Q. The proposed Water Management Agreement sets out mechanisms for coordinating the production of power at the Upper Churchill and Lower Churchill hydroelectric generating stations. Please provide simulated power production schedules illustrating how those mechanisms will function for two sample months selected to illustrate seasonal variations. The simulations should address operation of the hydroelectric generating stations with and without the implementation of a Water Management Agreement. Please identify any assumptions made when preparing the simulations and provide adequate explanation of tables and charts.

A. Below are simulations that illustrate the application of the principles contained in the Water Management Agreement for the Churchill River. The simulations, two for a month in which there are little uncontrolled natural inflows to the Gull Island reservoir, and two for a month in which substantial inflows exist, show how the inflow – outflow balance in the Gull Island reservoir can be maintained by properly proportioning the systems' total required production between the CF(L)Co facility and the proposed Gull Island facility. An infinite number of potential simulations, hour by hour, are possible. The simulations presented below are conditioned on[1]:

1) <u>Stable CF(L)Co Customer Requirements</u>

CF(L)Co's three major customers and related entitlements are:

a. Hydro-Quebec – 29.5 TWh/year
b. Recall Block – 300 MW @ 90% load factor, 2.3 TWh/year
c. Twinco Block – 225 MW @ 100% load factor, 2.0 TWh/year

[1] These simulations include a correction in relation to the CF(L)Co annual energy production from that presented at the Technical Conference. That simulation used 29.5 TWh (annual entitlement of Hydro-Quebec) rather than the total 33.8 TWh (including Twinco and recapture entitlements). These simulations also include other minor refinements in source data.

This 33.8 TWh/year is assumed to be produced evenly throughout the year resulting in 92.7 GWh/day of production, or equivalently 3,863 MW of continuous demand.

2) Stable Gull Island Production

The Gull Island facility is expected to produce approximately 11.9 TWh/year on average. This production is assumed to be produced evenly throughout the year resulting in 32.6 GWh/day of production, or approximately 1,358 MW of continuous demand.

3) Stable System Requirements

A system demand of 5,221.0 MW was derived from 1 and 2 above. In the simulations that did not employ water management, each facility generated (or attempted to generate) its respective demand expressed in 1 and 2 above. In the simulations that employ water management, the total system demand was proportioned between the two facilities to fulfill the combined demand requirements, maintaining a constant level in the Gull Island reservoir as expressed in 5 below.

4) Stable Natural Inflows over the Month

Inflows to the Gull Island reservoir were considered to be the same for each day of the chosen month, but differed from month to month.

a. High inflow month:

May was chosen as the wet month. Average uncontrolled inflows into the Gull Island reservoir, based on approximately 50 years of data, are estimated to be 102 million cubic meters (MCM) of water per day.

b. Low inflow month:

March was chosen as the dry month. Average uncontrolled inflows into the Gull Island reservoir, based on approximately 50 years of data, are estimated to be 6.6 million cubic meters of water per day.

5) Maintaining a Constant Elevation in the Gull Island Reservoir

In the simulations that employ water management, a constant storage volume in the reservoir for each day of the month was maintained. In all the cases that employ water management this volume is 575 million cubic meters.

6) Energy Conversion Factor

The rate at which hydraulic energy is converted to electrical energy at both plants is considered to be fixed for the month. The assumed conversion rate at CF(L)Co is 0.790 GWh/MCM; for Gull Island the assumed rate is 0.215 GWh/MCM.

7) Electrical Losses

Electrical system losses are ignored.

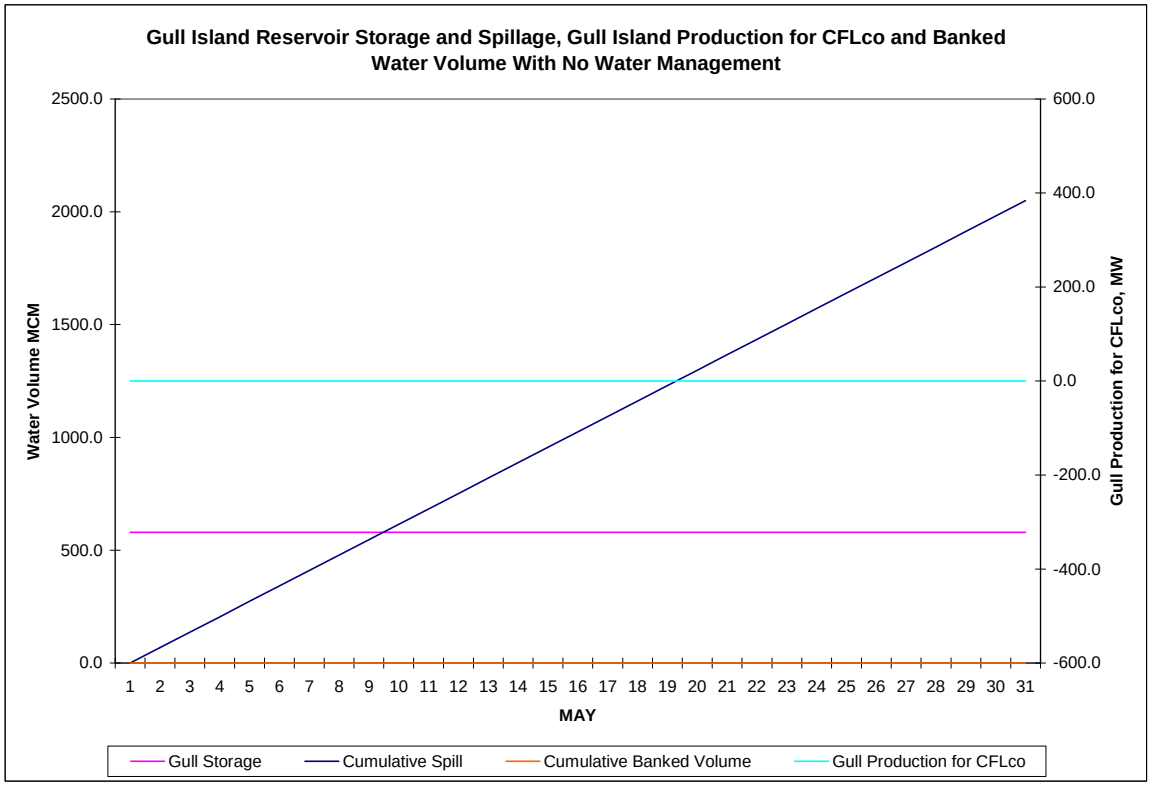
As indicated, for the sake of the illustrations both hydraulic conditions and electrical system requirements are considered constant over all hours of the month.

