

**MILK RIVER WATERSHED
WATER MONITORING REPORT 2023 AND 2024**



Prepared for: Milk River Watershed Council Canada

Prepared by: Palliser Environmental Services Ltd.

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Cover Photo: Milk River at Weir Bridge (July 2024), S. Riemersma



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1.0 INTRODUCTION

The Milk River is the most southern major river system in Alberta and the only river in the province that eventually flows to the Gulf of Mexico. The headwaters of the Milk River originate in Montana, and the river flows eastward through Alberta for about 288 km. The mainstem of the Milk River is prairie fed and is often referred to as the South Fork of the Milk River. Flows in the North Fork of the Milk River are augmented by water from the St. Mary River (i.e., the St. Mary River Diversion) as part of the 1909 Boundary Waters Treaty.

The Milk River Watershed Council Canada (MRWCC) has monitored the Milk River and some of its tributaries since 2006. This report is a compilation of water monitoring data collected in 2023 and 2024, with reference to the results from the previous three years (i.e., 2020-2022) (Palliser Environmental 2021 to 2023). Comparisons are made to Water Quality Objectives that were developed as part of the Milk River Integrated Watershed Management Plan (IWMP) (PESL 2015) and relevant provincial guidelines (GoA 2018).

2.0 METHODS

Grab samples were collected twice monthly (April-June) and monthly (July-October) (N=10) from five sites: **North Fork at 501, Milk River at 501, Upstream of the Town of Milk River (U/S Milk River), HWY 880 Bridge** and the **Pinhorn** site (Figure 1). Staff from the MRWCC collected the water samples at the North Fork at 501, Milk River at 501, U/S Milk River and Pinhorn sites. The HWY 880 site was sampled by MRWCC staff (3 samples) and staff from Alberta Environment and Protected Areas (EPA) (7 samples). The site 'd/s Milk River' was also sampled once in each of July and August in 2024 to observe water quality upstream and downstream of the Town of Milk River during the low flow condition that resulted from the failure of the St. Mary Diversion siphon in July 2024.

Red Creek near Mouth was monitored in 2023 and 2024 by EPA. Monitoring in previous years at Red Creek included an upstream and middle site sampled by the MRWCC; however, these sites have not been sampled since 2019. The MRWCC Research and Monitoring Team determined sufficient data has been collected to understand the trends and conditions on Red Creek and a summary report was completed in 2020. Three samples were collected at Red Creek near Mouth in 2023, and two samples were collected in 2024. Verdigris Coulee and Miners Coulee, two ephemeral tributaries to the Milk River, have been sampled intermittently since 2018. At Miners Coulee, three samples were collected in each of May, June and July 2023, and one sample was collected in May 2024. No flow condition was reported at Verdigris Coulee in 2023 and 2024; thus, no samples were collected.

Samples were only collected when flows could be visually detected. Sample bottles were submersed to mid-depth by hand or using a sample pole (with sample bottle attached) when the water was deep or fast-flowing. Each sample container was prepared using standard protocols (e.g., sample preservation, where required). Sterile sample containers were provided by the analytical laboratory. The water samples were kept on ice in coolers and transported to ALS Laboratories in Calgary. ALS Laboratories is **CALA**¹ accredited for criteria and standards established by the Association under their Certificate of Laboratory Proficiency.

¹ **CALA** – Canadian Association for Laboratory Accreditation Inc.

Samples were analysed using APHA approved methods for general parameters (e.g., pH, specific conductivity), nutrients (total phosphorus (TP), total dissolved phosphorus (TDP), nitrate+nitrite nitrogen (NO3+NO2-N), total kjeldahl nitrogen (TKN) and total nitrogen [TN; calculated]), total suspended solids (TSS) and fecal coliform bacteria (FCB).

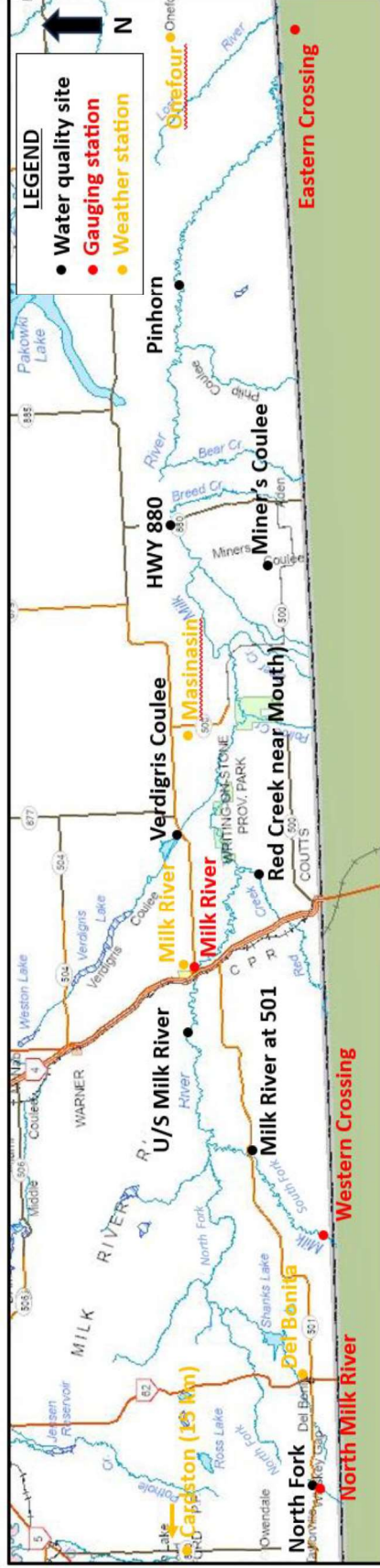


Figure 1 - Map showing water monitoring locations sampled in the Milk River watershed, 2023 and 2024.

Water monitoring results were compared to Milk River Water Quality Objectives (WQO) and to applicable provincial surface water quality guidelines (GoA 2018). The WQO were established using data from 2006 to 2011 at four main river reaches (i.e., North Fork Milk River, Mainstem Milk River, Milk River Gravel Bed and Milk River Sand Bed) (PESL 2015). The Milk River IWMP Implementation Strategy suggests that water quality data should be compared to the WQOs annually with a trend analysis completed every five years. The current 2022 data set is the tenth year of data collected since the WQOs were established.

Table 1 – Summary of the number of water samples collected at the five Milk River monitoring sites, 2007 to 2024.

Site	Sample Type	Sample Numbers																	
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Milk River at 501	Natural Flow	8	13	9	10	10	10	10	10	8	7	7	8	10	9	6	9	7	7
		-some samples not collected in 2007, 2008, 2015-2018 and 2020-2024 due to dry channel or no flow conditions -no sample collected June 3/09 -no FCB results Apr 23/23 as sample was received more than 24 hours after collection.																	
North Fork at 501	Diversion	11	12	8	8	2	9	9	5	6	8	8	7	8	3	9	9	7	4
	Natural Flow	4	2	1	2	8	1	1	5	4	2	2	3	2	7	1	1	3	6
		-no sample collected October 8/08 (natural flow) -no sample collected June 3/09 (diversion)																	
U/S Milk River	Diversion	11	12	9	8	2	9	9	5	6	8	8	7	8	3	9	9	7	5
	Natural Flow	4	3	1	2	8	1	1	5	4	2	2	3	2	7	1	1	3	5
		-all samples collected from 2007 to 2022																	
HWY 880	Diversion	11	12	12	8	2	5	6	5	6	8	8	7	8	3	9	9	7	5
	Natural Flow	4	3	1	2	5	2	1	4	4	2	2	3	2	7	1	1	3	5
		-no sample collected May 14/14 (natural flow)																	
Pinhorn	Diversion	11	12	9	8	2	9	9	5	6	8	8	7	8	0	7	9	7	4
	Natural Flow	4	3	1	2	8	1	1	4	4	2	2	3	2	0	1	1	3	6
		-no sample collected May 14/14 (natural flow) -no sampling completed in 2020 due to global pandemic -no samples collected April 7 and 19, 2021 (diversion)																	

3.0 RESULTS

3.1 Precipitation

Overall, total precipitation (April-October) in the Milk River watershed in 2023 and 2024 varied moderately across the watershed, ranging from 164.4 mm at Del Bonita to 217.8 mm at Cardston in 2023, and from 223.9 mm at Cardston to 268.6 mm at Onefour in 2024 (Tables 1 and 2). June was the wettest month (average: 58.4 mm) in 2023, while May was the wettest month (average: 86.4 mm) in 2024. The driest month was April (average: 11.1 mm) in 2023, and October (average: 3.0 mm) in 2024 (Table 1). Comparing mean total precipitation for each year, 2023 was the seventh driest of the ten years (average: 199.8 mm) (2014-2023), and 2024 was the fifth driest (2015-2024) (Table 2). The driest year was recorded in 2017 (average: 178.8 mm) and the wettest year occurred in 2014 (average: 344.0 mm) a difference of 165.2 mm of precipitation between the wettest and driest years. Based on ten-year averages (2015-2024), the weather station Cardston was the wettest (average: 268.4mm) while the weather station Onefour (average: 214.7mm) was the driest.

Typically, the western part of the watershed receives more precipitation compared to the eastern part. However, it was uncharacteristically drier in Del Bonita (2023) and Cardston (2024) compared to more eastern regions (Table 2). In 2023, the Cardston weather station had the lowest precipitation of ten years at that station (2014-2023) (217.8 mm), and second lowest in ten years (2015-2024) in 2024 (268.6 mm).

Table 1 – Total precipitation (mm) at five weather stations, April to October, 2023 and 2024. Refer to Figure 1 for weather station locations.

Month	Cardston	Del Bonita	Milk River	Masinasin	Onefour
2023					
April	20.1	10.7	10.2	9.8	4.8
May	18.4	32.4	35.3	21.6	39.9
June	70.3	30.9	50.0	68.1	72.6
July	37.1	8.3	26.6	47.4	14.6
August	19.9	31.9	28.2	35.0	12.6
September	32.4	30.2	11.6	12.8	13.8
October	19.6	20.0	39.0	18.3	44.8
Total	217.8	164.4	200.9	213.0	203.1
2024					
April	13.7	22.3	31.3	29.1	13.3
May	65.7	77.1	108.6	84.5	95.9
June	33.3	54.9	27.8	48.1	46.9
July	12.0	11.0	9.1	2.5	20.7
August	62.1	55.7	34.3	68.0	24.5
September	34.6	37.2	24.9	30.7	64.2
October	2.5	2.3	2.1	5.0	3.1
Total	223.9	260.5	238.1	267.9	268.6

Data Source: Environment Canada - http://climate.weather.gc.ca/index_e.html (Note: April data for Milk River is from ACIS viewer: <http://agriculture.alberta.ca/acis/alberta-weather-data-viewer.jsp>)

Table 2 - Historical total precipitation (mm) at five weather stations for the water monitoring period April to October, 2013 to 2024. Refer to Figure 1 for weather station locations.

Year	Cardston	Del Bonita	Milk River	Masinasin	Onefour	Average
2014	376.8	404.7	290.1	333.7	314.7	344.0
2015	256.3	192.6	199.6	123.5	198.6	194.1
2016	304.0	309.3	315.5	323.1	319.1	314.2
2017	184.4	175.9	261.6	132.2	140.0	178.8
2018	303.9	251.9	195.4	180.0	154.0	217.0
2019	369.2	334.3	299.4	278.5	250.2	306.3
2020	272.5	246.5	294.3	283.0	232.3	265.7
2021	294.1	224.3	160.2	157.1	139.9	195.1
2022	258.0	288.5	264.9	271.6	241.2	264.8
2023	217.8	164.4	200.9	213.0	203.1	199.8
2024	223.9	260.5	238.1	267.9	268.6	251.8
Avg. 2014-23	283.7	259.2	248.2	229.6	219.3	-
Avg. 2015-24	268.4	244.8	243.0	223.0	214.7	-

Data Source: Environment and Climate Change Canada - http://climate.weather.gc.ca/index_e.html

3.2 Red Creek (Near Mouth)

3.2.1 General Water Chemistry

Three water samples (N=3) were collected at the Red Creek near Mouth site in 2023 (one in each of April, May and June), and two samples (N=2) were collected in 2024 (one in each of April and May). Red Creek did not have any flow during the July to October site visits in 2023, and the June to October visits in 2024.

In 2023, the median water temperature (15.2°C) was within the range of previous years and the maximum water temperature (15.3°C) was the lowest from 2017 to 2023 (Table 3). The maximum water temperature at Red Creek in 2023 occurred in June. In 2024, the maximum water temperature was 13.3°C in May.

The median dissolved oxygen concentration at the Red Creek site (11.33 mg/L) met the acute (≥ 5.0 mg/L) and chronic (≥ 6.5 mg/L) guideline in 2023. All dissolved oxygen samples at the downstream Red Creek site were in compliance in 2023 and 2024. From 2017 through 2022, the median dissolved oxygen and all samples at the downstream site have met the acute and chronic dissolved oxygen guidelines. The compliance rate for the acute and chronic guideline is high (100%) and stable at Red Creek near Mouth site.

