



June 12, 2012

File: 5600-15-WAT-LIC-AWS

Sent by e-mail: Alain.Magnan@dfo-mpo.gc.ca

Alain (Al) Magnan, R.P. Bio., CPESC
Senior Habitat Biologist
Habitat Management
South Coast
Fisheries and Oceans Canada
3225 Stephenson Point Road
Nanaimo, BC
V9T 1K3

Re: Englishman River Water Intake

Dear Mr. Magnan,

This letter is in response to your e-mail request dated June 6, 2012 regarding the proposed Englishman River Water Intake.

During our meeting on May 26, 2011 it was brought to your attention that our latest planning study concluded the best location for the water intake is just upstream of Highway 19. Further to this meeting we provided you with a copy of the Environmental Assessment of Alternate Water Intake Sites in the Englishman River, prepared by LGL Limited Environmental Research Associates and asked that you provide us with your initial comments so that we could take these into consideration with our next phase of planning and engineering activities.

On September 7, 2011 we received your preliminary comments on the proposed location of the Englishman River drinking water intake. Your letter suggested that if AWS was to continue with the new intake just upstream of Highway 19, a detailed in-stream flow study of the river reach between the present and proposed intake sites would be required. Your request for AWS to further study existing baseline flow requirements (post Dam construction) suggests that DFO has changed its original position on Englishman River base flow requirements and does not recognize the benefits and design parameters of the Arrowsmith Dam and Reservoir. These potential fisheries impacts were previously addressed and mitigated with our original licence application and the resulting construction of the Arrowsmith Dam and augmented flow releases during critical summer months.

As you are aware a Conditional Water Licence was issued in March 1997 authorizing the construction of the Arrowsmith Dam and storage of 9,000,000 m³. Half of that volume is reserved for fisheries enhancements. The Conditional Water Licence and corresponding Provisional Operating Rule (specifying a flow of 1.60 m³/s at the Hwy 19A Bridge) were issued based on the premise of utilizing the existing City of Parksville intake in the interim until such time the future proposed AWS water intake was constructed upstream of the Englishman River Water Survey Canada (WSC) hydrometric gauge (08HB002). Our original licence application, attached in Appendix A, proposed to locate the intake downstream of the confluence of the Englishman River and South Englishman Rivers.

As part of the stakeholder consultation process for our Water Licence, an Application Report prepared by the Ministry of Environment at the time of granting the water licence (attached in Appendix B), references correspondence from the Provincial Fisheries and Federal Fisheries.

Federal Fisheries comments:

- The recommended stream flows as measured at the WSC gauge (08HB002); spawning flow should be maintained at 8.5 m³/s from October to December and should not fall below 5.67 m³/s during this period of the year.
- Rearing flow should be maintained at 1.13 m³/s as measured at the WSC gauge (08HB002), through the summer low flow period generally from July to October and should never fall below 0.71 m³/s.

Provincial Fisheries comments:

- The proposed storage on Arrowsmith Lake should provide minimum summer flow, in excess of all other withdrawals, as measured at the WSC gauge (08HB002) downstream of Highway 19 bridge crossing to be maintained at or above 1.13 m³/s on a 1:20 year drought return period.

This input at the time was part of the information that formed the basis for the design and construction of the Arrowsmith dam and reservoir and for proceeding with the project.

The recently prepared hydrology assessment, discussed in more detail later in this letter indicates that Federal and Provincial requirements (listed above) can be achieved below a 1:20 year drought return period.

Various consultation meetings with staff from DFO and MoE since the construction of the dam in preparation for our next phase of works (new intake), have resulted in AWS focusing our efforts on a site located downstream of the original upstream location at the confluence of the South Englishman River. This has resulted in extensive studies undertaken to determine the best location of the new intake using a triple bottom line approach that considered cost, environment and social factors. Through these discussions it was apparent that DFO and MoE wanted to see some additional enhancement activities in the Englishman River. As a result, when assembling our project team to help in the AWS future capital program we explored the technology of Aquifer Storage and Recovery (ASR) as an option to further reduce our water extraction during peak water demands and low flows in the Englishman River. If the ASR program is determined to be feasible, it could potentially further reduce the peak summer time surface water demands during critical low flow summer periods in the Englishman River up to 50 %.

The following fisheries enhancement improvements must be recognized as part of our ongoing commitment to fisheries enhancements in the Englishman River:

- Conservation agreements and land acquisition (Block 602) by the Regional District of Nanaimo have secured a significant portion of the riparian habitat as a secure public trust.
- The construction of the dam has increased the mean annual discharge in the Englishman River to 13.54 m³/s (previously 13.11 m³/s).
- Coho, pink and Chinook salmon abundance appears to be much higher from 1999 onward. This is a direct result of additional Englishman River base flows that have allowed the reintroduction of Pink Salmon eggs, Coho fry and Chinook smolts and the two flow controlled side channels constructed to increase rearing habitat. Pink Salmon stocks were nonexistent in the Englishman River prior to the construction of the Dam. (Englishman River Instream Flow Study – Background Data Review – Ecofish Research Ltd., May 2010)
- In previous operational years AWS has worked with DFO and MoE staff to provide additional summer flow augmentation in the Englishman River in times when we did not need to operate for water consumption.
- Significant summer base flow improvement has been very apparent and has allowed other environmental stakeholders to create additional habitat enhancements.



The summer flows in the Englishman River have dramatically increased since the dam was constructed. The flow records indicate before the Arrowsmith Dam was constructed in 1998, minimum daily flows varied between 0.1 m³/s and 0.7 m³/s, averaging 0.3 m³/s. Since the construction of the Arrowsmith Dam in 1998, the minimum daily flows are now greater than 1.0 m³/s, (over 300 % increase in base flows in the critical summer months). The below table shows the monthly average discharge volumes in the Englishman River from 1913 – 2010 recorded at the Water Survey Canada (WSC) flow measurement gauge (08HB002) located at Highway 19a and the Englishman River. The values in **Red** indicate monthly average flows below 1.0 m³/s, in **Blue**, monthly average flows above 1.6 m³/s and in **Black**, values between 1.0 and 1.6 m³/s.

