Volume 1, Section 7 Snake Lake Reservoir Expansion Project
Project Description
Water Management

Submitted to:

a division of Englobe

MPE
a division of Englobe
Lethbridge, Alberta

On behalf of:

Eastern Irrigation District

Eastern Irrigation District
Brooks, Alberta

Submitted by:

AAR Environmental Services®

AAR Environmental Services
Calgary, Alberta

March 28, 2025

AARES Project #: 21-127

Executive Summary

The Eastern Irrigation District (EID) is applying for approval under the *Environmental Protection and Enhancement Act* (EPEA; Government of Albert [GOA], 2000) to construct the proposed Snake Lake Reservoir (SLR) Expansion Project (the Project). The Project, located between Bassano and Brooks in Alberta, involves the construction of a roughly 8 km long, up to 20 m high dam to increase the storage capacity of the reservoir system from 19.25 million m^3 to 87.4 million m^3. This document provides a description of the water management plans for the Project, which meets the requirements outlined in the Final Terms of Reference (FTOR; Volume 2, Appendix A).

All water in the EID is used and managed per the EID's Water Licence with Alberta Environment and Protected Areas (Alberta EPA), which includes managing water diversions from the Bow River. The water licence requirements ensures that minimum instream objectives (IO) downstream of Bassano Dam are maintained, and that there is sufficient flow in the Bow River to continue to Saskatchewan (50%). There will be no new effects to the Bow River downstream of the Project, therefore the existing water licence does not need to be revised or renewed. Water diversion from the Bow River will continue to be managed to ensure the EID allocation needs are achieved while also meeting provincial and interprovincial flow needs.

During a drought that occurred in 2023, water levels remained low and diversion rates essentially matched the maximum upstream flow, while ensuring the minimum downstream flow was achieved. This required some water rationing through the growing season. Landowners in the EID employed multiple farming strategies to manage the impacts of this drought including leaving fields fallow, planting lower demand crops, etc.; however, farming was still negatively impacted. The proposed expansion would help alleviate these effects for lands downstream of SLR and the rest of the EID. The proposed SLR expansion, as designed, would store 87.4 million m^3 of water, and would be able to meet most downstream water needs for a full year with minimal diversion of additional water from the Bow River.

Average precipitation data over 72 years was analyzed, and findings suggest droughts may be becoming more prevalent with time. Water use by the EID varies annually, between about 250 million m^3 and 700 million m^3, averaging about 500 million m^3 over 10 years. Additional water requirements for the Project during construction and operation include process water, potable water for workers, non-potable water for road watering and material conditioning, etc., and water supply to fill the expanded reservoir. The required water use for the Project once filled and operating was estimated to be an average of 64 million m^3/y.

There are various surface water management and environmental considerations for the SLR expansion during construction and operation of the completed reservoir. EID will follow the various strategies outlined in this document to manage surface water during various stages of the Project. For example, an Erosion and Sediment Control (ESC) plan will be developed for the Project site and will be implemented during all stages of construction. Ephemeral drainages and wetlands will be removed in the Project footprint. As per the Alberta Wetland Policy, these impacts can be offset by paying an in-lieu fee for wetland loss to be used for new wetland construction elsewhere in the province or wetland losses can also be offset by development of replacement wetland areas in the reservoir.

Table of Contents

7.1 WATER SUPPLY....1
7.1.1 EID's Water Licence and Allocation 1
7.1.2 Bow River Flow Below Bassano Dam 1
7.1.3 Water Quality Effects on Red Deer River from Return Flow 2
7.1.4 Water Management During Drought 3
7.1.5 Project Need 4
7.2 EID ANNUAL WATER USE....6
7.2.1 Precipitation Analysis 6
7.2.2 Water Supply: Construction, Operation, and Decommissioning 11
7.3 SURFACE WATER....12
7.3.1 Surface Water Management Strategy 12
7.3.2 Alterations or Realignments of Waterbodies 14
7.3.3 Pre- and Post-Disturbance Drainages, Wetlands, and Waterbodies 15
7.3.4 Describe and Map Crossings of Drainages, Wetlands, and Waterbodies 15
7.3.5 Agricultural Water Needs Downstream of the Project in Normal and Severe Drought 15
7.3.6 Project Effects on the Bow River in Normal and Drought Conditions 15
7.3.7 Project Effects on Bow River Water Quality Downstream of Bassano Dam 16
7.4 REFERENCES....17

Figures

Figure 7-1: Total EID Water Withdrawal at Bassano Dam (2004-2023) 1
Figure 7-2: Bow River and EID Discharge at Bassano Dam (Mean 2010 to 2023).... 3
Figure 7-3: Bow River and EID Discharge at Bassano Dam (2023).... 4
Figure 7-4: Mean Water Use for the EID.... 6
Figure 7-5: Annual Precipitation (1950 to 2023) for the City of Brooks, AB 7
Figure 7-6 Predicted Snake Lake Water Use for Average, Wet, and Dry Years 8
Figure 7-7: Water Withdrawal at Bassano Dam in Wet, Dry and Average Years (2010-2023).... 9

Tables

Table 7-1: Seasonal Water Withdrawal at Bassano Dam for EID and the Project 9

Attachments

Figure 7A-1: Surface Water Interactions – Project + 100m Buffer.... 1

Abbreviations

Alberta EPA	Alberta Environment and Protected Areas
DUC	Ducks Unlimited Canada
EIA	Environmental Impact Assessment
EID	Eastern Irrigation District
ESC	Erosion Sedimentation Control
GOA	Government of Alberta
IO	Instream objective
SHC	Spring Hill Canal
SLR	Snake Lake Reservoir
Stdev	Standard deviation
TDS	Total dissolved solids
TSS	Total suspended solids

7.1 WATER SUPPLY

The water source for the Eastern Irrigation District (EID), including the Snake Lake Reservoir (SLR) Project is the Bow River, upstream of the EID at the Bassano Dam. This water flows throughout the EID to all irrigable lands through a network of canals, pipelines, and off stream reservoirs (see Volume 1, Section 2, Attachment 2, Figure 2A-1).

7.1.1 EID's Water Licence and Allocation

The EID has an allocation of 938 million m^3/y as per their Alberta *Water Act* Licence (No. 00071066-00-00). Water volumes diverted over the last 20 years have averaged around 500 million m^3 (Figure 7-1), substantially lower than the licenced volume. In the last 20 years, this volume has varied from 260 to 690 million m^3/y. The reservoir will require 94 million m^3 to fill. Even in drought years there is sufficient volume of allocation remaining to fill the reservoir, which amounts to <10% of the licenced volume. However, if water supply in the Bow River is low, due to drought, the reservoir will be filled slowly to ensure minimum river flows are always maintained.

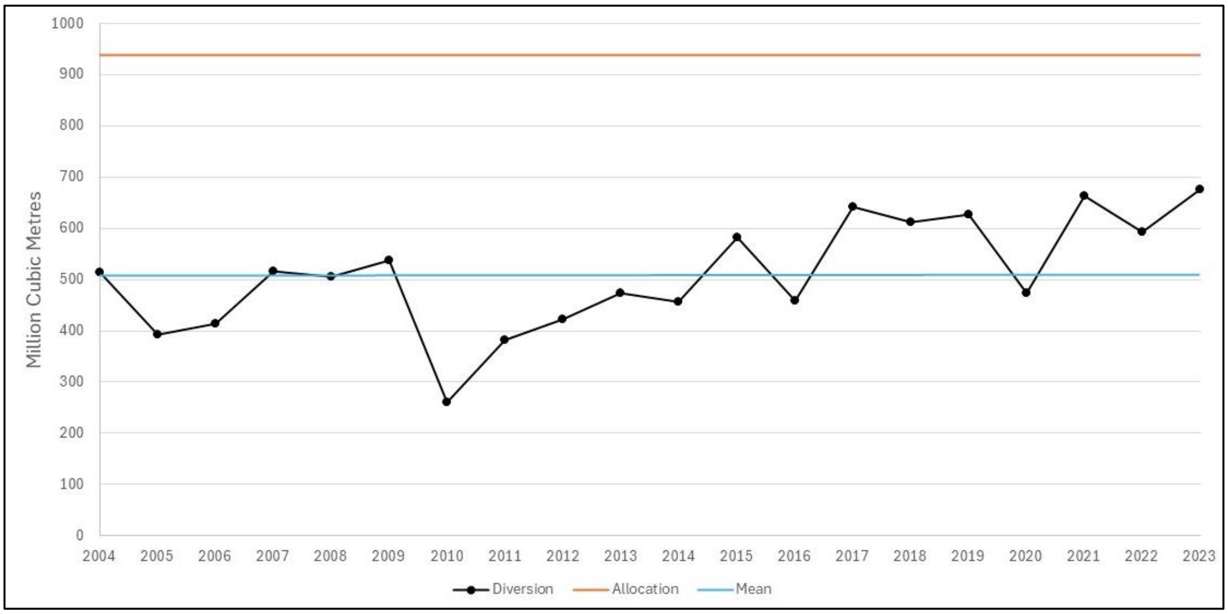


Figure 7-1: Total EID Water Withdrawal at Bassano Dam (2004-2023)