Discussion

May with No Water Management

The chart associated with this month's production and inflows shows that when CF(L)Co is self-supplying its 3,863 MW of demand each hour, and Gull Island is producing 1,358 MW to serve its own needs, the total inflow into the Gull Island reservoir (controlled releases from the CF(L)Co facility associated with that facility's

production combined with uncontrolled natural inflows) exceeds the volume of outflow associated with Gull Island production. As a result, storage in the Gull Island reservoir quickly reaches its full supply quantity of 580 million cubic meters and after that 2,049 million cubic meters of water are diverted through the Gull Island spillway and are not used for production.



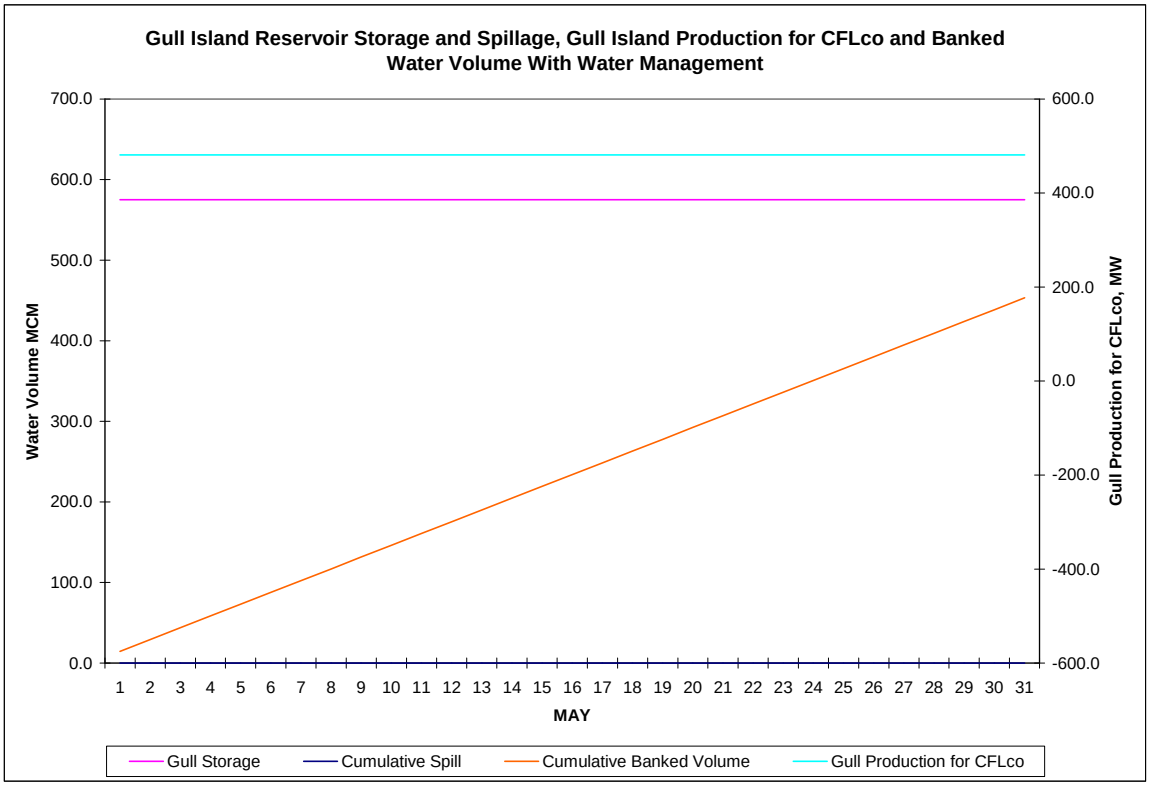
MAY - No Water Management

CFLco			Gull				
HQ yearly Entitlement	29.5	TWh	Starting Storage	575	MCM		
Recall Yearly Entitlement	2.3652	TWh	Full Supply Level	580	MCM		
Twinco Yearly Entitlement	1.971	TWh	Low Supply Level	0	MCM	System Demand	
total yearly	33.8362	TWh				5221.0	MW
			Daily Inflow	102.6	MCM		
Monthly Energy Entitlement	2.5	TWh	Expected Average Energy	1.0	TWh		
Daily Equivalent	92.7	GWh	Daily Equivalent	32.6	GWh		
MW Equivalent	3862.6	MW	MW Equivalent	1358.4	MW		
Conversion Factor	0.790031	GWh/MCM	Conversion Factor	0.215	GWh/MCM		

