2.9 EAST STRAIT CLALLAM INDEPENDENT DRAINAGES

Characterizations of the streams in the East Strait (Figure 2.9-1) are based primarily on information developed during the Limiting Factors Analysis (Haring, 1999). There has been little additional or independent characterization work (such as Perry, 2001 for West WRIA 18) done for these smaller, East WRIA 18 watersheds outside the Dungeness watershed itself—and characterization of them has not been a component of this 2514 planning process.

2.9.1 Meadowbrook Creek (WRIA# 18-0020)

Meadowbrook Creek is a relatively small low elevation drainage immediately east of the mouth of the Dungeness River that historically drained variably into either the mouth of the Dungeness River or directly to Dungeness Bay. It is fed by steep-gradient groundwater discharge from the north slopes of the Olympic Mountains and drains a watershed of only 0.5 mi^2. The stream is generally low gradient, with limited flushing capability. This tributary, located near the mouth of the Dungeness River, is identified in the 1855 depiction as being an independent tributary to Dungeness Bay (Figure 23, Haring 1999). In recent years, the mouth of Meadowbrook Creek has been either tributary to the lower Dungeness, or opening into Dungeness Bay immediately adjacent to the Dungeness River. In the spring of 1999, shoreline erosion east of the mouth of the Dungeness River broke through a meander in lower Meadowbrook, moving the mouth of the creek approx. 1,400 ft. to the east, and eliminating 15 acres of intertidal estuary from direct connection with Meadowbrook Creek. The mouth now opens directly into Dungeness Bay.

Fish and Habitat

No fish access concerns are identified.

Floodplain

Historic wetland function in the lower 1,000 yards of the stream has been significantly altered by channelization and fill associated with adjacent land uses (primarily agriculture). Prior to construction of the levees along the lower Dungeness River, Meadowbrook Creek was heavily influenced by flooding in the Dungeness. Construction of the dike on the lower Dungeness has dramatically reduced the sediment loading and also eliminated dramatic increases in stream energy previously associated with floodwaters from the river. The loss of these processes may be a causal factor of the erosion/loss of estuary that is occurring at the mouth. The Sequim-Dungeness Way bridge at the mouth of Meadowbrook Creek severely restricts tidal flux as well as floodplain function. Increasing the span of the bridge would help restore floodplain function.

Channel Condition/Substrate

Pool presence throughout Meadowbrook Creek is characterized as poor (Randy Johnson). LWD is reported to be totally depleted, except for a few short sections where LWD has been placed (Haring 1999).

Riparian

Haring (1999) characterizes the riparian condition in Meadowbrook Creek as poor, with a lack of woody vegetation in most areas. Uncontrolled animal access, adversely affecting physical habitat features and water quality, is of major concern upstream of the Sequim-Dungeness Road, and in some areas downstream of the Sequim-Dungeness Road.

Estuarine

Whether Meadowbrook Creek is a tributary to the Dungeness River or an independent drainage to Dungeness Bay has alternated over time. The connection of the lower creek to the Dungeness River was severed in 1999, as the berm separating the creek from Dungeness Bay was breached by marine water. The previous estuarine slough portion of the lower creek is now disassociated from the creek. Estuarine habitat could be improved with a widening of the Sequim-Dungeness Way bridge, which would increase tidal flux upstream of the bridge.

Water Quality

Water temperature in Meadowbrook Creek exceeds optimal levels for salmon spawning and rearing (Joel Freudenthal). It is classified as a Class A water body.

Water Quantity

Meadowbrook Creek was listed for low flow on the SWSL list in 1971. Recently, instream flow recommendations have been made for Meadowbrook Creek, based on toe-width measurements made at Sequim-Dungeness Way. These recommendations are included as part of Section 3.3.2. Toe-width is primarily influenced by bank-full flows in winter months. However, it may be additionally influenced in this watershed by groundwater returns (that are themselves influenced by irrigation recharge), as well as by past land use. Instream flows in Meadowbrook Creek may be influenced by groundwater return flows from irrigation. The limited flow data that is available for Meadowbrook Creek was not reviewed to ascertain consistency with recommended instream flows. The Department of Ecology is currently conducting scientific research (collecting water quality and flow information) on Meadowbrook Creek (Cynthia Nelson).

