

2.6 MORSE CREEK (WRIA #18-0185)

2.6.1 Geography

Morse Creek is the largest of the independent drainages to salt water between the Dungeness and Elwha rivers, entering the Strait of Juan de Fuca approximately two miles east of Port Angeles. The stream extends 16.3 miles from its headwaters in the Olympic National Park and is the easternmost watershed of East WRIA 18. Its moderate watershed (52.7+ mi²)¹ drains steep headwaters, including Hurricane Ridge, Mount Angeles, and Deer Park. Natural falls at RM 4.9² divide the watershed, posing an impassable barrier to anadromous fish (Haring 1999). The major stream crossings occur at RM 2.1 where a bridge spans the stream at 4 Seasons Park, RM 1.2, where Highway 101 spans the creek, at RM 1.0, where an old railroad trestle crosses, and at the 4 Seasons Ranch bridge at RM 0.5.

The watershed's upper boundaries lie at elevations exceeding 6000 feet, well above timberline (Perry 2001). The southern, high-elevation bounding divide is primarily defined by Hurricane Ridge. North-trending tributary valleys extend from this highland divide, typically glacial, stepped valleys with very steep north-facing headwall slopes. These steep north-facing slopes lie in daylong shade most of the year and may not become snow-free until late summer to mid-fall (Perry 2001).

The upper reaches of Morse Creek are steep and confined, flowing through forested and alpine meadow vegetation. The middle reaches below the National Park boundary at RM 9 flow through heavily forested foothills, passing through moderately incised canyons with a number of falls and cascades. Although Morse Creek continues to be confined in a ravine-like canyon through large portions of its lower reach, between RM 3 and RM 1 flat bottomland occurs along the creek. Below approximately RM 1.7, the valley broadens into a relatively wide floodplain. The lowest, coastal subwatershed has a channel gradient ranging from 1% at the mouth to 4% at Four Seasons Park. The gradient increases to 6% at the upstream extent of the subwatershed, at the Mining Creek confluence with Morse Creek, with short stretches of 10 to 12% gradient. The average gradient for the entire length of Morse Creek is greater than 6% (Ecology 1983).

Major Subbasins, Tributaries and Stream Reaches

Upper Morse Creek above Diversion

Morse Creek is diverted at RM 7.2 for hydroelectric generation. Much of upper Morse Creek above the diversion lies within the Olympic National Park, entering the Park at RM 9. This reach of Morse Creek is in generally excellent, near-pristine condition (Haring 1999).

¹The City of Port Angeles FERC application gives the watershed area as 46 mi² above the diversion at RM 7.2. Perry (*draft* 2001) describes the upland and highland areas as totaling 46.6 mi². WDOE (1983) gives the total drainage area as 57 mi².

²The FERC application notes that anadromous fish are limited to reaches below impassable falls at RM 5.5. An IFG conducted for the application and the Order issued by FERC all reference a 0.5 mile reach of stream affected *above* the powerhouse at RM 5.0, yet the LFA places the falls at RM 4.9.

Morse Creek between Diversion and Falls

Diverted flows are routed to a powerhouse at RM 5.0 and returned to the creek approximately ½ mile below the falls. Morse Creek extends 11.4 miles above its falls and, other than flow reductions in the 2.2 miles of creek affected by hydro operations, this reach is also considered of high quality (Goin pers. comm. 2001).

Lower Morse Creek between the falls and Four Season Park

Lower Morse Creek above Four Seasons Park, from about RM 3.0 to the falls is in fair condition, but is severely lacking in LWD. This lack of LWD reduces the number and depth of pools and decreases the stability of spawning habitat. Occasional deep pools have formed in association with boulder/bedrock bed control. A 40:60 pool:riffle ratio provides a good habitat mixture. Riffle areas provide well-sorted, unarmored gravels for salmonid spawning. Streamside vegetation provides abundant shading and a source of large woody debris (Economic and Engineering Services, Inc. 1996).

Lower Morse Creek between the Four Season Park and the mouth

The lower 2.5 miles of Morse Creek are heavily affected by land development, including Four Seasons Park and Four Seasons Ranch, a major development on the estuary; channelization; road crossings and other floodplain constrictions; and vegetation removal. The entire reach is diked, armored, and isolated by restrictive culverts from its small hillside drainages and tributaries. It provides poor fish habitat and no suitable spawning gravels.

2.6.2 Climate

Perry (2001) reports average annual precipitation for Morse Creek to be 58.0 inches, with the highland areas receiving 63.0 inches per year and the uplands 42.5 inches. In the lowlands, Perry reports 28.5 inches per year average annual precipitation.

2.6.3 Geology

The Olympics are composed mainly of basalt and sedimentary rocks formed from sediments deposited from ancient oceans (CDC 1995). Glaciers have been the primary sculptors of the mountains, foothills, and coastal lowlands (CDC 1995), including the Morse Creek watershed. The upper watershed of Morse Creek is composed of basalt, which with time alters the pH of the water (McHenry 2000).

In Clallam County, geologic hazards include areas subject to flooding, landslides, erosion and seismic hazards, or earthquakes (CDC 1995). Geologic evidence suggests that at least six subduction earthquakes (magnitude 8 or greater) have occurred on the Olympic Peninsula (Atwater, 1987, as quoted by McHenry et al. 1996). One of these earthquakes is likely to have caused uplift at RM 4.9, creating the falls and imposing a barrier to fish passage. Geologic maps developed by Tabor and Cady (1978) indicate the presence of three separate faults oriented perpendicular to Morse Creek stream flow.

Small boulders and large gravel dominate the substrate in the steep upper reaches. The lower reaches are generally flatter, and the floodplain and substrate are dominated by silted large gravel, small boulder, cobble and pebble (Orth 1983).

2.6.4 Soils

The USDA Soil Conservation Service *Soil Survey of Clallam County, Washington* (SCS 1987) characterizes the soils of Morse Creek. The SCS describes 11 soil units for Clallam County, three of which are found in the Morse Creek watershed.

The soils of the high Morse Creek watershed (above the City of Port Angeles diversion) and headwaters of its western tributaries are Terbies-Louella, which are deep to very deep and well-drained on moderately to extremely steep slopes and mountain sides. These are gravelly loams and very gravelly silt loams. They have a high erosion potential due to the large amount of precipitation common to the area and the steepness of the slopes. Disturbance, such as logging and development, can greatly increase the chances of slides. The SCS found these soils suitable for forest land but not most other uses, due to steep slopes.

Much of the watershed contains Elwha-Clallam-Catla soils. These are shallow to moderately deep soils, moderately well-drained on nearly level to extremely steep slopes and hills. This soil unit is generally found on slopes up to 35 percent, however much of Morse Creek is mapped in gravelly to very gravelly silt loams that are found on slopes to 65 and 70 percent. The SCS (1987) considers this soil suitable for development only with caution as to construction techniques and septic design.

In the lower two miles the river cuts through a mix of Carlsborg gravelly sandy loam and Dungeness silt loam. Carlsborg-Dungeness soils are very deep and range from poorly drained to excessively drained. They occur on nearly level and gently sloping topography, terraces, floodplains, and alluvial fans (SCS 1987).

2.6.5 Hydrology and Geohydrology

Hydrology

Morse Creek is classified as a fourth order stream. Its major tributaries are Mining Creek, Frog Creek, Lake Creek (confluence at RM 7.5, drainage area 7.45 mi²) and Maiden Creek (confluence at RM 10.5, drainage area 22.0 mi²).³ Like other watersheds on the North Olympic Peninsula that accumulate significant snowpack, Morse Creek exhibits two peaks in annual discharge (one associated with winter rainstorms and the other resulting from spring snowmelt) (Haring 1999).

Perry (2001) defines four subwatersheds (Figure 2.6-1 and Table 2.6-1). Perry states that the largest contributor to flow is an extensive highland subwatershed (35.38 mi²), which includes Lake and Rocky creeks, the Morse Creek-Cox Valley basin and Maiden Creek basin. Perry also defines a “somewhat extensive” upland subwatershed (11.22 mi²) which includes Surveyor Creek, a tributary not recognized by Haring (see footnote 4). Below the Surveyor Creek confluence, Perry noted a “large” lowland subwatershed (6.05 mi²) which includes the drainages of Frog and Mining creeks. Below its confluence with Mining Creek, an “elongate coastal subwatershed” continues to the Strait (no area given by Perry).

³Perry (*draft* 2001) provides the most comprehensive list of tributaries. WDOE (1983) is the source for the tributary drainage areas. Others list Surveyor Creek as a tributary, but this appears to be equivalent to upper Morse Creek.

The smallest of the North Olympic Peninsula's bimodal peak flow streams or "snow streams", Morse Creek's flows are "primarily developed" in its highland subwatershed. The creek's lower subwatersheds do not develop bimodal peak flows and generally contribute peak flow developed in response to winter precipitation maxima. (Some small portions of the upland subwatershed, e.g., on the flanks of Burnt Mountain, have highland characteristics and contribute limited snowmelt runoff.) Perry finds the lowland subwatershed, although of moderate size, to have a poorly developed drainage network. For that reason, the lowland drainage area contributes relatively little flow, and coastal lowland has "virtually no drainage network" and produces little inflow to Morse Creek (Perry 2001).

Table 2.6-1. Morse Creek Watershed Areas

Highland and upland watershed	46.6 sq. miles
Surveyor Creek highland and upland	2.392 sq. miles
Morse Creek lowland subwatershed	6.055 sq. miles
Morse Creek coastal lowland sub-watershed	1.68 sq. miles
Total Area of Watershed	56.73 square miles

Source: Perry 2001.

Perry determined the flow of Morse Creek at two locations, each at the foot of major subwatersheds. The first, just below the confluence with Surveyor Creek, includes flow developed in both the upland and highland subwatersheds. The second, below the confluence with Mining Creek, adds the inflow developed in the lowland subwatershed. Perry estimated streamflow using the watershed characteristics method. Perry's "unrestricted synthetic record" of Morse Creek flow for these two locations for the period October 1952 through September 1976 are reported in appendices.

