PROVINCE OF BRITISH COLUMBIA
MINISTRY OF ENVIRONMENT, LANDS AND PARKS
VANCOUVER ISLAND REGION

SAN JUAN RIVER

WATER ALLOCATION PLAN

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1.0 INTRODUCTION

The Water Management Program's goals are to sustain a healthy water resource through anticipating and planning for water uses. Water Allocation Plans are a means of identifying water demands and ensuring that water use is compatible with the goals of a sustainable environment. The advantages are:

1. Water Management's position on water allocation decisions is available to applicants and public.

2. Response time is reduced.

3. Eliminates the need for individual studies and reports on each application.

4. Consistency of decisions are improved.

5. Specific allocation directions and decisions are defined.

6. Plans are more comprehensive.

7. Eliminates the need for referrals on individual applications.

The Vancouver Island Region developed the following policy to provide water allocation direction:

Regional Policy:

The region shall be subdivided into watershed areas and a water allocation plan shall be prepared for each watershed area. Water licence decisions will be made in accordance with approved plans.

Assessments undertaken as part of the water allocation planning process include identifying the surface water resources available, the instream requirements for fish, the existing and potential licencable water demands and providing direction regarding further water licence allocations.

Input may be sought from other agencies. Referrals go to Federal & Provincial Fisheries agencies and to Water Management in Victoria.

2.0 GENERAL WATERSHED INFORMATION

2.1 Geography and Morphology

The San Juan River Water Allocation Plan Area (Figure 1) is located on the southern portion of Vancouver Island in the Coastal Western Hemlock biogeoclimatic zone. The area encompasses from Bamfield in the west to Otter Point in the east with the Nitinat River as the northern extremity. Most of the water flows in a southerly and or westerly direction towards Juan de Fuca Strait which is the southern boundary of the plan area.

Mount Hooper, in the northern portion of the plan area, at 1491 metres is the highest point in the allocation plan area. The elevation of the land decreases toward the coast. There are a number of lakes distributed throughout the plan area. Nitinat Lake, a salt water body found in the western portion of the plan area, is the largest of these with a surface area of 2130 ha.

2.2 Climate

The San Juan River Water Allocation Plan area is characterized by warm, relatively dry summers and mild wet winters. Climatic normals from Environment Canada's, Atmospheric Environment Service (AES) stations at Bamfield, Port Renfrew and the mouth of Jordan River represent the climatic averages for the area (Appendix A). The warmest month is August with average temperatures of 14.5^{o}C. The coolest is January with an average of 3.7^{o}C. The overall mean temperature for the year is 9.1^{o}C.

2.3 Geology

The geological history of the San Juan River Water Allocation Plan area has been shaped by the occurrences of structural, erosional and depositional processes. Glaciation during the Pleistocene epoch along with marine tidal fluctuations have greatly influenced the local landscape. Unconsolidated sands, gravel and tills (boulder clays) are commonly found within the area.

2.4 History and Development

The first people to inhabit the south western coast of Vancouver Island were the Pacheenaht, Ditidaht and Ohiat First Nations bands. The Pacheenaht First Nations band is an independent band with between 100-200 members centred near Port Renfrew at the mouth of the San Juan and Gordon Rivers. The Ditidaht band is a First Nation of the Nuu-Chah-Nulth Tribal Council with approximately 380 members centred on Nitinat Lake near Caycuse River. To the north and west of the Ditidaht band is the Ohiat, another First Nation of the Nuu-Chah-Nulth Tribal Council with approximately 440 members. The Ohiat are centred at Bamfield, just north of the plan area. The traditional culture of these bands were based on marine resources..

After the founding of Fort Victoria in 1859 the first Europeans started to settle in the area now known as Port Renfrew. However, it wasn't until the 1950's that a road was built to Port Renfrew. Port Renfrew now has a population of approximately 250 people. The south eastern portion of the plan area has a small population residing along the highway. Access into and through the plan area is by Provincial Highway 14 and by logging roads, the ocean and trails.

Employment in the plan area has traditionally been related to resource extraction industries such as logging, fishing and to a lesser extent mining and farming. More recently tourism to the area has increased with the Botanical Beach, the West Coast Trail and the Juan de Fuca Trail becoming increasingly popular.

2.5 Significant Drainage Areas

For the purpose of assessing water supplies for allocation demands, the San Juan River Water Allocation Plan area has been divided into significant drainage areas. These areas were digitized using 1:50,000 NTS maps. The following table and Figure 2 illustrate these drainage areas.

San Juan River Water Allocation Plan Significant Drainage Areas	
Drainage	**Area (km^2)**
Tugwell Creek	19.4
Muir Creek	67.5
Kirby Creek	23.9
Jacob Creek	5.3
Jordan River	160.1
Loss Creek	76.5
San Juan River	680.9
Gordon River	297.4
Walbran Creek	128.5
Carmanah Creek	67.9
Caycuse River	191.4
Campus Creek	5.3
Nitinat River	441.1
Klanawa River	237.2

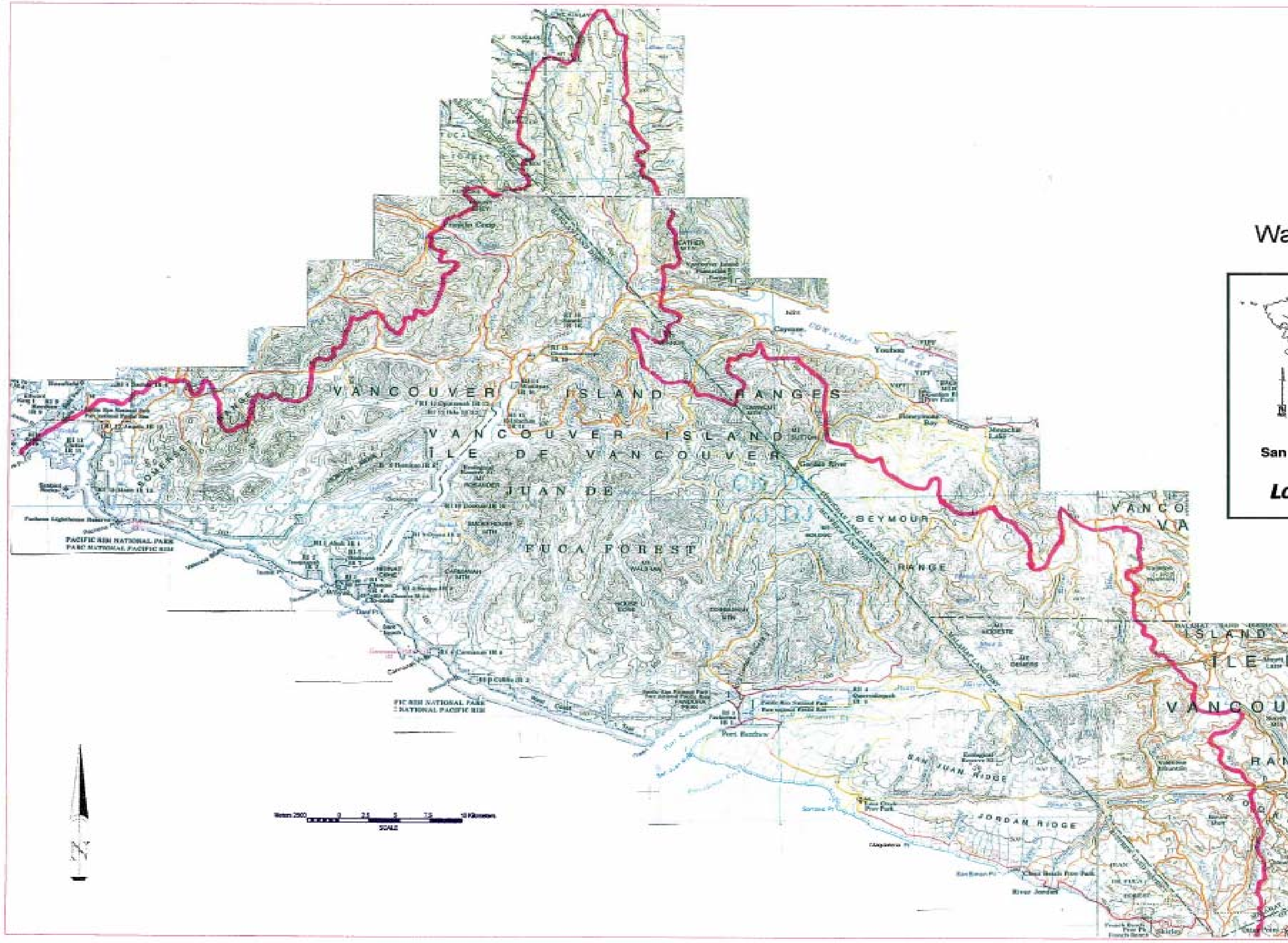
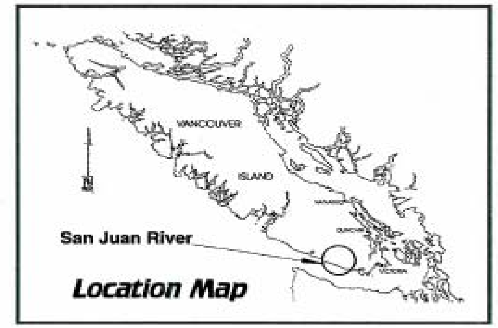


figure 1

San Juan River
Water Allocation Plan Area



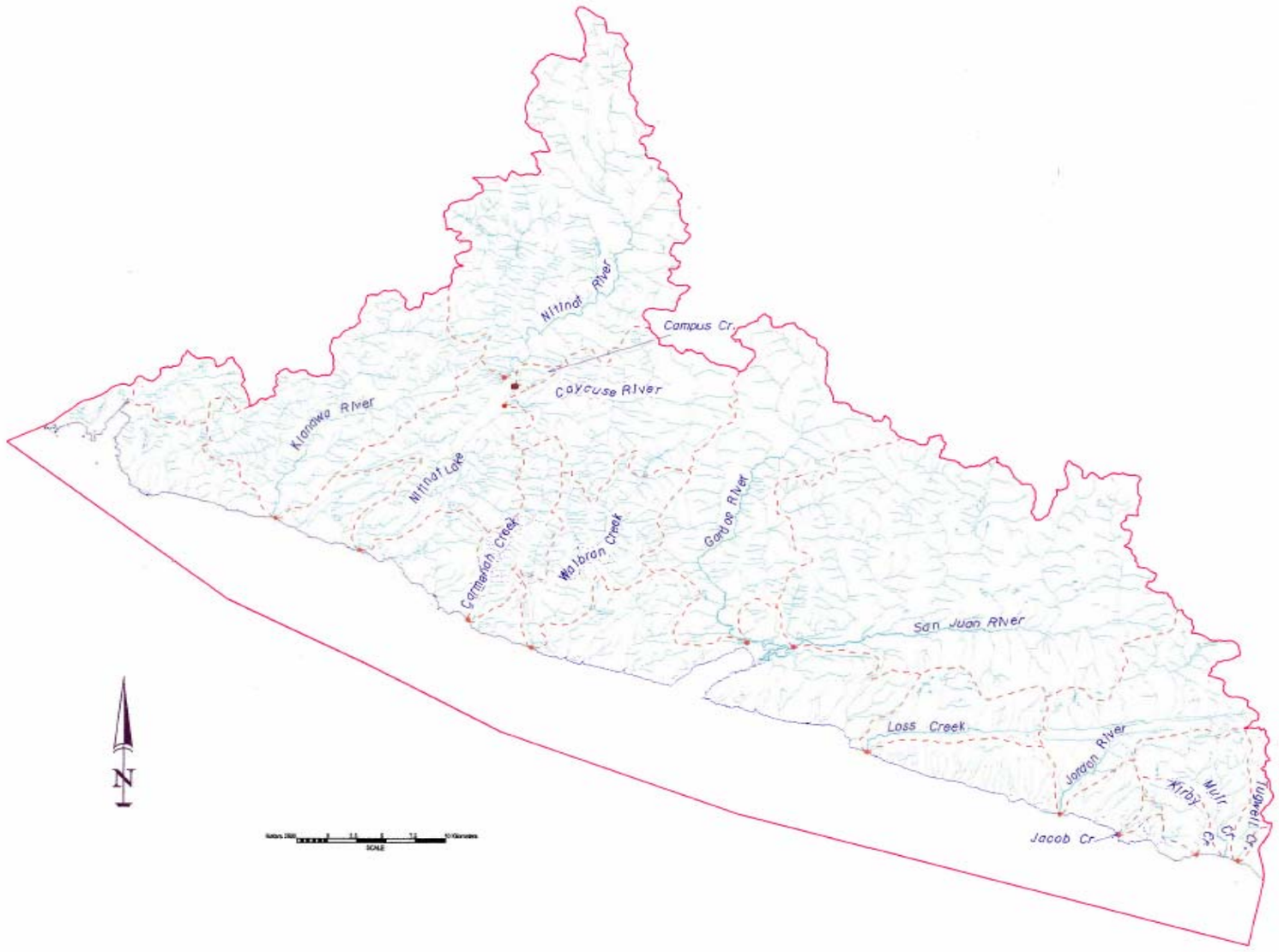


figure 2

San Juan River
Water Allocation Plan
Significant Drainage Areas

3.0 HYDROLOGY

3.1 Precipitation

The average of the mean monthly 1951-80 precipitation normals of Bamfield East, Port Renfrew BCFP and River Jordan Atmospheric Environmental Service (AES) stations were used to indicate the San Juan River Water Allocation Plan area precipitation. See Appendix A for the mean monthly 1951-80 precipitation normals of Bamfield East, Port Renfrew BCFP and River Jordan Atmospheric Environmental Service (AES) stations. The following graph illustrates the the San Juan River Water Allocation Plan area precipitation.

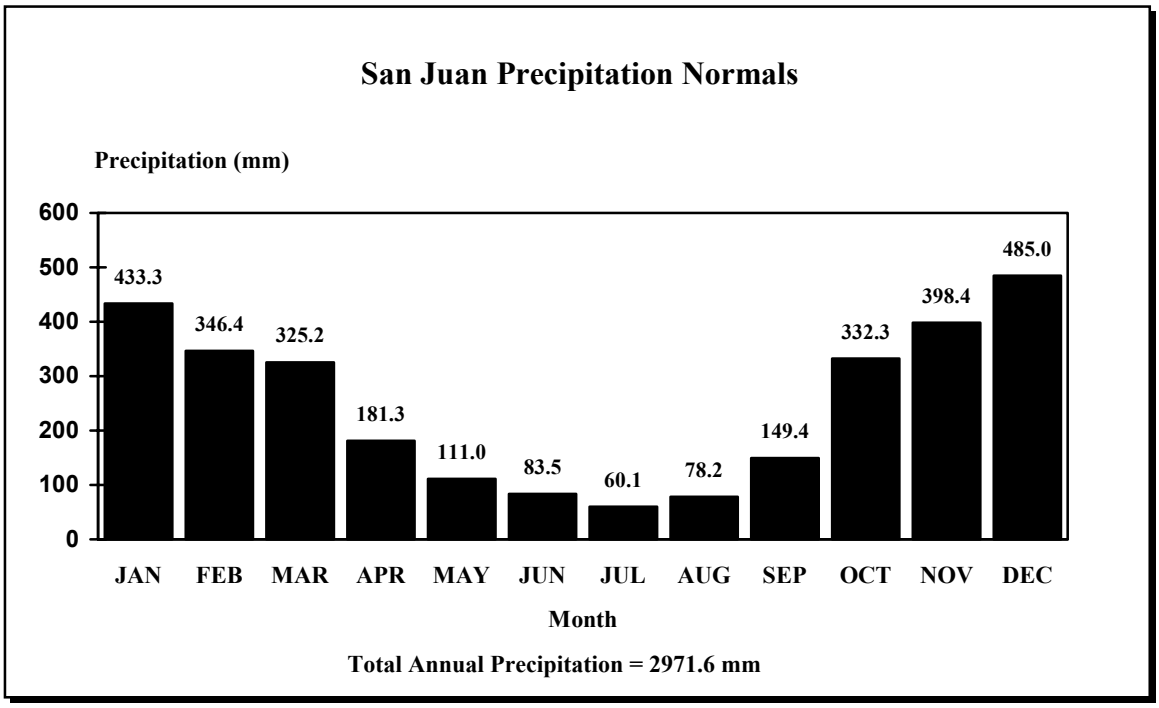


Figure 3

Precipitation in the region is low during the summer months and high throughout the winter months. The minimum mean monthly precipitation is 60.1 mm in July and the maximum mean monthly precipitation is 485.0 mm in December. The mean number of days with measurable precipitation is 194 (189 mean days of rain and 7 days of snow). The total annual precipitation is 2,971.6 mm.

3.2 Hydrometric Information

There are two Water Survey Canada (WSC) hydrometric stations within the San Juan River Water Allocation Plan area, as listed in the following table.

Water Survey of Canada Stations In the Plan Area				
Station Number	**Station Name**	**Period of Record**	**Drainage Area (km^2)**	**Mean Annual Discharge (m^3/s)**
08HA010	San Juan River near Port Renfrew	1959 - 1994	580	48.32
08HA031	Tugwell Creek at the Mouth	1973 - 1977	19.4*	-

* Drainage area planimetered from 1:50,000 NTS maps.

There are annual flow records from 1959 to 1994 for San Juan River near Port Renfrew (08HA010). There are April through September flow records from 1973-1977 for Tugwell Creek at the Mouth (08HA031).

The above indicates there is limited flow information within the San Juan River Water Allocation Plan area. The hydrology for most of the identified significant drainage areas must be inferred from WSC hydrometric stations both within and outside of the plan area. The following table lists the additional WSC hydrometric stations outside the plan area that were used to derive flow estimates.

Water Survey of Canada Stations Outside the Plan Area				
Station Number	**Station Name**	**Period of Record**	**Drainage Area* (km^2)**	**Mean Annual Discharge (m^3/s)**
08HA017	Leech River at the Mouth	1963 - 1966	104	5.45
08HB014	Sarita River near Bamfield	1948 - 1994	162	19.6
08HA047	Colquitz River at Violet Avenue	1981 - 1994	42.6	0.552
08HA023	Veitch Creek at the Mouth	1969 - 1970	24.6	-
08HA025	De Mamaiel Creek at the Mouth	1969 - 1974	26.9	-
08HB048	Carnation Creek at the Mouth	1972 - 1996	10.1	0.823

The San Juan River near Port Renfrew (08HA010), Leech River at the Mouth (08HA017) and Sarita River near Bamfield (08HB014) WSC hydrometric stations were used to derive flows for rivers and creeks in the plan area that have large drainages (over 100 km²) or with a significant portion of the watershed at high elevations. The following monthly discharge runoff per square kilometre and mean annual discharge runoff per square kilometre were used to estimated watershed discharges for the Jordon River, San Juan River, Gordon River, Walbran Creek, Carmanah Creek, Caycuse River, Nitnat River and Klanawa River.

The mean monthly and mean annual discharge runoff per square kilometre for each WSC hydrometric record and the average is in the following table.

Large Watershed - High Elevation
Discharge Runoff per Square Kilometre
(litres/second/ km^2)

WSC Station	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAD
08HA010 (San Juan)	161	148	107	81	49	23	11	8	16	75	149	167	83
08HA017 (Leech Riv)	125	104	70	57	33	7	4	2	3	50	107	105	52
08HB014 (Sarita Riv)	215	202	144	115	62	39	21	19	35	142	219	239	121
Average	167	151	107	84	48	23	12	10	18	89	158	170	85

The Colquitz River at Violet Avenue (08HA047), Veitch Creek at the Mouth (08HA023), DeMamiel Creek at the Mouth (08HA025), Tugwell Creek at the Mouth (08HA031) and Carnation Creek at the Mouth (08HB048) WSC hydrometric stations were used to derive flows for rivers and creeks in the plan area that have small drainages (under 100 km²) and with a significant portion of the watershed at low elevations. The following monthly discharge runoff per square kilometre and mean annual discharge runoff per square kilometre were used to estimated watershed discharges for the Tugwell Creek, Muir Creek, Kirby Creek, Jacob Creek, Loss Creek and Campus Creek.

The mean monthly and mean annual discharge runoff per square kilometre for each WSC hydrometric record and the average is in the following table.

Small Watershed - Low Elevation Discharge Runoff per Square Kilometre (litres/second/ km^2)													
WSC Station	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAD
08HA047 (Colquitz)	37	30	17	11	5	3	2	2	2	3	19	28	13
08HA017 (Veitch)				23	5	1	0	0	0				
08HA025 (DeMamei)				25	5	2	2	0	2				
08HA031 (Tugwell)				23	9	5	1	2	3	28			
08HB048 (Carnation)	149	143	99	69	37	25	14	15	19	82	173	158	82
Average	93	86	58	30	12	7	4	4	5	37	96	93	44

The discharge records of the above WSC hydrometric stations are summarized in Appendix B. The locations of the hydrometric stations and AES climatic stations in and adjacent to the plan area are illustrated in Figure 4.

