

Interim EFN Tool User's Guide

**for Decisions on Applications for Water Diversion and Use in the
Blueberry, Upper Beatton, and Lower Sikanni Chief Watersheds**

Prepared for:

Province of British Columbia

Prepared by:

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1 List of Acronyms

BCER	British Columbia Energy Regulator (formerly BC Oil and Gas Commission)
BRFN	Blueberry River First Nations
EBF	Ecosystem Baseflow
EFN	Environmental Flow Needs
FOR	Ministry of Forests
MAD	Mean Annual Discharge
MWA	Maximum Cumulative Water Allocation
NEWT	Northeast Water Tool
NRO	Natural Resource Officer
POD	Point of Diversion
SWAD	Alberta Surface Water Allocation Directive
WAT	Water Allocation Tool (BRFN)
WMB	Water Management Basins
WSA	Water Sustainability Act
WSC	Water Survey of Canada

2 Definitions

Exceedance Flow	The probability that a specific flow would be equaled or exceeded. For example, the exceedance percentile Q95 can be interpreted as the discharge which can be expected to be equaled or exceeded 95% of the time for a specific time interval. Q80 is a low flow and Q95 is an extremely low flow. Flow at the 5 th percentile is the same as flow at the 95 th percent exceedance.
Naturalized Flow	Recorded (measured) streamflow or water levels that are deemed to be relatively free of anthropogenic influence and therefore reflect the natural hydrologic conditions within a watershed.
Watershed Size Class	Similar to the BC EFN Policy stream size classification; Watershed Class 3 is $MAD \geq 10$ m ³ /s (large); Watershed Class 2 is $MAD \geq 2 - \leq 10$ m ³ /s (medium); Watershed Class 1 is $MAD < 2$ (small)

3 Purpose

Provide technical guidance to Water Officers in the BC Ministry of Forests (FOR) and Natural Resource Officers in the BC Energy Regulator (BCER) to implement a new interim Environmental Flow Needs (EFN) approach using the Interim North-East EFN Tool (Interim Tool).

For specific details associated with the review of new short term use approval applications and background, refer to the "Comptroller's Guidance for Decisions on Applications for Water Diversion and Use in the Blueberry, Upper Beatton, and Lower Sikanni Chief Watersheds".

4 Context

On January 18, 2023, the Blueberry River First Nations (BRFN) and the Government of British Columbia (Province) reached a historic agreement that will guide them forward in a partnership approach to land, water and resource stewardship.

The BRFN and the Province agreed to jointly develop a quantitative environmental flow needs (EFN) approach and process, described in Schedule P of the agreement. The parties agreed to pilot this approach in the review and adjudication of applications for new water diversion and use within the basins of the Blueberry River, the Upper Beatton River, and the Lower Sikanni Chief River (Figure 1). The implementation of the interim EFN approach is based on the use of the new Interim Environmental Flow Needs (EFN) Tool (Interim Tool), developed as a component of the agreement between the Blueberry River First Nations (BRFN) and the Province of British Columbia.

5 Interim Environmental Flow Needs Approach

The Interim EFN approach is based on the Alberta Surface Water Allocation Directive (SWAD; AB, 2019). The Interim EFN approach identifies environmental base flow (EBF) thresholds below which diversion of water is likely to harm aquatic ecosystems. To minimize downstream impacts to the aquatic environment, instantaneous cumulative diversion limits have been set based on percent exceedance values from natural flow in the stream. These thresholds are based on the percent exceedance values corresponding to low (Q80) and extremely low (Q95) natural stream flows and vary depending on stream size.

The maximum cumulative water allocation (MWA) volume during the Interim period for the three watersheds will be based on monthly flows for the watershed at the point of diversion as described in Table 1.

Mean annual discharge (MAD) is used to distinguish the Watershed Size Class.

The MWA limits in Table 1 should be ramped down such that the limit (i.e., 10%, 5% or 0%) will occur at natural flows equal to the threshold exceedance value of Q80 or Q95, respectively.

