# 3.12 INDEPENDENT NEARSHORE TRIBUTARIES IN WRIA 9)

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## INTRODUCTION

The nearshore tributaries of WRIA 9 include 15 independent streams that directly enter Puget Sound (Longfellow Creek was historically an independent tributary but it currently flows into the West Waterway and is discussed as a Green River tributary). The numbering system used in this report is that described by Williams (1975). The first two digits designate the WRIA number, and the remaining numbers identify individual streams. Bordered by Fauntleroy Creek to the north and Joe's Creek to the south, these streams include:

- Joe's Creek (09.0369) (also called Younglove Creek in some of the literature);
- Lakota Creek;
- Cold Creek
- Buenna Creek;
- Salmon Creek;
- Miller Creek;
- Des Moines Creek;
- Fauntleroy Creek;
- McSorley Creek;
- Woodmont Creek;
- Redondo Creek;

Three unnamed creeks north of Three Tree Point (09.0367, 09.0353 and 09.070); and an un-named creek (09.0380) immediately south of Des Moines Creek. All are typical of Puget Sound lowland drainages that receive their flow from springs, seeps, lake outlets, rainfall and ground-water runoff. All of these creeks have experienced the types of habitat degradation associated with industrial development and/or urbanization.

This chapter presents information on Joe's, Lakota, Cold, Buenna, Salmon, Miller, De Moines, and Fauntleroy creeks. Miller and Des Moines creeks are the largest and generally have the largest amount of information. Little or no information is available for McSorley, Woodmont, and Redondo creeks, or for the unnamed creeks.

## JOE'S CREEK

### PHYSICAL DESCRIPTION

#### STREAM COURSE AND MORPHOLOGY

The East Fork of Joe's Creek (09.0369) is a seasonal stream fed by surface runoff. A stormwater detention pond on the south side of 340$^{th}$ Street empties into the streambed via a culvert with the stream first surfacing immediately south of SW 338$^{th}$ Street. This fork then flows through

Olympic View Park and the Twin Lakes Golf Course to meet the West Fork Joe's Creek at the stormwater detention pond on SW 320th Street.

The West Fork Joe's Creek is a fed by groundwater and surface runoff that begins at a storm-water detention pond at the Wedgewood Apartments and Golf Course. The streambed then follows Hoyt Road North to the constructed Lakes Lorene and Jeane (also known as Twin Lakes). It flows out of the northeast portion of Lake Jeane, through the Twin Lakes Golf Course and into another holding pond and joins the East Fork.

The mainstem of Joe's Creek currently has its origins from this stormwater detention pond on the south side of SW 340th Street. Joe's Creek then drops into a high-gradient stream channel that falls through a wooded ravine, eventually flattening immediately prior to entering Puget Sound on the east side of Dumas Bay.

### SALMONID USE

Historically, salmon were observed as far upstream as the first culvert beneath 320th Street. However, salmon have not been observed this far upstream for at least several decades (Kimpo and Maher 1997).

The known freshwater distribution of anadromous salmonids is depicted in the Fish Distribution Maps located in the Appendix. In Joe's Creek there is the occasional report by local residents of adult salmon observed. However, the species of salmon is unknown.

Several age classes of juvenile cutthroat trout have been observed by Puyallup tribal fisheries biologists (Ladley pers. comm.).

Both creeks flow directly into Dumas Bay and provide an important freshwater input into this area of Puget Sound. Dumas Bay has been characterized as a 253-acre intertidal sandflat habitat integral to the nearshore ecosystem in this part of Puget Sound. No data are available detailing juvenile or salmonid usage of this area. However, coastal cutthroat trout have been observed being caught (J. Kerwin pers. obser.), and juvenile chinook salmon, chum salmon, and steelhead have been captured in beach seine sets (NRC 1995) in Dumas Bay.

## FACTORS OF DECLINE

### RIPARIAN CONDITION

The riparian habitat in this stream does not meet any criteria of properly functioning. The lack of adequate riparian habitat is a limiting factor to natural salmonid production.

The riparian communities along Joe's Creek are composed primarily of young trees, shrubs, non-native species, and ornamental plantings. It is almost completely lacking medium or large trees that would provide the shade necessary to support salmonid habitat. Aerial photos show that most of Joe's Creek streambed channel is visible from above, indicating that existing shade levels are less than 25 percent. The target shade percentage deemed necessary to maintain temperatures below 16°C at this elevation ranges from 80 to 90 percent.

Only the riparian habitat in the reach from RM 0.1 to 1.0 is considered suitable to provide good shade at the present time. This area support stands of maturing deciduous and coniferous trees are considered to be in fair condition. Left undisturbed and allowed to mature, they will provide shade for this area of the channel.

Land use activities upstream of this point will preclude achieving good shade conditions along the remainder of Joe's Creek. In particular, the residential development, recreational land use in areas adjacent to the channel upstream of RM 1.0 will continue to prohibit development of mature riparian vegetation capable of providing shade.

### Large Woody Debris

No specific information on historic amounts of LWD was located during this investigation. However, based on channel type, it is assumed that laterally-stable, moderate- to high-gradient reaches of the lower mile supported dense stands of conifers (including Douglas-fir, western red cedar, and western hemlock). The trees were removed through logging and development.

There is no systematic survey of present amounts of LWD in Joe's Creek. The lack of tall, mature trees effectively limits the supply of organic matter and terrestrial insects delivered to Joe's Creek. Limited amounts of LWD is present in the lower river mile (Kerwin 2000). If left undisturbed, the trees in these areas will mature and begin to provide functional LWD.

The potential for LWD recruitment throughout the remainder of Joe's Creek subbasin is poor, as land use activities effectively preclude the development of mature riparian stands.

## HYDROLOGY

Impervious surfaces associated with single and multi-family residences, commercial activities and roads are the primary contributors to high flows and large sediment loads in the tributaries and mainstem of Joe's Creek. Peak flows are believed to be exceed 150 percent over historical flows (Federal Way 1990). Because the land is largely built out, current peak flows in these creeks are likely to approximate future flows.

## SEDIMENT CONDITION

Impervious surfaces associated with single- and multi-family residences are the primary contributors to high flows and large sediment loads in this creek. Because riparian communities along Joe's Creek are composed primarily of young trees, shrubs, non-native species, and ornamental plantings, none of the stream system is considered to have good bank stability.

The presence of dense stands of young coniferous or deciduous trees or shrubs is sufficient to provide good sediment filtration where the riparian zone is at least 150 feet wide. Only in the reach between RM 0.1 to 1.0 are there sufficient amounts and distance to provide good sediment filtration. However, this is the high-gradient ravine where the creek transitions from the headwater to beach. Upstream of this point, roads, development or other contributing activities adjacent to the stream effectively eliminate the ability of riparian area to filter fine sediment.

The substrate within this creek consists of pebbles and cobble-sized particles with localized sand depositions. Gravel deposits are very local and spawning opportunities are typically few. These features are typical of flow alterations caused by unretained or underretained stormwater.

With the conversion of the historic forested uplands into low- and high-density residences, water fluctuation and sedimentation have increased (King County 1991). Siltation (caused by construction activities, increases of impervious surfaces and associated peak flood flows) have resulted in local flooding concerns that further degrade salmonid habitats.

## WATER QUALITY

Joe's Creek appears on the 1998 Department of Ecology 303(d) water quality violations list for exceeding fecal coliforms.

High percentages of impervious surfaces in this area indicate that contaminates in surface water runoff likely adversely impact salmonids.

