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INITIAL WATERSHED ASSESSMENT
TUCANNON RIVER WATERSHED
Part of Water Resources Inventory Area 35

Open file Report 95-04

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Introduction

This report is the product of an initiative by the Washington State Department of Ecology (Ecology) to assess the availability of ground and surface water for each watershed within Washington State. This initiative is part of a larger overall effort to increase the efficiency of the water rights decision making process. The watershed assessment process will not only reduce the time needed to make decisions, but will also allow Ecology to make better informed decisions based on a more comprehensive understanding of each watershed. Ecology also believes these reports will be useful to local governments for planning purposes.

Ecology's Water Resources Program is charged with managing the state's water resources to ensure the waters of the state are protected and used for the greatest benefit. When considering whether to grant a permit for water use, Ecology must first determine that the proposed water use passes four statutory tests (RCW 90.03.290): 1) that the use will be beneficial; 2) it will not be detrimental to the public interest; 3) that the water is physically available; and 4) that the use will not impair existing rights.

The information for this report was obtained from published reports, geologic maps, Water Rights Information System and Claims Registries, personal communications, water well reports, historic flow measurements obtained from the U.S.G.S. gage near Starbuck (ID 13344500) and miscellaneous stream flow and temperature measurements collected by Ecology regional staff and the Washington Department of Fisheries (Fisheries). Two continuous-recording stream flow gages have been temporarily re-established on the Tucannon River by Ecology personnel. The first of these gages was initially installed by Fisheries at the Tucannon River Hatchery and was subsequently discontinued (ERO Miscellaneous Site ID # 00347). The second gage, established by Ecology, is located downstream at the site of the U.S.G.S. gage near Starbuck (ERO Miscellaneous Site ID # 00348). See Map 1 for locations.

Watershed Description

Area Description

The Tucannon River watershed, located in southeastern Washington, encompasses approximately 502 square miles within Garfield and Columbia Counties (Figure 1). The Tucannon River headwaters begin at Oregon Butte in the Blue Mountains at an elevation of 6,387 feet above sea level (Fuller 1986). As the river flows through its 50-mile-long course, it descends 5,800 feet in elevation before joining the Snake River at River Mile (RM) 63, at an elevation of 500 feet above sea level (Kelley et al. 1982). The Tucannon River Watershed is part of Water Resource Inventory Area number 35.

Land Use

The primary land uses within the Tucannon Watershed are agriculture, range, and recreation. The upper drainage area is located within the Umatilla National Forest. As it continues downstream, the Tucannon River flows through lands owned and managed by the Washington Department of Wildlife (W.T. Wooten Wildlife Recreation Area). The lower portions of the drainage are dominated by cultivated and grazed farmlands and private rangelands. The pool created by Lower Monumental Dam has resulted in the lower two miles of the Tucannon River becoming marshlands (Kelley et al. 1982). There are two perennial sub-watersheds that form tributaries to the Tucannon River, these are Cummings Creek and Pataha Creek.

The Tucannon River is an adjusting and evolving stream. During the past several decades, it has undergone fundamental changes in the flow regime, bed conditions, water quality, and habitat values. Many of these changes are related to land uses in the watershed. Most of the changes in the Pataha channel seem to have occurred in the first 30 to 50 years following establishment of the region's agricultural economy. The form of the Tucannon River below Willow Creek is still undergoing long-term adjustment; it is clear, however, that most channel changes in the lower part of the river pre-date extreme floods that occurred in the 1960s and 1970s. Most of the changes observed above Willow Creek took place during the 1964 to 1978 interval (Hecht et al. 1982).

A Natural Resources Conservation Service (formerly known as the Soil Conservation Service) report prepared by Hecht et al. (1982) identified and evaluated changes in the riparian area and streambed and channel conditions of the Tucannon River between 1937 and 1978. These changes suggest a 33 to 55 percent decrease of riparian woodland during this time period, much of which was attributed to major floods after 1964. Flood periods were determined to have had their greatest impacts in the middle and upper reaches of the river, while alterations below Marengo (RM 24) pre-date these events. The authors attributed some of the woodland loss to the encroachment of other land use practices, principally irrigated fields and pasture lands. Further, as wooded riparian zones were replaced with open zones, shade was diminished and banks likely became less stable. The authors could not determine whether the biggest influence in the loss of riparian woodland was flooding or land use practices (Hecht et al. 1982).

The above-quoted report concluded that the most significant limiting factors to salmonid production in the Tucannon River are elevated stream temperatures and sedimentation, both of which are perpetuated by limited redevelopment of riparian vegetation. The combined annual sediment yield to streams for the entire watershed was determined to be approximately 170,000 tons per year (USDA 1984). The most severe sedimentation problems occur in the lower one-third of the watershed, with noticeable decrease in severity upstream.

Climate and Precipitation Trends

The climate of the Tucannon Watershed varies markedly and is largely influenced by topography. The watershed receives a mean annual precipitation of 23 inches including a mean annual snowfall of 65 inches. Rainfall ranges from more than 40 inches in the higher elevations

to 10 to 15 inches in the lower elevations. Ninety percent of the precipitation occurs between September and May with 30 percent of the winter's precipitation in the form of snow. Snowfall at elevations less than 1,500 feet seldom lingers beyond three or four weeks, occasionally melting quickly enough to produce severe erosion (Kelley et al. 1982, Fuller 1986).

Figure 2 depicts the average yearly precipitation recorded at the Pomeroy and Dayton Weather Service Stations for the period 1959 – 1992. Linear regression analysis of these data sets indicate that precipitation at these locations has increased slightly during this period. This linear regression analysis provides a linear representation of a relationship between the variables of time in years and precipitation or streamflow.

The growing season in the area averages 110 days to 140 days. Temperatures range from minus 22 degrees Fahrenheit (F) in the winter to 109 degrees F in the summer (USDA 1984 draft).

Hydrogeology

Hydrology

Hydrology is the study of the occurrence, circulation, distribution and properties of the earth's waters and their reaction with the environment. Water occurs in the form of rain and snow and then circulates as ground water and surface water. See Figure 3.

Precipitation in the form of rain and snow fall on the Tucannon watershed. Some of this precipitation is taken up by plants, another portion is lost to consumptive human activities, some goes into the ground to form ground water, and the rest of it becomes run-off that ends up in the Tucannon River. Precipitation and ground water augmentation (ground water that flows directly into the river) provide the only water sources that form the Tucannon River and associated tributaries.

Geology and Ground Water

The Tucannon River drains the Blue Mountains, a broad anticlinal arch uplifted during the last 20 million years. The Blue Mountains are comprised of a core of Paleozoic and Mesozoic metamorphic rocks mantled by flows of the Columbia River Basalt Group.

The bedrock of the Tucannon River Watershed consists nearly entirely of lava flows of the Columbia River Basalt Group. These lava flows are about 16.5 million to 6 million years old (Miocene) and belong to the Grande Rhonde and Wanapum formations. The flows are composed of black to dark gray basalt of basaltic-andesite. Average flow thickness is about 90 to 120 feet (Columbia Basin System Planning, 1990). Overlying these bedrock units are diverse unconsolidated sediments. The most common unit is wind-deposited loess, which blankets highland areas between drainages. The loess is light-brown to buff, massive, homogeneous silt that often forms large dunes. The loess unit is generally 20,000 years old or less.

Soils in the Tucannon Watershed consist mostly of silt loams formed from loess or water-deposited material, ranging from 40 inches to over 60 inches deep (Fuller 1986). All drainages contain thin deposits of river alluvium along the present-day floodplains. The alluvium consists of gravel, sand, and silt derived from erosion of flood deposits, loess, and basalt (Columbia Basin System Planning, 1990). Sedimentary interbeds and lava flows within the Columbia River Basalt Group are both known to make good aquifers and may contain substantial ground water resources.

One of the most notable geologic features in the Tucannon Watershed is the Hite Fault. This is a major fault system that forms the western margin of the Blue Mountains between Pomeroy, Washington and Pendleton, Oregon, and has been the locus of many historic earthquakes (U.S. Department of Energy, 1988). This fault is 135 kilometers in length and crosses both the Tucannon River and Pataha Creek at right angles trending 330-335 degrees (Map 1). This is a vertical, en echelon, and strike-slip fault with a vertical offset from 0 meters to more than 300 meters.

As the Hite Fault is active, it may be the cause of elevated ground water temperatures well above the standard geothermal gradient as recorded in local wells. The fish-hatchery well (10N/41E-27), located two miles upstream from the Hite Fault as it crosses the Tucannon River (Map 1), was drilled to 100 feet in depth into basalt and encountered water temperatures of 51 degrees F. The well was then deepened an additional 100 feet and water temperatures of 61 degrees F were recorded (for a change of 10 degrees in 100 feet). The normal temperature change due to standard geothermal gradient should have been less then one degree. See Appendix A for well logs.

The Washington Department of Corrections (Corrections) constructed two test wells, one near Starbuck and the other near Willow Creek (Map 1). The Starbuck well (12N/38E-23) was 322 feet in depth (into the Grande Rhonde formation) with a static water level of 103 feet below land surface datum on November 14, 1990 (814’ above mean sea level (MSL)). The water temperature of this well was reported to be 68 degrees F (see Appendix A). It should also be noted that when the Starbuck well was tested, a positive recharge boundary was encountered. Because the well is located approximately 1,400 feet from the Tucannon River, Ecology staff believe the recharge boundary is the Tucannon River.

Corrections’ second well near Willow Creek (11N/39E-16) was drilled to 1,180 feet in depth into the Grande Rhonde Basalt with a static water level of 970 feet below land surface datum in June of 1992 (845’ above MSL). It is proposed that, correcting for elevation differences, these two wells are producing ground water from the same aquifer. The water temperature in the Willow Creek well was 71 degrees F. An additional well, located in 12N/38E-17, was constructed to a depth of 177 feet in January, 1994. It had a static water level of 41 feet below land surface and a recorded water temperature of 68 degrees F (see Appendix A). Very few of the shallow local wells for which well logs exist have recorded water temperatures. However, a few of the shallower wells that do show temperatures are in the low 50 degree range. It appears that temperature rises significantly with depth and that wells that are completed into the Grande Rhonde Formation are warmer than standard geothermal gradient can account for.

Ground Water/Surface Water Interaction

Precipitation and ground water augmentation provide the only water sources that form the Tucannon River and associated tributaries.

On July 27, 1994, Ecology staff took flow measurements at the following six locations on the Tucannon River: 1) at the fish-hatchery gage located in Sec. 27, T. 10 N., R. 41 E.W.M. (00347); 2) the bridge crossing below the confluence of Cummings Creek and the Tucannon River within Sec. 21, T10 N., R. 41 E.W.M. (00349); 3) Cummings Creek within this same section (00352); 4) at the bridge crossing on the south section line of Sec. 4, T. 10 N., R. 41 E.W.M. (00350); 5) at the bridge crossing within the NE¼ of Sec. 31, T. 11 N., R. 41 E.W.M. (00351); and 6) at the U.S.G.S. gage near Starbuck (00348). See Map 1 for sampling locations.

The purpose of measuring these transects was to determine if the Tucannon River is a gaining stream, that is, a stream being recharged by ground water. These measurements are listed from the upstream gage at the fish hatchery to the downstream U.S.G.S. gage as follows: the measurement at the fish hatchery gage was 30 cubic feet per second (cfs); the point below the confluence of Cummings Creek was 42 cfs, which included the 1.4 cfs contributed by Cummings Creek; the bridge crossing in Sec. 4 was 45 cfs; the bridge crossing in Sec. 31 was 42 cfs; and the flow at the U.S.G.S. gage on this date was 35 cfs. See Table 1.

Table 1: Miscellaneous streamflow measurements, Tucannon River

Date	Station ID	Measured flow in cfs
07/24/94	00347	30
	00349	42
	00350	45
	00351	42
	00348	35
10/20/94	00347	31
	00351	47
	00348	62

On the date of these measurements, no irrigation was observed upstream of the bridge crossing in Sec. 31 (00351). However, most of the irrigation projects downstream of Sec. 31 were in operation. It should be noted that the flow dropped from 42 cfs in Sec. 31 (00351) to 35 cfs at the U.S.G.S. gage (00348) for a difference of seven cfs. It appeared on the date of these measurements that surface water was being diverted far in excess of the seven cfs difference between sites. In order to account for this small difference in flow considering the large diversions between sites, it is therefore assumed that ground water is contributing significantly to the flow of the river between measurement sites. (Pataha Creek, which is the only significant tributary to the Tucannon River between these measurement sites, was not flowing at the road culvert on State Route 261 (12N/39E-19) just above its confluence with the Tucannon River on

the date of the measurements.) It should also be noted that there are many well developed wetlands and spring areas between the upper and lower measuring points that are fed by the ground water system and contribute to the base flow of the Tucannon River system.