**Monthly Average Discharge Volumes
Englishman River 1913 - 2010**

9/12/2011

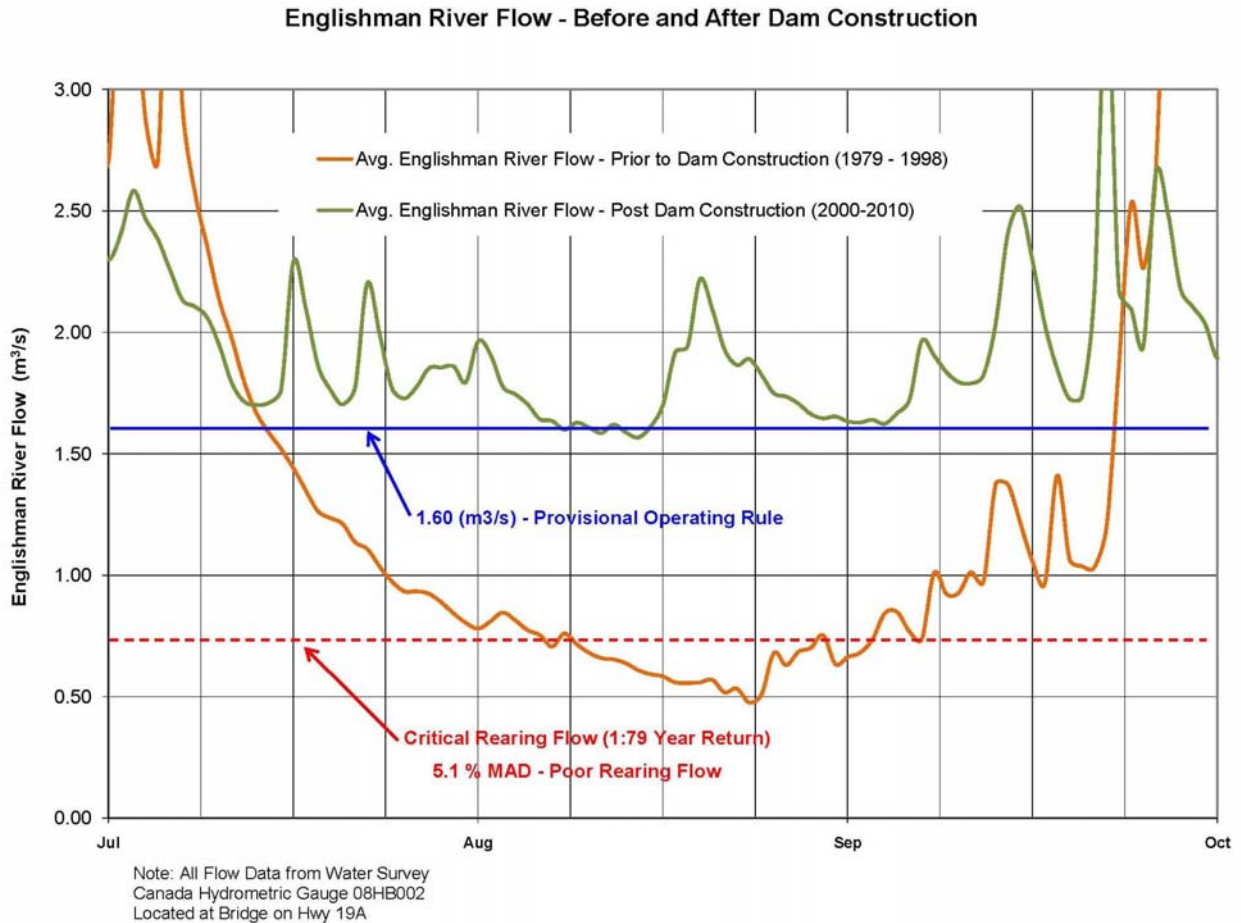
Year	June	July	August	September	October
1913	9.25	5.43	1.01		7.94
1914	7.24	2.42	0.63		
1915	3.04	1.24	0.78	0.68	17.50
1916	17.30	9.11	3.04	1.15	2.18
1917	11.70	4.60	1.24	1.42	
1970	6.38	1.43	0.65	0.88	
1971	13.30	7.11	2.06	2.04	
1979	2.85	2.40	0.65	6.06	12.90
1980	5.94	3.39	0.84	1.21	1.61
1981	4.95	1.75	0.65	2.84	21.50
1982	12.00	3.50	1.03	0.71	22.80
1983	6.59	5.16	1.04	0.97	2.96
1984	7.33	2.84	0.72	1.21	17.20
1985	4.64	1.29	0.50	0.85	10.30
1986	4.88	1.79	0.53	0.42	1.29
1987	5.94	1.55	0.58	0.34	0.29
1988	8.32	3.07	0.87	0.70	1.84
1989	4.32	1.93	0.87	0.40	5.79
1990	6.65	1.32	0.38	1.02	21.60
1991	2.15	0.89	7.10	3.10	0.64
1992	1.31	1.04	0.42	0.84	6.87
1993	6.17	1.34	0.50	0.25	1.13
1994	4.06	1.14	0.48	0.46	3.36
1995	4.09	1.62	0.91	0.35	7.49
1996	3.41	1.16	0.33	0.50	8.29
1997	9.48	5.37	1.98	5.62	28.40
1998	4.00	1.63	0.39	0.34	2.34
1999	18.01	10.5	4.38	2.11	4.87
2000	8.51	2.59	2.29	1.58	8.58
2001	3.51	1.52	2.51	1.72	3.27
2002	6.83	2.14	1.72	1.58	1.11
2003	3.6	1.34	1.23	1.57	31.7
2004	2.85	2.06	1.83	2.89	8.9
2005	3.55	1.85	1.74	1.76	10.3
2006	6.49	2.34	1.61	1.18	1.03
2007	3.41	3.91	1.77	1.79	11.21
2008	7.97	2.42	2.04	2.07	4.59
2009	3.06	1.27	1.26	1.50	5.39
2010	8.98	2.50	1.66	3.63	9.13

Arrowsmith Dam in Operation

 Values of below 1.0 cubic metres per second
 Values greater than or equal to 1.6 cubic metres per second

Note:
 This information was taken from the Water Survey of Canada Archived Hydrometric Data - Englishman River near Parksville site 08HB002 - Monthly Mean Discharge (m³/s) AWS Englishman River Historical.xls

The figure below is another illustration of flow enhancement that shows an average of daily flows in the Englishman River, as measured above Highway 19A, before and after construction of the dam.



The release of additional flows from the Arrowsmith Lake also provides cooler temperatures for fish in the lower reaches of the Englishman River.

Since the construction of the dam, a significant increase in summer flows and minimum fish enhancement flows can now be maintained in the river, even during dry summer periods. However, the design of the Arrowsmith Dam, given its catchment area is only capable of providing adequate flows for a 1:15 year drought period. Over the course of operating the dam, the Provisional Operation Rule has been amended during some operating seasons given the drought occurrence was outside of the design parameters of the Dam.

Over ten years operating the Arrowsmith Dam through both drought and above average snow pack conditions has clearly demonstrated that the management of the dam flow releases can be improved with more frequent calibrations prior to and during the critical flow periods between August 15 and October 15 to ensure water is not wasted. In some years too much water was being released prior to this period and wasted due to outdated calibration data. This could possibly be mitigated by installing a fixed flow gauge in conjunction with the new intake or relocating the WSC gauge to a non-alluvial reach in the river. In the past several years we have had discussions with Water Survey Canada to address this situation. Another solution is to formally adopt an operation rule curve that takes into account the Arrowsmith Lake reservoir levels (volume of water behind the dam), time of year and provisional flow release requirement.

Our recent detailed planning engineering planning studies, which are discussed in more detail later in this letter, have analyzed the required future water demands and fisheries releases in conjunction with drought year return periods and have determined:

- the best intake type and location,
- the limitations of the Arrowsmith Reservoir and Dam,
- the appropriate operational flow releases to better manage water flows in the Englishman River during the critical summer months and drought year return periods for both public consumption and fisheries purposes.

The DFO minimum fisheries resource flows for salmon species have been addressed in detail in the Manuscript Report # 1676 – Water Requirements for the Fisheries Resource of the Englishman River, by R. Hamilton / G. Kasakoski dated September 1992, currently on-line located at the following address:

http://dsp-psd.pwgsc.gc.ca/collection_2007/dfo-mpo/Fs97-4-1676E.pdf

This report indicated that flows recorded (between 1913 to 1979) at the WSC gauge (08HB002) frequently fall below $1.13 \text{ m}^3/\text{s}$ during the critical summer months.

The report also indicates:

- the most critical low flow period is usually between August 10 to September 20,
- flows frequently drop below $0.71 \text{ m}^3/\text{s}$ during August 10 to September 20,
- spawning habitat becomes virtually zero during August 10 to September 20,
- upstream migration may not be possible during such flows.

In previous stakeholder meetings with staff from DFO, MoE, BCCF and MVIHES it was indicated that the most critical fish habitat in the mainstream of the Englishman River is located in Reach 3 (from the confluence of the South Englishman downstream to Top Bridge Park) and Reach 4 (from below the confluence of Morison Creek downstream to the South Englishman confluence).

