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

CHASE TO NANOOSE

WATER ALLOCATION PLAN

APRIL 1994

Watershed Files: 4-21-60 to -90 inclusive

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Date: 29 April 1994

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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 many advantages include:

1. Knowing our position in advance for standard applications (pro-active management, information available to applicants and public);

2. Reducing our response time by having plans in place prior to applications;

3. Eliminating separate studies and reports on each application (presently some duplication);

4. Improving the consistency of our approach and decisions, regardless of individual staff;

5. Replacing or reducing most Water Licence Application Reports by pre-defining specific allocation directions and decisions;

6. Being more comprehensive in the plan than in present reports;

7. And, eliminating the need for many referrals.

The following regional policy was developed to provide 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 licensable 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

The Chase to Nanoose Water Allocation Plan area (Figure 1) is located on the east coast of Vancouver Island in and around the City of Nanaimo. For the purpose of assessing water supplies for allocation demands, the Plan area was divided into significant drainage areas as shown in Table 1 and Figure 2.

Table 1 Drainage Areas

Drainage Area	**Area (km^2)**
Craig Creek	11.7
Enos Creek	2.7
Strudwick Brook	5.5
Williams Creek	1.8
Dublin Gulch	8.1
Indian Reserve Creek	1.0
Knarston Creek	7.6
Stewart Creek	4.2
Bloods Creek	4.2
Cottle Creek	3.8
Departure Creek	2.4
Nanoose Creek	32.6
Bonell Creek	47.8
Millstone River	93.2
Chase River	35.3
Richards Creek	11.5
Beck Creek	6.7
Other Areas	51.9

figure 1

CHASE RIVER TO NANOOSE CREEK
WATER ALLOCATION PLAN AREA

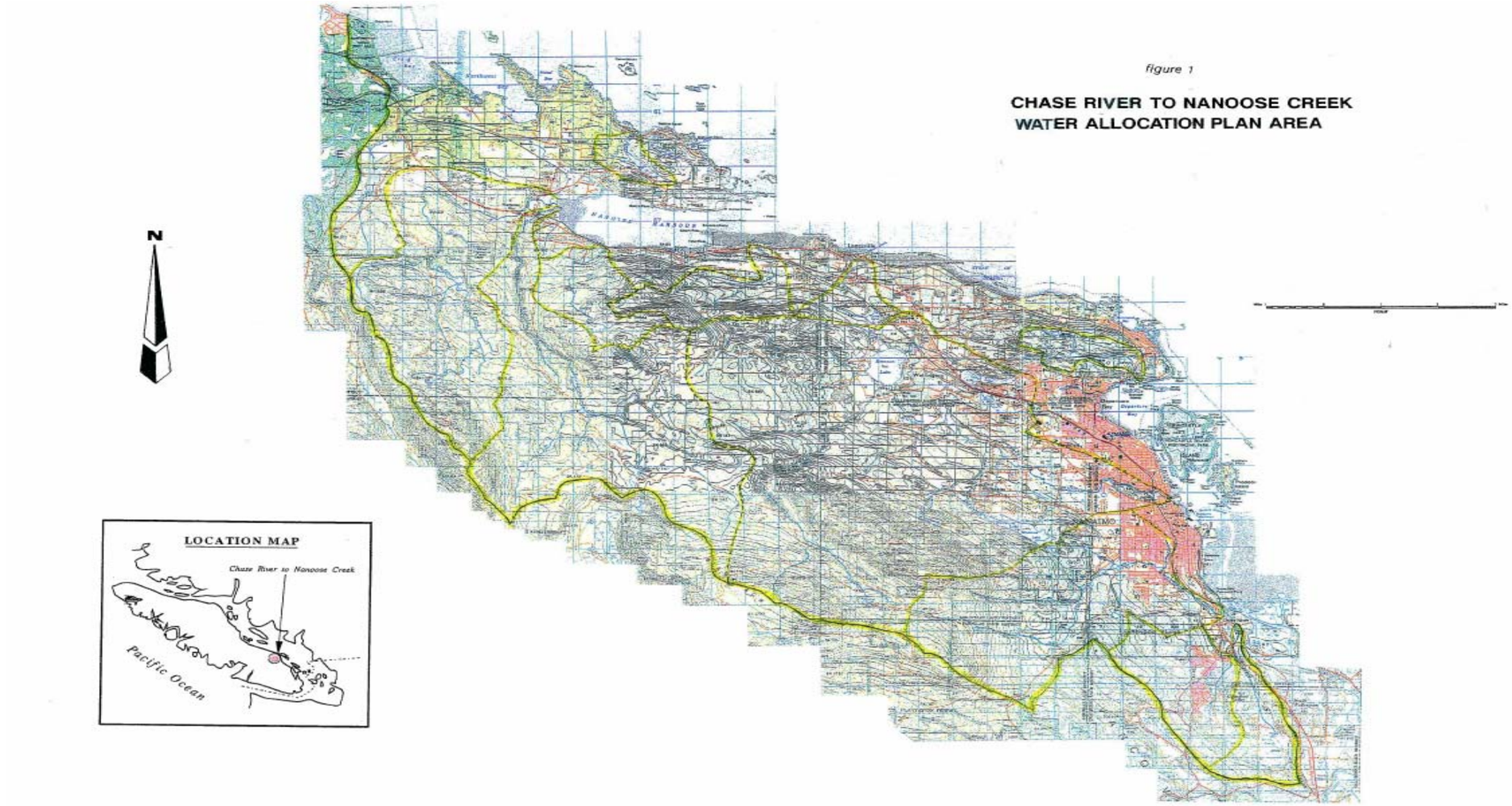
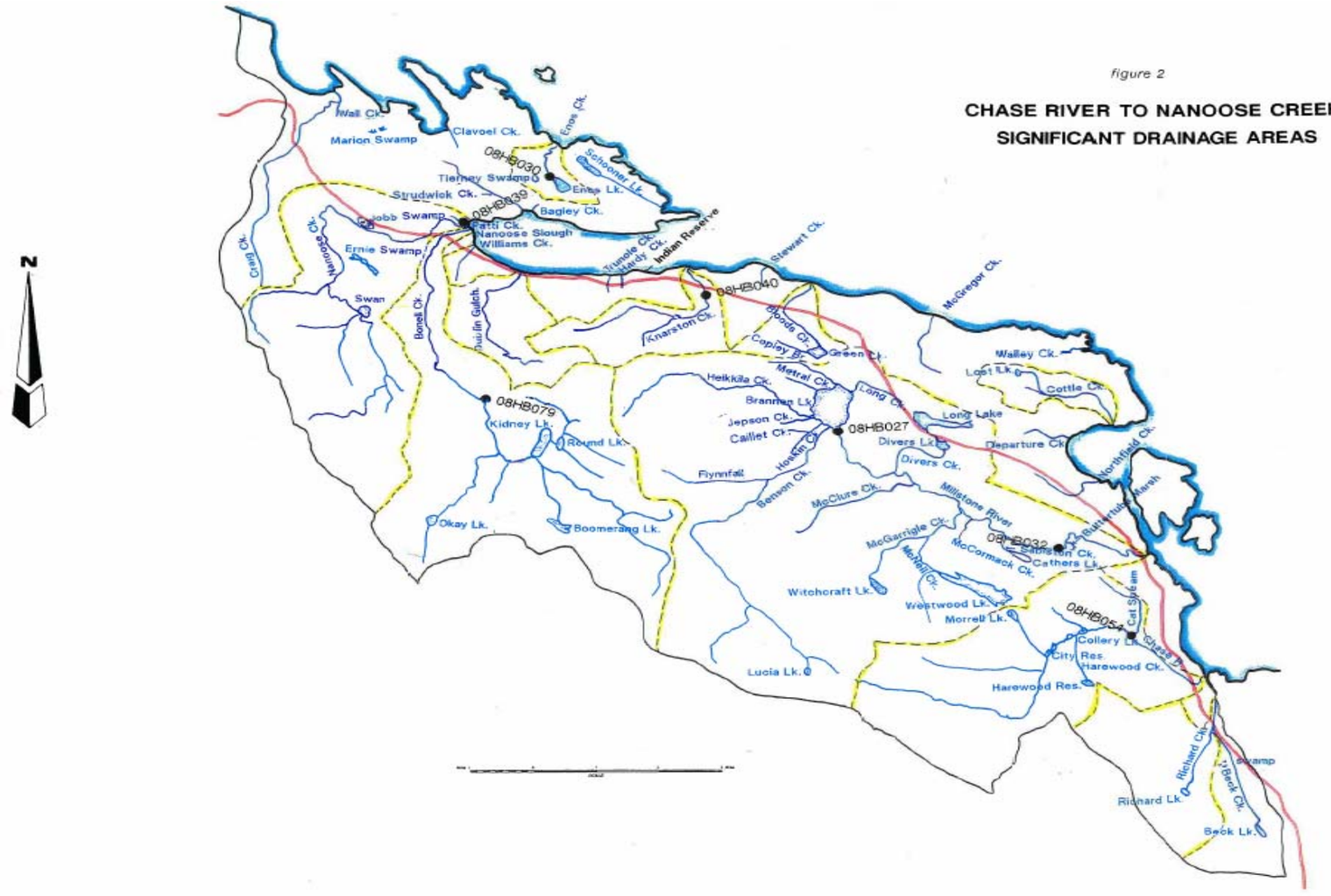


figure 2

CHASE RIVER TO NANOOSE CREEK
SIGNIFICANT DRAINAGE AREAS



3.0 HYDROLOGY

3.1 STREAMFLOW OBSERVATIONS AND MEASUREMENTS

3.1.1 Craig Creek

Craig Creek flows in a northerly and north-easterly direction from a maximum elevation of 500 metres to Craig Bay in the Strait of Georgia (Ocean). The total watershed area is 11.74 km². Eikanger, Wall and Hamilton Creeks are tributaries to Craig Creek.

The following flows were observed in the Craig Creek:

- 1.5 cfs on March 19, 1985 at south-western boundary of DL 172 (method not recorded),
- 43,200 gpd (0.08 cfs) on July 27, 1990 at Northwest Bay road culvert (bucket and stopwatch),
- 0.24 cfs on August 27, 1986 above Northwest Bay Road culvert (6 inch modified Parshall flume),
- Average low flows of 0.3 cfs during 1992 above Northwest Bay Road (6 inch modified Parshall flume),
- Average low flows of 5.7 litre per sec. (0.2 cfs) during 1993 above Northwest Bay Road (6 inch modified Parshall flume)

Wall Brook flows were measured at the dam on May 8,1979 and July 27, 1990 with 66,960 gpd (0.12 cfs) and 21,000 gpd (0.04 cfs) respectively by bucket and stopwatch. The upstream drainage area is 0.5 km² as planimetered from 1:50,000 topographic maps.

3.1.2 Enos Creek

Enos Creek originates on Nanoose Hill (elevation 250 metres) and flows through Enos Lake north to Ballenas Channel in the Strait of Georgia (Ocean).

Hydrometric station 08HB030 (Appendix A) on Enos Creek at the outlet of Enos Lake has flow records for 1962 to 1976 inclusive. The drainage area to this hydrometric station is 1.68 km².

Enos Creek has flow measurements taken by D. Kudrick during July to December 1982 and July to September 1983 at Dolphin Road which record the creek as dry during August and September both years. A measurement of 0.168 cubic metres per second (5.93 cfs) was recorded at Dolphin Road on Feb. 16, 1983 by current meter.

Hydrometric station 08HB031 (Appendix A) on Enos Lake near Nanoose Bay has water levels in 1962 to 1978. From these records it is noted that the lake level fluctuates 1.0 metres (3.28 feet) annually.

Two reports have been completed on a water supply from Enos Lake by Walker and Associates in June 1961 and Water Rights Branch in October 1973.

3.1.3 Strudwick Brook

Strudwick Brook has a drainage area of 5.5 km² as planimetered from 1:50,000 topographic maps. The Engineer's report dated Oct. 10, 1958 states that this brook is dry between May and November each year.

3.1.4 Williams Brook

William Brook has a drainage area of 1.82 km² and flows north into Nanoose Bay in the Strait of Georgia (Ocean). There are no flow measurements on file.

3.1.5 Dublin Gulch

Dublin Gulch flows north into Nanoose Bay and has a drainage area of 8.1 km². Flow measurements recorded for water licences (file 0365142) in Dublin Gulch are 3 cfs on March 13, 1974 at Highway, 0.1 cfs on September 29, 1979 below dam, and 4.5 cfs on Feb. 27, 1980 on lot 23 Plan 29314.

3.1.6 Indian Reserve Creek

Indian Reserve Creek flows from an average elevation of 107 metres in a northerly direction into Nanoose Bay. Measured flow reported in water licence File 0199850 on Indian Reserve Creek was 34,600 gpd (0.07 cfs) on September 10, 1974. Hydrometric stations 08HB051 on Indian Reserve Creek (North Fork) and 08HB052 on Indian Reserve Creek (South Fork) for years 1975 to 1979 indicate average flows of 0.001 cubic metres per second (0.03 cfs) for the months of May through to October.

3.1.7 Knarston Creek

Knarston Creek parallels Indian Reserve Creek and has had a number of low flow measurements recorded as follows:

- low of 0.015 cfs in 1977 from readings through the months of July to September taken upstream of Superior Road,
- low of 1 litre per second (0.03 cfs) flumed on September 11, 1985 at Knarston Creek near Lantzville,
- Hydrometric Station 08HB040 (Appendix A) on Knarston Creek at Superior Road has flow readings for April to September for the Years 1970 and 1971 which indicate low flows of 0.001 (0.035 cfs) and 0.002 (0.07 cfs) cubic metres per second for each year in August.

3.1.8 Bloods Creek

Bloods Creek drains from Green Lake in a northerly direction into Nanoose Bay. Engineer's report on File 0310385 states that Bloods Creek was dry on August 1, 1972. Zero flows were also recorded in this creek for the months of August, September and October in 1989.

3.1.9 Nanoose Creek

Nanoose Creek is located south of the Nanoose Peninsula and tributary to the head of Nanoose Bay (ocean) just north of Bonell Creek.

The watershed is approximately 10.8 km long with a maximum width of 4.3 km. The total watershed of Nanoose Creek to the ocean is 32.6 km^2. and the watershed upstream of the Island Highway is 29.0 km^2. The median elevation of the basin is 240 metres with the highest elevation on Okay Mountain at 888 metres.

Originating on Okay Mountain, Nanoose Creek meanders in a northerly direction for approximately 10 km. Near the Island Highway the creek turns east and flows parallel to the Highway for about 4 km before crossing and meandering to the ocean.

The minimum recorded streamflow at the Island Highway Bridge was 0.001 cubic metres per second (0.035 cfs). During the period of continuous flow measuring (1970-72), the minimum monthly discharge was 0.010 cubic metres per second (0.35 cfs). Low flow recording in 1992 and 1993 between July and September show minimum flows of 3.12 (0.11 cfs) litres per second.

3.1.10 Bonell Creek

Bonell creek is located south of the Nanoose peninsula and tributary to the Nanoose Bay (ocean). The watershed is approximately 15 km long with a maximum width of 7.5 km. The total watershed of Bonell Creek is 47.8 km² with 46 km² located upstream of the Island Highway bridge.

This creek originates at Cottle Lake then flows through Boomerang Lake and northward to Nanoose Bay. An unnamed creek flows through Round Lake and Kidney Lake to join Bonell Creek at the 295 metre elevation. Another unnamed creek rises in the southwest part of the watershed, flows through Okay Lake and connects to Bonell Creek at the 285 metre elevation. The highest elevation in the watershed is on Blackjack ridge at 920 metres.

Flow measurements taken at the Island Highway bridge during the period 1959 to 1986 are shown in Table 2.

Table 2 Streamflow - Bonell Creek @ Highway Bridge

Date	Discharge m^3/s	Agency
Sept 12, 1959	Nil	WSC
Sept 26, 1959	Nil	WSC
Oct 13, 1960	Nil	WSC
Jan 20, 1961	2.039	WSC
Jan 27, 1961	0.728	WSC
Sept 18,1961	Nil	WSC
Nov 17, 1961	0.702	WSC
Nov 23, 1961	0.532	WSC
Feb 5, 1962	0.957	WSC
Aug 15, 1985	Nil	BCE
Aug 27, 1986	Nil	BCE

From September 1990 to December 1991, a continuous flow measuring station (08HB079) was installed approximately 5 km upstream of the Island highway bridge by Water Survey of Canada. Streamflow measuring was initiated in response to a preliminary water supply study (Bonell Creek Water Supply Feasibility Study, Chatwin Engineering Ltd., 1989), proposing the use of Bonell Creek as a community water supply for the Regional District of Nanaimo (Nanoose peninsula) and the Lantzville Improvement District[1]. The data collected from this flow measuring station located above the lower gravels reaches is shown in Appendix A. The minimum daily flow of 0.001 cubic metres per second (0.035 cfs) was recorded for a total of 29 days during the 16 month period of record. The minimum mean monthly flow of 0.007 cubic metres per second (0.25 cfs) was recorded during July 1991.

The data confirms past observations that during the summer there is no flow in Bonell Creek near the Island Highway while there is flow in the upper reaches of the creek. Near the Highway, the creek has a gravel bed and water flowing into this reach percolates downwards into the gravels and flows underground towards Nanoose Bay.

[1] The Bonell Creek Water Study was put on hold as the Regional District is pursuing the possibility of using the Engishman River with storage on Arrowsmith Lake to serve the area from Lantzville to Qualicum Beach inclusive.

3.1.11 Millstone River

The Millstone River originates at the 619 metre (2030 ft) elevation around Lucid Lake, west of Mount Benson which at elevation 1019 metre (3340 ft) is the highest point in the watershed. Benson Creek flows from Lucid Lake in a northerly direction into Brannen Lake. Several other small creeks (Metral, Heikkila, Jepson and Long) also flow into Brannen Lake. The Millstone River drains Brannen Lake flowing generally in a southeasterly direction into the Strait of Georgia at the Nanaimo Harbour. Downstream of the Brannen Lake outlet, Divers, Cathers, Long and Westwood Lakes drain into the Millstone River. The total drainage area of the Millstone river is 93.2 km² of which 46 km² is above Brannen Lake.

There are two Water Survey of Canada hydrometric stations on the Millstone River- Millstone River at Nanaimo (08HB026) and Millstone River near Wellington (08HB027) The streamflow records are shown in Appendix A. From these records, the 7-day average low flows for Millstone River are shown in Table 3.

Table 3 Millstone River - 7Day Average Low Flows

Station	Drainage Area (ha)	Return Period Estimate (m^3/s)		
		Mean	5 year	10 year
08HB032 Millstone R @ Nanaimo	86.2	0.009	0.003	0.002
08HB027 Millstone R nr Wellington	46.1	0.015	0.000	0.000

Water levels were recorded on Long Lake near Wellington (08HB028) from 1973 to 1978 and on Brannen Lake Near Wellington (08HB026) from 1962 to 1978 (Appendix **). These measurements indicate that Long Lake's water level fluctuated approximately 0.294 metres (0.96 ft) each year and Brannen Lake's water level approximately 0.615 metres (2.0 ft).

In addition to the WSC Hydrometric stations, further information related to stream flows and water volumes are available from past site inspections, reports and observations related to water licence applications and other activity, these are:

- Govt. of Canada/Mines Department, 1969 flow readings in McNeil Creek at Westwood Lake recorded zero flow August 6,
- Zero flow recorded at outlet of Westwood Lake on September 10, 1966 (Westwood Lake assessment report Dec. 15, 1986),
- BCE, 1977 stream flow readings from July to September on the Millstone with minimum reading of 0.08 cfs on August 20,
- Engineer's Report on file 0221007 recorded streamflow in the Millstone as 1 cfs on August 7, 1958
- Approximately 20 cfs was measured at outlet of Lucid lake on April 29, 1974 by a Fish and Wildlife technician.

3.1.12 Chase River

The Chase River originates on the south slopes of Mount Benson and flows eastward through the southend of the City of Nanaimo to the ocean (cove near Nanaimo River estuary). Several small streams including Harewood Creek and Cat Stream are tributary to the Chase River.

The Chase River's total watershed area is 34.6 km^2 of which 34.4 km^2 is located upstream of the Island Highway. The maximum elevation within the drainage area is 900 metres and the median elevation above the WSC station is 205 metres.

A Water Survey of Canada Station 08HB054 (Appendix A) was situated on the Chase River at the Park Avenue bridge during the low flow period for the years 1976 to 1978 inclusive. The drainage area above this station is 28.6 km^2. The monthly mean discharges are shown in Table 4.

Table 4 Chase River WSC 08HB054 Monthly Mean Discharges (m^3/s)

Year	Apr	May	June	July	Aug	Sept	Oct
1976	0.968	0.372	0.169	0.083	0.117	0.128	-
1977	0.502	0.216	0.073	0.067	0.066	0.146	0.216
1978	0.842	0.438	0.120	0.053	0.147	0.335	-
Mean	0.771	0.342	0.121	0.068	0.110	0.203	0.216

During 1985, several low flow measurements were also taken by BCE. On September 10, the flow was 0.084 m^3/s and on September 12, the flow was 0.089 m^3/s.

From the limited streamflow records, low flow conditions are summarized in Table 5.

Lakes in this watershed include three Colliery Park Lakes on the main stem of the Chase River and Harewood Lake tributary to Harewood Creek. The Greater Nanaimo Water District maintains an open storage reservoir beside the Chase River in Colliery Dams which is not part of the Chase River water storage supply.

Table 5 Chase River WSC 08HB054 - Summary of Low Flow Conditions

Minimum 1985 Low Flow Measurement	0.084 $m^{3/}s$
WSC Stn 1976-78 - Min Daily	0.017 m^3/s
" - Min Mean Monthly	0.068 m^3/s
" - 1976 Avg 7day Low Flow[1]	0.071 $m^{3/s}$
" - 1977 " [1]	0.022 m^3/s
" - 1978 " [1]	0.024 m^3/s
[1] - RER Water Licence file #0355097	

3.1.13 Richard Creek

The Richard Creek flows in a northerly direction from Richard Lake at the south side of the City of Nanaimo from a maximum elevation of 220 metres into the Nanaimo River estuary.

Drainage area for Richard Creek is 11.5 km² as planimetered from a 1:50,000 maps. There is no flow in Richard Creek for a short distance before it joins Beck Creek in the low flow periods.

3.1.14 Beck Creek

Beck Creek flows parallel to Richards Creek from Beck Lake to Nanaimo River estuary. Flows downstream of Beck Lake are zero in the summer.

3.1.15 Stewart Creek

Stewart Creek flows into Nanoose Bay. There are no flow records.

3.1.16 Other Small Watersheds

Several springs and small "lakes" have been measured or flows estimated:

- **Lewis Spring** - in Water Licence File 1000489, the flow was reported as 1 gal/min. in Aug. and Oct.
- **Benjamin Spring** - in water licence File 0270772, the flow was reported as 10 gal/min. in Dec 1969 by E.W. Weeks,
- **Cozens Spring** - in water licence File 1000077 the flow was recorded as 5000 gal/day in August 1984,

- **Lyons Spring** - in water licence File 0281886 the flow was estimated as 6000 gal/day in September 1976,
- **Alton Springs** - in water licence File 0342209 a pump test recorded the supply from this spring at 7500 gal/day in October 1976,
- **Melvin Spring** - in water licence File 270642 this spring was estimated at 300 to 400 gal/day.
- **Arthur Lake** - no outflow was reported in water licence File 0317145 for this "lake" in August 1973 and surface area was recorded as 3 acres.

Several springs have dugouts or ponds associated with the works.

3.2 MEAN ANNUAL DISCHARGE

Within the Plan area, the only long term streamflow measuring stations operating on an annual basis are located on the Millstone River and Enos Creek. For these watersheds, the Mean Annual Discharges are based on actual measurements. For all other watersheds within the Plan Area that have limited or no measuring, an estimation of the Mean Annual Discharge is utilized.

3.2.1 Millstone River

From the available WSC streamflow records on Millstone River, the mean monthly and annual discharges are shown in Tables 6 and 7 with the streamflow hydrographs are also shown in Figures 3 and 4.

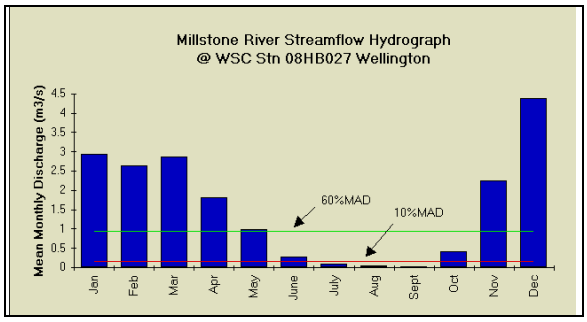


Figure 3 Millstone River at Wellington WSC 08HB027 - Streamflow Hydrograph

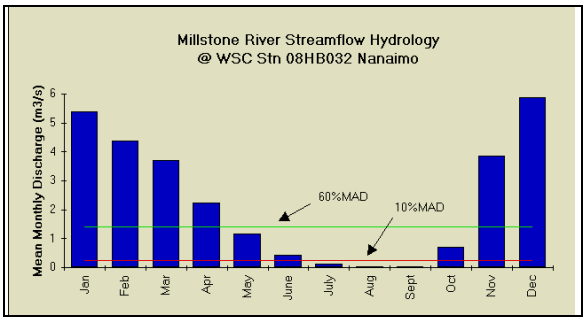


Figure 4 Millstone River at Nanaimo WSC 08HB032 - Streamflow Hydrograph

Table 6 Millstone River near Wellington (WSC 08HB027)

	Distribution of Mean Annual Discharge												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	MAD
%MAD	189	169	183	116	64	18	7	3	1	26	144	281	
m^3/s	2.94	2.64	2.86	1.81	0.99	0.27	0.10	0.04	0.02	0.40	2.25	4.38	1.56

The **mean annual discharge was 1.56 m^3/s at WSC Station 08HB027** located at the Brannen Lake outlet to the Millstone River. As the upstream drainage area is 46.1 km^2, the **mean annual runoff is 1067 mm** and the **annual yield is 49,196 dam^3**

Table 7 Millstone River @ Nanaimo (WSC 08HB032)

	Distribution of Mean Annual Discharge												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	MAD
%MAD	232	188	160	96	50	19	5	1	1	30	166	254	
m^3/s	5.37	4.37	3.70	2.23	1.16	0.44	0.11	0.03	0.03	0.70	3.86	5.88	2.32

The **mean annual discharge was 2.32 m^3/s at WSC Station 08HB032** located at the Bowen Road bridge over the Millstone River. As the upstream drainage area is 86.2 km^2, the **mean annual runoff is 849 mm** and the **annual yield is 73,164 dam^3**

3.2.2 Enos Creek

The annual volume of water available in this area is estimated using the historical streamflow summary for Enos Creek at outlet of Enos Lake (station 08HB030, Appendix A). The **mean annual discharge was 0.036 m^3/s** at the WSC station for the period 1962-1978 inclusive. The mean monthly and annual discharge is shown in Table 8 with the streamflow hydrograph shown in Figure 5.

