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

ENGLISHMAN RIVER

WATER ALLOCATION PLAN

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1.0 INTRODUCTION

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

1. Water Managements position on water allocation decisions is available to applicants and public.

2. Response time is reduced.

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

4. Consistency of decisions are improved.

5. Specific allocation directions and decisions are defined.

6. Plans are more comprehensive.

7. Eliminates the need for referrals on individual applications.

The 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 Englishman River Water Allocation Area (Figure 1) is located south-west of the City of Parksville on Vancouver Island. The Englishman River flows in an easterly direction from Mount Arrowsmith and discharges into the Strait of Georgia, north of Craig Bay. The watershed includes parts of the Cameron, Dunsmuir, and Nanoose Land Districts and has a drainage area of 324 km^2. The highest elevation is 1819 metres at Mount Arrowsmith.

The predominate soil types in the lower part of the Englishman River watershed are loamy sands and sandy clay loams. These lower lands are primarily used for rural and urban subdivision developments and agriculture. The upper part of the watershed is heavily forested with Douglas Fir, Western Hemlock, and Red Cedar and used for logging by MacMillan Bloedel. Soils in the steep areas are prone to erosion with resulting stream sedimentation.

Most licensed water demand occurs in the lower part of the Englishman River and the its tributary of Morison Creek. Pollard Creek, Dayton Brook and Connell Creek are tributary to Swane Creek. Swane Creek and Digby Creek are tributary to Morison Creek. The watershed area of Morison creek is 48.60 km^2, or 15% of the total Englishman River watershed.

The largest tributary of the Englishman River is the South Englishman River. The watershed area of the South Englishman River is 77.83 km^2, or 24% of the total Englishman River watershed.

These significant drainage areas of the Englishman River watershed are illustrated in Figure 2.

The largest lakes in the watershed area are: Arrowsmith, Hidden, Fishtail, Rowbotham, Healy, Shelton, and Rhododendron. The combined area of these lakes is 6.31 km^2.

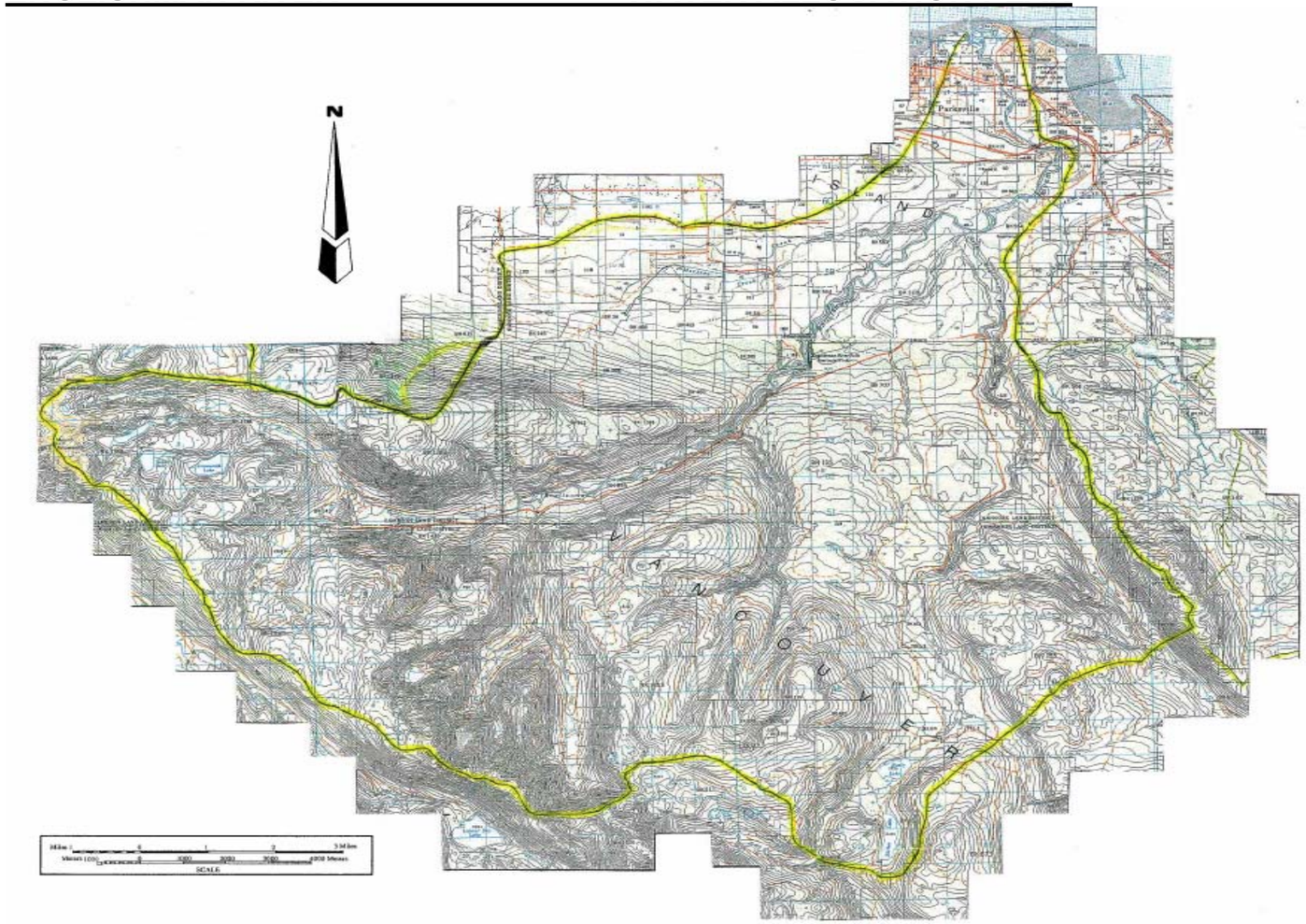
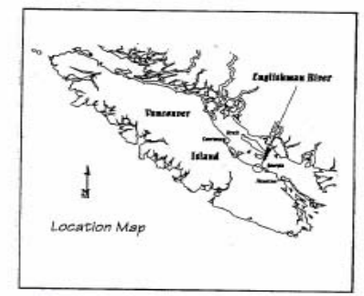