7.1.2 Bow River Flow Below Bassano Dam

The Project will not directly interact with the Bow River upstream or downstream of the Project as no new water allocation is needed support the reservoir expansion. The EID already interacts with the Bow River at the diversion site, and unused water in the irrigation system is returned into existing outfalls on the Bow River and Red Deer River; however, water flowing through and downstream of SLR only returns to the Red Deer River. All water in the EID is used and managed per the EID's Water Licence with Alberta Environment and Protected Areas (Alberta EPA).

Water diversion from the Bow River is managed by the province of Alberta and the EID, to ensure the EID allocation needs are achieved while also meeting provincial and interprovincial flow needs as per provincial and EID Water Licence requirements. These requirements ensure the EID maintains:

- Minimum instream objective (IO) for flow downstream of Bassano Dam of 11.3 m^3/s; and
- In cooperation with the Alberta Government and other downstream users on the Bow/Oldman/Red Deer/South Saskatchewan Drainage, sufficient flow to ensure 50% of total water in Alberta continues into Saskatchewan.

As there is an existing licence for water use that is not being revised or renewed for this Project, there will not be any new effects downstream of the Project on the Bow River.

7.1.3 Water Quality Effects on Red Deer River from Return Flow

Return flow of irrigation water downstream of SLR runs into the Red Deer River. Some of this return flow is field run-off that returns to the canal system after interacting with agricultural lands. Alberta EPA is concerned that return flow waters could increase in volume due to more area being irrigated, increasing the water quality as a result, or will decrease in quality due to increased interaction with irrigated land area, resulting in impacts on the Red Deer River. However, the Project is only changing the amount of water stored before being used for irrigation, not the irrigated area downstream of SLR or the rate of irrigation use per acre, and thus the Project will not result in changes to water return flow quantity or quality.

Alberta EPA is also concerned that if diversion occurs when water is more turbid or contaminated during flood conditions, and if this water eventually flows back into the Red Deer River, it may continue to have poor quality that could affect the river. However, this is unlikely to occur as (1) water stored in off-stream reservoirs will precipitate much of the suspended sediments, (2) water quality monitoring from sites throughout the EID (see Volume 2, Section 7, Appendix E) show that suspended sediments generally remain low, and when these values are higher they flush directly through the canal system, returning in a few days when the river water is still turbid from the freshet or flooding, and (3) when water returns to the river, it will have a reduced effect on river water quality as the small return flows are diluted in the much higher river flows downstream of the EID. Additionally, the EID can reduce or stop water extractions during highly turbid flood conditions to reduce the flow of turbid water through the canal system. This is in the EID's interest to do so, as irrigation water quality guidelines need to be met, and suspended solids can damage pumps.

7.1.4 Water Management During Drought

The average river flow at Bassano Dam includes a spring freshet lasting from mid-May to end of July (Figure 7-2). Water levels run high, up to 250 m^3/s in the peak of the freshet, while water withdrawal at Bassano dam remains much lower at 20 to 50 m^3/s during the freshet, leaving high water levels in the river below Bassano Dam for most of the spring and summer. By early September, total water withdrawn drops to around 12 m^3/s as the main water needs by this date is for watering harvested fields and haylands in preparation for the following year (to increase groundwater levels) and topping up reservoirs. The water flow in the river typically stays between 50 and 75 m^3/s throughout fall.

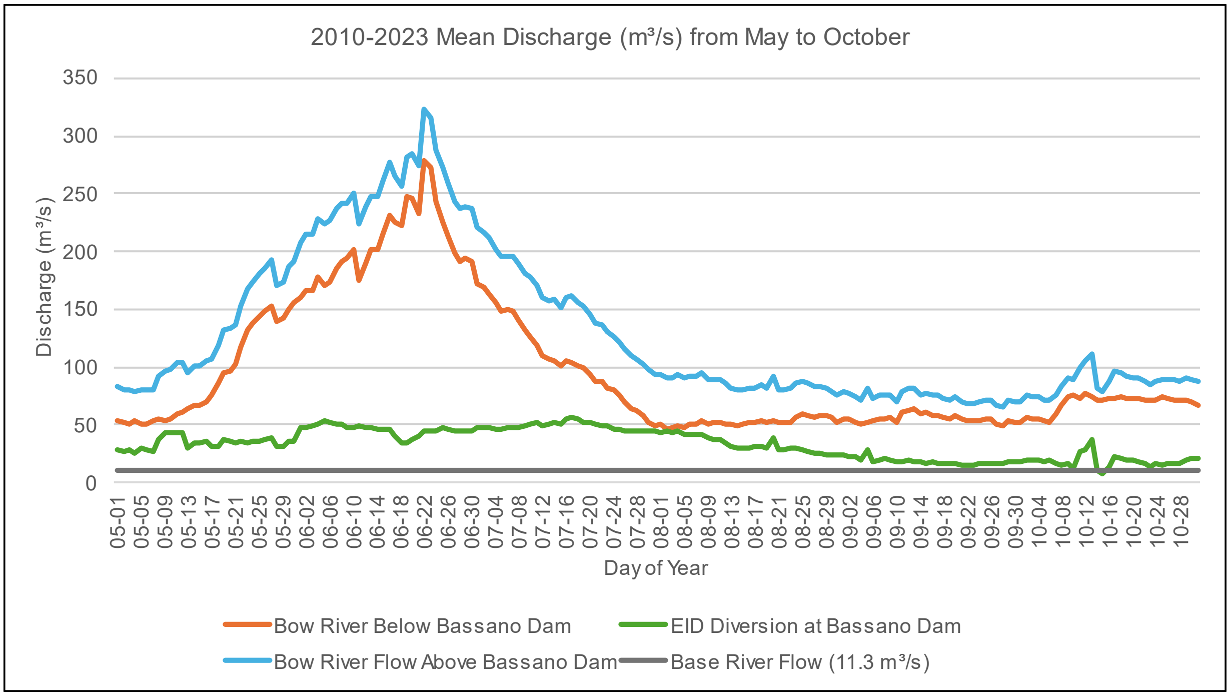


Figure 7-2: Bow River and EID Discharge at Bassano Dam (Mean 2010 to 2023)

During the 2023 drought, the spring freshet occurred earlier, peaking in mid to late May, dropping to low flows below between 50 and 100 m^3/s through most of June, then to <50 m^3/s in July and staying low to the end of October. During the entire year, water levels remained low and diversion rates essentially matched the maximum upstream flow, while ensuring the minimum downstream flow was achieved (Figure 7-3, below). River flow was so low in the mid to late summer period that the reservoirs needed to be drawn down several metres to provide the required water for irrigation. There were two periods in October when water flows into the EID's main canal had to be nearly shut down to maintain the IO, as the flow in the river dropped; however, enough flow was available to provide water to fill most of the off-stream reservoirs to winter storage levels in this period.