On October 10, 1994, Ecology staff again took flow measurements at selected sites along the Tucannon River. Flows were measured at the Fish Hatchery (00347), at the bridge in section 31 (00351) and at the U.S.G.S. gage near Starbuck (00348). These sites were revisited because virtually all irrigation had ceased by this date (no more than 200 gallons per minute – or 0.4 cfs – of irrigation was observed, and Pataha Creek was flowing at less than one cfs at the road culvert). The instantaneous flow measurements were as follows: At the Fish Hatchery, 31 cfs (00347); at the bridge in Section 31, 47 cfs (00351); and at the U.S.G.S. gage, 62 cfs (00348). See Table 1. Comparing the late-fall, no irrigation flows with the mid-summer, significant irrigation flows suggests that the amount of water being consumed by irrigation on July 27, 1994 was on the order of 22 cfs (between sites 00351 and 00348).

Review of stream flow data indicates that virtually all of the base flow in the Tucannon River Watershed comes from ground water discharge (summer thundershowers elevate streamflow for only short periods of time). Base flow at the hatchery (00347) was approximately 30 cfs during the summer of 1994. Estimated base flow at the old U.S.G.S. gage site (00348) appears to have been approximately 60 cfs for 1994 (as adjusted for irrigation withdrawals).

Ground Water Status

No long-term or short-term ground water level data are available for the Tucannon Watershed, nor are there any static water level data available for any of the wells within the watershed. None of Ecology's Observation Well Network sites is located within the watershed; further, there does not appear to be any significant water level data available for watershed wells in the U.S.G.S.'s NWIS system.

Water Demand

Water Use: Water Rights and Claims

A state-issued water right is a legal authorization to use a certain amount of public water for specific beneficial purposes. The basis for water rights is "first in time, first in right". Washington State law requires most users of public water to receive approval from the state before using the water. This approval is granted in the form of a water right permit or certificate. Water right claims are different from state-issued water rights. Claims filed under the Water Right Claim Registration Act predate state water law. Claims are not confirmed water rights.

Water rights issued by Ecology or its predecessor agencies were assigned gallons per minute (gpm) and acre-feet per year (acft/yr) based on historic water use for the types of crops grown in a specific area. More recently, Research Bulletin XB 0925 (USDA Natural Resources Conservation Service, in cooperation with the Washington State Cooperative Extension Service, 1985), has been used to determine water duties for a specific crop type within this general geographic area. A water duty is the amount of water typically required to grow a particular crop within a certain region.

Research Bulletin XB 0925 has been used as a guide for determining seasonal amounts of irrigation water needed within the Tucannon River Watershed. Based upon data in this bulletin, a maximum water duty for this area is 44.3 inches per acre, for an annual allotment of 3.69 acre-feet per acre.

Tucannon Watershed Water Rights

There are currently 67 state-issued surface water rights and 54 state-issued ground water rights on file with Ecology for the Tucannon Watershed. The paper rights for active permits and certificates are shown in Table 2, below.

Table 2: State-Issued Ground/Surface Water Rights, Tucannon River Watershed

	Q_i	Q_a	Irrigated Acres
Ground	10,907 gpm (24 cfs)	6,922 acft/yr	1,177
Surface	60 cfs	4,982 acft/yr	1,147

Qi = instantaneous
Qa = annual

The relative distribution of uses for the rights summarized in Table 2 can be seen in Figure 4. Irrigation is the predominant use, as would be expected in an agricultural area like the Tucannon Watershed.

Outstanding Water Right Applications

There are currently six water right applications on file for the Tucannon Watershed; three are for surface water uses and three are for ground water uses. All six are on hold pending the outcome of this watershed assessment. The three outstanding surface water applications request a total of 0.3 cfs from Tumalum Creek (a tributary of the Tucannon) for irrigation of 13 acres and domestic use. The three outstanding ground water applications request a total of 1,800 gpm (equivalent to 4 cfs) for 640 acre-feet per year for irrigation of 141 acres.

Tucannon Watershed Claims

Most of the water rights issued by the State of Washington have been assigned a water duty equivalent to that recommended by Washington State Irrigation Guide Research Bulletin XB 0925. However, the claims filed by individuals during the claims registry period were not always consistent with this seasonal guide and the annual and instantaneous quantities filed were, in many cases, incorrectly stated. In an attempt to quantify the 765 claims on file in the watershed, Ecology assigned a water duty of 3.69 acre-feet per irrigated acre to each of the claimed acres as per Bulletin XB 0925. The instantaneous rate of diversion was based on nine gallons per minute (0.02 cfs) per acre which is consistent with current allocation practices for state-issued water rights. Domestic and stockwater uses, which include up to ½ acre non-commercial lawn and garden, were assigned 0.02 cfs, two acre-feet per year. These claims have been assigned water duties as described above and are as follows:

Table 3: Water Duties assigned to Water Claims on file with the state, Tucannon River Watershed

	Q_i	Q_a	Irrigated Acres
Ground	4,919 gpm (11 cfs)	1,246 acft/yr	156
Surface	133 cfs	24,023 acft/yr	6,351

Qi = instantaneous
Qa = annual

Water Rights and Claims Total

To date, a total of 228 cfs in state-issued rights and claims registries has been allocated ("on paper") for surface and ground water within the watershed. A comparison of state-issued and claimed water rights indicates that the total use filed under claims is disproportionately larger than state-issued water rights. It has been Ecology's experience in recent general adjudications where claims were involved, that a large percentage of the claims were held to be invalid as they did not meet with the statutory requirements of the Claims Registration Act. However, since this watershed has not been adjudicated, Ecology is unable to determine the validity of these claims. For the purposes of this report, we have accepted them at face value.

Presently, the total of the water right claims and state-issued water rights for surface water diversions amounts to 193 cfs from the watershed, which is more than the yearly mean daily

flow as measured at the U.S.G.S. gage (see Tables 2 and 3). Ecology staff have not verified actual use within this watershed. However, the Natural Resources Conservation Service has determined that there are surface water pumping installations capable of diverting approximately 40 cfs within this watershed based on recent field investigations (Blomgrem, 1994). Map 2 depicts the locations of points of diversion/withdrawal for the 121 water rights and six applications on file (indexed by their annual quantity allocated in acre-feet/yr). It also depicts the sections where claims have been filed for water within the watershed (indexed by the total quantity of water claimed (in acre-feet/yr) and summed by section). In addition, Map 2 illustrates the location of water demands within the watershed from a paper rights perspective.

Figure 5 shows the relationship between the cumulative annual quantity of both ground and surface water rights issued since 1959, and the linear regression of the mean annual flow as measured at the U.S.G.S. gage, both in acre-feet/yr. As can be seen, the increase in allocated water right quantities coincides with a trend of decreasing annual flows (as smoothed out by the linear regression of the yearly flow data).

Long-term precipitation trends can not be used to explain the long-term decline in yearly flows for the watershed. Riparian vegetation in the watershed has been gradually returning (due in large part to the efforts of the Natural Resources Conservation Service and local landowners) after being decimated in the 1964 floods. As would be expected, water being used by this maturing riparian vegetation must account for some of the observed decrease in yearly annual flow.

Recommended Flows

A low flow for the Tucannon River of 50 cfs as measured at the confluence of the Tucannon and Snake Rivers was recommended by the Washington Department of Fisheries in December of 1972. This source was closed to further appropriation above Cummings Creek on this same date (Section 22, T. 10 N., R. 41 E.W.M.). On August 24, 1993 a recommended IFIM flow was established for the Tucannon River as measured at the Starbuck Dam, RM 7.9, U.S.G.S. gage #13344500 (Caldwell B., 1993). The recommended flows are shown in Table 4.

Table 4: Recommended Flow for Tucannon River

Time Period	Recommended IFIM Flow
October 1 through February 28	65 cfs
March 1 through June 14	100 cfs
June 15 through August 14	65 cfs
August 15 through September 30	70 cfs

Surface water rights issued after 1972 but prior to the recommended IFIM flow in 1993 are subject to the 50 cfs low flow recommendation. Surface water rights issued after the recommendation of IFIM flows are subject to those new recommendations. Ground water rights issued within this watershed have not been subjected to either of the recommendations.

Water Quality

The Tucannon River and two of its tributaries are listed on Ecology's 303(d) list of water bodies that fail to meet state water quality standards. For the mainstem, from its mouth to Tumalum Creek (RM 32.7), the 303(d) report (Butkus, S., 1994) lists both fecal coliform and temperature violations of the standards (fecal coliform – 14 excursions beyond criteria at Ecology ambient monitoring station 35B060 between 1/1/90 and 1/1/92; temperature – two excursions beyond criteria at Ecology ambient monitoring station 35B060 between 1/1/90 and 1/1/92). For the mainstem from the National Forest Boundary (RM 38.1) to RM 53.4, the 303(d) report lists temperature violations of the standards (six excursions beyond criteria at the USFS station 14030005 between 7/1/87 and 7/1/91). For Pataha Creek, the 303(d) report lists fecal coliform and Ammonia-N violations. For Cummings Creek, the 303(d) report lists temperature violations of the standards (seven excursions beyond criteria at USFS station 14030017 between 7/1/87 and 7/1/91). See Table 5.

Table 5: Water Quality Parameters Exceeded in Tucannon River

Monitoring Station/ RM Location	Parameters Exceeding Standards	Description of Parameter Exceedance
Monitoring Station 35B060 Tumalum Creek (RM 32.7)	fecal coliform temperature	14 excursions beyond criteria between 1/1/90 and 1/1/92. 2 excursions beyond criteria between 1/1/90 and 1/1/92.
Mainstem, from Umatilla National Forest Boundary (RM 38.1 to RM 53.4)	temperature	6 excursions beyond criteria at USFS station 14030005 between 7/1/87 and 7/1/91
Pataha Creek	fecal coliform ammonia N	n/a
Cummings Creek	temperature	7 excursions beyond criteria at USFS station 14030017 between 7/1/87 and 7/1/91

There are currently three facilities permitted to discharge wastewater to the Tucannon River and its tributaries. These facilities are permitted to discharge on the assumption that the receiving streams contain water of sufficient quantity and quality, to assimilate the discharges such that surface water quality standards are not exceeded.

Fisheries

The Tucannon River Watershed is a top fisheries priority due to its vital role in the salmon and steelhead recovery efforts currently in progress. The Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program calls for long-term planning for salmon and

steelhead production. The Tucannon River has been determined to be a valuable salmon and steelhead spawning stream, and as a result, many state and federal agencies are currently evaluating the health of the fishery resource within this watershed. The success of these salmon recovery efforts largely depends on surface water being available in quantity and quality adequate to sustain or enhance this resource.

Two recent studies regarding the health of fish stocks in Washington State have been conducted. Data from these studies were compared for the Tucannon River. The primary comparison is demonstrated on Table 6, which lists all of the stocks identified by the two studies as being in some degree of decline. Although separate, these studies are each part of ongoing analyses of the status of anadromous fish stocks. Consequently, the information in Table 6 is essentially a snapshot of what was known or believed at the time the reports were prepared; some of the information may be revised as the analyses continue.

Nehlsen et al. 1991, authored Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington (referred to hereafter as the "AFS" report). It was prepared by the Endangered Species Committee of the American Fisheries Society. The paper "…provides a list of depleted Pacific Salmon, Steelhead, and sea-run cutthroat stocks from California, Oregon, Idaho and Washington …"; 214 stocks were identified "… that appear to be facing a high or moderate risk of extinction, or are of special concern." The AFS study sounded the alarm regarding the significant depletion of anadromous species of the Pacific coast.

The Salmon and Steelhead Stock Inventory (SASSI) was prepared by the Washington State Departments of Fisheries and Wildlife, with the assistance of twenty three Indian Tribes and Tribal organizations. The SASSI is a "…summary report on the status of wild salmon and steelhead populations in Washington State." The inventory was prepared as the "…first step in a statewide effort to maintain and restore wild salmon and steelhead stocks and fisheries. The inventory's intent is to help identify currently available information and to guide future restoration planning and implementation."

Table 6: Comparison of "AFS" and "SASSI" Reports

Water Body	Stock	AFS Status	SASSI Status
Tucannon	Chinook spring	High Risk	Depressed
Tucannon	Steelhead summer	Special Concern	Depressed

Water body – A river, creek, lake, etc. that is named as the place of origin for the identified stock (i.e., where the stock returns to spawn).