figure 1

ENGLISHMAN RIVER WATER ALLOCATION AREA



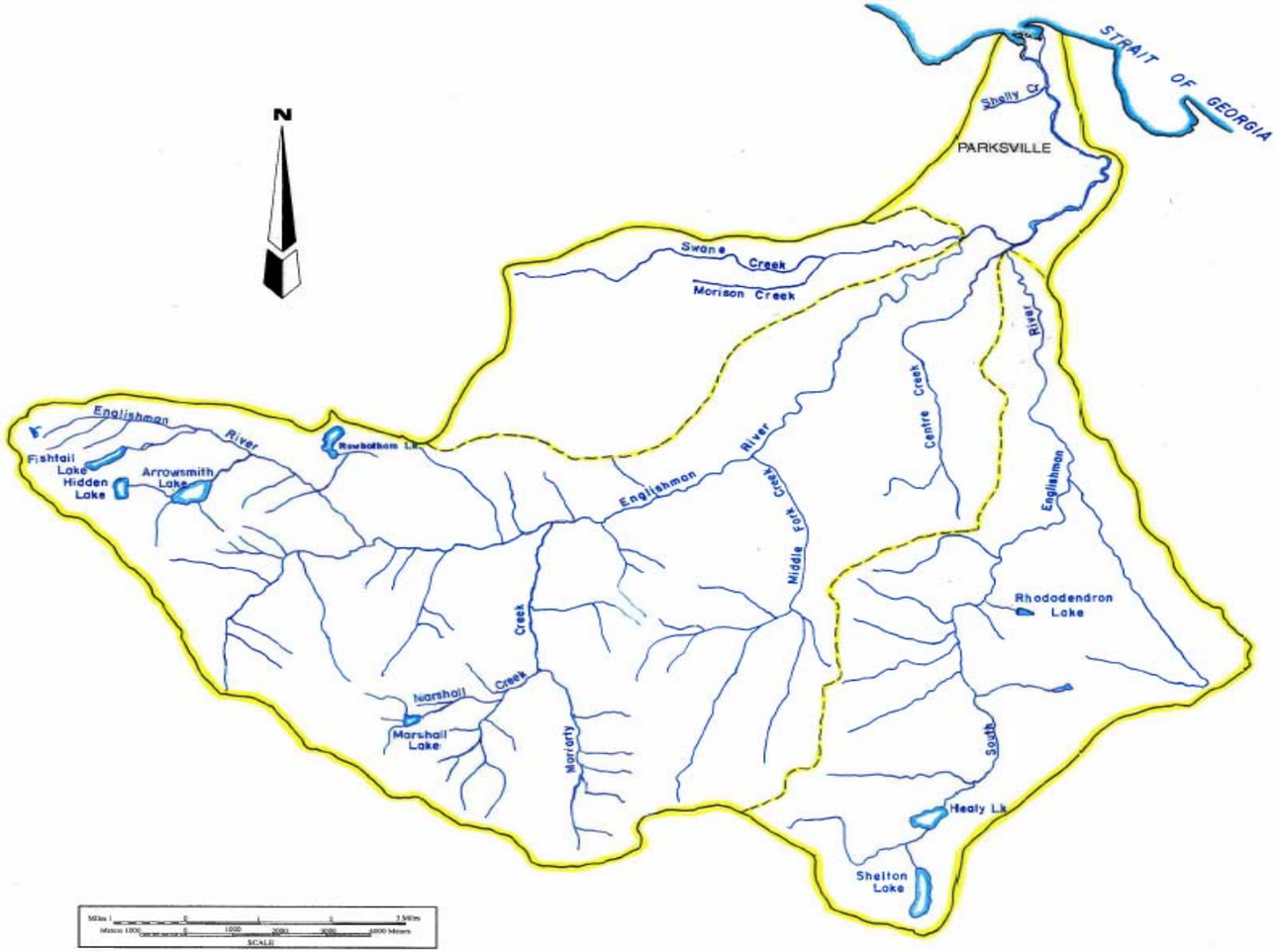


figure 2

ENGLISHMAN RIVER SIGNIFICANT DRAINAGE AREAS

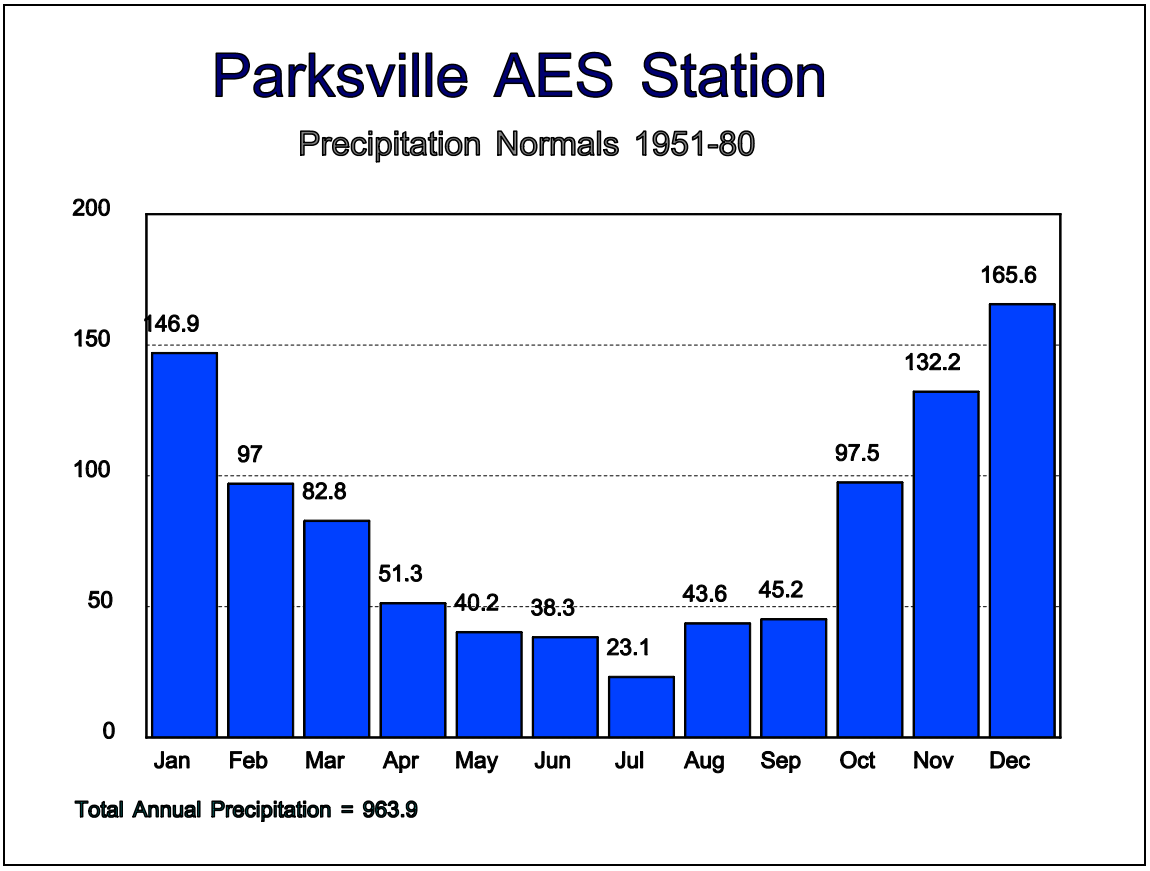
3.0 HYDROLOGY

3.1 Precipitation

There is one AES precipitation station in Parksville in the Englishman River Allocation Plan area. A bar graph showing the monthly precipitation normals for the 1951 to 1980 period for these stations is shown in Figure 3. The Canadian Climatic Normals 1951-1980 data is provided in Appendix A.

The mean total annual precipitation is 963.9 mm (37.9 inches). The minimum mean monthly precipitation is 23.1 mm (0.9 inch) in July and the maximum mean monthly precipitation is 165.8 mm (6.5 inches) in December. The mean number of days with measurable precipitation is 180 days; with 173 days with rain and 11 days with snow.

Figure 3 Parksville Precipitation Normals



Snowfall accumulates on Mount Arrowsmith and Mount Cokely during the winter months. Although the snowmelt does not usually cause flooding during the freshet, it does contribute to spring and early summer flows in the Englishman River. The Mount

Cokely snow survey station (3B02A) is located in the extreme westerly portion of the Englishman watershed near the summit of Mount Cokely. The following table shows the average snowpack and water equivalent for March, April, and May, for 1980 to 1992.

Mount Cokely Snow Survey Station (3B02A)
Elevation 1190 metres

YEARS	MARCH		APRIL		MAY	
1980-1992	Snow(cm)	Water(mm)	Snow(cm)	Water(mm)	Snow(cm)	Water(mm)
Mean	161	615	172	723	160	716
Normal	188	716	207	873	202	912
Maximum	262	1016	329	1342	341	1494
Minimum	56	178	87	331	70	274

3.2 Streamflow

3.2.1 Englishman River

There is one Water Survey Canada (WSC) hydrometric station within the Englishman River Water Allocation Plan area with significant discharge records. The WSC hydrometric station Englishman River near Parksville (08HB002) has daily flow records for the years 1916, 1917 and 1970 to 1991. The mean monthly discharge summary for this station is in the following table and the monthly discharges are noted in Appendix B:

Englishman River near Parksville (08HB002) Mean Monthly Discharges (m^3/sec)

MONTH	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	ANNUAL
MEAN	20.80	25.41	15.83	13.89	11.40	7.24	3.11	1.26	1.44	9.85	26.11	29.25	13.70

The mean annual discharge (MAD) of the Englishman River is 13.70 m^3/sec (483 cfs).

The April to September 7-day average low flow for the Englishman River is:

a) mean - 0.58 m^3/sec (20.47 cfs)
b) 5 year recurrence - 0.32 m^3/sec (11.30 cfs).

The average minimum daily discharge is 0.443 m^3/sec (15.65 cfs). The minimum

recorded daily discharge was 0.085 m^3/sec (3 cfs) on September 4, 1914.

3.2.2 Morison Creek

Using the Englishman River near Parksville (08HB002) records and the percentage of the Morison Creek watershed to the total watershed of the Englishman River (15%), the estimated mean monthly and mean annual (MAD) discharge of Morison Creek is in the following table:

Morison Creek Mean Monthly Discharges (m^3/sec)

MONTH	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	ANNUAL
MEAN	3.1	3.8	2.4	2.1	1.7	1.1	0.5	0.2	0.2	1.5	3.9	4.4	2.1

The estimated mean April to September 7-day average low flow for Morison Creek is 0.09 m^3/sec (3.18 cfs).

3.2.3 South Englishman River

The South Englishman River watershed is 24% of the total watershed of the Englishman River. Therefore the estimated mean monthly and mean annual (MAD) discharge of the South Englishman River is in the following table:

South Englishman River Mean Monthly Discharges (m^3/sec)

MONTH	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	ANNUAL
MEAN	5.0	6.1	3.8	3.3	2.8	1.7	0.7	0.3	0.3	2.4	6.3	7.0	3.3

The estimated mean April to September 7-day average low flow for the South Englishman River is 0.14 m^3/sec (4.94 cfs).

3.2.4 Arrowsmith Creek

In Recent years another Water Survey Canada (WSC) hydrometric station has been established on Arrowsmith Creek at the Outlet of Arrowsmith Lake. The following table provides the monthly discharge records for 1990 to 1992.

Arrowsmith Creek at Outlet of Arrowsmith Lake (08HB080)
litres/second

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Annual
1990										248	915	360	
1991	453	877	164	326	440	237	100	302	138	45	545	477	338
1992	1060	695	299	373	253	94	42	11	27	348	420	189	316
MEAN	**757**	**786**	**232**	**350**	**347**	**166**	**71**	**157**	**83**	**197**	**483**	**333**	**327**

This information indicates that the runoff per unit of area at higher elevations may be 3 times greater that the average runoff per unit of area for the total watershed.

3.3 Lakes

Most of the lakes in the Englishman River watershed are at high elevations and include Arrowsmith Lake, Hidden Lake, Healy Lake, Shelton Lake, Fishtail Lake, Rowbotham Lake and Rhododendron Lake. Their elevations, surface areas, and watershed areas are estimated in the following table:

Lakes in the Englishman River Watershed

LAKE	ELEVATION (metres)	SURFACE AREA (km^2)	WATERSHED AREA (km^2)
Arrowsmith Lake	816	1.39	3.23
Hidden Lake	1110	0.60	1.82
Healy Lake	548	1.16	7.56
Shelton Lake	510	1.50	3.63
Fishtail Lake	1020	0.65	2.85
Rowbotham Lake	820	0.84	0.88
Rhododendron	450	0.17	1.58
TOTAL	n/a	6.31	21.55

Hidden Lake is tributary to Arrowsmith Lake, and Shelton Lake is tributary to Healy Lake.

