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STILLAGUAMISH RIVER BASIN INSTREAM RESOURCES PROTECTION PROGRAM INCLUDING PROPOSED ADMINISTRATIVE RULES

DRAFT

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

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STILLAGUAMISH RIVER BASIN
INSTREAM RESOURCES PROTECTION PROGRAM
INCLUDING
PROPOSED ADMINISTRATIVE RULES

(WATER RESOURCES INVENTORY AREA)

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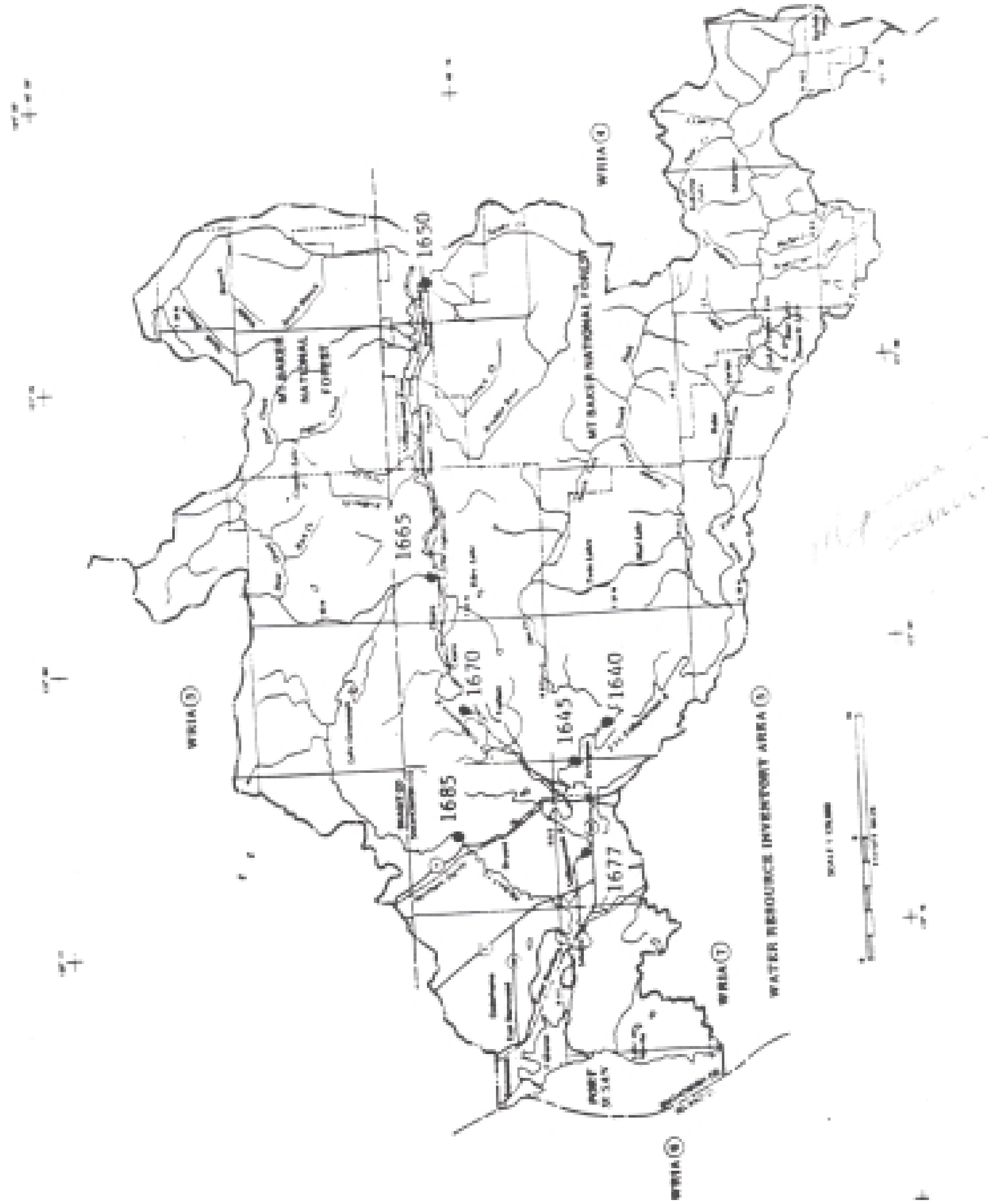
Figure 1



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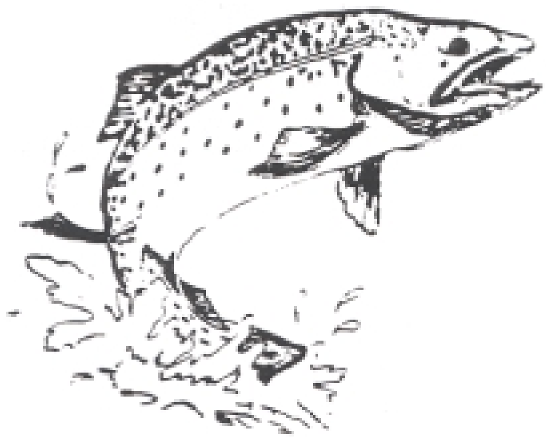


I. STILLAGUAMISH RIVER BASIN INSTREAM RESOURCE PROTECTION PROGRAM OVERVIEW

The Stillaguamish River Basin Instream Resource Protection Program proposes to establish specific instream flow levels and stream closures to protect the instream resources of fish, wildlife, water quality, navigation, recreation, scenic, aesthetic and other environmental values. An overall Western Washington Instream Resources Protection Program proposal and Environmental Impact Statement has been circulated to the public and governmental agencies. (Copies are available from Department of Ecology',.,'(DOE), Olympia, WA 98504.) The conceptual approach and technical procedures used to determine the instream flows are outlined in that document.

Authority

The Water Resources Act of 1971 provides that perennial streams and rivers shall be retained with base flows necessary to provide for preservation of wildlife; fish; navigation; and scenic, aesthetic, and other environmental and navigational values. (RCW 90.54.020 (3)(a) 19711. The state may also establish minimum water flows or levels for streams, lakes, or other public waters for the purposes of protecting water quality, fish, game, birds, or other wildlife resources or recreational or aesthetic values (RCW 90.22.010). The base or minimum flows proposed in this program are referred to by the generic name "instream flows."

Public Participation

All interested individuals, private groups, and public agencies are encouraged to comment on any aspect of the recommended measures for streams and lakes in the Stillaguamish River Basin. An ongoing series of coordination meetings has been accomplished with local, county, state, federal, and tribal agencies and interested private ividuals and organizations. Public workshops were held in

Arlington on December 1, 1980 and January 20, 1981. A public hearing will be held in Arlington during March 1981 to receive formal public comments on the program report and the proposed administrative rules.

Planning Assumptions

The first assumption made in the development of the Stillaguamish River Basin Instream Resources Protection Program is that adequate data are available at the present time upon which to develop an instream resources protection program. A second assumption is that no supplemental environmental impact statement (EIS) is required because the overall EIS for the Western Washington Instream Resource Protection Program adequately addresses anticipated environmental impacts that may occur in this basin as a result of the program.

Methodology & Planning

Utilizing the Water Resources Act of 1971 and the Minimum Water Flows and Levels Act of 1969 as the basis for establishing minimum flows, DOE has formulated a planning team to evaluate the water resources of the Stillaguamish River Basin. Contained within the Water Resources Act is the fundamental concept that the quality of the natural environment shall be protected and where possible, enhanced through the retention of sufficient base flows to provide for preservation of wildlife, fish, and other instream values. The fundamental objective in establishing such flows is the protection and preservation of these instream values.

The terms base flows and minimum flows are, for the purpose of this program, synonymous. These are interpreted as levels of flow that can be expected to be exceeded a relatively high percentage of the time. Base or minimum flows as authorized by state law. are referred to generically by the department as "instream flows."

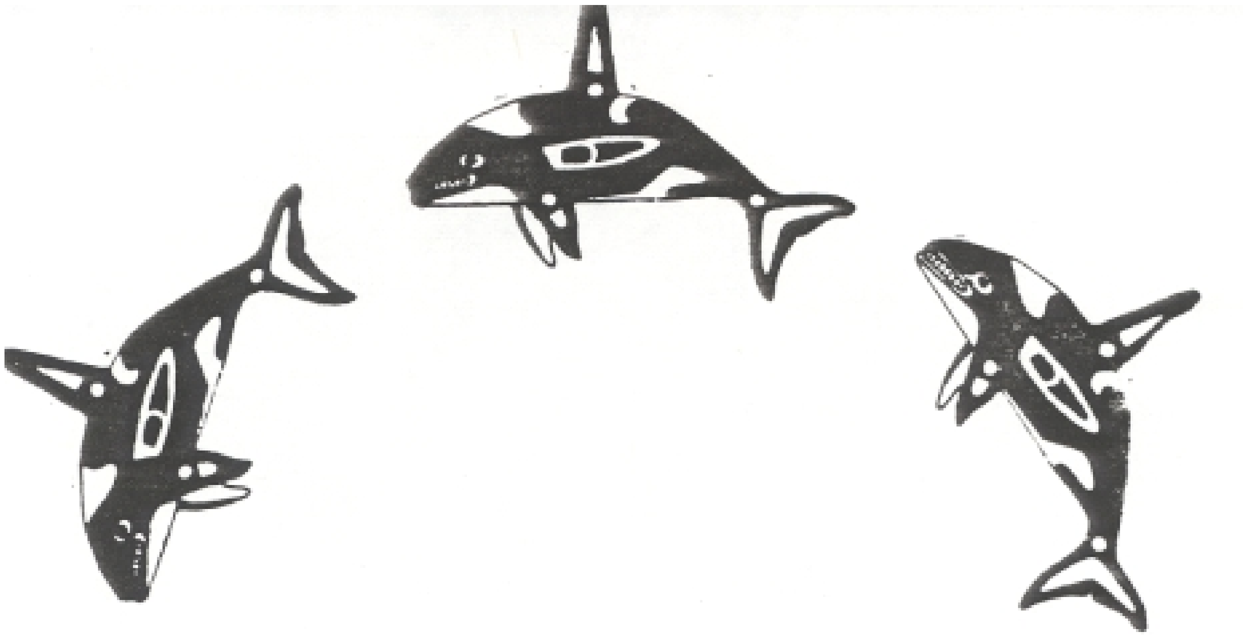
Minimum flows referred to within this program are those flows required to maintain, preserve, and protect existing levels of fish and other aquatic organisms, wildlife, water quality, scenic and aesthetics, and recreational activities to. extent possible commensurate with the human needs for water. (10)

As a first step, the river basin planning team members conduct a comprehensive stream system analysis. Whenever possible, existing stream gage information is used to determine the historic record of stream flows. Appropriate gaging stations chosen as instream flow control stations and are identified by stream name; reach, description; control station number; river mile; and section, range, and township. Next the planning team classifies each stream reach and/ or major tributary as to its importance to the instream resources. Team members rate each stream on a scale of one to four for specific instream attributes that will be considered along with other factors in establishing minimum flows.

Technical water resources information is developed by the planning team engineers in the form of the Basin Technical Bulletin. Of primary importance are the discharge duration hydrographs prepared for each control station. These graphs show the relative year-round expectancy of different levels of stream flow for a specific stream location based on a statistical analysis of the historical stream flow record for that location.

Planning team members representing private, state, federal, and tribal agencies show the available fish habitat for spawning and rearing at various instream flow levels. Socioeconomic aspects, municipal, irrigation, and other out-of-stream use of water is also considered by the team.

Finally, planning team members make recommendations to the Department of Ecology on the minimum flow levels needed to protect fish, wildlife, water quality, scenic and aesthetic, navigation and environmental factors. These recommendations are reviewed by'DOE decision makers and, if accepted, are recommended to the public and the state Ecological Commission in draft form for review and comment. This recommendation is in the form of a draft program report and the proposed administrative rules. In addition to the minimum flows, the draft regulation include sections which adopt past administrative stream closures and low flow limitations, define appropriate new closures, and define management procedures and relationships. Following a 60-day comment period and public hearings, the department incorporates comments and suggestions and seeks additional input and communication with interested parties. The department attempts to respond to all substantive comments and questions in writing. Finally, the final proposed rules are considered for adoption by the director or deputy director of the department in a public adoption proceeding. As the decision-maker, he may adopt



II. ENVIRONMENTAL OVERVIEW

Area Description

The Stillaguamish River system originates in the Cascade Mountains and drains into Port Susan and Skagit Bay. The basin occupies 690 square miles. Located within Skagit and Snohomish counties, the tributaries of this river system extend into Skagit County to the north and the Mt. Baker-Snoqualmie National Forest to the east. The western lowland region is comprised of a large floodplain that consists of approximately 25 square miles of agricultural land. Adjacent gently rolling hills are covered with a mixture of forest, pasture, and residential land. Three small communities, Stanwood, Granite Falls, and Arlington, constituting the major population centers in the basin. The basin is divided into three principle drainages: North Fork, South Fork, and main stem. These subbasins are further divided into the smaller subbasins described on following pages.

SUBBASIN DESCRIPTION

1. Stanwood Subbasin

Rivers

The Stanwood Subbasin encompasses the lowland area adjacent to Port Susan and Skagit Bay, including Hat Slough and the Old Stillaguamish River. The Old Stillaguamish River is an interesting hydrological phenomenon that is connected to the main river only during periods of high flow. Its waters are affected by the tidal action of Skagit Bay and Port Susan. Because of dredging and diking work done on Hat Slough by the Corps of Engineers, most of the river's water now bypasses the Stillaguamish River channel and discharges directly into Port Susan. In general, the low topographical characteristics of the Port Susan and Stillaguamish estuary area have created a relatively slow tidal flushing action. The shallow water around the mouths of the Stillaguamish River delta and the sediment deposits at the mouth of the Snohomish River have caused a poor assimilative capability for the waters of Port Susan to naturally treat and disperse wastes. The velocity of the estuarine waters very widely with the incoming and outgoing tide. (7)

Lakes

There are two important lakes in the Stanwood Subbasin, Lake Howard (27.1 acres), and Lake Martha (58.4 acres). Ninety percent of the land around Lake Howard and 70 percent of Lake Martha are currently developed, with residential development the predominant use for both lakes. The Shoreline Management Master Program has designated the lakes "suburban," as they presently contain extensive amounts of low to medium density residential development and are well-suited for compatible recreational use. (2)

Development

The town of Stanwood is located in the flood region on the banks of the Old Stillaguamish River. The Warm Beach Recreation and Conference area is on Port Susan Bay, south of Hat Slough, near Lake Howard and Lake Martha. The population of this subbasin (approximately 4,400) is steadily increasing with the growth of the two food processing industries. From 1968 to 1973, the manufacturing employment population of Stanwood grew from 494 to 900 people. (2)-i,

Environmental Features

All of the estuarine waters of the Stillaguamish River system are contained in the Stanwood Subbasin. The importance of this area for anadromous fish migration cannot be understated. Both Hat Slough and the Old Stillaguamish River are important brackish water conversion areas. Salmon remain for up to a week in this zone in order to adjust to fresh or saline water conditions. As a result, the water quality has a significant impact upon their rearing, migratory habits, and population. The banks of the estuarine zone are generally low and muddy, and are covered with several species of grass and bash.

Chinook, coho, pink and chum salmon, steelhead and searun cutthroat and Dolly Varden inhabit the estuarine waters of the Stillaguamish. The marine waters of Port Susan are also important for shellfish production. Crabs, shrimp, Pacific oysters, and littleneck, butter, horse, Manila and soft shell clams are in abundance. Flounder and sole inhabit these waters. Port Susan and the estuary waters of the Stillaguamish are used intensively for recreational and commercial purposes. Steelhead fishing is also very popular in this region. (2)

Wildlife in this subbasin ranges from an extensive waterfowl population to numerous varieties of fur animals. The waterfowl species, order of abundance, include mallard, pintail, widgeon and green-winged teal. (2)

2. Pilchuck Subbasin

Rivers

Pilchuck Creek enters the main stem of the Stillaguamish River from the north, encompassing a gourd-shaped area of 52 square miles. The headwaters of Pilchuck Creek contain Lake Cavanaugh at an elevation of 1,016 feet. The flow characteristics of this creek are very sensitive to climatic changes, varying dramatically with rain-fall conditions. The mountains and ridges that surround the upper, reaches of this subbasin lie at an elevation ranging from 2,500 to 4,000 feet. The lower 25 square miles contain a low glacial outwash plain, ranging from 50 feet up to 500 feet in elevation. (2)

Lakes

The most important hydrological feature is Lake Cavanaugh which covers an area of 844 acres. Lake Cavanaugh is the largest lake in the Stillaguamish Basin and is significant as a residential and recreational area. The area surrounding this lake has been extensively logged. Sixty to seventy percent of the lake's perimeter has been developed residentially.