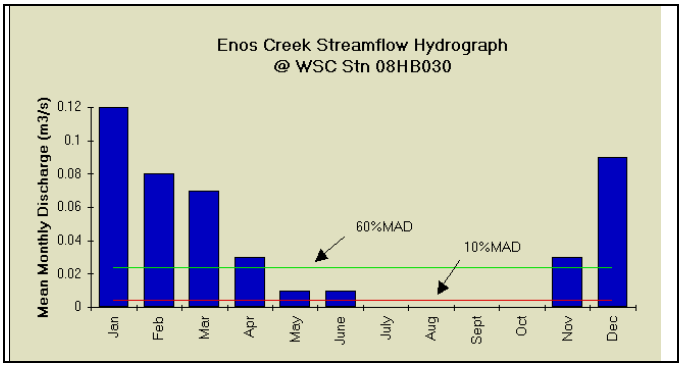


Figure 5 Enos Creek @ WSC 08HB030

Table 8 Enos Creek @ Outlet of Enos Lake (WSC 08HB030)

	Distribution of Mean Annual Discharge												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	MAD
%MAD	328	211	194	72	17	19	3	0	0	6	92	261	
m^3/s	0.12	0.08	0.07	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.09	0.04

As the upstream drainage area is 1.68 km^2, the **mean annual runoff is 676 mm** and the **annual yield is 1,135 dam^3**.

3.2.3 Estimation of Mean Annual Discharge in Ungauged Basins

As the other streams within the Allocation Plan area that have limited or no streamflow records, the hydrologic characteristics of these watersheds must be inferred from regional Water Survey of Canada stations. The stations used in this analysis are listed in Table 9. The stations are all located on the east coast of Vancouver Island in the same bio-climatic zone and have a similar stream profile and aspect.

Table 9 Regionalization of Streamflow

Regional Water Survey of Canada Stations					
Station number	Station Name	Drainage Area (km^2)	Median Elevation (m)	Mean Discharge (m^3/s)	Mean Annual Runoff (mm)
08HB032	Millstone @ Nanaimo	86.2	260	2.32	849
08HB027	Millstone @ Wellington	46.1	340	1.56	1067
08HA003	Koksilah @ Cowichan Stn	209	508	9.63	1453
08HA001	Chemainus @ Westholme	355	620	19.1	1697
08HB002	Englishman @ Parksville	324	570	13.9	1353
08HB003	Haslam Creek @ Cassidy	95.6	595	4.38	1445
08HB030	Enos Cr @ Enos Lake	1.68	80	0.036	676
08HA016	Bings @ mouth	15.5	170	0.46	936

Several methods based on median elevation, drainage area and precipitation were compared, with a median elevation - annual runoff relationship being the most efficient. The relationship is shown in Figure 6.

Therefore, estimation of streamflow in ungauged basins located in the Allocation Plan area is based on the median elevation - mean annual runoff relationship. By using the slope and y-axis intercept from the regression line (R^2=0.92), the following formula is derived.

$$y = 1.62x + 547$$

where y = mean annual runoff (mm)
x = median elevation (m)

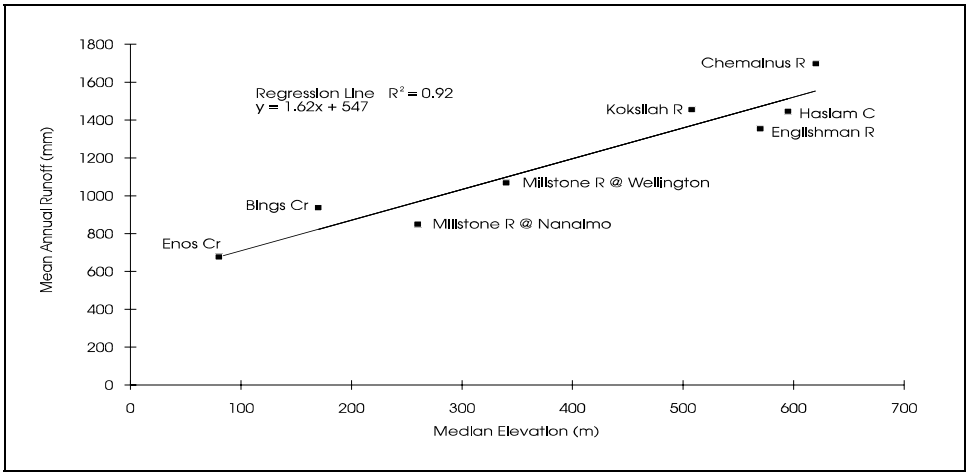


Figure 6 Mean Annual Runoff at Gauged Basins

The mean annual runoff (mm) can be converted to Mean Annual Discharge (m^3/s) by using the watershed area of the ungauged basin. The Mean Annual Runoff and Mean Annual Discharge for ungauged basins within the Plan area are shown in Table 10.

Table 10 MAD for Ungauged Basins

Drainage	Area (km²)	Median Elevation (Metres)	Annual Runoff (mm)	MAD (cms) #
Craig Creek	11.7	90	693	0.25
Strudwick Brook	5.5	40	612	0.11
Williams Brook	1.8	60	644	0.04
Dublin Gulch	8.1	270	984	0.02
Indian Reserve	1.0	70	660	0.16
Knarston Creek	7.6	200	871	0.21
Bloods creek	4.2	100	709	0.09
Departure Creek	2.4	70	660	0.05
Cottle Creek	3.8	140	774	0.09
Nanoose Creek	32.6	240	936	0.97
Bonell Creek	47.8	390	1179	1.79
Chase River	34.6	205	879	0.96
Beck Creek	6.7	50	628	0.13
Richards Creek	11.5	85	684	0.25
Stewart Creek	4.2	80	677	0.09

* Annual Runoff = 1.62(median elevation)+547
\# MAD(cms) = drainage(km²) x annual runoff(mm) x 0.0000317

In order to develop a monthly streamflow hydrograph based on the above estimate, the average of the monthly percentages of MAD at each WSC gauged basin was used. The resultant distribution of MAD is shown at the top of Table 11. At all of the regional gauged basins, the minimum mean monthly flow was less than 10% of Mean Annual Discharge. The months where mean monthly discharge is greater than 60% are November to April inclusive.

For the major ungauged streams within the Plan area, the estimated distributions of MAD are shown in Table 11 with the streamflow hydrographs are shown in Appendix B.

Table 11 Mean Annual Discharge for Ungauged Basins

Chase to Nanoose Water Allocation Plan - Ungauged Streams Estimated Distribution of Mean Annual Discharge													
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
% MAD used for Mean Monthly Flow		201	187	154	102	60	27	11	4	6	45	165	248
STREAM	MAD	MEAN MONTHLY FLOW (m^3/s)											
Craig	0.25	0.50	0.47	0.39	00.26	0.15	0.07	0.03	0.01	0.01	0.11	0.41	0.62
Strudwick	0.11	0.22	0.21	0.17	00.11	0.07	0.03	0.01	0.004	0.007	0.05	0.18	0.27
Williams	0.04	0.08	0.08	0.06	0.04	0.02	0.01	0.004	0.002	0.002	0.02	0.07	0.10
Dublin	0.02	0.04	0.03	0.03	0.02	0.01	0.005	0.002	0.001	0.001	0.01	0.03	0.05
Indian	0.16	0.30	0.30	0.25	0.16	0.10	0.04	0.02	0.006	0.01	0.07	0.26	0.40
Knarston	0.21	0.42	0.39	0.32	0.21	0.13	0.06	0.02	0.008	0.01	0.09	0.35	0.52
Bloods	0.09	0.18	0.17	0.14	0.09	0.05	0.02	0.01	0.004	0.005	0.04	0.15	0.22
Departure	0.05	0.10	0.09	0.08	0.05	0.03	0.01	0.006	0.002	0.003	0.02	0.08	0.12
Cottle	0.09	0.18	0.17	0.14	0.09	0.05	0.02	0.01	0.004	0.005	0.04	0.15	0.22
Nanoose	0.97	1.95	1.81	1.49	0.99	0.58	0.26	0.11	0.04	0.06	0.44	1.60	2.41
Bonell	1.79	3.60	3.35	2.76	1.73	1.07	0.48	0.2	0.07	0.11	0.81	2.95	4.44
Chase	0.96	1.93	1.79	1.48	0.98	0.58	0.26	0.11	0.04	0.06	0.43	1.58	2.38
Beck	0.13	0.26	0.24	0.20	0.13	0.08	0.04	0.01	0.005	0.008	0.06	0.21	0.32
Richards	0.25	0.50	0.47	0.39	0.26	0.15	0.07	0.03	0.01	0.01	0.11	0.41	0.62
Stewart	0.09	0.18	0.17	0.14	0.09	0.05	0.02	0.01	0.004	0.005	0.04	0.15	0.22

3.3 LAKES, PONDS, SWAMPS AND MARSHES

The available data for lakes, ponds and swamps in the plan area is summarized in Table 12

Table 12 Lakes, Ponds and Swamps - Available Data

Lake	Surface Area (ha)	Volume (dam3)	Bath Survey	Depths Max/Mean (m)	Control on Lake	Comments
Enos	18.2	866	yes	13/6	yes	waterworks, irrigation
Schooner	7.82*	77	no	2/1	yes	industrial (golf course)
Green	13.06*	759	yes	9.0/5.7	no	irrigation use - beaver activity at outlet
Cottle	2.75*	-	no	-	-	
Lost	1.9*	-	no	-	-	
Boomerang	10.9	567.4	yes	12.5/5.2	no	
Cottle	2.8	106.1	yes	9.1/3.8	no	
Kidney	6.9	331.8	yes	14.6/4.8	no	
Okay	4.2	-	no	-	no	
Round	3.7	170.1	yes	10.0/4.6	no	
Brannen	46.1	-	yes	-	no	fisheries/aesthetics
Westwood	62.7	2714	yes	7.0/4.3	yes	fisheries/land improvement
Long	33.6	2047	yes	14.0/6.0	no	fisheries/ recreational/ aesthetics
Diver	15.5	521	yes	7.0/3.3	no	fisheries/ recreational
Witchcraft	4.62*	-	no	-	yes	man-made with control in poor condition
Cathers	4.5	85	yes	3.8/1.9	yes	irrigation/fisheries/ aesthetic
Buttertubs	18.2	185		mean 1.0	yes	bird sanctuary
Lucid	3.9	59.9	yes	3.0/1.6	no	fisheries
Colliery #1	1.43	78.8	yes	10.0/6.0	yes	recreational
Colliery #2	1.42	80.1	yes	10.0/5.6	yes	recreational
Colliery #3	0.6	13.5	yes	6.0/2.0	yes	recreational
Harewood	7.59	-	yes	max 7.2	yes	recreational
Richards	3.6	57.7	yes	3.5/1.6	no	irrigation/fisheries/ aesthetic/beaver activity at outlet
Beck	7.3	-	-	max 3.4	no	fisheries/irrigation
* as measured from NTS 1:50000 maps						

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 also providing instream flow requirements for water quality, recreational, aesthetic and cultural values. The Provincial Ministry of Environment 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 modified version of the Tennant (Montana) Method as shown in Table 13.

Table 13 Fisheries Criteria

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 drainages 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 following Regional policies were developed to implement the Provincial directive.

> **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 licensed demands should only be allowed for the period of months when the mean monthly flow is above 60% of the MAD**

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 when the mean monthly flow is above 60% of the MAD (Figure 1.3). Where the mean 7-day average low 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%.

All streams within the Plan area have minimum mean monthly discharges of less than 10% of the MAD (Section 3.2). Extractive demands are only available during the period November to April inclusive when mean monthly flow is greater than 60% of MAD.

4.1 IDENTIFIED FISH VALUES

Fisheries habitat information for streams within the Plan area is shown on Figure 7. Fisheries values are described below for the major streams,

4.1.1 Craig Creek

Craig Creek has important fish values for both Coho salmon and Cutthroat trout. However, the gravel bar at the mouth prohibits the upstream movement of salmon and trout until the flow increases to allow them to move upstream to spawn.

4.1.2 Enos Lake

Enos Lake contains a population of Sticklebacks which are only found in the Lake itself. The Committee on the Status of Endangered Wildlife in Canada has classified this species as "threatened" because of the threat to subdivision and water withdrawals from Enos Lake. This will become an issue when further development is proposed.

The lake outflow is reportedly dry during July to October and therefore does not contribute outflow to maintain low flows downstream in Enos Creek.

4.1.3 Green Lake

Green Lake has been stocked with Rainbow and Cutthroat trout over the last four years.

The outlet of Green Lake supports a spawning population of lake fish that leave the lake to spawn in the creek. It is assumed the progeny of these fish are able to get back into the creek before it drys.

The lake outflow is reportedly dry in July, August and September and therefore does not contribute outflow to maintain low flows downstream in Bloods Creek for fish. However, it should be mentioned that Bloods Creek has a run of Coho salmon and Cutthroat trout in the lower section.

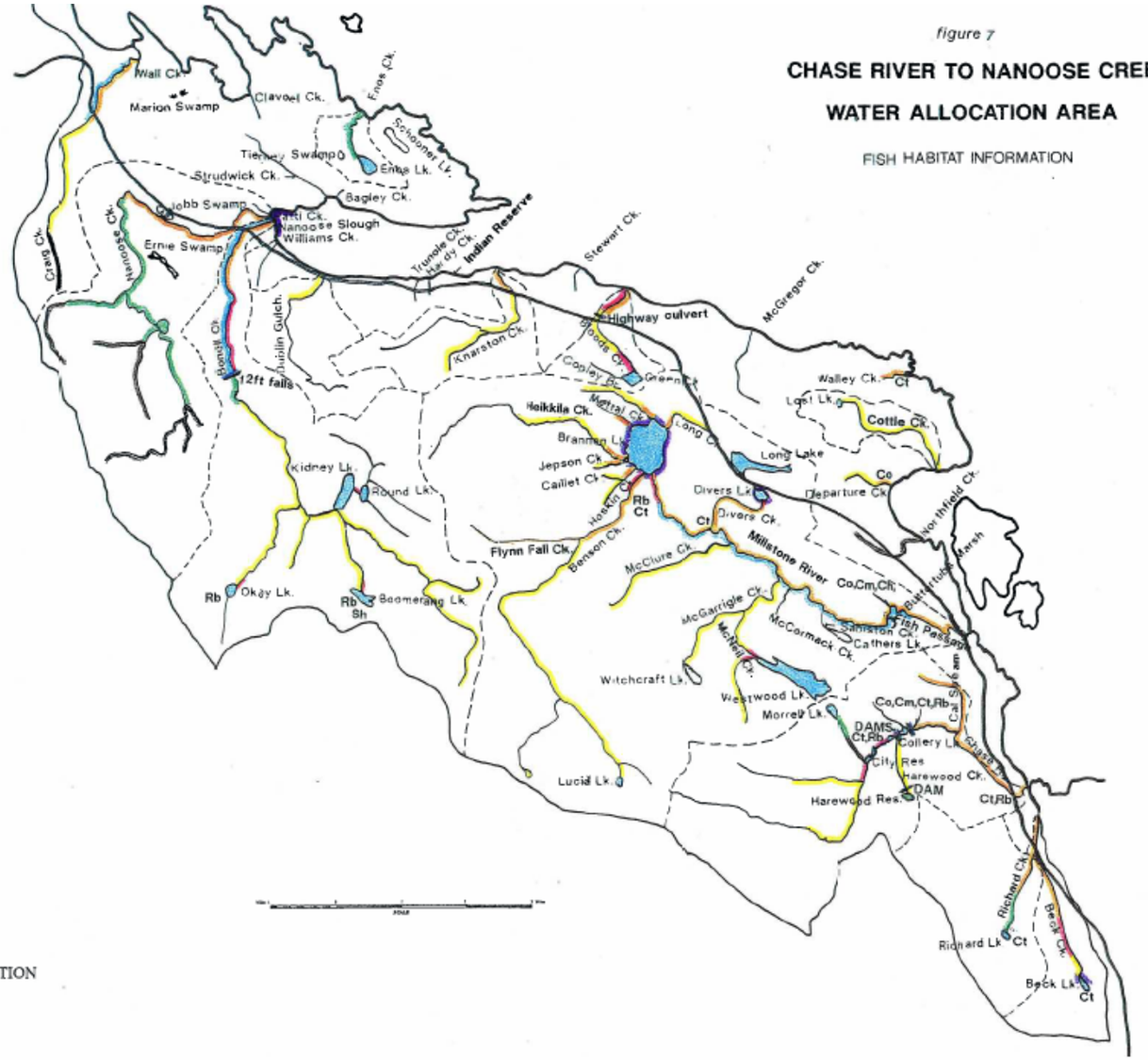
4.1.4 Nanoose Creek

Nanoose Creek is a valuable producer of Cutthroat trout, Coho and Chum salmon. Steelhead trout are observed up to 4 km. from the mouth.

figure 7

CHASE RIVER TO NANOOSE CREEK WATER ALLOCATION AREA

FISH HABITAT INFORMATION



KEY

	SPORT FISHING WATER
	ANADROMOUS FISH WATER
	POTENTIAL FISH HABITAT
	NON ANADROMOUS FISH WATER
	NO VALUE AS FISH HABITAT
	KNOWN SPAWNING AREA
	FALLS
	HIGH CAPABILITY BIOTIC LAND
Ct	RESIDENT CUT THROAT
Rb	RAINBOW
Co	COHO
Ch	CHINOOK
Pk	PINK
Sk	SOCKEYE
Sh	STEELHEAD
Smb	SMALL MOUTHED BASS
Cm	CHUM
S	STOCKED

BRANNEN LAKE
Rb, Ct, S
LONG LAKE
Rb, Ct, Smb, S
GREEN LAKE
Rb, Ct, Smb, S
WESTWOOD LAKE
Rb, Ct, S

NOT COMPLETE INFORMATION
CONTACT FISHERIES SECTION
FOR MORE UP TO DATE INFORMATION

4.1.5 Bonell Creek

Although the mouth of the Bonell Creek dries up in the summer, Chum can enter and leave between fall and spring. Coho fry hatch in the spring and spend a year in the upstream pools before leaving the following spring.

Lakes (Boomerang, Cottle, Kidney, Okay and Round) within the Bonell watershed are actively stocked and supports a moderately strong sports fishery.

4.1.6 Millstone River

The Millstone River is accessible to anadromous fish to Brannen Lake. Smolts from the Big Qualicum hatchery have been stocked in the lower Millstone on a number of occasions and Steelhead trout have been observed spawning in the upper reaches of the lower Millstone.

A fishladder has been placed in the Millstone River at the Falls site at Bowen Park to accommodate fish movement in the lower reaches .

Brannen, Cathers, Divers, Long, Lucid, and Westwood Lakes have been stocked with either Rainbow or Cutthroat trout.

During the low flow period, Brannen Lake contributes a significant percentage of the downstream flow in the Millstone River.

4.1.7 Chase River

There are fish in the Chase River, Harewood Creek, Cat Stream and their associated lakes.

The Collery Dam Lakes are stocked, however, the remaining lakes in the Chase River system maintain natural populations of trout. The outflows are regulated from these lakes to maintain downstream flows in the Chase River for fish.

4.1.8 Beck (Hong Kong) Creek

Beck Lake maintains a natural and stocked population of fish. There are reports of no outflow during the summer months and, therefore, the lake does not contribute to downstream flows in Beck Creek during the summer for fish.

Hong Kong Creek is heavily used by adult Cutthroat trout and Coho salmon.

4.1.9 Richard Creek

Richards Lake maintains a natural and stocked population of fish. There are reports of no outflow during the summer months and, therefore, the lake does not contribute to downstream flows in Richards Creek during the summer for fish.

There is limited information on fish or fish flow requirements for other small streams in the Plan area. These small streams experience "no flow" conditions for approximately six months of the year and it is unlikely that they maintain sufficient flows to support any significant fish populations. Therefore, it will be assumed that there are no instream flow requirements on other small streams in the plan area unless further studies indicate otherwise.

5.0 LICENSED WATER DEMAND

5.1 EXISTING LICENSED DEMAND

Water licence information is available on the WLIS database. For the Plan area, a list of water licences within this Plan area are shown in Appendix D. A summary of the existing licensed demand by purpose is shown in Table 14.

Table 14 Licensed Demand Summary

Licensed Demand by Purpose			
Purpose	Quantity/Units	Equivalent Low Flow & Volume *	
		litres/second	dam3
Waterworks	767000 gpd	39.95	528.1
Domestic	117925 gpd	6.14	81.2
Irrigation	453.87 acft	71.26	559.8
Industrial	366.4 gpd	91.09	383.1
Total Extractive Demand			
Storage	791.34 acft	-124.24	-976.1
Total Unsupported Demand		-33.15	-593.0
* based on 90 day irrigation period			

Existing licensed water demand is summarized by the percentage each represents of the total water demand during the low flow period in Figure 8.

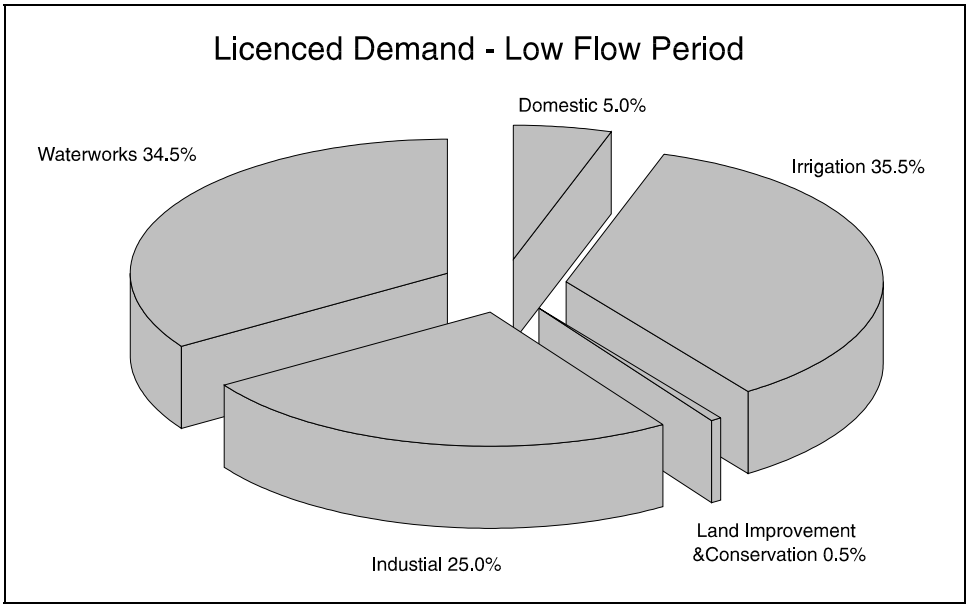


Figure 8 Existing Water Demand

5.2 PROJECTED DEMAND

Over 20 water licence demands are pending as of November 1993. A summary of the pending applications by purpose/use is shown in Table 15 and is detailed in Appendix E.

Most of the population is served by community water supplies (Appendix F). The Greater Nanaimo Water District is the largest supplier of water with two member districts, namely the City of Nanaimo and the Southwest Extension Waterworks District. This water system is supplied from the Nanaimo River watershed (Jump Creek) which is outside the Chase to Nanoose Allocation Plan area. The other community water supplies are located to the north of the City and include Lantzville Improvement District, Sunset Beach Improvement District, Williams Spring Waterworks District, and the Specified Areas on the Nanoose peninsula which are operated by the Regional District of Nanaimo. These smaller systems have both surface and groundwater sources that are experiencing problems with meeting the increasing water demand. The Regional District is studying the feasibility of using the Englishman River watershed as a source of water for all water systems located from Lantzville to Qualicum Beach inclusive.

Future water demands in the plan area are anticipated to be for domestic, irrigation, and small industrial (associated with agricultural and commercial) purposes. Some waterworks purpose demands associated with subdivision development outside of existing community water utility areas where groundwater is inadequate. There is insufficient water in the plan area for process water or for significant hydro electric development.

Table 15 Licence Application Summary

License Application by Purpose			
Purpose	Quantity/Units	Equivalent Low Flow & Volume *	
		litres/second	dam3
Domestic	3000 gpd	0.16	2.1
Irrigation	112 acft	17.81	138.0
Industrial	2595 gpd	118.48	3193.9
Total Extractive Demand		136.45	3332.0
Storage	2582 acft	-117.96	-3185.0
Total Unsupported Demand		18.48	147.1
* based on 90 day irrigation period			

6.0 CONCLUSIONS

The population of the Allocation Plan area is rapidly increasing. The greatest increase in development and population is within areas served by community water supplies. For future demand, the City of Nanaimo will continue to use water supplied by Nanaimo River watershed and the Regional District of Nanaimo is pursuing the use of the Englishman River both of which are outside the Plan area.

During the summer low flow period, there are zero flow or flows below 10% of mean annual discharge in all streams within the Plan area.

There is fish and fish habitat in all significant streams within the Plan area. Fish migration, rearing and habitat maintenance are limited by existing low flows. The fish agencies and local sports groups are very active in fish stocking and enhancement work in the creeks and lakes.

Further extractions of water from Brannen and Green Lakes may reduce the critical low flows downstream. To maintain primary habitat for fish in the lakes the shoal area or top 6 metres (20 feet) of the lakes height shall not be reduced by more than 10%.

Recreational use of the water systems are high in the Plan area.

Brannen Lake has a high nutrient level in the water and any water withdrawal in the summer months will aggravate water quality (see Whately letter in appendix)

Brannen, Cathers, Divers, Long and Westwood Lakes all have adjacent residential development that may be affected by storage proposals.