3.4 Water Supply

The following table summarizes the estimated water supplies for the Englishman River and the two identified significant tributary drainage areas:

Estimated Water Supplies

Watershed	Area(km^2)	Percent of Total	Mean Annual Discharge (m^3/sec)	Mean 7-Day Average Low Flow (m^3/sec)	Oct-May Volume (dam^3)
Morison Creek	49	15%	2.05	0.09	59,778
South Englishman River	78	24%	3.29	0.14	95,645
Englishman River	324	100%	13.7	0.58	398,520

The Englishman River watershed receives most of its flow from rainfall during the winter season. Some precipitation is stored as snowfall on Mount Arrowsmith and Mount Cokely.

The report entitled "Regional Water Supply System - Englishman River - Draft Predesign Report - July 1992" by Koers & Associates Engineering Ltd and Reid Crowther & Partners Ltd assess the hydrology of the Englishman River and Arrowsmith

Lake for the potential water supply for the Regional District of Nanaimo.

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 7.

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. 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%.

4.1 Identified Fish Values

Fisheries habitat information for streams within the Englishman River Water Allocation Plan area is shown in Figure 4. The Englishman River and its tributaries support coho, chum, and chinook salmon; as well as steelhead, cutthroat, and rainbow trout species. Sockeye and Pink salmon have been observed.

Anadromous Steelhead, Chum, and Coho are present in the Englishman River up to the Englishman River Falls. The Englishman River Falls, located approximately 13 km from the mouth of the river, creates a natural fish barrier to migrating salmon and winter steelhead. The critical months for migrating salmon runs for spawning are October to December.

Natural populations of Rainbow Trout are found in Arrowsmith Lake. Natural resident trout species exits in Rhododendron and Healy Lakes. Cutthroat trout are also found in Shelton, Fishtail, Hidden, and Arrowsmith Lakes.

Salmon enhancement projects have created strong coho populations in the South Englishman River and Morison Creek tributaries. Chinook and chum are stocked in the rearing channel of Morison Creek (pers. com. Craig Wightman, Senior Fisheries Biologist, Vancouver Island Region, Environment BC). Hidden Lake, Fishtail Lake, Rowbotham Lake, and Marshall Lake are stocked annually with Rainbow Trout and Rhododendron Lake is stocked with Cutthroat Trout. Steelhead fry are stocked annually in Moriarty Creek and its tributaries.

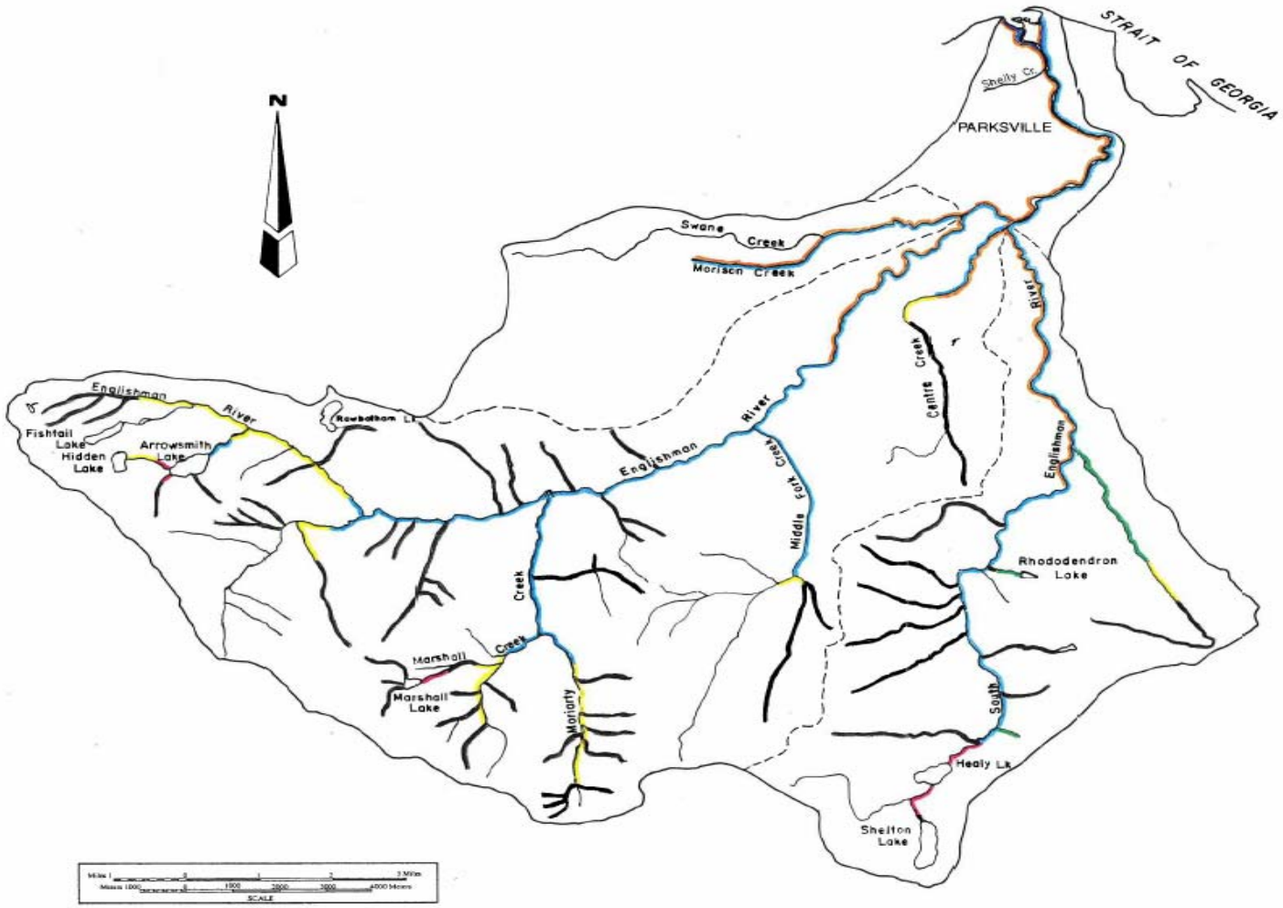


figure 4

ENGLISHMAN RIVER

FISH HABITAT INFORMATION

KEY

- SPORT FISHING WATER
- ANADROMOUS FISH WATER
- POTENTIAL FISH HABITAT
- MARGINAL FISH HABITAT
- NO VALUE AS FISH HABITAT
- KNOWN SPAWNING AREA
- HIGH CAPABILITY BIOTIC LAND

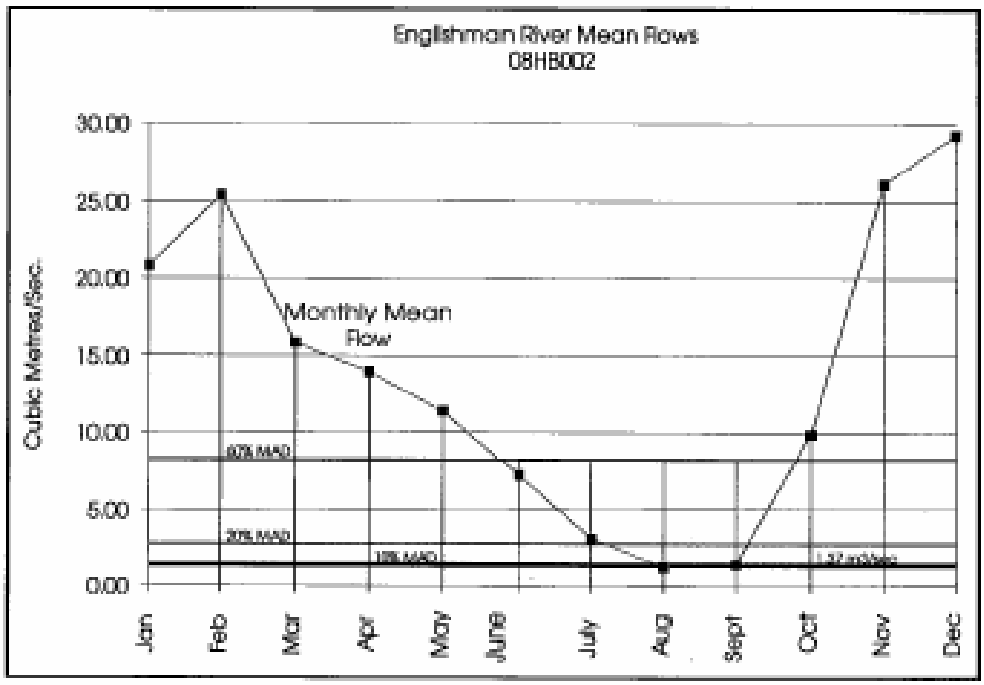
Ct	RESIDENT CUT THROAT
Rb	RAINBOW
Co	COHO
Ch	CHINOOK
Pk	PINK
Sk	SOCKEYE
Sh	STEELHEAD
Smb	SMALL MOUTHED BASS
Cm	CHUM
S	STOCKED

Healy Lake - Rb
Shelton Lake - Rb
Rhododendron Lake - S,Ct,Rb
Marshall Lake - Rb
Rowbotham - S,Rb
Arrowsmith Lake - Rb
Hidden Lake - S,Rb
Fishtail - S,Rb

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

Figure 5 shows the Englishman River mean monthly flows hydrograph and the 10%, 20%, and 60% mean annual discharge levels.

Figure 5 Englishman River Instream Flow Requirement



Ten percent of the mean annual discharge (MAD) for the Englishman River is 1.37 m^3/sec (48.4 cfs). The mean monthly discharge of the Englishman River is below 10% MAD in August and only slightly above the 10% MAD for September.

Similarly all streams within the Englishman River Water Allocation Plan area are estimated to have minimum mean monthly discharges of less than 10% of the MAD. Therefore extractive water demands in the Englishman River Water Allocation Plan area are only to be allowed during the period of November to April inclusive when mean monthly flow is greater than 60% of MAD.