## LAND USE

Upstream, the creek is bordered by residential areas with little or no riparian habitat present. Olympic View Park is located immediately downstream of the confluence of the East and West forks. This public park has a thin wooded strip along the creek of approximately 100 feet on either side of the creek. Numerous bicycle and pedestrian trails transect this buffer and impair its ability to function as a riparian habitat. Joe's Creek passes also through low- and high-density residential housing areas, Twin Lakes and Northshore golf courses, and Twin Lakes (two constructed ornamental lakes not identified in Wolcott (1965)).

The lower river mile of this creek passes through a ravine bordered by a 200- to 500-foot-wide corridor of second-growth (up to 28 inches in diameter) red cedar, western hemlock and Douglas fir. This vegetation stabilizes the slopes that are up to 150 feet high with slopes in the range of 60 to 90 percent.

## NON-NATIVE SPECIES

### Animals

No exotic aquatic animal species were identified in the stream reaches that anadromous salmonids inhabit during the course of this investigation. Warmwater fish species have been reported in some of the lakes in the upper reaches of Joe's Creek and its tributaries.

### Plants

Reed canarygrass (*Phalaris arundinacea*) is abundant throughout this subbasin. Other exotic plant communities in the riparian zone consist of Himalayan blackberries and willow species (*Salix spp.*), and numerous ornamental plantings associated with the golf courses and residential communities.

### HYDROMODIFICATION

No information was located that showed current vs. historic stream channel. However, given the extensive residential development and the presence of several thousand feet of culvert in this subbasin, there is little doubt that the streambed has been relocated in some reaches.

The mainstem creek and its tributaries are crossed by nine roads in a relatively short distance. In addition, the mainstem Joe's Creek travels for approximately 600 feet through a culvert as it exits a water detention pond at the Twin Lakes Golf Course. The West Fork of Joe's Creek travels through five culverts for a combined distance of approximately 1,350 feet. The East Fork of Joe's Creek travels through two culverts for a combined approximate distance of 1,150 feet.

#### Off Channal Habitat

No information was located that described site specific-historical riparian conditions along mainstem Joe's Creek. In general, it is likely that vegetation in the Joe's Creek subbasin was similar to that elsewhere in the Puget Sound region. There are numerous small ponds and lakes in the upland areas that form the headwaters of the tributaries. Soils maps suggest there were also numerous wetlands in the upper Soos Creek basin. A mixture of emergent wetlands probably characterized these areas or wet meadows intermixed with forested wetlands and uplands supporting Douglas-fir on the dryer sites. The canyon reach (RM 0.1 to RM 1.0) most likely supported a dense stand of conifers. Riparian vegetation communities would have been similar to that described for the middle Green River in the vicinity of Soos Creek.

## LAKOTA CREEK (09.0386)

### PHYSICAL DESCRIPTION

#### SUBBASIN

The Lakota Creek subbasin is located entirely within the City of Federal way. It drains an area of approximately 1,387 acres, and has 24 acres of lakes and 8 acres of wetlands. The subbasin contains a complex system of tributaries; many of which are roadside-associated drainage ditches, stormwater detention ponds, and ornamental ponds.

#### STREAM COURSE AND MORPHOLOGY

In the eastern portion of the subbasin, all of the tributaries (Northeast Limb, Southeast Limb, Southeast Wetland and Mirror Lake Overflow) drain into Fisher's Pond. Water from this pond flows into the South Central Limb, the Southwest Wetlands and the North Central Limb, which converge at the North Fork Wetlands. These collectively form the North Fork (NF) Lakota Creek which meets the South Fork (SF) Lakota Creek along SW Dash Point Road. Lakota Creek then continues along the road in a northwesterly direction, passing through the Lakehaven Sewage and Wastewater Treatment Plant before entering Puget Sound at Dumas Bay. Lakota Creek provides an important freshwater input into this area of Puget Sound.

### SALMONID USE

The known freshwater distribution of anadromous salmonids is depicted in Appendix B, Figures 1-6. Adult salmon have been reported spawning in the lower reaches of Lakota Creek (WDFW Spawning Ground Survey Database, Anthony and Catton 1996). Chum salmon were observed spawning in the 1990s, and an occasional coho adult has been reported. Surveys in 1987 found juvenile coho salmon (as well as cutthroat and steelhead trout and sculpins) (Shapiro and Assoc. 1987). Several age classes of juvenile cutthroat trout have been observed by Puyallup tribal fisheries biologists (Ladley 1999).

No data are available detailing juvenile or salmonid usage of Dumas Bay. However, coastal cutthroat trout have been observed being caught in Dumas Bay (Kerwin 2000). Juvenile chinook salmon, chum salmon, and steelhead were captured in beach seine sets in Dumas Bay during surveys conducted in 1995 (NRC 1995).

## FACTORS OF DECLINE

### FISH PASSAGE

A culvert under Highway 509 (Dash Point Road) creates a blockage to anadromous fish and eliminates further upstream access.

### RIPARIAN CONDITION

Very little intact riparian habitat exits in the subbasin. Narrow strips of young coniferous forests are present in the vicinity of Decatur High School but generally the creek flows through residential areas and alongside roads. The riparian habitat along the lower reaches of Lakota Creek currently consists of small deciduous trees with an understory of shrubs.

Similar to bank stability, shade is considered to be in good condition only where there are dense stands of medium or large sized coniferous or deciduous trees. The Lakota Creek streambed channel was generally visible on aerial photos, indicating that existing shade levels are less than 25 percent. The target shade percentage deemed necessary to maintain temperatures below 16$^{o}$C at this elevation ranges from 80 to 90 percent. Land use activities throughout the Lakota Creek subbasin will preclude achieving good shade. In particular, the residential development, recreational land use in areas adjacent to the channel upstream of RM 1.0 will continue to prohibit development of mature riparian vegetation capable of providing shade.

#### Large Woody Debris

No specific information on historic amounts of LWD was located during the investigation for this report. Based on channel type, it is assumed that laterally-stable moderate to high gradient contained reaches of the lower mile supported dense stands of conifer including Douglas-fir, western red cedar, and western hemlock. The riparian communities associated with unconfined low- and moderate-gradient reaches upstream of the crest of the bluff were probably similar stands to those in the ravine.

There were not any systematic surveys of current LWD amounts located as a part of this investigation for this subbasin.

Without exception, the potential for LWD recruitment throughout the Lakota Creek subbasin is poor. Within the lower 1.0 creek mile corridor, if left undisturbed and as the riparian stand matures, it will begin to provide functional LWD within the next 50 – 100 years. LWD recruitment along the remainder of Lakota Creek is expected to remain low, as land use activities effectively preclude the development of mature riparian stands.

## HYDROLOGY

Impervious surfaces associated with single and multi-family residences, commercial activities and roads are the primary contributors to high flows and large sediment loads in the tributaries and mainstem of Lakota Creek. Peak flows are believed to exceed 150 percent over historical flows (Federal Way 1990). Because the land is largely built out, current peak flows in these creeks are likely to approximate future flows.

## SEDIMENT CONDITION

Because riparian communities along Lakota Creek are composed primarily of young trees, shrubs, non-native species and ornamental plantings none of the stream system is considered to have good bank stability. The substrate within this creek consists of pebbles and cobble-sized particles with localized sand depositions. Gravel deposits are very local and spawning opportunities are typically few. These features are typical of flow alterations caused by unretained or underretained stormwater. A sediment detention basin constructed at the entrance to the Dakota Treatment Plant is emptied after major storms. This is indicative of continuing erosion problems upstream of this point

With the conversion of the historic forested uplands into low and high density residences increases in water fluctuation and sedimentation have occurred (King County 1991). Siltation, caused by construction activities, increases in impervious surfaces and associated peak flood flows have all contributed to local flooding concerns.

## WATER QUALITY

Water quality is adversely impacted by the high percentage of impervious surfaces within the subbasin and the presence of domestic trash throughout the stream channel is both an aesthetic and water quality problem.