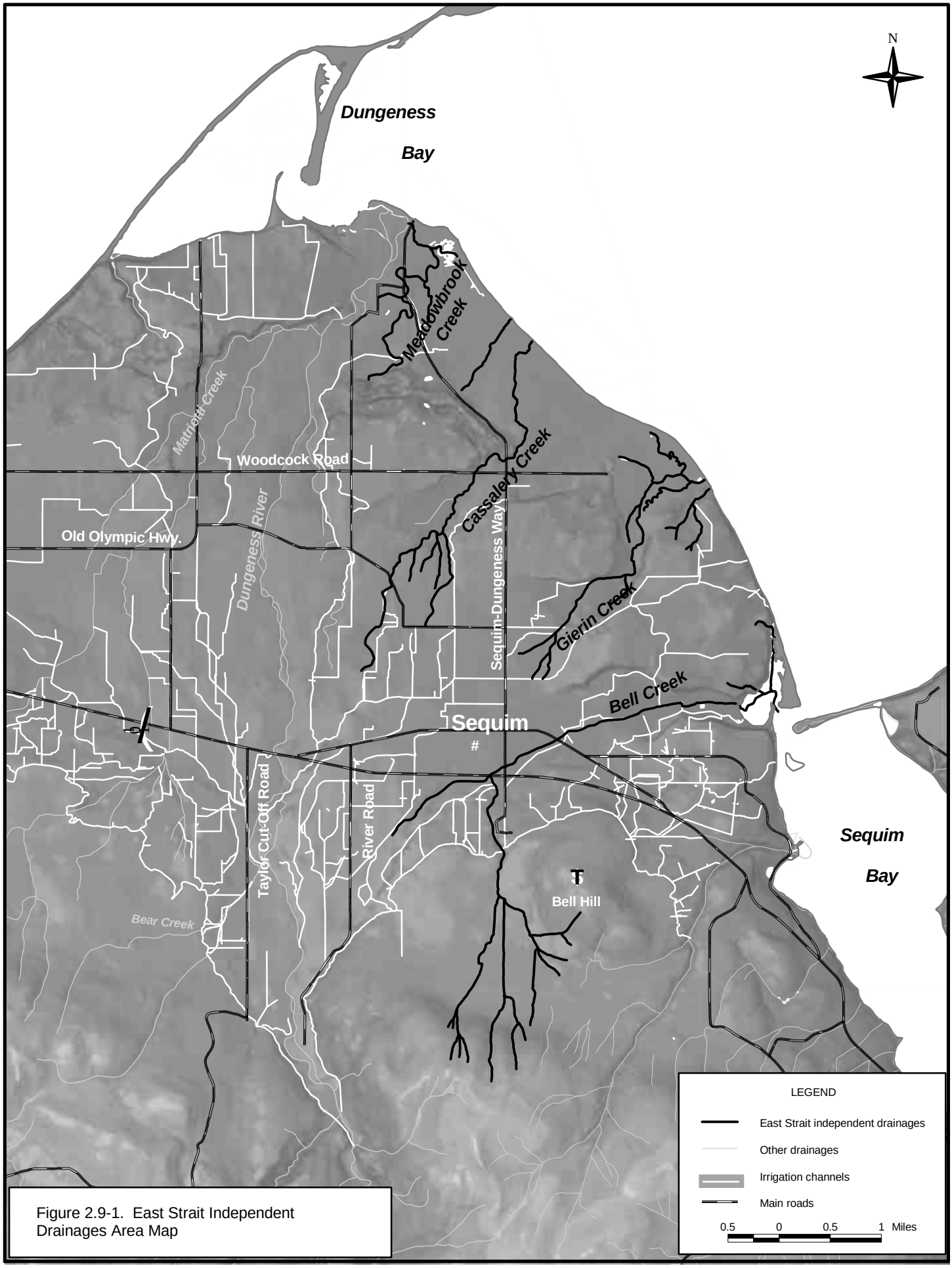

Figure 2.9-1. East Strait Independent Drainages Area Map

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2.9.2 Cooper Creek (WRIA# 18-0017)

Cooper Creek is a relatively small independent drainage on the east side of the Dungeness plain, entering salt water between Sequim Bay and the Dungeness River. It is fed by steep-gradient groundwater discharge from the north slopes of the Olympic Mountains. Cooper Creek is a short (approximately one mile) drainage that has similar characteristics to other neighboring drainages, draining low elevation areas and being affected by irrigation from the Dungeness River.

Fish and Habitat

Juvenile coho salmon and adult cutthroat trout have been observed in the lower watershed (Randy Johnson). Prior to 1995, a tide gate at the mouth of Cooper Creek was an approximately 95% barrier to fish ingress and a total barrier to tidal flux. In 1995, a small portion of the tide gate (about 1-1/2 square feet) was removed to allow fish passage. Significant tidal flux now occurs, and it is assumed that associated fish passage conditions have also improved considerably. A water level control structure (to maintain high water levels to attract waterfowl), located in a tidal channel within the estuary, severely impairs fish access into and out of approximately four acres of salt marsh. No other impediments to fish passage are known to exist in Cooper Creek.

Channel Condition

The majority of Cooper Creek has been channelized. Few good pools and scant LWD exist.

Substrate

No information available.

Riparian

Riparian condition is generally poor, composed primarily of reed canary grass, willow, wild rose, and a few alder.

Water Quality

Cooper Creek is classified as a Class A water body.

Estuarine

Tidal flux into the Cooper Creek estuary was only partially restored by the 1995 tidegate modification project. Approximately 10 acres of salt marsh are being maintained by this tidal action. Salmonid use of the salt marsh could likely be significantly improved by increasing the amount of tidal flux occurring within the estuary.

2.9.3 Cassalery Creek (WRIA# 18-0015)

Cassalery Creek is a relatively small independent drainage to salt water on the east side of the Dungeness plateau, entering salt water between Sequim Bay and the Dungeness River. It is approximately 4 miles in length, draining a 3.2 mi^2 watershed of low elevation land on the east side of the lower Dungeness Valley. Cassalery Creek is fed by steep-gradient groundwater discharge from the north slopes of the Olympic Mountains. The stream itself is low gradient, with low velocity flows, flowing primarily through rural agricultural land. The Clallam Conservation District has implemented several habitat improvement/fencing projects, and more are planned.

Fish and Habitat

Cassalery Creek has historically supported coho and chum salmon, steelhead, cutthroat and rainbow trout, and dolly varden. Adult salmon access was impaired by a culvert near the mouth until approximately 1990 (PSCRBT 1991). The culvert, which extends through the natural beach berm at the mouth of Cassalery Creek, has been modified to allow salmon access. However, the culvert frequently plugs, especially during winter storms, creating an obstruction to flow. Salmon have been seen in the vicinity of the outlet (Haring, 1999), and salmon and steelhead have been observed spawning upstream of Jamestown Road by Conservation District personnel.

The partially blocking culvert under Jamestown Road was replaced with a bottomless arch by Clallam Conservation District in 1999. This should decrease the large sediment accumulation that formerly occurred upstream. Streamkeepers report that the culvert at reach #2 (Taylor Ranch Rd., RM 1.1) has a “precipitous drop”, but the impacts to fish passage are unspecified. The problem appears to be associated with the gradient within the culvert; the downstream end was surveyed (September 1998, normal streamflow) as being approximately five inches below water level (Paul Hansen CCD). Streamkeepers also indicates that there are four culverts north of Woodcock Rd., with the lower two obstructing fish passage. Specific culvert fish passage assessments and extent of habitat availability are currently unavailable.

