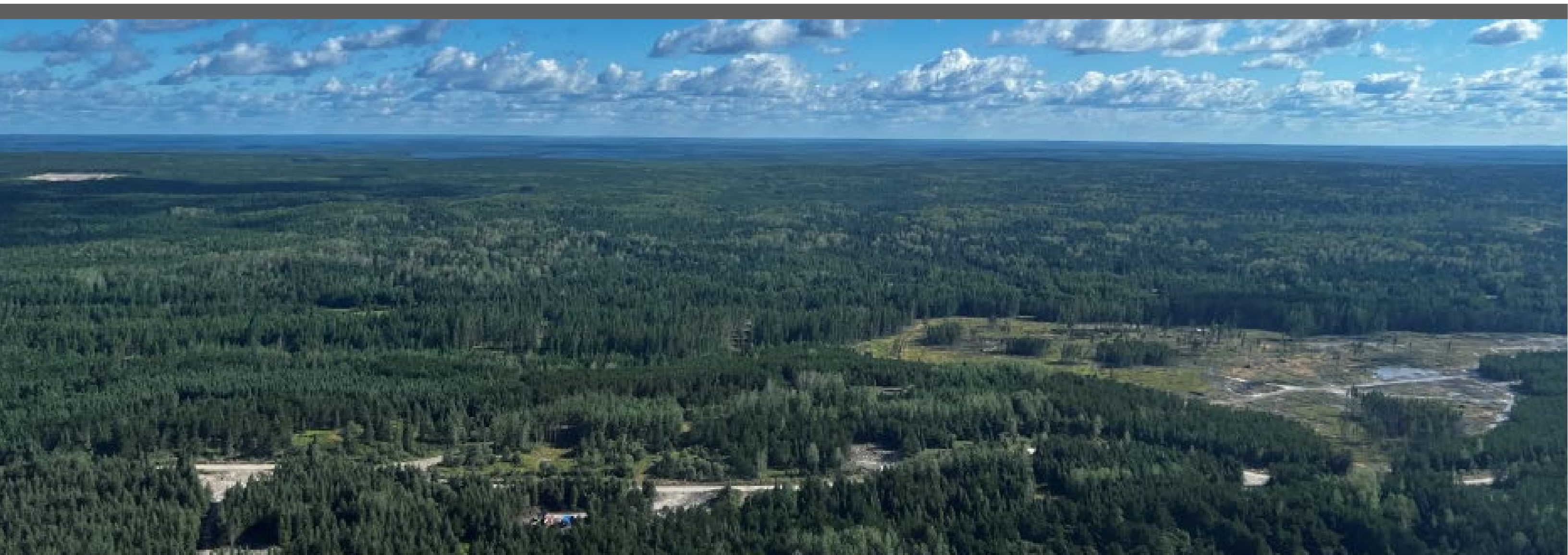
# Great Bear Gold Project Impact Statement

## Appendix I-1:

### Hydrology Baseline Report



GREAT BEAR RESOURCES LTD.

# GREAT BEAR PROJECT

## HYDROLOGY BASELINE REPORT

SEPTEMBER 2025

# GREAT BEAR PROJECT

## HYDROLOGY BASELINE REPORT

GREAT BEAR RESOURCES LTD.

PROJECT NO.: OMEMA2303
SEPTEMBER 2025

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# ABBREVIATIONS

| | |
|---|---|
| ADCP | Acoustic Doppler Current Profiler |
| ECCC | Environment and Climate Change Canada |
| ha | hectare |
| km | kilometre |
| m | metre |
| cm | centimetre |
| mm | millimetre |
| NAD | North American Datum |
| UTM | Universal Transverse Mercator |
| WSC | Water Survey of Canada |
| WSP | WSP Canada Inc. |

# TABLE OF CONTENTS

ABBREVIATIONS ........................................................ II

1 INTRODUCTION ................................................ 1

1.1 Project Background ........................................................ 1

1.2 Objective ........................................................................ 1

2 REGIONAL HYDROLOGICAL CONTEXT ........... 3

2.1 Regional Setting ............................................................ 3

2.2 Manitou Falls Generating Station Watershed ....................... 3

2.3 Chukuni River Above Pakwash Lake ................................... 3

2.4 Dixie Creek Watershed ..................................................... 4

3 CLIMATE ...................................................... 11

3.1 Regional Stations ........................................................ 11

3.2 Onsite Meteorological Station ......................................... 11

3.3 Summary of Regional Climate Data .................................. 12

3.3.1 Historic Climate Data ........................................................ 12

3.3.2 Wet and Dry Years of Various Return Periods ....................... 12

3.3.3 Statistical Rainfall ............................................................ 12

3.3.4 Statistical Rainfall and Snowmelt ........................................ 12

3.3.5 Probable Maximum Precipitation ......................................... 12

3.4 Summary of Onsite Climate Data ...................................... 13

4 HYDROLOGY ................................................. 23

4.1 Methodology ................................................................ 23

4.2 Data Sources ................................................................ 23

4.2.1 Regional hydrometric Monitoring Stations ............................ 23

4.2.2 Local Hydrometric Monitoring Program ................................ 24

4.2.2.1 Rating curves and hydrographs ........................................ 25

4.2.2.2 Bathymetric Data .......................................................... 25

4.2.3 Ice Thickness ................................................................... 25

4.3 Streamflow and Water Levels .......................................... 25

4.3.1 Chukuni River Above Pakwash Lake .................................... 26

4.3.1.1 Data screening .............................................................. 26

4.3.1.2 Monthly Streamflow ...................................................... 26

4.3.1.3 Peak Flow Conditions.....27
4.3.1.4 Low flow Conditions.....27
4.3.1.5 Water Level.....28
4.3.2 Dixie Creek & Project Area Tributaries.....28
4.3.2.1 Monthly Streamflow.....29
4.3.2.2 Peak Flow Conditions.....29
4.3.2.3 Low Flow Conditions.....30
4.3.2.4 Water Level.....30
4.4 Monthly Runoff Coefficients.....31
5 SUMMARY OF MAIN FINDINGS.....44
6 REFERENCES.....45

## TABLES

TABLE 3.1: REGIONAL ENVIRONMENT AND CLIMATE CHANGE CANADA STATIONS ........................... 14
TABLE 3.2: ONSITE METEOROLOGICAL STATION ..................... 14
TABLE 3.3: AVERAGE MONTHLY REGIONAL CLIMATE (1950-2022) ..................................................................... 14
TABLE 3.4: HARGREAVES POTENTIAL EVAPOTRANSPIRATION ESTIMATES FOR CURRENT CLIMATE BASELINE PERIOD (1950-2022) ......................................................... 15
TABLE 3.5: WET AND DRY YEARS FOR VARIOUS RETURN PERIODS .............................................................. 15
TABLE 3.6: EXTREME PRECIPITATION STATISTICS ACROSS DURATIONS AND RETURN PERIODS (MM) ..... 16
TABLE 3.7: EXTREME COMBINED RAINFALL AND SNOWMELT STATISTICS ACROSS DURATIONS AND RETURN PERIODS (MM) ..... 16
TABLE 3.8: CLIMATE INPUT FOR USE IN PROBABLE MAXIMUM PRECIPITATION DEVELOPMENT ... 17
TABLE 3.9: ONSITE PRECIPITATION COMPARISON WITH ECCC EAR FALLS AUT (MM)............................. 18
TABLE 3.10: ONSITE TEMPERATURE COMPARISON WITH ECCC EAR FALLS AUT (°C)............................... 19
TABLE 4.1: WSC SUMMARY TABLE............................................. 32
TABLE 4.2: LOCAL MONITORING STATION SUMMARY.............. 33
TABLE 4.3: REGIONAL ICE THICKNESS STATIONS.................... 34
TABLE 4.4: MONTHLY AND ANNUAL STREAMFLOW STATISTICS - CHUKUNI RIVER NEAR EAR FALLS (05QC001) ............................................... 35
TABLE 4.5 PEAK FLOW SUMMARY FOR CHUKUNI RIVER ABOVE PAKWASH AND DIXIE CREEK STATIONS .......................................................... 38
TABLE 4.6: LOW FLOW SUMMARY FOR CHUKUNI RIVER ABOVE PAKWASH LAKE .................................... 38
TABLE 4.7: AVERAGE ANNUAL PRO-RATED WSC FLOW VERSUS MEASURED FLOW 2022-2024............ 38
TABLE 4.8: 1:100 WET YEAR, 1:100 DRY YEAR AND AVERAGE STREAMFLOW CONDITIONS FOR SELECTED DIXIE CREEK STATIONS................ 38
TABLE 4.9: LOW FLOW SUMMARY FOR SELECTED DIXIE CREEK STATIONS ............................................. 40
TABLE 4.10: MONTHLY RUNOFF COEFFICIENT ......................... 40

## FIGURES

FIGURE 1.1: PROJECT LOCATION .... 2
FIGURE 2.1: REGIONAL SETTING .... 6
FIGURE 2.2: REGIONAL WATERSHEDS .... 7
FIGURE 2.3: CHUKUNI RIVER AT DIXIE CREEK .... 8
FIGURE 2.4: DIXIE CREEK WATERSHED .... 9
FIGURE 2.5: LOCAL WATERSHEDS .... 10
FIGURE 3.1: REGIONAL STATIONS .... 20
FIGURE 3.2: METEOROLOGICAL AND HYDROMETRIC MONITORING STATIONS .... 21
FIGURE 3.3: AVERAGE MONTHLY REGIONAL CLIMATE DATA FROM 1950 TO 2022 .... 22
FIGURE 4.1: PAKWASH LAKE, CHUKUNI RIVER AND DIXIE CREEK WATER ELEVATION COMPARISON .... 41
FIGURE 4.2: DIXIE CREEK PROFILE .... 41
FIGURE 4.3: PHOTOGRAPH OF BEAVER DAM DOWNSTREAM FROM THE DIXIE LAKE OUTLET (HF-07) .... 42
FIGURE 4.4: WSC MONTHLY RUNOFF WITH ADJUSTMENT FACTORS .... 43
FIGURE 4.5: PRORATED GOLDEN CREEK HYDROGRAPH AND SIMULATED RUNOFF HYDROGRAPH FOR NATURAL GROUND .... 43

## APPENDICES

APPENDIX A: HYDROMETRIC FIELD DATA SUMMARY
APPENDIX B: BATHYMETRY MAPPING
APPENDIX C: WATER SURVEY OF CANADA SUMMARY STATISTICS
APPENDIX D: WATER SURVEY OF CANADA STATIONS FLOW DURATION CURVES
APPENDIX E: REGIONAL AND ONSITE HYDROLOGICAL DATA GRAPHICAL COMPARISON

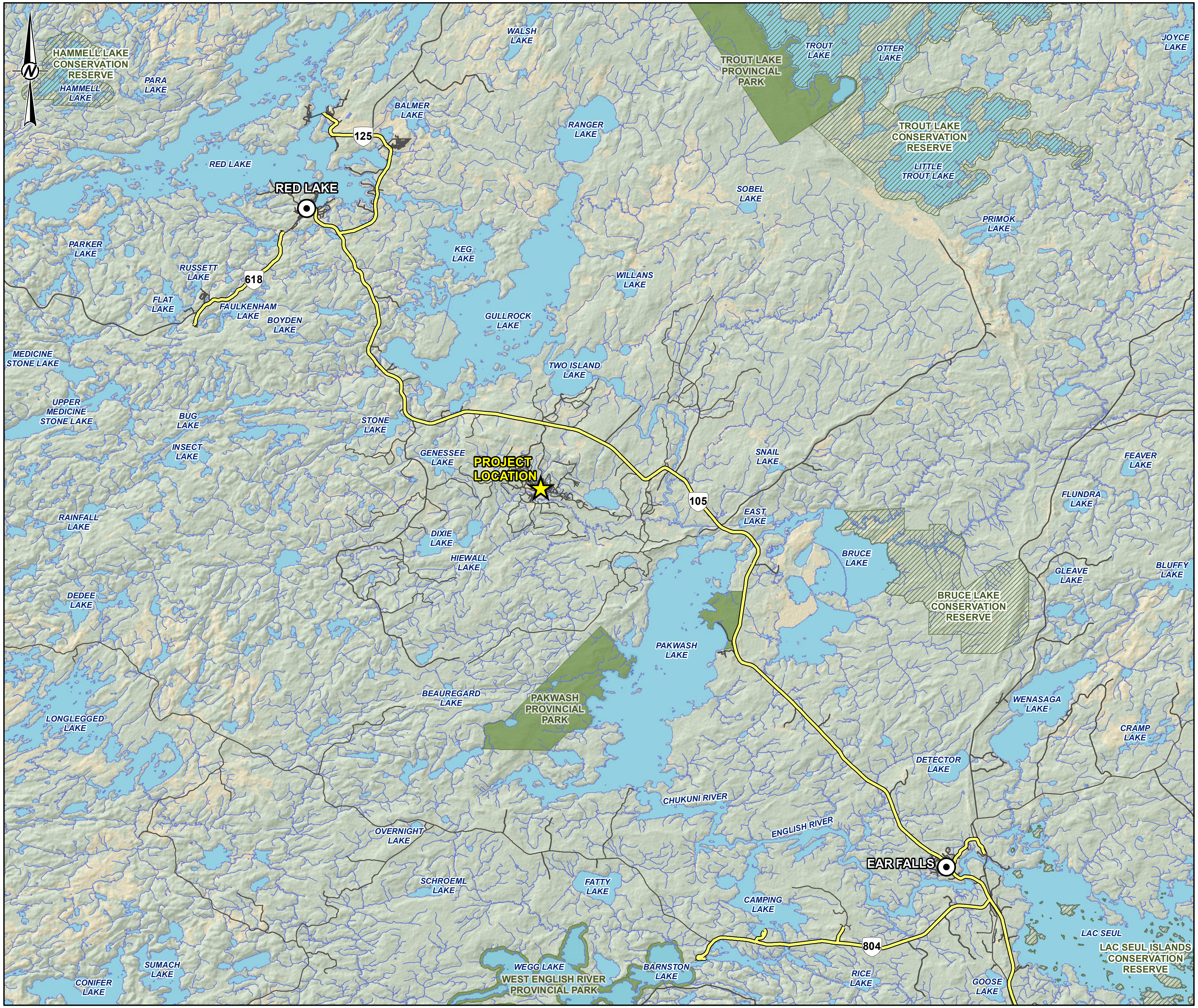
# 1 INTRODUCTION

## 1.1 PROJECT BACKGROUND

Great Bear Resources Ltd. (Great Bear Resources), a wholly owned subsidiary of Kinross Gold Corporation, proposes to develop a gold mine at the Great Bear Property (the Property). The Property is located in the Red Lake mining district, in northwestern Ontario, approximately 25 kilometres (km) southeast of the Municipality of Red Lake (Figure 1.1) in northwestern Ontario. This report has been prepared by WSP Canada Inc. (WSP) to describe the baseline (existing) hydrology conditions in the area around the planned development. Surface water quality data has also been collected and is provided in a separate water quality baseline report.

## 1.2 OBJECTIVE

The primary objective of the Hydrology Baseline Report is to characterize the existing climatic and hydrologic conditions in the local and regional area at the Project. Baseline hydrological and climate information provided herein will contribute to the body of documents that will support the design, Impact Statement and environmental approvals for the Project. The information contained in this report is based onsite investigations conducted during 2022 to 2024 and publicly available data.




KEY MAP


SCALE 1:30,000,000

**LEGEND**

- PROJECT LOCATION
- TOWN
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- RESOURCE/ RECREATION ROAD
- WATERCOURSE
- WATERBODY

0 2.5 5 10
1:250,000 KILOMETRES

**NOTE(S)**

1. ALL LOCATIONS ARE APPROXIMATE

**REFERENCE(S)**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. WATERCOURSES AND WATERBODY ACQUIRED FROM LAND INFORMATION ONTARIO (MNRF) AND MODIFIED TO MATCH AERIAL IMAGERY AND LIDAR.
3. ROADS INFORMATION PROVIDED BY KINROSS, AUGUST 2022.
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
KINROSS GOLD CORPORATION

PROJECT
GREAT BEAR PROJECT

TITLE
**PROJECT LOCATION**

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2024-09-23 |
| DESIGNED | ---- |
| PREPARED | MD |
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# 2 REGIONAL HYDROLOGICAL CONTEXT

## 2.1 REGIONAL SETTING

The Project is located in the English River watershed above Pakwash Lake as illustrated on Figure 2.1. The English River below Pakwash Lake receives inflows from the Lac Seul watershed and then joins the Lake of the Woods watersheds to become the Winnipeg River. The Winnipeg River discharges northwest to Lake Winnipeg which discharges to the Nelson River, ultimately reporting to Hudson Bay.

Regulation of the water level and streamflow within the Winnipeg River and English River systems is the responsibility of the Lake of the Woods Control Board (2000), as a substantial portion of the Lake of the Woods watershed is in the United States. The Lake of the Woods Control Board was established at the recommendation of the International Joint Commission in the early 1900's. The Canadian branch of the Lake of the Woods Control Board manages water levels when they are within the normal operating range. When water levels are above or below the normal operating range, or when there is a dispute between the two member countries (Canada and the United States), then the operation requires approval by the International Lake of the Woods Control Board, managed under the International Joint Commission (IJC 2023). As Pakwash Lake is a large storage feature within the English River system the Lake of the Woods Control Board provides operational targets and uses Pakwash Lake for additional storage under flooding conditions.

## 2.2 MANITOU FALLS GENERATING STATION WATERSHED

The Manitou Falls Generating Station, operated by Ontario Power Generation, is located downstream of Pakwash Lake along the upper portion of the English River, with a total watershed area of 48,880 km$^2$ (Figure 2.2). Between Pakwash Lake and the Manitou Falls Generating Station are Camping Lake and the Chukuni River (Figure 2.3). The watersheds of Camping Lake, Chukuni River and Pakwash Lake, are affected by the operation of the Manitou Falls Generating Station. As the water level upstream of generating station rises, a backwater effect occurs in these waterbodies causing them to act as a single storage system, herein referred to as the Manitou Falls Generating Station storage system.

The Manitou Falls Generating Station watershed receives inflows from Lac Seul, Cedar River, Trout Lake and the Chukuni River (Figure 2.2). The Lac Seul watershed is the largest, comprising approximately 80% of the total contributing watershed area to the Manitou Falls Generating Station while the Chukuni River watershed, upstream of Pakwash Lake, contributes approximately 10%. Watershed areas for each of these inflows are summarized in Table 2.1.

Within the Manitou Falls Generating Station storage system watershed, is the Lac Seul Generating Station, located at the outlet of Lac Seul and Snowshoe Rapids Dam operated by the Ministry of Natural Resources which is located on the Chukuni River approximately 18 km upstream of Pakwash Lake.

## 2.3 CHUKUNI RIVER ABOVE PAKWASH LAKE

The Snowshoe Rapids Dam is located on the Chukuni River between Two Island Lake and Highway 105 as illustrated on Figure 2.4. The Snowshoe Rapids Dam is used to control outflows and water levels on a series of lakes, including Red Lake, Gullrock Lake, Keg Lake, Ranger Lake and Two Island Lake. These have a combined surface area of approximately 282 km$^2$. The Ministry of Natural Resources operates the Snowshoe Rapids Dam using stop-log control structures to manage water levels and discharge from the system. It was originally constructed in 1927 to elevate the upstream lake water levels to support the transportation of equipment and goods to gold mining operations in the Red Lake area before the availability of road access (Highway 105). It is now operated to address multiple objectives that consider flood protection, navigation, water supply and environmental considerations (Hatch 2009). Water levels and flows are managed based on a “rule curve” developed to balance these objectives.

The Water Survey of Canada (WSC) hydrometric monitoring station, Chukuni River near Ear Falls (05QC001) records the streamflow and water level approximately 8 km downstream of Snowshoe Rapids Dam just above a set of rapids that provides a hydraulic control for the WSC gauge. This is designated as a regulated station by the WSC and is discussed further in subsequent sections.

Approximately 5 km downstream of Highway 105 and 2 km upstream of Pakwash Lake, the Dixie Creek watershed discharges to the Chukuni River, adding 365 $km^2$ of watershed to the Chukuni River’s 4,419 $km^2$ watershed area. Water levels at the location of the confluence are influenced by the regulation of water levels in the Manitou Falls Generating Station storage system. This influence is discussed further in subsequent sections.

## 2.4 DIXIE CREEK WATERSHED

The Project is located primarily within the watershed of Dixie Creek, with a large portion of the Property located to the north of Dixie Creek (Figure 2.4). Dixie Creek generally flows eastward discharging to the Chukuni River, receiving inflow from Dixie Lake, Unnamed Waterbody 2, Unnamed Watercourse 3, Unnamed Watercourse 7, Unnamed Waterbody 6 and a number of smaller tributaries. Dixie Creek at Chukuni River has a watershed area of 365 $km^2$. The watersheds for the tributaries and waterbodies within the Dixie Creek watershed are displayed on Figure 2.5. In comparison to the overall Chukuni River watershed, Dixie Creek accounts for approximately 8% of the watershed area.

Dixie Lake has a watershed area of approximately 180 $km^2$, which accounts for approximately 50% of the overall Dixie Creek watershed. The Dixie Lake watershed includes several tributaries and unnamed watercourses as well as Genesse Lake. Both Dixie Lake and Genesse Lake provide additional water storage within the Dixie Creek system.

Dixie Creek between Dixie Lake and Tuzyk’s Road is characterized as meandering and has a relatively flat slope of approximately 0.02%. This section of Dixie Creek receives inflows from Unnamed Watercourse 2, which has upstream inflows from Unnamed Waterbody 1 and Unnamed Waterbody 2. The surficial geology of these waterbodies is mainly outwash deposits, and a portion is located within an esker ridge.

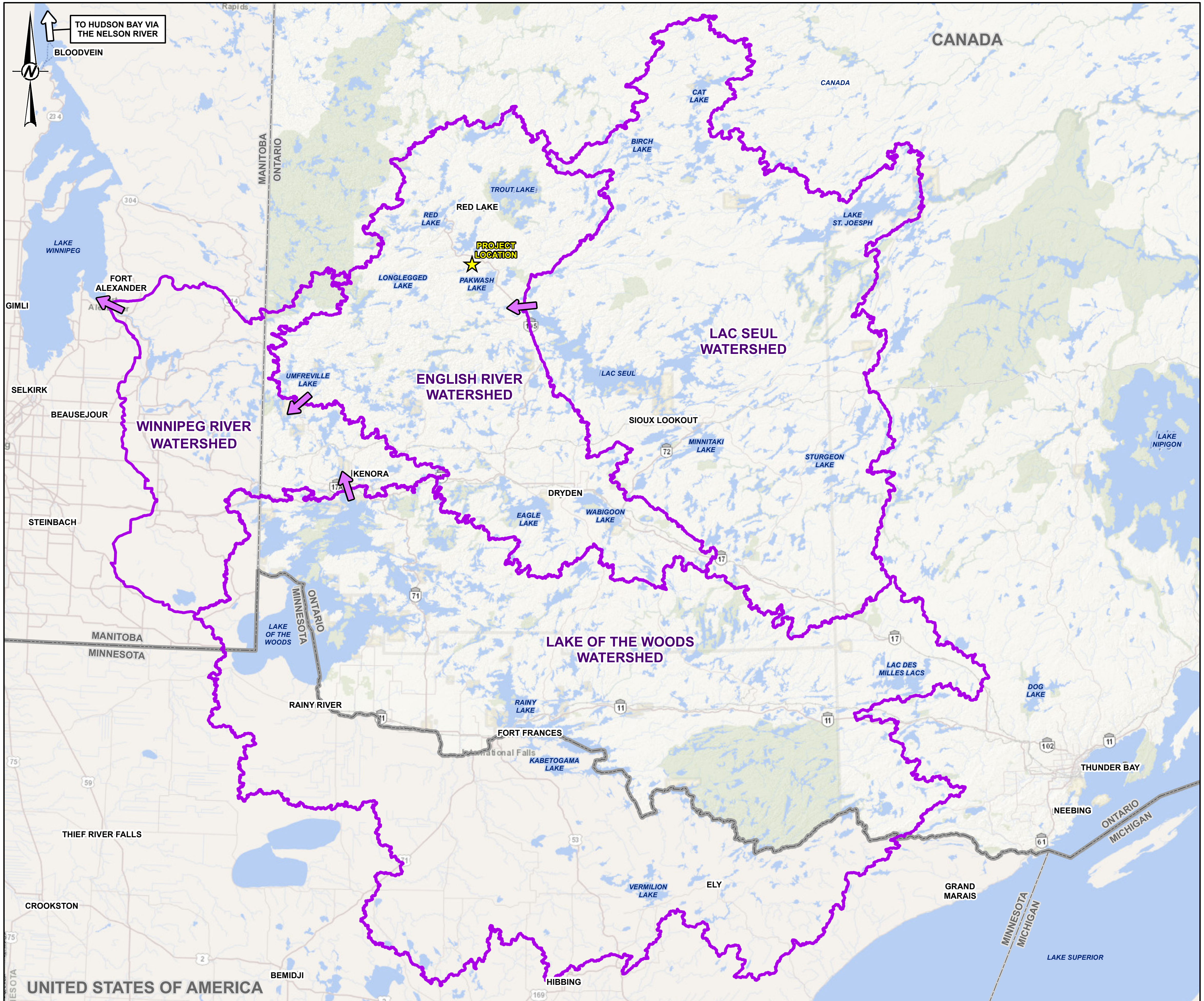
The Dixie Creek watercourse reach from Tuzyk’s Road to the confluence with Unnamed Watercourse 7 has considerable beaver activity with several dams observed throughout Dixie Creek. The gradient along this stretch is approximately 0.1%, with a cascade feature located upstream of the Unnamed Watercourse 3 confluence. Unnamed Watercourse 3 is characterized by a number of smaller tributaries with little to no water storage features. The geology in the area corresponds to a geological feature known as LP Fault and an esker ridge with pockets of sand in upper portions of watershed.

Following this feature Dixie Creek flattens to a low lying wetland and floodplain with a gradient of less than 0.01%. This section receives inflows from Unnamed Watercourse 7 and Unnamed Waterbody 6. Unnamed Watercourse 7 is approximately 30% of the Dixie Creek watershed area, is comprised of a number smaller tributaries and receives inflow from Hiewall Lake. Unnamed Waterbody 6 discharges to Dixie Creek immediately upstream of Tote Road. Similar to this section of Dixie Creek, Unnamed Waterbody 6 is characterized by a large flood plain and a flat slope. Surficial geology in this area is characterized as mainly clay, silt and some fine sand, with gravelly to bouldery sand to till.

The downstream portion of Dixie Creek from Unnamed Watercourse 7 to the Chukuni River is controlled in part by the water level of the Chukuni River at times, with backwater flows observed to impact this portion of Dixie Creek.

**Table 2.1: Manitou Falls Generating Station Storage System Watershed Inflows**

| **Watershed** | Chukuni River | Trout Lake | Lac Seul | Cedar River | Pakwash Lake and Camping Lake | Manitou Falls Generating Station |
|---|---|---|---|---|---|---|
| **Watershed Area ($km^2$)** | 4,801 | 3,021 | 38,969 | 1,743 | 346 | 48,880 |




**LEGEND**

- PROJECT LOCATION
- WATERSHED
- WATERSHED OUTLET
- NATIONAL BOUNDARY
- PROVINICAL / STATES BOUNDARY

0 25 50 100

1:2,050,000 KILOMETRES

**NOTE(S)**

1. ALL LOCATIONS ARE APPROXIMATE

**REFERENCE(S)**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. WATERSHEDS DELINEATED USING ONTARIO WATERSHED BOUNDARY (TERTIARY) AND THE NATIONAL HYDROLOGY NETWORK.
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
KINROSS GOLD CORPORATION

PROJECT
GREAT BEAR PROJECT

TITLE
**REGIONAL SETTING**

CONSULTANT

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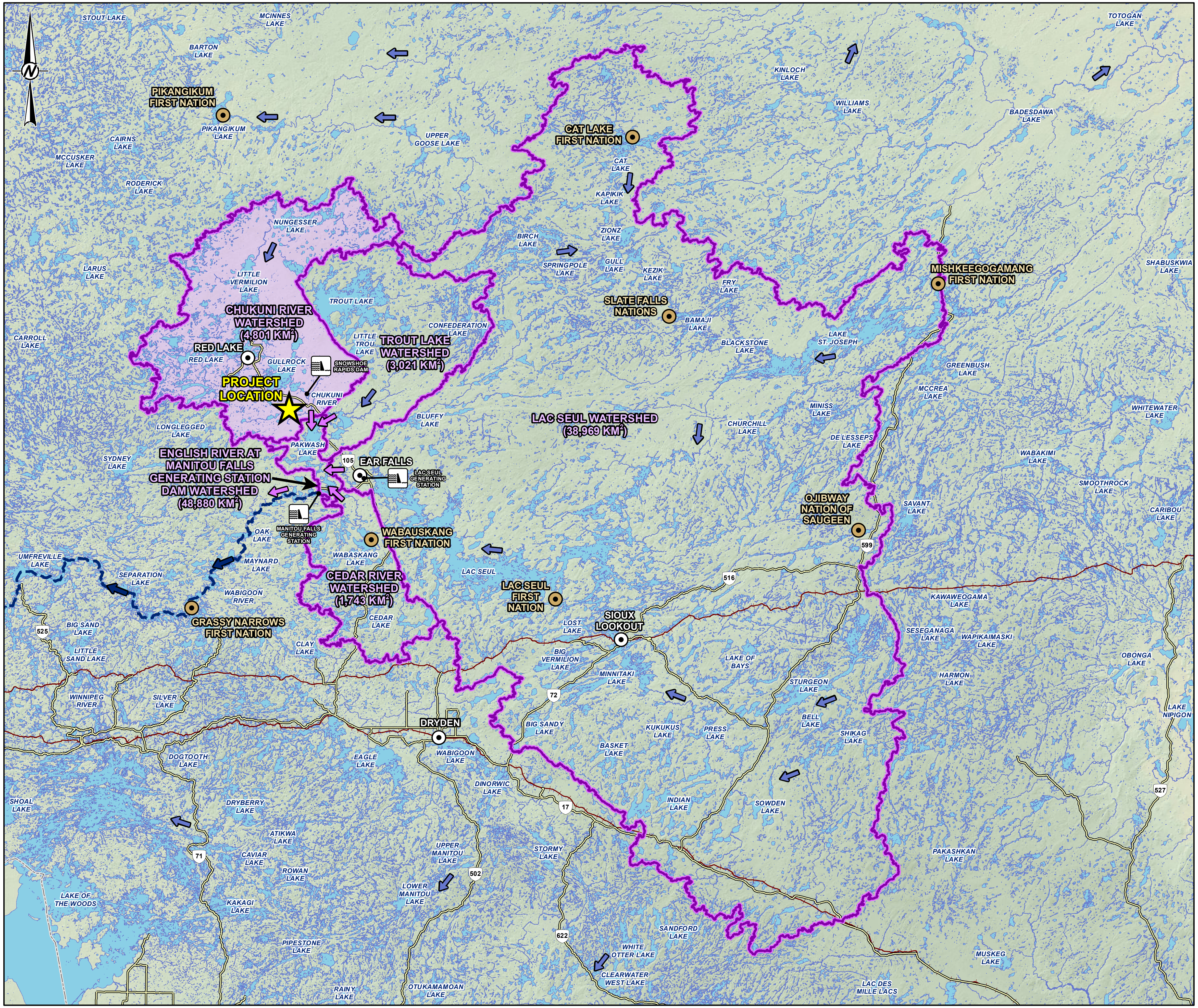


LEGEND

- PROJECT LOCATION
- FIRST NATION RESERVE
- TOWN
- DAM / GENERATING STATION
- CHUKUNI RIVER WATERSHED
- OTHER WATERSHED
- APPROXIMATE FLOW DIRECTION OF THE ENGLISH RIVER SYSTEM
- HIGHWAY
- RAILWAY
- NATIONAL BOUNDARY
- WATERSHED OUTLET
- FLOW DIRECTION

0 12.5 25 50

1:1,400,000 KILOMETRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. WATERSHEDS DELINEATED USING ONTARIO WATERSHED INFORMATION TOOL (MNRF).
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT

KINROSS GOLD CORPORATION

PROJECT

GREAT BEAR PROJECT

TITLE

REGIONAL WATERSHEDS

CONSULTANT

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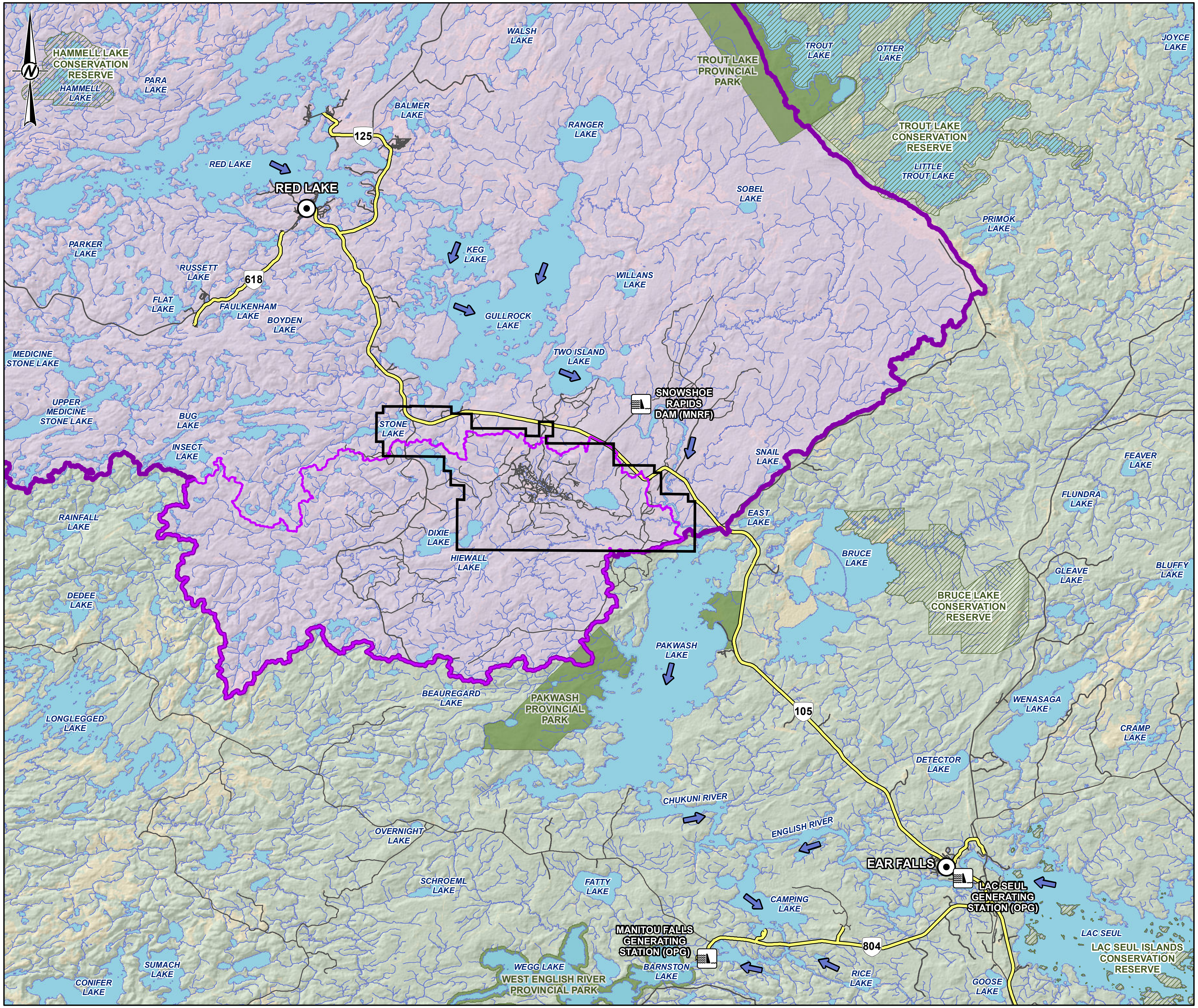
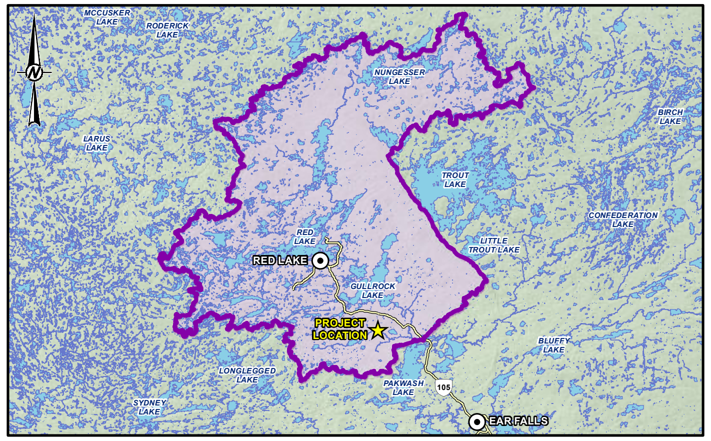



CHUKUNI RIVER WATERSHED OVERVIEW

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**LEGEND**

- PROPERTY BOUNDARY
- CHUKUNI RIVER WATERSHED
- DIXIE CREEK WATERSHED
- TOWN
- DAM / GENERATING STATION
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- RESOURCE/ RECREATION ROAD
- WATERCOURSE
- WATERBODY
- FLOW DIRECTION

0 2.5 5 10
1:250,000 KILOMETRES

**NOTE(S)**
1. ALL LOCATIONS ARE APPROXIMATE

**REFERENCE(S)**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. WATERCOURSES AND WATERBODY ACQUIRED FROM LAND INFORMATION ONTARIO (MNRF) AND MODIFIED TO MATCH AERIAL IMAGERY AND LIDAR.
3. ROADS INFORMATION PROVIDED BY KINROSS, AUGUST 2022.
4. PROPERTY BOUNDARY PROVIDED BY KINROSS, AUGUST 2024.
5. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
KINROSS GOLD CORPORATION