	Daily Schedule, MW (Assumed Equal in each hour)			Inflows to Gull Reservoir, MCM		Gull Outflows MCM			Gull Storage MCM	Gull Production for CFLco	Banked Water Volume	
				Uncontrolled	Cflco Tailrace						Daily	Cummulative
Day	CFLco	Gull	Total	Local Inflow	Flows	Production	Spill	Cumulative Spill		MW	MCM	MCM
1	3862.6	1358.4	5221.0	102.6	117.3	151.6	0.0	0.0	580.0	0.0	0.0	0.0
2	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	68.3	580.0	0.0	0.0	0.0
3	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	136.6	580.0	0.0	0.0	0.0
4	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	204.9	580.0	0.0	0.0	0.0
5	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	273.3	580.0	0.0	0.0	0.0
6	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	341.6	580.0	0.0	0.0	0.0
7	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	409.9	580.0	0.0	0.0	0.0
8	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	478.2	580.0	0.0	0.0	0.0
9	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	546.5	580.0	0.0	0.0	0.0
10	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	614.8	580.0	0.0	0.0	0.0
11	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	683.1	580.0	0.0	0.0	0.0
12	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	751.4	580.0	0.0	0.0	0.0
13	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	819.8	580.0	0.0	0.0	0.0
14	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	888.1	580.0	0.0	0.0	0.0
15	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	956.4	580.0	0.0	0.0	0.0
16	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1024.7	580.0	0.0	0.0	0.0
17	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1093.0	580.0	0.0	0.0	0.0
18	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1161.3	580.0	0.0	0.0	0.0
19	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1229.6	580.0	0.0	0.0	0.0
20	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1297.9	580.0	0.0	0.0	0.0
21	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1366.3	580.0	0.0	0.0	0.0
22	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1434.6	580.0	0.0	0.0	0.0
23	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1502.9	580.0	0.0	0.0	0.0
24	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1571.2	580.0	0.0	0.0	0.0
25	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1639.5	580.0	0.0	0.0	0.0
26	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1707.8	580.0	0.0	0.0	0.0
27	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1776.1	580.0	0.0	0.0	0.0
28	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1844.4	580.0	0.0	0.0	0.0
29	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1912.8	580.0	0.0	0.0	0.0
30	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	1981.1	580.0	0.0	0.0	0.0
31	3862.6	1358.4	5221.0	102.6	117.3	151.6	68.3	2049.4	580.0	0.0	0.0	0.0

May with Water Management

The chart illustrates that with the storage constant at 575 million cubic meters in the Gull Island reservoir, CF(L)Co production is reduced to 3,381 MW while Gull Island production is increased to 1,840 MW. Having Gull Island produce 481.2 MW each hour to serve CF(L)Co customer requirements establishes the required inflow – outflow balance at the Gull Island reservoir. This practice of having Gull Island produce for the needs of CF(L)Co permits CF(L)Co to avoid the consumption of water, and the production of energy, that it would otherwise have to produce if Gull Island were not serving CF(L)Co's requirements. The amount of energy and water avoided by CF(L)Co is the quantity of energy and associated water banked by Gull Island. For the course of the month, it is calculated to be 481.2 MW for all 744 hours in the month, 358 GWh, and using an energy conversion factor of approximately 0.79 GWh/MCM, equates to 453 MCM of water stored.


Gull Island Reservoir Storage and Spillage, Gull Island Production for CFLco and Banked Water Volume With Water Management
Water Volume MCM
Gull Production for CFLco, MW
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
600.0
400.0
200.0
0.0
-200.0
-400.0
-600.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
MAY
Gull Storage
Cumulative Spill
Cumulative Banked Volume
Gull Production for CFLco

MAY - With Water Management

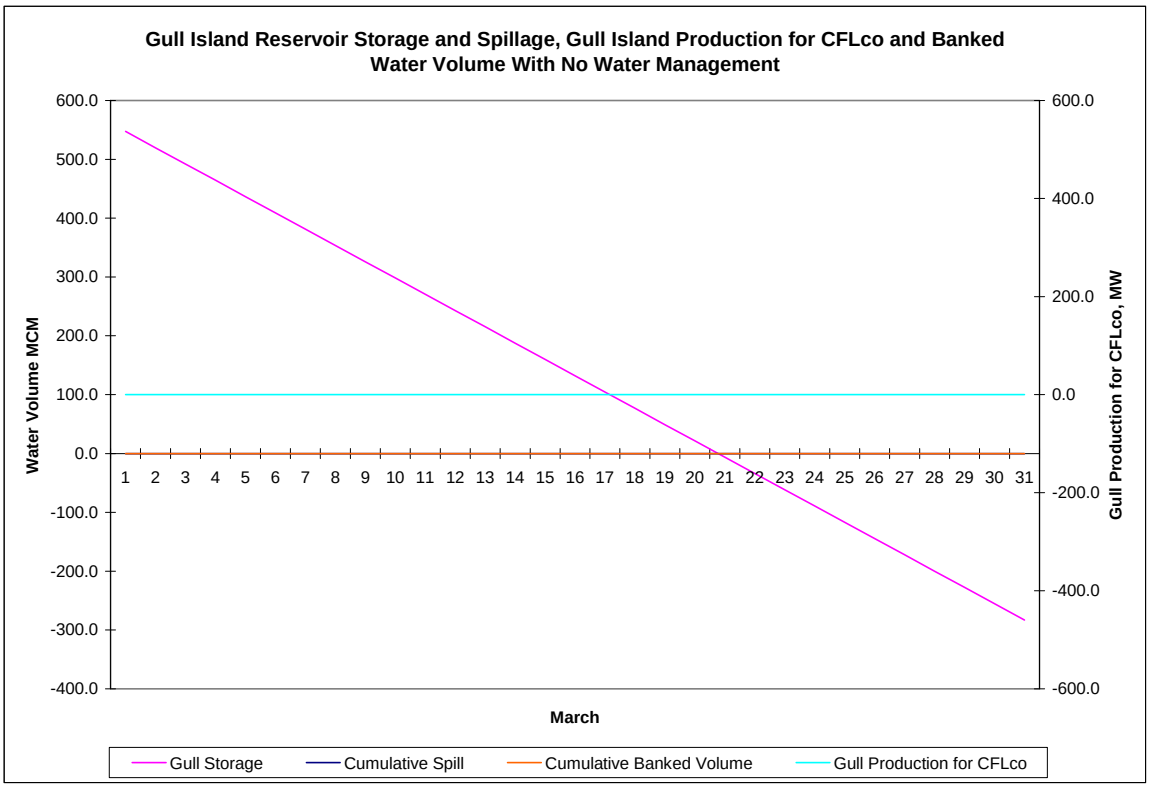
CFLco			Gull		
HQ yearly Entitlement	29.5	TWh	Starting Storage	575	MCM
Recall Yearly Entitlement	2.3652	TWh	Full Supply Level	580	MCM
Twinco Yearly Entitlement	1.971	TWh	Low Supply Level	0	MCM
total yearly	33.8362	TWh			
			Daily Inflow	102.6	MCM
Monthly Energy Entitlement	2.5	TWh	Expected Average Energy	1.0	TWh
Daily Equivalent	92.7	GWh	Daily Equivalent	32.6	GWh
MW Equivalent	3862.6	MW	MW Equivalent	1358.4	MW
Conversion Factor	0.790031	GWh/MCM	Conversion Factor	0.215	GWh/MCM

