



Water Management and Reservoir Operating Plan- Bluefish

Water Licence Number:

MV2005L4-0008

December 31, 2020

Prepared by:

Eileen Hendry C.E.T.
Manager, System Control
Northwest Territories Power Corporation

Contents

1	MAP	3
2	SUMMARY	4
3	ENERGY FORECAST	5
4	REVIEW OF PREVIOUS OPERATING PLAN	6
5	INDICATORS	8
5.1	Flows and Trends	8
5.2	Precipitation	9
5.3	Snow Survey.....	9
5.4	Expected Inflows.....	10
5.4.1	May Yellowknife River Forecast	10
5.5	Forecast Water Flows and Levels	10
5.5.1	Reservoirs.....	10
5.5.2	Water Use Efficiencies.....	11
6	ACTUALS EXAMPLE	12
7	COMMENTARY ON OPERATIONS AND COMPLIANCE	12
8	COMMENTARY ON REPORTS AND INSPECTIONS	12

Tables and Figures

<i>Table 1: Bluefish Hydro Production (GWh)</i>	5
<i>Table 2: Bluefish Hydro Actual and Forecast Water Flow (m³/s)</i>	6
<i>Table 3: Bluefish Lake Reservoir - Forebay Levels (m)</i>	7
<i>Table 4: Yellowknife Precipitation</i>	9
<i>Table 5: Snow Survey Results (Snow Water Equivalent mm)</i>	9
<i>Table 6: Forecast Flows and Levels</i>	10
<i>Table 7: Generation & Forecast Efficiencies</i>	11
<i>Figure 1: Map of Bluefish Hydro System Area</i>	3
<i>Figure 2: Bluefish Hydro Actual and Forecast Output (GWh)</i>	5
<i>Figure 3: Bluefish Hydro Forecast and Actual Water Flow (m³/s)</i>	6
<i>Figure 4: Bluefish Lake Reservoir - Forebay Levels (m)</i>	7
<i>Figure 5: Annual Flow Trends - Yellowknife River at Bluefish</i>	8
<i>Figure 6: Actual and Forecast Flows</i>	12