PROJECT
GREAT BEAR PROJECT

TITLE
**CHUKUNI RIVER AT DIXIE CREEK**

CONSULTANT

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| YYYY-MM-DD | 2024-09-24 |
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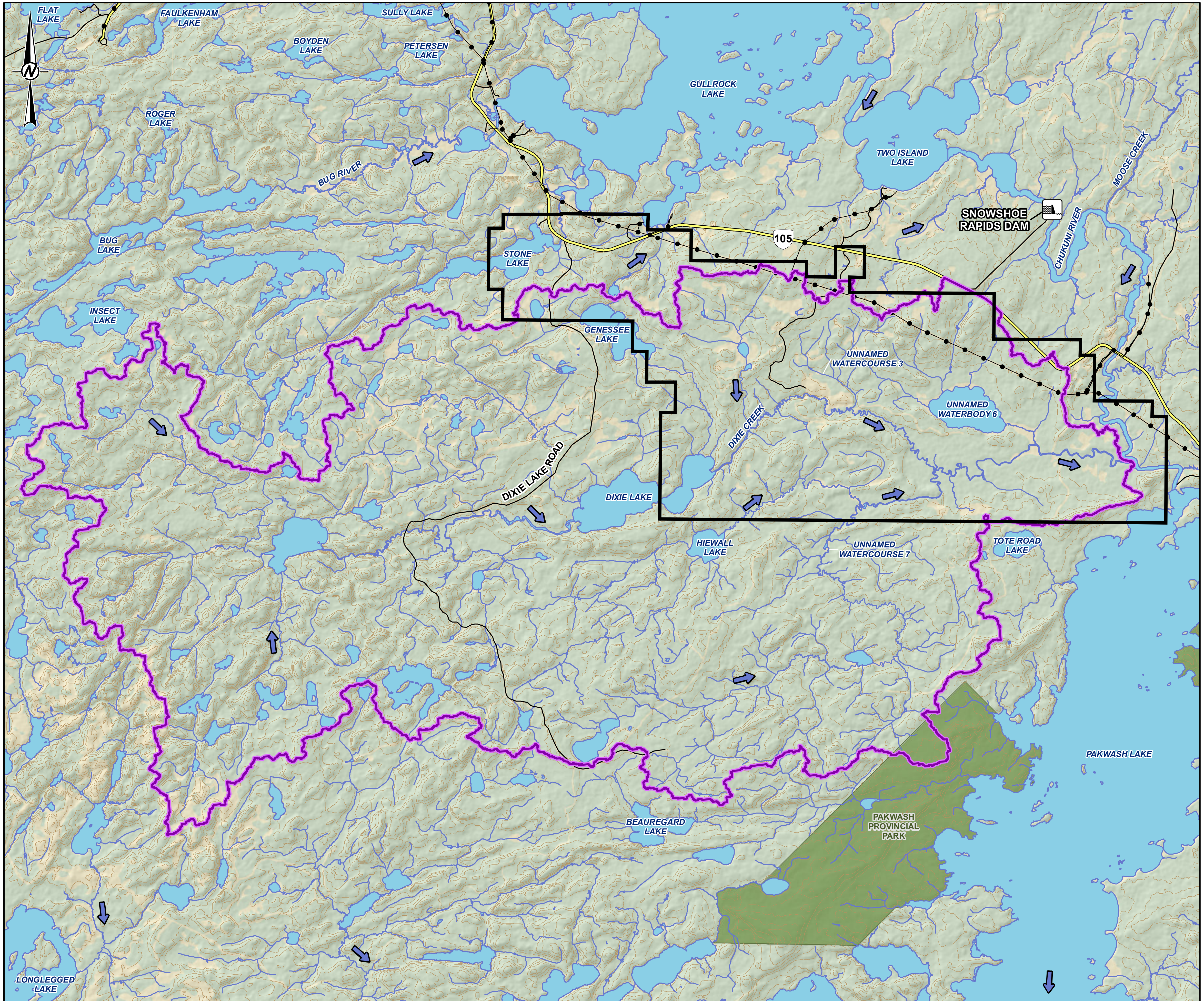


**LEGEND**

- PROPERTY BOUNDARY
- DIXIE CREEK WATERSHED
- HIGHWAY
- LOCAL ROAD
- SNOWSHOE RAPIDS DAM
- POWER LINE
- CONTOURS (10 M INTERVAL)
- PROVINCIAL PARK
- WATERCOURSE
- WATERBODY
- FLOW DIRECTION

0 1.5 3 6

1:118,000 KILOMETRES

**NOTE(S)**

1. ALL LOCATIONS ARE APPROXIMATE

**REFERENCE(S)**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. WATERCOURSES AND WATERBODY ACQUIRED FROM LAND INFORMATION ONTARIO (MNRF) AND MODIFIED TO MATCH AERIAL IMAGERY AND LIDAR.
3. ROADS INFORMATION PROVIDED BY KINROSS, AUGUST 2022.
4. PROPERTY BOUNDARY PROVIDED BY KINROSS, AUGUST 2024.
5. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
KINROSS GOLD CORPORATION

PROJECT
GREAT BEAR PROJECT

TITLE
**DIXIE CREEK WATERSHED**

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2024-10-07 |
| DESIGNED | ---- |
| PREPARED | MD |
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| APPROVED | ---- |

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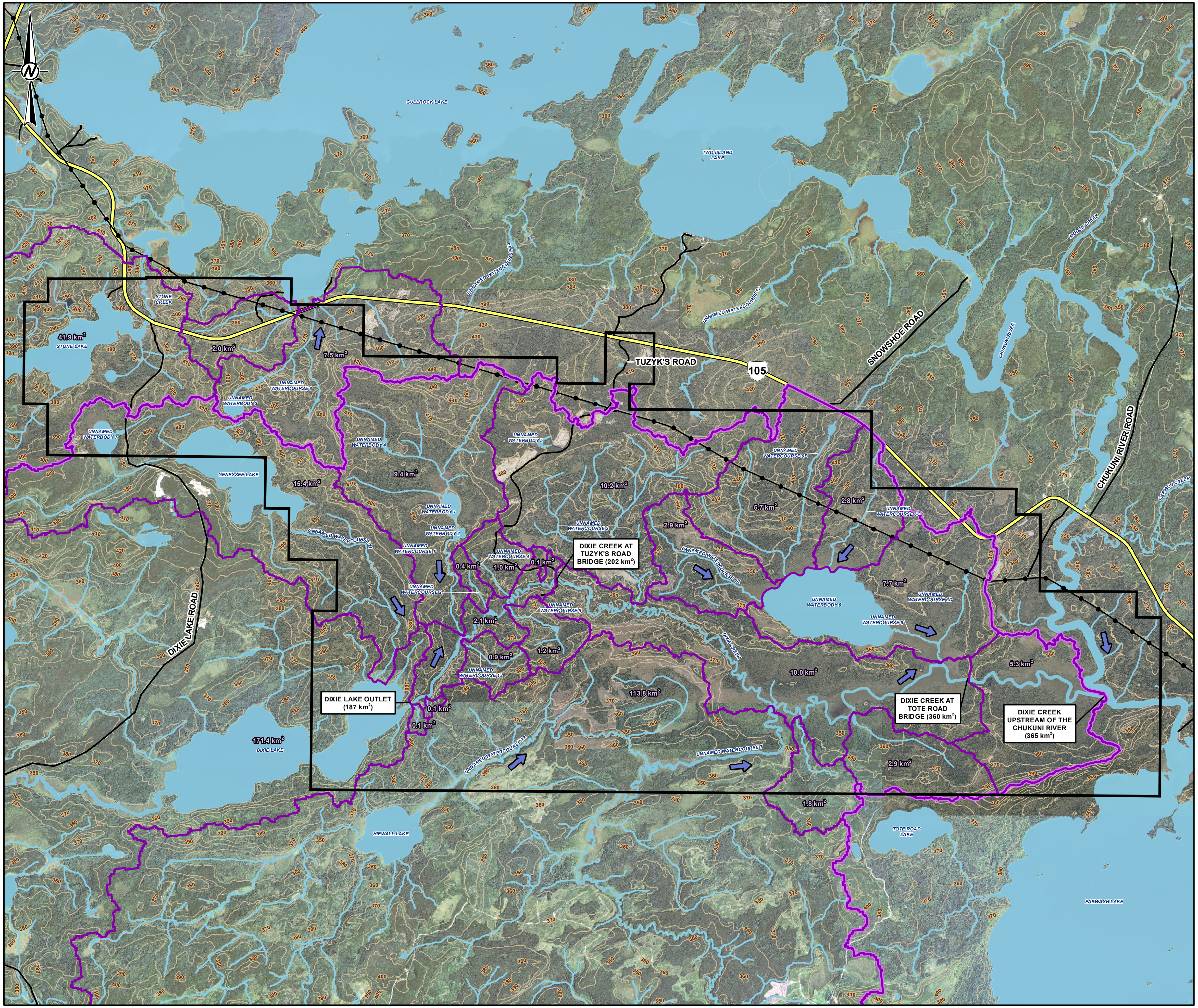


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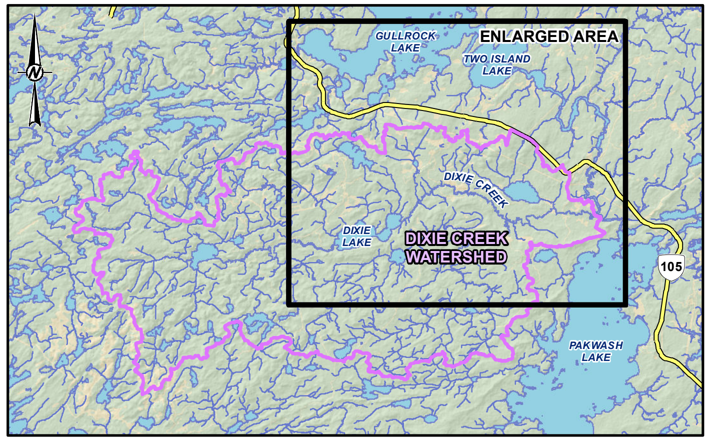


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**LEGEND**

- PROPERTY BOUNDARY
- LOCAL SUBCATCHMENT
- DIXIE CREEK WATERSHED
- HIGHWAY
- LOCAL ROAD
- EXISTING TRANSMISSION LINE
- CONTOUR (10 M INTERVAL)
- WATERCOURSE
- WATERBODY
- FLOW DIRECTION

0 1 2 4

1:70,000 KILOMETRES

**NOTE(S)**

1. ALL LOCATIONS ARE APPROXIMATE

**REFERENCE(S)**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. AERIAL IMAGERY PROVIDED BY KINROSS (SCENE DATE: SEPTEMBER 2022).
3. PROPERTY BOUNDARY PROVIDED BY KINROSS, AUGUST 2024.
4. ROADS INFORMATION PROVIDED BY KINROSS, AUGUST 2022.
5. CONTOURS ACQUIRED FROM LAND INFORMATION ONTARIO (MNRF), 2022 AND DERIVED FROM 2022 LIDAR PROVIDED BY KINROSS.
6. LOCAL SUBCATCHMENT BOUNDARIES DELINEATED USING 2022 LIDAR AND THE ONTARIO WATERSHED INFORMATION TOOL (MNRF).
7. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
KINROSS GOLD CORPORATION

PROJECT
GREAT BEAR PROJECT

TITLE
**LOCAL WATERSHEDS**

CONSULTANT

wsp

| | |
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| YYYY-MM-DD | 2024-11-04 |
| DESIGNED | ---- |
| PREPARED | MD |
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| APPROVED | ---- |

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# 3 CLIMATE

The following section provides a summary of selected climate data compiled for the Project from this report for convenient reference from WSP (2025a).

## 3.1 REGIONAL STATIONS

Environment Canada and Climate Change (ECCC) climate monitoring stations near the Project were reviewed and the regional climate stations ECCC Red Lake A and ECCC Ear Falls were selected based on their proximity, length of record and the availability of continuous daily observations (WSP 2025a) to develop a baseline historical climate dataset for the Project.

The ECCC Red Lake A climate stations are located approximately 24 km northwest of the Project and have an available of record from 1930 to 2024, while the ECCC Ear Falls climate stations are located approximately 40 km southeast of the Project with an available record from 1928 to 2024. The Red Lake and Ear Falls ECCC climate stations are summarized in Table 3.1 and displayed on Figure 3.1.

The ECCC Red Lake A stations were selected as the base stations to represent climate conditions in the Project. Where data gaps occurred in this existing dataset the record was infilled with the ECCC Ear Falls climate stations, followed by additional climate data sources. This methodology resulted in a historical daily climate record for temperature and precipitation of 72 years from 1950 to 2022.

WSP (2025a) estimated potential evaporation rates for the Project using the Hargreaves equation. This was calculated using the maximum, minimum and mean temperature from the historical climate record developed for the Project. For months when the temperatures were near or below zero adjustments were applied as evapotranspiration would be negligible during these months.

Snow survey measurements from ECCC for Red Lake A and ECCC Ear Falls climate monitoring stations were summarized and compared with modelled snow depth and snowmelt for the Project (WSP 2025a). From the analysis, baseline datasets of snowfall and snowmelt were calculated using the baseline climate dataset and the Louie and Hogg (1980) methodology adopted by ECCC. Based on this methodology the baseline temperature record was utilized to calculate the rainfall and snowfall distribution from the precipitation record.

## 3.2 ONSITE METEOROLOGICAL STATION

A Project meteorological station, referred to as Station 1 was installed by WSP in 2022 and is continually monitored as of October 2024, at the location detailed in Table 3.2 and displayed on Figure 3.2. The following parameters are recorded hourly by the sensors mounted on a 10 m tower:

- Wind speed and wind direction
- Barometric pressure
- Humidity
- Evaporation
- Temperature
- Solar radiation.

A tipping bucket precipitation collector is also present at the station. The sensors were connected to a Campbell Scientific CR1000 datalogger supplied with power from the Property. This power supply was also connected to a heater within the precipitation collector, allowing for snowfall to be recorded. A comparison of available data from the ECCC Ear Falls AUT and ECCC Red Lake A climate stations is provided in subsequent sections.

## 3.3 SUMMARY OF REGIONAL CLIMATE DATA

### *3.3.1 HISTORIC CLIMATE DATA*

The average monthly summary of the historical climate, including rainfall, snowfall, snow depth and temperature for the Project are provided in Table 3.3 and displayed on Figure 3.3. The average annual temperature for the Project is 1.0 °C, with a minimum average monthly temperature of -19.2 °C occurring in January and maximum average monthly temperature of 18.3 °C occurring in July.

Based on the compiled precipitation data the average annual precipitation for the Project is 633 millimetres (mm), with July being the wettest month (90 mm) and February being the driest (20 mm). Precipitation is greatest during the summer and fall months with the proportion of snowfall being 25%. Average monthly snow depth for the historical record ranged from approximately 12 cm in December to approximately 28 cm in March.

The average annual potential evaporation is 585 mm which is approximately 92% of the average annual precipitation. Average monthly potential evaporation values are provided in Table 3.4.

### *3.3.2 WET AND DRY YEARS OF VARIOUS RETURN PERIODS*

Annual total precipitation for dry and wet years was determined for the following return periods of 5-, 10-, 20-, 50-, and 100-years (WSP 2025a). Annual precipitation depths for wet and dry years are presented in Table 3.5. The variation between the wet and dry 5-year return period is approximately 237 mm. For the 100-year return period annual total precipitation variation between the wet and dry years was approximately 683 mm. In general, the increase of annual total precipitation with return period is greater for the smaller return periods. For example, in the wet years there is an increase of approximately 80 mm from the 5-, to 10-year return periods and a 64 mm increase from the 50-, to 100-year return periods.

### *3.3.3 STATISTICAL RAINFALL*

Calculated rainfall statistics for durations ranging from 24 hours to 120 days for the following return periods of 2-, 5-, 10-, 25-, 50, 100-, 200-, 500-, 1,000-, 2,000- and 10,000-years were also determined (WSP 2025a). Precipitation depths for the 24-hour rainfall event for the identified return periods are presented in Table 3.6. The 2-year event for a 24-hour duration corresponds to a precipitation depth of 43.6 mm, while the 10,000-year event for a 24-hour duration corresponds to a precipitation depth of 153.1 mm. The 2-year event for 120 days corresponds to a precipitation depth of 353.0 mm and the 10,000-year event corresponds to a precipitation depth of 1010.0 mm.

### *3.3.4 STATISTICAL RAINFALL AND SNOWMELT*

WSP (2025a) calculated long term rainfall and snowmelt statistics for the following return periods of 2-, 5-, 10-, 25-, 50, 100-, 200-, 500-, 1,000-, 2,000- and 10,000-years. Precipitation depths for a number of durations ranging from 1 day to 120 days, rainfall and snowmelt events for the identified return periods are presented in Table 3.7. The 2-year event for a 1-day duration corresponds to a precipitation depth of 19.1 mm, while the 10,000-year event for a 1-day duration corresponds to a precipitation depth of 65.7 mm. The 2-year for 120-days corresponds to a precipitation depth of 140.7 mm and the 10,000-year corresponds to a precipitation depth of 536.2 mm.

### *3.3.5 PROBABLE MAXIMUM PRECIPITATION*

The Probable Maximum Precipitation event was calculated based on the Hershfield method (WMO 2009b), with adjustments applied using Hopkinson (2001) to account for the durations of 1-day to 3-days.

Based on this approach the Probable Maximum Precipitation ranged from 319.2 mm to 342.2 mm for 1-day to 3-days durations. Precipitation depths for the Probable Maximum Precipitation are presented in Table 3.8.

## 3.4 SUMMARY OF ONSITE CLIMATE DATA

Data from the onsite meteorological station, referred to as Station 1, was compiled from the meteorological station for the period of September 2022 to October 2024. Winter precipitation amounts recorded by the onsite meteorological station were affected by a tipping bucket malfunction from November 2023 to October 2024.

Precipitation was compared against the ECCC Ear Falls AUT climate station for the same period of record and is summarized in Table 3.9. Precipitation was not recorded at ECCC Red Lake A climate station for this period. Recorded precipitation was typically similar between sites with lower precipitation amounts recorded in the winter months and higher precipitation in the summer and fall months. In August 2024 the onsite meteorological station recorded approximately 193 mm of precipitation, while ECCC Ear Falls AUT climate station recorded 98 mm of precipitation. These were both higher than the wettest month in the historical baseline summary which was 90 mm in July. After reviewing daily data and historical radar for the area precipitation events between 20 mm and 95 mm occurred throughout the month. The difference of 95 mm between the onsite climate station and the ECCC Ear Falls AUT climate station is mainly due to a 120 mm event recorded at the Property on August 7 and August 8, 2024.

Average monthly temperature for the period of record ranged from -15.0 °C in December 2022 and February 2023 to 18.7 °C in July 2024. Which was similar to the average monthly temperature recorded at the ECCC Ear Falls AUT and the ECCC Red Lake A climate stations for the available period of record. Average monthly temperature data for the onsite climate monitoring station and the ECCC climate stations are provided in Table 3.10.

**Table 3.1: Regional Environment and Climate Change Canada Stations**

| Station Name | Climate ID | Coordinates (Latitude, Longitude) | Distance to Site (km) | Elevation (m) | Period of Record |
|---|---|---|---|---|---|
| Ear Falls | 6012198 | 50.63°N, 93.22°W | 39.9 | 361 | 1928-1999 |
| Ear Falls (AUT) | 6012199 | 50.63°N, 93.22°W | 39.9 | 363 | 1999-2024 |
| Red Lake A | 6016970 | 51.07°N, 93.79°W | 24.3 | 386 | 2012-2018 |
| Red Lake A | 6016971 | 51.07°N, 93.79°W | 24.3 | 386 | 2018-2024 |
| Red Lake A | 6016975 | 51.07°N, 93.79°W | 24.3 | 386 | 1930-2012 |
| Red Lake Forestry | 6016979 | 51.07°N, 93.82°W | 25.3 | 376 | 1959-1960 |

*Source: WSP (2025a)*

**Table 3.2: OnSite Meteorological Station**

| Station | General Location | Coordinates (NAD 83 UTM Zone 15 N) | | Installation Date |
|---|---|---|---|---|
| | | Easting | Northing | |
| Station 1 | Thunder Bay Mobility Towers | 455610 | 5637937 | September 2022 |

**Table 3.3: Average Monthly Regional Climate (1950-2022)**

| Month | Temperature (°C) | Precipitation (mm) | Rainfall (mm) | Snowfall (mm) | Snow Depth (cm) |
|---|---|---|---|---|---|
| January | -19.2 | 29 | 0 | 29 | 20 |
| February | -15.9 | 20 | 1 | 19 | 24 |
| March | -7.9 | 27 | 6 | 21 | 28 |
| April | 1.5 | 34 | 19 | 15 | 12 |
| May | 9.3 | 63 | 60 | 3 | 0 |
| June | 15.2 | 89 | 89 | 0 | 0 |
| July | 18.3 | 90 | 90 | 0 | 0 |
| August | 16.9 | 82 | 82 | 0 | 0 |
| September | 11.0 | 75 | 75 | 0 | 0 |
| October | 4.1 | 54 | 44 | 10 | 0 |
| November | -5.8 | 39 | 7 | 32 | 4 |
| December | -15.5 | 30 | 1 | 29 | 12 |
| Annual | 1.0 | 633 | 475 | 157 | 20 |

*Source: WSP 2025a*

**Table 3.4: Hargreaves Potential Evapotranspiration Estimates for Current Climate Baseline Period (1950-2022)**

| Month | Mean (mm) |
|---|---|
| January | 0 |
| February | 0 |
| March | 0 |
| April | 0 |
| May | 107.9 |
| June | 131.9 |
| July | 140.5 |
| August | 112.1 |
| September | 63.0 |
| October | 29.3 |
| November | 0 |
| December | 0 |
| **Annual** | 584.7 |

*Source: WSP 2025a*

**Table 3.5: Wet and Dry Years for Various Return Periods**

| Return Period (years) | Annual Precipitation (mm) | |
|---|---|---|
| | **Wet Year** | **Dry Year** |
| 5 | 724.3 | 487.5 |
| 10 | 803.2 | 439.6 |
| 20 | 874.9 | 403.6 |
| 50 | 963.2 | 366.6 |
| 100 | 1,026.9 | 343.8 |

*Source: WSP 2025a*

**Table 3.6: Extreme Precipitation Statistics Across Durations and Return Periods (mm)**

| Duration (days) | Return Period (years) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2** | **5** | **10** | **25** | **50** | **100** | **200** | **500** | **1,000** | **2,000** | **10,000** |
| 24-hour | 43.6 | 57.6 | 66.9 | 78.7 | 87.4 | 96.0 | 104.6 | 116.0 | 124.6 | 133.2 | 153.1 |
| 1 | 38.6 | 51.0 | 59.2 | 69.6 | 77.3 | 85.0 | 92.6 | 102.7 | 110.3 | 117.9 | 135.5 |
| 2 | 46.5 | 59.8 | 68.6 | 79.8 | 88.0 | 96.2 | 104.4 | 115.2 | 123.4 | 131.5 | 150.5 |
| 3 | 51.1 | 65.3 | 74.8 | 86.7 | 95.5 | 104.3 | 113.0 | 124.5 | 133.2 | 141.9 | 162.1 |
| 4 | 56.1 | 72.8 | 83.9 | 97.9 | 108.3 | 118.6 | 128.8 | 142.4 | 152.6 | 162.8 | 186.6 |
| 5 | 61.0 | 78.5 | 90.1 | 104.7 | 115.5 | 126.3 | 137.0 | 151.2 | 161.9 | 172.6 | 197.4 |
| 6 | 65.4 | 82.7 | 94.1 | 108.6 | 119.3 | 129.9 | 140.5 | 154.5 | 165.1 | 175.7 | 200.2 |
| 7 | 69.1 | 87.4 | 99.5 | 114.9 | 126.3 | 137.6 | 148.8 | 163.7 | 174.9 | 186.1 | 212.2 |
| 10 | 80.1 | 99.8 | 112.8 | 129.3 | 141.5 | 153.7 | 165.8 | 181.7 | 193.8 | 205.9 | 233.9 |
| 20 | 112.4 | 140.6 | 159.2 | 182.7 | 200.1 | 217.4 | 234.7 | 257.5 | 274.7 | 291.9 | 331.8 |
| 30 | 141.9 | 175.6 | 197.9 | 226.1 | 247.0 | 267.7 | 288.4 | 315.6 | 336.3 | 356.9 | 404.7 |
| 50 | 192.2 | 240.0 | 271.6 | 311.5 | 341.2 | 370.6 | 399.9 | 438.6 | 467.8 | 497.0 | 564.9 |
| 75 | 252.2 | 313.5 | 354.1 | 405.3 | 443.4 | 481.1 | 518.7 | 568.3 | 605.8 | 643.3 | 730.4 |
| 90 | 287.7 | 356.9 | 402.8 | 460.7 | 503.6 | 546.3 | 588.8 | 644.8 | 687.2 | 729.6 | 827.9 |
| 120 | 353.0 | 437.2 | 492.9 | 563.4 | 615.6 | 667.5 | 719.2 | 787.4 | 838.9 | 890.4 | 1010.0 |

*Source: WSP 2025a*

**Table 3.7: Extreme Combined Rainfall and Snowmelt Statistics across Durations and Return Periods (mm)**

| Duration (days) | Return Period (years) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2** | **5** | **10** | **25** | **50** | **100** | **200** | **500** | **1,000** | **2,000** | **10,000** |
| 1 | 19.1 | 25.1 | 29.1 | 34.1 | 37.8 | 41.4 | 45.1 | 49.9 | 53.6 | 57.3 | 65.7 |
| 2 | 31.0 | 40.2 | 46.4 | 54.2 | 59.9 | 65.6 | 71.3 | 78.8 | 84.5 | 90.2 | 103.4 |
| 3 | 40.9 | 54.0 | 62.7 | 73.6 | 81.7 | 89.8 | 97.8 | 108.4 | 116.4 | 124.4 | 143.0 |
| 4 | 49.4 | 65.7 | 76.5 | 90.1 | 100.3 | 110.3 | 120.3 | 133.5 | 143.5 | 153.5 | 176.7 |
| 5 | 57.0 | 75.9 | 88.3 | 104.1 | 115.8 | 127.4 | 139.0 | 154.3 | 165.8 | 177.4 | 204.1 |
| 6 | 63.3 | 84.5 | 98.5 | 116.3 | 129.4 | 142.5 | 155.5 | 172.6 | 185.6 | 198.6 | 228.7 |
| 7 | 68.3 | 91.6 | 106.9 | 126.3 | 140.7 | 155.0 | 169.3 | 188.1 | 202.3 | 216.5 | 249.4 |
| 10 | 81.2 | 111.5 | 131.7 | 157.1 | 176.0 | 194.7 | 213.3 | 238.0 | 256.6 | 275.2 | 318.3 |
| 20 | 104.5 | 142.6 | 167.8 | 199.7 | 223.3 | 246.8 | 270.2 | 301.1 | 324.4 | 347.7 | 401.8 |
| 30 | 118.4 | 162.9 | 192.4 | 229.7 | 257.4 | 284.8 | 312.2 | 348.3 | 375.6 | 402.8 | 466.1 |
| 50 | 133.1 | 183.2 | 216.3 | 258.1 | 289.2 | 320.0 | 350.7 | 391.2 | 421.9 | 452.5 | 523.5 |
| 75 | 138.0 | 188.6 | 222.0 | 264.4 | 295.7 | 326.9 | 358.0 | 398.9 | 429.9 | 460.8 | 532.6 |
| 90 | 139.0 | 190.3 | 224.2 | 267.1 | 298.9 | 330.5 | 362.0 | 403.5 | 434.9 | 466.3 | 539.1 |
| 120 | 140.7 | 191.3 | 224.9 | 267.3 | 298.8 | 330.0 | 361.1 | 402.2 | 433.2 | 464.2 | 536.2 |

*Source: WSP 2025a*

**Table 3.8: Climate Input for use in Probable Maximum Precipitation Development**

| Event Duration | Probable Maximum Precipitation (mm) |
|---|---|
| 1-day | 319.2 |
| 2-day | 319.6 |
| 3-day | 342.2 |

*Source: WSP 2025a*

**Table 3.9: Onsite Precipitation Comparison with ECCC Ear Falls AUT (mm)**

| Parameter | Year | Month | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Total Recorded for Period of Record** |
| Onsite Total Precipitation (mm) | 2022 | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | 29 | 27 | 23 | 27 | 106 |
| | 2023 | 4 | 7 | 8 | 39 | 21 | 96 | 98 | 54 | 62 | 73 | 48 | 18 | 528 |
| | 2024 | 5 | 35 | 34 | 48 | 116 | 193 | 79 | 193 | 147 | 18 | n/a[2] | n/a[2] | 867 |
| ECCC Ear Falls AUT Total Precipitation (mm) | 2022 | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | 36 | 40 | 47 | 42 | 165 |
| | 2023 | 11 | 8 | 9 | 39 | 9 | 97 | 118 | 77 | 37 | 101 | 41 | 15 | 564 |
| | 2024 | 15 | 45 | 23 | 33 | 109 | 150 | 63 | 98 | 90 | 20 | n/a[2] | n/a[2] | 644 |

*Note:*

*n/a[1]: Monitoring station was installed in September 2022*

*n/a[2]: For the purpose of the hydrology baseline data was limited to October 2024.*

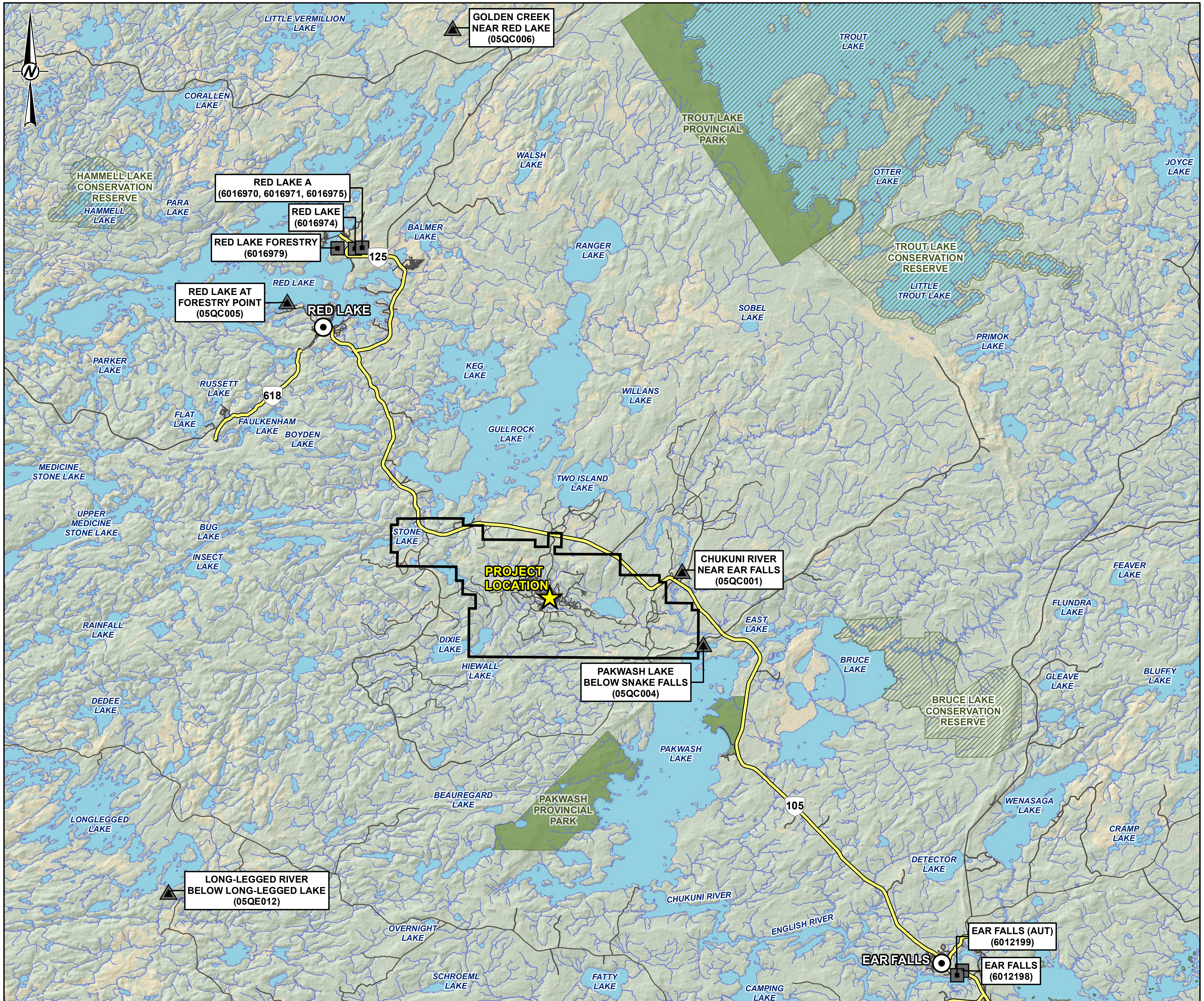
**Table 3.10: Onsite Temperature Comparison with ECCC Ear Falls AUT (°C)**

| Parameter | Year | Month | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Average Temperature for Period of Record |
| Onsite Mean Temperature (°C) | 2022 | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | 9.2 | 4.1 | -4.9 | -15.0 | -1.7 |
| | 2023 | -12.6 | -15.0 | -9.4 | -0.6 | 13.1 | 17.8 | 16.1 | 15.9 | 13 | 4.4 | -5.3 | -6.4 | 2.6 |
| | 2024 | -13.7 | -9.6 | -8.4 | 2.7 | 9.1 | 14.2 | 18.7 | 17.1 | 14.7 | 5.0 | n/a[2] | n/a[2] | 5.0 |
| ECCC Ear Fall AUT Average Temperature (°C) | 2022 | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | 12.2 | 5.6 | -3.8 | -13.9 | 0.1 |
| | 2023 | -11.7 | -13.9 | -8.8 | -0.2 | 13.4 | 18.7 | 16.9 | 17.0 | 14.3 | 5.7 | -4.1 | -5.6 | 3.5 |
| | 2024 | -12.6 | -9.0 | -7.4 | 3.5 | 9.7 | 15.1 | 19.6 | 18.4 | 16.0 | 6.8 | n/a[2] | n/a[2] | 6.0 |
| ECCC Red Lake A Average Temperature (°C) | 2022 | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | n/a[1] | 11.7 | 4.9 | -4.5 | -17.5 | -1.3 |
| | 2023 | -12.8 | -16.0 | -9.8 | -0.43 | 12.9 | 17.8 | 16.7 | 16.5 | 13.9 | 5.3 | -4.6 | -6.2 | 2.8 |
| | 2024 | -13.5 | -10.0 | -8.7 | 3.4 | 9.3 | 14.9 | 19.4 | 18.3 | 15.3 | 5.9 | n/a[2] | n/a[2] | 5.4 |

*Note:*

*n/a[1]: Monitoring station was installed in September 2022*

*n/a[2]: For the purpose of the hydrology baseline data was limited to October 2024.*




**LEGEND**

- PROJECT LOCATION
- PROPERTY BOUNDARY
- ECCC CLIMATE STATION (LABELLED WITH STATION NAME AND ID)
- WATER SURVEY CANADA (WSC) STATION (LABELLED WITH STATION NAME AND ID)
- TOWN
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- RESOURCE/ RECREATION ROAD
- WATERCOURSE
- WATERBODY

0 2.5 5 10
1:260,000 KILOMETRES

**NOTE(S)**
1. ALL LOCATIONS ARE APPROXIMATE

**REFERENCE(S)**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. WATERCOURSES AND WATERBODY ACQUIRED FROM LAND INFORMATION ONTARIO (MNRF) AND MODIFIED TO MATCH AERIAL IMAGERY AND LIDAR.
3. ROADS INFORMATION PROVIDED BY KINROSS, AUGUST 2022.
4. PROPERTY BOUNDARY PROVIDED BY KINROSS, AUGUST 2024.
5. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
KINROSS GOLD CORPORATION