System Demand	
5221.0	MW

	Daily Schedule, MW Assumed Equal in each hour			Inflows to Gull Reservoir, MCM Uncontrolled	Cflco Tailrace		Gull Outflows MCM			Gull Storage MCM	Gull Production for CFLco	Banked Water Volume Daily	Cummulative
Day	CFLco	Gull	Total	Local Inflow	Flows		Production	Spill	Cumulative Spill		MW	MCM	MCM
1	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	14.6
2	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	29.2
3	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	43.9
4	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	58.5
5	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	73.1
6	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	87.7
7	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	102.3
8	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	116.9
9	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	131.6
10	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	146.2
11	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	160.8
12	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	175.4
13	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	190.0
14	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	204.7
15	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	219.3
16	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	233.9
17	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	248.5
18	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	263.1
19	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	277.7
20	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	292.4
21	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	307.0
22	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	321.6
23	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	336.2
24	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	350.8
25	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	365.4
26	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	380.1
27	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	394.7
28	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	409.3
29	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	423.9
30	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	438.5
31	3381.4	1839.6	5221.0	102.6	102.7		205.3	0.0	0.0	575.0	481.2	14.6	453.2

March with No Water Management

The chart illustrates, for the conditions chosen, that if CF(L)Co is self-supplying its 3,863 MW of demand each hour, and Gull Island is producing 1,358 MW to serve its own needs, the total inflow into the Gull Island reservoir will not be sufficient and the reservoir will deplete to its low supply level.



MARCH - No Water Management

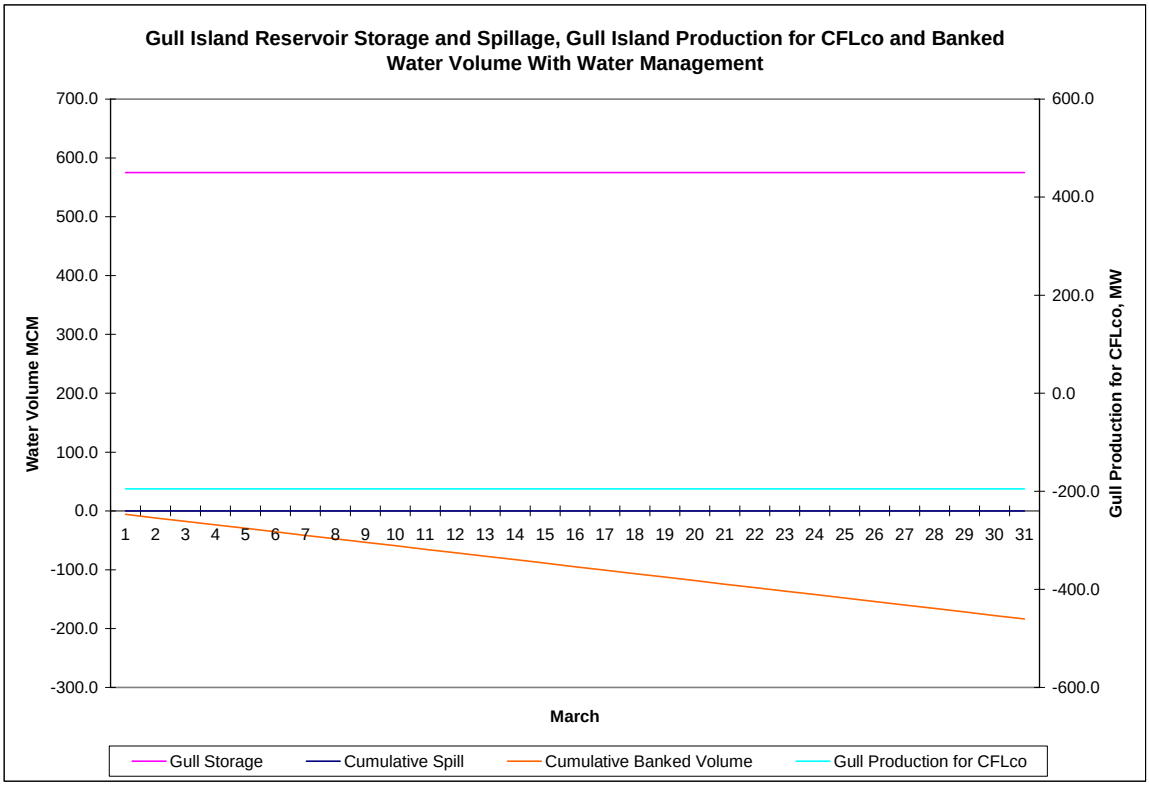
CFLco			Gull		
HQ yearly Entitlement	29.5	TWh	Starting Storage	575	MCM
Recall Yearly Entitlement	2.3652	TWh	Full Supply Level	580	MCM
Twinco Yearly Entitlement	1.971	TWh	Low Supply Level	0	MCM
total yearly	33.8362	TWh			
			Daily Inflow	6.6	MCM
Monthly Energy Entitlement	2.5	TWh	Expected Average Energy	1.0	TWh
Daily Equivalent	92.7	GWh	Daily Equivalent	32.6	GWh
MW Equivalent	3862.6	MW	MW Equivalent	1358.4	MW
Conversion Factor	0.790031	GWh/MCM	Conversion Factor	0.215	GWh/MCM