The Englishman River estuary is considered an environmentally sensitive area. Many species of wildfowl use the area as a migratory stopover and feeding area. This estuary area has recently been designated a wildlife sanctuary.

5.0 LICENSED WATER DEMAND

There are 37 water licenses currently (October 1994) within the Englishman River Water Allocation Plan area. These licences are concentrated in the lower part of the Englishman River and Morison Creek and its tributaries A little less than half of these water licences (15) are for domestic purposes for rural residential demands. Figure 6 illustrates the number of water licences issued for each purpose for streams within theplan area. There are 7 water licences for irrigation purposes, 5 water licences for storage purposes, 4 water licences for municipal waterworks purposes, 4 water licences for industrial purposes, 1 water licence for land improvement purpose and 1 water licence for conservation purpose

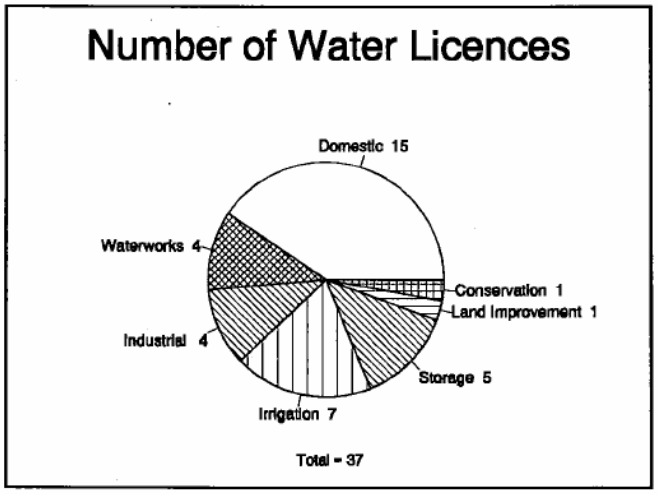


Figure 6 Number of Water Licences

Of greater significance for water management is the estimated average annual licenced water demands and low flow water demands. The total estimated average annual licenced water demand for the plan area is 4,197.3 dam^3. Figure 7 illustrates the estimated average annual licenced water demands for each purpose under which water licences have issued within the plan area. The largest annual water demand is for waterworks purpose. The water licenced demand of the City of Parksville and the Parksville East Waterworks District account for most of the consumptive demand

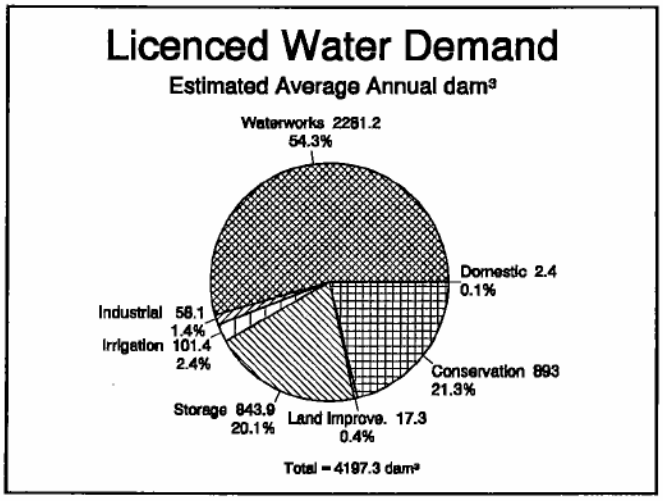


Figure 7 Licenced Water Demand

The second largest annual water demand is for conservation purpose; followed by storage purpose, irrigation purpose, industrial purpose, land improvement purpose and finally domestic purpose. The following table summarizes these annual water demands.

Estimated Average Annual Licenced Demand

Purpose	No. of Lic	Quantity Licenced	Average Annual Licenced Demand*	
			l/sec	dam^3
Municipal Waterworks	4	2,750,000 gpd	72.3	2,281.2
Domestic	15	8,500 gpd	0.4	2.4
Industrial				
(Motel)	1	7,000 gpd	0.4	11.6
(Mobile Home Park)	1	20,000 gpd	1.1	33.2
(Trailer Park)	1	5,000 gpd	0.3	8.3
(Water Delivery)	1	3,000 gpd	0.2	5.0
Sub total	4		2.0	58.1
Irrigation	7	82.17 acft	13.0	101.35
Storage	5	684.17 acft	108.5	843.9
Land Improvement	1	14.0 acft	2.2	17.3
Conservation			28.3	
(Side Channel Enhancement)	1	1.0 cfs		893.0
Total	37		226.7	4,197.3

* Assumes that municipal waterworks demand and domestic demand is the authorizes maximum daily licenced divided by 2 to estimate the average daily demand and multiplied by 365 days to determine the annual demand. Industrial and conservation licenced demands are assumed to be uniform demands over the year and the licenced volume is the total annual demand. Irrigation, storage and land improvement licenced demands are assumed to be 90 day demands.

The low flow licenced water demand may be critical between competing water uses and instream flow requirements to maintain the fish resources. Irrigation water demands occur only during the low flow period. Most of the irrigation licenced demand are located on Morison Creek and its tributaries. Also municipal waterworks demands increase

significantly during the low flow period. All municipal waterworks demands are from the Englishman River near Parksville. Although there is a water licence for the development of storage to support municipal waterworks demands and to ensure that this demand will have less impact on the fish resources, there has been no storage developed to support this demand. There have been proposals to develop municipal waterworks supplies from the South Englishman River but, at present, there is no water demand on this tributary. The low flow licenced demand for the Englishman River watershed and the tributary Morison Creek watershed are summarized in the following table:

Low Flow Licensed Demand

Drainage	Low Flow Water Demand*	
	(l/sec)	Dam^3
Englishman River	51.463	400.3
Morison Creek	4.838	37.7
South Englishman River	0.0	0.0

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

5.1 Projected Demand

Population growth in the area north of Nanaimo from Lantzville to Qualicum Beach has been increasing at 4% to 5% per year. This growth rate is expected to hold or be exceeded in the foreseeable future. This will increase future water demands significantly, especially for municipal waterworks purpose. The Nanaimo Regional District is looking into the possibility of developing a water supply system that would provide a combined water system from Lantzville to Qualicum Beach. Groundwater sources in the area are declining and may not be able to supply the expected increased water demand in the area. The Englishman River is the most probable source of water and Arrowsmith Lake is being considered as the best opportunity for developing supporting storage.

Municipal waterworks purpose is the largest licenced water demand from the Englishman River. Municipal waterworks demand is over half of the total estimated average annual demand. The City of Parksville holds all the municipal waterworks water licenced demands with a total of 12,499,505 litres/day (2,750,000 gpd) maximum daily allowable demand in 4 water licences. The City of Parksville also has a water licence for

802 dam^3 (650 acre-feet) to develop storage on Arrowsmith Lake, Fishtail Lake and Hidden Lake to support their municipal waterworks and mitigate the impact on the fish resource. These storages have not been constructed. The Nanaimo Regional District may take over and develop storage on Arrowsmith Lake and incorporate this licenced storage and municipal waterworks into their integrated water supply system plan.

The second largest water demand on the Englishman River is for fish conservation purpose. The Department of Fisheries and Oceans, Canada, holds the only water licence for 0.028 m^3/sec (1.0 cfs) to enhance flows in a side channel of the Englishman River for fish habitat improvement. There is an similar water licence application for 0.566 m^3/sec (20.0 cfs) on another side channel just upstream of the existing licenced diversion channel. If granted, conservation purpose would become the largest water demand on the Englishman River. Diversions for conservation purpose are nonconsumptive and only impact on the main channel instream flow requirements for the distance of the side channel. Water demands for fish conservation purposes will continue to grow.

Irrigation water demands are primarily in the Errington area drained by Morison Creek. This water demand is generated from small farms and rural residential lots which receive improved crop production when irrigation is developed. Further subdivision of lands in this area and development of existing lots indicate that the water demand for relatively small irrigation developments and supporting dugout storage will continue to grow.

The 4 licenced industrial water demands from the Englishman River are associated with mobile home parks, trailer parks, motel units and water delivery to residential lots which are outside of the municipal waterworks supply area of the City of Parksville. Further similar industrial demands would be discouraged if an integrated regional municipal waterworks supply, as noted above, was developed.

The water demand for licenced storage will continue to increase as the development of licenced storage will be required in order to mitigate the impact of existing and future waterworks and irrigation demands. Water demands for municipal waterworks supply are anticipated to continue to grow in the Englishman River and compete with the increasing water demands for maintaining instream flows for fish and flow diverted for fish conservation purposes (ie. side channel enhanced flows for fish habitat improvement).

6.0 CONCLUSIONS AND RECOMMENDATIONS

The mean annual discharge in the Englishman River near Parksville (08HB002) is 13.70 m^3/sec. The mean monthly discharge for August of 1.26 m^3/sec (44.5 cfs) is below 10% of the mean annual discharge (MAD) limit of 1.37 m^3/sec (48.38 cfs) required to maintain the fisheries resource. The mean monthly discharge for September of 1.44 m^3/sec (50.85 cfs) is below; and the mean monthly discharge for July of 3.11 m^3/sec (109.83 cfs) is slightly above; the 20% MAD of 2.74 m^3/sec (96.76 cfs) required to maintain a good fisheries spawning and rearing habitat. Therefore, within the plan area, there is a three month low flow period, from July through September.