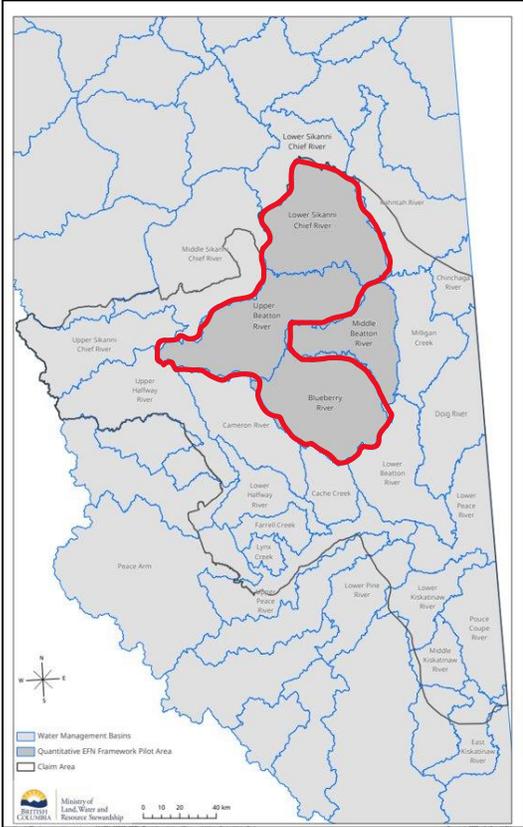


Figure 1. Area in red outlines the three pilot watersheds that the EFN approach and Interim Tool apply to.

Table 1. River and stream maximum cumulative percent water allocation limits (withdrawal) based on natural instantaneous discharge for monthly exceedance data as determined by mean annual discharge (adapted from SWAD).

Mean Annual Discharge (MAD)	Maximum Cumulative Withdrawal (% of Natural or Naturalized Weekly or Monthly Exceedance Flow)		
	>Q80	≤Q80 - >Q95	≤Q95
m ³ /s			
≥10	15%	5%	5%
≥2 - <10	15%	5%	0%
<2	10%	0%	0%

In small watersheds with MAD less than 2 m³/s, when stream flow is:

- greater than Q80 the MWA is 10% of the flow; and
- equal to or less than Q80 no water from the stream is available for diversion and use.
 - >Q80 indicates that up to 80% of the time, 10% of flows are available for diversion and use.

In medium-sized watersheds with MAD between 2 and 10 m³/s, when stream flow is:

- greater than Q80 the MWA is 15% of the flow;
- equal to or less than Q80 and greater than Q95 the MWA is 5% of the flow; and
- equal to or less than Q95 no water from the stream is available for diversion and use.

In large watersheds with MAD of 10 m³/sec or greater, when stream flow is:

- greater than Q80 the MWA is 15% of the flow; and
- equal to or less than Q80 the MWA is 5% of the flow. In large watersheds the interim EFN approach allows some water diversion even at low flows.

6 Interim Tool

The Interim EFN Tool (Interim Tool), is an Excel-based framework, that uses information output from the Northeast Water Tool (NEWT) to calculate the EBF's and MWA for any point of diversion (POD) on a river or stream within the three pilot watersheds. The Interim Tool is intended to:

- Correct NEWT monthly discharge estimates to better align with the observation record (acknowledging the weaknesses and errors within NEWT);
- Determine an Ecosystem Base Flow (EBF) value for each month, as outlined in Table 1; and,
- Calculate the potential maximum water available at the POD for each month and takes into consideration other water authorizations.

The excel spreadsheet contains numerous worksheets, some of which require the user to input data/information from NEWT, and others that are locked and used for the EFN Framework calculations.

The Interim Tool worksheets that require input from NEWT to be entered include the "annual", "monthly", "variability" and "allocations" worksheets (blue tabs). Worksheets that perform the EFN Approach calculations include the "WSA-adjust", "Q-Data", "EBF Calculation", "lookup", "WSC" and "thresholds" (grey tabs) – these sheets are locked. The worksheets most important to the decision maker are the "Output" and "Diversion Schedule" (orange tabs).