1 MAP

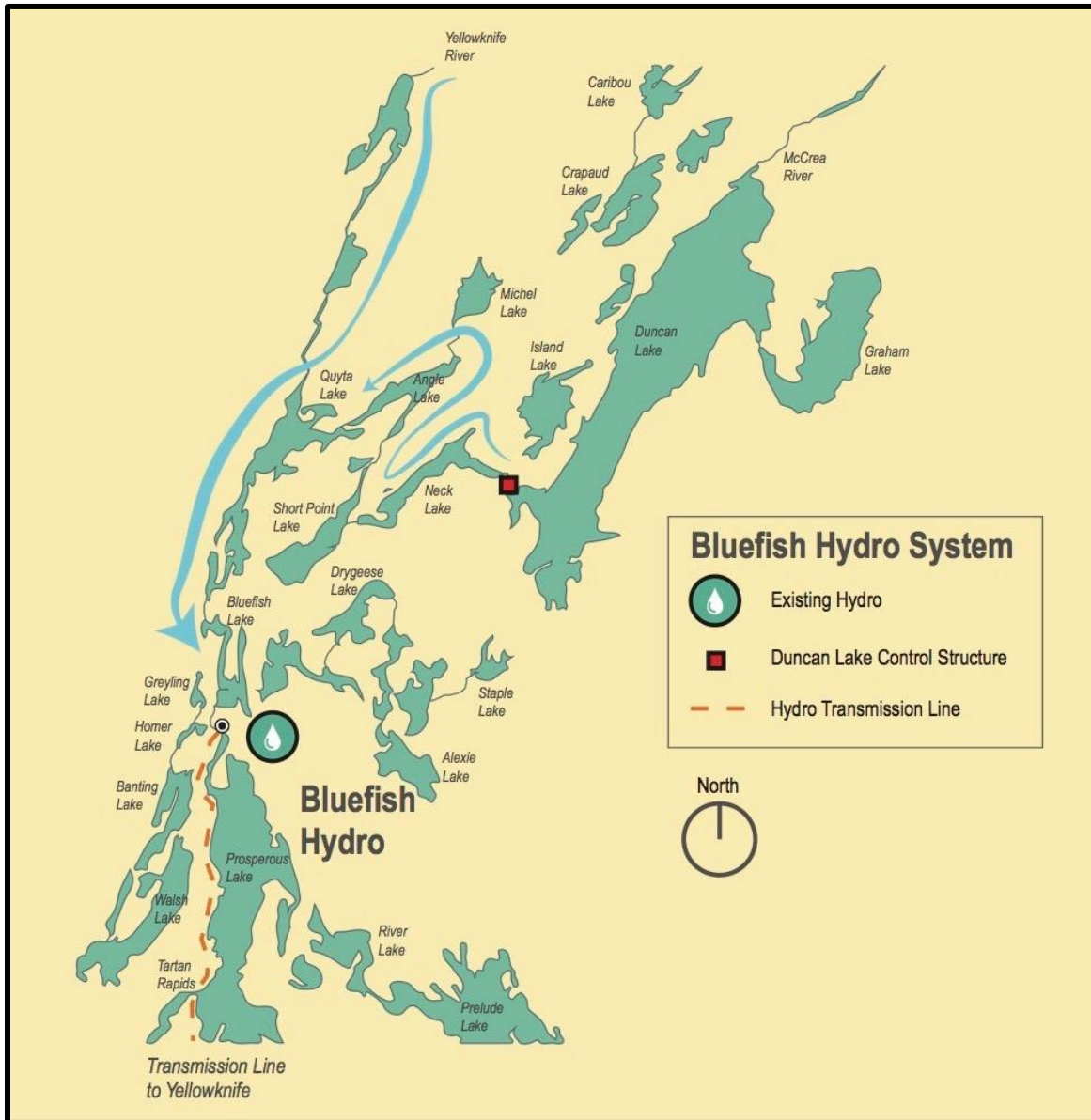


Figure 1: Map of Bluefish Hydro System Area

2 SUMMARY

Snow survey results of the Yellowknife basin in early April were 105% of average. The model using this data suggests peak flows of 61.5 m³/s, very close to historical average, and similar to the 1993 hydrograph template. Actual inflows and an Indin River peak of 31 m³/s in June confirm this selection. With contributions from the Duncan reservoir, flows like the 1992 hydrograph could be achieved. NTPC expects Bluefish operations to be above average during winter months.

The spillway at Duncan Lake was fully closed on September 20, 2019 to bring the spillway elevation to 212.5 m. At this time, the water level in Duncan Lake was 212.509 m so a small amount of spill continued. Water levels in Duncan Lake continued to rise, increasing outflow over the top stop log during the remainder of 2019. Flow over the top stop log and through the side spill channels, combined with natural inflow to Bluefish Lake was enough to support full output from the hydro plants throughout the early months of 2020 without removing any stop logs from the Duncan Lake control structure.

One log was removed on August 18, 2020, when the level of Duncan Lake reached 213.0074 m. This balanced the outflow with the natural inflows to Duncan Lake and stabilized the water level in the lake. By December 2020, the level of the Duncan Lake Reservoir remained relatively high, at 212.79 m. Flow through the side spill channels and over the top log of the spillway continues to be sufficient to fully supply the Bluefish plants when combined with other natural inflows to the system.

The Bluefish fore bay level is presently in the top range of the operating level. The facility will be operated to maintain this level for reserve capacity in the event of temporary issues arising at Snare Hydro.

3 ENERGY FORECAST

Forecast and actual energy production (GWh) for the months of July 2020 through June 2021 are shown in Table 1 and Figure 2.

Table 1: Bluefish Hydro Production (GWh)

	JUN-20 FORECAST	ACTUAL LOAD	DEC-20 FORECAST
JUL-20	2.28	3.72	
AUG-20	2.00	4.24	
SEP-20	2.06	3.98	
OCT-20	2.53	3.45	
NOV-20	2.61	4.27	
DEC-20	3.14	4.31	4.31
JAN-21			3.17
FEB-21			2.92
MAR-21			1.70
APR-21			2.45
MAY-21			3.18
JUN-21			1.94