The LGL Environmental report suggests that a decrease in river discharge after the licensed extraction can be mitigated by ensuring that releases from Arrowsmith Dam meet, where conditions permit, maintain a minimum discharge in the mainstream up to a specific location downstream. Minimum discharge provisions should ensure that all important spawning and rearing sections of the river remain productive and viable for salmon and trout. A suitable minimum river maintenance flow up to Highway 19A (WSC flow measuring gauge 08HB002) would mitigate potential impacts as a result of water withdrawal and maintain the current capacity and productivity of important spawning and rearing habitats within the majority of the anadromous zone of the river.

Overall the LGL environmental study evaluated the top three selected sites;

1. Turner Road (existing City of Parksville intake),
2. Upstream of Highway 19A,
3. Upstream of Highway 19

and determined that these sites have a lower impact on fish and fish habitats than the originally proposed intake location at the confluence of the Englishman River and the South Englishman River. For the intake site upstream of Highway 19, it was recommended that implementation of mitigation measures that ensure a minimum river maintenance flow during low summer flow would mitigate the potential impact, making this site a more acceptable alternative.

The Watershed Hydrological Assessment prepared by Kerr Wood Leidal on June 2010 as part of the technical Discussion Paper 6-1 of the Phase 1 Conceptual Planning Report concluded:

1. With proper flow release procedures, the existing Arrowsmith Lake reservoir and its outlet structure is adequate to meet the minimum conservation discharge flow of $1.2 \text{ m}^3/\text{s}$ at the WSC gauge including existing water supply demand under the 10-year return period drought conditions.
2. The lake storage would be adequate to meet the minimum $1.2 \text{ m}^3/\text{s}$ conservation discharge flow including water supply demand, but the outlet structure at the dam would not be adequate to release the desired flows at all times, under 10-year return period drought conditions with climate change impacts and the 100-year return period drought conditions without climate change impacts.
3. The lake storage would be adequate to meet the minimum $1.2 \text{ m}^3/\text{s}$ conservation flow plus the 2050 demand under the 10-year return period drought conditions, but the outlet structure at the dam would not be able to discharge the desired flows at all times.
4. Under the 10-year drought conditions with climate change impacts and under all 100-year drought conditions, both lake storage and discharge capacity would not be sufficient to meet the minimum $1.2 \text{ m}^3/\text{s}$ conservation flow plus the 2050 demand.
5. The existing Arrowsmith Lake reservoir and outlet structure would not be adequate to meet the ideal conservation flow of $1.4 \text{ m}^3/\text{s}$ at the WSC gauge plus the additional 2050 water demand under both the 10-year and 100-year drought conditions.
6. Increasing the storage capacity of the Arrowsmith reservoir would not reduce the storage deficit as the inflows collected by the lake would not be sufficient to fill up the existing lake storage in extreme drought years.

In summary, the Province sought a regional local government approach to look towards one source of future water surface supply and in doing so remedy the depleting fisheries stocks in the Englishman River. As a result the AWS was formed and is committed to this effort. To us this is a win – win situation and is therefore embedded into our mission statement.

An environmental sensitive use of water to improve fish habitat and domestic water supply.

In order to meet future water supply demands and comply with the imposed changes to our Water System Operating Conditions from VIHA (new water treatment by December 2016), the AWS requires the appropriate permits to be in place prior to proceeding with the next preliminary design phase of this project. The first permit required is a minor amendment to the Conditional Water Licence 110050 to formally approve a Change of Works to define the location of the proposed new intake for the ultimate AWS surface water supply components of the regional water system. A formal Change of Works application was sent to the Ministry of Forests, Lands and Natural Resource Operations on March 13, 2012. In consultation with the Ministry we were advised that this application would be referred to DFO and Provincial Fisheries for comment and input. The legal notice in the May 15, 2012, Parksville Qualicum Beach News was another requirement of this application. The Change of Works application will also initiate discussions and changes to the Provisional Operation Rule.

The Change of Works application also supports concerns from DFO, MoE, BCCF and MVIHES as they indicated through stakeholder meetings that their preferred intake location would be as far downstream as possible. An intake location downstream of Allsbrook Canyon would be considered more favourable to agency staff and key stakeholders than an intake location above Allsbrook Canyon.

We are tasked with addressing the needs of the fishery resource with the requirements of the health authorities who favour an intake location as far upstream as possible, in the interest of protecting public health. We believe the proposed location, upstream of Highway 19, balances the needs of both agencies.

Previous comments from both DFO and MoE prior to the Arrowsmith Dam construction recommended stream flows as measured at the WSC gauge (08HB002); spawning flow should be maintained at 8.5 m³/s from October to December and should never fall below 5.67 m³/s during this period of the year. Rearing flow should be maintained at 1.13 m³/s through the summer low flow period generally from July to October and should never (even in a drought year) fall below 0.71 m³/s.

The AWS original water licence application was based on the premise of acquiring a water licence and constructing a dam to support storage for not only future potable water demand but fisheries enhancements based on the intake being just downstream of the confluence of the South Englishman River and the Englishman River. Extensive research and studies have been undertaken before and after the construction of the Arrowsmith Dam for fisheries benefits. Considerable ecological and Fisheries enhancements resulting from the construction of the Arrowsmith Dam are very apparent. We trust that the benefits of constructing the Dam are acknowledged and that this partnership can continue in an effort to augment river flows during critical rearing and spawning times.

The Change of Works and Revised Provisional Operation Rule would also trigger the cancellation of the existing City of Parksville Water Licences.

As part of the process to modify the Arrowsmith Lake Reservoir Provisional Operation Rule, we formally recommend the following:

1. In consultation with the partnership committee, stakeholders from AWS, DFO & MoE should consider utilizing the proposed Operating Rule Curve (shown in Appendix C) to determine release flows in any given operational year in an effort to achieve:
 - From July 1 to October 31, the following operating rule curve flows shall be maintained at the WSC gauge given the anticipated drought year return period:
 - 1:1 drought year return = 1.30 m³/s
 - 1:10 drought year return = 1.20 m³/s
 - 1:20 drought year return = 1.00 m³/s
 - 1:50 drought year return = 0.90 m³/s

*With the minimum flow never to fall below 0.71 m³/s.

The 1:1 and 1:10 drought year conditions meet the DFO and MoE recommended fisheries rearing flow of 1.13 m³/s for the summer period and are within the design parameters of the Arrowsmith Reservoir and Dam. Drought years in excess of a 1:20 drought year are beyond the design limits of the Arrowsmith Reservoir and Dam.

2. Cancel the Water Licences belonging to the City of Parksville in favour of a revised Operation Rule and Relocation of Works permit. The water licenses are:
 - C022058 – City of Parksville Waterworks = 132,745.8 m³/year
 - C023297 – City of Parksville Waterworks = 82,966.1 m³/year
 - C026692 – City of Parksville Waterworks = 663,729.14 m³/year
3. Continue to promote a partnership committee of DFO, MoE and AWS staff to determine reservoir releases on an annual basis for all conditions.

The construction of the Arrowsmith Dam and Arrowsmith Lake storage reservoir resulted from direction from the Province of British Columbia to the Town of Qualicum Beach, City of Parksville and the Regional District of Nanaimo to look towards the Englishman River as a single source of future surface water supply for the region, to help augment and stabilize summer base flows that support aquatic life, and to reduce impacts on groundwater. The Englishman River Water Allocation Plan prepared by the Province in 1993 indicated that all the licensed water allocations were utilized and any further extraction would require storage. As a result, the Arrowsmith Dam was designed and constructed to store water for the benefit of future water supply needs, for fisheries benefits, and to ensure groundwater and existing water licence users are not negatively impacted. The Englishman River now serves as a natural waterway that conveys water from the Arrowsmith Reservoir to the point of extraction from the river. Not all water released from the Arrowsmith Reservoir reaches the extraction point. Depending on the time of year, approximately 30 % of this water is lost to evaporation or enters the ground, which helps recharge the Englishman River aquifer. Without the dam and reservoir, the flows in the Englishman River would at times return to critical historic levels and reduce the benefit to groundwater recharge from the river that is now occurring during the summer and fall low flow period.