system	
5221.0	MW

	Daily Schedule, MW Assumed Equal in each hour			Inflows to Gull Reservoir, MCM Uncontrolled	Cflco Tailrace	Gull Outflows MCM			Gull Storage MCM	Gull Production for CFLco	Banked Water Volume Daily	Cummulative
Day	CFLco	Gull	Total	Local Inflow	Flows	Production	Spill	Cumulative Spill		MW	MCM	MCM
1	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	547.3	0.0	0.0	0.0
2	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	519.6	0.0	0.0	0.0
3	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	492.0	0.0	0.0	0.0
4	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	464.3	0.0	0.0	0.0
5	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	436.6	0.0	0.0	0.0
6	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	408.9	0.0	0.0	0.0
7	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	381.3	0.0	0.0	0.0
8	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	353.6	0.0	0.0	0.0
9	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	325.9	0.0	0.0	0.0
10	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	298.2	0.0	0.0	0.0
11	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	270.5	0.0	0.0	0.0
12	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	242.9	0.0	0.0	0.0
13	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	215.2	0.0	0.0	0.0
14	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	187.5	0.0	0.0	0.0
15	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	159.8	0.0	0.0	0.0
16	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	132.2	0.0	0.0	0.0
17	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	104.5	0.0	0.0	0.0
18	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	76.8	0.0	0.0	0.0
19	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	49.1	0.0	0.0	0.0
20	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	21.4	0.0	0.0	0.0
21	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-6.2	0.0	0.0	0.0
22	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-33.9	0.0	0.0	0.0
23	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-61.6	0.0	0.0	0.0
24	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-89.3	0.0	0.0	0.0
25	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-116.9	0.0	0.0	0.0
26	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-144.6	0.0	0.0	0.0
27	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-172.3	0.0	0.0	0.0
28	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-200.0	0.0	0.0	0.0
29	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-227.7	0.0	0.0	0.0
30	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-255.3	0.0	0.0	0.0
31	3862.6	1358.4	5221.0	6.6	117.3	151.6	0.0	0.0	-283.0	0.0	0.0	0.0

March with Water Management

The chart illustrates that with a constant storage elevation in the Gull Island reservoir, CF(L)Co production is increased to 4,057 MW while Gull Island production is decreased to 1,163 MW. Having CF(L)Co produce 195 MW each hour to serve Gull Island customer requirements establishes the required inflow – outflow balance at the Gull Island reservoir. Having CF(L)Co produce for the needs of Gull Island increases the quantity of energy and the volume of water that would otherwise have been consumed at CF(L)Co over the course of the month. The amount of energy and water consumed in excess of CF(L)Co requirements represents energy and associated water withdrawn from Gull Island's total banked quantity. For the course of the month, it is calculated to be 195 MW for all 744 hours in the month, 145 GWh, and using an energy conversion factor of approximately 0.79 GWh/MCM, equates to 184 MCM of water removed from Nalcor's storage.



MARCH - With Water Management

CFLco			Gull		
HQ yearly Entitlement	29.5	TWh	Starting Storage	575	MCM
Recall Yearly Entitlement	2.3652	TWh	Full Supply Level	580	MCM
Twinco Yearly Entitlement	1.971	TWh	Low Supply Level	0	MCM
total yearly	33.8362	TWh			
			Daily Inflow	6.6	MCM
Monthly Energy Entitlement	2.5	TWh	Expected Average Energy	1.0	TWh
Daily Equivalent	92.7	GWh	Daily Equivalent	32.6	GWh
MW Equivalent	3862.6	MW	MW Equivalent	1358.4	MW
Conversion Factor	0.790031	GWh/MCM	Conversion Factor	0.215	GWh/MCM

system	
5221.0	MW

	Daily Schedule, MW Assumed Equal in each hour			Inflows to Gull Reservoir, MCM Uncontrolled	Cflco Tailrace	Gull Outflows MCM			Gull Storage MCM	Gull Production for CFLco	Banked Water Volume Daily	Cummulative
Day	CFLco	Gull	Total	Local Inflow	Flows	Production	Spill	Cumulative Spill		MW	MCM	MCM
1	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-5.9
2	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-11.8
3	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-17.8
4	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-23.7
5	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-29.6
6	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-35.5
7	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-41.5
8	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-47.4
9	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-53.3
10	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-59.2
11	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-65.2
12	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-71.1
13	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-77.0
14	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-82.9
15	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-88.8
16	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-94.8
17	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-100.7
18	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-106.6
19	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-112.5
20	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-118.5
21	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-124.4
22	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-130.3
23	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-136.2
24	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-142.1
25	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-148.1
26	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-154.0
27	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-159.9
28	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-165.8
29	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-171.8
30	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-177.7
31	4057.5	1163.5	5221.0	6.6	123.3	129.8	0.0	0.0	575.0	-195.0	-5.9	-183.6

1 The table below contains monthly values for Lower Churchill flows, spilled volumes
2 at Gull Island and banked storage volumes at CF(L)Co for each month based on the
3 assumptions presented earlier.