The mean monthly discharge is above 60% MAD (8.22 m^3/sec = 290.28 cfs) for October (9.85 m^3/sec), November (26.11 m^3/sec), December (29.25 m^3/sec), January (20.80 m^3/sec), February (25.41 m^3/sec), March (15.83 m^3/sec), April (13.89 m^3/sec) and May (11.40 m^3/sec). Therefore the period of October through May (8 months) is the high flow period and there is considerable flow available during this period for development.

The Englishman River and its tributaries support an important and varied fish resource. The flows in the streams in the Englishman River Water Allocation Plan area are naturally limiting to fish production and maintenance of fish habitat. There is fish and fish habitat identified in most of the watershed. Fisheries agencies are active in fish stocking and enhancement work in this watershed. Water is available from this watershed only in the high flow period from October through May when the flow is above 60% MAD. In order to protect and maintain the fish resources, storage development will be required to support any further extractive water demand in the low flow period from July through September.

Although the largest number of water licences have issued for domestic purposes, the licenced demand for domestic purpose does not significant impact other water interests; except where there is a local competing water demand conflict. The largest existing annual licenced water demands are for community waterworks purpose for the City of Parksville. Conservation purpose and storage purpose annual licenced demands are also large demands within the Englishman River Water Allocation Plan area. These larger demands may conflict with local fish enhancement and maintenance efforts.

Irrigation water demands have the largest impacts on the low flows in the Morison Creek watershed. Demand is coincident with the low flow period and the critical fish instream flow requirements.

There is not sufficient storage developed or proposed to maintain and support the existing and projected water demands through the low flow period. Further extractive demands, such as municipal waterworks and irrigation will require supporting storage if the instream fish resources are to be maintained. Also any further significant salmon

enhancement proposals that would increase fish stocks in the stream side channels will require the development of supporting storage to maintain required low flows in the main channel. Storage shall be required for all existing and proposed licenced water demand when applications for increased licenced water demands are received from an existing licensee.

Healy and Shelton Lakes have been identified as excellent reservoir sites, but Fisheries have identified these as trophy lakes, with storage of water having a detrimental effect on an important fish resource. Arrowsmith Lake is therefore one of the most economically and environmentally attractive sites for storage. Hidden Lake could provide additional storage to Arrowsmith Lake. The watershed area of Arrowsmith Lake is 5.05 km^2.

Fish and debris screens shall be required on all intake or diversion works within the identified fish habitat areas. Fish and debris screens are part of good intake design and should be encouraged on all intakes or diversion works. Fish passage provisions for both juvenile and adult fish shall be required on all storage dams or diversion works constructed on sources frequented by fish.

In stream works are to be constructed only during the period specified by the fisheries agencies to minimize impacts on the fish resources. In stream work will normally only be allowed during the low flow period from July to October.

6.1 Waterworks

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

The demand for waterworks will greatly increase in the coming years, as the City of Parksville and the Morison Creek watershed areas are further developed.

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.

The Nanaimo Regional District (NRD) has proposed the integration of all community water systems from Lantzville to Qualicum. The Englishman River is the most probable source of supply. The NRD have proposed that 7000 dam^3 of water could be stored in Arrowsmith Lake from the high flow period to support their proposed municipal waterworks demands from the Englishman River.

No further water licences shall issue within the Englishman River Water Allocation Plan area for waterworks purpose unless storage is provided. Existing undeveloped storage and waterworks water licences shall be cancelled unless development of supporting storage proceeds.

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

The licensee shall be required to meter or measure and record the water diverted from the source stream.

The licensee shall be required to treat the water supply in accordance with Ministry of Health requirements.

Adequate system balancing storage 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 existing community waterworks licences shall be allowed unless meters and other conservation measures have been used.

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.

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

6.2 Domestic

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

Domestic water licence shall not be issued to provide evidence to subdivision approval authorities of an "adequate potable water supply" for subdivision development. Residential land subdivisions shall be required to connect to existing community water supply systems or develop a community water system acceptable to the Regional District of Nanaimo for the regional district to operate.

To ensure an adequate domestic water supply for household uses, applicants shall be required to develop storage. For the average daily demand of 1,136 l/day (250 gpd) for a three month period (92 days) a volume of 0.1 dam^3 (4,000 ft^3 or 0.08 acre feet) is required. This requires a reservoir or dugout approximately 7 m (23 feet) long by 5 (16 feet) wide, with an average depth of 3.5 m (12 feet); allowing 0.3 m (1 foot) for evaporation loss.

A spring shall be licensed for an individual domestic water demand provided that it is 30 metres away from any existing licensed springs. Multiple domestic water licenses on a spring will only be allowed if the applicant can provide assurances that adequate water is available by determining the safe flow yield near the end of the low flow period (ie. pump test in August or September) and by satisfying any written concerns and objections of any 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.

6.3 Industrial

Industrial purposes water licence applications to supply water from the Englishman River watershed to community or residential type developments, such as mobile home parks, motels, trailer parks and water delivery, shall be discouraged. Residential and commercial developments shall be required to connect to existing community water supply systems to ensure that public water supplies comply with community water supply standards and requirements.

Cattle or livestock watering requiring more than 450 l/day (100 Igpd) are to be considered an Industrial (Agricultural) demand. Cattle or livestock requiring 450 l/day (100 Igpd) or less will be considered a Domestic (livestock) demand. Estimated livestock demands are:

Recommended Livestock Water Requirements

Livestock	Water Requirements	
	l/day	Igpd
cattle (beef) per animal	45	10
cattle (dairy) per animal	132	29
chickens per 100 animals	27	6
turkeys per 100 animals	55	12

6.4 Irrigation

The crop rooting depth, soil type and climatic characteristics determine requirements for irrigation.

Different crops and their rooting depth and water availability coefficient were classified into shallow (0.5 metre) and deep (1.0 metre) effective rooting depths. The available water storage capacity (AWSC) was estimated for shallow and deep root zone depth for classes of similar soil associations identified for the French Creek Water Allocation Plan area on the maps for the publication Soils of Southern Vancouver Island (J.R. Jungen, P.Ag., Ministry of Environment, August 1985). Where composites of 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.

The following table was made using the climatic information for Parksville and the AWSC of irrigation requirements for different crop effective rooting depth classes and soil classes. A colour mapped of irrigation requirements is provided in Figure 8.

Annual Irrigation Water Requirements millimetres (inches)		
Crops	Peas, Potatoes, Tomatoes, Lettuce, Pasture Species, Cranberries	Brussels Sprouts, Corn, Clover Grapes, Fruit trees, Alfalfa, Raspberries
Effective Rooting Depth	Shallow 0.5 m (1.6 ft)	Deep 1.0 m (3.3 ft)
Arrowsmith (AR) - **organic**	380 (15)	305 (12)
Tolmie (T) - **sandy clay loam** Fairbridge (F) - **silty clay loam**	460 (18)	305 (12)
Bowser (B) - **loamy sand to gravelly sandy loam** Kuhushan (KA) - **sandy loam to loamy sand** Kye (KY) - **loamy sand**	530 (21)	460 (18)
Quinsam (QN), Quimper (QP), Robertson (RB), Sarita (SR), Rossiter (RT), Cullite (CT), Nitinat (NI), Moyeha (MI), Ritherton(RH), Reginald (RE) - **gravelly sandy loam** Dashwood (D) - **very gravelly loamy sand to gravelly loamy sand** Hawarth (HA), Qualicum (Q), Honeymoon (HM), Cassidy (CA) - **very gravelly loamy sand** Shephard (SP), Strata (ST), Guemes (GS), Green Mtn. (GN), Granite (GT), Hiller (HL) - **gravelly loamy sand**	610 (24)	610 (24)