6.1 Where to Access the Interim Tool and Associated Documents

To access the Interim Tool or if you have questions contact:

- Liia Schilds with the Ministry of Forests at northeastwaterstewardship@gov.bc.ca
- Ryan Rolick with the BC Energy Regulator at Ryan.Rolick@bc-er.ca

The "Comptroller's Guidance for Decisions on Applications for Water Diversion and Use in the Blueberry, Upper Beatton, and Lower Sikanni Chief Watersheds" document is available at:

- [BC's Water Policies webpage](#)
- [BC's Water – EFN webpage](#)

6.2 How to Run the Interim Tool

To run the Interim Tool:

1. Open the [Northeast Water Tool \(NEWT\)](#).
2. Select the Watershed Reporting Tool.
3. Run NEWT for a proposed POD and select "Show Report".
4. Select "Download PDF" for your records.

5. Select "Download CSV" and select:
 - a. Annual Hydrology
 - b. Monthly Hydrology
 - c. Allocations
 - d. Hydrologic Variability
6. These CSV files will be downloaded as a Zip file. Open the Zip File. To open each CSV file in Excel, select the file of interest, and right click to select "Open with Excel". **All** the information within each CSV file will need to be copied and pasted into the corresponding Interim Tool 'Input' worksheets as shown in Table 2. The best way to do this is to highlight the entire content of the NEWT output CSV file (control-A) and copy (control-C), put the cursor in cell "A1" on the corresponding EFN worksheet, and paste. The content from NEWT needs to be in the correct cells.
7. Go to the "Output" worksheet and click the box labelled "Run WSA Authorizations Macro" to load any existing Water Sustainability Act (WSA) authorizations (i.e., water licence and short-term use approval) data into the Interim Tool.
8. Enter the application information in the blue cells on the "Output" worksheet.

Table 2. Corresponding NEWT CSV files and Interim Tool 'input' Worksheets.

Interim Tool 'input' Worksheet	NEWT .CSV File
Annual worksheet	Annual-hydrology.csv
Monthly worksheet	Monthly-hydrology.csv
Variability worksheet	Hydrologic-variability.csv
Allocation worksheet	Allocations.csv

6.3 Adjustments to the Interim Tool

The "WSA-adjust" worksheet in the Interim Tool allows for two types of adjustments to the WSA allocation data extracted from NEWT:

- Water Officers or Natural Resource Officers (NRO's) with FOR or BCER may need to make an adjustment in the NEWT allocation data when they know the NEWT data to be incorrect. The worksheet "WSA-adjust" allows the monthly adjustments to be input to a table. The adjustments are positive (e.g., an increase of 0.062) when the adjustment causes an increase to the monthly allocation, and negative (e.g., a decrease of 0.43 or -0.43 to be written) when the adjustment causes a decrease in the monthly allocation.

These adjustments are added to the "Existing WSA Authorizations" column in the "Output" worksheet. When a Water Officer or NRO adjusts the NEWT allocation data in any way, they must document the adjustment and the rationale as part of their decision record and provide it to BRFN.

6.4 Interim Tool Output Worksheets

The "Output" and "Diversion Schedule" worksheets are locked. Users can only enter information into the blue cells.

6.4.1 Output Worksheet

The "Output" worksheet presents detailed information on the monthly modelled hydrology and EFN variables at the proposed POD. It assesses current WSA-authorized water demand across a range of flow conditions, from low flow (e.g., at 20% (Q80) and 5% (Q95) monthly flow exceedance levels), through near-average conditions (e.g., at the median or 50% (Q50) monthly flow exceedance level), to high flow conditions (e.g., at the 70% or 80% monthly flow exceedance levels). It links the EBF and MWA values to an estimated monthly discharge at the POD, and to discharge values at a reference real-time hydrometric gauge (which are, at the present time, all Water Survey of Canada gauges).