Monthly Values for Flow, Spill and Banked Energy associated with the Assumptions Previously Established

	Lower Churchill Daily Flow Volume, MCM		Gull Island Monthly Spill Volume, MCM		Banked Volume, MCM
	With out Water Management	With Water management	With out Water Management	With Water management	With Water management
Jan	126.0	131.5	0.0	0.0	-169.9
Feb	124.9	130.6	0.0	0.0	-160.1
Mar	123.9	129.8	0.0	0.0	-183.6
Apr	128.3	133.3	0.0	0.0	-149.4
May	219.9	205.3	2049.4	0.0	453.2
Jun	216.6	202.7	1885.9	0.0	417.5
Jul	159.5	157.8	237.6	0.0	52.5
Aug	149.0	149.5	0.0	0.0	-17.4
Sep	146.5	147.6	0.0	0.0	-32.9
Oct	151.5	151.5	0.0	0.0	-0.8
Nov	141.2	143.4	0.0	0.0	-66.8
Dec	130.1	134.7	0.0	0.0	-142.3
				Net	0.0

Q. Please list the permits and approvals that must be obtained for the development of the Lower Churchill hydroelectric generating stations at Gull Island and Muskrat Falls and for related facilities with a description of the subject matter to be addressed by each permit or approval and identification of the agency granting or issuing the permit or approval.

A. The list of permits, approvals and authorizations that may be required for the Lower Churchill Project is attached. This list is contained in a response to an Information Request (JRP 24) to the Joint Review Panel in the Environmental Assessment process.

Table IB-G-1 List of Permits, Approvals and Authorizations that may be required for the Lower Churchill Hydroelectric Generation Project

Activity	Approval/Certificate/ License/Permit/Inspection	Legislation	Regulating Agency
Government of Newfoundland and Labrador			
Project Construction/ Commencement	Release from the Newfoundland and Labrador *Environmental Protection Act*, Part X, Environmental Assessment	*Environmental Protection Act,* S.N.L. 2002, c.E-14.2	Environmental Assessment Division, Newfoundland and Labrador Department of Environment and Conservation (NLDEC)
	Development Permit to build on and develop land, whether Crown or privately owned, within the building control lines of the Trans Labrador Highway (Quebec Border to Goose Bay) Protected Road Zoning Plan (PRZP)	*Urban and Rural Planning Act, 2000,* S.N.L. 2000, c. U-8, Section 61	Newfoundland and Labrador Department of Government Services (NLDGS), on behalf of Newfoundland and Labrador Department of Municipal Affairs (NLDMA)
	Authorization to "enclose, mark off or take possession of" Crown land requiring permission under one of the following Sections of the *Lands Act*: - Section 3, Lease of Crown Land; - Section 4, Grants of Crown Land; - Section 5, Easement; or - Section 6, Licence to Occupy.	*Lands Act*, S.N.L. 1991, c.36	NLDEC, Lands Branch
Establishment of Work Camps	Certificate of Approval – Septic System with daily flow of less than 4,546 litres, and Final Approval Certificate	*Health and Community Services Act*, S.N.L. 1995, c.P-37.1; *Sanitation Regulations,* C.N.L.R. 803/96	NLDGS, on behalf of Newfoundland and Labrador Department of Health and Community Services (NLDHCS)
	Certificate of Approval – Septic system with daily flow greater than 4,546 litres	*Water Resources Act.* S.N.L. 2002, c. E-14.2	NLDGS, on behalf of NLDEC
	Certificate of Approval for Commercial Building under National Building Code, National	*Fire Prevention Act*, S.N.L. 1991, c.34	NLDMA, Office of the Fire Commissioner

Activity	Approval/Certificate/ License/Permit/Inspection	Legislation	Regulating Agency
	Fire Code, and NFPA101 Life Safety Code		
	Application for Building Registration (for each building to be constructed)	*Building Accessibility Act*, R.S.N.L. 1990, c. B-10; B*uilding Accessibility Regulations*, C.N.L.R. 1140/96	NLDGS
	Food Establishment Application (for Construction Camps and operations)	*Food and Drug Act*, R.S.N.L. 1990, c.F-21; *Food Premises Regulations,* C.N.L.R. 1122/96	NLDGS, oh behalf of NLDHCS
	Building Accessibility	*Building Accessibility Act*, R.S.N.L. 1990, c.B-10; *Building Accessibility Regulations,* C.N.L.R. 1140/96	NLDGS
	Electrical Permit – required for any electrical work undertaken or installations completed during the Project	*Public Safety Act,* S.N.L. 1996, c. P-41.01; *Electrical Regulations*, N.L.R. 120/96	NLDGS
Land Requirements	Crown Lands – Crown Land Lease/License/Permit	*Lands Act*, S.N.L. 1991, c.36	NLDEC
	Notice of Intent for Reservation of Shoreline	*Lands Act*, S.N.L. 1991, c.36	NLDEC
Waste Management Related to Construction Activities	Waste Oil – Handling , Storage and Disposal	*Environmental Protection Act*, S.N.L. 2002, c.E-14.2; *Used Oil Control Regulations,* N.L.R. 82/02	NLDEC and NLDGS
Garbage Disposal/Waste Management	Waste Management System, Certificate of Approval	*Environmental Protection Act*, S.N.L. 2002, c.E-14.2, Part IV, Waste Disposal and Litter	NLDEC or NLDGS
	Certificate of Approval - Collection and transportation of hazardous/special waste	*Environmental Protection Act,* S.N.L. 2002, c.E-14.2	Regional Operator: NLDGS Province-Wide Operator: NLDEC
Access Roads	Bridges, Certificate of Approval, Application for Environmental Permit to Alter a Body of Water	*Water Resources Act*, S.N.L. 2002, c.W-4.01, Section 48	NLDEC
	Culvert Installation, Certificate of Approval, Application for Environmental Permit to Alter a Body of Water	*Water Resources Act*, S.N.L. 2002, c.W-4.01, Section 48	NLDEC
	Certificate of Approval for Stream Fording, Application for Environmental Permit to Alter a	*Water Resources Act*, S.N.L. 2002, c.W-4.01, Section 48	NLDEC