What we have constructed to date and what our future plans entail is a sustainable water supply program that meets our future water supply needs while benefiting the environment and enhancing fish stock.

As requested, the following is the current status of our work plan in priority order relating to the new intake:

1. Submit Change of Works Application (March 2012)
2. Complete Phase 2 ASR investigation (April 2013) **
3. Pre-design (Jan 2013 – Jan 2014)
4. Value Engineering (2014)
5. Draft revisions to the Provisional Operation Rule (2014)
6. Detailed Design (March 2014 – March 2015)
7. Tender / Construction (April 2015 – April 2016)
8. Commissioning (April 2016 to December 2016)

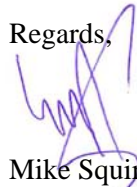
** Critical Path – prior to starting the pre-design and making any changes to the Provisional Operation Rule, the ASR Phase 2 feasibility assessment needs to be complete.

We have also enclosed our Water System Brochure for your further reference and understanding of our water supply system and plans. For further details of the AWS and ERWS Board meetings, future plans, operations and general benefits and operating structure of the Arrowsmith Dam, please refer to our Web Site (see link below). Our web site is the main central repository of up to date information and current studies.

www.arrowsmithwaterservice.ca

We welcome your comments. Should you have any questions, please feel free to contact me.

Regards,



Mike Squire, AScT

Program Manager – Arrowsmith Water Service / Englishman River Water Service

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cc: Margaret Wright, DFO
Mike McCulloch, Fish and Wildlife - FLNR
John Baldwin, Water Protection - FLNR
Paul Marquis, Water/Public Safety - FLNR
Dr. Paul Hasselback, VIHA
Murray Sexton, VIHA
Bill Wrathall, VIHA
Bob Weir, TQB
John Finnie, RDN
AWS Management Board

APPENDIX A

WATER LICENCE APPLICATION



Province of British Columbia
 Ministry of Environment, Lands and Parks
 Water Management

WATER LICENCE APPLICATION
 Water Act, Section 8

PLEASE REFER TO GUIDELINES WHEN COMPLETING THIS APPLICATION

1. NAME & MAILING ADDRESS		FOR OFFICE USE ONLY	
SURNAME		GIVEN NAME(S)	
Regional District of Nanaimo			
MAILING ADDRESS			
6300 Hammond Bay Road			
P.O. Box 40, Lantzville, B. C.		POSTAL CODE	
		VOR 2H0	
BUSINESS / MESSAGE PHONE#	HOME PHONE#	FAX#	
390-6560		390-1542	
Do you hold another water Licence? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		LICENCE / FILE NUMBERS (IF KNOWN)	
		FILE#	WLIS#
2. PLACE OF USE - Legal description of property where water is to be used.			
Regional water system to supply Qualicum Beach, Parksville, French Creek, Nanoose, Lantzville and Nanaimo (partially)			
TENURE TO LAND		CERTIFICATE OF TITLE / PARCEL IDENTIFICATION NUMBER (PID#)	
Registered Owner <input type="checkbox"/>		Healy	
LESSEE / OTHER:		Copy of Legal Plan attached? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
3. PURPOSE(S) & QUANTITY - Please refer to Schedule 1 - Water Purpose & Application Fees.			
Bulk water supply. Annual average use initially 595,000,000 up to 2,513,000,000 gallons a year at 25 years.			
4. SOURCE OF WATER			
Englishman River		DISCHARGES INTO Strait of Georgia	
5. WORKS - Existing or proposed to divert and convey water to place of use.			
PROPOSED POINT OF DIVERSION LOCATION			
Confluence of Englishman River and South Englishman River			
a) DIVERSION WORKS	Pump <input checked="" type="checkbox"/> Gravity Feed <input type="checkbox"/>	LENGTH OF PIPE 2800 m	DIAMETER OF PIPE 60 to 75 cm
OTHER WORKS High lift pumps, balancing reservoir, treatment plant (future).			
PROPOSED RESERVOIR LOCATION			
Arrowsmith Lake (Healy Lake alternately/additionally)			
b) STORAGE WORKS	VOLUME OF WATER STORED 9,000,000 m ³	DAM HEIGHT 13.5 m	AREA OF RESERVOIR 48.6 ha
Joint work with others? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		IF YES, WITH WHOM?	
c) ADDITIONAL INFORMATION	Works constructed? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Partially <input type="checkbox"/>		
6. LANDS AFFECTED - The works will physically affect (by crossing or flooding) the following lands:			
LAND DESCRIPTION		NAME OF OWNER (INCLUDING CROWN)	
Arrowsmith Lake area		MacMillan Bloedel (entirely)	
Intake pipe/treatment plant		Fletcher Challenge Canada	

APPLICANT / AGENT'S SIGNATURE: *W. K. Colclough* DATE: *Aug 16, 1995*

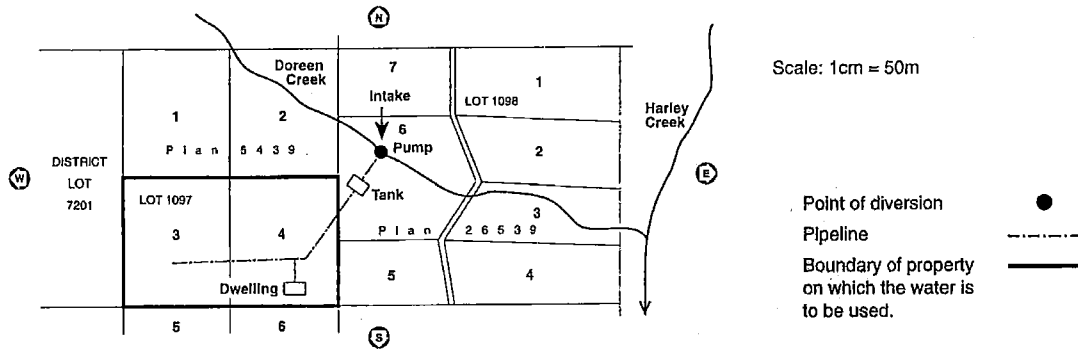


Province of British Columbia
 Ministry of Environment, Lands and Parks
 Water Management

WATER LICENCE APPLICATION
 Water Act, Section 8

WATER LICENCE APPLICATION DRAWING

SAMPLE DRAWING - Typical drawing for domestic and irrigation licence.



APPLICANT'S DRAWING - Prepare a drawing to submit with your application. Refer to Application Guidelines for a list of required elements.



Please refer to the attached report
 Key Plan, Figure 2.1, Rev. 1 of Regional Water Supply
 System - Englishman River, Draft Pre-design Report (UPDATE)
 September 1993



Scale:



Province of British Columbia
 Ministry of Environment, Lands and Parks
 Water Management

SCHEDULE 2
DAM & RESERVOIR
INFORMATION

REQUIRED IN SUPPORT OF A WATER LICENCE APPLICATION FOR STORAGE PURPOSE

WATER LICENCE APPLICATION INFORMATION

NAME OF APPLICANT <i>Regional District of Nanaimo</i>			FILE#
MAILING ADDRESS <i>6300 Hammond Bay Road</i>			
P.O. Box 40, Lantzville BC		POSTAL CODE <i>V0R 2N0</i>	PHONE# <i>390-6560</i>
			FAX# <i>390-1542</i>
SOURCE(S) OF WATER (NAME OF STREAM WHERE WORKS ARE TO BE CONSTRUCTED) <i>Englishman River</i>			
PROJECT CONSULTANT <i>Keers and Associates</i>		<input type="checkbox"/> BC Environment may recommend that the dam be designed by, and constructed under the supervision of, a Professional Engineer registered in the Province of BC.	
MAILING ADDRESS <i>P.O. Box 1289, 132 Memorial Ave</i>			
<i>Parksville BC</i>		POSTAL CODE <i>V9P 2H3</i>	PHONE# <i>248-3151</i>
			FAX# <i>248-5362</i>

PROPOSED WORKS - Please complete 1 or 2 where applicable to your project.