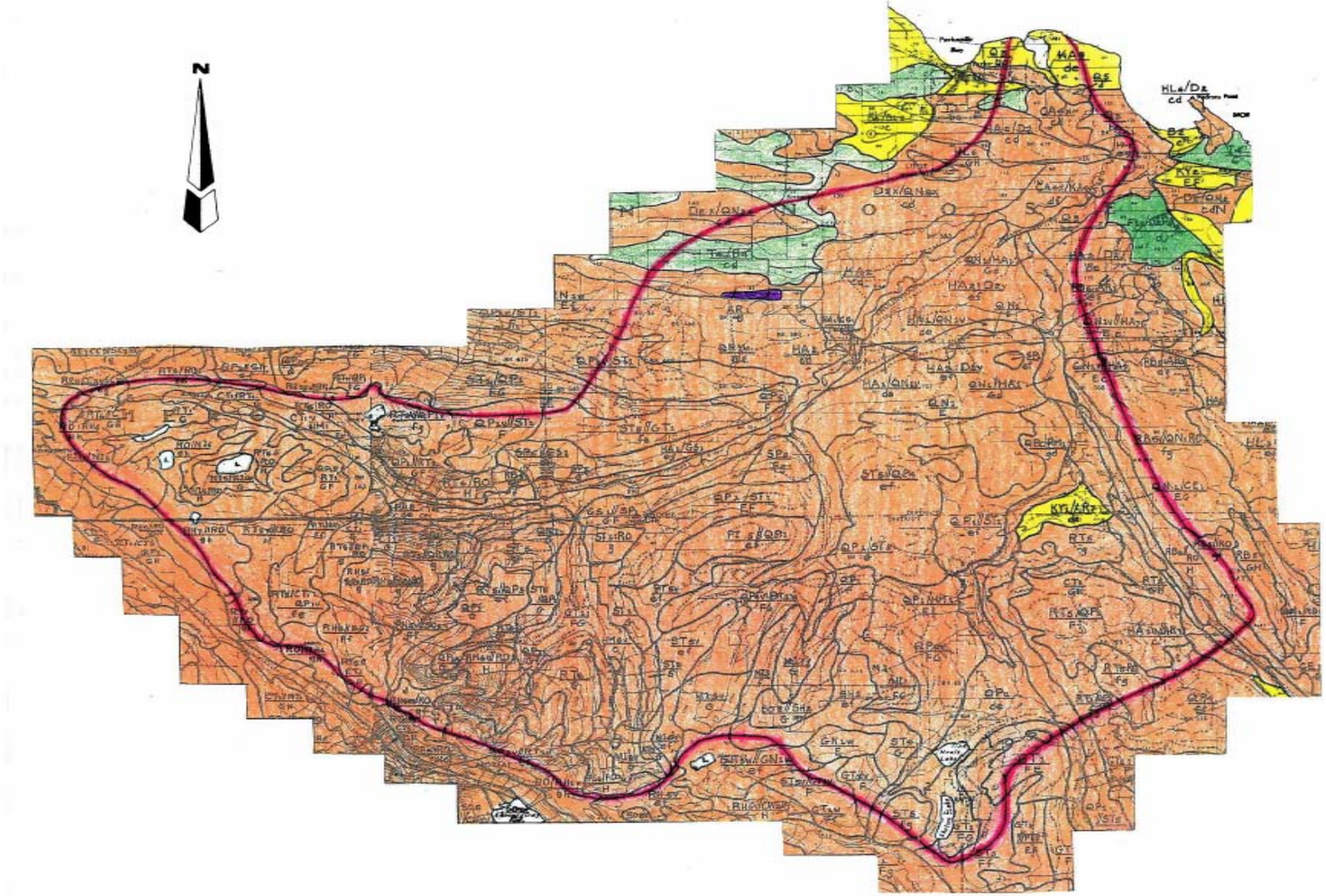


figure 8

ENGLISHMAN RIVER SOIL INFORMATION

Figure 12 -Annual Irrigation Water Requirements in millimetres (inches)

Crops / Soils / Effective Rooting Depth	Peas, Potatoes, Tomatoes, Lettuce, Onions Spinach, Cucumbers	Brussel Sprouts, Corn, Carrot Crops, Cole Crops, Beans, Raspberries
	Shallow 0.5 m (1.6 ft)	Deep 1.0 m (3.3 ft)
Amaranth (AR) -organic	380 (15)	305 (12)
Tolmie (T) - sandy clay loam Fairbridge (F) - silty clay loam	460 (18)	305 (12)
Bowser (B) - loamy sand to gravelly sandy loam Kalloshan (KA) - sandy loam to loamy sand Rye (RY) - loamy sand	530 (21)	460 (18)
Quinsam (QN) Quimper (QP) Robertson (RB) Serba (SR) Fossiter (RT) Collins (CT) Milnet (NE) Rithetion (RH) Moyeka (M) Reginald (RE) - gravelly sandy loam Deslwood (D) - very gravelly loamy sand to gravelly loamy sand Haworth (HA) Gordstream (G) Honeymoon (HM) Cassidy (CA) - very gravelly loamy sand Shepherd (SP) Sinta (ST) Sicamous (SS) Green Mtn. (GR) Grizzly (GY) Hiller (HL) - gravelly loamy sand	610 (24)	610 (24)

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

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

Irrigation gun or flood irrigation systems 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.

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

6.5 Land Improvement

Water required for land improvement aesthetic ponds shall be the volume of the pond to be created. All the requirements noted for storage development shall be required for land improvement development where applicable.

6.6 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.

Salmon enhancement proposals that would significantly increase fish stocks in the stream channels will require the development of supporting storage to maintain required low flows. All the requirements noted for storage development shall be required for conservation development where applicable.

6.7 Storage

Storage purpose is the impoundment of water, either on-stream or off-stream in a dugout or behind a dam. In the unlikely event that a large storage development (ie. BC Hydro power, pulp & paper, large waterworks) is proposed a more specific supply versus demand and environmental impact assessment will be required.

The storage quantity required to support the smaller water demands anticipated to support domestic, industrial, commercial and irrigation uses shall be the volume of the water demand during the low flow period as noted above plus an additional allowance of 0.3 metres (1.0 foot) depth over the surface area of the storage reservoir for evaporation and other losses.

The water licence applicant shall be required to submit a completed report form entitled "Dam and Reservoir Information Required in Support of a Water Licence Application for Storage Purpose (Schedule 2)" before the application be considered.

Total storage (dead and live) will be licensed. Dead storage should be licensed as it will in most cases have some intrinsic value such as providing conservation of water for wildlife or aesthetic value.

Diversion of water into off-stream storage will be during the high flow period of October through May (8 months). All in-stream storage will be required to pass any inflow to the reservoir down stream during the low flow period from July through September.

The applicant shall obtain written agreement, right-of-way or easement for works or flooding affecting other lands.

Fish passage is required for both juvenile and adult fish, at all dams in fish bearing

streams. Design of storage dams must consider fish ladders and provide adequate flow release and maintain fish passage where required. In stream storage works are to be constructed only during the period specified by the fisheries agencies to minimize impacts on the fish resources. In stream work will normally only be allowed during the low flow period from July to October. Mitigation work will be required for loss of spawning areas in the creeks affected by any storage.

Design plans must be submitted and accepted in writing before construction commences on any proposed dam over 3 m (10 ft) in height or on storage of 12 dam^3 (10 acft) or more.

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

Off-stream storage dugouts are encouraged that provide the following advantages:

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

6.8 Allocation Plan Update

The Englishman River Water Allocation Plan should be reviewed and updated on or before November 1999.

Appendix A

Parksville
Canadian Climatic Normals
1951 - 1980

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	9.5	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	-16.0	-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	63.9	73.9	51.3	40.2	38.3	23.1	43.6	45.2	97.5	128.1	144.6	888.7	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	8	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	66.5	54.9	51.6	47.2	48.3	36.1	42.2	37.8	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	37.8	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

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

QUALICUM R FISH RESEARCH
49° 24'N 124° 37'W 8 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	4.9	7.2	8.9	12.5	16.4	19.1	22.0	21.4	18.1	13.0	8.2	6.2	13.2	8	Température Maximale Quotidienne
Daily Minimum Temperature	-0.4	0.9	1.1	3.4	6.8	9.9	11.4	11.3	8.8	5.5	2.6	1.1	5.2	8	Température Minimale Quotidienne
Daily Temperature	**2.3**	**4.1**	**5.0**	**8.0**	**11.6**	**14.5**	**16.7**	**16.4**	**13.4**	**9.3**	**5.4**	**3.7**	**9.2**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	1.6	1.2	0.8	0.8	0.7	1.2	0.9	1.0	1.1	0.7	1.0	1.7	0.4	4	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	14.4	16.1	18.9	23.3	26.1	30.0	31.1	31.1	27.2	22.0	17.8	16.0	31.1		Température Maximale Extrême
Years of Record	18	18	18	17	17	18	18	19	19	19	19	19			Années de Relèves
Extreme Minimum Temperature	-15.6	-7.8	-6.5	-2.8	0.0	2.8	5.0	4.4	0.0	-2.8	-7.0	-14.4	-15.6		Température Minimale Extrême
Years of Record	18	18	18	17	17	18	18	19	19	19	19	19			Années de Relèves
Rainfall	189.4	140.5	113.2	61.4	44.5	39.3	26.3	41.8	58.6	137.9	203.4	219.0	1275.3	8	Chutes de Pluie
Snowfall	24.4	6.3	2.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0	12.1	47.4	8	Chutes de Neige
Total Precipitation	**204.5**	**151.8**	**116.9**	**61.7**	**44.5**	**39.3**	**26.3**	**41.5**	**58.6**	**137.9**	**204.4**	**229.8**	**1317.2**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	110.2	56.0	49.1	34.8	16.5	18.4	22.9	28.8	40.3	91.3	97.9	76.3	219.9	4	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	117.3	61.7	69.1	29.5	27.7	34.2	25.4	38.1	31.8	72.6	85.1	85.4	117.3		Chute de Pluie Record en 24 heures
Years of Record	18	18	18	17	16	18	18	18	19	19	19	19			Années de Relèves
Greatest Snowfall in 24 hours	49.0	45.7	12.7	4.6	0.0	0.0	0.0	0.0	0.0	0.0	11.7	45.7	49.0		Chute de Neige Record en 24 heures
Years of Record	18	18	18	17	18	18	18	19	19	19	19	19			Années de Relèves
Greatest Precipitation in 24 hours	117.3	61.7	69.1	29.5	27.7	34.2	25.4	38.1	31.8	72.6	85.1	85.4	117.3		Précipitation Record en 24 heures
Years of Record	18	18	18	17	16	18	18	18	19	19	19	19			Années de Relèves
Days with Rain	16	15	16	12	10	9	6	8	10	15	17	19	153	8	Jours de Pluie
Days with Snow	4	1	1	0	0	0	0	0	0	0	1	2	9	8	Jours de Neige
Days with Precipitation	19	16	16	12	10	9	6	8	10	15	18	20	159	8	Jours de Précipitation

Appendix B

Water Survey Canada
Monthly and Annual Mean Discharges
Englishman River

Englishman River near Parksville (08HB002)
Monthly and Annual Mean Discharge (m^3/sec)