Table 3 - Median and range of water quality at Red Creek near Mouth, 2017-2024.

Parameter	Red Creek – Near Mouth							
	2017	2018	2019	2020	2021	2022	2023	2024
Water Temperature, °C	17.0 8.9-21.6	15.0 0.1-22.1	14.4 4.9-22.0	20.0 3.1-22.5	12.1 0.5-20.8	14.7 -0.03-22.8	15.2 9.6-15.3	11.1 8.8-13.3
Dissolved Oxygen, mg/L	10.75 9.50-13.47	10.64 10.18-11.58	10.60 9.62-11.26	12.64 10.31-15.10	13.03 12.77-14.23	11.83 7.80-12.54	11.33 10.13-12.81	11.70 10.70-12.67
pH	8.35 7.97-8.50	8.17 8.06-8.56	8.24 7.71-8.48	8.29 8.19-8.39	8.28 7.94-8.43	7.88 7.76-8.06	8.10 7.94-8.12	8.06 7.94-8.18
Specific Conductivity, µS/cm	2,630 1,530-2,920	2,489 510-2,796	2,585 1,560-2,880	2,700 2,500-3,000	2,550 1,200-2,800	2,650 2,200-2,685	2,731 1,760-2,928	2,724 2,634-2,814
Total Phosphorus, mg/L	0.036 0.019-0.180	0.026 0.009-0.400	0.026 0.011-0.121	0.006 0.004-0.017	0.019 0.017-0.070	0.036 0.002-0.053	0.016 0.013-0.064	0.013 0.008-0.017
Total Dissolved Phosphorus, mg/L	0.019 0.007-0.160	0.020 0.003-0.320	0.011 0.007-0.068	0.003 0.002-0.009	0.009 0.006-0.051	0.004 0.002-0.013	0.008 0.034-0.008	0.007 0.005-0.009
Nitrate+Nitrite Nitrogen, mg/L	0.050 0.002-0.050	0.039 0.025-0.850	0.096 0.055-0.920	0.260 0.210-1.500	0.185 0.019-0.330	0.110 0.009-0.280	0.002 0.002-0.026	0.009 0.008-0.010
Total Kjeldahl Nitrogen, mg/L	1.02 0.51-1.30	0.82 0.25-1.40	0.71 0.44-1.55	0.63 0.49-0.97	0.78 0.57-1.30	0.85 0.45-1.1	0.93 0.48-1.2	0.87 0.73-1.01
Total Nitrogen, mg/L	1.07 0.51-1.30	1.05 0.64-2.04	0.81 0.53-2.47	1.06 0.71-1.99	0.89 0.80-1.60	0.96 0.45-1.4	0.96 0.48-1.20	0.87 0.74-1.00
Total Suspended Solids, mg/L	4 1-9	1.6 0.5-135	4.8 1.2-16	4.3 2.7-7.9	4.6 2.2-7.3	2.4 0.5-18	2.1 0.5-3.1	0.8 0.5-1.1
Fecal Coliform Bacteria, cfu/100 mL	118 1-700	100 6-3,600	121 1-2,000	20 6-1,091	5 1-1,364	39 8 - >60,000	31 4-118	28 1-55
Sample Size	7	9	3	4	4	5	3	2

Table 4 - Summary of Red Creek water quality compliance (%) with dissolved oxygen acute and chronic guidelines (GOA 2018), 2021-2024. Note that compliance has been 100% for both the acute and chronic guidelines since 2015.

Year	Red Creek near Mouth	
	Acute: ≥ 5.0 mg/L	Chronic: ≥ 6.5 mg/L
2021	100	100
2022	100	100
2023	100	100
2024	100	100
Trend	Stable	Stable

In 2023, the median pH at the Red Creek near Mouth site (8.10) and all individual pH samples (range: 7.94 to 8.12) met the pH guideline of ≥ 6.5 to ≤ 9.0 for aquatic life (Table 3). In 2024, the pH ranged from 7.94-8.18. From 2017 to 2024, the median pH and all individual pH samples at Red Creek met the guideline.

Median specific conductivity at the Red Creek near Mouth site in 2023 (2,731 $\mu\text{S}/\text{cm}$) exceeded the safe irrigation guideline ($\leq 1,000$ $\mu\text{S}/\text{cm}$) and would be considered unsuitable for irrigation ($\geq 2,000$ $\mu\text{S}/\text{cm}$) (GoA 2018). The specific conductivity results in 2023 at the downstream site were similar to previous years (2017-2022) (Table 3). In 2024, the specific conductivity ranged from 2,634-2,814 $\mu\text{S}/\text{cm}$ and would also be considered unsuitable for irrigation.

3.2.2 Nutrients

In 2023 at Red Creek, the median total phosphorus (0.016 mg/L) was the second lowest of the seven years (2017-2023), and the maximum total phosphorus (0.064 mg/L) was the third lowest (Table 3). The maximum total phosphorus concentration at Red Creek occurred in April and was likely due to spring runoff. In 2024, the median total phosphorus was 0.013 mg/L (range: 0.008-0.017 mg/L). The maximum value in 2024 was tied for lowest maximum concentration in seven years with 2020. An average of 54% (2023) and 55% (2024) of the total phosphorus at the Red Creek Near Mouth site was present in the dissolved form.

The median total nitrogen concentration in 2023 at Red Creek was 0.96 mg/L (range: 0.48-1.20 mg/L) was similar to and within the range of previous years. In 2024, the median total nitrogen concentration was 0.87 mg/L (range: 0.74-1.00 mg/L), and was also within the range of previous years. In 2023 at Red Creek, an average of 99% of the total nitrogen was present in the organic (TKN) form and 1% of the total nitrogen present was in the soluble form (nitrate+nitrite nitrogen) (Table 3). In 2024, an average of 100% of the total nitrogen was present in the organic form.

3.2.3 Total Suspended Solids

In 2023 at Red Creek near Mouth, the median total suspended solids (TSS) concentration was 2.1 mg/L and was within the range of previous years. The maximum TSS at the downstream site (3.1 mg/L) was the lowest of the seven years (2017-2022) (Table 3). In 2024, TSS ranged from 0.5-1.1 mg/L, and were the lowest of all years. The maximum total suspended solids concentrations at Red Creek have typically occurred during the spring and were likely the result of increased stream flows from snow melt runoff and/or higher precipitation.

3.2.4 Fecal Coliform Bacteria

In 2023, the median fecal coliform bacteria count at the Red Creek site was 31 cfu/100 mL and within the range of previous years (Table 3). The median fecal coliform bacteria count at Red Creek met the provincial guideline for irrigation (100 cfu/100 mL) (GoA 2018). One of three samples (33%) from Red Creek was greater than the irrigation guideline. The maximum fecal coliform bacteria count was 118 cfu/100 mL (June 15) and was the lowest maximum count of seven years (2017-2023) (Table 3). In 2024, fecal coliform bacteria ranged from 1-55 cfu/100 mL. The maximum count was the lowest maximum of eight years (2017-2024) (Table 3).

Fecal coliform bacteria counts appear to be highly variable from year to year at Red Creek (Table 3) and may be the result of fluctuating wildlife populations and usage near the creek, varied cattle grazing intensity and environmental bacteria (i.e., self-sustaining naturalized populations of coliform bacteria). The lowest maximum values were observed in the last two years perhaps due, in part, to changing land use practices, the use of BMPs such as fencing and offstream watering to manage livestock access, and minimal flows that resulted in small sample sizes in 2023 and 2024 (i.e., 3 samples and 2 samples, respectively).

3.2.5 Other Parameters

A review of a 5-year dataset of historical water quality data for lower Red Creek from 2016 to 2020 (PESL 2021b) indicated some exceedances for livestock, irrigation and protection of aquatic life (PAL). The data from 2023 and 2024 was reviewed (Table 5) and the following observations were made:

- Livestock Water Guidelines: From 2006 to 2020 (10-year dataset), sulphate sometimes exceeded the guideline (1,000 mg/L). In 2023, sulphate ranged from 700 to 1,200 mg/L (N=3) and two samples exceeded the livestock water guideline. In 2024, sulphate ranged from 1,300 to 1,300 mg/L (N=2) and two samples exceeded the livestock water guideline.
- Irrigation Guidelines: From 2016 to 2020 (5-year dataset), total boron occasionally exceeded the guideline (500 µg/L). In 2023, total boron ranged from 205 to 402 µg/L (N=3) and no sample exceeded the irrigation guideline. Similarly in 2024, total boron ranged from 299 to 336 µg/L (N=2) and no sample exceeded the irrigation guideline.
- Protection of Aquatic Life Guidelines:
 - From 2016 to 2020 (5-year dataset), total arsenic occasionally exceeded the chronic guideline (5 µg/L). In 2023, total arsenic ranged from 1.96 to 2.53 µg/L (N=3) and no sample exceeded the PAL guideline. Similarly in 2024, total arsenic ranged from 1.12 to 1.96 µg/L (N=2) and no sample exceeded the PAL guideline.
 - From 2016 to 2020, total copper rarely exceeded the chronic guideline (7 µg/L). In 2023, total copper ranged from 0.47 to 1.29 µg/L (N=3) and no sample exceeded the PAL guideline. Similarly in 2024, total copper ranged from 0.36 to <0.8 µg/L (N=2) and no sample exceeded the PAL guideline.
 - From 2016 to 2020, total mercury rarely exceeded the chronic guideline (5 ng/L). In 2023, total mercury ranged from 1.67 to 2.34 ng/L (N=3) and none of the samples exceeded the PAL guideline. Similarly in 2024, total mercury ranged from 0.80 to 1.77 ng/L (N=2) and no sample exceeded the PAL guideline.
 - From 2016 to 2020, total selenium almost always exceeded the chronic guideline (2 µg/L). In 2023, total selenium ranged from <0.2 to 6.7 µg/L (N=3) and two samples exceeded the PAL guideline. In 2024, total selenium ranged from 2.1 to 4.0 µg/L (N=2) and two samples exceeded the PAL guideline.

Table 5 - Summary of Red Creek water quality compliance (%) with select guidelines (GOA 2018), 2021-2024.

Parameter	Red Creek – Near Mouth							
	2021 (N=4)		2022 (N=5)		2023 (N=3)		2024 (N=2)	
	Range	Exceedances	Range	Exceedances	Range	Exceedances	Range	Exceedances
Sulphate	400-1,100	1	840-1,200	2	700-1,200	2	1,300-1,300	2
Total Boron	81.5-128	0	227-457	0	205-402	0	299-336	0
Total Arsenic	1.33-2.92	0	0.96-2.04	0	1.96-2.53	0	1.12-1.96	0
Total Copper	0.29-1.31	0	0.27-0.88	0	0.47-1.29	0	0.36- <0.8	0
Total Mercury	0.86-2.27	0	0.87-2.87	0	1.67-2.34	0	0.8-1.77	0
Total Selenium	2.7-10.4	4	3.2-9.7	5	<0.2-6.7	2	2.1-4.0	2

3.3 Ephemeral Tributaries

Miners Coulee contributed minor flow to the Milk River in 2023 and 2024. Flowing water was observed on three of eight monthly site visits between March 20 and October 17, 2023 (May, June and July), and during one visit between March 11 and October 16, 2024 (May). Verdigris Coulee contributed little to no flow to the Milk River in 2023 and 2024. During eight site visits, no flowing water was observed at Verdigris Coulee and no water samples were collected at Verdigris Coulee in 2023 or 2024 (Table 6).

3.3.1 General Water Chemistry

Miners Coulee – The median dissolved oxygen concentrations were 10.31 mg/L (2023) and 10.66 mg/L (2024) at Miners Coulee; these values were within the range of previous years (4.32 to 12.21 mg/L). The median dissolved oxygen at Miners Coulee met the acute (≥ 5.0 mg/L) and chronic (≥ 6.5 mg/L) guideline. The pH in 2023 (7.82) and 2024 (7.94) met the aquatic life guideline (≥ 6.5 and ≤ 9.0) and was within the historic range of 7.56 to 8.28 (2018-2022). The median specific conductivity at Miners Coulee was 618 $\mu\text{S}/\text{cm}$ (2023) and 460 $\mu\text{S}/\text{cm}$ (2024), and was within the range of previous years (583 to 1,100 $\mu\text{S}/\text{cm}$) (2018-2022). The 2023 and 2024 specific conductivity was considered ‘safe’ for irrigation ($< 2,000$ $\mu\text{S}/\text{cm}$) (GoA 2018) (Table 6).