Lakota Creek appears on the 1998 Department of Ecology 303(d) water quality violations list for exceeding fecal coliforms.

## LAND USE

No information was located that described site specific historical riparian conditions along mainstem Lakota Creek or its tributaries. A land survey conducted by the U.S. Geological Survey in

1897 (USGS 1900) indicates that in the lower reaches of Lakota Creek, the timber had been harvested and restocked while the upper reaches appeared to be unharvested and were described as "Merchantable forests." One area around Mirror Lake appeared as a "Burnt area restocking."

With the exception of the lower river mile, all of the area adjoining Lakota Creek is heavily developed.

## NON-NATIVE SPECIES

Reed canarygrass, Himalayan blackberries and numerous ornamental plantings are abundant throughout this subbasin. Other exotic plant communities in the riparian zone consist of Himalayan blackberries and willow species, and numerous ornamental plantings associated with the golf courses and residential communities.

## HYDROMODIFICATION

### Floodplain Modifications

No information was located during the course of this investigation that compared or showed current vs. historic stream channel.

The lower reach of the stream was relocated as a part of an upgrade to the Lakehaven Sewage and Wastewater Treatment Plant in 1987. A bypass (overflow) culvert takes the portion of the creek that is not accommodated in the stream channel and empties directly into Dumas Bay southwest of the Lakota Creek mouth. Given the extensive residential development, the parallel stream course to roads, the presence of numerous road crossings, and stormwater detention ponds there is little doubt that the streambed has been relocated in numerous reaches.

### Off Channel Conditions

In general, it is likely that vegetation in the Lakota Creek subbasin was similar to that elsewhere in the Puget Sound region. There are numerous small ponds and lakes in the upland areas that form the headwaters of the tributaries. Soils maps suggest there were also numerous wetlands in the Lakota Creek subbasin. A mixture of emergent wetlands or wet meadows intermixed with forested wetlands and uplands supporting Douglas-fir and western Hemlock on the dryer sites probably characterized these areas. Riparian vegetation communities would have been similar to that described elsewhere in this report for the middle Green River in the vicinity of Soos Creek.

The majority of these wetlands have been drained and filled for development purposes

## COLD CREEK (09.0381)

### PHYSICAL DESCRIPTION

#### STREAM COURSE AND MORPHOLOGY

Located entirely within the city limits of Federal Way, Cold Creek is listed by Williams (1975) as an unnamed tributary and designated as stream number 09.0382. The creek originates from Easter Lake and together with its tributary (09.0382) is approximately 1.55 miles in length (8,200 feet) (Cutler pers. comm). After leaving Easter Lake the creek follows S 308$^{th}$ Street prior to entering a culvert and resurfaces in the vicinity of South 306$^{th}$ Street where it almost immediately enters a steep ravine prior to entering Puget Sound.

#### SALMONID USE

The known freshwater distribution of anadromous salmonids is depicted in Appendix B, Figures 1-6. Local residents occasionally report adult coho and chum salmon in the lower reaches, but dates and numbers could not be confirmed during this investigation. The Washington Department of Fish and Wildlife Spawning Ground Survey Database does not have any information showing observations of any salmonid species in this creek.

### FACTORS OF DECLINE

#### RIPARIAN CONDITION

The upstream portion of Cold Creek passes through low- and high-density residential housing areas, and commercial developments and the riparian corridor is severely degraded.

The lower reach of Cold Creek and into the lower end of the ravine has a riparian habitat consisting of second-growth deciduous and coniferous trees, shrubs, non-native species, and ornamental plantings. Areas such as the reach between RM 0.1 and RM 0.33 that support stands of mixed deciduous and coniferous trees are considered to be in fair condition, and will attain good condition if left undisturbed and allowed to mature.

Similar to bank stability, shade is considered to be in good condition only where there are dense stands of medium or large sized coniferous or deciduous trees. The Cold Creek streambed channel was generally visible on aerial photos, indicating that existing shade levels are less than 25 percent. The target shade percentage deemed necessary to maintain temperatures below 16$^{o}$C at this elevation ranges from 80 to 90 percent. Only the riparian habitat in the reach from RM 0.05 to 0.33 is considered suitable to provide good shade at the present time. Land use activities upstream of this point will preclude achieving good shade conditions along the remainder of Cold Creek. In particular, the residential development, recreational land use in areas adjacent to the channel upstream of RM 0.33 will continue to prohibit development of mature riparian vegetation capable of providing shade.

### Large Woody Debris

No data was located that indicated the current condition of riparian zones with respect to organic matter and terrestrial insect recruitment. The lack of tall, mature trees is thought to effectively limit the supply of organic matter and terrestrial insects delivered to Cold Creek.

No specific information on historic amounts of LWD was located during the investigation for this report. Based on channel type, it is assumed that laterally-stable moderate to high gradient contained reaches of the lower mile supported dense stands of conifer including Douglas-fir, western red cedar, and western hemlock. The riparian communities associated with unconfined low and moderate gradient reaches upstream of the crest of the bluff probably similar stands to those in the ravine. In Cold Creek there have not been any systematic surveys of current LWD amounts that could be located as a part of this investigation for this subbasin.

With the exception of the lower 0.33 mile of Cold Creek, the potential for LWD recruitment throughout the subbasin is poor. Within the lower 0.33 mile corridor, if left undisturbed and as the riparian stand matures, it will begin to provide functional LWD. LWD recruitment along the remainder of Cold Creek is expected to remain low, as land use activities effectively preclude the development of mature riparian stands.

## HYDROLOGY

Impervious surfaces associated with commercial development, single- and multi-family residences are the primary contributors to high flows and large sediment loads in the tributaries and mainstem of Joe's Creek. Localized flooding around Easter Lake has been the cause of some concern by local residents. Because the land is largely built out, current peak flows in this creek are likely to approximate future flows.

## SEDIMENT CONDITION

The presence of dense stands of young coniferous or deciduous trees or shrubs are sufficient to provide good sediment filtration where the riparian zone is at least 150 feet wide. Only in the reach between RM 0.1 to 0.5 (the canyon reach) are there sufficient amounts and distance to provide good sediment filtration. However, this is the high gradient reach of the stream that is in the ravine where the creek transitions from the headwater to beach. Upstream of this point, roads, development or other contributing activities adjacent to the stream effectively eliminate the ability of riparian area to filter fine sediment.

The substrate within this creek consists of pebble and cobble sized particles with localized sand depositions. Gravel deposits are very local and spawning opportunities are typically few. These features are typical of flow alterations caused by unretained or underretained stormwater.

## WATER QUALITY

Water quality is adversely impacted by the high percentage of impervious surfaces within the subbasin.

The presence of domestic trash throughout the stream channel is both an aesthetic and water quality problem.

Cold Creek appears on the 1998 Department of Ecology 303(d) water quality violations list for exceeding fecal coliforms.

### HYDROMODIFICATION

No information was located during the course of this investigation that showed current vs. historic stream channel. However, given the extensive residential and commercial development present there is little doubt that the streambed has been relocated in some reaches.

There are a minimum of nine storm drains that contribute stormwater runoff to Cold Creek. Four of these enter Easter Lake and five directly enter the creek. The Easter Lake drains convey water from a largely commercial area.

### NON-NATIVE SPECIES

#### Animals

No exotic aquatic animal species were identified in the stream reaches that anadromous salmonids inhabit during the course of this investigation.

#### Plants

Reed canarygrass (*Phalaris arundinacea*) is abundant throughout this subbasin. Other non-native plant communities in the riparian zone consist of Himalayan blackberries and willow species (*Salix spp.*), and numerous ornamental plantings associated with residential communities and commercial developments.