Stock – A population of fish that spawns in a particular season and generally does not breed with fish that spawn in a different body of water or different season. These populations possess adaptive genetic differences based on the relatively unique characteristics of the location and season in which they spawn.

AFS Status – A set of ratings ranging from "Of Special Concern" to "Extinct". The rating "High Risk" (at high risk of extinction) refers to those populations whose spawning escapements are declining; fewer than one adult fish returns to spawn from each parent spawner. Populations with escapements of less than 200 in the last one to five years were placed in this category unless the escapements were historically small. A stock in this category is likely to meet the threshold for listing as endangered under the Endangered Species Act. The rating "Special concern" refers to those populations for which the following conditions apply: 1) relatively minor disturbances could threaten them, especially if a specific threat is known; 2) insufficient information on population trends exists, but available information suggest depletion; 3) there are relatively large ongoing releases of nonnative fish, and the potential exists for interbreeding with the native population; 4) or the population is not presently at risk, but requires attention because of a unique character.

SASSI Status – A set of status ratings ranging from "Healthy" to "Extinct". The rating "Depressed" refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.

Stream Flow

The mean annual flow of the Tucannon River at Starbuck (RM 7.9) is 166.3 cfs, with a mean low flow of 60.4 cfs in August and a mean high flow of 288.6 cfs in May (Table 7).

Table 7: Mean monthly discharge values (cfs) for the Tucannon River near Starbuck from 1915 to 1990 (U.S.G.S. Station 13344500).

Month Discharge	Mean (cfs)	Month Discharge	Mean (cfs)
January	211.6	July	83.0
February	242.6	August	60.4
March	237.8	September	70.3
April	266.5	October	82.3
May	288.6	November	105.7
June	199.7	December	156.2

Looking at the period of continuous records (1959 – 1990) for the U.S.G.S. gage, it appears that the mean annual flow of the Tucannon River has been declining for the past 31 years. Figure 6 depicts the yearly average daily discharge for the water years 1959 through 1990. A linear regression of the flow data indicates a downward trend through this period of record. Using the slope of the linear regression analysis, the calculated yearly average flow is 185 cfs for the year 1960 and 148 cfs for the year 1990 (a drop of 37 cfs over 30 years). Looking at the flow trends for the drier, summer months (July, August, and September), the same downward trend can be observed (with a reduced slope). Assuming that precipitation trends at Pomeroy and Dayton, which straddle the drainage, are representative of precipitation trends throughout the drainage, the declining flow trends cannot be attributed to decreased precipitation in the drainage. (As mentioned earlier, both of these weather stations indicate that annual precipitation has increased slightly – see Figure 2.)

Figure 7 depicts exceedance curves for the Tucannon River based on historical flow data from the U.S.G.S. gage. The exceedance program used to generate the exceedance curves for Figure 7 computes 10, 50, and 90 percent annual exceedance probabilities three times per month for the entire year. This information indicates how often the actual instream flow may be expected to equal or exceed the recommended instream flow in a given year. For example, the 10 percent exceedance curve represents that flow rate which has a 10 percent probability of equaling or exceeding the recommended flow at a particular time of year. Stated another way, each point on the 10 percent curve is likely to be equaled or exceeded once every 10 years. Similar information can be derived for the 50 and 90 percent exceedance curves. Plotting the recommended flows with these frequency curves represents the likelihood of how often there is enough water to meet the instream flow needs for each time of year based on the flow history. Comparison of the exceedance curves with the recommended IFIM flow curve indicates that the flow recommended by the IFIM analysis is not met more than 50 percent of the time during late July, through all of August and into early September.

Figure 8 depicts the lowest mean discharge recorded at the Tucannon River gage for seven consecutive days for each climatic year (April 1 through March 31) for the period of record. The 65 cfs line representing the recommended IFIM flow is also depicted. With the exception of several wet years in the early 1970s, the seven-day low flows have fallen below the IFIM set flows almost yearly. The seven-day low flows have fallen below the old, 1972 50 cfs low flow set by Fisheries for 10 of the 20 years since its establishment.

Duration analyses for the Tucannon River gage were used to plot the number of days per year when the mean daily discharge fell below the recommended IFIM flow of 65 cfs (Figure 9). A linear regression of the data shows that over time, the number of days per year where the flow is not met have increased from approximately 30 days in 1960 to more than 60 days in 1990.

Conclusions

The following conclusions can be drawn from the information contained in this report:

- The Tucannon River Watershed encompasses roughly 502 square miles in the southeastern corner of Washington State (within WRIA 35). Its headwaters are in the Blue Mountains in the Umatilla National Forest. Principal land uses are agriculture, rangeland and recreation. Mean annual precipitation averages 23 inches (varying between 10 and 40 inches) and appears to have remained fairly constant during the period 1959 through 1992.

- Precipitation and ground water augmentation provide the only water sources for the Tucannon River and associated tributaries. Streamflow measurements along the river indicate the river is a gaining stream throughout its length, with virtually all of the base flows supplied by ground water.

- Ground water is in continuity with surface water in the watershed. No long-term information on ground water levels within the watershed is available, nor is there any accurate data on actual water use, especially for ground water.

- A total of 228 cfs in state-issued and claimed rights exist for surface and ground within the watershed (193 cfs in surface water and 35 cfs in ground water). This combined total is higher than the mean annual discharge for the Tucannon River. Without additional research, Ecology is unable to determine which of these rights is being actively used or how many are supplemental to other rights.

- Since 1972 all state-issued surface water rights from the Tucannon River and tributaries were subjected to a 50 cfs low flow recommendation as measured at confluence with the Snake River. The Tucannon River is closed to further appropriation upstream of a point in Section 22, T. 10 N., R. 41 E.W.M. On August 24, 1993 Ecology recommended an IFIM flow for the Tucannon River of 65 cfs during the low flow summer months, as measured at the U.S.G.S. gage near Starbuck. Ground water withdrawals have not been subjected to these low flow requirements.

- An Ecology-funded gage from another drainage was discontinued and the funding shifted to reactive the U.S.G.S. gage near Starbuck (13344500) in late fall, 1994.

- The Tucannon River and two of its tributaries are listed on the Ecology's 303(d) list of water bodies that fail to meet state water quality standards.

- The seven-day low flows of the Tucannon River have exceeded the recently recommended IFIM flow in almost every year since 1959. Any new surface water rights issued will be subject to the IFIM recommended flow and would likely be regulated in August of each year.

- Linear regression analysis of the mean annual flow data at the U.S.G.S. gage suggests that flows have been decreasing over the period 1959 through 1990. Using the slope of the linear regression analysis, the calculated yearly average flow is 185 cfs for the year 1960 and 148 cfs for the year 1990 (a drop of 37 cfs over 30 years). During this same period of time Ecology issued over 8,000 acre-feet in surface and ground water rights.

- Duration analyses for the Tucannon River gage were used to plot the number of days per year when the mean daily discharge fell below the recommended IFIM flow of 65 cfs. Linear regression analysis shows that over time, the number of days per year where the flow is not met has increased from approximately 30 days in 1960 to more than 60 days in 1990.

- Studies by other state and federal agencies have shown that the major environmental hazards to steelhead and salmon production within the Tucannon River System are siltation, elevated temperature and reduced flow. The elevated temperatures are the result of reduced base flows and the loss of riparian habitat, much of which was destroyed by major floods in 1964. Siltation is a result of farming practices and high run-off events from lands adjacent to the stream.

- As more water rights are issued that are subjected to the recommended flow, the recommended flow threshold will be reached earlier in the irrigation season each year. This may adversely affect senior water rights, making some irrigation projects less viable due to the continually shortened irrigation season.

- The potential for presently unused claims and state rights being activated, domestic exempt wells and continued vegetation re-establishment are all debts against the system that can not be readily accounted for. All could result in continued declining streamflows, regardless of any future permitting actions.

- Continued issuance of water rights subject to the recommended flow will require regulation almost every year. As assessments are completed in other watersheds it is likely that flows will be recommended in these watersheds as well. The possibility of many regulatory actions in any given year would overload Ecology's existing staff; field checking for compliance with the recommended flow restrictions would become impractical.

- Further appropriation of either surface or ground water from the Tucannon River Watershed will put additional stress on the system.

Recommendations

The following recommendations for further action are made based on the information contained in this report:

- Ground water permits, if issued, should have the same restrictions and be tied to the recommended flow similar to surface water permits.

- A long-term funding source should be established to maintain the U.S.G.S. gage near Starbuck (13344500) indefinitely. The funding should also be increased to allow the gage site to be telemetered into the U.S.G.S.'s ADAPS system to allow real-time monitoring of the flows. Without real-time data, it is impossible to regulate existing users to maintain established instream flows.

- A network of observation wells (into the basalts) should be established to allow monitoring of the ground water fluctuations throughout the watershed.

- In order to calculate a true water budget for this watershed, the actual water use (both ground water and surface water) should be determined.