The Interim Tool uses a reference WSC stream flow gauge for each user-selected POD, using the similarity metric used by NEWT to estimate flow variability. In most cases, the "default" reference flow gauge extracted from NEWT will be the best and most appropriate to use. In some cases, though, the user may want to select a different flow gauge. To do this, in the worksheet named "Output" click on the box to the right of "WSC Reference Gauge" labelled "User Selected". This has a drop-down list of real-time flow gauges that can be used in the Tool. The full list of WSC stations is listed in the "WSC" worksheet. Be careful with selecting a different WSC reference gauge from the default, as the selection of the gauge can affect the EFN Tool results. The WSC reference gauge needs to be as hydrologically consistent with the selected POD as can be achieved (proximity, drainage area, watershed elevation, etc.). Where a different reference gauge is selected and used for a WSA authorization decision, the Water Officer or NRO needs to document the hydrologic rationale for the gauge selected as part of their decision record and provided to BRFN. Below are two examples when a different reference WSC gauge is recommended:

- At the present time, some PODs in the Upper Beaton River mainstem channel will default to the Kiskatinaw River or the Moberly River as the reference gauge. It is recommended that this be changed to the Blueberry River below Aitken Creek (07FC003) or, as a second choice, the Beaton River near Fort St John (07FC001).
- A POD selected on the Sikanni Chief River mainstem will select the Halfway River above Graham River as the reference gauge. It is recommended that this be changed to the Sikanni Chief River near Fort Nelson (10CB001).

A map showing the WSC station locations is available on the Water Portal.

- <http://waterportal.geoweb.bcogc.ca/>

A series of columns under the heading "Maximum Water Diversion" presents EFN (EBF and MWA) information based on current WSA authorizations, for a range of flow conditions presented as decile groups (80-70% flow exceedance, 70-60% flow exceedance, 60-50% flow exceedance, etc.). Where the numbers in the columns labelled "m³/s, with application" and "m³/day, with application" are negative, in a **red font**, it means that the river at the POD may already be over-allocated during that month and during those flow conditions. The column labelled "m³/day, before application", will reflect these negative numbers as zero, meaning that no additional water is available for authorization.

The user can also test the effects of adding additional water withdrawal associated with a WSA application by inputting the application amounts as m³/s, m³/day or m³/year. The Tool will convert these values to m³/s, add them to the WSA authorization volumes, and generate new output showing the EFN effect of the application, if approved. The numbers under the "m³/s, with application" and "m³/day, with application" columns will change, to reflect the application rate or volume being assessed. The numbers under the "m³/day, before application" remain unchanged, to provide a static reference back to the current, pre-application results (Chapman, 2023).

6.4.2 Diversion Schedule Worksheet

The worksheet named "Diversion Schedule" is intended to be used by the Water Officer or NRO to inform the set of conditions drafted within the authorization. It contains detailed information on the "no diversion" flow values, and the maximum water withdrawal volume (m³/day) and diversion rate (m³/s) associated with an application you have evaluated, across a full range of flow conditions. Because the "Diversion Schedule" is linked to an application amount, it has no information unless an application amount is input to the "Output" worksheet. There will be cases where the application amount cannot be met, either fully or partially, in some months. Where there is no water remaining for diversion, the value shown will be zero. If there is some water available for diversion, the values shown will be less than the application amount and greater than zero.

6.4.3 Summary

The "Output" and "Diversion Schedule" worksheets use a reference WSC gauge and show estimated discharge values at the POD. The information provide in the "Diversion Schedule" worksheet is intended to be used to inform the decision and help draft the conditions within the authorization.

Decision Makers may want to consider the MWAs generated by the Interim Tool but allocate less water to improve reliability of supply to short term user approval authorizations. Decision Makers may want to consider adjusting the EBF's to ensure adequate protection of fish and fish habitat when supplementary information is available. The total remaining water in a stream should not be allocated to one user.

When starting a new application review, it is recommended that a new copy of the Interim Tool is populated to ensure that previous information is not carried forward.