### HYDROMODIFICATION

No information was located that described site-specific historical riparian conditions along mainstem Cold Creek. In general, it is likely that vegetation in the Cold Creek subbasin was similar to that elsewhere in the Puget Sound region. A mixture of emergent wetlands probably characterized the upper reaches and wet meadows intermixed with forested wetlands and uplands supporting Douglas-fir on the dryer sites. The canyon reach (RM 0.05 to RM 0.5) most likely supported a dense stand of conifers. Riparian vegetation communities would have been similar to that described for the middle Green River in the vicinity of Soos Creek.

The majority of these wetlands have been drained and filled for development purposes

## BUENNA CREEK (09.0384)

### PHYSICAL DESCRIPTION

#### STREAM COURSE MORPHOLOGY

Buenna Creek (and its unnamed, unnumbered tributary stream) is a seasonal intermittent stream system fed by surface runoff that flows directly into Puget Sound just south of Redondo. The mouth of the creek is perched above the normal high water tide line, effectively limiting access by anadromous fish.

#### SALMONID USE

There is no known utilization of this creek by salmonids. The known freshwater distribution of anadromous salmonids is depicted in Appendix B, Figures 1-6.

### FACTORS OF DECLINE

#### FISH PASSAGE

No impediments to fish passage were identified from existing databases during the course of this investigation.

#### RIPARIAN CONDITION

No information was located that described site-specific historical riparian conditions along main-stem Buenna Creek. Jones (2000) described riparian land use as a combination of existing residential and early successional forest with a 15-foot buffer from the stream channel at the development of Redondo Bay. Plant communities included an overstory of deciduous trees with an understory of Himalayan blackberry, salmonberry, vine maple and stinging nettle (Jones 2000). In general, it is likely that vegetation in the Buenna Creek subbasin was similar to that elsewhere in the Puget Sound region. Historic riparian vegetation communities would have been similar to that described for the middle Green River in the vicinity of Soos Creek.

No data was located that indicated the current condition of riparian zones with respect to organic matter and terrestrial insect recruitment. The lack of tall, mature trees is thought to effectively limit the supply of organic matter and terrestrial insects delivered to Buenna Creek. The absence of suitable riparian habitat is an indicator that effective sediment filtration can not occur in this creek.

Section 22-1306 of the Federal Way Code requires a 50-foot setback from the ordinary. The City of Federal Way Code, Section 22-1, divides streams into two definitions. Major streams are defined as supporting under normal circumstances resident or migratory fish. Minor streams is defined as any stream that does not mean the definition of a major stream. Buenna Creek has been determined by the City of Federal Way to be a “minor creek”. It was not clear how the development of Redondo Bay was granted a 15-foot stream buffer.

The Buenna Creek streambed channel was generally visible on aerial photos, indicating that existing shade levels are less than 25 percent. Land use activities will preclude achieving good shade conditions along Buenna Creek.

### Large Woody Debris

No specific information on historic amounts of LWD was located during the investigation for this report. Based on channel type, it is assumed that laterally-stable moderate- to high-gradient contained reaches of the lower 0.25 mile once supported dense stands of conifer including Douglas-fir, western red cedar, and western hemlock. The riparian communities associated with unconfined low- and moderate-gradient reaches upstream of the crest of the bluff probably similar stands to those in the ravine. In Buenna Creek there were not any systematic surveys of current LWD amounts located as a part of this investigation for this subbasin.

Without exception, the potential for LWD recruitment throughout the Buenna Creek subbasin is poor and is expected to remain poor, as land use activities effectively preclude the development of mature riparian stands.

## HYDROLOGY

No information was located that provided an approximation of historic, current or future flows during the course of this investigation. Because the land is largely built out, current peak flows in these creeks are likely to approximate future flows.

## SEDIMENT CONDITION

Impervious surfaces associated with single and multi-family residences, commercial development and roads are the primary contributors to high flows and large sediment loads in these creeks.

Because riparian communities along Buenna Creek are composed primarily of young trees, shrubs, non-native species, and ornamental plantings, none of the stream system is considered to have good bank stability.

The substrate within this creek consists of pebble and cobble sized particles with localized sand depositions. Gravel deposits are very local and spawning opportunities are typically few. These features are typical of flow alterations caused by unretained or underretained stormwater.

## WATER QUALITY

Water quality is adversely impacted by the high percentage of impervious surfaces within the subbasin. The presence of domestic trash throughout the stream channel is both an aesthetic and water quality problem.

Buenna Creek does not appear on the 1998 Department of Ecology 303(d) water quality violations list for exceeding any water quality parameters.

### LAND USE

Jones (2000) described riparian land use as a combination of existing residential and early successional forest.

### NON-NATIVE SPECIES

#### Animals

No exotic aquatic animal species were identified in the stream reaches that anadromous salmonids inhabit during the course of this investigation.

#### Plants

Reed canarygrass (*Phalaris arundinacea*) is abundant throughout this subbasin. Other non-native plant communities in the riparian zone consist of Himalayan blackberries and willow species (*Salix spp.*), and numerous ornamental plantings associated with the golf courses and residential communities.

### HYDROMODIFICATION

No information was located during the course of this investigation that showed current vs. historic stream channel. However, with the extensive residential development and the presence of several culvert sections of stream channel there is little doubt that the streambed has been relocated in some reaches.

## SALMON CREEK (09.0362)

## PHYSICAL DESCRIPTION

### STREAM COURSE AND MORPHOLOGY

Salmon Creek and its tributaries encompass a 2.3-square-mile drainage basin in western King County. The basin's northern boundary is in the vicinity of Southwest Henderson Street inside the city limits of the City of Seattle. The eastern boundary is in the vicinity of Fourth Avenue SW, the western boundary is immediately east of 21st Avenue SW, and the southern boundary borders the Miller Creek subbasin along approximately 126th Street.

Williams (1975) lists the headwaters as Garrett Lake, locally called Hicks Lake (Wolcott 1967), while Heller et al (1987) determined that the headwaters are located in a wetland just north of Southwest 100th Street. Ames (1981) listed four unnamed tributaries, while Heller et al. (1987) found 13 unnamed tributaries. The stream system empties directly into Puget Sound south of Seola Beach.

### SALMONID USE

The known freshwater distribution of anadromous salmonids is depicted in Appendix B, Figures 1-6. While the name of the mainstem creek suggests that anadromous salmonids may have been historically present, there have been no recent observations of any species of anadromous salmonids in this system. The only recorded observations are from a spot spawning ground survey conducted on December 27, 1956. One hundred twenty-eight chum salmon adults were observed in unnamed tributary 09.0365, and 95 chum salmon adults were observed in unnamed tributary 09.0366 (WDFW Spawning Ground Survey Database).

## FACTORS OF DECLINE

### FISH PASSAGE

Access for anadromous salmonids is blocked by a total barrier at approximately RM 0.3.

### RIPARIAN CONDITION

Only limited information was located that described site-specific historical riparian conditions along mainstem Salmon Creek or any of its tributaries.

The riparian habitat in the reach where Salmon Creek drops off the bluff through a ravine is the best of any riparian habitats in this subbasin. Consisting of a deciduous-dominated second-growth forest with some conifers and a shrub understory, the riparian zone in this reach is "Fair" according to the criteria contained in the report Appendix.

Similar to bank stability, shade is considered to be in good condition only where there are dense stands of medium or large sized coniferous or deciduous trees. Where the Salmon Creek subbasin streambed channel was on the surface it was generally visible on aerial photos, indicating that existing shade levels are less than 25 percent. Inside the ravine, the stream channel was more difficult to observe. The riparian habitat appears good but the target shade percentage deemed necessary to maintain temperatures below 16$^{o}$C at this elevation ranges from 80 to 90 percent. Land use activities throughout this subbasin will preclude achieving good shade conditions. In particular, the residential and commercial development in the areas adjacent to the stream channels will continue to prohibit development of mature riparian vegetation capable of providing shade.