There is a resort located on the south end of the lake that provides excellent access, including a boat launch and numerous camping sites. Increased recreational development has occurred over the past few years. (2)

Development

Most of the Pilchuck Creek Subbasin is sparsely populated (total subbasin population is approximately 1,400), with a small amount of agricultural development in the floodplain region. A proposed development called Tatoosh, which has an unknown population potential, may be constructed in this subbasin. The economy of Pilchuck Subbasin is based on agricultural, recreational, and forestry activities. (2)

Environmenta1 Features

The area north and east of Lake Cavanaugh contains an abundant population of deer, black bear and numerous species of furbearing animals and birdlife. Pilchuck Creek is also used for anadromous fish spawning up to Bryant, where stream obstacles prevent passage. Chinook, pink, coho, dolly varden, chum, steelhead and searun cutthroat inhabit these waters during their migratory life cycle. Chinook, coho, pink, and chum use this stream. It experiences extremely low summerfall flows. (6) Lake Cavanaugh is stocked with a variety of trout species.

Beaver, mink, and muskrat are the most abundant furbearing animals in this subbasin. Nesting areas for mallard, pintail, widgeon, and green-winged teal are also available. (2)

3. Arlington Subbasin

Rivers

The Arlington Subbasin includes the area from Arlington downstream to the western confluence of Cook Slough on the main stem of the Stillaguamish. Armstrong and Portage creeks enter the Stillaguamish River from the north and south, respectively. Most of the Arlington Subbasin is located in the floodplain region, encompassing an area of about 22 square miles. Armstrong Creek covers 7.3 square miles, with Lake Armstrong at its headwaters. Portage Creek is the principal tributary in this basin draining a residential and agricultural region of approximately eight square miles. (2)

Lakes

Lake Ki is located 7 3/4 miles northwest of Marysville at an elevation of 414 feet above sea level. The lake drains northerly to Portage Creek and through Cook Slough to the Stillaguamish River. Covering 97.4 acres, Lake Ki is 100 percent developed. The land use is 84 percent residential, 5 percent recreational, and 11 percent constitutes roads and access.

The Shoreline Management Master Program designates Lake Ki as "Suburban," as it is an area presently consists 'largely of low to medium density residential development and is suitable for low to medium intensity recreational use. The lake area has been designated in the adopted plans of public agencies for the expansion of residential usage.

Development

The economy of the area has a mixture of agriculture and industry. The Portage Creek drainage basin and the floodplain area adjacent to the Stillaguamish River contains extensive agricultural activity, with a growing rural population in the more upland areas to the south. Dairy operations of a moderate intensity are found in the subbasin. The commercial center is located around the Arlington Airport region, and within the city limits of Arlington. For the past several years, employment indices have shown a rapid improvement in economic conditions. The number of manufacturing businesses have increased in Arlington from 25 in 1968, employing at the maximum 313 employees, to 38 businesses in 1973, employing up to 897 employees. This growth has been largely a product of commercial and industrial development south of Arlington, near the Arlington Airport. In addition, there is a sand and gravel mining downstream of Arlington on the main stem of the Stillaguamish and several gravel extraction sites along Portage Creek. (2)

Environmental Features

Abundant varieties of anadromous and resident fish inhabit the streams, lakes and rivers of the Arlington Subbasin. The main stem of the Stillaguamish contains suitable spawning beds for pink, coho, chinook, searun cutthroat, and dolly varden. Steelhead trout are also in abundance, and constitute an important recreational and commercial resource. (2)

Fish passage facilities exist on Armstrong Creek. Forage fish inhabit most of the lower elevation tributaries and lakes; threespined sticklebacks are common in Portage and Armstrong creeks. Brook, cutthroat, and rainbow trout are found in most tributaries of the Arlington Subbasin. (2) The lowland creeks and marshes offer an ideal environment for beaver, muskrat, mink and waterfowl, and provide excellent nesting areas for mallard, pintail, widgeon-and green-winged teal. (2)

4. Deer Creek Subbasin

Rivers

Deer Creek, with an average flow of 493 cubic feet per second, is the major tributary to the North Fork of the Stillaguamish. The small community of Oso is located at the confluence of the North Fork Stillaguamish and Deer Creek. The northern tributaries of this drainage basin originate in the mountainous areas in Skagit County, moving swiftly to the narrow floodplain area of the North Fork. There are more than 20 miles of river system in the Deer Creek drainage basin, encompassing an area of 71 square miles. (2)

Development

Development of this area is just beginning with several recreational sites selected for future utilization. At the present time, however, the Deer Creek drainage basin is sparsely populated with most of the people living in the small community of Oso. The estimated population of this subbasin is 130. (2)

Environmental Features

The Deer Creek Subbasin is predominantly a forest area, with a large section of t'he river within the Baker/Snoqualmie National Forest and Skagit County. Deer and bear inhabit this subbasin in moderate intensity, while the population of furbearing animals and upland game is abundant. Pheasant, grouse, cottontail and snowshoe rabbits, and band-tailed pigeon and mourning dove inhabit the Deer Creek Subbasin. This stream has limited summer Chinook usage in the lower end. It is also utilized by an early run of coho (end of August) and pink salmon, low natural fall flows are the limiting factor for rearing coho. Most of the coho spawning occurs in small tributaries which are especially sensitive to reduction in flow. (2)

Beaver populations are found in areas where low gradient creeks, shallow water, and lakes support an abundant aquatic vegetation. (2)

5. Boulder River Subbasin

Rivers

The Boulder River Subbasin encompasses an area of 63.5 square miles. The major tributary to this basin is Boulder River, which enters the North Fork of the Stillaguamish, running 12 miles from the south. Rolling and Dick's creeks are rapidly moving streams that enter the North Fork from the north. The Boulder River headwaters begin at the base of Mt. Bullon, which rises to 5,974 feet. Meadow Mountain, (4,620 feet) and Whitehorse

Mountain, (6,852 feet) ring this subbasin. The North Fork of the Stillaguamish has an average discharge of 1,732 cfs at its' confluence with the Boulder River. (2)

Development

This area is undeveloped, with the exception of a few farms located along the banks of the Stillaguamish River. Most of the basin is in natural forested areas and wilderness. The population of the Boulder River Subbasin according to 1970 census data was approximately 190. (2)

Environmental Features

The Boulder River Subbasin contains a variety of scenic and mountainous peaks that constitute an area of aesthetic and recreational value. Four thousand-forty acres of the Boulder Subbasin are presently being considered as a candidate for designation as a national wilderness area under addition to the National Wilderness Preservation Act. Much of the subbasin exists within the Baker/Snoqualmie National Forest. Many hiking trails exist in this region, which attract an increasing number of hikers and campers. (2)

Anadromous fish migration is restricted to the lower portion of the Boulder River drainage basin because of the falls, at about river mile 5. Pink, chinook, chum, Dolly Varden, steelhead, and searun cutthroat are all found in the stream during their respective migratory periods`. There is an early run of summer chinook which spawns in August. These fish experience low flows and access problems. This stream also moderates temperature in the mainstem. (6) Resident fish in the Boulder River Subbasin include brook trout, rainbow trout, and other introduced and natural species. (2)

6. North Fork Subbasin

Rivers

The Lower North Fork of the Stillaguamish extends 14.3 miles from the confluence of the North and South Fork at Arlington to Deer Creek. Rock and Grant creeks enter this river from the north, near Arlington, while Hall Creek discharges into the North Fork from the south near the confluence of Deer Creek and the Stillaguamish. In teal, the tributaries entering the North Fork are small, fast moving streams that descend from high, mountainous areas to the narrow floodplain of the North Fork. The Lower North Fork Subbasin encompasses an area of approximately 46.6 square miles. Stimpson Hill, Ebby Hill, and Frailey Mountain surround this subbasin to the north and south at an approximate average elevation of 2,000 feet. (2)

The upper North Fork of the Stillaguamish encompasses an area of 102 square miles. The North Fork headwaters begin in Skagit County, at the base of Rinker Ridge, elevation 3,400 feet, in the Baker/ Snoqualmie National Forest. As the North Fork moves southerly it connects with the tributaries Alder Creek, North Branch, Middle Branch, Crevice Creek and South Branch. The headwaters of these tributaries are located to the west, near Segelsen Ridge, at an elevation of 4,516 feet. Near Darrington the North Fork changes direction and falls to the west, bringing in Squire Creek from the south. Squire Creek originates near Whitehorse Mountain, elevation 6,530 feet, to the west, Summit

Mountain, 5,480 feet, to the east, and Squire Creek Pass to the south. Like Boulder River, this is a scenic and recreational area that includes a variety of trails and camping facilities. The headwater region of Squire Creek, near Whitehorse Mountain, is presently a candidate for consideration in the National Wilderness Preservation System. The North Fork Stillaguamish floodplain area, as it extends downstream to the west, is controlled by private, corporate, and state interests. (2)

Development

The economy of this subbasin is primarily agricultural within the floodplain area; however, several proposed recreational facilities are being considered for development along the North Fork. The present population is approximately 870. Associated Sand and Gravel, Inc. has an existing gravel mining operation near the junction of the North and South Forks. In addition, the State Highway Department has completed a proposal for a similar gravel pit to be located contiguous to the existing Associated Sand and Gravel operation. Lumber operations occur on the northern side of the North Fork, with evidence of a clearcut operation near Rock Creek. The major east/west corridor in the subbasin runs through the Lower North Fork Subbasis, containing Highway 530 and the Burlington Northern Railroad.

Logging operations to the north are within the jurisdiction of the U.S. Forest Service. The economy of Darrington is heavily dependent upon the adjacent logging and lumbermill operations. The growth in these operations has steadily increased over the past five years (Table 2.6). Access from the west and east is provided by Highway 530 that parallels the North Fork. (2)

Environmental Features

The lower North Fork Subbasin is utilized by all major species of anadromous fish. The gravelly characteristics of the stream bed provide an ideal spawning zone for incubation and rearing. Coho, chinook, Dolly Varden, chum, searun cutthroat, and steelhead trout are in evidence during their migratory life cycles in the basin. Resident fish include brook, rainbow, and cutthroat trout, in addition to sculpins, suckers and peamouth. Flows in this portion of the river are often limiting to pink spawner distribution now. Because of low flows, pinks are sometimes- limited-to spawning in the lower North Fork and main river. Access to Pilchuck Creek is sometimes shut off. Chinook and coho rear in the mainstem in this area. Lake Riley is stocked with rainbow trout while Little Lake contains an abundance of cutthroat. (2)

Waterfowl utilize the agricultural lands on the North Fork for foraging and nesting. However, their densities are not as great as other areas of the basin. (2)

Perhaps the most invaluable resource in this region is the abundance of scenic and recreational land. Whitehorse Mountain has numerous trails and wilderness areas, which have remained in their natural state. Deer and bear are abundant in this region, in addition to mountain goat in the more rugged mountainous areas. (2)

In areas where the vegetation and water conditions are appropriate, beaver, mink and muskrat are in evidence. (2)

Anadromous fish are present in this subbasin; however, river conditions prohibit the passage of fish into the extremities of either Squire Creek and the North Fork. Pink, coho, chum, Dolly Varden, searun cutthroat, and steelhead trout utilize the waters of the North Fork during their spawning, rearing, and migration. The area upstream to Squire Creek is the most important mainstem spawning area for summer chinook, pink and chum. At present, low flow limits distribution of pink and summer chinook spawning. Chinook and coho rear in the mainstem here. (6) There is a fish hatchery :located near the confluence of Squire Creek and North Fork, in addition to a Washington Department of Game stream improvement project. Squire Creek and the upper North Fork already have critical temperature problems during low flow period. This portion of the river already experiences very critical low flows and during drier years, spawning distribution is severely restricted. Pinks salmon still spawn above Squire Creek but few summer chinook do, probably because their spawning occurs earlier when water conditions are poorest. Coho rear and spawn in the mainstem above Squire Creek. (6)

7. Jim Creek Subbasin

Rivers

Jim Creek drains an area of 48.9 square miles, with an average seasonal flow of 198 cfs, that dischargers into the South Fork near Arlington. Jim Creek is more than 15 miles long, originating at the base of Mount Ditney, 4,435 feet, moving west through an extensive floodplain zone,, interspersed-with boulder zone areas. A small slide area exists on Jim Creek, which has increased turbidity and the siltation of spawning beds. Recent clearcutting operations have been identified in the upper reaches of this drainage basin. This South Fork portion of this subbasin has numerous pool and riffle sections, with falls and a fish ladder located upstream near . ate Falls. (2)

Development

In general, the development of the South Fork, with a growing trend in recreational and permanent residences, is more extensive than that of the North Fork. Arlington Heights, a residential development, is located east of Arlington and runs north and west of Jim Creek. This area is presently unsewered, with an increasing growth pressure resulting from nearby economic and commercial expansion. The development of this subbasin is dependent upon the economic growth of the Arlington area. Agricultural activity is extensive, near the confluence of the South Fork at Arlington, with both pasture and cropland use in evidence. (2)

Access to this area is provided by State High 1-A, with numerous secondary roads concentrated along the banks of both Jim Creek and the Stillaguamish River.

Environmental Features

The suitability of this area for recreational use is evidenced by its increasing popularity for recreational development. Wildlife of a variety of types is found throughout this region. Deer populations are moderate to substantial in numbers, with pheasant and waterfowl found in abundant numbers, particularly in the South Fork region. Most of the anadromous fish, indigenous to the other tributaries of the Stillaguamish River, are also found in this subbasin. Chinook, coho, pink, and chum use this stream. It already experiences low flow problems, in fact, pink salmon were not able to enter the stream at all in 1979. Chum salmon have also experienced passage problems in this creek. An egg box program for pink and chum salmon has been operating for three years on a tributary of this stream (at naval station). It raises pink and chumr which are released back into Jim Creek to produce brood stock. (6) The Twin Lakes contain an abundant supply of rainbow, cutthroat, eastern brook trout, and steelhead. (2)

8. Canyon Creek Subbasin

Rivers

Canyon Creek drains an area of 58.3 square miles, and runs 12 miles east to west from the base of Liberty and Big Ben mountains, both elevations 5,600 feet. Several small tributaries enter Canyon Creek, including Saddle Creek, Baldy Creek, and the small tributary that originates from Mudd Lake. Other mountains in this subbasin include Old Mountain, 3,451 feet, and Blue Mountain, elevation 3,012. Approximately one half of this subbasin is contained in the Baker/Snoqualmie National Forest. The area near the headwaters of Canyon Creek is contained in the new proposed study area for classification in the National Wildlife Preservation System. The velocity of Canyon Creek varies dramatically with seasonal fluctuations, with extremes ranging from 8,880 cfs to 32 cfs. Field studies by Snohomish County indicate that most of Canyon Creek is in a floodway zone, interrupted briefly by one stretch of boulder zone. (2)

Development

The economy of this area is based primarily upon timber operations that are scattered throughout the subbasin, and numerous private, recreational developments. (7)

Environmental Features

Canyon Creek is an important spawning and rearing area for anadromous salmonoids. The pool and riffle areas, gravel beds and slow velocity combine to form an ideal environment for spawning. As a result, pink, coho, chinook, chum, Dolly Varden, searun cutthroat, and steelhead trout (summer and winter run) are evident throughout this region up to the confluence with the North Fork of Canyon Creek. A spring chinook remnant run still exists in this creek. Pink and coho (an early and normal coho run) also utilize the stream. A falls at R.M. 3.5 presents fish passage problems. Low summer fall flows are already a limiting factor. (6) Resident fish, such as brook and rainbow trout, are indigenous to this area.

The streambed of Canyon Creek is rapidly being changed due to the effects of clearcut logging according to local environmentalists. Increased runoff is resulting in the filling of holding pools by heavy cobbles and debris, thus eliminating important escape cover and habitat.summer run steelhead trout. (9)

9. South Fork Subbasin

Rivers

The Upper South Fork Subbasin encompasses an area of 116 square miles. There are numerous mountains and ridges in this region that make it a significant aesthetic and recreational area. The South Fork of the Stillaguamish falls approximately 2,000 feet to the valley, at an elevation of 1,800 feet on the valley floor. It then flows 26 miles through a gradually widening valley, flanked by high mountains such as Bald Mountain, Stillaguamish Peak, Twin Peaks, Big Four Mountain, Vesper Peak and Pilchuck Mountain. There are many ridges `and lesser peaks that are scattered through this subbasin. Small tributaries such as Boardman, Martin, Gordon, and Malady enter from the north and south falling rapidly into the narrow floodplain of the South Fork. Granite Falls, near the confluence of Canyon Creek, is an excellent scenic and recreational area, where visitors can observe salmon migrating upstream at the fish ladders. (2)

Development

A portion of this basin, near Monte Cristo, is presently being considered for designation as a wilderness area.

Adjacent to the proposed wilderness area is a proposed copper mine operation that could have a significant impact on the economy, development and physical landscape of this subbasin. The minimum life span of this mining operation will be 25 years, employing 300-400 full-time employees.

Environmental Features

In the areas where vegetation and water conditions are suitable, beaver, mink, and muskrat are found. Waterfowl forage and next in small ponds and lakes in the lower portions of the Upper North Fork Subbasin.