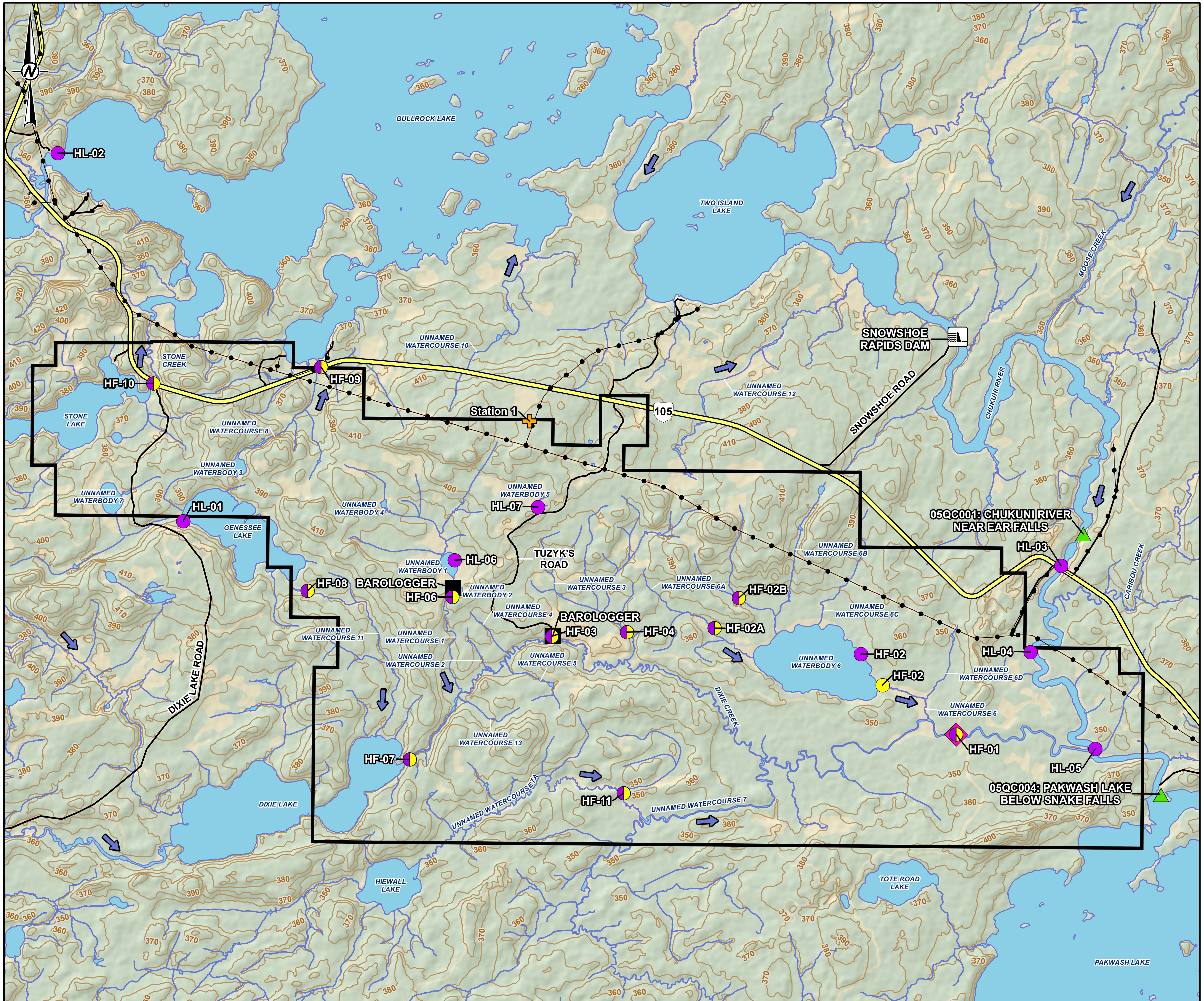
PROJECT
GREAT BEAR PROJECT

TITLE
**REGIONAL STATIONS**

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2024-11-04 |
| DESIGNED | ---- |
| PREPARED | MD |
| REVIEWED | ---- |
| APPROVED | ---- |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| OMEMA2303 | 0001 | A | 3.1 |




**LEGEND**

- PROPERTY BOUNDARY
- HIGHWAY
- LOCAL ROAD
- POWER LINE
- WATERCOURSE
- WATERBODY
- WATER SURVEY OF CANADA STATION
- METEOROLOGICAL STATION
- SNOWSHOE RAPIDS DAM
- FLOW DIRECTION

**HYDROMETRIC STATION**

(BY INSTRUMENTATION)

- BAROLOGGER
- LEVEL
- FLOW
- LEVEL AND FLOW
- SONTEK IQ

0 1 2 4

1:72,000 KILOMETRES

**NOTE(S)**

1. ALL LOCATIONS ARE APPROXIMATE

**REFERENCE(S)**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. PROPERTY BOUNDARY PROVIDED BY KINROSS, AUGUST 2024.
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT

KINROSS GOLD CORPORATION

PROJECT

GREAT BEAR PROJECT

TITLE

**METEOROLOGICAL AND HYDROMETRIC MONITORING STATIONS**

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2024-11-01 |
| DESIGNED | ---- |
| PREPARED | MD |
| REVIEWED | ---- |
| APPROVED | ---- |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| OMEMA2303 | 0001 | A | 3.2 |

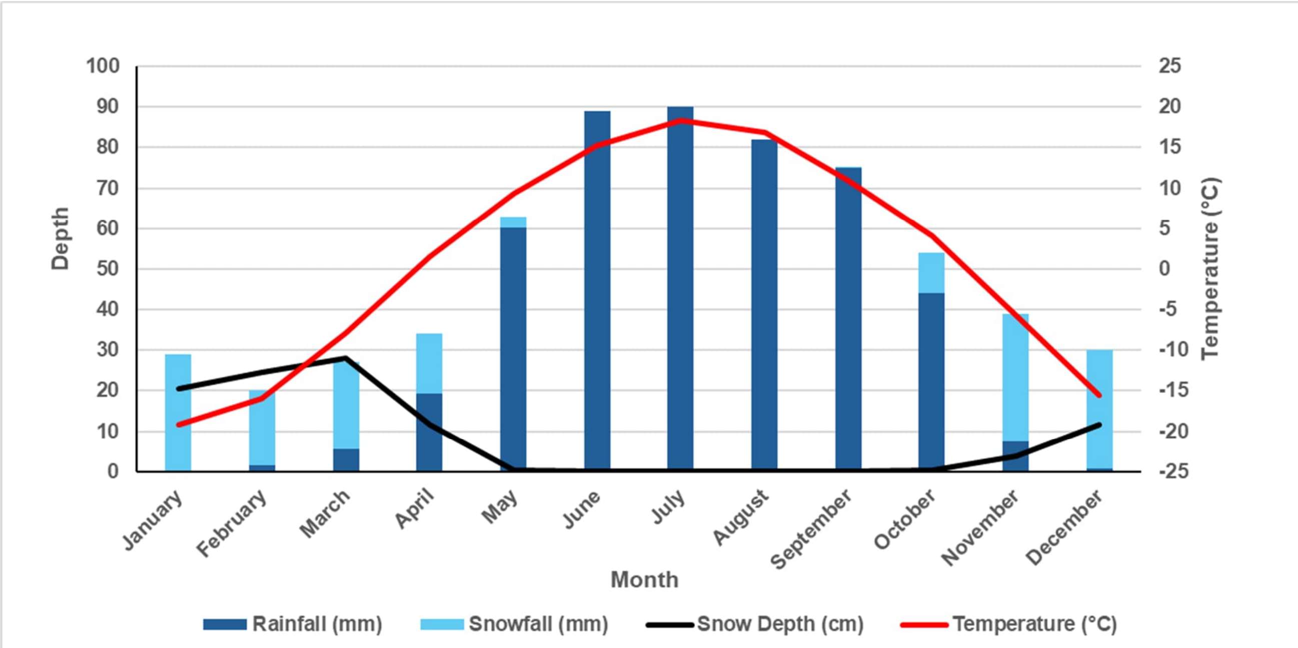



**Figure 3.3: Average Monthly Regional Climate Data from 1950 to 2022**

# 4 HYDROLOGY

## 4.1 METHODOLOGY

The report compiles and summarizes hydrologic data from multiple sources including hydrometric monitoring stations based on a site-specific monitoring program which measures streamflows and water levels, as well as utilizing long-term regional WSC station to characterize hydrological conditions. Using data from multiple sources allows an estimation of long-term statistical and design conditions relevant to the Project site.

## 4.2 DATA SOURCES

The following data sources were utilized to develop a baseline understanding of existing conditions:

- Regional Hydrometric Monitoring Stations
- Local Hydrometric Monitoring Program
- Ice Thickness

Further details on each of these sources are provided in the sections below.

### *4.2.1 REGIONAL HYDROMETRIC MONITORING STATIONS*

A number of WSC hydrometric monitoring stations near the Project site were reviewed to provide a historical record of the regional streamflow conditions. WSC hydrometric monitoring stations were selected based on proximity to the Project, record of available data, watershed area, land cover and general waterbody and watercourse features. Based on these criteria the following stations were selected for further analysis:

- Chukuni River near Ear Falls (05QC001)
- Long-Legged River below Long-Legged Lake (05QE012)
- Golden Creek near Red Lake (05QC006)
- Pakwash Lake below Snake Falls (05QC004)
- Red Lake at Forestry Point (05GC005).

Summary details such as watershed area, coordinates, measured parameters and period of record for each of these selected WSC hydrometric stations are summarized in Table 4.1. The locations of the WSC hydrometric stations are provided in Figure 3.1.

The WSC hydrometric monitoring station Chukuni River near Ear Falls is located downstream of the Snowshoe Rapids Dam and upstream of the confluence with Dixie Creek, approximately 10 km upstream of the Project. The watershed area provided on-line by WSC is approximately 4,920 $km^2$, however WSC staff have indicated that this value will be updated to 4,360 $km^2$ based on a new regional basin delineation project (ECCC 2024c). For the purpose of the baseline the updated WSC station value of 4,360 $km^2$ was carried forward for the analysis. The WSC hydrometric station was established in 1962 and currently records discharge and water level measurements. As it is located downstream of the Snowshoe Rapids Dam, this WSC station is a regulated station and discharge measured at this monitoring station is influenced by the operation of the dam, especially under low flow conditions. It is therefore not considered a suitable gauge for characterizing natural watersheds, however it was considered herein due to its relevance to the Project, its long-term period of record and proximity to the Property. Further details on streamflow in the Chukuni River are provided in Section 4.3.

The WSC hydrometric monitoring station Long-Legged River below Long-Legged Lake is located at the outlet of Long-Legged Lake. Long-Legged River drains to Wilcox Lake located on the English River downstream of Pakwash Lake. This station has been in operation since 1980 and is currently still in operation, recording flow and water level. The Long-Legged River WSC hydrometric monitoring station watershed area is 548 $km^2$, with a number of surface water storage features. The flow regime at this station is considered natural. A summary of streamflow including monthly average streamflows, frequency analysis and low flow values for the Long-Legged River WSC station are provided in Appendix C.

The WSC hydrometric monitoring station Golden Creek near Red Lake is located to the north of the Municipality of Red Lake, discharging to the east bay of Red Lake. The WSC station is approximately 40 km northeast of the Project within the Chukuni River watershed. This station was established in 2009 and currently records discharge and water level. Unlike the other two WSC stations, the Golden Creek hydrometric monitoring station's watershed lacks water storage features and is characterized by a number of small tributaries discharging to Golden Creek. This WSC station has the smallest watershed area, 58.1 $km^2$, of the three stations selected. Streamflow data including monthly average streamflows and low flow values are provided in Appendix C.

The Pakwash Lake below Snake Falls WSC station is located in the north end of Pakwash Lake near the Chukuni River inflow, approximately 10 km from the site. The station currently collects water level data and has been in operation since 1993.

The Red Lake at Forest Point WSC station records water levels on Red Lake at a location roughly 2 km northwest of the Municipality of Red Lake. The station collects water level data and has been in operation since 2006. Real time data from this station is used in the operation of the Snowshoe Rapids Dam (Hatch 2009).

### *4.2.2 LOCAL HYDROMETRIC MONITORING PROGRAM*

Between June 2022 and October 2024, 19 hydrometric monitoring stations were established in the vicinity of the Project. Sites were strategically located with the objective of characterizing existing streamflow and water levels in surface water features that may be impacted by the Project. Site selection considered watercourse cross-section shape and stability, hydraulic controls, backwater considerations, existing infrastructure and accessibility.

Of the 19 hydrometric monitoring stations, 13 hydrometric monitoring stations were established along Dixie Creek and the inflow tributaries to Dixie Creek. In addition, three stations were installed within watersheds draining north to the lakes that are part of the Chukuni River system, and three stations were installed on the Chukuni River. Depending on the station, parameters collected varied between streamflow and water level or only water level. Table 4.2 provides a summary of the onsite hydrometric monitoring stations established, including a description of the location of the station, coordinates, installation date and parameters measured. The hydrometric monitoring stations are also displayed on Figure 3.2.

Each of the 19 hydrometric stations were instrumented with an automatic water level pressure datalogger (Van Essan Divers), used to record continuous water level and temperature data. In addition, two barometric pressure sensors (Van Essen Divers) were installed onsite to correct the water level pressure sensors for hydrostatic pressure. Surveys were completed at the onsite hydrometric monitoring stations which consisted of the establishment and measurement of three temporary benchmarks. A survey of the water level was also completed to align the continuous water level with the relative datum. The Dixie Creek at Tote Road station (HF-01) was also instrumented with a SonTek IQ which employs acoustic doppler technology to record continuous streamflow measurements. The SonTek IQ allows streamflow to be measured directly without the requirement of developing a stage discharge relationship and is better suited to this location due to the backwater effects observed here from the Chukuni River.

Hydrometric measurements were aimed at capturing a range of hydrologic conditions (i.e., wet periods and dry periods) throughout the monitoring period. During each monitoring campaign, data from the water level pressure dataloggers was collected and a topographic survey was completed. Topographic surveys were completed to measure the water level against a consistent datum, provide corresponding stage to the discharge measurements, and monitor the movement of the water level pressure dataloggers from their initial positions. Where possible geodetic surveys were completed, and the station relative benchmarks and water levels were adjusted to geodetic elevations.

In addition to water level measurements, discrete streamflow measurements were conducted during each field visit at 11 streamflow monitoring stations. For smaller streams that were deemed safe to wade a SonTek FlowTracker 2 handheld acoustic doppler velocimeter (ADV), or an OTT MF Pro / Hach FH950 handheld electromagnetic velocity meter (EVM) was used in accordance with WSC procedure for use of the SonTek FlowTracker Acoustic Doppler Velocimeter (WSC 2008). For streams deemed unsafe to wade, the SonTek River Surveyor ADCP was utilized and operated in accordance with WSC procedure for use of the SonTek RS5 Acoustic Doppler Current Profiler (WSC 2015). During winter monitoring rounds, under ice measurements were completed.

#### *4.2.2.1 RATING CURVES AND HYDROGRAPHS*

Rating curves were developed for the hydrometric monitoring stations where sufficient streamflow and water level data were measured for the monitoring period. Details on rating curve development are provided in Appendix A.

Utilizing the rating curves and the continuous water level record for each site, streamflow hydrographs were developed for each of the onsite hydrometric stations (Appendix A). The hydrographs were adjusted for the periods of ice cover based on ice thickness measurements and the approach outlined in Appendix A. For the remaining stations hydrographs were not adjusted for the periods of ice cover and the discharge is likely overestimated for these periods.

#### *4.2.2.2 BATHYMETRIC DATA*

Bathymetric surveys were completed for a 5 km section of the Chukuni River from approximately 250 m upstream of the regional transmission line corridor to the confluence with Dixie Creek (Appendix B). Measurements were completed using a Lowrance Live Sonar™ with perimeter transects, and cross-waterbody transects following perpendicular pathways (WSP 2025b). The water surface was surveyed and tied to a geodetic form of reference allowing the measured depths to be presented as elevations. Point elevations were logged electronically and modelled in Geographic Information System software to generate bathymetric layers.

Bathymetry for other lakes and waterbodies in the property area is presented in the fisheries resources baseline report (WSP 2025b).

### *4.2.3 ICE THICKNESS*

Ice thickness data was obtained from three ECCC ice monitoring locations outlined below:

- Rawson Lake (Lake 239 – part of the IISD Experimental Lakes Area)
- Lake Winnipeg at Gimli (GIMLI YGM)
- Red River near Lockport (05OJ010).

At each of these locations ice thickness data is collected from November to April. Table 4.3 summarizes coordinates, period of record and distance to the Project and the average, minimum and maximum monthly ice thickness for each of these stations.

## 4.3 STREAMFLOW AND WATER LEVELS

As outlined above, the Chukuni River and Dixie Creek are key surface water features located adjacent to the Project. To establish the range of existing streamflow and water level conditions throughout these features the following was analyzed:

- Monthly streamflow

- Instantaneous peak streamflow conditions
- Low flow conditions
- Water levels

A summary of each of these conditions is detailed in the sections below.

### 4.3.1 CHUKUNI RIVER ABOVE PAKWASH LAKE

As outlined in further detail in Section 2.3, the Chukuni River above the Pakwash Lake is located to the east of the Project and receives discharge from Dixie Creek located south of the proposed Project. Along this stretch of the Chukuni River downstream of the Snowshoe Rapids Dam is the Chukuni River WSC station located approximately 10 km from the Project. Due to the proximity of the Chukuni River WSC to the Project Site and the period of available record this WSC gauge was utilized to establish the existing conditions within this stretch of the Chukuni River.

#### 4.3.1.1 DATA SCREENING

Prior to summarizing streamflow and water level records from the existing Chukuni River WSC data set, the following was completed:

- A review of available data for each year. This included reviewing the percentage of data missing for each year and the seasonality of the missing data.
- A review of the WSC stations recorded notes on observed conditions (i.e. construction upstream of the WSC station on the Snowshoe Rapids Dam)
- Statistical tests (e.g., skewness, standard deviation)
- A review of Snowshoe Rapids operational manuals

Based on the review, there were seven years (1962, 1999, 2002, 2006, 2007, 2009, and 2019) where more than 10% (i.e,. approximately one month) of the data was missing on an annual basis. Years where there was less than 10% of the data missing on an annual basis were reviewed based on the seasonality of low flow or peak flow during these missing periods.

In addition, based on a review of the WSC station recorded notes on observed conditions 1963 and 2011 were excluded from the period of record as it was identified that construction occurred during these years restricting streamflow through the Snowshoe Rapids Dam. The streamflow values during these years were reviewed in comparison to the Snowshoe Rapids Dam operating conditions and were outside the recommended low flow operating conditions.

The following sections provide further details on statistical analysis and when these were completed.

#### 4.3.1.2 MONTHLY STREAMFLOW

The following monthly and annual streamflow statistics are provided in Table 4.4 for the Chukuni River WSC station:

- Monthly average streamflow
- Annual runoff
- Monthly mean streamflows for the period of record
- Monthly median streamflows for the period of record
- 1st, 5th, 95th and 99th streamflow percentile
- 1:20 year and 1:100 year return periods for wet and dry climate condition

The mean annual discharge was determined to be 30.2 $m^3$/s and the mean annual runoff was determined to be 218 mm. The percentile monthly values are annualized monthly values, and not percentile values calculated from individual monthly data. For example, the mean monthly Chukuni River runoff values were multiplied by a factor of (11.0/30.2) where 11.0 $m^3$/s is the 1st percentile annual streamflow and 30.2 $m^3$/s is the mean annual streamflow. The annual streamflow ranged from 11.0 $m^3$/s for the 1st percentile and 56.7 $m^3$/s for the 99th percentile.

To determine 1:20 year and 1:100 year return periods for wet and dry climate conditions a frequency analysis was performed. As part of this analysis a number of distributions were examined, and the Pearson Type III distribution was selected as the best fit from the average annual streamflow record. Annual streamflows ranged from 14.0 $m^3$/s for the 1:20 dry year and 51.0 $m^3$/s for the 1:20 wet year. For the 1:100 dry year streamflow was 9.7 $m^3$/s and 62.6 $m^3$/s for the 1:100 wet year. Similar to the percentile flows, the monthly return period streamflows are annualized monthly values.

#### *4.3.1.3 PEAK FLOW CONDITIONS*

A frequency analysis was conducted using the annual instantaneous streamflow data set from the Chukuni River WSC monitoring station to estimate 1:20-year and 1:100-year peak flow conditions. The maximum instantaneous flow for each year was provided and utilized for the frequency analysis. Based on this analysis the Pearson Type III distribution was identified as the best fit and carried forward to estimate the peak flow conditions.

The Chukuni River WSC monitoring station was estimated to have an instantaneous peak flow of 152 $m^3$/s and 184 $m^3$/s under a 1:20-year and 1:100-year return periods (Table 4.5). As described in Section 4.2.1 the operation of the Snowshoe Rapids Dam regulates the discharge at the Chukuni River WSC station which may influence peak flows, resulting in various streamflows under different climate events.

#### *4.3.1.4 LOW FLOW CONDITIONS*

Low flows for selected return periods were calculated for the Chukuni River WSC monitoring station. Daily discharge data for each of the selected WSC hydrometric stations was reviewed and the consecutive 7-day average low flow periods were identified. A frequency analysis was then completed on this dataset. For this analysis it was determined that the Pearson Type III were the best fit and was carried forward in the analysis. In addition, variables such as standard deviation, skewness and coefficient of variation were reviewed.

The resulting 7-day average low flow values are shown in Table 4.6 for return periods varying from 2 to 20 years. The common notation for the 7-day average low flow is 7Q followed by the return period (e.g., the lowest 7-day average flow that is expected to occur in a 20-year period is denoted as 7Q20).

The Chukuni River WSC monitoring station low flows range from 7.41 $m^3$/s for the 7Q2 to 1.85 $m^3$/s for the 7Q20. As described in Section 4.2.1 the operation of the Snowshoe Rapids Dam regulates the discharge at the Chukuni River WSC monitoring station especially under low flow conditions.

The Chukuni River WSC monitoring station is impacted by the operation of the Snowshoe Rapids Dam therefore two additional analyses were completed to provide further understanding of the potential natural flow regime, if the Chukuni River WSC monitoring station was unregulated. These include prorating the Long-Legged River WSC monitoring station low flow estimates to the Chukuni River WSC monitoring station and completing a regression analysis on the low flow regime. The 7Q2 and 7Q20 for the Chukuni River WSC monitoring station based on the proration from the Long-Legged River WSC monitoring station ranged from 6.70 $m^3$/s to 2.58 $m^3$/s.

As the watershed areas between the Chukuni River WSC monitoring station and the Long-Legged River WSC monitoring station differ by an order of magnitude an additional regression analysis was performed to provide a third point of reference. WSC monitoring stations were reviewed based on the watershed area, proximity to the site, period of record, percent lake / wetland, land cover, regulation type and watershed characteristics. Based on this review six stations were selected, and low flow return periods were calculated. The low flow return periods (7Q2, 7Q5, 7Q10 and 7Q20's) were used to complete a regression analysis performed by plotting the low flow values versus the drainage area. From this analysis the natural low flow values were calculated to range from the 7Q2 value of 12.56 $m^3$/s to a 7Q20 was of 5.9 $m^3$/s (Table 4.6).

In addition, flow durations curves were prepared for the Chukuni River WSC monitoring station with the average daily flows (Appendix D). The flow duration curve shows the percentage of time that the total daily discharge will be greater than the average annual discharge for a given station. Based on the Chukuni River WSC monitoring station flow duration curve the low flow estimates range from 11.3 $m^3$/s for the Q80 (ie. when the flow is equalled or exceeded 80% of the time for the period of record) and 46.7 $m^3$/s for the Q20 (ie. when the streamflow is exceeded or equalled 20% of the time for the period of record).

#### *4.3.1.5 WATER LEVEL*

As discussed in Section 2.2., Pakwash Lake water levels are controlled by the Lake of the Woods Control Board with the typical operating range between 346.1 masl and 346.3 masl and an extreme water elevation of 348.8 masl (LWCB 2000). When operating in the normal operating range discharge from Pakwash Lake is controlled by OPG Manitou Falls Generating Stations to range from 500 $m^3$/s to 100 $m^3$/s, with discharge in the summer months restricted as possible to maintain water levels at Snake Falls for recreational purposes (LWCB 2000).

Water levels for Pakwash Lake from the real-time hydrometric data, as outlined in Section 4.2.1, were compared to the water levels measured along the Chukuni River (HF-01 and HL-03) for the period from June 2022 to October 2024. This comparison indicates that for the observed range of water levels the three stations followed similar patterns, with high water levels observed in spring 2022 and lower water levels beginning fall of 2022 through to spring 2024, indicating that the water levels in the Chukuni River (HL-03) at least up to Highway 105 are affected by backwater from Pakwash Lake (Figure 4.1).

Therefore, the operation of the Manitou Falls Generating Station is likely to affect not only the water levels within Pakwash Lake but also the Chukuni River upstream of Pakwash Lake, which is adjacent to the Project Site.

### *4.3.2 DIXIE CREEK & PROJECT AREA TRIBUTARIES*

To develop a historical record of streamflow for the area, real-time and historical hydrometric data for three WSC monitoring stations (Chukuni River, Long-Legged River, Golden Creek) were used to compare the streamflow characteristic to the onsite hydrometric stations. Data screening methods outlined in Section 4.3.1.1 were applied to Long-Legged River and Golden Creek stations. Daily streamflow data were compared to the onsite hydrometric stations to determine if the regional WSC monitoring stations could be used as analogues to the local watercourses. Based on a review of the hydrological monitoring stations the following stations HF-01, HF-03, HF-04, HF-06 and HF-10, were carried forward as representative onsite stations for analysis with the regional WSC stations.

To complete this analysis each of the selected WSC stations were prorated based on watershed area to the onsite stations, using available real time discharge data for the monitoring period (2022 to 2024). The real-time data from WSC for 2024 is provisional and may be subject to change prior to being released as part of the historical datasets. The comparison examined the seasonal response and discharge magnitude between the prorated WSC hydrometric monitoring station and the onsite stations. Figures of the discharge comparison are provided for each station in Appendix E. Table 4.7 summarizes the comparison of the annual average discharge to the period of record. The onsite measured flows generally produce a lower average streamflow than the WSC stations. In terms of annual runoff (or runoff yield) the onsite stations most closely align with the Long-Legged River WSC monitoring station.

When examining the seasonal variation, the comparison of the onsite discharge records with the prorated WSC station records generally showed the prorated Long-Legged River WSC monitoring station displayed similar seasonal variation and response of high flows and recessions. Stations on Unnamed Watercourse 3 (HF-04), Unnamed Watercourse 1 (HF-06) discharge records have larger peaks and recession limbs of short durations (i.e., steep slopes) similar to that of the prorated Golden Creek WSC monitoring station. The likely reason for the more intense peaks at Unnamed Watercourse 3 (HF-04), Unnamed Watercourse 1 (HF-06) and prorated Golden Creek WSC monitoring station is likely the relatively small size of the watersheds and the lack of surface water storage features within the watershed which would attenuate streamflow. Although, both the Unnamed Watercourse 3 station (HF-04), Unnamed Watercourse 1 station (HF-06) hydrograph shapes matched that of Golden Creek WSC monitoring station, the annual runoff for these onsite stations were similar to the Long-Legged River WSC monitoring station runoff volume.

Overall, the comparison showed that for seasonality and annual average discharge, the Long-Legged River WSC station was generally similar with the onsite measured flow. Therefore, Long-Legged River was selected as the representative WSC monitoring station. For the HF-04 and HF-06 stations, the hydrograph shape of these stations aligned with the Golden Creek WSC monitoring station, while the annual average discharge aligned with the Long-Legged station. The Golden Creek streamflow statistics were adjusted to align with the annual Long-Legged station values (average annual discharge of 200 mm / 270 mm = 0.74). This preserved the hydrograph response displayed at these stations while aligning the average annual discharge.

Streamflow statistics for the three representative WSC stations were developed based on the long-term record for the stations. The monthly distribution of runoff for these three stations with the changes noted above are provided in Figure 4.2. The Long-Legged River and Chukuni River hydrographs show very similar shapes, with peak streamflows generally occurring in June of each year. The Golden Creek hydrograph shows a more peaked distribution with peak streamflows occurring in May instead of June. The distribution also includes a secondary peak in the fall (consistent with smaller watersheds). The distribution also shows less baseflow in the winter, which would be expected in smaller watersheds. As noted above, the Long-Legged River streamflow distribution should be used for the majority of the watersheds onsite. For smaller watersheds (smaller than 10 km$^2$, such as HF-04 and HF-06), the Golden Creek x 0.74 distribution should be used.

From this assessment monthly streamflow, peak flows and low flows were developed and are summarized in the sections below.

#### *4.3.2.1 MONTHLY STREAMFLOW*

Collected discharge data for the existing hydrometric stations is provided in Appendix A. As outlined in Section 4.1.3.1, discharge hydrographs for each hydrometric station were developed based on the established rating curve and available water level data. Rating curves and hydrographs are provided in Appendix A.

Based on the streamflow comparison, Long-Legged River was selected as the representative WSC monitoring station for most of the monitoring stations at the Project site, with the exception of tributaries with a watershed area less than 10 km$^2$ discharging to Dixie Creek. Therefore, to establish baseline streamflows along Dixie Creek based on a longer monitoring period, the Long-Legged River WSC monitoring station was prorated for Dixie Creek at the Dixie Lake outlet (HF-07), Dixie Creek at Tuzyk’s Road (HF-03) and Dixie Creek at Tote Road (HF-01). Monthly streamflow for each of these conditions is summarized in Table 4.8. When comparing streamflow between each selected station, discharge increases with the progression downstream as the watershed area increases with the annual average for Dixie Lake outlet (HF-07) calculated to be 1.18 m$^3$/s to 2.28 m$^3$/s at Dixie Creek at Tote Road (HF-01).

For the Dixie Lake Outlet (HF-07), the annual discharge ranged from 0.27 m$^3$/s during the 1:100 dry year to 2.62 m$^3$/s during the 1:100 wet year conditions. For Dixie Creek at Tuzyk’s Road (HF-03) mean annual discharge ranged from 0.29 m$^3$/s for the 1:100 dry year to 2.83 m$^3$/s for the 1:100 wet year conditions, and for Dixie Creek at Tote Road (HF-01) mean annual discharge ranged from 0.51 m$^3$/s to 5.04 m$^3$/s.

#### *4.3.2.2 PEAK FLOW CONDITIONS*

Peak flows in Dixie Creek were calculated at three stations along Dixie Creek using Long-Legged River WSC monitoring station to estimate the peak daily flow for a 1:20 year and 1:100 year return period. Long term daily discharge data from Long-Legged River WSC monitoring station was selected as a representative station to provide a long-term record for Dixie Creek as outlined in Section 4.4.1.

The Long-Legged River WSC monitoring station was prorated based on the coefficient for the northwestern Ontario area to each of the following Dixie Creek hydrometric stations (MNR 2013). Dixie Lake outlet (HF-07) peak were calculated to range from 7.8 $m^3/s$ to 10.6 $m^3/s$ for the 1:20 year and 1:100 year return periods. Tuzyk's Road station (HF-03) is estimated to have a peak flow for a 1:20 year and 1:100 year return period of 11.1 $m^3/s$ and 15.0 $m^3/s$, respectively. Tote Road station (HF-01) is estimated to have a peak flow for ranging from 16.6 $m^3/s$ and 22.6 $m^3/s$ for the 1:20 year and 1:100 year return periods. Peak flow statistics for Dixie Creek are presented in Table 4.8.

#### *4.3.2.3 LOW FLOW CONDITIONS*

Low flows for various return periods were calculated for three stations along Dixie Creek to establish low flow conditions based on prorating the Long-Legged WSC monitoring station. The prorated dataset developed for these stations, HF-07 (Dixie Creek at the Dixie Lake outlet), HF-03 (Dixie Creek at Tuzyk's Road) and HF-01 (Dixie Creek at Tote Road) was utilized in this analysis. The daily prorated discharge data for each was reviewed and the consecutive 7-day average low flow periods were identified. A frequency analysis was then completed on this dataset. For this analysis it was determined that the Log Pearson Type III distribution was the best fit and was carried forward in the analysis.

Low flow statistics for each of the three stations are presented in Table 4.9. The Dixie Lake outlet (HF-07) monitoring station flows range from 0.29 $m^3/s$ for the 7Q2 to 0.11 $m^3/s$ for the 7Q20. For the Dixie Creek at Tuzyk's Road station (HF-03) the low flows ranged from 0.31 $m^3/s$ for the 7Q2 to 0.12 $m^3/s$ for the 7Q20 and the Dixie Creek at Tote Road station (HF-01) ranged from 0.55 $m^3/s$ for the 7Q2 to 0.21 $m^3/s$ for the 7Q20.

In addition, streamflow duration curves were developed for HF-07 (Dixie Creek at the Dixie Lake outlet), HF-03 (Dixie Creek at Tuzyk's Road) and HF-01 (Dixie Creek at Tote Road) by prorating the Long-Legged WSC monitoring station flow data. Flow duration curves for each of these stations are provided in Appendix D. For the Dixie Creek at Tuzyk's Road station (HF-03) the streamflow ranged from 0.46 $m^3/s$ for the Q80 to 1.90 $m^3/s$ for the Q20 and the Dixie Creek at Tote Road station (HF-01) ranged from 0.80 $m^3/s$ for the Q80 to 3.39 $m^3/s$ for the Q20. For the tributaries to Dixie Creek flow duration curves are provided in Appendix D for Unnamed Water Course 3 (HF-04) and Unnamed Watercourse 7A (HF-11). Streamflows ranged from 0.0039 $m^3/s$ for the Q80 for Unnamed Watercourse 3 (HF-04) and 0.092 $m^3/s$ for the Q80 for Unnamed Watercourse 7A (HF-11) to 0.08 $m^3/s$ for the Q20 for Unnamed Watercourse 3 (HF-04) and 0.38 $m^3/s$ for the Q20 for Unnamed Watercourse 7A (HF-11).

During the monitoring period, beaver activity along Dixie Creek and around the Property has been observed with a number of beaver dams throughout Dixie Creek affecting water levels and discharge measurements. As an example, one of the larger beaver dams identified downstream of Dixie Lake outlet (HF-07) during the monitoring period is presented in Figure 4.3.

Further discussion on the groundwater and surface water interaction is presented in the Hydrogeological Baseline (WSP 2025c). This report details further monitoring and analysis completed to understand the groundwater interaction specifically during low flow periods within Dixie Creek and the tributaries to Dixie Creek.

#### *4.3.2.4 WATER LEVEL*

Surveyed water levels for each waterbody are provided in Appendix A. Average monthly water levels for each onsite waterbody station are provided in Appendix A. For the available period of record, the average water elevation change on an annual basis ranges from 0.1 m to 0.6 m for Unnamed Waterbody 6. At Dixie Lake an average water elevation change on an annual basis ranged from 0.3 m to 0.6 m (Appendix A). Peak water levels were generally observed during the spring months, corresponding to the spring freshet, while low water levels correspond to the winter and summer low flow periods.

As described in Section 4.3.1.5 water levels within the Chukuni River above Pakwash Lake are influenced by the management of the Manitou Falls Generating station. Water levels at Dixie Creek at Tote Road (HF-01) were compared with the Chukuni River water levels and the Pakwash Lake water levels as displayed on Figure 4.1. Figure 4.2 illustrates the longitudinal profile of Dixie Creek from its headwaters to its confluence with the Chukuni River. Also illustrated is the Pakwash Lake extreme high level as defined by the LWCB. It can be seen that water levels in the lower Chukuni River (ultimately Pakwash Lake) will potentially influence water levels in the lower portion of Dixie Creek up to the first significant riffle sequence above Dixie Creek at Tote Road (HF-01).

## 4.4 MONTHLY RUNOFF COEFFICIENTS

The natural ground runoff coefficient for the Project was calculated based on the estimated average annual runoff at the site (200 mm) and the average annual precipitation for the site (633 mm). Based on this information the natural ground runoff coefficient was calculated to be approximately 0.32. This is consistent with the long-term runoff coefficient observed at the Long-Legged River WSC monitoring station.

Given the relative size of the potential Project footprint (approximately 18 $km^2$) the runoff hydrograph shape would be expected to match closer to the Golden Creek watershed (58.1 $km^2$) than the Long-Legged watershed (548 $km^2$). However, the Golden Creek station recorded greater runoff than that recorded onsite. As a result, the Golden Creek hydrograph was adjusted to the annual Long-Legged River discharge values, while maintaining the monthly distribution of runoff for smaller watersheds. The adjusted hydrograph was utilized to develop monthly runoff coefficients.

The re-distribution of precipitation to account for snowmelt is required to utilize a monthly runoff coefficient. Monthly runoff coefficients were varied until the shape of the resulting hydrograph resembled the shape of the prorated Golden Creek hydrograph. The resulting runoff coefficients for natural ground are provided in Table 4.10. The prorated Golden Creek and resulting simulated hydrograph for natural ground are provided in Figure 4.5.