Overall, the riparian habitat in this stream does not meet any criteria of properly functioning. The lack of adequate riparian habitat is a limiting factor to natural salmonid production.

#### Large Woody Debris

No specific information on historic amounts of LWD was located during the investigation for this report. Based on channel type, it is assumed that laterally-stable moderate- to high-gradient contained reaches of the lower mile supported dense stands of conifer including Douglas-fir, western red cedar, and western hemlock. The riparian communities associated with unconfined

low- and moderate-gradient reaches upstream of the crest of the bluff probably had similar stands to those in the ravine.

No data was located that indicated the current condition of riparian zones with respect to organic matter and terrestrial insect recruitment. The lack of tall, mature trees is thought to effectively limit the supply of organic matter and terrestrial insects delivered to creeks in this subbasin.

Without exception, the potential for LWD recruitment in the low gradient reaches in this subbasin is poor. The stream reach in the ravine has better potential due to better riparian habitat but land use practices throughout the subbasin generally preclude any LWD recruitment.

## HYDROLOGY

Local flooding, undersized water conveyance systems associated with the streams in this subbasin, and impervious surfaces associated with single and multi-family residences are the primary contributors to high flows and large sediment loads throughout this subbasin (Heller 1987). Because of local channelization there is little opportunity to buffer peak flows in the lower reaches. Because the land is largely built out, current peak flows in this creek are likely to approximate future flows.

## SEDIMENT CONDITION

Impervious surfaces associated with single- and multi-family residences, commercial development, and the road infrastructure are the primary contributors to high flows and large sediment loads. Stream flows directed over the steep slopes in the western portion of this subbasin have caused excessive downcutting and created several ravines.

No quantitative information on substrate composition was found during the course of this investigation. Heller (1987) noted several instances where sedimentation problems associated with landslides resulted in poor water quality.

Because riparian communities in this subbasin are composed primarily of young trees, shrubs, exotic species (i.e.: reed canary grass along roadside ditches) and ornamental plantings none of the stream system is considered to have good bank stability.

## WATER QUALITY

Water quality is adversely impacted by the high percentage of impervious surfaces within the subbasin. The presence of domestic trash throughout the stream channel is both an aesthetic and water quality problem.

This creek does not appear on the 1998 Department of Ecology 303(d) water quality violations list for exceeding fecal coliforms.

## LAND USE

The land use within this subbasin is primarily single-family residences, followed by multi-family, commercial development, and schools and parks that have large tracts. It is expected that this land use pattern will continue, although there may be some conversion of single-family residences to multi-family residences.

## NON-NATIVE SPECIES

Reed canarygrass (*Phalaris arundinacea*) is found in localized areas along the stream throughout this subbasin. Other exotic plant communities in the riparian zone consist of Himalayan blackberries and willow species (*Salix spp.*), and numerous ornamental plantings associated with the private and public facilities.

## HYDROMODIFICATION

In general, it is likely that the historic vegetation communities in the Salmon Creek subbasin was similar to that elsewhere in the Puget Sound region. There are numerous small ponds and lakes in the upland areas that form the headwaters of the tributaries. Soils maps suggest there were also numerous wetlands in the upper Salmon Creek subbasin. A mixture of emergent wetlands probably characterized these areas or wet meadows intermixed with forested wetlands and uplands supporting Douglas-fir on the dryer sites. The canyon reach (RM 0.1 to RM 0.8) most likely supported a dense stand of conifers. Riparian vegetation communities would have been similar to that described for the middle Green River in the vicinity of Soos Creek.

No information was located during the course of this investigation that showed current vs. historic stream channel. However, given the extensive residential development and the presence reaches that are within culverts in this subbasin there is little doubt that the streambed has been relocated in some reaches.

Development throughout the Salmon Creek subbasin has had numerous impacts to channel conditions.

Approximately the first 400 feet of the lower reaches of the mainstem creek have been engineered and are channelized and rock lined in an effort to stabilize the streambanks and channel bottom. At several points, the stream is entirely within long stretches of culverts. Upstream of that point, the next approximate 1,500 feet are unmodified.

Heller (1987) noted at least four points where Salmon Creek or one of its tributaries entered pipes. The unnamed tributary 09.0362 from RM 0.0-0.15 has been straightened and channelized. An impassable barrier occurs in that same stream at RM 0.01.

The placement of the stream inside pipes in the central and northern portions of the basin have left no functioning riparian habitat. A sewer line has been placed in the remaining natural system in the lower 1/3 of the subbasin. Numerous single-family residences have been constructed on potential landslide terrain along the incised ravines of the lower one-third of the subbasin.

Localized flooding as a result of stream channel alterations and undersized water conveyance facilities were found to be problems in the subbasin.

Heller (1987) noted several concerns with erosion and landslides. These included tributaries 09.0362C and 09.0363 that had numerous locations where the channels were downcutting and flow associated landslides were present, and drainage from a roof that had apparently caused a landslide, which in turn endangered a private single-family residence.

Heller (1987) also noted the presence and accumulation of trash in the stream channel and ravines of this subbasin.

## MILLER CREEK (09.0371)

### PHYSICAL DESCRIPTION

#### STREAM COURSE AND MORPHOLOGY

The Miller Creek subbasin is located in southwest King County, with the eastern boundary formed by SeaTac Airport, the City of Normandy Park to the south, with the plateau edge above Seahurst and the hill line north of Arbor Lake forming the western and northern boundaries respectively. A complex system of at least 15 locally named and unnamed tributaries form the Miller Creek subbasin. The tributaries of the upper basin have their origins on a rolling till plateau with glacial outwash sediment partially filling broad swales from which small lakes, bogs and depressions serve as the origins for these tributaries. Arbor and Tubs (sometimes referred to as Bug Lake) Lakes form the headwaters of two of the tributary streams. The other tributaries are fed by Lake Burien, stormwater runoff, and groundwater seeps.

#### SALMONID USE

The known freshwater distribution of anadromous salmonids is depicted in Appendix B, Figures 1-6. In Miller Creek, there are annual observations for the last eight years of adult coho spawning, and one report from the 1980s of a single sockeye adult observed (WDFW Spawning Ground Survey Database).

### FACTORS OF DECLINE

#### FISH PASSAGE

An impassable cascade was identified at RM 1.0, an impassable fall at RM 1.9 and 2.5 by Williams (1975). A reconnaissance survey conducted by King County (Heller 1987a) did not identify any impassable barriers. Additionally, the SSHIAP database does not indicate that these barriers exist as of 1999.

## RIPARIAN CONDITION

Only limited information was located that described site-specific riparian conditions along mainstem Miller Creek. A functioning riparian habitat along this stream is limited to the stream reaches in the creek where it drops over the top of the bluff down a steep ravine. Even in this area, residential housing encroaches on the stream. Consisting of a deciduous-dominated second-growth forest with some conifers and a shrub understory, the riparian zone in this reach is "Fair" according to the criteria contained in the report Appendix.

The riparian habitat does not meet criteria of properly functioning. The lack of adequate riparian habitat is a limiting factor to natural salmonid production.

### Large Woody Debris

No specific information on historic amounts of LWD was located during the investigation for this report. Based on channel type, it is assumed that laterally-stable moderate to high gradient contained reaches of the lower mile supported dense stands of conifer including Douglas-fir, western red cedar, and western hemlock.

The potential for the natural recruitment of LWD throughout the Miller Creek subbasin is poor and land use activities effectively preclude the development of mature riparian stands.