For specific details about the Interim Tool calculations refer to Chapman (2023). Refer to the associated "Comptroller's Guidance for Decisions on Applications for Water Diversion and Use in the Blueberry, Upper Beaton, and Lower Sikanni Chief Watersheds" document on how to implement the new Interim EFN approach.

7 Items to Consider

- The existing monthly WSA Authorizations summarized in the "Output" worksheet is a summary of authorizations ONLY upstream of the proposed POD. These existing monthly WSA Authorizations values DO NOT consider the existing downstream authorizations. The user should check downstream of the proposed POD to confirm if any "large" authorizations could be impacted if the proposed authorization is issued.
- Real-Time flows at the WSC stations are not available during the winter months. The discharge shown during the winter months is based on regression model output. Water Survey of Canada staff visit each station a couple of times during the winter, so measured discharge measurements may be available. When the WSC stations are operating in real-time, there may be inaccuracies with the data. A Qualified Professional should be consulted if there are questions or concerns with the WSC station data.
- The decision maker may specify that the authorization holder review instantaneous flow information from a specified WSC station or conduct their own flow measurements either at the POD or at the WSC station. Refer to the "Comptroller's Guidance for Decisions on Applications for Water Diversion and Use in the Blueberry, Upper Beaton, and Lower Sikanni Chief Watersheds" document.

- There is very limited streamflow information available for small watersheds (e.g., less than 500 km²). Output from both the NEWT and the Interim Tool should be carefully reviewed and supplemental information or data considered to inform the decision and associated authorization conditions.
- Decision makers may use the information generated by the Interim Tool but may include other values in authorizations. Refer to the "Comptroller's Guidance for Decisions on Applications for Water Diversion and Use in the Blueberry, Upper Beatton, and Lower Sikanni Chief Watersheds" document for details.

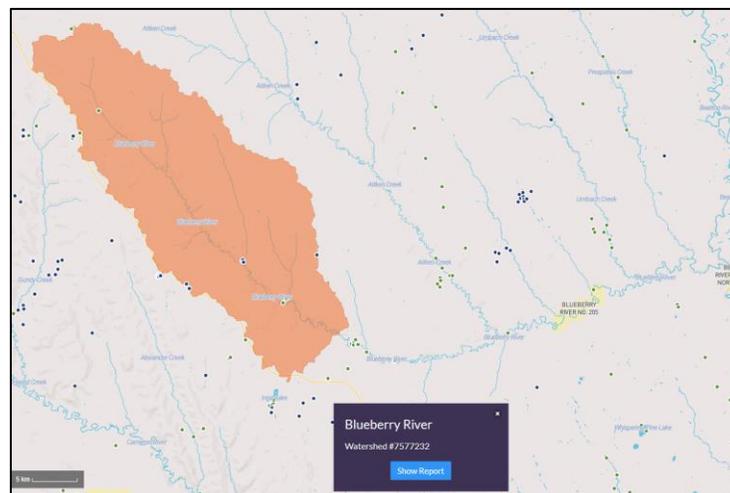
8 Example of How to Use the Interim Tool Output

8.1 Blueberry River upstream

Let's assume that company XYZ submits a Use Approval application on the Blueberry River upstream of the confluence with Aitken Creek. The NEWT Watershed WFI #7577232, coordinates 56.690N, -121.561W, watershed area 568 km² and MAD 1.51 m³/s.

The applicant is requesting 50,000 m³/ year at a rate of 0.05 m³/s.

Steps 1, 2 and 3: Open NEWT and select the proposed POD in the application.



Step 4: Download the NEWT Report.

Step 5: Download the NEWT CSV files.

Step 6: Copy and paste the information from the CSV files into the corresponding Interim Tool "Input" worksheets.

Step 7: In the "Output" worksheet, select the 'Run WSA Authorizations Macro'.

Step 8: Enter the application information in the blue cells of the "Output" worksheet.