Perry's synthetic records were constructed using statistical techniques based on 10 years of monitoring data (July 1966 to September 1976) at a single USGS gage (No. 12047300) located on Morse Creek at RM 6.4, corresponding with the foot of Perry's upland and highlands watersheds (drainage area above the gage is 46.6 mi² according to WDOE 1983). WDOE (1983) correlated flows at this gage to a site at the Highway 101 bridge (RM 1.1), however it is not clear what, if any, flow measurements were obtained at that location. Perry also gathered miscellaneous peak flow records for 1967-1979 and miscellaneous flow measurements taken from 1899 to 1961 (Appendix 3, Perry 2001).

The USGS gage, from which the bulk of instream flow records for Morse Creek are available, is located below the City of Port Angeles diversion structure and thus reflects post-diversion flows. The LFA (1983), adjusted for the diversion using the City's records, to calculate an average discharge of 134 cfs for Morse Creek at the gage over the period of record. WDOE reports the maximum instantaneous recorded flow at the gage was 3,160 cfs on December 5, 1975 and the minimum was 5 cfs (not adjusted for diversion) on October 8 and October 13, 1966. WDOE's calculated mean monthly flows and lowest mean monthly flows for the period of record are shown in Table 2.6-2 (both adjusted for City diversions).

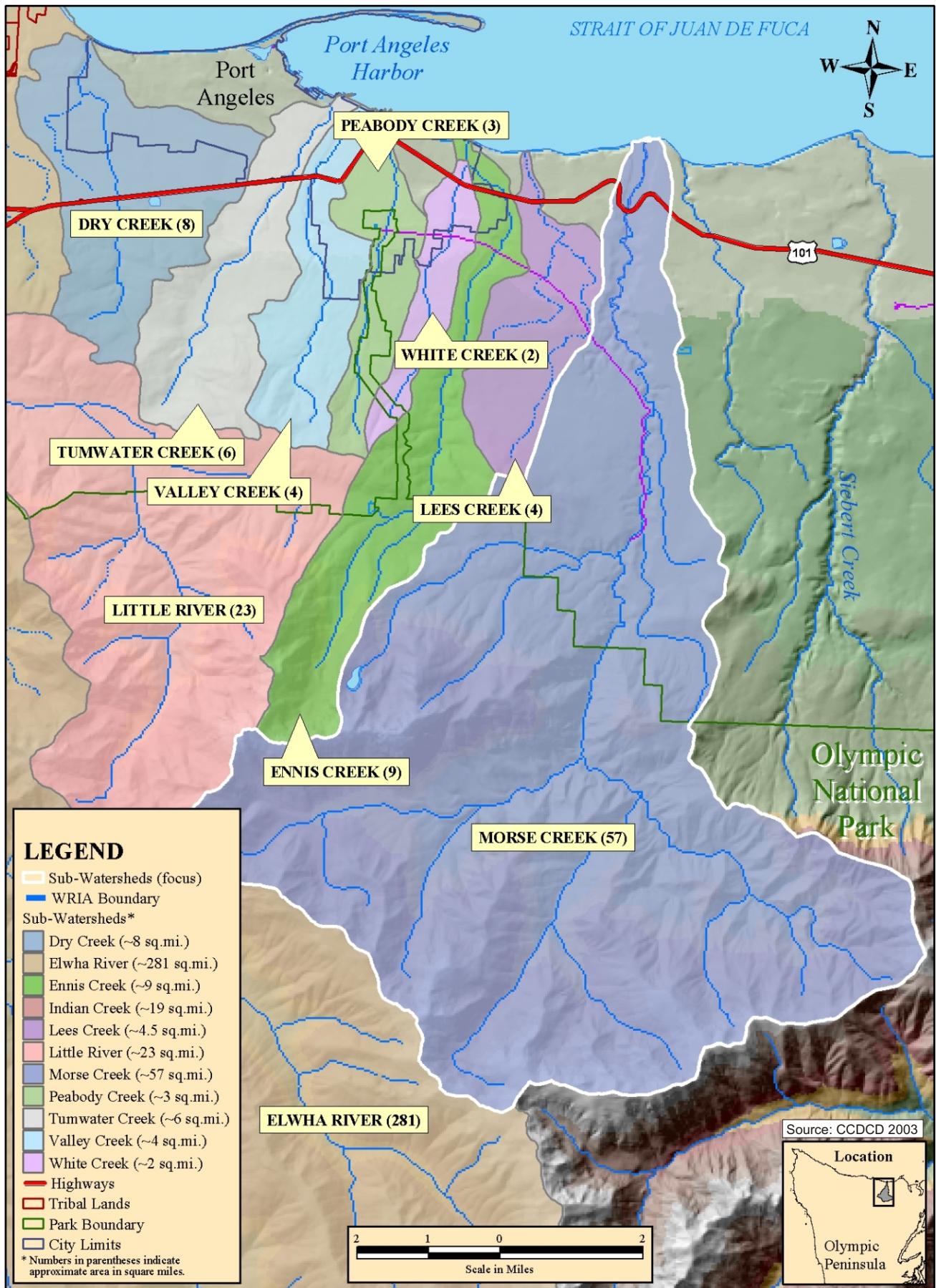


Figure 2.6-1. Morse Creek Area Map.

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**Table 2.6-2. Mean Monthly Flows for Morse Creek at Gage No. 12047300
(RM 6.4, adjusted for City of Port Angeles diversions)**

Month	Adjusted Mean Flow (cfs)	Adjusted Lowest Mean Monthly Flow (cfs)
January	214.2	114.9
February	153.6	78.2
March	144.2	67.9
April	102.6	57.0
May	174.7	116.7
June	199.4	105.1
July	115.4	62.2
August	62.1	37.9
September	42.2	27.4
October	64.3	30.3
November	120.9	66.6
December	201.0	109.8

Source: WDOE (1983)

WDOE noted that Morse Creek flows follow the typical pattern of declining to an annual low during late summer or early fall. Average daily flows have commonly been below 25 cfs during September and October, and less frequently in August or November. Table 2.6-3 shows the percent of days with flows below 10, 15, 20 and 25 cfs for the ten-year period of record.

**Table 2.6-3. Percent of Days Below Level Stated Morse Creek Flows
At Gage No. 12047300 (RM 6.4)**

Month	25 cfs	20 cfs	15 cfs	10 cfs
August	4.2%	0%	0%	0%
September	16.0%	5.0%	0%	0%
October	24.5%	Note 1	5.2%	2.3%
November	4.0%	0%	0%	0%

Note 1: Error in data as reported. Likely value is 7 percent.

Source: Ecology 1983.

Perry's exceedance curves for the combined upland/highland subwatershed are shown in Figure 2.6-2. Winter flows at this location peak at 420 cfs in January, and spring flow peaks in May and June reach 295 cfs. September-November low flows are in the 25 to 30 cfs range, and in August the lowest flow is 41 cfs.

At the lowland location, Perry's exceedance flows are shown in Figure 2.6-3. This location includes all accruals from the higher watersheds and, because the coastal subwatershed contributes so little flow, Perry believes that this flow is essentially equivalent to flow at the mouth of Morse Creek. Because the contribution from the lowland subwatershed is minor,

flow patterns, peaks and lows are little changed from that noted further upstream (the January peak is 438 cfs; the fall low remains ca. 25 cfs. Ecology (1983) calculated that annual runoff between the USGS gage at RM 6.4 and the Highway 101 bridge – essentially Perry’s lowland subwatershed – contributes an additional 11.1 percent to the total discharge measured at the gage. Thus, the 134 cfs estimated average annual flow for Morse Creek would be adjusted to roughly 149 cfs at the bottom of the lowland subwatershed.

The City of Port Angeles Application for License for a Minor Water Power Project on Morse Creek includes a table of Morse Creek weekly flow data at the 10, 20, 50 and 90 percent exceedance levels, but does not identify the period of record to which it refers. The table shows flows peaking in late January, a second smaller peak in mid-March, and a third time in late May-early June. At the 50 percent level, winter flows reach 350 cfs briefly; early spring flows reach 163 cfs, and late spring flows reach 218 cfs. Flow curves (50 percent exceedance) drop as low as 108 cfs in late February-early March, 87 cfs in late April, and 38 cfs for an extended period in late September-early October. The peak flow at 10 exceedance occurred in mid-January at 932 cfs, and the lowest flow at the 90-exceedance level was 26 cfs in late September. Based on this information, Perry calculated flow durations curves for Morse Creek near Port Angeles (Figure 2.6-4).

In its August 1999 application to surrender its FERC license, the City characterizes flows at the project’s diversion dam as ranging from a low of 5 cfs in October to a peak of 370 cfs in December (City of Port Angeles 1999). Flows at that location averaged 120 cfs. A City record of Morse Creek flows, measured at a point just above (before) the diversion, was researched by Eloise Kailin, yielding the following incidence of flows less than 7 cfs:

- 1989: 22 days, September 7 through November 15
- 1990: 6 days, September 14 through October 23
- 1991: 22 days, September 3 through October 23
- 1992: 20 days, September 1 through October 21

Elsewhere in the literature, average annual flows are reported by the Puget Sound Cooperative River Basin Team (1993) and City of Port Angeles (1996). The two agree fairly well. PSCRBT reports annual flows in Morse Creek average 125 cfs, with two-year flood flow and base low flows between 8 and 15 cfs (PSCRBT 1993). The City reports an average flow discharge of 130 cfs, with normal low flow of 10-15 cfs (City of Port Angeles 1996). Note that the low flows are well below those constructed by Perry.

Geohydrology

Perry (*draft* 2001) states that an alluvial aquifer composed of valley-fill alluvium is found in association with Morse Creek in its coastal subwatershed. He states that water in this aquifer is in hydraulic connection with the stream and probably comes from the stream.

Information on groundwater is contained in the Puget Sound Cooperative River Basin Team report, *Port Angeles Regional Watershed* (PSCRBT 1993). According to this document, groundwater regions that may interact with Morse Creek include those numbered 4 (Deer Park Road), 5 (Lees Creek), and 6 (Mount Pleasant Road).