IS THE DUGOUT CONSTRUCTED IN THE STREAM CHANNEL OR OFF STREAM?

1. DUGOUT / POND	STORAGE CAPACITY dam ³ or m ³	LENGTH m	WIDTH m	MAXIMUM DEPTH m
2. DAM / RESERVOIR	NOTE: PLEASE ATTACH A DETAILED PLAN FOR (a) THROUGH (d) BELOW SHOWING CROSS SECTIONS AND PLAN VIEWS OF THE PROPOSED DAM / RESERVOIR STRUCTURE.			
	HEIGHT m	LENGTH m	CREST WIDTH m	
a) STORAGE DAM	TYPE OF CONSTRUCTION MATERIALS <i>see attached report "Regional Water System - Englishman River"</i>			
b) RESERVOIR	STORAGE CAPACITY dam ³ or m ³	FLOODED AREA ha		
	Land tenure where works are to be constructed and / or flooded, owned by: Applicant <input type="checkbox"/> Private <input type="checkbox"/> Crown <input type="checkbox"/>			
	DESCRIPTION / TYPE			
c) SPILLWAY	DESIGN FLOW m ³ /s	FREEBOARD m		
	DESCRIPTION / TYPE			
d) LOW LEVEL OUTLET (SLUICeway)	NUMBER OF SEEPAGE COLLARS		CONTROL WORKS USED	

STREAM HYDROLOGY FLOW INFORMATION

- (i) If the stream is perennial or flows intermittently, please provide a low flow assessment (for filling and maintaining reservoirs) and a high flow assessment (for determining dam design flood) and/or a complete hydrological assessment in support of your application.
- (ii) If the stream flow is ephemeral in nature (i.e., flows only during wet periods or during spring runoff), please provide an estimate of the drainage area above the dam or dugout location, an adequate summary of any measured stream flow information available and/or an estimate of high flows in support of your application.

Note: If you have any questions concerning the hydrology of your stream (source), please contact your local Water Management Office for more detailed information.

FISH POND PERMIT

If you intend to place or maintain fish in your dugout or reservoir, you must obtain a Private Fish Pond permit or Commercial Fish Farm Licence. Please contact the nearest office of BC Environment's Fish and Wildlife Branch or the Ministry of Agriculture, Fisheries and Food for more information.

NOTE: IF SPACE IS INSUFFICIENT, PLEASE ATTACH THE REQUESTED INFORMATION IN A COVERING LETTER OR REPORT

In reference to File No. 1001868

WATER ACT

Proof of Serving Application for a Water Licence

(ALSO PROOF OF PUBLICATION WHEN DIRECTED)

In the matter of the application for a water licence by Regional District of Nanaimo
(Applicant)

on Englishman River
(Source)

I, William Robert Colclough
(Full name of declarant)

of 6300 Hammond Bay Road, P.O. Box 40, Lantzville, B.C. V9R 2H0
(Address)

by occupation a Director of Operational Services, do solemnly declare:

1. That notice of the said application was served upon the following persons holding licences or prior applications on the same stream and having points of diversion at or below the point of diversion set out therein:

Name and Address	Date of Service	How Served (Registered Mail or Delivered)

2. That, as directed by the Regional Water Manager, a copy of the said application was published in the "The News"
a newspaper published at Parksville, B.C., the publication being on the 7th day of September, 19 95. A copy of the published application is hereto attached and marked "A".

*And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of the *Canada Evidence Act*.

Declared before me at NANAIMO

this 15 day of SEPTEMBER, 19 95

(Signature of official) [Signature]

(Title of official) SECRETARY (COMMISSIONER)
(Notary Public, Justice of the Peace, or Commissioner)

WR Colclough
(Signature of declarant)

NOTE - If proof of serving or publishing is made by different persons or at different times, duplicates of this blank may be used, and so much of the form as is appropriate filled in in each case.

* IMPORTANT - This declaration must be completed in full and declared before a proper official, and filed with the Regional Water Manager, 2569 Kenworth Road, Nanaimo, B.C., V9T 4P7.

APPENDIX B

WATER LICENCE APPLICATION REPORT

Water Licence Application Report

File Number: 1001868 Watershed: Englishman River

Source: Englishman River Tributary to: ocean

Recommendation Summary:

I recommend that separate water licences issue for each of the following purposes:

<u>Purpose:</u>	<u>Quantity:</u>	<u>Period of Use:</u>	<u>Appurtenance:</u>
Waterworks	1,540,000,000 gallons per year but not to exceed 10,550,000 gallons per day	Whole year	all lands within the boundaries
Storage	7300 ac.ft.	Whole year	Support of above water licence

See Plan: Englishman River Water Allocation Plan

Special Clauses/Conditions:

For both licences recommended herein:

The intakes shall be adequately screened to prevent debris and fish from entering the intake works.

The licensee shall be responsible for the monitoring of water levels on Arrowsmith Lake and the streamflow on Arrowsmith Creek and Englishman River as required by the Engineer under the Water Act.

For waterworks purpose licence:

The diversion of water authorized under this licence may be restricted or prohibited at any time by an order in writing of the Engineer under the Water Act in order to maintain a minimum flow in the stream.

The water authorized to be diverted and used under this licence during the period June to October must be fully supported from storage provided in the reservoir authorized.

A flow measuring device suitable to the Engineer under the Water Act shall be incorporated into the works at the source.

For storage purpose licence:

Construction of the dam/works authorized under clause (h) hereof shall not be commenced until plans prepared by a professional engineer registered in B.C. have been submitted to, and leave to commence construction granted, by an Engineer under the Water Act.

The development of storage on Arrowsmith Lake shall require debris and vegetation removal from the lands subject to flooding, the restoration of inlet stream channels, creation of fish spawning terraces, and construction of a cartop boat access to the lake.

The licensee shall make releases of water past the dam/diversion structure authorized under clause (h) hereof as may from time to time be ordered by the Engineer under the Water Act.

Authorized Works:

For both licences recommended herein:

nil

For waterworks purpose licence:

intake, pipe and pumps

For storage purpose licence:

dam located at outlet to Arrowsmith Lake

Address Objections, Concerns, & Comments:

A. Legal Objectors

The following have been considered as legal objectors under the Water Act:

1. MacMillan Bloedel Limited

As the land owner of Blk 1324 surrounding Arrowsmith Lake, representatives of MacMillan Bloedel Limited have indicated that property rights would be affected by the flooding of lands and control of access.

Response: MacMillan Bloedel Limited and the applicants have reached substantial agreement on compensating M&B for the loss of property rights and for providing the applicants access for construction, operation, and maintenance of the storage facility on Arrowsmith Lake.

2. Miles Porter, Parksville

Mr. Porter is a downstream riparian landowner who has expressed objections to the issuance of this licence for the following reasons:

- water conservation should be implemented before developing new sources,
- Englishman River should remain as a "wild river",
- population growth should be controlled, and
- logging and herbicide application should be controlled within the Englishman River watershed.

Response: Mr. Porter's rights as a downstream riparian owner should not be affected by the issuance of this licence.