Estimated evaporation losses from lakes is 0.3 metres per year.

To maintain primary fish habitat in the shallow Beck Lake and Richard Lake, no further water is available for significant extractive demands during the period from May to October unless further storage is developed to support the demand.

Diversion structures must be capable of maintaining existing base flows and providing fish passage.

There is adequate water available during the high flow period (November through April) for storage to support water use during the low flow period (July through September) demands without adversely affecting instream fish flow requirements. A summary of water from significant streams during the high flow period is shown in Table 16.

Table 16 Water Available during High Flow Period

Water Available during November to April inclusive			
Drainage	**Drainage Area (km^2)**	**Volume Available**	
		dam^3	**ac-ft**
Craig Creek	11.7	4263	3456
Strudwick Creek	5.5	1920	1556
Enos Creek	2.7	1286	1043
Williams Creek	1.8	808	655
Dublin Gulch	8.1	366	296
Hardy Creek	7.6	3732	3025
Indian Reserve Creek	1.0	3447	2794
Stewart Creek	4.2	1694	1373
Cottle Creek	3.8	1696	1375
Bloods Creek	4.2	1694	1373
Departure Creek	2.4	888	720
Nanoose Creek	32.6	17685	14337
Bonell Creek	47.8	32428	26290
Millstone River	93.2	78808	63890
Chase River	34.6	16973	13760
Beck and Richard Creek	18.2	6567	5323

7.0 RECOMMENDATIONS

7.1 DOMESTIC

A domestic water licence shall be 2,273 l/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 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.

A domestic water licence should not be used as evidence of a "adequate water supply" for subdivision development and speculative purposes. Large subdivisions shall be encouraged to form an approved community water system.

To ensure an adequate water supply, applicants should be prepared to develop storage or use lake storage. For the average daily demand of 1,136 l/day (250 gpd) for a five month period (150 days) a volume of 0.17 dam^3 (6000 ft^3 or 0.14 acre feet) is to be recommended. This requires a reservoir or dugout approximately 6.1 m (20 feet) wide by 9.1 (30 feet) long, with an average depth of 3.4 m (11 feet) allowing for 0.3 m (1 foot) for evaporation loss.

A spring shall be licensed for an individual domestic water demand provided that it is 30 m apart from any existing licensed springs. Multiple water licensing of one spring will be permitted if water is available. The onus is on the applicant to determine the flow yield and to satisfy the written concerns and objections of existing water licensees.

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. meters) is not usually required on domestic water use. But screening of intake works shall be required to prevent fish or debris entering the works.

7.2 WATERWORKS

Waterworks purpose demand includes 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.

Water required for waterworks licences shall be based upon a ten year projected maximum daily and annual demand; except that a longer projected demand period shall be authorized where the capital cost of construction of works must be amortised over a longer period.

Adequate balancing storage on the distribution system shall be required to ensure that the rate of withdrawal from the source during short term or maximum hour demand does not exceed the maximum daily demand. Good conservation techniques must be practised at all times and no increase in the amount of water in the existing community waterworks licences shall be allowed

unless meters and other conservation measures have been used.

It is recommended that the applicant for a waterworks water licence be required to provide the ten year projected maximum daily and annual demands and the projected volume of balancing storage.

All waterworks water licence applications require a storage at the source stream except where the water supply is from a lake that has water available within 10% of the shoal area.

To maintain primary habitat for fish in the lakes the shoal area or top 6 metres (20 feet) of the lakes height shall not be reduced by more than 10%.

Diversion structures must be capable of maintaining existing base flows and providing fish passage.

7.3 IRRIGATION

The soil type, crop rooting depth and climatic characteristics determine requirements for irrigation. The soils in the Chase to Nanoose Water Allocation Area, for the purpose of potential irrigation demands, were classified into groups as indicated on the Soils map found in the Appendix G. Many of the soil associations on the map were composites of two or three soil associations. Composite map symbols were used on the soils map where two or three soil associations are intermixed or occupy such small areas that they cannot be separated at the scale of the mapping. Only the predominant soil association was considered and colour mapped for irrigation requirements. Where more specific soil assessment are made available for a given area, that soil assessment may be used to assess irrigation demands.

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

CHASE RIVER TO NANOOSE CREEK
WATER ALLOCATION AREA

SOIL INFORMATION

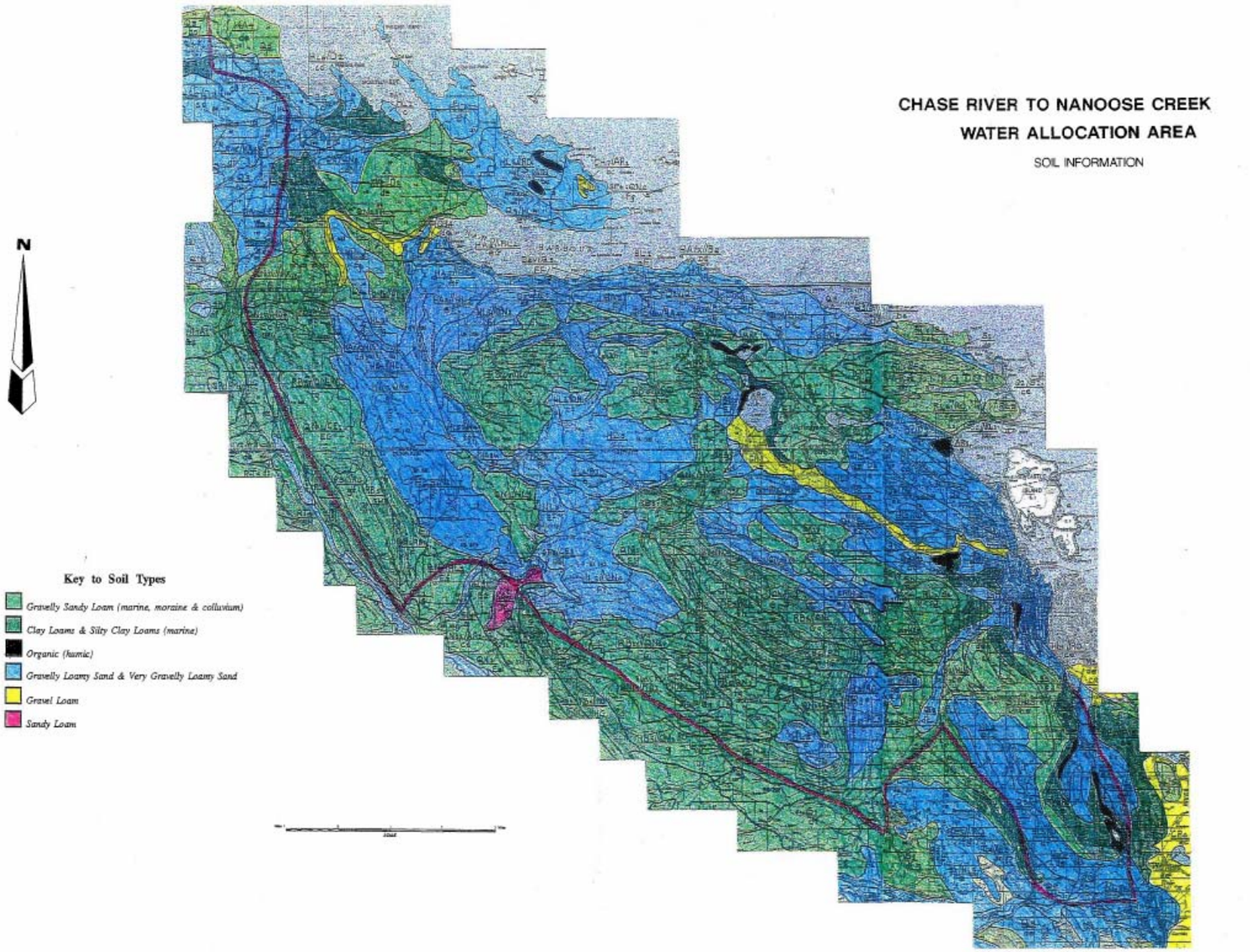


Table 17 Irrigation Requirements

Annual Irrigation Requirements for Chase to Nanoose Allocation Plan Area (inches of water per acre)					
Effective Rooting Depth	Shallow 1.5 ft	Medium Shallow 2.0 ft	Medium Deep 3.0 ft	Deep 4.0 ft	
	Lettuce Pasture Species Cranberries	Peas Potatoes Tomatoes	Brussel Sprouts Corn (sweet) Clover (red)	Alfalfa Corn (field) Raspberries	Grapes Fruit trees
Clay Loam & Silty Clay Loam	18	15	12	9	12
Gravelly Sandy Loam	24	18	15	12	15
Organic	15	12	12	6	9
Gravelly Loamy Sand & very Gravelly Loamy Sand	24	24	18	15	18
Availability Coefficient = 0.5					

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

Irrigation gun or flood irrigation systems require greater irrigation quantities and should be discouraged. If irrigation gun and flood irrigation practices are to be used then 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 sprinkler irrigation system.

Trickle irrigation can reduce water requirements by 35% and should be encouraged where practical.

All irrigation water demands must be supported by 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.

The maximum irrigation system flow rate shall not exceed 19.1 l/sec (4.2 imperial gals. per minute) per 0.4 hectare (1 acre), and users must be 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.

All intake works in fish bearing waters shall be screened as per the Fish Screening Directive found in the Appendix H.

7.4 INDUSTRIAL AND COMMERCIAL

The tables in Appendix I indicate the quantity of water required for small commercial or industrial purposes.

Commercial fish hatcheries and/or rearing purposes shall require an industrial water licence. Use of water by government and non-profit organizations will be licensed as conservation purpose. Information on fish species and size, water temperature requirements and operating methods will be required in support of an application for a water licence. Fish Farm and Waste Management Permits will also be required.

Off-stream storage is required for fish ponds for commercial fish farming.

7.5 POWER (RESIDENTIAL)

The application for a water licence for small hydro power project shall provide all information, measurements, calculations and specifications to prove power development feasibility. The form " Information Required in Respect of an Application for Power Purposes" shall be completed by the applicant.

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

7.6 LAND IMPROVEMENT

Land improvement purpose is the diversion of water to improve drainage, to protect from flooding, to prevent erosion or to divert and use water for aesthetic purposes.

For land improvement drainage and aesthetic channel works, the works and operational requirements are authorized in the water licence. No water quantity is specified.

Water required for land improvement aesthetic ponds shall be the volume of the pond to be created. All storage recommendations shall be required.

7.7 CONSERVATION

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

To maintain flows in streams through the June to October period and for fish rearing ponds, storage development will be required. Works in stream/channels and in and around lakes, marshes, and other bodies may be authorized to conserve fish and wildlife without a quantity being specified in the water licence. Timing constraints may apply for the construction of work.

7.8 STORAGE

Storage purpose is the impoundment of water, either on-stream or off-stream, in a dugout and/or behind a dam. An additional 0.3 metres (1.0 ft) depth over the surface area of the storage reservoir or natural water body is to be allowed for evaporation and other losses.

Major (ie greater than 100 dam^3 (81 acrefeet) or storage dam height greater than 10 metres) storage development will require engineering and environmental impact reports in support of the application. Lesser storage may require reports.

Design plans must be submitted and accepted in writing before construction commences on any proposed dam over 3.0 metres (9.8 feet) in height or on storage of 10 dam^3 (8.1 acre feet) or more.

All storage greater than 30 dam^3 shall require water level recording and the results shall be submitted to the Regional Water Management office annually.

Off-stream storage is to be encouraged at all times, with off-stream sites that are:

- outside the high water winter wetted perimeter of any watercourse,
- not accessible by fish, and
- do not adversely impact on flows in any watercourse(s) during the dry period.

Instream storage works are to be constructed during the period June to October. The design of reservoirs need to consider upstream and downstream migration of adult and juvenile fish and provision for fisheries flows. Mitigation work will be required for loss of spawning areas in the creeks affected by any storage. In those systems where the MAD drops below 10%, any water licence must be supported by storage.

The Applicant must obtain separate written agreement, easement or right-of-way for works or flooding affecting other lands.

Total storage volume created by a control structure shall be licensed. The dead storage created in most cases have some intrinsic value such as providing conservation of fish and wildlife or aesthetic value.

Diversion of water in to storage will be between November 1 and March 31.

7.9 ALLOCATION PLAN REVISION

The Chase to Nanoose Water Allocation Plan should be reviewed and updated on or before April 1999

APPENDIX A

Hydrometric Records

INDIAN RESERVE CREEK (NORTH FORK) NEAR LANTZVILLE - STATION NO. 08HB061

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1976	---	---	---	0.003	0.003	0.002	0.002	0.002	0.002	---	---	---	---	1976
1977	---	---	---	0.003	0.002	0.002	0.002	0.001	0.001	0.001	---	---	---	1977
1978	---	---	---	0.002	0.001	0.001	0.001	0.001	0.001	---	---	---	---	1978
1979	---	---	---	0.002	0.001	0.001	0.001	0.001	0.001	---	---	---	---	1979
MEAN	---	---	---	0.003	0.002	0.002	0.002	0.001	0.001	0.001	---	---	---	MEAN

LOCATION - LAT 49 15 04 N
LONG 124 07 15 W NATURAL FLOW

INDIAN RESERVE CREEK (NORTH FORK) NEAR LANTZVILLE - STATION NO. 08HB061

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m^3/s)	MAXIMUM DAILY DISCHARGE (m^3/s)	MINIMUM DAILY DISCHARGE (m^3/s)	TOTAL DISCHARGE (dam^3)	YEAR
1976	---	---	---	---	1976
1977	---	---	---	---	1977
1978	---	---	---	---	1978
1979	---	---	0.001 ON MAR 15 *	---	1979
		* - EXTREME RECORDED FOR THE PERIOD OF RECORD		---	MEAN

INDIAN RESERVE CREEK (SOUTH FORK) NEAR LANTZVILLE - STATION NO. 08HB062

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1976	---	---	---	0.001	0.001	0.001	0	0	0	---	---	---	---	1976
1977	---	---	---	0.001	0.001	0	0.001	0	0	0	---	---	---	1977
1978	---	---	---	0.001	0.001	0.001	0.001	0.001	0.001	---	---	---	---	1978
1979	---	---	---	0.001	0.001	0.001	0.001	0.001	0.001	---	---	---	---	1979
MEAN	---	---	---	0.001	0.001	0.001	0.001	0.001	0.001	0	---	---	---	MEAN

LOCATION - LAT 49 15 04 N
LONG 124 07 15 W NATURAL FLOW

INDIAN RESERVE CREEK (SOUTH FORK) NEAR LANTZVILLE - STATION NO. 08HB062

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m^3/s)	MAXIMUM DAILY DISCHARGE (m^3/s)	MINIMUM DAILY DISCHARGE (m^3/s)	TOTAL DISCHARGE (dam^3)	YEAR
1976	---	---	---	---	1976
1977	---	---	---	---	1977
1978	---	---	---	---	1978
1979	---	---	0.001 ON MAR 15 *	---	1979
		* - EXTREME RECORDED FOR THE PERIOD OF RECORD		---	MEAN

KNARSTON CREEK AT SUPERIOR ROAD - STATION NO. 08HB040

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1970	---	---	---	0.053	0.020	0.004	0.002	0.001	0.001	---	---	---	---	1970
1971	---	---	---	0.188	0.028	0.012	0.005	0.002	0.003	---	---	---	---	1971
MEAN	---	---	---	0.121	0.024	0.008	0.004	0.002	0.002	---	---	---	---	MEAN

LOCATION - LAT 49 14 52 N DRAINAGE AREA, 3.89 km^2
LONG 124 05 03 W NATURAL FLOW

KNARSTON CREEK AT SUPERIOR ROAD - STATION NO. 08HB040

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m^3/s)	MAXIMUM DAILY DISCHARGE (m^3/s)	MINIMUM DAILY DISCHARGE (m^3/s)	TOTAL DISCHARGE (dam^3)	YEAR
1970	---	---	0.001 ON JUL 10	---	1970
1971	---	---	0 ON AUG 25 *	---	1971
		* - EXTREME RECORDED FOR THE PERIOD OF RECORD		---	MEAN

ENOS CREEK AT OUTLET OF ENOS LAKE - STATION NO. 08HB030

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1962	---	---	---	0.004	0.008	0.001	0.001	0	0	0.005	0.045	0.190	---	1962
1963	0.045	0.008	0.008	0.008	0.002	0	0	0.001	0.004	0.003	0.118	0.082	0.024	1963
1964	0.242	0.145	0.017	0.006	0	0	0	0	0	0	0	0.001	0.034	1964
1965	0.078	0.085	0.028	0.007	0.007	0	0	0	0	0.002	0.028	0.086	0.026	1965
1966	0.188	0.052	0.124	0.068	0.025	0.013	0.007	0.001	0	0.015	0.003	0.008	0.048	1966
1967	0.127	0.068	0.101	0.025	0.009	0.004	0	0	0	0.003	0.002	0.103	0.037	1967
1968	0.153	0.093	0.081	0.042	0.024	0.007	0.002	0	0	0.002	0.071	0.183	0.054	1968
1969	0.045	0.088	0.029	0.033	0.003	0.001	0	0	0	0.001	0.004	0.133	0.026	1969
1970	0.107	0.073	0.055	0.034	0.003	0.001	0	0	0	0	0.001	0.152	0.036	1970
1971	0.134	0.071	0.118	0.030	0.001	0	0	0	0	0	0.001	0.088	0.038	1971
1972	0.087	0.078	0.114	0.073	0.008	0.005	0	0	0	0	0	0.083	0.035	1972
1973	0.147	0.035	0.028	0.009	0.001	0.001	0	0	0	0	0.047	0.187	0.038	1973
1974	0.148	0.082	0.154	0.034	0.012	0.002	0	0	0	0	0.005	0.078	0.044	1974
1975	0.103	0.068	0.055	0.018	0.002	0	0	0	0	0.011	0.231	---	---	1975
1976	---	0.073	0.073	0.022	0.001	0	0	0	0	0	0	0	---	1976
1977	0.005	0.029	0.081	0.015	0.001	0	0	0	0	0	0	0.055	0.015	1977
1978	---	0.050	0.031	0.017	0.003	0	0	0	0	0	0	0	---	1978
MEAN	0.118	0.078	0.070	0.026	0.006	0.007	0.001	0	0	0.002	0.033	0.084	0.036	MEAN

LOCATION - LAT 48 17 13 N DRAINAGE AREA, 1.68 km²
LONG 124 08 32 W REGULATED

ENOS CREEK AT OUTLET OF ENOS LAKE - STATION NO. 08HB030

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m^3/s)	MAXIMUM DAILY DISCHARGE (m^3/s)	MINIMUM DAILY DISCHARGE (m^3/s)	TOTAL DISCHARGE (dam^3)	YEAR
1962	---	0.377 ON NOV 30	0 ON JUN 29 *	---	1962
1963	---	0.303 ON DEC 31	0 ON MAR 1	1 070	1963
1964	---	0.283E ON JAN 1	0 ON APR 18	1 080	1964
1965	---	0.411 ON FEB 5	0 ON JAN 8	884	1965
1966	---	0.991 ON JAN 7 *	0E ON JUN 9	1 680	1966
1967	---	0.595 ON JAN 20	0 ON JUL 1	1 160	1967
1968	---	0.977 ON JAN 18	0 ON JUL 8	1 710	1968
1969	---	0.484 ON DEC 13	0 ON MAY 13	880	1969
1970	---	0.745 ON DEC 11	0 ON MAY 31	1 140	1970
1971	---	0.458 ON DEC 17	0 ON MAY 28	1 200	1971
1972	---	0.829 ON FEB 28	0 ON JUL 4	1 120	1972
1973	---	0.711 ON DEC 18	0 ON APR 20	1 180	1973
1974	---	0.687E ON MAR 11	0 ON JUN 22	1 370	1974
1975	---	0.748 ON NOV 15	0 ON JUN 14	---	1975
1976	---	0.484A ON FEB 28	0 ON MAY 10	---	1976
1977	0.227 AT 13:50 PST ON DEC 18	0.224 ON DEC 18	0 ON JAN 1	488	1977
1978	0.287 AT 18:31 PST ON JAN 10 *	0.260 ON JAN 10	0 ON MAY 21	---	1978
				1 140	MEAN

A - MANUAL GAUGE
(SEE REFERENCE INDEX)
E - ESTIMATED
* - EXTREME RECORDED FOR THE PERIOD OF RECORD

BONELL CREEK NEAR NANOOSE - STATION NO. 08HB079

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1990

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	0.001	0.543	1.05	1
2	---	---	---	---	---	---	---	---	---	0.001	0.417	2.21	2
3	---	---	---	---	---	---	---	---	---	0.001	0.369	---	3
4	---	---	---	---	---	---	---	---	---	0.001	0.361	---	4
5	---	---	---	---	---	---	---	---	---	0.003	0.369	5.96	5
6	---	---	---	---	---	---	---	---	---	0.001	0.344	1.28	6
7	---	---	---	---	---	---	---	---	---	0.001	0.405	2.34	7
8	---	---	---	---	---	---	---	---	---	0.001	0.412	2.33	8
9	---	---	---	---	---	---	---	---	---	0.001	2.05	2.76	9
10	---	---	---	---	---	---	---	---	---	0.001	---	2.97	10
11	---	---	---	---	---	---	---	---	---	0.001	---	2.51	11
12	---	---	---	---	---	---	---	---	---	0.001	6.88	2.11	12
13	---	---	---	---	---	---	---	---	---	0.001	5.37	1.74	13
14	---	---	---	---	---	---	---	---	---	0.001	4.26	1.50	14
15	---	---	---	---	---	---	---	---	---	0.001	3.28	1.88	15
16	---	---	---	---	---	---	---	---	---	0.009	0.001	2.66	16
17	---	---	---	---	---	---	---	---	---	0.002	0.002	2.36	17
18	---	---	---	---	---	---	---	---	---	0.001	0.002	1.64	18
19	---	---	---	---	---	---	---	---	---	0.001	0.002	1.48	19
20	---	---	---	---	---	---	---	---	---	0.001	0.002	1.26 B	20
21	---	---	---	---	---	---	---	---	---	0.001	0.014	1.11 B	21
22	---	---	---	---	---	---	---	---	---	0.001	0.004	0.967	22
23	---	---	---	---	---	---	---	---	---	0.001	0.003	0.888	23
24	---	---	---	---	---	---	---	---	---	0.001	0.003	0.805	24
25	---	---	---	---	---	---	---	---	---	0.001	0.077	4.36	0.739	25
26	---	---	---	---	---	---	---	---	---	0.001	0.078	2.56	0.686	26
27	---	---	---	---	---	---	---	---	---	0.001	0.078	1.98	0.631	27
28	---	---	---	---	---	---	---	---	---	0.001	0.078	1.60	0.574	28
29	---	---	---	---	---	---	---	---	---	0.001	0.078	1.31	0.518	29
30	---	---	---	---	---	---	---	---	---	0.001	0.078	5.10	0.465	30
31	---	---	---	---	---	---	---	---	---		0.078		0.528	31
TOTAL	---	---	---	---	---	---	---	---	---		2.512	---	---	TOTAL
MEAN	---	---	---	---	---	---	---	---	---		---	---	---	MEAN
MAX	---	---	---	---	---	---	---	---	---		---	---	---	MAX
MIN	---	---	---	---	---	---	---	---	---		0.001	---	---	MIN

DISCHARGES IN CUBIC METRES PER SECOND

SUMMARY FOR THE YEAR 1990.