3.3.2 Nutrients

Miners Coulee – Median total phosphorus at Miners Coulee was 0.097 mg/L in 2023, and was 0.059 mg/L on May 21 in 2024. These values were within the range of previous years (0.020 to 0.160 mg/L) (2018-2022) (Table 6). The median total dissolved phosphorus concentration at Miners Coulee was 0.089 mg/L in 2023, and was 0.044 mg/L on May 21 in 2024. These values were within the range of previous years (0.011 to 0.150 mg/L) (Table 6). In 2023, the median total nitrogen at Miners Coulee was 0.780 mg/L in 2023, and was 0.550 mg/L on May 21 in 2024. These values were within the range of previous years (0.61 to 1.0 mg/L) (2018-2022) (Table 6). Total nitrogen was nearly entirely comprised of organic nitrogen (TKN). The median nitrate+nitrite nitrogen concentration was 0.002 mg/L in 2023 and 2024, less than the detection limit of the analytical equipment (Table 6).

3.3.3 Total Suspended Solids

Miners Coulee – The median total suspended solids concentration was 390 mg/L (range: 370-490 mg/L) in 2023. Both the median and maximum values were substantially higher than the highest values recorded in previous years (< 1 to 4.8 mg/L) (2018 to 2022) (Table 6). The TSS concentration was 3 mg/L in 2024 and within the range of historic values (2018 to 2022).

3.3.4 Fecal Coliform Bacteria

Miners Coulee – The median fecal coliform bacteria count at Miners Coulee was 75 cfu/100 mL in 2023, and within the historic range of condition (2018-2022) (Table 6). FCB was 260 cfu/100 mL on May 21, 2024 and did not meet the irrigation guideline (100 cfu/100 mL) (GoA 2018).

Table 6 - Median and range for water quality parameters at the ephemeral tributaries (Miners Coulee and Verdigris Coulee), 2018 to 2024.

Parameter	Miners Coulee							Verdigris Coulee								
	2018 (N=2)	2019 (N=1)	2020 (N=2)	2021 (N=4)	2022 (N=1)	2023 (N=3)	2024 (N=1)	2018 (N=4)	2019 (N=1)	2020 (N=0)	2021 (N=0)	2022 (N=0)	2023 (N=0)	2024 (N=0)		
Water Temperature, °C	7.1 - 15.7	15.78	18.8 - 19.6	10.1 1.6 - 17.4	15.7	14.9 7.6-15.2	11.3	16.4 1.47 - 17.9	3.02	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Dissolved Oxygen, mg/L	5.22 - 10.78	8.12	4.32 - 9.75	10.40 9.07 - 12.21	6.48	10.31 7.75-10.44	10.66	4.57 2.14 - 11.06	8.41	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
pH	7.90 - 8.13	7.67	8.22 - 8.28	8.25 8.08 - 8.27	7.56	7.82 7.77-7.86	7.94	8.42 7.53 - 9.29	7.19	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Specific Conductivity, µS/cm	583 - 905	994	590 - 650	925 780 - 1,100	658	618 599-747	460	2,562 83 - 4,414	277	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Total Phosphorus, mg/L	0.096 - 0.160	0.043	0.061 - 0.072	0.034 0.020 - 0.054	0.096	0.097 0.030-0.100	0.059	0.109 0.044 - 0.350	0.190	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Total Dissolved Phosphorus, mg/L	0.082 - 0.150	0.027	0.047 - 0.067	0.024 0.011 - 0.045	0.097	0.089 0.024-0.094	0.044	0.054 0.031 - 0.280	0.140	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Nitrate+Nitrite Nitrogen, mg/L	<0.004 - 0.008	0.01	0.002	0.008 <0.004 - 0.019	0.039	0.002 0.002-0.005	0.002	0.007 <0.004 - 0.024	0.45	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Total Kjeldahl Nitrogen, mg/L	0.90 - 0.91	0.87	0.80 - 0.81	0.66 0.60 - 1.0	0.84	0.78 0.65-0.89	0.551	1.93 0.340 - 3.8	0.71	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Total Nitrogen, mg/L	0.90 - 0.92	0.88	0.80 - 0.81	0.67 0.61 - 1.0	0.88	0.78 0.65-0.89	0.550	1.93 0.370 - 3.8	1.2	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Total Suspended Solids, mg/L	<1	2.2	2.2 - 4.8	3.6 1.7 - 4.4	<1	390 370-490	3	9.65 1.3 - 45	6.5	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Fecal Coliform Bacteria (cfu/100 mL)	20 - 310	173	900 - 1,091	75 <2 - 220	590	75 13-520	260	360 1 - 900	220	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)
Sample Dates	Apr 23, May 22	May 14	Jun 23, Jul 21	Mar 16, Apr 19, May 17, Jun 21	Jun 20	Apr 17, May 23, Jun 15	May 21	Apr 23, May 22, Jun 19, Jul 16	Oct 8	No samples collected due to lack of flow (Mar 14, Apr 19, May 24, Jun 20, Jul 18, Aug 24, Sep 15) or lack of water (Oct 12)					No samples collected due to lack of flow (Mar 20, Apr 17, May 23, Jun 15, Jul 11, Aug 15, Sep 19, Oct 17)	No samples collected due to lack of flow (Mar 11, Apr 22, May 21, Jun 17, Jul 24, Aug 13, Sep 18, Oct 16)

3.4 Milk River

3.4.1 St. Mary/Milk River Diversion Operation

The St. Mary/Milk River Diversion was initiated on April 25 and shut-down on September 1, 2023. In 2023, the rate of diversion to the St. Mary Canal was increased to 1.4 m³/s (50 cfs) on April 5. On April 11, diversions to the St. Mary Canal were shut-off to repair a turnout gate. The diversion was restarted on April 25 with an increase to the St. Mary Canal to 1.4 m³/s (50 cfs). Diversions were ramped up from May 5 (8.5 m³/s; 300 cfs, to maximum diversion rate on May 17 (17.0 m³/s; 600 cfs). The diversion to the St. Mary Canal was maintained at approximately 17.0 m³/s (600 ft³/s) from May 17 to August 17. Ramping down of the diversion flow was initiated on August 17, with a decrease in diversion to the St. Mary Canal to 14.2 m³/s (500 cfs). A further rate reduction occurred August 25, 2023 to 11.3 m³/s (400 cfs), again on August 31 (1.4 m³/s; 50 cfs), before reaching a zero diversion on September 1 (shut-down complete).

In 2024, the St. Mary/Milk River Diversion was initiated on April 10 and shut-down on June 17 (Table 7). Increased diversion to the St. Mary Canal (1.4 m³/s; 50 cfs) began on March 25. Diversions to the St. Mary Canal were subsequently shut-off for repairs to the St. Mary Siphon. Diversions resumed on April 10 (1.4 m³/s; 50 cfs) and ramped-up to maximum diversion on April 16 (17.0 m³/s; 600 cfs). The maximum diversion to the St. Mary Canal was maintained from April 16 to June 17. On June 17 diversions to the St. Mary Canal were shut-off due to failure of the St. Mary Siphon. Table 7 shows the start-up and shut-down dates of the St. Mary/Milk River Diversion since 2006.

Table 7 - St. Mary/Milk River Diversion start-up and shut-down dates for the 2006 through 2024 monitoring period.

Year	Start Date	End Date
2006	March 05	September 24
2007	March 07	September 03
2008	March 17	September 12
2009	March 16	September 24
2010	March 21	September 03
2011	July 24	October 06
2012	April 9	September 15
2013	March 11	September 24
2014	May 13	September 10
2015	March 31	August 28
2016	March 22	September 10
2017	March 22	September 22
2018	May 9	September 28
2019	April 8	September 27
2020 ^a	March 31	October 31
2021	March 22	September 16
2022	March 15	September 30
2023 ^b	April 25	September 1
2024 ^b	April 10	June 17

^aDue to a drop structure failure, there was no diversion to the St. Mary Canal from May 17 to October 7, 2020.

^bInitiated on April 5 and shut down on April 11th, restarted April 25 after repairs to gate were made (2023); Initiated March 25, but restarted on April 10 after repairs to the St. Mary Diversion siphon were made (2024).

3.4.2 Streamflow

Mean daily streamflow data for 2023 and 2024 is shown in Figures 2 to Figure 5 at four Milk River sites. Refer to Figure 1 for gauging station locations.

At ‘Milk River at Western Crossing of International Boundary’ the streamflow is not augmented by the St. Mary diversion; therefore, flows are always natural. For the period April 1 to October 31, the median streamflow was 0.07 m³/s (range: 0.00-18.30 m³/s) in 2023, and 0.02 m³/s (range: 0.00-10.60 m³/s) in 2024 (Figure 2). The maximum flow (18.30 m³/s) occurred on April 11, 2023, and on May 10, 2024 (10.60 m³/s). In 2023, the maximum flow of 18.3 m³/s (April 11) resulted from snowmelt after 6 days (April 6 to 11) with daytime air temperature ranging from 7.9 to 18.8°C (Del Bonita AGDM weather station). A smaller peak flow of 6.34 m³/s (June 11) resulted from 22.6 mm of rainfall on June 9 (Del Bonita AGDM weather station). The peak flow in 2024 of 10.6 m³/s (May 10) occurred after a total of 40.3 mm of rainfall on May 7 and 8 (Del Bonita AGDM weather station). In 2023, a recorded flow of 0.00 m³/s occurred on eighty-four (84) consecutive days, from July 27 to October 18. Zero flow was also recorded from July 24 to August 11, 2024; 19 days). Following August 11, there were no flows recorded at this station, or flows observed on the sample dates. There was no flow data after October 31 in either 2023 or 2024 as the streamflow gauging station stopped operation. The April to October total discharge in 2023 was 24,341 dam³ and 14,940 dam³ in 2024, compared to 27,680 dam³ (2022), 19,366 dam³ (2021), 52,423 dam³ (2020), and 47,458 dam³ (2019)². Total discharge in 2023 and 2024 were the third lowest and the lowest, respectively, from 2019 to 2024.

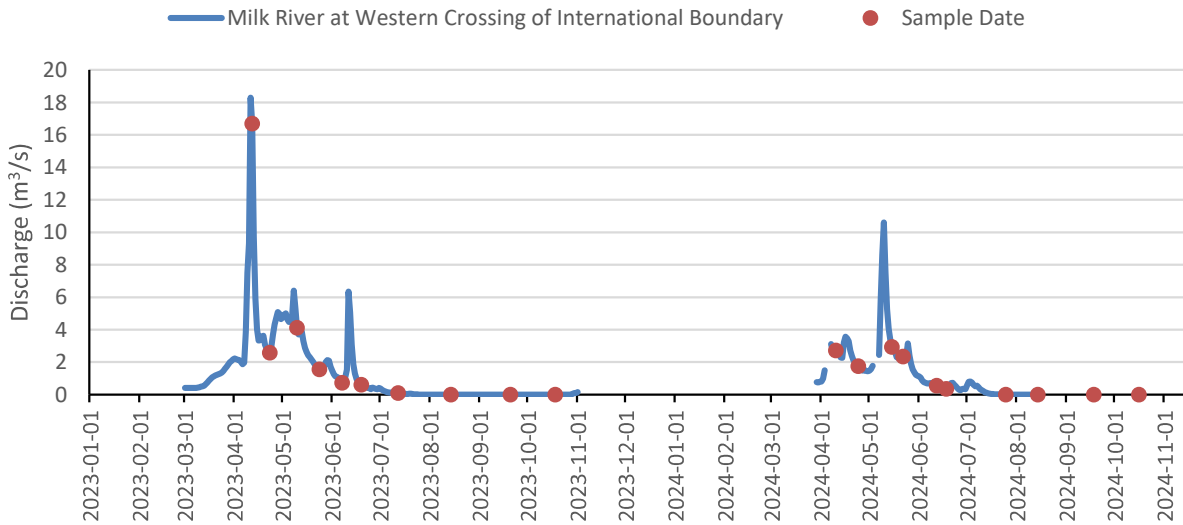


Figure 2. Discharge at the Station 11AA025: Milk River at Western Crossing of International Boundary, 2023 and 2024 (EPA 2025; NRT (WSC) data). Discharge represents natural flow only.

² dam³ (cubic decameter): 1 dam³ = 1,000 m³ or 1,000,000 litres

At ‘North Milk River near International Boundary’, for the period April 1 to October 31, median flow was 12.25 m³/s (range: 0.17-17.60 m³/s) in 2023, and 0.27 m³/s (0.11-20.40 m³/s) in 2024. There was a false start to the season in 2023, with flows ramping up to 10.50 m³/s before water was shut off for maintenance on April 11. The second start up in 2023 occurred on May 17 when flows were already quite high (14.80 m³/s) from 18.7 mmm of rainfall between May 6 and 11 (Del Bonita AGDM weather station) (Figure 3). In 2024, peak flow occurred on May 9 (20.40 m³/s) after a total of 40.3 mm of rainfall on May 7 and 8 (Del Bonita AGDM weather station). On June 17, 2024 there was a siphon failure at the St. Mary Diversion that ended the diversion period for the season (Figure 3). In 2024, there was little precipitation to augment flows. The April to October total discharge in 2024 was 92,474 dam³ compared to 166,367 dam³ (2023), 259,900 dam³ (2022), 236,044 dam³ (2021), 53,072 dam³ (2020) and 220,510 dam³ (2019). Total discharge in 2022 was the highest recorded from 2019 to 2024. The lowest total discharge occurred in 2020 due to a drop structure failure resulting in no water diversion to the St. Mary Canal from May 17 to October 7, 2020. The second lowest total discharge occurred in 2024 when the St. Mary River Diversion siphon failed on June 17.