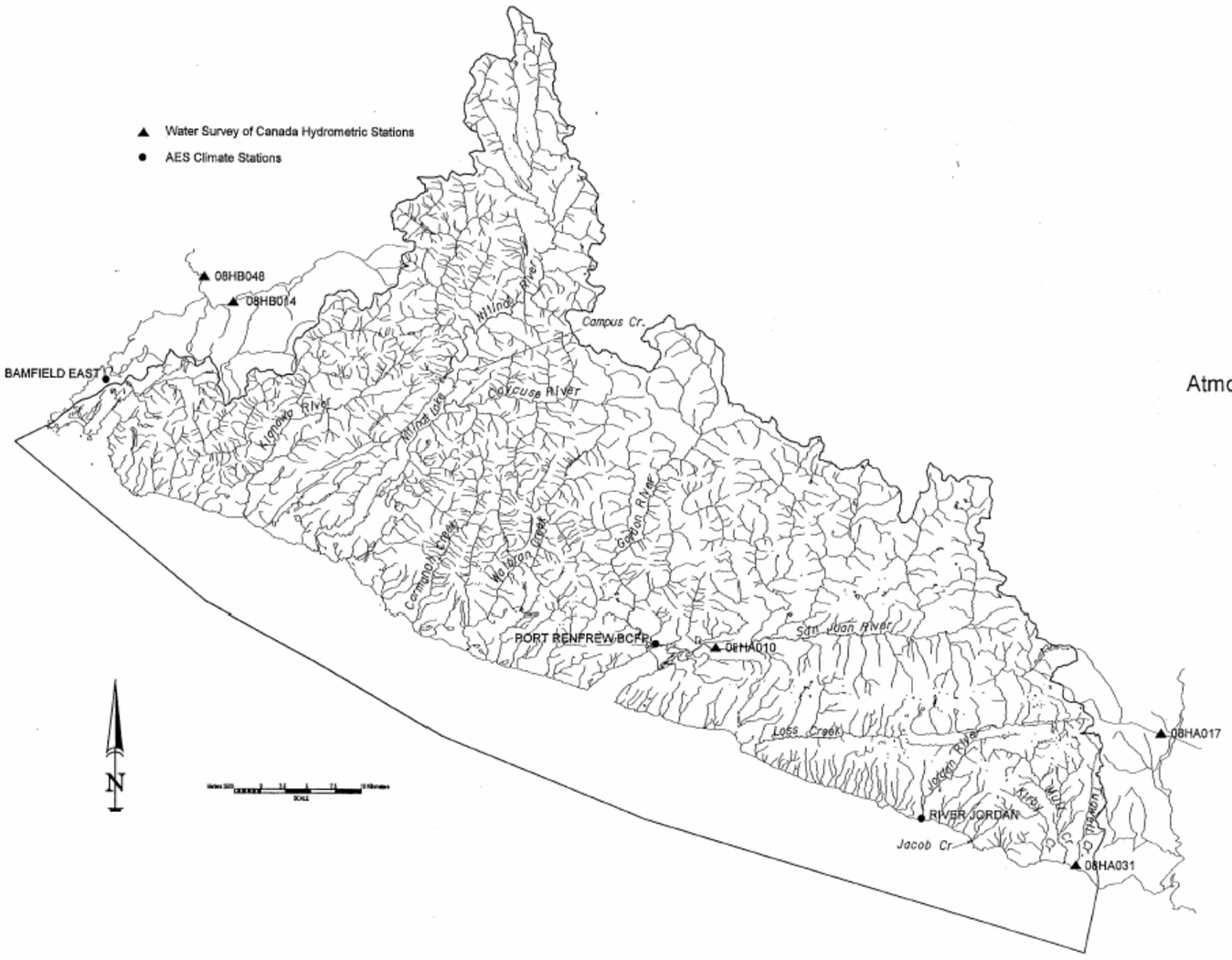


figure 4

Water Survey of Canada
Hydrometric Stations and
Atmospheric Environment Service
Climate Stations

tic Stations

3.2.1 Tugwell Creek Drainage

The estimated drainage area of Tugwell Creek is 19.4 km^2 .

There are streamflow measurements for April through September from 1973 to 1977 and October 1977 on Tugwell Creek (Tugwell Creek at the Mouth - 08HA031). Using these flow measurements and the Small Watershed - Low Elevation Discharge Runoff per Square Kilometre for the November through March period, the following mean monthly and mean annual discharges have been estimated.

Mean Monthly and Mean Annual Discharge (litres/second)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
1,805	1,678	1,124	608	248	122	30	58	71	740	1,862	1,797	841

3.2.2 Muir Creek Drainage

The estimated drainage area of Muir Creek is 67.5 km^2.

Muir Creek flow estimates are based on the average Small Watershed - Low Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table.

Mean Monthly and Mean Annual Discharge (litres/second)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
6,280	5,838	3,912	2,164	875	496	258	274	356	2,770	6,477	6,254	2,981

3.2.3 Kirby Creek Drainage

The estimated drainage area of Kirby Creek is 23.9 km^2.

Kirby Creek flow estimates are based on the average Small Watershed - Low Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (litres/second)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
2,224	2,067	1,385	766	310	176	91	97	126	981	2,293	2,214	1,056

3.2.4 Jacob Creek Drainage

The estimated drainage area of Jacob Creek is 5.3 km^2.

Jacob Creek flow estimates are based on the average Small Watershed - Low Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (litres/second)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
493	458	307	170	69	39	20	22	28	217	509	491	234

3.2.5 Jordan River Drainage

The estimated drainage area of Jordan River is 160.1 km^2.

Jordan River flow estimates are based on the average Large Watershed - High Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (litres/second)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
26,674	24,248	17,159	13,527	7,669	3,707	1,937	1,537	2,892	14,269	25,337	27,273	13,801

3.2.6 Loss Creek Drainage

The estimated drainage area of Loss Creek is 76.5 km^2.

Loss Creek flow estimates are based on the average Small Watershed - Low Elevation

Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (litres/second)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
7,118	6,616	4,433	2,452	991	562	292	311	403	3,139	7,341	7,088	3,379

3.2.7 San Juan River Drainage

The San Juan River flows into Port San Juan (ocean). The total drainage area of the San Juan River at the mouth of the estuary is 680.9 km² (excluding Gordon River). At the head of the estuary the San Jaun River splits into two main channels (northern and southern channels) and numerous smaller channels. Gordon River and Browns Creek flow into the northern channel of the estuary while Murton Creek, Falls Creek and Mosquito flow into the southern channel. The main flow frequently changes between the northern and southern channels due to log jams and sediment deposition. The flow through the San Juan River estuary is influenced by tidal ebbs and floods. Also the water is probably brakish and unsuitable for most common extractive water allocation uses. Therefore the flow only to the head of the San Juan River estuary is estimated herein.

The drainage area to the head of the estuary is 636.1 km². The drainage area of the San Juan River near Port Renfrew (08HA010) is 580 km^2.

San Juan River flow estimates are based on the San Juan River near Port Renfrew (08HA010) mean monthly and mean annual flow plus the average Small Watershed - Low Elevation Discharge Runoff per Square Kilometre noted above for the additional 56.1 km² drainage area to the head of estuary.

Mean Monthly and Mean Annual Discharge (m^3/sec)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
98.3	90.7	65.3	48.7	29.4	13.8	6.9	4.9	9.3	45.9	91.7	102.0	50.8

3.2.8 Gordon River Drainage

Gordon River is tributary to the northern estuary channel of the San Juan River at the mouth. The estimated drainage area of Gordon River is 297.4 km^2.

Gordon River flow estimates are based on the average Large Watershed - High Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (m^3/sec)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
49.6	45.0	31.9	25.1	14.2	6.9	3.6	2.9	5.4	26.5	47.1	50.6	25.6

3.2.9 Walbran Creek Drainage

The estimated drainage area of Walbran Creek is 128.5 km^2.

Walbran Creek flow estimates are based on the average Large Watershed - High Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (m^3/sec)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
21.4	19.5	13.8	10.9	6.2	3.0	1.6	1.2	2.3	11.5	20.3	21.9	11.1

3.2.10 Carmanah Creek Drainage

The estimated drainage area of Carmanah Creek is 67.9 km^2.

Carmanah Creek flow estimates are based on the average Large Watershed - High Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (m^3/sec)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
11.3	10.3	7.3	5.7	3.3	1.6	0.8	0.6	1.2	6.1	10.7	11.6	5.9

3.2.11 Caycuse River Drainage

The estimated drainage area of Caycuse River is 191.4 km^2.

Caycuse River flow estimates are based on the average Large Watershed - High Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (m^3/sec)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
31.9	29.0	20.5	16.2	9.2	4.4	2.3	1.8	3.5	17.1	30.3	32.6	16.5

3.2.12 Campus Creek Drainage

The estimated drainage area of Campus Creek is 5.3 km^2.

Campus Creek flow estimates are based on the average Small Watershed - Low Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (litres/second)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
493	458	307	170	69	39	20	22	28	217	509	491	234

3.2.13 Nitinat River Drainage

The Nitinat River flows from Nitinat Lake through a short channel into the ocean. The total drainage area of the Nitinat River at the mouth is 793.6 km². The total mean annual discharge is estimated as 80.1 m³/sec (Hal Coulson, MELP - January,1997). The local drainage area to Nitinat Lake is 162.6 km² and the mean annual discharge is estimated as 12.9 m³/sec (Hal Coulson, MELP - January,1997).

However the flow from the lake is influenced by tidal ebbs and floods. Also the water is probably brackish and unsuitable for most common extractive water allocation uses. Therefore the flow in the Nitinat River above Nitinat Lake is estimated below. The estimated drainage area of Nitinat River above Nitinat Lake is 441.1 km^2.

Nitinat River flow estimates are based on the average Large Watershed - High Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (m^3/sec)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
73.5	66.8	47.3	37.3	21.1	10.2	5.5	4.2	8.0	39.3	69.8	75.1	38.0

3.2.14 Klanawa River Drainage

The estimated drainage area of Klanawa River is 237.2 km^2.

Klanawa River flow estimates are based on the average Large Watershed - High Elevation Discharge Runoff per Square Kilometre noted above. The mean monthly and mean annual discharge flow estimates are in the following table

Mean Monthly and Mean Annual Discharge (m^3/sec)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
39.5	35.9	25.4	20.0	11.4	5.5	2.9	2.3	4.3	21.1	37.5	40.4	20.4

3.2.15 Other Drainages

Flow in other small drainages not identified above may be calculated from the the average Small Watershed - Low Elevation Discharge Runoff per Square Kilometre noted above and multiplied by the drainage area.

3.3 Lakes

The following table summarizes data available for some of the lakes located within the San Juan River Water Allocation Plan area.

LAKES					
Lake	**Elevation (m)**	**Surface Area (ha)**	**Maximum Depth (m)**	**Mean Depth (m)**	**Volume (dam^3)**
Bear Creek Reservoir	414	87.1	15	6.3	5,500
Black Lake	107	130	27.2	11.1	14,400
Cheewhat Lake	10	152	21	9	13,680
Darlington Lake	240	13.1	28	15.5	2,029
Diversion Reservoir	389	200	-	-	-
Doobah Lake	46	65	-	-	-
Elliot Reservoir	351	21	-	-	-
Fairy Lake	5	33.3	5	2.3	779
Flora Lake	198	14.8	12.8	7.5	1,116
Forslund Lake	671	1.3	3	1	13.2
Francis Lake	240	42.4	41	22.5	9,530
Glad Lake	351	8	-	-	-
Hitchie Lake	137	46	-	-	-
Hobiton Lake	18	355	107	52	184,800
Lizard Lake	91	9	-	-	-
McClure Lake	351	36	-	-	-
Nitinat Lake	0	2130	200	129	27,500,000
Oyees Lake	76	27	-	-	-
Pachena Lake	73	59	26	11	6,306.9
Pixie Lake	91	5.8	4.3	2.3	134.5
Ranger Lake	732	3.3	5.2	2.1	68.1
Rosseau Lake	120	13.1	11	5.8	759
Sprise Lake	46	53	-	-	-
Squalicum Lake	85	224	81	37.9	85,000
Tsuquadra Lake	24	26.3	15	6.8	1,810
Tsusiat Lake	18	286	66	28.8	76,900
Tuck Lake	113	44.5	15.5	4.9	2,160
Wye Lake	869	17	-	-	-

During the summer months approximately 0.3 m (1 ft) of water may be lost over the surface of the water body due to evaporation.

4.0 INSTREAM FLOW REQUIREMENTS

Maintaining the natural stream environment and instream uses is of paramount importance for present and future generations. Maintaining water for the fisheries resource is a key factor in maintaining instream flow requirements for water quality, wildlife, recreational, aesthetic and cultural values. The Ministry of Environment **Provincial policy** is:

> **In situations where a water allocation decision will significantly impact instream uses of water, the comptroller or regional water manager may refuse the application or include water licence conditions to protect the instream use.**

Instream fisheries flow requirements are based on a Provincially modified version of the Tennant (Montana) Method. The following table outlines the modified version used within the San Juan Water Allocation Plan area.

Modified Tennant (Montana) Method Instream Flow Requirements	
Flows	**Description**
30-60% MAD	Excellent spawning/rearing
20-30% MAD	Good spawning/rearing
10-20% MAD	Fair spawning/rearing
5-10% MAD	Poor spawning/rearing
>5% MAD	Severely degraded spawning/rearing

In drainage's where fish are present, the minimum flow required to sustain the fisheries resource for fair spawning and rearing habitat is 10% of the Mean Annual Discharge (MAD). Therefore, the **Regional policies** to implement the Provincial policy are:

> **The minimum flow required to sustain the fisheries resources for spawning and rearing is 10% of the Mean Annual Discharge (MAD); unless a more rigorous analysis indicates a different minimum flow requirement.**
>
> **For streams where the natural mean monthly flow falls below 10% of the MAD, extractive licenced demands should only be allowed for the period of months when the mean monthly flow is above 60% of the MAD.**

SAN JUAN RIVER **WATER ALLOCATION PLAN**

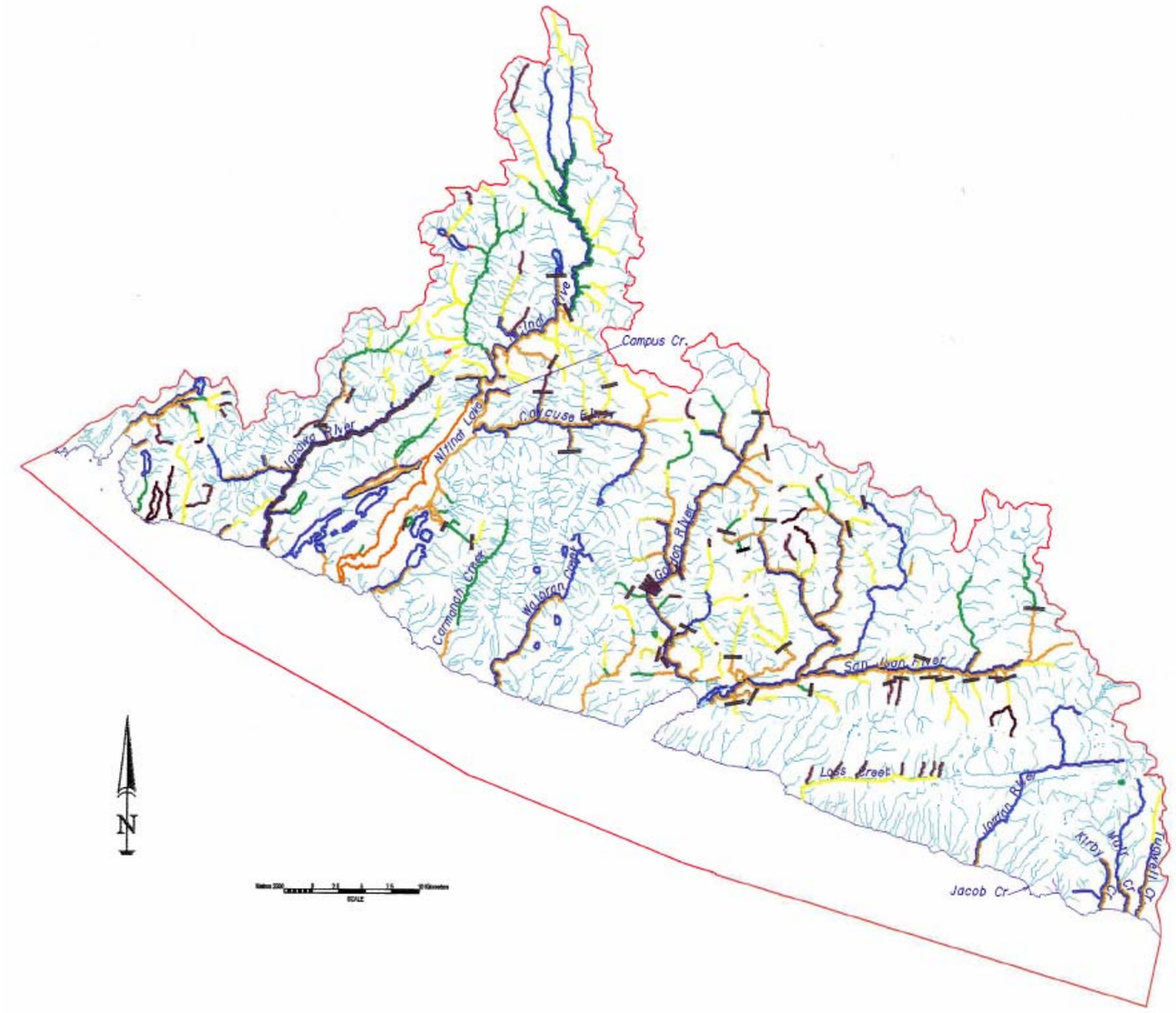


figure 5

Fish Habitat

KEY

- SPORT FISHING WATER
- ANADROMOUS FISH WATER
- POTENTIAL FISH HABITAT
- MARGINAL FISH HABITAT
- NO VALUE AS FISH HABITAT
- KNOWN SPWANING AREA
- HIGH CAPABILITY BIOTIC LAND
- FISH BARRIER
- STOCKED
- LOG JAM

NOT COMPLETE INFORMATION
CONTACT FISHERIES AND WILDFIFE,
MINISTRY OF ENVIRONMENT FOR MORE
DETAILED INFORMATION

For streams where the mean 7-day average low flow falls below 10% of the MAD, extractive demands should only be allowed for the period of months monthly flow is above 60% of the MAD. Where the mean 7-day average low when the mean flow remains above 10%, then the 7-day low flow amount above 10% MAD is available.

Withdrawals from natural water bodies (lakes, ponds, swamps and marshes) supporting natural fisheries resources shall not reduce the shoal area more than 10%.

Figure 5 illustrates fish habitat within the San Juan Water Allocation Plan area.

4.1 Tugwell Creek Instream Requirements

There are fish present in the Tugwell Creek drainage area.

Figure 6 illustrates that the estimated mean monthly flow in Tugwell Creek falls below 10% of the mean annual discharge (MAD) during the months of July, August and September. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (505 litres/second).

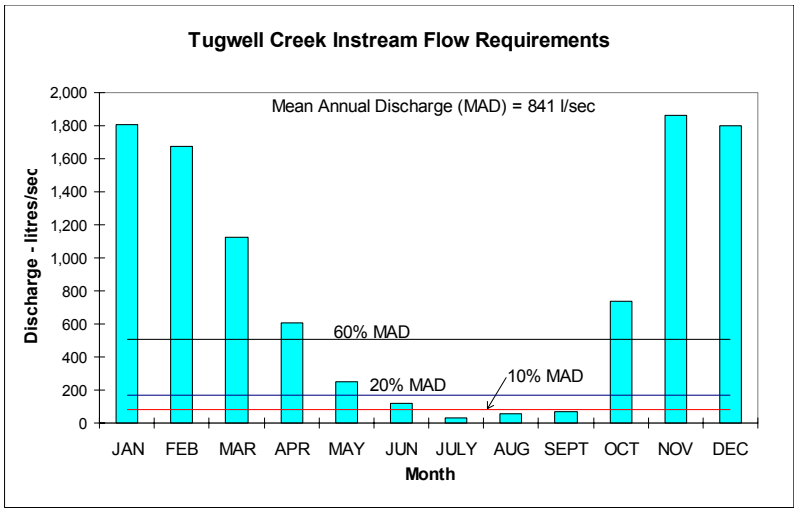


Figure 6

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Tugwell Creek during the months of October through April. The estimated volume of water available for this period is 15,800 dam^3.

4.2 Muir Creek Instream Requirements

There are fish present in the Muir Creek drainage area.

Figure 7 illustrates that the estimated mean monthly flow in Muir Creek falls below 10% of the mean annual discharge (MAD) during the months of July and August. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (1,789 litres/second).

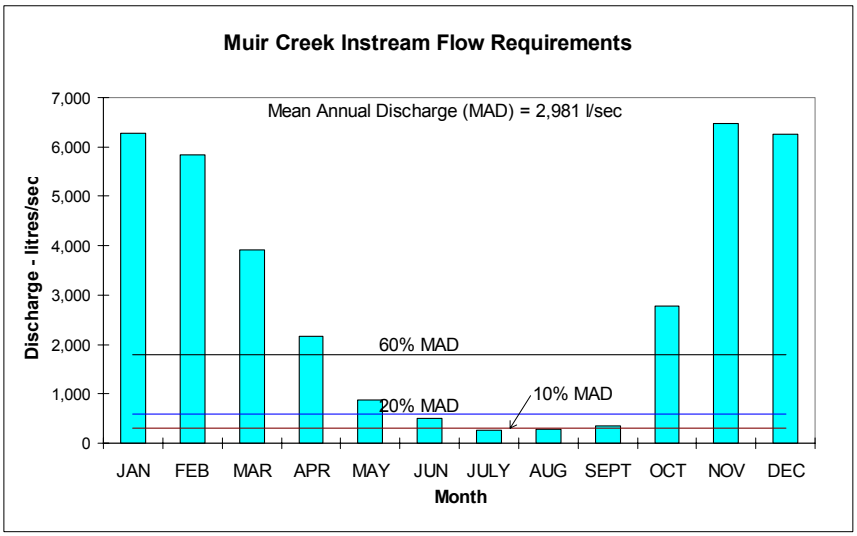


Figure 7

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Muir Creek during the months of October through April. The estimated volume of water available for this period is 55,300 dam^3.