TYPE OF GAUGE - RECORDING
LOCATION - LAT 49 13 25 N
LONG 124 11 48 W

A = MANUAL GAUGE
B = ICE CONDITIONS

NATURAL FLOW

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	---
FEB	---	AUG	---
MAR	---	SEP	---
APR	---	OCT	217
MAY	---	NOV	---
JUN	---	DEC	---

MILLSTONE RIVER AT NANAIMO - STATION NO. 08HB032

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1961	---	---	---	---	---	0.377	0.088	0.017	0.047	0.858	2.58	5.91	---	1961
1962	4.86	2.80	3.07	1.82	2.41	0.904	0.088	0.087	0.084	2.87	5.45	6.24	2.84	1962
1963	2.88	5.43	3.89	4.05	2.84	0.183	0.138	0.018	0.007	1.47	5.84	8.08	2.87	1963
1964	7.87	5.27	4.30	1.78	0.736	0.468	0.170	---	---	---	---	---	---	1964
1965	---	6.88	2.26	2.22	---	---	---	---	---	---	---	---	---	1965
1966	---	---	---	---	---	---	---	---	---	---	---	---	---	1966
1967	8.24	5.52	4.73	1.20	0.411	0.110	0.045	0.008	0.038	0.018	2.35	5.63	---	1967
1968	4.23	1.84	2.83	2.42	0.861	0.880	0.148	0.044	0.034	0.182	5.84	4.13	2.25	1968
MEAN	5.78	4.52	3.52	2.27	1.38	0.439	0.112	0.035	0.036	0.884	3.84	5.11	1.87	MEAN
													2.41	

LOCATION - LAT 48 10 38 N
LONG 123 58 04 W
DRAINAGE AREA, 88.2 km²
NATURAL FLOW

MILLSTONE RIVER AT NANAIMO - STATION NO. 08HB032

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m³/s)	MAXIMUM DAILY DISCHARGE (m³/s)	MINIMUM DAILY DISCHARGE (m³/s)	TOTAL DISCHARGE (dam³)	YEAR
1961	---	---	0.006 ON AUG 7	---	1961
1962	---	14.8 ON NOV 26	0.011 ON JUL 25	78 800	1962
1963	---	16.7E ON DEC 24	0.006 ON AUG 9	83 500	1963
1964	---	12.2 ON JAN 28	---	---	1964
1965	---	---	---	---	1965
1966	---	---	---	---	1966
1967	25.7 AT 04:25 PST ON DEC 10 *	23.8 ON DEC 10 *	0.004 ON SEP 21 *	---	1967
1968	23.8 AT 21:58 PST ON JAN 14	20.8 ON JAN 15	0.005 ON SEP 27	70 900	1968
			0.014 ON SEP 16	58 100	
		* - EXTREME RECORDED FOR THE PERIOD OF RECORD		75 800	MEAN

E - ESTIMATED

MILLSTONE RIVER NEAR WELLINGTON - STATION NO. 08HB027

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1961	---	---	---	1.38	1.25	0.212	0.068	0.030	0.028	0.717	1.73	3.54	---	1961
1962	2.67	1.35	1.42	1.18	1.38	0.806	0.081	0.073	0.056	1.53	3.48	4.23	1.61	1962
1963	1.83	2.88	1.88	2.17	1.73	0.215	0.116	0.052	0.047	0.846	3.44	4.08	1.61	1963
1964	4.48	3.28	2.12	1.32	0.480	0.352	0.122	0.057	0.026	---	---	---	---	1964
1965	1.22	2.55	3.43	3.53	0.950	0.192	---	---	---	0.247	1.37	5.36	---	1965
1970	2.48	1.78	1.81	0.843	0.414	0.127	0.018	0.004	0.004	0.018	1.31	4.09	1.08	1970
1971	3.04	3.76	3.63	2.43	1.52	0.355	0.239	0.053	0.018	0.038	3.50	1.78	1.68	1971
1972	1.80	3.81	5.85	2.85	1.24	0.038	0.207	0.003	0.003	0.003	0.231	4.93	1.72	1972
1973	4.82	1.37	1.76	0.524	0.108	0.257	0.044	0.003	0.001	0.070	2.86	7.85	1.87	1973
1974	4.01	3.16	3.57	2.06	0.858	0.378	0.041	0.104	0.008	0.001	2.18	3.56	1.86	1974
MEAN	2.84	2.84	2.86	1.81	0.992	0.273	0.104	0.044	0.021	0.397	2.25	4.28	1.58	MEAN

LOCATION - LAT 48 12 22 N
LONG 124 03 08 W
DRAINAGE AREA, 48.1 km²
NATURAL FLOW

MILLSTONE RIVER NEAR WELLINGTON - STATION NO. 08HB027

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m³/s)	MAXIMUM DAILY DISCHARGE (m³/s)	MINIMUM DAILY DISCHARGE (m³/s)	TOTAL DISCHARGE (dam³)	YEAR
1961	---	---	0.023 ON AUG 30	---	1961
1962	---	10.8E ON JAN 3	0.048 ON SEP 8	47 500	1962
1963	---	15.8 ON DEC 24	0.040 ON SEP 11	50 900	1963
1964	---	---	0.020 ON SEP 28	---	1964
1969	---	18.7 ON DEC 14	0.004 ON JUL 14	---	1969
1970	---	15.0 ON DEC 17	0.002 ON SEP 27	34 200	1970
1971	---	13.1 ON MAR 12	0 ON JUN 23 *	53 000	1971
1972	---	19.0 ON DEC 19	0.001 ON AUG 13	54 400	1972
1973	---	22.4 ON DEC 16 *	0 ON AUG 17	52 800	1973
1974	---	15.2 ON JAN 16	0 E ON SEP 15	52 300	1974
		* - EXTREME RECORDED FOR THE PERIOD OF RECORD		48 300	MEAN

E - ESTIMATED

CHASE RIVER NEAR NANAIMO - STATION NO. 08HB084

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1976	---	---	---	0.858	0.372	0.188	0.083	0.117	0.128	---	---	---	---	1976
1977	---	---	---	0.502	0.218	0.073	0.057	0.086	0.148	0.218	---	---	---	1977
1978	---	---	---	0.842	0.438	0.128	0.053	0.147	0.338	---	---	---	---	1978
MEAN	---	---	---	0.771	0.342	0.121	0.068	0.116	0.203	0.218	---	---	---	MEAN

LOCATION - LAT 48 08 52 N
LONG 123 56 38 W
REGULATED

STA NO. 29

~~PRELIMINARY~~ DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1991

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
Dec 31	0.528												
1	0.356		0.493	0.380	0.174	0.040	0.015	0.003	0.351	0.006	0.015	0.877	1
2	0.374		0.534	0.373	0.156	0.038	0.013	0.003	0.332	0.006	0.014	0.775	2
3	0.358	7.60	0.649	0.945	0.145	0.038	0.012	0.003	0.267	0.006	0.015	0.695	3
4	0.331		0.743	3.25	0.138	0.035	0.011	0.003	0.207	0.006	0.020	0.677	4
5	0.311		0.717	3.12	0.139	0.033	0.010	0.003	0.151	0.008	0.024	1.05	5
6	0.298	4.06	0.678	2.56	0.139	0.028	0.009	0.003	0.114	0.009	0.021	3.92	6
7	0.312	3.24	0.670	2.04	0.139	0.023	0.009	0.004	0.092	0.009	0.027	3.88	7
8	0.313	3.53	0.670	1.63	0.136	0.022	0.010	0.011	0.068	0.009	0.034	2.92	8
9	0.307	3.40	0.684	1.43	0.124	0.018	0.007	0.008	0.040	0.009	0.030	3.59	9
10	0.305	2.82	0.717	1.17	0.116	0.015	0.007	0.007	0.027	0.008	0.030	3.52	10
11	1.26	2.30	0.697	1.04	0.111	0.015	0.007	0.007	0.022	0.009	0.086	4.30	11
12	5.30	1.94	0.720	0.871	0.099	0.013	0.007	0.007	0.020	0.008	0.154	3.98	12
13	7.67	1.77	0.749	0.737	0.093	0.014	0.004	0.009	0.019	0.008	0.275	3.15	13
14	4.84	1.56	0.757	0.658	0.083	0.011	0.006	0.008	0.018	0.009	0.281	2.35	14
15	3.72	1.33	0.744	0.585	0.081	0.013	0.007	0.006	0.017	0.008	0.276	1.87	15
16	2.86	1.17	0.745	0.505	0.076	0.019	0.007	0.006	0.015	0.017	0.553	1.52	16
17	2.48	1.05	0.703	0.446	0.065	0.023	0.004	0.006	0.014	0.015	2.21	1.21	17
18	2.39	1.01	0.655	0.414	0.059	0.021	0.004	0.005	0.014	0.015	2.03	1.12	18
19	2.25	1.15	0.674	0.372	0.055	0.022	0.004	0.004	0.015	0.015		0.997	19
20	1.84	1.12	0.708	0.334	0.051	0.019	0.004	0.004	0.013	0.014		0.899	20
21	1.54	1.06	0.691	0.306	0.044	0.020	0.005	0.003	0.009	0.013	4.12	0.970	21
22	1.30	0.979	0.690	0.287	0.041	0.024	0.004	0.002	0.010	0.017	2.67	0.919	22
23	1.10	0.840	0.696	0.278	0.037	0.025	0.004	0.002	0.010	0.013	2.01	0.841	23
24	0.949	0.742	0.680	0.269	0.051	0.025	0.004	0.002	0.007	0.013	1.69	0.797	24
25	0.782	0.684	0.625	0.244	0.056	0.024	0.006	0.002	0.008	0.014	1.70	0.796	25
26	0.682	0.650	0.539	0.234	0.057	0.024	0.004	0.002	0.008	0.014	1.68	1.52	26
27	0.610	0.600	0.512	0.218	0.051	0.025	0.004	0.003	0.007	0.012	1.49	2.70	27
28	0.533	0.542	0.503	0.212	0.047	0.024	0.005	0.004	0.007	0.009	1.30	2.48	28
29	0.496		0.439	0.218	0.047	0.022	0.003	0.043	0.006	0.011	1.11	2.03	29
30	0.457		0.423	0.196	0.047	0.020	0.003	0.343	0.006	0.012	0.991	1.79	30
31	0.502		0.405		0.041		0.003	0.517		0.015		1.52	31
TOTAL	46.866		19.910	25.322	2.700	0.693	0.202	1.033	1.894	0.337		60.481	TOTAL
MEAN	1.51		0.642	0.844	0.087	0.023	0.007	0.033	0.063	0.011		1.95	MEAN
~~CMS~~	~~4030~~		~~1720~~	~~2190~~	~~233~~	~~59.9~~	~~17.5~~	~~89.3~~	~~164~~	~~29.1~~		~~5230~~	~~CMS~~
MAX	7.67		0.757	3.25	0.174	0.040	0.015	0.517	0.351	0.017		4.30	MAX
MIN	0.298		0.405	0.196	0.037	0.011	0.003	0.002	0.006	0.006		0.677	MIN

(L)

PREPARED BY/DATE W. EDWARDS MAR 23/92
CHECKED BY/DATE E. MAYERT MAR 26/92
APPROVED BY/DATE C. ROBINSON 92-03-27

MINIMUM INSTANTANEOUS DISCHARGE .002 m³/s AT 1236 PST ON Aug 23
MAXIMUM INSTANTANEOUS DISCHARGE, Not available m³/s AT 0318 PST ON Feb 2
outside range of stage/discharge relationship

Table N° 2. JAN 1 TO Aug 31
Table N° 3 SEP 1 TO Dec 31

Feb 1, 2, 3, 4. Nov 19, 20 - OUTSIDE RANGE OF STAGE/DIS Table

PARKSVILLE
49° 18'N 124° 18'W 82 m

Daily Maximum Temperature	4.7	7.7	9.7	13.2	17.4	20.3	23.5	23.0	19.5	13.6	8.2	5.8	13.9	8	Température Maximale Quotidienne
Daily Minimum Temperature	-1.6	-0.6	-0.1	2.1	5.0	8.1	9.8	9.6	7.4	4.2	1.0	-0.3	3.7	8	Température Minimale Quotidienne
Daily Temperature	1.6	3.6	4.8	7.7	11.2	14.3	16.7	16.4	13.5	8.9	4.6	2.8	8.8	8	Température Quotidienne
Standard Deviation, Daily Temperature	1.9	1.7	1.0	1.1	1.9	2.0	2.1	1.3	0.9	0.6	1.8	1.3	1.0	6	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	12.2	13.9	16.7	25.0	28.9	31.7	33.9	30.6	29.4	23.3	15.0	12.8	33.9		Température Maximale Extrême
Years of Record	6	6	7	7	7	6	6	6	6	6	6	6			Années de Relèves
Extreme Minimum Temperature	-15.0	-12.2	-8.9	-3.9	-2.8	1.1	4.4	3.9	-0.6	-3.3	-13.9	-10.0	-15.0		Température Minimale Extrême
Years of Record	6	6	7	7	7	6	6	6	6	6	6	6			Années de Relèves
Rainfall	119.0	83.9	73.9	51.3	40.2	38.3	23.1	43.6	45.2	97.5	126.1	144.6	886.7	8	Chutes de Pluie
Snowfall	25.4	10.7	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	18.8	66.1	8	Chutes de Neige
Total Precipitation	146.9	97.0	82.8	51.3	40.2	38.3	23.1	43.6	45.2	97.5	132.2	165.8	963.9	8	Précipitations Totales
Standard Deviation, Total Precipitation	59.4	41.9	27.0	25.3	10.1	20.0	20.6	36.0	21.2	54.4	63.7	46.8	122.1	6	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	66.5	54.9	51.6	47.2	48.3	36.1	42.2	37.6	44.2	54.9	69.3	68.6	69.3		Chute de Pluie Record en 24 heures
Years of Record	43	43	41	43	44	43	44	42	42	43	44	45			Années de Relèves
Greatest Snowfall in 24 hours	35.6	61.0	43.2	10.2	0.8	0.0	0.0	0.0	0.0	5.1	22.9	27.9	61.0		Chute de Neige Record en 24 heures
Years of Record	44	45	45	45	45	44	44	44	45	45	45	45			Années de Relèves
Greatest Precipitation in 24 hours	66.5	61.0	51.6	47.2	48.3	36.1	42.2	37.6	44.2	54.9	69.3	68.6	69.3		Précipitation Record en 24 heures
Years of Record	42	43	41	43	44	43	44	42	42	43	44	45			Années de Relèves
Days with Rain	17	16	17	14	15	11	7	10	11	16	19	20	173	8	Jours de Pluie
Days with Snow	4	2	1	0	0	0	0	0	0	0	1	3	11	8	Jours de Neige
Days with Precipitation	20	17	17	14	15	11	7	10	11	16	20	22	180	8	Jours de Précipitation

NANAIMO DEPARTURE BAY
49° 13'N 123° 57'W 8 m

Daily Maximum Temperature	5.7	8.1	9.8	13.1	16.8	19.5	22.6	22.3	19.4	13.9	9.1	6.7	13.9	2	Température Maximale Quotidienne
Daily Minimum Temperature	0.7	1.9	2.4	4.7	7.8	11.0	13.4	13.5	10.8	7.0	3.6	2.0	6.6	2	Température Minimale Quotidienne
Daily Temperature	**3.2**	**5.0**	**6.1**	**8.9**	**12.4**	**15.3**	**18.0**	**17.9**	**15.1**	**10.5**	**6.4**	**4.4**	**10.3**	**2**	**Température Quotidienne**
Standard Deviation, Daily Temperature	1.6	1.2	1.0	1.0	1.3	1.4	1.3	1.6	1.2	1.0	1.1	1.5	0.5	2	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	16.7	17.8	22.2	27.8	30.6	33.9	38.3	36.1	30.6	26.7	19.4	16.0	38.3		Température Maximale Extrême
Years of Record	62	61	60	63	61	61	62	62	65	63	63	63			Années de Relèves
Extreme Minimum Temperature	-13.9	-11.7	-8.3	-6.7	-1.1	1.7	4.4	1.1	1.1	-4.4	-9.4	-14.0	-14.0		Température Minimale Extrême
Years of Record	61	61	59	62	61	61	62	61	63	62	60	62			Années de Relèves
Rainfall	129.4	87.2	79.1	46.8	37.6	34.3	26.3	34.6	45.1	95.1	128.9	150.2	894.6	2	Chutes de Pluie
Snowfall	22.8	9.0	4.7	T	0.0	0.0	0.0	0.0	0.0	0.0	1.9	11.8	50.2	2	Chutes de Neige
Total Precipitation	**151.6**	**96.5**	**84.0**	**46.8**	**37.6**	**34.3**	**26.3**	**34.6**	**45.1**	**95.1**	**130.7**	**162.5**	**945.1**	**2**	**Précipitations Totales**
Standard Deviation, Total Precipitation	59.8	41.8	41.8	23.6	16.8	22.2	18.4	25.1	28.4	52.8	61.4	57.8	151.9	2	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	67.1	54.4	45.2	35.3	32.5	32.3	37.1	52.1	54.6	63.0	60.7	92.2	92.2		Chute de Pluie Record en 24 heures
Years of Record	61	53	58	58	59	60	59	58	55	61	59	56			Années de Relèves
Greatest Snowfall in 24 hours	66.0	42.7	21.6	1.3	0.0	0.0	0.0	0.0	0.0	T	20.3	45.7	66.0		Chute de Neige Record en 24 heures
Years of Record	61	62	60	64	63	63	63	63	64	64	63	58			Années de Relèves
Greatest Precipitation in 24 hours	91.4	54.4	45.2	35.3	32.5	32.3	37.1	52.1	54.6	63.0	60.7	92.2	92.2		Précipitation Record en 24 heures
Years of Record	61	54	59	58	59	60	59	58	56	61	59	54			Années de Relèves
Days with Rain	18	14	14	11	10	8	6	7	9	14	17	18	146	2	Jours de Pluie
Days with Snow	3	1	1	*	0	0	0	0	0	0	*	2	7	2	Jours de Neige
Days with Precipitation	20	15	14	11	10	8	6	7	9	14	17	20	151	2	Jours de Précipitation

GABRIOLA ISLAND
49° 9'N 123° 44'W 46 m

Daily Maximum Temperature														Température Maximale Quotidienne
Daily Minimum Temperature														Température Minimale Quotidienne
Daily Temperature														**Température Quotidienne**
Standard Deviation, Daily Temperature														Écart Type de la Température Quotidienne
Extreme Maximum Temperature														Température Maximale Extrême
Years of Record														Années de Relèves
Extreme Minimum Temperature														Température Minimale Extrême
Years of Record														Années de Relèves
Rainfall	118.3	87.1	72.5	43.2	34.5	29.9	22.3	29.8	49.1	79.1	119.6	129.2	814.6	8	Chutes de Pluie
Snowfall	16.2	6.6	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	13.4	38.4	8	Chutes de Neige
Total Precipitation	**133.2**	**89.5**	**78.1**	**43.2**	**34.5**	**29.9**	**22.3**	**29.8**	**49.1**	**79.1**	**118.7**	**140.4**	**847.8**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	49.2	27.0	42.3	22.7	17.4	20.5	13.3	26.3	30.1	51.7	64.7	61.3	160.3	5	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	49.0	38.6	35.1	24.9	24.4	21.3	22.4	40.6	37.3	35.6	43.1	46.6	49.0		Chute de Pluie Record en 24 heures
Years of Record	13	13	13	14	14	14	13	12	13	13	13	11			Années de Relèves
Greatest Snowfall in 24 hours	22.9	30.5	8.1	T	0.0	0.0	0.0	0.0	0.0	0.0	12.7	63.5	63.5		Chute de Neige Record en 24 heures
Years of Record	13	13	14	14	14	14	14	14	14	14	14	14			Années de Relèves
Greatest Precipitation in 24 hours	49.0	38.6	35.1	24.9	24.4	21.3	22.4	40.6	37.3	35.6	43.1	46.6	49.0		Précipitation Record en 24 heures
Years of Record	12	13	13	14	14	14	13	12	13	13	13	11			Années de Relèves
Days with Rain	13	12	12	10	8	6	5	6	8	11	14	16	121	8	Jours de Pluie
Days with Snow	3	1	0	0	0	0	0	0	0	0	0	2	6	8	Jours de Neige
Days with Precipitation	15	12	12	10	8	6	5	6	8	11	15	17	125	8	Jours de Précipitation

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

	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	CODE CODE	
NANAIMO A															
49° 3'N 123° 52'W 30 m															
Daily Maximum Temperature	5.2	8.1	10.1	13.8	18.0	20.7	24.3	23.9	20.5	14.7	9.0	6.4	14.6	1	Température Maximale Quotidienne
Daily Minimum Temperature	-1.7	-0.5	-0.1	2.2	5.5	8.7	10.4	10.3	7.7	4.2	0.9	-0.3	3.9	1	Température Minimale Quotidienne
Daily Temperature	**1.8**	**3.8**	**5.0**	**8.0**	**11.7**	**14.8**	**17.4**	**17.1**	**14.1**	**9.5**	**5.0**	**3.0**	**9.3**	1	**Température Quotidienne**
Standard Deviation, Daily Temperature	1.7	1.3	1.1	0.9	1.2	1.5	1.3	1.3	1.0	0.7	1.2	1.5	0.5	1	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	15.6	18.3	19.6	25.6	31.7	34.4	36.1	36.7	32.2	25.6	19.4	17.5	36.7		Température Maximale Extrême
Years of Record	33	33	33	34	34	33	32	34	32	34	33	33			Années de Relèves
Extreme Minimum Temperature	-17.8	-16.7	-12.2	-5.0	-4.4	0.6	2.8	3.3	-1.1	-6.7	-16.1	-20.0	-20.0		Température Minimale Extrême
Years of Record	33	33	33	34	34	33	33	34	32	34	33	32			Années de Relèves
Rainfall	139.3	102.3	96.9	57.4	38.4	39.7	22.6	32.7	45.3	101.2	154.8	174.2	1004.8	1	Chutes de Pluie
Snowfall	36.7	13.0	11.1	0.1	T	0.0	0.0	0.0	0.0	0.0	5.2	26.2	92.3	1	Chutes de Neige
Total Precipitation	**177.5**	**117.1**	**108.4**	**57.5**	**38.4**	**39.7**	**22.6**	**32.7**	**45.3**	**101.2**	**161.4**	**201.8**	**1103.6**	1	**Précipitations Totales**
Standard Deviation, Total Precipitation	76.7	52.4	54.8	28.7	18.2	22.1	15.2	25.8	26.5	65.2	79.9	70.7	163.3	1	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	70.6	55.1	46.0	58.7	30.2	29.9	23.6	50.3	47.2	91.7	84.1	74.4	91.7		Chute de Pluie Record en 24 heures
Years of Record	33	33	33	34	33	33	33	33	33	33	33	34			Années de Relèves
Greatest Snowfall in 24 hours	36.6	73.7	29.5	1.3	T	0.0	0.0	0.0	T	0.0	25.9	47.8	73.7		Chute de Neige Record en 24 heures
Years of Record	33	33	33	34	34	33	33	34	34	33	33	33			Années de Relèves
Greatest Precipitation in 24 hours	70.6	84.6	46.0	58.7	30.2	29.9	23.6	50.3	47.2	91.7	84.1	74.4	91.7		Précipitation Record en 24 heures
Years of Record	33	33	33	34	33	33	33	33	33	33	33	33			Années de Relèves
Days with Rain	17	14	15	12	11	10	6	8	10	14	18	19	154	1	Jours de Pluie
Days with Snow	6	2	2	*	0	0	0	0	0	0	1	3	14	1	Jours de Neige
Days with Precipitation	20	15	15	12	11	10	6	8	10	14	18	21	160	1	Jours de Précipitation
NANAIMO CHUB															
49° 10'N 123° 56'W 21 m															
Daily Maximum Temperature	5.3	7.5	9.4	13.0	17.2	19.9	23.1	22.5	19.2	13.5	8.7	6.4	13.8	8	Température Maximale Quotidienne
Daily Minimum Temperature	0.1	1.3	1.8	4.4	8.0	11.1	13.5	13.1	10.6	6.4	2.9	1.4	6.2	8	Température Minimale Quotidienne
Daily Temperature	**2.5**	**4.2**	**5.4**	**8.4**	**12.1**	**14.9**	**17.8**	**17.4**	**14.3**	**9.7**	**5.6**	**3.9**	**9.7**	8	**Température Quotidienne**
Standard Deviation, Daily Temperature	1.0	1.4	0.9	1.1	1.0	1.4	1.1	1.5	1.4	0.5	0.9	1.6	0.3	6	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	13.3	15.6	17.2	25.6	27.2	29.4	33.9	34.4	30.0	23.3	17.2	13.9	34.4		Température Maximale Extrême
Years of Record	8	8	8	8	7	7	7	8	8	8	8	7			Années de Relèves
Extreme Minimum Temperature	-11.1	-8.3	-7.2	-2.2	1.7	2.2	7.8	5.6	1.1	-2.8	-7.8	-10.6	-11.1		Température Minimale Extrême
Years of Record	8	8	8	8	7	7	7	8	8	7	8	8			Années de Relèves
Rainfall	124.0	94.2	75.0	44.4	28.2	40.1	23.1	32.3	44.1	82.0	128.5	151.0	866.9	8	Chutes de Pluie
Snowfall	22.4	6.9	3.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.7	11.5	45.9	8	Chutes de Neige
Total Precipitation	**146.0**	**93.5**	**76.2**	**44.5**	**28.2**	**40.1**	**23.1**	**32.3**	**44.1**	**82.0**	**126.0**	**165.4**	**901.4**	8	**Précipitations Totales**
Standard Deviation, Total Precipitation	43.3	28.2	54.4	22.1	10.8	24.6	19.1	25.5	32.2	60.4	70.2	49.6	133.9	6	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	34.5	37.1	29.5	25.4	13.0	22.6	30.2	36.3	21.8	30.2	34.3	40.6	40.6		Chute de Pluie Record en 24 heures
Years of Record	8	8	8	8	7	7	7	6	8	8	8	8			Années de Relèves
Greatest Snowfall in 24 hours	35.6	27.2	10.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7	21.6	35.6		Chute de Neige Record en 24 heures
Years of Record	8	8	8	8	7	7	7	8	8	8	8	8			Années de Relèves
Greatest Precipitation in 24 hours	35.6	37.1	29.5	25.4	13.0	22.6	30.2	36.3	21.8	30.2	34.3	40.6	40.6		Précipitation Record en 24 heures
Years of Record	8	8	8	8	7	7	7	6	8	8	8	8			Années de Relèves
Days with Rain	15	14	14	10	8	8	5	7	9	12	16	17	135	8	Jours de Pluie
Days with Snow	3	1	0	0	0	0	0	0	0	0	0	1	5	8	Jours de Neige
Days with Precipitation	17	14	14	10	8	8	5	7	9	12	16	18	138	8	Jours de Précipitation

KEY:

STUDY AREA

CONTOUR DESCRIPTION:

1000 mm precipitation (40")

1250 mm precipitation (50")

MEAN ANNUAL PRECIPITATION

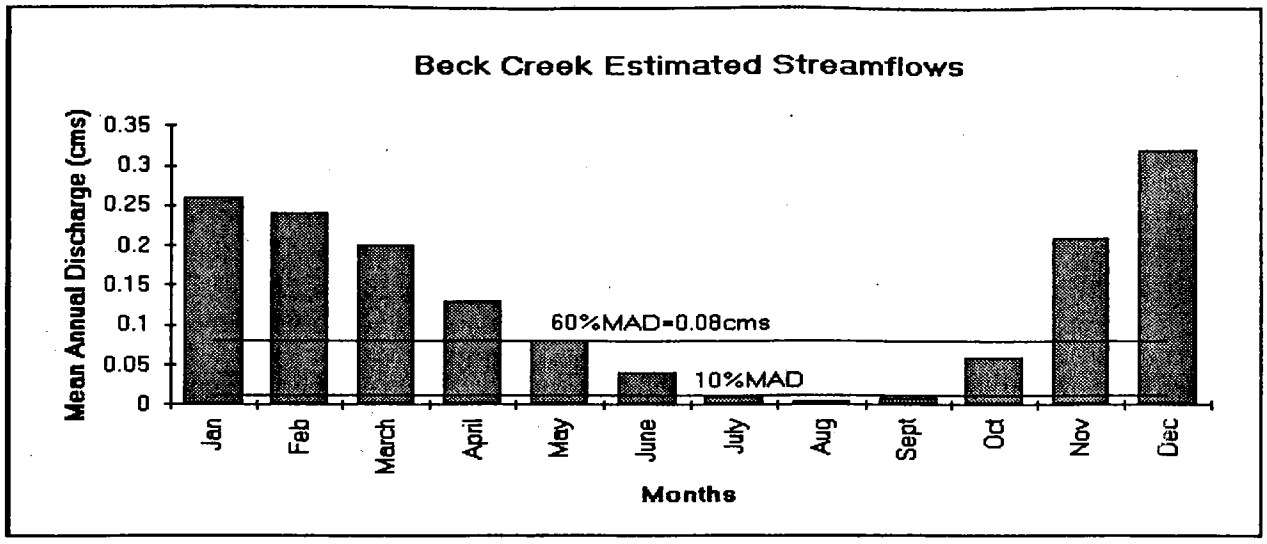
(BASED ON 1941-70 READINGS)