Floodplain Modifications

Most of the length of Cassalery Creek below the springs has been artificially straightened and confined. The Creek is severely channelized downstream of Jamestown Road. This channelization, loss of floodplain, and loss of tidal energy has increased sediment accumulations in the channel in the lowermost 0.5 miles of the stream. This is likely further compounded due to frequent clogging of the culvert at the mouth of Cassalery Creek at high flows.

Channel Conditions/Substrate

Streambanks are trampled through much of the watershed due to unrestricted animal access (PSCRBT 1991). Streamkeepers notes that instream habitat is heavily silted and lacks cover, with LWD presence only in the lower portion of the stream. The Clallam Conservation District completed a habitat restoration project in the reach from Jamestown Road upstream in 1999, including replacement of the culvert under Jamestown Road with

a bottomless arch, removal of silt, placement of stream gravels, placement of LWD, construction of pools, and fencing to exclude cattle access.

Streamkeepers reports the creek north of Jamestown Road is overgrown with vegetation and heavily silted from past upstream activity. There is little gravel substrate, and dense willow and other vegetation blocks segments of the stream. Benthic macroinvertebrate sampling conducted by Streamkeepers, looking at number of taxa and EPT richness, scored as poor.

Riparian

The PSCRBT (1991) indicated a lack of good riparian cover throughout Cassalery Creek. Streamkeepers indicates that canopy varies widely, from zero canopy cover in two of the sampled reaches to 85% cover in the downstream sample reach (with only 30% conifers). No riparian widths were identified. Even the downstream sample reach would likely rank as poor using standard habitat ranking criteria, due to the low occurrence of conifer in the riparian area.

Water Quality

Cassalery Creek is designated as a Class AA water body. The creek provides estuarine habitat, clams, waterfowl habitat, bald eagle habitat, irrigation conveyance, and is listed for aesthetic beneficial use. It is listed on the Clean Water Act 303(d) list for fecal coliform contamination (Ecology 1998). Other nonpoint issues listed by the *Dungeness River Area Watershed Management Plan* include nutrients, lack of vegetation, and animal access. The PSCRBT (1991) reported that water quality in Cassalery Creek is adversely affected by direct animal waste input due to unrestricted animal access to the channel. Nitrate results are suggestive of increased nutrient loading, but the accuracy is in doubt (Streamkeepers). Dissolved oxygen sampling indicated a high of 13 mg/L, a low of 9.3 mg/L, and an average of 10.2 mg/L; temperature sampling indicated a high of 14.9^0C, a low of 8^0C, and an average of 11.3^0C.

Water Quantity

Cassalery Creek is predominantly spring-fed, with limited inputs from the irrigation system; flow is fairly uniform throughout the year. Streamkeepers noted increasing use of creek water by landowners for irrigation purposes and for maintenance of ponds, but noted a lack of data on effects to instream flow. North of Jamestown Road, there are several man-made diversions which divert stream flow into the adjacent fields. The creek was listed for low flow in 1985 and residents of the upper watershed reported low or no flow in the creek in the summers of 1999 and 2000. Figure 2.9-2 presents the overall hydrograph for Cassalery Creek.

Instream flow recommendations, based on toe width measurements taken at Woodcock Rd., have been developed for Cassalery Creek. These recommendations are included as part of Section 3.3.2. Toe-width is primarily influenced by bank-full flows in winter months, however it may be additionally influenced in this watershed by groundwater returns (that are themselves influenced by irrigation recharge), as well as by past land use. The limited

flow data that is available for Cassalery Creek was not reviewed to ascertain consistency with recommended instream flows.

Estuarine

The culvert at the mouth of Cassalery Creek (~100 feet in length) is thought to significantly alter estuarine conditions at the mouth of the creek. It is unclear whether Cassalery Creek historically had open flow to Dungeness Bay at all flows, or whether it may have been similar to other streams in this area, which have natural sand berms that, at low flow levels, isolate these creek flows from surface connection to salt water. In either case, the stream would likely have naturally formed a wetland pond/marsh on the upstream side of the berm. The presence of the culvert likely alters the natural tidal influx and exchange process, limiting estuarine conditions that would be beneficial to salmonids, although the extent of limitations is unknown. However, the loss of natural estuarine conditions may be balanced to some extent by the free passage conditions to salt water at all flows. The culvert frequently plugs, especially during winter storms, flooding the area upstream for at least 1,200 feet and as much as one-half mile wide. Following these plugging episodes, the culvert has to be manually cleared by downstream landowners (Streamkeepers). These obstructions occur most frequently at spawning season and, although salmon have been seen in the vicinity of the outlet, none have been observed to traverse it. Potential juvenile stranding and mortality that results from the ponding effect is unknown. Estuarine restoration potential would likely be dependent on acquisition of the McGinnis farm at the mouth of the creek (Haring, 1999).