3. Davis & Avis, Barristers & Solicitors on behalf of B.C. Water Service

B.C. Water Service has a water licence (C045309) to divert a maximum of 3000 gallons per day from the Englishman River for the purpose of water delivery. The POD is located upstream of the existing Island Highway. Concern is for the proposed upstream community water supply intake causing "an interruption or substantial diminishment of flow" at the B.C. Water Service authorized POD.

Response: Issuance of a water licence will not affect this licensee's rights to divert water for water delivery. During the low flow period, the proposed withdrawal will be fully supported by storage.

4. Englishman Aggregates Ltd. (Terry Molony)

Englishman Aggregates Ltd. leases property (Block 579, Nanoose Land District) owned by Timberwest Forest Ltd. An application has been made for a mining permit to develop a gravel pit operation on this land which is bounded by the Englishman and South Englishman Rivers. Englishman Aggregates Ltd. has objected to the issuance of a water licence if water withdrawal or waterworks interfere with their gravel pit proposal.

Response: Issuance of this downstream water licence to divert water for waterworks purpose or for a water licence to store and release water on Arrowsmith Lake to support the summer withdrawals will not affect Englishman Aggregates Ltd.'s application for a gravel pit operation. The proposed waterworks are not located on the Englishman Aggregates Ltd's leased property. This water licence will not require any additional community watershed requirements, as there are already existing licensed withdrawals for individual and community water supplies located downstream of this proposed development.

B. Other Government Agencies

1. Provincial Fisheries

Comments regarding provincial fisheries' interests are summarized in George Reid's letter of October 22, 1992. In order to provide minimum fisheries maintenance flows in the Englishman River, the proposed storage on Arrowsmith Lake should provide: "minimum summer flow, in excess of all other withdrawals, as measured at the Water Survey of Canada Gauging Station Number 08HB002 (downstream of Highway 19 bridge crossing) to be maintained at or above 40cfs (1.13 m³/s) on a 1:20 year return period".

Other comments and recommendations by the BCE Fisheries Section included:

- a committee to be formed to consider matters such as appropriate minimum fisheries flows in years where storage would not provide 40 cfs throughout the anticipated dry summer period,
- optimal fisheries maintenance flows is regarded as 15% mean annual discharge (approximately 75 cfs). In the event of further water storage development in the Englishman River watershed, flow enhancement should strive for optimal fisheries flows.
- in response to the proposed intake locations in the predesign report, the downstream pumping site at the South Englishman River is preferred to the upstream gravity intake.
- mitigation for impacts on fisheries values on Arrowsmith Lake

should include: removal of vegetation and logging debris around lake perimeter that is subject to flooding; restore inlet stream channels; create terraces for spawning habitat; construct cartop boat access for recreational fisheries; and assist in the stocking of other lakes within the watershed (Hidden, Fishtail, Rowbotham Lakes).

2. Federal Fisheries

Fisheries and Oceans Canada (DFO) comments are presented in Richard Eliason's letter dated November 24, 1992. The recommended streamflows as "measured at the lower river gauge # 08HB002, spawning flow should be maintained at 300 cfs (8.50 cms) from October to December and should not fall below 200 cfs (5.67 cms) during this period of the year. Rearing flow should be maintained at 40 cfs (1.13 cms) through the summer low flow period generally from July to October and should never (even in a drought year) fall below 25 cfs (0.71 cms)".

Additional recommendations included:

- the provision of fish migration pulse flows in late August-early September to move chinook stocks upstream to their spawning grounds;
- the development of an operating rule curve so that reservoir operating plan (storage and release regime) can be completed to ensure adequate annual water requirements for all user groups;
- the establishment of a committee of DFO, MOELP, RDN, and municipal waterworks staff to determine reservoir releases;
- the water intake to be located as far downstream as is technically feasible on the Englishman River to maintain as much flow and wetted area for fish over the longest possible distance in the river prior to the withdrawal point.

Response to #1 & #2: The proposed development of storage on Arrowsmith Lake to support the summer domestic water demand downstream on the Englishman River should provide an opportunity to enhance flows for the fisheries resource.

The existing flows on the Englishman River near Parksville (08HB002) frequently fall below 40 cfs (1.13 m³/s), the fisheries rearing flow as recommended above by both the federal and provincial fisheries agencies. Further, there are 17 months during the period of record where the mean monthly flows are less than the 25 cfs (0.71 m³/s) considered the "absolute lowest sustainable rearing flow" by DFO. The development of up to 9,000,000 m³ of storage on Arrowsmith Lake to support the summer water demands will provide additional water for enhancement of Englishman River baseflows.

Upstream of the water supply intake, the Englishman River base flow will be increased during the low flow period by the water released to support the community water supply withdrawals and the water released to meet fisheries flow targets. Below the intake, flow enhancement will be gained by the fisheries release only. Initially, water withdrawals will be made at the existing City of Parksville's intake near the mouth of the Englishman River.

The existing streamflows during the salmon spawning period in October are frequently lower than that recommended by DFO. Water releases from Arrowsmith Lake storage for spawning flows or migration pulse flows will only be available when licensed water withdrawal can be supported to the end of the low streamflow period and when agreed by fisheries agencies to deviate from the fisheries baseflow targets.

A provisional operation rule will be implemented to provide direction for the release of water from the Arrowsmith Lake storage. After the initial years of operation, the operation rule will be reviewed in consultation with the applicants and fisheries agencies to maximize benefits to the fisheries resource while continuing to support the water demands.

The development of storage on Arrowsmith Lake will require vegetation and debris removal for the lands to be flooded, the restoration of inlet stream channels and the creation of terraced spawning beds in the inlet stream areas.

The promotion of recreational fisheries opportunities is supported by the applicants. A commitment to work with provincial fisheries in providing cartop boat access on Arrowsmith Lake and to assist in a fish stocking program has been confirmed. However, as most of the lands in the Englishman River watershed are under private ownership, agreement with the landowner(s) is also required.

C. First Nations

The Nanoose Indian Band have inquired by telephone as to whether the fisheries resource was protected. Also, Mr. Jeff Bob met on September 20, 1996 for an update on the re-structured water supply proposal. He was interested on whether the Regional District intended to serve the Lantzville side of the Nanoose harbour.

Response: The band was advised that DFO recommendations for enhancement of base flows were being proposed. Mr. Bob was provided access to information on the proposal. He was also advised that contact should be made directly to the Regional District to discuss the opportunity for the Band to be serviced by the proposed system.

D. Others

Numerous objections, concerns, and comments were made by other persons both by correspondence and by oral presentation at the June 20, 1996 public meeting. The concerns can be categorized into four main issues: growth management, water conservation, alternative sources (ie. groundwater), and the fisheries resource.

The opportunity to address the growth management issue is best provided in the development of both the Regional District Growth Management Strategy and the local official community plans.

The water demand (average $0.55\text{m}^3/\text{day}/\text{capita}$, maximum $1.375\text{m}^3/\text{d}/\text{c}$) is based on a existing water use which is similar to the water consumption by other communities on the east coast of Vancouver Island. All three jurisdictions have implemented water conservation programs and it is anticipated that changing attitudes on water use will reduce water consumption. Nevertheless, a prudent water supply strategy should be based on the current demands with the benefits of water conservation programs extending the supply capacity to serve other users or service areas over a longer period.

All three jurisdictions have investigated the possibility of developing additional groundwater sources to meet future demands. The studies have concluded that although some of the aquifers are large in volume, the annual recharge rate would be inadequate to provide a reliable yield to satisfy future demand.