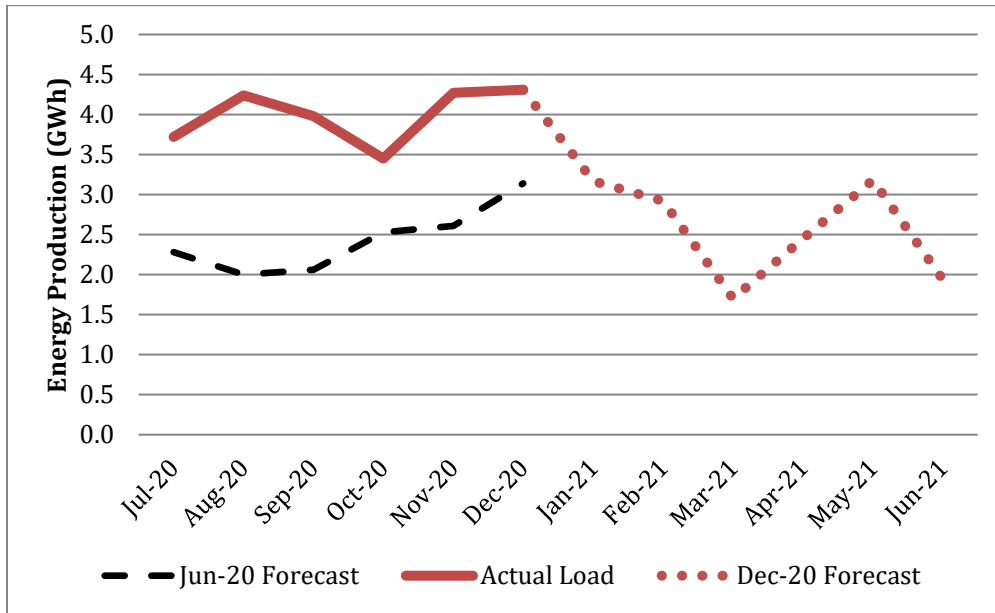


Figure 2: Bluefish Hydro Actual and Forecast Output (GWh)

4 REVIEW OF PREVIOUS OPERATING PLAN

Forecast and actual inflow and outflow in cubic meters per second for the months of July 2020 through June 2021 are shown in Table 2 and Figure 3.

Table 2: Bluefish Hydro Actual and Forecast Water Flow (m³/s)

	YELLOWKNIFE RIVER			DUNCAN LAKE		
	Jun-20 Forecast Inflow	Actual Inflow	Dec-20 Forecast Inflow	Jun-20 Forecast Outflow	Actual Outflow	Dec-20 Forecast Outflow
JUL-20	6.6	30.8		6.3	9.9	
AUG-20	4.2	50.2		8.3	18.8	
SEP-20	5.0	34.8		7.6	21.6	
OCT-20	7.7	24.8		5.6	18.4	
NOV-20	13.4	19.4		0	15.4	
DEC-20	14.9	16.5	16.5	0	15.1	15.1
JAN-21			18.0			14.0
FEB-21			17.0			13.0
MAR-21			14.0			12.0
APR-21			12.0			12.0
MAY-21			8.0			12.0
JUN-21			21.0			13.0

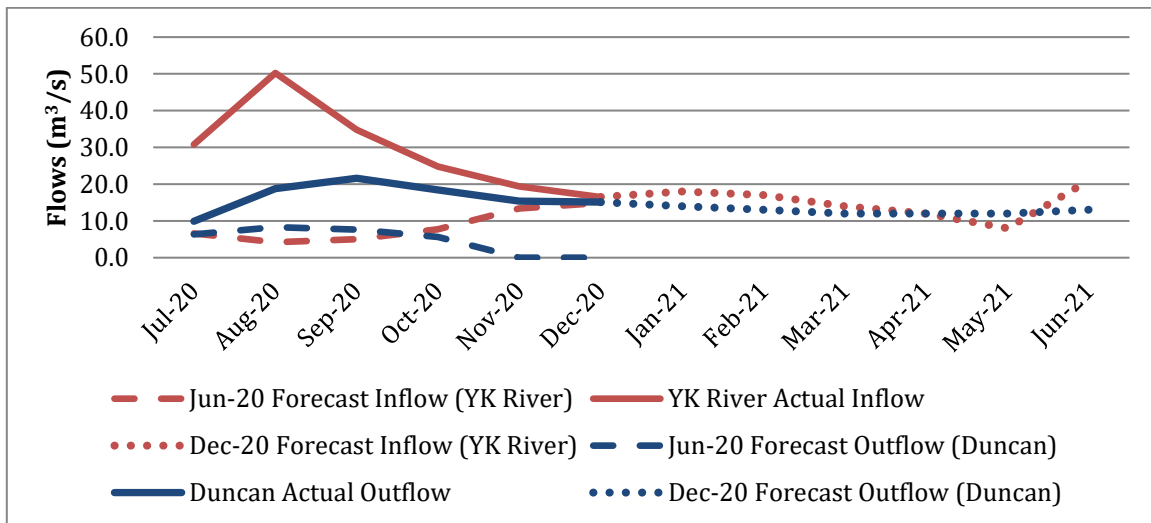


Figure 3: Bluefish Hydro Forecast and Actual Water Flow (m³/s)

Forecast and actual reservoir levels in meters of elevation above sea level for the months of July 2018 through June 2019 are shown in Table 3 and Figure 4.