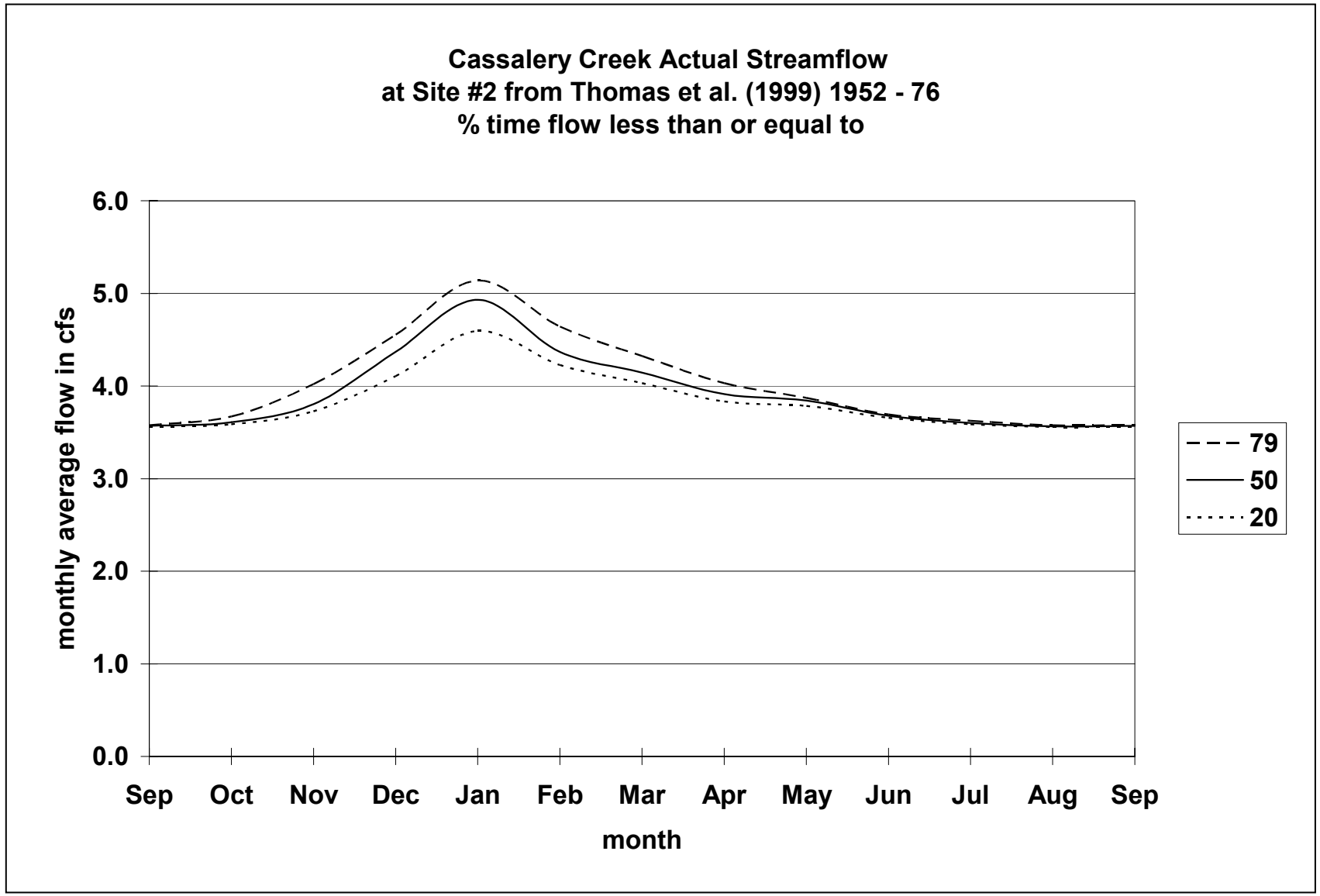

Figure 2.9-2. Cassalery Creek Hydrograph. Recent data indicate these flows are overestimated.

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2.9.4 Gierin Creek (WRIA# 18-0004)

Gierin Creek is a relatively small independent drainage on the east side of the Dungeness plain, entering salt water between Sequim Bay and the Dungeness River. It is fed by steep-gradient groundwater discharge from the north slopes of the Olympic Mountains. There are 8.3 miles of streams and tributaries in the 3.1 mi^2 Gierin Creek watershed. Primary land uses in the watershed are pasture/grassland (2%) and commercial timber (19%) (PSCRBT 1991).

Once a saltwater marsh, the mouth of Gierin Creek is artificially maintained as a freshwater marsh today by the presence of a tidal gate. The majority of the lower portion of the Gierin Creek watershed is in single, private ownership and called “Graysmarsh”, which is the approximately 140-acre fresh/brackish water marsh maintained by the tidal gate and associated agricultural uplands. The size of the marsh may be similar to historic, but the tide gate was installed at the mouth of the creek in approximately 1919 for agricultural purposes. In contemporary times, Graysmarsh has been managed exclusively for wildlife and fish habitat. Livestock are not allowed access to the marsh, nor do any agricultural practices occur within the marsh. There is some agriculture on Graysmarsh uplands immediately adjacent to its marshlands.

Fish and Habitat

Gierin Creek historically supported coho and chum salmon, steelhead, cutthroat and rainbow trout, and dolly varden. Currently, a fish ladder provides unrestricted adult salmonid passage at Victoria Falls at RM 1.3, although the ability of juvenile salmonids to pass upstream through this ladder is not known at this time. A tidegate, located at the mouth of Gierin Creek, may impair fish passage at certain tidal stages, although a significant amount of salt water passes through the tide gate. Adult salmon have also been observed upstream of the tidegate. In addition to impairment of fish passage, the primary effect of the tidegate is that salt water interchange with the historic estuary is severely limited.

Floodplain

The floodplain of Gierin Creek is generally intact. However, the main channel of Gierin Creek historically bisected the marsh, with the outlet at the northeast corner of the marsh. But this lower main channel was rerouted to an alignment along the southern edge of the marsh and its discharge was moved to route through the current location of the tidegate. This has disassociated much of the intertidal flow from the historic saltmarsh area. With loss of flow through the historic saltmarsh channels, they tend to accumulate sediments and periodically need to be dredged to remove accumulated sediment and vegetation, and to retain open water characteristics in the channels.

Channel Conditions

Streambanks throughout portions of the upper drainage are trampled due to unrestricted animal access. South of Holland Road, the stream corridor is seriously degraded as a result of animal access, channelization, and residential development (PSCRBT 1991). The channel is generally lacking LWD, except for some presence in the forested reaches through Graysmarsh and in isolated locations where LWD has been placed. Pools are

also generally non-existent upstream of RM 1.5, except for isolated locations where pools have been dug as part of stream restoration efforts (Haring, 1999).