**Table 4.1: WSC Summary Table**

| Station Name | Station Number | Data | Period of Record | NAD 83 UTM Zone 15 N | | Gross Drainage Area (km²) |
|---|---|---|---|---|---|---|
| | | | | Easting (m) | Northing (m) | |
| Chukuni River Near Ear Falls | 05QC001 | Flow and Level | 1963 - Present | 465895 | 5635882 | 4,360 [1] |
| Long-Legged River Below Long-Legged Lake | 05QE012 | Flow and Level | 1980 - Present | 431465 | 5614350 | 548 |
| Golden Creek Near Red Lake | 05QC006 | Flow and Level | 2009 - Present | 450511 | 5672335 | 58.1 |
| Pakwash Lake below Snake Falls | 05QC004 | Level | 1993 - Present | 467330 | 5630992 | n/a |
| Red Lake at Forestry Point | 05QC005 | Level | 2006 - Present | 439407 | 5653980 | n/a |

*Note 1: Current WSC online documentation indicates the Chukuni River drainage area at 4,920 km², however ECCC staff have indicated that this value will be updated to 4,360 km² (ECCC 2024c)*

**Table 4.2: Local Monitoring Station Summary**

| Station ID | Station Description | Parameters | NAD 83 UTM Zone 15 N | | Period of Record |
|---|---|---|---|---|---|
| | | | Easting (m) | Northing (m) | |
| HF-01 | Dixie Creek at Tote Road | Flow and water level | 463528 | 5632124 | 2022 to 2024 |
| HF-02 | Unnamed Waterbody 6 Outflow above Dixie Creek | Flow and water level | 461767 | 5633620 | 2022 to 2024 |
| HF-02A | Unnamed Watercourse 6A | Flow and water level | 459040 | 5634093 | 2024 |
| HF-02B | Unnamed Watercourse 6B | Flow and water level | 459492 | 5634658 | 2024 |
| HF-03 | Dixie Creek Upstream of Unnamed Watercourse 3 | Flow and water level | 456019 | 5633939 | 2022 to 2024 |
| HF-04 | Unnamed Watercourse 3 | Flow and water level | 457433 | 5634011 | 2022 to 2024 |
| HF-06 | Unnamed Waterbody 2 Outflow | Flow and water level | 454168 | 5634674 | 2022 to 2024 |
| HF-07 | Dixie Lake Outflow | Flow and water level | 453381 | 5631660 | 2022 to 2024 |
| HF-08 | Genessee Lake Outflow | Flow and water level | 451486 | 5634791 | 2022 to 2024 |
| HF-09 | Unnamed Watercourse 8 | Flow and water level | 451734 | 5638946 | 2023 to 2024 |
| HF-10 | Stone Lake Outflow | Flow and water level | 448619 | 5638645 | 2022 to 2024 |
| HF-11 | Unnamed Watercourse 7A | Flow and water level | 457355 | 5631032 | 2024 |
| HL-01 | Genessee Lake | Water level | 449174 | 5636085 | 2022 to 2024 |
| HL-02 | Gullrock Lake | Water level | 446845 | 5642924 | 2022 to 2024 |
| HL-03 | Chukuni River Upstream of Dixie Creek at HWY 105 | Water level | 465475 | 5635260 | 2022 to 2024 |
| HL-04 | Chukuni River Upstream of Dixie Creek at the Hydro Corridor | Water level | 464922 | 5633647 | 2024 |
| HL-05 | Chukuni River at Dixie Creek | Water level | 466112 | 5631851 | 2024 |
| HL-06 | Unnamed Waterbody 1 | Water level | 454235 | 5635359 | 2023 to 2024 |
| HL-07 | Unnamed Waterbody 5 | Water level | 455762 | 5636344 | 2024 |

**Table 4.3: Regional Ice Thickness Stations**

| Station Name | | Lake Winnipeg at Gimli (GIMLI YGM) | Rawson Lake (Lake 239) | Red River near Lockport (05OJ010) |
|---|---|---|---|---|
| **Distance to Project (km)** | | 240 | 135 | 295 |
| **NAD 83 UTM Zone 15 N** | **Easting (m)** | 642616 | 447860 | 631234 |
| | **Northing (m)** | 5610992 | 5501493 | 5490556 |
| **Period of Record** | | 1971 to 1991 | 2010 to 2023 | 1963 to 1979 |
| **Average Monthly Ice Thickness (m)** | Jan | 0.69 | 0.46 | 0.44 |
| | Feb | 0.88 | 0.48 | 0.55 |
| | Mar | 0.97 | 0.52 | 0.68 |
| | Apr | 0.95 | 0.71 | 0.67 |
| | Nov | 0.34 | N/A | N/A |
| | Dec | 0.51 | N/A | N/A |
| **Maximum Monthly Ice Thickness (m)** | Jan | 1.02 | 0.51 | 0.51 |
| | Feb | 1.13 | 0.62 | 0.71 |
| | Mar | 1.22 | 0.76 | 0.85 |
| | Apr | 1.16 | 0.79 | 0.74 |
| | Nov | 0.37 | N/A | N/A |
| | Dec | 0.79 | N/A | N/A |
| **Minimum Monthly Ice Thickness (m)** | Jan | 0.31 | 0.41 | 0.34 |
| | Feb | 0.56 | 0.36 | 0.42 |
| | Mar | 0.66 | 0.23 | 0.40 |
| | Apr | 0.70 | 0.62 | 0.62 |
| | Nov | 0.32 | N/A | N/A |
| | Dec | 0.26 | N/A | N/A |

**Table 4.4: Monthly and Annual Streamflow Statistics - Chukuni River near Ear Falls (05QC001)**

| Year | Flow ($m^3/s$) | | | | | | | | | | | | | Mean Annual Runoff (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean | |
| 1964 | 6.9 | 7.7 | 7.2 | 12.0 | 76.9 | 43.7 | 35.8 | 22.4 | 38.0 | 40.5 | 30.9 | 25.1 | 29.1 | 210.2 |
| 1965 | 20.5 | 16.1 | 13.1 | 13.3 | 51.2 | 67.1 | 34.4 | 16.4 | 19.4 | 26.5 | 23.8 | 23.3 | 27.1 | 196.3 |
| 1966 | 19.6 | 15.1 | 12.9 | 16.2 | 77.8 | 100.4 | 70.6 | 15.1 | 13.4 | 13.0 | 13.4 | 12.4 | 31.8 | 229.7 |
| 1967 | 11.3 | 11.2 | 11.0 | 22.8 | 85.9 | 72.5 | 48.1 | 50.7 | 12.2 | 9.6 | 10.1 | 10.3 | 29.8 | 215.6 |
| 1968 | 9.1 | 9.0 | 9.3 | 27.7 | 61.0 | 93.1 | 75.7 | 54.3 | 60.2 | 65.8 | 46.7 | 33.6 | 45.6 | 330.1 |
| 1969 | 31.5 | 29.8 | 26.1 | 31.6 | 49.2 | 66.5 | 68.6 | 40.4 | 42.1 | 61.6 | 38.5 | 33.8 | 43.4 | 314.0 |
| 1970 | 29.7 | 20.2 | 18.8 | 19.4 | 44.4 | 49.4 | 45.8 | 25.6 | 29.0 | 47.2 | 85.4 | 60.5 | 39.7 | 287.2 |
| 1971 | 42.2 | 29.1 | 23.0 | 23.8 | 60.3 | 46.1 | 55.0 | 16.5 | 11.5 | 9.6 | 12.6 | 14.6 | 28.8 | 208.0 |
| 1972 | 15.7 | 14.4 | 14.0 | 19.6 | 89.4 | 53.3 | 33.8 | 19.2 | 12.6 | 13.8 | 13.0 | 11.4 | 26.0 | 187.8 |
| 1973 | 10.6 | 11.0 | 11.8 | 20.1 | 37.8 | 43.6 | 36.1 | 44.2 | 66.9 | 67.7 | 30.1 | 25.7 | 33.9 | 245.4 |
| 1974 | 22.0 | 18.4 | 16.9 | 27.3 | 141.6 | 162.0 | 73.5 | 38.9 | 66.2 | 35.4 | 23.4 | 13.6 | 53.4 | 386.1 |
| 1975 | 14.0 | 14.5 | 14.9 | 27.7 | 66.5 | 62.0 | 39.0 | 40.5 | 32.3 | 29.6 | 19.8 | 8.6 | 30.9 | 223.4 |
| 1976 | 9.6 | 10.6 | 13.7 | 41.0 | 32.2 | 15.2 | 10.5 | 8.8 | 8.0 | 11.4 | 17.5 | 6.5 | 15.4 | 111.3 |
| 1977 | 3.3 | 3.4 | 3.0 | 6.4 | 4.2 | 11.1 | 43.3 | 28.3 | 77.8 | 68.2 | 30.7 | 26.4 | 25.6 | 185.3 |
| 1978 | 21.2 | 19.6 | 18.3 | 19.4 | 58.3 | 72.2 | 71.4 | 52.4 | 42.1 | 36.2 | 17.1 | 11.3 | 36.8 | 265.9 |
| 1979 | 10.4 | 10.4 | 11.3 | 36.7 | 87.2 | 76.5 | 27.4 | 29.5 | 44.4 | 26.0 | 23.6 | 26.2 | 34.2 | 247.4 |
| 1980 | 16.2 | 15.1 | 16.9 | 32.0 | 42.9 | 27.5 | 21.5 | 15.4 | 19.3 | 23.8 | 28.1 | 14.1 | 22.8 | 164.7 |
| 1981 | 11.7 | 11.3 | 11.7 | 10.3 | 6.4 | 14.4 | 27.0 | 3.9 | 12.0 | 19.4 | 21.9 | 15.1 | 13.8 | 99.6 |
| 1982 | 10.9 | 10.3 | 10.2 | 16.8 | 73.4 | 86.9 | 40.1 | 39.9 | 15.9 | 21.6 | 28.2 | 15.5 | 30.9 | 223.5 |
| 1983 | 12.9 | 12.3 | 12.0 | 13.2 | 6.9 | 25.1 | 56.8 | 16.3 | 10.4 | 6.5 | 15.3 | 15.0 | 16.9 | 122.5 |
| 1984 | 14.3 | 12.2 | 10.5 | 9.3 | 35.5 | 71.5 | 46.4 | 15.6 | 7.3 | 13.8 | 30.5 | 23.9 | 24.3 | 175.5 |
| 1985 | 17.9 | 12.6 | 12.6 | 28.3 | 71.3 | 56.0 | 76.1 | 44.2 | 65.5 | 54.2 | 26.3 | 21.8 | 40.8 | 294.8 |
| 1986 | 20.8 | 18.1 | 15.3 | 25.8 | 75.7 | 33.4 | 18.3 | 17.8 | 8.4 | 22.5 | 22.2 | 17.5 | 24.7 | 178.8 |
| 1987 | 14.9 | 14.0 | 14.2 | 33.0 | 21.9 | 18.8 | 11.9 | 7.7 | 0.6 | 0.5 | 5.5 | 6.2 | 12.4 | 89.7 |
| 1988 | 5.8 | 5.7 | 5.7 | 8.6 | 9.4 | 10.9 | 11.8 | 6.4 | 5.6 | 10.5 | 17.3 | 14.9 | 9.4 | 67.9 |

| Year | Flow (m³/s) | | | | | | | | | | | | | Mean Annual Runoff (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean | |
| 1989 | 13.3 | 11.6 | 10.1 | 17.6 | 27.9 | 56.1 | 60.6 | 28.7 | 20.9 | 15.9 | 14.1 | 11.6 | 24.1 | 174.3 |
| 1990 | 10.7 | 10.2 | 10.5 | 19.2 | 80.4 | 83.6 | 77.7 | 34.2 | 5.2 | 7.2 | 12.2 | 9.8 | 30.2 | 218.7 |
| 1991 | 10.1 | 8.9 | 8.7 | 10.2 | 20.7 | 46.2 | 84.6 | 29.6 | 13.6 | 27.9 | 40.4 | 33.3 | 28.0 | 202.6 |
| 1992 | 26.6 | 22.0 | 18.4 | 13.8 | 55.0 | 72.1 | 54.2 | 22.0 | 45.1 | 56.3 | 43.5 | 31.3 | 38.4 | 277.9 |
| 1993 | 22.8 | 17.4 | 10.0 | 4.4 | 6.7 | 6.6 | 12.4 | 39.7 | 35.4 | 30.5 | 24.7 | 19.5 | 19.2 | 138.9 |
| 1994 | 13.5 | 10.3 | 9.4 | 7.7 | 5.0 | 10.0 | 17.9 | 25.8 | 20.7 | 24.8 | 44.8 | 55.1 | 20.5 | 148.3 |
| 1995 | 43.0 | 26.4 | 20.5 | 15.4 | 27.6 | 58.7 | 78.8 | 82.8 | 33.5 | 11.0 | 16.8 | 15.7 | 36.0 | 260.2 |
| 1996 | 14.4 | 12.8 | 11.0 | 11.5 | 36.9 | 49.9 | 36.0 | 26.1 | 24.8 | 16.5 | 26.8 | 28.0 | 24.6 | 178.1 |
| 1997 | 24.0 | 20.2 | 20.5 | 23.9 | 95.8 | 69.8 | 42.2 | 12.1 | 10.3 | 63.4 | 70.1 | 26.1 | 40.0 | 289.3 |
| 1998 | 22.9 | 16.6 | 15.6 | 62.2 | 61.2 | 27.2 | 20.0 | 9.6 | 6.8 | 7.8 | 8.1 | 8.1 | 22.2 | 160.5 |
| 1999 | 7.6 | 7.5 | 7.4 | 8.7 | 11.5 | 15.1 | 39.3 | 21.8 | 7.4 | 32.8 | 30.3 | 21.1 | 17.6 | 127.6 |
| 2000 | 18.7 | 17.4 | 17.3 | 23.4 | 47.4 | 101.3 | 97.2 | 48.4 | 76.2 | 38.8 | 58.4 | 34.1 | 48.3 | 349.4 |
| 2001 | 21.6 | 19.4 | 16.4 | 14.8 | 41.0 | 71.6 | 32.3 | 17.3 | 17.9 | 3.9 | 8.3 | 13.2 | 23.1 | 167.3 |
| 2003 | 8.6 | 8.3 | 8.2 | 11.7 | 20.4 | 19.6 | 19.5 | 21.9 | 36.1 | 31.9 | 20.1 | 15.6 | 18.5 | 134.0 |
| 2004 | 17.0 | 13.6 | 12.1 | 28.0 | 70.0 | 51.2 | 24.0 | 26.2 | 91.0 | 75.2 | 52.0 | 27.3 | 40.7 | 294.3 |
| 2005 | 31.3 | 13.5 | 16.5 | 52.3 | 63.0 | 93.2 | 92.1 | 50.1 | 48.2 | 19.5 | 39.6 | 23.4 | 45.3 | 327.9 |
| 2008 | 21.6 | 10.2 | 15.2 | 19.2 | 60.1 | 58.8 | 77.9 | 74.2 | 45.2 | 12.1 | 22.3 | 29.1 | 37.4 | 270.4 |
| 2009 | 18.4 | 18.1 | 16.4 | 19.2 | 83.8 | 103.1 | 86.9 | 167.9 | 131.8 | 61.7 | 11.0 | 8.7 | 60.9 | 440.3 |
| 2010 | 12.8 | 12.8 | 18.8 | 19.8 | 52.1 | 81.5 | 81.5 | 82.9 | 89.9 | 69.7 | 28.7 | 22.2 | 47.9 | 346.6 |
| 2012 | 4.8 | 6.2 | 14.8 | 38.6 | 33.8 | 65.7 | 61.7 | 42.3 | 6.1 | 6.5 | 38.5 | 35.0 | 29.6 | 214.1 |
| 2013 | 21.8 | 17.9 | 16.5 | 15.4 | 47.2 | 46.1 | 22.6 | 14.6 | 30.5 | 33.0 | 12.7 | 14.3 | 24.4 | 176.6 |
| 2014 | 14.0 | 14.0 | 14.1 | 20.8 | 95.0 | 75.9 | 50.9 | 22.7 | 11.4 | 21.1 | 22.9 | 19.5 | 32.0 | 231.3 |
| 2015 | 17.7 | 16.0 | 13.9 | 16.3 | 43.2 | 50.8 | 38.3 | 77.7 | 74.9 | 19.9 | 28.7 | 56.4 | 38.0 | 274.5 |
| 2016 | 27.5 | 21.9 | 21.0 | 49.3 | 71.7 | 62.5 | 23.8 | 30.6 | 64.1 | 61.2 | 56.8 | 51.2 | 45.2 | 326.8 |
| 2017 | 31.3 | 28.2 | 15.6 | 35.7 | 51.1 | 25.9 | 25.6 | 15.3 | 8.2 | 19.0 | 14.2 | 13.8 | 23.6 | 171.1 |
| 2018 | 12.2 | 11.6 | 16.4 | 14.2 | 19.1 | 21.3 | 13.1 | 9.1 | 9.9 | 33.5 | 29.3 | 18.6 | 17.4 | 125.8 |
| 2019 | 16.4 | 14.6 | 17.4 | 23.9 | 30.0 | 17.3 | 19.5 | 13.1 | 17.4 | 79.2 | 52.2 | 16.4 | 26.5 | 191.9 |

| Year | Flow (m³/s) | | | | | | | | | | | | | Mean Annual Runoff (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean | |
| 2020 | 19.5 | 16.5 | 24.1 | 26.9 | 15.7 | 40.0 | 42.4 | 32.8 | 27.4 | 19.1 | 14.2 | 11.3 | 24.2 | 175.0 |
| 2021 | 12.3 | 13.1 | 15.2 | 25.3 | 14.8 | 21.6 | 13.3 | 9.3 | 16.8 | 9.0 | 13.5 | 16.3 | 15.0 | 108.6 |
| 2022 | 15.6 | 15.7 | 19.2 | 30.7 | 155.9 | 133.8 | 85.0 | 48.5 | 37.8 | 12.4 | 10.6 | 12.8 | 48.4 | 349.9 |
| 2023 | 14.4 | 13.6 | 12.3 | 32.0 | 27.3 | 12.5 | 4.5 | 5.9 | 5.2 | 15.4 | 14.3 | 13.3 | 14.2 | 102.7 |
| Mean | 17.3 | 14.6 | 14.2 | 22.4 | 50.7 | 54.1 | 44.9 | 32.4 | 32.0 | 29.8 | 27.0 | 21.4 | 30.2 | 218.1 |
| Median | 15.7 | 13.8 | 14.1 | 19.7 | 48.3 | 52.2 | 39.7 | 26.0 | 20.8 | 23.2 | 23.5 | 16.9 | 26.2 | 189.7 |
| 1st Percentile | 6.3 | 5.4 | 5.2 | 8.2 | 18.6 | 19.8 | 16.4 | 11.9 | 11.7 | 10.9 | 9.9 | 7.8 | 11.0 | 79.9 |
| 5th Percentile | 8.1 | 6.8 | 6.7 | 10.5 | 23.7 | 25.3 | 21.0 | 15.1 | 14.9 | 13.9 | 12.6 | 10.0 | 14.1 | 101.9 |
| 95th Percentile | 27.7 | 23.4 | 22.8 | 35.9 | 81.2 | 86.6 | 72.0 | 51.9 | 51.2 | 47.8 | 43.3 | 34.3 | 48.3 | 349.5 |
| 99th Percentile | 32.6 | 27.5 | 26.8 | 42.2 | 95.4 | 101.8 | 84.5 | 61.0 | 60.2 | 56.2 | 50.8 | 40.3 | 56.7 | 410.5 |
| 1:100 Dry Year | 5.6 | 4.7 | 4.6 | 7.2 | 16.3 | 17.4 | 14.4 | 10.4 | 10.3 | 9.6 | 8.7 | 6.9 | 9.7 | 70.2 |
| 1:20 Dry Year | 8.0 | 6.8 | 6.6 | 10.4 | 23.5 | 25.1 | 20.8 | 15.0 | 14.8 | 13.8 | 12.5 | 9.9 | 14.0 | 101.1 |
| 1:20 Wet Year | 29.3 | 24.7 | 24.1 | 37.9 | 85.7 | 91.4 | 75.9 | 54.8 | 54.1 | 50.5 | 45.6 | 36.2 | 51.0 | 368.9 |
| 1:100 Wet Year | 35.9 | 30.3 | 29.6 | 46.5 | 105.2 | 112.2 | 93.2 | 67.2 | 66.4 | 61.9 | 56.0 | 44.5 | 62.6 | 452.8 |

*Note: Monthly flow statistics are distributed based on annualized values.*

**Table 4.5 Peak Flow Summary for Chukuni River above Pakwash and Dixie Creek Stations**

| Peak Flow – Return Period | Peak Daily Flow ($m^3/s$) | | | |
|---|---|---|---|---|
| | Chukuni River Near Ear Falls (05QC001) | Dixie Creek at Tote Road (HF-01) | Dixie Creek at Tuzyk's Road (HF-03) | Dixie Lake Outlet (HF-07) |
| 1:20 Year | 151.9 | 14.5 | 8.2 | 7.5 |
| 1:100 Year | 184.1 | 19.6 | 11.0 | 10.2 |

**Table 4.6: Low Flow Summary for Chukuni River above Pakwash Lake**

| 7-Day Average Low Flows | Minimum 7-Day Average Flow ($m^3/s$) | | |
|---|---|---|---|
| | Chukuni River Near Ear Falls (05QC001) | Chukuni River Near Ear Falls (05QC001) – Prorated from Long-Legged River (05QE012) | Chukuni River Near Ear Falls (05QC001) Natural Low Flow – Regression Analysis– |
| 7Q2 | 7.41 | 6.70 | 12.56 |
| 7Q5 | 4.31 | 3.87 | 8.915 |
| 7Q10 | 2.91 | 3.03 | 7.174 |
| 7Q20 | 1.85 | 2.58 | 5.90 |

**Table 4.7: Average Annual Pro-Rated WSC Flow versus Measured Flow 2022-2024**

| Station | Prorated Long-Legged Flow ($m^3/s$) | Prorated Golden Creek Flow ($m^3/s$) | Prorated Chukuni River Flow ($m^3/s$) | Onsite Measured Flow ($m^3/s$) |
|---|---|---|---|---|
| Dixie Creek at Tote Road (HF-01) | 2.28 | 3.09 | 2.49 | 1.64 |
| Dixie Creek at Tuzyk's Road (HF-03) | 1.28 | 1.73 | 1.22 | 1.37 |
| Unnamed Watercourse 3 (HF-04) | 0.06 | 0.08 | 0.02 | 0.05 |
| Unnamed Watercourse 1 (HF-06) | 0.05 | 0.07 | 0.03 | 0.03 |
| Stone Lake Outlet (HF-10) | 0.26 | 0.35 | 0.45 | 0.20 |

**Table 4.8: 1:100 Wet year, 1:100 Dry year and Average Streamflow Conditions for Selected Dixie Creek Stations**

| Station | Condition | Flow ($m^3/s$) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
| | Average Year | 0.70 | 0.61 | 0.54 | 0.84 | 2.07 | 2.45 | 2.00 | 1.34 | 1.04 | 0.94 | 0.87 | 0.78 | 1.18 |

| Station | Condition | Flow ($m^3/s$) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
| Dixie Lake Outlet (HF-07) | Median | 0.61 | 0.59 | 0.54 | 0.67 | 1.74 | 2.40 | 1.68 | 1.00 | 0.68 | 0.72 | 0.69 | 0.66 | 1.00 |
| | 1:100 Dry Year | 0.16 | 0.14 | 0.12 | 0.19 | 0.46 | 0.55 | 0.45 | 0.30 | 0.23 | 0.21 | 0.20 | 0.17 | 0.27 |
| | 1:20 Dry Year | 0.27 | 0.24 | 0.21 | 0.33 | 0.80 | 0.95 | 0.78 | 0.52 | 0.40 | 0.36 | 0.34 | 0.30 | 0.46 |
| | 1:20 Wet Year | 1.24 | 1.08 | 0.96 | 1.50 | 3.68 | 4.37 | 3.56 | 2.38 | 1.84 | 1.67 | 1.55 | 1.38 | 2.11 |
| | 1:100 Wet Year | 1.54 | 1.34 | 1.20 | 1.86 | 4.57 | 5.43 | 4.43 | 2.96 | 2.29 | 2.08 | 1.93 | 1.72 | 2.62 |
| Dixie Creek at Tuzyk's Road (HF-03) | Average Year | 0.76 | 0.66 | 0.59 | 0.91 | 2.24 | 2.66 | 2.17 | 1.45 | 1.12 | 1.02 | 0.94 | 0.84 | 1.28 |
| | Median | 0.66 | 0.64 | 0.59 | 0.73 | 1.88 | 2.60 | 1.82 | 1.08 | 0.74 | 0.78 | 0.74 | 0.71 | 1.08 |
| | 1:100 Dry Year | 0.17 | 0.15 | 0.13 | 0.20 | 0.50 | 0.59 | 0.49 | 0.32 | 0.25 | 0.23 | 0.21 | 0.19 | 0.29 |
| | 1:20 Dry Year | 0.29 | 0.26 | 0.23 | 0.35 | 0.87 | 1.03 | 0.84 | 0.56 | 0.44 | 0.39 | 0.37 | 0.33 | 0.50 |
| | 1:20 Wet Year | 1.35 | 1.17 | 1.04 | 1.62 | 3.98 | 4.73 | 3.86 | 2.58 | 2.00 | 1.81 | 1.68 | 1.50 | 2.28 |
| | 1:100 Wet Year | 1.67 | 1.46 | 1.30 | 2.01 | 4.94 | 5.87 | 4.79 | 3.20 | 2.48 | 2.25 | 2.08 | 1.86 | 2.83 |
| Dixie Creek at Tote Road (HF-01) | Average Year | 1.35 | 1.17 | 1.04 | 1.62 | 3.98 | 4.73 | 3.86 | 2.58 | 2.00 | 1.81 | 1.68 | 1.50 | 2.28 |
| | Median | 1.17 | 1.15 | 1.04 | 1.30 | 3.35 | 4.63 | 3.23 | 1.93 | 1.31 | 1.39 | 1.32 | 1.27 | 1.93 |
| | 1:100 Dry Year | 0.30 | 0.26 | 0.23 | 0.36 | 0.89 | 1.06 | 0.86 | 0.58 | 0.45 | 0.41 | 0.38 | 0.34 | 0.51 |
| | 1:20 Dry Year | 0.52 | 0.46 | 0.41 | 0.63 | 1.55 | 1.84 | 1.50 | 1.00 | 0.78 | 0.70 | 0.65 | 0.58 | 0.89 |
| | 1:20 Wet Year | 2.40 | 2.09 | 1.86 | 2.88 | 7.09 | 8.42 | 6.87 | 4.58 | 3.55 | 3.22 | 2.99 | 2.67 | 4.06 |
| | 1:100 Wet Year | 2.98 | 2.59 | 2.31 | 3.58 | 8.80 | 10.46 | 8.53 | 5.69 | 4.41 | 4.00 | 3.71 | 3.31 | 5.04 |

**Table 4.9: Low Flow Summary for Selected Dixie Creek Stations**

| 7-Day Average Low Flows | Flow ($m^3/s$) | | |
|---|---|---|---|
| | Dixie Lake Outlet (HF-07) | Dixie Creek at Tuzyk's Road (HF-03) | Dixie Creek at Tote Road (HF-01) |
| 7Q2 | 0.29 | 0.31 | 0.55 |
| 7Q5 | 0.17 | 0.18 | 0.32 |
| 7Q10 | 0.13 | 0.14 | 0.25 |
| 7Q20 | 0.11 | 0.12 | 0.21 |

**Table 4.10: Monthly Runoff Coefficient**

| Month | Natural Ground Runoff Coefficient |
|---|---|
| Jan | 0.35 |
| Feb | 0.35 |
| Mar | 0.35 |
| Apr | 0.45 |
| May | 0.40 |
| Jun | 0.25 |
| Jul | 0.25 |
| Aug | 0.25 |
| Sep | 0.30 |
| Oct | 0.40 |
| Nov | 0.35 |
| Dec | 0.35 |
| Average Annual | 0.32 |

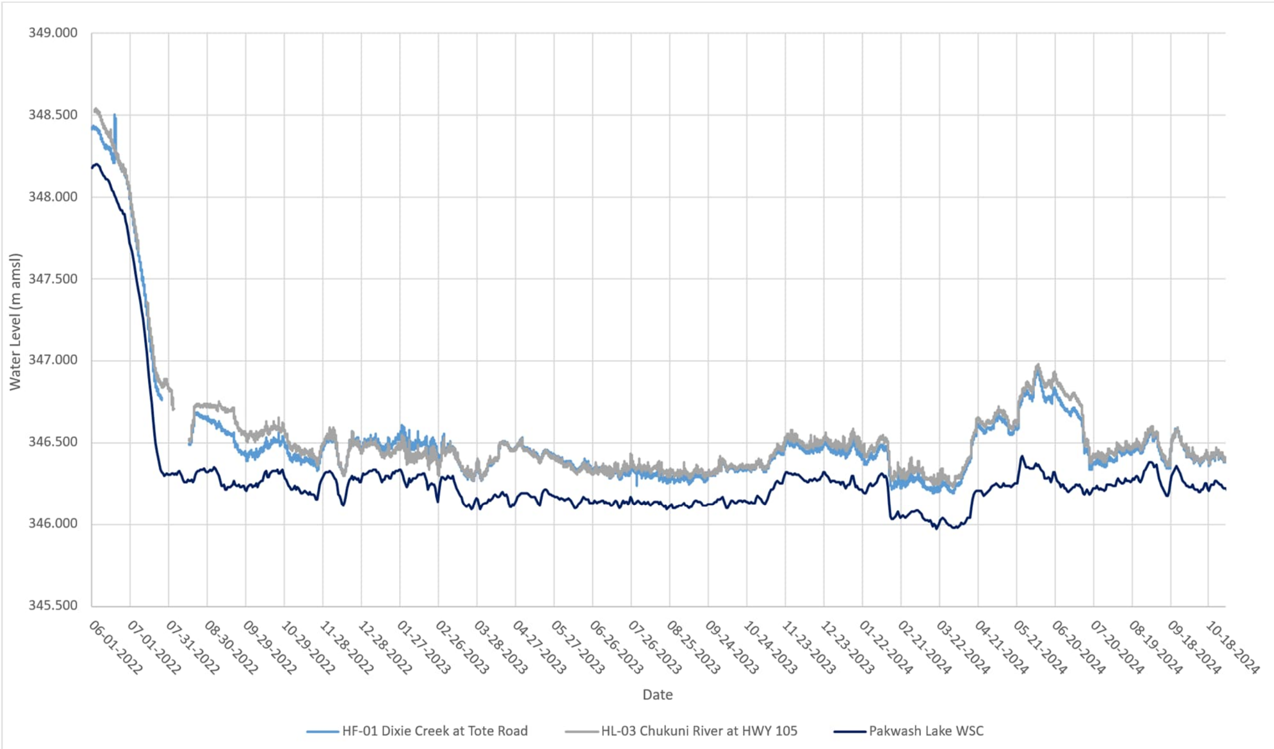



**Figure 4.1: Pakwash lake, Chukuni River and Dixie Creek Water Elevation Comparison**

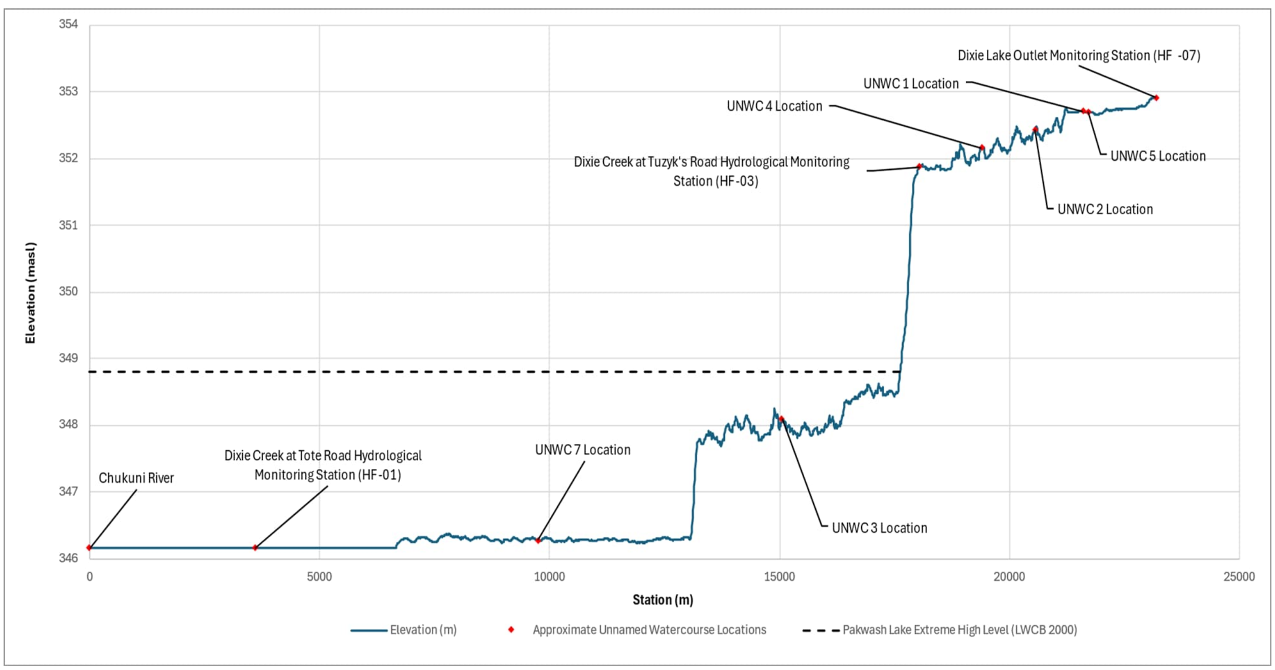



**Figure 4.2: Dixie Creek Profile**


**Figure 4.3: Photograph of beaver dam downstream from the Dixie Lake outlet (HF-07)**

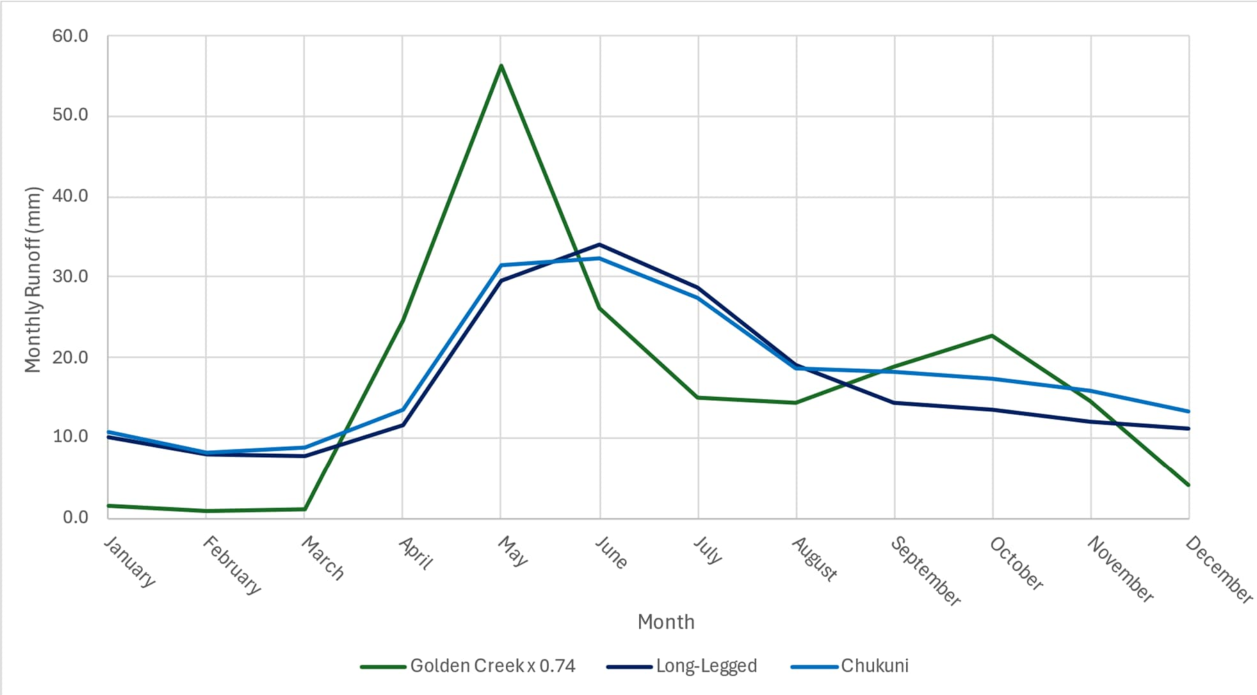



**Figure 4.4: WSC Monthly Runoff with Adjustment Factors**

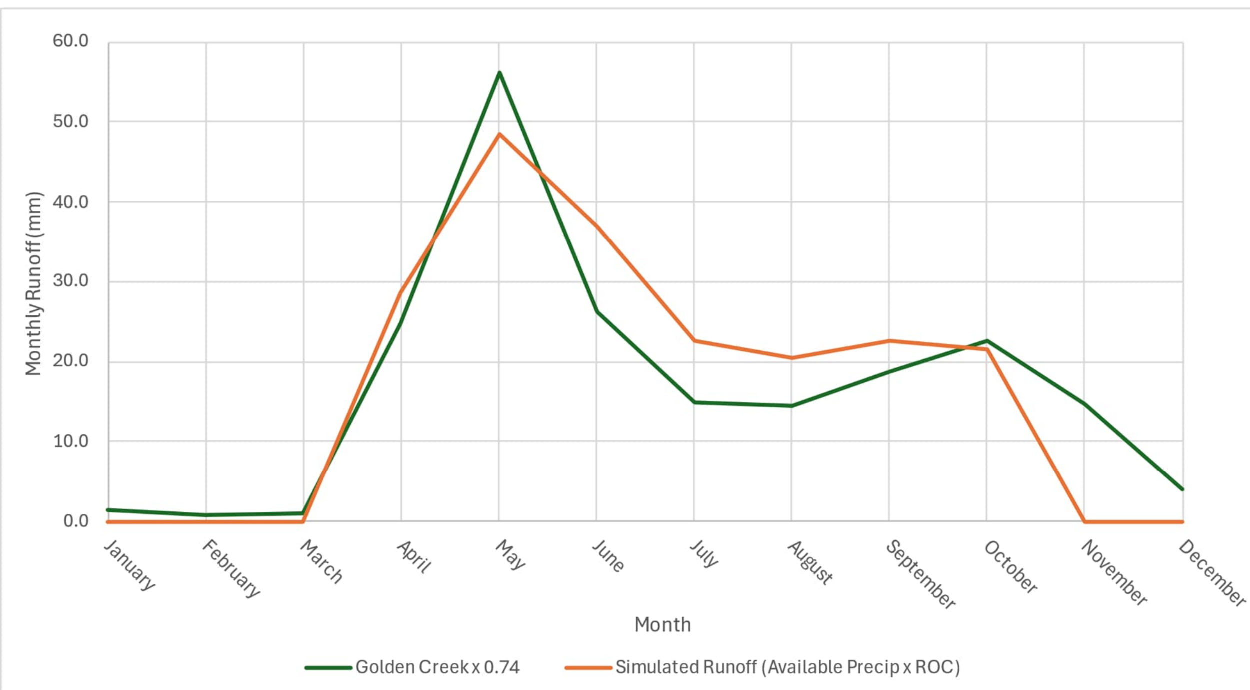



**Figure 4.5: Prorated Golden Creek Hydrograph and Simulated Runoff Hydrograph for Natural Ground**

# 5 SUMMARY OF MAIN FINDINGS

A total of 12 flow monitoring stations and 19 water level monitoring stations were installed in the area of the Project from 2022 to 2024. Based on the monitoring data flows tend to peak during spring freshet between April and June, with low flows observed during the winter months, January through March. For each of the flow stations with sufficient monitoring data rating curves and discharge hydrographs were developed.

A climate analysis estimates that the Project receives 633 mm of precipitation with a potential evaporation of approximately 92% annually. The Project has an average temperature of 1.0 °C, with six months of the year recording an average temperature below 0 °C (November to April). Further data in regard to onsite climate conditions can be found in the Climate Change Dataset Report (2025a).