Table 3: Bluefish Lake Reservoir - Forebay Levels (m)

	JUN-20 FORECAST	ACTUAL ELEVATION	DEC-20 FORECAST
JUL-19	186.17	186.27	
AUG-19	186.20	186.46	
SEP-19	186.30	186.36	
OCT-19	186.25	186.28	
NOV-19	186.20	186.19	
DEC-19	186.15	186.17	186.17
JAN-20			186.17
FEB-20			186.20
MAR-20			186.30
APR-20			186.25
MAY-20			186.20
JUN-20			186.15

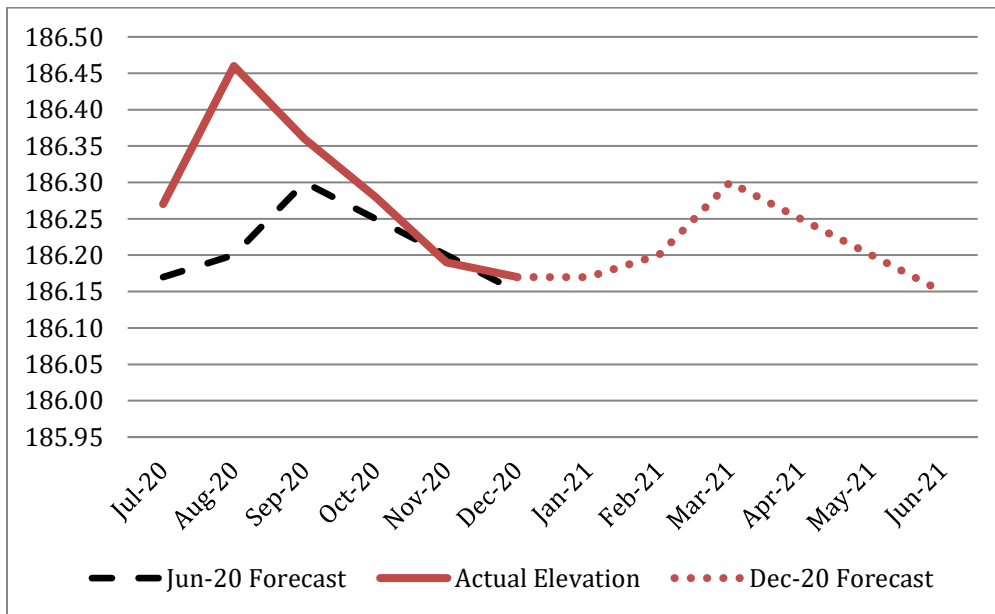


Figure 4: Bluefish Lake Reservoir - Forebay Levels (m)

5 INDICATORS

5.1 Flows and Trends

Figure 5 illustrates annual flows and trends for the Yellowknife River at Bluefish. 1993 provided a suitable forecast template for the first six months of 2020, with the second half of the year following more closely with 1992. The historical peak year (1991) is provided for reference purposes.