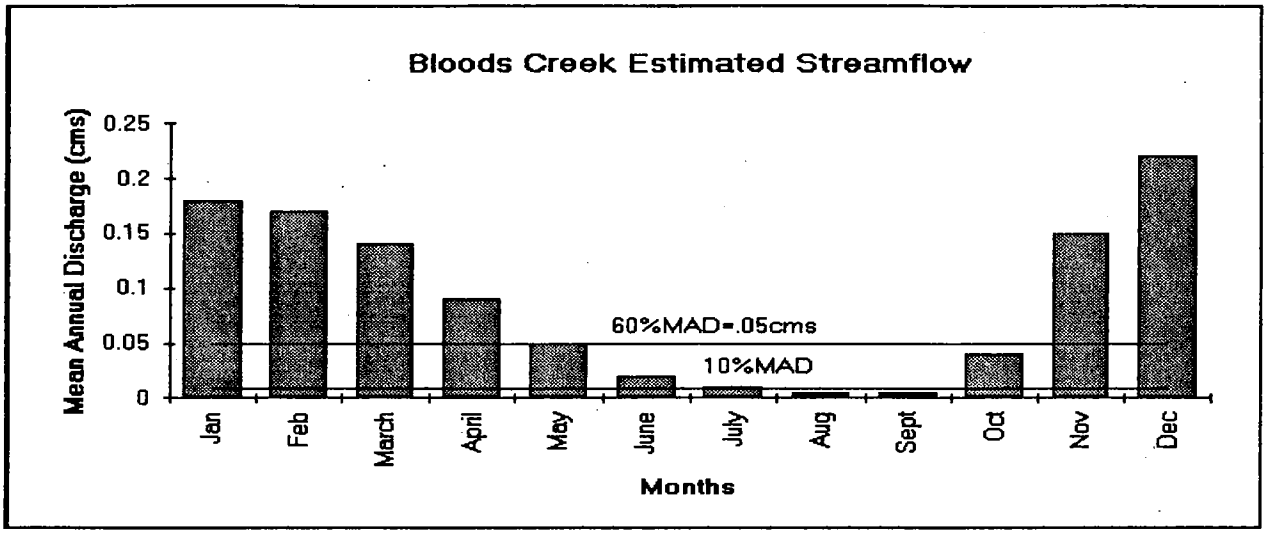
Scale 1: 250,000

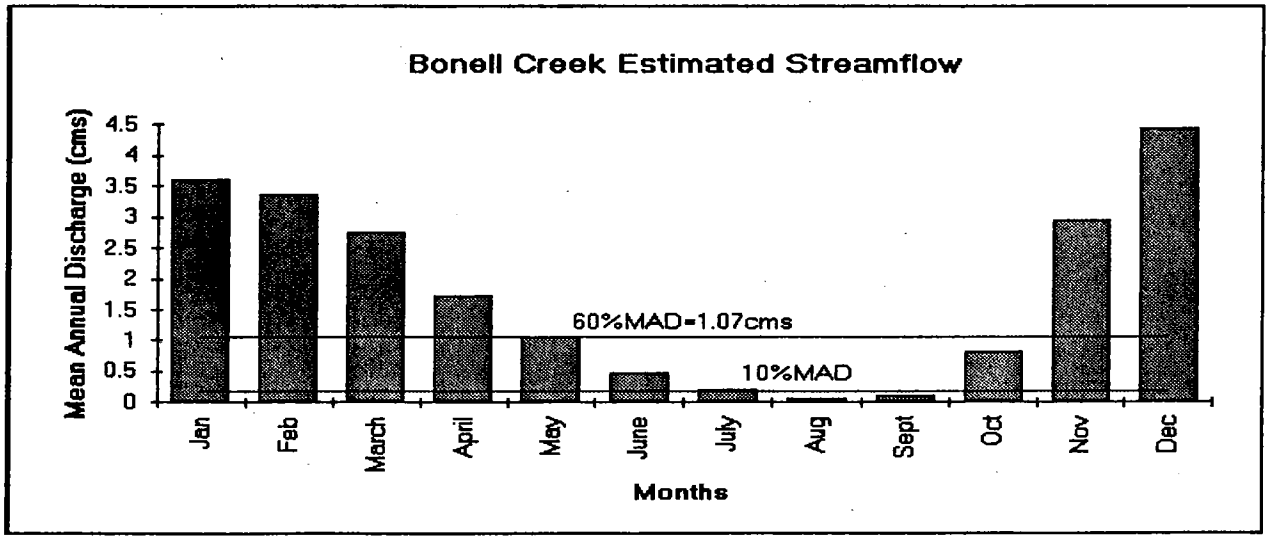
APPENDIX B

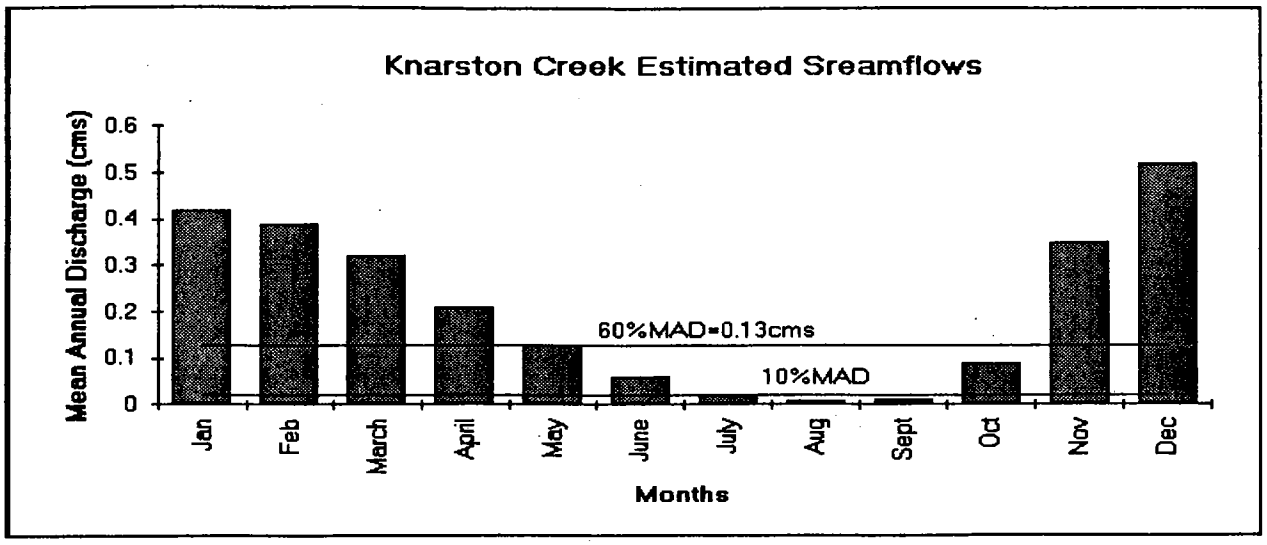
Streamflow Hydrographs for Ungauged Streams

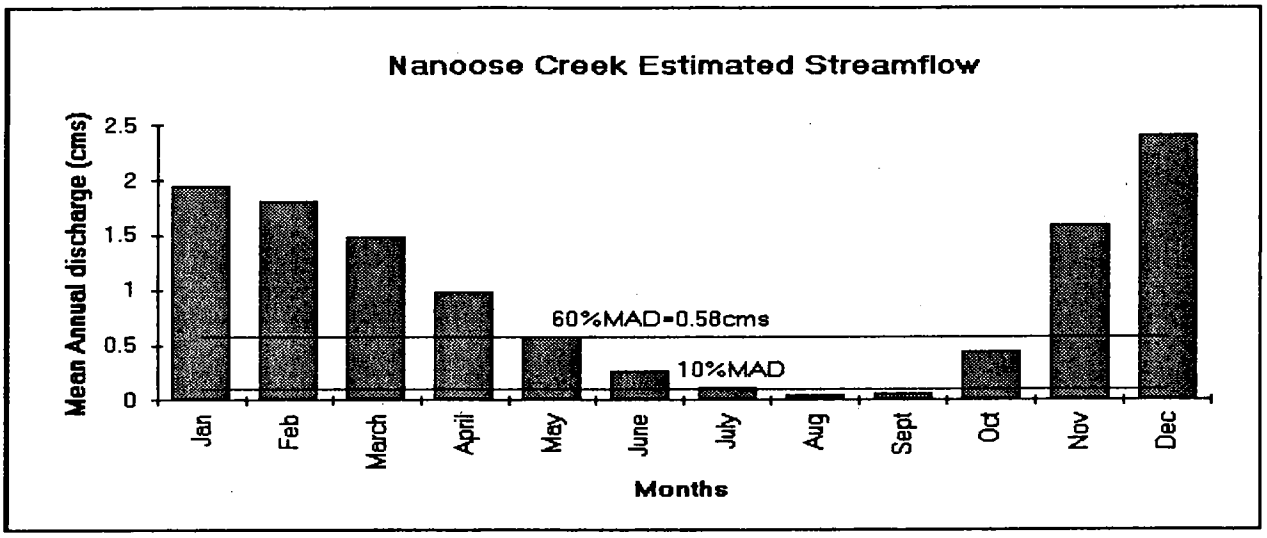
Ungauged Streams within Chase to Nanoose Water Allocation Plan															
Estimated Distribution of Mean Annual Discharge and Volumes Available															
Streams		**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**60% MAD**	**Total Vol. Above 60% MAD**
	% MAD used for dist	201	187	154	102	60	27	11	4	6	45	165	248		
Craig Ck.	Dist.of MAD	0.5	0.47	0.39	0.26	0.15	0.07	0.03	0.01	0.01	0.11	0.41	0.62		
(0.25 cms)	Flow above 60%	0.35	0.32	0.14	0.11	0	0	0	0	0	0	0.26	0.47		
	Volume Available	760	628	304	231	0	0	0	0	0	0	546	1021	0.15	3490
Strudwick	Dist.of MAD	0.22	0.21	0.17	0.11	0.07	0.03	0.01	0.004	0.007	0.05	0.18	0.27		
Brook	Flow above 60%	0.15	0.14	0.1	0.04	0	0	0	0	0	0	0.11	0.2		
(0.11cms)	Volume Available	326	274	217	84	0	0	0	0	0	0	231	434	0.07	1566
Williams	Dist.of MAD	0.08	0.08	0.06	0.04	0.02	0.01	0.004	0.002	0.002	0.02	0.07	0.1		
Brook	Flow above 60%	0.06	0.06	0.04	0.02	0	0	0	0	0	0	0.05	0.08		
(0.04cms)	Volume Available	130	118	87	42	0	0	0	0	0	0	105	174	0.02	656
Dublin	Dist.of MAD	0.04	0.03	0.03	0.02	0.01	0.005	0.002	0.001	0.001	0.01	0.03	0.05		
Gulch	Flow above 60%	0.03	0.02	0.02	0.01	0	0	0	0	0	0	0.02	0.04		
(0.02cms)	Volume Available	65	39	43	21	0	0	0	0	0	0	43	87	0.01	298
Indian	Dist.of MAD	0.3	0.3	0.25	0.16	0.1	0.04	0.02	0.006	0.01	0.07	0.26	0.4		
Reserve	Flow above 60%	0.2	0.2	0.15	0.06	0	0	0	0	0	0	0.16	0.3		
(0.16cms)	Volume Available	434	392	326	126	0	0	0	0	0	0	336	651	0.1	2805
Knarston	Dist.of MAD	0.42	0.39	0.32	0.21	0.13	0.06	0.02	0.008	0.01	0.09	0.35	0.52		
Creek	Flow above 60%	0.29	0.26	0.19	0.08	0	0	0	0	0	0	0.22	0.39		
(0.21cms)	Volume Available	630	510	412	168	0	0	0	0	0	0	462	847	0.13	3029
Bloods	Dist.of MAD	0.18	0.17	0.14	0.09	0.05	0.02	0.01	0.004	0.005	0.04	0.15	0.22		

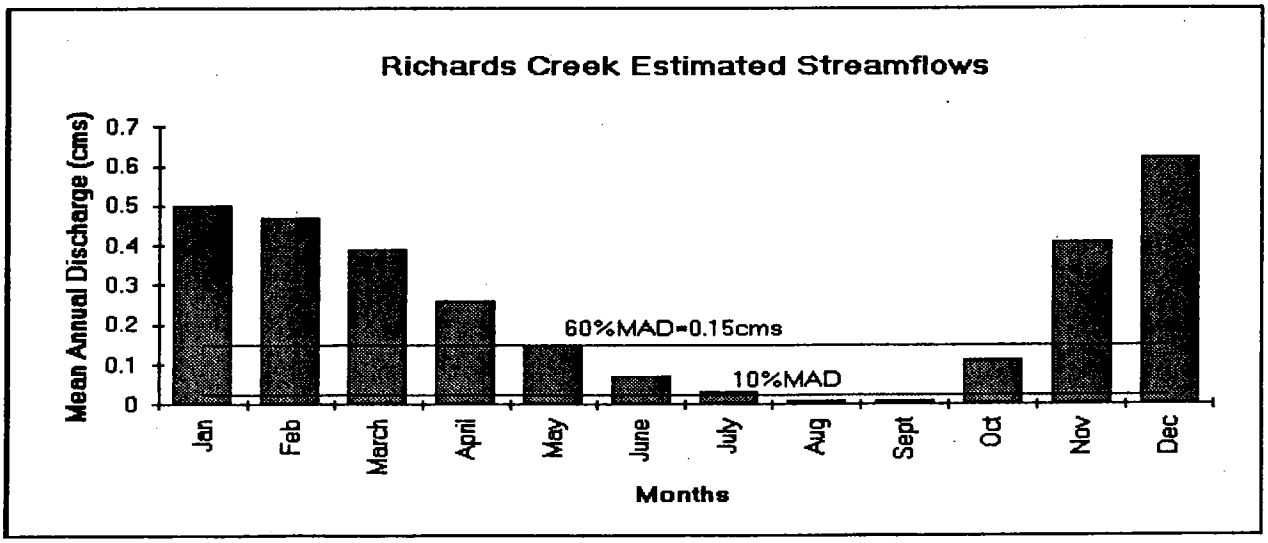

Beck Creek Estimated Streamflows
Mean Annual Discharge (cms)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
60%MAD=0.08cms
10%MAD
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Months


Bloods Creek Estimated Streamflow
Mean Annual Discharge (cms)
0.25
0.2
0.15
0.1
0.05
0
60%MAD=.05cms
10%MAD
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Months


Bonell Creek Estimated Streamflow
Mean Annual Discharge (cms)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
60%MAD=1.07cms
10%MAD
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Months


Knarston Creek Estimated Sreamflows
Mean Annual Discharge (cms)
0.6
0.5
0.4
0.3
0.2
0.1
0
60%MAD=0.13cms
10%MAD
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Months


Nanoose Creek Estimated Streamflow
Mean Annual discharge (cms)
2.5
2
1.5
1
0.5
0
60%MAD=0.58cms
10%MAD
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Months


Richards Creek Estimated Streamflows
Mean Annual Discharge (cms)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
60%MAD=0.15cms
10%MAD
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Months

APPENDIX C

Fisheries Concerns

Province of British Columbia
Ministry of Environment and Parks

MEMORANDUM

2569 Kenworth Road, Nanaimo, British Columbia V9T 4P7 / Telephone: (604) 758-3951

To: B. Hollingshead
Regional Water Manager

Date: June 10, 1988

File: 0371 ~~1000838~~
Bonell Creek

ATTENTION: G. Bryden

Re: WLA #1000838 for Diversion and Storage of Water in Vicinity of Bonell Creek

[redacted] Nan/Con P.U.

We request that this application be held in abeyance at this time, pending results of the engineering study commissioned by the Improvement District.

As discussed at our meeting with the consultants and Department of Fisheries and Oceans (R. Eliasen) we have the following concerns:

1. Low Flows Due to presence of chum salmon, coho salmon and sea-run cutthroat trout in the system, reduction in the already critical low summer flows would be unacceptable. Minimum flows equal to or greater than current levels must be provided and fully supported by storage at initial development stages.

2. Lake Storage Evaluation of using lakes present in the system as reservoirs should include consideration of the following facts.

   The lakes in question support a moderately strong sports fishery. As small, low elevation lakes form a key component of the regional fisheries plan, we would want to maintain recreational access and resident trout spawning and rearing in inlets and/or outlets. Design of impoundments would need to include fry migration fishways in outlet dams and enhanced inlet spawning areas where currently used gravels would be inundated during spring spawning periods.

   Consideration could be given to creating storage in areas currently forested where damming would be above anadromous waters and where a completely new reservois would enhance both water supply and fishery concerns. Suggestion was also made regarding joint works with Department of Fisheries and Oceans and Ministry of Environment and Parks, Fisheries Branch, regarding creating additional storage, surplus to water supply needs, that would enhance critical low flows in the summer and fall.

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3. Supply Line Intake. Inventory mapping indicates anadromous access to approximately the 500 ft. contour. Design of intake structures within the anadromous portion would require that access past the structure be maintained.

Yours truly,

Ron Diederichs

R. R. Diederichs
Habitat Protection Technician
Fish and Wildlife

RRD/cb

cc: R. Eliasen, Department of Fisheries and Oceans, Nanaimo (South Coast Div.)
C. Harlow, Department of Fisheries and Oceans, Nanaimo (Front Street)
Chatwin Engineering, Parksville
P. D. Law, Fisheries Biologist, Recreational Fisheries Program

APPENDIX D

Licensed Water Demand by Drainage and Purpose/Use

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
								litre/sec *	dam3	dam3
Alder										
F005973	17031	19191127	DOM	Jan. 01	Dec. 31	1,000.000 GD	Alder Creek	0.053		
C030325	263425	19650421	DOM	Jan. 01	Dec. 31	1,000.000 GD	Alder Creek	0.053		
C070337	262043	19650421	DOM	Jan. 01	Dec. 31	500.000 GD	Alder Creek	0.026		
					TOTAL	2,500.000 GD		0.13	1.7	2.4
Bagley										
C050148	346116	19681202	DOM	Jan. 01	Dec. 31	500.000 GD	Bagley Brook	0.026		
C044020	323727	19740826	DOM	Jan. 01	Dec. 31	500.000 GD	Bagley Spring	0.026		
C043722	323757	19740830	DOM	Jan. 01	Dec. 31	500.000 GD	Bagley Spring	0.026		
					Sub-total	1,500.000 GD		0.078	1	1.5
C050148	346116	19681202	IRR	Apr. 01	Sep. 30	1.500 AF	Bagley Brook	0.235	1.8	0
					TOTAL			0.313	2.8	1.5
Beck										
C054067	330654	19760517	PONDS	Jan. 01	Dec. 31	1.000 CS	Richard Lake	28.316		
					TOTAL	1.000 CS		28.316	nonconsumptive	
C051346	346291	19680522	IRR	Apr. 01	Sep. 30	5.000 AF	Richard Lake	0.785		
C051347	281084	19680522	IRR	Apr. 01	Sep. 30	5.000 AF	Richard Lake	0.785		
C040906	310600	19720731	IRR	Apr. 01	Sep. 30	1.000 AF	Beck Creek	0.157		
F051619	323381	19740715	IRR	Apr. 01	Sep. 30	4.850 AF	Beck Lake	0.761		
C066105	328616	19750410	IRR	Apr. 01	Sep. 30	3.500 AF	Beck Lake	0.549		
C058421	367933	19810223	IRR	Apr. 01	Sep. 30	30.000 AF	Beck Lake	4.71		
					Sub-total	49.350 AF		7.748	61.6	0
C058422	367933	19810223	STONP	Jan. 01	Dec. 31	30.000 AF	Beck Lake	4.71		
					Sub-total	30.000 AF		-4.71	-37	37
					TOTAL			3.04	24.6	37

Chase to Nanoose Licenced Water Demand by Drainage Areas

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
								litre/sec *	dam3	dam3
Bloods										
F012724	157619	19450924	DOM	Jan. 01	Dec. 31	1,000.000 GD	Bloods Creek	0.053		
F070335	158082	19451022	DOM	Jan. 01	Dec. 31	500.000 GD	Bloods Creek	0.026		
C031914	270479	19660908	DOM	Jan. 01	Dec. 31	1,000.000 GD	Copley Brook	0.053		
					Sub-total	2,500.000 GD		0.132	1.7	2.4
C065798	212191	19560604	IRR	Apr. 01	Sep. 30	21.700 AF	Green Lake	3.407		
Z100823	1000812	19880127	IRR	Apr. 01	Sep. 30	15.000 AF	Green Lake	2.355		
Z100828	1000905	19880718	IRR	Apr. 01	Sep. 30	3.000 AF	Green Lake	0.471		
					Sub-total	39.700 AF		6.233	49	0
					TOTAL			6.465	50.7	2.4
Chase										
C022585	206319	19541215	WWKLA	Jan. 01	Dec. 31	500000 GD	Reservoir No. 1	nonconsumptive		48.2
F047405	202434	19531217	DOM	Jan. 01	Dec. 31	1,000.000 GD	Harewood Creek	0.053		
C055732	296421	19700513	DOM	Jan. 01	Dec. 31	500.000 GD	Harewood Creek	0.026		
					Sub-total	1,500.000 GD		0.079	1	1.4
F047406	214694	19570124	IRR	Apr. 01	Sep. 30	1.000 AF	Harewood Creek	0.157		
F049556	309278	19711116	IRR	Apr. 01	Sep. 30	0.090 AF	Chase River	0.014		
C048543	328027	19741025	IRR	Apr. 01	Sep. 30	3.000 AF	Chase River	0.471		
					Sub-total	4.090 AF		0.642	5	0
C051473	340823	19770214	LDIMP	Jan. 01	Dec. 31	42.000 AF	Harewood Reservc	6.594		
C061423	355174	19790802	LDIMP	Jan. 01	Dec. 31	140.000 AF	Chase River	21.98		
C061424	355097	19790802	LDIMP	Jan. 01	Dec. 31	75.000 AF	Chase River	11.775		
					Sub-total	257.701 AF		nonconsumptive		317.9

Chase to Nanoose Licenced Water Demand by Drainage Areas

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
								litre/sec *	dam3	dam3
C022586	206319	19541215	STONP	Jan. 01	Dec. 31	50.000 AF	Reservoir No. 1	nonconsumptive		61.7
					TOTAL			0.642	6	429.2
Craig										
C035956	285604	4 196911	0 WWKOT	Jan. 01	Dec. 31	50,000.000 GD	Wall Brook	2.631	3.4	4.8
F012725	156614	19450716	DOM	Jan. 01	Dec. 31	1,000.000	Craig Creek	0.053		
F017775	192319	19511108	DOM	Jan. 01	Dec. 31	500.000	Craig Creek	0.026		
C035957	290454	19691015	DOM	Jan. 01	Dec. 31	500.000	Wall Brook	0.026		
C061305	369097	19810813	DOM	Jan. 01	Dec. 31	500.000	Craig Creek	0.026		
C100871	1001161	19891124	DOM	Jan. 01	Dec. 31	500.000	Elkanger Cre	0.026		
					Sub-total	3,000.000 GD		0.157	2.1	2.9
C042137	316619	19730320	WTRNG	Apr. 01	Sep. 30	2.000 A	Hamilton Bro	0.314		
C100829	1000935	19880906	WTRNG	Apr. 01	Sep. 30	6.000 A	Hamilton Spr	0.942		
					Sub-total	8.000 AF		1.256	9.9	0
F017775	192319	19511108	IRR	Apr. 01	Sep. 30	44.000 A	Craig Creek	6.908	119.6	0
C042138	316619	19730320	STONP	Jan. 01	Dec. 31	2.000 A	Hamilton Bro	0.314		
C061415	1000435	19850222	STONP	Jan. 01	Dec. 31	20.000 A	Craig Creek	3.14		
C100829	1000935	19880906	STONP	Jan. 01	Dec. 31	6.000 A	Hamilton Spr	0.942		
					Sub-total	28.000 AF		-4.396	-34.5	34.5
					TOTAL			6.556	100.5	42.2
Departure										
F016555	198491	19530206	DOM	Jan. 01	Dec. 31	1,000.000 GD	Joseph Creek	0.053		
F016568	200370	19530625	DOM	Jan. 01	Dec. 31	500.000 GD	Joseph Creek	0.026		
					Sub-total	1,500.000 GD		0.079	1	1.5

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
								litre/sec *	dam3	dam3
F020495	67025	19260301	IRR	Apr. 01	Sep. 30	4.000 AF	Departure Creek	0.628	4.9	0
					TOTAL			0.707	5.9	1.5
Dublin										
C031295	269136	19660131	DOM	Jan. 01	Dec. 31	500.000 GD	Dublin Gulch	0.026		
C053859	364704	19780925	DOM	Jan. 01	Dec. 31	500.000 GD	Dublin Gulch	0.026		
C054323	355891	19800114	DOM	Jan. 01	Dec. 31	500.000 GD	Fresnel Sprl	0.026		
					Sub-total	1500.000 GD		0.078	1	1.4
C054530	365142	19790206	PONDS	Jan. 01	Dec. 31	400.000 GD	Dublin Gulch	0.021	0.3	0.4
C057097	269135	19660131	IRR	Apr. 01	Sep. 30	0.330 AF	Dublin Gulch	0.052		
C057098	267172	19660131	IRR	Apr. 01	Sep. 30	0.330 AF	Dublin Gulch	0.052		
					Sub-total	0.660 AF		0.104	0.8	0
					TOTAL			0.203	2.1	1.8
Enos										
C023280	209893	19551026	WWKOT	Jan. 01	Dec. 31	200,000.000 GD	Enos Lake	10.523	139.2	192.9
C064021	1000375	19840515	WTRNG	Apr. 01	Sep. 30	140.000 AF	Enos Lake	21.98	172.7	0
C063959	1000636	19860818	LDIMP	Jan. 01	Dec. 31	0.080 AF	Tierney Swam	0.012	0.1	0
C024317	209537	19551027	STONP	Jan. 01	Dec. 31	140.000 AF	Enos Lake			
C028789	225531	19620509	STONP	Jan. 01	Dec. 31	140.000 AF	Enos Lake			
					Sub-total	280.000 AF		-43.96	-345.4	345.4
					TOTAL			-11.552	-33.4	538.3