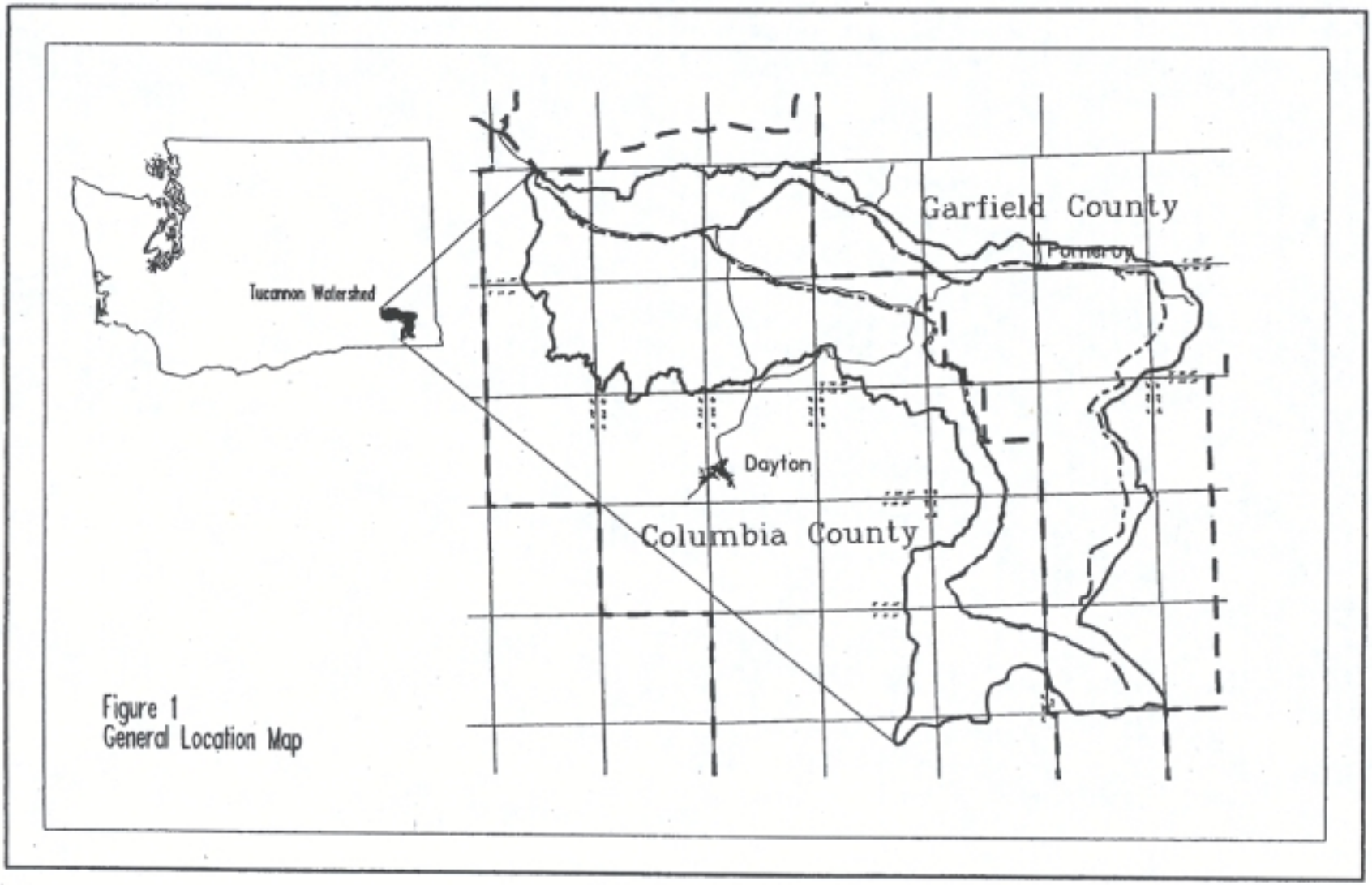
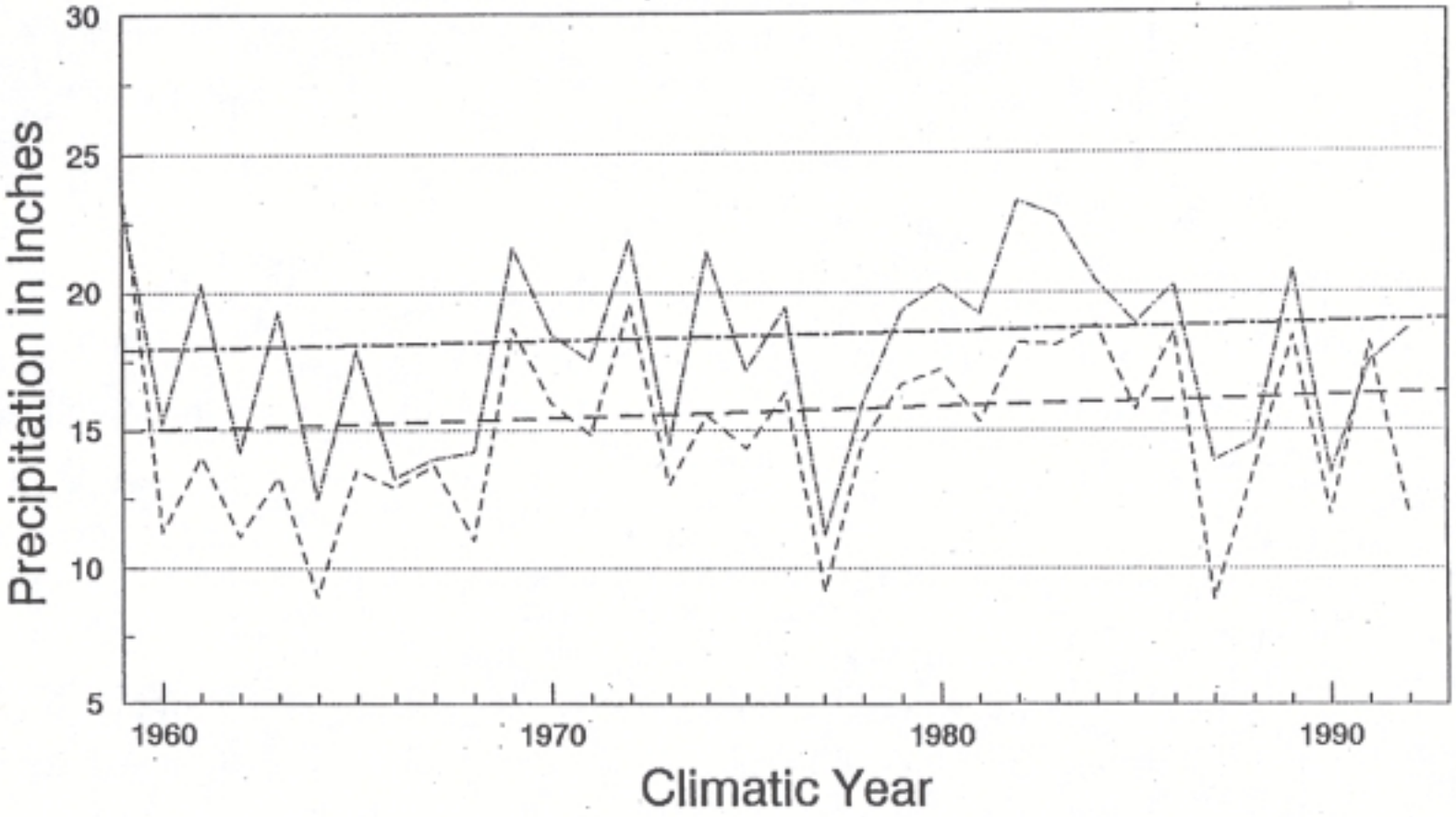


Figure 1
General Location Map

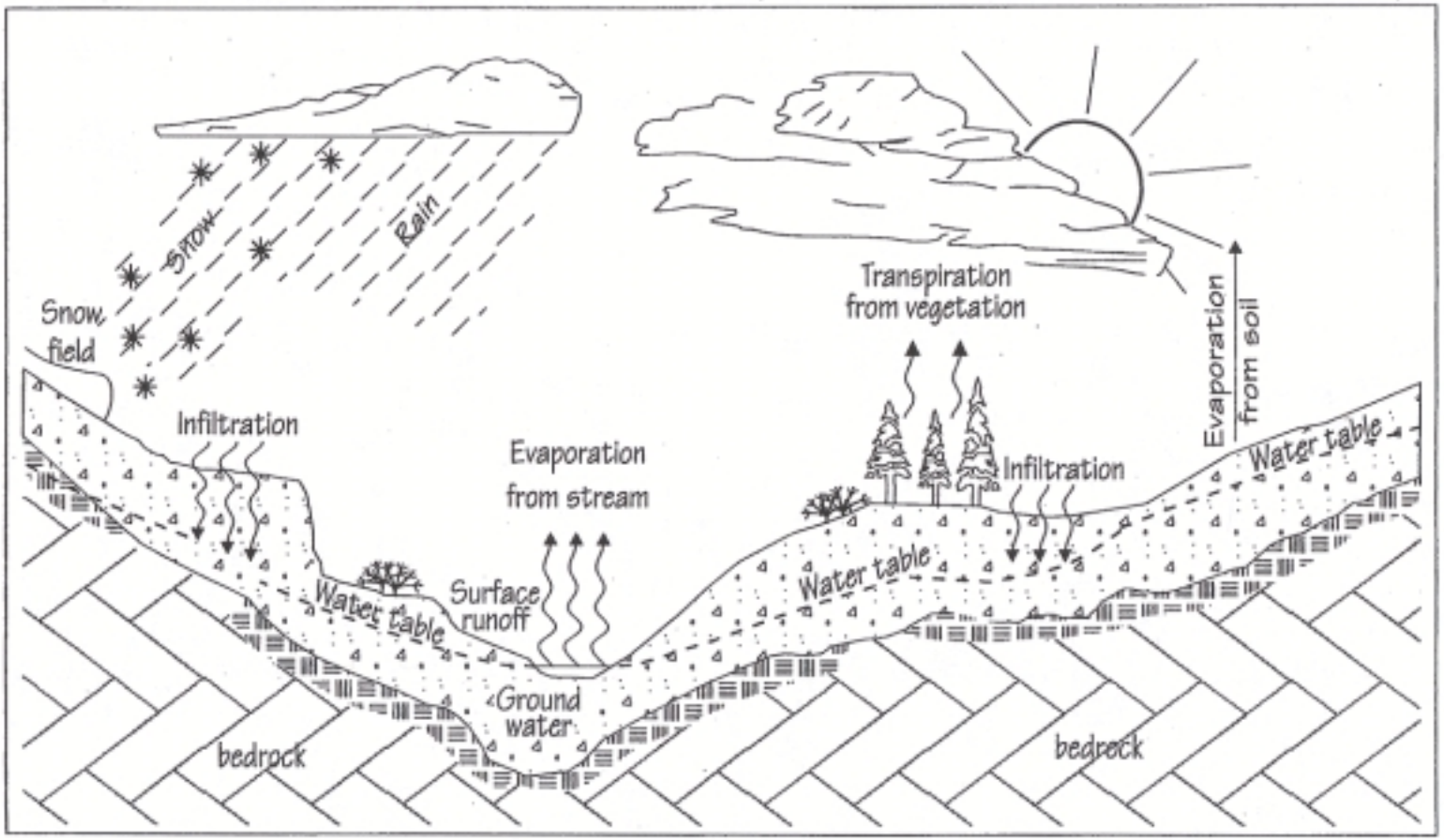
Tucannon River Area Precipitation



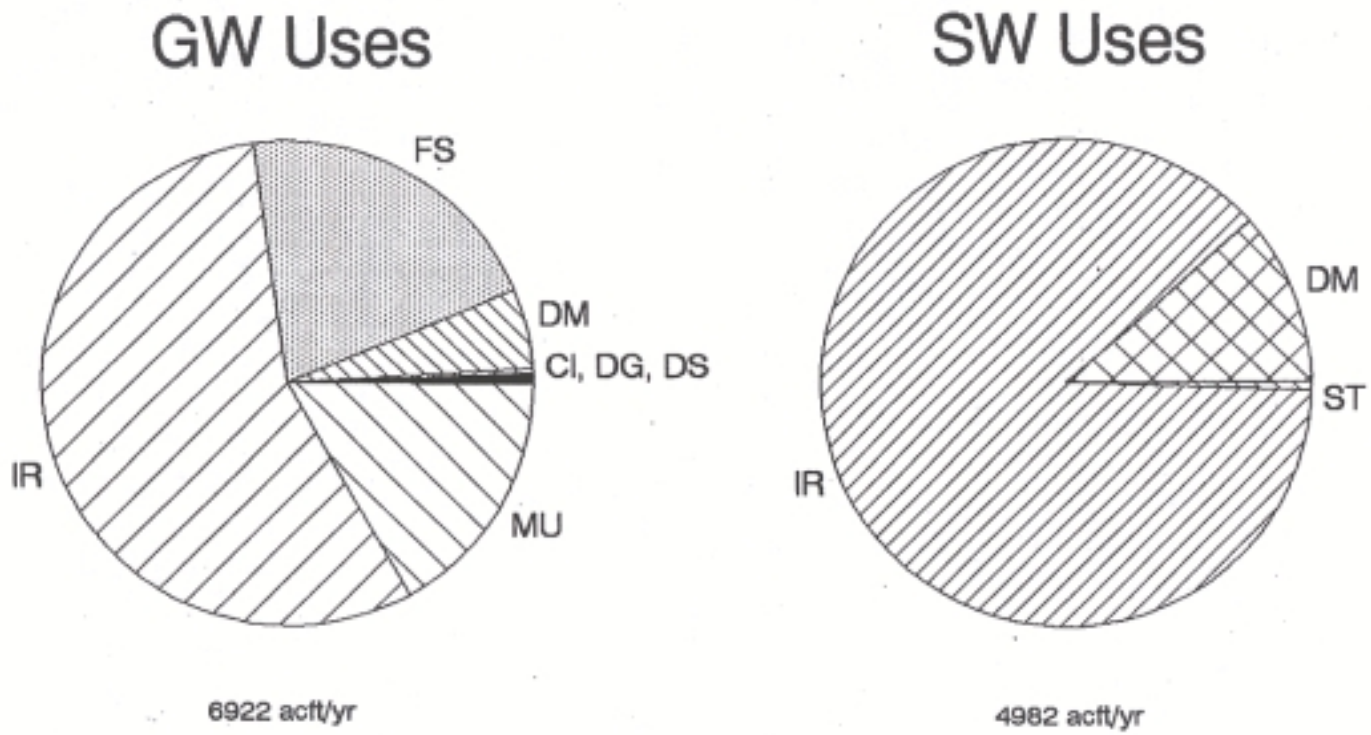
Climatic Year 4/1 - 3/31

Figure 2

Figure 3
General Representation of the Hydrologic Cycle
(Modified from Walter and Nassar)