Substrate

No information available.

Riparian

Riparian condition is considered to be generally good through Graysmarsh to RM 1.5. The channel flowing through the wooded area on the south side of the marsh likely has more canopy cover than the historic natural channel, which flowed diagonally across the marsh (which would have had limited tree cover). Most of Gierin Creek downstream of Port Williams Road has been fenced to exclude livestock. Some problems with stock access to the channel continue upstream of Port Williams Road, although this is not continuous. Riparian habitat from Holland Road to Port Williams Road is generally poor, but stock have been excluded and riparian planting has been done. Riparian habitat upstream of Port Williams Road is poor to non-existent (Paul Hansen).

Water Quality

Gierin Creek is designated as a Class AA water body. It provides beneficial uses in estuarine habitat, clams, waterfowl habitat, aesthetics and recreation. Nonpoint issues listed by the *Dungeness River Area Watershed Management Plan* include bacteria and nutrients, animal access, residential development, channelization and lack of a vegetative buffer. Water quality is adversely affected by direct animal waste input due to animal access to the channel (PSCRBT 1991), although animal access issues are thought to be generally corrected downstream of Holland Road (Paul Hansen; Haring 1999). Animal access to the stream remains a concern upstream of Holland Road. Dredging of channels in Graysmarsh has been done on a periodic basis to remove vegetation and sediment that obstruct the channels. This may be in part due to increased sediment and nutrients from animal access and pasture runoff upstream of Graysmarsh, but is also a consequence of decreased tidal flux into the estuary.

Water Quantity

Flows in Gierin Creek are thought to be heavily influenced by groundwater return flows from irrigation diversions from the Dungeness River. Irrigation conservation in the Dungeness River and reduction in the amount of irrigated acreage have likely resulted in decreased flows in Gierin Creek, particularly during low flow periods. Figure 2.9-3 presents the overall hydrograph for Gierin Creek.

Instream flow recommendations, based on toe width measurements taken at Holland Rd., have been developed for Gierin Creek. These recommendations are included as part of Section 3.3.2. As noted above, instream flows are influenced by groundwater return flows (that are themselves influenced by irrigation recharge). Toe-width is primarily influenced by bank-full flows in winter months, however it may be additionally influenced in this watershed by groundwater returns and past land use. The limited flow data that is available for Gierin Creek was not reviewed to ascertain consistency with recommended instream flows.

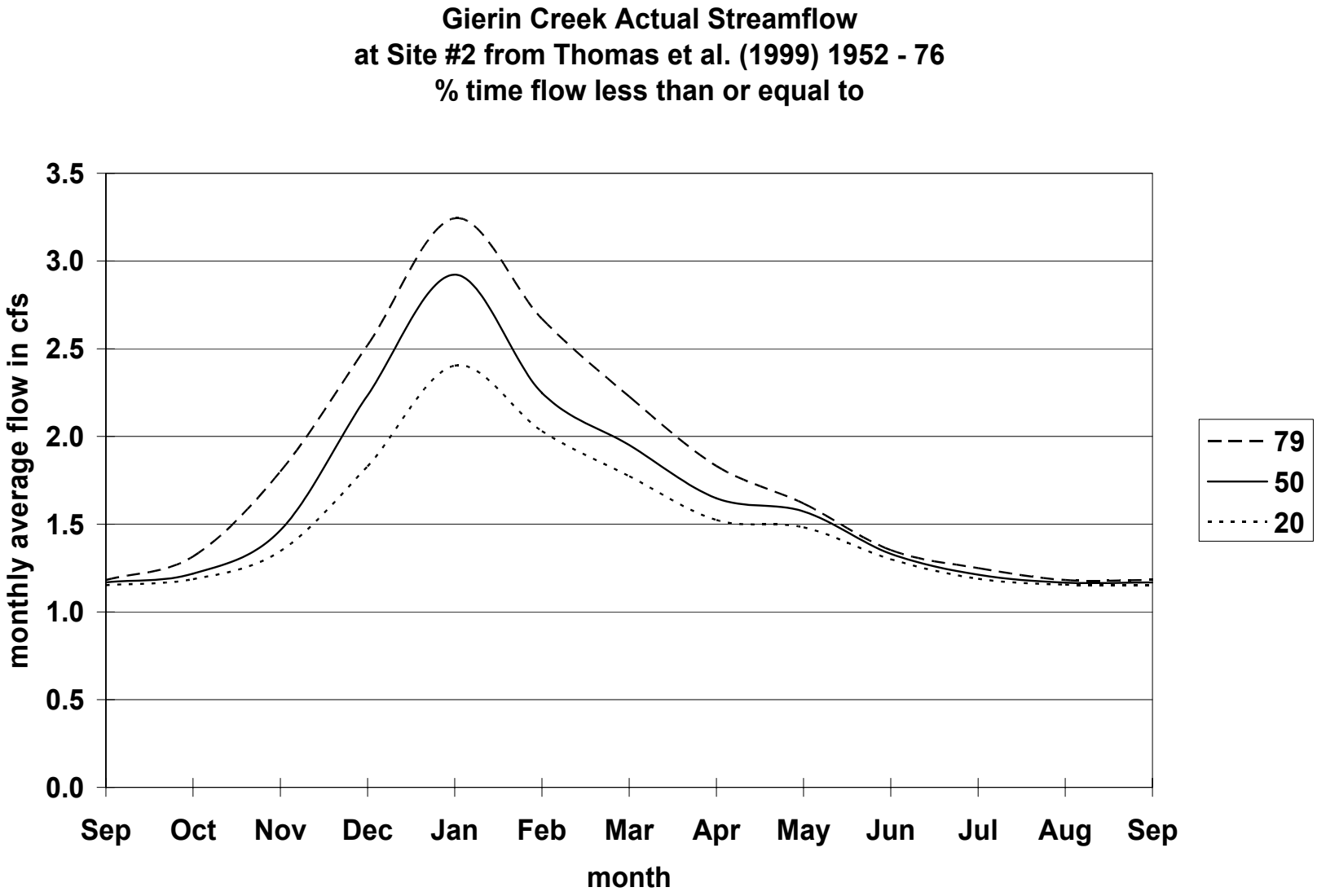

Figure 2.9-3. Gierin Creek Hydrograph. Recent data indicate these flows are overestimated.