Location (USER):	Upper Blueberry	Date:	2023-02-28	Enter WSA Application Amount:	
Location (NEWT):	Blueberry River (Upstream):			m ³ /s, or	0.050
Coordinates:	56.690N, -121.561W	Run WSA Authorizations Macro			
Watershed Area (km ²):	568			m ³ /day, or	
Mean Annual Discharge (MAD) (m ³ /s):	1.51			m ³ /year	
Watershed Size Class:	1	MAD < 2.0 m3/s			m ³ /s, used in further calculations
Maximum Water Allocation (MWA) rates, based on EBF threshold			WSC Reference Gauge:	Default	User Selected
When discharge is > 20% Ecosystem Base Flow (EBF) threshold:			10%	07FC003	
When discharge is > 5% and ≤ 20% Ecosystem Base Flow (EBF) threshold:			0%		
When discharge is ≤ 5% Ecosystem Base Flow (EBF) threshold:			0%	Blueberry River below Aitken Creek	

Enter Application amount

Chose appropriate WSC Reference Gauge from WSC worksheet

Step 9. Review the information in the Maximum Water Diversion columns of the "Output" worksheet. The values in black show the total water available for allocation, including the existing authorizations and the proposed application when streamflow is at various frequencies and instantaneous withdraw rates. Water is not available for the proposed application in the months and at the streamflow frequencies shown in red. Decision Maker's may want to consider the MWA's generated by the Interim Tool but allocate less water.

Month	Maximum Water Diversion (m ³ /sec, m ³ /day), when discharge is:												Ecosystem Base Flow (EBF) (m ³ /s) at Point of Diversion (POD)		Ecosystem Base Flow (EBF) (m ³ /s) at WSC Reference Gauge				
	≤ 50% < 40% Frequency			≤ 40% and > 30% Frequency			≤ 30% and > 20% Frequency			≤ 20% and > 5% Frequency			≤ 5% Frequency		(Percent Exceedance)		(Percent Exceedance)		
	m ³ /day, before application	m ³ /day, with application	m ³ /sec, with application	m ³ /day, before application	m ³ /day, with application	m ³ /sec, with application	m ³ /day, before application	m ³ /day, with application	m ³ /sec, with application	m ³ /day, before application	m ³ /day, with application	m ³ /sec, with application	m ³ /day, before application	m ³ /day, with application	m ³ /sec, with application	20%	5%	20%	5%
Jan	0	-4,963	-0.057	0	-5,004	-0.058	0	-5,043	-0.058	0	0	0.000	0	0	0.000	0.010	0.001	0.031	0.003
Feb	0	-4,988	-0.058	0	-5,016	-0.058	0	-5,057	-0.059	0	0	0.000	0	0	0.000	0.009	0.000	0.028	0.001
Mar	0	-4,927	-0.057	0	-4,963	-0.057	0	-5,001	-0.058	0	0	0.000	0	0	0.000	0.012	0.001	0.036	0.002
Apr	7,462	3,142	0.036	3,042	-1,278	-0.015	890	-3,430	-0.040	0	0	0.000	0	0	0.000	0.095	0.026	0.298	0.082
May	30,945	26,625	0.308	24,777	20,457	0.237	18,968	14,648	0.170	0	0	0.000	0	0	0.000	1.588	0.587	4.960	1.835
Jun	12,053	7,733	0.090	8,983	4,663	0.054	6,715	2,395	0.028	0	0	0.000	0	0	0.000	0.598	0.229	1.868	0.715
Jul	6,936	2,616	0.030	4,613	293	0.003	2,953	-1,367	-0.016	0	0	0.000	0	0	0.000	0.299	0.083	0.933	0.260
Aug	1,208	-3,112	-0.036	489	-3,831	-0.044	27	-4,293	-0.050	0	0	0.000	0	0	0.000	0.068	0.020	0.212	0.062
Sep	791	-3,529	-0.041	201	-4,119	-0.048	0	-4,572	-0.053	0	0	0.000	0	0	0.000	0.046	0.008	0.144	0.026
Oct	533	-3,787	-0.044	289	-4,091	-0.047	54	-4,266	-0.049	0	0	0.000	0	0	0.000	0.078	0.038	0.243	0.118
Nov	0	-4,564	-0.053	0	-4,700	-0.054	0	-4,777	-0.055	0	0	0.000	0	0	0.000	0.035	0.018	0.110	0.057
Dec	0	-4,824	-0.056	0	-4,891	-0.057	0	-4,950	-0.057	0	0	0.000	0	0	0.000	0.017	0.007	0.054	0.022
Annual																			