Tucannon Watershed Water Uses
for both Ground Water & Surface Water Rights



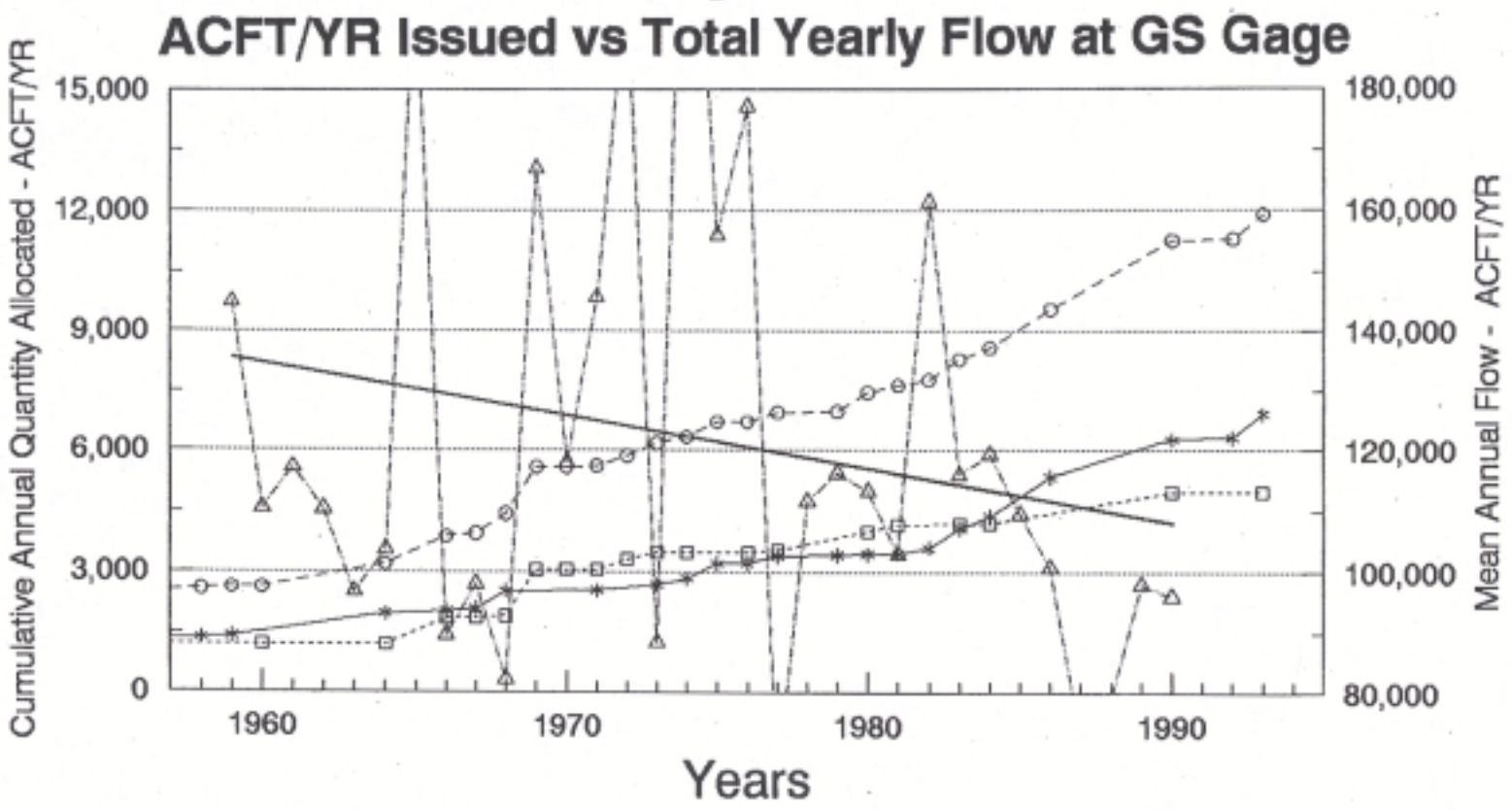
IR - Irrigation FS - Fish Propagation MU - Municipal ST - Stockwater

CI - Commercial DS - Domestic DG - Domestic General DM - Domestic Multiple

IR uses often contain stockwater provisions

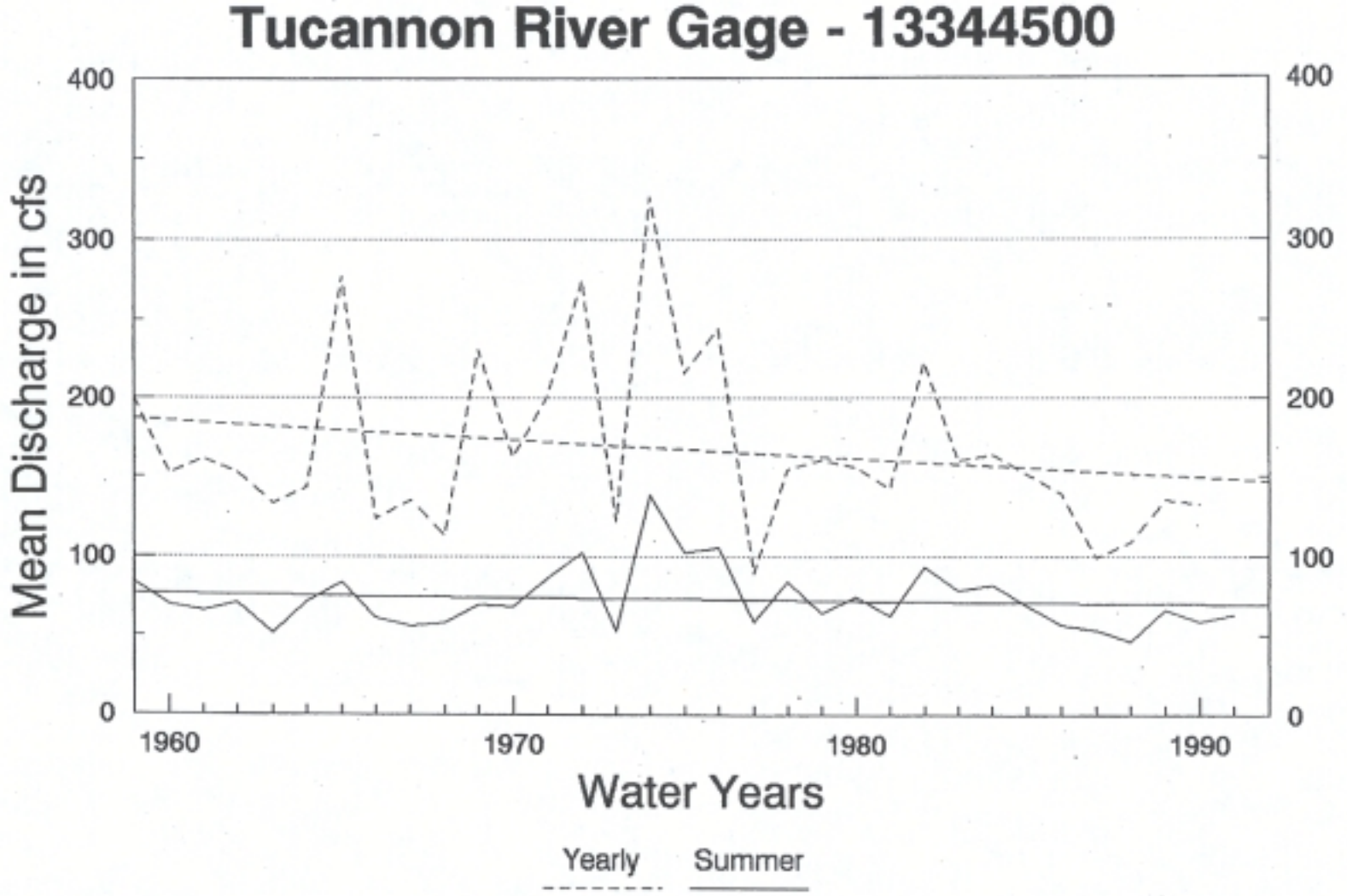
Figure 4

Tucannon Watershed Rights and Mean Annual Flow



Water Rights are summed by Priority Date year
GS Gage 13344500 Operated Continuously 1959 - 90

Figure 5



Summer is defined as the average of flows for July, August, and September

Figure 6

Tucannon River Exceedance Curves & IFIM Minimum Flows

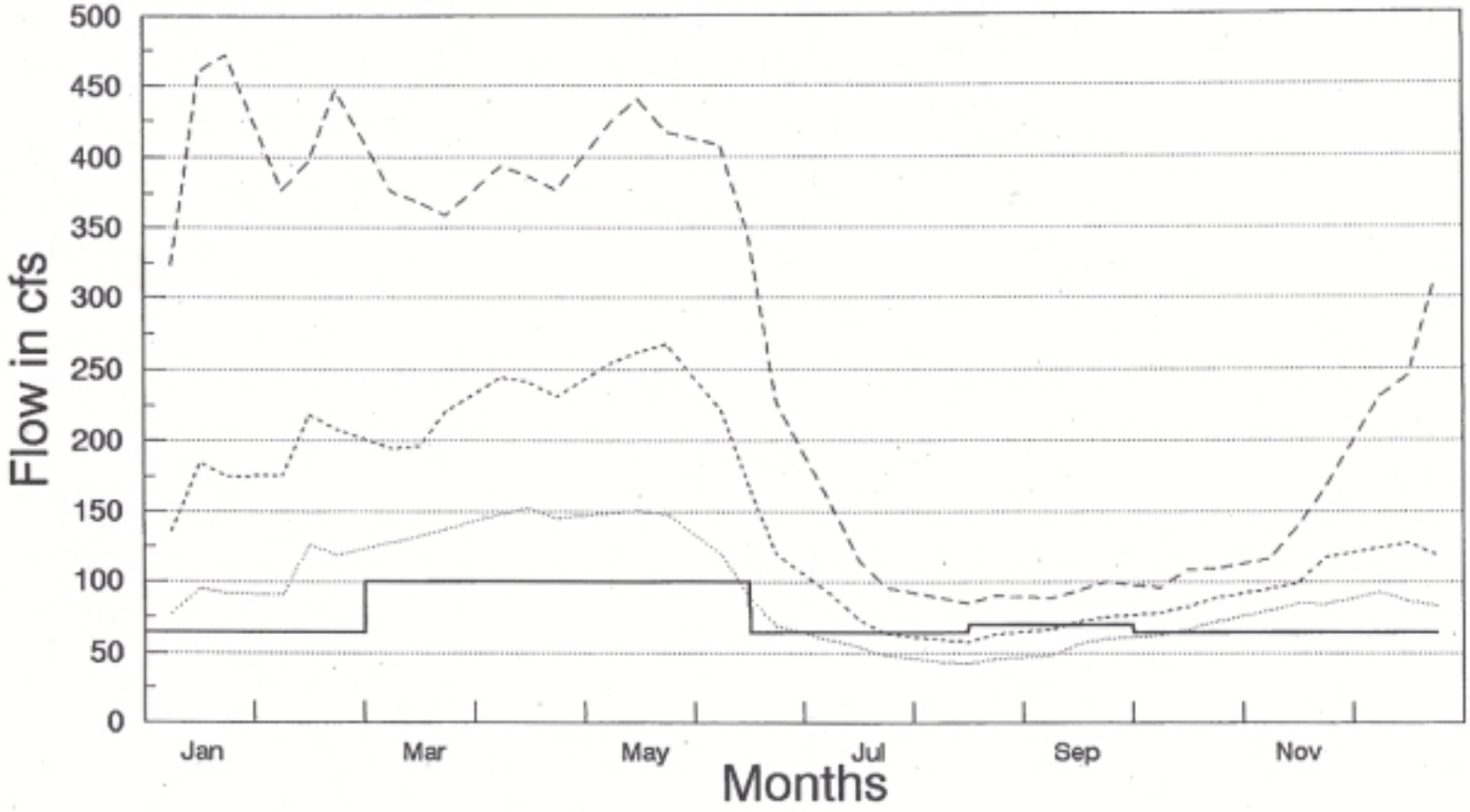
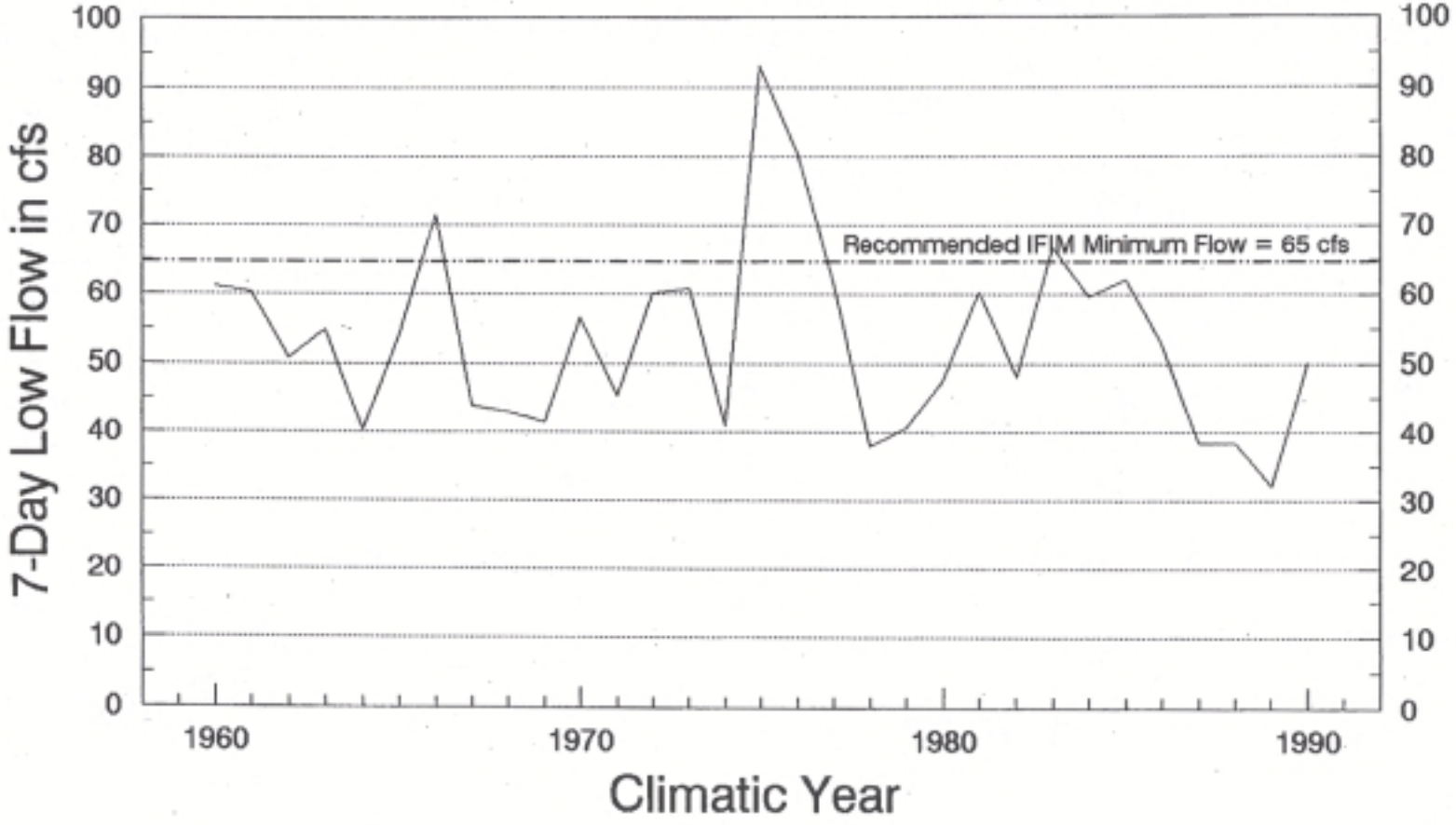