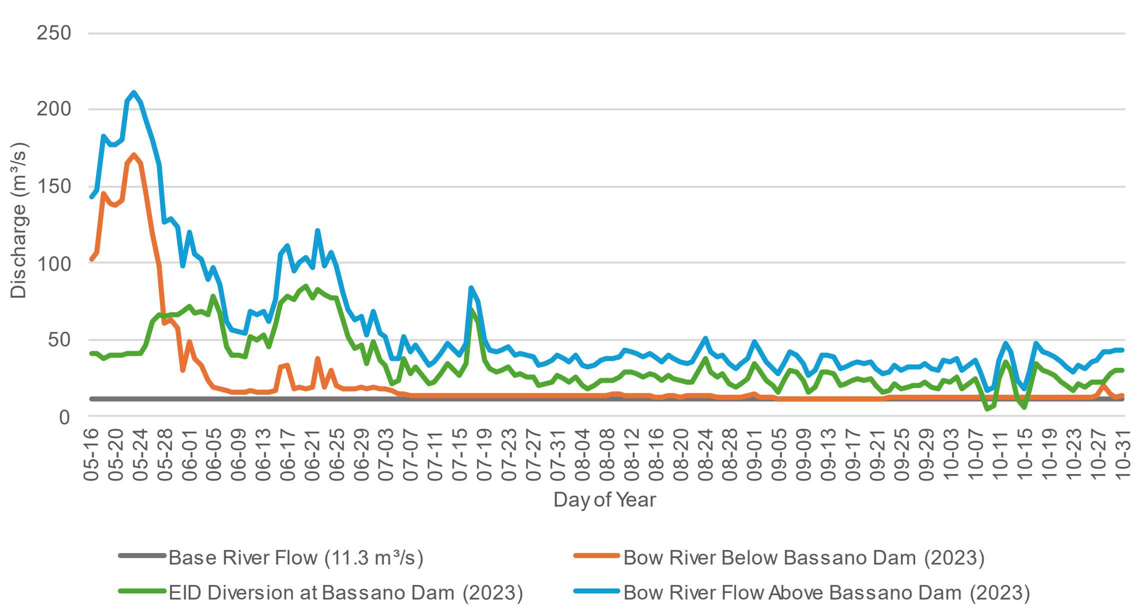


Figure 7-3: Bow River and EID Discharge at Bassano Dam (2023)

Additional tactics employed by the producers within the EID in 2023 included planting lower water demand crops, leaving some fields as summer fallow, cutting some crops early for feed or silage, and transferring water to those crops that need the irrigation most rather than watering all fields equally. In addition, it was observed that due to higher mean temperatures, crops both grew quicker and were harvested earlier than normal, reducing the need for fall irrigation.

7.1.5 Project Need

While the above information from 2023 showed the EID can manage areas dependent on direct-from-river water, the drought still had an impact on farming as crops were cut early and/or had reduced yield. The proposed expansion would alleviate these effects during future droughts for lands downstream of SLR with indirect benefits for the rest of the EID.

The extant SLR holds 19.25 million m^3 when full and can supply less than 20% of the needed water for the 20,000 ha of irrigated land downstream of this reservoir. If a drought were to occur for an extended time, about 16.2 million m^3 could be released from the reservoir (assuming holdback and losses by evaporation of 2.4 million m^3). The average irrigation requirement per year downstream of SLR is 16 inches (41 cm) per unit area (acre or ha), over a 4-month growing season (May to August). The 16.2 million m^3 of water would only supply 8 cm (about 3 inches) per unit area, or about 1/5 of the needed water, and at an extraction rate of 6.25 m^3/s, or 540,000 m^3/day, this would only supply water for 30 days, with none left for the remainder of the year. Thus, the lands below the extant SLR rely on direct-from-river water for most of their irrigation water and would only receive water from the reservoir during short-term droughts.

To supply the needed water (41 cm) over an entire summer season, the current reservoir would need to be able to supply about 5 times the water stored (i.e., about 90 million m^3, allowing a total of 83 million m^3 of water to be sent downstream over a full growing season (accounting for hold back and various water losses). The proposed SLR expansion, as designed, would store 87.4

million m^3 of water, and would be able to deliver 72.6 million m^3 of water over a full year without diversion of additional water from the Bow River, supplying 14.1 inches (35.8 cm) of water per unit area. With a minimal amount of direct-from-river water this would allow the 20,000 ha of downstream land to be irrigated for the entire year. There will also be indirect benefits on the rest of the EID. By using water in off stream reservoirs during droughts, other areas of the EID can make use of the direct-from-river water that is still available.

7.1.5.1 Upstream and Downstream Demands

The Bow River is important as a source of water for much of the population of southern Alberta. Conservation objectives in severe drought situations (when water needs to be rationed) aim to preferentially preserve water uses for all upstream and downstream users with priority water use set for household uses, then livestock, then industries, and finally agricultural needs.

A review of users on the Bow River showed that the river supports several urban municipalities, including the City of Calgary, 12 rural or regional municipalities, and three First Nations, making it the most populous river basin in Alberta. The Bow River and its tributaries provide water for drinking, irrigation, livestock, waste assimilation, electricity generation, and wildlife, as well as for recreational activities such as fishing, rafting, kayaking, and canoeing (Bow River Basin Council, 2010). Most of the allocation is divided among three irrigation districts (Bow River Irrigation District, Western Irrigation District, and the EID) which collectively have 1.1 billion m^3 of storage capacity.

The main users of Bow River water upstream of Bassano Dam are City of Calgary, including other municipalities on the City of Calgary Water System (i.e., Strathmore, Airdrie, etc.), Western Irrigation District (covering farms near Strathmore, Gleichen, Irricana, and Rockyford), Bow River Irrigation District (covering farms near Lomond, Enchant, Vauxhall) and the Siksika First Nation Irrigation System. Smaller centres such as Kananaskis Village, Bragg Creek, Waiparous, Ghost Village, Banff, Canmore, Okotoks, High River, Diamond Valley, Cluny, and Gleichen, etc., make use of water extracted from the Bow River or its many tributaries or sub-tributaries. Upstream water may also be extracted from the canals for municipal water systems of the above listed irrigation districts or municipalities, or directly from the Bow River or its tributaries or sub-tributaries or licences for industries and agri-food businesses such as feedlots.

Downstream users of the water extracted at Bassano Dam include City of Brooks and several smaller towns and villages (i.e., Bassano, Countess, Lathom, Rosemary, Matzhiwin, Duchess, Cassels, Millicent, Bantry, Patricia, Tilley, Rolling Hills, Scandia, and Ranier) within County of Newell and the EID, which mostly overlap in area. Water is also used by farms and rural households connected to pipelines, and by EID irrigators, industries, agribusinesses, confined feeding operations, and Ducks Unlimited Canada (DUC).

Bow River water users downstream of Bassano Dam water include municipalities of Bow Island, Redcliff, Medicine Hat, and users in Saskatchewan. Besides municipal users, there are also irrigators, farms and rural properties, industries and agri-food businesses such as feedlots. The needed water for these communities and users is under current licences.

In event of a drought, Alberta's Drought Response Plan (GOA, 2024) includes provisions agreed upon by the EID and other users that priority for water is to supply municipal needs, followed by livestock needs, and then other agricultural and industrial needs.

Priorities depend on who has existing water allocations (Bow River Basin Council, 2015), However, the Bow River Basin is a closed basin, which means no new allocations can be issued. In event of a drought, however, water can be shared from one allocation to another and can be formalized through issuance of temporary diversion licences.

7.2 EID ANNUAL WATER USE

Water use by the EID averages about 500 million m^3 over 10 years (Figure 7-4), with more water extracted in hot, dry years and less extraction in cool, wet years. Mean water use in the EID by user type, including losses and return flows, is shown in Figure 7-4.