Total water available for allocation including existing authorizations and proposed application when discharge at the WSC is between the frequency values

Water is not available for the proposed application (0.05 m³/s) in red cells when discharge at POD is between 30-20% (see the EBF Calculation worksheet for discharge values)

Step 10: Review the information in "Diversion Schedule" worksheet and fill in the blue cells. The information is used to support the decision and help inform the conditions within the authorization. Two options are presented below on how consider the "Diversion Schedule" output to draft authorization conditions.

Authorization Draft Conditions Option #1: Attach the "Diversion Schedule worksheet (Similar to what Alberta does):

- If the Rate of Flow is greater than the value in Column [K] (at WSA Station), then the Maximum Diversion Rate is the value specified in Column J on page xx (or an Appendix) of this authorization (or in Appendix xx – Diversion Schedule).
- If Rate of Flow is greater than value in Column [N] (at WSA Station) and less than Rate of Flow value in Column [K] (at WSC station), then the Maximum Diversion Rate is the value specified in Column [M].
- Etc...
- If Rate of Flow is less than the value in Column [T] (at WSC Station), then no diversion of water is permitted from the POD.

The first option has the potential to allocate all remaining water to one user. The DM may want to adjust the Maximum Diversion Rates associated with each Rate of Flow.

Column Discharge Percentile	[H] 60%	[I]	[J]	[K] 50%	[L]	[M]	[N] 40%	[O]	[P]	[Q] 30%	[R]	[S]	[T] 20%	[U]	[V]	[W] 5%
Description	60% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 60% Frequency	m ³ /s	50% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 50% Frequency	m ³ /s	40% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 40% Frequency	m ³ /s	30% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 30% Frequency	m ³ /s	20% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 20% Frequency	m ³ /s	"No Diversion" Cutoff Threshold at Reference Gauge
Month	m ³ /s	m ³ /day	m ³ /s	m ³ /s	m ³ /day	m ³ /s	m ³ /s	m ³ /day	m ³ /s	m ³ /s	m ³ /day	m ³ /s	m ³ /s	m ³ /day	m ³ /s	m ³ /s
Jan	0.103	0	0.000	0.080	0	0.000	0.065	0	0.000	0.051	0	0.000	0.031	0	0.000	0.003
Feb	0.077	0	0.000	0.071	0	0.000	0.061	0	0.000	0.046	0	0.000	0.028	0	0.000	0.001
Mar	0.110	0	0.000	0.093	0	0.000	0.080	0	0.000	0.066	0	0.000	0.036	0	0.000	0.002
Apr	5.054	4,320	0.050	3.010	4,320	0.050	1.412	3,042	0.035	0.634	890	0.010	0.298	0	0.000	0.082
May	15.400	4,320	0.050	11.500	4,320	0.050	9.270	4,320	0.050	7.170	4,320	0.050	4.960	0	0.000	1.835
Jun	6.158	4,320	0.050	4.670	4,320	0.050	3.560	4,320	0.050	2.740	4,320	0.050	1.868	0	0.000	0.715
Jul	3.728	4,320	0.050	2.820	4,320	0.050	1.980	4,320	0.050	1.380	2,953	0.034	0.933	0	0.000	0.260
Aug	1.120	2,234	0.026	0.749	1,208	0.014	0.489	489	0.006	0.322	27	0.000	0.212	0	0.000	0.062
Sep	0.935	1,722	0.020	0.599	791	0.009	0.385	201	0.002	0.221	0	0.000	0.144	0	0.000	0.026
Oct	0.623	859	0.010	0.505	533	0.006	0.417	289	0.003	0.332	54	0.001	0.243	0	0.000	0.118
Nov	0.275	0	0.000	0.224	0	0.000	0.175	0	0.000	0.147	0	0.000	0.110	0	0.000	0.057
Dec	0.148	0	0.000	0.130	0	0.000	0.106	0	0.000	0.085	0	0.000	0.054	0	0.000	0.022