Hydrographs and annual runoff were compared between onsite stations and three selected WSC monitoring stations, Long-Legged River, Golden Creek and Chukuni River. Based on the comparison Long-Legged River below Long-Legged Lake was selected as the representative station for majority of the site, with an adjustment factor applied to account for the smaller tributaries with little to no water storage features. From this analysis flows through Dixie Creek ranged from 0.27 $m^3/s$ at Dixie Lake outlet to 0.51 $m^3/s$ $m^3/s$ at Dixie Creek at Tote Road for the 1:100 dry year and 2.62 $m^3/s$ at Dixie Lake outlet to 5.04 $m^3/s$ at Dixie Creek at Tote Road for the 1:100 wet year. The mean annual baseline flow for Chukuni River was 30.2 $m^3/s$ for an average year, under 1:100 dry year and 1:100 wet year the estimated discharge is 9.7 $m^3/s$ and 62.6 $m^3/s$ respectively.

A low flow analysis was conducted based on this analysis 7Q20's in Dixie Creek ranged from 0.11 $m^3/s$ at Dixie Lake outlet to 0.21 $m^3/s$ at Dixie Creek at Tote Road. In addition, the 7Q20 was estimated to be 1.85 $m^3/s$ at the Chukuni River WSC monitoring station.

# 6 REFERENCES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# Appendix A:
# Hydrometric Field Data Summary

# Appendix A

## 1 HYDROMETRIC FIELD DATA SUMMARY

Over the baseline monitoring period 14 trips were completed from June 2022 to October 2024. During this period, streamflow measurements, water level surveys and continuous water level measurements were completed at 12 streamflow monitoring stations and 19 water level monitoring stations (Table A1.1). During the monitoring period Dixie Creek at Tote Road (HF-01) was identified as a location where it was difficult to establish a rating curve due to the backwater influence on the water levels, from the Manitou Falls Generating Station storage system (WSP 2024). Due to this influence this monitoring station (HF-01) had a Sontek IQ installed in June 2023 to collect continuous streamflow and water levels measurements. The SonTek IQ settings were adjusted as required throughout the monitoring period to optimize data collection, accounting for open water periods and on ice periods.

Beaver activity was observed along Dixie Creek and around the Project throughout the monitoring period. Two beaver dams resulting in large changes to the local flow regime were identified, one located approximately 2 kilometres (km) downstream of Dixie Lake outlet (HF-07) and the other located approximately 500 metres (m) upstream of the Genessee Lake streamflow station (HF-08). In the summer of 2023, these beaver dams were identified to restrict discharge downstream of these to monitoring stations. The beaver dam located downstream of Dixie Lake outlet was removed in October 2023, the 2024 flow data suggests that the pre-dam local flow regime was restored.

The measured in-situ flows and surveyed water level are provided in Table A1.2. Water levels are provided as elevations on a geodetic datum where possible. Relative datums may be retroactively converted to geodetic upon completion of subsequent geodetic surveys as needed. Topographic surveys showed shifts at some stations. This is to be expected after the initial installation as the datalogger anchor settles. Where applicable, this survey data was utilized to update the continuous water level records to account for this settling.

**Table A1.1: Local Monitoring Station Summary**

| Station ID | Station Description | Parameters | NAD 83 UTM Zone 15 N | | Period of Record | Watershed Area (km²) |
|---|---|---|---|---|---|---|
| | | | Easting (m) | Northing (m) | | |
| HF-01 | Dixie Creek at Tote Road | Flow and water level | 463528 | 5632124 | 2022 – 2024 | 360 |
| HF-02 | Unnamed Waterbody 6 Outflow above Dixie Creek | Flow and water level | 461767 | 5633620 | 2022 – 2024 | 15.2 |
| HF-02A | Unnamed Watercourse 6A | Flow and water level | 459040 | 5634093 | 2024 | 1.6 |
| HF-02B | Unnamed Watercourse 6B | Flow and water level | 459492 | 5634658 | 2024 | 1.5 |
| HF-03 | Dixie Creek Upstream of Unnamed Watercourse 3 | Flow and Water level | 456019 | 5633939 | 2022 – 2024 | 202 |
| HF-04 | Unnamed Watercourse 3 | Flow and Water level | 457433 | 5634011 | 2022 – 2024 | 9.8 |
| HF-06 | Unnamed Waterbody 2 Outflow | Flow and Water level | 454168 | 5634674 | 2022 – 2024 | 8.3 |
| HF-07 | Dixie Lake Outflow | Flow and Water level | 453381 | 5631660 | 2022 – 2024 | 187 |
| HF-08 | Genessee Lake Outflow | Flow and Water level | 451486 | 5634791 | 2022 – 2024 | 11.1 |
| HF-09 | Unnamed Watercourse 8 | Flow and Water level | 451734 | 5638946 | 2023 – 2024 | 6.6 |
| HF-10 | Stone Lake Outflow | Flow and Water level | 448619 | 5638645 | 2022 – 2024 | 40.7 |
| HF-11 | Unnamed Watercourse 7A | Flow and Water level | 457355 | 5631032 | 2024 | 41.2 |
| HL-01 | Genessee Lake | Water level | 449174 | 5636085 | 2022 – 2024 | 10.8 |
| HL-02 | Gullrock Lake | Water level | 446845 | 5642924 | 2022 – 2024 | 4,049 |
| HL-03 | Chukuni River Upstream of Dixie Creek at HWY 105 | Water level | 465475 | 5635260 | 2022 – 2024 | 4396 |
| HL-04 | Chukuni River Upstream of Dixie Creek at the Hydro Corridor | Water level | 464922 | 5633647 | 2024 | 4415 |
| HL-05 | Chukuni River at Dixie Creek | Water level | 466112 | 5631851 | 2024 | 4419 |
| HL-06 | Unnamed Waterbody 1 | Water level | 454235 | 5635359 | 2023 – 2024 | 8.0 |
| HL-07 | Unnamed Waterbody 5 | Water level | 455762 | 5636344 | 2024 | 1.3 |

**Table A1.2: Measurement Streamflow and Water Level Data**

| Watershed | Monitoring Location | Station Description | Date (yyyy-mm-dd) | Streamflow ($m^3/s$) | Surveyed Water Elevation (m) |
|---|---|---|---|---|---|
| Dixie Creek Watershed | HL-01 | Genessee Lake | 2022-06-03 | n/a[1] | 379.31 |
| | | | 2022-07-14 | n/a[1] | 379.25 |
| | | | 2022-08-19 | n/a[1] | 379.38 |
| | | | 2022-09-22 | n/a[1] | 379.32 |
| | | | 2023-02-11 | n/a[1] | 379.31 |
| | | | 2023-03-13 | n/a[1] | 379.28 |
| | | | 2023-06-18 | n/a[1] | 379.37 |
| | | | 2023-07-27 | n/a[1] | 379.35 |
| | | | 2023-09-22 | n/a[1] | 379.29 |
| | | | 2023-10-22 | n/a[1] | 379.29 |
| | | | 2024-03-10 | n/a[1] | 378.59 |
| | | | 2024-06-06 | n/a[1] | 378.98 |
| | | | 2024-08-11 | n/a[1] | 378.94 |
| | | | 2024-10-08 | n/a[1] | 378.91 |
| | HF-08 | Genessee Lake Outflow | 2022-06-03 | 0.17 | 29.28* |
| | | | 2022-07-15 | n/a[2] | 28.89* |
| | | | 2022-08-19 | 0.0010 | 29.01* |
| | | | 2022-09-21 | <1 L/s | 29.03* |
| | | | 2023-03-13 | 0.016 | 28.99* |
| | | | 2023-06-16 | <1 L/s | 28.86* |
| | | | 2023-07-27 | 0.0033 | 28.90* |
| | | | 2023-09-22 | <1 L/s | 28.91* |
| | | | 2023-10-21 | 0.11 | 29.20* |
| | | | 2024-06-11 | 0.15 | 29.11* |
| | | | 2024-08-14 | 0.030 | 28.93* |
| | | | 2024-10-10 | 0.0099 | 28.91* |
| | HF-07 | Dixie Lake Outflow | 2022-06-02 | 5.2 | 26.87* |
| | | | 2022-07-15 | 0.80 | 26.56* |
| | | | 2022-08-17 | 2.5 | 26.70* |
| | | | 2022-09-22 | 0.66 | 26.56* |
| | | | 2023-06-16 | 0.040 | 26.61* |
| | | | 2023-07-26 | 0.13 | 26.66* |
| | | | 2023-09-21 | 0.034 | 26.64* |
| | | | 2023-10-21 | 0.068 | 26.86* |
| | | | 2024-06-08 | 5.2 | 27.02* |
| | | | 2024-08-11 | 0.71 | 26.62* |
| | | | 2024-10-08 | 0.44 | 26.67* |
| | HL-07 | Unnamed Waterbody 5 | 2024-06-10 | n/a[1] | 29.19* |
| | | | 2024-08-12 | n/a[1] | 28.66* |
| | | | 2024-10-06 | n/a[1] | 28.62* |
| | HL-06 | Unnamed Waterbody 1 | 2023-09-19 | n/a[1] | 28.60* |
| | | | 2023-10-23 | n/a[1] | 28.67* |
| | | | 2024-06-06 | n/a[1] | 29.21* |
| | | | 2024-08-14 | n/a[1] | 379.08 |
| | | | 2024-10-06 | n/a[1] | 378.89 |
| | HF-06 | Unnamed Waterbody 2 Outflow | 2022-06-01 | 0.11 | 379.43 |
| | | | 2022-07-13 | 0.034 | 379.28 |
| | | | 2022-08-18 | 0.021 | 379.23 |
| | | | 2022-09-19 | 0.0050 | 379.16 |

| Watershed | Monitoring Location | Station Description | Date (yyyy-mm-dd) | Streamflow ($m^3/s$) | Surveyed Water Elevation (m) |
|---|---|---|---|---|---|
| | | | 2023-02-10 | <1 L/s | 379.12 |
| | | | 2023-03-12 | n/a[2] | 380.89 |
| | | | 2023-06-16 | 0.0090 | 379.19 |
| | | | 2023-07-29 | 0.0069 | 379.13 |
| | | | 2023-09-20 | <1 L/s | 379.09 |
| | | | 2023-10-23 | 0.0095 | 379.15 |
| | | | 2024-03-12 | n/a[2] | 379.14 |
| | | | 2024-06-05 | 0.43 | 379.60 |
| | | | 2024-08-14 | 0.068 | 379.27 |
| | | | 2024-10-06 | 0.020 | 379.17 |
| | HF-03 | Dixie Creek Upstream of Unnamed Watercourse 3 | 2022-05-31 | 5.3 | 352.48 |
| | | | 2022-07-12 | 1.2 | 352.05 |
| | | | 2022-08-17 | 2.7 | 352.24 |
| | | | 2022-09-20 | 0.75 | 352.02 |
| | | | 2022-09-23 | n/a[2] | 351.99 |
| | | | 2023-02-08 | 0.40 | 352.04 |
| | | | 2023-03-12 | 0.22 | 351.95 |
| | | | 2023-06-17 | 0.028 | 351.73 |
| | | | 2023-07-25 | 0.024 | 351.87 |
| | | | 2023-07-30 | n/a[2] | 351.91 |
| | | | 2023-09-25 | 0.0084 | 351.71 |
| | | | 2023-10-20 | 0.029 | 351.92 |
| | | | 2024-03-09 | 0.39 | 351.92 |
| | | | 2024-06-05 | 5.8 | 351.99 |
| | | | 2024-08-13 | 0.83 | 352.00 |
| | | | 2024-10-09 | 0.57 | 351.95 |
| | HF-04 | Unnamed Watercourse 3 | 2022-06-04 | 0.089 | 351.93 |
| | | | 2022-07-16 | 0.010 | 351.71 |
| | | | 2022-08-16 | 0.013 | 351.74 |
| | | | 2022-09-19 | 0.0030 | 351.75 |
| | | | 2023-02-09 | 0.0010 | 351.77 |
| | | | 2023-06-17 | 0.0040 | 351.77 |
| | | | 2023-07-25 | <1 L/s | 351.71 |
| | | | 2023-09-19 | <1 L/s | 351.71 |
| | | | 2023-10-22 | 0.014 | 351.82 |
| | | | 2024-06-05 | 0.48 | 352.33 |
| | | | 2024-08-13 | 0.012 | 351.77 |
| | | | 2024-10-06 | 0.0032 | 351.84 |
| | HF-11 | Unnamed Watercourse 7A | 2024-06-09 | n/a[2] | 29.40* |
| | | | 2024-06-12 | 0.92 | 29.33* |
| | | | 2024-08-13 | 0.061 | 29.67* |
| | | | 2024-10-10 | n/a[2] | 29.78* |
| | HF-02A | Unnamed Watercourse 6A | 2024-06-09 | 0.0099 | 29.14* |
| | | | 2024-08-12 | 0.0018 | 29.09* |
| | | | 2024-10-07 | 0.00010 | 29.11* |
| | HF-02B | Unnamed Watercourse 6B | 2024-06-10 | 0.0067 | 29.11* |
| | | | 2024-08-12 | n/a[2] | 29.12* |
| | | | 2024-10-07 | 0.0003 | 29.14* |
| | HF-02 | | 2022-08-20 | 0.27 | 347.41 |
| | | | 2022-09-21 | 0.15 | 347.25 |

| Watershed | Monitoring Location | Station Description | Date (yyyy-mm-dd) | Streamflow ($m^3/s$) | Surveyed Water Elevation (m) |
|---|---|---|---|---|---|
| | | Unnamed Waterbody 6 Outflow above Dixie Creek | 2023-02-12 | n/a[2] | 346.97 |
| | | | 2023-03-15 | n/a[2] | 346.90 |
| | | | 2023-06-16 | <1 L/s | 347.03 |
| | | | 2023-07-27 | n/a[2] | 346.99 |
| | | | 2023-09-22 | n/a[2] | 346.92 |
| | | | 2023-10-22 | n/a[2] | 347.01 |
| | | | 2024-03-12 | n/a[2] | 347.00 |
| | | | 2024-06-07 | n/a[2] | 347.44 |
| | | | 2024-08-12 | n/a[2] | 347.44 |
| | | | 2024-10-09 | n/a[2] | 347.30 |
| | HF-01 | Dixie Creek at Tote Road | 2022-06-01 | 7.40 | 348.42 |
| | | | 2022-07-13 | 3.80 | 347.32 |
| | | | 2022-08-16 | 3.00 | 346.49 |
| | | | 2022-09-20 | 1.30 | 346.51 |
| | | | 2023-02-09 | 0.56 | 346.49 |
| | | | 2023-03-14 | 0.34 | 346.37 |
| | | | 2023-06-14 | 0.59 | 346.34 |
| | | | 2023-07-25 | n/a[2] | 346.33 |
| | | | 2023-07-28 | 0.82 | 346.33 |
| | | | 2023-09-20 | 0.31 | 346.27 |
| | | | 2023-10-20 | 0.38 | 346.34 |
| | | | 2024-03-11 | 0.46 | 346.24 |
| | | | 2024-06-05 | 11.79 | 346.92 |
| | | | 2024-06-12 | 7.2 | 346.76 |
| | | | 2024-08-13 | 1.62 | 346.43 |
| | | | 2024-10-07 | 1.19 | 346.40 |
| Gullrock Lake Watershed | HF-09 | Unnamed Watercourse 8 | 2023-09-25 | 0.0022 | 29.89* |
| | | | 2023-10-20 | 0.0070 | 29.91* |
| | | | 2024-03-11 | 0.020 | 29.87* |
| | | | 2024-06-06 | 0.014 | 30.56* |
| | | | 2024-08-11 | 0.012 | 29.92* |
| | | | 2024-10-06 | n/a[2] | 30.08* |
| | HF-10 | Stone Lake Outflow | 2022-06-01 | 1.3 | 368.14 |
| | | | 2022-07-13 | 0.27 | 367.87 |
| | | | 2022-08-15 | 0.27 | 367.86 |
| | | | 2022-09-19 | 0.090 | 367.80 |
| | | | 2023-02-10 | 0.060 | 367.79 |
| | | | 2023-03-11 | 0.040 | 367.75 |
| | | | 2023-06-18 | 0.060 | 367.79 |
| | | | 2023-07-29 | 0.034 | 367.78 |
| | | | 2023-09-23 | 0.0032 | 367.72 |
| | | | 2023-10-23 | 0.065 | 367.78 |
| | | | 2024-03-09 | 0.069 | 367.78 |
| | | | 2024-06-06 | 1.2 | 368.12 |
| | | | 2024-08-11 | 0.26 | 367.85 |
| | | | 2024-10-07 | 0.0001 | 367.92 |
| | HL-02 | Gullrock Lake | 2022-06-04 | n/a[1] | 356.32 |
| | | | 2022-07-12 | n/a[1] | 355.84 |
| | | | 2022-08-15 | n/a[1] | 355.82 |
| | | | 2022-09-19 | n/a[1] | 355.55 |

| Watershed | Monitoring Location | Station Description | Date (yyyy-mm-dd) | Streamflow ($m^3/s$) | Surveyed Water Elevation (m) |
|---|---|---|---|---|---|
| | | | 2023-02-12 | n/a[1] | 355.66 |
| | | | 2023-03-12 | n/a[1] | 355.62 |
| | | | 2023-06-20 | n/a[1] | 355.67 |
| | | | 2023-07-29 | n/a[1] | 355.75 |
| | | | 2023-09-22 | n/a[1] | 355.71 |
| | | | 2023-10-22 | n/a[1] | 355.74 |
| | | | 2024-03-11 | n/a[1] | 355.71 |
| | | | 2024-06-06 | n/a[1] | 355.78 |
| | | | 2024-08-12 | n/a[1] | 355.80 |
| | | | 2024-10-07 | n/a[1] | 355.72 |
| Chukuni River Watershed | HL-03 | Chukuni River Upstream of Dixie Creek at HWY 105 | 2022-06-03 | n/a[1] | 348.54 |
| | | | 2022-07-14 | n/a[1] | 347.36 |
| | | | 2022-08-16 | n/a[1] | 346.51 |
| | | | 2022-09-20 | n/a[1] | 346.65 |
| | | | 2023-02-09 | n/a[1] | 346.41 |
| | | | 2023-03-14 | n/a[1] | 346.38 |
| | | | 2023-06-14 | n/a[1] | 346.32 |
| | | | 2023-07-25 | n/a[1] | 346.35 |
| | | | 2023-09-22 | n/a[1] | 346.30 |
| | | | 2023-10-20 | n/a[1] | 346.36 |
| | | | 2024-03-11 | n/a[1] | 346.29 |
| | | | 2024-06-06 | n/a[1] | 346.96 |
| | | | 2024-08-14 | n/a[1] | 346.48 |
| | | | 2024-10-06 | n/a[1] | 346.39 |
| | HL-04 | Chukuni River Upstream of Dixie Creek at the Hydro Corridor | 2024-06-13 | n/a[1] | 346.65 |
| | | | 2024-08-14 | n/a[1] | 346.32 |
| | | | 2024-10-06 | n/a[1] | 346.24 |
| | HL-05 | Chukuni River at Dixie Creek | 2024-06-13 | n/a[1] | 346.60 |
| | | | 2024-08-14 | n/a[1] | 346.22 |
| | | | 2024-10-06 | n/a[1] | 346.27 |

*Notes:*

*n/a[1]: Streamflow not monitored at location*

*n/a[2]: Streamflow measurement unavailable due to site conditions*

**: Water level not surveyed geodetically measured to a relative datum*

## 2 PRELIMINARY RATING CURVE AND HYDROGRAPHS

### 2.1 PRELIMINARYRATING CURVE

Preliminary rating curves were developed to relate continuously measured water levels to the discrete flow measurements. These rating curves were developed using the data collected during the monitoring period, June 2022 to October 2024. The rating curves were developed utilizing the Water Survey of Canada procedures for stage-discharge model development (2016) and the International Organization for Standardization standard on the determination of the stage-discharge relationship (2020a) using the general rating curve equation as follows:

$$Q=C(H-H_0)^B$$

where,

| | |
|---|---|
| $Q$ | is the calculated flow (m3/s) |
| $C$ | is a coefficient |
| $H$ | is the water surface elevation (m or masl) |
| $H_0$ | is the gauge height of zero flow or offset (m or masl) |
| $(H-H_0)$ | is the effective gauge height (m or masl) |
| $B$ | is the slope of the rating curve when plotted using a logarithmic scale |

The zero flow was determined for each station by either subtracting the maximum cross-section depth and velocity head from the measured water level for each of the streamflow measurements or estimating a zero flow elevation based on streamflow measurement and downstream features such as hydraulic controls.

The preliminary rating curve formulas developed for each station may be refined as additional measurements are collected. Combination or compound controls were not considered in the development of the rating curves. As more field measurements are completed, combination or compound controls may become evident and can result in multiple rating curve formulas to be developed for ranges of water surface elevations. Additionally, the rating curves may shift over time due to environmental factors such as beaver activity or changes to the channel geometry through erosion and deposition. Human factors may also result in shifting rating curves such as bridge construction.

The preliminary rating curves were developed for the monitoring stations outlined in Table A1.2 at the Project are based on field measurements recorded between June 2022 and October 2024. Rating curve plots developed from June 2022 to October 2024 are provided in Figure A2.1 through Figure A2.7. The number of measurements recorded and utilized in the development of the rating curve may differ as a result of the variable conditions seen across the Project during this time period. Dixie Lake Outlet (HF-07) required the development of two rating curves due to beaver activity and further rational is outline in the subsequent subsection. Additional rating curves may be developed as the program continues and additional datapoints are available for other monitoring station locations.

#### 2.1.1 UNDER ICE CORRECTION FACTOR

Under-ice streamflow measurements were not used in developing the open water rating curves. Streamflow measurements conducted during the open water season exhibit different hydraulic conditions than the under-ice flows as the under-ice condition experience higher flow resistance due to the friction of the ice layer. A correction factor was developed using the under-ice flow measurements to relate the discharge calculated based on the open water rating curve to the under-ice flow conditions. The under-ice rating curve correction factors were developed for Dixie Creek at Tote Road (HF-01) and Dixie Creek at

Tuzyk's Road (HF-03) utilizing the United States Geological Survey procedures for Effects of Ice on Stream Flow (1913) under-ice correction factor equation as follows:

$$C = Q \div Q_2 \geq 1.00$$

$$C' = Q \div Q_1 = \pm 1.00$$

where,

| | |
|---|---|
| $C$ | is the coefficient with effective gauge height to the waters surface |
| $C'$ | is the coefficient with effective gauge height to the bottom of ice |
| $Q$ | is the measured discharge ($m^3/s$) |
| $Q_1$ | is the applied discharge from the open water rating curve with effective height to the bottom of ice ($m^3/s$) |
| $Q_2$ | is the applied discharge from the open water rating curve with effective height to the water surface |

The correction factor was calculated for two hydrometric stations, Dixie Creek at Tote Road (HF-01) and Dixie Creek at Tuzyk's Road (HF-03). These stations both have multiple under-ice measurements that can be used to apply a correction factor. The correction factors are provided in Table A2.1. As discussed in the Hydrology Baseline Report (WSP 2025) the water levels at the Dixie Creek at Tote Road (HF-01) stations are influenced by the Chukuni River. In February 2024 a decrease in water level at the Dixie Creek at Tote Road (HF-01) station was measured and corresponds to a decrease in water levels in Pakwash Lake. To account for this an additional correction factor was calculated for the period of February 13, 2024 to April 15, 2024.

### 2.1.2 RATING CURVE DEVELOPMENT – HF-07

Due to beaver activity downstream of Dixie Lake Outlet (HF-07), located on Dixie Creek immediately downstream of Dixie Lake, two rating curves were required to represent the June 2022 to October 2024 monitoring period. One rating curve was developed to represent the period unaffected by the influence of the Dixie Creek beaver dam and a second rating curve was developed to represent the period of March 2023 to November 2023 which are influenced by the downstream beaver dams.

The rating curve developed to represent streamflow without influence of the Dixie Creek beaver activity, uses data collected in 2022 and 2024, for estimating streamflow. Between this period a beaver dam on Dixie Creek was constructed which resulted in a change in the stage discharge relationship. Additionally, the 2023 streamflow measurements were collected while the beaver dam was actively being constructed, as can be observed from the October 2023 field measurement. The October 2024 field measurement was observed to be influenced by an additional beaver dam immediately downstream of the hydrometric monitoring station. This measurement is not used in the development of the rating curves due to limited data from the point of time the beaver dam was constructed.

## 2.2 FLOW HYDROGRAPHS

Streamflow hydrographs were developed using the rating curves, under-ice correction factors and water level data for each of the stations. Hydrograph plots with water level and streamflow developed from June 2022 to October 2024 are provided in Figure A2.8 through Figure A2.13. Some periods of missing data are the result of the water level dropping below the absolute pressure datalogger when flows were receding in spring / summer of 2022 and from freezing of the dataloggers in the winter periods. Average monthly streamflow's are presented in Table A2.2.

As outlined above the Dixie Lake Outlet station (HF-07) was affected by downstream beaver dams, these periods have been identified on the hydrographs.

The Dixie Creek at Tote Road (HF-01) monitoring station is impacted by backwater effects from the Chukuni River (WSP 2024). Initial streamflow measurements conducted at this station in June 2022 and September 2022 are impacted by the backwater from the Chukuni River, making the establishment of a stage discharge relationship difficult to establish. For the purpose of the streamflow hydrograph discharge between these points were estimated as a linear relationship between manual flow measurements. From September 2022 to April 2024 there was sufficient information to establish a stage discharge relationship. This was then applied to calculate discharge for this period. In April 2024, the SonTek IQ continuous discharge data was available and has been applied to the hydrograph until October 2024.

## 2.3 WATER LEVEL HYDROGRAPHS

Continuous water level plots are available from the date of install to October 2024. For most stations this period is early June 2022 to October 2024. In certain cases, gaps are present in the continuous level data due to levels receding below the initial position of the datalogger or damage caused to the dataloggers during freezing temperatures. The station located on Unnamed Waterbody 6 (HF-02) had a larger gap in data than other stations due to the malfunction of the station’s datalogger. This malfunction was due to the freezing of the device which caused a malfunction of the internal pressure sensor. Dataloggers were either redeployed at deeper locations or replaced during subsequent visits. Continuous level plots for each station are provided in Figure A2.14 through Figure A2.26. Average monthly water levels are presented in Table A2.3.

**Table A2.1: Under-Ice Correction Factor**

| Station | Correction Factor | Number of Under Ice Measurements |
|---|---|---|
| HF-01 | 0.370 | 2 |
| HF-01* | 2.31 | 1 |
| HF-03 | 0.429 | 3 |

** Represents the period between February 13, 2024 to April 15, 2024.*

**Table A2.2: On Site Monitoring Station Summary – Average Monthly Streamflow ($m^3/s$)**

| Year | Month | Unnamed Watercourse 1 (HF-06) | Unnamed Watercourse 3 (HF-04) | Stone Lake Outlet (HF-10) | Dixie Lake Outlet (HF-07) | Dixie Creek at Tote Road (HF-01) | Dixie Creek at Tuzyk's Road (HF-03) |
|---|---|---|---|---|---|---|---|
| 2022 | Jun | 0.09 | 0.05 | 0.78 | 1.22 | 6.12 | 3.33 |
| | Jul | 0.05 | 0.04 | 0.27 | 0.85 | 4.03 | 1.19 |
| | Aug | 0.04 | 0.02 | 0.35 | 2.19 | 2.44 | 2.45 |
| | Sep | 0.01 | 0.01 | 0.13 | 0.86 | 1.67 | 1.02 |
| | Oct | 0.01 | 0.01 | 0.05 | 0.08 | 1.70 | 0.75 |
| | Nov | 0.01 | 0.01 | 0.07 | NA | 0.40 | 0.90 |
| | Dec | 0.01 | 0.01 | 0.08 | NA | 0.62 | 1.13 |
| 2023 | Jan | 0.01 | 0.01 | 0.08 | NA | 0.76 | 1.03 |
| | Feb | <0.01 | 0.01 | 0.05 | NA | 0.61 | 1.02 |
| | Mar | <0.01 | n/a[1] | 0.02 | n/a[1] | 0.35 | 0.56 |
| | Apr | 0.04 | n/a[1] | 0.13 | 0.01 | 0.49 | 1.25 |
| | May | 0.11 | 0.07 | 0.47 | 0.10 | 1.33 | 2.13 |
| | Jun | 0.01 | 0.03 | 0.11 | 0.05 | 0.74 | 0.37 |
| | Jul | <0.01 | 0.01 | 0.02 | 0.04 | 0.54 | 0.30 |
| | Aug | <0.01 | <0.01 | 0.02 | 0.07 | 0.41 | 0.12 |
| | Sep | <0.01 | <0.01 | 0.01 | 0.08 | 0.40 | 0.04 |
| | Oct | 0.01 | 0.03 | 0.06 | 0.42 | 0.65 | 0.76 |
| | Nov | 0.01 | 0.02 | 0.07 | 1.14 | 0.46 | 1.43 |
| | Dec | <0.01 | 0.01 | 0.06 | 1.23 | 0.59 | 0.95 |
| 2024 | Jan | <0.01 | <0.01 | 0.05 | 0.55 | 0.50 | 1.44 |
| | Feb | <0.01 | 0.01 | 0.05 | 0.14 | 0.61 | 0.86 |
| | Mar | 0.01 | 0.03 | 0.05 | 0.06 | 0.55 | 0.83 |
| | Apr | 0.10 | 0.27 | 0.32 | 2.32 | 1.72 | 2.24 |
| | May | 0.15 | 0.12 | 0.85 | 3.65 | 3.73 | 4.32 |
| | Jun | 0.14 | 0.14 | 0.97 | 4.06 | 5.48 | 4.77 |
| | Jul | 0.03 | 0.02 | 0.31 | 1.39 | 1.83 | 1.91 |
| | Aug | 0.02 | 0.01 | 0.11 | 1.02 | 0.49 | 0.70 |
| | Sep | 0.02 | 0.06 | 0.18 | 1.56 | 1.10 | 0.73 |
| | Oct | 0.02 | 0.02 | 0.41 | 1.97 | 0.90 | 0.78 |

*Note: n/a[1]: Monitoring data unavailable due to equipment malfunction.*

**Table A2.3: Summary of Local Lake Level Data - Average Monthly Water Elevation**

| Year | Month | Dixie Lake Water Level (HF-07, m)* | Stone Lake Water Elevation (HF-10, masl) | Unnamed Waterbody 6 Water Elevation (HF-02, masl) | Gullrock Lake Water Elevation (HL-02, masl) | Genessee Lake Water Elevation (HL-01, masl) | Unnamed Waterbody 1 Water Elevation (HL-06, masl) | Unnamed Waterbody 5 Water Elevation (HL-07, masl)* |
|---|---|---|---|---|---|---|---|---|
| 2022 | Jun | 26.61 | 367.99 | n/a[1] | 356.12 | 379.28 | n/a[1] | n/a[1] |
| | Jul | 26.58 | 367.88 | n/a[1] | 355.84 | 379.27 | n/a[1] | n/a[1] |
| | Aug | 26.71 | 367.90 | 347.38 | 355.80 | 379.35 | n/a[1] | n/a[1] |
| | Sep | 26.58 | 367.82 | 347.25 | 355.63 | 379.33 | n/a[1] | n/a[1] |
| | Oct | 26.46 | 367.78 | 347.12 | 355.53 | 379.30 | n/a[1] | n/a[1] |
| | Nov | 26.39 | 367.79 | 347.08 | 355.59 | 379.31 | n/a[1] | n/a[1] |
| | Dec | 26.37 | 367.80 | n/a[2] | 355.64 | 379.32 | n/a[1] | n/a[1] |
| 2023 | Jan | 26.36 | 367.80 | n/a[2] | 355.67 | 379.33 | n/a[1] | n/a[1] |
| | Feb | 26.29 | 367.77 | n/a[2] | 355.65 | 379.30 | n/a[1] | n/a[1] |
| | Mar | n/a[2] | 367.75 | n/a[2] | 355.62 | 379.28 | n/a[1] | n/a[1] |
| | Apr | 26.45 | 367.81 | n/a[2] | 355.57 | 379.31 | n/a[1] | n/a[1] |
| | May | 26.66 | 367.93 | n/a[2] | 355.59 | 379.36 | n/a[1] | n/a[1] |
| | Jun | 26.62 | 367.81 | n/a[2] | 355.67 | 379.38 | n/a[1] | n/a[1] |
| | Jul | 26.61 | 367.74 | n/a[2] | 355.71 | 379.32 | n/a[1] | n/a[1] |
| | Aug | 26.64 | 367.75 | 346.92 | 355.74 | 379.32 | n/a[1] | n/a[1] |
| | Sep | 26.65 | 367.73 | 347.00 | 355.71 | 379.30 | 378.77 | n/a[1] |
| | Oct | 26.82 | 367.78 | 347.06 | 355.75 | 379.31 | 378.84 | n/a[1] |
| | Nov | 26.67 | 367.79 | 347.06 | 355.75 | n/a[2] | 378.86 | n/a[1] |
| | Dec | 26.62 | 367.79 | 347.06 | 355.73 | n/a[2] | 378.94 | n/a[1] |
| 2024 | Jan | 26.54 | 367.78 | 347.06 | 355.72 | n/a[2] | n/a[2] | n/a[1] |
| | Feb | 26.48 | 367.78 | n/a[2] | 355.71 | n/a[2] | n/a[2] | n/a[1] |
| | Mar | 26.47 | 367.78 | 347.20 | 355.71 | n/a[2] | n/a[2] | n/a[1] |
| | Apr | 26.66 | 367.87 | 347.30 | 355.68 | n/a[2] | n/a[2] | n/a[1] |
| | May | 26.83 | 368.01 | 347.42 | 355.70 | n/a[2] | 379.16 | n/a[1] |
| | Jun | 26.86 | 368.03 | 347.42 | 355.77 | 378.96 | 379.12 | 29.07 |
| | Jul | 26.64 | 367.88 | 347.42 | 355.68 | 378.96 | 378.96 | 28.73 |
| | Aug | 26.60 | 367.81 | 347.40 | 355.79 | 378.92 | 378.95 | 28.66 |
| | Sep | 26.65 | 367.83 | 347.35 | 355.77 | 378.92 | 378.94 | 28.68 |
| | Oct | 26.69 | 367.92 | 347.29 | 355.74 | 378.92 | 378.92 | n/a[2] |