Most anadromous fish species are found in this subbasin, with the exception of pink salmon, which do not pass the fish ladders at Granite Falls. However, chum, chinook, coho, Dolly Varden, searun cutthroat, and winter and summer run steelhead trout utilize extensive pool and riffle sections of the river for spawning and rearing. Siltation resulting from Gold Basin slide and other activities in the watershed has already reduced mainstem production. Pink, chum, and summer-fall chinook utilize the south fork from the forks to Canyon Creek. Large numbers of coho utilize the tributaries above and below Granite Falls. Coho also use the mainstem in this area for rearing. Chum and pink-spawn heavily in the mainstem near Jim Creek where flows are already a limiting factor. (6) Brook, rainbow trout, and cutthroat are found n the lakes in this subbasin. (2)

Coho utilize most accessible tributaries for spawning and rearing. Some pink usage also occurs here in the mainstem. Flows get very low in the fall and limit spawning access.

The Puget and Adjacent Waters Study has identified a number of historic and scenic areas of specific significance, including the Three Fingers scenic area, Deer Creek Road, Fossils/Geologic area, Berry Creek scenic area, Big Four Geological area, and Gold Basin Geological area. (2)

Economy

The economy of the Stillaguamish Basin is rapidly improving, with the growth of food processing in Stanwood, lumber mills in the central and eastern region, and manufacturing near the Arlington Airport. Employment trends for each of the key industries in the basin indicate that the maximum yearly employment rate doubled between 1971 and 1973.

Lumber mills have shown a substantial increase in manpower requirements, reflecting the increase in logging operations in the basin. Agricultural activity has intensified with more acreage placed under irrigation. It is evident from the general improvement of agriculturally related businesses that a substantial improvement in crop yields and productivity has occurred in the past few years. (2)

There is an abundance of anadromous fish that utilize the streams and rivers of the Stillaguamish River system for rearing and spawning. While the fishery industry does not influence directly the economy of the basin (estimates range from $3-11 million), it does have a substantial impact on the economics of other areas, particularly the Tulalip Indian Reservation, located on Port Susan. The recreational use of these waters for sports fishing is extensive during the summer and winter. (2)

From 1965-66 through 1978-79, winter steelhead sport catch in the Stillaguamish River averaged 4,789 fish per year. According to Oliver, et al., (1975), the economic value of this catch in 1975 dollars is $462,133.

Land Use

Land use in the Stillaguamish Basin is predominantly agriculture, forestry, and rural residential in areas beyond the urban centers of Arlington and Stanwood which originated as agricultural service and processing centers. Both towns have retained some measure of their original functions but much diversification has occurred, especially south of Arlington. Smaller population nodes such as Silvana, Bryant, and Oso are also notable, however, growth and diversification has occurred only in the larger centers. (3)

Future land uses are addressed by the respective plans and are discussed below.

Darrington - The concept underlying the recently (1979) approved Darrington plan is "rural diversification." This concept provides special management and protection of predominantly rural areas where residents have expressed a strong preference to maintain independent and self-sufficient lifestyles. The plan supports the establishment of a low density mixture of land uses, which in a more intensively developed area, might be incompatible. Minimal restrictions on traditional and appropriate land uses are expected and the rural character of the planning area will be protected by controlling the size, location, and design of more intensive developments. Outlying areas are expected to maintain a fairly low level of residential density.

This concept translates to an expected growth rate significantly lower than that of the county, or the Stillaguamish Basin.

Arlington - The concepts underlying the plan for the Arlington planning area are more complex, but could be characterisized as "balanced land use." This planning area presents a greater challenge to the location of potentially incompatible land uses than is the situation to the east (Darrington area). Principal land use goals of this plan include the avoidance of agricultural and premature rural land use conversion, the maintenance of quality rural residential environments, and the concentration of commercial and industrial land uses at specific locations. (3)

This concept translates to a growth rate closer, yet still below, that of the county as a whole between now and 1990. The plan projects increases in urban, commercial, and industrial land consumption, however, a significant portion of this land is south of Arlington in the Quilceda Basin. Significant conversions of land in the Stillaguamish Basin are not proposed by this plan, though it is likely that the cumulative impacts of low density residential uses will alter the percentage of upland areas now undeveloped. (3)

Figure

Stanwood - The land use plan for the Stanwood area is seventeen years old, thus for most purposes, it is outdated. A proposal to revise this plan in 1981 is under consideration. The concept of this plan is the maintenance and enhancement of a number of residential communities within the planning area. Industrial land uses beyond the City of Stanwood are not projected, and commercial uses are limited to Silvana Island Crossing, and a few other major crossroads. (3)

This concept translates to moderate population growth with commercial activity primarily limited to Stanwood and its surrounding influence area and a few "crossroad" intersections.

In summary, the Stillaguamish Basin is expected to accommodate the lowest growth level of the three major river basins in Snohomish County. This is, in large measure, due to the absence of significant new employment opportunities. Even so, population growth is expected to increase 63 percent between 1971 and 1990.- This growth will increase the demand for the basin's resources including municipal and industrial water supply. Growth south of the basin (e.g. Kayak Point, Marysville) will also affect Stillaguamish Basin water supply. A percentage of Marysville's M&I water supply is now taken from the Stillaguamish River. (3)

Climate

The climate associated with the Stillaguamish River Basin is classified as "Marine West Coast." Moist, mild winters and cool, dry summers characterize this climate. The maritime air has a moderating influence on the climate in both summer and winter. (2)

The mountainous areas above 2,500 feet can receive as much as 300500 inches of snowfall, with maximum accumulation of 120-300+ inches.

The Stillaguamish River Basin is characterized by precipitation which occurs during every month of the year. As is the case of the total Puget Sound area, however, maximum rainfall occurs during the winter months, with drought conditions frequently prevailing in the summer period. Approximately 75 percent of the yearly precipitation falls during October through, March,, largely occurring at night. Generally, the inland positions receive greater precipitation due to the orographicr influences. Heavy rainfall, commonly associated with thunderstorms, is usually limited to 5-10 days in Western Washington. (2)

The form that precipitation takes in the Stillaguamish River Basin is largely dependent on the elevation of any given area within the study area. For example, the coastal lowlands, which possess elevations of 1,500 feet or less, are characterized by light to moderate rainfall.

In the foothills and mountain valleys, which range in elevation from 1,500 to 2,500 feet, rain and snowfall totals tend to increase and accumulations range between 3060 inches in depth, and generally experience a total snowfall of 75-100 inches. (2) The winter snow pack serves as a natural storage reservoir for water release during the spring months.

Population

The figures in the preceding chart depict rapid population growth between 1975 and 1980, which moderates, yet remains relatively high between 1980 and 1900. (3)

Population Estimates and Projections
Stanwood, Arlington and Darrington Panning Areas
for Area, Within Stillaguamish basin
1971 - 1990

Planning Area	1971 (% Inc.)	1975 (% Inc.)	1980 (%. Inc.)	1985 (% Inc.)	1990 (% Inc.)
Stanwood (80% of total)	6282 (-)	6402 (2%)	7722 (21%)	8512 (10%)	9770 (15%)
Arlington (90I of total) 7	572 (-)	7930 (5%)	10,180 (28%)	11,480 (13%)	13,137 (14%)
Darrington (25% of total)	545 (-)	537 (-1%)	535 (N.C.)	562 (5%)	607 (8%)
TOTALS	14,399 (-)	14,875 (3%)	18,437 (24%.)	20,554 (12%)	23,514 (14%)

Overall Increase is 63% for period.

Average Annual Increase is 2.4-

Approximately 40 percent of the population of the Stillaguamish Basin is under 20 years of age, while approximately 11 percent is 65 years or over. There are approximately the same number of men and women in the basin, and the nonwhite population is less than one percent-of the total population.

Geology

The Stillaguamish River Basin is an area of striking geologic contrast. From the primitive mountain headwaters in metamorphosed* sediments,, granite intrusions and older volcanic rocks, through the river alluvium* and glacial outwash* of the North and South Fork Valleys, to the broad floodplain of the main stem Stillaguamish below Arlington and the estuarine marshlands of Hat Slough and the mouth, the basin geology represents diverse processes which have occurred throughout several eras of geologic time. (4)

Of particular significance in terms of water resources in the basin are the bedrock sculpturing and outwash deposition of alpine and continental glaciations* that have occurred within the past 20,000 years. The continental glaciation, which filled and modified the Puget Lowland, left a concrete-like clay layer called glacial till.

Till often separates ground water in overlying sand and gravel from deeper ground water sources. This poorly permeable till layer also increases surface water runoff and flooding by discouraging infiltration of precipitation. Large amounts of sand and gravel called outwash was deposited by meltwater streams emanating from the ice and now contains ground water reservoirs which help maintain summer streamflows. (4)

The interesting geologic environment of the Stillaguamish River Basin provides the substrate* upon which all life and activity in the basin occurs. Gold and silver mining in the basin predated the 1890s and left remnants of mining activity which annually attract geologists, historians and curious hikers alike-. Today, most mining in the basin is for sand and gravel near Arlington Heights or from gravel bars along the main stem Stillaguamish below Arlington. Outdoor enthusiasts are also attracted to the cathedral-like canopy of one of the last virgin timbered valleys in the basin along the Boulder River, where resistant bedrock cliffs form spectacular waterfalls. The basin provides special challenges for mountain climbers in the form of several peaks rising well over 6,000 feet in elevation. Among these are Big Four Mountain at the South Fork Stillaguamish headwaters, and at the Squire Creek and Boulder River headwaters; Three Fingers and Whitehorse Mountains. Whitehorse Mountain is one of the most notable alpine images in the Cascades as it rises over 6,000 feet above the Town of Darrington. It is interesting to note that snow avalanches from the high north-facing walls of Big Four and Whitehorse Mountains have generated small glacier-like bodies of ice which at between 2,000 and 3,000 feet in elevation above sea level are probably the lowest ice found in the Cascades today. (4)

III. WATER RESOURCES

Surface Water

The Stillaguamish Basin has an area of 690 square miles, including six square miles of salt water. The Stillaguamish River, the only major stream in the study area, rises in the Cascade Mountains at elevations of 4,000 to 6,000 feet and drains an area of 684 square miles. The upper drainages are steep mountainous valleys containing turbulent streams and forested lands. The lower, or western, portion consists of an extensive delta plain, alluvial flats, low glacial outwash plans, and a few lateral or frontal moraines.* (1)

The main tributaries are the North and South Forks, which join near Arlington. From the confluence, the Main stem flows for approximately 23 miles to Puget Sound and Port Susan. The North Fork heads above Darrington, where it emerges from its narrow valley at an altitude of 500 feet. It then meanders westerly approximately 30 miles in a wide valley to its confluence with the South Fork. (1)

The South Fork heads above Silverton and falls more than 2,000 feet in three miles as it flows north from its source to the main valley at elevation 1,800 feet. Thence-, it flows 26 miles through a gradually widening valley flanked by high mountains and ridges; in this reach, the river falls 1,000 feet to the head of Robe Canyon, and another 600 feet in eight miles to the mouth of Canyon Creek, its principal tributary. Below Canyon Creek, the South Fork flows northwesterly through a canyon cut into glacial deposits, and enters a broader floodplain four miles above its confluence with the North Fork.

Below Arlington the river meanders through a broad, fertile floodplain to Puget Sound. Most of the river's flow enters the Sound through Hat Slough, the main outlet. During high flood stages, some flow also discharges through a small channel that divides into two tributaries known as South Pass and West Pass. Hydrographs depicted in figures 2-8 illustrate the historical flow records, compiled from USGS sources, of the Stillaguamish River and its principle tributaries. (1)

Runoff

Although the headwater tributaries of the Stillaguamish stream system do not extend to the crest of the Cascade Range, the upper reaches of the South Fork lie adjacent to the highly productive Sultan River basin, and, therefore, experience a similarly high runoff. Discharge from high altitude areas within the South Fork watershed probably averages about 140 inches annually and about 120 inches in the North Fork watershed. The Olympic Mountains orographic barrier* exerts some influence on precipitation in the lowland area of the Stillaguamish Basin, so that mean annual runoff

*Defined in the glossary.

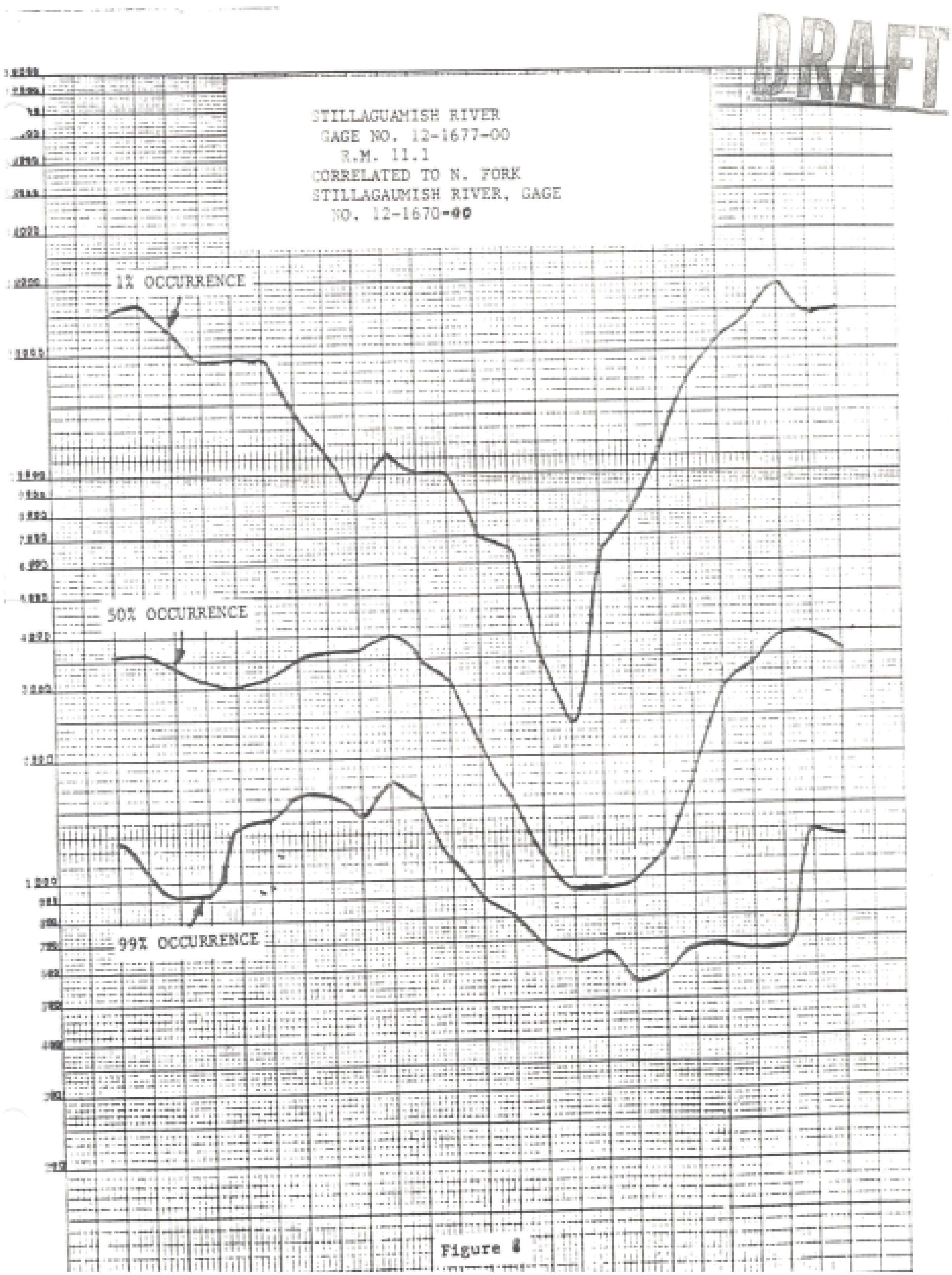

DRAFT
STILLAGUAMISH RIVER
GAGE NO. 12-1677-00
R.M. 11.1
CORRELATED TO N. FORK
STILLAGAUMISH RIVER, GAGE
NO. 12-1670-00
1% OCCURRENCE
50% OCCURRENCE
99% OCCURRENCE