4.3 Kirby Creek Instream Requirements

There are fish present in the Kirby Creek drainage area.

Figure 8 illustrates that the estimated mean monthly flow in Kirby Creek falls below 10% of the mean annual discharge (MAD) during the months of July and August. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (653 litres/second).

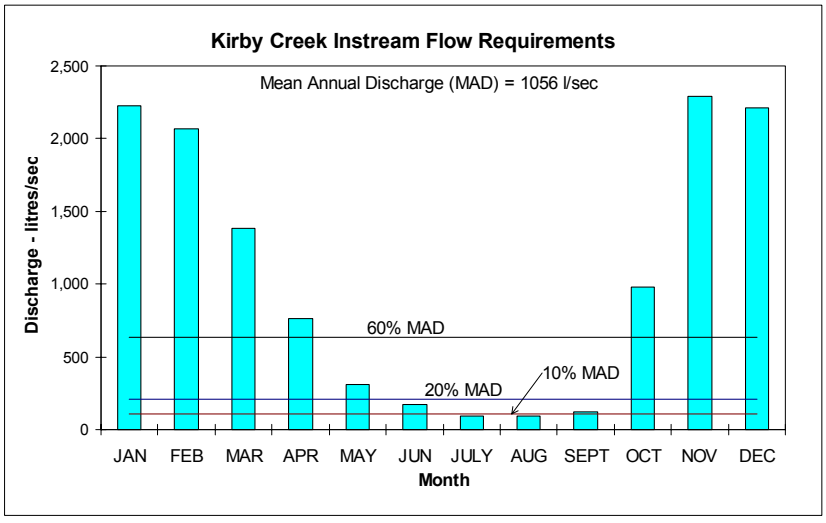


Figure 8

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Kirby Creek during the months

of October through April. The estimated volume of water available for this period is 19,500 dam^3.

4.4 Jacob Creek Instream Requirements

There are fish present in the Jacob Creek drainage area.

Figure 9 illustrates that the estimated mean monthly flow in Jacob Creek falls below 10% of the mean annual discharge (MAD) during the months of July and August. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (140 litres/second).

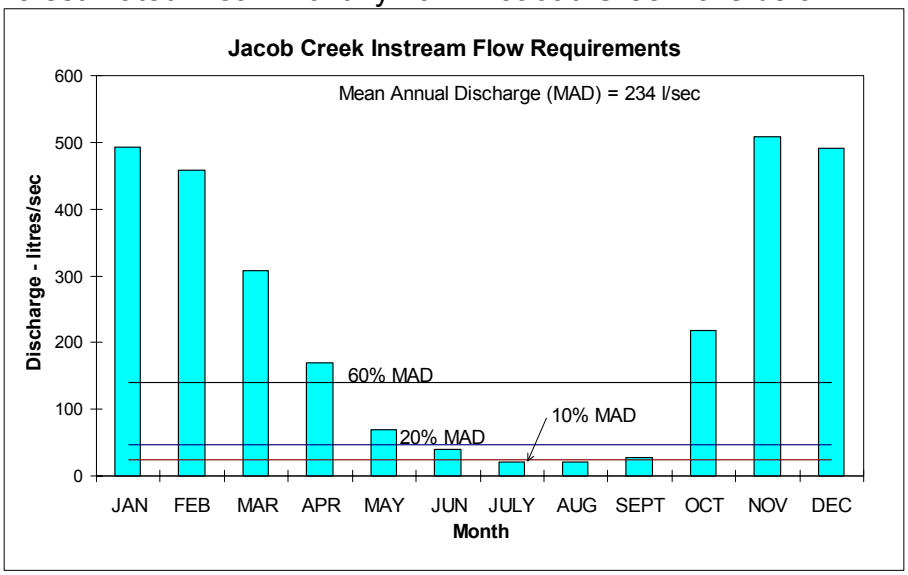


Figure 9

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Jacob Creek during the months of October through April. The estimated volume of water available for this period is 4,300 dam^3.

4.5 Jordan River Instream Requirements

There are fish present in the Jordan River drainage area.

Figure 10 illustrates that the estimated mean monthly flow in Jordan River is between 10% and 20% of the mean annual discharge (MAD) for the months of July and August. However the mean 7-day average low flow is below 10% MAD. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (8,281 litres/second).

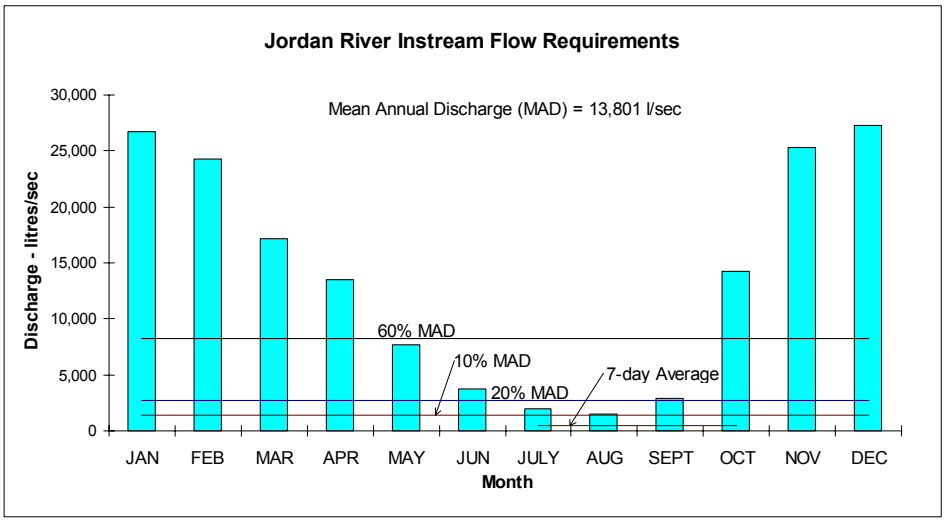


Figure 10

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Jordan River during the months of October through April. The estimated volume of water available for this period is 236,700 dam^3.

4.6 Loss Creek Instream Requirements

There are fish present in the Loss Creek drainage area.

Figure 11 illustrates that the estimated mean monthly flow in Loss Creek falls below 10% of the mean annual discharge (MAD) during the months of July and August. The mean monthly flows are less than

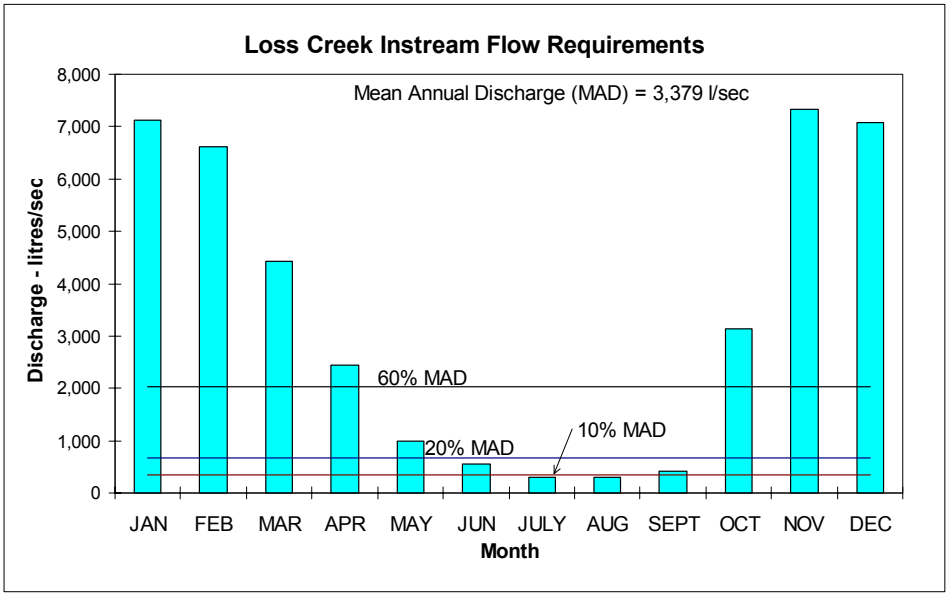


Figure 11

60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (2,027 litres/second).

Therefore no water is available for extractive demands during the May through September low flow period. .Water is only available from Loss Creek during the months of October through April. The estimated volume of water available for this period is 62,600 dam^3.

4.7 San Juan River Instream Requirements

There are fish present in the San Juan River drainage area.

Figure 12 illustrates that the estimated mean monthly flow in San Juan River falls below 10% of the mean annual discharge (MAD) during the month of August. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (30,229 litres/second).

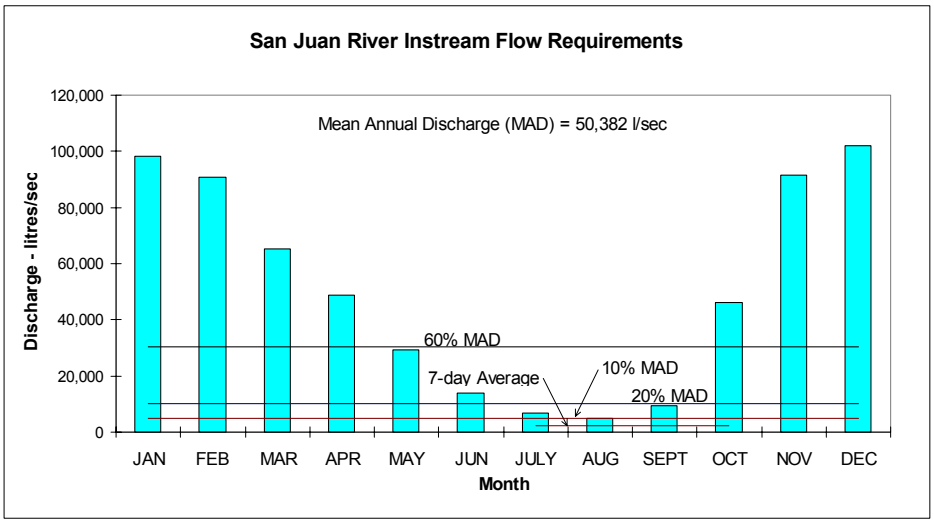


Figure 12

Therefore no water is available for extractive demands during the May through September low flow period. .Water is only available from San Juan River during the months of October through April. The estimated volume of water available for this period is 865,200 dam^3.

4.8 Gordon River Instream Requirements

There are fish present in the Gordon River drainage area.

Figure 13 illustrates that the estimated mean monthly flow in Gordon River is between 10% and 20% of the mean annual discharge (MAD) for the months of July and August. However the mean 7-day average low flow is below 10% MAD. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (15,382 litres/second).

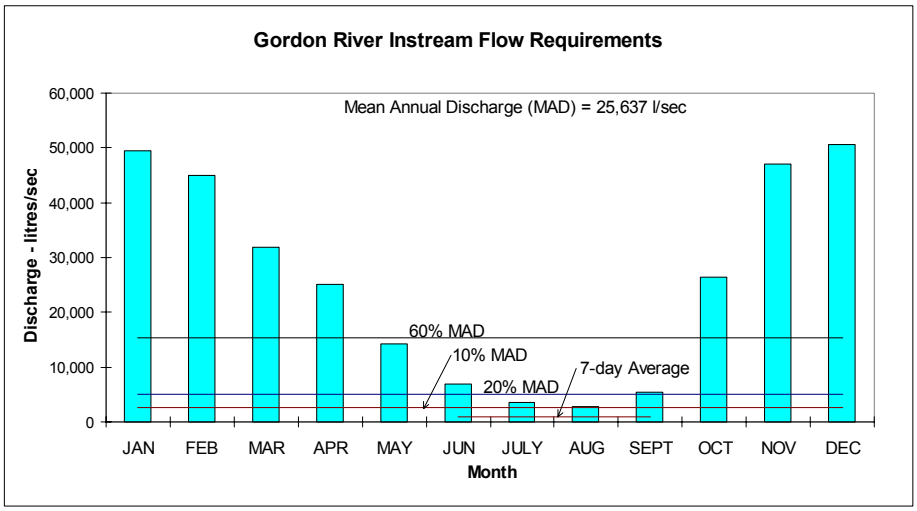


Figure 13

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Gordon River during the months of October through April. The estimated volume of water available for this period is 439,700 dam^3.

4.9 Walbran Creek Instream Requirements

There are fish present in the Walbran Creek drainage area.

Figure 14 illustrates that the estimated mean monthly flow in Walbran Creek is between 10% and 20% of the mean annual discharge (MAD) for the months of July and August. However the mean 7-day average low flow is below 10% MAD. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during

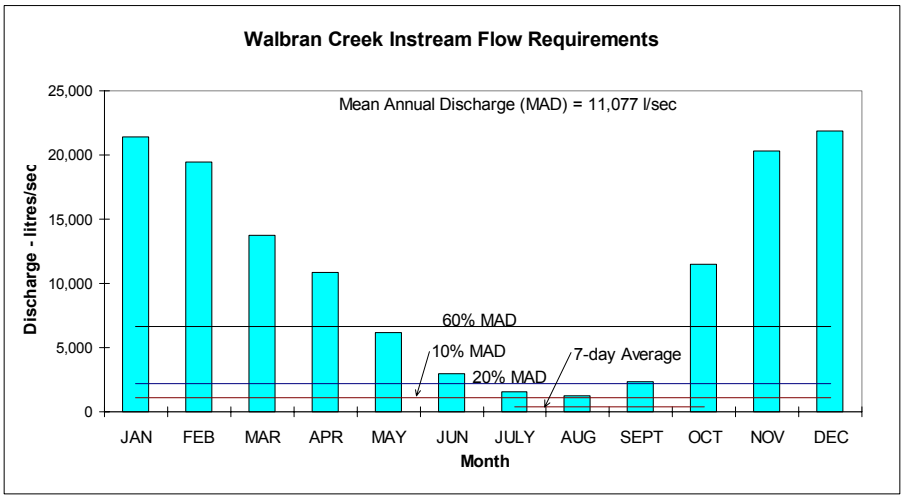


Figure 14

months when the mean monthly discharge is greater than 60% MAD (6,646 litres/second).

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Walbran Creek during the months of October through April. The estimated volume of water available for this period is 190,000 dam^3.

4.10 Carmanah Creek Instream Requirements

There are fish present in the Carmanah Creek drainage area.

Figure 15 illustrates that the estimated mean monthly flow in Carmanah Creek is between 10% and 20% of the mean annual discharge (MAD) for the months of July and August. However the mean 7-day average low flow is below 10% MAD. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (3,512 litres/second).

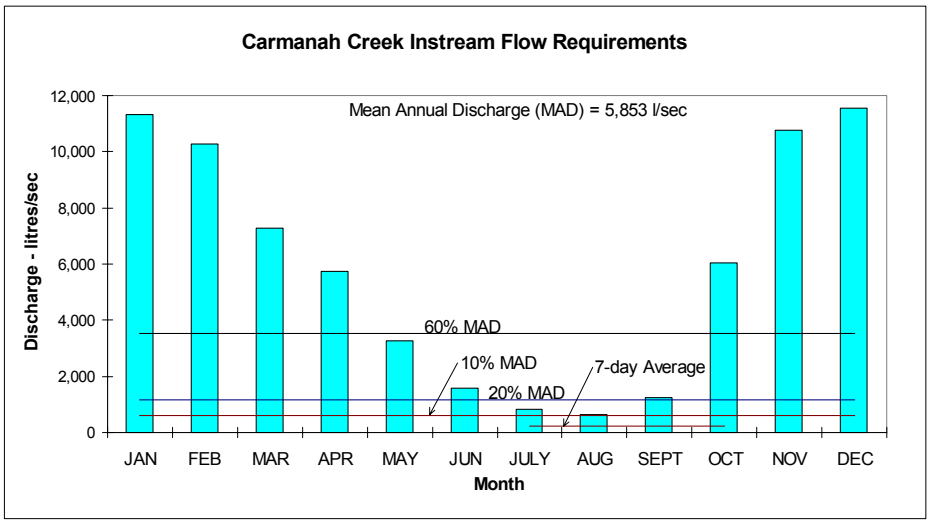


Figure 15

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Carmanah Creek during the months of October through April. The estimated volume of water available for this period is 100,400 dam^3.

4.11 Caycuse River Instream Requirements

There are fish present in the Caycuse Creek drainage area.

Figure 16 illustrates that the estimated mean monthly flow in Caycuse River is between 10% and 20% of the mean annual discharge (MAD) for the months of July and August. However the mean 7-day average low flow is below 10% MAD. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (9,900 litres/second).

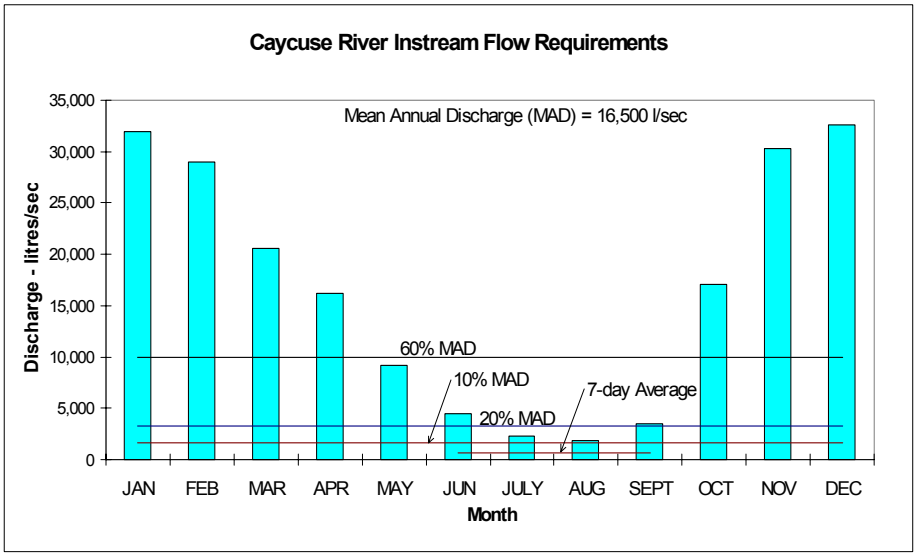


Figure 16

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Caycuse River during the months of October through April. The estimated volume of water available for this period is 283,000 dam^3.

4.12 Campus Creek Instream Requirements

There are fish present in the Campus Creek drainage area.

Figure 17 illustrates that the estimated mean monthly flow in Campus Creek falls below 10% of the mean annual discharge (MAD) during the months of July and August. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (140 litres/second).

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Campus Creek during the months of October through April. The estimated volume of water available for this period is 4,300 dam^3.

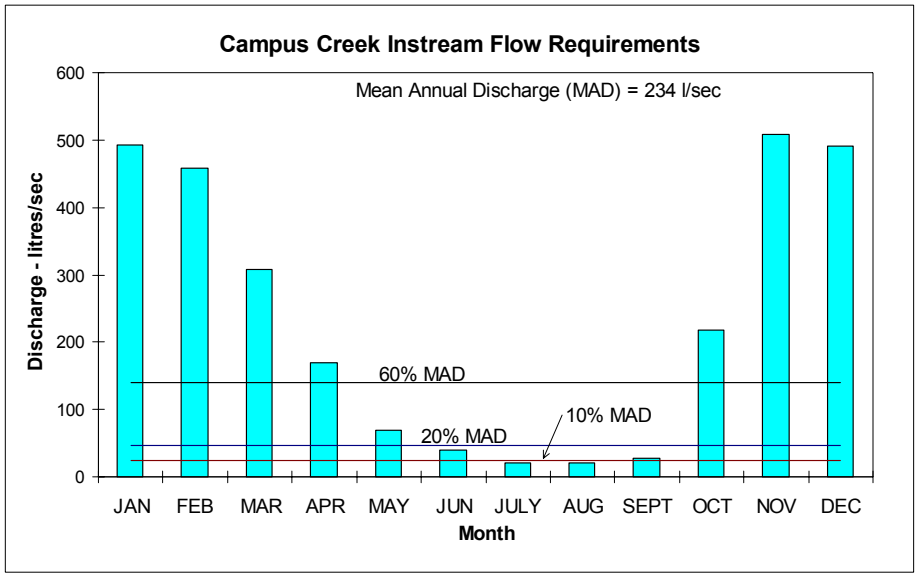


Figure 17

4.13 Nitinat River Instream Requirements

There are fish present in the Nitinat River above Nitinat Lake drainage area.

Figure 18 illustrates that the estimated mean monthly flow in Nitinat River above Nitinat Lake is between 10% and 20% of the mean annual discharge (MAD) for the months of July and August. However the mean 7-day average low flow is below 10% MAD. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (22,815 litres/second).