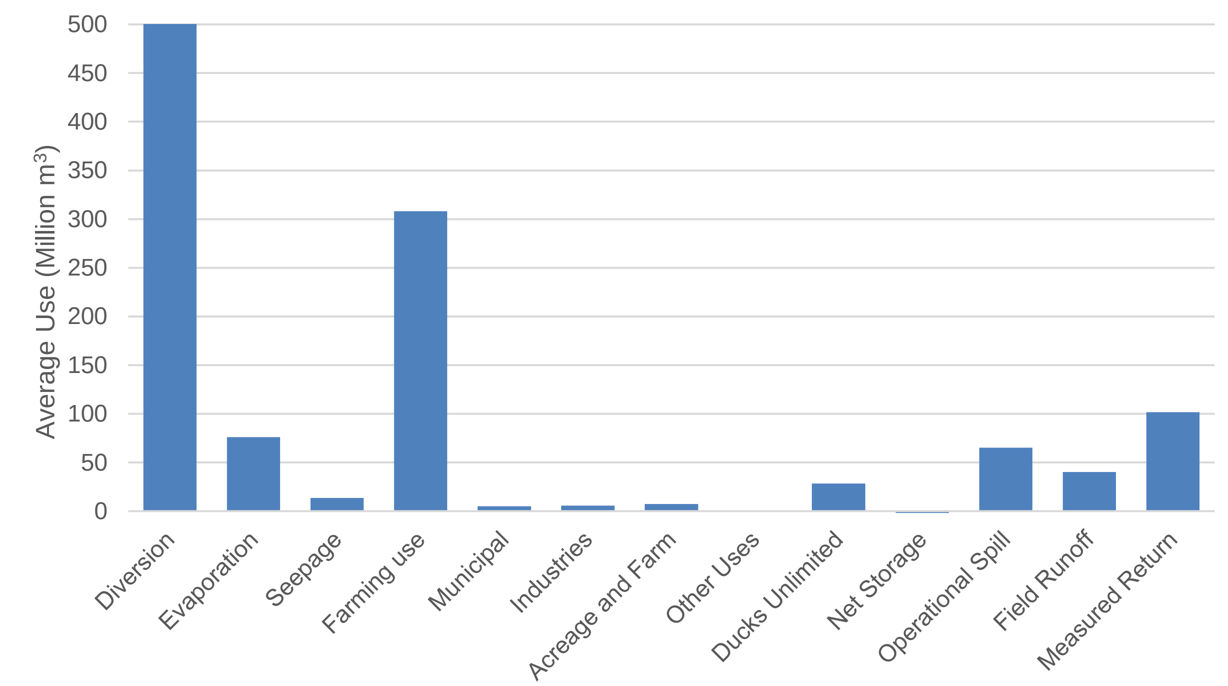
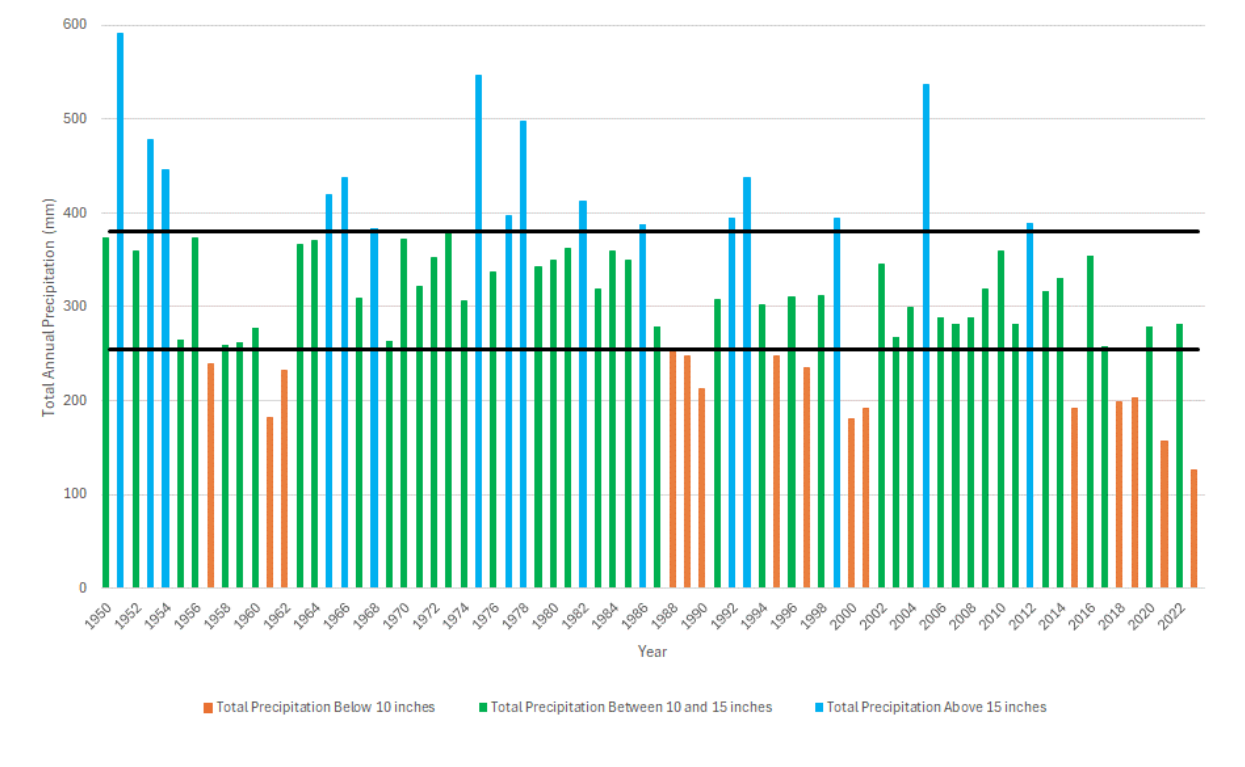


Figure 7-4: Mean water use for the EID

7.2.1 Precipitation Analysis

Analytical figures are provided comparing cool/wet, average, and hot/dry (i.e., possible drought) years. Public weather records from Brooks, Alberta (GOA, 2020) were compiled to determine the average precipitation (rainfall equivalent) over 72 years of records (Figure 7-5). Brooks occurs centrally in the EID and provides a reasonable location to assess wet and dry years for the EID. The mean total precipitation per year was compared to determine average years (years within 1 standard deviation of the mean [stdev]), wet years (years above 1 stdev, and dry years (years below 1 stdev).

As shown in Figure 7-5, hot, dry (potential drought) years occurred when annual precipitation was less than 250 mm (about 10 in) of total annual precipitation and wet years occurred when there was over 380 mm (about 15 in). Based on this definition, the first 36 years (1950 to 1986) had 3 years of drought, and the second 36 years (1987 to 2023) had 15 years of drought. In addition, 5 of the last 10 years, to the end of 2023, have been potential droughts. This evidence suggests that droughts may be becoming more prevalent with time. Of note, 2023 had the lowest recorded precipitation on record with 130 mm (5 inches), versus an average of 320 mm (about 12.5 in) among the 72 years on record.



Data compiled from various weather stations at or near Brooks, Alberta Showing Potential Drought Line (<10 inches/250 mm) and wet years (>15 inches/380 mm).
Source: (GOA, 2020).

Figure 7-5: Annual Precipitation (1950 to 2023) for the City of Brooks, Alberta

7.2.1.1 Annual Water Requirements

In the initial year of filling a total of 94.4 million m^3 will be required. This is based on the need for 87.4 million m^3, the operational volume of the reservoir at full supply level (782.0 m asl), plus the addition of around 7 million m^3 to fill excavated borrow pits within the reservoir footprint. This additional water will occur in excavations lower than the outlet level and will never be drawn out, therefore this is not considered in the operation supply level. Once filled, the Project will require between 0 and 155 million m^3 of water per year depending on the drawdown state at the start of the year. The upper end is based on needing to fill a fully drawn-down reservoir with 72.6 million m^3 of water, plus supplying 82 million m^3 to achieve 16 inches (41 cm) of water per unit area downstream. In wet years, all reservoir water could be bypassed directly through Springhill Canal resulting in no water needs for the Project (0 m^3), but in practice, much of the water will likely still flow through the reservoir, even in wet years. In most years, however, the reservoir is expected to be near full in the spring, reducing the total needed water for the SLR to the through-flow total (the amount immediately being shunted through for downstream irrigation). The mean annual use is calculated to be about 64 million m^3/year. This estimate was based on an assumption that about 2/3 of water needed below SLR will be shunted through the SLR first and the other 1/3 is direct from river through Springhill Canal. Based on similar assumptions, the expected total flow in wet and dry years was calculated as shown in Figure 7-6.

Water withdrawals at Bassano Dam from 2010 to 2023 were also analyzed to compare water use for the EID among wet, dry and average years).