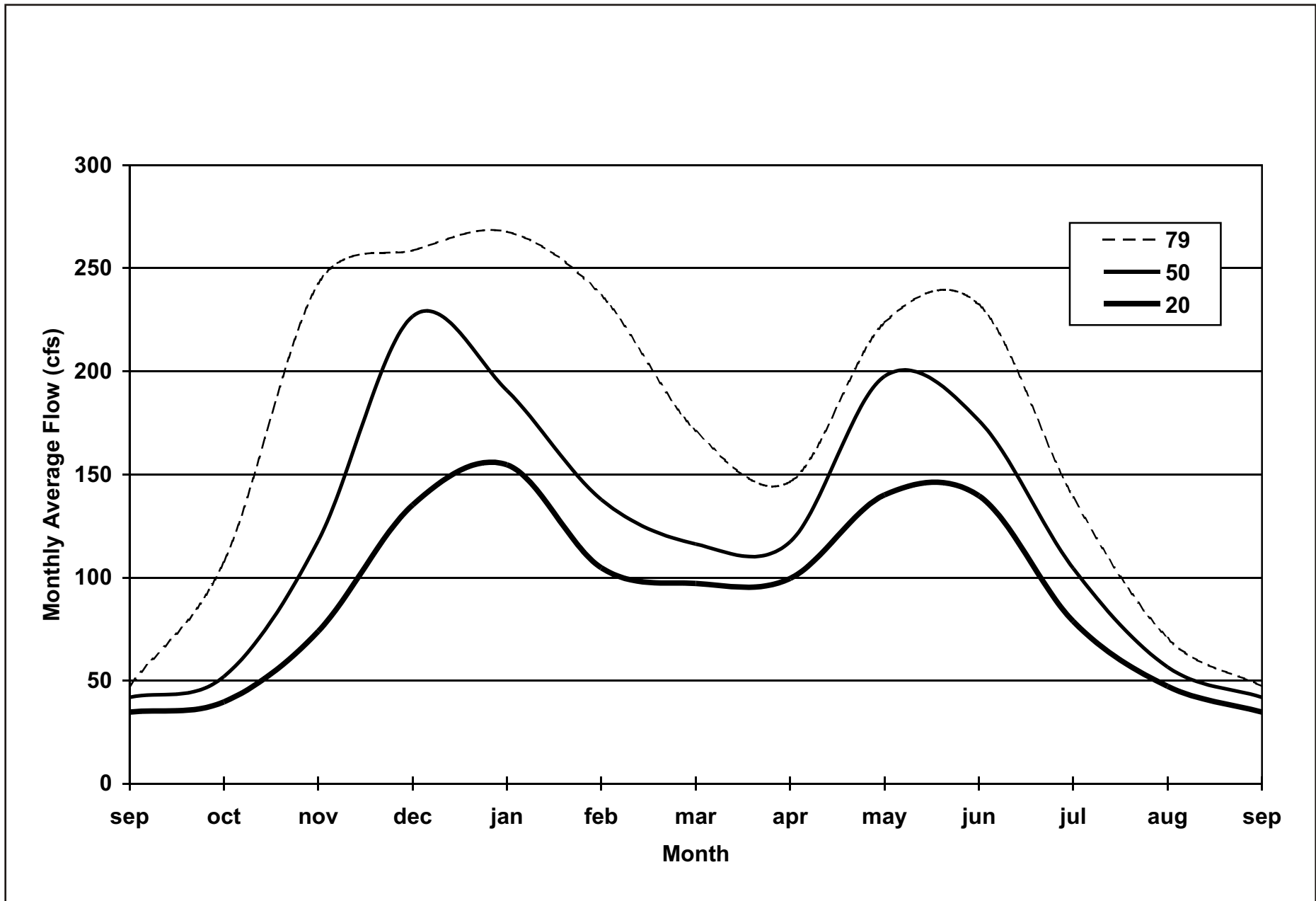


Figure 2.6-2. Morse Creek between Mining Creek 1952-76 (upland subwatershed). Recent data indicate flows are overestimated. Exceedance Flow Duration Curves at less than or equal to 79, 50, and 20 percent.

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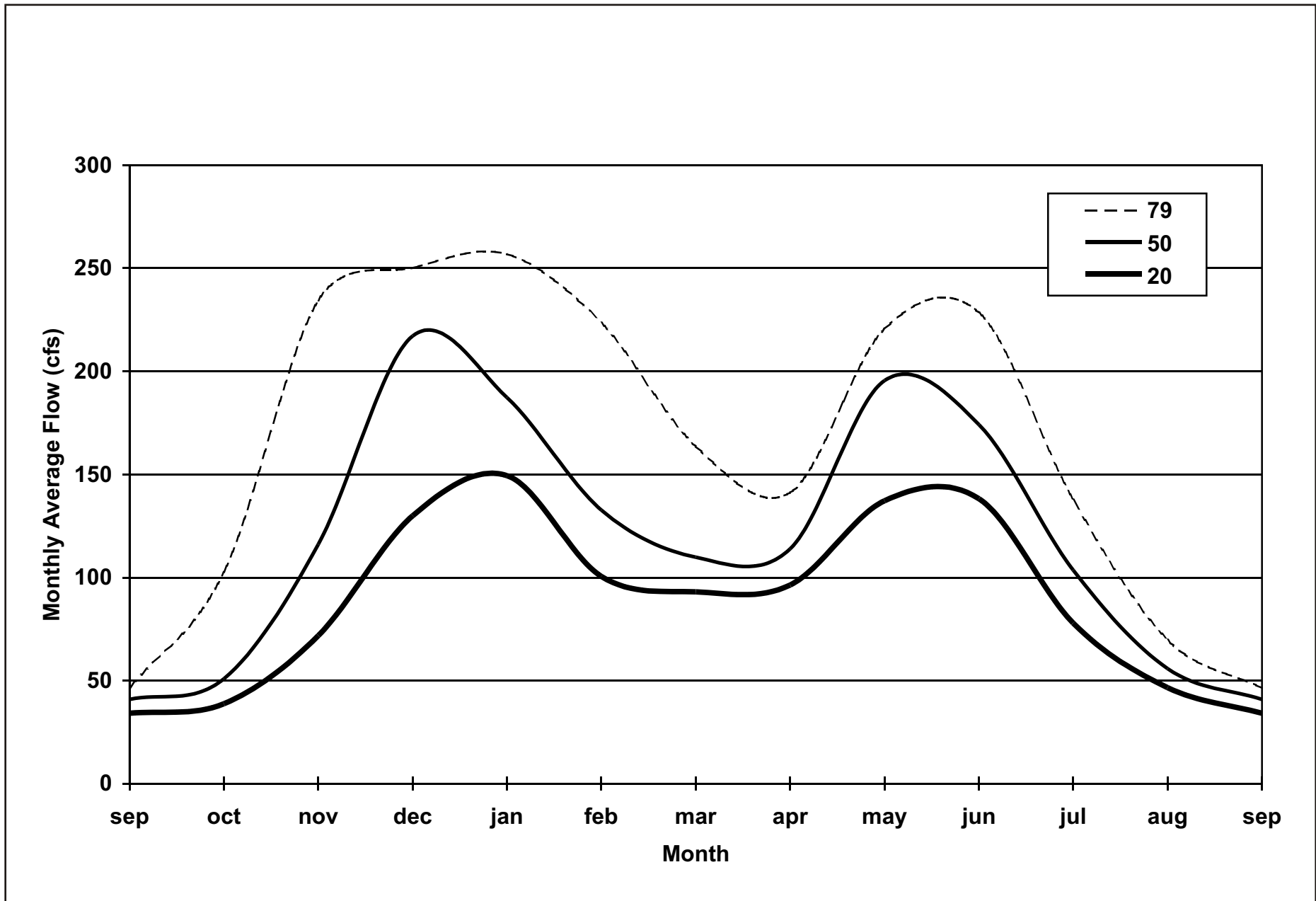


Figure 2.6-3. Morse Creek between Surveyor Creek 1952-76 (lowland subwatershed). Recent data indicate flows are overestimated. Exceedance Flow Duration Curves at less than or equal to 79, 50, and 20 percent.

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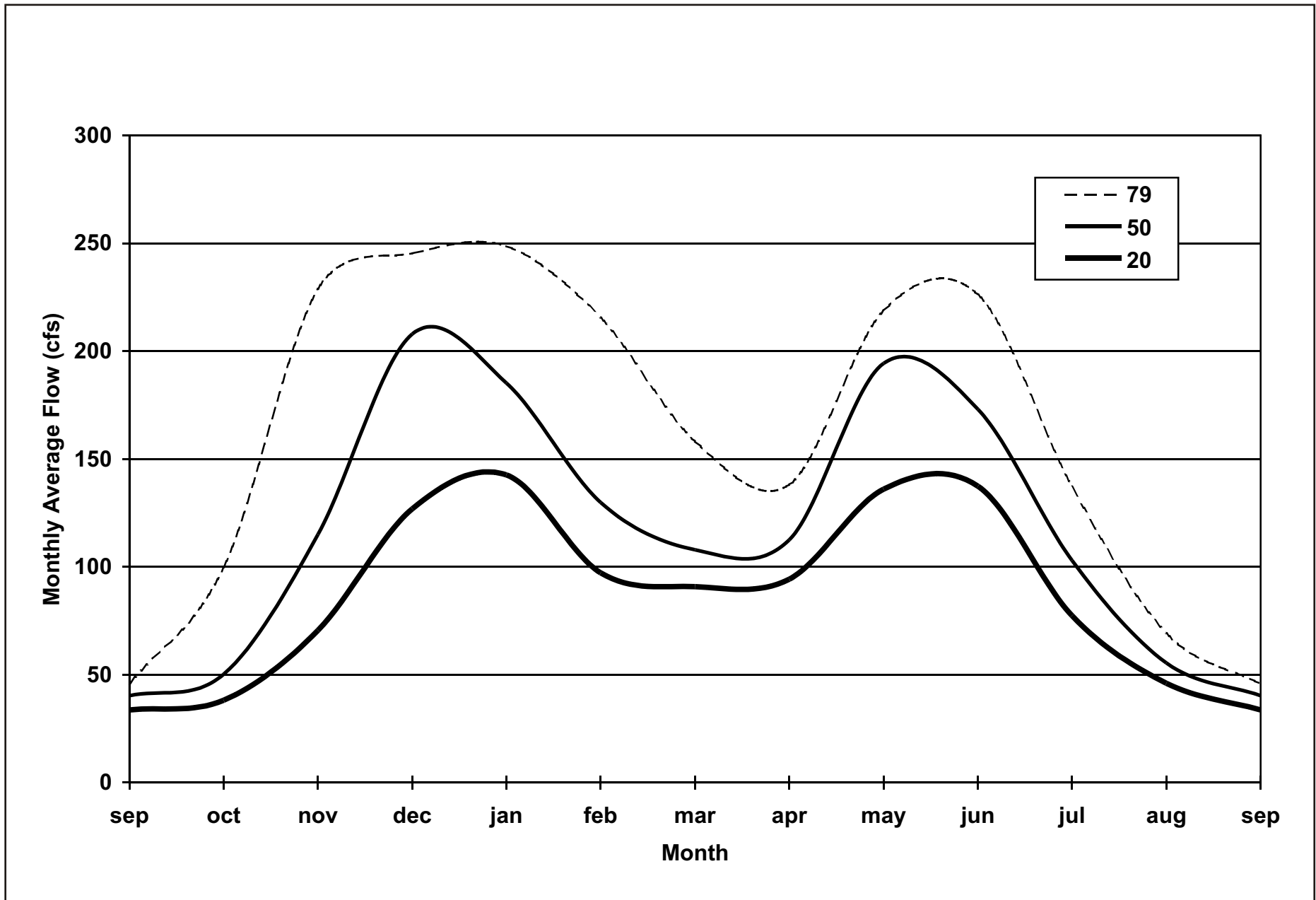


Figure 2.6-4. Morse Creek near Port Angeles 1952-76. (Perry draft 2001) Recent data indicate flows are overestimated. Exceedence Flow Duration Curves at less than or equal to 79, 50, and 20 percent .