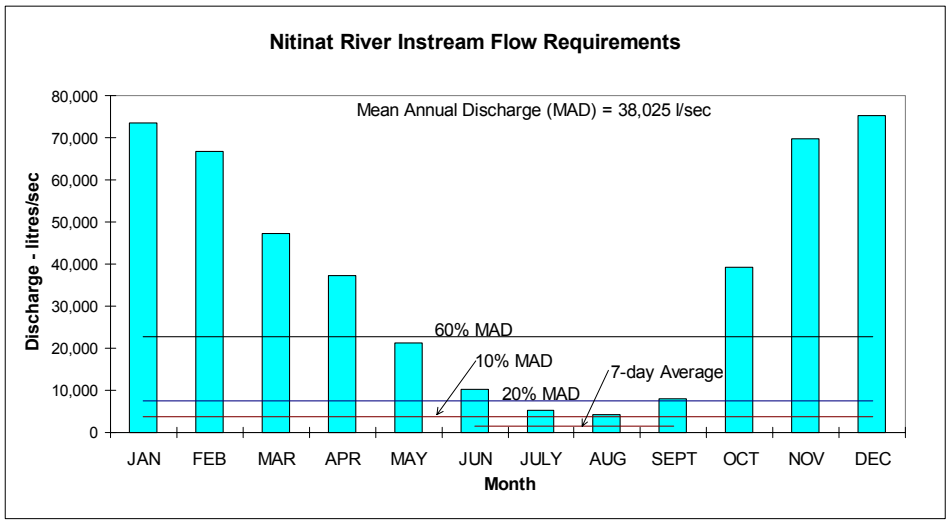


Figure 18

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Nitinat River above Nitinat Lake during the months of October through April. The estimated volume of water available for this period is 652,200 dam^3.

4.14 Klanawa River Instream Requirements

There are fish present in the Klanawa River drainage area.

Figure 19 illustrates that the estimated mean monthly flow in Klanawa River is between 10% and 20% of the mean annual discharge (MAD) for the months of July and August. However the mean 7-day average low flow is below 10% MAD. The mean monthly flows are less than 60% MAD for May through September. Water is only available for extractive use during months when the mean monthly discharge is greater than 60% MAD (12,269 litres/second).

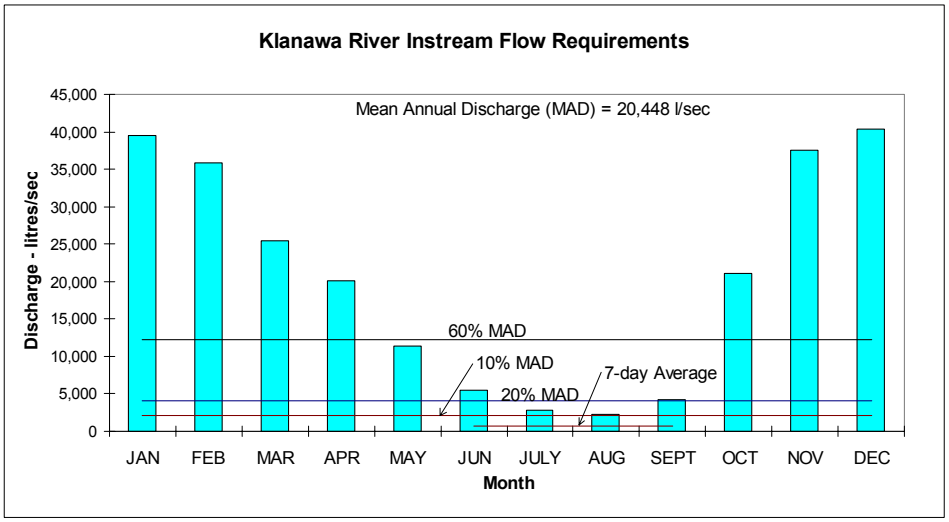


Figure 19

Therefore no water is available for extractive demands during the May through September low flow period. Water is only available from Klanawa River during the months of October through April. The estimated volume of water available for this period is 350,700 dam^3.

4.14 Other Drainages

Various other drainages not identified above may support fish populations. Where fish are identified, water will only be available from those drainages during the period when the mean monthly flow is greater than 60% MAD. Estimated flows and 60% MAD can be determined using procedures identified above.

5.0 WATER DEMAND

5.1 Licenced Demand

There are 101 water Licences currently (July 1996) within the San Juan Water Allocation Plan area. Figure 20 illustrates the number of water Licences issued for each purpose for the water within the plan area. The largest number of water Licences support domestic demands (53 water Licences) and industrial demands (22 water Licences). There are 8 Licences for storage purposes, 6 for irrigation uses, 4 for waterworks, 4 for conservation, 3 for power and 1 for mining.

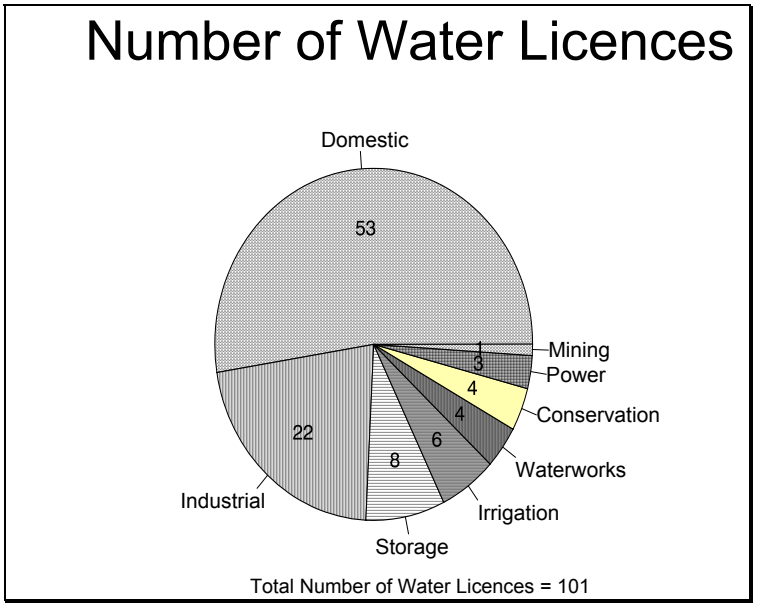


Figure 20

Of greater significance is the estimated average annual licenced water demand and low flow water demand. The total estimated average annual licenced water demand for the plan area is 400,379 dam^3. Figure 21 illustrates the estimated average annual licenced water demand for each purpose under which water Licences have been issued within the plan area.

Power is the largest annual water demand (82.2%) in the plan area. Most of the water demand for power is at the BC Hydro power plant on the Jordon

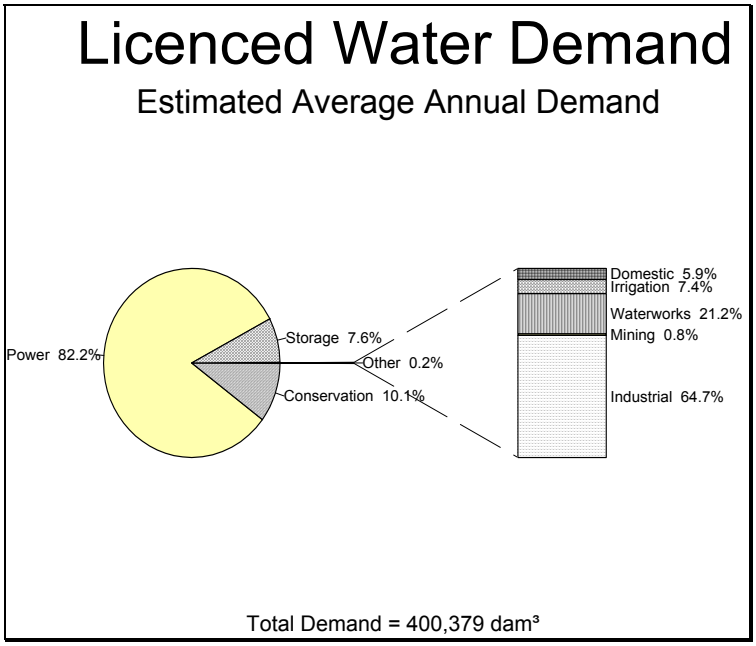


Figure 21

River. The peak, short term, water demand of the BC Hydro plant at Jordan River is estimated to be 70.8 m³/sec (2,500 ft³/sec) during peak flow periods. However the estimated average annual water demand for BC Hydro power on the Jordan River is estimated to be 10.4 m³/sec (366.6 ft³/sec). The BC Hydro power plant on the Jordon River is a run-of-the-river power plant which generates power primarily from natural river flow and therefore does not divert water from the source and does not significantly impact on instream flow requirements.

Likewise the second largest annual water demand for conservation (10.1%) and the third largest annual water demand for storage (7.6%) are non-consumptive and do not significantly impact on instream flow requirements. Only the other (0.2%), consists of industrial, waterworks, irrigation, domestic and mining purposes, are extractive.

Annual licenced water demands within the San Juan Water Allocation Plan area are detailed in Appendix C and summarized in the following table.

Estimated Average Annual Licenced Water Demand

PURPOSE	NUMBER OF LICENCES	QUANTITY LICENCED	ANNUAL DEMAND (dam³)*
Power	3	81.3 m³/sec (2,868.6 cfs)	329,162**
Conservation	4	1.28 m³/sec (45.17 cfs)	40,337
Storage	8	30,249 dam³ (24,523.2 acft)	30,249
Industrial			
Brake Cooling	2	9,092 lpd (2,000 gpd)	3.3
Cooling	1	136,377 lpd (30,000 gpd)	49.8
Enterprise	11	261,162 lpd (57,450 gpd)	95.3
Fire Protection	2	136,377 lpd (30,000 gpd)	49.8
		7 dam³ (5.5 acft)	7
Ponds	1	3 dam³ (2.5 acft)	3
Processing	3	545,508 l lpd (120,000 gpd)	199.1
Lawn Watering	1	0.4 dam³ (0.33 acft)	0.4
Stockwatering	1	455 lpd (100 gpd)	0.2
Industrial - Total	22	-	408
Waterworks	4	133,551,530 litres/year (29,382,500 gpy)	134
Irrigation	6	47 dam³ (37.75 acft)	47
Domestic	53	100,692 lpd (44,300 gpd)	37
Mining	1	0.17 l/sec (0.006 cfs)	5
TOTAL	**101**	**-**	**400,379**

*Assumes that domestic and waterworks are the authorized maximum daily licenced amount divided by 2 to estimate the average daily demand, then multiplied by 365 days to determine the annual demand. Industrial, storage, conservation, mining, power and irrigation represent total annual licenced volumes.

** Assumes that BC Hydro's 70.8 m³/sec (2,500 cfs) demand is a peak surcharge demand only during very brief periods and is not a significant annual demand. Therefore total annual demand is 10.5 m³/sec (368.6 ft³/sec).

The low flow licenced water demand may be critical between competing water uses and instream flow requirements to maintain the fish resources. The estimated low flow licenced demand for each identified drainage area and for other drainages in the San Juan Water Allocation Plan area are summarized in Appendix D and the following table.

Low Flow Licenced (Consumptive) Water Demand per Drainage Area		
SIGNIFICANT DRAINAGE AREA	**LOW FLOW WATER DEMAND***	
	litres/second	**dam^3**
Tugwell Creek	0.29	2.26
Muir Creek	0.19	1.48
Kirby Creek	0.13	1.01
Jacob Creek	0.55	4.28
Jordan River	5.46	42.46
Loss Creek	0.22	1.71
San Juan River	3.01	23.41
Gordon River	1.16	9.02
Walbran Creek	0	0
Caramanah River	0	0
Caycuse River	0.79	6.14
Campus Creek	1.84	14.31
Nitinat River	0.05	0.39
Klanawa River	0	0
Other Areas	11.1	86.32

*Based on an estimated licenced water demand assuming that: irrigation and industrial demands are totally withdrawn over a 90 day period; domestic and waterworks demands are the authorized licenced maximum daily amount for 90 days; authorized storage balances demand and results in a negative demand over 90 days; conservation and power is non-consumptive and, therefore, has no extractive demand.

5.2 Projected Demand

There are 10 water licence applications pending as of July 1996. The potential annual water demand and the purposes of these existing applications are detailed in Appendix E and summarized in the following table.

Water Licence Applications			
Purpose	**Number of Licences**	**Quantity**	**Average Annual Demand (dam^3)**
Conserv.- Construct.	1	12.2 dam^3 (9.9 acft)	12.2
Domestic*	2	6,819 lpd (1,500 gpd)	1.3
Industrial			
Camps**	1	18,184 lpd (4,000 gpd)	1.6
Enterprise	3	51,141 lpd (11,250 gpd)	18.7
Irrigation	1	11.1 dam^3 (9 acft)	11.1
Public Facility	2	9,091 lpd (2,000 gpd)	3.3
Total	**10**	**-**	**48.2**

* Based on the assumption that the demand is the authorized maximum daily licenced divided by 2 to estimate the average daily demand and multiplied by 365.25 days to determine the annual demand.
** Based on an estimated 90 day period demand assuming that all demands are withdrawn over the 90 day period.

Future water demands are anticipated to be similar to existing licenced water demands. Waterworks, domestic, industrial, irrigation and land improvement Licences will increase in number as the population of the plan area expands. Conservation purpose demands will increase as conservation groups and fish agencies attempt to preserve and protect fish and wildlife habitat from urban encroachment and destruction. Storage of winter high flows will be required in all drainage areas to support extractive water demands during the summer five month (May through September) low flow period.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The San Juan River Water Allocation Plan area is sparsely populated with the main population centred on the Village of Port Renfrew and First Nation settlements at Nitinat Lake and near the mouth of the San Juan River. The primary employment is logging, fishing and tourism.

There is limited flow information within the San Juan River Water Allocation Plan area. However mean monthly and mean annual flow information may be extended using hydrometric station flow information to the north and south of the plan area. Minimum mean monthly flow occurs in August. The low flow period, when flows are less than 60% MAD, occur from May through September.

Large watershed, high elevation drainages exhibit higher mean monthly and mean annual flow than small watershed, low elevation drainages. In large watershed, high elevation drainages the minimum mean monthly flows of July and August are between 10% and 20% MAD. However the mean 7-day average low flow (4% MAD) is below 10% MAD.

In small watershed, low elevation drainages the minimum mean flow of July and August are less than 10% MAD.

All significant drainages within the plan area support the spawning and rearing of anadromous fish such as salmon and sea-run Cut-throat trout. As well, there are resident fish such as Rainbow and Cut-throat trout in many of the streams and lakes within the plan area.

Therefore the flow during the low flow period in both large watershed, high elevation and small watershed, low elevation drainages are naturally limiting to instream fish habitat and fish production.

The high flow period, in which mean monthly flow, is greater than 60% MAD occur from October through April. There is considerable flow available to develop supporting storage for water demands during this seven month period when flow is excessive to instream fish habitat and fish production needs.

The most significant licenced water demand within the San Juan River Water Allocation Plan area is a BC Hydro hydro-electric power development on Jordan River. However the power, conservation and storage licenced demands are non-consumptive and will not impact on instream fish flow requirements during the low flow period. Only 0.2% of the annual demand in the plan area is for the extractive domestic, industrial, irrigation, mining and municipal waterworks purpose demands.

The following table summarizes the water available for the identified significant drainage areas, exclusive of existing licenced water demand.

San Juan River Water Allocation Plan - Water Availability			
SIGNIFICANT DRAINAGE	**DRAINAGE AREA (km^2)**	**WATER VOLUME AVAILABLE**	
		OCT - APR (dam^3)*	**MAY-SEPT (l/s)****
Tugwell Creek	19.4	15,800	0
Muir Creek	67.5	55,300	0
Kirby Creek	23.9	19,500	0
Jacob Creek	5.3	4,300	0
Jordan River	160.1	236,700	0
Loss Creek	76.5	62,600	0
San Juan River	680.9	865,200	0
Gordon River	297.4	439,700	0
Walbran Creek	128.5	190,000	0
Carmanah Creek	67.9	100,400	0
Caycuse River	191.4	283,000	0
Campus Creek	5.3	4,300	0
Nitinat River	441.1	652,200	0
Klanawa River	237.2	350,700	0

*Oct - Apr (dam^3) is the total volume of water available for storage and water use above 60% MAD during the October through April high flow period.
**May - Sept (l/s) is the minimum mean monthly flow of water available above 10% MAD during the May through September low flow period.

Fish and debris screens are part of good intake design and shall be required on all intake or diversion works within identified fish habitat areas. Fish passage provisions for both juvenile and adult fish will be required on all storage dams or diversion works constructed on sources frequented by fish. Appendix F contains information on fish screening requirements.

Instream works are to be constructed only during the period specified by the fisheries agencies to minimize impacts on the fish resources. Instream works will normally only be approved for construction from June - September.

6.1 Domestic

A domestic water licence shall be 2,273 litres/day (500 gpd) for each rural dwelling as indicated on the plan attached to the water licence application. This amount will allow for the maintenance of 0.10 hectares (0.25 acres) of garden area associated with the dwelling. It is not appropriate, where the primary source of domestic water supply is insufficient, to issue additional water Licences for the maintenance of green lawns and gardens.

Domestic water Licences shall not be issued to provide evidence to subdivision approval authorities of an “adequate potable water supply” for subdivision development. Residential land subdivisions shall be encouraged to connect to existing community water supply systems.

To ensure an adequate domestic water supply for household uses, applicants should be prepared to develop storage or to use naturally stored water from lakes or marshes. For the average daily demand of 1,136.5 litres/day (250 gpd) for a four month period (June - September; 122 days) a volume of 0.139 dam^3 (4,900 ft^3) is required. This requires a reservoir or dugout approximately 8 m (26 ft) long by 5.5 m (18 ft) wide, with an average depth of 3.5 m (11.5 ft), allowing 0.3 m (1 ft) for evaporation loss over the surface of the reservoir.

Dimple springs or springs that are not directly connected by a surface channel to a stream may not require supporting storage if the spring can supply at least 2,273 litres/day (500 gpd) during the months of June through September. The applicant shall provide adequate pump tests and measurements during this period to determine the safe flow yield. Multiple domestic water Licences on a spring will only be allowed if the applicant can provide assurances that adequate water is available by determining the safe flow yield near the end of the low flow period (i.e. pump test in August or September) and by satisfying any written concerns and objections of any existing water licencees. Springs with a surface channel connecting to a stream should be prepared to develop storage.

A water licence for domestic use shall not be issued to a residence within a community water supply area unless written leave to do so is obtained from the community water supply agency.

Measuring or regulating (i.e. metering) is not usually necessary with domestic water usage. An adequate screen shall be installed on the intake to prevent fish or debris from entering the works.

6.2 Waterworks

Waterworks purpose in the Water Act is the carriage or supply of water by a municipality, improvement district, regional district or private utility for the purpose of providing water to a residential area.

Applicants for a waterworks licence shall be required to assess the supply for a ten year projected demand and provide evidence that the projected demand is not excessive in comparison with adjoining community demands, that water conservation is being promoted (i.e. residential meters, pricing practices, education) and that adequate system balancing storage (i.e. volume difference between maximum hour and maximum daily demands) will be constructed or is available for peek hour demands. Water Utilities will also have to provide evidence that the appropriate requirements for a Certificate of Public Convenience and Necessity (CPCN) have been met and a CPCN will be obtained. Licenced allocations will be limited to a 10 year projected demand except where the applicant can provide satisfactory evidence that a longer projection period is required (i.e. because the cost of construction of works must be amortised over a longer period).

The licencee shall be required to meter and record the water diverted from the source stream. The licencee shall be required to treat the water supply in accordance with the Ministry of Health requirements. All waterworks Licences will require storage to support demand.

Storage and diversion structures must be capable of maintaining or improving existing low flows during the low flow period and maintaining fish passage where required.

6.3 Irrigation

The soil type, crop rooting depth and climatic characteristics determine the water requirements for irrigation. The irrigation demands for different crops and their rooting depths along with the water availability coefficient are classified into two categories, shallow (0.5 metre) and deep (1.0 metre) effective rooting depths. The available water storage capacity (AWSC) was estimated for shallow and deep root zone depth for the soil types present within the plan area. Where composites of two or three soil associations are intermixed or occupy such small areas that they cannot be separated at the scale of mapping, only the predominant soil association was considered. Areas

identified as predominately rock outcrop, coastal beach or tidal flats were assumed to have no potential irrigation demand.

Figure 22 indicates the annual irrigation water requirements for various soil groups within the plan area.