No data was located that indicated the current condition of riparian zones with respect to organic matter and terrestrial insect recruitment. However, the lack of tall, mature trees is thought to effectively limit the supply of organic matter and terrestrial insects delivered to this subbasin.

## HYDROLOGY

Impervious surfaces associated with single and multi-family residences are the primary contributors to high flows and large sediment loads in the tributaries and mainstem of Miller Creek.

## SEDIMENT CONDITION

Outside of the ravine stream reach, the riparian communities along Miller Creek and its tributaries are composed primarily of young trees, shrubs, exotic species and ornamental plantings and none of the stream system is considered to have good bank stability.

Heller (1987a) noted landslides in the steep ravines of the lower basin as a significant problem that contributed silt and sediment to downstream reaches. Natural soil conditions in the ravine are likely promoting the landslides in this location that is then transported downstream by higher water events.

Heller (1987a) also noted significant sedimentation problems at the outlet to Tubs Lake, which was filled with sediment that reversed flow direction of roadway associated drainage ditches allowing runoff to discharge directly into the lake. He also found erosion problems associated with culverts and concrete-lined stream channel.

Impervious surfaces associated with single- and multi-family residences, commercial development and SeaTac Airport that reach 40 percent and are expected to be 50 percent when the land is fully built-out (Heller 1987a), are believed to be the primary contributors to high flows and large sediment loads in these creeks.

## WATER QUALITY

Water quality is adversely impacted by the high percentage of impervious surfaces within the subbasin. The presence of domestic trash throughout the stream channel is both an aesthetic and water quality problem.

Miller Creek does not appear on the 1998 Department of Ecology 303(d) water quality violations list.

## NON-NATIVE SPECIES

### Animals

No exotic aquatic animal species in the subbasin were identified during the course of this investigation.

### Plants

Reed canarygrass (*Phalaris arundinacea*) is found in localized reaches of stream channels throughout this subbasin. Other exotic plant communities in the riparian zone consist of Himalayan blackberries and willow species (*Salix spp.*), and numerous ornamental plantings associated with the residential communities.

## HYDROMODIFICATION

No information was located that described site specific historical riparian conditions along the mainstem Miller Creek or any of its tributaries. In general, it is likely that vegetation in the Miller Creek subbasin was similar to that elsewhere in the Puget Sound region. There are numerous wetlands, bogs, small ponds and lakes in the upland areas that form the headwaters of the tributaries. A mixture of emergent wetlands probably characterized these areas or wet meadows intermixed with forested wetlands and uplands supporting Douglas-fir on the dryer sites. Riparian vegetation communities would have been similar to that described for the middle Green River in the vicinity of Soos Creek.

Heller (1987a) was unable to locate any unaltered streams in this subbasin. With the headwaters of all seven main tributaries in pipelines or roadside ditches, and major stream reaches of all the tributaries and mainstem channelized or otherwise modified, these creeks have been altered from their natural state. The lower three miles of the mainstem Miller Creek have been straightened, have a streamside-associated sewer line, and all LWD removed.

As is the case in many urbanized stream setting, the filling of wetlands has reduced natural stormwater storage capabilities of the subbasin and the construction of single family residences

within the 100-year floodplain and associated flood control efforts has altered the stream channel in numerous locations. Because the land is largely built out, current peak flows in these creeks are likely to approximate future flows.

## DES MOINES CREEK (09.0377)

### PHYSICAL DESCRIPTION

#### STREAM COURSE AND MORPHOLOGY

Des Moines Creek drains an area of approximately 5.8 square miles of heavily urbanized lands. As is true with most independent tributary streams, Des Moines Creek originates from a diverse series of groundwater seeps on a plateau where it has a fairly low gradient. The creek drops through a steep canyon shortly prior to entering into Puget Sound.

Des Moines Creek has two major tributaries, two smaller tributaries and uncounted small diverse seeps. Inside the subbasin are also Bow Lake and the Northwest Ponds complex. The east fork (09.0377) has its origins from Bow Lake, while the west fork (09.0379) originates from the Northwest Ponds complex along the western edge of the Tyee Golf Course. Both forks merge on the grounds of the Tyee Golf Course. Both forks are fed by a combination of groundwater and surface runoff.

Previous studies (King County 1974 and 1987; METRO 1987 and 1989) conducted by King County have established that this subbasin has been severely degraded by urbanization. The habitat problems and processes identified in these studies include channel and bank erosion, degraded fisheries and flooding.

Stream habitats within Des Moines Creek have been surveyed and inventoried several times in recent years. The results of these studies are reported below.

#### SALMONID USE

The known freshwater distribution of anadromous salmonids is depicted in Appendix B, Figures 1-6. Juvenile coastal cutthroat trout, coho salmon and steelhead have all been recently observed in Des Moines Creek(King County 1997). Adult coastal cutthroat, coho and pink salmon have also been observed in Des Moines Creek (King County 1997). Juvenile hybrid rainbow/cutthroat trout have also been reported being captured in the creek.

### FACTORS OF DECLINE

#### FISH PASSAGE

There are several known and/or potential fish passage barriers in Des Moines Creek. Table Near-shore-1 gives barrier name, location and type.

At Marine View Drive, there is a 4 x 6 foot box culvert that at almost all flows presents a velocity barrier to adult salmonids. During low flows, the shallow water depth may also pose a barrier. Finally, the gradient within this culvert is steeper at the upper end than the lower, which allows the collection of sediments in the lower end.

**Table Nearshore-1. Fish Passage Barriers in the Des Moines Creek Subbasin.**

| Barrier Name | RM Location | Type/Comments |
|---|---|---|
| Marine View Drive Culvert | RM 0.4 | Velocity and water depth barrier at most flows |
| Midway Treatment Plant Log and Concrete Weirs | RM 0.9 | Partial barrier depending on stream flows |
| Tyee Golf Course Weirs | RM 2.1 | Complete barrier, three 3- to 4- foot-high weirs |

Source: King County 1997.

## RIPARIAN CONDITION

A functioning riparian habitat along this stream is virtually nonexistent. The headwaters of all the two major tributaries (East and West forks) and the two minor tributaries originate in heavily urbanized areas.

The East Fork Des Moines Creek originates from Bow Lake and for the first half mile of its existence flows through buried pipes and finally surfaces in the vicinity of 26$^{th}$ Avenue South. The West Fork originates from a regional stormwater detention facility called the Northwest Ponds complex in the vicinity of the Tyee Golf Course. SeaTac airport straddles the boundary between the two forks and contributes flows to both through a complex series of subsurface drainage pipes.

The first functional riparian habitat is encountered downstream of South 200$^{th}$ Street where Des Moines Creek passes through a large wetland with a developed riparian zone before the creek enters a ravine at RM 1.85. At this point, the creek is paralleled by a service road that contains a sewer district trunk line. In many places, the service road functions as the stream bank. Only downstream of the Midway Sewage Treatment plant does the creek again have a stream adjacent riparian zone that provides limited function. In the vicinity of Marine View Drive (RM 0.4) the creek enters a 225-foot-long box culvert before entering Beach Park. Two buildings in this park are built directly over the stream.

No data was located that indicated the current condition of riparian zones with respect to organic matter and terrestrial insect recruitment. However, the lack of tall, mature trees is thought to effectively limit the supply of organic matter and terrestrial insects delivered to this subbasin.

The riparian habitat present consists primarily of young red alder and few coniferous trees. Himalayan blackberry, salmonberry, vine maple and Indian plum are the dominant species that are found along the streambanks.

The riparian habitat does not meet any criteria of properly functioning. The lack of adequate riparian habitat is a limiting factor to natural salmonid production.