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
								litre/sec *	dam3	dam3
Hardy										
C058436	368182	19810304	WWKOT	Jan. 01	Dec. 31	7,000.000 GD	Hardy Creek	0.368	4.9	6.7
F014789	154874	19441212	DOM	Jan. 01	Dec. 31	4,500.000 GD	Hardy Creek	0.237		
C048361	340147	19760819	DOM	Jan. 01	Dec. 31	500.000 GD	Hardy Creek	0.026		
					Sub-total	5,000.000 GD		0.263	3.5	4.8
					TOTAL			0.631	8.4	11.5
Indian Reserve										
C021816	199850	19530522	WWKLA	Jan. 01	Dec. 31	10000 GD	Indian Reserve Cre	0.526	6.9	9.6
F015535	131698	19380727	DOM	Jan. 01	Dec. 31	1,000.000 GD	Indian Reserve Cre	0.053		
F044660	144634	19410820	DOM	Jan. 01	Dec. 31	500.000 GD	Indian Reserve Cre	0.026		
C022501	206387	19541222	DOM	Jan. 01	Dec. 31	2,000.000 GD	Indian Reserve Cre	0.105		
					Sub-total	3,500.000 GD		0.184	2.4	3.4
C044957	329587	19381112	IRR	Apr. 01	Sep. 30	0.360 AF	Indian Reserve Cre	0.056		
C044955	329585	19381112	IRR	Apr. 01	Sep. 30	0.370 AF	Indian Reserve Cre	0.058		
C044953	133489	19381112	IRR	Apr. 01	Sep. 30	2.480 AF	Indian Reserve Cre	0.389		
C044954	329584	19381112	IRR	Apr. 01	Sep. 30	0.510 AF	Indian Reserve Cre	0.08		
					Sub-total	3.720 AF		0.584	4.6	0
					TOTAL			1.288	13.9	13
Knarston										
F016289	194468	19520421	DOM	Jan. 01	Dec. 31	500.000 GD	Knarston Creek	0.026		
F020570	213294	19560827	DOM	Jan. 01	Dec. 31	500.000 GD	Knarston Creek	0.026		
F021519	262372	19650505	DOM	Jan. 01	Dec. 31	500.000 GD	Knarston Creek	0.026		
C105816	290637	19691201	DOM	Jan. 01	Dec. 31	1,000.000 GD	Doumont Creek	0.053		
C048185	340344	19761001	DOM	Jan. 01	Dec. 31	500.000 GD	Knarston Creek	0.026		
					Sub-total	3,500.000 GD		0.183	2.4	3.4

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
								litre/sec *	dam3	dam3
F021470	155474	19450312	IRR	Apr. 01	Sep. 30	4.500 AF	Knarston Creek	0.706	5.5	0
					TOTAL			0.889	8.9	3.4
McGregor										
C026016	232091	1960072	1 DOM	Jan. 01	Dec. 31	1,000.000 GD	McGregor Creek	0.053	0.7	1
Millstone										
F010171	128930	19370817	DOM	Jan. 01	Dec. 31	1,000.000 GD	Rannies Creek	0.053		
F016497	194661	19520506	DOM	Jan. 01	Dec. 31	1,000.000 GD	McClure Creek	0.053		
C072608	195565	19520707	DOM	Jan. 01	Dec. 31	500.000 GD	McNeil Creek	0.026		
F017877	207527	19550419	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F021468	305007	19550419	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F021469	207528	19550419	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F020078	207636	19550421	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F017474	207642	19550422	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
C025764	207642	19550422	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
C022827	207639	19550425	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F044335	213670	19560924	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F017849	216733	19570702	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F070334	217035	19570726	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F017851	217885	19571003	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
C024038	217887	19571004	DOM	Jan. 01	Dec. 31	1,000.000 GD	Long Lake	0.053		
F017852	218435	19571119	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F021370	224590	19590317	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026		
F021185	226803	19590723	DOM	Jan. 01	Dec. 31	500.000 GD	Helkkila Brook	0.026		
C026017	232102	19600722	DOM	Jan. 01	Dec. 31	1,000.000 GD	Metral Creek	0.053		
F021518	252060	19631127	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026		
C029472	256864	19640528	DOM	Jan. 01	Dec. 31	500.000 GD	McNeil Creek	0.026		
F019905	257770	19640717	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026		
F019636	270205	19660718	DOM	Jan. 01	Dec. 31	1,000.000 GD	Helkkila Brook	0.053		
F019636	270205	19660718	DOM	Jan. 01	Dec. 31	1,000.000 GD	Helkkila Brook	0.053		
C032608	273013	19670207	DOM	Jan. 01	Dec. 31	500.000 GD	Jepson Brook	0.026		

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
C037403	300595	19701222	DOM	Jan. 01	Dec. 31	500.000 GD	Brannen Lake	0.026		
F042621	309643	19720216	DOM	Jan. 01	Dec. 31	500.000 GD	Krall Brook	0.026		
C039679	309679	19720301	DOM	Jan. 01	Dec. 31	500.000 GD	Millstone River	0.026		
C052117	310803	19720907	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026		
C052653	322624	19740218	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026		
C046942	330110	19760120	DOM	Jan. 01	Dec. 31	200.000 GD	Heikkila Brook	0.011		
C051984	341031	19770331	DOM	Jan. 01	Dec. 31	500.000 GD	Drozdoff Brook	0.026		
C053496	341366	19770603	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026		
C051845	364487	19780803	DOM	Jan. 01	Dec. 31	500.000 GD	McClure Creek	0.026		
C055882	366742	19800612	DOM	Jan. 01	Dec. 31	500.000 GD	Millstone River	0.026		
C058798	62210	19250718	DOM	Jan. 01	Dec. 31	500.000 GD	Carthor Creek	0.026		
					Sub-total	24,700.000 GD		1.286	17.2	23.8
C042791	316730	19730411	PROCE	Oct. 01	Mar. 31	100,000.000 GD	Mowbray Brook	nonconsumptive		
C058236	370241	19520325	WTRNG	Jan. 01	Dec. 31	1.500 AF	Millstone River	0.235	1.8	0
F055733	237702	18610727	IRR	Apr. 01	Sep. 30	38.400 AF	Sabiston Creek	6.028		
F015984	157054	19450818	IRR	Apr. 01	Sep. 30	12.500 AF	Benson Creek	1.962		
C103164	187403	19510119	IRR	Apr. 01	Sep. 30	6.000 AF	Millstone River	0.942		
C103165	1001207	19510119	IRR	Apr. 01	Sep. 30	0.700 AF	Millstone River	0.11		
C103166	1001208	19510119	IRR	Apr. 01	Sep. 30	0.950 AF	Millstone River	0.149		
F020814	190452	19510818	IRR	Apr. 01	Sep. 30	4.100 AF	Brannen Lake	0.644		
F016883	190451	19510820	IRR	Apr. 01	Sep. 30	12.000 AF	Brannen Lake	1.884		
C048359	341564	19520107	IRR	Apr. 01	Sep. 30	4.500 AF	Millstone River	0.706		
C048358	341563	19520107	IRR	Apr. 01	Sep. 30	3.100 AF	Millstone River	0.487		
F052626	193057	19520107	IRR	Apr. 01	Sep. 30	4.200 AF	Millstone River	0.659		
C058235	194068	19520325	IRR	Apr. 01	Sep. 30	6.000 AF	Millstone River	0.942		
F049550	203928	19540525	IRR	Apr. 01	Sep. 30	2.000 AF	Millstone River	0.314		
C042910	322580	19540525	IRR	Apr. 01	Sep. 30	2.000 AF	Millstone River	0.314		
F049551	322573	19540525	IRR	Apr. 01	Sep. 30	2.000 AF	Millstone River	0.314		

LICENCE	FILE	PRIORITY		TERM	TERM			CONVERTED DEMAND		
NUMBER	NUMBER	DATE	PURPOSE	START	END	QUANTITY/UNITS	SOURCE NAME		lowflow	highflow
C042909	322579	19540525	IRR	Apr. 01	Sep. 30	1.700 AF	Millstone River	0.267		
F049554	322577	19540525	IRR	Apr. 01	Sep. 30	1.500 AF	Millstone River	0.235		
F049555	322578	19540525	IRR	Apr. 01	Sep. 30	1.000 AF	Millstone River	0.157		
F049552	322574	19540525	IRR	Apr. 01	Sep. 30	1.200 AF	Millstone River	0.188		
F049553	322576	19540525	IRR	Apr. 01	Sep. 30	0.800 AF	Millstone River	0.126		
C042905	322575	19540525	IRR	Apr. 01	Sep. 30	0.900 AF	Millstone River	0.141		
F017878	207875	19550513	IRR	Apr. 01	Sep. 30	0.250 AF	Long Lake	0.039		
F052375	216716	19570620	IRR	Apr. 01	Sep. 30	2.800 AF	Diver Lake	0.44		
F017600	217890	19571004	IRR	Apr. 01	Sep. 30	0.500 AF	Long Lake	0.078		
F018755	239930	19611213	IRR	Apr. 01	Sep. 30	0.750 AF	Long Lake	0.118		
C032893	273041	19670216	IRR	Apr. 01	Sep. 30	20.000 AF	McClure Creek	3.14		
C045308	328302	19750131	IRR	Apr. 01	Sep. 30	0.500 AF	Long Lake	0.078		
C046035	329378	19750822	IRR	Apr. 01	Sep. 30	0.250 AF	Long Lake	0.039		
C061365	369220	19810804	IRR	Apr. 01	Sep. 30	10.000 AF	Metral Creek	1.57		
C061368	1000261	19810804	IRR	Apr. 01	Sep. 30	5.000 AF	Rannies Creek	0.785		
C061466	1000434	19850201	IRR	Apr. 01	Sep. 30	5.000 AF	Van Tine Pond	0.785		
					Sub-total	190.600 AF		29.924	235.1	0
C051984	341031	19770331	LDIMP	Jan. 01	Dec. 31	2.600 AF	Drozdoff Brook	0.203		
C057665	365422	19790417	LDIMP	Jan. 01	Dec. 31	4.030 AF	Long Creek	0.314		
					Sub-total	7.630 AF		0	0	9.4
C026017	232102	19600722	LDIMP	Jan. 01	Dec. 31	1,000.000 GD	Metral Creek	0.053	0.7	1
C018816	175978	19481007	LDIMP	Jan. 01	Dec. 31	0.000 TF	Millstone River	0		
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0		
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0		
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0		
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0		
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0		
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0		
					Sub-total	0.000 TF		0	0	0

Chase to Nanoose Licenced Water Demand by Drainage Areas

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
C064048	369220	19810804	PRCOM	Jan. 01	Dec. 31	4.200 CS	Metral Creek	18.927	nonconsumptive	
C032894	273041	19670216	STONP	Jan. 01	Dec. 31	5.000 AF	McClure Creek			
C061367	369220	19810804	STONP	Jan. 01	Dec. 31	10.000 AF	Metral Creek			
C061369	1000261	19810804	STONP	Jan. 01	Dec. 31	5.000 AF	Rannles Creek			
C061467	1000434	19850201	STONP	Jan. 01	Dec. 31	5.000 AF	Van Tine Pond			
					sub-total	25.000 AF		-3.925	-30.8	30.8
F055734	237702	18610727	STONP	Oct. 01	Jun. 30	38.400 AF	Sabiston Creek	-6.029	-47.4	47.4
C050895	340167	19760825	CONST	Oct. 01	Apr. 30	150.000 AF	Millstone River	0	0	185
C058827	1000107	19820705	CONWK	Jan. 01	Dec. 31	7.000 CS	Millstone River	98.212	nonconsumptive	
C061449	1000421	19850121	CONWK	Jan. 01	Dec. 31	0.000 TF	Millstone River	0	0	0
					TOTAL	0.000 TF		21.544	176.6	297.4
Nanoose										
C033372	277013	19670901	DOM	Jan. 01	Dec. 31	1,000.000 GD	Beevor-Potts Creek	0.053		
C039867	305855	19710812	DOM	Jan. 01	Dec. 31	500.000 GD	Nanoose Creek	0.026		
C065819	310838	19720911	DOM	Jan. 01	Dec. 31	500.000 GD	Jobb Swamp	0.026		
C061388	1000396	19840712	DOM	Jan. 01	Dec. 31	500.000 GD	Ernie Swamp	0.026		
C061406	1000418	19841029	DOM	Jan. 01	Dec. 31	1,000.000 GD	Whitta Spring	0.053		
C019058	178365	19490509	DOM	Jan. 01	Dec. 31	500.000 GD	Loat Brook	0.026		
					Sub-total	4,000.000 GD		0.208	2.8	3.9
C058232	370274	19511006	IRR	Apr. 01	Sep. 30	12.500 AF	Harry Creek	1.962		
C058231	24282	19511006	IRR	Apr. 01	Sep. 30	12.500 AF	Harry Creek	1.962		
C020558	191047	19511006	IRR	Apr. 01	Sep. 30	2.000 AF	Harry Creek	0.314		
F058233	199389	19530416	IRR	Apr. 01	Sep. 30	20.000 AF	Nanoose Creek	3.14		
C033372	277013	19670901	IRR	Apr. 01	Sep. 30	2.000 AF	Beevor-Potts Creek	0.314		
C035146	285581	19690520	IRR	Apr. 01	Sep. 30	8.000 AF	Jobb Swamp	1.256		

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
C035402	285659	19690602	IRR	Apr. 01	Sep. 30	0.670 AF	Nanoose Creek	0.105		
C039867	305855	19710812	IRR	Apr. 01	Sep. 30	1.000 AF	Nanoose Creek	0.157		
C061406	1000418	19841029	IRR	Apr. 01	Sep. 30	2.000 AF	Whitta Spring	0.314		
					Sub-total	60.670 AF		9.525	74.8	0
C034813	285580	19690520	LDIMP	Jan. 01	Dec. 31	0.000 TF	Nanoose Creek	0	0	0
					TOTAL			9.733	77.6	3.9
Nanoose Slough										
C065763	1000658	19861008	ONST	Jan. 01	Dec. 31	10.400 AF	Nanoose Slough	0.816	0	12.8
Patti										
C050688	330859	19760618	DOM	Jan. 01	Dec. 31	1,000.000 GD	Dart Brook	0.053	0.7	1
C050688	330859	19760618	PONDS	Jan. 01	Dec. 31	288,000.000 GD	Dart Brook	15.153	nonconsumptive	
C050688	330859	19760618	IRR	Apr. 01	Sep. 30	1.500 AF	Dart Brook	0.235	1.8	0
					TOTAL			0.288	2.5	1
Schooner										
C027661	243314	19620402	DOM	Jan. 01	Dec. 31	10,000.000 GD	Schooner Creek	0.526	6.9	9.6
C027661	243314	19620402	IRR	Apr. 01	Sep. 30	50.000 AF	Schooner Creek	7.85	61.7	0
C027662	243314	19620402	STONP	Jan. 01	Dec. 31	10.000 AF	Schooner Creek	-0.784	-12.3	12.3
					TOTAL			7.592	56.3	21.9

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND		
									lowflow	highflow
Stewart										
F017014	220604	19580603	DOM	Jan. 01	Dec. 31	500.000 GD	Stewart Creek	0.026		
F017014	220604	19580603	DOM	Jan. 01	Dec. 31	500.000 GD	Stewart Creek	0.026		
F070338	222681	19581028	DOM	Jan. 01	Dec. 31	500.000 GD	Stewart Creek	0.026		
F039375	263765	19650804	DOM	Jan. 01	Dec. 31	225.000 GD	Stewart Creek	0.012		
					TOTAL	1,725.000 GD		0.09	1.2	1.7
Strudwick										
C048061	221738	1958081	IRR	Apr. 01	Sep. 30	2.100 AF	Strudwick Brook	0.33		
C060494	340596	1958081	IRR	Apr. 01	Sep. 30	6.400 AF	Strudwick Brook	1.005		
C060496	370379	1958081	IRR	Apr. 01	Sep. 30	1.500 AF	Strudwick Brook	0.235		
					Sub-total	10.000 AF		1.57	12.3	0
C048062	221738	1958081	STONP	Oct. 01	Jun. 15	2.100 AF	Strudwick Brook	0.33		
C060497	370379	1958081	STONP	Oct. 01	Jun. 15	1.500 AF	Strudwick Brook	0.235		
C060495	340596	1958081	STONP	Oct. 01	Jun. 15	6.400 AF	Strudwick Brook	1.005		
					Sub-total	10.000 AF		-1.57	-12.3	12.3
					TOTAL					
Walley										
F048232	305333	19710521	IRR	Apr. 01	Sep. 30	0.500 AF	Walley Creek	0.079		
					TOTAL	0.500 AF		0.079	0.6	0
Williams										
C056808	367258	19800916	DOM	Jan. 01	Dec. 31	500.000 GD	Williams Brook	0.026		
C056808	367258	19800916	DOM	Jan. 01	Dec. 31	500.000 GD	Williams Brook	0.026		
					TOTAL	1000.000 GD		0.052	0.7	1
* based on an estimated 90 day irrigation period										
Lowflow is 153 days from June-Oct.										
Highflow is 212 days from Nov -May										

Chase to Nanoose Licenced Water Demand by Purpose

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
									dam3
Domestic									153 days
F005973	17031	19191127	DOM	Jan. 01	Dec. 31	1,000.000 GD	Alder Creek	0.053	
C030325	263425	19650421	DOM	Jan. 01	Dec. 31	1,000.000 GD	Alder Creek	0.053	
C070337	262043	19650421	DOM	Jan. 01	Dec. 31	500.000 GD	Alder Creek	0.026	
C050148	346116	19681202	DOM	Jan. 01	Dec. 31	500.000 GD	Bagley Brook	0.026	
C044020	323727	19740826	DOM	Jan. 01	Dec. 31	500.000 GD	Bagley Spring	0.026	
C043722	323757	19740830	DOM	Jan. 01	Dec. 31	500.000 GD	Bagley Spring	0.026	
F012724	157619	19450924	DOM	Jan. 01	Dec. 31	1,000.000 GD	Bloods Creek	0.053	
F070335	158082	19451022	DOM	Jan. 01	Dec. 31	500.000 GD	Bloods Creek	0.026	
C031914	270479	19660908	DOM	Jan. 01	Dec. 31	1,000.000 GD	Copley Brook	0.053	
F047405	202434	19531217	DOM	Jan. 01	Dec. 31	1,000.000 GD	Harewood Creek	0.053	
C055732	296421	19700513	DOM	Jan. 01	Dec. 31	500.000 GD	Harewood Creek	0.026	
F012725	156614	19450716	DOM	Jan. 01	Dec. 31	1,000.000 GD	Craig Creek	0.053	
F017775	192319	19511108	DOM	Jan. 01	Dec. 31	500.000 GD	Craig Creek	0.026	
C035957	290454	19691015	DOM	Jan. 01	Dec. 31	500.000 GD	Wall Brook	0.026	
C061305	369097	19810813	DOM	Jan. 01	Dec. 31	500.000 GD	Craig Creek	0.026	
C100871	1001161	19891124	DOM	Jan. 01	Dec. 31	500.000 GD	Elkanger Cre	0.026	
F016555	198491	19530206	DOM	Jan. 01	Dec. 31	1,000.000 GD	Joseph Creek	0.053	
F016568	200370	19530625	DOM	Jan. 01	Dec. 31	500.000 GD	Joseph Creek	0.026	
C031295	269136	19660131	DOM	Jan. 01	Dec. 31	500.000 GD	Dublin Gulch	0.026	
C053859	364704	19780925	DOM	Jan. 01	Dec. 31	500.000 GD	Dublin Gulch	0.026	
C054323	355891	19800114	DOM	Jan. 01	Dec. 31	500.000 GD	Fresnel Spri	0.026	
F014789	154874	19441212	DOM	Jan. 01	Dec. 31	4,500.000 GD	Hardy Creek	0.237	
C048361	340147	19760819	DOM	Jan. 01	Dec. 31	500.000 GD	Hardy Creek	0.026	
F015535	131698	19380727	DOM	Jan. 01	Dec. 31	1,000.000 GD	Indian Reserve Cree	0.053	
F044660	144634	19410820	DOM	Jan. 01	Dec. 31	500.000 GD	Indian Reserve Cree	0.026	
C022501	206387	19541222	DOM	Jan. 01	Dec. 31	2,000.000 GD	Indian Reserve Cree	0.105	
F016289	194468	19520421	DOM	Jan. 01	Dec. 31	500.000 GD	Knarston Creek	0.026	
F020570	213294	19560827	DOM	Jan. 01	Dec. 31	500.000 GD	Knarston Creek	0.026	
F021519	262372	19650505	DOM	Jan. 01	Dec. 31	500.000 GD	Knarston Creek	0.026	
C105816	290637	19691201	DOM	Jan. 01	Dec. 31	1,000.000 GD	Doumont Creek	0.053	

* 90 day for irrigation period

Chase to Nanoose Licenced Water Demand by Purpose

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
C048185	340344	19761001	DOM	Jan. 01	Dec. 31	500.000 GD	Knarston Creek	0.026	
C026016	232091	1960072	1 DOM	Jan. 01	Dec. 31	1,000.000 GD	McGregor Creek	0.053	
F010171	128930	19370817	DOM	Jan. 01	Dec. 31	1,000.000 GD	Rannies Creek	0.053	
F016497	194661	19520506	DOM	Jan. 01	Dec. 31	1,000.000 GD	McClure Creek	0.053	
C072608	195565	19520707	DOM	Jan. 01	Dec. 31	500.000 GD	McNeil Creek	0.026	
F017877	207527	19550419	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F021468	305007	19550419	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F021469	207528	19550419	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F020078	207636	19550421	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F017474	207642	19550422	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
C025764	207642	19550422	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
C022827	207639	19550425	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F044335	213670	19560924	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F017849	216733	19570702	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F070334	217035	19570726	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F017851	217885	19571003	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
C024038	217887	19571004	DOM	Jan. 01	Dec. 31	1,000.000 GD	Long Lake	0.053	
F017852	218435	19571119	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F021370	224590	19590317	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026	
F021185	226803	19590723	DOM	Jan. 01	Dec. 31	500.000 GD	Heikkila Brook	0.026	
C026017	232102	19600722	DOM	Jan. 01	Dec. 31	1,000.000 GD	Metral Creek	0.053	
F021518	252060	19631127	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026	
C029472	256864	19640528	DOM	Jan. 01	Dec. 31	500.000 GD	McNeil Creek	0.026	
F019905	257770	19640717	DOM	Jan. 01	Dec. 31	500.000 GD	Long Lake	0.026	
F019636	270205	19660718	DOM	Jan. 01	Dec. 31	1,000.000 GD	Heikkila Brook	0.053	
F019636	270205	19660718	DOM	Jan. 01	Dec. 31	1,000.000 GD	Heikkila Brook	0.053	
C032608	273013	19670207	DOM	Jan. 01	Dec. 31	500.000 GD	Jepson Brook	0.026	
C037403	300595	19701222	DOM	Jan. 01	Dec. 31	500.000 GD	Brannen Lake	0.026	
F042621	309643	19720216	DOM	Jan. 01	Dec. 31	500.000 GD	Krall Brook	0.026	
C039679	309679	19720301	DOM	Jan. 01	Dec. 31	500.000 GD	Millstone River	0.026	
C052117	310803	19720907	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026	
C052653	322624	19740218	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026	

* 90 day for irrigation period

Chase to Nanoose Licenced Water Demand by Purpose

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
C046942	330110	19760120	DOM	Jan. 01	Dec. 31	200.000 GD	Heikkila Brook	0.011	
C051984	341031	19770331	DOM	Jan. 01	Dec. 31	500.000 GD	Drozdoff Brook	0.026	
C053496	341366	19770603	DOM	Jan. 01	Dec. 31	500.000 GD	McGarrigle Creek	0.026	
C051845	364487	19780803	DOM	Jan. 01	Dec. 31	500.000 GD	McClure Creek	0.026	
C055882	366742	19800612	DOM	Jan. 01	Dec. 31	500.000 GD	Millstone River	0.026	
C058798	62210	19250718	DOM	Jan. 01	Dec. 31	500.000 GD	Carthor Creek	0.026	
C033372	277013	19670901	DOM	Jan. 01	Dec. 31	1,000.000 GD	Beevor-Potts Creek	0.053	
C039867	305855	19710812	DOM	Jan. 01	Dec. 31	500.000 GD	Nanoose Creek	0.026	
C065819	310838	19720911	DOM	Jan. 01	Dec. 31	500.000 GD	Jobb Swamp	0.026	
C061388	1000396	19840712	DOM	Jan. 01	Dec. 31	500.000 GD	Ernie Swamp	0.026	
C061406	1000418	19841029	DOM	Jan. 01	Dec. 31	1,000.000 GD	Whitta Spring	0.053	
C019058	178365	19490509	DOM	Jan. 01	Dec. 31	500.000 GD	Loat Brook	0.026	
C050688	330859	19760618	DOM	Jan. 01	Dec. 31	1,000.000 GD	Dart Brook	0.053	
C050688	330859	19760618	DOM	Jan. 01	Dec. 31	1,000.000 GD	Patti Brook	0.053	
C027661	243314	19620402	DOM	Jan. 01	Dec. 31	10,000.000 GD	Schooner Creek	0.526	
F017014	220604	19580603	DOM	Jan. 01	Dec. 31	500.000 GD	Stewart Creek	0.026	
F017014	220604	19580603	DOM	Jan. 01	Dec. 31	500.000 GD	Stewart Creek	0.026	
F070338	222681	19581028	DOM	Jan. 01	Dec. 31	500.000 GD	Stewart Creek	0.026	
F039375	263765	19650804	DOM	Jan. 01	Dec. 31	225.000 GD	Stewart Creek	0.012	
C056808	367258	19800916	DOM	Jan. 01	Dec. 31	500.000 GD	Williams Brook	0.026	
C056808	367258	19800916	DOM	Jan. 01	Dec. 31	500.000 GD	Williams Brook	0.026	
C100894	1001269	19900403	DOM	Jan. 01	Dec. 31	600.000 GD	Garner Spring	0.032	
C041653	316738	19730412	DOM	Jan. 01	Dec. 31	500.000 GD	Cluchey Spring	0.026	
F017304	216540	19570611	DOM	Jan. 01	Dec. 31	1,000.000 GD	Richardson Spring	0.053	
C039685	309948	19720417	DOM	Jan. 01	Dec. 31	500.000 GD	Afton Spring	0.026	
C022860	209676	19551011	DOM	Jan. 01	Dec. 31	5,000.000 GD	Marion Swamp	0.263	
F045495	277390	19671204	DOM	Jan. 01	Dec. 31	500.000 GD	William Springs	0.026	
C070898	270772	19661115	DOM	Jan. 01	Dec. 31	500.000 GD	Benjamin Spring	0.026	
C070899	1000897	19661115	DOM	Jan. 01	Dec. 31	500.000 GD	Benjamin Spring	0.026	
C028075	248444	19630304	DOM	Jan. 01	Dec. 31	3,000.000 GD	Arlington Spring	0.158	
C043111	322763	19740321	DOM	Jan. 01	Dec. 31	500.000 GD	Barnetson Spring	0.026	
F019895	198427	19530131	DOM	Jan. 01	Dec. 31	500.000 GD	Kingsley Spring	0.026	