YEAR	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec		ANNUAL
1913	Missing	Missing	7.66	Missing	Missing	9.25	5.43	1.01	Missing	7.94	Missing	Missing		Missing
1914	Missing	Missing	Missing	Missing	Missing	7.24	2.42	0.63	Missing	Missing	Missing	Missing		Missing
1915	17.40	17.30	18.60	17.10	6.51	3.04	1.24	0.78	0.68	17.50	18.20	34.70		12.70
1916	5.38	29.30	32.90	21.70	20.90	17.30	9.11	3.04	1.15	2.18	10.40	10.10		13.60
1917	10.20	11.70	6.02	14.60	19.10	11.70	4.60	1.24	1.42	Missing	Missing	Missing		Missing
1970	Missing	Missing	Missing	Missing	10.80	6.38	1.43	0.65	0.88	Missing	Missing	Missing		Missing
1971	Missing	Missing	Missing	17.60	21.50	13.30	7.11	2.06	2.04	Missing	Missing	Missing		Missing
1979	Missing	Missing	Missing	6.37	9.82	2.85	2.40	0.65	6.06	12.90	8.05	54.50		Missing
1980	19.80	29.50	13.10	17.40	7.19	5.94	3.39	0.84	1.21	1.61	41.70	53.30		16.20
1981	19.20	34.60	7.85	17.30	9.56	4.95	1.75	0.65	2.84	21.50	39.20	44.00		16.80
1982	17.50	33.10	13.00	10.30	13.90	12.00	3.50	1.03	0.71	22.80	11.80	40.00		14.90
1983	33.60	57.10	31.90	9.97	10.10	6.59	5.16	1.04	0.97	2.96	61.10	11.50		19.00
1984	32.00	24.30	16.40	10.50	13.80	7.33	2.84	0.72	1.21	17.20	30.20	17.10		14.40
1985	6.48	9.18	6.11	16.80	10.90	4.64	1.29	0.50	0.85	10.30	6.88	9.13		6.89
1986	42.90	29.90	20.30	6.32	11.30	4.88	1.79	0.53	0.42	1.29	19.60	31.60		14.20
1987	35.20	22.70	30.50	10.50	8.11	5.94	1.55	0.58	0.34	0.29	6.82	20.90		11.90
1988	16.30	11.50	13.90	18.70	12.90	8.32	3.07	0.87	0.70	1.84	24.40	16.60		10.70
1989	18.30	10.00	15.00	17.40	7.97	4.32	1.93	0.87	0.40	5.79	11.00	16.40		9.13
1990	19.90	18.90	13.40	12.30	6.35	6.65	1.32	0.38	1.02	21.60	83.10	57.70		20.20
1991	17.90	42.00	6.60	11.30	4.55	2.15	0.89	7.10	3.10	0.64	19.20	21.20		11.20
MEAN	20.80	25.41	15.83	13.89	11.40	7.24	3.11	1.26	1.44	9.85	26.11	29.25		13.70

Appendix C

Licenced Annual Water Demand by Purpose

Englishman River Watershed

Morison Creek Watershed

October 1994

Englishman River Watershed
Licenced Annual Water Demand
Oct. 03, 1994

LICENCE NUMBER	FILE NUMBER	SOURCE NAME	QUANTITY	DEMAND dam^3/year
Waterworks				
C022058	0203320	Englishman River	200,000.000 GD	165.90
C023297	0210491	Englishman River	50,000.000 GD	41.48
C026692	0236212	Englishman River	1,000,000.000 GD	829.51
C057408	0364821	Englishman River	1,500,000.000 GD	1,244.27
		Sub-total	2,750,000.000 GD	2,281.16
Domestic				
F015340	0087125	Englishman River	500.000 GD	0.41
C028120	0247782	Englishman River	1,000.000 GD	0.83
C035883	0296147	Swane Creek	1,000.000 GD	0.83
C038418	0305434	Englishman River	500.000 GD	0.41
C037976	0305445	Englishman River	500.000 GD	0.41
C037975	0305470	Englishman River	500.000 GD	0.41
C039684	0309810	Englishman River	500.000 GD	0.41
C052934	0364504	Englishman River	500.000 GD	0.41
C059297	0369105	Englishman River	500.000 GD	0.41
C059703	1000201	Englishman River	500.000 GD	0.41
C059692	1000204	Englishman River	500.000 GD	0.41
C064079	1000690	Englishman River	500.000 GD	0.41
C064098	1000716	Swane Creek	500.000 GD	0.41
C100831	1001123	Englishman River	500.000 GD	0.41
C101980	1001405	Englishman River	500.000 GD	0.026
		Sub-total	8,500.000 GD	2.40
Industrial				
C024281	0219965	Englishman River	7,000.000 GD	11.61
C059595	0285091	Englishman River	20,000.000 GD	33.18
C042793	0322616	Englishman River	5,000.000 GD	8.30
C045309	0328759	Englishman River	3,000.000 GD	4.98

LICENCE NUMBER	FILE NUMBER	SOURCE NAME	QUANTITY	DEMAND dam^3/year
Subtotal			35,000.000 GD	58.07
Irrigation				
F015340	0087125	Englishman River	3.000 AF	3.70
C022596	0207099	Shelley Creek	15.000 AF	18.50
C064085	0248448	Morison Creek	10.000 AF	12.33
C029475	0256916	Digby & Morison Creeks	30.000 AF	37.00
C039208	0305628	Dayton Brook	20.000 AF	24.67
C065779	1000790	Connell Creek	2.170 AF	2.68
C070373	1001039	Pollard Creek	2.000 AF	2.47
Sub-total			82.170 AF	101.35
Land Improvement				
C100850	1000952	Sands Swamp	14.000 AF	17.27
Sub-total			14.000 AF	17.27
Storage				
C064085	0248448	Morison Creek	10.000 AF	12.33
C039209	0305628	Dayton Brook	20.000 AF	24.67
C057409	0367389	Arrowsmith, Fishtail & Hidden Lakes	650.000 AF	801.77
C065779	1000790	Connell Creek	2.170 AF	2.68
C070373	1001039	Pollard Creek	2.000 AF	2.47
Subtotal			684.170 AF	843.92
Conservation				
C072654	1001154	Englishman River	1.000 CS	893.01
Sub-total			21.000 CS	893.01
Total				4,197.2

* Assumes that municipal waterworks demand and domestic demand is the authorizes maximum daily licenced divided by 2 to estimate the average daily demand and multiplied by 365 days to determine the annual demand. Industrial and conservation licenced demands are assumed to be uniform demands over the year and the licenced volume is the total annual demand. Irrigation, storage and land improvement licenced demands are assumed to be the total licenced volume.

Morison Creek Watershed
Licenced Low Flow Demand
October 1994

LICENCE NUMBER	FILE NUMBER	SOURCE NAME	LICENCE QUANTITY	FLOW* l/s
Domestic				
C035883	0296147	Swane Creek	1,000.000 GD	0.053
C064098	1000716	Swane Creek	500.000 GD	0.026
Subtotal			1,500.000 GD	0.079
Irrigation				
C064085	0248448	Morison Creek	10.000 AF	1.586
C029475	0256916	Digby & Morison Creek	30.000 AF	4.759
C039208	0305628	Connell Brook	20.000 AF	3.173
C065779	1000790	Connell Creek	2.170 AF	0.344
C070373	1001039	Pollard Creek	2.000 AF	0.317
Subtotal			64.170 AF	10.179
Land Improvement				
C100850	1000952	Sands Swamp	14.000 AF	0.000
Subtotal			14.000 AF	0.000
Storage				
C064085	0248448	Morison Creek	10.000 AF	-1.586
C039209	0305628	Dayton Brook	20.000 AF	-3.173
C065779	1000790	Connell Creek	2.170 AF	-0.344
C070373	1001039	Pollard Creek	2.000 AF	-0.317
Subtotal			34.170 AF	-5.420
TOTAL				4.838

* Low flow based on an estimated 90 day irrigation and storage demands; Authorized storage balances demand and therefore is a negative demand over the 90 day period; land improvement is a non-consumptive during the low flow period and therefore has no demand.

Appendix D

Fish Screening Requirements

FISH SCREENING DIRECTIVE

Government of Canada
Department of Fisheries and Oceans

WATER INTAKE FISH PROTECTION FACILITIES

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

PROVISIONS OF THE FISHERIES ACT - SECTION 28

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

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

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

PROCEDURES FOR INSPECTION AND APPROVAL OF INTAKE STRUCTURES

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

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

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

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

SPECIFICATIONS FOR INTAKE STRUCTURES WITHOUT PROVISION FOR AUTOMATIC CLEANING

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

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

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

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

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

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

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

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

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

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

SPECIFICATIONS FOR INTAKE STRUCTURES WITH PROVISIONS FOR AUTOMATIC CLEANING

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

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

ALTERNATE FISH PROTECTION FACILITIES

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

Conversion Factors:

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

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

Addresses for Correspondence and Approvals

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

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

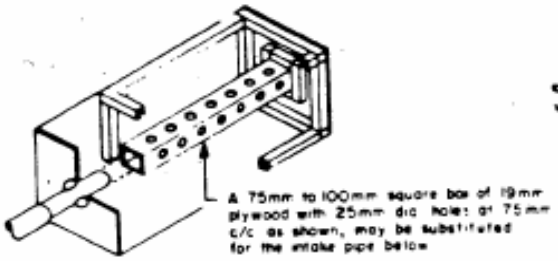
3. Senior Habitat Management Biologist
   North Coast Division
   Department of Fisheries and Oceans
   Room 109, 417 - 2nd Avenue West
   Prince Rupert, B.C. V6J 1G8 — Phone: 624-9385

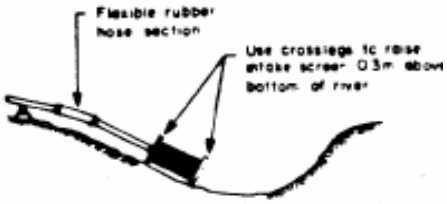
Other Federal and Provincial agencies having jurisdiction in water withdrawals and construction pertaining to watercourses in British Columbia include:

1. Transport Canada
   Canadian Coast Guard.
2. B.C. Ministry of Environment
   Fish and Wildlife Management.
3. B.C. Ministry of Environment
   Water Management.
4. B.C. Ministry of Agriculture and Food.
5. B.C. Ministry of Lands, Parks and Housing.