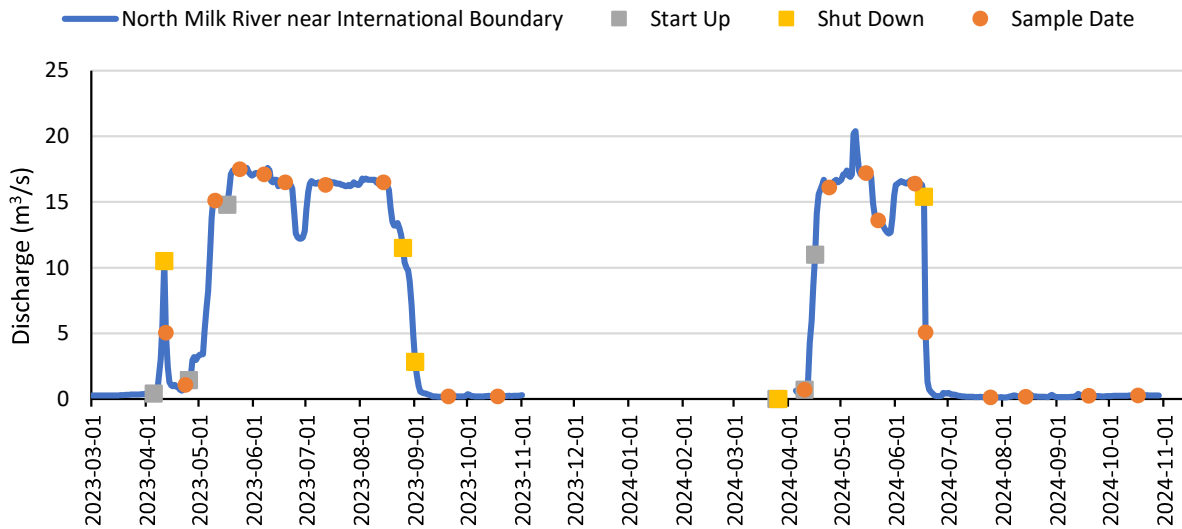


Figure 3. Discharge at the Station 11AA001: North Milk River near International Boundary, 2023 and 2024 (EPA 2025; NRT (WSC) data).



Water sampling at the site Milk River u/s Milk River in July 2024.
Photo Credit: W. King

At 'Milk River at Milk River', for the period April 1 to October 31, median flow was 13.2 m³/s (range: 0.32-33.4 m³/s) in 2023, and 0.369 m³/s (0.002-35.7 m³/s) in 2024. There was a false start to the season in 2023, with flows increasing to 29.50 m³/s before water was shut off for maintenance on April 11. The peak flow occurred just after the April 11 shut down (April 12: 33.40 m³/s) and resulted from a combination of diversion water and snowmelt after 8 days (April 5 to 12) with daytime air temperature ranging from 6.1 to 22.9°C (Milk River weather station). The second start up in 2023 occurred on May 17 at which time the flow had receded to 4.79 m³/s (Figure 3). In 2024, peak flow occurred on May 9 (35.70 m³/s) resulting from the 67.9 mm of rainfall that occurred on May 7 and 8 (Milk River weather station). On June 17, 2024 there was a siphon failure at the St. Mary Diversion that ended the diversion period for the season (Figure 3). The April to October total discharge in 2024 was 115,016 dam³ compared to 190,427 dam³ (2023) 288,400 dam³ (2022), 252,570 dam³ (2021), 106,158 dam³ (2020) and 259,300 dam³ (2019). Total discharge was highest in 2022 for the period 2019 to 2024. The lowest total discharge occurred in 2020 and second lowest occurred in 2024 as described previously.

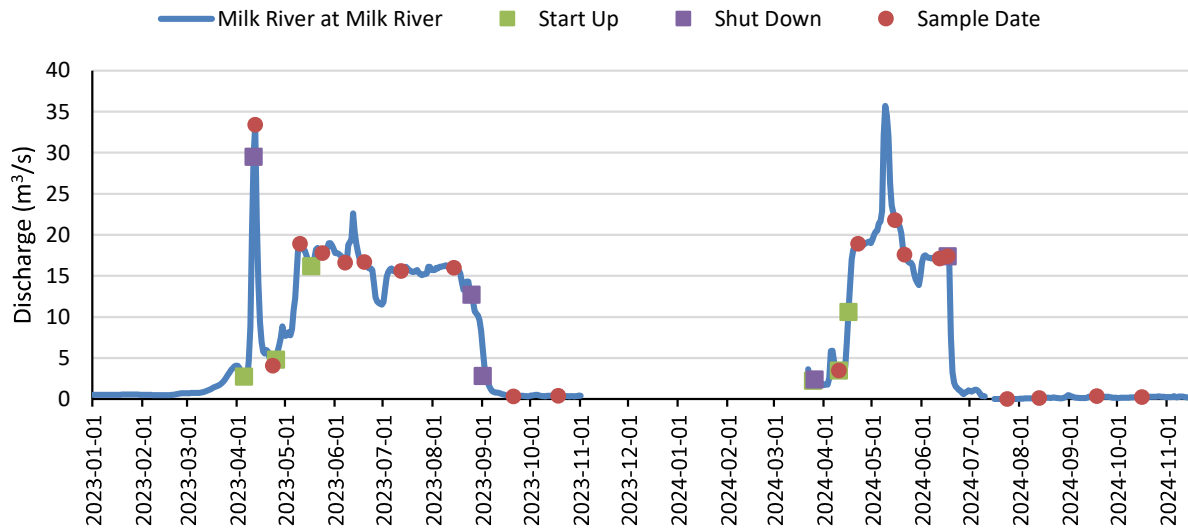


Figure 4. Discharge at Station 11AA005: Milk River at Milk River, 2023 and 2024 (EPA 2025; NRT (WSC) data).



At ‘Milk River at Eastern Crossing of International Boundary’, for the period April 1 to October 31, median flow was 12.7 m³/s (range: 0.39-22.50 m³/s) in 2023, and 0.583 m³/s (0.00-36.60 m³/s) in 2024. In 2023, flow data was not available for the period April 1 to April 19 (Figure 5). The eastern part of the watershed did not receive the early rainfall that the western part did (Figures 2-4), and peak flow occurred on June 15, 2023 (22.50 m³/s). In 2024, peak flow occurred on May 8 (36.60 m³/s) due to 67.9 mm of rainfall at Milk River on May 7 and 8 (Milk River weather station) and 51 mm of rainfall at Onefour on May 6 and 7 (Onefour weather station). On June 17, 2024 there was a siphon failure at the St. Mary Diversion that ended the diversion period for the season (Figure 3). A small increase in flow occurred on September 19, 2024 (5.36 m³/s), resulting from 48.6 mm of rainfall at Onefour between September 12 and 18 (Onefour weather station). Total discharge was 113,075 dam³ in 2024 and 158,720 dam³ in 2023.

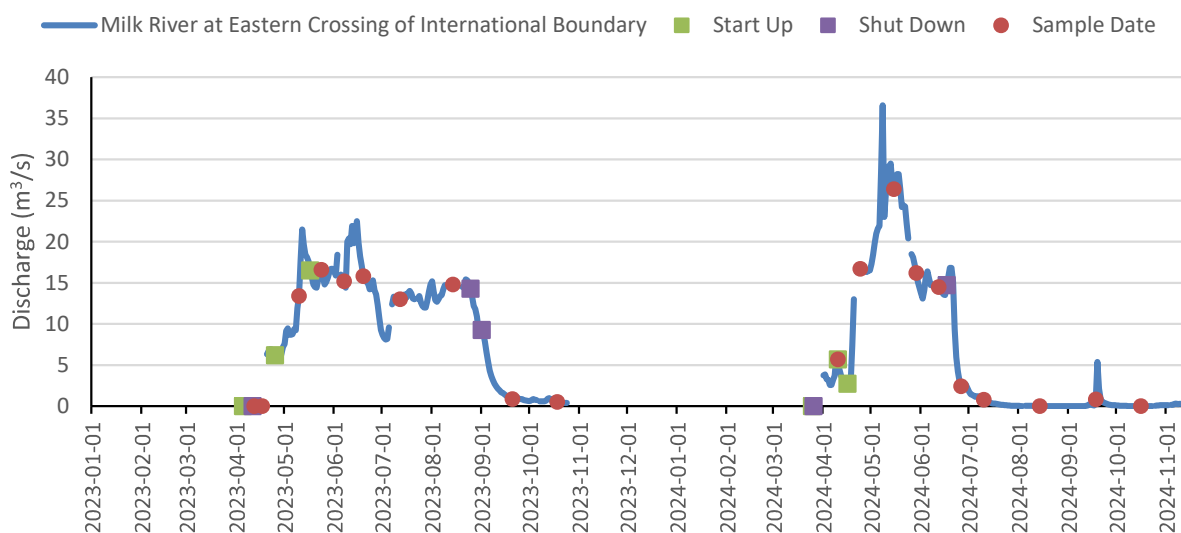


Figure 5. Discharge at Station 11AA031: Milk River at Eastern Crossing of International Boundary, 2023 and 2024 (EPA 2025; NRT (USGS) data).

3.4.3 General Water Chemistry

Water chemistry parameters are presented in Table 8. Note that while water chemistry results from 2021 and 2022 are presented in the tables, they are generally not discussed in detail in the result summaries. In 2023, median water temperature ranged from 10.5°C at the North Fork at 501 site to 13.8°C at the HWY 880 site. In 2024, median water temperature ranged from 10.6°C at the North Fork at 501 site to 16.2°C at the Pinhorn site. Maximum water temperatures were highest in 2024 compared to the 2019 to 2023 period likely due to low flows caused by the siphon failure (Table 8).

In 2023, median dissolved oxygen concentration ranged from 10.74 mg/L at the U/S Milk River site to 11.48 mg/L at the Pinhorn site (Table 8). In 2024, median dissolved oxygen concentration ranged from 10.75 mg/L at the HWY 880 site to 11.33 mg/L at the North Milk River at 501 site (Table 8). In 2023 and 2024, all samples met the acute daily minimum guideline (≥ 5 mg/L) and the chronic guideline (≥ 6.5 mg/L) at all Milk River sites.

Table 8 - Summary (median and range) of general water quality parameters at the Milk River, 2021 to 2024.

Site	Water Temperature (°C)											
	2021			2022			2023			2024		
	N	Median	Range	N	Median	Range	N	Median	Range	N	Median	Range
N. Fork at 501	10	11.7	0.4-18.1	10	11.2	2.8-17.9	10	10.5	0.8-17.3	10	10.6	4.5-20.5
Milk R. at 501	6	10.4	4.5-22.3	9	12.1	2.8-17.0	7	11.5	2.1-19.0	7	11.1	6.0-19.2
U/S Milk River	9	13.7	3.8-20.4	10	13.0	3.4-19.3	10	12.7	2.0-20.4	10	12.8	6.5-23.4
HWY 880	10	13.9	0.8-20.5	10	12.6	3.9-21.8	10	13.8	5.2-20.4	10	12.9	5.7-21.0
Pinhorn	8	14.5	0.6-20.3	10	12.4	2.9-21.5	10	13.5	5.7-20.2	10	16.2	5.1-22.7

Site	Dissolved Oxygen (mg/L)											
	2021			2022			2023			2024		
	N	Median	Range	N	Median	Range	N	Median	Range	N	Median	Range
N. Fork at 501	10	10.41	9.47-14.07	9	11.98	10.64-15.50	10	11.16	9.67-15.12	10	11.33	10.06-14.85
Milk River at 501	6	10.00	9.33-13.10	9	11.45	9.39-14.96	7	10.90	10.09-13.60	7	10.88	9.92-13.13
U/S Milk River	9	9.59	8.21-12.90	9	11.16	9.37-13.47	10	10.74	9.17-13.32	10	10.80	8.71-13.53
HWY 880	10	9.65	8.14-12.97	10	11.00	9.27-13.93	10	10.80	9.11-12.00	10	10.75	7.35-13.84
Pinhorn	8	8.93	7.98-13.30	10	11.90	9.75-14.70	10	11.48	9.57-14.50	10	10.80	10.26-13.82

Site	pH											
	2021			2022			2023			2024		
	N	Median	Range	N	Median	Range	N	Median	Range	N	Median	Range
N. Fork at 501	10	8.09	7.31-8.41	10	8.11	7.66-8.27	10	8.14	8.00-8.30	10	8.30	8.00-8.60
Milk R. at 501	6	8.34	8.12-8.64	9	8.30	8.17-8.58	7	8.39	7.92-8.58	7	8.60	8.17-8.93
U/S Milk River	10	8.25	7.42-8.38	10	8.04	7.82-8.28	10	8.10	7.87-8.28	10	8.14	8.03-8.60
HWY 880	10	8.10	7.51-8.49	10	8.10	7.74-8.49	10	8.11	7.90-8.38	10	8.31	7.82-8.57
Pinhorn	8	8.23	7.55-8.48	10	8.20	7.53-8.43	10	8.36	7.98-8.64	10	8.56	8.30-8.71



Algae growing on rocks during low flow in the Milk River. Photo Credit: S. Riemersma

The pH guideline for the protection of aquatic life is ≥ 6.5 and ≤ 9.0 (GoA 2018). The median pH values ranged from 8.10 to 8.39 in 2023, and from 8.14 to 8.60 in 2024. These values were within guideline for the protection of aquatic life at all Milk River sites in both years. No individual sample exceeded the guideline (Table 8). Median pH values were somewhat higher at all the Milk River sites in 2024 compared to previous years (Table 8).