7.2.1.2 Water Requirements in Wet, Average and Dry Years

From 2010 to 2023 (the years where river discharge data were available) the following years were:

- Wet - 2012,
- Dry - 2015, 2018, 2019, 2021, 2023
- Average - 2010, 2011, 2013, 2014, 2016, 2017, 2020, 2022.

The water requirements will also vary among wet and dry years as less water is needed to irrigate crops in wet years with higher rainfall, and more water is needed in dry years. In dry years the water use of SLR is predicted to be 84 million m^3, while in wet years it is predicted to be 54 million m^3.

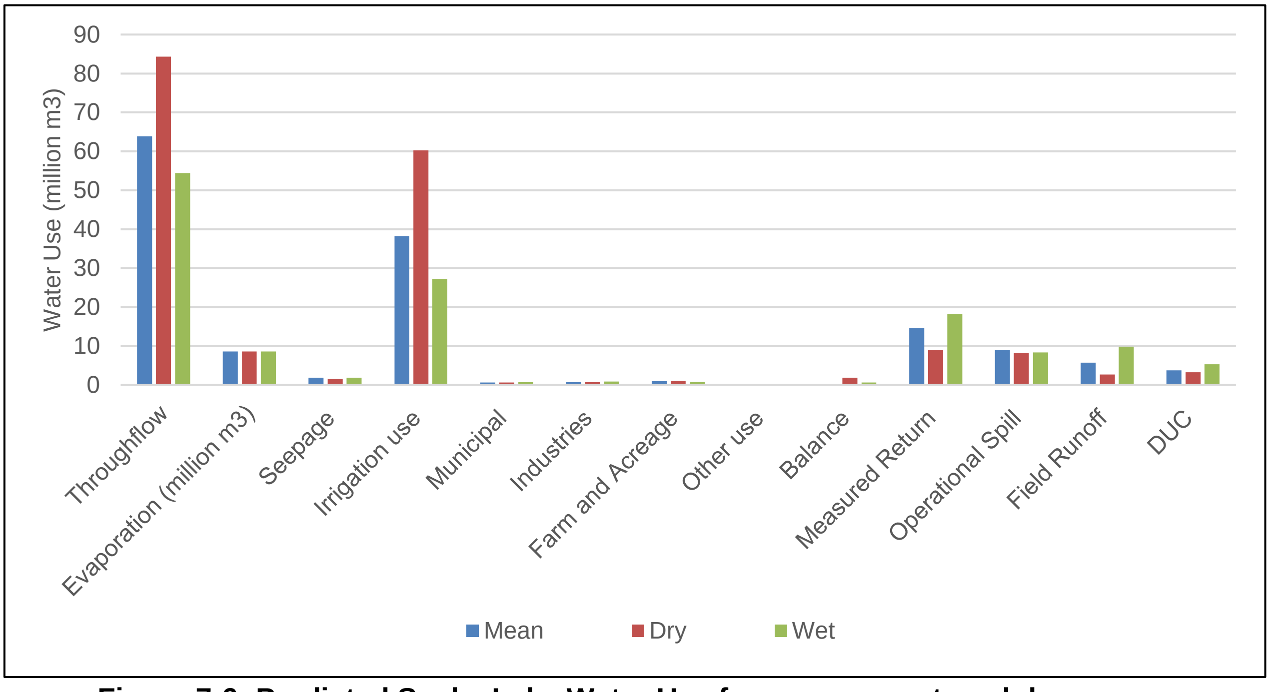


Figure 7-6: Predicted Snake Lake Water Use for average, wet, and dry years

Water withdrawals in wet, average, and dry years based on records at Bassano Dam were assessed for the EID among years (Figure 7-7). This showed that:

- In wet years water use is reduced in early spring to early summer but peaks at various times of the year. However, as there was only one wet year in the analyzed period, water withdraws are highly variable and this analysis should be used with caution regarding season trends.
- In average years, water withdrawal varied between 15 and 35 m^3/day until mid-summer, then increased to between 35 and 50 m^3/s through July and August, then decreased again to between 15 to 35 m^3/s in the fall.
- In dry years the water withdrawals ranged from 20 to 40 m^3/s in early spring, and then from mid-May to mid-August were much higher, from 40 to 73 m^3/s. Water use dropped

off in late summer to fall, between 10 and 20 m^3/s, possibly reflecting lower demand as crops were harvested earlier in those years.

- As could be expected, in the wet years, withdrawals were lowest (438.8 million m^3), in average years they were moderate but close to wet years (447.5 million m^3), and in dry years use was much higher (598.0 million m^3).

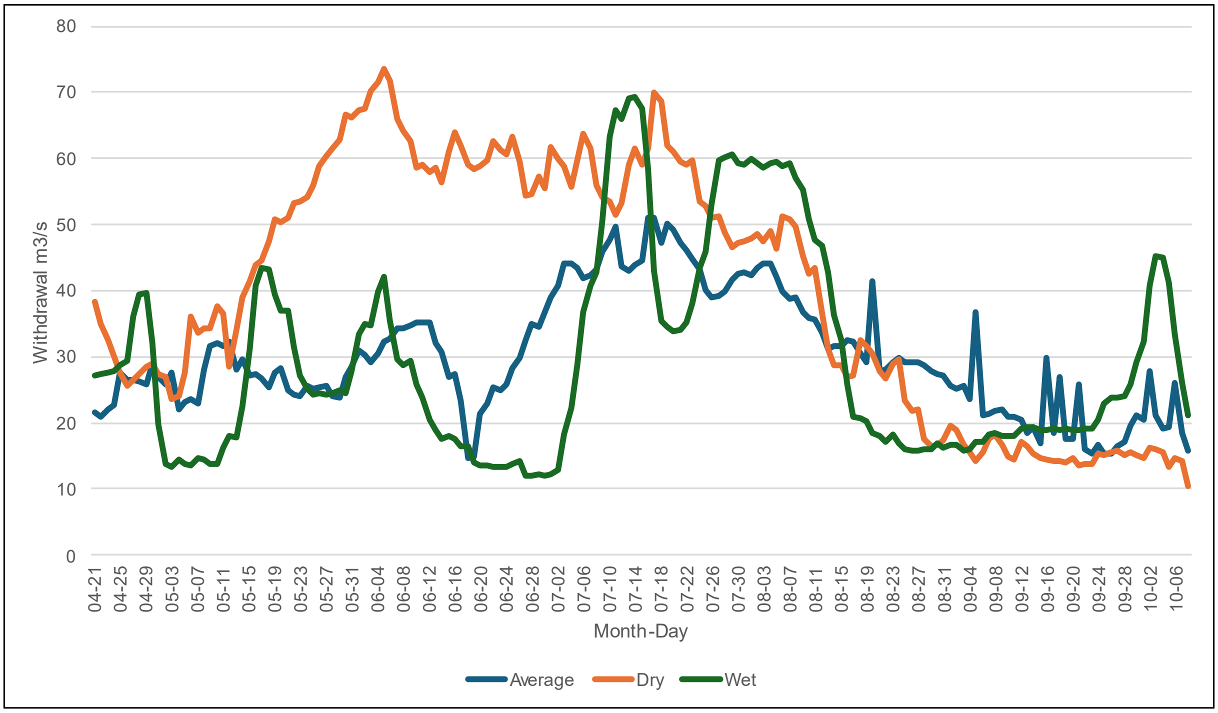


Figure 7-7: Water Withdrawal at Bassano Dam in Wet, Dry and Average Years (2010-2023)

7.2.1.3 Seasonal Water Use

Mean EID withdrawal at Bassano Dam typically occurs for 51 days in spring (May 1 to June 20), 92 days in summer (June 21 to September 20) and 41 days in fall (September 21 to October 31), although in some years withdrawals start sooner or end later (Table 7-1). This data shows that for the EID seasonal water use is typically highest in summer (55.4% of total), followed by spring (32.5%) with only 12.1% of use in fall. The water use for the EID as a whole and predicted for the Project are shown in Table 7-1. Note that this data was based on 14 years of data, so the total water use per year differs somewhat from totals summarized previously. The water use for the Project was determined as 16.8% of the EID use, based on the ratio between mean SLR use for dry years (Figure 7-6) and measured EID use (Figure 7-4).

