant species of birds were those generally adapted to habitats located within urban environments. The study attempted to identify species that might not be commonly observed by residents, as a result night surveys were conducted and identified the presence of significant numbers of bats and one group of western screech owls. Bats and owls were observed in the forested areas of the watershed, generally adjacent to Reaches 3, 4, and 5. Other wildlife observations recorded during the habitat surveys included waterfowl (mallard), pileated woodpecker excavations, eastern gray squirrel, Pacific chorus frog, mole tunnels, and Virginia opossum.

Discussion

It is interesting to note that bats and owls were only detected at the stations that were located near medium to large conifer trees. Structure for bat roosting could be limited to where conifer trees are present. Peeling bark and fissures provide potential roost sites for bats. Smaller deciduous trees usually lack peeling bark and fissures that characterize medium to large conifer trees. Songbirds were common throughout the basin. It should be noted that nocturnal mammals and amphibians may be under represented by the study methods. It is likely that additional species of amphibians and mammals occur within the Woodin Creek basin.

Recommendations

Study and Monitoring

If wildlife habitat management is determined to be a priority, additional studies could be conducted that target both amphibians and nocturnal mammals. Studies that target these animals would provide a more complete data set relative to which animals live in the Woodin Creek basin. Such studies could also include the location and mapping of specific, high valued wildlife habitat such as snags or stands of mature conifers.

Projects for Consideration

The area of Woodin Creek Park actively maintained as lawn could be reduced to provide additional upland habitat for wildlife adjacent to Reach 1. Enforcement and/or education related to maintaining native growth protection areas adjacent to Reaches 4 and 5 could be considered. There were observations of yard waste and litter being disposed of in these areas. In addition, control and removal of invasive/non-native/obnoxious riparian species along the stream, and planting of riparian native species, as described in the Stream Habitat Elements section, would also benefit wildlife.