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Data Gaps

More research is needed to determine the extent and location of aquifers and the interaction between surface and ground water.

2.6.6 Biology

North Olympic Peninsula streams having bimodal peak flows are quite productive, and Morse Creek is particularly productive for its size (classified a Tier 1 stream by the North Olympic Lead Entity). Bimodal peak flow streams are generally used by pinks, summer steelhead, and spring Chinook, all of which were present in Morse Creek (Dick Goin, pers. comm. 2001).

Morse Creek is classified a Type 1 waterbody. This designation is based on DNR/WDFW stream typing to regulate buffer widths based on the Shoreline Management Act (greater than 20 cfs is a Type 1). The buffer width for Minor New Developments in Clallam County is either the equivalent to the setback set forth by the Shoreline Master Program, or 65 feet. (Clallam County Critical Areas Code, 2001).

Climax vegetation in the forested regions of the North Olympic Peninsula is dominated by western red cedar, western hemlock and Sitka spruce. Douglas fir, a long-lived subclimax species, shares dominance through much of these forest lands. Documentation of vegetation along Morse Creek is sparse and scattered through such documents as the *Limiting Factors Analysis for WRIA 18* (Haring, 1999), an unpublished stream study conducted by Peninsula College students (1994), and the *Eight Streams Project: Citizens Report on Stream Health* (Streamkeepers, 2000)

Perry (*draft* 2001) notes that the Morse Creek mainstem lies within a heavily wooded ravine. Haring (1999) reports that the Morse Creek riparian corridor is largely vegetated, although not fully functional. The stream reach within the National Park contains coniferous trees and native vegetation (Haring, 1999). (Perry [*draft* 2001] characterizes this as “essentially old growth.”)

Below the Park boundary, logging has affected the composition of riparian vegetation. In the upper reach, riparian habitat is dominated by deciduous trees, primarily alder, and salmonberry. Lower reach riparian habitat is predominantly small deciduous trees, willow and alder (Peninsula College 1994). There is little vegetation along the Four Seasons corridor, and the mouth of the river has been clear-cut (WSU 2000).

The City of Port Angeles Stormwater Plan (1996) provides detail on riparian vegetation in the four reaches surveyed in the coastal lowland subwatershed. The Elwha-Morse Management Team subcommittee report (EMMT 2000) lists typical species of trees, shrubs, other flora, mammals, marine mammals, and birds. The City of Port Angeles FERC Application EIS contains descriptions of flora and fauna at the project site and along the pipeline and other associated project corridors.

2.6.7 Factors of Change

The City of Port Angeles Stormwater Plan (Economic and Engineering Services, Inc. 1996) aptly summarizes “The lower reaches of Morse Creek have been modified by channelization, floodplain development, roadway and railway construction, and vegetation

management.” Upstream, the primary effects have been due to construction of a stream diversion and hydroelectric project.

Human Influences/Major Projects

Diversions

The City of Port Angeles holds a water right to 20 cfs in Morse Creek, and operates a diversion dam at RM 7.2. The diversion consists of a concrete dam 10 feet high and 25 feet wide, with a crest elevation of 675 feet. The dam was initially used to provide municipal water supply; it later was converted to serve hydropower generation, a non-consumptive use.

From 1926 through 1977, the City withdrew up to 19 cfs from Morse Creek for municipal water supply (City of Port Angeles 1984). Diversions were halted after the Washington Department of Social and Health Services initiated legal action to require filtration due to concerns over frequent violations of turbidity and coliform standards in the Morse Creek water supply. Rather than construct filtration facilities, the City turned to its present water supply from the Elwha River. Although the City has since moved its water supply to the Elwha River, it retains its water right (see Section 2.3).

In 1984, the City changed the water right purpose to include hydroelectric generation and applied to license a small project. The license, granted in 1985, allows up to 19 cfs to be diverted from Morse Creek, reducing flows in a 2.2 mile bypassed reach. Hydro operations commenced in 1987 and were discontinued in 1997.

The City’s FERC application states that daily stream flows, as measured at the USGS gage located downstream of the diversion structure, were reduced to as low as 17 cfs during 10 years of record (1967-1976). The PSCRBT states that diversions varied from 5 to 13.5 cfs, with the heaviest demand during the summer (PSCRBT 1993).

According to Haring (1999), the dam is currently operated by the Clallam County Public Utility District No. 1 to provide domestic drinking water to Clallam County residents. The PUD draws less water than previously used by the City of Port Angeles, although the City’s right to obtain emergency water remains. The PUD also withdraws groundwater from aquifers that may be in continuity with Morse Creek.

Morse Creek Hydroelectric Project and Pipeline

In 1984, the City applied to the Federal Energy Regulatory Commission (FERC) for a license to construct, operate and maintain Morse Creek Project No. 6461. This small hydropower project (capacity 465 kW)⁴ diverts water at RM 7.2, delivering it to a powerhouse at RM 5.0. Flows return to the creek 2.2 miles below the diversion dam (City of Port Angeles 1984, FERC 1985).

The project consists of the preexisting concrete weir and concrete tunnel, a steel pipeline, penstock, powerhouse, transmission line, and access road. Diverted water is pumped

⁴This nameplate capacity is from the FERC application. The City’s application states that it has generated a maximum of 500 kW with average annual generation of 2,891 MWh.

uphill, then dropped through a penstock (24-inch concrete cylinder, 1,500 feet in length) to a return gate at the powerhouse. The transmission line consist of 2,800 feet of buried 12.5 kV cable. The access road improvements involved 1,700 feet of existing road, plus 3,100 feet of new road from the existing pipeline tap to the powerhouse.

The pipeline serving the project is for the most part old, installed in 1962. An 11,400 foot run of pipe begins at the diversion dam on the east side Morse Creek, passes north and supplies water to the PUD on the east side, crosses to the west side and then northwest across Mt. Pleasant Road to Port Angeles. A tee connects to a newer (1986-87) steel 24-inch line dropping sharply down to the powerhouse (ca. 1500 feet long).

Landslides and leaks have been recorded at several points along the pipeline. According to a City of Port Angeles Public Works Dept Memo (dated March 14, 1997) the pipe consists of a "1960 vintage" concrete cylinder at its age limit for reliability. The memo reports an average of one failure per year over the past five years with a water line of similar age and type in the Mount Pleasant Road area. The memo states that repair of the upper Morse Creek line in steep canyon areas would be "next to impossible" without replacing large sections of pipe.

HartCrowser's January 26, 1987 "*Morse Creek Hydroelectric Project Landslide Exploration and Rehabilitation*" geotechnical assessment letter regarding "recent" (1987) landslide activity in silt/clay unit identifies a "reasonably high level of risk for pipeline failure." However, it is not clear that this risk is due to anything other than uncertainty. HartCrowser notes that where the pipe crosses tributary valleys or gullies, and at the Morse Creek crossing, it drops abruptly to remain buried (does not maintain grade). This leads to the need for six-inch blowoff pipes to flush blockages. These blowoff pipes discharge directly to slopes and have caused substantial erosion and instability. HartCrowser recommended extending the pipes to discharge in stable areas. They also recommended drainage of wet areas along the pipeline and rip-rapping Morse Creek in areas of local slope undercutting (which may have affected the stream channel).

Concerns of intervenors focused on potential impacts to anadromous fish. In their motions to intervene, the Washington Department of Fisheries and Game and the Point No-Point Treaty Council asserted that flow reductions in the bypassed reach would adversely affect anadromous trout (steelhead and cutthroat) and salmon (chinook, coho, chum, and pink) that use the lower 0.5 mile of the bypassed reach. Resident rainbow and cutthroat use the entire bypassed reach. An operations schedule was agreed to in order to provide for flow releases to protect resident and anadromous fish, including spawning habitat. Minimum stream flows were set for April, August, October and November, and no operation was allowed in the month of September (FERC 1985). (See discussion under "Instream Flows" below for detail.)

Other concerns stated in the Order Issuing License included water quality, tailrace design, and fish screens. Mitigation offered in the City's FERC application included limiting tailrace velocity to 0.5 feet per second and installing a screen on the tailrace weir with two feet of freeboard and one-inch bar spacing.

The project was considered to have negligible impacts to stream water temperatures and only short-term turbidity effects. Because no air would be entrained under design conditions; gas supersaturation is not an issue.

In August, 1999, the City of Port Angeles published a Final Environmental Assessment and Application for Surrender of License. This document states that the City discontinued operation of the Morse Creek hydro project in October 1997 and on October 8, 1998 filed application to FERC to surrender its license, noting that it had become uneconomic to operate. An Order Conditionally Accepting Surrender of License was issued October 22, 1999 setting certain conditions for surrender. The deadline for surrender was extended by FERC (May 25, 2000, unpublished order) and in September 2000 FERC wrote to the City asking for its decision to surrender the license or reactivate the project. The City replied that it intended to continue operating the facility through a lease to a professional hydroelectric operator (letter dated October 20, 2000) and in March 2001, the City notified FERC that it had approved a lease agreement with a qualified operator. It also provided notice that it had received a Certificate of Compliance from Clallam County for the repair of the pipeline (conditions limit work to dry season and dry streambed).