* 90 day for irrigation period

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
F043956	273076	19530131	DOM	Jan. 01	Dec. 31	500.000 GD	Kingsley Spring	0.026	
F020978	217889	19571003	DOM	Jan. 01	Dec. 31	500.000 GD	Kingsley Spring	0.026	
C039790	309935	19720413	DOM	Jan. 01	Dec. 31	500.000 GD	Kingsley Spring	0.026	
C061355	1000077	19820929	DOM	Jan. 01	Dec. 31	500.000 GD	Cozens Spring	0.026	
F043955	281886	19681021	DOM	Jan. 01	Dec. 31	500.000 GD	Lyons Spring	0.026	
F043954	281901	19681024	DOM	Jan. 01	Dec. 31	500.000 GD	Lyons Spring	0.026	
C053863	355215	19790824	DOM	Jan. 01	Dec. 31	500.000 GD	Lyons Spring	0.026	
C051092	342209	19770331	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C051093	341021	19770331	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053321	364035	19780503	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053322	355468	19780503	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053411	365007	19790102	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053613	365005	19790102	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053282	365006	19790102	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C026856	238220	19610828	DOM	Jan. 01	Dec. 31	500.000 GD	Hillview Spring	0.026	
F018753	238246	19610905	DOM	Jan. 01	Dec. 31	500.000 GD	Hillview Spring	0.026	
F018754	249970	19630527	DOM	Jan. 01	Dec. 31	500.000 GD	Hillview Spring	0.026	
C032101	270642	19661005	DOM	Jan. 01	Dec. 31	500.000 GD	Melvin Spring	0.026	
C061288	1000071	19820915	DOM	Jan. 01	Dec. 31	500.000 GD	Fielding Spring	0.026	
F015844	190450	19510818	DOM	Jan. 01	Dec. 31	500.000 GD	Steinnes Spring	0.026	
F007382	71841	19260911	DOM	Jan. 01	Dec. 31	1,000.000 GD	Craigwell Springs	0.053	
F011184	92564	19300819	DOM	Jan. 01	Dec. 31	2,000.000 GD	Craigwell Springs	0.105	
C100894	1001269	19900403	DOM	Jan. 01	Dec. 31	600.000 GD	Garner Spring	0.032	
C041653	316738	19730412	DOM	Jan. 01	Dec. 31	500.000 GD	Cluchey Spring	0.026	
F017304	216540	19570611	DOM	Jan. 01	Dec. 31	1,000.000 GD	Richardson Spring	0.053	
C039685	309948	19720417	DOM	Jan. 01	Dec. 31	500.000 GD	Afton Spring	0.026	
C022860	209676	19551011	DOM	Jan. 01	De c. 31	5,000.000 GD	Marion Swamp	0.263	
F045495	277390	19671204	DOM	Jan. 01	Dec. 31	500.000 GD	William Springs	0.026	
C070898	270772	19661115	DOM	Jan. 01	Dec. 31	500.000 GD	Benjamin Spring	0.026	
C070899	1000897	19661115	DOM	Jan. 01	Dec. 31	500.000 GD	Benjamin Spring	0.026	
C028075	248444	19630304	DOM	Jan. 01	Dec. 31	3,000.000 GD	Arlington Spring	0.158	
C043111	322763	19740321	DOM	Jan. 01	Dec. 31	500.000 GD	Barnetson Spring	0.026	

* 90 day for irrigation period

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
F019895	198427	19530131	DOM	Jan. 01	Dec. 31	500.000 GD	Kingsley Spring	0.026	
F043956	273076	19530131	DOM	Jan. 01	Dec. 31	500.000 GD	Kingsley Spring	0.026	
F020978	217889	19571003	DOM	Jan. 01	Dec. 31	500.000 GD	Kingsley Spring	0.026	
C039790	309935	19720413	DOM	Jan. 01	Dec. 31	500.000 GD	Kingsley Spring	0.026	
C061355	1000077	19820929	DOM	Jan. 01	Dec. 31	500.000 GD	Cozens Spring	0.026	
F043955	281886	19681021	DOM	Jan. 01	Dec. 31	500.000 GD	Lyons Spring	0.026	
F043954	281901	19681024	DOM	Jan. 01	Dec. 31	500.000 GD	Lyons Spring	0.026	
C053863	355215	19790824	DOM	Jan. 01	Dec. 31	500.000 GD	Lyons Spring	0.026	
C051092	342209	19770331	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C051093	341021	19770331	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053321	364035	19780503	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053322	355468	19780503	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053411	365007	19790102	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053613	365005	19790102	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C053282	365006	19790102	DOM	Jan. 01	Dec. 31	500.000 GD	Alton Spring	0.026	
C026856	238220	19610828	DOM	Jan. 01	Dec. 31	500.000 GD	Hillview Spring	0.026	
F018753	238246	19610905	DOM	Jan. 01	Dec. 31	500.000 GD	Hillview Spring	0.026	
F018754	249970	19630527	DOM	Jan. 01	Dec. 31	500.000 GD	Hillview Spring	0.026	
C032101	270642	19661005	DOM	Jan. 01	Dec. 31	500.000 GD	Melvin Spring	0.026	
C061288	1000071	19820915	DOM	Jan. 01	Dec. 31	500.000 GD	Fielding Spring	0.026	
F015844	190450	19510818	DOM	Jan. 01	Dec. 31	500.000 GD	Steinnes Spring	0.026	
F007382	71841	19260911	DOM	Jan. 01	Dec. 31	1,000.000 GD	Craigwell Springs	0.053	
F011184	92564	19300819	DOM	Jan. 01	Dec. 31	2,000.000 GD	Craigwell Springs	0.105	
				Sub-total		**117925 GD**		**6.14**	**81.2**
Waterworks									
C022585	206319	19541215	WWKLA	Jan. 01	Dec. 31	50,000.000 GD	Reservoir No. 1	26.307	
C035956	2856044	19691110	WWKOT	Jan. 01	Dec. 31	50,000.000 GD	Wall Brook	2.631	
C023280	209893	19551026	WWKOT	Jan. 01	Dec. 31	200,000.000 GD	Enos Lake	10.523	
C058436	368182	19810304	WWKOT	Jan. 01	Dec. 31	7,000.000 GD	Hardy Creek	0.368	

* 90 day for irrigation period

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
C021816	199850	19530522	WWKLA	Jan. 01	Dec. 31	10,000.000 GD	Indian Reserve Cree	0.526	
				Sub-total		**767,000.000 GD**		**39.948**	**528.1**
Irrigation									
C050148	346116	19681202	IRR	Apr. 01	Sep. 30	1.500 AF	Bagley Brook		
C051346	346291	19680522	IRR	Apr. 01	Sep. 30	5.000 AF	Richard Lake	0.785	
C051347	281084	19680522	IRR	Apr. 01	Sep. 30	5.000 AF	Richard Lake	0.785	
C040906	310600	19720731	IRR	Apr. 01	Sep. 30	1.000 AF	Beck Creek	0.157	
F051619	323381	19740715	IRR	Apr. 01	Sep. 30	4.850 AF	Beck Lake	0.761	
C066105	328616	19750410	IRR	Apr. 01	Sep. 30	3.500 AF	Beck Lake	0.549	
C058421	367933	19810223	IRR	Apr. 01	Sep. 30	30.000 AF	Beck Lake	4.71	
C065798	212191	19560604	IRR	Apr. 01	Sep. 30	21.700 AF	Green Lake	3.407	
Z100823	1000812	19880127	IRR	Apr. 01	Sep. 30	15.000 AF	Green Lake	2.355	
Z100828	1000905	19880718	IRR	Apr. 01	Sep. 30	3.000 AF	Green Lake	0.471	
F047406	214694	19570124	IRR	Apr. 01	Sep. 30	1.000 AF	Harewood Creek	0.157	
F049556	309278	19711116	IRR	Apr. 01	Sep. 30	0.090 AF	Chase River	0.014	
C048543	328027	19741025	IRR	Apr. 01	Sep. 30	3.000 AF	Chase River	0.471	
F017775	192319	19511108	IRR	Apr. 01	Sep. 30	44.000 AF	Craig Creek	6.908	
F020495	67025	19260301	IRR	Apr. 01	Sep. 30	4.000 AF	Departure Creek	0.628	
C057097	269135	19660131	IRR	Apr. 01	Sep. 30	0.330 AF	Dublin Gulch	0.052	
C057098	267172	19660131	IRR	Apr. 01	Sep. 30	0.330 AF	Dublin Gulch	0.052	
C044957	329587	19381112	IRR	Apr. 01	Sep. 30	0.360 AF	Indian Reserve Cree	0.056	
C044955	329585	19381112	IRR	Apr. 01	Sep. 30	0.370 AF	Indian Reserve Cree	0.058	
C044953	133489	19381112	IRR	Apr. 01	Sep. 30	2.480 AF	Indian Reserve Cree	0.389	
C044954	329584	19381112	IRR	Apr. 01	Sep. 30	0.510 AF	Indian Reserve Cree	0.08	
F021470	155474	19450312	IRR	Apr. 01	Sep. 30	4.500 AF	Knarston Creek	0.706	
F055733	237702	18610727	IRR	Apr. 01	Sep. 30	38.400 AF	Sabiston Creek	6.028	
F015984	157054	19450818	IRR	Apr. 01	Sep. 30	12.500 AF	Benson Creek	1.962	
C103164	187403	19510119	IRR	Apr. 01	Sep. 30	6.000 AF	Millstone River	0.942	
C103165	1001207	19510119	IRR	Apr. 01	Sep. 30	0.700 AF	Millstone River	0.11	
C103166	1001208	19510119	IRR	Apr. 01	Sep. 30	0.950 AF	Millstone River	0.149	

* 90 day for irrigation period

Chase to Nanoose Licenced Water Demand by Purpose

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
F020814	190452	19510818	IRR	Apr. 01	Sep. 30	4.100 AF	Brannen Lake	0.644	
F016883	190451	19510820	IRR	Apr. 01	Sep. 30	12.000 AF	Brannen Lake	1.884	
C048359	341564	19520107	IRR	Apr. 01	Sep. 30	4.500 AF	Millstone River	0.706	
C048358	341563	19520107	IRR	Apr. 01	Sep. 30	3.100 AF	Millstone River	0.487	
F052626	193057	19520107	IRR	Apr. 01	Sep. 30	4.200 AF	Millstone River	0.659	
C058235	194068	19520325	IRR	Apr. 01	Sep. 30	6.000 AF	Millstone River	0.942	
F049550	203928	19540525	IRR	Apr. 01	Sep. 30	2.000 AF	Millstone River	0.314	
C042910	322580	19540525	IRR	Apr. 01	Sep. 30	2.000 AF	Millstone River	0.314	
F049551	322573	19540525	IRR	Apr. 01	Sep. 30	2.000 AF	Millstone River	0.314	
C042909	322579	19540525	IRR	Apr. 01	Sep. 30	1.700 AF	Millstone River	0.267	
F049554	322577	19540525	IRR	Apr. 01	Sep. 30	1.500 AF	Millstone River	0.235	
F049555	322578	19540525	IRR	Apr. 01	Sep. 30	1.000 AF	Millstone River	0.157	
F049552	322574	19540525	IRR	Apr. 01	Sep. 30	1.200 AF	Millstone River	0.188	
F049553	322576	19540525	IRR	Apr. 01	Sep. 30	0.800 AF	Millstone River	0.126	
C042905	322575	19540525	IRR	Apr. 01	Sep. 30	0.900 AF	Millstone River	0.141	
F017878	207875	19550513	IRR	Apr. 01	Sep. 30	0.250 AF	Long Lake	0.039	
F052375	216716	19570620	IRR	Apr. 01	Sep. 30	2.800 AF	Diver Lake	0.44	
F017600	217890	19571004	IRR	Apr. 01	Sep. 30	0.500 AF	Long Lake	0.078	
F018755	239930	19611213	IRR	Apr. 01	Sep. 30	0.750 AF	Long Lake	0.118	
C032893	273041	19670216	IRR	Apr. 01	Sep. 30	20.000 AF	McClure Creek	3.14	
C045308	328302	19750131	IRR	Apr. 01	Sep. 30	0.500 AF	Long Lake	0.078	
C046035	329378	19750822	IRR	Apr. 01	Sep. 30	0.250 AF	Long Lake	0.039	
C061365	369220	19810804	IRR	Apr. 01	Sep. 30	10.000 AF	Metral Creek	1.57	
C061368	1000261	19810804	IRR	Apr. 01	Sep. 30	5.000 AF	Rannles Creek	0.785	
C061466	1000434	19850201	IRR	Apr. 01	Sep. 30	5.000 AF	Van Tine Pond	0.785	
C058232	370274	19511006	IRR	Apr. 01	Sep. 30	12.500 AF	Harry Creek	1.962	
C058231	24282	19511006	IRR	Apr. 01	Sep. 30	12.500 AF	Harry Creek	1.962	
C020558	191047	19511006	IRR	Apr. 01	Sep. 30	2.000 AF	Harry Creek	0.314	
F058233	199389	19530416	IRR	Apr. 01	Sep. 30	20.000 AF	Nanoose Creek	3.14	
C033372	277013	19670901	IRR	Apr. 01	Sep. 30	2.000 AF	Beevor-Potts Creek	0.314	
C035146	285581	19690520	IRR	Apr. 01	Sep. 30	8.000 AF	Jobb Swamp	1.256	
C035402	285659	19690602	IRR	Apr. 01	Sep. 30	0.670 AF	Nanoose Creek	0.105	

* 90 day for irrigation period

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
C039867	305855	19710812	IRR	Apr. 01	Sep. 30	1.000 AF	Nanoose Creek	0.157	
C061406	1000418	19841029	IRR	Apr. 01	Sep. 30	2.000 AF	Whitta Spring	0.314	
C050688	330859	19760618	IRR	Apr. 01	Sep. 30	1.500 AF	Dart Brook	0.235	
C050688	330859	19760618	IRR	Apr. 01	Sep. 30	1.500 AF	Patti Brook	0.235	
C027661	243314	19620402	IRR	Apr. 01	Sep. 30	50.000 AF	Schooner Creek	7.85	
C048061	221738	1958081	IRR	Apr. 01	Sep. 30	2.100 AF	Strudwick Brook	0.33	
C060494	340596	1958081	IRR	Apr. 01	Sep. 30	6.400 AF	Strudwick Brook	1.005	
C060496	370379	1958081	IRR	Apr. 01	Sep. 30	1.500 AF	Strudwick Brook	0.235	
F048232	305333	19710521	IRR	Apr. 01	Sep. 30	0.500 AF	Walley Creek	0.079	
F017304	216540	19570611	IRR	Apr. 01	Sep. 30	1.000 AF	Richardson Spring	0.159	
F017305	210608	19560124	IRR	Apr. 01	Sep. 30	3.000 AF	Hersley Spr	0.477	
C064023	1000489	19850605	IRR	Apr. 01	Sep. 30	0.500 AF	Lewis Spring	0.078	
F045495	277390	19671204	IRR	Apr. 01	Sep. 30	19.200 AF	William Springs	3.013	
F007382	71841	19260911	IRR	Apr. 01	Sep. 30	2.350 AF	Craigwell Springs	0.369	
C042341	317145	19730625	IRR	Apr. 01	Sep. 30	2.000 AF	Arthur Lake	0.314	
				Sub-total		**453.87 AF**		**71.26**	**559.8**
Industrial Enterprises									
C042137	316619	19730320	WTRNG	Apr. 01	Sep. 30	2.000 AF	Hamilton Bro	0.314	2.5
C100829	1000935	19880906	WTRNG	Apr. 01	Sep. 30	6.000 AF	Hamilton Spr	0.942	7.4
C064021	1000375	19840515	WTRNG	Apr. 01	Sep. 30	140.000 AF	Enos Lake	21.98	172.7
C058236	370241	19520325	WTRNG	Jan. 01	Dec. 31	1.500 AF	Millstone River	0.235	1.9
C042791	316730	19730411	PROCE	Oct. 01	Mar. 31	100,000.000 GD	Mowbray Brook	5.208	0
C064048	369220	19810804	PRCOM	Jan. 01	Dec. 31	4.200 CS	Metral Creek	18.927	0
C054067	330654	19760517	PONDS	Jan. 01	Dec. 31	1.000 CS	Richard Lake	28.316	0
C054530	365142	19790206	PONDS	Jan. 01	Dec. 31	400.000 GD	Dublin Gulch	0.021	0.3
C050688	330859	19760618	PONDS	Jan. 01	Dec. 31	288,000.000 GD	Dart Brook	15.153	198.3
				Sub-total		**366.4 AF**		**91.09**	**383.1**

* 90 day for irrigation period

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS	LOW FLOW
C026017	232102	19600722	LDIMP	Jan. 01	Dec. 31	1,000.000 GD(0.33AF)	Metral Creek	0.053	
C018816	175978	19481007	LDIMP	Jan. 01	Dec. 31	0.000 TF	Millstone River	0	
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0	
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0	
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0	
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0	
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0	
C024896	222531	19581017	LDIMP	Jan. 01	Dec. 31	0.000 TF	McGarrigle Creek	0	
C034813	285580	19690520	LDIMP	Jan. 01	Dec. 31	0.000 TF	Nanoose Creek	0	
C100894	1001269	19900403	STONP	Jan. 01	Dec. 31	1.400 AF	Garner Spring		
C064024	1000489	19850605	STONP	Jan. 01	Dec. 31	0.500 AF	Lewis Spring	0.078	
F045496	277390	19671204	STONP	Jan. 01	Dec. 31	2.000 AF	William Springs	0.314	
F045496	277390	19671204	STONP	Jan. 01	Dec. 31	2.000 AF	William Springs	0.314	
				Sub-total		**791.34 AF**		**124.24**	**976.1**

* 90 day for irrigation period

APPENDIX E

Pending (1993) Water License Applications by Purpose/Use and Drainage

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	PURPOSE	TERM START	TERM END	QUANTITY/UNITS	SOURCE NAME	CONVERTED DEMAND: LS		COMMENTS
Bloods										
Z100822	1000774	19870918	PONDS	Jan. 01	Dec. 31	10,000.000 GD	Green Lake	0.526		
Z100823	1000812	19880127	IRR	Apr. 01	Sep. 30	15.000 AF	Green Lake			
Z100828	1000905	19880718	IRR	Apr. 01	Sep. 30	3.000 AF	Green Lake			
Bonell						3 000 000 m^3/Y				
Z100824	1000838	198803	14 WWKL	Jan. 01	Dec. 31	10,000,000.000 ~~CY~~	Bonell Creek	1.441		includes storage
Chase										
Z105094	1001596	19920715	LDIMP	Jan. 01	Dec. 31	0.700 AF	Harewood Creek			
Z105344	1001614	19920916	LDIMP	Jan. 01	Dec. 31	0.001 AF	Harewood Creek			
Z105346	1001615	19920916	STONP	Jan. 01	Dec. 31	0.001 AF	Harewood Creek			
Craig										
Z100821	1000707	19870331	IRR	Apr. 01	Sep. 30	53.000 AF	Craig Creek			
Dublin										
Z104103	1001538	19920109	DOM	Jan. 01	Dec. 31	500.000 GD	Dublin Gulch	0.026		
Z104106	1001539	19920109	DOM	Jan. 01	Dec. 31	500.000 GD	Dublin Gulch	0.026		
Enos										
Z106552	1001644	19921123	WTRNG	Apr. 01	Sep. 30	150.000 AF	Enos Lake			
Z106552	1001644	19921123	STONP	Jan. 01	Dec. 31	150.000 AF	Enos Lake			
Knarston										
Z105028	1001587	19920709	PONDS	Jan. 01	Dec. 31	0.500 AF	Z Swamp (66141)			

Millstone										
Z105030	1001589	19920710	IRR	Jan. 01	Dec. 31	1.000 AF	ZZ Lake (66144)			
Z100830	1000995	19890105	IRR	Apr. 01	Sep. 30	40.000 AF	Brannen Lake			
Z104124	1001542	19920116	LDIMP	Jan. 01	Dec. 31	1.000 AF	ZZ Creek (65239)			
Nanoose										
Z101352	1001419	19910318	DOM	Jan. 01	Dec. 31	500.000 GD	Nanoose Creek	0.026		
Z101351	1001418	19910318	DOM	Jan. 01	Dec. 31	500.000 GD	Nanoose Creek	0.026		
Z102329	1001469	19910703	DOM	Jan. 01	Dec. 31	500.000 GD	Nanoose Creek	0.026		
Z105112	1001599	19920727	DOM	Jan. 01	Dec. 31	500.000 GD	Nanoose Creek	0.026		

Water Licence Applications by Purpose/use

FILE NUMBER	SOURCE NAME	QUANTITY/UNITS	EQUIVALENT l/sec	owflow dam3*	COMMENTS	
Domestic						
1001538	Dublin Gulch	500.000 GD	0.026	0.344		
1001539	Dublin Gulch	500.000 GD	0.026	0.344		
1001419	Nanoose Creek	500.000 GD	0.026	0.344		
1001418	Nanoose Creek	500.000 GD	0.026	0.344		
1001469	Nanoose Creek	500.000 GD	0.026	0.344		
1001599	Nanoose Creek	500.000 GD	0.026	0.344		
	Sub-Total	**3000.000 GD**	**0.156**	**2.064**		
Irrigation						
1000812	Green Lake	15.000 AF	2.385	18.502		
1000905	Green Lake	3.000 AF	0.477	3.7		
1000707	Craig Creek	53.000 AF	8.427	65.374		
1001589	ZZ Lake (66144)	1.000 AF	0.159	1.233		
1000995	Brannen	40.000 AF	6.36	49.339		
	Sub-Total	**112 AF**	**17.808**	**138.148**		
Industrial						
1000774	Green Lake	10,000.000 GD(13.5AF)	0.521	6.9		
1000838	Bonell Creek	660,000,000.000GY(2432A	94.11	3000		
1001644	Enos Lake	150.000 AF	23.85	185.022		
	Sub-Total	2595.5 AF	**118.481**	**3191.9**		
Land Improvement						
1001596	Harewood Creek	0.700 AF	0.111	0.864	nonconsumptive	
1001614	Harewood Creek	0.001 AF	0.001	0.001	nonconsumptive	
1001542	ZZ Creek (65239)	1.000 AF	0.159	1.233	nonconsumptive	
	Sub-Total	**1.701 AF**	**0.271**	**2.098**		
Conservation						
1001587	ZZ Swamp (66141)	**0.500 AF**	**0.079**	**0.617**	nonconsumptive	
Storage						
1001615	Harewood Creek	0.001 AF	-0.001	-0.001		
1001644	Enos Lake	150.000 AF	-23.85	-185.022		
1000838	Bonell Creek	660000000.000 GY	-94.11	-3000		
	Sub-Total	**2582.00 AF**	**-117.961**	**-3185.023**		

*Based on an estimated 90 day irrigation period demand. Total of 20 Applications in the Study area.