Figure 8

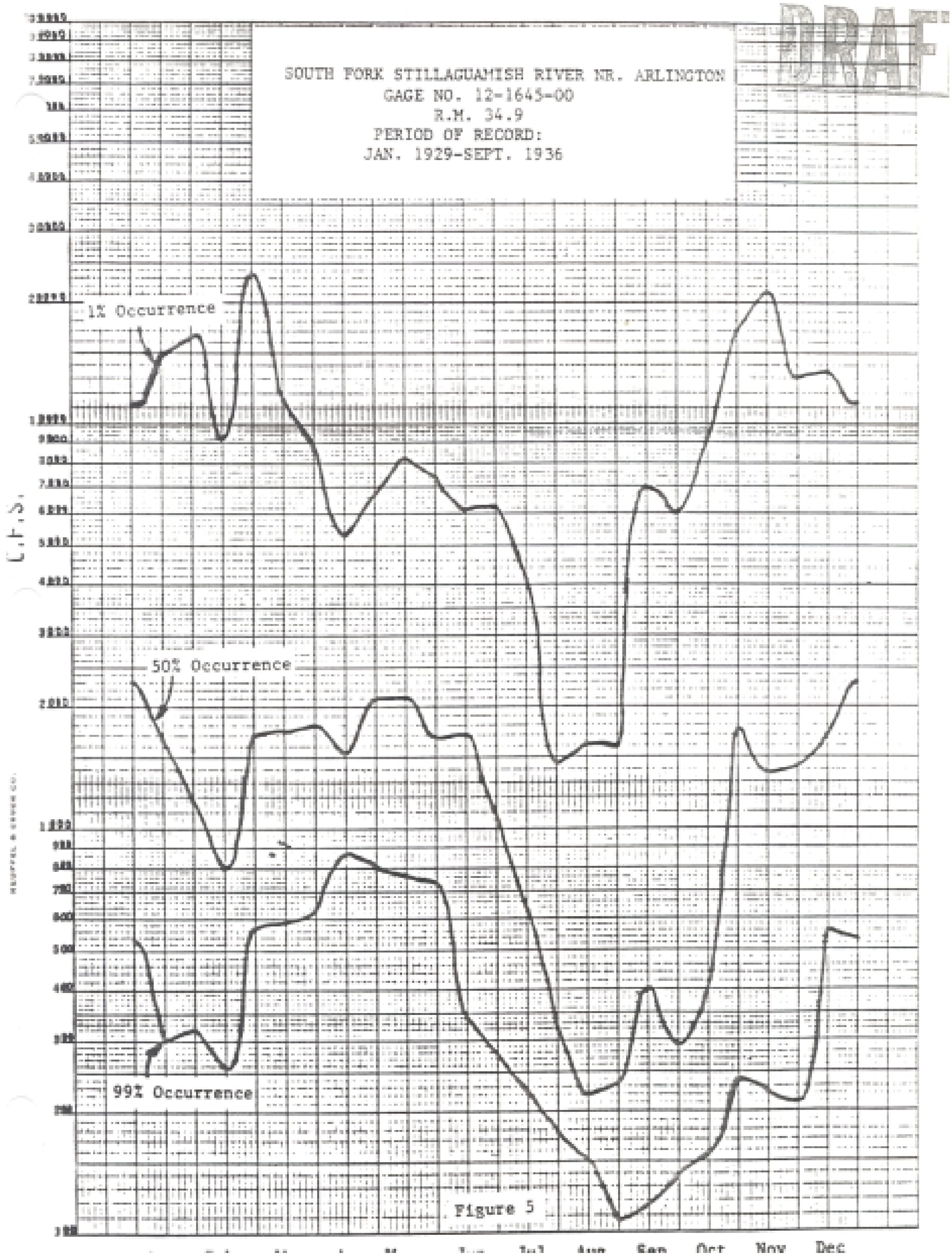

SOUTH FORK STILLAGUAMISH RIVER NR. ARLINGTON
GAGE NO. 12-1645-00
R.M. 34.9
PERIOD OF RECORD:
JAN. 1929-SEPT. 1936
1% Occurrence
50% Occurrence
99% Occurrence
DRAF
Jul
Aug
Sep
Oct
Nov
Dec

Figure 5

is reduced to less than 15 inches near the mouth. The unit runoff is about 7.1 cfs per square mile from the North Fork and 8.0 cfs per square mile for the South Fork. The average annual yield of the entire basin is estimated to be about 80 inches, or 2,900,000 acre-feet. (1)

During the period of record, the greatest runoff on the North Fork Stillaguamish River occurred in the 1959 water year when the discharge at the Arlington gage amounted to 141 percent of the 30-year mean. Minimum yearly flows were recorded in tie 1930 water year when the yield of the North Fork was only 61 percent of the 30-year mean. The records display a 10-year period of below normal runoff from about 1936 to 1945; similar trends are shown by nearby streams.

Seasonal runoff patterns for both forks of the Stillaguamish are quite similar. Both streams display winter and spring peak flows that are typical of rain and snow fed streams in Western Washington. Because of a high percentage of low altitude area, the watersheds of both forks receive much of their precipitation as rain. Snow storage at higher altitudes is sufficient to produce a moderate spring runoff peak in each fork. This factor is more significant in the South Fork drainage, however, where a greater percentage of the catchment area lies at high altitude. (1)

Stream gaging stations on the lower reaches of the North and South Forks measure runoff from approximately 75 percent of the Stillaguamish Basin. Average annual discharge below the confluence of the forks is approximately 3,500 cfs. (1)

Streamflow usually begins to increase in September or October from the summer base flow. Runoff generally decreases from December through March as a result of colder weather. As temperatures begin rising in April, snowmelt causes small increases in streamflow which reach a maximum following the snowmelt peak, usually by the end of May. Streamflow recedes to minimum base flow as snowpacks are depleted, usually by the end of August. At this time, discharge is sustained largely by ground water. Only six small glaciers exist in the basin,, and these contribute little to summer low flows. (1)

Flooding and Low Flows

Floods caused by high rainfall with accompanying snowmelt are shown by characteristically sharp rises on a hydrograph, followed by recessions almost as rapid. Two or more peaks often occur within two weeks. The maximum recorded discharges, which occurred on February 9, 1951, were 30,600 cfs on the North Fork and 27,000 cfs on the South Fork. The corresponding peak flow in the main stem of the Stillaguamish River near Arlington was estimated to be about 64,000 cfs. (1)

Flood frequency curves of discharges of North and South Forks of the Stillaguamish River are presented in Figures and. The periods of record are 1919-64 for ,the North Fork gage, and for the South Fork. Frequency statistics were extended to an equivalent record of 44 years for the North Fork and to 35 years for the South Fork by correlation with data from the South Fork Skykomish River near. Index, which has a record period of 54 years. (1)

Low flow characteristics of streams in the Stillaguamish Basin are compared using indexes from low flow frequency curves at nine gaging stations. The indexes indicate that the low flow yields are good in the South Fork basin and are only fair in the North Fork.

Streamflow in the Stillaguamish Basin is unaffected by regulation and diversion and. represents natural flow conditions.

Low flow indexes in the basin range from 0.10 cfs per square mile, in Pilchuck Creek basin to 1.30 cfs per square mile, in Squire Creek basin. The rather small indexes in the basin, in comparison to those in the adjacent Skagit Basin, are probably due to the absence of appreciable glacial melt water during critical summer months.

Lowland basins along Puget Sound have the smallest values. The very small indexes for Armstrong and Pilchuck creeks are attributed to the minor amount of contributions from ground water storage.

The slope index* of the 7-day frequency curve which shows the variability of low flows from year to year, ranges from _1.61 for the North Stillaguamish River basin to 5.00 for the Plchuck Creek watershed. All but two of the nine indexes are between 1.6 and 1.9, and all are greater than the regional average. (1)

Spacing index` ranges from 2.12 in Armstrong Creek basin to 22.2 in Pilchuck Creek basin; the latter is the highest computed in the entire Puget Sound area. The low values for Armstrong Creek and for nearby Fish Creek probably reflect the high porosity of the alluvial sediments in watersheds. (1)

<u>Storage</u>

The total amount of storage in lakes and glaciers in the basin is not known, but the surface area covered by the these water bodies provide at least a comparative indication of the amount of water that is stored.

The total lake surface area in the basin is about 28 square miles, most of which is accounted for by Lake Cavanaugh. The total surface area of glaciers in the basin is only about one-half of a square mile. (1)

<u>Diversion</u>

Of the many diversions in the Stillaguamish Basin, most are small; only two are 5 cfs or more. Near the headwaters of the North Fork of the Stillaguamish River, the State Department of Game diverts 5 cfs from a small tributary, called Whitehorse Mountain Springs. Nearly all the water returned to the stream about 1,000 feet below

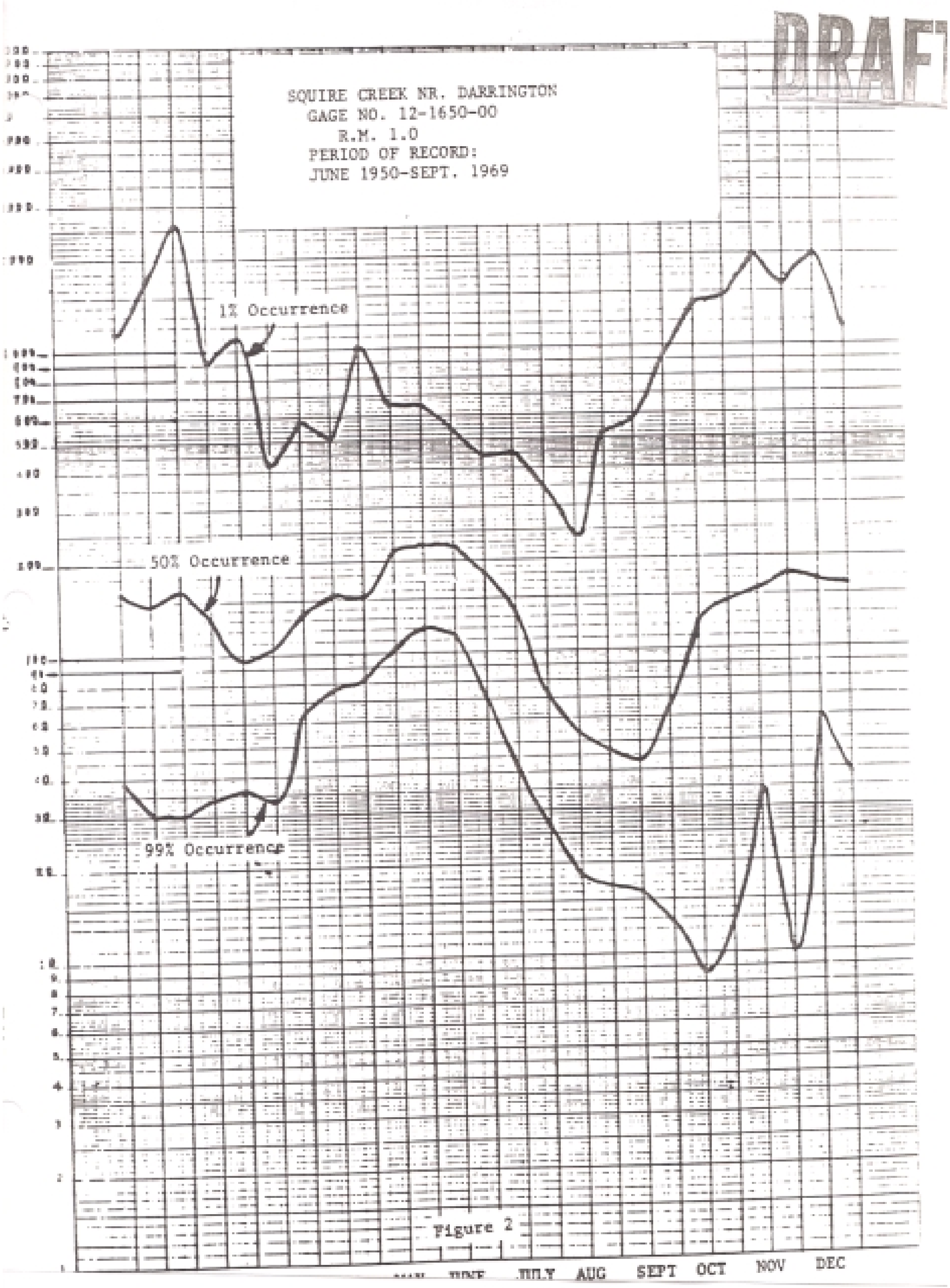

DRAFT
SQUIRE CREEK NR. DARRINGTON
GAGE NO. 12-1650-00
R.M. 1.0
PERIOD OF RECORD:
JUNE 1950-SEPT. 1969
1% Occurrence
50% Occurrence
99% Occurrence
AUG
SEPT
OCT
NOV
DEC

Figure 2

the point of diversion. The State Department of Fisheries holds rights to 25 cfs to operate a fishway at Granite Falls on the South Fork of the Stillaguamish River. The fishway lies adjacent to the stream channel for several hundred feet. The City of Marysville pumps about 10 MGPD from shallow "Ranney collector" wells in the lower river. The city plans to increase this to about 24.5 MGPD by 2020. Marysville services approximately 18,000 persons at the present time. (8)

As estimated, 4,000 acre-feet of water was diverted for irrigation in the Stillaguamish watershed in 1965; most of the irrigation was in the lower part of the basin. (1)

Lakes

Freshwater lakes are features of the landscape that have been formed by any of several geologic processes; e.g., land rising or subsiding, volcanic activity, river erosion, landslides, and glacial action. Glacial action, in particular, has been active, directly or indirectly, in forming lowland lakes found at elevations below 3,000 feet as a result of ice erosion, morainal dams in valleys, or the formation of kettles.*

There are over 169 lakes in the Stillaguamish Basin. About one-half of the lakes have a surface area of less than five acres and all the lakes are relatively small (Table 2.2). Some of the lakes are provided with outlet controls for the purpose of modifying their size depth or for regulation purposes. (2)

The shores of easily accessible lakes have become favored residential sites and the lakes are coming under increasing recreational use. Many of these installations depend on septic tanks and garbage dumps for waste disposal where soil conditions often are unfavorable for such uses.

Estuaries

Port Susan Bay is the major receiving water for the Stillaguamish River. Shallows in Port Susan are caused by the Stillaguamish River delta at its northern end of the port and the Snohomish River delta at the southern end. Otherwise, Port Susan is steepslided with depths up to 360 feet acting apart from the rest of the marine waters in the area. (2)

The Stillaguamish River inflows are not large, and tend to be greater in the winter than in the spring or summer. Because of the entrance sill, Port Susan is not afforded continuous tidal flushing that occurs in the more open waters of Port Gardner Bay. Some of the waters below 300 feet remain trapped for several months. Net circulation consists of inflowing saline water from Possession Sound, entering at mid-depth and moving very slowly northward, and outflowing less saline surface water from the Stillaguamish River. Net current velocities are low, and flushing is a long-term situation. (2)

Research has demonstrated that reducing freshwater inflows to an estuary can cause the following effects: nearshore waters become more saline; estuarine habitats derived from inland areas; bottom sediments become anaerobic and less productive; beach and marsh erosion exceeds replenishment of sand and fine sediments transported from inland areas; saltwater encroachment alters the natural coastal environments and ground water supplies; and reduced ability to serve as nursery areas for finfish and shellfish. (3)

The protection of the estuarine ecosystem is an integral part of the Instream Research Protection Program (IRPP), the fresh water and salt water mixing process inherent to the estuary creates or supports a combination of water temperatures, salinities, food sources, substrates, and biota not found elsewhere. And that delicate ecological balance is totally dependent upon adequate daily inflows of fresh water. (10)

The Stillaguamish estuary serves as an essential transition area for anadromous salmonids entering and leaving the river. The estuary serves as an important rearing area for juvenile chum, pink, and chinook salmon. (10)

In addition, the estuary provides an equally important, resting, feeding, and protective area for many species of waterbirds, waterfowl, and raptors including the bald and golden eagles. The endangered peregrine falcon is found here. It preys upon waterbirds and small ducks as well as other animals that in turn require the habitat provided by the estuarine salt marsh. Other species of concern that utilize the protected waters of the estuary are the brantsm, snow geese, canvas-back duck, whistling swan, and trumpeter swan. Preserving estuarine ecosystems such as that of the Stillaguamish River and its related fresh water flower insures that essential points of refuge for migratory birds and waterfowl will continue to exist. (10)

GROUND WATER

The contrasts in geologic environments in the basin result in significant differences in ground water conditions. In the lowlands, from Arlington to the Sound, the important aquifers consist of glacial deposits that are continuous over about 150 square miles, and in some cases exceed 2,000 feet in thickness. It is generally possible to obtain ground water from depths of less than 100 feet below surface level. Recharge to the lowland aquifers is by infiltration and rainfall at an estimated annual rate of 40,000 acre-feet. In the Pilchuck Creek watershed, the older tertiary bedrock contains little ground water supplies; while in the valleys of the North and South Fork of the Stillaguamish River, abundant precipitation in conjunction with sand and gravel aquifers result in a high:ground, water yield potential. (2)

The varied geologic conditions between lowland and mountainous terrain determine the availability, distribution, and quality of ground water sources.

Figure

Ground water is generally in abundant supply, with the exception of a few limited areas where geologic conditions limit the number of wells which can be economically drilled. Near Bryant, ground water quantities are low with noticeable iron content, while the wells northwest of Granite Falls have experienced salt water influence.(2)

Small yields are obtained in the upland portions of Pilchuck Creek, in the uplands southeast of Arlington, and at the mouth of the t Stillaguamish. Both the North Fork of the Stillaguamish River Valley near Darrington and the Sauk River Valley of Water Resource Inventory Area 04 have valley floors of flat-lying river alluvium flanked by relatively steep valley walls of bedrock. The geomorphology* of the intersection of these valleys indicates that they were once occupied by the same alpine glacier system which converged near Darrington to flow down the North Fork Stillaguamish Valley. Well logs show the depth of sand and gravel near Darrington is at least 170 feet. The thickness and saturation of the valley fill, and the low topography of the divide between the Sauk and the North Fork Stillaguamish basins, indicate there is continuity of ground water across the topographical boundary separating the two water sheds. Although at times, such as extreme flooding in the Sauk River, there may be net ground water flow into the Stillaguamish, the general ground water divide corresponds to the land-surface divide. (4)

Ground water storage has a most important influence on late summer streamflows in the Puget Sound. This is especially true in the Stillaguamish Basin where ice and snowmelt do not contribute to low flows as much as in the nearby Skagit River watershed.