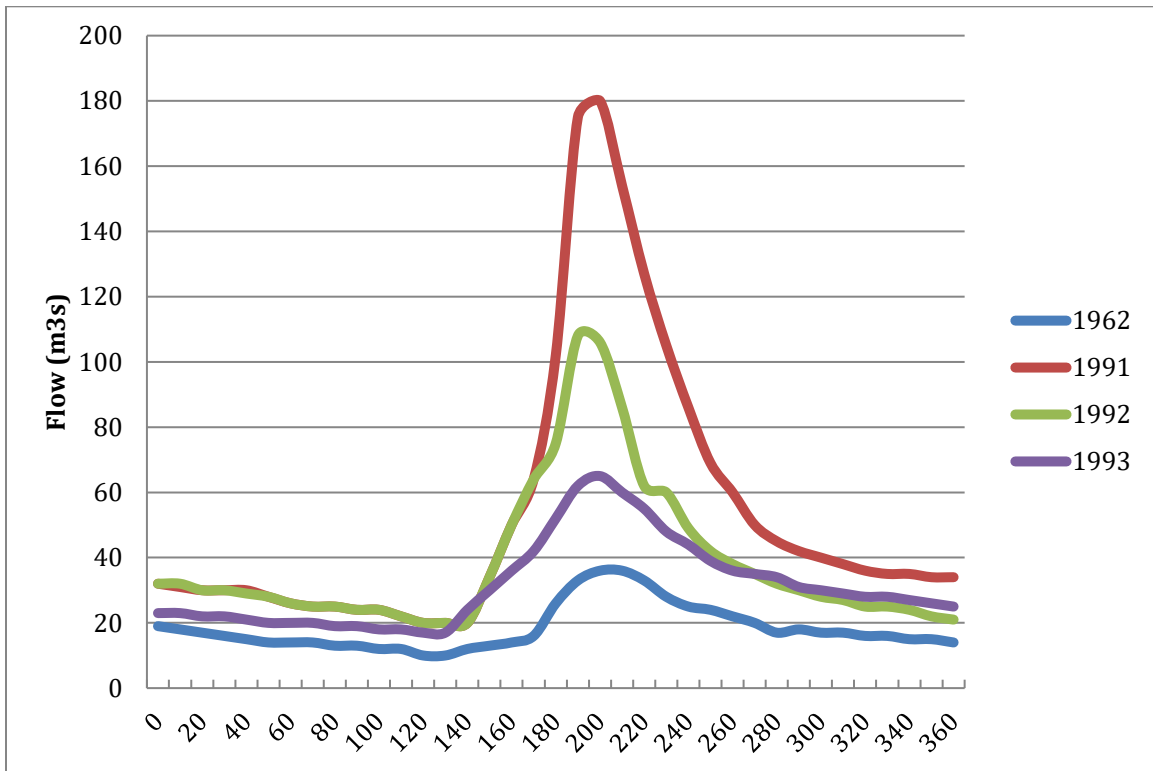


Figure 5: Annual Flow Trends - Yellowknife River at Bluefish

5.2 Precipitation

Table 4 shows the 2020 and historical normal monthly precipitation at Yellowknife. Lower precipitation during the first five months of the year was offset by higher than average amounts June through August, resulting in total precipitation in 2020 on par with normal historical values.

Table 4: Yellowknife Precipitation¹

MONTH	NORMAL PRECIPITATION (MM)	2020 PRECIPITATION (MM)
JAN	14.3	6.2
FEB	14.1	8.5
MAR	13.9	5.3
APR	11.3	8.1
MAY	18.4	3
JUN	28.9	28.6
JUL	40.8	97.6
AUG	39.3	67.4
SEP	36.3	27.2
OCT	30.3	13.2
NOV	24.8	14.3
DEC	16.2	3.9
TOTAL	288.6	283.3

5.3 Snow Survey

Results of the 2020 Spring Snow Survey are summarized in Table 5.

Table 5: Snow Survey Results (Snow Water Equivalent mm)

	2020 SWE (MM)	AVERAGE SWE (MM)	YEARS OF RECORD	PERCENT OF AVERAGE
ALAN LAKE	79.0	86.3	32	91.5
BLUEFISH HYDRO	80.5	80.8	25	99.6
DENIS LAKE	109.5	108.8	33	91.7
JOLLY LAKE	115.0	135.5	8	84.9
LITTLE LATHAM LAKE	108.0	98.0	33	103.8
NARDIN LAKE	117.5	105.7	33	101.6
SHARPLES LAKE EAST	124.5	108.0	33	104.9
TIBBITT LAKE	85.0	84.1	38	95.8
AVERAGE	102.4	100.9		104%

¹ Precipitation data from Environment Canada <https://weather.gc.ca/> retrieved 2021-01-29

5.4 Expected Inflows

The Runoff Forecasting Model results for 2020 using the snow water equivalent in the Yellowknife River basin suggested an average water year similar to 1993.

5.4.1 May Yellowknife River Forecast

Snow Survey Basin *SWE*

100.6

SWE > 80

$$Q_{max} = 0.0137 * SWE^2 - 0.789 * SWE + 2.2$$

61.5

SWE < 80

$$Q_{max} = 0.336 * SWE$$

33.8

Forecast Peak Flow =

61.5 m³/s

mean date Julian 195 (July 14)

Template Year

1993

Peak Flow =

65.0 m³/s

The McCrea River peak inflow, based on the 2020 Indin River Peak of 31.0 m³/s, is estimated to be 11.1 m³/s.

JUNE McCREA RIVER FORECAST

$$Q_{max} = 0.469 * Q_{indin} - 3.4$$

Indin Peak

31.0 m³/s

McCrea

11.1 m³/s

24.0

lag past Indin = July 22

5.5 Forecast Water Flows and Levels

5.5.1 Reservoirs

The following table summarizes the expected flows for the Yellowknife River, McCrea River and Duncan Lake outflow and Duncan Lake reservoir level for the next six months.