### Large Woody Debris

A 1993 survey (King County 1997) of LWD amounts identified only an average of seven to ten pieces per 100 yards. Most of the wood was described as small, located along the stream edge, or suspended over the channel. Debris complexes were described as “very limited” (King County 1997). Surveys conducted in 1986 and 1993 indicate that the amount of LWD may be decreasing (King County 1997).

The short- and long-term potential for LWD recruitment throughout the Des Moines Creek subbasin is poor, and land use activities effectively preclude the development of mature riparian stands.

## HYDROLOGY

The hydrology problems in the Des Moines Creek subbasin are a classic example of an area that historically was covered with coniferous and deciduous forests and then developed to permit the construction of cities and their associated infrastructure. The understanding of the importance of the need to control stormwater quantity and quality, and the importance of rainfall to base flows, has lagged behind the development and urbanization process in this subbasin.

This subbasin now has an impervious surface area of 35 percent. Impervious surfaces associated with single- and multi-family residences and SeaTac International Airport are the primary contributors to high flows and large sediment loads in these creeks. The existing stormwater retention and detention infrastructure is not sufficient to control the increased frequency and duration of storm event peak runoff flows into Des Moines Creek. These increased flood flows have resulted in channel erosion and the scour of spawning gravels with a resultant loss of spawning areas.

While impervious surface area is expected to increase by almost 58 percent the combined regional detention and water diversion recommendations contained in the Des Moines Creek Basin Plan (King County 1997) for flow control could be designed to reduce flood frequency through the diversion of flood lows associated with frequent but small flood events.

## SEDIMENT CONDITION

The degree of damage to hillslopes from past land use activities is significantly less in Des Moines Creek than many of the other Puget Sound independent tributaries in this chapter. This is primarily due to the stream’s geologic origin and history. While most stream systems are formed in advance glacial outwash deposits, Des Moines Creek was formed largely in recessional glacial outwash formations. As a result, erosion (and especially hillslope erosion from increased storm-water flows) has resulted in some loss of the overlying soil layers, but the catastrophic downcutting seen in many other systems is not evident here.

That is not to say that there are not problem areas in Des Moines Creek. Three hillside failures are present just upstream of road fill of Des Moines Memorial Way (between RM 0.45 and 0.55). During the February 1996 storm, debris flows from these bank failures carried substantial amounts of sediments several hundred feet downstream.

There is also evidence of hillslope erosion sites that appear to be the result of road end stormwater discharges. The largest known of these sites is the expansion of the natural channel at RM 1.35 where additional runoff from 18th Avenue South enters the creek. Thirteen bank erosion or slope failure problems were identified during a 1993 habitat survey (King County 1997).

Two conditions that adversely effect stream channel condition: the confinement of the original stream floodplain by fill that surrounds a sewer trunk line and the access road exacerbate channel conditions in this ravine. This creates a situation where storm flows scour stream sediments down to rock and clay deposits that while relatively stable, little or no suitable pools are available that would allow for salmonid rearing. Of the 133 residual pool depths identified during a 1993 stream habitat inventory, the median pool depth was 0.9 feet and the substrate consisted mostly of 15 to 80 mm sands and gravels.

Outside of the ravine, the stream channel conditions can be summarized as composed of low-gradient riffles with a few lateral scour pools and shallow pools. Sediments varies from silt and sands to small gravels, boulders and large areas of exposed clay (the later two found primarily in the incised ravine).

## WATER QUALITY

The quality of water in Des Moines Creek is also directly linked to the land use activities in the subbasin. Because of the urbanization throughout the subbasin, the nonpoint source pollution from anthropogenic activities is the primary source of pollutants entering the creek.

Des Moines Creek appears on the EPA 1998 303(d) list for fecal coliform violations. The source of the elevated levels of fecal coliforms may come from failing septic systems, leaking sewer lines, illicit sewer connections, birds (geese) residing on the Tyee Golf Course, domestic animals or some combination of any of the previous examples. The presence of elevated fecal coliform levels is in itself not necessarily detrimental to salmonid production, but may be an indicator of other urbanization-associated problems.

Water quality problems that have been identified in the Des Moines Creek subbasin include the following:

- Previous studies have indicated that the Tyee Golf Course may be contributing excess phosphorus and nitrogen to the creek.
- Turbidity and suspended solids concentrations increase substantially during storm events. Some likely sources include surface runoff, streambank erosion and streambank failure. The increase in concentrations also suggest high levels of gravel scour and deposition of fines.
- Stream water temperatures exceed the optimal upper temperature limit of 14$^{o}$C for salmonids. They also exceeded the current Washington State standard of 22$^{o}$C on numerous occasions from April through September 1996. However, they did not reach the lethal limit of 22$^{o}$C. during that same time period.

- Dissolved oxygen (DO) concentrations are directly linked to stream water temperature (Boyle's Law) and they fell as low as 2 mg/L in the West Fork and typically to 7 mg/L in the East Fork (measured upstream of the Tyee Golf Course weir). While DO levels recovered before the waters reached the salmonid fish zone they are of concern.

It should be noted that both the Port of Seattle (SeaTac Airport) and the City of Des Moines have ongoing water quality monitoring programs in Des Moines Creek or stormwater outfalls into the creek.

## LAND USE

The effects of urbanization that have occurred on the natural and historic riparian habitats in Des Moines Creek are as profound as anywhere in the urbanized Puget Sound ecoregion. Approximately 35 percent of the subbasin is currently covered with impervious surfaces (King County 1997). This in turn causes elevated flow levels following storm events, accelerated rates or streambed erosion and sedimentation, aquatic habitat degradation and elevated pollutant levels. Under future conditions, it is estimated that 46 percent of this subbasin will be covered by impervious surfaces.

## NON-NATIVE SPECIES

### Animals

The only non-native fish species identified in this subbasin are pumpkinseed sunfish. The likely source of these fish is Bow Lake and/or the Tyee Golf Course Ponds. No other non-native aquatic animal species in the subbasin were identified during the course of this investigation.

### Plants

Reed canarygrass (*Phalaris arundinacea*) is abundant throughout this subbasin. Other exotic plant communities in the riparian zone consist of Himalayan blackberries and willow species (*Salix spp.*), and numerous ornamental plantings associated with the residential communities.

## HYDROMODIFICATION

No information was located during the course of this investigation that showed current vs. historic stream channel. However, given the extensive residential and commercial development and the presence of regional stormwater detention facilities, several thousand of feet of pipes and culverts in this subbasin there is little doubt that the streambed has been relocated in some reaches.

## FAUNTLEROY CREEK (09.0361)

### PHYSICAL DESCRIPTION

#### STREAM COURSE AND MORPHOLOGY

With a drainage basin of approximately 98 acres, Fauntleroy Creek is a small independent tributary stream to Puget Sound. It is bounded by Williams and Brace Points and enters Puget Sound in the vicinity of the Vashon-Fauntleroy Ferry Dock. Similar to many of these small independent creeks, Fauntleroy Creek originates from a diverse series of groundwater seeps and bogs on the plateau, most of which are in or adjacent to Fauntleroy Park. With six small low-gradient tributaries, the creek traverses the plateau before it drops through a steep canyon, losing approximately 300 feet in elevation shortly prior to entering into Puget Sound in Fauntleroy Cove.

#### SALMONID USE

The known freshwater distribution of anadromous salmonids is depicted in Appendix B, Figures 1-6. Juvenile and adult coho salmon have been observed to spawn and rear respectively in Fauntleroy Creek (Seattle, In Progress). No information was obtained that indicates utilization by other salmonid species.