Authorization Draft Condition Option #2:

- Water can only be withdrawn from the POD during the months of April to July at the maximum diversion rate of 0.05 m³/s (4,320 m³/day) when flows at the WSC station are equal to or greater than:
 - April = 1.412 m³/s
 - May = 4.960 m³/s
 - June = 1.868 m³/s
 - July = 1.380 m³/s

Column Discharge Percentile	[H] 60%	[I]	[J]	[K] 50%	[L]	[M]	[N] 40%	[O]	[P]	[Q] 30%	[R]	[S]	[T] 20%	[U]	[V]	[W] 5%
Description	60% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 60% Frequency	m ³ /s	50% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 50% Frequency	m ³ /s	40% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 40% Frequency	m ³ /s	30% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 30% Frequency	m ³ /s	20% Frequency Cutback Threshold at Reference Gauge	Diversion Limit at POD when Discharge at Reference Gauge is ≤ 20% Frequency	m ³ /s	"No Diversion" Cutoff Threshold at Reference Gauge
Month	m ³ /s	m ³ /day	m ³ /s	m ³ /s	m ³ /day	m ³ /s	m ³ /s	m ³ /day	m ³ /s	m ³ /s	m ³ /day	m ³ /s	m ³ /s	m ³ /day	m ³ /s	m ³ /s
Jan	0.103	0	0.000	0.080	0	0.000	0.065	0	0.000	0.051	0	0.000	0.031	0	0.000	0.003
Feb	0.077	0	0.000	0.071	0	0.000	0.061	0	0.000	0.046	0	0.000	0.028	0	0.000	0.001
Mar	0.110	0	0.000	0.093	0	0.000	0.080	0	0.000	0.066	0	0.000	0.036	0	0.000	0.002
Apr	5.054	4,320	0.050	3.010	4,320	0.050	1.412	3,042	0.035	0.634	890	0.010	0.298	0	0.000	0.082
May	15.400	4,320	0.050	11.500	4,320	0.050	9.270	4,320	0.050	7.170	4,320	0.050	4.960	0	0.000	1.835
Jun	6.158	4,320	0.050	4.670	4,320	0.050	3.560	4,320	0.050	2.740	4,320	0.050	1.868	0	0.000	0.715
Jul	3.728	4,320	0.050	2.820	4,320	0.050	1.980	4,320	0.050	1.380	2,953	0.034	0.933	0	0.000	0.260
Aug	1.120	2,234	0.026	0.749	1,208	0.014	0.489	489	0.006	0.322	27	0.000	0.212	0	0.000	0.062
Sep	0.935	1,722	0.020	0.599	791	0.009	0.385	201	0.002	0.221	0	0.000	0.144	0	0.000	0.026
Oct	0.623	859	0.010	0.505	533	0.006	0.417	289	0.003	0.332	54	0.001	0.243	0	0.000	0.118
Nov	0.275	0	0.000	0.224	0	0.000	0.175	0	0.000	0.147	0	0.000	0.110	0	0.000	0.057
Dec	0.148	0	0.000	0.130	0	0.000	0.106	0	0.000	0.085	0	0.000	0.054	0	0.000	0.022

Prepared by: Suzan Lapp, PhD, PGeo

9 References

Alberta, 2019. Alberta Environment and Parks, Government of Alberta. Surface Water Allocation Directive. February 2019.

Chapman, 2023. North-East (BFRN-BC) Environmental Flow Needs (EFN) Tool (Interim). March 2023.