*Note: n/a[1]: Equipment was not installed.*

*n/a[2]: Monitoring data unavailable due to equipment malfunction.*

** not tied to geodetic – relative elevation.*

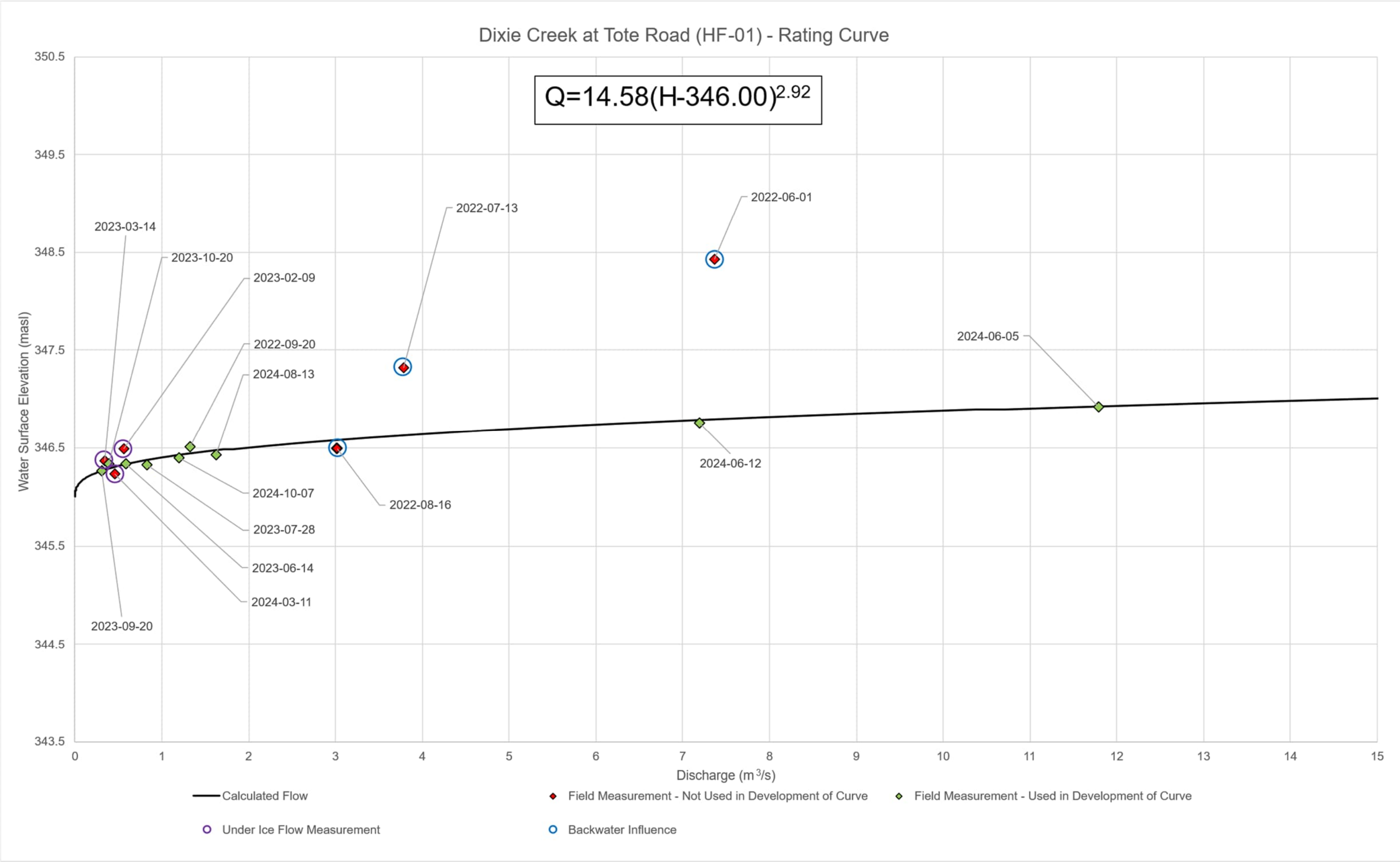



Figure A2-1: Dixie Creek at Tote Road (HF-01) – Rating Curve

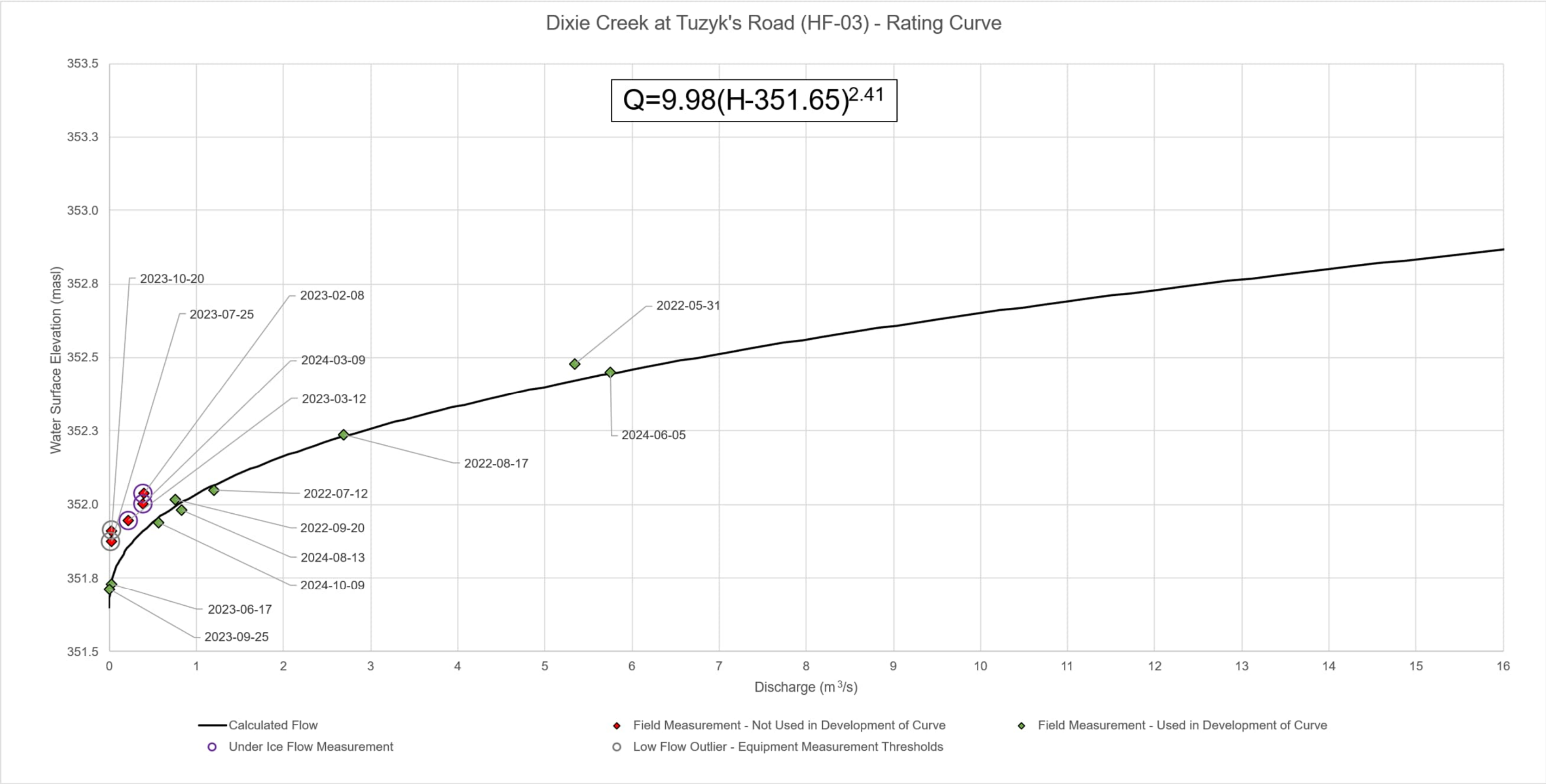



Figure A2-2: Dixie Creek at Tuzyk's Road (HF-03) – Rating Curve

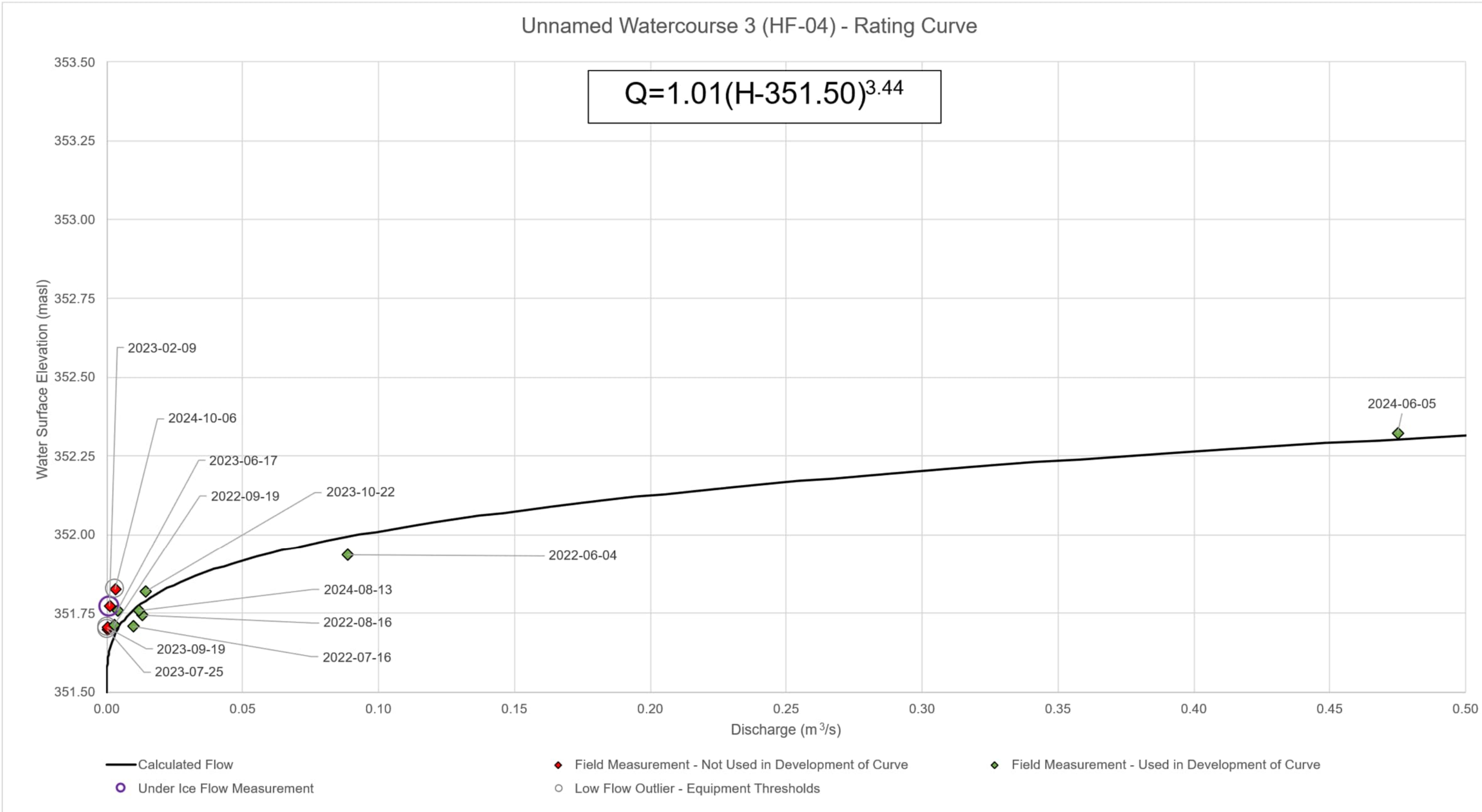



Figure A2-3: Unnamed Watercourse 3 (HF-04) – Rating Curve

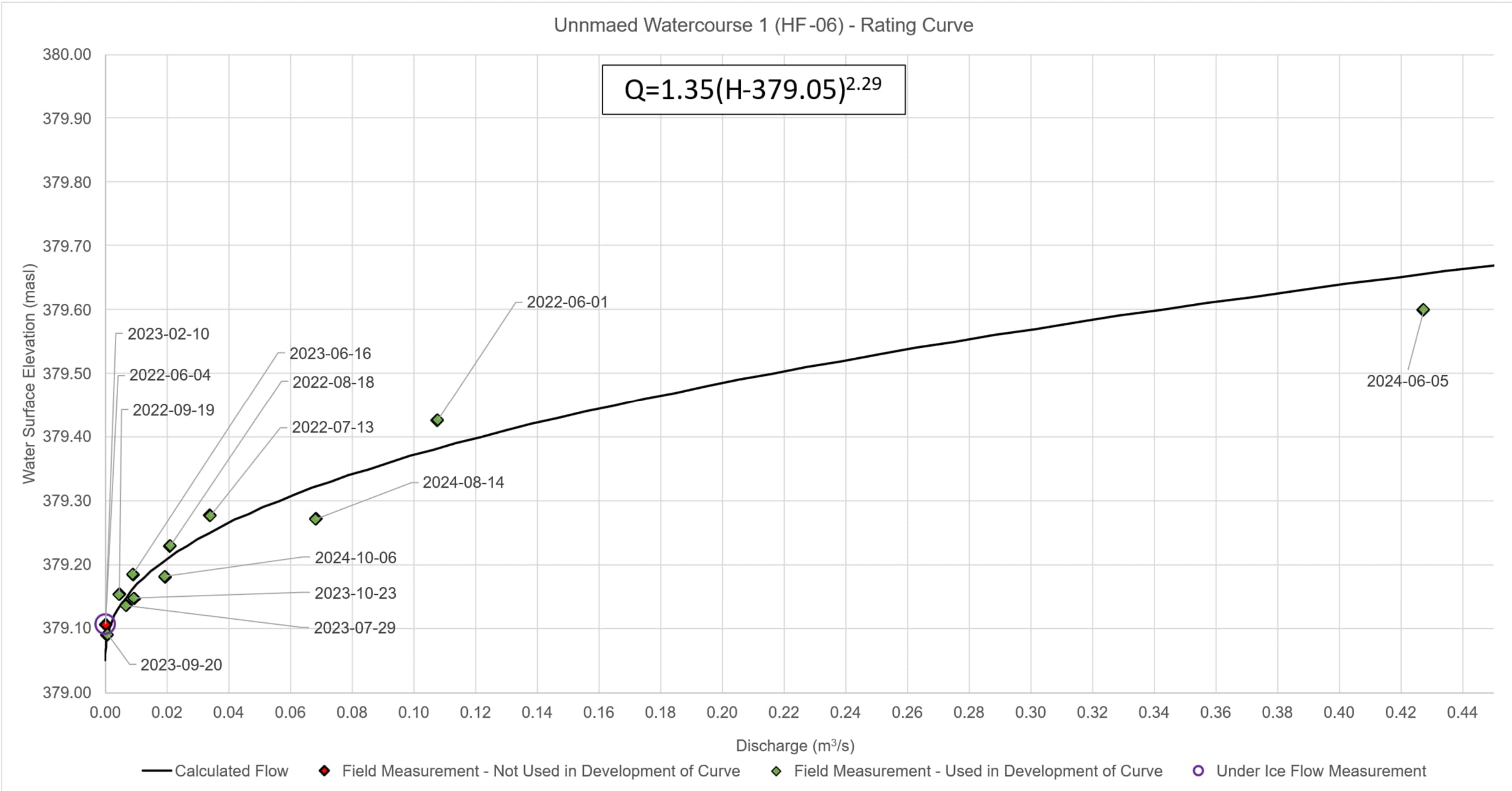



Figure A2-4: Unnamed Watercourse 1 (HF-06) – Rating Curve

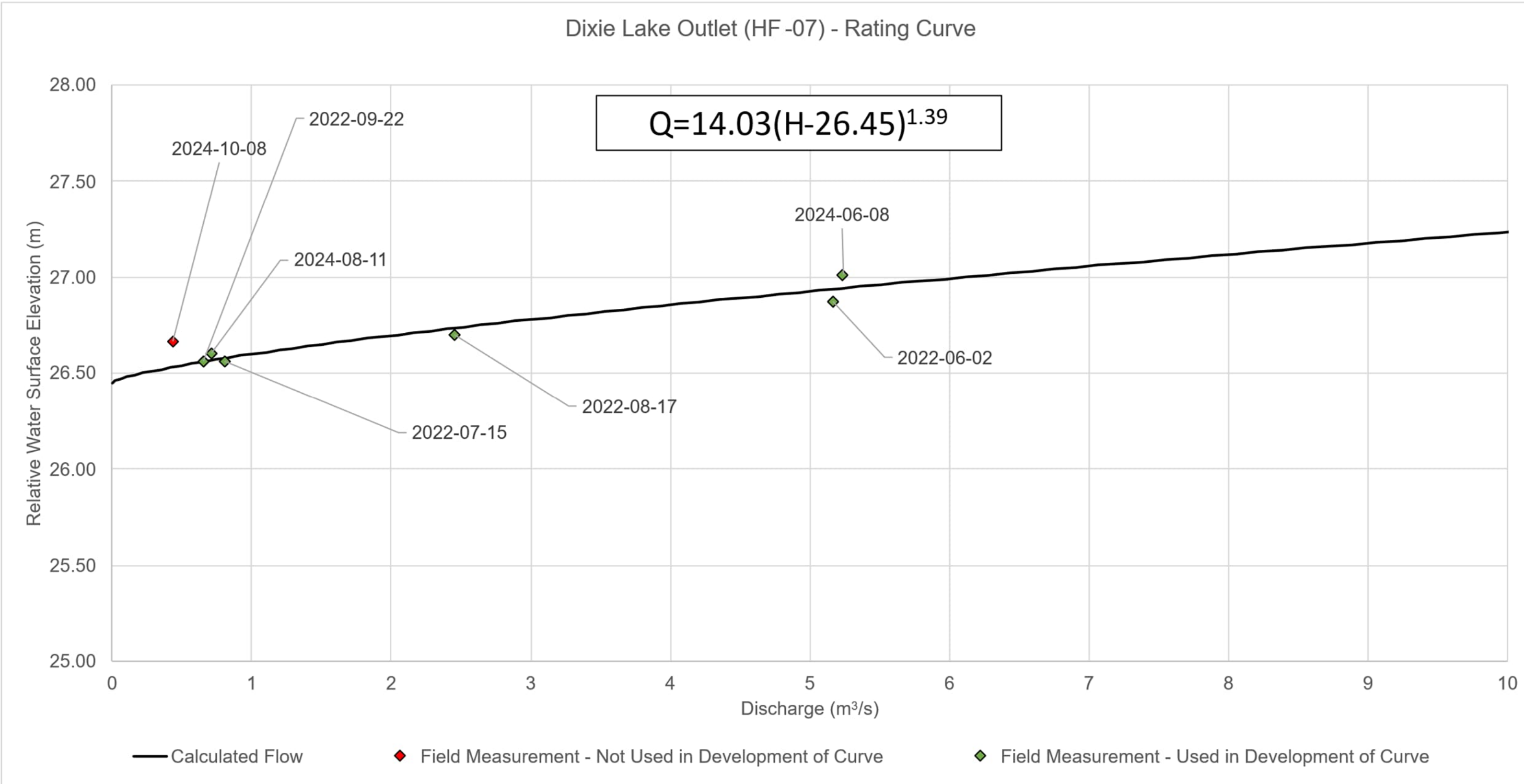



Figure A2-5: Dixie Lake Outlet (HF-07) – Rating Curve

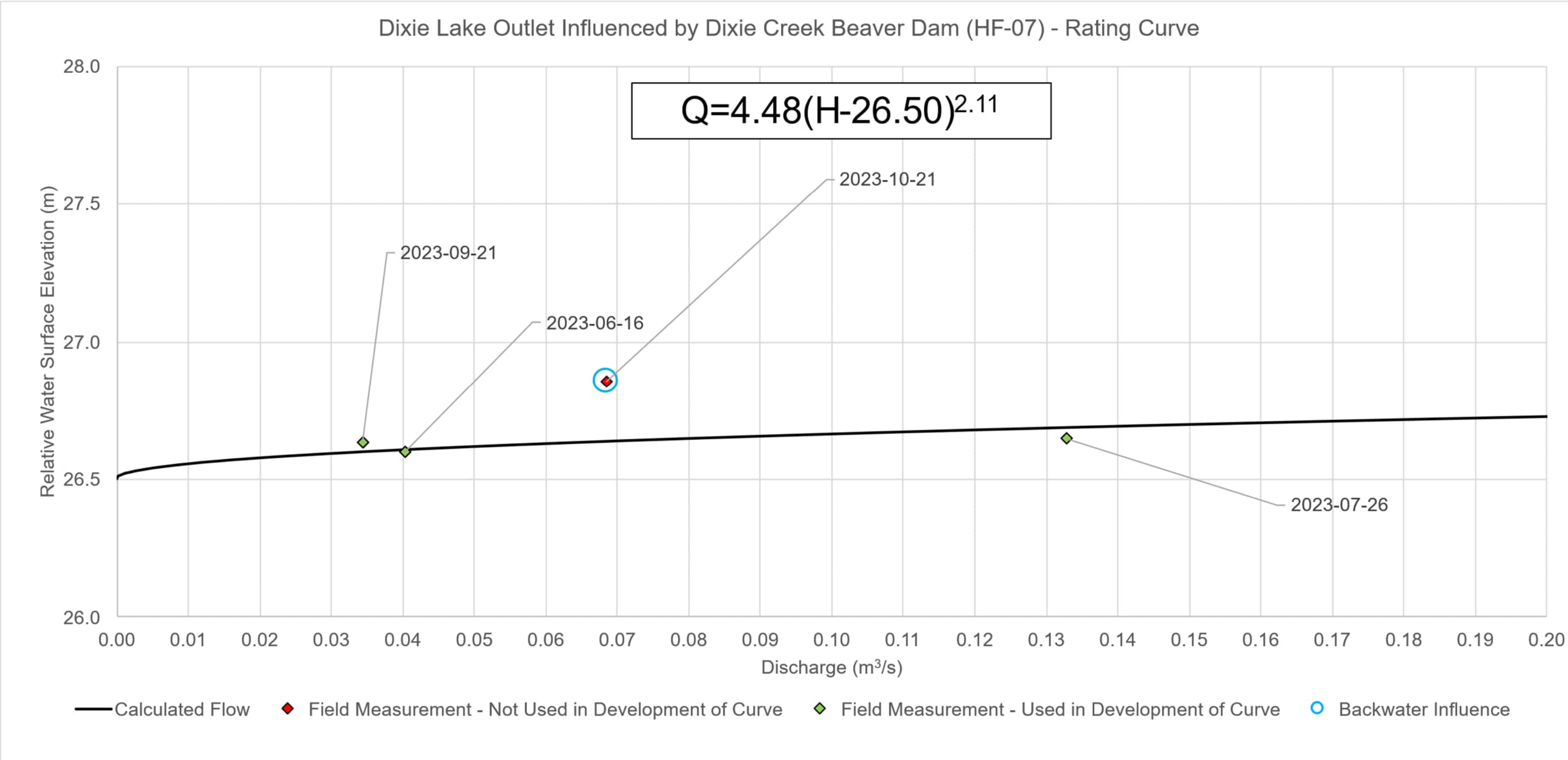



Figure A2-6: Dixie Lake Outlet (HF-07 – Dixie Creek Beaver Dam) – Rating Curve

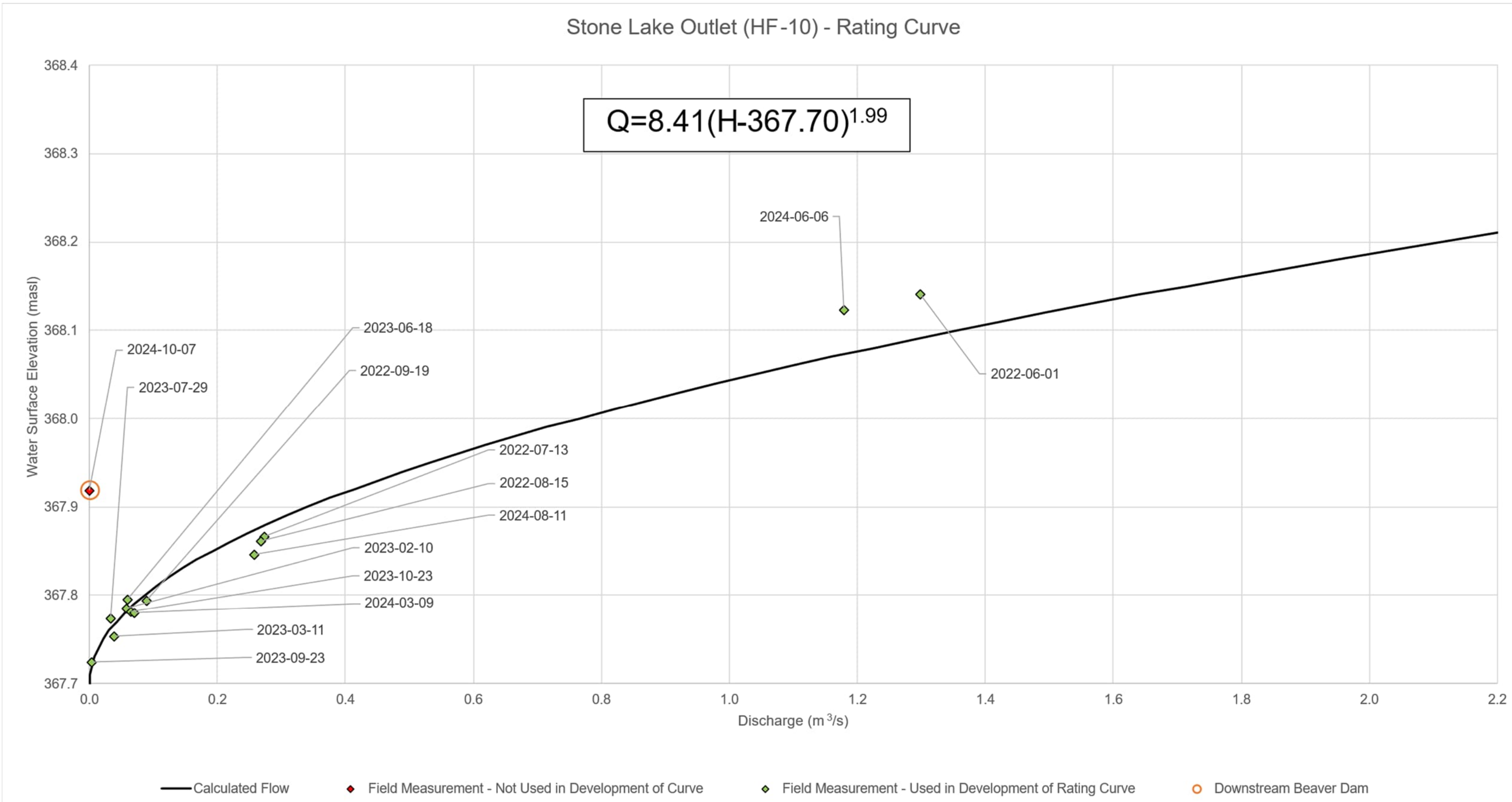



Figure A2-7: Stone Lake Outlet (HF-10) – Rating Curve

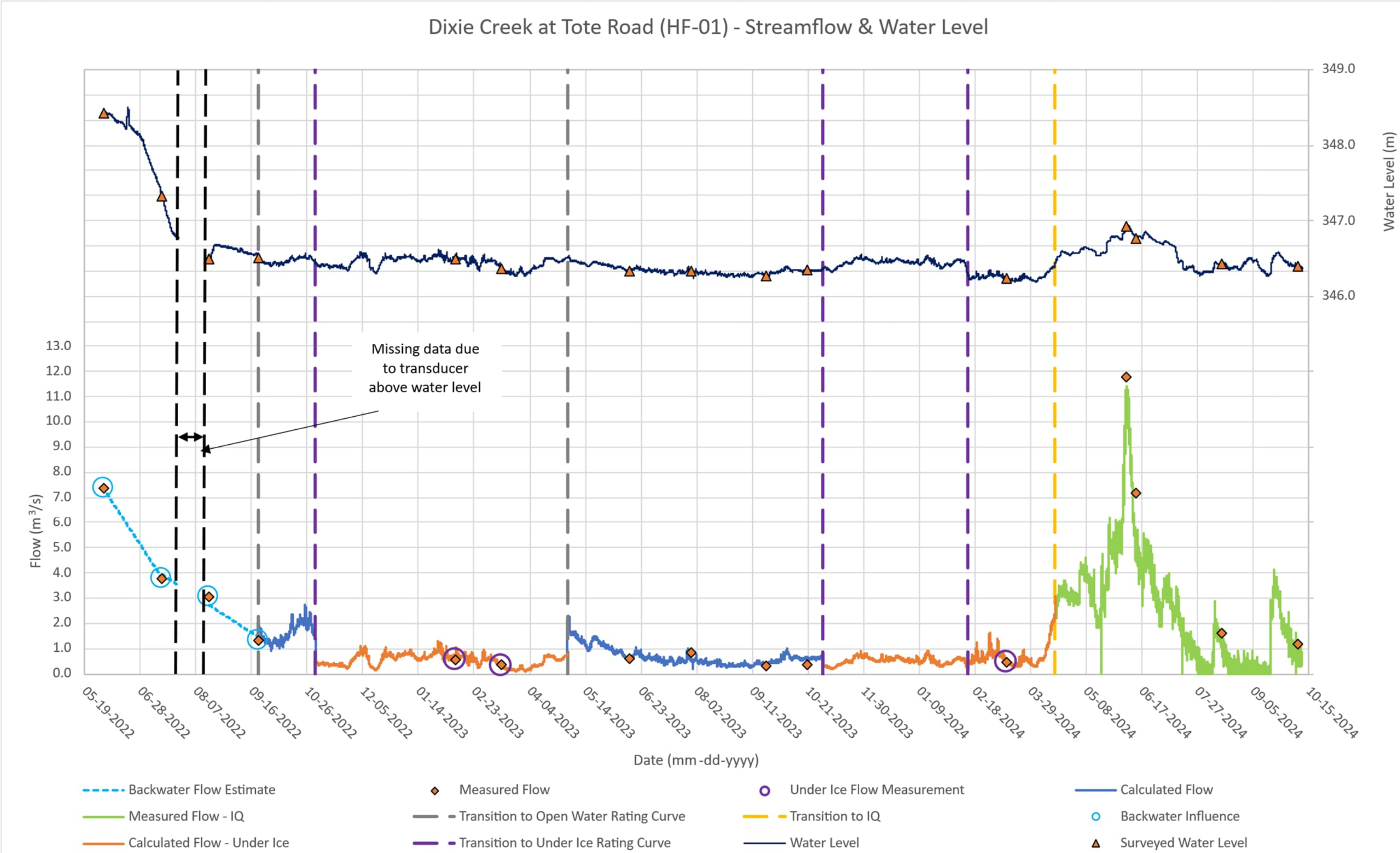



Figure A2-8: Dixie Creek at Tote Road (HF-01) – Streamflow & Water Level

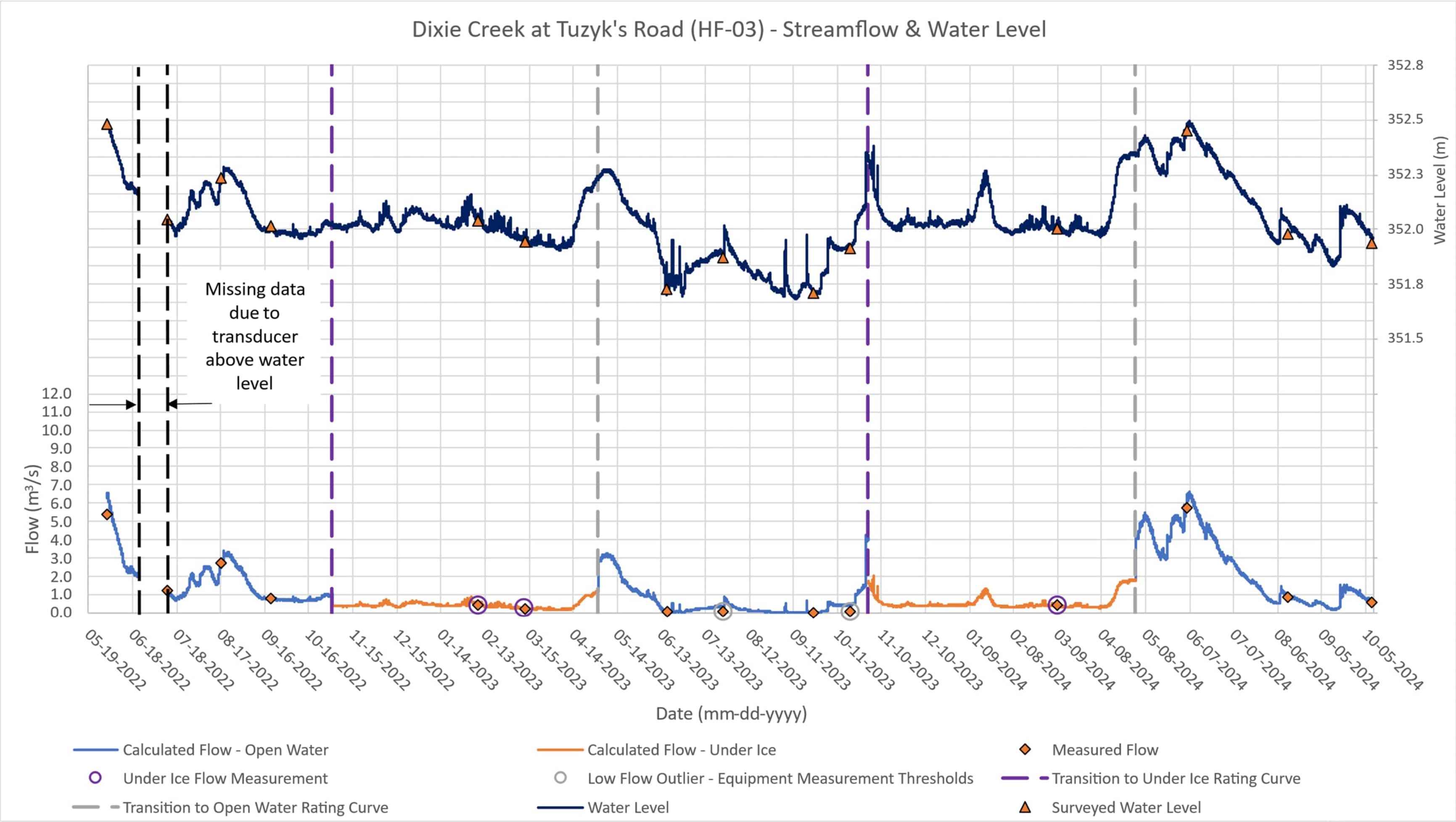



Figure A2-9: Dixie Creek at Tuzyk's Road (HF-03) – Streamflow & Water Level

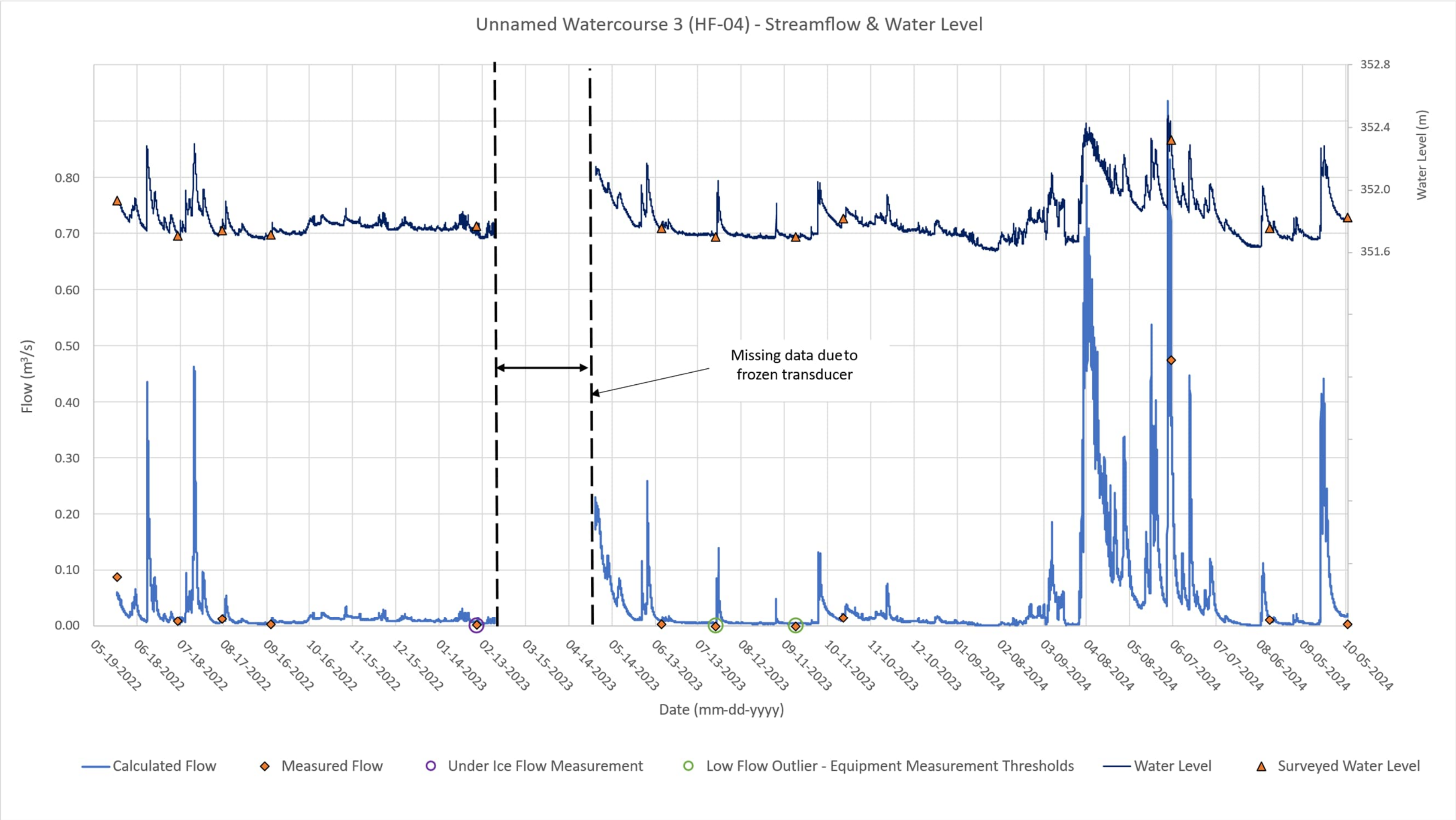



Figure A2-10: Unnamed Watercourse 3 (HF-04) – Streamflow & Water Level

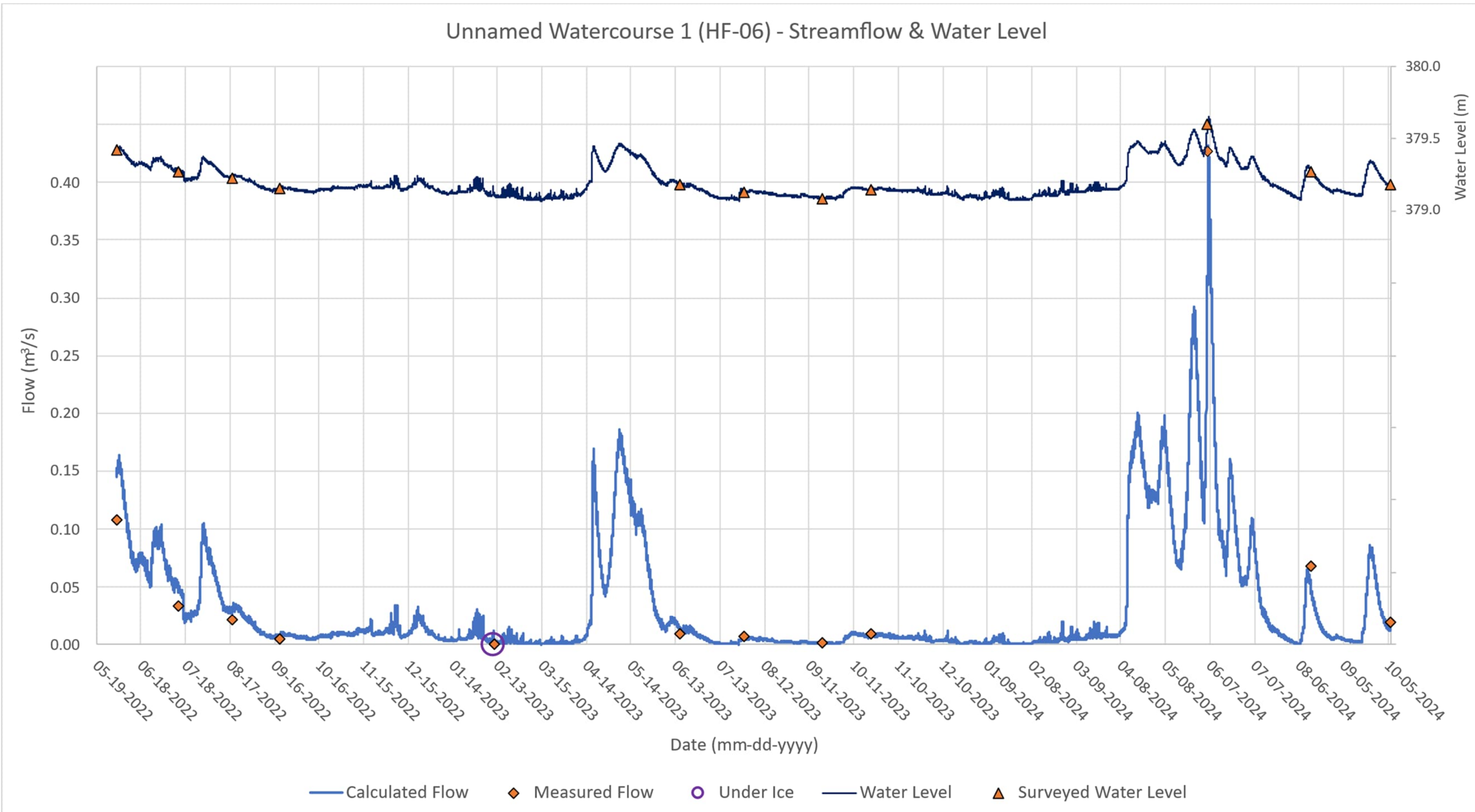
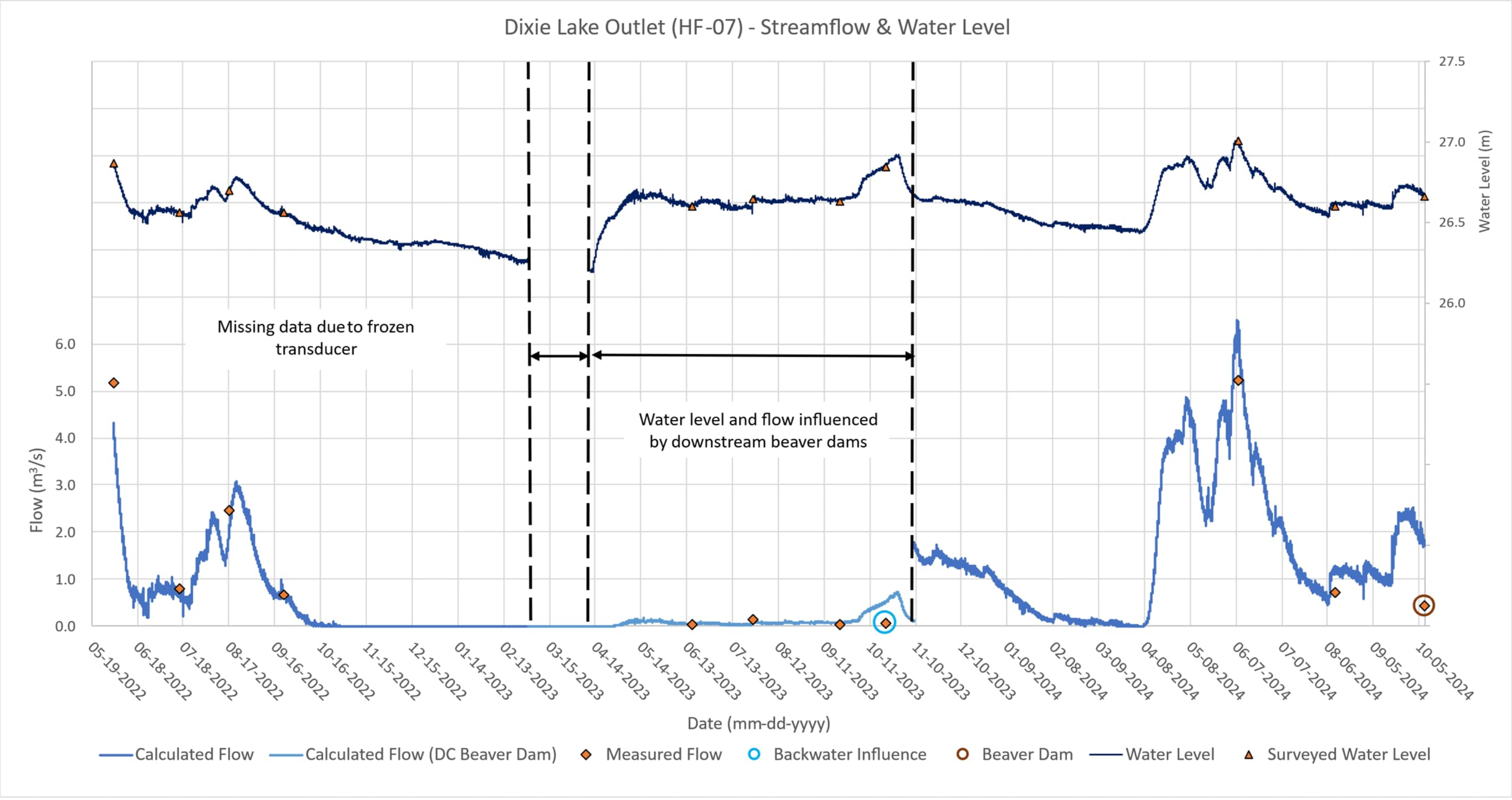