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Estuarine

Evidence indicates that at least 115 acres of Graysmarsh were once saltmarsh (Randy Johnson). This area provided estuarine rearing habitat for Gierin Creek salmonids, and also likely was used for rearing by juvenile salmon originating from neighboring watersheds. As a result of the tidegate at the mouth of the estuary, only approximately 30 acres of salt marsh remains. The remaining salt marsh is also not well linked to the stream corridors. As a result of the decreased tidal interchange, channels in the estuary marsh tend to fill with sediment. Dredging of the channels has been conducted on a periodic basis to retain the open water channels for duck habitat. WDFW and the Jamestown S'Klallam Tribe have recommended that Graysmarsh owners consider removing the tidegate, allowing the saltmarsh habitat to naturally restore. In addition to benefits to salmon, steelhead, cutthroat, and possibly waterfowl, this would allow sediment to move through the marsh, reducing or eliminating the "need" for maintenance dredging.

2.9.5 Bell Creek (WRIA# 18-0001)

Bell Creek is a relatively small independent drainage to salt water on the east side of the Dungeness plain, entering Washington Harbor on the marine shoreline just outside (north) of the mouth of Sequim Bay. It is 3.8 miles long and drains a watershed of over 3100 acres (8.9 mi^2). Bell Creek flows from the uplands of Happy Valley and the north flank of Burnt Hill through the eastern portion of the City of Sequim and into a lagoon at Washington Harbor. During at least one time in its geologic history, it is believed to have been the active channel of the Dungeness River. In more recent times, it probably operated as an ephemeral stream fed by precipitation runoff. Bell Creek has served historically as a conveyance channel for irrigation water. Much of the creek has been heavily altered by rural and urban development. The lower 2.0 miles of Bell Creek are channelized and the lower 0.25 mile is diked. The creek is thought to be primarily spring fed, with stable flows and a limited floodplain.

A wetland complex at the base of Bell Hill was connected to the creek for efficient irrigation water transfer. An unscreened irrigation diversion is said to take up to half the flow of the creek (Haring 1999).

Fish and Habitat

Bell Creek supported spawning coho salmon as recently as 1998. Based on WDFW smolt trapping data, coho, steelhead, and cutthroat trout numbers are increasing in the creek. Some reports suggest the creek may support chum salmon and bull trout.

The Jamestown S'Klallam Tribe commissioned a habitat inventory (De Lorm 1999) that provided an inventory of basic habitat features of Bell Creek, from the mouth to the headwaters. In addition, the project intent was to map past, current, and planned projects that have occurred along the stream corridor and to assess the cumulative impacts of the various actions on each other and on the watershed as a whole. Upstream anadromous passage is blocked by a natural waterfall at RM 3.0 and one fork is reported to be completely obstructed by blackberries and reed canary grass (De Lorm 1999). De Lorm also reported that the upper creek has excellent habitat throughout the confined Happy Valley area, from its headwaters to the point at which the irrigation ditch joins it, east of Third Avenue in Sequim. De Lorm states that an unnamed drainage joins the creek at the waterfall (RM 3.0), adding considerable flow. Above the waterfall she reports that the creek often dries out and canopy coverage is poor. Below the point at which the irrigation ditch joins, the creek is more disturbed, although a number of improvements have been made from the mouth of the creek to Bell Creek Plaza. Vegetation completely obstructs the creek in several places in this reach.

Although several culverts are identified in De Lorm (1999), it does not appear the culverts were evaluated for fish passage. However, De Lorm found many small fish (species unidentified) in the confined reach extending from the fork at RM 2.0 to Happy Valley. A culvert at the outlet of the lower pond at Carrie Blake Park (~RM 1.4), which was previously identified as a barrier, has been removed and passage may no longer be a concern at this site (TAG).

Fish passage is also affected by low flow conditions. Lack of instream flow is identified as a fish passage concern in the vicinity of Carrie Blake Park. In addition, local fisheries

biologists identified a chronically unscreened irrigation diversion just upstream of Carrie Blake Park, which diverts up to 50% of the water in Bell Creek. The diversion operation and water use are by separate groups (landowner and City of Sequim), creating conflicts in headgate operation coordination. The HB 2514 Watershed Planning Unit should investigate alternatives to maintain instream flow in Bell Creek, and the Departments of Ecology and Fish & Wildlife should ensure enforcement of the screening requirements on the irrigation diversion, to ensure that juvenile and adult fish are not entrained in the irrigation diversion.

Several segments of lower Bell Creek (downstream of the forks at RM 2.0) and the fork that flows under and along Third Avenue in Sequim are reported to be completely obstructed due to presence of blackberries and reed canary grass (De Lorm 1999). It is unknown to what extent these areas may preclude upstream adult salmonid passage or strand juvenile salmonids.