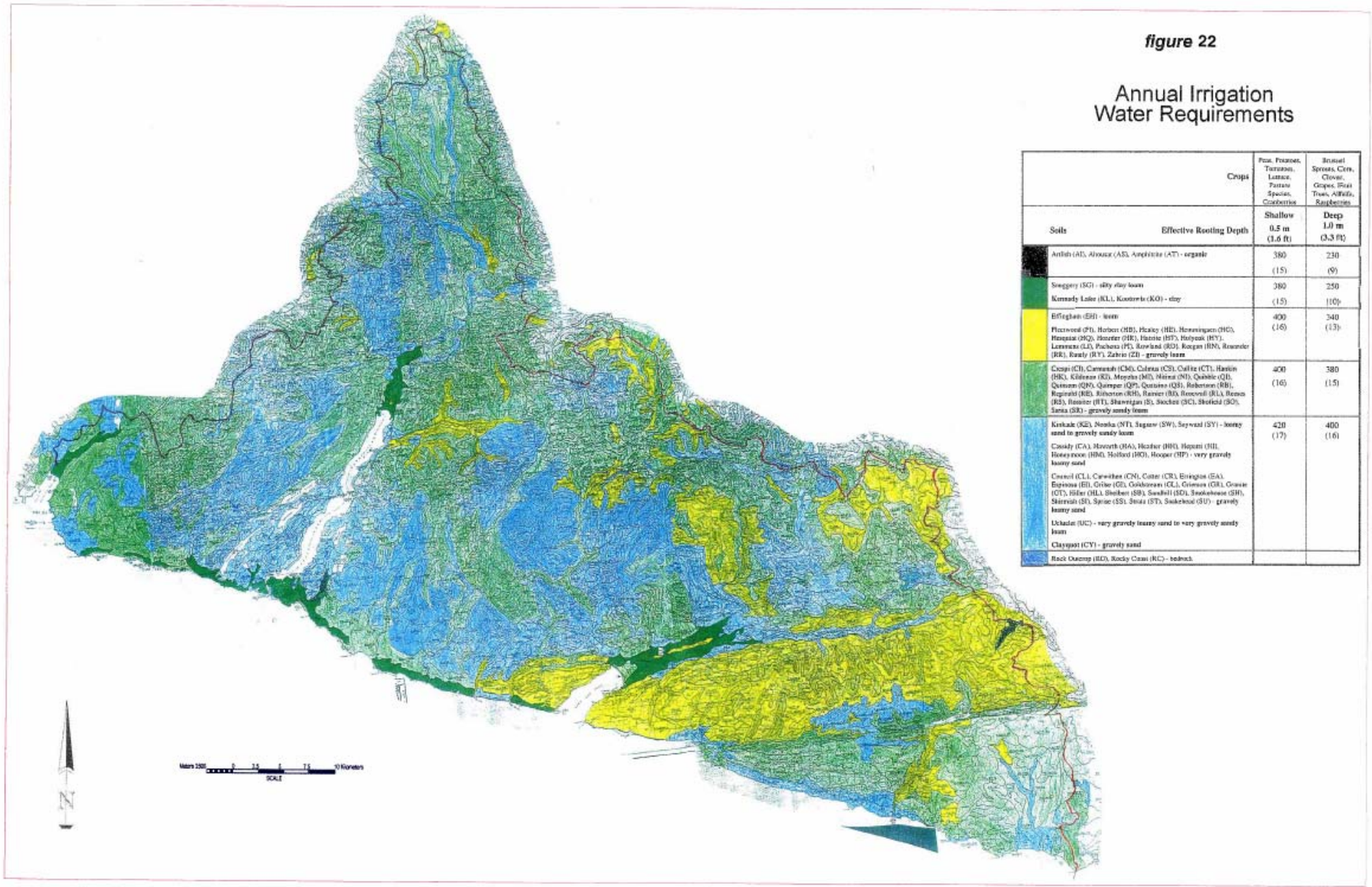


figure 22

Annual Irrigation Water Requirements

Soils / Effective Rooting Depth	Crops: Peas, Potatoes, Tomatoes, Lettuce, Pasture Species, Cranberries — Shallow 0.5 m (1.6 ft)	Crops: Brussel Sprouts, Corn, Clover, Grapes, Fruit Trees, Alfalfa, Raspberries — Deep 1.0 m (3.3 ft)
Anfish (AI), Alouette (AS), Amphicote (AT) - organic	380 (15)	230 (9)
Snoggery (SG) - silty clay loam Kennedy Lake (KL), Kootowis (KO) - clay	380 (15)	250 (10)
Effingham (EH) - loam Fleetwood (FI), Horbon (HB), Healey (HE), Hemmingsen (HG), Hesquiat (HQ), Hesnriet (HR), Hustvie (HT), Holyoak (HY), Lemmens (LE), Pachena (PI), Rowland (RO), Keegan (RN), Rosander (RR), Rundy (RY), Zabria (ZI) - gravelly loam	400 (16)	340 (13)
Cleppi (CI), Cammanah (CM), Colonia (CS), Cullite (CT), Hanlon (HK), Kildonan (KI), Meyers (MI), Moirat (NI), Quisitis (QI), Quinsam (QN), Quimper (QP), Quinsino (QS), Robertson (RB), Reginald (RE), Robertson (RH), Rennie (RI), Rosewall (RL), Rennes (RS), Rossiter (RT), Shawnigan (S), Stockes (SC), Sholield (SO), Sarita (SR) - gravelly sandy loam	400 (16)	380 (15)
Kinkade (KE), Nootka (NT), Saguaw (SW), Seywaul (SY) - loamy sand to gravelly sandy loam Cassidy (CA), Haworth (HA), Heather (HH), Hupomi (HI), Honeymoon (HM), Holford (HO), Hooper (HP) - very gravelly loamy sand Council (CL), Carwithen (CN), Cotter (CR), Errington (EA), Espinosa (EI), Grube (GI), Goldstream (GL), Grierson (GR), Granite (GT), Hiller (HL), Sheltzen (SB), Sandhill (SD), Snokomass (SH), Skinnish (SI), Spruce (SS), Strata (ST), Saukeleosi (SU) - gravelly loamy sand Ucluelet (UC) - very gravelly loamy sand to very gravelly sandy loam Clayquot (CY) - gravelly sand	420 (17)	400 (16)
Rock Outcrop (RO), Rocky Coast (RC) - bedrock		

Annual Irrigation Water Requirements in millimetres (inches)		
Crops	Peas, Potatoes, Tomatoes, Lettuce, Pasture Species, Cranberries	Brussels Sprouts, Corn, Clover, Grapes, Fruit Trees, Alfalfa, Raspberries
Effective Rooting Depth	**Shallow 0.5 m (1.6 ft)**	**Deep 1.0 m (3.3 ft)**
Artlish (AI), Ahousat (AS), Amphitrite (AT)	380	230
Kennedy Lake (KL), Kootowis (KO), Snuggery (SG)	380	250
Effingham (EH), Fleetwood (FI), Herbert (HB), Healey (HE), Hemmingsen (HG), Hesquiat (HQ), Hoarder (HR), Hatzite (HT), Holyoak (HY), Lemmens (LI), Pachena (PI), Rowland (RD), Reegan (RN), Rosander (RR), Rutely (RY), Zebrio (ZI)	400 (16)	340 (13)
Crespi (CI), Carmanah (CM), Calmus (CS), Cullite (CT), Hankin (HK), Kildonan (KI), Moyeha (MI), Nitinat (NI), Quibble (QI), Quinsam (QN), Quimper (QP), Quatsino (QS), Robertson (RB), Reginald (RE), Ritherton (RH), Rainier (RI), Rosewall (RL), Reeses (RS), Rossiter (RT), Shawnigan (S), Stockett (SC), Shofield (SO), Sarita (SR)	400 (16)	380 (15)
Cassidy (CA), Council (CL), Carwithen (CN), Cotter (CR), Clayquot (CY), Errington (EA), Espinosa (EI), Grilse (GI), Goldstream (GL), Grierson (GR), Granite (GT), Hawarth (HA), Heather (HH), Hepatzi (HI), Hiller (HL), Honeymoon (HM), Holford (HO), Hooper (HP), Kinkade (KE), Nootka (NT), Shelbert (SB), Sandhill (SD), Smokehouse (SH), Shirmish (SI), Sprise (SS), Strata (ST), Snakehead (SU), Sugsaw (SW), Sayward (SY), Ucluelet (UC)	420 (17)	400 (16)

If the applicant for a water licence can provide more specific soil assessment and irrigation requirement information for a given area, that soil assessment and irrigation requirement may be used to assess irrigation demands.

It should be noted that these annual irrigation water requirements are for sprinkler irrigation systems only.

Irrigation gun or flood irrigation systems may require greater irrigation quantities and should be discouraged. In the case where irrigation gun or flood irrigation practices are to be used suitable meters shall be installed and water withdrawals limited to the equivalent annual irrigation requirements for sprinkler systems. As the equivalent annual irrigation water requirements for sprinkler systems may not be adequate to sustain crops using these less efficient methods of irrigation, the applicant may be required to reduce crops, limit the acreage irrigated or convert to a more efficient irrigation system. Trickle irrigation can reduce water requirements by 35% and should be encouraged where practical.

All irrigation water demands must be supported by off-stream storage development. Storage required to support irrigation demands is the total required amount as per crop and soils, plus an additional allowance for evaporation and other losses from the storage reservoir. Diversion into storage will be authorized for the period that the mean monthly flows are above 60% MAD.

The maximum irrigation system flow rate shall not exceed 19.1 litres/second (4.2 imperial gallons/second) per 0.4 hectares (1 acre), and irrigators are encouraged to employ good agricultural practices (field size, system selection and farm management) to conserve water. The authorized period of use for irrigation shall be from April 1 to September 30.

As noted above, all intake works in fish bearing waters shall be screened to prevent fish and debris from entering the intake.

6.4 Industrial and Commercial

The industrial water Licences and water licence applications within the plan area are demands associated with brake cooling, cooling, enterprise, fire protection, ponds, processing, residential lawn gardening and stock watering.

Commercial fish hatcheries and/or rearing purposes shall require an industrial water licence. Use of water by government and non-profit organizations will be licenced as conservation purpose. Information on fish species and size, water temperature

requirements and operating methods will be required in support of an application for water licence. Fish Farm and Waste Management Permits will also be required. Off-stream storage is required for fish ponds associated with commercial fish farming.

Golf course watering is essentially an irrigation water demand except that the watering is not limited to the irrigation period of April to September. The quantity of water required should be determined as previously stated in the irrigation section. Except for the period of water withdrawal, which shall be the whole year, the same requirements and conditions as irrigation demands shall apply. Off-stream storage is required to support these demands. Diversion into storage will be authorized for the period that the mean monthly flows are above 60% MAD.

Cattle or livestock watering requiring more than 450 litres/day (100 gpd) are to be considered an Industrial (Agricultural/Stockwatering) demand. Cattle or livestock requiring 450 litres/day (100 gpd) or less will be considered a Domestic (Livestock) demand. Estimated amounts of water required for livestock watering demands are listed in the following table.

Recommended Livestock Water Requirements		
	Water Requirements	
Livestock	litres/day	gallons/day
Cattle (beef) per animal	45	10
Cattle (dairy) per animal	132	29
Chickens per 100 animals	27	6
Turkeys per 100 animals	55	12

Industrial demands related to commercial and resort development should be handled similar to multiple domestic demands with the same requirements.

6.5 Storage

Storage purpose is the impoundment of water, either on-stream or off-stream in a dugout or behind a dam. In the event that a large storage development to support a major water demand (i.e. hydro power, pulp & paper, community works) is proposed a more specific supply versus demand and environmental impact assessment will be required.

The storage quantity required to support the smaller water demands of domestic, industrial and irrigation uses shall be the low flow period volume of the water demand plus an additional allowance of 0.3 metres (1 foot) depth over the surface area of the storage reservoir for evaporation and other losses. Off-stream storage in a dugout will

be required for these demands in most cases. Storage in swamps or natural depressions may be considered where fish and wildlife are not adversely impacted or where the natural habitat is enhanced.

The water licence applicant will be required to complete an adequate report for “Dam and Reservoir Information Required in Support of a Water Licence Application for Storage Purpose (Schedule 2)”. If the required report is not provided, the application will be refused.

Diversion of water into off-stream storage will be during the high flow period. Provision to maintain flows during the low flow period shall be required for all in-stream storage reservoirs.

The applicant must obtain written agreement, a right of way or an easement for works or flooding of other lands.

Fish passage is required, for both juvenile and adult fish, at all dams in fish bearing streams. Design of storage dams must consider fish ladders and provide adequate flow release to maintain fish passage where required. Loss of spawning areas and modification of fish habitat due to storage development may require mitigation work in the affected stream.

Design plans must be submitted and accepted in writing before construction commences on any proposed dam over 3 metres (10 feet) in height or on storage 12 dam^3 (10 acre feet) or more in volume.

All water licencees that develop storage greater than 100 dam^3 (80 acre feet) shall be required to record and report the water level of the reservoir and flows from the reservoir as directed by the “Engineer” as defined in the Water Act of BC.

6.6 Land Improvement

Currently there are no water Licences within the plan area for land improvement purposes; however, with potential future development requiring water Licences for land improvement purposes this section has been included in San Juan Water Allocation Plan. Land improvement purpose is the impoundment of water on a stream or the diversion of water from a stream to facilitate the development of a park, to construct and maintain an aesthetic pond, to protect property from erosion or to drain and reclaim land. No significant water quantity is removed from the stream. Land improvement water demands are non-consumptive uses of the water resources.

Water used to facilitate the development of park is usually maintained in a dammed lake for recreation (i.e. boating, fishing, swimming, golf course water traps) and aesthetics.

The dammed lake is usually filled during the high flow period and the water levels maintained or gradually lowered during the low flow period. Golf courses also acquire water Licences to construct and maintain dugouts or to control the volume of water in small ponds for water traps and aesthetics. Property owners may acquire a water licence to construct and maintain dugouts or to control the volume of small ponds for aesthetics and to increase property values. These water demands are essentially storage developments that do not support an extractive use. Therefore, all the requirements noted for storage development shall be required for land improvement development where applicable. The water quantity required to facilitate the development of a park or to create an aesthetic pond shall be the volume of the impoundment.

Constructing ditches to drain swamps or marshes, confining or straightening the meandering of stream channels and relocating a stream channel adjacent to a property line is sometimes proposed to accommodate subdivision or building development. Streams should not be relocated to accommodate development. Post-development flow conditions should be maintained as near as possible to pre-development flow conditions. The development of land improvement detention dugouts or the control of water in natural ponds, swamps and marshes to reduce flood flow and increase low flow releases will be encouraged. Proposed construction of works on streams that drain swamps or marshes or increase high flow conditions and reduce low flow conditions will not be authorized.

6.7 Conservation

Conservation purpose is the use and storage of water or the construction of works in and about a stream for the enhancement of fish and wildlife for non-profit purposes.

Salmon enhancement proposals that would significantly increase fish stocks in the stream channels will require the development of supporting storage to maintain required low flows.

6.8 Power

The B.C. Hydro power station located on Jordan River has a water licence for a maximum of 2,500 cfs diversion into a run-of-the-river power plant for short periods. An average diversion flow of 366.6 cfs is noted in the water licence.

The water licence applicant will be required to complete an adequate report for “Information Required in Support of a Water Licence Application for Power Purpose (Schedule 3)”. If the required report is not provided, the application will be refused.

In the event that a large power development is proposed a more specific supply versus demand and environmental impact assessment will be required. For small power the following assessments shall be used to determine the required water demand.

The water demand Q will be estimated (in cubic meters per second) from the power requirement p (in kw) and head h (in metres) as follows (overall efficiency - 30%, e=0.3):

$$Q = \frac{0.34p}{h}$$

A hydro power supply with a 30.5 metre (100 ft.) head and sufficient storage to store variations between the five month higher winter flows requires approximately the following flow.

Hydro Power Requirements
With Automatic Load Management & 30.5 metre (100 ft) Head

Description	Power Kw	Flow cfs
3-4 Bedroom with elec. Stove	14	5.5
2 Bedroom	7	2.7
Cabin	4	1.6
Home Supply with Batteries and Alternative Supply	1	0.34
Few Appliances with Batteries	0.1	0.04

The period of hydro power use will be from October through April unless the reduction in flow between the diversion and return to the stream will not impact on other water demands or instream fish flows. In most instances adequate storage must be developed to extend the period and maintain the natural flow .

Water returned to the stream after generation of hydro power may be licensed for subsequent compatible water demands. Hydro power use that diverts water away from subsequent use should be discouraged.

Fish passage is required, for both juvenile and adult fish, at all power diversion works in fish bearing streams. Fish and debris screens may be required at both intake and outlet works to ensure that fish are not loss due to operation of the power plant. Loss of spawning areas and modification of fish habitat due to power development may require mitigation work in the affected stream.

6.9 Allocation Plan Revision

The San Juan Water Allocation Plan should be reviewed and updated on or before January 1, 2002.

APPENDIX A: Climatic Normals

Bamfield East, Port Renfrew BCFP and River Jordan
Canadian Climatic Normals

Environment Canada
Atmospheric Environment Service

BAMFIELD EAST
48° 50'N 125° 7'W 4 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE
Daily Maximum Temperature	6.9	8.9	9.5	11.2	13.6	15.7	17.6	17.9	17.4	14.0	10.1	7.7	12.5
Daily Minimum Temperature	1.0	2.2	2.0	3.7	6.2	8.8	10.4	10.7	9.0	6.5	3.6	2.2	5.5
Daily Temperature	**4.0**	**5.6**	**5.8**	**7.5**	**9.9**	**12.3**	**14.0**	**14.3**	**13.2**	**10.3**	**6.8**	**5.0**	**9.1**
Standard Deviation, Daily Temperature	1.4	1.2	0.9	0.9	0.8	1.0	0.6	0.8	1.1	0.8	1.0	1.4	0.4
Extreme Maximum Temperature	14.4	19.4	21.7	23.4	30.6	32.8	31.7	30.0	30.6	23.3	20.0	16.1	32.8
Years of Record	21	21	21	21	21	21	21	22	22	22	22	22	
Extreme Minimum Temperature	**-9.4**	-6.1	-3.9	-2.2	-0.6	2.2	4.4	4.0	0.0	-2.8	-4.4	-10.6	-10.6
Years of Record	21	21	21	21	21	21	21	22	22	22	22	22	
Rainfall	360.0	329.0	326.4	191.5	129.1	74.7	62.1	98.3	133.2	334.4	386.3	428.7	2853.7
Snowfall	12.2	1.5	2.3	T	0.0	0.0	0.0	0.0	0.0	0.0	0.8	8.4	25.2
Total Precipitation	**372.2**	**330.5**	**328.7**	**191.5**	**129.1**	**74.7**	**62.1**	**98.3**	**133.2**	**334.4**	**387.1**	**437.0**	**2878.8**
Standard Deviation, Total Precipitation	180.4	155.3	127.7	80.0	67.9	36.0	54.6	72.2	69.6	193.9	133.4	130.0	386.6
Greatest Rainfall in 24 hours	141.7	98.6	101.6	72.6	71.6	43.9	138.4	92.2	81.5	185.9	117.6	123.2	185.9
Years of Record	21	21	21	21	21	21	21	21	21	22	22	22	
Greatest Snowfall in 24 hours	16.5	7.6	12.7	T	0.0	0.0	0.0	0.0	0.0	0.0	6.4	22.9	22.9
Years of Record	21	21	21	21	21	21	21	21	22	22	22	22	
Greatest Precipitation in 24 hours	141.7	98.6	101.6	72.6	71.6	43.9	138.4	92.2	81.5	185.9	117.6	123.2	185.9
Years of Record	21	21	21	21	21	21	21	21	21	22	22	22	
Days with Rain	20	19	19	17	14	10	8	10	11	18	21	22	189
Days with Snow	3	*	1	0	0	0	0	0	0	0	*	2	6
Days with Precipitation	21	19	20	17	14	10	8	10	11	18	22	23	193

PORT RENFREW BCFP
48° 35'N 124° 24'W 6 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE
Daily Maximum Temperature	6.3	8.2	9.4	12.0	14.7	16.6	18.5	18.4	18.0	14.2	9.7	7.3	12.8
Daily Minimum Temperature	0.1	1.0	1.1	3.0	5.6	8.7	10.4	10.4	8.8	5.8	2.8	1.3	4.9
Daily Temperature	**3.1**	**4.6**	**5.3**	**7.5**	**10.1**	**12.6**	**14.3**	**14.4**	**13.3**	**9.9**	**6.1**	**4.2**	**8.8**
Standard Deviation, Daily Temperature	1.3	1.3	1.3	1.1	0.7	1.0	0.7	1.1	1.1	0.9	1.1	1.7	0.4
Extreme Maximum Temperature	13.9	15.0	17.8	22.9	27.2	28.3	31.7	31.7	28.9	24.0	17.2	14.0	31.7
Years of Record	10	10	11	11	11	11	11	11	11	11	11	10	
Extreme Minimum Temperature	-9.4	-7.2	-6.7	-2.2	0.0	1.7	5.6	2.2	-0.6	-2.8	-6.1	-11.1	-11.1
Years of Record	10	10	11	11	11	11	11	10	11	11	11	10	
Rainfall	579.7	441.0	391.8	215.8	143.5	122.6	80.1	87.8	201.1	420.5	522.2	677.3	3883.2
Snowfall	15.4	10.9	18.7	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	15.3	61.7
Total Precipitation	**590.7**	**451.1**	**410.6**	**212.6**	**143.5**	**122.6**	**80.1**	**87.8**	**201.1**	**420.5**	**521.8**	**687.0**	**3943.2**
Standard Deviation, Total Precipitation	234.9	178.2	167.0	104.3	88.4	51.1	60.9	89.4	107.0	291.7	207.8	236.2	638.0
Greatest Rainfall in 24 hours	166.4	192.8	121.9	94.7	91.7	91.4	106.7	54.6	88.9	216.4	142.2	234.6	234.6
Years of Record	10	11	11	11	11	11	11	11	11	11	11	10	
Greatest Snowfall in 24 hours	19.0	15.2	14.6	7.9	0.0	0.0	0.0	0.0	0.0	0.0	15.2	25.4	25.4
Years of Record	10	11	11	11	11	11	11	11	11	11	11	10	
Greatest Precipitation in 24 hours	166.4	192.8	121.9	94.7	91.7	91.4	106.7	54.6	88.9	216.4	142.2	234.6	234.6
Years of Record	10	11	11	11	11	11	11	11	11	11	11	10	
Days with Rain	20	19	20	16	13	13	8	10	12	18	21	23	195
Days with Snow	5	2	2	0	0	0	0	0	0	0	0	2	11
Days with Precipitation	24	20	21	16	13	13	8	10	12	18	21	24	202