Specific conductivity was lowest during the diversion period. In 2023, during diversion, median conductivity was lowest at the North Fork at 501 site (149 $\mu\text{S}/\text{cm}$) and highest at the Pinhorn site (255 $\mu\text{S}/\text{cm}$). During natural flow, median specific conductivity ranged from 422 $\mu\text{S}/\text{cm}$ at the North Fork at 501 site to 800 $\mu\text{S}/\text{cm}$ at the HWY 880 site (Table 9). In 2024, during diversion, median conductivity was lowest at the U/S Milk River site (194 $\mu\text{S}/\text{cm}$) and highest at the North Fork at 501 site (306 $\mu\text{S}/\text{cm}$). During natural flow, median specific conductivity ranged from 474 $\mu\text{S}/\text{cm}$ at the North Fork at 501 site to 1,139 $\mu\text{S}/\text{cm}$ at the HWY 880 site (Table 9). At the Milk River at 501 site the median specific conductivity was 430 $\mu\text{S}/\text{cm}$ (2023) and 498 $\mu\text{S}/\text{cm}$ (2024).

The WQO-50 and WQO-90 objectives for specific conductivity were met at all Milk River sites in 2023 during both natural and diversion flow (Table 9) and tied 2022 for the highest compliance from 2021 to 2024. In 2023, all of the samples from the Milk River sites met the provincial guideline for safe irrigation ($\leq 1,000$ $\mu\text{S}/\text{cm}$).

During diversion in 2024, the WQO-50 and WQO-90 objectives for specific conductivity were not met at the North Fork at 501 site, and the WQO-50 was in the cautionary range at the Pinhorn site (Table 9). Both objectives were also not met at the HWY 880 and Pinhorn sites in 2024 during natural flow, and the WQO-90 was in the cautionary range for the North Fork at 501 site (Table 9). The year 2024 had the lowest compliance compared to previous years (2021-2023). In 2024, during natural flow, 4 of 5 samples (80%) at the HWY 880 site, and 3 of 6 samples (50%) at the Pinhorn site did not meet the provincial guideline for safe irrigation ($\leq 1,000$ $\mu\text{S}/\text{cm}$). All other samples collected at the remaining upstream sites met the guideline.

Table 9 - Summary of specific conductivity ($\mu\text{S}/\text{cm}$) at the Milk River, 2021 to 2024.

Site	Flow Period	WQO		2021			2022			2023			2024						
		WQO-50	WQO-90	N	50 th	90 th	Range	N	50 th	90 th	Range	N	50 th	90 th	Range				
N. Fork at 501	Diversion	165	246	9	161	176	136-180	9	151	172	136-176	7	149	204	140-242	4	306	480	151-498
	Natural	445	512	1	435	--	435	1	422	--	422	3	422	431	411-433	6	474	587	381-618
Milk R. at 501	Natural	510	882	6	476	508	418-522	9	433	669	368-1,009	7	430	510	266-596	7	498	556	440-618
	Diversion	210	398	9	223	262	152-350	9	193	211	150-223	7	182	270	161-274	5	194	259	177-262
U/S Milk River	Natural	570	674	1	267	--	267	1	469	--	469	3	483	520	472-529	5	581	689	516-696
	Diversion	250	540	9	214	254	176-270	9	215	244	179-248	7	249	359	189-392	5	227	331	150-357
HWY 880	Natural	727	936	1	895	--	895	1	625	--	625	3	800	915	439-944	5	1,139	1,268	583-1,314
	Diversion	250	540	7	236	287	192-299	9	235	268	176-278	7	255	398	198-402	4	296	380	188-397
Pinhorn	Natural	727	936	1	873	--	873	1	659	--	659	3	765	961	649-1,010	6	1,008	1,505	582-1,600

If the measured 50th (median) or 90th percentile value is $\leq 10\%$ above the WQO it is considered to meet the WQO (**Green**); if the value is $>10\%$ but $\leq 20\%$ above the WQO, it is considered within the normal but cautionary range (**Orange**); if the measured value is $>20\%$ above the WQO, it exceeds the WQO (**Red**).

3.4.4 Nutrients

Total Phosphorus (TP)

In 2023 and 2024, TP in the Milk River tended to increase in the downstream direction during diversion flow. During the diversion period in 2023, median TP concentration ranged from 0.007 mg/L at the North Fork at 501 site to 0.118 mg/L at the Pinhorn site (Table 10). During diversion in 2023, the median TP did not meet the WQO-50 at the Pinhorn site, and the WQO-90 was not met at the U/S Milk River, HWY 880 or Pinhorn sites. In 2023, during natural flow, median TP ranged from 0.004 mg/L at the North Fork at 501 site and HWY 880 sites to 0.035 mg/L at the U/S Milk River site. In the same year, the U/S Milk River site was the only site that did not meet the WQO-50, and the WQO-90 was not met at the Milk River at 501, HWY 880 and the Pinhorn sites.

During the diversion period in 2024, median TP concentration ranged from 0.010 mg/L at the North Fork at 501 site to 0.146 mg/L at the Pinhorn site (Table 10). During natural flow in the same year, median TP ranged from 0.006 mg/L at the North Fork at 501 and U/S Milk River sites to 0.015 mg/L at the Pinhorn site. In 2024, the Pinhorn site was the only site that did not meet the WQO-50 during the diversion, and all sites met the WQO-90. During natural flow in the same year, the WQO-50 was met at all sites except the Pinhorn which was in the cautionary range; the Pinhorn site was the only site that did not meet the WQO-90 objective during the natural flow period (Table 10).

Total Dissolved Phosphorus (TDP)

During diversion in 2023, median TDP concentration ranged from 0.002 mg/L at the North Fork at 501 and U/S Milk River sites to 0.004 mg/L at the Pinhorn site (Table 11). In the same year, during diversion, TDP met the WQO-50 at all sites, and did not meet the WQO-90 at the North Fork at 501, U/S Milk River, the HWY 880, and Pinhorn sites. During natural flow period in 2023, median TDP concentration ranged from 0.002 mg/L at the North Fork Milk River, U/S Milk River and Hwy 880 sites to 0.008 mg/L at the Pinhorn site (Table 11). In 2023, the WQO-50 for TDP was met at all sites during natural flow except the Pinhorn site (cautionary at the Milk River at 501 site), and the WQO-90 was met at all sites except at the Milk River at 501 site (Table 11).

During the diversion period in 2024, median TDP concentration ranged from 0.002 mg/L at the North Fork at 501, U/S Milk River, and HWY 880 sites to 0.006 mg/L at the Pinhorn site (Table 11). In the same year, the TDP WQO-50 was met at all sites except for the Pinhorn site, and met the WQO-90 at all sites during the diversion except the U/S Milk River site. During natural flow in 2024, the median TDP concentration ranged from 0.002 mg/L at the North Fork Milk River, U/S Milk River and HWY 880 sites to 0.006 mg/L at the Milk River at 501 site. In the same year, during natural flow, the WQO-50 and WQO-90 were met at all sites except the WQO-90 at the Milk River at 501 site.

Table 10 - Summary of total phosphorus concentrations (mg/L) at the Milk River, 2021 to 2024.

Site	Flow Period	WQO			2021			2022			2023			2024					
		WQO-50 th	WQO-90 th	N	50 th	90 th	Range	N	50 th	90 th	Range	N	50 th	90 th	Range				
N. Fork at 501	Diversion	0.014	0.037	9	0.003	0.030	0.003-0.053	9	0.012	0.049	0.004-0.064	7	0.007	0.017	0.001-0.027	4	0.010	0.012	0.002-0.013
	Natural	0.012	0.100	1	0.003	--	0.003	1	0.005	--	0.005	3	0.004	0.015	0.004-0.018	6	0.006	0.098	0.003-0.160
Milk R. at 501	Natural	0.019	0.186	6	0.016	0.031	0.007-0.040	9	0.025	0.098	0.015-0.220	7	0.011	0.409	0.005-0.946	7	0.011	0.087	0.006-0.160
	Diversion	0.044	0.148	9	0.023	0.112	0.011-0.214	9	0.034	0.094	0.015-0.130	7	0.030	0.440	0.007-0.984	5	0.035	0.108	0.005-0.140
U/S Milk River	Natural	0.013	0.504	1	0.006	--	0.006	1	0.006	--	0.006	3	0.035	0.042	0.005-0.044	5	0.006	0.019	0.002-0.028
	Diversion	0.088	0.220	9	0.063	0.176	0.005-0.322	9	0.075	0.134	0.048-0.160	7	0.071	0.395	0.007-0.748	5	0.072	0.188	0.054-0.220
HWY 880	Natural	0.013	0.086	1	0.003	--	0.003	1	0.006	--	0.006	3	0.004	0.105	0.004-0.130	5	0.009	0.026	0.007-0.034
	Diversion	0.088	0.220	7	0.099	0.196	0.023-0.202	9	0.101	0.298	0.065-0.402	7	0.118	0.445	0.004-0.902	4	0.146	0.222	0.074-0.226
Pinhorn	Natural	0.013	0.086	1	0.003	--	0.003	1	0.008	--	0.008	3	0.010	0.326	0.003-0.405	6	0.015	0.391	0.004-0.754

If the measured 50th (median) or 90th percentile value is ≤10% above the WQO it is considered to meet the WQO (Green); if the value is >10% but ≤20% above the WQO, it is considered within normal but cautionary range (Orange); if the measured value is >20% above the WQO, it exceeds the WQO (Red).

Table 11 - Summary of total dissolved phosphorus concentrations (mg/L) at the Milk River, 2021 to 2024.

Site	Flow Period	WQO			2021			2022			2023			2024					
		WQO-50 th	WQO-90 th	N	50 th	90 th	Range	N	50 th	90 th	Range	N	50 th	90 th	Range				
N. Fork at 501	Diversion	0.003	0.007	9	0.003	0.003	0.002-0.003	9	0.002	0.003	0.001-0.008	7	0.002	0.030	0.001-0.071	4	0.002	0.003	0.002-0.003
	Natural	0.005	0.066	1	0.003	--	0.003	1	0.004	--	0.004	3	0.002	0.005	0.002-0.006	6	0.002	0.042	0.002-0.065
Milk R. at 501	Natural	0.006	0.015	6	0.006	0.007	0.002-0.007	9	0.004	0.011	0.002-0.012	7	0.007	0.030	0.002-0.059	7	0.006	0.030	0.002-0.065
	Diversion	0.003	0.010	9	0.003	0.004	0.002-0.008	9	0.002	0.004	0.001-0.008	7	0.002	0.031	0.001-0.067	5	0.002	0.020	0.002-0.032
U/S Milk River	Natural	0.005	0.173	1	0.003	--	0.003	1	0.002	--	0.002	3	0.002	0.010	0.002-0.012	5	0.002	0.007	0.002-0.011
	Diversion	0.004	0.011	9	0.003	0.006	0.002-0.009	9	0.002	0.006	0.001-0.013	7	0.003	0.021	0.002-0.046	5	0.002	0.010	0.002-0.014
HWY 880	Natural	0.004	0.021	1	0.003	--	0.003	1	0.002	--	0.002	3	0.002	0.020	0.002-0.025	5	0.002	0.022	0.002-0.034
	Diversion	0.004	0.011	7	0.005	0.007	0.003-0.003	9	0.011	0.082	0.003-0.102	7	0.004	0.037	0.003-0.049	4	0.006	0.008	0.004-0.009
Pinhorn	Natural	0.004	0.021	1	0.003	--	0.003	1	0.007	--	0.007	3	0.008	0.011	0.004-0.011	6	0.004	0.012	0.002-0.012

If the measured 50th (median) or 90th percentile value is ≤10% above the WQO it is considered to meet the WQO (Green); if the value is >10% but ≤20% above the WQO, it is considered within normal but cautionary range (Orange); if the measured value is >20% above the WQO, it exceeds the WQO (Red).