Floodplain

The configuration of Bell Creek is likely altered from historic condition. Joel Freudenthal indicates that Bell Hill historically drained to a wetland complex at the base of the hill, where the drainage then soaked into coarse sediments that are the remnant of a prehistoric channel of the Dungeness River. It is thought there was no historic direct surface water connection between this wetland and the headwaters of Bell Creek. Historically, Bell Creek is thought to have been primarily spring fed, with stable flows and limited floodplain. This former wetland and agricultural area has been wholly replaced with urban land uses within the City of Sequim. Much of the historic wetland complex at the base of Bell Hill has been eliminated, and runoff has been routed directly, via surface water channels, to Bell Creek, increasing flow fluctuation. The wetland complex was connected to Bell Creek to provide for efficient transfer of irrigation water from the Highland and other irrigation systems to the Bell Creek system. Historic maps (1957 USGS topo) also show a tributary to Bell Creek originating in the vicinity of the Silberhorn Road intersection with River Road, near the Dungeness River. This tributary was also constructed as an irrigation ditch connection to Sequim Prairie and Bell Creek, to irrigate one of the most productive soil types in the valley.

The lower 2.0 miles of Bell Creek are channelized, and the lower 0.25 miles are diked, effectively eliminating the stream's connection to its floodplain and estuarine wetlands and increasing stream energy during high flows. In 1999, Clallam County completed a restoration project on a previous dairy farm in the estuary, which included removal of two marine dikes and construction of several estuarine channels. Immediately upstream of the estuary the stream is channelized for approximately 800 feet. Upstream of this channelized section, the stream has been remeandered, and/or restored (with LWD added, riparian fencing, and riparian plantings) to its natural location for approximately the next 4,000 feet by Clallam County, Clallam Conservation District, and WDOT as mitigation for the Sequim Bypass. Portions upstream of that point (within the City of Sequim), have also been remeandered, but the majority of the streambed remains channelized (in the former floodplain of the Dungeness River) until the creek enters the ravine section. The Bell Creek watershed is in an area that is rapidly being developed. There is currently a development proposal upstream of Highway 101, where the developer is indicating a

desire for channel reconstruction. Channel reconstruction may be beneficial, but the developer is proposing that only a small riparian buffer would be provided.

Channel Condition

Within the anadromous use zone, all areas that have not previously been restored are extremely deficient in LWD and pools (Haring 1999; Randy Johnson, WDFW). Specific reaches that have been identified as deficient in LWD are noted on LFA maps.

Substrate

Gravel substrate condition is good in certain areas in the stream, particularly in the lower system from RM 0.4-0.6. However, the channel bed downstream of Schmuck Road is heavily cemented with fines. The sediment transport capacity is low, as the creek does not flood much and the natural gradient is low. Local governments should take actions so that adequate stormwater protection is implemented to ensure that natural hydrology is maintained as this watershed is developed.

Riparian

De Lorm (1999) reports the riparian condition to be generally poor throughout much of the length of Bell Creek. There are, however, some segments where the canopy coverage remains generally good. From the mouth to Schmuck Rd., there are some alders 1-4' diameter and a few small Douglas fir (planted in 1989), but the riparian condition is generally poor and non-functional.

Water Quality

Bell Creek is designated as a Class AA water body. It is listed on the Clean Water Act Section 303(d) list of impaired waterbodies, based on elevated fecal coliform counts (Ecology 1998). Although fecal coliform is not known to directly affect salmonids, it is often an indicator of other water quality impacts in the watershed that can adversely affect salmonids. These other impacts include direct animal access to the channel (which affects riparian condition and bank stability), high fine sediment levels in the substrate from stormwater and agricultural runoff, and high nutrient levels in the stream which may cause excessive plant growth and reduce dissolved oxygen levels. Water quality has been most impacted to date by unrestricted animal access in the watershed; however, there is increasing concern about stormwater as urban/rural development occurs in the watershed.

Stormwater runoff due to land development has increased significantly. A proposal has been made to release treated Class A water during winter (and a smaller amount during summer) from the City of Sequim wastewater treatment plant.

Water Quantity

Flows in Bell Creek are heavily influenced by groundwater return that is, in turn, influenced by recharge from the irrigation network that originates with the Dungeness River. Reduction of irrigation acreage and reduced conveyance loss through leakage have decreased groundwater infiltration to Bell Creek, particularly during low flow periods, with an associated reduction in surface water flows. During low flow periods, instream flow is

further compromised by a chronically unscreened irrigation diversion just upstream of Carrie Blake Park, which diverts up to 50% of the water (see Fish and Habitat section above).

Stormwater runoff from developed areas is an increasing concern in Bell Creek, with increased incidence of flood events in Sequim in recent years. Effects of stormwater runoff are expected to increase significantly as the basin is further developed. The primary impacts at this time are from runoff from the Bell Hill development. Local governments should ensure that natural hydrology in the Bell creek watershed is maintained as the watershed is developed.

A proposal to release treated Class A water from the City of Sequim wastewater treatment plant to Bell Creek is currently under consideration. The proposal is to release 0.6 cfs of water into Bell Creek during winter months, and approximately one-tenth of that during summer months (Cynthia Nelson). Although augmentation of summer low flows may benefit salmonids in Bell Creek, there are a number of concerns associated with this proposal that should be thoroughly considered. The release of treated water in winter months has the potential to increase both the frequency and magnitude of storm flows, which are already identified as a concern in Bell Creek. This proposed release also has the potential to alter the channel characteristics created by the bank-full flow, altering habitat conditions for salmonids. Release of water during summer months should also be reviewed, to ensure that the temperature of the released water will not adversely affect salmonids.

The Highland Irrigation ditch intercepts stormwater runoff from several gullies, and the ditch has a history of bursting, releasing high flows and large amounts of fine sediment into Bell Creek. Although this typically occurs upstream of the anadromous access area, the downstream channel is impacted by the instantaneous increase in flow and the significant downstream sedimentation that results. Figure 2.9-4 presents the overall hydrograph for Bell Creek.