RIVER JORDAN
48° 25'N 124° 3'W 3 m

	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE
Daily Maximum Temperature	6.9	8.5	9.3	11.9	14.9	17.2	19.3	19.3	17.4	13.6	10.0	7.8	13.0
Daily Minimum Temperature	0.9	1.8	1.9	3.7	6.1	8.5	9.8	10.1	8.6	6.2	3.4	1.9	5.2
Daily Temperature	**3.9**	**5.2**	**5.6**	**7.8**	**10.6**	**12.9**	**14.5**	**14.8**	**13.0**	**10.1**	**6.7**	**5.0**	**9.2**
Standard Deviation, Daily Temperature	1.8	1.5	1.1	0.9	0.9	0.9	0.8	0.6	1.0	0.8	1.3	1.3	0.7
Extreme Maximum Temperature	13.9	18.9	17.8	21.1	26.7	27.8	31.1	28.9	27.2	21.1	17.8	16.1	31.1
Years of Record	26	27	27	28	28	27	28	26	24	25	26	26	
Extreme Minimum Temperature	-15.6	-10.0	-9.4	-2.2	-0.6	3.9	4.4	3.9	0.6	-1.7	-11.1	-12.8	-15.6
Years of Record	25	26	26	28	28	27	28	26	25	26	27	27	
Rainfall	316.8	247.2	187.3	139.5	80.4	53.1	38.0	48.6	113.9	242.0	286.1	324.4	2057.3
Snowfall	11.1	2.2	6.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	6.5	27.1
Total Precipitation	**327.9**	**257.7**	**194.1**	**139.8**	**80.4**	**53.1**	**38.0**	**48.6**	**113.9**	**242.0**	**286.3**	**330.9**	**2092.7**
Standard Deviation, Total Precipitation	125.6	117.5	68.9	76.5	30.7	33.6	35.8	32.1	69.2	109.2	111.9	84.6	344.3
Greatest Rainfall in 24 hours	127.0	189.0	104.6	108.2	46.0	57.2	57.4	53.8	101.6	136.1	125.0	142.2	189.0
Years of Record	63	63	62	62	64	64	64	64	64	63	63	62	
Greatest Snowfall in 24 hours	29.2	30.5	24.9	6.4	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.8	30.5
Years of Record	65	65	63	65	65	64	65	65	65	63	64	63	
Greatest Precipitation in 24 hours	127.0	189.0	104.6	108.2	46.0	57.2	57.4	53.8	101.6	136.1	125.0	142.2	189.0
Years of Record	63	63	62	62	64	64	64	64	64	63	63	62	
Days with Rain	22	18	19	16	12	10	6	9	11	17	21	23	184
Days with Snow	2	1	1	*	0	0	0	0	0	0	*	1	5
Days with Precipitation	23	19	19	16	12	10	6	9	11	17	21	23	188

APPENDIX B: Water Survey of Canada Hydrometric Stations

Mean Monthly and Mean Annual Discharges

Station Name: **LEECH RIVER AT THE MOUTH**

Station Number: 08HA017
Natural or Regulated N

Drainage Area (sq.km.): 104
Discharge in: m³/sec

	Degrees	Minutes	Seconds
Latitude	48	29	50
Longitude	123	43	40

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1963							0.477	0.26	0.135	7.37	16	13.3	
1964	15.1	9	9.69	6.32	2.88	0.867	0.43	0.275	0.75	2.92	6.22	6.34	5.06
1965	9.4	16.2	4.95	5.63	3.91	0.608	0.207	0.123	0.107	5.36	11.2	13.1	5.83
1966	14.4	7.31											
MEAN	12.967	10.837	7.320	5.975	3.395	0.738	0.371	0.219	0.331	5.217	11.140	10.913	5.445
% MAD	238%	199%	134%	110%	62.4%	13.5%	6.8%	4.0%	6.1%	95.8%	205%	257%	100%

7-Day Average Low Flow (m³/sec)			
Date of Occurrence	Period: Apr 1 to Sep 30	Date of Occurrence	Period: Jan 1 to Dec 31
9-Sep-63	0.101	30-Sep-63	0.09
11-Sep-64	0.104	11-Sep-64	0.104
10-Sep-65	0.07	10-Sep-65	0.07
MEAN	0.092		0.088
% MAD	2%		2%

Station Name: **SAN JUAN RIVER NEAR PORT RENFREW**
Station Number: 08HA010
Natural or Regulated: N

Drainage Area (sq.km.): 580
Discharge in: m³/sec

	Degrees	Minutes	Seconds
Latitude	48	34	38
Longitude	124	17	49

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1959										35.1	85.2	77.4	
1960	63.6	87.5	46.1	75.1	39.3	18.5	3.81	3.97	7.58	56.7	73	55.8	44
1961	184	174	83.5	45.5	29.4	7.16	2.75	3.69	6.67	57.9	69.3	118	64.6
1962	80.9	32.2	23.2	52.1	35.3	12.6	3.28	7.7	5.86			126	
1963	52.3	107	37.6	41.1	23.3	3.29	6.04	2.14	2.14	84.7	142	110	50.5
1964	131	64.8	66	46.6	29.7	20.5	13.9	6.36	19.5	40.4	57.8	52.1	45.8
1965	76.3	120	31.3	43.7	32.3	5.74	1.85	1.81	1.47	77	95.1	109	49.2
1966	134	57.1	74	47.7	24.6	13.4	7.72	2.54	4.52	56.1	82.3	190	58.1
1967	144	97.2	73.9	27.5	25.4	8.79	2.06	1.33	3.38	139	54.3	130	59
1968	166	114	74.7	37.5	15.7	8.75	5.64	5.41	24.1	83.1	88.3	106	60.7
1969	42.7	40.5	76.8	86.1	45.1	14.4	6.59	5.21	31.2	31.8	46.4	83.5	42.5
1970	77.6	51.2	44.4	72.1	14.7	4.44	3.43	2.93	11.2	28.7	58.1	94.5	38.5
1971	102	78.8	78	50.3	47.2	25.7	9.2	3.99	9.87	49.6	94.1	49.4	49.6
1972	91.8	127	146	59	26.4	7.48	17.7	4.5	12.4	5.22	50.1	153	58.3
1973	107	37.2	37.5	16.2	22.5	17	4.73	1.91	2.01	35.4	92.5	147	43.5
1974	150	99.6	123	60.1	53	31.8	18.1	3.44	3.23	2.08	88	111	61.7
1975	64.6	43.1	49.6	28.1	37.6	14.3	3.82	12.8	6.7	112	158	133	55.4
1976	93.5	82.5	63.3	51.9	40.6	21.1	9.43	6.65	9.55	31.5	41.5	60.2	42.6

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1977				36.9	19.3	13	4.61	3.19	10.4	40.2	131	104	
1978	46.7	45.7	40.6	20.2	21.7	8.03	3.43	7.69	30.3	14.2	36	57.6	27.6
1979	17.3	117	69.8	28.6	17.3	5.35	6.5	2.33	19	44.7	27.5	183	44.6
1980	65.1	103	56.1	53	12.1	7.9	9.18	3.16	13.8	11.8	150	159	53.3
1981	41.5	112	25.7	75.7	23.6	28.7	5.85	2.47	14.2	83.2	110	109	52.1
1982	99.9				28.4	10.6	3.37	2.47	3	55.7	57.9	92.9	
1983	101	150	72.3	25.1	11	11.6	31.6	4.87	8.93	15.3	171	33	52.1
1984	111	82.3	66.9	48.9	50.2	14.8	6.54	2.37	8.52	61.7			
1985					25.4	8.41	2.24	1.36	2	57.8	44.6	38.3	
1986	116	73.8	77.2	25.9	64.8	17.3	5.63	1.72	2.28	8.75	93.1	88.6	47.8
1987	99.3	63.7	71	36.7	22.9	20.2	4.67	1.86	1.4	1.07	40.6	79.9	36.9
1988	60	56.7	60.3	65.6	37.9	19.5	4.81	2.17	4.77	19.1	112	63.3	42
1989	103	34.4	57.7	62	13.7	4.66	6.32	2.19	1.33	25.9	88.6	68.7	39.1
1990	59.8	116	82.3	35.8	13	23.7	4.44	2.41	2.51	67.6	200	97.2	58.1
1991	91.9	198	12.6	38.8	15.9	4.78	3.01	37.5	13.1	3.37	92.2	87.4	48.8
1992	153	74.6	17.5	45.1	10.1	3.16	1.9	2.54	8.29	37.4	72.1	50.1	39.6
1993	53.4	21.2	85.9	60.4	45.6	20.5	4.05	3.39	1.48	9.66	44.2	71.7	35.3
1994							5.03	2.35					
MEAN	93.1	85.9	62.1	46.9	28.7	13.4	6.66	4.64	9.02	43.6	86.3	96.8	48.3
% MAD	193%	178%	128%	97.0%	59.3%	27.8%	13.8%	9.6%	18.7%	90.3%	179%	95%	100%

7-Day Average Low Flow (m^3/sec)			
Date of Occurrence	Period: Apr 1 to Sep 30	Date of Occurrence	Period: Jan 1 to Dec 31
12-Aug-60	1.62	12-Aug-60	1.62
26-Aug-61	1.27	26-Aug-61	1.27
30-Jul-62	1.75	30-Jul-62	1.75

7-Day Average Low Flow (m³/sec)			
Date of Occurrence	Period: Apr 1 to Sep 30	Date of Occurrence	Period: Jan 1 to Dec 31
8-Sep-63	1.82	8-Sep-63	1.82
11-Sep-64	3.5	11-Sep-64	3.5
10-Sep-65	1.27	28-Sep-65	1.26
23-Aug-66	1.39	23-Aug-66	1.39
28-Aug-67	1.25	28-Aug-67	1.25
10-Aug-68	2.15	10-Aug-68	2.15
9-Aug-69	4.16	9-Aug-69	4.16
30-Aug-70	2.51	30-Aug-70	2.51
16-Aug-71	2.61	16-Aug-71	2.61
15-Sep-72	3.26	15-Sep-72	3.26
14-Sep-73	1.52	14-Sep-73	1.52
27-Sep-74	1.7	23-Oct-74	1.42
3-Aug-75	1.67	3-Aug-75	1.67
10-Aug-76	4.34	10-Aug-76	4.34
19-Aug-77	1.76	19-Aug-77	1.76
7-Aug-78	2.02	7-Aug-78	2.02
29-Aug-79	1.93	29-Aug-79	1.93
23-Aug-80	2.55	23-Aug-80	2.55
15-Sep-81	2.12	15-Sep-81	2.12
1-Sep-82	1.79	1-Sep-82	1.79
25-Aug-83	3.08	16-Oct-83	3.08
23-Aug-84	2.01	23-Aug-84	2.01
26-Aug-85	1.04	26-Aug-85	1.04
14-Sep-86	1.32	14-Sep-86	1.32
27-Sep-87	1.07	25-Oct-87	0.925
15-Sep-88	1.71	15-Sep-88	1.71

7-Day Average Low Flow (m^3/sec)			
Date of Occurrence	Period: Apr 1 to Sep 30	Date of Occurrence	Period: Jan 1 to Dec 31
27-Sep-89	1.09	2-Oct-89	1.07
27-Sep-90	1.52	29-Sep-90	1.5
3-Aug-91	2.180	3-Aug-91	2.180
1-Aug-92	1.710	1-Aug-92	1.710
27-Sep-93	1.290	29-Sep-93	1.286
MEAN	2.00		1.99
% MAD	4%		4%

Station Name: **SARITA RIVER NEAR BAMFIELD**
Station Number: 08HB014
Natural or Regulated: N

Drainage Area (sq.km.): 162
Discharge in: m³/sec

	Degrees	Minutes	Seconds
Latitude	48	53	34
Longitude	124	57	54

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1948			21.3	29.2	15.4	4.25							
1949				18.1	11.2	3.88	4.37	4.84				31.3	
1950	13.7	46.6	45.3	35.9	12.5	5.48	1.83	1.93	3.12	39.2	30.4	57.9	24.4
1951	39.3	36.8	12.8	9.91	7.69	1.82	0.761	0.483	5.88	20.3	40.3	26	16.7
1952	21.4	47.4	15.6	26.3	14.5	16.7	1.61	5.57	2.77	3.08	25	45.9	18.7
1953	68.5	39.2	33.5	15.2	12.5	3.47	3.59	4.07	11.5	42.2	56.9	53.8	28.7
1954	26.1	70.3	12.3	23.1	4.92	7.15	6.89	2.05	5.26	30.6	61	40.6	23.8
1955	17.1	14.6	8.96	27.9	37.1	20.8	4.31	5.04	3.84	23.8	27.9	34.4	18.8
1956	42.5	14.5	29.3	19.4	11.1	14	3.4	1.02	6.17	37.2	21.6	62.7	22
1957	10.6	18.2	23.2	17.3	5.56	3.24	4.92	5.73	5.73	10.6	13.2	45.3	13.6
1958	64.8	46.2	13.8	15.1	2.11	1.01	0.541	0.687	5.42	27.3	16.6	60.2	21
1959	29.3	15.6	26.4	25.8	6.89	7.47	2.61	1.38	8.39	17.9	16.8	44.2	16.9
1960	46.2	30	18.3	32.6	15.4	9.71	1.02	1.76	6.39	26.7	45.5	32.7	22.1
1961	106	55.8	34.6	18.6	12	4.59	1.72	0.769	5.61	20.9	22.5	33.9	26.3
1962	19.3	17.8	10.3	24.7	10.2	8.28	2.89	7.6	3.63	25.1	71.8	58.3	21.6
1963	5.89	52.8	28.7	16.7	9.42	1.08	3.87	3.54	1.46	46.4	50.5	34.4	21
1964	40.2	17.9	26.4	12.9	8.99	6.48	11.8	5.23	11.3	14.3	19	16.6	16
1965	31.9	27.9	8.76	17.8	10.8	2.01	0.737	1.27	0.882	32.7	35.7	44	17.8
1966	52.7	20	31.3	9.67	5.26	5.89	3.46	2.15	5.55	24.2	39.7	60.9	21.8

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1967	35.8	24.4	28.9	9.8	6.06	2.29	1.05	0.588	4.15	69.2	23.4	47.8	21.2
1968	64.8	34.3	33.4	14.3	6.3	4.85	3.93	6.08	10.6	38.3	38	36.9	24.3
1969	12.9	19.5	20	26.7	15	4.09	1.39	3.34	27.5	17.4	30.4	41.6	18.3
1970	23	15	16.5	22.2	4.16	1.01	0.907	1.29	5.41	17.8	32.9	38.5	14.9
1971	31.1	29.3	30.4	17.2	13.2	9.87	3.41	2.68	5.48	29.8	57.5	11.3	20
1972	33.2	41.7	41.4	27.2	6.38	1.45	11.1	1.09	4.65	2.95	29.1	57.8	21.5
1973	56.7	28.4	22	7.29	11.1	14.6							
1976				16.6	13.6	7.26	6.25	4	4.98	12.2	15.7	29.2	
1977	13.3	31.5	26.6	13.5	10.6	6.33	1.81	2.59	5.78	25.5	42.2	29.9	17.4
1978	20.3	18.2	22	12.2	8.18	4.43	1.13	11.3	21.4	9.01	14	20.6	13.5
1979	6.59	49.9	21.9	13.3	11.5	6.64	10.2	1.94	12.9	19.2	11.9	58.7	18.5
1980	18	33.1	17.3	20.5	3.64	2.6	6.33	1.18	8.71	6.7	48.8	51.4	18.1
1981	12.5	31.1	8.21	22.6	5.37	7.72	1.95	0.844	7.63	35	44.3	45.2	18.4
1982	40.8	48.7	17.4	20.5	7.71	2.15	1.79	0.984	2.24	48.2	28.2	48.4	22.1
1983	62.3	65.9	37.4	9.87	5.48	7.01	12.4	2.1	3.3	12.1	70	18.4	25.2
1984	41.6	35.6	21.4	15.1	10.8	2.86	2.67	2.09	3.41	40.8	52.2	21.3	20.8
1985	5.9	17.2	14.8	19.3	7.9	2.41	0.625	0.508	2.85	27	12.7	14.1	10.4
1986	48.3	31.1	36.9	19.6	21.1	7.08	3.41	0.834	1.55	7.51	35.4	37.6	20.8
1987	48.2	29.1	34.9	15.9	14.4	16.8	1.48	0.448	0.54	0.598	26.1	35.8	18.6
1988	27.1	23.3	26.7	23.5	17.7	8.4	2.01	0.961	2.43	7.67	47.2	22.9	17.4
1989	31.8	23.2	20.7	19	2.22	2.06	5.74	1.43	0.626	21.1	45.7	24.6	16.5
1990	34.3	35.9	21.2	7.08	4.05	14.5	2.09	0.998	0.944	32.6	72.1	38.5	21.9
1991	30.5	54.7	7.8	14.8	7.21	2.17	1.58	24.2	3.57	0.937	37.6	40.5	18.6
1992	69.3	32.4	5.88	16.3	3.34	1.17	0.668	0.986	4.63	22.2	24.7	19.6	16.7
1993	22	7.66	28.9	29.3	14.8	7.78	1.63	1.85	0.885	5.49	14.3	41.7	14.8
1994	34.2	42.4	40.3	10.3	3.8	10.9	2.03	0.758	2.19	14.2	40.7	51.6	21
MEAN	34.8	32.7	23.3	18.7	10.0	6.3	3.4	3.0	5.7	23.0	35.5	38.8	19.6
% MAD	178%	167%	119%	95.4%	51.0%	32.5%	17.6%	15.5%	29.4%	118%	181%	198%	100%

7-Day Average Low Flow (m³/sec)			
Date of Occurrence	Period: Apr 1 to Sep 30	Date of Occurrence	Period: Jan 1 to Dec 31
17-Sep-50	1.3	17-Sep-50	1.3
26-Aug-51	0.39	26-Aug-51	0.39
18-Aug-52	0.523	18-Aug-52	0.523
13-Aug-53	1.62	13-Aug-53	1.62
14-Aug-54	1.71	14-Aug-54	1.71
8-Sep-55	0.807	8-Sep-55	0.807
4-Sep-56	0.743	4-Sep-56	0.743
23-Sep-57	1.97	23-Sep-57	1.97
16-Jul-58	0.431	16-Jul-58	0.431
12-Aug-59	0.871	12-Aug-59	0.871
2-Aug-60	0.37	2-Aug-60	0.37
20-Aug-61	0.576	20-Aug-61	0.576
30-Jul-62	1.02	30-Jul-62	1.02
7-Sep-63	0.461	7-Sep-63	0.461
11-Sep-64	1.59	11-Sep-64	1.59
6-Aug-65	0.449	6-Aug-65	0.449
7-Aug-66	1.12	7-Aug-66	1.12
27-Aug-67	0.458	27-Aug-67	0.458
9-Aug-68	1.53	9-Aug-68	1.53
8-Aug-69	0.482	8-Aug-69	0.482
14-Jul-70	0.831	14-Jul-70	0.831
15-Aug-71	1.2	15-Aug-71	1.2
3-Sep-72	0.824	3-Sep-72	0.824

7-Day Average Low Flow (m³/sec)			
Date of Occurrence	Period: Apr 1 to Sep 30	Date of Occurrence	Period: Jan 1 to Dec 31
9-Aug-76	1.35	9-Aug-76	1.35
19-Aug-77	0.825	19-Aug-77	0.825
6-Aug-78	0.881	6-Aug-78	0.881
28-Aug-79	1.75	28-Aug-79	1.75
13-Aug-80	1.06	13-Aug-80	1.06
24-Aug-81	0.659	24-Aug-81	0.659
1-Sep-82	0.699	1-Sep-82	0.699
24-Aug-83	1.1	24-Aug-83	1.1
27-Aug-84	2.03	27-Aug-84	2.03
26-Aug-85	0.33	26-Aug-85	0.33
15-Sep-86	0.396	15-Sep-86	0.396
29-Aug-87	0.342	21-Oct-87	0.329
15-Sep-88	0.393	15-Sep-88	0.393
23-Sep-89	0.477	1-Oct-89	0.458
12-Aug-90	0.543	12-Aug-90	0.543
11-Jul-91	0.791	31-Oct-91	0.694
24-Aug-92	0.349	24-Aug-92	0.349
27-Sep-93	0.710	2-Oct-93	0.681
4-Aug-94	0.692	4-Aug-94	0.692
MEAN	0.9	MEAN	0.9
% MAD	4%	% of MAD	4%

Station Name: **COLQUITZ RIVER AT VIOLET AVENUE**
Station Number: 08HA047
Natural or Regulated: N