Activity	Approval/Certificate/ License/Permit/Inspection	Legislation	Regulating Agency
	Body of Water		
	Permit for Access off any Highway	*Urban and Rural Planning Act, 2000,* S.N.L. 2000, c.0-8; *Highway Sign Regulations, 1999,* N.L.R. 85/99	NLDMA
	Authorization for construction of branch/access roads off the Trans Labrador Highway	*Urban and Rural Planning Act, 2000*, S.N.L. 2000, c.U-8; *Protected Road Zoning Regulation*, C.N.L.R. 996/96	NLDMA
	Authorization for restricting access.	*Lands Act*, S.N.L. 1991, c.36; *Forestry Act,* R.S.N.L. 1990, c.F-23	NLDEC, Lands Branch Newfoundland and Labrador Department of Natural Resources (NLDNR), Forestry Branch
Construction of Dams	Dams and Appurtenant Structures, Certificate of Approval	*Water Resources Act*, S.N.L. 2002, c.W-4.01, Section 48	NLDEC
Construction of Generating Facilities	Water Resources – Water Course Crossings, Certificate of Environmental Approval	*Water Resources Act*, S.N.L. 2002, c.W-4.01, Section 48	NLDEC
	Construction (Site Drainage) Certificate of Approval	*Water Resources Act*, S.N.L. 2002, c.W-4.01, Section 48	NLDEC
Stream Crossings/ Fording	Water Resources – Water Course Crossings, Certificate of Environmental Approval	*Water Resources Act*, S.N.L. 2002, c.W-4.01, Section 48	NLDEC
Fuel Storage	Fuel Storage & Handling – Temporary Storage Remote Locations	*Environmental Protection Act*, S.N.L. 2002, c.E-14.2; *Storage and Handling of Gasoline and Associated Products Regulations, 2003*, N.L.R. 58/03; *Environmental Guidelines for Fuel Cache Operations in Newfoundland and Labrador*	NLDEC and NLDGS
	Fuel Storage & Handling – A Permit Flammable & Liquid Storage & Dispensing (above or below ground) & for Bulk Storage (above ground only)	*Environmental Protection Act*, S.N.L. 2002, c.E-14.2; *Storage and Handling of Gasoline and Associated Products Regulations, 2003*, and *Fire Prevention Act*, *1991*, S.N.L. 1991, c.34	NLDEC and NLDMA (Office of the Fire Commissioner)

	Fuel storage tanks ≤2,500 L and connected to a heating appliance	*Environmental Protection Act,* S.N.L. 2002, c.E-14.2; *Heating Oil Storage Tank Regulations, 2003.* N.L.R. 60/03; *Storage and Handling of Gasoline and Associated Products Regulations, 2003*	NLDEC and NLDGS
	Certificate of Approval – Used oil storage system	*Environmental Protection Act*, SNL 2002, c.E-14.2; *Used Oil Control Regulations,* N.L.R. 82/02	NLDGS
Potable Water Supply	Water Resources – License to Drill Water Wells	*Water Resources Act*, S.N.L. 2002, c.W-4.01; *Well Drilling Regulations, 2003*, N.L.R. 63/03	NLDEC, Water Resources Division
Water Supply for Camp/Work Site	Water Resources – General Application for Water Use Authorization – for all beneficial uses of water from any source – Application for Permit for Using Ground Water for Non-Domestic Uses	*Water Resources Act*, S.N.L. 2002, c.W-4.01	NLDEC, Water Resources Division
Water Use	Water Use Authorization	*Water Resources Act*, S.N.L. 2002, c.W-4.01	NLDEC
	Approval for Water Supply System	*Water Resources Act*, S.N.L. 2002, c.W-4.01	NLDEC
Construction Activities	Operating Permit/Fire Season – Crown or private land for a company or individual to operate during forest fire season	*Forestry Act*, R.S.N.L. 1990, c.F-23; *Forest Fire Regulations,* C.N.L.R 11/96	NLDNR, Forest Resources Division
	Permit to Cut Crown Timber – A permit is required for commercial or domestic cutting of timber on Crown land	*Forestry Act*, R.S.N.L. 1990, c.F-23; *Cutting of Timber Regulations*; C.N.L.R. 1108/96	NLDNR, Forest Resources Division
	Permit to Burn	*Forestry Act*, R.S.N.L. 1990, c.F-23, *Forest Fire Regulations,* 1108/96, C.N.L.R. 11/96	NLDNR, Forest Resources Division
	Letter of Advice to New Construction Project or Industrial Enterprise	*Forestry Act*, R.S.N.L. 1990, c.F-23	NLDGS
	Authorization pursuant to the Protected Road Zoning Regulations (PRZR) and the Protected Road Zoning Plan (PRZP) implemented by the Trans Labrador Highway (Quebec Border to Goose Bay)	*Urban and Rural Planning Act, 2000,* S.N.L. 2000, c.U-8	NLDMA