Table 7-1: Seasonal water use for EID and the Project

Season	Dates	Days	Volume Used (million m^3)		
			EID	Project (Most Years)	%
Summer	June 21 to September 20	92	171.8	28.9	32.5
Fall	September 21 to October 31	41	292.6	49.2	55.4
Spring	May 1 to June 20	51	64.1	10.8	12.1
	Total	184	528.5	88.8	100

7.2.1.4 Expected Water Balance

The water balance for the reservoir is the difference between water inputs and outputs and can be a surplus or a loss. The annual water balance for the Project is expected to average 0.0 m^3/y, as the same amount of water will flow into the SLR as exits. However, in the first year of operations, 94.4 million m^3 will be needed to fill the reservoir; thus, the balance would be +94.4 million m^3/y. During operations if the reservoir was drawn down at the start of the year and ended up filled to FSL there will be a positive water balance. Conversely, if the reservoir was full in spring and was drawn down by year end, there will be a negative water balance. See Figure 7-6 (above) for a balance in terms of the different outputs or losses of water for the reservoir among wet, dry, and average years.

7.2.1.5 Water Lost from Canals and Reservoirs

For the EID, based on volumes published in their annual reports, from 2004 to 2023, total water loss averages 89.7 million m^3, or 17.6% of total diversion. Of the total loss 84.8% is from evaporation, while 15.2 % has been due to seepage. The EID data shows that seepage has been decreasing from 22.2 million m^3 in 2004 to 10.7 million m^3 in 2023. Evaporation has generally been increasing, from about 65 million m^3 (mean value for 2004 to 2008) to 90 million m^3 (value from 2019 to 2023). Total evaporation varies with mean temperature, rainfall, and surface area of irrigation works, which increases as new reservoirs come online and decreases as canals are converted to pipelines. The predicted water loss for the Project is 10.5 million m^3 for an average year, with 82% due to evaporation and 18% due to seepage.

7.2.1.6 Volume and Quality of Return Flows

For the EID, based on volumes published in their annual reports, from 2004 to 2023, the total return flow averages 101.6 million m^3, or 19.9% of total diversion. Of the return flow 39.5% is from field run-off, while 60.5% is the operational spill (water that flows from inlet through to the outlet without being used). EID data shows field run-off has been decreasing from an average of 57.5 million m^3 (mean of 2004 to 2008) to 24.1 million m^3 (2019 to 2023). Operation spill has not generally been changing over time; 57.5 million m^3 (2004 to 2008) compared to 61.8 million m^3 (2019 to 2023). Field run-off improvements likely relate to more efficient use of water on farm (i.e., irrigating closer to the field capacity, and conversion of small canals to closed pipeline systems).

Water quality of return flows is tracked by monitoring stations throughout the EID (Alberta Irrigation Districts Association, 2024). Return flow sites downstream of SLR occasionally have exceedances of total suspended solids (TSS), sulphate, total dissolved solids (TDS), total phosphorus, manganese, cadmium, and various herbicides and pesticides, but generally the return flow water remains high in quality. However, there are often exceedances of E. coli, which makes the water less fit for irrigation or recreational use just prior to return. But these water quality changes between the reservoir and the return site are already occurring at baseline and are unlikely to change as there is no expected change in the amount of field run-off. Thus, water quality of return flow sites is not expected to change after development of the Project.

7.2.1.7 Water Uses other than Irrigation

For the EID, based on volumes published in their annual reports, from 2004 to 2023, the total for “other” uses averages 44.2 million m^3, or 8.7% of total diversion. On average, municipal use was

11.0 % of the other uses, while industries used 12.9%, other farm use totalled 16.6% and DUC projects received 5.6% of total water. Uncategorized uses made up 0.2%. The sum of these uses has been decreasing from an average of 55.8 million m^3 (mean of 2004 to 2008) to 33.6 million m^3 (2019 to 2023). The greatest contribution to this change has been water transferred to DUC projects which has decreased from 37.2 million m^3 (2004 to 2008) vs 23.7 million m^3 (2019 to 2023). The predicted other uses downstream of the Project are shown for an average year on Figure 7-6. The total other uses are predicted to be 6.4 million m^3/yr, made up of DUC use (59.4%), farm and acreage use (15.6%), industrial use (12.5%), municipal use (9.4%), and uncategorized uses (3.1%).

Irrigation uses averaged 312 million m^3/year from 2004 to 2023. Total Consumptive Use was determined as the sum of irrigation, municipal use, industrial use, other farm use, uncategorized use, reservoir balance, and DUC use, subtracting the field run-off which returns from irrigated lands to the irrigation system. Total Irrigation appears to have been increasing, based on higher irrigation use in 2017, 2019, 2021 and 2023. This increase reflects the drier conditions over the past 10 years, requiring increased irrigation. Total consumptive use (mean of million m^3) is largely driven by irrigation, which makes up 98.6% of the mean consumptive use (308 million m^3/year).

7.2.1.8 Expected Cumulative Effects on Water Losses/Gains

As the reservoir is an off-stream storage pond, the only losses related to the reservoir will be losses due to evaporation and seepage. There is likely to be increased evaporation due to the larger surface area of the reservoir. This is expected to increase the EID's evaporative losses from 90 million m^3 to 97 million, an increase of 7.8%.

7.2.2 Water Supply: Construction, Operation, and Decommissioning

This section examines the process water, potable water, and non-potable water requirements and basin water supply sources for construction and normal operation of the reservoir. The volume of water to be withdrawn from each source and potential changes in the operation of upstream water supply reservoirs is discussed.

- Process water includes water used for testing the reservoir and irrigation infrastructure (outlet). These will be used under licence from the extant SLR. The amount of water needed to for these uses is estimated as 1% of the reservoir storage volume, or 903,000 m^3, and would be the amount of water filled in about 1 day. As this water will still flow down the Snake Lake Canal, it will still be used for irrigation or other downstream purposes.
- Potable water includes water for washing stations and drinking water needs on site; this water will be shipped to site. If we assume each person needs 2 L of water per day, then based on the estimate of 350 person years for the Project, 255 m^3 will be required. Potable water will be trucked to site in large tanks. There will be no onsite water treatment or need for chemicals to treat water.
- Non-potable water use will be for construction support (dust abatement) and for conditioning the clay-till materials for use in construction. This water will be supplied from the extant reservoir, at a pumping station. Dust abatement is calculated to require 715 truck loads per day at 15.1 m^3/ truck covering 900 ha of working surface. The watering will need to soak the top cm with water each day to 12 percent moisture content requiring 12 m^3/ha, or 10,800 m^3 to cover the 900 ha. The water trucks hold 4000 gallon or 15.1 m^3,

thus needing 715 truck loads per day. The estimated number of days for watering is 540 days plus 150 nights (hotter summer period where watering will occur day and night), resulting in a need for 7.5 million m^3 of non-potable water. Water conditioning will occur in limited areas by soaking the portion of the area that needs surface conditioning (estimated as a maximum of 10 ha) at any one time with up to 25 mm of water (this will vary depending on the weather). This would require 2,500 m^3 of water per soaking. If this is needed for 100 days, this would total 250,000 m^3 of water. Total non potable water use is estimated at 7.75 million m^3.

- Efficiencies in use will come via adaptive management of watering. On wet and cool days, less watering will likely be needed. Watering will cease or be completed at a lower rate if water pooling or run-off is observed.

7.3 SURFACE WATER

7.3.1 Surface Water Management Strategy

7.3.1.1 Prior to Filling

Surface water features in and surrounding the extant reservoir, and interactions of these features with roads and other linear disturbances are shown in Attachment 7, Figure 7A-1**.** Prior to filling, water management includes avoidance of interactions with, wetlands, other waterbodies, and drainages. When crossings are required, they are done under a Code of Practice approval under the *Water Act*.