Drainage Area (sq.km.): 42.6
Discharge in: m³/sec

	Degrees	Minutes	Seconds
Latitude	48	28	3
Longitude	123	23	56

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1981										0.17	0.598	2.03	
1982	3.24	2.25	0.699	0.342	0.11	0.096	0.106	0.081	0.077	0.099	0.174	1.3	0.708
1983	2.27	1.13	0.8	0.346	0.173	0.086	0.097	0.058	0.189	0.183	0.988	1.08	0.614
1984	1.88	0.654	0.587	0.31	0.275	0.203	0.165	0.062	0.078	0.196	1.18	1.36	0.58
1985	0.942	0.862	0.279	0.278	0.17	0.141	0.064	0.054	0.038	0.216	0.412	0.425	0.32
1986	1.38	1.93	0.794	0.464	0.373	0.133	0.088	0.06	0.07	0.075	0.76	0.41	0.536
1987	0.84	0.758	0.578	0.237	0.177	0.089	0.062	0.059	0.039	0.027	0.061	0.359	0.272
1988	0.509	0.518	0.891	0.818	0.197	0.102	0.068	0.078	0.09	0.179	0.737	1.24	0.452
1989	2.05	0.915	1.12	0.943	0.193	0.113	0.08	0.065	0.049	0.093	0.368	0.915	0.575
1990	1.72	2.22	0.531	0.279	0.145	0.168	0.173	0.135	0.084	0.258	4.21	2.79	1.05
1991	2.46	2.08	1.11	1.43	0.278	0.09	0.076	0.102	0.06	0.087	0.8	1.7	0.849
1992	2.01	2.03	0.537	0.298	0.147	0.124	0.086	0.041	0.046	0.076	0.417	0.502	0.521
1993	1.05	0.363	0.524	0.24	0.17	0.107	0.092	0.062	0.05	0.04	0.049	0.289	0.253
1994	0.360	0.660	0.952	0.25	0.133	0.116	0.038	0.029	0.085	0.142	0.452	2.12	0.445
MEAN	1.593	1.259	0.723	0.480	0.195	0.121	0.092	0.068	0.073	0.132	0.800	1.180	0.552
% MAD	289%	228%	131%	86.9%	35.4%	21.9%	16.7%	12.3%	13.3%	23.8%	145%	214%	100%

Station Name: **VEITCH CREEK AT THE MOUTH**
Station Number: 08HA023
Natural or Regulated: N

Drainage Area (sq.km.): 24.6
Discharge in: m³/sec

	Degrees	Minutes	Seconds
Latitude	48	23	28
Longitude	123	37	19

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1969							0.005	0.001	0.005				
1970				0.573	0.119	0.015	0.003	0	0.005				
MEAN				0.573	0.119	0.015	0.004	0.001	0.005				

Station Name: **DE MAMIEL CREEK AT THE MOUTH**
Station Number: 08HA025
Natural or Regulated: N
Drainage Area (sq.km.): 36.3
Discharge in: m^3/sec

	Degrees	Minutes	Seconds
Latitude	48	23	23
Longitude	123	42	31

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1969				1.11	0.186	0.027	0.005	0.001	0.182				
1971				0.553	0.067	0.014	0.003	0	0.005				
1972				1.49	0.17	0.014	0.176	0.01	0.099				
1973				0.507	0.174	0.048	0.015	0.007	0.011				
1974					0.375	0.256	0.101	0.014	0.011				
MEAN				0.915	0.194	0.072	0.060	0.006	0.062				

Station Name: **TUGWELL CREEK AT THE MOUTH**
Station Number: 08HA031
Natural or Regulated: N

Drainage Area (sq.km.): 26.9
Discharge in: m³/sec

	Degrees	Minutes	Seconds
Latitude	48	22	33
Longitude	123	50	56

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1973				0.305	0.231	0.195	0.057	0.018	0.012				
1974					0.305	0.166							
1975				0.514	0.257	0.058	0.015	0.129	0.064				
1976				1.11	0.37	0.15	0.038	0.069	0.102				
1977				0.501	0.078	0.039	0.011	0.017	0.106	0.74			
MEAN				0.608	0.248	0.122	0.030	0.058	0.071	0.740			

Station Name: **CARNATION CREEK AT THE MOUTH**
Station Number: 08HB048
Natural or Regulated: N
Drainage Area (sq.km.): 10.1
Discharge in: m³/sec

	Degrees	Minutes	Seconds
Latitude	48	54	56
Longitude	124	59	52

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1972												2.34	
1973	2.03	0.737	0.974	0.293	0.503	0.464	0.069	0.025	0.031	0.861	1.62	2.53	0.849
1974	2.1	2.09	2.41	1.11	0.731	0.369	0.267	0.077	0.088	0.262	1.89	1.97	1.11
1975	1.22	0.71	0.905	0.43	0.506	0.227	0.106	0.616	0.143	2.31	3.14	2.24	1.05
1976	1.68	1.51	1.24	0.548	0.495	0.298	0.191	0.17	0.236	0.491	0.598	1.5	0.746
1977	0.73	1.56	1.16	0.46	0.365	0.189	0.109	0.122	0.189	0.886	1.8	1.22	0.726
1978	0.717	0.737	0.826	0.494	0.277	0.198	0.056	0.591	0.841	0.328	0.716	0.87	0.553
1979	0.233	1.86	0.9	0.341	0.221	0.09	0.252	0.04	0.577	0.744	0.469	2.38	0.669
1980	0.876	1.36	0.874	0.799	0.145	0.145	0.287	0.082	0.508	0.224	2.28	2.61	0.846
1981	0.58	1.38	0.426	1.45	0.399	0.589	0.114	0.074	0.519	1.54	1.55	1.46	0.834
1982	1.98	1.89	0.688	0.776	0.197	0.043	0.053	0.019	0.072	1.83	1.11	1.94	0.878
1983	2.5	2.67	1.28	0.33	0.196	0.201	0.615	0.036	0.079	0.459	2.8	0.68	0.975
1984	2.35	1.57	0.952	0.903	0.903	0.153	0.178	0.032	0.288	1.81	1.61	0.852	0.966
1985	0.184	0.704	0.576	0.774	0.3	0.1	0.013	0.01	0.154	1.32	0.566	0.492	0.43
1986	1.88	2.03	1.41	0.654	0.948	0.259	0.193	0.024	0.083	0.246	1.34	1.8	0.9
1987	2.05	1.18	1.43	0.738	0.621	0.442	0.045	0.014	0.01	0.035	1.09	1.5	0.761
1988	0.905	0.961	0.985	0.957	0.586	0.279	0.05	0.036	0.153	0.387	2.01	1	0.69
1989	1.58	0.517	1.01	0.851	0.062	0.043	0.205	0.069	0.028	0.908	2.39	0.914	0.715
1990	1.81	2.15	0.807	0.223	0.164	0.772	0.091	0.036	0.03	1.6	4.04	1.91	1.13
1991	1.44	3.04	0.386	0.658	0.213	0.062	0.063	1.34	0.09	0.025	1.98	1.83	0.913

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MAD
1992	3.36	1.27	0.279	0.88	0.104	0.051	0.028	0.068	0.218	1.05	1.22	0.715	0.769
1993	1.37	0.184	1.31	1.26	0.637	0.405	0.046	0.043	0.01	0.142	0.538	1.78	0.648
1994	1.36	1.8	1.37	0.308	0.075	0.339	0.07	0.007	0.055	0.458	1.44	1.95	0.763
1995	1.61	1.7	1.34	0.466	0.082	0.097	0.045	0.069	0.032	1.1	4.02	1.72	1.02
1996	1.50	1.15	0.440	1.07	0.294								
MEAN	1.50	1.45	1.00	0.699	0.376	0.253	0.137	0.157	0.193	0.827	1.75	1.59	0.823
% MAD	182%	176%	121%	84.9%	45.7%	30.7%	16.6%	19.0%	23.4%	100%	212%	193%	100%

APPENDIX C: Licenced Water Demand

by Purpose

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	SOURCE	QUANTITY	UNITS	DEMAND (dam^3/year)
Conserv.-Construct. Works Purpose			**Number of Licences = 4**			
C052868	0364724	19781003	Four Mile Creek	1	cfs	446.89
C058341	0368186	19810406	Calvin Creek	1	cfs	598.83
C059648	0369643	19811201	Nitinat River	20	cfs	17,875.58
C065804	1000801	19871222	Nitinat River	24	cfs	21,450.70
			Total =	**45**	**cfs**	**40,372.01**
Domestic Purpose°			**Number of Licences = 53**			
C019282	0125743	19490928	MacVicar Spring	500	gpd	0.42
C023427	0213380	19560911	Rockbottom Creek	3,000	gpd	2.49
C025228	0225519	19590519	Kirby Creek	2,000	gpd	1.66
C029705	0257393	19640708	Clarke & Adcock Spring	2,000	gpd	1.66
C030370	0263731	19650730	Frenchome Creek	2,000	gpd	1.66
C032912	0270499	19660912	San Juan River (North Outlet)	500	gpd	0.42
C034950	0285364	19690410	Vye Creek	500	gpd	0.42
C040617	0310649	19720811	East Defiance Creek	500	gpd	0.42
C043284	0323094	19740518	Hohert Spring	500	gpd	0.42
C043386	0322771	19740326	Craig Brook	200	gpd	0.17
C051988	0365027	19780525	Defiance Creek	500	gpd	0.42
C051989	0365029	19780525	Defiance Creek	500	gpd	0.42
C051990	0365028	19780525	Defiance Creek	500	gpd	0.42
C052941	0365076	19790123	Muir Creek	1,500	gpd	1.25
C053060	0342763	19780310	Tugwell Creek	500	gpd	0.42
C056134	0365105	19790131	Hazard Creek	3,000	gpd	2.49
C056455	0198772	19530304	Stanley Creek	2,000	gpd	1.66
C056789	0364448	19780717	Crystal Creek	2,000	gpd	1.66
C056805	0355576	19791029	Keoppel Spring	500	gpd	0.42
C057103	0366496	19800502	Rudd Spring	500	gpd	0.42
C059226	0370381	19520729	Jacob Creek	500	gpd	0.42
C061320	1000258	19840224	Bliss Spring	500	gpd	0.42
C062065	1000131	19830131	Mackie Creek	600	gpd	0.50
C065767	1000745	19870707	Austin Creek	500	gpd	0.42
C072208	1000732	19870611	Austin Creek	250	gpd	0.21
C072289	1001270	19900322	Pioneer Creek	250	gpd	0.21
C104404	1001552	19920310	Hugh Brook	1,000	gpd	0.83
C105906	1001651	19921221	Grace Creek	500	gpd	0.42
C106324	1001668	19930318	Jacob Creek	500	gpd	0.42
C106842	1001694	19670217	Goudie Creek	1,000	gpd	0.83
C107836		19471208	Hugh Brook	500	gpd	0.42
F009790	0115793	19340223	Rudd Spring	1,000	gpd	0.83
F011450	0131968	19380816	Bliss Spring	1,000	gpd	0.83
F011451	0143841	19410616	Bliss Spring	500	gpd	0.42
F012739	0131968	19380816	Bliss Spring	1,000	gpd	0.83

F014458	0150651	19430909	Bliss Spring	1,000	gpd	0.83
F014742	0181097	19491013	Bliss Spring	1,000	gpd	0.83
F043648	0277967	19680430	Craig Brook	500	gpd	0.42
F043649	0285134	19690115	Jacob Creek	500	gpd	0.42
F043949	0221889	19580903	Goudie Creek	1,000	gpd	0.83
F043950	0290704	19691230	Smith Spring	500	gpd	0.42
F044524	0268240	19660314	Tugwell Creek	500	gpd	0.42
F044525	0277233	19671017	Jacob Creek	500	gpd	0.42
F044868	0310884	19720925	San Juan River (North Outlet)	500	gpd	0.42
F047426	0252600	19631008	Pioneer Creek	500	gpd	0.42
F047427	0137324	19391010	Defiance Creek	1,000	gpd	0.83
F047594	0340560	19490122	Pioneer Creek	500	gpd	0.42
F049888	0340401	19761026	Pioneer Creek	500	gpd	0.42
F059225	0195980	19520729	Jacob Creek	500	gpd	0.42
F106028		19660314	Tugwell Creek	500	gpd	0.42
F107652	0268256	19660317	Hugh Brook	500	gpd	0.42
F110306	0166816	19470414	Killiecrankie Creek	500	gpd	0.42
F110384		19380816	Bliss Spring	1,000	gpd	0.83
			Total =	**44,300**	**gpd**	**36.78**
Industrial (Brake Cooling)			**Number of Licences = 2**			
C035414	0290243	19690828	Wilson Creek	1,000	gpd	1.66
C052868	0364724	19781003	Four Mile Creek	1,000	gpd	1.66
			Total =	**2,000**	**gpd**	**3.32**
Industrial (Cooling)			**Number of Licences = 1**			
C023832	0216718	19570627	Jordan River	30,000	gpd	49.81
			Total =	**30,000**	**gpd**	**49.81**
Industrial (Enterprise)			**Number of Licences = 11**			
C039529	0309541	19720106	Tugwell Creek	4,000	gpd	6.64
C043387	0322295	19731227	Cook Springs	2,000	gpd	3.32
C044262	0317844	19730920	Loss Creek	1,000	gpd	1.66
C049842	0330011	19751216	Rosemond Creek	6,000	gpd	9.96
C057103	0366496	19800502	Rudd Spring	250	gpd	0.42
C057298	0369098	19810817	Frenchome Creek	1,200	gpd	1.99
C058368	0364835	19781108	Campus Creek	2,000	gpd	3.32
C062064	1000105	19821124	Jacob Creek	5,000	gpd	8.30
C065815	1000769	19870904	Campus Creek	30,000	gpd	49.81
F021523	0305051	19520729	Jacob Creek	3,000	gpd	4.98
F047428	0137324	19391010	Defiance Creek	3,000	gpd	4.98
			Total =	**57,450**	**gpd**	**95.39**
Industrial (Fire Protection)			**Number of Licences = 2**			
C023832	0216718	19570627	Jordan River	30,000	gpd	49.81
C072277	1001142	19891010	Valentine Brook	5.5	acft	6.79
			Total =	**30,000**	**gpd**	**56.60**
				5.5	**acft**	

Industrial (Ponds)			**Number of Licences = 1**			
C061468	1000182	19830627	Jordan River	3	acft	3.08
			Total =	**3**	**acft**	**3.08**
Industrial (Processing)			**Number of Licences = 3**			
C056455	0198772	19530304	Stanley Creek	8,000	gpd	13.28
C060614	0296220	19700408	Hauk Creek	22,000	gpd	36.53
C064074	1000562	19860212	Ardwell Creek	90,000	gpd	149.44
			Total =	**120,000**	**gpd**	**199.25**
Industrial (Res/Lawn Gardening)			**Number of Licences = 1**			
C104632		19920423	Hugh Brook	0.33	acft	0.41
			Total =	**0.33**	**acft**	**0.41**
Industrial (Stockwatering)			**Number of Licences = 1**			
C101424	1001427	19910322	Tom Baird Creek	100	gpd	0.17
			Total =	**100**	**gpd**	**0.17**
Irrigation Purpose			**Number of Licences = 6**			
C032912	0270499	19660912	San Juan River	15.00	acft	18.51
C050704	0341036	19770404	Hilborn Creek	0.25	acft	0.31
C059089	0368897	19810716	Skookum Creek	3.00	acft	3.70
C062065	1000131	19830131	Mackie Creek	14.00	acft	17.27
C108159		19670227	Goudie Creek	1.50	acft	1.85
F009790	0115793	19340223	Rudd Spring	4.00	acft	4.94
			Total =	**37.75**	**acft**	**46.58**
Mining-Placer Purpose			**Number of Licences = 1**			
C044262	0317844	19730920	Loss Creek	0.006	cfs	5.36
			Total =	**0.006**	**cfs**	**5.36**
Power			**Number of Licences = 3**			
C033836	0281532	19680819	Jordan River (maximum)	2,500.0	cfs	0.00
C064075	1000562	19860212	Ardwell Creek	2.0	cfs	1,786.01
F012749	0241160	19090930	Jordan River	366.6	cfs	327,376.30
			Total =	**367**	**cfs**	**329,162.31**
Storage			**Number of Licences = 8**			
C049219	0340708	19770110	Defiance Creek	0.50	acft	0.62
C059090	0368897	19810716	Skookum Creek	3.00	acft	3.70
C062066	1000131	19830131	Mackie Creek	4.00	acft	4.94
C064074	1000562	19860212	Ardwell Creek	4.00	acft	4.94
C065767	1000745	19870707	Austin Creek	0.10	acft	0.12
C072208	1000732	19870611	Austin Creek	0.10	acft	0.12
C072277	1001142	19891010	Valentine Brook	5.50	acft	6.79
F012750	0241160	19090930	Jordan River	24,506.00	acft	30,238.08
			Total =	**24,523.20**	**acft**	**30,259.30**

Waterworks (Other) Purpose[o]			Number of Licences = 4			
C033592	0277124	19670928	Malachan Creek	7,000	gpd	5.81
C039528	0309328	19711130	Goudie Creek	23,907,500	gal/yr	54.34
C058488	0367914	19810217	Malachan Creek	8,000	gpd	6.64
F016842	0168806	19470804	Lumber Spring	15,000	gpd	12.45
			Total =	**30,000**	**gpd**	**79.25**
				23,907,500	**gal/yr**	

[o] Based on the assumption that the demand is the authourized maximum daily licenced divided by 2 to estimate the average daily demand and multiplied by 365.25 days to determine the annual demand.

APPENDIX D: Low Flow Licenced Water Demand

by Drainage Area

DRAINAGE AREA	PURPOSE	LICENCED QUANTITY	LOW FLOW WATER DEMAND	
			(litres/second)	(dam^3)
Campus Creek	Domestic (max. day)	3,000 gpd	0.16	1.24
	Industrial (max. day)	32,000 gpd	1.68	13.06
		Total Consumption	**1.84**	**14.31**
Caycuse Creek	Waterworks (max. day)	15,000 gpd	0.79	6.14
		Total Consumption	**0.79**	**6.14**
Gordon Creek	Industrial (max. day)	22,000 gpd	1.16	9.02
		Total Consumption	**1.16**	**9.02**
Jacob Creek	Domestic (max. day)	2,500 gpd	0.13	1.01
	Industrial (max. day)	8,000 gpd	0.42	3.27
		Total Consumption	**0.55**	**4.28**
Jordan River	Domestic (max. day)	7,500 gpd	0.39	3.03
	Industrial (max. day)	60,250 gpd	3.17	24.65
	Industrial	8 acft	1.27	9.88
	Irrigation	4 acft	0.63	4.90
	Power	2,866.6 cfs	0	0.00
	Storage - Power Purpose	24,511.5 acft	0	0.00
		Total Consumption	**5.46**	**42.46**
Kirby Creek	Domestic (max. day)	2,500 gpd	0.13	1.01
		Total Consumption	**0.13**	**1.01**
Loss Creek	Industrial (max. day)	1,000 gpd	0.05	0.39
	Mining-Placer Purpose	0.006 cfs	0.17	1.32
		Total Consumption	**0.22**	**1.71**
Muir Creek	Domestic (max. day)	1,500 gpd	0.08	0.62
	Industrial (max. day)	2,000 gpd	0.11	0.86
		Total Consumption	**0.19**	**1.48**
Nitinat River	Industrial (max. day)	1,000 gpd	0.05	0.39
	Conserv.-Construct.	44 cfs	0	0.00
		Total Consumption	**0.05**	**0.39**

DRAINAGE AREA	PURPOSE	LICENCED QUANTITY	LOW FLOW WATER DEMAND (litres/second)	LOW FLOW WATER DEMAND (dam^3)
San Juan River	Domestic Purpose (max. day)	3,000 gpd	0.16	1.24
	Industrial (max. day)	9,000 gpd	0.47	3.65
	Irrigation	15 ac ft	2.38	18.51
	Conserv.-Construct.	1.17 cfs	0	0.00
		Total Consumption	**3.01**	**23.41**
Tugwell Creek	Domestic (max. day)	1,500 gpd	0.08	0.62
	Industrial (max. day)	4,000 gpd	0.21	1.63
		Total Consumption	**0.29**	**2.26**
Other	Domestic (max. day)	22,800 gpd	1.2	9.33
	Industrial (max. day)	100,300 gpd	5.28	41.06
	Industrial	0.33 ac ft	0.05	0.39
	Irrigation	18.75 ac ft	2.98	23.17
	Power-General	2 cfs	0	0.00
	Storage - Non-Power	11.7 ac ft	-1.86	-14.46
	Waterworks (max. day)	23,922,500 gpy	3.45	26.83
		Total Consumption	**11.1**	**86.31**

Based on an estimated 90 day period demand assuming that: irrigation and industrial demands are totally withdrawn over the 90 day period; domestic and waterworks demand are the authourized licenced maximum daily for 90 days; storage balances demand, and therefore, is a negative demand over the 90 days; conservation and power are non-consumptive and, therefore, have no demand.

APPENDIX E: Pending Water Licence Applications

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	SOURCE	QUANTITY	UNITS	DEMAND (dam^3/year)
Conserv.-Construct. Works Purpose			**Number of Licences =**	**1**		
Z109428	1001828	19950313	ZZ Pond (70700)	9.9	AF	12.22
			Total =	**9.9**	**AF**	**12.22**
Domestic Purpose°			**Number of Licences =**	**2**		
Z105645		19920904	Hugh Brook	500	GD	0.42
Z107731	1001754	19940217	Hugh Brook	1000	GD	0.83
			Total =	**1500**	**GD**	**1.25**
Industrial (Camps)°°			**Number of Licences =**	**1**		
Z102557		19910723	Tugwell Creek	4000	GD	1.64
			Total =	**4000**	**GD**	**1.64**
Industrial (Enterprise)			**Number of Licences =**	**3**		
Z101074		19900716	Frenchome Creek	5500	GD	9.13
Z110196		19950825	Bliss Spring	750	GD	1.25
Z110715		19960219	Rudd Spring	5000	GD	8.30
			Total =	**11250**	**GD**	**18.68**
Irrigation Purpose			**Number of Licences =**	**1**		
Z107934	1001768	19940329	Skookum Creek	9	AF	11.11
			Total =	**9**	**AF**	**11.11**
Public Facility Purpose			**Number of Licences =**	**2**		
Z105645		19920904	Hugh Brook	1500	GD	2.49
Z110876		19960401	Rudd Spring	500	GD	0.83
			Total =	**2000**	**GD**	**3.32**

° Based on the assumption that the demand is the authourized maximum daily licenced divided by 2 to estimate the average daily demand and multiplied by 365.25 days to determine the annual demand.