FERC licenses typically include provisions that allow the license to be reopened to protect fish and wildlife, such as for consultation on listed species (e.g., Chinook and bull trout in Morse Creek).

Land Development

Residential land development has affected the estuary and lowland reaches of Morse Creek, including two large developments, Four Seasons Ranch (at the mouth) and Four Seasons Park (at RM 2.0, south of Highway 101). Ecology (1983) describes the conversion of 2 cfs water right associated with an old farmstead to the Four Seasons Park development.

According to the Clallam County Comprehensive Plan, in 1995 the Ranch was nearly built out but the Park still had building lots available, although many are not buildable. Average density is more than four units per acre, with many lots under 10,000 ft² in size. Neighborhood concerns include flooding, hilltop development visible from the Ranch, road failures near the entrance to the Park, traffic access and noise from Highway 101.

The Four Seasons Ranch residential development and golf course sits astride the once-productive Morse Creek estuary. Its car bridge had once constricted the floodplain, but has been reconstructed to better span the crossing. A golf course foot bridge connects to diking on both sides of the channel. Four Seasons Ranch shows dispersed development, including mobile homes close to the river. Failing septic systems and lawn fertilizer runoff affect water quality at both developments. Riparian vegetation is disturbed with some attendant bank destabilization. Road runoff at the two developments and from Highway 101 contributes oil and grease to the river, and road banks and maintenance (e.g., winter sanding at the Highway 101 curves) contributes sediments.

Along the south side of Highway 101, a major septic system serving the Wal-Mart store is in a chronically failing status, requiring daily pumping to avoid overflows to Morse Creek. Also on the south side, the Four Seasons Park Road is rip-rapped along the west banks of Morse Creek, confining it to an eastern meander. At the Bonneville Power Administration transmission line crossing further upstream, vegetation control and utility roads on the bank also affect the creek. Creek habitat becomes more natural moving upstream from these disturbances, and a spawning refuge pool is under consideration for construction at the hydro plant.

Landfill

A 76-acre landfill is located on Mt. Pleasant Road, west of Morse Creek. The site was originally used to mine sand and gravel until purchased by Rayonier in 1978 for disposal of wastes generated from its pulp and paper mill. The landfill contains two cells that received wastewater treatment plant sludge, ash, and wood waste. One cell received sludge from 1979 to 1990, while the other took ash and wood waste from 1989 to 1997, when the mill was shut down. Each cell has both a groundwater and leachate collection system, but only the first (receiving sludge) has an artificial liner. The collection system draws groundwater into the landfill from all directions (prior to landfill construction, shallow groundwater in the area flowed southwest, toward Morse Creek) (Washington State Department of Health 2000).

In 1997, the US Environmental Protection Agency conducted a Preliminary Assessment and Site Investigation in response to a community petition. An evaluation of landfill closure plans by the Department of Health notes a system of 17 groundwater monitoring wells, in addition to sediment samples collected from the Morse Creek drainage area, Morse Creek, and other drainages in the vicinity. The evaluation concluded that, although levels of some metals and dioxins/furans in landfill waste material are elevated above background levels, off-site measures of these contaminants found levels consistent with background levels. No exposure pathways were evident that would allow for contact with landfill contaminants in off-site groundwater or soil. The report recommended that the landfill be capped to ensure against any migration of contaminants, together with ongoing monitoring of landfill, groundwater, and surface water.

Testimony submitted to the Clallam County Board of Health included arguments that the landfill contains large amounts of dangerous, persistent, and bio-accumulative waste materials that have known health effects at very low exposures. The testimony states that the landfill leaks and that morbidity and mortality rates in the neighborhood are high compared to other nearby areas and statewide averages (Protect the Peninsula's Future 2001).

Modifications to Hydrograph/Fluvial Geomorphology

Channel Conditions

The Morse Creek channel has been altered by channelization, forest practices, and development. The channel is constrained in many areas by riprap, concrete, and the Highway 101 crossing at RM 1.2 (Peninsula College 1994). Diking extends from upper Four Seasons Park, about RM 2.0, to the mouth of Morse Creek, covering 40 percent of the anadromous reach (Haring 1999).

According to Haring (1999) lower Morse Creek was channelized in the late 1950s to facilitate land development, creating a uniform straightened channel. Haring states that "hydro modifications" resulted in the near complete loss of pool habitat and suitable spawning gravel from lower Morse Creek.⁵

⁵Haring does not explain what modifications he refers to or how they are linked to these losses. It appears that he may be referring to channelization, rather than hydropower operations.

Haring also states that the percentage of pool area in the lower mile of Morse Creek has been estimated at 12 percent, with only three pools in the first mile (0.18 pools/100 m). The extreme channel simplification and associated lack of channel diversity downstream of RM 1.75 has eliminated refugia for juvenile salmonids (coho and steelhead) overwintering in the lower river, with the likely result that these juveniles are flushed to saltwater during high flow events. From the mouth to RM 2.0, the stream is characterized as a continuous riffle with no deep pools, side-channel habitat, or backwater areas; from RM 2.0-3.8, the channel has a 40 percent pool/60 percent riffle ratio (Economic and Engineering Services (1996).

Substrate

Morse Creek is not considered to have ever been a gravel rich system (Dick Goin, cited by Haring 1999). The creek has moderate gravel availability, historically alternating between hardpan and gravel from the mouth to the falls. There currently is very limited gravel availability throughout the system. A small area of spawning gravels exists just upstream of the estuary, where some chum and coho spawn, but the next spawning area occurs over a mile upstream. This is of particular concern below Four Seasons Park where gravel is lacking, leaving mainly coarse substrate. Habitat inventories found no suitable spawning gravels below Highway 101 (Peninsula College, unpublished data 1994; City of Port Angeles 1996). This is likely related to historic channelization, hydraulic constrictions and the lack of LWD throughout the anadromous zone to hold gravel. There are no currently identified fine sediment concerns (Haring 1999). Prior to this activity Morse Creek was a multi-channel stream that meandered from one side of the valley to the other. It has been reported that for a number of years there were two mouths.

The City of Port Angeles Stormwater Plan (1996) provides detail on substrate in the four reaches surveyed in the coastal lowland subwatershed.

Stormwater

Likely stormwater impacts resulting from altered hydrology in Morse Creek include greater frequency and magnitude of peak storm flows. Runoff from impervious surfaces has increased, as existing development was constructed largely without stormwater detention and treatment facilities. Haring states that it is likely that the creek has been adversely affected by stormwater, but the extent of impact is difficult to assess because of the extent of other channel modifications (Haring 1999). Annual storm events produce runoff volumes two to three times average annual flow (Peninsula College 1994).

The *County-Wide Comprehensive Plan* (1995c) states that stormwater runoff is causing considerable bluff-front gully erosion and deposition in the Four Seasons neighborhoods, and recommends controls on commercial development to limit stormwater impacts on adjacent residential developments. The Comprehensive Plan recommends natural water control in the form of wetlands, together with retention and slow release of stormwater.

Soil Erosion and Sediment Load

The *City of Port Angeles Stormwater Management Plan* (Economic and Engineering Services, Inc. 1996) reports extremely unstable, easily eroded stream banks along Frog Creek, a Morse Creek tributary. Along Deer Park Road, slides, perched culverts and

evidence of erosion were noted. Several recently exposed slides and evidence of numerous repairs were noted on the road. These slide areas result from a combination of unstable soils and geology, road location, subsurface hillside drainage, and continued excavation and disturbance of the toe of the slope by the stream. This series of slides appeared to be contributing a significant amount of fine and course sediments into the creek (Economic and Engineering Services, Inc. 1996). The 1996 Stormwater Management Plan also notes erosion from old railroad embankments, contributing significant fine and course sediments to Morse Creek between Highway 101 and Four Seasons Ranch.

The pipeline and penstock serving the Morse Creek hydro project and diversion are located in unstable soils. Landslides are recorded at several stations along the Morse Creek pipeline and, by 1987, landslide activity had occasioned the preparation of a geotechnical report by HartCrowser (1987) to assess stabilization alternatives and reduce future risks to the pipeline.

Peninsula College students surveyed Morse Creek in 1996 and reported 20,111 m³ of unstable banks on the entire reach (mouth to RM 4.9). No unstable banks were seen below the Highway 101 bridge, due to extensive diking. South of Highway 101 to RM 3.0, unstable banks appeared to be caused by tributaries, groundwater seepage and undercut banks. Detail by RM is given in the students' report.

2.6.8 Land Use and Demographics

Land Use

The upland subwatersheds of Morse Creek, except parts of the Surveyor, Rock, and Lake creek drainages, and all of the creek's highland subwatershed, lie within Olympic National Park. Here, vegetative cover has been protected and is predominantly old-growth forest (Perry 2001).

Logging is the primary land use in the middle reaches of Morse Creek, while the lower two miles have been heavily affected by residential development in the floodplain (Four Seasons Ranch, Four Seasons Park) (McHenry et al. 1996). Perry (2001) notes evidence of smaller clear-cuts and larger regrowth areas in the upland subwatershed. He characterizes the vegetation in the lowland subwatershed as "considerably altered [by] extensive logging, clear-cutting, and land-clearing." Perry states that because the land has largely reverted to grassland/shrub and because the lowland drainage network is poorly integrated, these changes have had little effect on the streamflow contributed by the lowland tributary area.

Perry (2001) reports that residential development is "quite marked" along the valley floor, with "extensive clearing and development" in the lowermost segment of the coastal lowland subwatershed, north of Highway 101. South of the highway, he finds minimal clearing except along the valley rim. Non-tributary areas west of the subwatershed have been extensively developed along the highway corridor, while to the east less development is apparent.