7.3.1.2 During Construction

Run-off water plus onsite water from drained wetlands and rainfall/snowmelt will be drained to the east in a series of temporary collection ditches. Prior to east side dam construction, this water will flow directly into a ditch for transport east of the site. Silt controls, if necessary, will be in place to capture water for silt settling prior to release offsite. Once the berm is constructed, water will be captured in a temporary pond for silt to settle and water to evaporate. If water is too plentiful, portable pumps will be used to direct water into the offsite ditch. Groundwater dewatering will occur during excavation of borrow pits. This water will be stored in a temporary pond and tested for water quality issues prior to release. If the groundwater is higher in salinity than natural water in the meltwater drainage, this water may need to be diluted with reservoir water prior to release or trucked offsite for disposal.

7.3.1.3 During Filling

No additional measures will be needed. Any additional water will be captured and stored in the reservoir.

7.3.1.4 During Operations

Run-off, Run-on, and Seepage

Run-on in the new reservoir area will be negligible and will not be managed. Run-on would only occur from rainwater or snowmelt from the top of the berm to the water edge along a 2 m strip of that totals less than 2 ha. There is potential for run on into the extant SLR: a catchment area of 1.6 km^2 drains into the existing reservoir.

Run-off water on outer berms will be expected to either naturally infiltrate into the drainage system within the berm or run down the edge to the outer drainage ditch. All water will then flow to the low point on the east side of the dam and be directed to an outlet ditch.

Seepage water will be captured in the gravel filter layer in the inner berms and directed to the outlet ditch.

Erosion and Sediment Control

An Erosion and Sediment Control (ESC) plan will be developed for the Project site and will be implemented during all stages of construction. During initial site clearing, ESC measures such as silt fencing or logs will be used if necessary to prevent silt movement into surrounding waterways and wetlands. Water will be redirected into ditches and directed out to the surrounding environment. This water will be held in a settling pond and tested before release. Topsoil and subsoil piles will also require measures to prevent erosion and contain run-off silt. These piles will be sloped at an angle that is not conducive to run-off and if they will be in place for greater than 1 year, a cover crop will be seeded to establish a rooted grass cover that will not persist into the future.

During construction the ESC measures will be kept in place and will also require measures to protect berms from rainfall and run-off as they are being constructed. Construction will occur in stages and as each layer is constructed, additional ESC measures will be installed if needed. This will depend on the time of year of construction, but in spring when snow melts and summer when heavy rainfalls can occur, additional measures may include tarping or matting of new build areas. This may include new silt fencing at the base of each new slope. As structures are being built, the internal gravel filter layers will be constructed to convey water to the base of the dam and out to the low-lying ditches surrounding the dams.

During reclamation of the berms and other disturbances/borrow pits, soil erosion control measures will be inspected and replaced before activities start. The soils will be spread across the site and a tracked machine will be driven up and down the slopes to create a dimpled surface that will hold water in the soil rather than forming run-off rills. This surface texture will assist in capturing rain to support planted native species.

7.3.1.5 Geotechnical Stability Concerns

The reservoir berms have been designed for stability. This design includes a prepared surface of clay till that will not interact with groundwater, a central clay till core to hold water in the reservoir, an outer bench of unconsolidated materials for additional stability, and an outer filter channel of sands and gravels to collect and transfer any surface infiltration or seepage water to an outer drainage ditch. Thus, there are no geotechnical stability concerns for the new reservoir.

7.3.1.6 Surface Water Quality Issues

During run-off and run-off management – water will be allowed to settle to reduce silt. If any water shows signs of a hydrocarbon sheen, the water will be tested prior to release. If water is deemed unsuitable for release, it will be pumped to a tuck for disposal at an approved treatment facility.

During filling, testing of the reservoir will occur as needed for salinity and turbidity. If water is initially too salty or turbid, water will be allowed to fill until this is diluted to acceptable concentrations before release into the outflow canal. Once filled, water quality monitoring (see Volume 2, Section 7) will occur to ensure water meets the standards for agricultural use.

7.3.1.7 Surface Water Protection and Groundwater Interaction

Groundwater modelling for this Project (Volume 2, Section 6 – Hydrogeology) shows there is limited surface water/groundwater interaction, as the underling shale is an aquitard and the overlying clay till over most of the site prevents infiltration. Any interaction will be confined to the narrow area surrounding the planned footprint, and any additional groundwater would be captured in the drainage ditches surrounding the berms.

7.3.1.8 Waterbody Dewatering and Groundwater Interactions

Groundwater wells may be needed to draw down groundwater to facilitate borrow pit extraction and other excavations (Volume 2, Section 6 – Hydrogeology). Due to low surface water/groundwater interaction, and as per the hydrogeological modelling report (Volume 2, Section 6) this is not expected to affect surface water in wetlands surrounding the footprint.

7.3.1.9 Waterbody Drawdown or Increase in Water Level

The expanded reservoir could be drawn down 9 m, resulting in a maximum drawdown depth of 8 m in the expansion area and 3 m in the extant reservoir (although this may be deeper in excavated borrow pits), and resulting in exposed mudflats in over 90% of the extant reservoir and in about 20% of west side of the expansion reservoir basin. This would amount to a drawdown of 72.6 million m^3 to a remainder of 14.8 million m^3. The remaining water surface area at full drawdown would be about 600 ha, vs 1069 ha for the combined reservoir when fully inundated. Additional information is available in Volume 1, Section 6 – Dam Safety.

Wetlands in the Project area will be fully drained during construction, as per *Water Act* approval. Wetlands in surrounding areas are not expected to change in water level as there is little surface/groundwater interaction.

7.3.1.10 Groundwater Seepage

Per the Hydrogeology assessment (Volume 2, Section 6) groundwater seepage is not expected beyond the boundary of the reservoir.

7.3.1.11 Flood Protection

The reservoir is designed to handle the natural input of water, even during severe storms. Following current dam safety guidelines, for a dam with a high confidence classification, the dam has been designed to accommodate a flood 1/3 between the 1:1000-year flood and the Probable Maximum Flood (See Volume 1, Section 6.3.2 for additional details).

7.3.2 Alterations or Realignments of Waterbodies

Wetlands, dugouts, drainages, canals, and ditches in the Project area will all be removed as per *Water Act* approval. There will be no offsite changes to any of these water features.

7.3.3 Pre- and Post-Disturbance Drainages, Wetlands, and Waterbodies

No permanent streams interact with the Project. Ephemeral drainages and wetlands will be removed in the Project footprint. New wetlands will be formed in areas < 2 m deep within the new combined reservoir area (see Volume 2, Section 10 – Vegetation and Wetlands). These wetlands will be delineated and measured to ensure they are functioning, as they will replace lost wetland function as per the *Water Act* application.

7.3.4 Describe and Map Crossings of Drainages, Wetlands, and Waterbodies

The pre and post construction crossings that interact with the Project are shown on Attachment 7, Figure 7A-1.

7.3.5 Agricultural Water Needs Downstream of the Project in Normal and Severe Drought

There is no official definition of drought, therefore drought scenarios were split into "normal" and "severe". For this examination, "normal drought" is considered to be a drought like 2023, when the river water was low for some periods requiring reservoir drawdown, but which was preceded and followed by enough flow in the Bow River to refill reservoirs in the same year. "Severe drought" is defined as a condition where river water levels remain lower than needed to maintain the IO, and all water needs to be drawn from reservoirs through the growing season

In a normal drought, some water will be directly supplied to the downstream farms via direct-from-river water in Springhill Canal, with the shortfall supplemented with reservoir drawdown. The combination of the reservoir and direct-from-river supplies will provide all needed water, approximately 82 to 86 million m^3, to the 50,000 irrigated acres downstream of the Project.

In a severe drought, the amount of water will be limited to water available in the reservoir at the start of the year. If the reservoir is at half capacity, about 40 million m^3 can be supplied, if the reservoir is fully drawn down, no water can be supplied.

If the Project is not constructed, the water in a normal drought will not greatly change as it is expected enough direct for river water will be available in these years; however, there will likely be periods in summer when water needs to be rationed if low flows last for several weeks to months. In a severe drought, the amount of water supplied ranges from none if fully drawn down at start of year to about 16 million m^3, which can be supplied by the extant reservoir or after the project is built up to 72.6 million m^3. The new reservoir expansion will be critical for maintaining agricultural production in a severe drought by this definition.

7.3.6 Project Effects on the Bow River in Normal and Drought Conditions

7.3.6.1 Conservation Objectives

In the Environmental Impact Assessment (EIA) there are two different conservation objectives discussed for water flows. The instream flow objective and the priority use of water in a drought.