Figure A2-11: Unnamed Watercourse 1 (HF-06) – Streamflow & Water Level




*Note:*

*"DC Beaver Dam" refers to the beaver dam identified in 2023, approximately 2 km downstream of the hydrometric station on Dixie Creek.*

Figure A2-12: Dixie Lake Outlet (HF-07) – Streamflow & Water Level

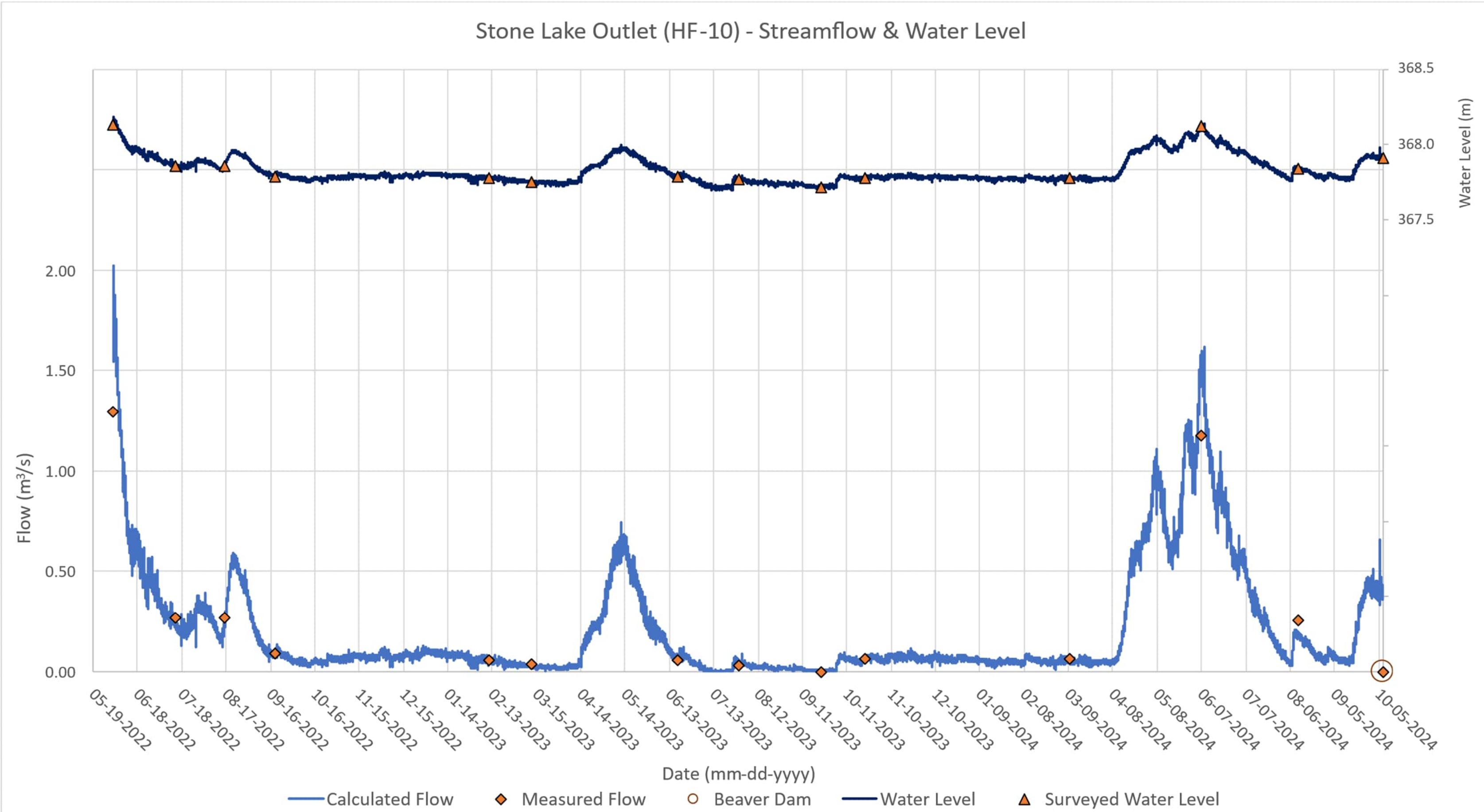



Figure A2-13: Stone Lake Outlet (HF-10) – Streamflow & Water Level

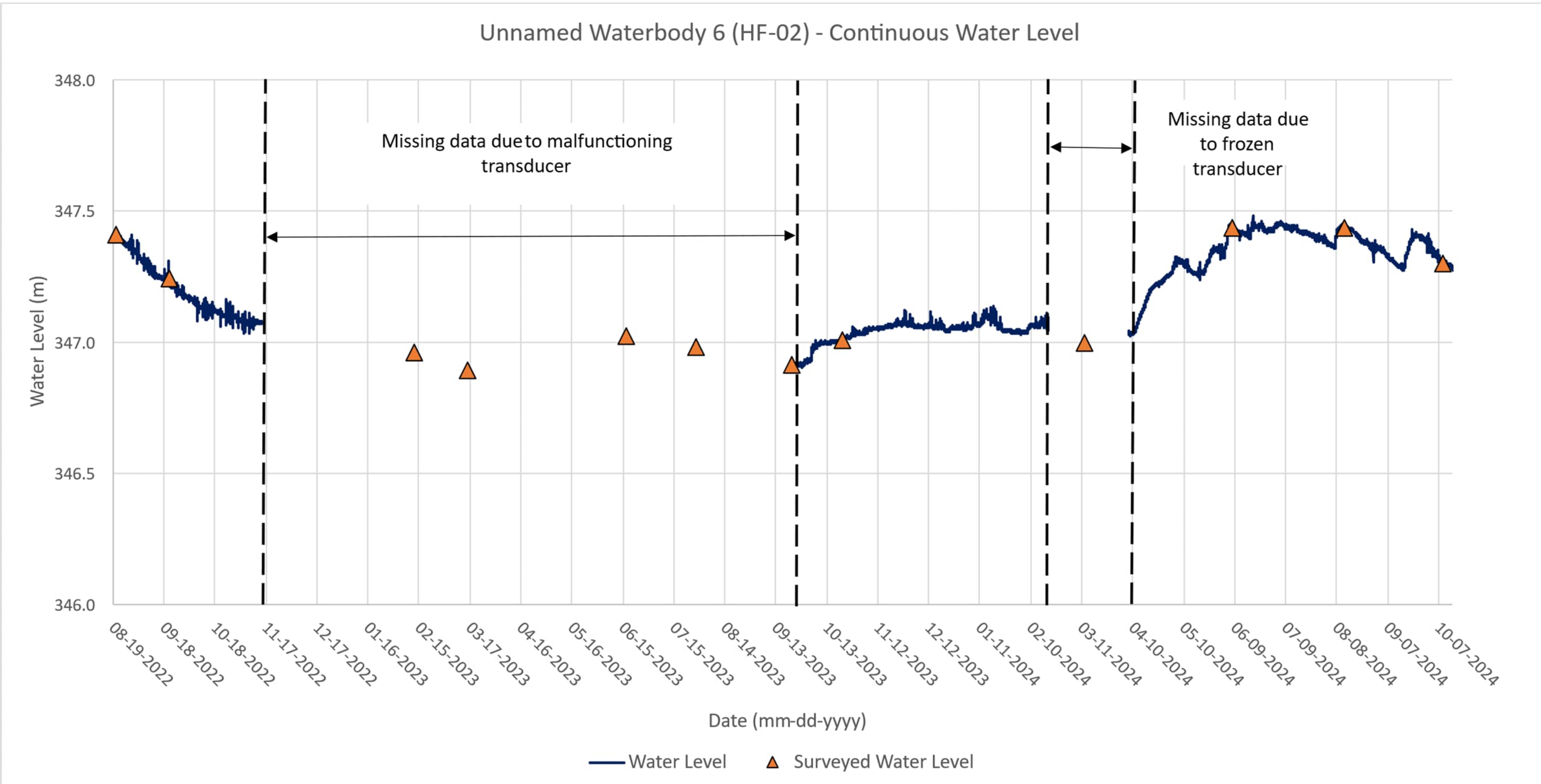



Figure A2-14: Unnamed Waterbody 6 (HF-02) – Continuous Water Level

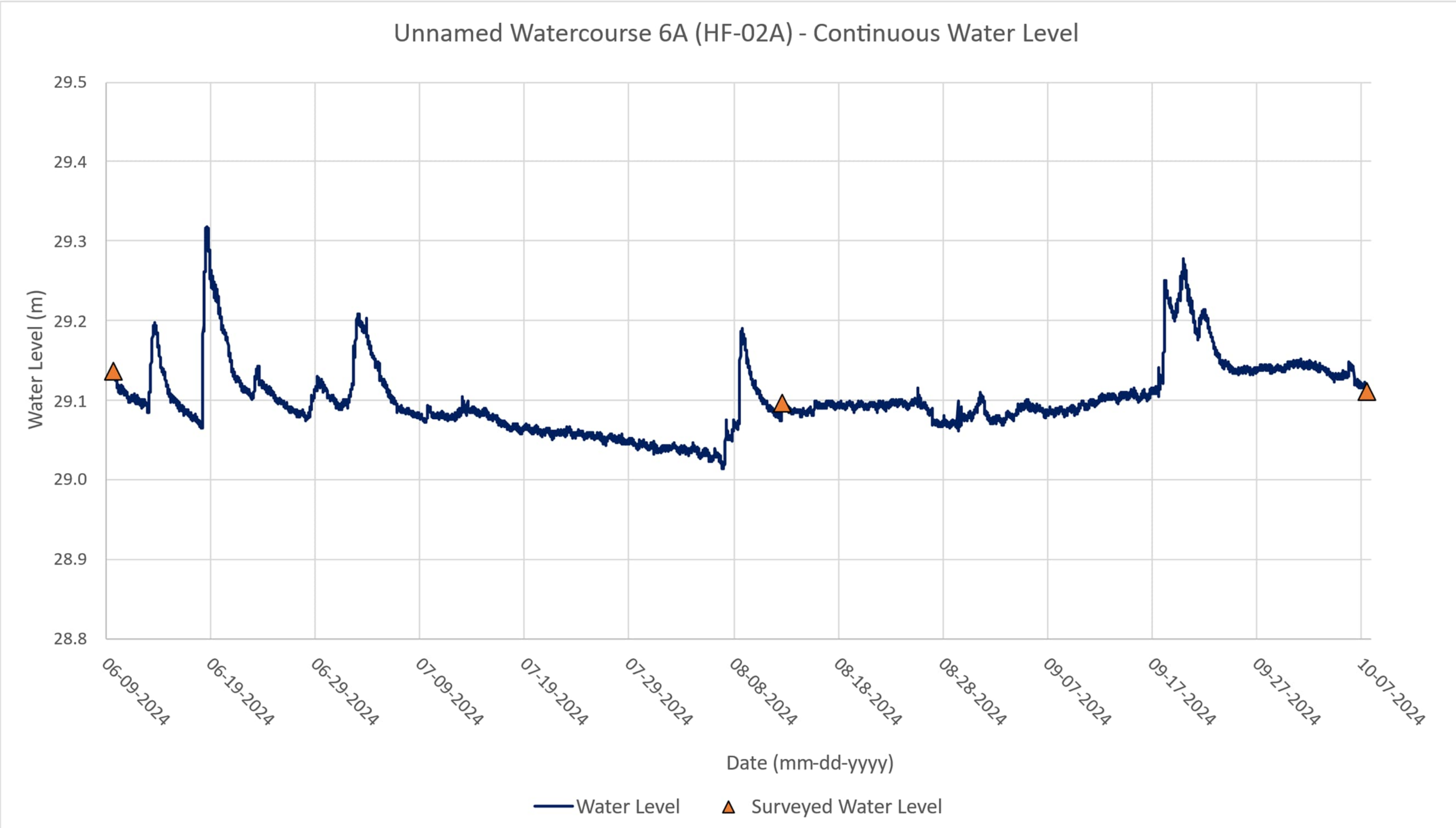



Figure A2-15: Unnamed Watercourse 6A (HF-02A) – Continuous Water Level

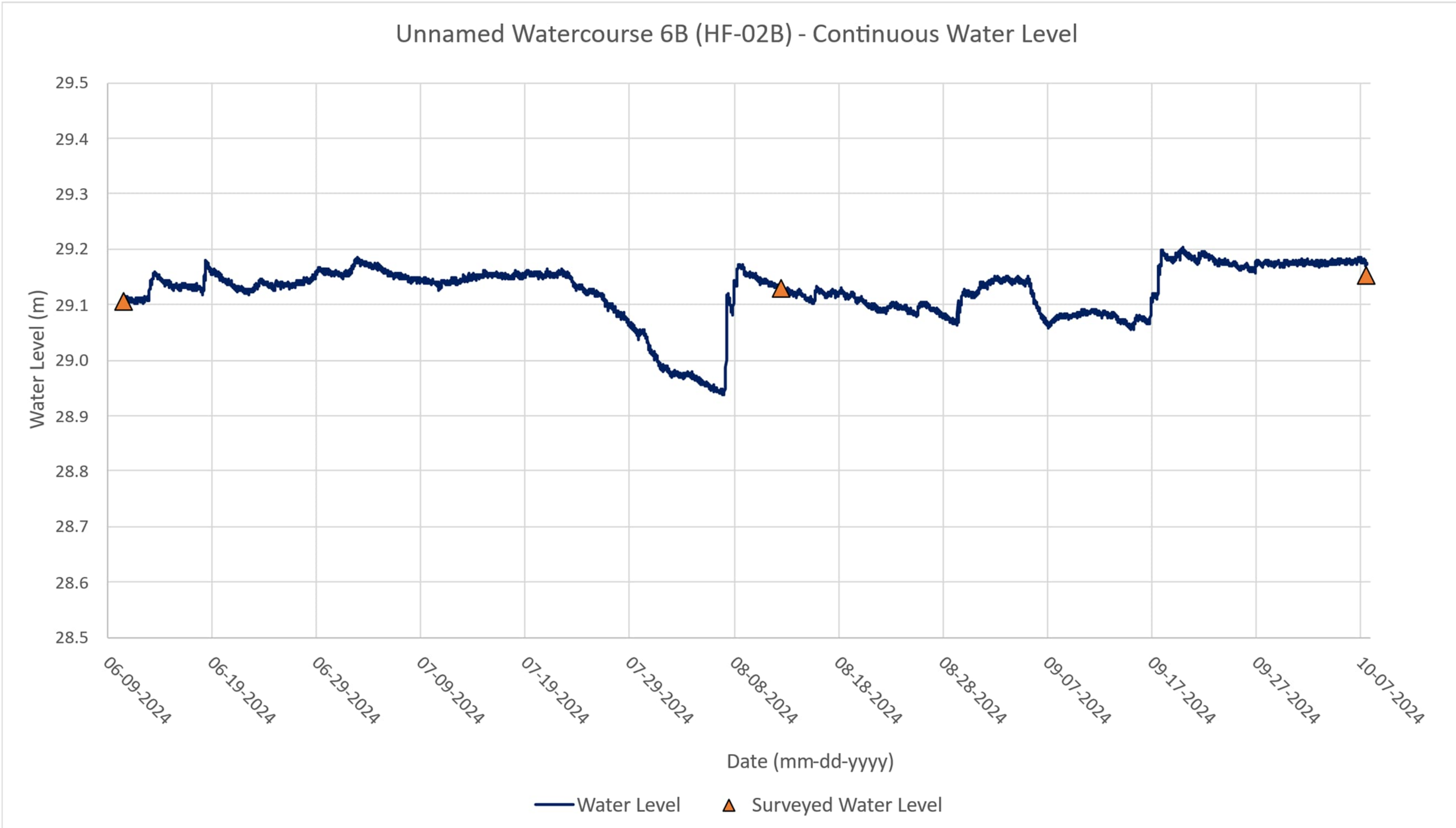



Figure A2-16: Unnamed Watercourse 6B (HF-02B) – Continuous Water Level

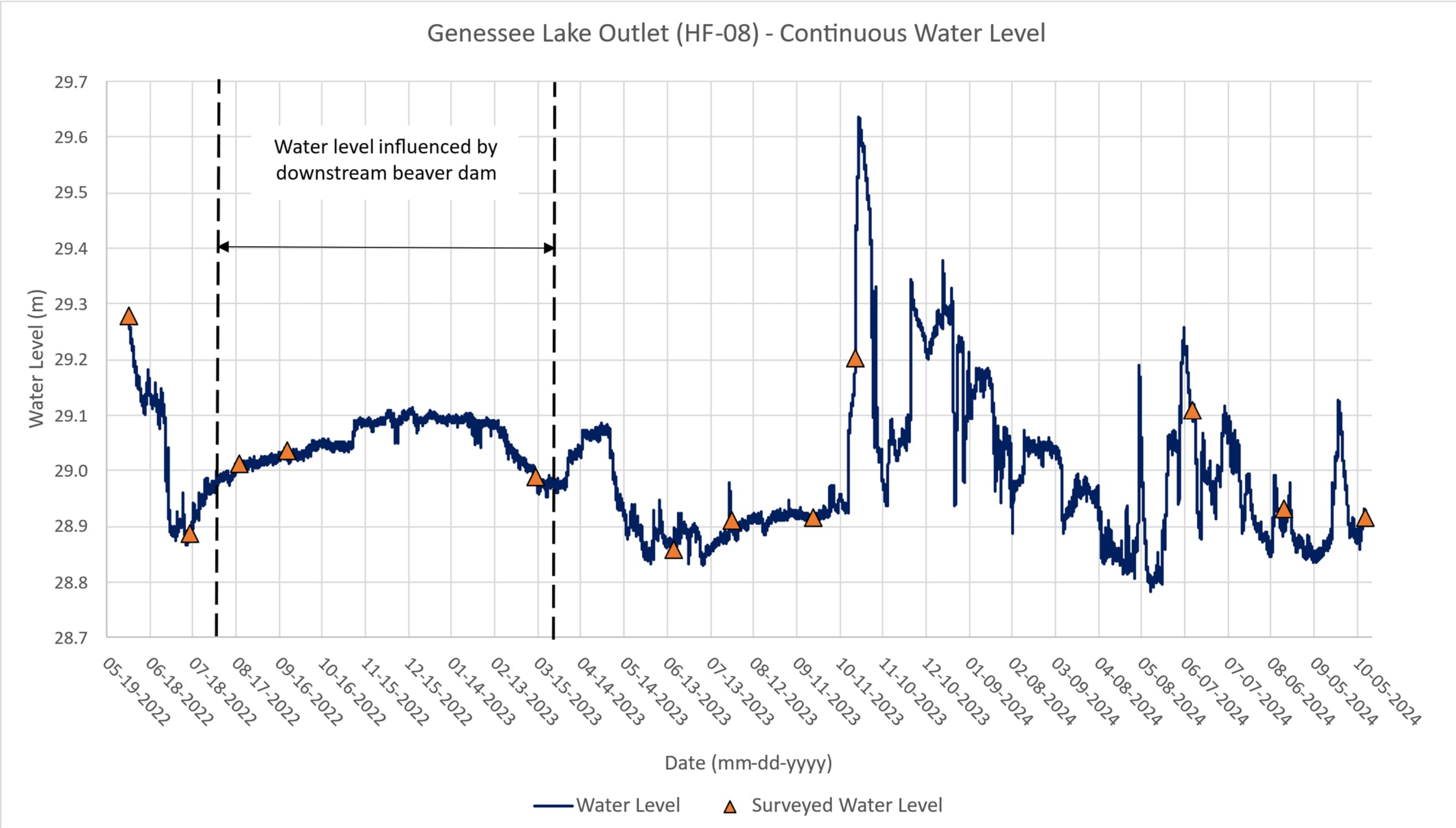



Figure A2-17: Genessee Lake Outlet (HF-08) – Continuous Water Level

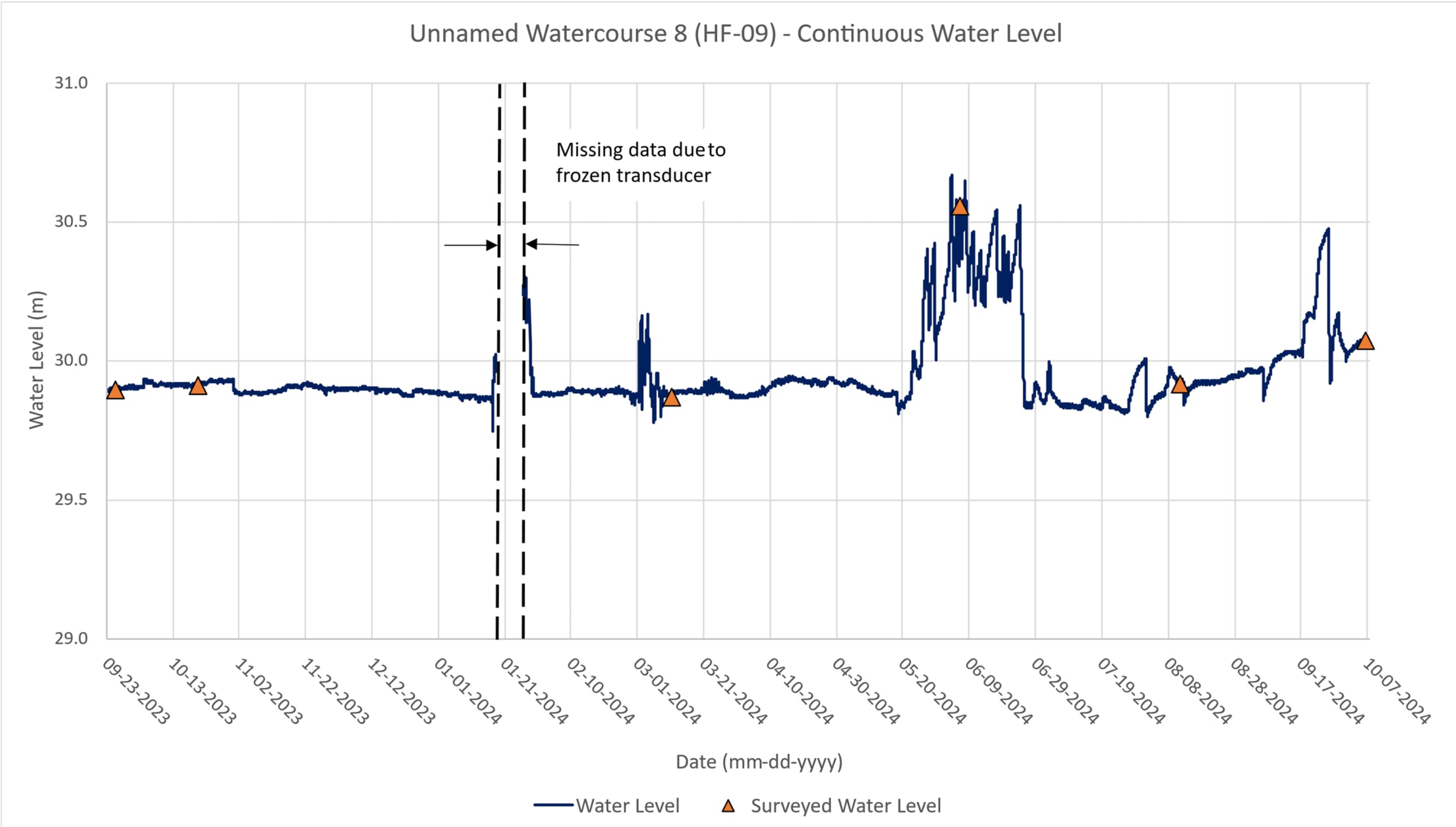



Figure A2-18: Unnamed Watercourse 8 (HF-09) – Continuous Water Level

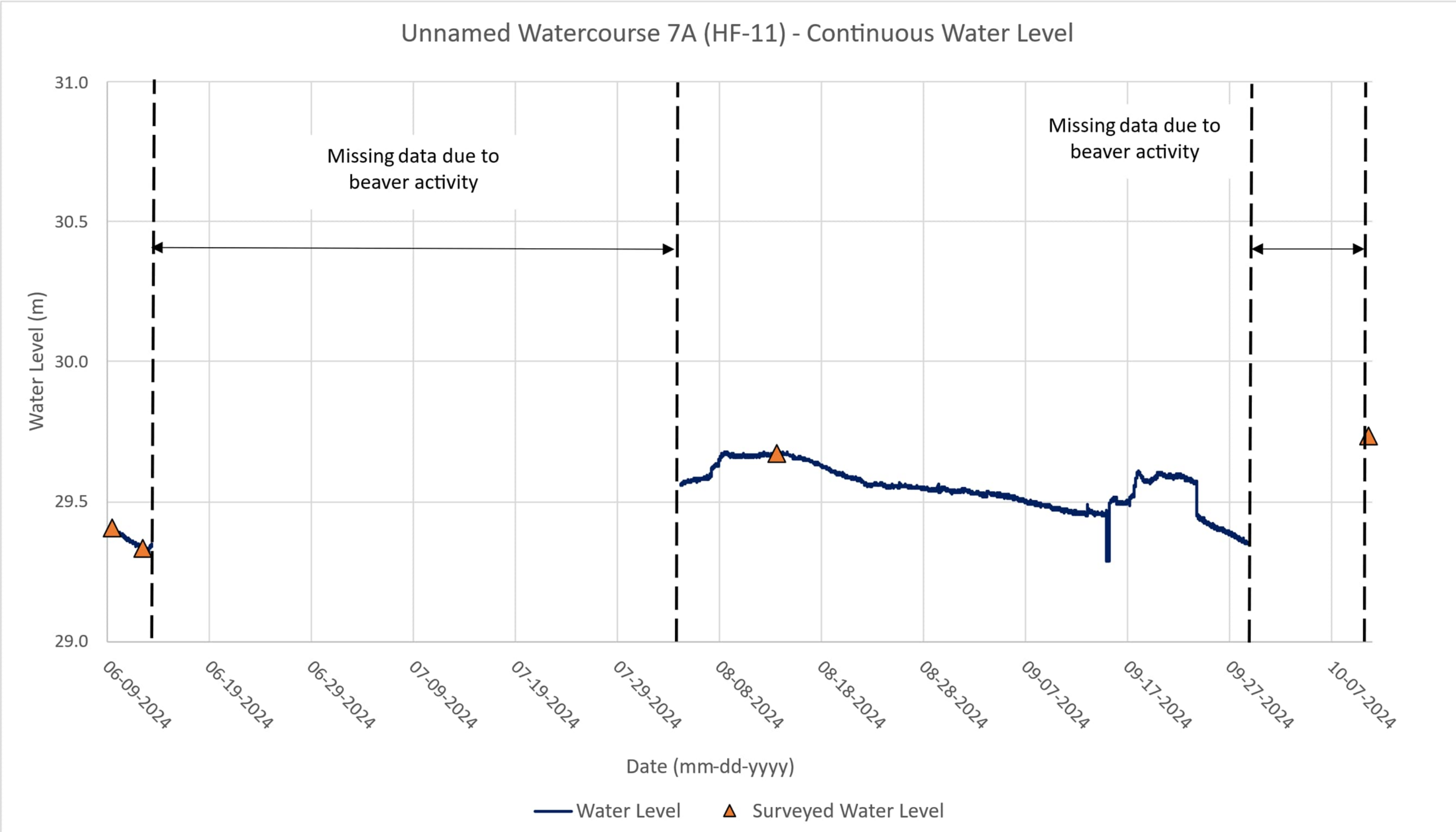



Figure A2-19: Unnamed Watercourse 7A (HF-11) – Continuous Water Level

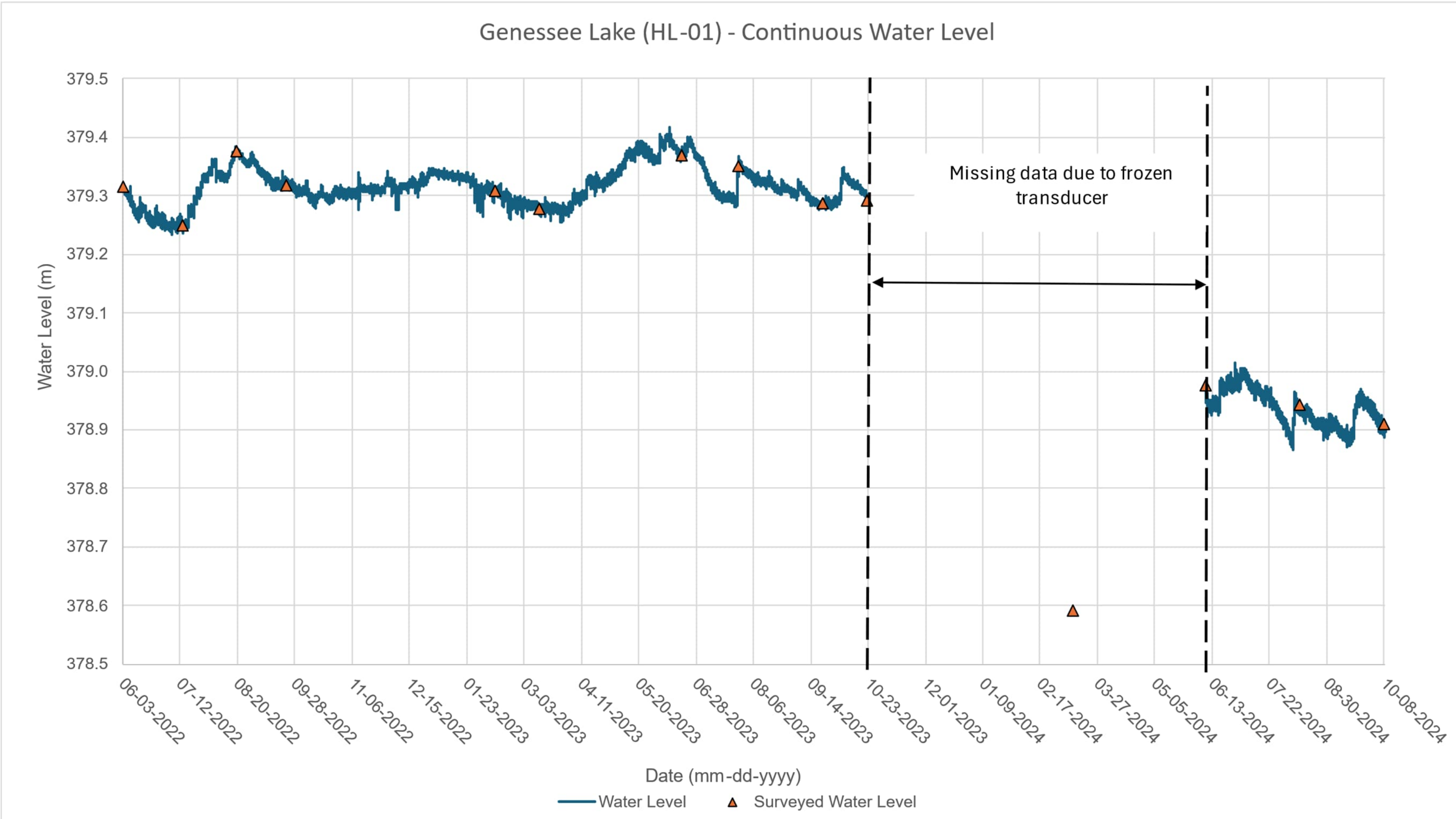



Figure A2-20: Genessee Lake (HL-01) – Continuous Water Level

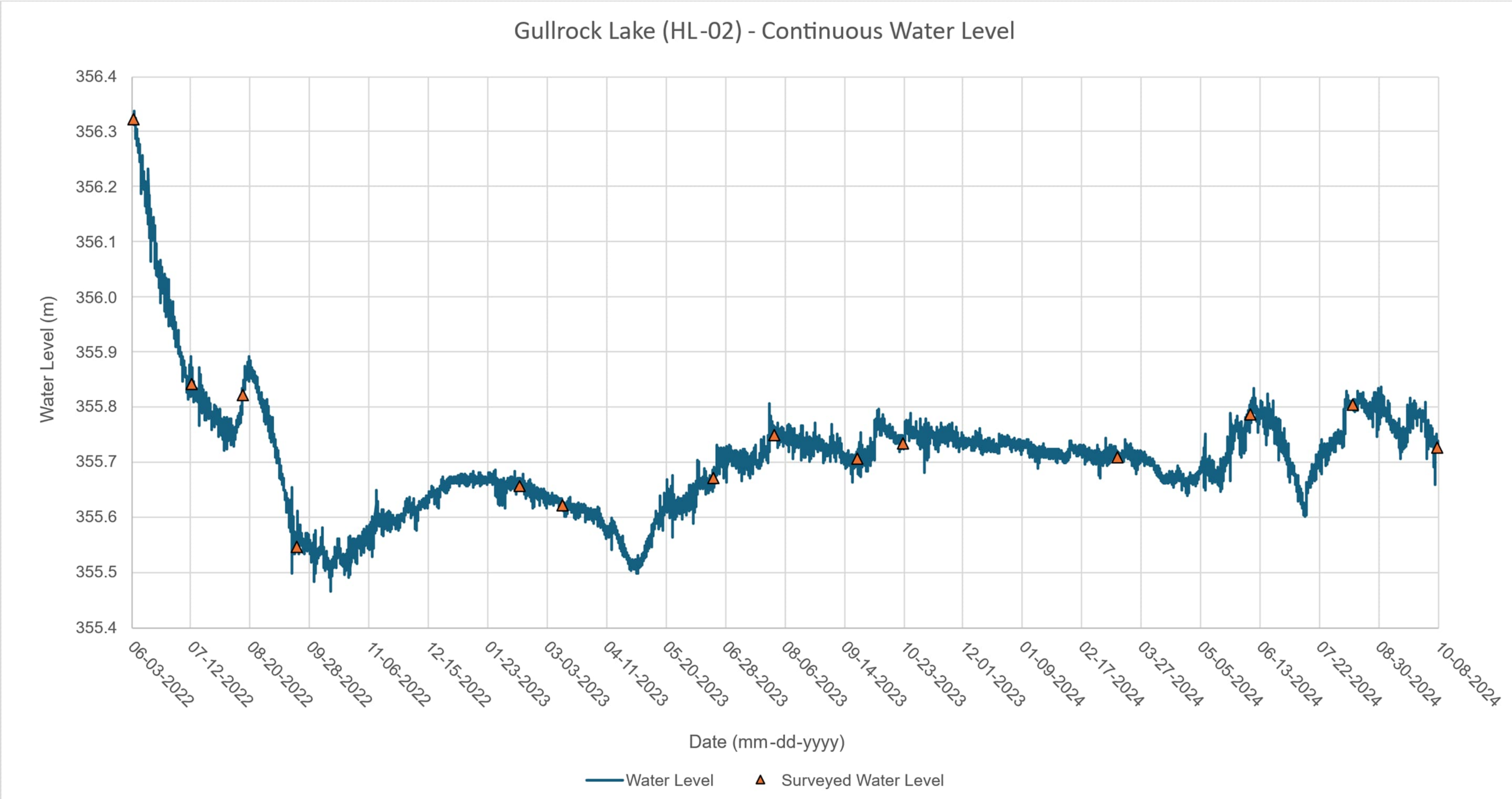



Figure A2-21: Gullrock Lake (HL-02) – Continuous Water Level

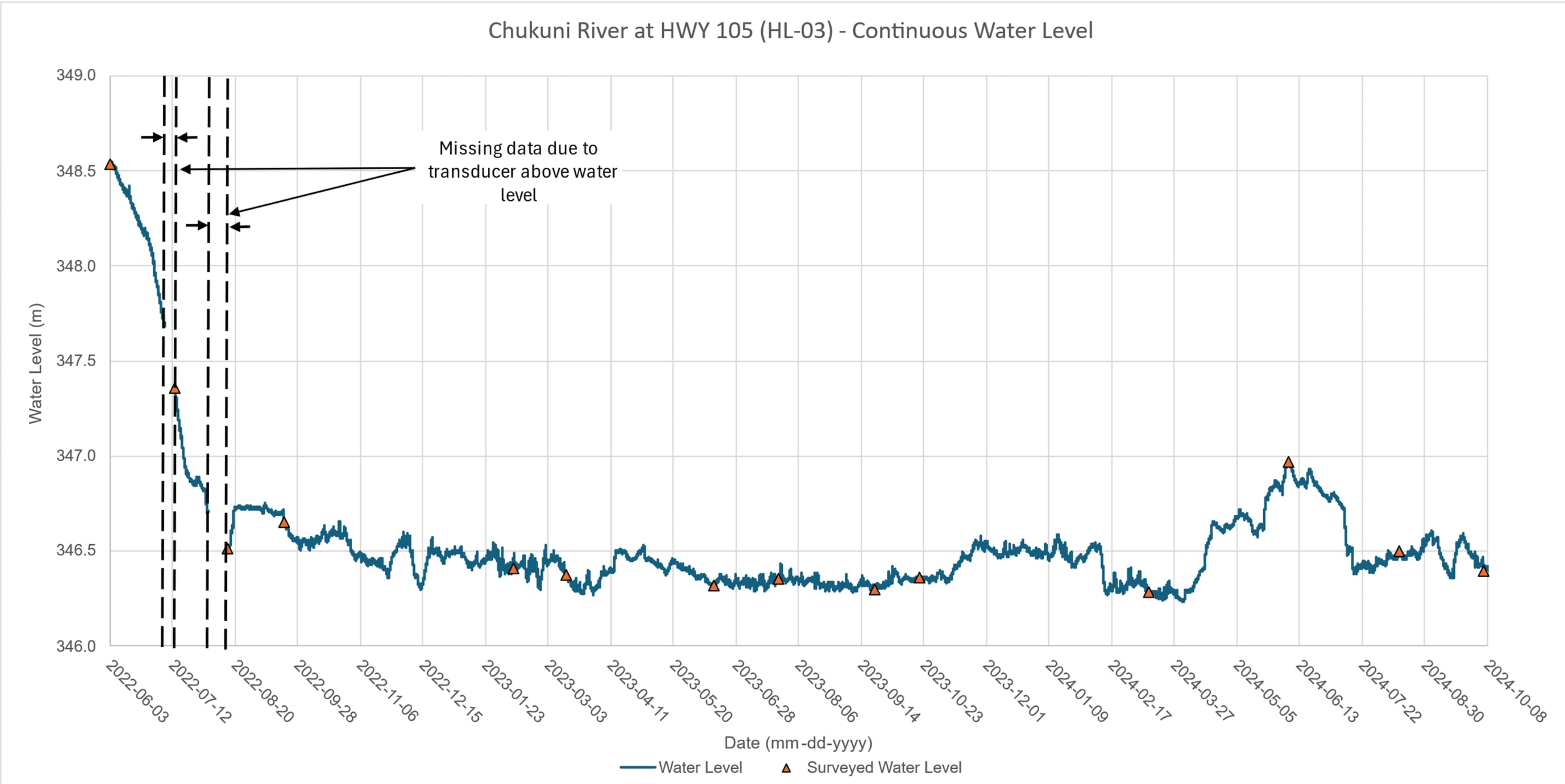



Figure A2-22: Chukuni River at HWY 105 (HL-03) – Continuous Water Level

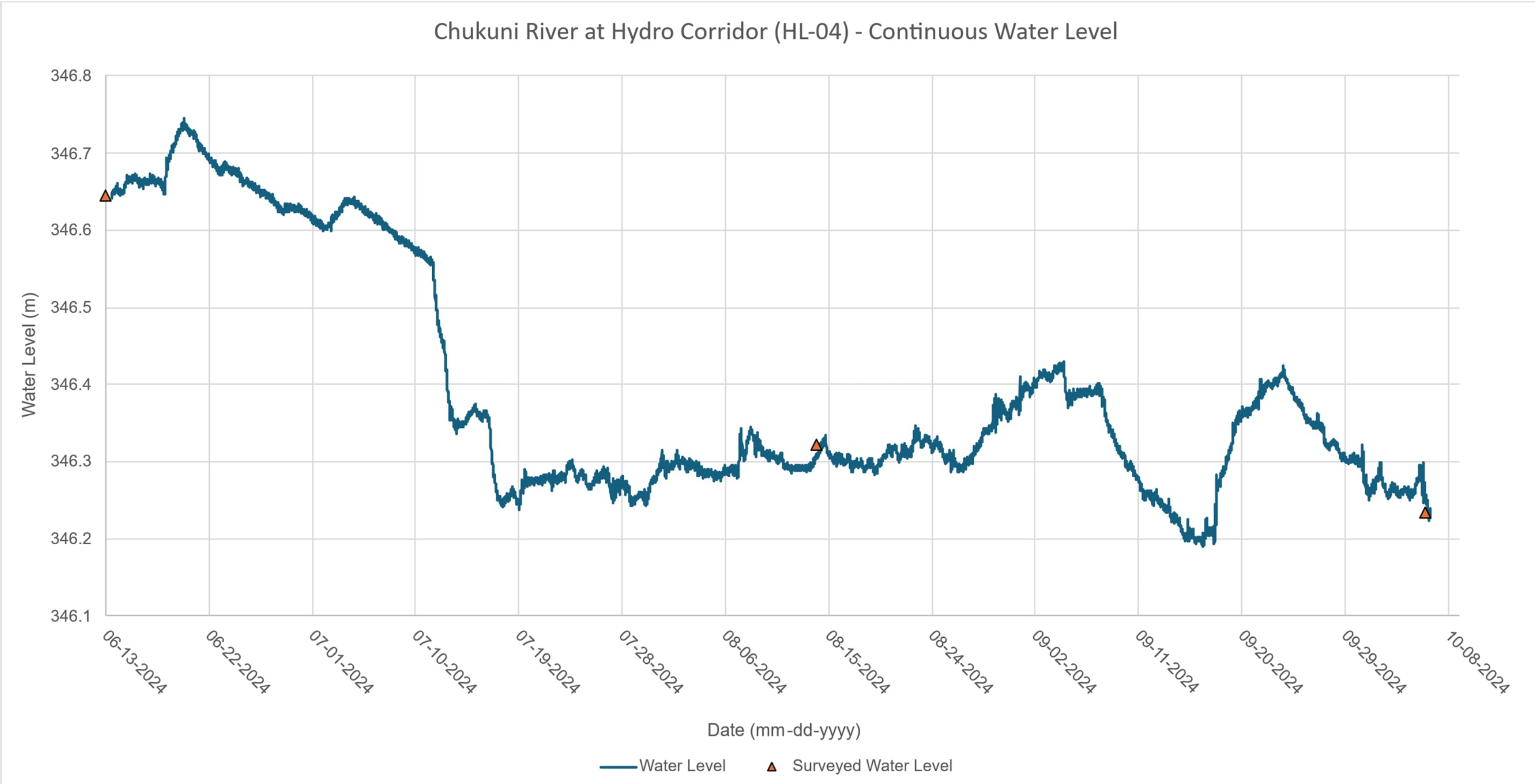



Figure A2-23: Chukuni River at Hydro Corridor (HL-04) – Continuous Water Level

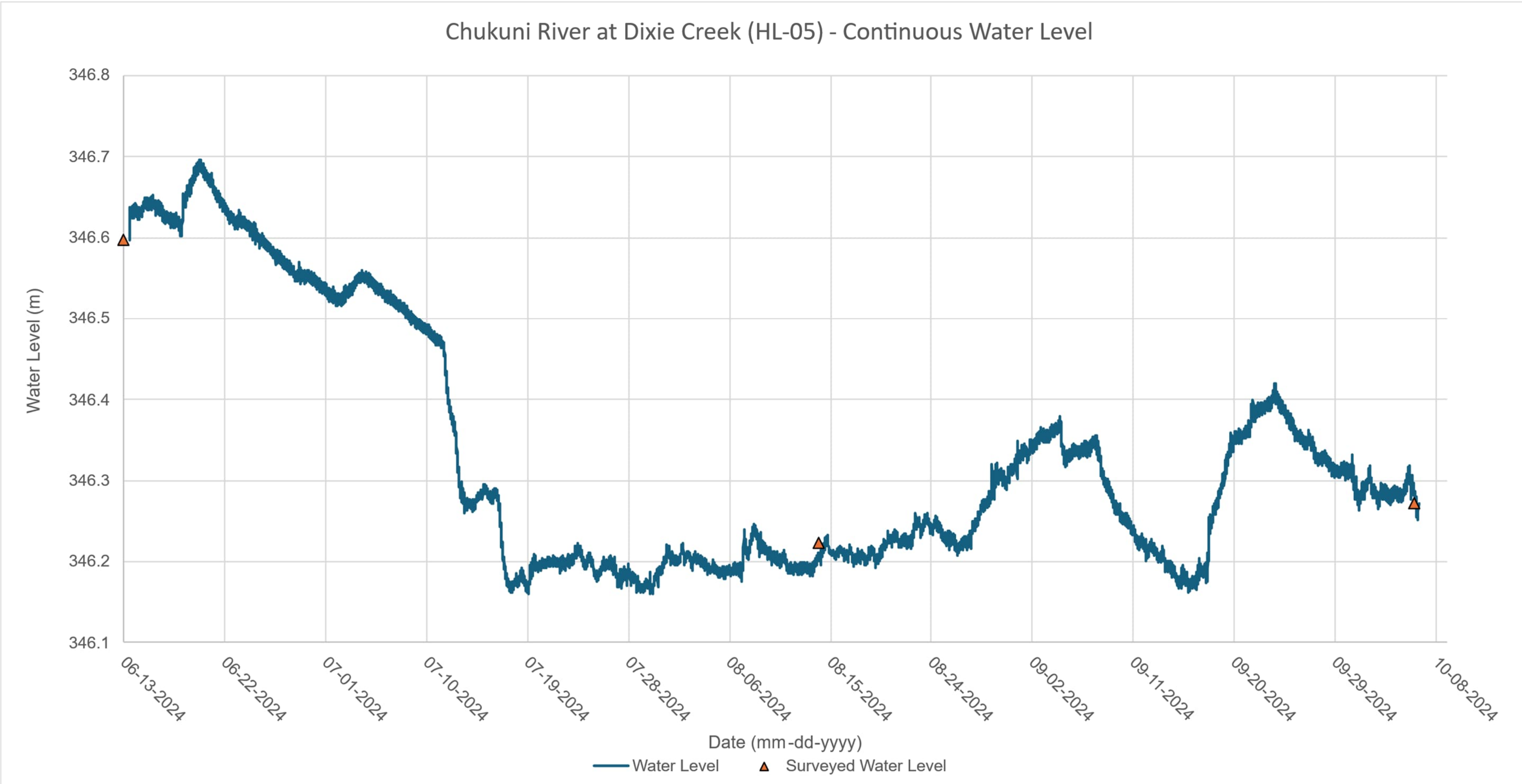



Figure A2-24: Chukuni River at Dixie Creek (HL-05) – Continuous Water Level

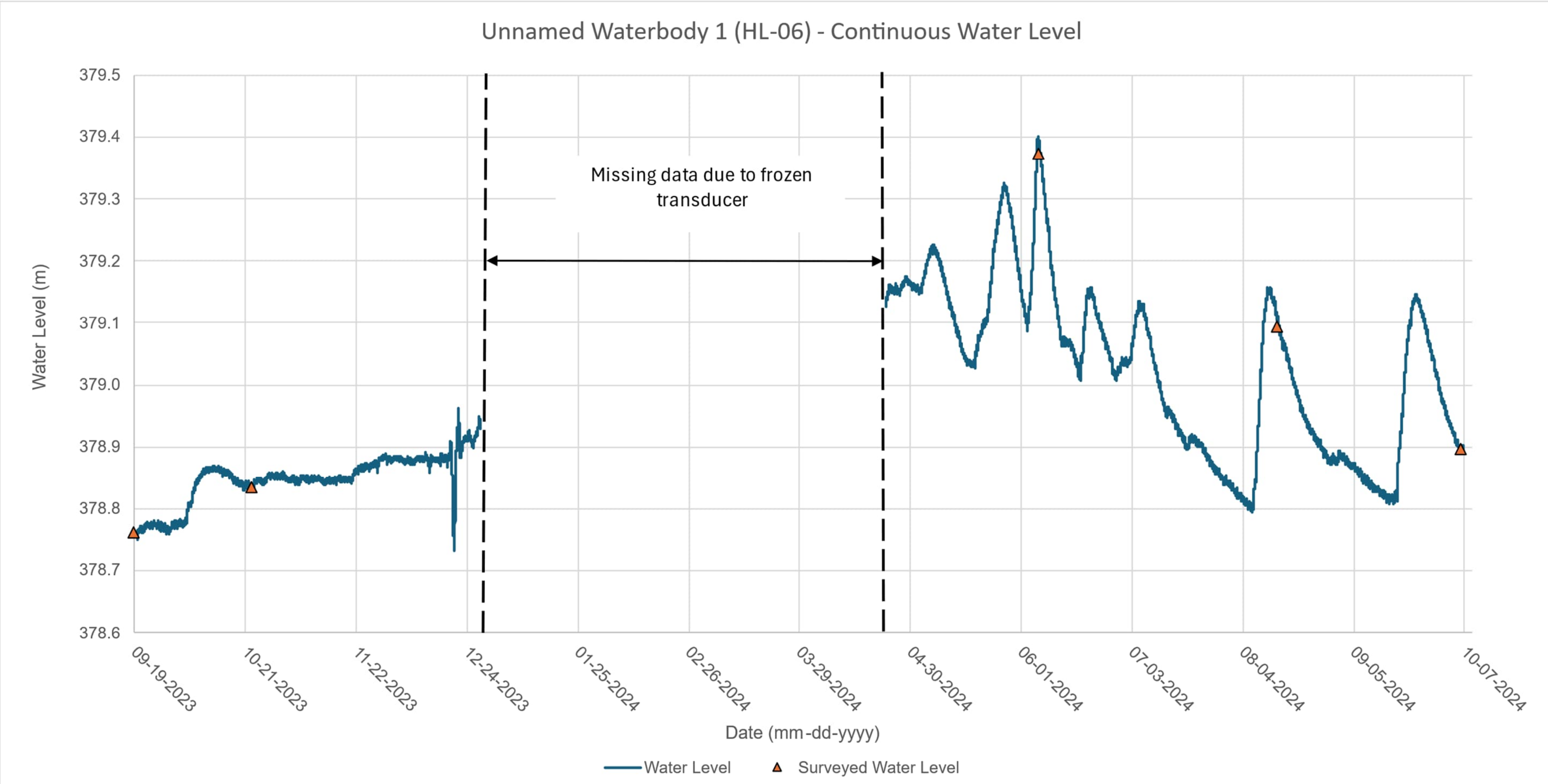



Figure A2-25: Unnamed Waterbody 1 (HL-06) – Continuous Water Level

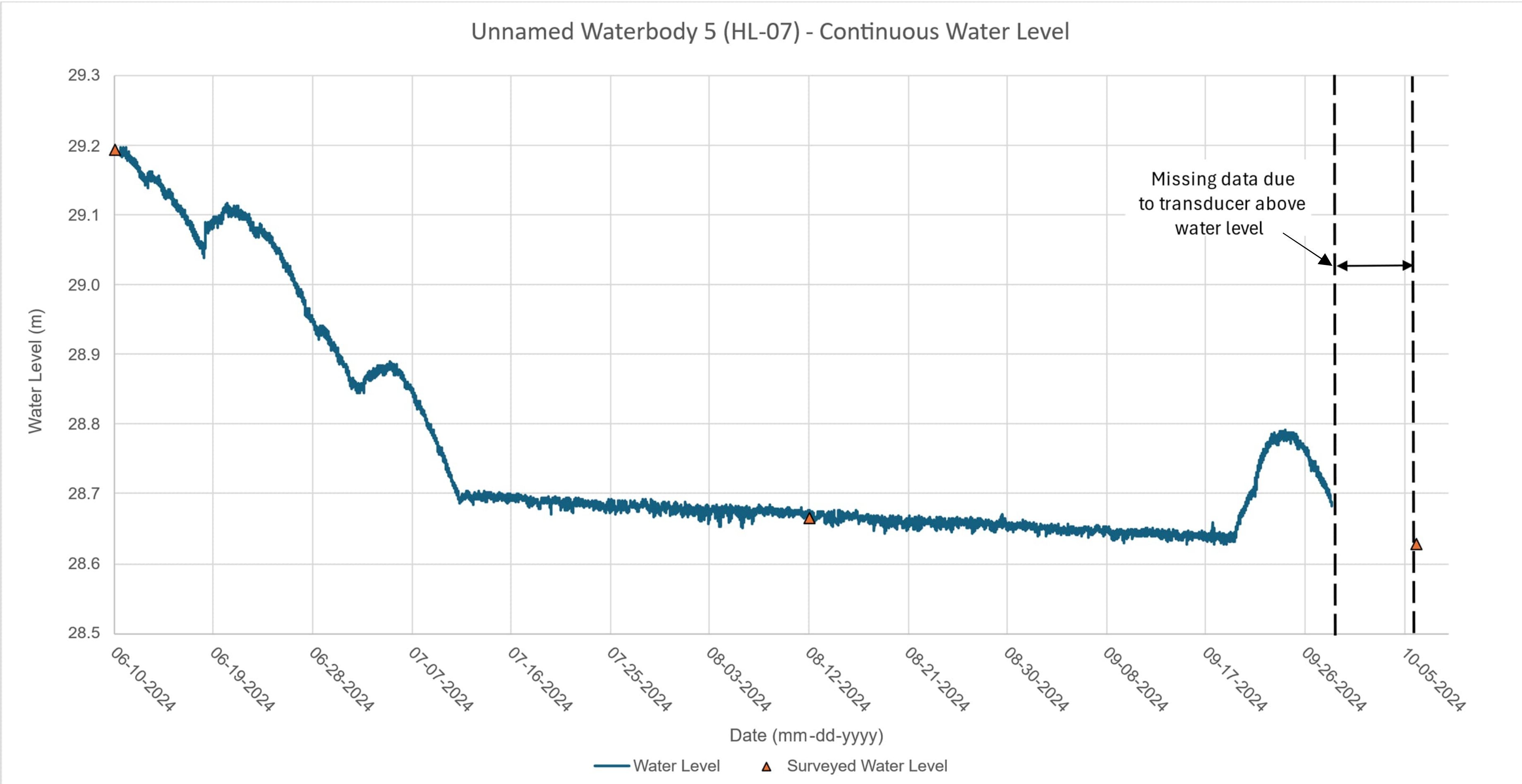



Figure A2-26: Unnamed Waterbody 5 (HL-07) – Continuous Water Level

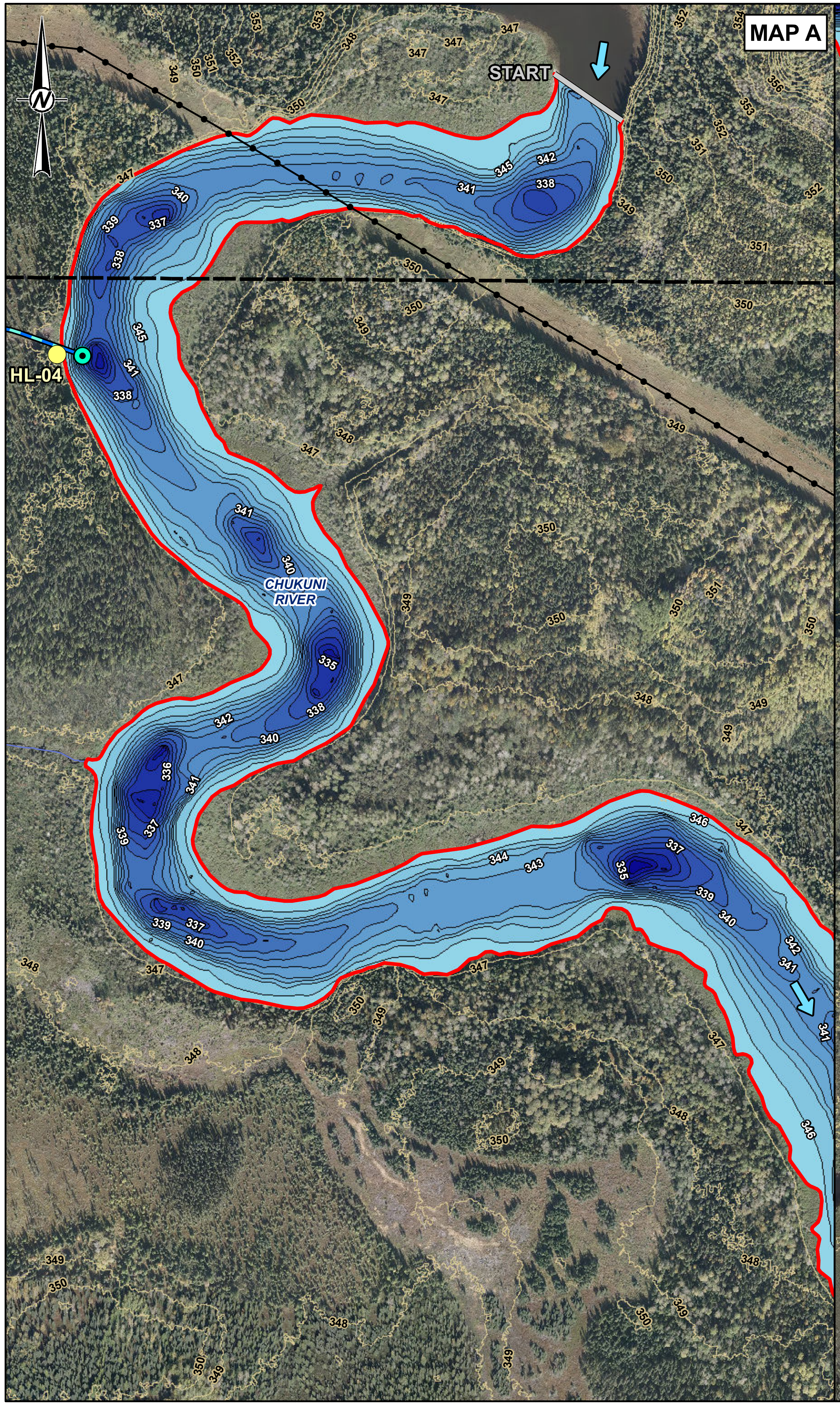
# 3 CONCLUSION

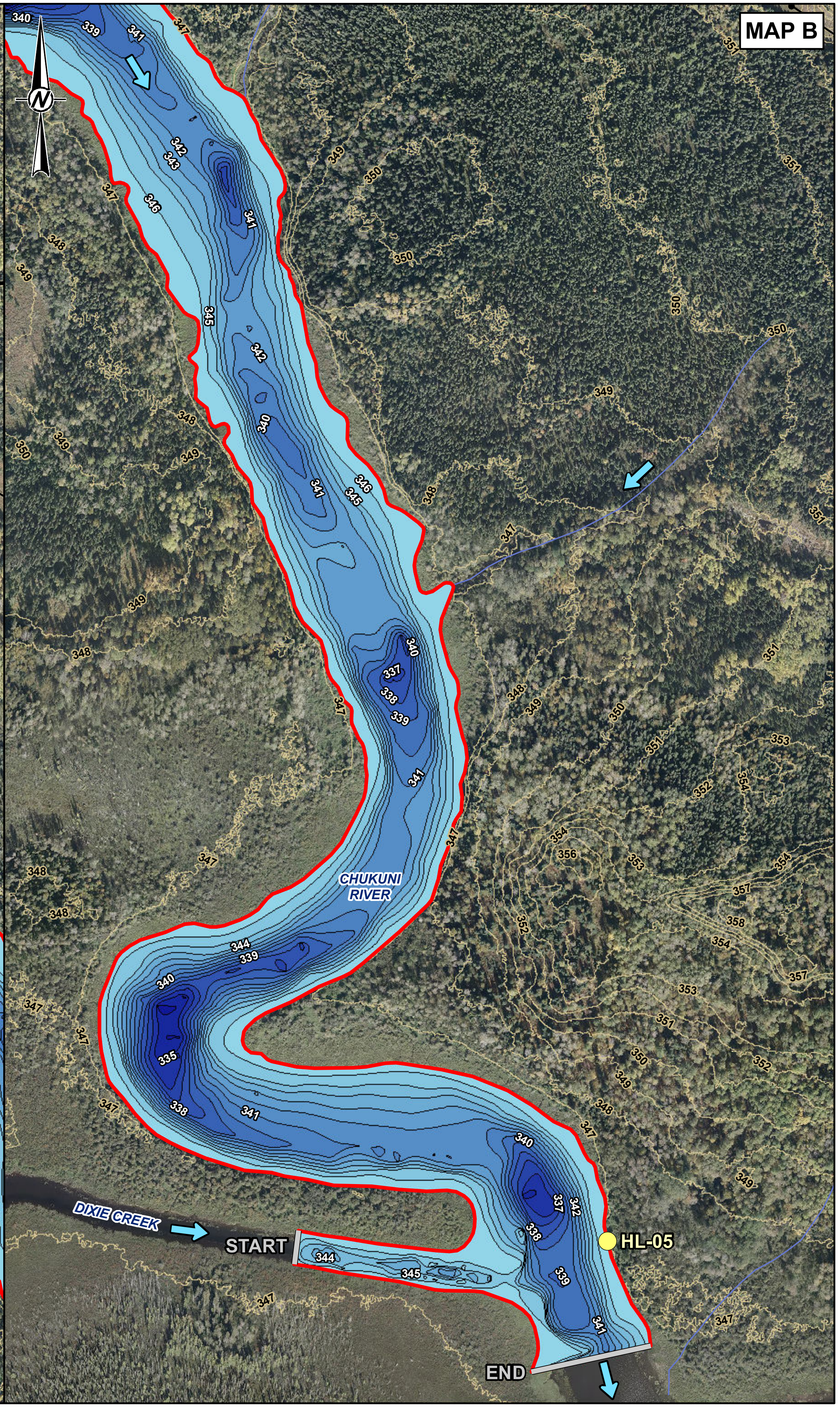
During the baseline monitoring program, 14 monitoring trips were completed. Throughout this period streamflow measurements, water level surveys and continuous water level measurements have been completed at 12 streamflow stations and 19 water level monitoring stations. The rating curves and hydrographs were prepared using data collected during throughout the baseline monitoring period.

# 4 REFERENCES

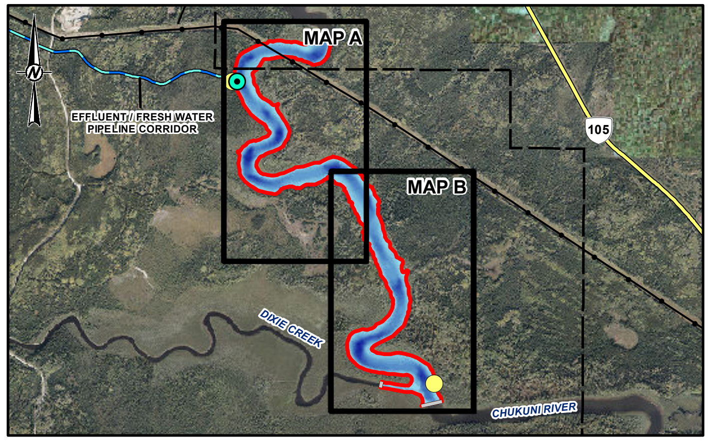

- International Organization for Standardization (ISO). 2020a. Hydrometric – Measurement of Liquid Flow in Open Channels – Determination of the stage-discharge Relationship. ISO 18320. July 2020.
- International Organization for Standardization (ISO). 2020b. Hydrometric Uncertainty Guidance. ISO 25377. December 2020.
- WSC. 2016. Stage-Discharge Model Development and Maintenance. Hydrometric Manual – Data Computation. Document No. qSOP-NA049-01.
- United States Geological Survey. 1913. The Effects of Ice on Stream Flow. Hoyt, W. G.
- WSP Canada (WSP). 2025. Hydrology Baseline Report. July 2025 – Draft.

# Appendix B:
# Bathymetry Mapping




KEY MAP




SCALE 1:45,000

**LEGEND**

- PROPOSED DISCHARGE LOCATION
- PROPOSED EFFLUENT / FRESH WATER PIPELINE CORRIDOR
- WATER LEVEL STATION
- BATHYMETRY START/END LIMITS
- BATHYMETRY ANALYSIS EXTENT
- BATHYMETRY CONTOUR (1 METRE INTERVAL)
- PROPERTY BOUNDARY
- EXISTING TRANSMISSION LINE
- FLOW DIRECTION
- WATERCOURSE
- CONTOUR (1 METRE INTERVAL)

**BATHYMETRY (ELEVATION, MASL) (FILLED CONTOURS)**

| | |
|---|---|
| 332 - 333 | 340 - 341 |
| 333 - 334 | 341 - 342 |
| 334 - 335 | 342 - 343 |