Total Nitrogen (TN)

During diversion in 2023, median total nitrogen concentrations ranged from 0.127 mg/L at the North Fork at 501 site to 0.410 mg/L at the Pinhorn site (Table 12). During diversion in 2023, the WQO-50 for TN was met at all sites except the Pinhorn site which was in the cautionary range, and the WQO-90 was not met at any site. During natural flow in 2023, median TN ranged from 0.193 mg/L at the Pinhorn site to 0.480 mg/L at the Milk River at 501 site (Table 12). In 2023, during natural flow, the WQO-50 for total nitrogen was met at all Milk River sites, and the WQO-90 was met at all sites except the Milk River at 501 site which was in the cautionary range.

During diversion in 2024, median TN concentrations ranged from 0.220 mg/L at the U/S Milk River site to 0.516 mg/L at the Pinhorn site. During diversion in 2024, the WQO-50 for TN was met at all sites except the Pinhorn site, and the WQO-90 was met at all sites except the Pinhorn which was in the cautionary range (Table 12). During natural flow in 2024, median TN ranged from 0.330 mg/L at the U/S Milk River site to 0.531 mg/L at the Pinhorn site. In 2024, during natural flow, the WQO-50 was not met at the Pinhorn site, and the HWY 880 site was in the cautionary range; the WQO-90 was not met at the North Fork at 501 site, and was in the cautionary range for the Milk River at 501 site.

3.4.5 Total Suspended Solids

Total Suspended Solids concentrations at the Milk River sites ranged from 1 to 2,640 mg/L in 2023 and from 1-1,770 mg/L in 2024.

During diversion in 2023, the median TSS concentrations ranged from 17 mg/L at the North Fork at 501 site to 200 mg/L at the HWY 880 site (Table 13). During the 2023 diversion, the WQO-50 was met at all sites except the HWY 880 and Pinhorn sites, and the WQO-90 was not met at any sites. During natural flow in 2023, median TSS concentrations ranged from 1 mg/L at HWY 880 to 35 mg/L at the U/S Milk River site (Table 13). During natural flow in 2023, the WQO-50 for TSS was not met at the U/S Milk River site, and the WQO-90 was not met at the Milk River at 501 site.

During diversion in 2024, the median TSS concentrations ranged 9 mg/L at the North Fork at 501 site to 212 mg/L at the Pinhorn site. During diversion in the same year, the WQO-50 for TSS was met at all sites except the Pinhorn site, and the WQO-90 was met at all sites. During natural flow in 2024, median TSS concentrations ranged from 3 mg/L at the U/S Milk River site to 8 mg/L at the Pinhorn site. During natural flow in the same year, the WQO-50 for TSS was met at all sites, and the WQO-90 was met at all sites except the Pinhorn site (Table 13).

Table 12 - Summary of total nitrogen concentrations (mg/L) at Milk River, 2021 to 2024.

Site	Flow Period	WQO		2021			2022			2023			2024						
		WQO-50	WQO-90	N	50th	90th	Range	N	50th	90th	Range	N	50th	90th	Range				
N. Fork at 501	Diversion	0.240	0.468	9	0.122	0.303	0.024-0.353	9	0.150	0.338	0.028-0.370	7	0.127	0.563	0.074-1.093	4	0.237	0.354	0.081-0.360
	Natural	0.900	1.578	1	0.339	--	0.399	1	0.240	--	0.240	3	0.280	0.408	0.250-0.440	6	0.440	2.905	0.270-3.300
Milk R. at 501	Natural	0.600	1.360	6	0.201	0.428	0.111-0.491	9	0.463	0.728	0.054-0.760	7	0.480	1.522	0.325-2.936	7	0.360	1.632	0.316-3.300
	Diversion	0.325	0.667	9	0.271	0.797	0.111-1.101	9	0.260	0.388	0.120-0.419	7	0.300	1.466	0.096-3.094	5	0.220	0.420	0.095-0.470
U/S Milk River	Natural	0.680	1.637	1	0.111	--	0.111	1	0.210	--	0.210	3	0.400	0.520	0.280-0.550	5	0.330	0.658	0.270-0.720
	Diversion	0.365	0.668	9	0.371	0.754	0.111-1.249	9	0.340	0.514	0.130-0.571	7	0.280	1.424	0.190-2.660	5	0.340	0.707	0.200-0.750
HWY 880	Natural	0.320	1.400	1	0.490	--	0.490	1	0.190	--	0.190	3	0.230	0.766	0.220-0.900	5	0.360	0.453	0.270-0.515
	Diversion	0.365	0.668	7	0.421	0.579	0.111-0.685	9	0.437	1.764	0.213-4.231	7	0.410	1.165	0.170-2.223	4	0.516	0.771	0.272-0.811
Pinhorn	Natural	0.320	1.400	1	0.271	--	0.271	1	0.161	--	0.161	3	0.193	0.392	0.180-0.441	6	0.531	1.473	0.223-2.353

If the measured 50th (median) or 90th percentile value is ≤10% above the WQO it is considered to meet the WQO (Green); if the value is >10% but ≤20% above the WQO, it is considered within the normal but cautionary range (Orange); if the measured value is >20% above the WQO, it exceeds the WQO (Red).

Table 13 - Summary of total suspended solids concentrations (mg/L) at Milk River, 2021 to 2024.

Site	Flow Period	WQO		2021			2022			2023			2024						
		WQO-50	WQO-90	N	50th	90th	Range	N	50th	90th	Range	N	50th	90th	Range				
N. Fork at 501	Diversion	16	59	9	13	58	3-162	9	17	101	5-144	7	17	92	7-141	4	9	10	6-10
	Natural	5	55	1	2	--	2	1	5	--	5	3	2	5	1-6	6	4	7	1-7
Milk R. at 501	Natural	14	247	6	17	50	6-61	9	24	142	3-330	7	7	444	2-1,060	7	7	36	2-42
	Diversion	56	282	9	46	184	18-359	9	54	146	20-180	7	58	688	25-1,280	5	52	244	41-350
U/S Milk River	Natural	7	267	1	2	--	2	1	1	--	1	3	35	46	20-49	5	3	12	2-17
	Diversion	131	384	9	95	257	7-483	9	124	200	2-210	7	200	1,273	67-2,640	5	110	312	67-390
HWY 880	Natural	13	228	1	2	--	2	1	2	--	2	3	1	71	1-88	5	5	18	4-26
	Diversion	131	384	7	136	297	45-335	9	149	473	89-657	7	190	792	105-1,640	4	212	327	102-330
Pinhorn	Natural	13	228	1	2	--	2	1	2	--	2	3	6	28	2-34	6	8	907	2-1,770

If the measured 50th (median) or 90th percentile value is ≤10% above the WQO it is considered to meet the WQO (Green); if the value is >10% but ≤20% above the WQO, it is considered within the normal but cautionary range (Orange); if the measured value is >20% above the WQO, it exceeds the WQO (Red).

3.4.6 Fecal Coliform Bacteria (FCB)

The FCB at the Milk River sites ranged from 5 to 316 cfu/100 mL in 2023 and from 1 to 24,000 cfu/100 mL in 2024.

During diversion in 2023, median FCB counts ranged from 42 cfu/100 mL at the U/S Milk River site to 112 cfu/100 mL at the HWY 880 site (Table 14). In the same year, during diversion, the median FCB counts did not meet the WQO-50 objective at the North Fork at 501 and HWY 880 sites, but met the WQO-90 objective at all sites. During natural flow in 2023, median FCB counts ranged from 21 cfu/100 mL at the North Fork at 501 site to 180 cfu/100 mL at the HWY 880 site. During natural flow in the same year, the FCB WQO-50 was not met at the Milk River at 501, HWY 880, and Pinhorn sites, and the U/S Milk River site was in the cautionary range; the WQO-90 was met at all sites except HWY 880 which was in the cautionary range (Table 14).

During diversion in 2024, median FCB counts ranged from 10 cfu/100 mL at the U/S Milk River site to 61 cfu/100 mL at the Pinhorn site (Table 14). In the same year, during diversion, the WQO-50 and WQO-90 objectives were met at all sites. During natural flow in 2024, median FCB counts ranged from 30 cfu/100 mL at the U/S Milk River site to 200 at the HWY 880 site (Table 14). During natural flow in the same year, the FCB WQO-50 was not met at the North Fork at 501, HWY 880, and Pinhorn sites, and the WQO-90 was not met at the North Fork at 501, Milk River at 501, HWY 880 and Pinhorn sites.

All of the Milk River sites had a least one exceedance of the provincial irrigation guideline for FCB (100 cfu/100 mL) in 2023 and 2024.

2023

- North Fork at 501: 1/9 samples exceeded (April sample during diversion)
- Milk River at 501: 3/6 samples in June and July
- U/S Milk River: 1/9 samples exceeded (April sample during diversion)
- HWY 880: 6/10 samples with four during the diversion flow period
- Pinhorn: 2/10 samples both exceedances occurred during the diversion period

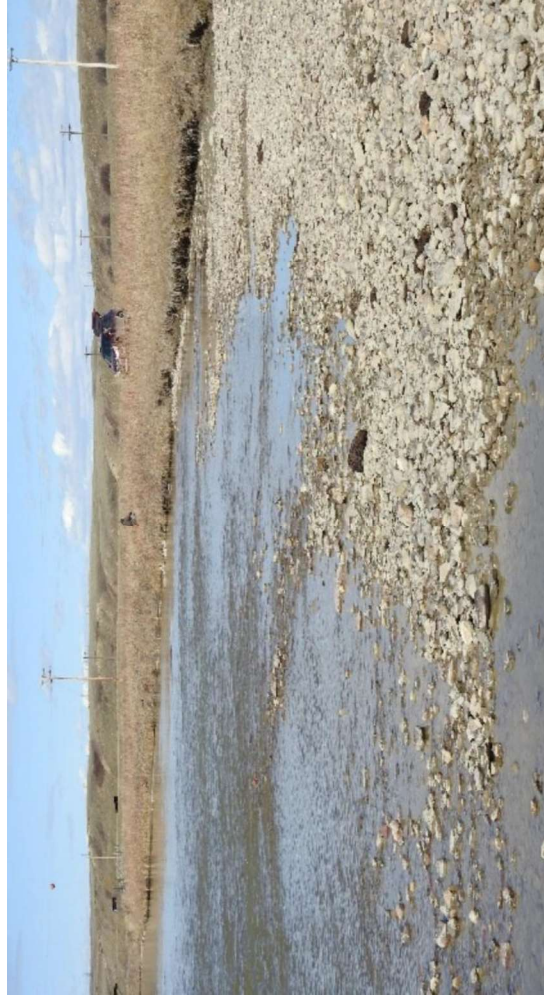
2024

- North Fork at 501: 4/10 samples, all exceedances during the natural flow period
- Milk River at 501: 2/7 samples, one in each of June and July
- U/S Milk River: 1/10 samples during the natural flow period
- HWY 880: 4/10 samples with three exceedances during the natural flow period
- Pinhorn: 4/10 samples with three exceedances during the natural flow period

Table 14 - Summary of fecal coliform bacteria counts (cfu/100 mL) at Milk River, 2021 to 2024.

Site	Flow Period	WQO		2021			2022			2023			2024						
		WQO-50	WQO-90	N	50th	90th	Range	N	50th	90th	Range	N	50th	90th	Range				
N. Fork at 501	Diversion	27	140	9	15	66	3-81	9	19	655	2-1,636	7	54	81	12-110	4	15	58	12-75
	Natural	55	668	1	3	--	3	1	7	--	7	3	21	32	6-35	6	120	12,087	4-24,000
Milk R. at 501	Natural	77	619	6	21	106	1-153	9	57	1,960	2-5,400	7	95	275	30-290	7	34	9,704	1-24,000
U/S Milk River	Diversion	68	272	9	24	119	5-204	9	15	485	4-1,545	7	42	108	23-135	5	10	34	3-50
	Natural	49	522	1	49	--	1	1	15	--	15	3	55	79	25-85	5	30	230	1-350
HWY 880	Diversion	78	280	9	48	136	9-187	9	29	168	4-280	7	112	169	10-200	5	54	95	18-115
	Natural	29	163	1	47	--	47	1	110	--	110	3	180	188	5-190	5	200	1,980	1-2,300
Pinhorn	Diversion	78	280	7	45	99	13-107	9	10	270	4-1,020	7	65	213	20-316	4	61	94	30-105
	Natural	29	163	1	12	--	12	1	3	--	3	3	38	47	36-49	6	100	2,955	4-5,600

If the measured 50th (median) or 90th percentile value is ≤10% above the WQO it is considered to meet the WQO (**Green**); if the value is >10% but ≤20% above the WQO, it is considered within the normal but cautionary range (**Orange**); if the measured value is >20% above the WQO, it exceeds the WQO (**Red**).