Figure 7

Tucannon River Gage - 13344500

7-Day Low Flow vs Recommended IFIM Minimum Flow



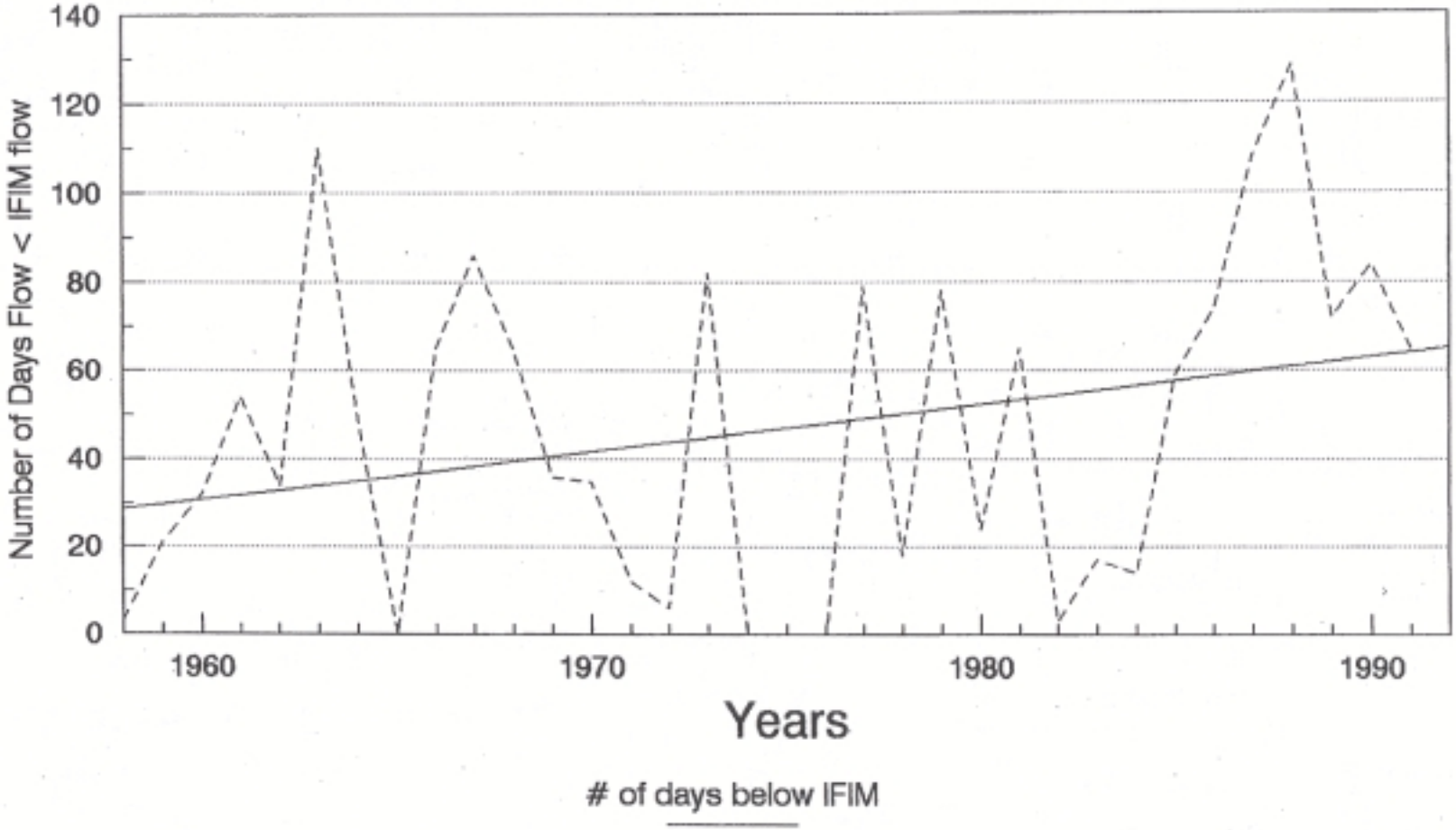
Yearly 7-Day Low Flow

Climatic Year 4/1 - 3/31

Figure 8

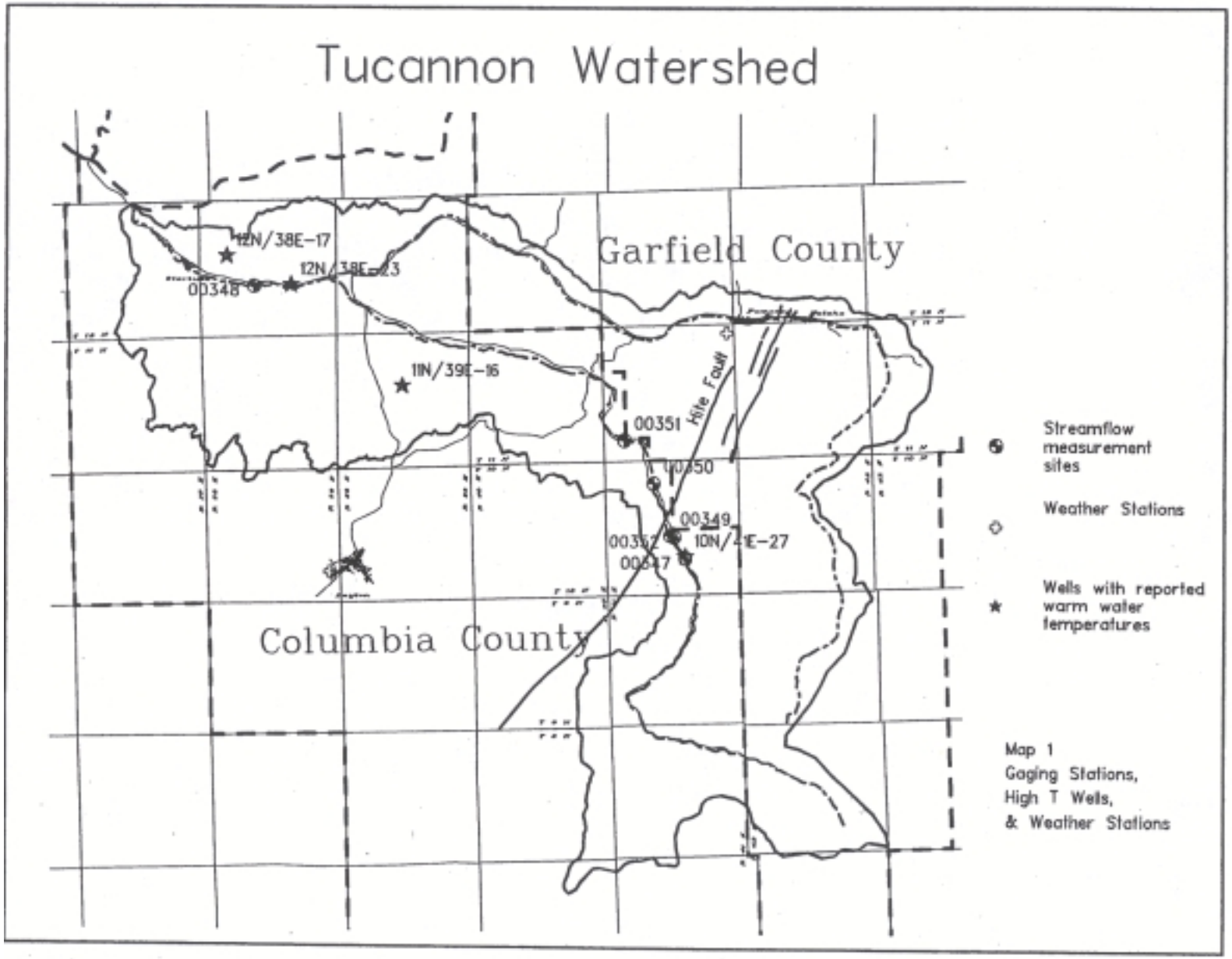
Tucannon River Gage - 13344500

Flows below Recommended IFIM Flow



Recommended Flow = 65 cfs
Data from duration analysis program

Figure 9


Tucannon Watershed
Garfield County
Columbia County
12N/38E-17
12N/38E-23
00348
11N/39E-16
00351
Hite Fault
00350
00349
10N/41E-27
00352
00347
Streamflow measurement sites
Weather Stations
Wells with reported warm water temperatures
Map 1
Gaging Stations,
High T Wells,
& Weather Stations

Tucannon Watershed

Claims by Section

Rights by Section

Legend

- more than 1000 Acre-feet/Year
- 100 to 1000 Acre-feet/Year
- 5 to 100 Acre-feet/Year
- less than 5 Acre-feet/Year

Map 2
Annual Quantities
Allocated, Summed
by Section

Tucannon River Watershed Assessment

Appendix A

Well Logs

Hole No.

DRILLING LOG

DIVISION: NPD

INSTALLATION: NPW

SHEET ___ OF ___ SHEETS

1. PROJECT: TUCANNON FM WATER SUPPLY
2. LOCATION (Coordinates or Station): N 372 439.07 E 2 716 761.14
3. DRILLING AGENCY: BUCKNER WELL DRILLING
4. HOLE NO. (As shown on drawing title and file number):
5. NAME OF DRILLER: ROBERT BUCKNER
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 71.5
8. DEPTH DRILLED INTO ROCK: 183.5
9. TOTAL DEPTH OF HOLE: 255.0
10. SIZE AND TYPE OF BIT: 16.12" ROCK
11. DATUM FOR ELEVATION SHOWN: [TBM or MSL]: MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: INGERSOLL RAND TH-1120
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED ___ UNDISTURBED ___
14. TOTAL NUMBER CORE BOXES: NA
15. ELEVATION GROUND WATER: ON -2114 6 FT. -2102.7
16. DATE HOLE: STARTED 4-8-83 COMPLETED 6-7-83
17. ELEVATION TOP OF HOLE: 2147.5
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: EVAN THOMPSON, LOG

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
2147.5	0		FILL - SANDY GRAVEL AND COBBLES			
	10		SANDY GRAVEL AND COBBLES			
	20		SAND AND GRAVEL; SANDY COBBLES AND BOULDERS			
			SANDY GRAVEL AND COBBLES			
	30					
	40					
	50					
	60					
	70					SWL @ 67' 6-7-83
2006.6			BASALT - FRACTURED, GREY TO BLACK			
	80					
	90					
			FLOW BRECCIA - RED TO BLACK.			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG

DIVISION

INSTALLATION

Hole No.