There should be no negative impacts to the fisheries resource in the Englishman River as the applicant's water withdrawals will be supported by storage during the low flow period. Any impacts to the fisheries resource on Arrowsmith Lake will be mitigated by releases of additional water downstream to enhance natural low flows on the Englishman River. Further mitigation measures to be provided include: creation of lake spawning beds; restoration of inlet stream channels; and construction of cartop boat access.

Quantity Required:

For waterworks purpose licence:

Application: The water quantity required in the initial water licence application was for a range of "initially 595,000,000 up to 2,513,000,000 gallons a year at 25 years". Water would be pumped from the confluence of Englishman River and South Englishman River.

Initial water demand projections were based on a Regional District Bulk Water Supply to serve the area from Lantzville to Qualicum inclusive with a 4.0% average annual growth rate over 25 years. As funding for this bulk water supply proposal was rejected in a public referendum on November 4, 1995, the various jurisdictions re-evaluated their options for future water supply. The current water supply proposal is based on a revised joint venture agreement to serve the City of Parksville, the Town of Qualicum Beach and the Regional District's water systems in the French Creek and Nanoose Bay areas.

The existing (1996) and projected 25 year (2021) water demand, as shown in Table 1, is based on 4% annual growth rate, average consumption 0.55m³/day/capita, maximum consumption 1.375m³/d/capita; peaking factor 2.5.

	1996			2021			90% Groundwater	Surface water
	Pop	Avg day m ³ /d	Max Day m ³ /d	Pop	Avg day m ³ /d	Max Day m ³ /d	Max Day m ³ /day	Max Day m ³ /day
City of Parksville	9,857	5,421	13,553	26,277	14,452	36,131	8,618	27,513
Town of Qualicum Beach	6,661	3,664	9,159	15,000	8,250	20,625	12,453	8,172
RDN-French Creek	2,967	1,632	4,080	7,910	4,350	10,876	5,468	5,944
RDN-Nanoose	3,573	1,965	4,913	9,525	5,239	13,097	6,837	6,260
Total	23,058	12,682	31,705	58,712	32,291	80,729	33,377	47,888

based on information by G.Scott, fax dated November 1, 1996

The use of a 25 year horizon for water demand is warranted as the design and construction of works (dam, intake, etc) would be cost effective and a longer amortization period is required.

The water demand (average 0.55m³/day/capita, maximum 1.375m³/d/c) is based on a existing water use which is similar to the water consumption by other communities on the east coast of Vancouver Island. All three jurisdictions have implemented water conservation programs and it is anticipated that changing attitudes on water use will reduce water consumption. Nevertheless, a prudent water supply strategy should be based on

the current demands with the benefits of water conservation programs extending the supply capacity to serve other users or service areas over a longer period.

The 25 year projected water demand shown in Table 1 is to be satisfied by both the proposed Englishman River withdrawal and the existing groundwater wells and licensed springs that are considered reliable. The reliable groundwater/spring sources currently produce a total maximum output of 37,086 m³/day. Based on past experiences with diminishing yields, a conservative estimate of long term capacity is based on a 10% reduction over the next 25 years. Therefore, the groundwater/spring sources will contribute 33,377 m³/day.

By using the maximum day water demand from Table 1 and subtracting the capacity of the existing groundwater/spring supplies, a **47,888 m³/day maximum day demand** from the Englishman River is required. The **6,991,663 m³/year annual demand** from the Englishman River is calculated by using the 2.5 peaking factor and multiplying the average day demand (19,155 m³/day) by 365.

With a conversion to imperial units, a water licence for waterworks purpose would state **1,540,000,000 gallons per year but not to exceed 10,550,000 gallons per day.**

The proposed point of diversion is the existing City of Parksville's water intake. There are no licensed points of diversion located downstream of this location. Even if the point of diversion was located further upstream as originally proposed, the demand is to be fully supported by storage during the summer low flow period and therefore, would not have any impact on any existing downstream withdrawals.

The City of Parksville currently has four existing water licences on the Englishman River for waterworks purpose. These licences are shown in Table 2.

Table 2 Existing Water Licences - City of Parksville				
Licence	Priority Date	Source	Purpose	Quantity
C022058	1954/03/30	Englishman River	Waterworks	200,000 gpd
C023297	1956/01/10	Englishman River	Waterworks	50,000 gpd
C026692	1961/05/11	Englishman River	Waterworks	1,000,000 gpd
C057408	1978/11/03	Englishman River	Waterworks	1,500,000 gpd
C057409	1980/10/22	Fishtail, Hidden, & Arrowsmith Lakes	Storage	650 ac-ft

The use of water authorised in water licence C057408 is contingent on the development of supporting storage under water licence

C057409. The City of Parksville has not developed the supporting storage or made use of the waterworks licence. This licence application is, in part, a substitution of these licences. .

The other water licences shall remain in the name of City of Parksville as they will be required prior to storage being developed to support the new licence.

Inquiries have been made by other communities (Lantzville Improvement District, Nanoose Indian Band, Errington/Coombs area) regarding the opportunity to participate in this water supply proposal at a later date or to develop independent water supplies on the Englishman River. A request for a Water Reserve under Section 44 of the Water Act should be made for the unrecorded water of Arrowsmith Lake and the Englishman River to provide an adequate time for communities north of the City of Nanaimo within the Nanaimo Regional District to determine their future water supply needs.

As per the Englishman River Allocation Plan (1993), the water extraction from the Englishman River during the low streamflow period must be fully supported by storage.

For storage purpose licence:

Application: The application stated a proposed development of 9,000,000 m³ water storage on "Arrowsmith Lake (Healy Lake alternately/additionally)". Storage would be created by a 13.5 metre dam and a 48.6 ha reservoir.

Although Healy Lake was indicated in the initial water licence application as a possible storage site, focus has been completely directed to the development of storage on Arrowsmith Lake only.

Updated flow records from the Water Survey of Canada Station (08HB002) on the Englishman River near Parksville for the 1913-1995 period are attached. Applying the Regional Water Management Policy for instream fisheries requirements to the Englishman River flows, the extractive water demand for the period June to October must be supported by storage.

Month	June	July	Aug	Sept	Oct	Total
% Annual Demand	11.9%	14.7%	14.1%	8.0%	7.3%	56%
Demand m3	832,008	1,027,774	985,824	559,333	510,391	3,915,331

The monthly distribution of the applicants' existing water demand, shown in Table 3, was used to calculate the volume of water that must be supported by storage. In addition, a volume of water is required to account for miscellaneous losses including evaporation in the reservoir and stream channel losses between the lake

storage and the river intake. A conservative estimate of 280,000 m³ based on 0.6 metres depth over the full supply area (46.7 ha) should account for any losses. Therefore, for the period June to October inclusive, the total storage volume required on Arrowsmith Lake to support the extractive water demand downstream on Englishman River is 4,410,000 m³.

The applicants propose to develop up to 9,000,000 m³ of storage to not only support their 25 year projected demand but also to improve existing low flow fisheries conditions in the Englishman River. As the storage development on Arrowsmith Lake would have a impact on the fisheries resource due to the lake level fluctuations, fisheries mitigation is proposed.

A streamflow target of 1.55 m³/s at the WSC station on Englishman River was used to estimate storage requirements on Arrowsmith Lake. The streamflow target included the maintenance of 1.13 m³/s (40 cfs) in Englishman River plus an additional 0.38 m³/s (13.4 cfs) to support the projected maximum monthly water supply demand. The estimated storage requirements for each year of complete streamflow records on the Englishman River are shown in Table 4.