In a basin such as the Stillaguamish, the amount of ground water storage available for low flow contribution can be appraised by comparing low stream discharges to mean annual discharges. The ratio of low-flow frequency to mean annual discharge of a stream is called the base-flow index. Differences in base flow indexes can be attributed to differences in basin hydrogeology with very little influence from climate. The base-flow indexes of Pilchuck, Armstrong, and Fish creeks are very low indicating that the compact glacial till and consolidated sedimentary rocks which underlie most of these basins increase runoff and inhibit transfer of ground water to surface streams. Base flow indexes for Jim Creek and the North Fork Stillaguamish above Darrington indicate that recent river alluvium and valley fill contribute some ground water to low flows but the proximity of bedrock in these subbasins is limiting ground water storage. The larger base flow indexes for the South Fork Stillaguamish above Jim Creek, Squire Creek, and the North Fork Stillaguamish between Darrington and Arlington reflect significant ground water contributions derived from alluvial and outwash sediments in these floodplains. (4)

In some of the areas just described as having little significant ground water contribution toward minimum streamflows, there may be available ground water resources at depth which, not having direct hydraulic continuity with streams, would provide alternatives to surface water withdrawals. (4)

Shallow wells in river alluvium generally have direct hydraulic connection with a stream. Very little is known about the ground water potential of the 800 to 1000 feet of unconsolidated sediments underlying Silvana. (4)

IV. WATER QUALITY

The water quality of the upper Stillaguamish Basin is generally excellent. The lack of significant development and the sparsely populated character of the basin have resulted in almost natural water quality conditions. There are several exceptions to this on the North Fork and on portions of the upper South Fork, where a combination of natural slide conditions and agricultural use have degraded the water quality to less than acceptable standards. However, the major tributaries -- Deer Creek, Jim Creek, Canyon Creek, and Squire Creek -- have an excellent quality of water. (2)

As the Stillaguamish River moves toward Port Susan and Skagit Bay, the water quality generally deteriorates as the population increases and development intensifies. The Arlington and Stanwood subbasins have the more severe pollution difficulties in the basin. (When a Water Quality Index that rates "mean" and "worst" conditions on a scale from 1 to 10 is applied, the Stanwood subbasin does not meet "acceptable" standards for average conditions.) During the worst case conditions recorded in this subbasin, the water quality rating was 3.9, indicating a pollution level exceeding the Snohomish estuary rating in the Port Gardner Bay area. The worst case in the Arlington subbasin resulted in a "slightly polluted" index rating. (2)

In general, the condition of the river basin changes dramatically with seasonal flow characteristics. When lowland rainfall is the major source of water in the basin, the water quality markedly deteriorates.

The Stillaguamish River runs decidedly turbid. The average turbidity is 38 JTU on the main stem below Arlington, 27 JTU on the North Fork, and 31 JTU on the South Fork. Turbidity ranges are from 400-0, with an overall average of 27.60. (2)

Excessive siltation caused by mud and clay slides on the North Fork, near the community of Hazel, and on the South Fork above the settlement of Robe may continue to be a problem in future years. Conditions Created over the downstream environment from these slides include excessive discoloration of the water, heavy silt deposits causing over-compaction of the stream bed gravel normally suitable for spawning, and smothering of aquatic vegetation and food organisms. (2)

Extensive clear-cut logging over vast sections of both the upper North and South Fork watersheds influences the runoff patterns, resulting in accelerated fall and spring flooding and reducing r summer flows. (2) Local sportsmens groups and environmentalists are very concerned over proposed clearcutting operations within the Boulder River, Deer Creek, and Canyon Creek. (9)

Nonpoint Sources of Waste

Nonpoint sources of waste are characterized by their diffuse distribution and by their variability with time and location. In many cases, it is

TABLE

WATER QUALITY INDEX RATING

SUB-BASIN	WORST MEAN	pH	DO	NO_3	F-COLI	T-COLI	$OP0_4$-P	TDS	TURBIDITY	WQ INDEX
Stanwood Sub-Basin	W	10	6		6	2	2	2	4	3.9
Old Stilly River	M	10	10		6	2	9	10	4	7.44
Pilchuck Creek	W		10	10	10	8	10			9.49
	M		10	10	10	8	10			9.49
Arlington Sub- Basin	W	8	6	10	6	2	2	10	2	5.70
	M	10	10	10	8	8	8	10	4	8.5
Lower North Fork	W	8	8	10.	8	6	8	10	4	7.10
Stillaguamish	M	10	10	10	8	8	10	10	6	10.0
Deer Creek	W		10	10	8	10	10			9.49
	M		l0	10	8	l0	l0			9.49
Boulder River	W	10	10	10		4	8	10	2	8.09
Sub-Basin	M	10	10	10		6	10	10	6	9.04
Upper North Fork	W	10	10			6	10	10	2	8.24
Stillaguamish	10	10				8	10	10	8	9.46
Jim Creek	W	10	10	10	8	6	2	10	2	7.44
Sub-Basin	M	10	l0	l0	8	8	8	l0	6	8.77
Canyon Creek	W		10	10	10	10	10			10.0
	M		10	10	10	10	10			10.0
Upper South Fork	W	10	8	10		6	2	10	2	7.06
Stillaguamish	M	10	10	10		8	8	10	6	9.04

WQI Rating :				
	9.5 - 10	Excellent	3.5 - 5.5	Polluted
	7.5 - 9.5	Acceptable	1.5 - 3.5	Heavily Polluted
	5.5 - 7.5	Slightly Polluted	0 - 1.5	Dead

TABLE
STREAM CLASSIFICATION USES

CLASS	GENERAL CLASSIFICATIONS	CLASSIFICATION USES
AA	Water quality of this class markedly and uniformly exceeds the requirements for all or substantially all uses	Water supply (domestic, industrial, agricultural); Wildlife habitat, stock watering; General recreation and aesthetic enjoyment (picnicking hiking, fishing, swimming, skiing and boating; General navigation; Fish and shellfish reproduction, rearing and harvest
A	Water quality of this class exceeds or meets the requirements for all or substantially all uses	Water supply (domestic, industrial, agricultural); Wildlife habitat, stock watering; General recreation and aesthetic enjoyment (picnicking, hiking, fishing, swimming, skiing and boating); Commerce and navigation; Fish and shellfish reproduction and rearing; Crustacean harvest
B	Water quality of this class exceeds or meets the requirements for most uses	General recreation and aesthetic enjoyment (fishing. swimming, skiing and boating); Fishery and wildlife habitat; Industrial and agricultural water supply; Stock watering; Commerce and navigation; Shellfish reproduction and rearing; Crustacean harvest
C	Water quality of this class exceeds or meets the requirements of selected and essential uses	Commerce and navigation; Cooling water; Boating; Fish passage

TABLE
WASHINGTON STATE DEPARTMENT OF ECOLOGY
WATER QUALITY STANDARDS

	UPPER BASIN		**Estuary ***		**INNER HABOR**
CONSTITUENTS	**AA**	**A**	**A**	**B**	**C**
Temperature ^{o}F					
Fresh	60	65	65	70	NA
Saline				66	72
Dissolved Oxyger, XG/L					
Fresh	>9.5	>8.0	>8.0	>6.5	NA
Saline			>6.0	>6.0	>4.0
Turbidity	5 JTU over Natural	5 JTU over Natural	5 JTU over Natural	10 JTU over Natural	10 JTU over Natural
Total Coliforms Col/100 ML	<50	240	240	1000	1000
pH					
Fresh	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	NA
Saline			7.0 - 8.5	7.0 - 8.5	7.0 - 9.0

* In brackish waters of estuaries, where the fresh and marine water quality criteria differ within the same classification, the criteria must be interpolated on the basis of salinity, except that the marine water quality criteria shall apply for dissolved oxygen when the salinity is one part per thousand or greater, and for total coliform organisms when the salinity is ten. parts per thousand or greater.[2]

2 Water Quality.Standards. State of Washington Department of Ecology. Olympia, Washington., June 19, 1973.

extremely difficult to collect samples of discharge from nonpoint sources in order to measure or characterize their pollutants, to assign or monitor compliance with effluent limitations, or to remove or neutralize pollutants prior to their discharge. Moreover, it is often difficult to establish a direct causal relationship between many nonpoint source "activities" and their impact upon water quality. (2)

The principal nonpoint sources of pollution in the Stillaguamish River Basin are thought to be agriculture, silviculture, construction, and failing septic tank systems. Because of the dominant roles of agriculture and forest products industry in the basin economy and the the large proportion of land devoted to these purposes, it appears likely that these two activities could account for a major portion of human-caused nonpoint source pollution found in the basin. Construction activities with major impacts on water quality in the upper basin are generally limited to road work and, perhaps, recreational site development. In the more densely populated lower basin, general construction activities, including road maintenance, could contribute toward water quality degradation in a variety of ways. (2)

There are several areas in the Stillaguamish Basin where poor soil conditions-of poorly constructed drainfields have resulted in septic tank system failures, which could significantly contribute to nonpoint source pollution. In some areas, especially the surrounding lakes, even properly functioning septic tank systems can cause a degradation of water quality. (2)

Chemical and Sanitary Quality

Chemical quality of surface water in the Stillaguamish Basin is excellent and the water is acceptable for practically all uses. Analyses of water samples collected monthly from the Stillaguamish River, near-Silvana, show that dissolved solids* content ranged from 17 to 58 ppm (parts per million), and that the maximum hardness was 39 ppm during the period of record. The North and South Forks are very similar chemically, and this quality changes only slightly from their confluence to the mouth of the Stillaguamish River. This dilute, soft water is typical of basins in Western Washington where the water resources are largely undeveloped.

The sanitary quality of the surface waters of the Stillaguamish Basin is generally good. Undesirable coliform* values .occasionally occur below points of waste disposal, but the maximum MPN value observed, near Silvana, was only 1,500. The average MPN there was only 205. The coliform count for sampling points on the North Fork, near Arlington, averaged less than 200 MPN and the MPN value for the South Fork, near Granite Falls, rarely exceeds 100. These data reflect a sanitary quality as good as that of any major stream on the east side of the Puget Sound study. area. (1)

Stream Temperatures

Records of stream temperature are available for four stations in the Stillaguamish Basin. Thermographs have been in operation at two of the

*See glossary.

four sites. Summer water temperatures in Pilchuck Creek are the highest in the basin. The summer flow in this stream is very small providing ample opportunity for heating by solar radiation. The observed winter minimum temperatures in the North Fork Stillaguamish River are unusual in that they remain at least 3 to 4°F above freezing. The reason may be that the watershed does not extend to the crest of the Cascade Range, and therefore, occupies a lower and warmer terrain than most other major drainages in the area. (1)

High stream temperatures are also experienced in the North Fork of the " Stillaguamish River below Squire Creek. USFS believes the cause of these high temperatures 73°F is due to lack of vegetative cover along the main river. (11)

Sediment Transport

In the upper drainage, the forks of the Stillaguamish River flow through mountainous terrain in narrow valleys that contain alluvail and glacial deposits. Much of the land is rough, broken, and rocky. Only shallow soils have been formed, and in much of the area these soils are mixed or mantled with glacial material. The well-drained glacial till and outwash materials are not easily eroded, however, two major clay slides contribute to the sediment load of the Stillaguamish River, one on the North Fork near Halterman, and the other on the South Fork at Gold Basin. Leaching deposits from these two slides are causing heavy siltation and compaction of the riverbed gravel downstream. (1)

Local environmentalists claim that many of the "summer holding pools" needed for summer run steelhead trout are being filled in by heavy sediment deposited after flood periods. (9)

The upper drainage receives much precipitation, but heavy vegetative cover normally retards erosion. In areas subjected to logging and accompanying road construction, however, fine sediments are removed by sheet and rill erosion during intense rain. The movement of bed materials in the stream channels during high runoff is evidenced by large deposits of gravel and cobbles. During low flow, most streams in the upper drainage are nearly sediment free. (9)
In the lower drainage, downstream from Arlington, the floodplains contain soils derived from alluvial deposits. Most soils in uplands of this area are underlain by loose glacial till and outwash and are well drained. Although precipitation is moderate, heavy vegetation normally prevents excessive erosion on steep slopes. Construction and farming in some parts of the lower drainage areas have nonetheless caused some increased sediment transport in streams. Some of the eroded sediments are deposited in numerous lakes and marshes, and therefore, do not enter the streams. (1)

The steambed of the Stillaguamish River contains large amounts of sand and gravel that probably move as bedload during high runoff. Analysis of sediment samples obtained from the Stillaguamish River, near Silvana, in 1965 and 1966 indicates that the suspended sediment concentration is generally about 50 ppm. Erosion of streambanks is the most widespread significant problem. (1)

V. INSTREAM RESOURCES

FISHERIES

The Stillaguamish River-is a moderately large stream with a mean annual flow of roughly 3;660 cfs at the forks. Anadromous game fish use nearly the entire basin since neither dams nor barrier falls block and main reach of either fork. The Stillaguamish is unusual among Puget Sound streams in having such a large portion accessible to anadromous fish. (6)

Chinook, coho, pink, chum salmon, sockeye, green sturgeon, steelhead trout, whitefish, cutthroat, and Dolly Varden trout utilize the Stillaguamish Basin for spawning and rearing. This natural production is enhanced by plants of state hatchery-reared stocks from nearby basins and Stillaguamish tribal releases from a rearing site on Armstrong Creek. In addition, the Washington Department of Fisheries (WDF) is planning to build a spring-summer chinook rearing station on Heather Creek, a tributary of the south fork. This station will be built in 1981 and will release 360,000 chinook into the system yearly. (6) The spring chinook populations have reached dangerously low levels within the Stillaguamish River Basin and is doubtful if former population levels can be regained. (9)

The Stillaguamish is an excellent steelhead trout stream. The North Fork is restricted to fly-fishing during summer, when steelhead can easily be observed through the clear water. The Stillaguamish has been famous for sea-run cutthroat trout, but overharvest has and destruction of spawning habitat reduced the population to such a degree that the Game Department has had to drastically reduce the catch limit. (7)

A sucker (Catostomus sp. cf. catostomus), which might prove to be a form unique to Puget Sound, occurs in the Stillaguamish River. This is one of only two known populations of this fish (McPhail, 1967). Suckers are fish of large streams and require adequate flows for survival. (7)

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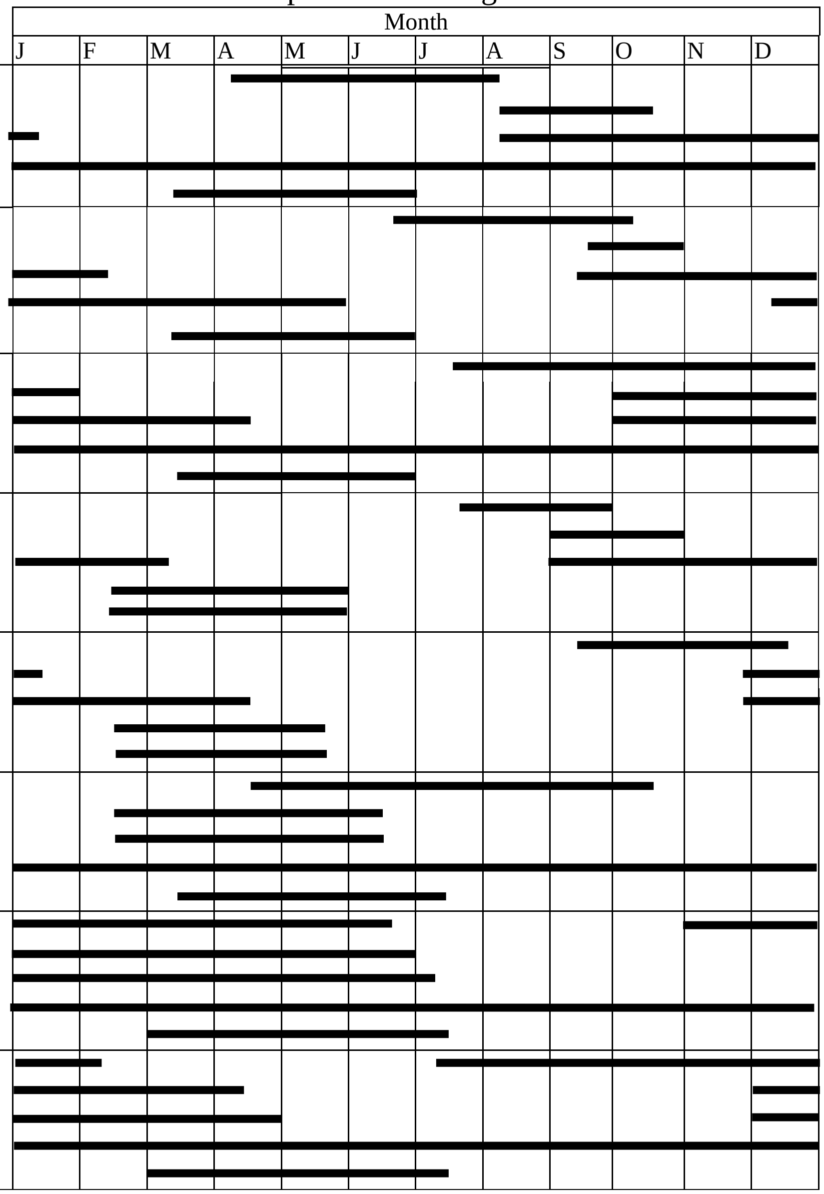
TABLE Timing of salmon and searun trout fresh-water life phases in Stillaguamish Basin

Species	Fresh-water Life Phase
Spring chinook	Upstream migration
	Spawning
	Intragravel develop.
	Juvenile rearing
	Juv. out migration
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
	Intragrevel develop.
	Juvenile rearing
	Juv. out migration
Chum	Upstream migration
	Spawning
	Intragravel develop.
	Juvenile rearing
	Juv. out migration
Summer steelhead	Upstream migration
	Spawning
	Intragravel develop
	Juvenile rearing[1]
	Juv. out migration
Winter steelhead	Upstream migration
	Spawning
	Intragravel develop.
	Juvenile rearing[1]
	Juv. out migration
Searun cutthroat	Upstream migration
	Spawning
	Intragravel develop.
	Juvenile rearing)
	Juv. out migration



[1]Normally extends over a two-year period.