SHEET OF SHEETS

1. PROJECT

2. LOCATION (Coordinates or Station)

3. DRILLING AGENCY

4. HOLE NO. (As shown on drawing title and this number)

5. NAME OF DRILLER

6. DIRECTION OF HOLE
☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.

7. THICKNESS OF OVERBURDEN

8. DEPTH DRILLED INTO ROCK

9. TOTAL DEPTH OF HOLE

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)

12. MANUFACTURER'S DESIGNATION OF DRILL

13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN | DISTURBED | UNDISTURBED

14. TOTAL NUMBER CORE BOXES

15. ELEVATION GROUND WATER

16. DATE HOLE | STARTED | COMPLETED

17. ELEVATION TOP OF HOLE

18. TOTAL CORE RECOVERY FOR BORING %

19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc.; if significant) g
			SOEM			
	110		BASALT - FRACTURED, GRAY TO BLACK			
	120		FLOW BOTTOM - RED TO BLACK			
	130		BASALT - FRACTURED GRAY TO BLACK.			
	140					
	150		BASALT - RED TO BLACK FRACTURED VESICULAR			
	160					
	170					
	180		BASALT - FRACTURED GRAY TO BLACK			
	190					
	200					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT TUCSON AZ WATER WELL

HOLE NO.

DRILLING LOG

DIVISION

INSTALLATION

Hole No.

SHEET ___ OF ___ SHEETS

1. PROJECT

2. LOCATION (Coordinates or Station)

3. DRILLING AGENCY

4. HOLE NO. (As shown on drawing title and title number)

5. NAME OF DRILLER

6. DIRECTION OF HOLE
☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.

7. THICKNESS OF OVERBURDEN

8. DEPTH DRILLED INTO ROCK

9. TOTAL DEPTH OF HOLE

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)

12. MANUFACTURER'S DESIGNATION OF DRILL

13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN | DISTURBED | UNDISTURBED

14. TOTAL NUMBER CORE BOXES

15. ELEVATION GROUND WATER

16. DATE HOLE | STARTED | COMPLETED

17. ELEVATION TOP OF HOLE

18. TOTAL CORE RECOVERY FOR BORING %

19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Descriptions) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			20cm			
			Flow Breccia - Red, Soft			
	21p					
			Basalt - Fractured, Black			
	22p					
	23p		Flow Breccia - Red, Soft			
			Basalt - Fractured, Black			
	24p		Flow Breccia - Red, Soft			
			Basalt - Fractured, Black.			
	25p					
912.5			Bottom of Hole			
	26p					

ENG FORM 1836, MAR 71 PREVIOUS EDITIONS ARE OBSOLETE

PROJECT

HOLE NO.

Well #2

NPWEN-FH

Completion Report, Tucannon Fish Hatchery
Water Well DACW68-83-M-5415

F&H Branch Files

K. C. Hutchinson

10 June 1983

1. Mobilization of drilling and testing equipment began 8 April 1983 by Buckner Well Drilling, Redmond, Oregon, under contract No. DACW68-83-M-5415 and was completed 7 June 1983.

2. The well is located at survey coordinates N 372,439.07, E 2,716,761.64 on the grounds of the Tucannon Fish Hatchery near Dayton, Washington. The hole was drilled to a depth of 255 feet with an Ingersol Rand TH-100 rotary rig. The hole was started by drilling a 16-inch hole down to the top of basalt which was found at 71.5 feet. Drilling mud was used to hold the hole open during this drilling stage. Afterwards, a 12-inch casing was firmly seated in the basalt. An 8-inch hole was then drilled to 255 feet and was later reamed with a 12-inch bit back to 255 feet. The grout surface seal was then placed from 0 to 71.5 feet. Materials found and other pertinent drilling data are shown on the inclosed drilling log (Eng Form 1836).

3. Because the Contractor needed the rig for another job, he was allowed to remove the rotary rig and replace it with a cable tool rig. The hole was then developed for a period of 24 hours with a surging disc and periodically bailed to remove sand and rock fragments.

4. Pumping equipment consisted of a 4-stage, 60 hp Jacuzzi submersible powered by a V-6 Murphy diesel engine along with a 100 kw, 3-phase generator. The intake of the bowls was set at 227 feet.

5. Upon completion of the pump installation, a 12-hour pump test was performed. The test began at 1100 hours on 7 June 1983 and ended at 2300 hours on the same day. The well yield was measured with a flow meter and drawdown was measured by an airline system. Pumping rates of 240, 420, 630 and 720 gpm were used with respective drawdowns of 24.25, 48.5, 80.26 and 98.74 feet. The static level in the well was 67 feet. A piezometer located 10 feet away from the pumping well showed a maximum drawdown of 11.4 feet from a 25.0 static. This piezometer is partially in overburden and partially in basalt. Approximately 90 percent recovery occurred within 15 minutes after shutdown. The well was then sterilized. Water temperature during the test ranged from 60° - 59°F. The well will be retested at a future date. This test will be for a 72-hour duration and the pumping rates will be 400 to 800 gpm. After this pumping test, a final pump setting and rate will be determined.

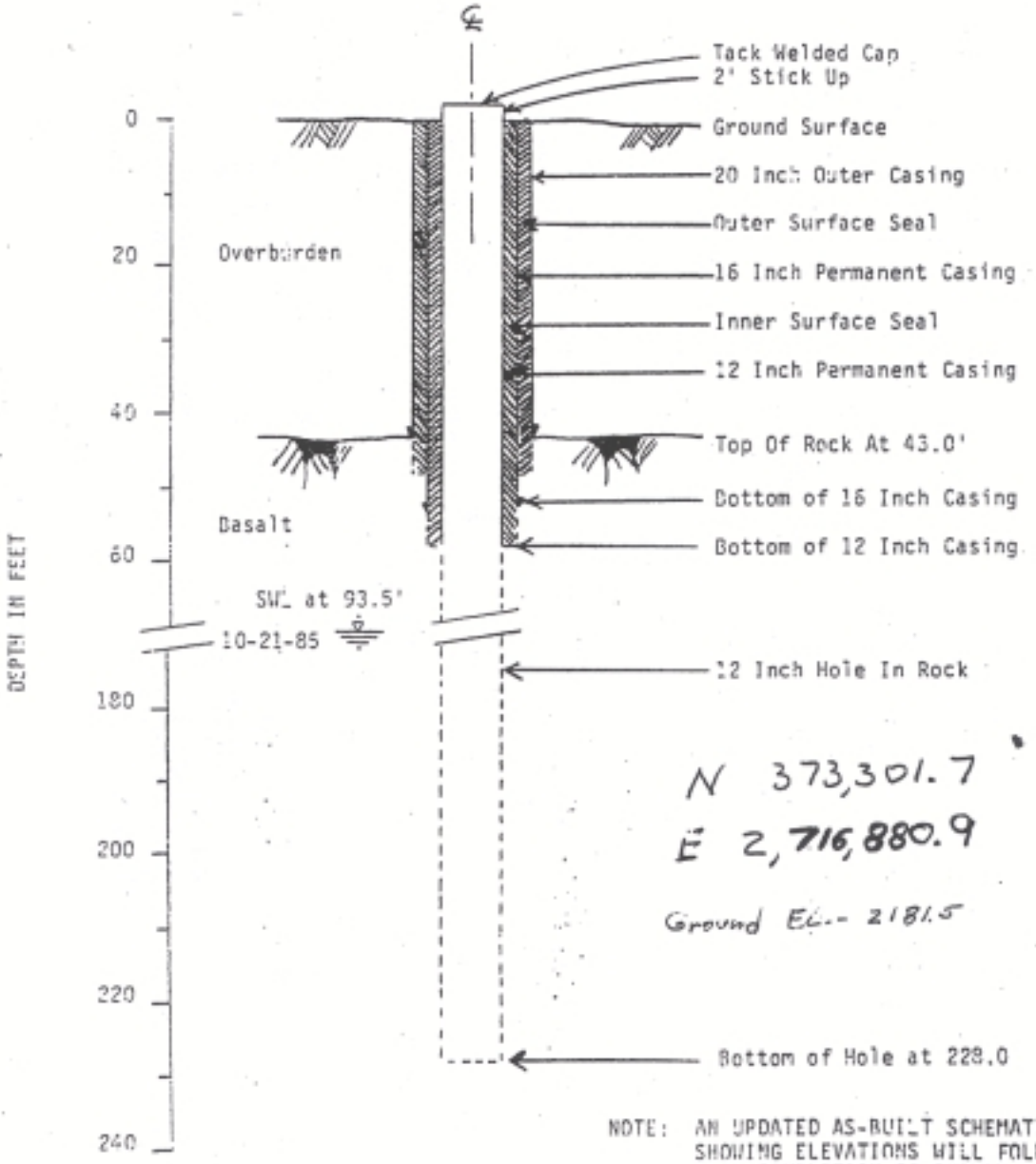
6. The well has been temporarily capped by welding a steel cap on top of the 12-inch casing.

Incl
as

K. C. HUTCHINSON
Geologist

CF:
Proj Mgr, McMichael

TUCANNON FISH HATCHERY
WATER WELL #3
AS-BUILT SCHEMATIC



N 373,301.7
E 2,716,880.9

Ground El.- 2181.5

NOTE: AN UPDATED AS-BUILT SCHEMATIC SHOWING ELEVATIONS WILL FOLLOW UPON COMPLETION OF SURVEY.

Meeting w/ F i, McDavitt, McDowell, S[illegible]n & Palmer. Agreed to move 600 gpm pump in well #2 to well # 3. A. will try to put new 400 gpm pump in well # 2. McDavitt will try to get 200gpm more out of spring coll. system. If all fails can drill 700' (cased to 350' and probably get 500-700 gpm 62°-63° H_2O.

5/7/85

NPWEN-FM

Completion Report - Tucannon Fish Hatchery Water Well No. 3, Contract No. DACW68-85-C-0061

F&M Branch Files

K. C. Hutchinson

4 Dec 85

1. Mobilization of drilling and testing equipment by Myrick Well Drilling, Inc., of Moses Lake, Washington, began 7 August 1985. Demobilization was in progress at the time of this report. Final well coordinates have not yet been established, however, an updated report will follow upon completion of survey.

2. The contractor elected to use a Bucyrus Erie cable tool rig for drilling operations. Well construction began by drilling and driving 20-inch diameter casing to the top of rock located at a depth of 43 feet. This 20-inch diameter hole was continued 5 feet into rock. At that point 16-inch diameter casing was added to the well and this casing was drilled and seated into the basalt to a depth of 53 feet. A 16-inch diameter hole was drilled to a depth of 58 feet where 12-inch diameter casing was added to the well and firmly seated into the basalt. From that point, a 12-inch diameter hole was drilled in the basalt to a final depth of 228.0 feet. During the drilling process, caving problems from 58.0 to 146.0 feet necessitated grouting this portion of the hole to stabilize the side walls. The grout was placed in the hole, allowed to set up and drilled out. No caving problems were found from 146.0 to 228.0.

3. On 21 October 1985 a 72-hour pumping test began. The purpose of this test was to determine well yield, drawdown characteristics and drawdown effect on the other two existing hatchery wells. Pumping equipment consisted of a right angle drive turbine pump powered by a diesel engine. Intake setting of the bowls was at 197.5 feet. Breccia and the possibility of caving material in the lower reaches of the hole dictated this setting. Drawdown was measured with an airline system and well yield was measured with a calibrated orifice meter. Static level in the well was 93.5 feet. Because the well was not drilled to the contract depth, it was feared that production might be less than was anticipated. Consequently, the pumping test was started at a much lower rate than called for. An initial rate of 300 gpm was requested. A stabilized rate of 293 gpm was reached with a drawdown of 15 feet. This rate was held for a period of 24 hours. After this period was over, well production was increased to 680 gpm with a stabilized drawdown of 62.4 feet. This left approximately 41.6 feet of water above the bowls and approximately 72.1 feet of water in the well. It was decided to finish the test at this rate to see if the stabilized pumping rate had any effect on Wells Nos. 1 and 2. At the end of the 72 hour period, no noticeable influence could be seen in any of the wells. Recovery to 90 percent occurred within 1½ minutes.

4. Water temperature throughout the test registered 60°F. Turbidity and a small amount of sand were recorded at the start of the test and again upon increasing pumping rate. These problems cleared within five minutes.

5. Upon completion of the pumping test, the contractor started to place the surface seals. The contractor was unable to pull the outer 20-inch casing so a request was made to LSRRO to allow him to leave it in place. This office checked with the Department of Ecology, State of Washington, concerning this problem. They stated it was acceptable to leave this casing in place. The contractor then placed the inner and outer surface seals, sterilized the well, and tack-welded a steel plate on the 12-inch casing as per contract requirement.