Regarding IO, the SLR Expansion aims to improve the conservation of water and efficiency of water use for irrigation by increasing the water storage capacity for use during drought times while reducing direct reliance on Bow River discharge at these times. This will benefit the Bow River by allowing for more water to flow to protect aquatic species when otherwise water would be drawn down to the minimum IO. While water flows are currently (without the new Project) close to or at the IO during a drought, with additional off-stream storage, more water could remain in the Bow River as it can be supplemented by reservoir drawdown.

Regarding the Alberta Drought Response Plan (GOA, 2024), the Bow River is important as a source of water for much of the population of southern Alberta. Conservation objectives outlined in this plan aim to preferentially preserve water uses for all upstream and downstream users with priority water use set for household uses, then livestock, then industries, and irrigation needs when severe drought situations occur (i.e. when water needs to be rationed). These conservation objectives are only applicable during a declared drought. The Project will not have any effect on meeting this objective, however, if the Project is operational, the EID will have more water stored to meet irrigation needs while these water conservation objectives are in place.

7.3.6.2 Instream Objectives

An IO is a flow guideline that specifies the minimum amount of water that must remain in a stream to protect the aquatic environment. The IO of 11.3 m^3/s has been discussed throughout the EIA. The instream flow objective will always be maintained, except if the upstream flow above Bassano Dam is lower than this target value.

7.3.6.3 Instream Flow Needs

Instream flow needs, also known as environmental flows, are the amount, quality, and timing of water flow that's required to keep freshwater ecosystems healthy. In absence of an assessed instream flow need the IO will be followed.

7.3.7 Project Effects on Bow River Water Quality Downstream of Bassano Dam

As stated previously, the Project will not alter return flow loadings from the EID into the Bow River, therefore no effects will occur on the water quality in the Bow River below Bassano dam.

7.4 REFERENCES

Alberta Irrigation Districts Association. (2024). Irrigation District Water Quality Data Tool. Retrieved March 2025, from http://www.idwq.ca/

Bow River Basin Council. (2010). Bow River Basin State of the Watershed Summary. Retrieved August 2024, from https://sswm.info/sites/default/files/reference_attachments/BOW%20RIVER%20BASIN%20COUNCIL%202010%20Bow%20River%20Basin%20State%20of%20the%20Watershed%20Summary%202010.pdf

Bow River Basin Council. (2015). State of the Watershed. Retrieved August 2024, from https://brbc.ab.ca/state-of-the-watershed

GOA. (2000). Environmental Protection and Enhancement Act. *Current as of December 12, 2024*. Edmonton: Alberta King's Printer. Retrieved February 2025, from https://open.alberta.ca/publications/e12

GOA. (2020). Alberta Climate Service (ACIS)-Find Current Weather Data. Retrieved March 2025, from Current and Historical Alberta Weather Station Data Viewer: https://acis.alberta.ca/weather-data-viewer.jsp

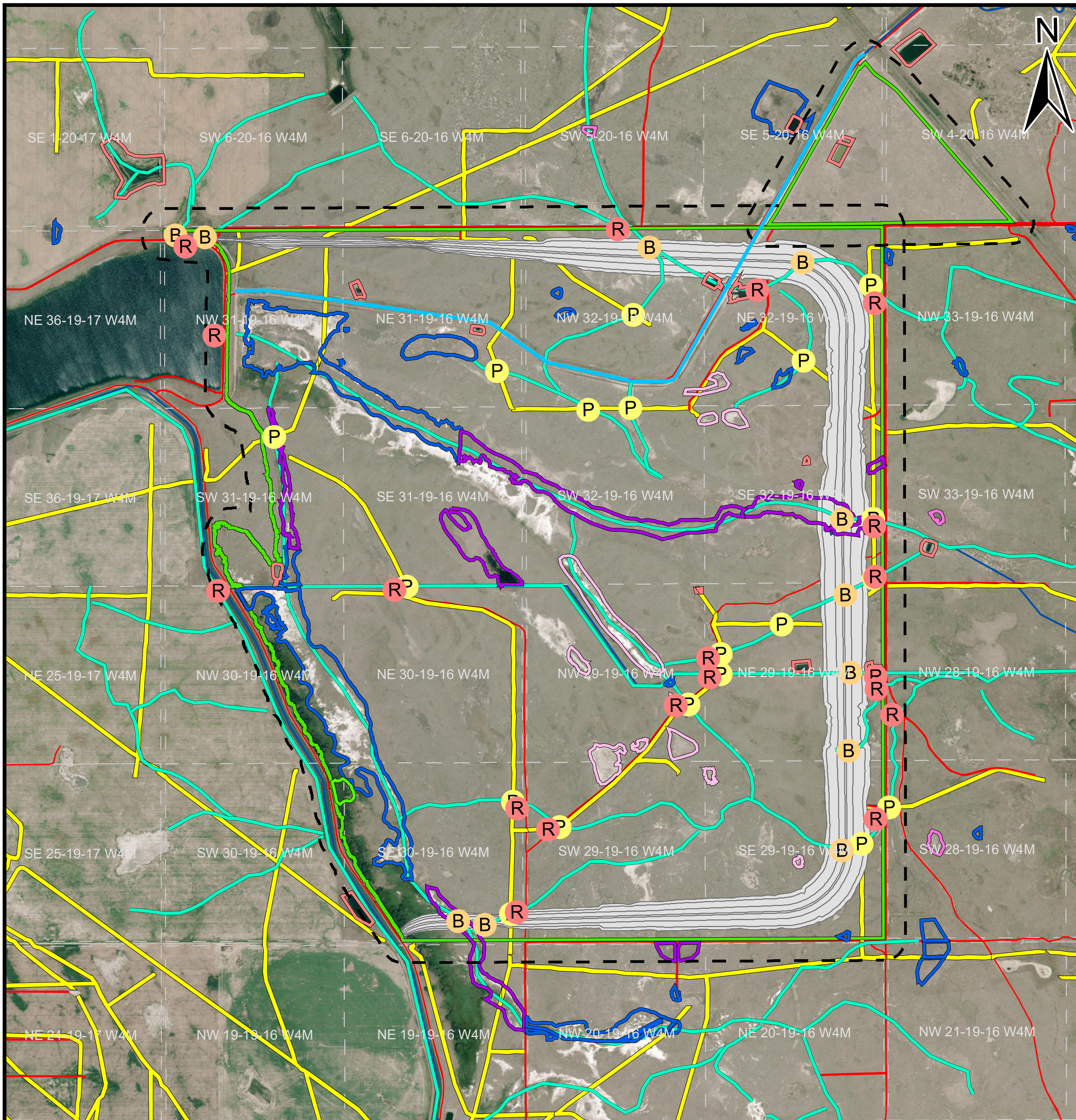
GOA. (2024). *Alberta Drought Response Plan*. Retrieved from https://www.alberta.ca/system/files/epa-alberta-drought-response-plan.pdf

Attachment 7

Attachment 7A: Figures

Figures

Figure 7A-1: Surface Water Interactions – Project + 100m Buffer.. 1



SCALE: 1:25,000

200 0 200 400 M

Drafted:	MM	Date:	Oct 22, 2024
Approved:	WB	Revision:	0
Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
Imagery Reference: ESRI 2021/07/10
ATS Grid: AltaLIS 2007

AAR Environmental Services

Please contact AARES for all other sources.

Please note that the imagery is from 2021 and although we have no reason to doubt the accuracy and completeness of it, users should be aware that discrepancies may be present

Legend

Routing:

- Snake Lake Reservoir Expansion Project Area
- Pipeline
- Road
- Berm
- 100m Buffer

Wetland & Drainage:

- Drainage
- Canal
- Temporary Marsh (M-G-II)
- Seasonal Swamp (S-S-III)
- Seasonal Marsh (M-G-III)
- Shallow Open Water (W-A-VI)
- Dugout

Crossings:

- P Pipeline Crossing
- R Road Crossing
- B Berm Crossing

EID

Surface Water Interactions Project + 100m Buffer

December 2024

REF.: AARES21-127 (ProjectDescription)

Figure 7A-1