TABLE
ANADROMOUS FISH NATURAL PRODUCTION (HARVEST_PLUS ESCAPEMENT!
STILLAGUAMISH BASIN

SPECIES	RANGE[1]	AVERAGE (ANNUAL)
Chinook	640-43,52	19,760
Coho	33,900 - 312,700	106,000
Pink	375,000 - 1,920,000	806,250
Chum	11,080 - 25,860	16,970
Summer Steelhead	1,346 - 3,530	2,200
Winter Steelhead	27,500 - 56,900	37,300
Searun Cutthroat	58,200 - 120,700	79,200
Searun Dolly Varden[2]		

[1]Period involved in determining fish numbers is 1956 - 1965. Exceptions:Pink salmon (1959 - 1965).Searun Cutthroat (1962 - 1966)

[2]Production limited, and therefore not determined

TABLE
SIGNIFICANT SPAWNING REACHES FOR ANADROMOUS FISH AND RESIDENT GAME FISH
STILLAGUAMISH BASIN[1]

STREAK	SECTION	STREAM MILEAGE	TYPE OF SPAWNING AREA
Stillaguamish River	Hat Slough to Interstate Highway 5	2.0 - 9.0	Few broad riffles, many slow glides, some patch gravel
	Interstate Highway 5 to Forks	9.0 - 10.0	Many broad riffles and beach gravel bars
North Fork	Mouth to Cicero	0.0 - 9.0	Few broad riffles, intermittent patch gravel bars
	Cicero to Boulder River	9.0 - 24.0	Numerous broad riffles, some patch and beach gravel
	Boulder River to Falls	24.0 - 34.0	Some broad riffles, some inter-mittent patch gravel
South Fork	Mouth to Canyon Creek	0.0 - 15.0	Numerous broad riffles, some channel splitting
	Canyon Creek to Robe	15.0 - 25.0	Few patch gravel sections only
	Robe to Headwaters	25.0 - 45.0	Occasional broad riffles, mostly patch and beach grave

[1]Additional spawning area is provided by virtually all tributaries entering within described reaches

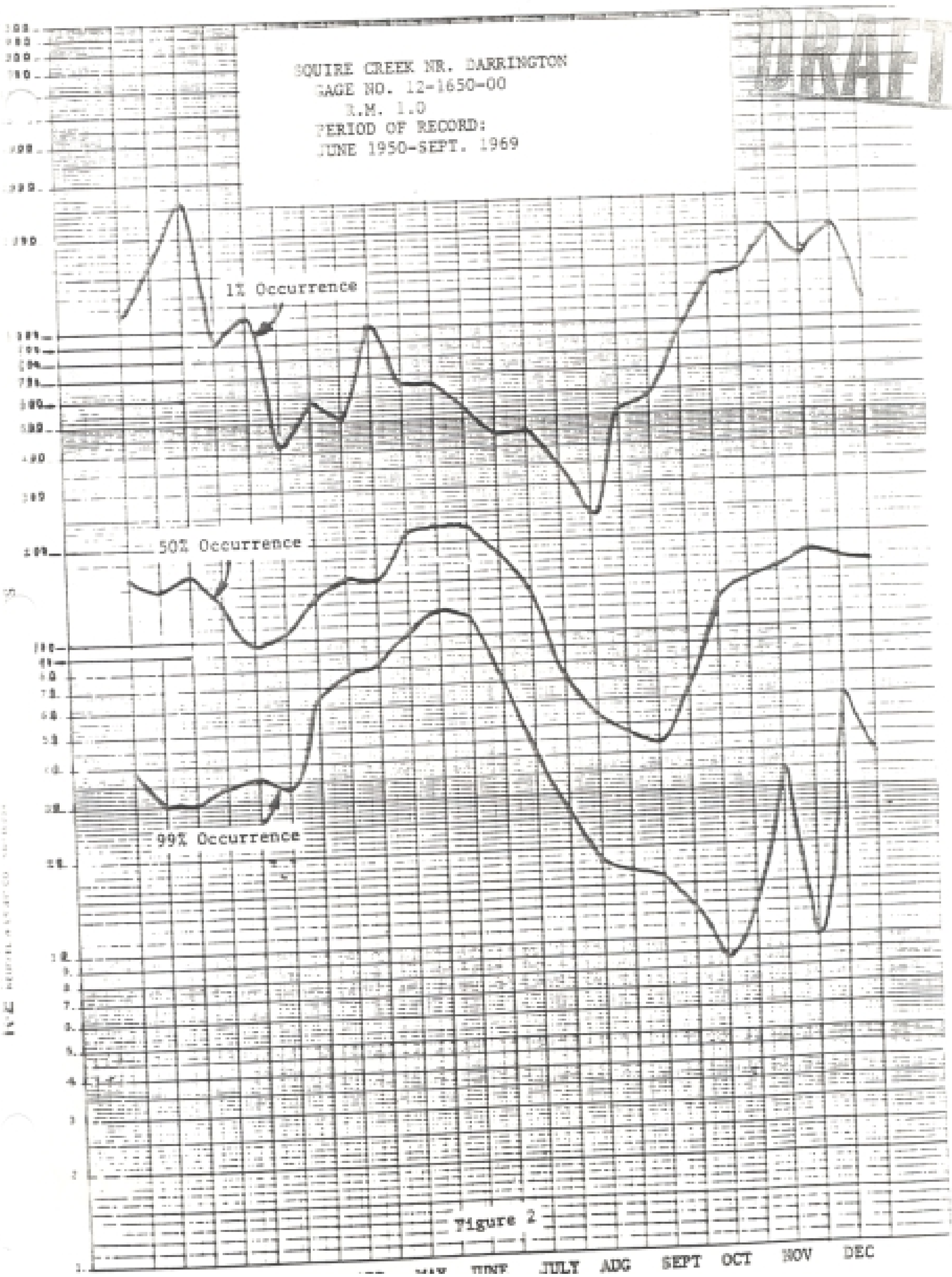

SQUIRE CREEK NR. DARRINGTON
GAGE NO. 12-1650-00
R.M. 1.0
PERIOD OF RECORD:
JUNE 1950-SEPT. 1969
DRAFT
1% Occurrence
50% Occurrence
99% Occurrence
JULY
AUG
SEPT
OCT
NOV
DEC

Figure 2

Minimum Flow Considerations

Ecological systems, such as the Stillaguamish basin or one of its subbasins, are in a dynamic equilibrium over moderate ranges (decades-centuries) of time, provided they are not greatly disturbed. Within this dynamic equilibrium, different elements, such as fish populations, remain relatively constant. A fish population E will have a mean or most likely number of individuals, but yearly production fluctuates naturally above and below the "mean" population size. Changes in the environment such as lowering of "normal" minimum flow levels can result in the elimination of good or peak population year cycles in fish production. This will have the effect of eventually reducing the "mean" fish population and increasing the likelihood of long-term reduction in fish species numbers. As the mean size of the population decreases, the probability of extinction increases. (6)

Salmon, Steelhead Trout and Trout Instream Resources

Chinook - Chinook spawning occurs throughout the accessible length of the north and south forks, plus in portions of the mainstem Stillaguamish below Arlington. Spawning also occurs in most of the larger tributaries. The current natural escapement goal for chinook in the Stillaguamish system is 2,000. This level of escapement can be expected to contribute about 8,000 chinook to the Washington sport plus commercial catch. Average annual chinook plants from nearby hatcheries for 1974 through 1977 totaled about 627,000 fish. (6)

A major limiting factor to chinook production is fall spawning flow. Many small to medium streams could and would support chinook runs if access for spawning in the fall were not a problem. A substantial number of the tributaries which do have chinook populations experience some passage problems during dry years. (6)

Coho - Coho salmon utilize virtually all accessible waters of the drainage for spawning and/or rearing. The natural escapement goal for coho in the system is 17,000. This level of escapement can be expected to contribute about 68,000 fish to the catch. Additional returns to the system can be expected due to WDF hatchery releases averaging about 86,000 fish per year (1974 through 1977). (6)

The main limiting factor to coho production is the summer-fall rearing flow (July through October). Because coho salmon rear in fresh water for one year prior to outmigration,.the number of outmigrants and thus adults fluctuates with amounts of rearing area available as determined by flows. Elimination of any flow during the low flow period results in a net reduction in harvestable numbers of coho. To maintain the coho resource at present levels, current fall flow fluctuations must be maintained. (6)

Water quality also is a limiting factor to coho production in some Stillaguamish streams. Coho streams in agricultural areas can be highly productive or completely nonproductive. The difference between the two types of production is often due to slight differences in water quality resulting from flow patterns. (6)

Pink - Odd year pink salmon have been recorded spawning in almost all accessible tributaries and mainstem areas of the Stillaguamish system. The escapement goal for pinks in the system is 155,000. This level of escapement can be expected to contribute approximately 232,500 fish to the catch. Because pinks are early spawners, low fall flows have a negative effect on total production. During dry years many ideal spawning areas are inaccessible to pink spawners. Large floods during the winter months also negatively impact pink production as does poor water quality in some streams. (6)

Chum - Chum salmon spawn in most tributary streams to the North Fork and in some South Fork and mainstem tributaries. Most mainstem spawning occurs in the north fork between Hazel and the mouth of Squire Creek. Some spawning also occurs in other mainstem areas. The natural escapement goal in odd numbered years (pink years) is 6,400, while in even years it is 16,500. These escapement levels can be expected to contribute about 13,000 and 33,000 fish to the catch, respectively. (6)

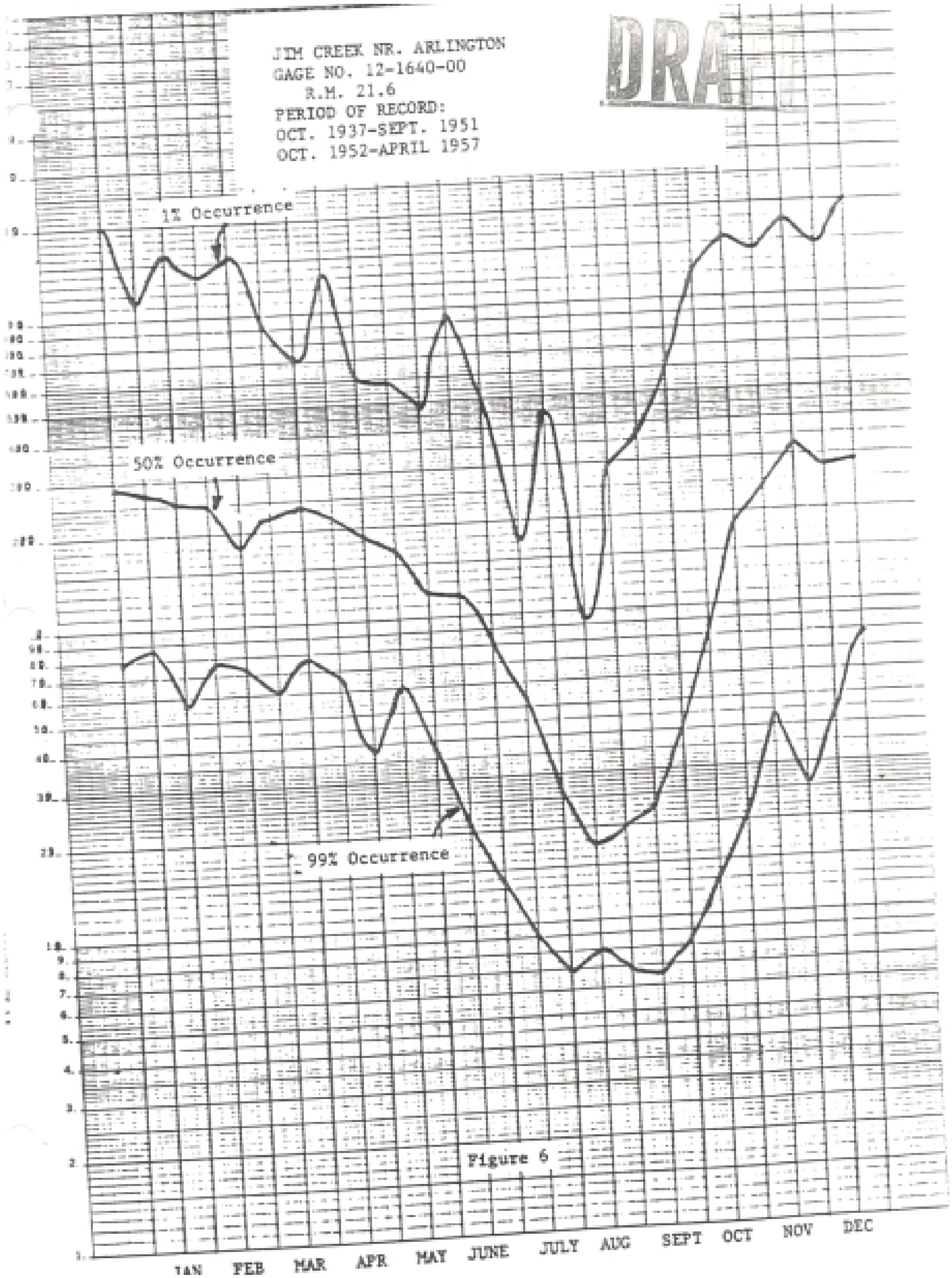
Natural low flows during the spawning period negatively impact chum production. During low flow years, substantial amounts of preferred spawning area are inaccessible to chum salmon in some streams. As with pink salmon, severe winter floods also negatively affect chum salmon production. Water quality is a problem in some Stillaguamish chum streams in agricultural areas. (6)