APPENDIX F

Community Water Supply Map

KEY:

STUDY AREA

WATER SUPPLY DISTRICTS

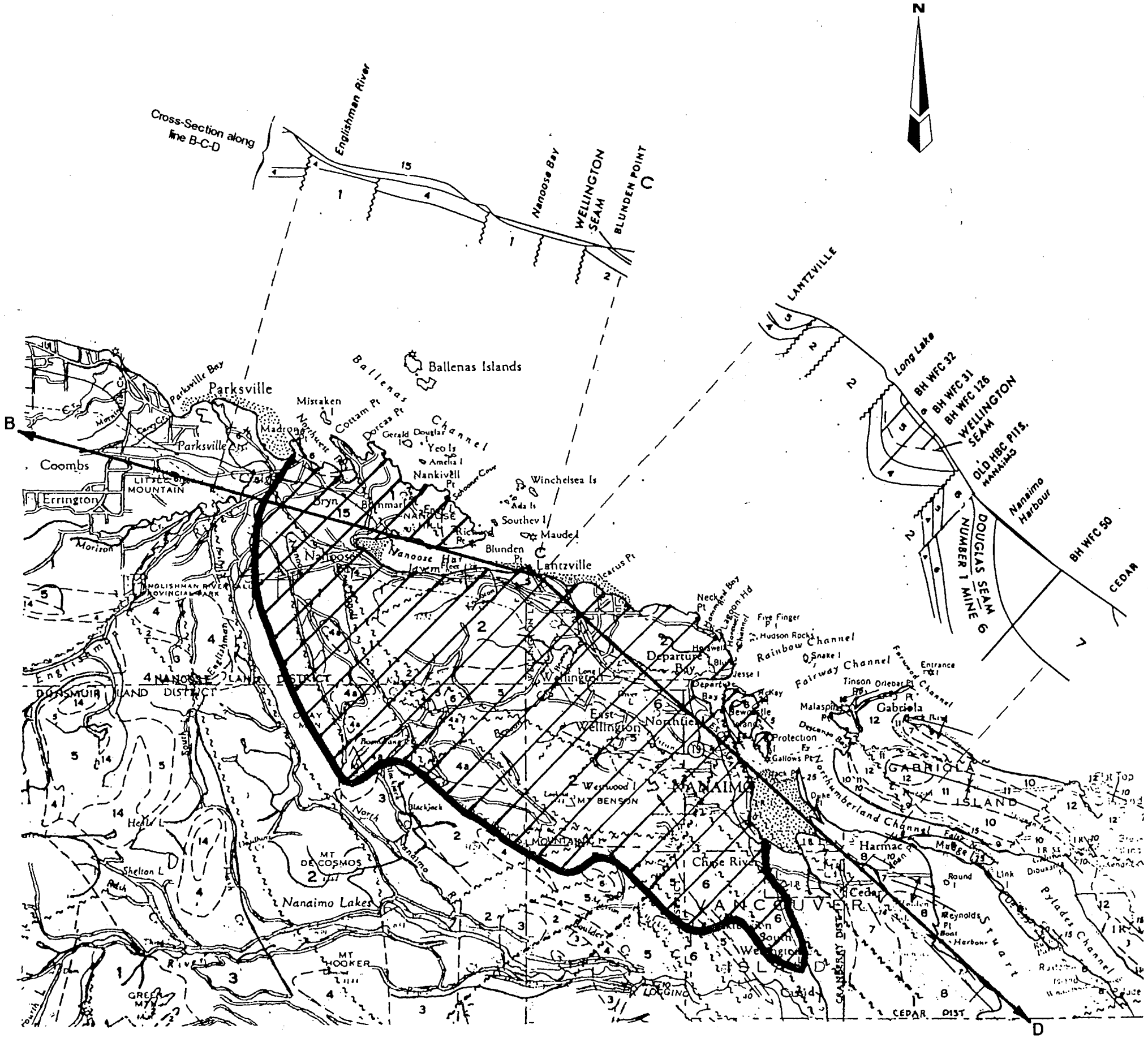
1 City of Nanaimo
2 Lantzville Improvement District
3 Sunset Beach Improvement District
4 William Springs W.W.D.
5 D.N.D.
6 Regional District of Nanaimo

Scale 1: 250,000

WATER SUPPLY DISTRICTS WITHIN STUDY AREA

APPENDIX G

Soil Map



KEY:

STUDY AREA

CROSS-SECTION DESCRIPTIONS:

PERMIAN AND OLDER SICKER GROUP
1 Tuff and breccia, limestone, argillite, quartzite, greenschist

UPPER TRIASSIC AND LOWER JURASSIC VANCOUVER GROUP
2 Volcanic flows and pyroclastics, limestone, argillite, greywacke

4 COMOX FORMATION: sandstone, shale, coal, minor conglomerate;

5 HASLAM FORMATION: shale, siltstone, sandstone

6 EXTENSION - PROTECTION FORMATION: conglomerate, sandstone, shale, coal

7 CEDAR DISTRICT FORMATION: shale, siltstone, sandstone

15 QUATERNARY
Glacial and postglacial deposits

MAP SYMBOLS:

GEOLOGICAL BOUNDARY (approximate)

FAULT (approximate, assumed)

GEOLOGICAL SURVEY OF CANADA

(DATED 1970)

(not to scale)

APPENDIX H

Fish Screening Information

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.

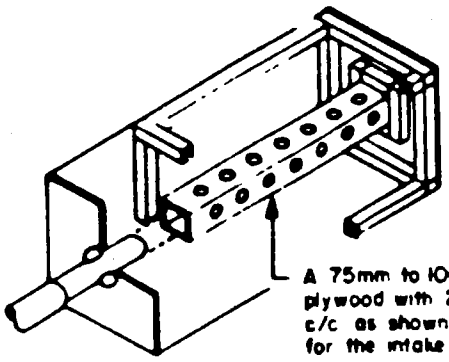
2. B.C. Ministry of Environment
   Fish and Wildlife Management.

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

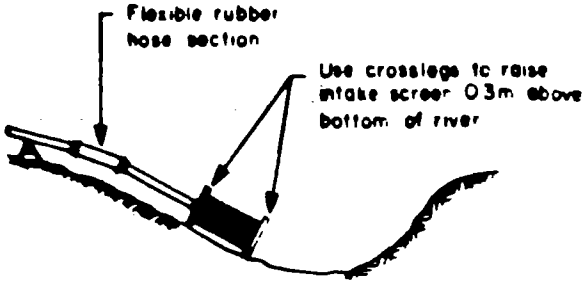
4. B.C. Ministry of Agriculture and Food.

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

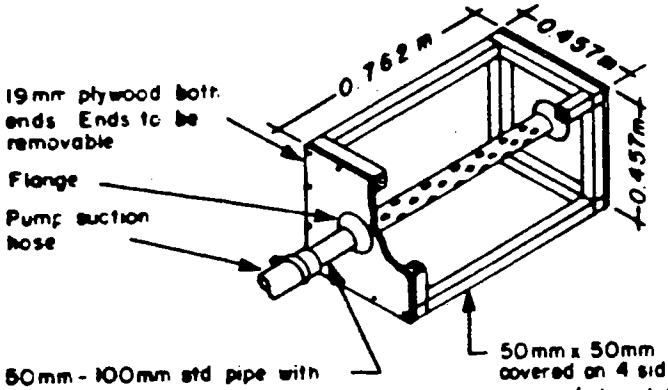
It may be necessary that several or all these agencies also be solicited for approvals prior to the installation of a water intake.

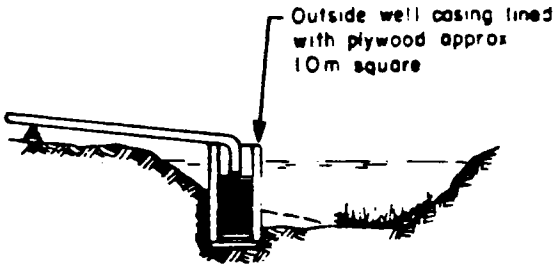


A 75mm to 100mm square box of 19mm plywood with 25mm dia holes at 75mm c/c as shown, may be substituted for the intake pipe below

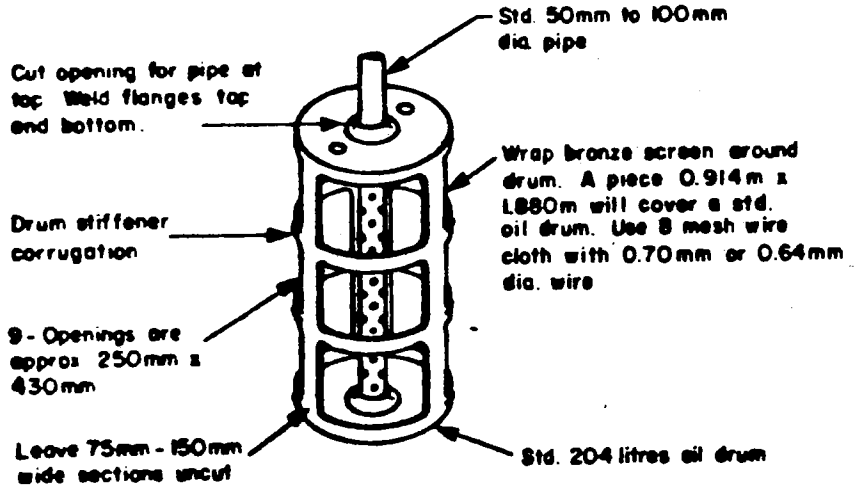


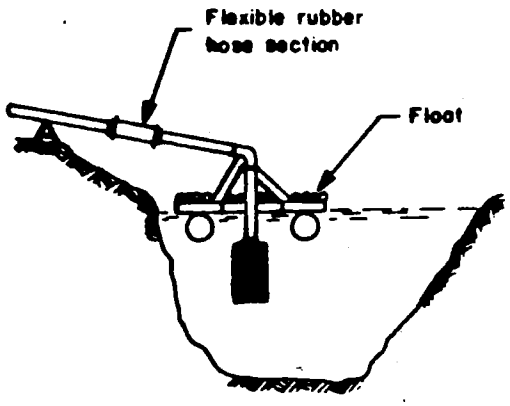
STANDARD INSTALLATION





INSTALLATION IN SHALLOW WATER MUDDY OVERGROWN BOTTOM





INSTALLATION IN DEEP WATER

NOTE

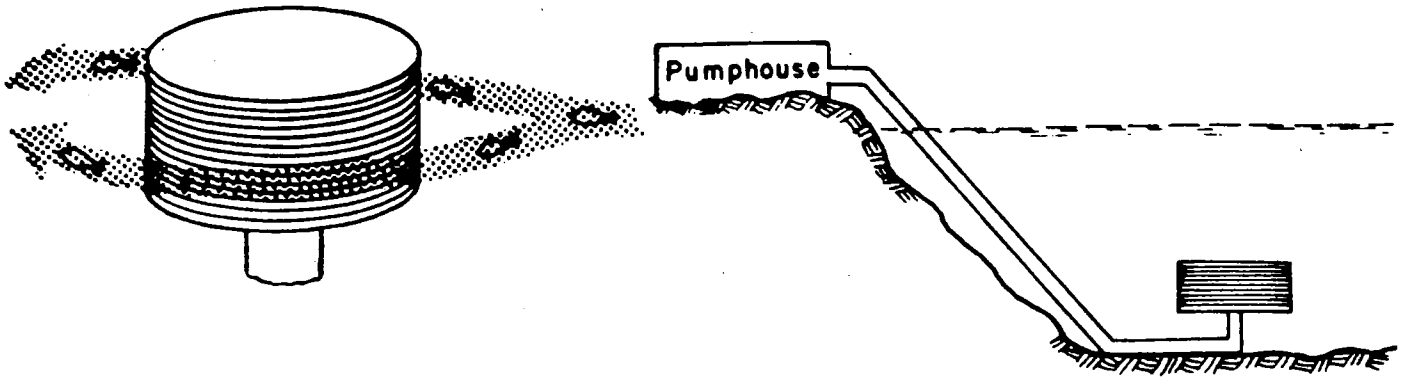
1. Oil drum shall be thoroughly washed out or steam cleaned before cutting openings
2. All loose rust shall be removed and the drum coated with metal primer Two coats of machinery enamel or epoxy paint shall be applied before covering with wire cloth.

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

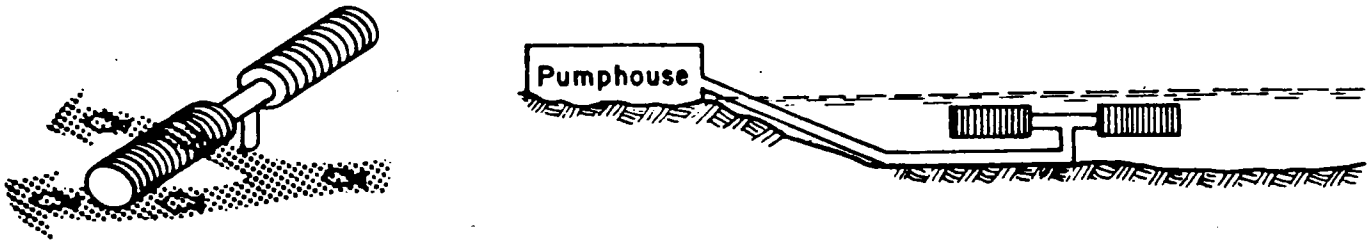
SMALL STATIONARY WATER INTAKE SCREENS

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



DEEP WATER WELL SCREEN

May be installed in lakes and the ocean.



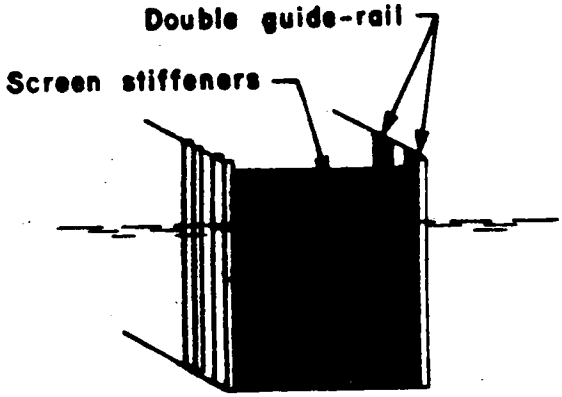
SHALLOW WATER WELL SCREEN

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).

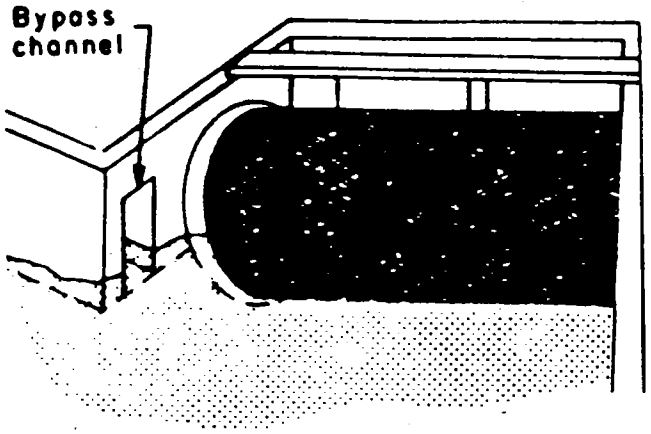
VERTICAL PANEL SCREENS

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.



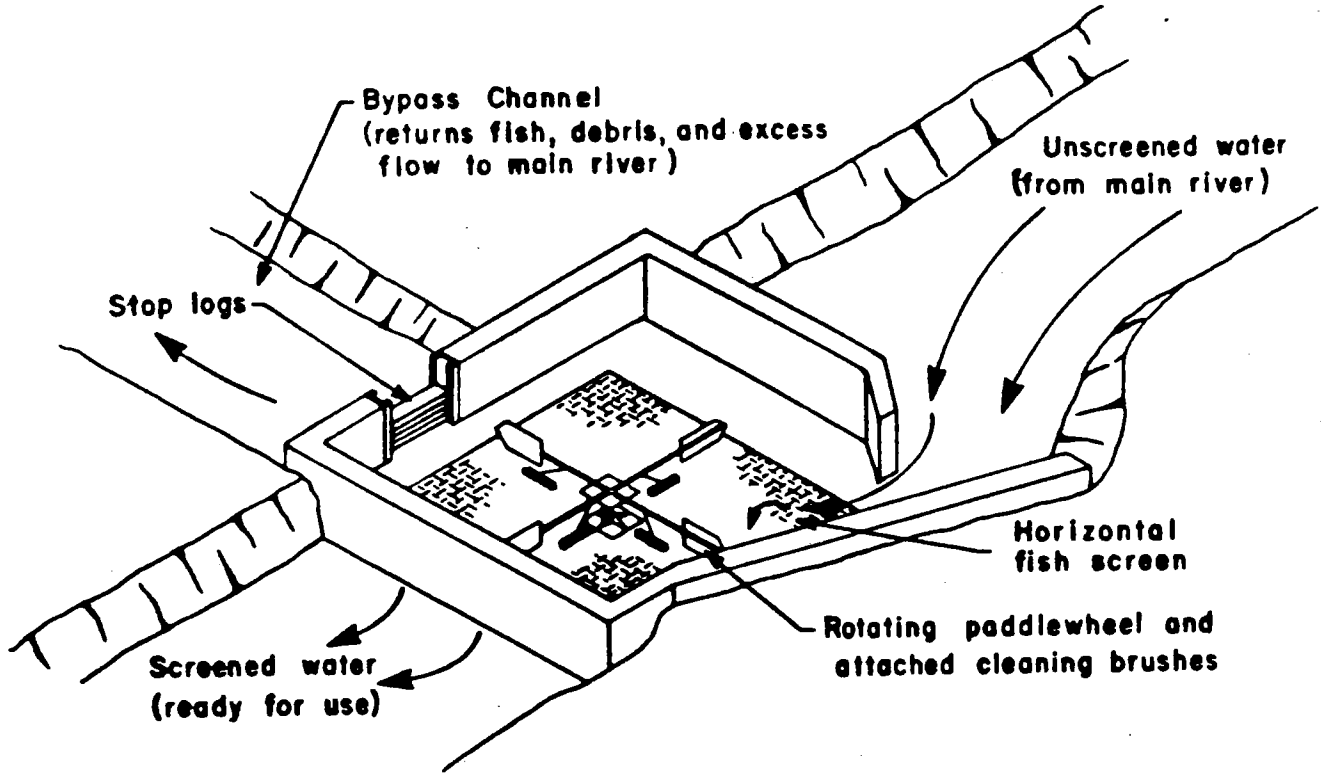
LARGE STATIONARY WATER INTAKE SCREENS

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



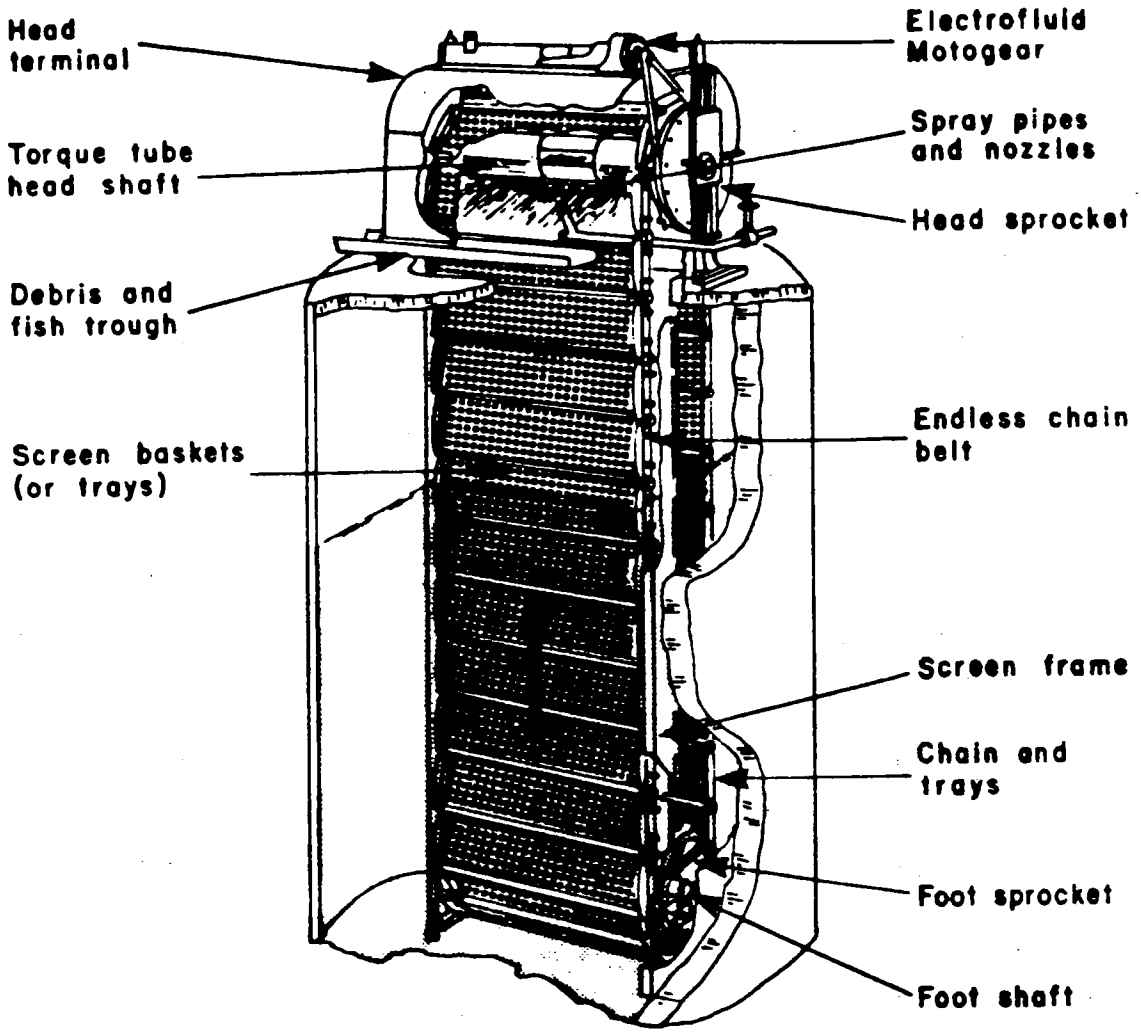
REVOLVING DRUM SCREEN, HORIZONTAL AXIS

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.



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

APPENDIX I

Industrial Water Requirements

SCHEDULE B: INDUSTRIAL WATER REQUIREMENTS (METRIC)

Type of Process	**Water Requirements**
Pulp and Paper Mills	404,558 litres/t
Paper Converting	20,603 litres/t
Saw Mills	6.25 litres/board-metre
Food Processing: Meat Packing Poultry Dressing Dairy Products Canned Fruit & Vegetables Frozen Fruit & Vegetables Malt Beverages	 30 litres/kg. of carcass 44 litres/bird 7 litres/kg. of milk 851 litres/case 24-303 cans 93.3 litres/kg. 5688 litres/barrel of malt
Nitrogenous Fertilizers	88,778 litres/t
Phosphatic Fertilizers	110,879 litres/t
Hydraulic Cement	4,233 litres/t
Steel	195,162 litres/t
Iron and Steel Foundries	38,583 litres/t
Washing Sand and Gravel Initial pond filling Make-up water	 880 litres/t (one time) 130 litres/t/day (8 hrs.)
Primary Copper	441 litres/kg.
Primary Aluminum	411 litres/kg.

SCHEDULE B: INDUSTRIAL WATER REQUIREMENTS (METRIC)

COMMERCIAL USES

Types of Establishment:	**Water Requirements**
Airports	13.65 lpd per passenger
Apartments, multiple family	227.5 lpd per resident
Bath houses	36.4 lpd per bather
Camps: Constr. camps, semi-permanent Day with no meals Luxury Resorts with limited plumbing Tourists with central bath and toilet	 191 lpd per worker 54.6 lpd per camper 387 lpd per camper 191 lpd per camper 132 lpd per camper
Cottages w/seasonal occupancy	191 lpd per resident
Courts, tourist w/individual bath units	191 lpd per person
Clubs: Country Country	 378 lpd per resident 191 lpd per member
Dwellings Boarding houses Luxury dwelling Multiple family apartments Rooming houses Single family	 191 lpd per boarder 378 lpd per person 150 lpd per resident 227.5 lpd per resident 191 lpd per resident
Factories	91 lpd per worker
Hotels: With private bath Without private bath	 227.5 lpd per person 191 lpd per person
Hospitals	1,228 lpd per bed
Institutions other than hospitals	387 lpd per person
Laundries, self service	191 lpd per customer
Motels: With bath and toilet With bath, toilet, and kitchen	 150 lpd per bed 191 lpd per bed

SCHEDULE B: INDUSTRIAL WATER REQUIREMENTS (METRIC)

COMMERCIAL USES

Types of Establishment:	**Water Requirements**
Parks: Overnight with flush toilets Trailers with individual bath units	 95.5 lpd per camper 191 lpd per camper
Picnic: With toilet With toilet, bath house and showers	 36.4 lpd per picnicker 77 lpd/picnicker
Restaurant: With toilet With toilet, bar and lounge	 36.4 lpd per patron 41 lpd per patron
Schools: Without cafeteria, gym or showers With cafeteria With cafeteria, gym and showers Boarding	 54.6 lpd per pupil 77 lpd per pupil 95.5 lpd per pupil 382 lpd per pupil
Service Stations	36.4 lpd per vehicle
Stores	1,515 lpd per toilet
Swimming Pools	36.4 lpd per swimmer
Theatres: Drive-in Movie and Stage	 18.2 lpd per car space 18.2 lpd per seat
Workers: Construction Office	 191 lpd per worker 54.6 lpd per staff

SCHEDULE B: INDUSTRIAL WATER REQUIREMENTS (METRIC)

AGRICULTURAL USES

Types of Agriculture Activity:	**Gallon/day**
Livestock Drinking: Cattle Dairy cattle (and servicing) Goat Hog Horse Mule Sheep Steer	 45.5 lpd per animal 132 lpd per animal 4.5 lpd per animal 13.6 lpd per animal 45.5 lpd per animal 45.5 lpd per animal 4.5 lpd per animal 45.5 lpd per animal
Poultry: Chicken (per 100) Turkeys (per 100)	 27.3 lpd per 100 54.6 lpd per 100
Flood harvesting (cranberries)	2 dam^3 per hectare
Crop suppression (potatoes)	.2 dam^3 per hectare (from Jan. to Mar.)
Frost protection and tree cooling	2 dam^3 per hectare

APPENDIX J

References

REFERENCE MATERIAL FOR STUDY AREA

- Stormwater Management Plans- Millstone River Basin- City of Nanaimo (Oct. 1982)
- Millstone River Flooding Report- M.O.E (1986)
- Ecosystems of B.C.- Prov. of BC (Feb. 1991)
- Regional District of Nanaimo Regional Water Supply - Associated Engineering Services Ltd. (1972)
- 1977 Lowflow monitoring Program - M.O.E
- 1985 Lowflow monitoring Program - M.O.E
- 1993 Lowflow monitoring Program - M.O.E
- Trout Stocking List - Prov. of BC (1987to1992)
- Regional Water Study Update - Regional District of Nanaimo (May 1982)
- M.O.E Water Licence R.E.Rs
- M.O.E Survey and Mapping Branch
  - Soil Legend-92 F/1&8 & G/4
  - Terrain-92 F/1&8 & G/4
  - Soil Capability for Agriculture-92 F/1&8 & G/4
- Bonell Creek Water Supply Study - Chatwin Engineering Ltd.(Aug.1989)
- Chase River Basin Drainage Study - City of Nanaimo(1981)
- Cat Stream Drainage Basin Study - City of Nanaimo(Dec.1981)
- Cat Stream Drainage Study - City of Nanaimo(May 1980)
- Regional Groundwater Potential for Supplying Irrigation Water - Ministry of Agriculture(1985)
- Historical Water Levels Summary B.C. to 1987 - Environment Canada
- Historical Streamflow Summary B.C. to 1990 - Environment Canada
- Enos Lake Water Supply - A Review of Water Availability and Current Licensing Status - M.O.E.(Oct.1973)
- Fish Habitat Inventory & Information Program
- Summary Catalogue Subdistrict #17 (Nanaimo)- Fisheries and Ocean Canada (July 1988)