Instream flow recommendations have been developed for Bell Creek, based on toe width measurements taken at Schmuck Rd. These recommendations are included as part of Section 3.3.2. As noted above, instream flows are influenced by groundwater that is, in turn, influenced by irrigation recharge. It is likely that toe width of the channel has increased due irrigation groundwater return flow and routing of stormwater through the irrigation delivery system to Bell Creek, artificially increasing peak flow frequency and magnitude in the channel. The limited flow data that is available for Bell Creek was not reviewed to ascertain consistency with recommended instream flows.

Estuarine

Washington Harbor, a broad intertidal estuary at the mouth of Bell Creek, likely once provided intertidal estuarine habitat for salmonids. Intertidal water exchange to the north end of the harbor was significantly restricted by the construction of 650-foot fill causeway across the tidelands to support the Sequim Wastewater Treatment Plant outfall. The causeway construction resulted in the direct loss of approximately 0.3 acres of intertidal area. The lower portion of Bell Creek, prior to entry into Washington Harbor, has been diked and highly confined for many years. This effectively eliminated stream and tidal interchange with the floodplain and historic saltmarsh habitat. However, in 1999 Clallam

County completed a restoration project on a previous dairy farm in the estuary, which included removal of two marine dikes and construction of several estuarine channels. This is expected to restore estuarine wetlands adjacent to the stream's mouth, but the stream itself remains diked in this area and is not functionally connected to its estuary. The northern end of Washington Harbor is adversely impacted by the presence of a road and dike across the harbor.

An additional 10 to 12 acres of intertidal estuary in the north end of the bay has been adversely affected by reduction of tidal flux and hypersalinity resulting from reduced tidal exchange. Although tidal flow access was maintained through culverts, Haring (1999) conjectures that these limit juvenile salmon access. The area provides significant shorebird habitat and once supported a large eelgrass bed to the north, which has been eliminated by the causeway. The north end of the estuary appears to be filling with sediment, as transport is also severely limited by the causeway (Haring 1999).

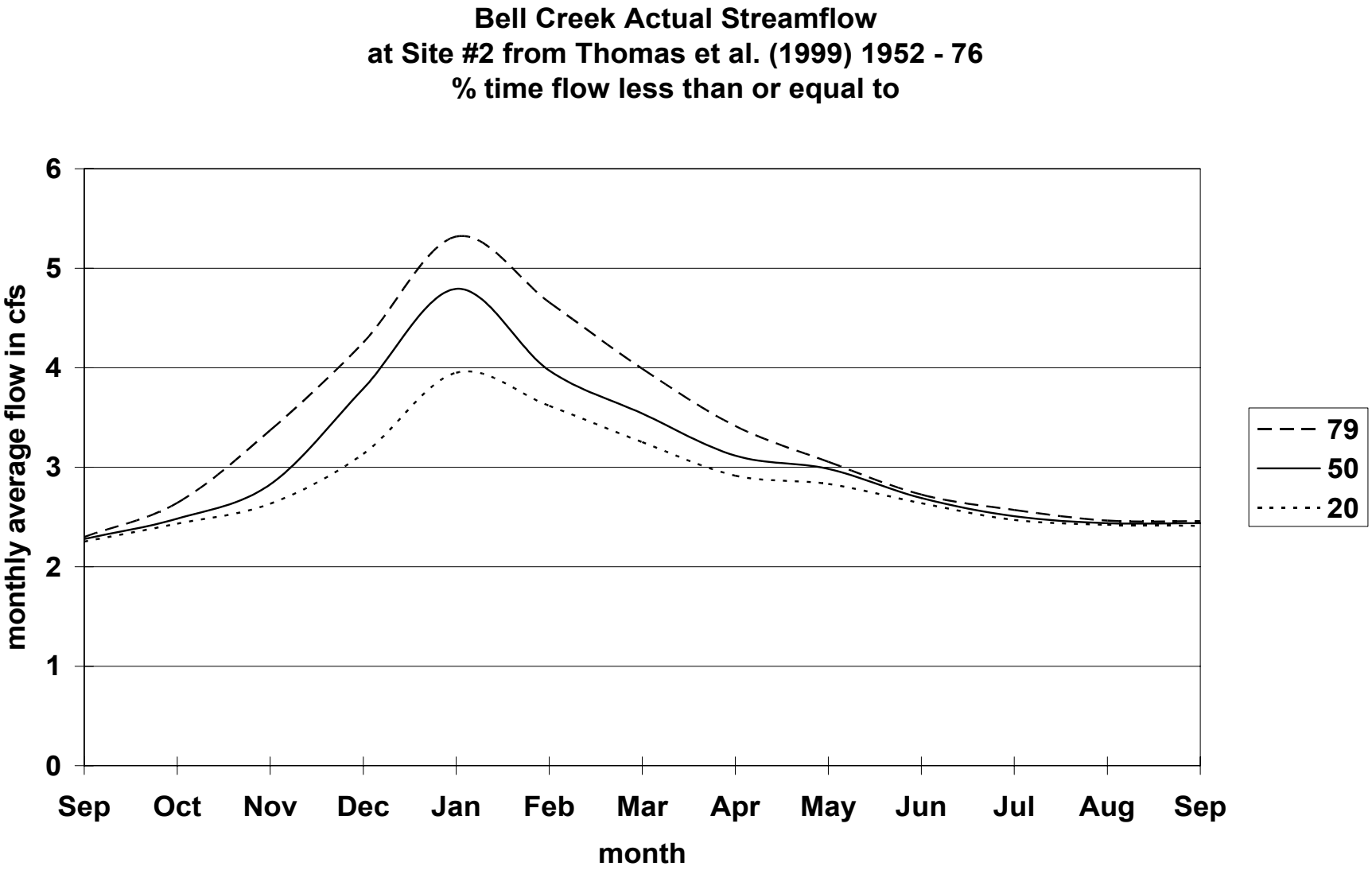

Figure 2.9-4. Bell Creek Hydrograph. Recent data indicate these flows are overestimated.

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