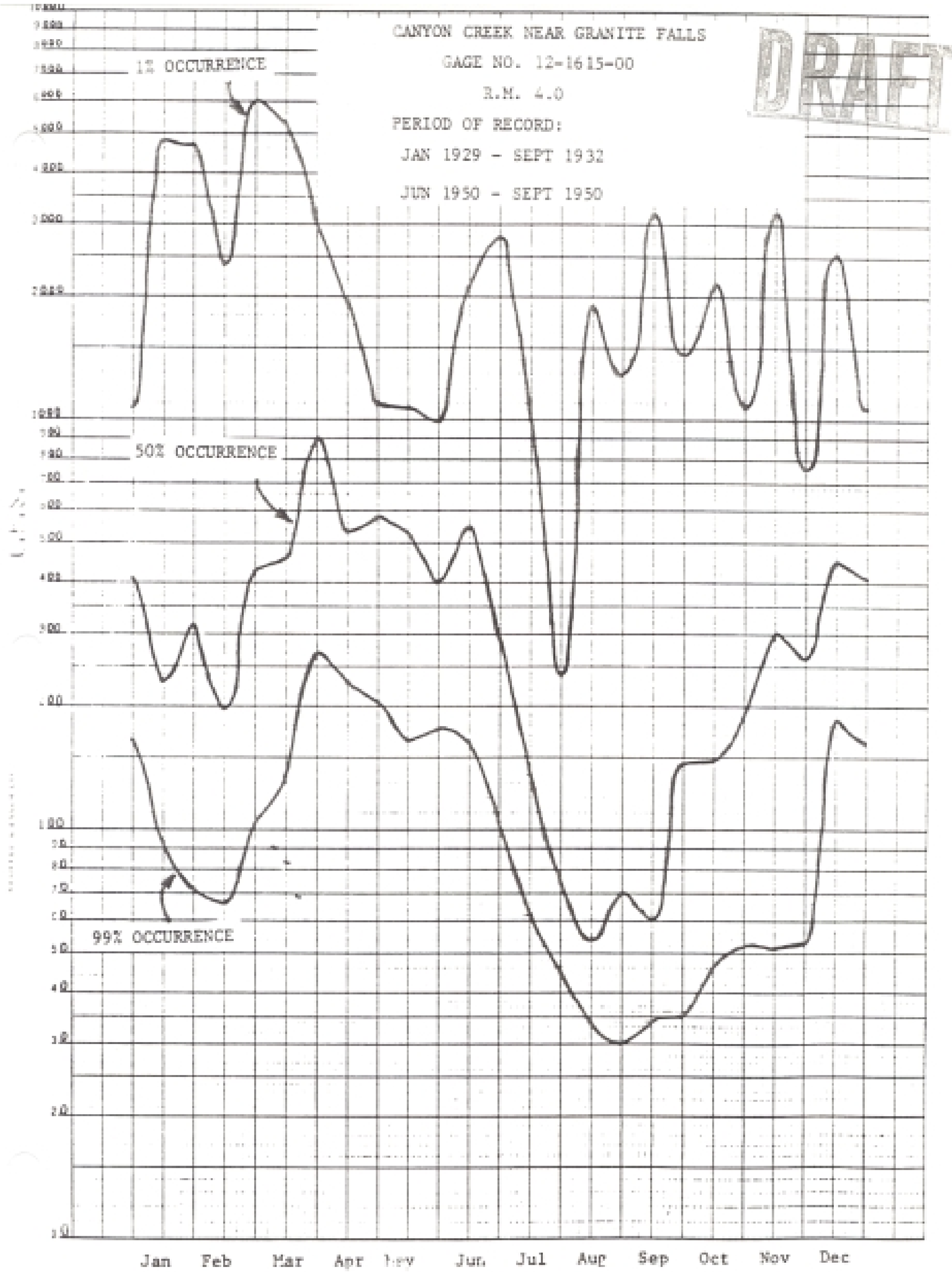
Shellfish

The Stillaguamish estuary contains abundant stocks of shellfish. A 1976 study by WDF estimated a standing crop of soft-shell clams in Port Susan of 5,940,000 pounds. The continued existence and usage of these clam stocks is dependent upon the quantity and quality of Stillaguamish outflow. A substantial clam resource on Warm Beach has already been negatively impacted by water quality. These clams have been decertified for commercial usage due to high coliform bacteria counts which are at least partly caused by Stillaguamish River water quality. Other types of clams are also present in the estuary at varying levels of abundance. The Stillaguamish estuary contains stocks of Dungeness and rock crab which also are dependent on river water quality and quantity. (6)

Flow Recommendations

WDF (Washington Department of Fisheries) flow recommendations are levels necessary for maintaining salmon runs at current abundance. The main considerations involve rearing flows for spring chinook and coho and spawning flows for chinook pink and chum. It is felt that flows probably have profound effects during other stages of the various species' life histories, however, the considerations mentioned are the most obvious and easily identified at this time. In the future, as more pertinent data becomes available relating flows to such things as estuary survival, food production, shellfish production, etc., WDF may request changes in its flow recommendations. (6)


JIM CREEK NR. ARLINGTON
GAGE NO. 12-1640-00
R.M. 21.6
PERIOD OF RECORD:
OCT. 1937-SEPT. 1951
OCT. 1952-APRIL 1957
DRAFT
1% Occurrence
50% Occurrence
99% Occurrence
Figure 6
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC


CANYON CREEK NEAR GRANITE FALLS
GAGE NO. 12-1615-00
R.M. 4.0
PERIOD OF RECORD:
JAN 1929 - SEPT 1932
JUN 1950 - SEPT 1950
DRAFT
1% OCCURRENCE
50% OCCURRENCE
99% OCCURRENCE
Jan
Feb
Mar
Apr
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Flow Recommendations

Washington Department of Game flow recommendations are for two sets of stages in game fish life histories: (1) spawning and incubation flows, and (2) rearing flows. The principal game fish are steelhead (Salmo gairdneri) and cutthroat trout (S. clarki), and Dolly Varden/bull trout (Salvelinus malma and _S. confluentus). Steelhead and cutthroat trout spawn in flowing water (lft/sec) over gravel during winter and spring (December through June). Dolly Varden and bull trout spawn during fall (August through December) and require spawning habitat similar to that of steelhead. Once fish have spawned, incubating eggs require continued flow of oxygen-bearing water through the gravel. Incubation is generally completed by the first of July, although some steelhead spawning continues into July. Following emergence of steelhead fry from the gravel, they rear for two years in the stream before smolting and migrating to sea in the spring (April-May). After two years at sea, the adults return to spawn in their native streams. They may enter the streams at almost any season, but peak migrations of steelhead occur in winter and summer, while the peak of the cutthroat and Dolly Varden migrations are in the late summer and fall. In certain places, flows can restrict passage of adults. (7)

Closure is recommended by Department of Game when median flow (Q50) is less than or equal to the recommended instream flow. At flows less than the recommended instream flow, steelhead production declines with flow reduction. When minimum flows are established, it is essential for wildlife, as well as for fish, that these flows not become _de facto maximum flows. Natural fluctuations, including flooding, must be allowed in the flow regime to protect riparian habitat. Minimum flow recommendations by the Game Department do not consider riparian habitat maintenance because no methodology exists. The Game Department regards any alteration of the natural flow regime as detrimental to riparian wildlife habitat. (7)

Steelhead: Multivariate analysis is needed to fully assess the many factors which influence salmonid production (see Figure 1; Zillges 1977). One factor, even one with a substantial effect, can be masked by. the combined effects of other factors; univariate statistical tests would often not indicate significance of a factor which is an important variable, perhaps even the most important variable, in a multivariate model which explains a significant portion of the variation in the dependent variable (steelhead production). Univariate statistical tests are, therefore, not very strong, and they may not be capable of detecting a relationship where one exists. (7)

In this report univariate tests of correlation (r) between stream flow and steelhead production are used, despite the lack of strength of such tests. (7)

The Stillaguamish River shows one of the clearest examples of the importance of rearing flow for steelhead production. Sport catches of winter-run steelhead in the North Fork and in the entire river

TABLE _ Winter steelhead sport catch and lowest flow during rearing years in Stillaguamish River.

SPORT CATCH			Lowest Flow (CFS							
			NORTH FORK				SOUTH FORK			
Year	Entire Stilla-gamish	North Fork Only	Age 1+	Year	Age 0+	Year	Age 1+	Year	Age 0+	Year
1978-79	2139	1060	251	1976	235	1975	260	1976	116	1975
1977-78	2390	1176	235	1975	208	1974	116	1975	105	1974
1976-77	2365	1344	208	1974	219	1973	105	1974	110	1973
1975-76	1270	891	219	1973	335	1972	110	1973	148	1972
1974-75	5407	2851	335	1972	348	1971	148	1972	170	1971
1973-74	3769	2303	348	1971	236	1970	170	1971	115	1970
1972-73	3444	2063	236	1970	203	1969	115	1970	140	1969
1971-72	5918	2821	203	1969	360	1968	140	1969	150	1968
1970-71	5958	2847	360	1968	235	1967	150	1968	109	1967
1969-70	3966	2035	235	1967	257	1966	109	1967	130	1966
1968-69	4505	2407	257	1966	220	1965	130	1966	134	1965
1967-68	7911	4579	220	1965	530	1964	134	1965	277	1964
1966-67	7680	4588	530	1964	276	1963	277	1964	132	1963
1965-66	10235	4706	276	1963	---	----	132	1963	---	----

	NORTH FORK CATCH WITH LOWEST			ENTIRE STILLAGUAMISH CATCH WITH LOWEST		
	Age 0 flow	Age 1 flow	Age 0 + Age 1 flow	Age 0 flow	Age 1 flow	Age 0 + Age 1
r	0.5613	0.4929	0.8555	0.6532	0.4002	0.8196
b	7.37	7.31	8.52	8.82	7.97	9.59
n	13	14	13	13	14	13
p	.05	10	0.01	05	.25	001

Stillaguamish River Basin
Table_ Planning Team Minimum Flow Recommendations

Stream Mainstem Stillaguamish River	DF Minimum Flow	DG Minimum Flow	USF&WS Minimum Flow	Tribal* Minimum Flow
N. Fk N. Fk (Upper)	Minimum flow & summer closure	Closure	Closure	Minimum Flow
S. Fork	Minimum flow	Closure		Minimum Flow
Church Cr.	Closure	Closure	Closure	
0030	Closure			
Portage Cr.	Existing closure	Existing closure	Existing closure	
Pilchuck Cr.	Existing closure	Existing closure	Existing closure	Existing closure
Armstrong Cr.	Closure	Closure	Closure	
Grant Cr.	Closure	Minimum flow	Closure	
Deer Cr.	Closure	Summer closure	Summer closure	Summer closure
Rollins Cr.	Minimum flow	Minimum flow		
Boulder Rv.	Summer closure	Summer closure	Summer closure	
French Cr.	Closure	Minimum flow		
0250/0252	Closure			
Forston Cr.	Closure	Closure	Closure	
Segelson Cr.	Closure			
Moose Cr.	Closure			
Squire Cr.	Closure	Closure	Closure	
Jim Cr.	Closure	Summer closure	Summer closure	Summer closure
Jordan Cr.	Closure	Closure		
Canyon Cr.	Existing closure	Existing closure	Existing closure	Existing closure `
Cranberry Cr.	Closure	Closure	Closure	
Trout Cr.	Closure	Closure	Closure	
Benson Cr.	Closure			
Silver Gulch Cr.	Closure	Closure	Closure	
Firland Cr.	Closure	Minimum flow		
Ashton Cr.	Closure	Minimum flow .		
Browns Cr.	Closure	Minimum flow		
Navy Base Cr.	Closure	Minimum flow		
Lake Recley Cr.	Closure	Minimum flow		
Fish Cr.	Closure	Closure	Closure	
Lake Ki	Existing closure	Existing closure	Existing closure	

are highly correlated (r=0.85 and r=0.82, respectively; P 0.001, Table _) with the lowest rearing flows during both rearing years (additive index). During the 1979-80 season, analysis of scales of 12 sport-caught Stillaguamish steelhead indicated that approximately 58 percent are wild fish. Low flow is a much better predictor of sport catch than is the number of smolts planted, underscoring the importance of low flows in limiting Stillaguamish steelhead production. A slope of 9.6 indicates that for every 1 cfs lost at lowest flow at the forks over a two-year rearing period, the corresponding sport catch will decline by 9.6 fish, assuming all other factors are unchanged. Using this index, a diversion of 0.25 cfs from the North Fork and 0.25 cfs from the South Fork on the days of lowest flow in 1980 and 1981 would reduce the 1983-1984 winter sport catch by 9.6 fish below what would have been expected without that diversion. Since lowest flow is an index of flow-related stress, it is assumed that in order to cause the predicted catch decline, the diversion continues throughout the low flow period and not just on the single day of lowest flow. (7) It is interesting to note that of the approximately 900 steelhead trout caught by the Stillaguamish Tribe during 1980, about 80 percent of these fish originated from hatchery stock. (7)

<u>Wildlife Resources</u>

The Stillaguamish River Basin possesses a wide variety of riparian oriented wildlife. Of special interest to the Instream Resources Protection Program are those species that are highly dependent on the maintenance of adequate stream flows and lake levels and the associated riparian habitat. Species found within the basin that are of high economic and recreational value to the people of Washington State include furbearing mammals, waterfowl, song birds, raptors (birds of prey) and big game animals. The basin ranks very high in the harvest of mink, muskrat and beaver.

The Stillaguamish River estuary is a southern extension of the Skagit-Samish Flats, one of the premier waterfowl areas on the Pacific coast. Significant numbers of migratory waterfowl including mallards, pintail, widgeon, wood ducks, coots, merganser, and teal are also produced within the Stillaguamish River Basin. Snow geese winter in the vicinity of Port Susan and Hat Slough where they feed upon the salt marsh vegetation of the estuary. Approximately 10,000 snow geese have been observed along the estuary during the winters of 1979 and 1980. (6)

(Several waterfowl hunting clubs are also located within the estuary.) Whistling and trumpter swans, Canada geese, and an occasional sandhill crane are also observed within the basin.

Species of Special Concern

Species of special concern include endangered species, threatened species, and species recognized by experts as being endemic, rare, declining, or vulnerable to disturbance. The first two categories include only species listed in the Federal Register under the Endangered Species Act(s). The third category includes species being considered for listing under the Endangered Species Act, as well as species listed only by other organizations and agencies. The entire list, incorporating all three categories, was compiled by the Non game Wildlife Program of the Game Department and the Washington Natural Heritage Program. In this report two terms, occurrence and sighting, will be used and must be distinguished. Occurrence of a species in an area refers to regular use for an important activity, such as nesting. Occurrence indicates that one or more individuals of a species depend significantly upon that location. A sighting indicates only that a species has been observed at a particular location; the individual may have been passing through an area that is nonessential to it. A sighting can also be an unproven occurrence, but "occurrence" implies evidence of importance of the area to the species. (7)

There is at least one occurrence of bald eagles, a threatened species nesting in the Stillaguamish River Basin. Moderate numbers of eagles occur along the Stillaguamish during the winter, feeding on salmon carcasses. Winter flows control availability of carcasses to eagles, f and the number of carcasses is related to size of salmon runs, which are affected by instream flows. Because of the dependence of the threatened bald eagle upon salmon, the Department of Game supports the maintenance of minimum flows that will continue to provide salmon resources upon which the eagles feed. (7)

Stream Flow Considerations

Flow regime, together with topography, controls riparian vegetation, which is extremely valuable wildlife habitat. Riparian vegetation is not a climax vegetation. It persists at early successional stages, which are very productive, because occasional floods pre vent the vegetation from reaching a climax stage. Floods are, therefore, an important part of the natural flow regime. A number of wildlife species are dependent upon fish for food. Instream flows can affect these wildlife species by affecting their food supply. While extremely low flows facilitate the capture of fish by piscivorous wildlife, continued heavy predation, together with other-adverse aspects of low flow, could reduce the fish population, causing a crash of the wildlife populations dependent upon fish. (7)

Riparian Related Species

The list of fish-eating wildlife is long, including kingfishers, several species of herons, ducks, especially mergansers, ravens, crows, eagles and ospreys, several members of the weasel family, raccoons, and bears. Species of special concern in the basin and which are dependent upon fish are discussed under Species of Special Concern. (7)

Other animal species of special concern which occur in the Stillaguamish Basin include great blue heron, fisher, spotted own, silverhaired bat, and tailed frog. (7)

Plant species of concern which occur in the Stillaguamish Basin include paintbrush (Castilleja parviflora var. albida), springbeauty (Claytonia lanceolata var. chrysantha), douglasia (Douglasia laevigata var. laevigata), spleenwort (Asplenium viride), grape-ferns (Botry-chium boreale and B. lanceolatum), Christmas-fern (Polystichum kruckebergii), fritillary (Fritillaria camschatcensus), gnome-plant (Hemitomes congestum), goldthread (Co tis asplenifolia), lobelia (Lobelia dortmanna), and rush (Juncus supiniformis). Mark Sheehan, plant ecologist for the Washington Natural Heritage Program, suggests that another rush (J. supinus) probably occurs in the basin. According to Sheehan, both species of rush and the lobelia are waterdependent plants which could be affected by changes in stream flow. (7)

VII PRESENT ADMINISTRATIVE STATUS

CURRENT ADMINISTRATIVE STATUS OF STREAMS AND LAKES, WRIA N0. 5 (STILLAGUAMISH)

Stream	Tributary of	Action	Dates
Armstrong Creek	Stillaguamish River	low flow (2.0 cfs minimum)*	None
Canyon Creek	South Fork Stillaguamish River	Closure	2/11/46
Cummings Lake	ND - Port Susan	Lake level (372 feet above MSL minimum)	9/14/64
Lake Rowland	ND - Port Susan	Lake level (10 feet depth minimum at deepest point)*	None
March Creek	Stillaguamish River	Low flow (0.5 cfs minimum)*	None
Jorgenson Slough(including Church Creek)	Stillaguamish River	Low flow (1/2 low flow must be allowed to bypass)	6/1/49
Pilchuck Creek	Stillaguamish River	Closure	9/7/51
Portage Creek	South Slough of Stillaguamish River	Closure	8/3/48
Tulalip Indian Reservation	(Interim Procedures - Indian Water Rights)		12/23/75
Unnamed Drainage Ditches	North Fork Stillaguamish River	Low flow (0.75 cfs minimum)*	None
Unnamed Stream (Johnson Creek)	North Fork Stillaguamish River	Low flow (1.0 cfs minimum)*	None
Unnamed Stream (Woods Creek	Jim Creek	Low flow (1.0 cfs minimum)	1/20/56
Unnamed Stream	Church Creek	Closure	4/11/75
Unnamed Stream	Kroeze Lake	Low flow (2.0 cfs minimum)*	None
Unnamed Stream	North Fork Stillaguamish River	Low flow (2.0 cfs minimum)*	None
Unnamed Stream	North Fork Stlllaguamish River	Low flow (1/2 established low flow allowed to bypass)	1/31/56
Unnamed Stream	North Fork Stillaguamish River	Low flow (0.20 cfs minimum)*	None
Unnamed Stream	South Fork Stillaguamish River	Low flow (1/2 low flow allowed to bypass)	5/25/53

*DOE action only. AV/W9(A22-23)

VIII. PROPOSED ADMINISTRATIVE STATUS

The department, based on information available and the recommendations from the Stillaguamish River Basin IRPP planning team, proposes to establish minimum flows for the Stillaguamish River and to establish new closures on Armstrong Creek, Deer Creek, Fortson Creek, Segalson Creek, Jim Creek, Moore Creek, Squire Creek, Grant Creek, and French Creek from June to November. In addition, this program confirms existing closures on Canyon Creek, Pilchuck Creek, Portage Creek, and Church Creek. Minimum flows are established for the mainstem of the Stillaguamish River and the north and south forks of the Stillaguamish River.