°° Based on an estimated 90 day period demand assuming that all demands are withdrawn over the 90 day period.

APPENDIX F: Fish Screening Requirements

FISH SCREENING DIRECTIVE

Government of Canada
Department of Fisheries and Oceans

WATER INTAKE FISH PROTECTION FACILITIES

The Department of Fisheries and Oceans has prepared this document as a guide to assist in the design and installation of water intakes and fish screening in British Columbia and the Yukon Territory to avoid conflicts with anadromous fish. Additional precautions must be taken at marine intake locations where entrainment of fish larvae, such as eulachon and herring larvae, is a possibility. The screening criteria constitutes the Department's policy regarding the design and construction requirements pursuant to Section 28 of the Fisheries Act.

PROVISIONS OF THE FISHERIES ACT - SECTION 28

Every water intake, ditch, channel or canal in Canada constructed or adapted for conducting water from any Canadian fisheries waters for irrigating, manufacturing, power generation, domestic or other purposes, shall, if the Minister deems it neccessary in the public interest, be provided at its entrance or intake with a fish guard or a screen, covering or netting, so fixed as to prevent the passage of fish from any Canadian fisheries waters into such water intake, ditch, channel or canal.

The fish guard, screen, covering or netting shall have meshes or holes of such dimensions as the Minister may prescribe, and shall be built and maintained by the owner or occupier of the water intake, ditch, channel or canal subject to the approval of the Minister or such officer as the Minister may appoint to examine it.

The owner or occupier of the water intake, ditch, channel or canal shall maintain the fish guard, screen, covering or netting in a good and efficient state of repair and shall not permit its removal except for renewal or repair, and during the time such renewal or repair is being effected, the sluice or gate at the intake or entrance of the water intake, ditch, channel or canal shall be closed in order to prevent the passage of fish into the water intake, ditch, channel or canal.

PROCEDURES FOR INSPECTION AND APPROVAL OF INTAKE STRUCTURES

Diversions less than 0.0283 cms (one cubic foot per second): The intake structure shall be constructed in accordance with specifications indicated herein. Upon completion of construction and prior to operation the owner shall contact a local representative of the Department of Fisheries and Oceans to arrange for on-site inspection and approval of the installation. Permanently submerged screens must be inspected prior to installation.

Diversons greater than 0.0283 cms (one cubic foot per second): The owner shall submit to the Department of Fisheries and Oceans 2 sets of detailed plans of the proposed installation for review and approval prior to fabrication. Design drawings are required whenever the diversion quantity exceeds 0.0283 cms (1.0 cfs) or 817,200 L/day (180,000 Igpd) for industrial diversions (calculated on the basis of 8 hours/day) or 123,350 cmy (100 ac.- ft./year) for irrigation diversions (calculated on the basis of 100 days/year and 12 hours/day). The plans shall contain the following information:

1. Intake structure location and dimensions.
2. Maximum discharge capacity of diversion.
3. Screen dimensions.
4. Mesh size.
5. Screen material.
6. Fabrication details.
7. Minimum and maximum water levels at the intake site.
8. Provision for bypassing fish.

The intake structure shall then be constructed in accordance with the approved plans. Upon completion of construction and prior to operation, the owner shall contact the local representative of the Department of Fisheries and Oceans to arrange for on-site inspection and approval of the installation. Permanently submerged screens must be inspected prior to installation.

SPECIFICATIONS FOR INTAKE STRUCTURES WITHOUT PROVISION FOR AUTOMATIC CLEANING

1. Screen Material: The screen material shall be either stainless steel, galvanized steel, aluminum, brass, bronze, or monel metal. Stainless steel is preferred since corrosion is greatly reduced.

2. Screen Mesh Size: Clear openings of the screen (the space between strands) shall not exceed 2.54 mm (0.10 inch). The open screen area shall not be less than 50% of the total screen area. The following square-mesh wire cloth screens are recommended:

   - 7 mesh, 1.025 mm (0.041 inch) wire, 51% open, 2.54 mm (0.10 inch) openings; or
   - 8 mesh, 0.875 mm (0.035 inch) wire, 52% open, 2.25 mm (0.09 inch) openings; or
   - 8 mesh, 0.700 mm (0.028 inch) wire, 60% open, 2.54 mm (0.10 inch) openings.

3. Screen Area: A minimum unobstructed screen area (gross area) of 0.93 square metre (10 square feet) shall be provided for each 0.0283 cms (1cfs) of water entering the intake. The required screen area shall be installed below minimum water level. Screen area lost by framing shall not be included as part of the unobstructed screen area.

4. Screen Support: The screen shall be adequately supported with stiffeners or back-up material to prevent excessive sagging.

5. Screen Protection: The intake structure shall, where necessary, be equipped with a trash rack or similar device to prevent damage to the screen from floating debris, ice, etc.

6. Screen Accessibility: The screen shall be readily accessible for cleaning and inspection. Screen panels or screen assemblies must be removable for cleaning, inspection and repairs.

7. Allowable Openings: The portion of the intake structure which is submerged at maximum water level shall be designed and assembled such that no openings exceed 2.54 mm (0.10 inch) in width.

8. Design and Location: The design and location of the intake structure shall be such that a uniform flow distribution is maintained through the total screen area.

9. Fish Bypass: The intake shall be designed to provide a transverse velocity (the component of the velocity parallel and adjacent to the screen face) to lead fish to a bypass or past the screens before they become fatiqued. In no case should the transverse velocity be less than double the velocity through the screen.

SPECIFICATIONS FOR INTAKE STRUCTURES WITH PROVISIONS FOR AUTOMATIC CLEANING

The specifications are identical to those for intake structures without provisions for automatic cleaning except that the minimum unobstructed screen area (gross area) of 0.23 square metre (2.5 square feet) need only be provided for each 0.0283 cms (1 cfs) of water entering the intake. However, a regular cleaning and maintenance schedule is required to ensure seals and screen panels remain in good repair preventing impingement and entrainment of fish and debris.

For these self-cleaning intake structures, the location, design and juvenile fish avoidance system all affect operating characteristics. The final design, therefore, may incorporate modifications reflecting the best current technology available for minimizing adverse impact upon the fisheries resource.

ALTERNATE FISH PROTECTION FACILITIES

Enquiries concerning the Department's requirements for indirect intakes, such as infiltration galleries and wells, for salt water ocean intakes, and for new methods or devices for screening intake structures should be directed to the Department of Fisheries and Oceans, Senior Habitat Management Biologist.

Conversion Factors:

1 cubic foot per second (cfs) = 449 U.S. gallons per minute (U.S. gpm).
= 374 Imperial gallons per minute (Igpm).
= 1.98 acre feet per day (Ac.-Ft./day).
= 28.3 litres per second (L/sec.).
= 0.0283 cubic metres per second (cms)

0.10 inch = 3/32" (approx.) = 2.54 millimetres

Addresses for Correspondence and Approvals

1. Senior Habitat Management Biologist
   Fraser River, Northern B.C. and Yukon Division
   Department of Fisheries and Oceans
   Room 330, 80 - 6th Street
   New Westminster, B.C. V3L 5B3
   Phone: 666-6479

2. Senior Habitat Management Biologist
   South Coast Division
   Department of Fisheries and Oceans
   3225 Stephenson Point Road
   Nanaimo, B.C. V9T 1K3
   Phone: 756-7270

3. Senior Habitat Management Biologist
   North Coast Division
   Department of Fisheries and Oceans
   Room 109, 417 - 2nd Avenue West
   Prince Rupert, B.C. V6J 1G8
   Phone: 624-9385

Other Federal and Provincial agencies having jurisdiction in water withdrawals and construction pertaining to watercourses in British Columbia include:

1. Transport Canada
   Canadian Coast Guard.

2. B.C. Ministry of Environment
   Fish and Wildlife Management.

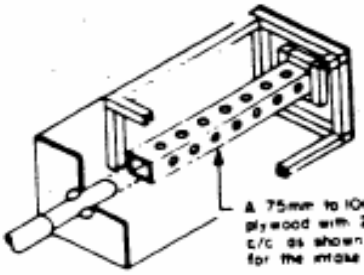
3. B.C. Ministry of Environment
   Water Management.

4. B.C. Ministry of Agriculture and Food.

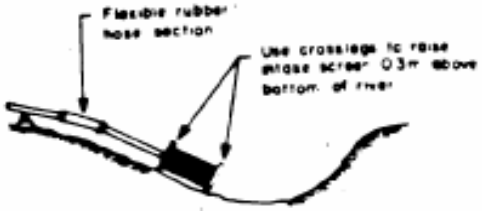
5. B.C. Ministry of Lands, Parks and Housing.

It may be necessary that several or all these agencies also be solicited for approvals prior to the installation of a water intake.

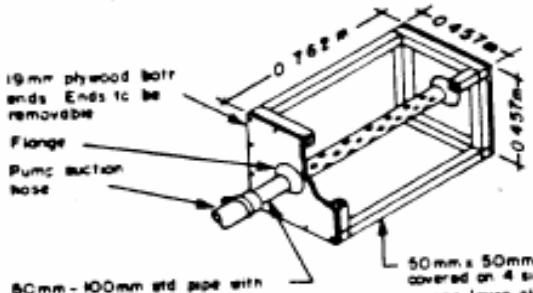
Revised January, 1986

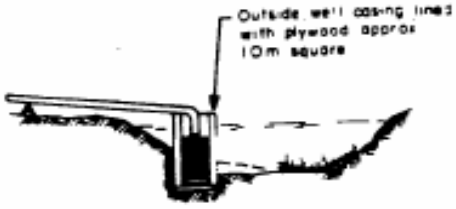


A 75mm to 100mm square box of 19mm plywood with 25mm dia. holes at 75mm c/c as shown, may be substituted for the intake pipe below

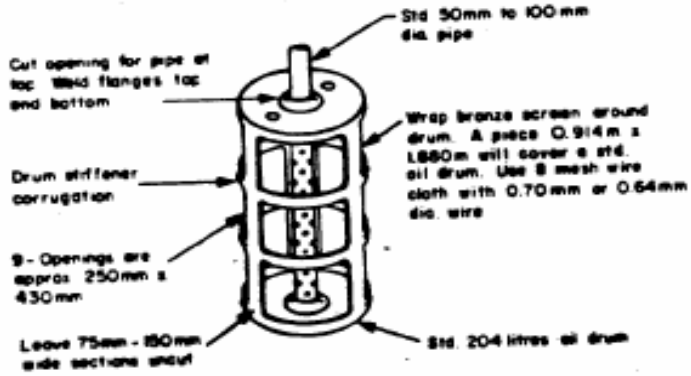


STANDARD INSTALLATION

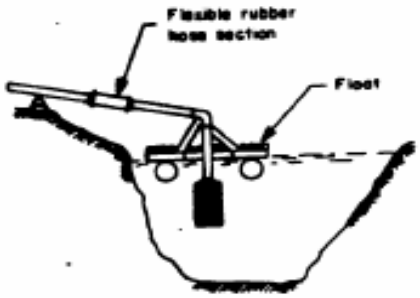




INSTALLATION IN SHALLOW WATER MUDDY OVERGROWN BOTTOM



NOTE
1. Oil drum shall be thoroughly washed out or steam cleaned before cutting openings
2. All loose rust shall be removed and the drum coated with metal primer. Two coats of machinery enamel or epoxy paint shall be applied before covering with wire cloth

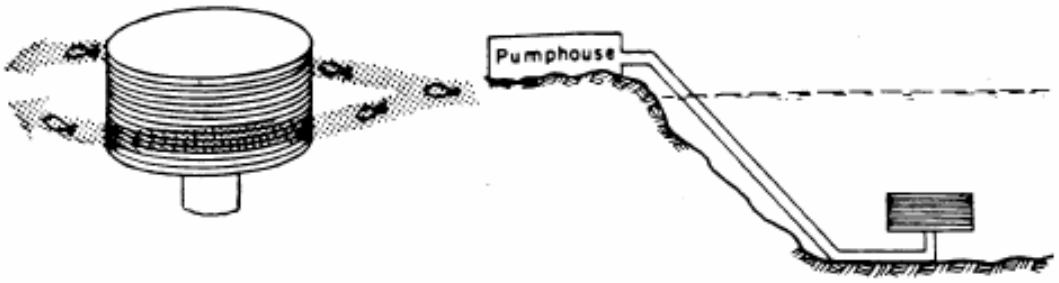


INSTALLATION IN DEEP WATER

NOTE
All screens shall be installed below minimum water level, shall be easily accessible for cleaning, and shall be cleared of debris at regular intervals

SMALL STATIONARY WATER INTAKE SCREENS

(For pumps of a capacity less than 28.3 L/sec [1 cfs, 449 U.S. or 374 Igpm])



DEEP WATER WELL SCREEN

May be installed in lakes and the ocean.

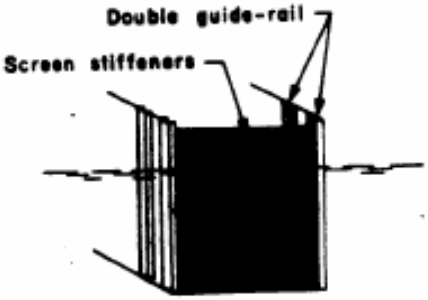
SHALLOW WATER WELL SCREEN

May be installed in lakes, pools, and stable areas in rivers.

Totally submerged cylindrical shaped stainless steel well screens provide for high intake capacity and large percentage of open area permitting water to enter at low velocities. Slot opening shall not exceed 2.54 mm (0.10 inch).

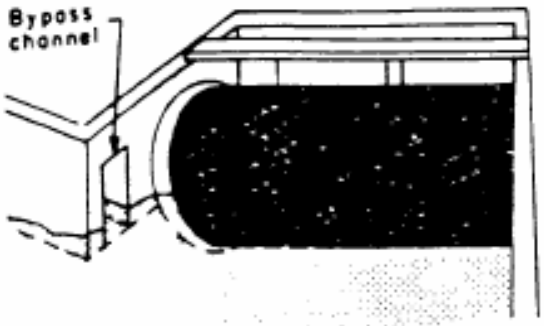
VERTICAL PANEL SCREENS

May be installed in rivers, lakes and the ocean. Generally, requires coarse trashracks, a sluice gate in river installations, double sets of guide-rails, and standby screen panels to allow for cleaning and repairs.



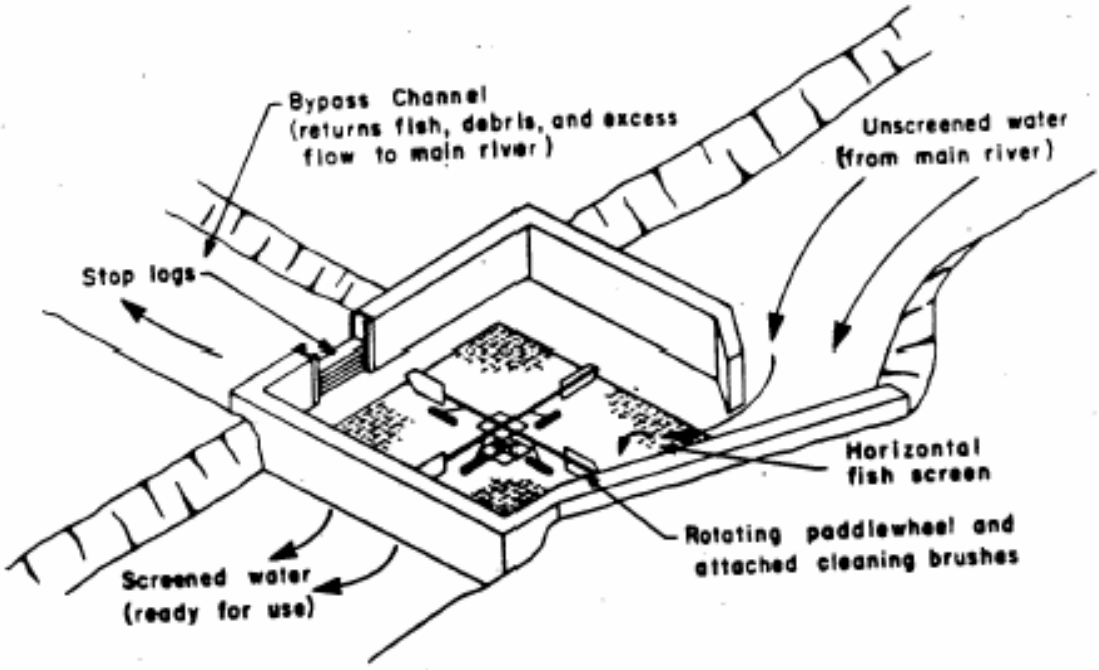
LARGE STATIONARY WATER INTAKE SCREENS

(For pumps of a capacity more than 28.3 L/sec [1 cfs, 449 U.S. or 374 Igpm])



REVOLVING DRUM SCREEN, HORIZONTAL AXIS

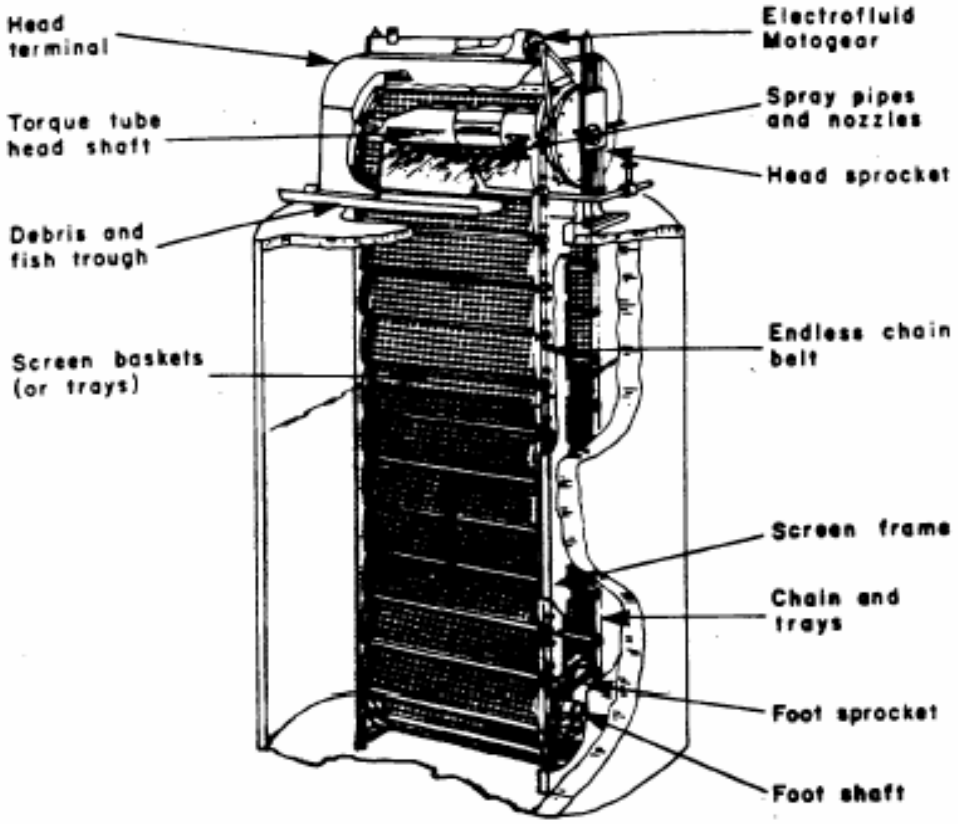
Generally, installed to divert fish from irrigation canals. Can be driven by a small motor or by a paddle wheel. To avoid juvenile fish impingement, a bypass channel is required near the front of the screen. Rubber seals are necessary along the base and sides.



FINNIGAN SCREEN

The horizontal, self-cleaning Finnigan Screen is another concept, generally installed to divert fish from irrigation or enhancement projects. The stationary horizontal screen is kept clean by a set of brushes attached to a revolving paddle wheel powered by the water current entering the structure. A portion of the flow, the suspended debris, and fish are directed to the bypass channel. The remainder of the flow passes through and below the screen for use as required.

IRRIGATION INTAKE SCREENS



CONVENTIONAL VERTICAL TRAVELLING SCREEN

May be installed in rivers, lakes and the ocean. A common screening method utilized by industry, these self-cleaning mechanical screens with modifications can prevent impact upon fish. Mounted flush to the stream bank (shoreline) or as pier intakes within streams and provided with an opening on the downstream end between the intake screens and trashracks, juvenile fish can generally escape entrapment. Rubber panel, side, and boot seals are required to prevent juvenile fish from gaining entry into the pumpwell. A safe bypass system is essential to return juvenile fish with debris back to the watercourse. Automatic controls are also necessary to ensure operation at a specific minimum head differential.

LARGE INDUSTRIAL AND DOMESTIC WATER INTAKE SCREEN