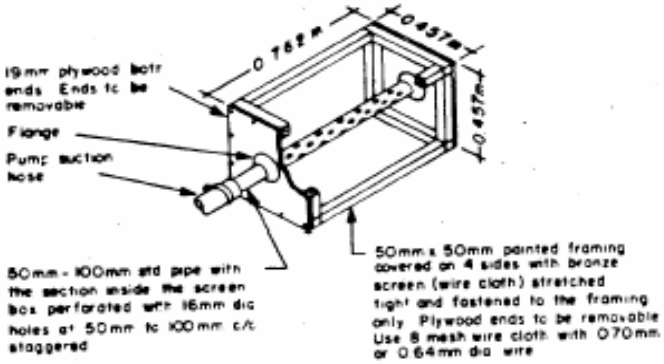
It may be necessary that several or all these agencies also be solicited for approvals prior to the installation of a water intake.

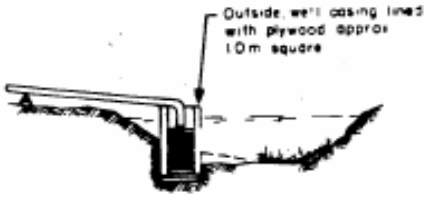
Revised January, 1986



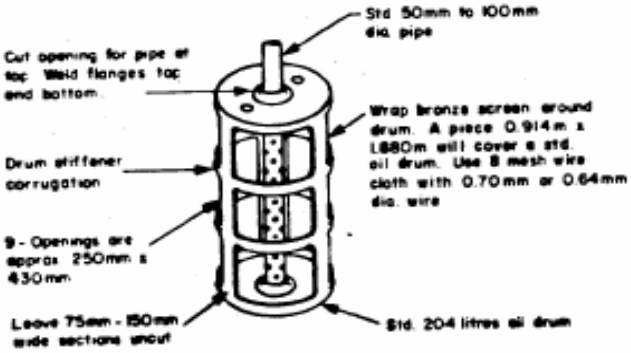


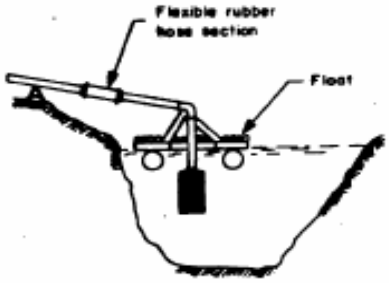
STANDARD INSTALLATION





INSTALLATION IN SHALLOW WATER
MUDDY OVERGROWN BOTTOM





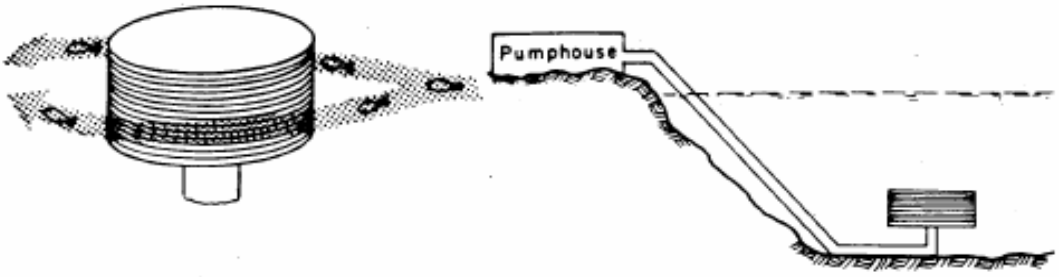
INSTALLATION IN DEEP WATER

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.

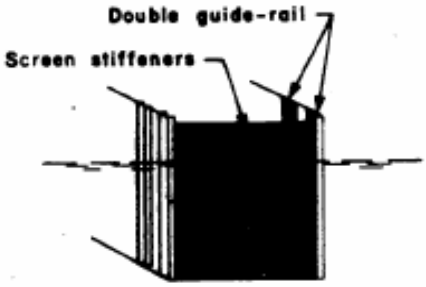
SHALLOW WATER WELL SCREEN

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).

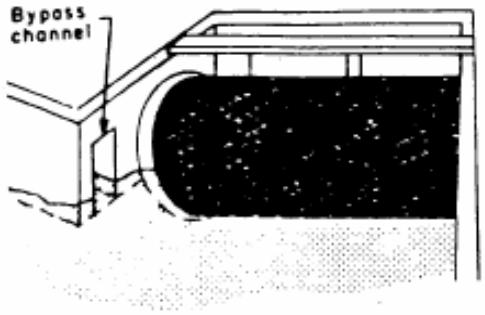
VERTICAL PANEL SCREENS

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.



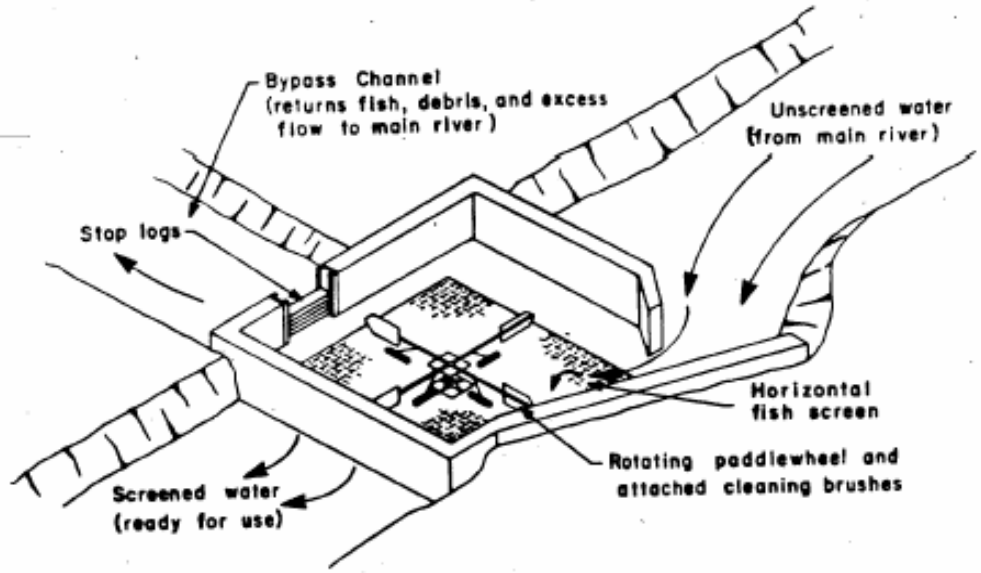
LARGE STATIONARY WATER INTAKE SCREENS

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



REVOLVING DRUM SCREEN, HORIZONTAL AXIS

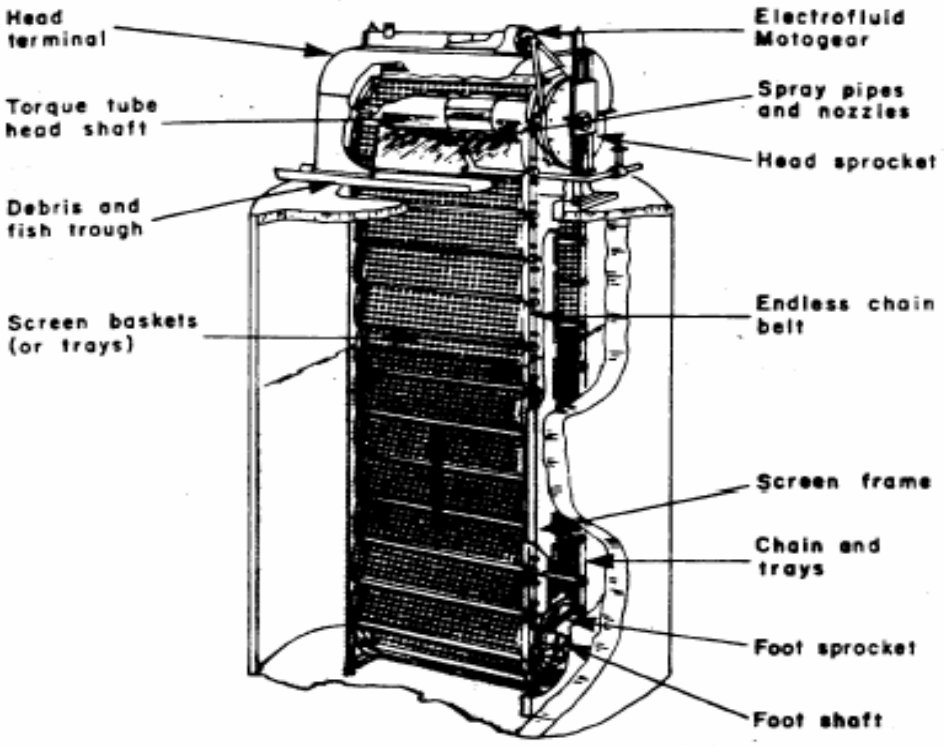
Generally, installed to divert fish from irrigation canals. Can be driven by a small motor or by a paddle wheel. To avoid juvenile fish impingement, a bypass channel is required near the front of the screen. Rubber seals are necessary along the base and sides.



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.

IRRIGATION INTAKE SCREENS



CONVENTIONAL VERTICAL TRAVELLING SCREEN

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

LARGE INDUSTRIAL AND DOMESTIC WATER INTAKE SCREEN