Table 6: Forecast Flows and Levels

MONTH	MCCREA RIVER (M ³ /S)	DUNCAN OUTFLOW (M ³ /S)	RESERVOIR WATER LEVEL (M)	YELLOWKNIFE RIVER (M ³ /S)
JANUARY	7.0	14.0	212.79	32
FEBRUARY	7.0	13.0	212.78	30
MARCH	4.5	12.0	212.77	26
APRIL	5.0	12.0	212.75	24
MAY	17.0	12.0	212.73	20
JUNE	23.0	13.0	212.73	34

5.5.2 Water Use Efficiencies

The following table summarizes the expected GWh to m³/s flow from the Yellowknife River and the Duncan Lake reservoir.

Table 7: Generation & Forecast Efficiencies

MONTH	YELLOWKNIFE RIVER (M ³ /S)	DUNCAN OUTFLOW (M ³ /S)	PLANT FLOW (M ³ /S)	SPILL (M ³ /S)	ENERGY (GWH)
JAN	16.5	15.1	31.6	8.0	4.31
FEB	18.0	14.0	32.0	2.5	3.17
MAR	17.0	13.0	30.0	0.0	2.92
APR	14.0	12.0	26.0	0.0	1.70
MAY	12.0	12.0	24.0	0.0	2.45
JUN	8.0	12.0	20.0	1.0	3.18

Notes:

- Plant Flow Capacity = 26.5 m³/s
- Gross Head = 33.0 m
- Hydraulic Efficiency = 98%
- Turbine Efficiency = 86%
- Generator Efficiency = 97%
- Overall Efficiency = 82%

5.6 Actuals example

A comparison of actual to forecast outflows at Bluefish in 2020-21 and other recent years is shown in Figure 6. The high amount of rain during the summer months caused a significant increase in outflow compared to forecast over the second half of 2018.

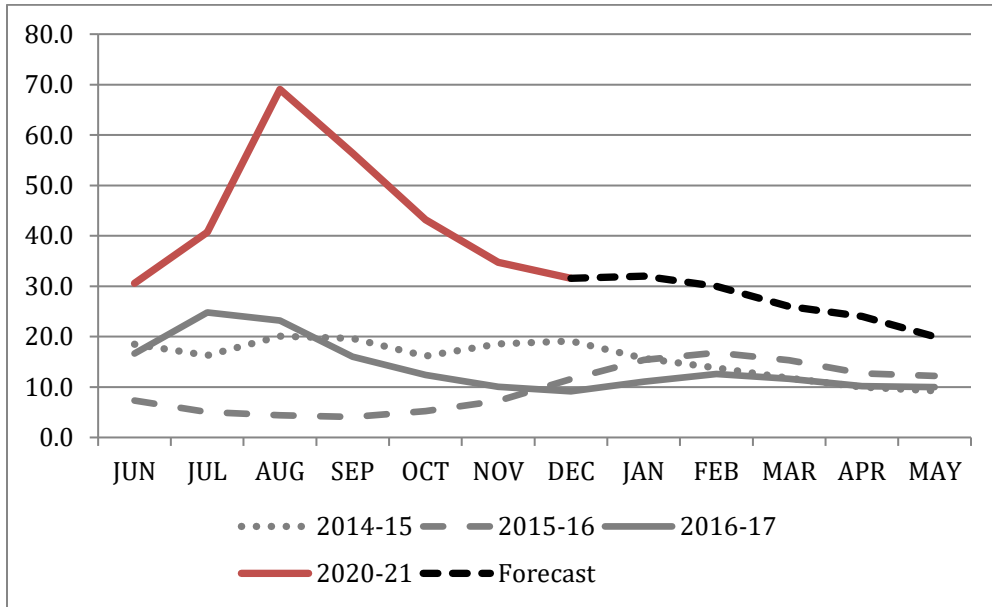


Figure 6: Actual and Forecast Flows

6 COMMENTARY ON OPERATIONS AND COMPLIANCE

The Bluefish Hydro facilities were operated within compliance of the water license throughout the previous six months. Bluefish water Licence inspection occurred on August 18, 2020 with ENR Water Licence Inspectors Heather Beck and David-Scott McQuinn.

7 COMMENTARY ON REPORTS AND INSPECTIONS

Bluefish water Licence inspection occurred on August 18, 2020 with ENR Water Licence Inspectors Heather Beck and David-Scott McQuinn.