There is no significant agricultural use in the watershed. There are several fields used for animal grazing, but there are no field crops, per se. In 2002, the Washington Department

of Fish and Wildlife acquired several parcels totaling over 120 acres within the lower Morse Creek watershed. This property is dissected by a ½-mile length of Morse Creek near Port Angeles and by Hwy 101. These acquisitions allow the permanent protection and ultimate restoration of mainstem, side channel and off-channel habitat historically used by Puget Sound chinook and currently used by bull trout, summer chum, fall chum, coho, pink, steelhead, and cutthroat. This section of the Creek is channelized, diked and depleted of wood throughout and will benefit greatly from restoration (Salmon Recovery Funding Board Application, A. McMillan, 2000).

Land Use Planning

The Clallam County Comprehensive Plan (CCDCD 1995c) designates land use in three neighborhoods encompassing Morse Creek: the North and South Monroe Road/Foothills Neighborhoods, and the Four Seasons Neighborhood. The Four Seasons Neighborhood is located within the ravine of Morse Creek, extending to the coast. It consists of two urban density subdivisions, the Four Seasons Park and Four Seasons Ranch. Permitted density is 9 units per acre in these subdivisions. Further commercial land use “should not be allowed in the Morse Creek curve”. The steep, unstable slopes of the Morse Creek ravine “should be designated for Urban Very Low residential density with an Open Space Overlay zone”, targeting them for “transfer of development rights to protect these largely unbuildable sites and allow them to remain in a natural state” (CCDCD 1995c).

The Monroe Road/Foothills Neighborhood lies to the west of Morse Creek and defines the creek as a “critical area”. Areas bordering the creek are designated Urban Very Low/Urban Low density. Forestlands in this neighborhood are designated “resource lands” and the Comprehensive Plan is geared to maintain continued viability of long-term forest production.

Sewer service is not available in the Four Seasons or Monroe Road/Foothills neighborhoods. According to the Port Angeles Regional Watershed report (PSCRBT 1993), Streamkeepers data does not suggest that a problem exists with failing septic systems and fecal coliform. However, the Clallam County Comprehensive Plan (CCDCD 1995c) reports a concern that on-site sewage disposal systems under the Four Seasons Ranch golf course may fail and states that pollution problems from failing septic systems should be addressed. The Comprehensive Plan encourages the City of Port Angeles or the PUD to provide sewer service to new land divisions in these neighborhoods.

The Comprehensive Plan defines “critical areas” to include steep-sided creek ravines and creek bottom lands of Morse Creek, and states that these “should be protected” for water quality and as linear wildlife corridors. The Comprehensive Plan recognizes that “when left in a natural state [these areas] stabilize geologically unstable ravine and bluff environments.” These areas, together with the marine shoreline, are “natural greenbelts” (but it is not clear that providing this service brings with it any formal protection). The Comprehensive Plan encourages owners of marine bluffs, wetlands and ravines to file conservation easements, and recommends that owners of critical areas qualify for open space taxation regardless of property size.

The Comprehensive Plan assigns a “high priority to Morse Creek restoration efforts due to potential for salmon habitat”. It desires to focus on the lower two miles of creek, to discourage residents from “cleaning” the riparian corridor, to revegetate the corridor and to

develop off-channel fish habitat. A recommendation is included to encourage the Four Seasons Homeowners Association to “adopt” the creek, assuming responsibility for helping monitor its condition and supporting restoration projects.

The Comprehensive Plan states that fish populations are particularly vulnerable to habitat degradation, and recommends limits on surface water withdrawals to maintain optimum instream flow for fish. It also encourages water conservation.

Port Angeles Urban Growth Area Boundary

The City of Port Angeles has requested that the Urban Growth Area boundary be moved from the west side of the Morse Creek Valley to an alignment east of Morse Creek, intending to include the residential and commercial areas along Deer Park Road and both north and south of Hwy 101. The County has indicated that it will review this request as a part of the next overall update to the Comprehensive Plan, scheduled to be completed in late 2004.

Effects of Current and Anticipated Land Use

Areas Protected

National Park management of the river above RM 9.0 protects the upper reaches and headwaters of Morse Creek. These areas are in pristine condition.

The Clallam County Comprehensive Plan has designated Morse Creek steep slopes and creek bottom as “critical areas.”

Morse Creek has been identified as a “Type 1 Water” within the City of Port Angeles Environmentally Sensitive Areas Protection Ordinance No. 2656 and pursuant to WAC 222-16-020.

Areas Most Affected

The lowest two miles of Morse Creek have been most affected by a combination of land development, channelization, diking and armoring, road and other floodplain constrictions, and riparian vegetation removal.

Areas at Greatest Risk of Future Impacts

Both the Mining Creek and Frog Creek watersheds are platted for urban development. Both are in the rain-on-snow zone in the Morse Creek watershed. Even if existing Critical Area Ordinances are enforced, new development will likely result in additional significant stormwater impacts (Joel Freudenthal, pers. comm., 2001).

Areas being considered for inclusion within any expansion of existing UGA boundaries also are at risk of experiencing greater impacts relating to increased impervious surface, stormwater, and nonpoint pollution.

Watershed History

The Morse Creek area was settled in the late 1880s as small farms both in the upland areas above the canyon and down in the estuary area. During the 1950s the estuary and areas up to RM 2+ were sold and developed as Four Seasons Ranch and Four Seasons Park. Valley areas above the 101 area were farmed and logged by the owners until sold and developed. During the past 30 years the upland areas have been slowly converted from small farms to residential uses with homes on sites of 1 to 5 or more acres. Little land is now used as farms providing incomes. In recent years there has been an increase in the number of urban type developments along the rim and in the uplands. This growth potential was made possible in part by the provision of a PUD water system, built in the 1970s using water from Morse Creek to serve the east rim of Morse Creek and the purchase of Elwha River water by the PUD (pers. comm. Gary Gleason, August, 2001).

2.6.9 Ecosystem Functions and Conditions

Floodplain

Floodplain function in the lower two miles of Morse Creek has been severely altered by floodplain constrictions (diking, development encroachment, and transportation corridors). Haring (1999) notes specific reaches where the Morse Creek floodplain is constrained on Map 8 (WRIA 18 Depleted LWD and Channel Constrictions).

The floodplain from Four Seasons Park up to the falls (RM 2.0-4.9) is relatively unconfined by human activities, though the stream is confined by canyon walls in lengthy reaches.

Downstream of Four Seasons Park to Highway 101 (RM 1.2-2.0), Morse Creek has been channelized and is diked and armored, effectively confining the creek between the dike and a bedrock outcrop. Here the channel is spanned by two bridges (Highway 101 and the railroad trestle). Both the Highway 101 bridge and the railroad trestle constrict the floodplain. The area between these constrictions has also been confined with armored banks, creating high hydraulic energy conditions and poor habitat. Homes have been constructed behind the dike at Four Seasons Park, limiting the potential for restoration without property acquisition.

Below Highway 101 Morse Creek is effectively diked on both banks (from RM 1.2 to its mouth). This alluvial reach was formerly unconfined and meandering. Downstream, the car bridge to Four Seasons Park (RM 0.5) had previously constricted the floodplain, but reconstruction of the bridge to provide a 110-foot span has improved conditions. A foot bridge (golf course crossing) at Four Seasons Ranch (RM 0.1) ties into the diking on both sides of the channel. The TAG estimates that more than 80 percent of the floodplain capacity has been lost in the area downstream of RM 1.75 (Haring 1999).

Constriction of the channel and floodplain results in greater channel scour during high flow events, as well as in the elimination of escape cover outside the active channel (Economic and Engineering Services, Inc. 1996). There is limited development in this lower river floodplain, including a golf course and a number of homes on the floodplain fringe. However, much of the floodplain area remains between the dike and the Four Seasons Ranch homes, providing significant floodplain restoration potential. Restoration would likely require property acquisition or conservation easements.

Data Gaps

A comprehensive flood plain study would be beneficial in determining the effects of loss of floodplain and the potential for recovery (EMMT 2000).

Nearshore/Estuary

The Morse Creek estuary, considered to have been an important contributor to the creek's historic productivity, has been largely eliminated by development. The marine nearshore habitat at the mouth of Morse Creek also has been altered by historic railroad construction and armoring within the intertidal area, which has eliminated the shallow nearshore habitat to the west of Morse Creek (Peninsula College 1996).

2.6.10 Water Quality

Fresh Surface Water Quality

At the time of the 1984 City of Port Angeles FERC Application, water quality in Morse Creek was classified as Class AA (Extraordinary). Summer stream temperatures are typically cool and the water is well oxygenated in the lower reaches as the result of groundwater contributions (Clallam County, Unpublished Data).

An abandoned fly ash dump is located just above Morse Creek at RM 1.5 (on the west side of the stream). This site was evaluated in 1997 by the Environmental Protection Agency as a potential site for inclusion under the federal Superfund cleanup of the abandoned Rayonier mill site, and has more recently been evaluated for a closure permit by the Washington Department of Health. These evaluations included assessment of groundwater quality beneath the dump site. Because the dump received a variety of materials, including chlorine compounds associated with the pulp bleaching process at the mill site, there are concerns expressed by local residents that toxic compounds including dioxin may leach to Morse Creek.

The TAG identified stormwater runoff from Highway 101 and other impermeable surfaces as a concern. Hydrocarbons, anti-freeze, metals, and sand originating from paved surfaces are delivered directly to Morse Creek during storm events. There does not appear to be a concerted strategy or effort to manage the adverse effects of stormwater runoff throughout WRIA 18 (Haring 2000).

The *City of Port Angeles Stormwater Management Plan* (Economic and Engineering Services 1996) noted animal waste observed on stream banks and in the stream along Frog Creek, a tributary to Morse Creek. The Stormwater Management Plan also noted that stormwater runoff from developed areas is a primary pathway for nonpoint source pollution. The City and the County are each pursuing updated stormwater management plans to more effectively address these and other stormwater issues. Runoff from residential and commercial areas, roads, and small farms; leachate from landfills; and failing septic systems carry nutrients, fertilizers, insecticides, oil and grease, heavy metals, and sediments into Morse Creek.