Year	Storage Deficit (m ³)
1915	4,387,880
1916	2,412,465
1980	3,380,327
1981	4,193,869
1982	4,210,631
1983	3,487,463
1984	3,701,735
1985	4,834,162
1986	6,018,524
1987	8,693,650
1988	6,315,070
1989	5,504,039
1990	4,619,890
1991	4,870,969
1992	5,752,854
1993	6,325,496
1994	6,336,745
1995	5,308,775

For all years during the period of streamflow record, the proposed 9,000,000 m³ of storage could meet the target release conditions. Even during 1987 with the lowest summer flows on record, the storage requirements are slightly less than the quantity being proposed. Table 5 shows the storage requirements to meet the target streamflows at various low flow return periods

Table 5 Storage Requirements - Return Intervals	
Return Year	Storage Deficit (m3)
1:2	4,885,000
1:5	6,185,000
1:10	6,950,000
1:20	7,630,000
based on Log Normal & Pearson Type III Distribution	

The proposed 9,000,000 m3 of storage should satisfy the fisheries requirement of 40 cfs in a 1:20 return year plus fully support the projected water demand during the summer low flow period.

A water licence for storage should be issued for up to 7,300 acre-feet in support of the waterworks purpose licence.

Proposed Works:

For waterworks purpose licence:

The current proposal is to use the existing City of Parksville intake location, approximately 400 metres downstream of the Island Highway. The existing intake will require upgrading to improve withdrawal capacity.

Future plans are to re-locate the intake further upstream above the urban development. The initial water licence application indicated that the intake location would be near the confluence with the South Englishman River. In discussions with the applicants and fisheries agencies, the future intake location would be located on the Englishman River between the South Englishman River confluence and the new Island Highway bridge. A Change of Works application will be submitted when the location and design specifications are finalized.

For storage purpose licence:

To fully support the water demand during the June to October low flow period, the development of storage on Arrowsmith Lake is being proposed. The concept, as outlined in the 1995 KRC Report and subsequent letters, is to utilize 4,000,000 m3 of water below the existing lake levels and to obtain an additional 5,000,000 m3 of storage by raising the present lake level 12 metres (spillway elevation).

A dam would be constructed on the bedrock sill outlet of Arrowsmith Lake. The preliminary designs show a concrete-faced rockfill dam extending approximately 65 metres between the rock outcrops on the north and south sides of the lake outlet. A concrete spillway (elevation 828.5m) would be 12 metres above the existing lake level (el.816.5m) with 1.5 metres of freeboard to the dam crest (el.830m). Two outlet pipes are proposed to provide

flexibility of operation and extraction of water at different levels (el.810m & el.802m).

Physical characteristics of Arrowsmith Lake under existing conditions and those with a dam to provide 9,000,000 m³ of storage are summarized in the letter report dated April 15, 1996 from Gartner Lee Limited and shown in Table 6.

	Existing	With Dam
Lake Surface Elevation (m)	816.5	828.5 (max) 802.0 (min)
Area (ha)	36.2	46.7 (max)
Average Depth (m)	36	43 (max) 29 (min)
Volume (m ³)	11-13 million	16-18 million (max) 7-9 million (min)
Length of Shoreline (m)	2,515	2,880 (max)
Storage Available for Release Downstream (m ³)	0	9,000,000

Arrowsmith Lake has a relatively small catchment area of approximately 5 km² which is only 1.5% of the total Englishman River drainage area (324 km²).

The contributing drainage area is comprised of steep rock bluffs and forested slopes with 4 or 5 streams. The two main tributaries are located at the west end of the lake - one stream flowing from Hidden Lake (el.1090m) and the watershed divide on Mount Arrowsmith (el.1570m). The flows of these creeks are braided or infiltrate to ground in the logged section between the old logging road and the gravel beach on the lakeshore. Another small gravel beach is formed where two other small creeks enter the south side of the lake.

The shoreline is comprised of either steep bedrock or steep rubble with the two small gravel beach areas at the west and south side tributaries. Some filling of the lake shore has occurred near the outlet and along the south shore where the logging road was constructed.

Accountability:

For both licences recommended herein:

At the time of issuance of this water licence, the City of Parksville's existing water licences, C057408 and C057409, for the diversion of a maximum 1,500,000 gallons per day from Englishman River supported by 650 acre-feet of storage on Arrowsmith, Fishtail, and Hidden Lakes should be cancelled. This licence is a replacement in part for these existing licences.

The water licensees are required to monitor the streamflow in the Englishman River and Arrowsmith Creek, the lake levels in Arrowsmith Lake, and the water withdrawals from the Englishman River. Monitoring and the submission of records are to be performed as directed by the Engineer under the Water Act.

The works authorized by this licence shall be operated and maintained by a joint works agreement between the Regional District of Nanaimo, the City of Parksville, and the Town of Qualicum Beach. The Town of Qualicum Beach will act as manager for the first five years.

For waterworks purpose licence:

The Engineer under the Water Act may regulate water withdrawals from the Englishman River in order to maintain a minimum flow in the Englishman River

For storage purpose licence:

The licensee(s) are required to submit detailed designs of the storage structure. Approval by the Engineer under the Water Act is required prior to construction.

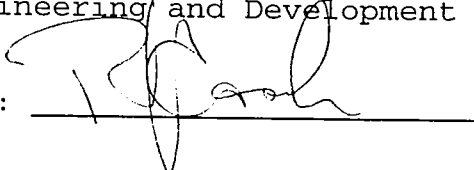
The licensee shall operate and maintain the water storage reservoir on Arrowsmith Lake and release of water past the dam as directed by the Engineer under the Water Act. A Provisional Operation Rule is attached.

Other Notes:

The licence should be issued in the name of all three jurisdictions - Regional District of Nanaimo, City of Parksville, and Town of Qualicum Beach.

The mailing address: Town of Qualicum Beach, Box 130, Qualicum Beach, B.C. V9K 1S7 Attn: Mr. R.K. Weir, P.Eng, Director of Engineering and Development Services

Signed: _____



Date: _____

Nov 3/96

Station Name:		ENGLISHMAN RIVER NEAR PARKSVILLE															
Station Number:		08HB002															
Natural or Regulated:		N															
Drainage Area (sq.km.):		324															
Location (Decimal):		Latitude		49.31667		Longitude		124.28278		Latitude		Degrees		Minutes		Seconds	
		Longitude		124.28278						Longitude		124		19		0	
STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MN ANN			
08HB002	1913	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1914	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1915	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1916	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1917	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1970	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1971	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1979	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1980	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1981	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1982	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1983	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1984	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1985	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1986	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1987	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1988	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1989	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1990	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1991	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1992	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1993	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1994	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB002	1995	M	M	M	M	M	M	M	M	M	M	M	M	M			
MEAN		22.7	25.1	25.2	25.2	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1			
% of MAD		168%	186%	125%	98%	79.0%	49.8%	20.8%	8.5%	9.4%	62.0%	184%	217%	100%			
Station Name:		ARROWSMITH CREEK AT OUTLET OF ARROWSMITH LAKE															
Station Number:		08HB080															
Natural or Regulated:		N															
Drainage Area (sq.km.):																	
Location (Decimal):		Latitude		49.22111		Longitude		124.53472		Latitude		Degrees		Minutes		Seconds	
		Longitude		124.53472						Longitude		124		13		16	
STATION	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MN ANN			
08HB080	1990	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB080	1991	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB080	1992	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB080	1993	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB080	1994	M	M	M	M	M	M	M	M	M	M	M	M	M			
08HB080	1995	M	M	M	M	M	M	M	M	M	M	M	M	M			
MEAN		0.546	0.823	0.492	0.256	0.62	0.415	0.147	0.085	0.037	0.378	1.17	0.752	0.469			
% of MAD		157%	166%	116%	104%	143%	82.8%	27.5%	25.6%	13.0%	55.3%	171%	153%	100%			

APPENDIX C

PROPOSED OPERATING RULE CURVE

Proposed Arrowsmith Lake Reservoir Operating Rule Curve