### FACTORS OF DECLINE

#### FISH PASSAGE

There are several known and/or potential fish passage barriers throughout Fauntleroy Creek. A partial barrier exists at the edge of tidewater where the creek flows over a rock revetment that requires anadromous fish to jump at least one foot. A series of 6- to 12-inch anthropogenic weirs in the lower reach may also be partial barriers. At approximately RM 0.2, there is a 14-inch cascade that is a barrier to all anadromous salmonids. Approximately 410 feet upstream of this initial barrier is a 2-foot-high, 3-square box structure with a sheer water drop of six feet that is also a barrier.

#### RIPARIAN CONDITION

The effects of urbanization that have occurred on the natural and historic riparian habitats in Fauntleroy are profound. A comprehensive inventory of riparian habitats is currently not available. However, the Fauntleroy Watershed Plan (Seattle, In Progress) does provide some preliminary insight into the condition of the riparian zone of Fauntleroy Creek. That work breaks the creek into the following critical stream reaches:

- Tidewater to Initial Fishway;
- Initial Fishway to 45$^{th}$ Ave S.W.;
- 45$^{th}$ Ave. S.W. to Kilbourne Park; and
- Kilbourne Park to Fauntleroy Park.

Each reach is assessed for riparian habitat. Reaches 1 and 3 were determined to NOT have adequate vegetation in the riparian zone. The native vegetation in Reach 2 was assessed as good to excellent. Reach 4 was assessed as a mixture of good to excellent native vegetation in the lower portion, while the upper portion was dominated by non-native and invasive species. The riparian habitat present consists primarily of young-to-maturing red alders and few coniferous trees. In Reach 1, property owners have expressed concern that any vegetation not block their views. Of the native plants found in the shrub canopy zone, salmonberry, vine maple, stink current, hazelnut, oceanspray, twinberry, red huckleberry, osoberry and Indian plum are the dominant species that are found along the streambanks. Numerous non-native species are found throughout the stream reaches (see Non-Native Species, below).

No data was located that indicated the current condition of riparian zones with respect to organic matter and terrestrial insect recruitment. However, Seattle (In Progress) did note pollution-intolerant (Class 1) macroinvertebrates were present in all four reaches. However, while the macroinvertebrates are present, they do not appear to be in sufficient numbers to support populations of salmonid fry (Seattle, In Progress). The lack of tall, mature trees is thought to effectively limit the supply of organic matter and terrestrial insects delivered to this subbasin.

The riparian habitat does not meet any criteria of properly functioning. The lack of adequate riparian habitat is a limiting factor to natural salmonid production.

### Large Woody Debris

LWD amounts have not been completely surveyed, but Seattle (In Progress) noted that LWD was “sparse” throughout the stream. The short- and long-term potential for LWD recruitment throughout Fauntleroy Creek is poor, and land use activities effectively preclude the development of mature riparian stands.

## HYDROLOGY

Kendra (1989) measured seasonal flows in June and August of 1988 at several locations throughout the stream. Flow was 0.1 cfs downstream of the headwater tributaries and 0.3 to 0.4 cfs at the three downstream sampling sites. Seattle (In Progress) stated that many of the current culverts are significantly undersized for the conveyance of current flood flows.

The hydrology problems in the Fauntleroy Creek are a classic example of an area that was historically covered with coniferous and deciduous forests, then developed to construct city infrastructure, As a result, a significant portion of the land in the subbasin becomes covered with effective impervious surface areas.

## SEDIMENT CONDITION

Streambanks in most instances appear stable, with some streambed incision noted in a few reaches. There is also evidence of hillslope erosion sites in the ravine.

Confinement of the original stream floodplain by channelized stream reaches, roads, and road crossings create storm flows that scour stream sediments, causing sedimentation in downstream

reaches and embedded gravels. Many of the pools associated with fishways in the lower reaches routinely fill with sediments and their usefulness as fishways is diminished or lost.

## WATER QUALITY

The quality of water in Fauntleroy Creek is also directly linked to the land use activities in the subbasin. Because of the urbanization throughout the subbasin, the nonpoint source pollution from anthropogenic activities is the primary source of pollutants entering the creek. Water quality is adversely impacted by the high percentage of impervious surfaces within the subbasin and the presence of domestic trash throughout the stream channel is both an aesthetic and water quality problem.

Fauntleroy Creek appears on the EPA 1998 303(d) list for fecal coliform violations. The source of the elevated levels of fecal coliforms may come from failing septic systems, leaking sewer lines, illicit sewer connections, birds (geese) residing Fauntleroy Park, domestic animals or some combination of any of the previous examples. METRO (1988) examined fecal contamination in Fauntleroy Creek and found higher levels in summer than those in winter. The presence of elevated fecal coliform levels is in itself not necessarily detrimental to salmonid production, but may be an indicator of other urbanization-associated problems.

Kendra (1989) examined water quality in Fauntleroy Creek and found relatively uniform results from the headwaters to the mouth for temperature, pH, conductivity, dissolved oxygen, phosphorus and total suspended solids. The sample results did not indicate any concerns that may impact salmonids.

## LAND USE

Impervious surfaces associated with single- and multi-family residences are the primary contributors to high flows and large sediment loads in these creeks. While no information was located that provided the amount of effective impervious surface area in the basin, based on adjacent subbasins it is expected to exceed 20 percent.

### Non-Native Species

#### Animals

There were no reports of exotic fish species identified in this subbasin during the course of this investigation.

#### Plants

Reed canarygrass (*Phalaris arundinacea*) is abundant throughout this subbasin. Other exotic plant communities in the riparian zone consist of Himalayan blackberries, English laurel, English ivy, English holly, clematis, polygonum, morning glory, nightshade, and giant hogweed along with numerous ornamental plantings associated with the residential communities.

No information was located during the course of this investigation that showed current vs. historic stream channel. However, given the extensive residential and commercial development along with at least five road crossings, several hundred feet of channelized streambank and several hundred feet of pipes and culverts in this subbasin there is little doubt that the streambed has been relocated in some reaches.

### HYDROMODIFICATION

In all four reaches, various distances of Fauntleroy Creek were contained in culverts, channelized though property right-of-ways and along roads.

### KEY FINDINGS AND HABITAT-LIMITING FACTORS

- There is currently only very limited utilization by anadromous salmonids in these streams.
- The impervious surface area of many of these subbasins is expected to range from 15 to 58 percent in the near future.
- Current and future development is (and will likely continue) generating increased stream flows, channel instability problems, excessive sediment loadings, instream and riparian habitat degradation.
- Wetlands played an important function in maintaining streamflows in many of these small streams. Many of these wetlands have been partly or completely eliminated, and the remaining wetlands are continuing to be degraded.
- Water quality is adversely impacted by the high percentage of impervious surfaces within these subbasins, and the presence of domestic trash throughout the stream channels is both an aesthetic and water quality problem.
- LWD is absent or deficient throughout these streams. Current land use activities effectively preclude any short- or long-term recruitment of LWD into most of these streams. The only passive source of LWD recruitment potential is generally in the stream reaches that cascade down the bluffline.
- Known and suspected anthropogenic barriers limit access to spawning and rearing habitat.
- Both the quality and quantity of gravels in the streams limit spawning success and, to a lesser degree, juvenile rearing habitat.
- Flood flows due to increased impervious surfaces adversely impact successful salmonid incubation.
- Riparian habitats are degraded and in poor condition.
- Generally, habitat trends are showing strong indications of a downward trend.

### DATA GAPS

- Comprehensive barrier surveys in this group of subbasins need to be initiated and/or updated.
- Comprehensive baseline riparian habitat surveys should be initiated.
- Aquatic invertebrate populations should be monitored.
- An inventory of LWD should be initiated.
- The level and impacts to salmonids from contaminated surface water is unknown.

## LIST OF TABLES