Data Gaps

Little actual water quality data has been collected for Morse Creek. Some data which is referenced in the literature is so old as to be of dubious value – e.g., reference is made in some documents to 1988 sampling data. Streamkeepers has collected data at four reaches on Morse Creek, as follows:

- Reach 1 (RM 0.3), mouth of Morse Creek, July 1997 to present
- Reach 2 (RM 1.1), near railroad trestle, July 1997 to Winter 2000
- Reach 3 (RM 2.0), Four Seasons Park, July 1997 to present
- Reach 4 (RM 4.1), near Port Angeles hydro project, summer 1998 to Winter 2000

Reaches 1 and 3 remain as sites of routine quarterly monitoring by Streamkeepers, and they are expected to be maintained in the monitoring program indefinitely.

2.6.11 Fish and Habitat

Salmon Distribution, Abundance & Stock Status

Fish Distribution, Abundance & Status

This section describes Morse Creek fisheries, including species and stocks, distribution, life histories, abundance, trends and status.

Natural Productivity

Morse Creek is known to have produced a high diversity of salmon species in greater numbers than would be expected for a stream of its size. As the smallest of the “snow streams” (with bimodal peaks in discharge), Morse Creek joins a class of streams which are generally used by pinks, summer steelhead, and spring Chinook. This may be why Morse Creek is so productive for its size. Other habitat conditions that may have contributed to Morse Creek’s historic high productivity include:

- North-facing stream – water remained cool (although potentially less of an impact as compared with snow melt contribution and groundwater)
- Abundance of log jams and LWD throughout anadromous zone
- High nutrient levels from large returns of adult salmon and steelhead
- High quality open estuary behind stable sand spit, with open access to salt water

The distribution of anadromous fish in Morse Creek is limited to the stretch of stream below the falls at RM 4.9. The falls present an impassable barrier to anadromous fish and are the upstream limit of anadromous fish migration in Morse Creek (McHenry et al 1996).

Stocks and Status

Historically, Morse Creek has been an important anadromous fish stream. Anadromous fishery stocks known to have inhabited Morse Creek include spring/summer Chinook,

coho, chum, and pink salmon, summer and winter steelhead, and searun cutthroat trout (WDFW et al 1994).

The City of Port Angeles (1984) FERC Application lists four species of salmon (Chinook, chum, coho, and pink) and two species of trout (steelhead and cutthroat) as occurring in Morse Creek. A resident population of rainbow trout occurs above the impassable falls. The FERC Application states that anadromous habitat occurs in only 0.5 miles of the 2.2 mile reach bypassed by diversion to the Morse Creek hydroelectric project. As part of its mitigation for the hydro project, the City offered to conduct spawning surveys from mid-August through June for salmon and March through June for steelhead, over a five-year period.

Spring/summer Chinook

Morse Creek Chinook salmon has been aggregated with Elwha River summer/fall Chinook, resulting in the stock being rated as healthy. Data from recent ground surveys, however, suggest supplementation efforts have not been successful. Only 10 fish per year have been observed (McHenry et al 1996).

Spring Chinook salmon were last observed by local informants in 1983. The Salmon and Steelhead Limiting Factors (1999) lists it as extinct in 1993. Fall Chinook is listed as threatened. Fall Chinook is a non-native species in Morse Creek. It has been planted once or twice, but has failed.

Fall Coho Salmon

Morse Creek Fall Coho are a composite of native and introduced non-native stocks. Their run time is considered 'normal.' These fish were typically large, with specimens to 20 pounds. Although the stream once supported between 4000 and 5000 fish, recent Lower Elwha Klallam Tribe surveys for 1993 and 1994 found 0 and 40 Coho respectively (McHenry et al 1996). Morse Creek coho include those coho spawning in McDonald, Siebert, Bagley, Morse, Lees, Ennis, Valley, and Tumwater creeks. The Morse Creek coho salmon stock does not demonstrate unique temporal or biological characteristics.

Fall Chum Salmon

WDFW et al (1994) group the Morse Creek run with other eastern Strait chum populations. Sporadic surveys generally report less than 10 fish a year. Historic abundance was about 1000 fish (McHenry et al 1996).

Summer Chum Salmon

Strays on the fringe of the threatened Strait/Hood Canal summer chum population may occur.

Pink Salmon

Recent surveys show small numbers of pinks returning to Morse Creek in odd years. Morse Creek Pinks are not currently recognized as a separate stock by state and tribal managers, although evidence suggests the contrary. Historic estimates of abundance are

approximately 10,000 to 15,000 fish during strong years. The Pinks run in August and September, around the same time as the upper Dungeness River and extinct Elwha Stocks. Morse Creek's Pink population shows no sign of recovery (McHenry et al 1996).

Winter Steelhead Trout

WDFW et al (1994) lists Morse Creek winter steelhead as a depressed stock. It is supplemented by WDFW using the Chambers Creek stock.

Summer Steelhead Trout

The most recent observation of Morse Creek summer steelhead by TAG members was approximately four years ago by Dick Goin (Haring 2000). Based on the location and size of the observed fish in Morse Creek, the steelhead observed four years ago were thought to be native. These may be stray hatchery fish from the Elwha or Dungeness (Randy Cooper), or may be true Morse Creek returns that should be considered for designation as a separate stock. The current status is unknown, but the consensus of the TAG is to consider the stock status as critical. They spawn upstream to the falls at RM 4.9, but the lower extent of spawning is unknown (McHenry 1996).

Bull Trout

Bull trout are listed as threatened by US Fish & Wildlife. It is not clear whether Morse Creek supports bull trout.

Resident Trout:

Other Resident Fish

Other resident fish include cottids (bullheads, sculpins), and sticklebacks. Marine perch and flounder were historically known to invade Morse Creek. Bull trout have been sighted and caught by local fishers (EMMT 2000).

Harvest

Local fishermen report that steelhead, cutthroat, and resident trout support a very active sport fishery in Morse Creek. Ecology (1983) describes Morse Creek as used "rather heavily" for sport fishing, and note occasional tribal fishing for Morse Creek steelhead. Its salmon runs once contributed to sport and commercial catches in the Pacific Ocean and Strait of Juan de Fuca as well (Ecology 1983).

Hatchery Production

The Washington Department of Fish and Wildlife occasionally plants juvenile coho into Morse Creek from the Department's Dungeness Hatchery (Economic and Engineering Services, Inc. 1996, Ecology 1983).

Instream Flows

An IFG IV instream flow study was conducted in consultation with resource agencies and tribes (the latter were represented by Point No Point Treaty Council), related to a proposal

by Clallam County PUD No. 1 to increase its groundwater withdrawal at an infiltration gallery adjacent to Morse Creek. The study examined two typical reaches, one above the falls and one below. Field data were collected for the uppermost of the two reaches, in the Four Seasons Park area at about RM 2. Data were collected at 55, 59, 89, and 257 cfs. Habitat curves for Morse Creek were obtained or developed for Chinook and steelhead juveniles and coho and steelhead fry for depth and velocity; Chinook and steelhead spawning depth and velocity; coho spawning velocity; chum and pink spawning depth and velocity; and chum, pink, coho, Chinook, and steelhead substrate.

Ecology (1983) reports that it was impossible to reach a consensus on flow. The agency proposed instream flow recommendations based on the study, which it proposed to use to condition future water rights on Morse Creek. These set flow minima at 90 cfs from December 15 to July 15, dropping to 72 cfs until August 1, then 57 cfs until August 15 and 35 cfs from August 15 until November 1. On November 1, the proposed flow minimum increase to 42 cfs, on November 15 to 54 cfs, and on December 1 to 70 cfs.

The FERC Application instream flow study was used as a basis for a determination that a 19 cfs withdrawal would have no significant impacts except during critical flow periods. As noted in the Washington Department of Fisheries comment letter (William Wilkerson, Director, April 20, 1984) "critical periods limit the carrying capacity of biota on Morse Creek and these periods are significant". Mitigation measures offered in the FERC Application included monitoring during April and August-November. Operations were to be curtailed when stream flows fell below the following levels (Table 2.6-4):

Table 2.6-4. FERC Flow Requirements

Month	Threshold Flow
April	85 cfs
August	90 cfs
September	no operation
October	100 cfs
November	65 cfs

Source: FERC

April minimum flows were set to protect steelhead spawning. August-November flows protect resident trout, steelhead juveniles, and spawning habitat. The City offered to limit its use of its 20 cfs consumptive use water right to emergencies (when water was not available in sufficient quantity from normal sources of supply). The City also offered to provide notice to the Directors of the Washington Departments of and Fisheries and Wildlife, and to the Point No-Point Treaty Council when it planned such use.

Habitat Connectivity

No artificial fish migration barriers are known to exist in this watershed. Detailed surveys of four reaches comprised of the lowest of the subwatersheds defined by Perry (the coastal lowland subwatershed, extending from the confluence with Mining Creek to the

mouth of Morse Creek) reported no barriers (City of Port Angeles 1996). Both the *Stormwater Management Plan* (Economic and Engineering Services, Inc. 1996) and Ecology (1983) indicate that a series of boulder/bedrock cascades at RM 3.8 may be migration barriers to anadromous and resident salmonids (WDOE states that this is a barrier to coho in particular). The Stream Catalog (Williams 1975) also shows a barrier at this location.

The natural falls at RM 4.9 poses a complete barrier to anadromous and resident salmonids. The Technical Advisory Group (TAG) of the Lead Entity Group (LEG) has speculated that the steelhead may have been able to pass this barrier in historic times (a geologic fault runs under Morse Creek at the falls, and the size of the falls may have been less at some point in the past). According to Dick Goin (pers. comm. April 2001), proposals have been made in the past to provide fish access to high quality habitat above the falls, but these proposals have been unsuccessful.

Two steep tributaries, Frog and Mining Creeks, flow into Morse Creek downstream of the falls. The distribution of fish within these tributaries is thought to be limited by stream gradient. Individuals with local knowledge report that fish are present in upper Frog Creek.

A population of rainbow trout exists above the falls at RM 4.9; the uppermost extent of their distribution is unknown.

Salmon Recovery

Factors Affecting Fish

The City of Port Angeles Stormwater Plan (1996) describes the effects of stream channel, bank and riparian modifications upon fish in the lower reaches of Morse Creek (from about RM 2.0 to the mouth): “channelization, floodplain development, roadway and railway construction, and vegetation management have restricted suitable salmonid spawning areas to those sections of the mainstem generally upstream of the Cottonwood Lane Bridge”. The small hillside drainages and tributaries within the channelized area have been isolated and are no longer accessible for resident or anadromous fish species. Channelization and riparian corridor management have also limited the amount of large woody debris recruitment into the stream system. Spawning, juvenile rearing, and adult cover habitats for anadromous salmonids within the lower reaches of Morse Creek have been greatly modified.”