Milk River u/s Milk River in April 2024.
Photo Credit: William King

4.0 SUMMARY

Weather and Streamflow

- Overall, total precipitation (April-October) in the Milk River watershed in 2023 and 2024 varied moderately across the watershed, ranging from 164.4 mm at Del Bonita to 217.8 mm at Cardston in 2023, and from 223.9 mm at Cardston to 268.6 mm at Onefour in 2024. The 2024 year was a wetter year compared to 2023.
- In 2023, June was the wettest month (average = 58.4 mm) and April was the driest month (average = 11.1 mm). Based on average precipitation, 2023 was the third driest year of 10 years (2014 to 2023) and would be considered a low precipitation year. In 2024, May was the wettest month (average = 86.4mm) and October was the driest month (average = 3.0 mm). Based on average precipitation, 2024 was the fifth wettest year of 10 years (2015 to 2024).
- In 2023, the streamflow regime and volume discharge at the three Milk River sites augmented by the St. Mary Diversion were similar to the previous years 2021 and 2022. The flow regime in 2024 was substantially different compared to previous years due to the structural failure of the St. Mary River Diversion siphon in Montana that resulted in no diversion to the Milk River from June 17, 2024 to the end of the irrigation season.

Red Creek near Mouth

- Only the Red Creek near Mouth site was sampled at Red Creek in 2023 and 2024.
- The median dissolved oxygen concentration, and all samples collected in 2023 and 2024, complied with acute and chronic water quality guidelines.
- All pH samples, and the median value in 2023 (8.10) and 2024 (8.06), met the aquatic life guideline.
- The median conductivity in 2023 (2,731 $\mu\text{S}/\text{cm}$) and 2024 (2,724 $\mu\text{S}/\text{cm}$) did not meet safe irrigation guideline and would be considered unsuitable for irrigation.
- The median total phosphorus concentration in 2023 (0.016 mg/L) was the second lowest for the period 2017 to 2023 (the 2020 median was 0.006 mg/L). The median total phosphorus concentration in 2024 (0.013 mg/L) was the second lowest for the period 2017 to 2024.
- In 2023 and 2024, the median TSS concentration was 2.1 mg/L and 0.8 mg/L, respectively. TSS concentrations were low and similar to previous years. Median TSS concentrations have been stable since 2017 and have ranged between 0.8 and 4.8 mg/L.
- The median fecal coliform bacteria count (31 cfu/100mL) met the irrigation guideline in 2023 and was the third lowest since 2017. The median fecal coliform bacteria count (28 mg/L) met the irrigation guideline in 2024 and was also the third lowest since 2017. The maximum fecal coliform bacteria count at Red Creek in 2023 was 118 cfu/100 mL (June 15) and 55 cfu/100 mL (May 21) in 2024; these were the second lowest and lowest maximums, respectively, during the period 2017 to 2024.
- Two (2) of three total selenium samples collected in 2023, and all total selenium samples collected in 2024 (N=2), exceeded the chronic guideline for the protection of aquatic life.

Miners Coulee

- Three water samples were collected in each of May, June and July 2023, and one sample was collected in May 2024.
- The median dissolved oxygen concentration at Miners Coulee was 10.31 mg/L in 2023, and it was 10.66 mg/L on May 21, 2024. The dissolved oxygen samples met the acute and chronic guideline for protection of aquatic life.

- The median pH value in 2023 was 7.82, and it was 7.94 on May 21, 2024. All pH values met the aquatic life guideline at Miners Coulee in 2023 and 2024.
- At Miners Coulee, the median specific conductivity was 618 in 2023, and the value was 460 on May 21, 2024. All specific conductivity samples met the objective for safe irrigation.
- The median total phosphorus concentration at Miners Coulee in 2023 was 0.097 mg/L, and the concentration was 0.059 mg/L on May 21, 2024. These values were within the range of previous years.
- The median total suspended solids concentration at Miners Coulee in 2023 was 390 mg/L and the highest median of all years since 2018. The total suspended solids concentration was 3 mg/L on May 21, 2024 and similar to previous years with the exception of 2023.
- The median fecal coliform bacteria count at Miners Coulee in 2023 was 75 cfu/100 mL, and the count was 260 cfu/100 mL on May 21, 2024. One sample collected in 2023 (520 cfu/100 mL), and the sample collected in 2024, did not meet the irrigation guideline (≤ 100 cfu/100 mL).

Milk River Mainstem

- Surface water quality guidelines (GoA 2018), and Milk River Water Quality Objectives (WQOs) (PESL 2015) were used to determine water quality compliance at sites in 2023 and 2024 (i.e., WQO-50 [50th percentile or median] and WQO-90 [90th percentile]).
- pH and dissolved oxygen (median and all samples) met aquatic life guidelines at Milk River sites in 2023 and 2024.
- The WQO-50 and WQO-90 objectives for specific conductivity were met at all Milk River sites in 2023 during both natural and diversion flow. The year 2023 tied 2022 for the highest compliance from 2021 to 2023. In 2023, all samples from the Milk River sites met the provincial guideline for safe irrigation ($\leq 1,000$ $\mu\text{S}/\text{cm}$). The year 2024 had the lowest compliance compared to previous years (2021-2023). In 2024, during natural flow, 4 of 5 samples (80%) at the HWY 880 site, and 3 of 6 samples (50%) collected at the Pinhorn site did not meet the provincial guideline for safe irrigation ($\leq 1,000$ $\mu\text{S}/\text{cm}$). All other samples collected at the upstream sites met the guideline.
- During diversion in 2023, the median TP did not meet the WQO-50 at the Pinhorn site, and the WQO-90 was not met at the U/S Milk River, HWY 880 or Pinhorn sites. In 2023, during natural flow, the U/S Milk River site was the only site that did not meet the WQO-50, and the WQO-90 was not met at the Milk River at 501, HWY 880 and the Pinhorn sites. In 2024, the Pinhorn site was the only site that did not meet the TP WQO-50 during the diversion, and all sites met the WQO-90. In 2024, during natural flow, the TP WQO-50 was met at all sites except the Pinhorn which was in the cautionary range; the Pinhorn site was the only site that did not meet the WQO-90 objective during natural flow.
- During diversion in 2023, the WQO-50 for TN was met at all sites except the Pinhorn site which was in the cautionary range, and the WQO-90 was not met at any site. In 2023, during natural flow, the WQO-50 for TN was met at all Milk River sites, and the WQO-90 was met at all sites except the Milk River at 501 site which was in the cautionary range. During diversion in 2024, the WQO-50 for TN was met at all sites except the Pinhorn site, and the WQO-90 was met at all sites except the Pinhorn which was in the cautionary range. In 2024, during natural flow, the WQO-50 was not met at the Pinhorn site, and the HWY 880 site was in the cautionary range; the WQO-90 was not met at the North Fork at 501 site, and was in the cautionary range for the Milk River at 501 site.
- During the 2023 diversion, the WQO-50 for TSS was met at all sites except the HWY 880 and Pinhorn sites, and the WQO-90 was not met at any site. During natural flow in 2023, the WQO-50 for TSS was not met at the U/S Milk River site, and the WQO-90 was not met at the Milk River at

501 site. During diversion in 2024, the WQO-50 for TSS was met at all sites except the Pinhorn site, and the WQO-90 was met at all sites. During natural flow in 2024, the WQO-50 for TSS was met at all sites, and the WQO-90 was met at all sites except the Pinhorn site.

- All of the Milk River sites had a least one exceedance of the provincial irrigation guideline for FCB (100 cfu/100 mL) in 2023 and 2024. In 2023, during diversion, the median FCB counts did not meet the WQO-50 objective at the North Fork at 501 and HWY 880 sites, but the WQO-90 objective was met at all sites. During natural flow in 2023, the FCB WQO-50 was not met at the Milk River at 501, HWY 880, and Pinhorn sites, and the U/S Milk River site was in the cautionary range; the WQO-90 was met at all sites except HWY 880 which was in the cautionary range. In 2024, during diversion, the WQO-50 and WQO-90 objectives were met at all sites. During natural flow in 2024, the FCB WQO-50 was not met at the North Fork at 501, HWY 880, and Pinhorn sites, and the WQO-90 was not met at the North Fork at 501, Milk River at 501, HWY 880 and Pinhorn sites.



Pinhorn site in April 2024. Photo Credit: William King

Water Quality and the Failure of the St. Mary Diversion Siphon

The 2024 water monitoring year provided an opportunity to collect additional samples during natural flow conditions. Typically, one to three samples have been collected during natural flow each year, but in 2024, five samples were collected. A summary of general observations for select parameters in 2024 were made below. Boxplots, that illustrate these observations are provided in Appendix 1, and include greater comparison among multiple years.

Dissolved Oxygen: A minor increase in median dissolved oxygen concentrations was observed in recent years. The increase may be the result of increased light penetration through the water column that is typically limited by high turbidity and total suspended solids during diversions throughout much of the summer. The increased light increases algal production when nutrients are not limiting. Although algal photosynthesis can increase dissolved oxygen concentrations during the day, the algae may decrease dissolved oxygen during the night when the process of respiration (which consumes oxygen) replaces photosynthesis.

Water Temperature: There was an observed increase in maximum water temperatures, particularly at the downstream sites (HWY 880 and Pinhorn). Although this analysis is limited to morning water temperature at time of sampling, continuous water temperature readings may also indicate this trend (currently not available at the Pinhorn site). Low flows and the wide Milk River make this reach particularly vulnerable to warming when water levels are low.

Specific Conductivity: Specific conductivity increased substantially at the HWY 880 and Pinhorn sites during natural flow. Some of the highest values at these sites were measured in 2024. The quality of natural flow is reflective of groundwater and soils high in salinity.

Total Phosphorus: Total phosphorus generally increased during the diversion period as it is mobilized by higher flows and transported with high total suspended solids concentrations. In 2024, median total phosphorus concentrations were generally lower compared to previous years, but similar to 2020, when repairs to drop structure 5 also decreased flows to natural for an extended period of time.

Total Nitrogen: Total nitrogen concentrations at the North Fork at 501 site (90th percentile: 2.905 mg/L) substantially exceeded the WQO-90 in 2024. This is uncharacteristic of the site where values are typically less than 0.500 mg/L.

Total Suspended Solids: Similar to total phosphorus, total suspended solids generally increase during the diversion period. In 2024, the extended period of natural flow decreased total suspended solids concentrations to some of the lowest observed since 2007.

Fecal Coliform Bacteria: Some of the highest fecal coliform bacteria counts were observed during the natural flow period in 2024, particularly at the North Fork at 501. It is likely that a combination of low flow and high-water temperatures cultured bacteria in the Milk River, with possible contributions from wildlife and livestock.

5.0 RECOMMENDATIONS

Red Creek

- Total selenium at the lower Red Creek site is chronically elevated and almost always exceeds the chronic guideline for the protection of aquatic life. The MRWCC may consider an expanded study of total selenium in Red Creek to determine spatial and temporal trends and to identify potential sources.
- Consider additional BMPs (e.g., offstream watering) at Red Creek to reduce time spent by cattle in the creek.

Eastern Tributaries

- Monitoring at the Eastern Tributaries was not completed from 2020 to 2024.
- Water Quality Objectives could be determined using the historical data collected by the MRWCC. Future water quality data could be compared to the established five-year objectives and other relevant provincial guidelines.

Milk River

- Water quality sampling at the existing Milk River (mainstem) sites should continue.
- The MRWCC should continue to collect water quality data at HWY 880 for consistency with the overall Milk River water quality database. AEP could consider increasing their monitoring frequency at HWY 880 to coincide with MRWCC sampling dates.
- The MRWCC should consider the occurrence of potential future events (e.g., streamflow conditions, spill, fire) and develop a plan to monitor them to help interpret annual water quality results. Guidance for monitoring events, in addition to the regular monitoring program, may consider a minimum of three sample collections to inform observations.