The Department of Ecology concludes that a network of three control stations will provide adequate control over future diversions from the remaining open surface water resources within the Stillaguamish River Basin.

Control Station	Stream Mgt Reach	Gage No.	River Mile
Stillaguamish River	From influence of mean annual high tide at low instream flow to forks, except Pilchuck Creek.	12-1677-00	11.1
North Fork Stillaguamish River	From confluence of forks to headwaters except Squire Creek and Deer Creek.	12-1670-00	6.5
South Fork Stillaguamish River	From confluence of 1 forks to headwaters, except Jim Creek.	2-1645-00	34.9

IX. ALTERNATIVE COURSES OF ACTION

Many alternative courses of action were considered with respect to the Stillaguamish River Basin Instream Resources Protection Program. Some of the options considered for the Instream Resource Protection Program included the following:

A. No action; Defer Stillaguamish River Basin Instream Resources Protection Program until a later date.

B. Establish a total closure of the entire basin to out-of-stream consumptive use until more data is available.

C. Establish a minimum flow and/or closures according to the data presented by the planning team.

D. Develop a Stillaguamish River Basin Plan.

The option chosen that accomplished the objectives and purpose of the overall instream program in a timely manner was course of action "C." This option establishes minimum flows and closure in order to insure that the protection of the instream resources are maintained.

The advantages of this option include the timely development of minimum stream flows and closures to insure the protection of the instream resources.

The "no action" option was seriously considered but it was recognized that the instream resources within the Stillaguamish River Basin are in need of protection in the near future and that any delays could be detrimental to the instream resources. The advantage of this option includes avoidance of potential controversy.

Option "B - Total Closure" was not considered necessary due to the adequate amount of data pertaining to the fish and water resources of the Stillaguamish River. This river has been the subject of detailed studies by Indian tribal biologist, USF&WS, U.S. Corps of Engineers, Department of Game, Department of Fisheries, and the Department of Ecology.

Course of Action "D - Stillaguamish River Basin Plan" was considered but not accepted due to the longer completion time required for the basin plan (up to five years). This option does involve a more comprehensive water resource allocation program than exists with the Instream Resources Protection Program. The basin plan would involve making an estimate of all water required for instream and out-of-stream consumptive use and additionally a program to allocate the beneficial uses of water.

Appendix B

GLOSSARY

Alluvium: Silt, sand, and gravel deposited by stream action.

Anaerobic: Able to live and grow where there is no air or free oxygen.

Barrier: Mountainous area which acts as an obstruction or diversion to approaching weather.

Geomorphology: The study of topographical features of the earth, and the means by which, and the manner in which they have been produced.

Glaciation: Alteration of the earth's solid surface through erosion and deposition by glacier ice.

Kettle: A depression in glacial deposits, made the wasting away of a detached mass glacier ice that had been either partly or wholly buried in the deposits.

Metamorphism: The mineralogical and structural adjustment of solid rocks to physical on chemical conditions differing from those under which the rock in question originated.

Orographic: Due to rising air currents adjacent to mountains.

Outwash: Stratified clay, silt, sand, gravel, and boulders deposited by meltwater streams beyond active glacier ice.

Scope Index: The ratio of the stream discharges at 2- and 20-year-recurrence intervals from the 7-day minimum frequency curve.

Spacing Index: The ratio between the discharges at the 2-year-recurrence intervals of the 183- and 7-day frequency curves.

Substrate: (= substratum) The ground or substance which lies beneath and supports another as a basis or foundation.

Selected References

1. Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters, State of Washington, Appendix III. March 1970.

2. Water Quality Management Plan for the Stillaguamish River Basin. Washington, November 1974, Vol. VI.

3. Snohomish County Planning, S. Rice; personal notes. 1980-81.

4. Washington Department of Ecology, N.W. Region D. Garland; personal notes and conversations. 1980-81.

5. Puget Power. R. Barnes; personal notes. 1981.

6. Washington Department of Fisheries, G. Zilleges and R. Orrell personal notes and memos. 1980-81.

7. Washington Department of Game, Dr. H. Beecher. 1980-81. t

8. City of Marysville, Washington, Butler. 1981.

9. David Munsel and Robert Herman. 1981.

10. USF&WS, P. Wampler. 1980.

11. USFS, R. La Rock . 1980-81.

Chapter 173-505 WAC
Instream Resources Protection Program--Stillaguamish River Basin,
Water Resource Inventory Area (WRIA) 5

NEW SECTION

WAC 173-505-010 GENERAL PROVISIONS. These rules apply to waters within the Stillaguamish River Basin, WRIA 5, as defined in WAC 173-500040. This chapter is promulgated pursuant to chapter 90.54 RCW (Water Resources Act of 1971), chapter 90.22 RCW (Minimum Water Flows and Levels), and in accordance with chapter 173-500 WAC (Water Resources Management Program).

NEW SECTION

WAC 173-505-020 PURPOSE. The purpose of this chapter is to retain perennial rivers, streams, and lakes in the Stillaguamish River Basin with instream flows and levels necessary to provide protection for wildlife, fish, scenic, aesthetic, environmental values, recreation, navigation, and to preserve water quality.

NEW SECTION

WAC 173-505-030 ESTABLISHMENT OF INSTREAM FLOWS. (1) Stream management units and associated control stations are established as follows:

Stream Management Unit Information

Control Station Number Stream Management Unit Name	Control Station Location, River Mile and Section, Township and Range	Affected Stream Reach
A. Squire Creek	12-1650-00 1.0 8, 32N, 9E	From confluence with North Fork Stillaguamish River to headwaters
B. Deer Creek	12-1665-00 1.4 5. 32N, 7E	From confluence with North Fork Stillaguamish River to headwaters
C. North Fork Stillaguamish River	12-1670-00 6.5 16, 32 N, 6E	From confluence of forks to headwaters, except Squire Creek and Deer Creek
D. South Fork Stillaguamish River	12-1645000 34.9 7.31N, 63	From confluence of forks to headwaters, except Jim Creek
E. Jim Creek	12-1685-00 6.4 16, 34N, 5E	.From confluence with South Fork Stillaguamish River to headwaters
F. Pilchuck Creek	12-1685-00 6.4 16, 34N, 5E	From confluence with Stillaguamish River to headwaters

Control Station Number Stream Management Unit Name	Control Station Location, River Mile and Section, Township and Range	Affected Stream Reach
G. Stillaguamish River	12=1677-00 11.1 6, 31N, 5E	From influence of mean annual high tide at low instream flow to forks, except Pilchuck Creek
H. Canyon Creek	New gage. RM .01	From confluence with the South Fork of the Stillaguamish River to the headwaters
I. Boulder River	RM .5	From confluence with the North Fork of the Stillaguamish River to the headwaters

(2) Instream flows established for the stream management unit described in WAC 173-505-030(1) are as follows:

INSTREAM FLOWS IN THE STILLAGUAMISH RIVER BASIN
(in cubic feet per second)

	Squire Creek USGS Gage 1650 R.M. 1.0	Deer Creek USGS Gage 1665 M. 1.4	Jim Creek USGS Gage 1640 R.M.
Jan 1	150	250	250
15	150	250	250
Feb 1	150	250	200
15	150	250	200
Mar 1	150	250	200
15	150	250	200
Apr 1	150	250	200
15	150	250	150
May 1	150	250	150
15	150	250	150
Jun 1	150	200	100
15	100	150 (Closed)	100 (Closed)
Jul 1	90 (Closed)	150 ↑	100 ↑
15	90 ↑	80	50
Aug 1	70	50	30
15	50	50	20
Sep 1	45	50	20
15 1	45	50	25
Oct 1	50	80	40 ↓
15	90 ↓	100 ↓	80 (Closed)
Nov 1	150 (Closed)	200 (Closed)	100
15	150	250	150
Dec 1	150	250	200
15	150	250	250

INSTREAM FLOWS IN THE STILLAGUAMISH RIVER BASIN
(in cubic feet per second)
(continued)

	North Fork USGS Gage 1670 R.M. 6.5	South Fork USGS Gage 1645 RM. 34.9	Stillaguamish R. USGS Gage 1677 R.M. 11.1
Jan 1	1500	1000	3000
15	1500	1000	3000
Feb 1	1500	1000	3000
15	1500	1000	3000
Mar 1	1500	1000	3000
15	1500	1000	3000
Apr 1	1500	1000	3000
15	1500	1000	3000
May 1	1500	1000	3000
15	1500	1000	3000
Jun 1	1500	1000	3000
15	1500	1000	2000
Jul 1	1000	1000	2000
15	500	600	1500
Aug 1	450 (Closed)	350 (Closed)	1000
15	450 ▲	300 ▲	1000
Sep 1	450 ▼	250	1000
15 1	450 (Closed)	300	1000
Oct 1	500	300 ▼	1000
15	600	400 (closed)	1500
Nov 1	1500	1000	2000
15	1500	1000	2500
Dec 1	1500	1000	3000
15	1500	1000	3000

	Boulder River USGS Gage R.M.
Jan 1	300
15	300
Feb 1	300
15	300
Mar 1	300
15	300
Apr 1	300
15	300
May 1	300
15	300
Jun 1	300
15	250
Jul 1	200
15	150
Aug 1	100
15	100
Sep 1	100
15 1	100
Oct 1	150
15	200
Nov 1	200
15	250
Dec 1	300
15	300

(3) Instream flow hydrographs, as represented in the document entitled "Stillaguamish River Basin Instream Resource Protection Program," shall be used for identification of instream flows on those days not specifically identified in WAC 173-505-030(2).

NEW SECTION

WAC 173-505-040 SURFACE WATER SOURCE LIMITATIONS TO FURTHER CONSUMPTIVE APPROPRIATIOU. (1) The department has determined that (a) certain streams exhibit low summer flows or have a potential for going dry, thereby inhibiting anadromous fish passage during critical life stages, and (b) historic flow regimes and current uses of certain other streams indicate that no water is available for additional appropriation. Based upon these determinations the following streams and lakes are closed to further appropriation for the periods indicated:

New Surface Water Closures

Stream or Lake Section, Township, and Range of Mouth or Outlet	Tributary to	Period of Closure
Deer Creek NW¼NE¼ Sec. 17, T32N, RAE	N. Fk. Stillaguamish River	Jul 15 - Nov 1
Jim Creek SE¼SE¼ Sec. 7, T31N, R6E	S. Fk. Stillaguamish River	Jul 1 - Oct 31
Squire Creek NW¼NW¼ Sec. 8, T32N, R9E	N. Fk. Stillaguamish River	Jul 1 - Nov 1
North Fork Stillaguamish Rv. SE¼NW¼ Sec. 2, T31N, R5E	Stillaguamish River	Aug 1 - Sep 30
South Fork Stillaguamish Rv. SE¼NW¼ Sec. 2, T31N, R5E	Stillaguamish River	Aug 1 - Oct 31

(2) The following stream and lake low flows and closures are adopted confirming surface water source limitations previously established administratively under the authority of chapter 90.03 RCW and RCW 75.20.050.

Existing Surface Water Source Limitations
Current Administrative Status of Streams and Lakes
Stillaguamish Basin, WRIA 5

Stream	Tributary to	Action	Dates
Armstrong Creek NW¼SE¼ Sec. 34, T32, R5E	Stillaguamish River	Low flow (2.0 cfs minimum)*	None
Canyon Creek SE¼SE¼ Sec. 12, T30, R6E	South Fork Stillaguamish River	Closure	2/11/46
Cummings Lake SE¼SW¼ Sec. 31, T31, R4E	ND - Port Susan	Lake level (300 feet above MSL minimum)	9/14/64
Lake Rowland SE¼SW¼ Sec. 29, T31, R4E	ND - Port Susan	Lake level (10 feet depth minimum at deepest point)*	None
March Creek NE¼NE¼ Sec. 9, T31, R5E	Stillaguamish River	Low flow (0.5 cfs minimum)*	None
Jorgenson Slough (including Church Creek) SW¼NW¼ Sec. 30, T32, R4E	Stillaguamish River	Low flow (1/2 low flow must be allowed to bypass)	6/l/49

Stream	Tributary to	Action	Dates
Pilchuck Creek NW¼NW¼ Sec. 6, T31, R5E	Stillaguamish River	Closure	9/7/51
Portage Creek NW¼NW¼ Sec. 12, T31, R4E	South Slough of Stillaguamish River	Closure	8/3/48
Tulalip Indian Reservation	(Interim Procedures Indian Water Rights)		12/23/75
Unnamed Drainage Ditches SE¼SW¼ Sec. 12, T32, R6E	North Fork Stillaguamish River	Low flow (0.75 cfs minimum)*	None
Unnamed Stream (Johnson Creek) NW¼NW¼ Sec. 16, T32, R7E	North Fork Stillaguamish River	Low flow (1.0 cfs minimum)*	None
Unnamed Stream (Woods Creek) NW¼NW¼ Sec. 16, T31, R6E	Jim Creek	Low flow (1.0 cfs minimum)	1/20/56
Unnamed Stream NE4NW4 Sec. 21, T32, ME	Church Creek	Closure	4/11/75
Unnamed Stream SWINE¼Sec. 30, T32, R6E	Kroeze Lake	Low flow (2.0 cfs minimum)*	None
Unnamed Stream NE4NE4 Sec. 15 T32, R6E	North Fork Stillaguamish River	Low flow (2.0 cfs minimum)*	None
Unnamed Stream NW¼NW¼ Sec. 17, T32, R7E	North Fork Stillaguamish River	Low flow (1/2 estab-lished low flow allowed to bypass)	1/31/56
Unnamed Stream NE4NW4 Sec. 16, T32, R7E	North Fork Stillaguamish River	Low flow (0.20 cfs minimum)*	None
Unnamed Stream NE¼NE¼ Sec. 10, T30, R6E bypass)	South Fork Stillaguamish River	Low flow (1/2 low flow allowed to	5/25/53

NEW SECTION

WAC 173-505-050 GROUND WATER. Future ground water withdrawal proposals will not be affected by this chapter unless it is verified that such withdrawal would clearly have an adverse impact upon the surface water system contrary to the intent and objectives of this chapter.

NEW SECTION

WAC 173-505-060 LAKES. In future permitting actions relating to withdrawal of lake waters, lakes and ponds shall be retained substantially in their natural condition. Withdrawals of water which would conflict therewith shall be authorized only in those situations where it is clear that overriding considerations of the public interest will be served.

NEW SECTION

WAC 173-505-070 EXEMPTIONS. (1) Nothing in this chapter shall affect existing water rights, riparian, appropriative, or otherwise existing on the effective date of this chapter, nor shall it affect existing rights relating to the operation of any navigation, hydroelectric or water storage reservoir or related facilities.

(2) If, upon detailed analysis, appropriate and environmentally sound proposed storage facilities are found to be compatible with this chapter, such facilities may be approved.

(3) Domestic use for a single residence shall be exempt from the provisions of this chapter. If the cumulative effects of numerous single domestic diversions would seriously affect the quantity of water available for instream uses, then only domestic in-house use shall be exempt if no alternative source. is available.

(4) Stock watering use, except that related to feedlots, shall be exempt from the provisions established in this chapter.

(5) Future rights for nonconsumptive uses may be granted.

NEW SECTION

WAC 173-505-080 FUTURE RIGHTS. No rights to divert or store public surface waters of the Stillaguamish River Basin, WRIA 5, shall hereafter be granted which shall conflict with the purpose of this chapter as stated in WAC 173-505-020.

NEW SECTION

WAC 173-505-090 ENFORCEMENT. In enforcement of this chapter, the department of ecology may impose such sanctions as appropriate under authorities vested in it, including but not limited to the issuance of regulatory orders under RCW 43.27A.190 and civil penalties under RCW 43.83B.335.

NEW SECTION

WAC 173-505-100 REGULATION REVIEW. The rules in this chapter shall be reviewed by the department of ecology at least once in every 4 years. In addition, the department may review this regulation whenever requested by private, public, state, and federal agencies.