Anadromous and resident fish habitat was observed to be limited in these lowest two miles of creek. Instream substrate was dominated by large cobble and boulders and little meander was present. Areas of available suitable salmonid spawning gravel or stable large woody debris were “virtually absent”, indicating that winter storm flows scour and remove these essential habitat features.

Existing High Quality Watershed Preservation/Protection Areas

Habitat quality and conditions are excellent in the watershed above the Olympic National Park boundary at RM 9.0. However, much of Morse Creek above the major developments affecting the lower two miles is in good or high quality condition, with reasonably intact

habitat-forming processes. The area above the falls is presently inaccessible to anadromous fish, but is occupied by a population of resident rainbow trout.

The greatest potential impact of restoration upon fish in Morse Creek most likely would be realized from restoring its estuary.

Habitat-Forming Processes and Causes of Change

Delivery/Routing of Organic Materials

Large Woody Debris

Historically, log jams and LWD were abundant all the way from the mouth to the falls (Dick Goin, cited by Haring 2000). LWD is thought to have been recruited from the adjacent riparian area, as the potential to move LWD of key piece size in the creek was negligible. The canyon was logged in 1948, and the presence of logjams and LWD has degraded since then. Extensive stream cleaning and debris removal occurred in lower Morse Creek beginning in the 1940s. In the 1970s, a large number of logs washed downstream during a high flow event and built up behind the railroad trestle, which constricts the channel. This backed up water and created local flooding upstream of the trestle. Landowners filed a lawsuit to remove the logs. During a later flood event the railroad dynamited the logjams at the trestle, which created a dam-break flood downstream, resulting in a loss of much of the remaining LWD from the system. In previous years, Rayonier used a crane to remove LWD that built up behind the trestle, preventing the movement of LWD to downstream areas. The City of Port Angeles currently owns the trestle and intends to retain it as part of a trail system. However, it continues to constrain the channel. Peninsula College conducted an inventory of LWD in the lower mile of Morse Creek and found only one piece larger than 24" diameter and longer than 20 feet. This rates as very poor when compared to the NMFS Coastal Salmon Conservation Working Guidance (September 1996) of more than 80 pieces/mile of 24" or greater diameter and 50 feet or greater length (Haring 2000).

Peninsula College students surveying Morse Creek in 1996 report 7589 m³ of LWD between the mouth and RM 4.9, the majority above RM 3.0. Detail by RM is given in the students' report.

Nutrients

The critical ecological role of marine nutrients, derived from salmonid carcasses, in supporting aquatic food webs and riparian vegetation has been documented by several authors (Bilby et al. 1996, Michael 1998). Diminished numbers of salmonids returning to spawn in freshwater streams has resulted in nutrient deficiencies compared to historic conditions, affecting productivity potential. Adult salmon and steelhead spawning escapements have significantly declined to a fraction of their historic abundance, raising concerns about a lack of marine-derived nutrients returning back to the system in the form of salmon carcasses. The ability to retain nutrients in the system may also be limited due to the extent of channelization in the lower river.

Delivery/Routing of Toxins

The extent of continuing and/or recurring toxic inputs to Morse Creek has not been fully investigated. The physical characteristics of the watershed, along with its comparatively limited development, suggest that it is not likely that there are any significant continuing toxic inputs. Specific areas that warrant examination include the railroad trestle, commercial areas (such as Wal-Mart) and any former landfills located within the watershed.

One long-standing source of toxic input to Morse Creek is the collection of creosoted piling supporting the former railroad trestle at ~RM 1.1. This trestle has been refurbished with deck and railings to be part of the Olympic Discovery Trail. The trestle, originally built in the early 1900s, was maintained for railroad use until 1985. Though a precise timing for the most recent reapplication of creosote or other toxic preservatives to those pilings is unknown, it is clear that they represent at least a modest current source for toxic input to the stream.

Creosote impact on water quality has been extensively studied. Current analysis indicates that the continuing leaching of creosote from older pilings dissipates to fairly low levels. Whether within or above water, these older pilings have relatively minor water quality impact. Leaching from pilings dug into the substrate has also been found to cause migration of contaminants for a distance of up to ~12 inches into the surrounding material.

Natural Disturbances

As noted in Haring (1999) there is some susceptibility to natural disturbance of geologic features. The glacial materials in the watershed are stored in terraces behind glacial till terrace walls. When land grading “nicks” these till walls, it appears to create a notch from which the water stored in the terrace above flows out. This results in increased flow for several months until the water level in the upstream terrace finds a new equilibrium with the level of the notch. This may also affect the extent of potential groundwater storage and groundwater flows to Morse Creek, but the extent of effect is unquantified.

Habitat Use and Availability

Figure 2.6-5, taken from Ecology (1983), graphically depicts the timing of salmon and steelhead life stages in the Morse Creek basin. Table 2.6-5 identifies the timing of adult salmon returning to Morse Creek to spawn.

Peninsula College students surveying Morse Creek in 1996 measured 1287 m² of spawning ground between the mouth and RM 4.9. They found 89 percent of suitable steelhead spawning ground below RM 3.0. Above RM 3.0 to RM 4.9, spawning habitat consisted primarily of small pockets of suitable substrate. Detail by RM is given in the students' report.

Table 2.6-5. Timing of Returning Spawners in Morse Creek

Fish Species	Timing of Adults Returning to Spawn
Spring Chinook (now extirpated)	April, May, and June with highpoint being about May 15 (snow runoff)
Summer Steelhead	Late June—first entry. Continues until early July (snow runoff). This is a trickle fish, never heavy numbers. Peaks in mid-July with a secondary run in mid-September.
Fall Coho	Fall/early winter rains, with first entry in October, peaking by early November.
Fall Chum	Fall/early winter rains—mostly late October to early November.
Winter Steelhead	Fall/early winter rains—first run starts in November and continues until June.

Source: Dick Goin and Mike Langley

Riparian Habitat

The Morse Creek riparian corridor is largely vegetated, although not fully functional. It is rare to find areas with less than 50 feet of riparian vegetation, except in Four Seasons Park and the estuary where there is little remaining riparian vegetation (TAG). Outside of Olympic National Park and in the upper reaches down to the “old firing range”, logging has occurred to the stream edge. As a result, the dominant canopy is deciduous trees which do not provide high quality LWD recruitment potential. Riparian vegetation downstream of Highway 101 is primarily young deciduous. Some of the riparian vegetation downstream of Highway 101 is located on or behind dikes and would be subject to disturbance or elimination in the event that the dikes are removed or relocated. The TAG indicated that even when mature trees do fall in the riparian zone or in the creek, they are typically removed or destabilized by local residents. The Four Seasons Ranch homeowners are also known to systematically remove vegetation in the estuary to enhance view corridors. (Haring 2000)

Nearshore and Estuarine Marine Habitat

The historic estuary conditions have been substantially altered and the characteristics of the once productive estuary have been lost. Haring’s Figure 24 (Haring 1999) allows comparison of Morse Creek estuary conditions in 1939 and 1997. The historic estuary configuration was a spit-built estuary, with a sand spit running parallel with the marine shoreline towards the east to the mouth. Upstream of the mouth was a very sinuous wood-rich channel behind the spit. Historically the creek contained about 3.96 acres of riverine tidal channel, compared with approximately 0.57 acres today (Randy Johnson, WDFW). There is also an indication of salt marsh inside the historic spit on the left bank with connection to the main channel. The historic estuary contained approximately 11.48 acres of estuarine marsh habitat, which has decline to about one acre today (Randy Johnson, WDFW). Historic conditions provided both a rich area for juvenile salmon rearing and for adults to mill prior to migration upriver. The Morse Creek estuary was considered exceptional, and likely contributed significantly to the higher than expected salmon production that originated from Morse Creek.

The spit and estuary (approx. 1,200 feet in length) were intact in the 1939 aerial photo (Figure 24, Haring 1999), and remained substantially intact into the 1950s. A side channel

on the west side of the mouth (noted by orange dotted line in Figure 24) was diverted in the late 1940s during the initial development of the Four Season's Ranch, cutting off the western corner of the estuary.

Sometime thereafter, the lower 3/8 mile of river, that had been very sinuous, was straightened, along with removal of the extensive amount of large wood that was in the estuarine portion of the river (pers. comm. Dick Goin). These changes resulted in a simplified channel that now drained directly to saltwater. The widened channel lost its ability to transport sediment through the lower reaches. The channel change resulted in almost total loss of the highly productive estuary, and loss of area for juvenile rearing and adult holding prior to migration upriver.

The loss of the sand spit that formed the Morse Creek estuary may, in large part, be the result of loss of longshore drift from the marine bluffs to the west of Morse Creek. This is evident when comparing aerial photos of Bagley, Siebert, and McDonald creeks, all of which are similar sub-tidally, but Morse Creek lacks the berm of littoral sands that these other creeks receive from the adjacent bluffs (pers. comm. Joel Freudenthal, 2001).

Additionally, productivity of Morse Creek salmon is thought to be heavily influenced by the quality of habitat conditions in Port Angeles Harbor. The harbor historically functioned as a large estuary, providing high quality rearing areas for many salmonid species. The harbor has been extensively altered by a variety of cumulative physical modifications (see Marine Habitat section).

Figure 2.6-5. Timing of Salmonid Life Stages in Morse Creek

Species	Fresh-water Life Phase	Month												
		J	F	M	A	M	J	J	A	S	O	N	D	
Summer-Fall Chinook	Upstream migration													
	Spawning													
	Intragravel develop.													
	Juvenile rearing													
	Juv. out migration													
Coho	Upstream migration													
	Spawning													
	Intragravel develop.													
	Juvenile rearing													
	Juv. out migration													
Pink	Upstream migration													
	Spawning													
	Intragravel develop.													
	Juvenile rearing													
	Juv. out migration													
Chum	Upstream migration													
	Spawning													
	Intragravel develop.													
	Juvenile rearing													
	Juv. out migration													
Steelhead	Up. Mig.													
	Spawning													
	Int. Dev.													
	Juv. Re.													
	Juv. O.M.													

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