6.0 LITERATURE CITED

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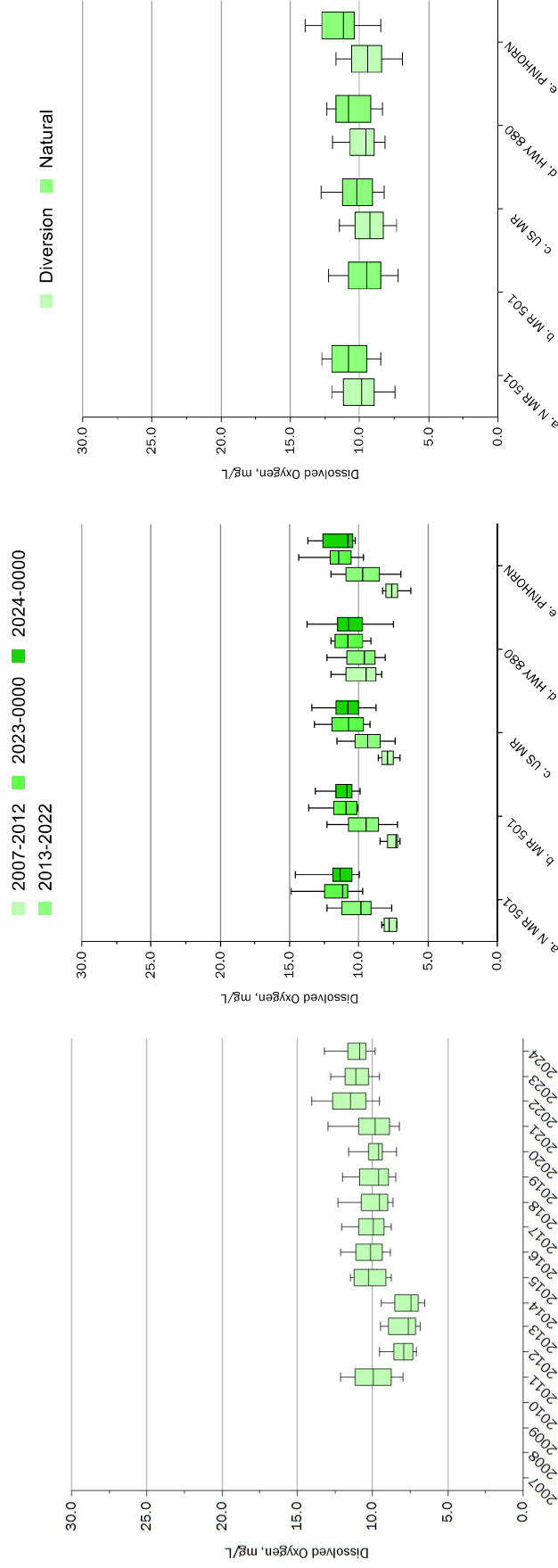
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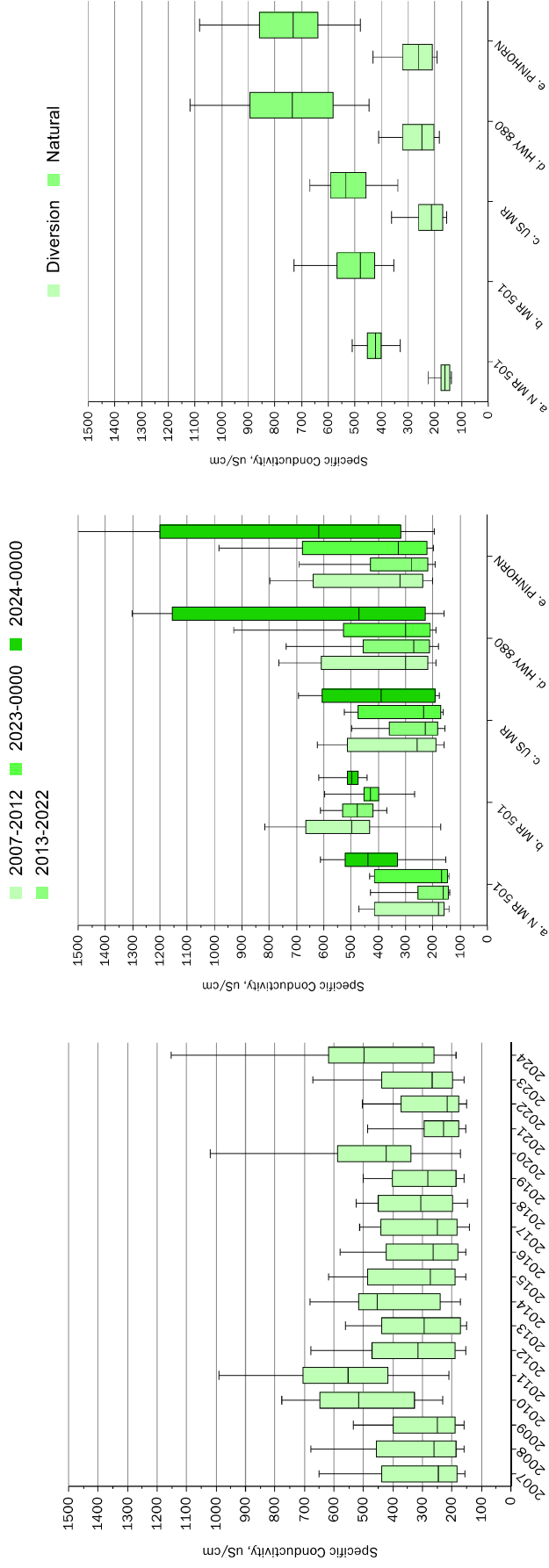
Palliser Environmental Services Ltd. 2023. Milk River Watershed Water Monitoring Report 2022. Prepared for the Milk River Watershed Council Canada, Milk River, Alberta. 23 pp.

Appendix 1. Boxplots comparing water quality (select parameters) for the period 2007 to 2024. The upper and lower bars represent the 90th and 10th percentile, respectively.

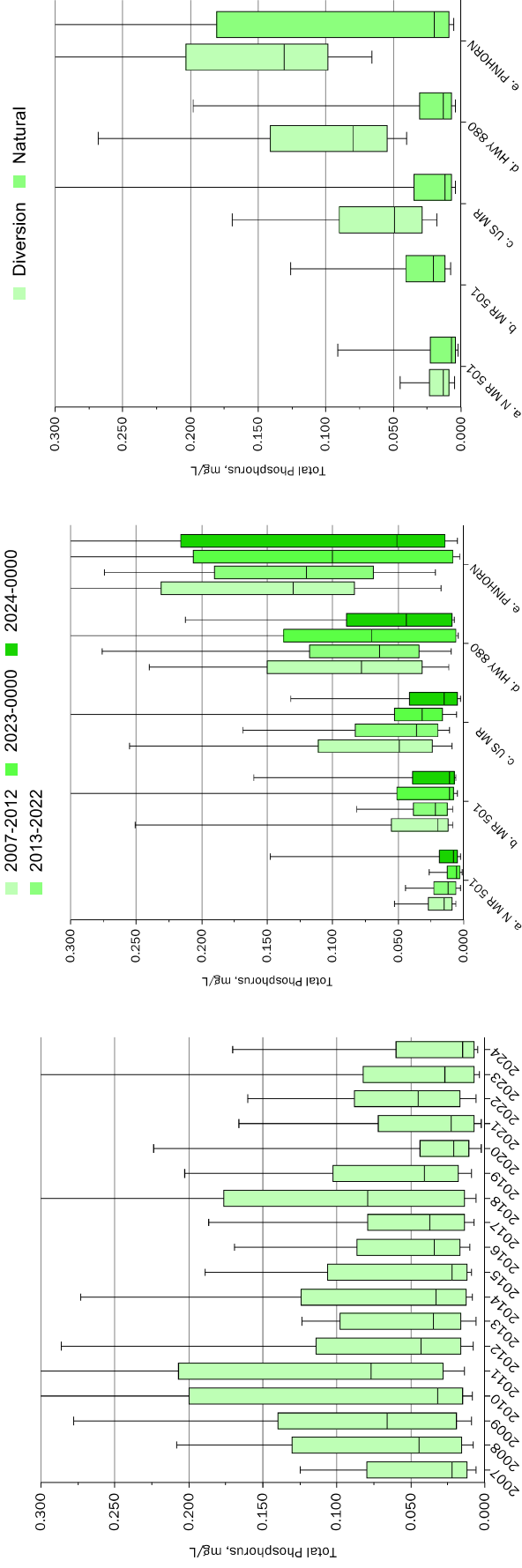
A.1. Dissolved Oxygen



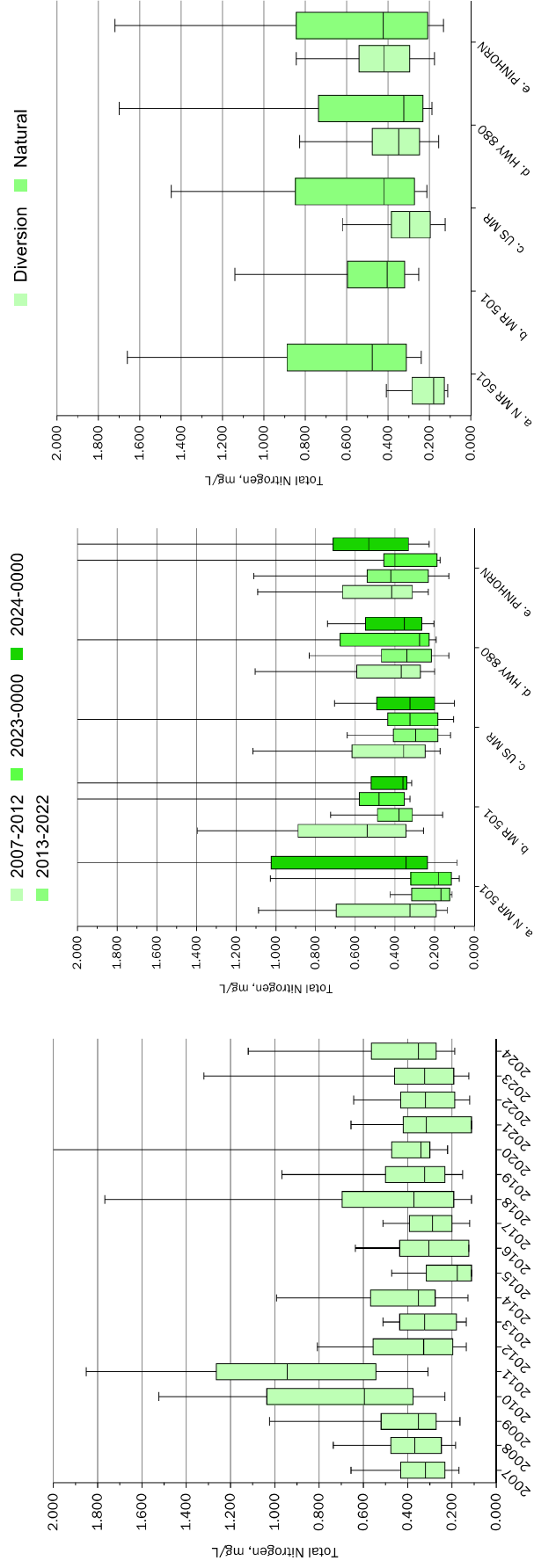
A.2. Specific Conductivity



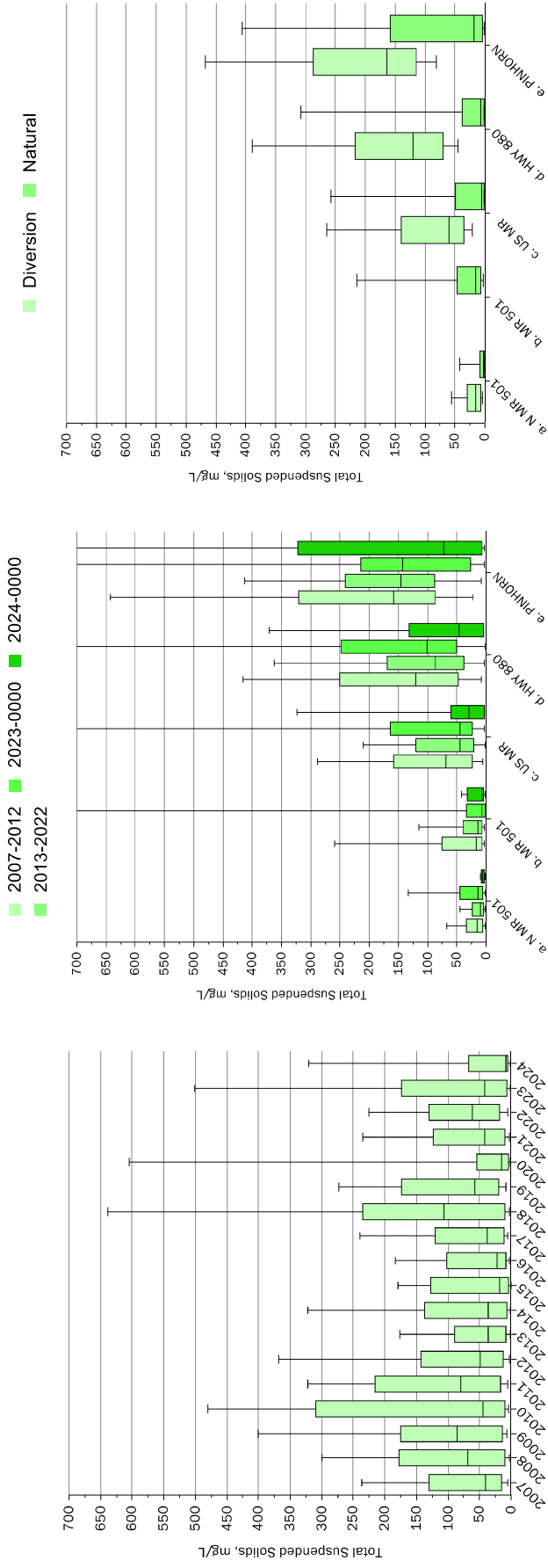
A.3. Total Phosphorus



A.4. Total Nitrogen



A.5. Total Suspended Solids



A.6. Fecal Coliform Bacteria