	Operating Permit	*Forestry Act*, R.S.N.L. 1990, c.F-23	NLDNR, Forest Resources Division, Local District Office, North West River
	Commercial Cutting Permit & associated conditions	*Forestry Act*, R.S.N.L. 1990, c.F-23, *Cutting of Timber Regulations,* C.N.L.R. 1108/96	NLDNR, Forest Resources Division, local district office, North West River
	Permit to Alter a Body of Water Schedule A – Culvert Schedule B – Bridge Schedule C – Dam Schedule D – Fording Schedule E – Pipe Crossing/Water Intake Schedule F – Stream Modification or Diversion Schedule H – Other works within 15 m of a body of water (i.e., wharf, boathouse, infilling, landscaping, dredging, debris removal, drainage works, settling ponds, other minor works)	*Water Resources Act*, S.N.L. 2002, c.W-4.01, Section 48	NLDEC, Water Resources Management Division
	Registration – all elevating devices	*Public Safety Act,* S.N.L. 1996, c. P-41.01; *Amusement Rides and Elevating Devices Regulations,* N.L.R. 118/96	NLDGS, Engineering Services Division
Borrow Pits and Rock Quarries	Quarry Development Permit – A permit is required to dig for, excavate, remove and dispose of any Crown quarry material	*Quarry Minerals Act, 1998,* S.N.L. 1998, c.Q-1.1	NLDNR, Mines and Energy Division
Control of Nuisance Wildlife	Control of Nuisance Wildlife Black Bear Protection Permit/Permit to Destroy Problem Animals	*Wild Life Act*, R.S.N.L., c.W-8, *Wild Life Regulations,* C.N.L.R. 1156/96.	NLDNR, Forest Resources Division
Highway Signage	Signs – Highway Services Fingerboard Signs, Approval	*Work Services and Transportation Act*, S.N.L. 1995, c. W-12	Newfoundland and Labrador Department of Transportation and Works (NLDTW)
	Permit for highway signs – other than fingerboard	*Urban and Rural Planning Act, 2000,* S.N.L. 2000, c.U-8, *Highway Sign Regulations, 1999,* N.L.R. 85/99	NLDGS

Temporary Diesel/Propane Generation and Permanent Emergency Diesel Generation	Permit to Operate Temporary Diesel Generator	*Environmental Protection Act*, S.N.L. 2000, c.E-14.2; *Air Pollution Control Regulations, 2004,* N.L.R. 39/04	NLDEC, Pollution Prevention Division
Government of Canada			
Project Commencement	Release	*Canadian Environmental Assessment Act,* S.C. 1992, c.37	Canadian Environmental Assessment Agency, Minister of Environment
Watercourse Alteration/ Diversion and Instream Activities	Approval under Part 1, Section 5 of the *NWPA* for any work to be built of placed in, on, over, under, through or across any navigable water Fish habitat creation/placement of boulders or islands within Gull Island Plateau to create additional fish habitat will require an Approval under the NWPA	*Navigable Waters Protection Act,* R.S.C 1985, c.N-22	Transport Canada
	Fish Habitat Authorization – For works or undertakings affecting fish habitat, require quantification of HADD and fish habitat compensation strategy for approval and authorization	*Fisheries Act, R.S.C. 1985, c. F-14,* Section 35(2)	Fisheries and Oceans Canada (DFO)
	Application for a Water Lot Lease	*Fisheries Act,* R.S.C. 1985, c. F-14	DFO
Handling and Transportation of Dangerous Goods	Permit to Transport	*Transport of Dangerous Good Act, 1992,* S.C. 1992, c. 34.	Transport Canada
Accidental Hazardous Material Spill	Report Mechanism/Response	Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances, and/or Marine Pollutants. TP9834E. under the *Canada Shipping Act, 2001,* S.C. 2001, c. 26	DFO – Canadian Coast Guard
Communications	Application For License To Install and Operate a Radio Station in Canada	*Radiocommunication Act,* R.S.C. 1985, c. R-2	Industry Canada Communications
Storage of Explosives	Magazine License, Temporary	*Explosives Act,* R.S.C. 1985, c. E-16, Section 7	Natural Resources Canada

Municipal Government			
Waste Disposal	Approval to dispose waste in municipal landfill		Relevant municipality

Provincial Guidelines

In addition to Hydro's EMS and EPP, the Project will also need to comply with the following guidelines:

- DFO's Guidelines for Protections of Freshwater Fish Habitat in Newfoundland and Labrador (Goss et al 1998)
- DFO's Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998)
- NLDNR' Environmental Guidelines for Construction and Mineral Exploration Companies
- NLDEC's Environmental Guidelines for General Construction Practices
- NLDEC's Guidelines for Culverts
- NLDEC's Guidelines for Diversions, New Channels, Major Alterations (1992)
- NLDEC's Environmental Guidelines for Water Course Crossings (1992)

Acronyms:

DFO	Fisheries and Oceans Canada
NLDEC	Newfoundland and Labrador Department of Environment and Conservation
NLDGS	Newfoundland and Labrador Department of Government Services
NLDHCS	Newfoundland and Labrador Department of Health and Community Services
NLDMA	Newfoundland and Labrador Department of Municipal Affairs
NLDNR	Newfoundland and Labrador Department of Natural Resources
NLDTW	Newfoundland and Labrador Department of Transportation and Works