6. During pump testing operations, personnel from the Environmental Resources Section collected water samples and ran dissolved gas tests. Results from these tests are not yet available, but will be included in the updated report.

7. Future tests will be conducted on the well to further define its drawdown characteristics. Until then, it is recommended that no more than 550 gpm be drawn from this well with an intake setting of 195 feet.

8. Additional Recommendations

a. Depending upon the final design of the pump installation, it is recommended that Mechanical Design provide a design for an access port for a measuring device. Possible designs are attached.

b. If additional water is required for hatchery rearing, an attempt should be made to increase the yield from the spring collector system prior to any additional well drilling.

c. Well No. 2 and recently completed Well No. 3 should both be connected to a pneumatic or other type reservoir for the domestic system. This allows redundency to the domestic system and insures that if maintenance or other operational problems render one well inoperable, the hatchery buildings will still be able to function.

d. If, as previously discussed, the spring collector system does not produce additional quantities of water which will be acceptable, another well may be drilled. As proposed, the additional well should be cased to 350 feet and drilled to approximatley 700 feet in depth. The probability that 500 to 700 gpm may be obtained is very likely although the temperature may be in the 60°F range.

KENNETH C. HUTCHINSON
Geology & Explorations Section

CF:
Mech Des
Constr Br
LSRRO
Pat Streamer

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 001016

Water Right Permit No. _____

(1) OWNER: Name Washington Dept. of Corrections Address _____

(2) LOCATION OF WELL: County Columbia SW ¼ ¼ Sec 23 T 12 N. R 38 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) _____

(3) PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ ☐ Irrigation Test Well ☒ Other ☐ ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____

Abandoned ☐ New well ☒ Method: Dug ☐ Bored ☐ Deepened ☐ Cable ☒ Driven ☐ Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 12 inches. Drilled 322 feet. Depth of completed well 322 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 12 " Diam. from +2 ft. to 103 ft.
Welded ☒ 10 " Diam. from 80 ft. to 322 ft.
Liner installed ☐
Threaded ☐ _____ " Diam. from _____ ft. to _____ ft.

Perforations: Yes ☒ No ☐
Type of perforator used Tourch
SIZE of perforations 6 in. by .125 in.
150 perforations from 280 ft. to 310 ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes ☐ No ☒
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 103 ft.
Material used in seal cement
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level _____ ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? Self
Yield: 175 gal./min. with 7.15 ft. drawdown after 24 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
0-Hr.	105.72	4 Hr.	98.67		
1-Hr.	98.86	5 Hr.	98.63		
2 Hr.	98.76	2 Hr.	98.59		

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Artesian _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	—	24
Black Broken Basalt	24	45
Brown " "	45	84
Brown Basalt	84	136
Black "	136	143
Red Porous	143	158
Brown Basalt	158	171
Black "	171	181
Grey "	181	234
Black "	235	285
Brown & Red Broken	295	297
Black Basalt	297	322

RECEIVED
DEPARTMENT OF ECOLOGY
EASTERN REGIONAL OFFICE

Work started 10-12 19 Completed 11-1 19 90

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Touchet Valley Pump (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address RT. 3 Box 4 Dayton, WA
(Signed) Jim Hickson (WELL DRILLER) License No. 995
Contractor's Registration No. TOUCHVP101DA Date 11-22 19 90

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329-

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. _____

Water Right Permit No. G3-29046

(1) OWNER: Name Dept. of Corrections Address _____

(2) LOCATION OF WELL: County Columbia SE ¼ SE ¼ Sec 16 T 11 N, R 39 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) _____

(3) PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ ☐ Irrigation ☐ Test Well ☒ Other ☐ ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____

Abandoned ☐ New well ☒ Method: Dug ☐ Bored ☐ Deepened ☐ Cable ☐ Driven ☐ Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 12 inches. Drilled 1190 feet. Depth of completed well 1190 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 12 " Diam. from +1.5 ft. to 40 ft.
Welded ☒ Liner installed ☐ Threaded ☐
_____ " Diam. from _____ ft. to _____ ft.
_____ " Diam. from _____ ft. to _____ ft.

Perforations: Yes ☐ No ☒
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes ☐ No ☒
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 40 ft.
Material used in seal cement
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level _____ ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " " " "
" " " " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
See Attached Sheet		

Work started 9-6 19 Completed _____ 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Touchet Valley Pump Service (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address RT 3 Box 4 Dayton WA

(Signed) _____ (WELL DRILLER) License No. 885

Contractor's Registration No. TouchVP101DB Date 3-1 19 92

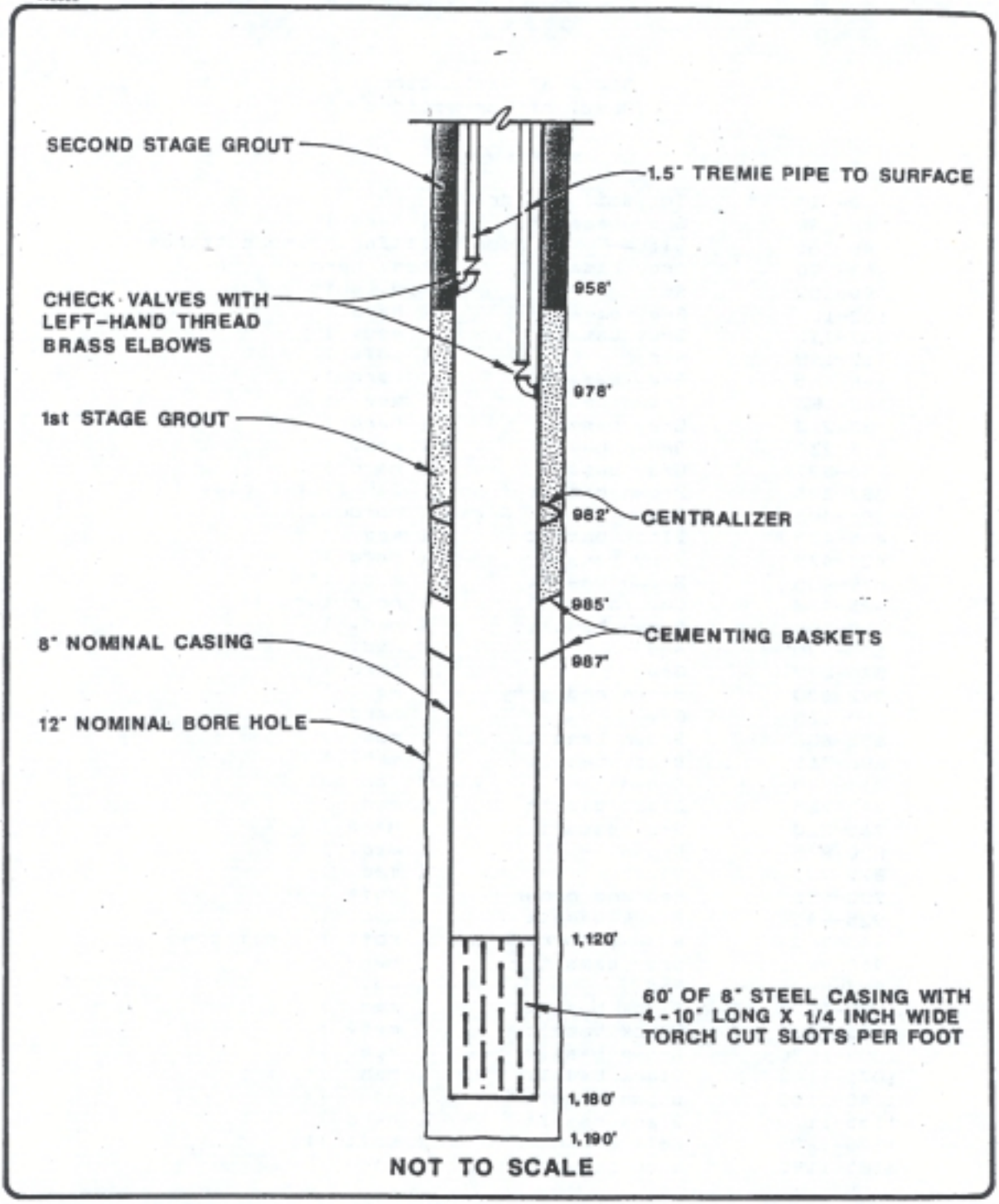
State of Washington
Dept. of Corrections

WELL LOG

0- 14	Top soil and gravel	
14- 48	Grey basalt	(hard)
48- 65	Black	(good drilling, fine cuttings)
65- 90	Grey Basalt	(med. hard)
90-102	Red	(med. soft)
102-107	Grey basalt	(hard)
107-115	Grey basalt	(med.)
115-148	Red	(soft)
148-165	Grey basalt	(hard)
165-183	Brown basalt	(med.)
183-213	Grey basalt	(hard)
213-230	Brown basalt	(med.)
230-387	Grey basalt	(hard)
387-395	Brown basalt	(soft with little clay)
395-405	Brown, black & red	(porous)
405-425	Black basalt	(med.)
425-479	Grey basalt	(hard)
479-485	Brown basalt	(med.)*
485-488	Cavern	(no return)*
488-508	Brown basalt	(med.)
508-520	Red	(med.)
520-592	Grey	(hard)
592-600	Brown and grey	(med.)
600-655	Grey	(hard)
655-686	Brown basalt	(med.)
686-715	Black basalt	(med.)
715-740	Brown	(soft porous)
740-765	Black basalt	(med.)
765-820	Grey basalt	(hard)
820-875	Brown	(med.)
875-900	Black	(med.)
900-925	Red and brown	(soft)
925-945	Black basalt	(med.)
945-960	Brown, no return	(soft) Theif zone
960-997	Grey basalt	(hard)
997-999	Red	(soft)
999-1005	Black basalt	(med.)
1005-1008	Black basalt	(med.)
1009-1070	Brown basalt	(med.)*
1071-1140	Black basalt	(Med.)
1140-1155	Brown basalt	(med.)*
1155-1170	Black basalt	(hard)
1170-1185	Soft brown	(soft)*
1185-1190	Hard grey	(hard)

* Water bearing zone

142332



EMCON Northwest, Inc.

DATE 9/93
DWN. JPE
APPR. CAS
REVIS.
PROJECT NO. 0620002.04

FIGURE 4
WILLOW CREEK MINIMUM SECURITY FACILITY
COLUMBIA COUNTY, WASHINGTON
GROUTING DETAIL

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

File Start Card No. W038466
UNIQUE WELL I.D. #
Water Right Permit No.

(1) OWNER: Name Hollis Fleshier Address

(2) LOCATION OF WELL: County Clarke 1/4 NW 1/4 Sec 17 T. 12 N. R. 3E W.M.

(2a) STREET ADDRESS OF WELL (or nearest address)

(3) PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ ☐ Irrigation ☐ Test Well ☐ ☑ STOCK ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned ☐ New well ☑ Method: Dug ☐ Bored ☐ Deepened ☐ Cable ☐ Driven ☐ Reconditioned ☐ Rotary ☑ Jetted ☐

(5) DIMENSIONS: Diameter of well 6" inches. Drilled 177 feet. Depth of completed well 177 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +1 ft. to 38 ft.
Welded ☐ Liner installed ☐ Threaded ☐ " Diam. from ft. to ft.
" Diam. from ft. to ft.

Perforations: Yes ☐ No ☐
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☐
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☐ Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes ☑ No ☐ To what depth? 38 ft.
Material used in seal
Did any strata contain unusable water? Yes ☑ No ☐
Type of water? Surface Depth of strata 31
Method of sealing strata off Cement

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level +1 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 150 gal./min. with stem set at 85 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 48 Was a chemical analysis made? Yes ☐ No ☑

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Silty Clay	0	2
Gravel H2O	2	31
Fractured Basalt	31	36
Basalt Grey	36	43
Basalt Brown	43	44
Basalt Grey	44	63
Basalt Brown / Red	63	85
Basalt Hard Piece 150		
Basalt Grey	85	122
Basalt Brown	122	131
Basalt Grey	131	177

RECEIVED MAY 25 1994 DEPARTMENT OF ECOLOGY

Work Started 1/25/94 Completed 2/1/ 19 94

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Hickam Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address Rt 1 Box 125-B, Dayton WA
(Signed) Gary Boston (WELL DRILLER) License No. 2077
Contractor's Registration No. HICKAWD988D Date 2-23 19 94

(USE ADDITIONAL SHEETS IF NECESSARY)