| 335 - 336 | 343 - 344 |
| 336 - 337 | 344 - 345 |
| 337 - 338 | 345 - 346 |
| 338 - 339 | 346 - 346.645 |
| 339 - 340 | |

0 50 100 200
1:5,500 METRES

**NOTE(S)**

1. ALL LOCATIONS ARE APPROXIMATE
2. CHUKUNI RIVER BATHYMETRY WAS RECORDED ON JUNE 13 AND 14, 2024.
3. SURFACE WATER ELEVATION OF CHUKUNI RIVER AT HL-04 WAS 346.645 MASL ON JUNE 13, 2024 AT 13:00.
4. RECORDED DISCHARGE AT WSC STATION CHUKUNI RIVER NEAR EAR FALLS (05QC001) RANGED FROM 86 - 89 CMS ON JUNE 13, 2024. - WSC 2024.

**REFERENCE(S)**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. CONTOURS ACQUIRED FROM 2022 LIDAR SURVEY.
3. PROPERTY BOUNDARY PROVIDED BY KINROSS, MARCH 2023.
4. ROADS INFORMATION PROVIDED BY KINROSS, AUGUST 2022.
5. SITE PLAN BASED ON INFORMATION PROVIDED BY WORLEY, APRIL/MAY 2024.
6. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
KINROSS GOLD CORPORATION

PROJECT
GREAT BEAR PROJECT

TITLE
**CHUKUNI RIVER BATHYMETRY (ELEVATION)**

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2024-11-01 |
| DESIGNED | ---- |
| PREPARED | MD |
| REVIEWED | ---- |
| APPROVED | ---- |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| OMEMA2303 | 0001 | A | B-1 |

# Appendix C:
# Regional WSC Stations Summary Statistics

**Table C-1: Monthly and Annual Streamflow Statistics – Long-Legged River below Long-Legged Lake (05QE012)**

| Year | Streamflow (m³/s) | | | | | | | | | | | | | Mean Annual Runoff (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean | |
| 1980 | 2.3 | 2.1 | 1.8 | 3.3 | 5.7 | 3.3 | 1.7 | 1.0 | 0.9 | 1.2 | 1.3 | 1.4 | 2.2 | 125.5 |
| 1981 | 1.4 | 1.3 | 1.1 | 1.1 | 1.1 | 1.8 | 3.6 | 4.6 | 3.9 | 3.0 | 2.5 | 2.1 | 2.3 | 131.4 |
| 1982 | 1.9 | 1.8 | 1.7 | 2.4 | 8.2 | 10.7 | 6.2 | 2.7 | 1.4 | 1.6 | 1.4 | 1.5 | 3.5 | 199.1 |
| 1983 | 1.5 | 1.3 | 1.5 | 1.5 | 2.6 | 4.3 | 4.6 | 2.8 | 1.5 | 1.1 | 0.9 | 1.0 | 2.1 | 118.1 |
| 1984 | 1.0 | 1.1 | 1.1 | 2.0 | 4.8 | 8.1 | 7.3 | 3.4 | 1.3 | 1.3 | 2.7 | 3.2 | 3.1 | 179.5 |
| 1985 | 3.0 | 2.4 | 1.8 | 2.4 | 9.1 | 6.4 | 5.7 | 5.0 | 7.5 | 7.3 | 5.5 | 3.8 | 5.0 | 288.5 |
| 1986 | 2.7 | 2.2 | 2.0 | 4.9 | 11.7 | 6.1 | 3.1 | 2.8 | 2.1 | 2.9 | 2.8 | 2.4 | 3.8 | 221.1 |
| 1987 | 1.8 | 1.4 | 1.4 | 3.4 | 3.9 | 2.7 | 2.2 | 1.9 | 1.0 | 0.5 | 0.4 | 0.4 | 1.7 | 100.6 |
| 1988 | 0.5 | 0.5 | 0.7 | 1.2 | 2.5 | 2.8 | 2.7 | 1.6 | 1.3 | 1.5 | 1.6 | 1.8 | 1.6 | 90.0 |
| 1989 | 2.0 | 1.8 | 1.6 | 1.7 | 8.6 | 10.9 | 7.8 | 4.1 | 1.9 | 0.9 | 0.7 | 0.7 | 3.6 | 204.6 |
| 1990 | 0.8 | 0.9 | 1.0 | 1.5 | 5.1 | 8.2 | 11.9 | 4.8 | 1.9 | 0.9 | 0.6 | 0.6 | 3.2 | 183.7 |
| 1991 | 0.7 | 0.6 | 0.6 | 0.8 | 1.7 | 2.5 | 7.7 | 5.8 | 4.3 | 4.8 | 4.9 | 4.5 | 3.3 | 187.9 |
| 1992 | 3.3 | 2.6 | 2.2 | 3.2 | 11.2 | 7.7 | 6.5 | 3.6 | 8.0 | 6.4 | 3.7 | 2.8 | 5.1 | 294.5 |
| 1993 | 2.4 | 2.0 | 1.7 | 1.9 | 3.8 | 3.1 | 3.4 | 5.8 | 4.5 | 2.9 | 2.3 | 2.0 | 3.0 | 171.8 |
| 1994 | 1.8 | 1.5 | 1.3 | 1.5 | 2.0 | 1.7 | 2.3 | 2.4 | 1.7 | 1.5 | 2.4 | 2.9 | 1.9 | 110.0 |
| 1995 | 2.8 | 2.4 | 2.3 | 3.1 | 6.9 | 10.9 | 10.2 | 9.3 | 4.4 | 2.2 | 1.9 | 1.8 | 4.9 | 280.3 |
| 1996 | 1.6 | 1.5 | 1.4 | 1.8 | 7.1 | 7.8 | 3.7 | 2.3 | 1.5 | 2.0 | 4.1 | 4.0 | 3.2 | 185.8 |
| 1997 | 3.2 | 2.5 | 2.0 | 4.1 | 16.8 | 10.1 | 5.3 | 2.5 | 1.7 | 6.2 | 7.1 | 4.4 | 5.5 | 317.1 |
| 1998 | 3.3 | 2.5 | 2.2 | 4.8 | 7.9 | 6.3 | 3.9 | 1.8 | 1.0 | 1.0 | 1.0 | 1.0 | 3.1 | 175.9 |
| 1999 | 0.9 | 0.9 | 0.8 | 1.2 | 2.0 | 2.4 | 3.5 | 1.6 | 0.9 | 1.0 | 1.2 | 1.3 | 1.5 | 85.5 |
| 2000 | 1.5 | 1.5 | 1.8 | 2.6 | 4.4 | 11.2 | 11.9 | 6.9 | 8.6 | 5.7 | 5.8 | 4.9 | 5.6 | 321.0 |
| 2001 | 3.6 | 2.7 | 2.0 | 2.8 | 6.6 | 9.2 | 4.9 | 2.6 | 0.9 | 0.4 | 0.5 | 0.6 | 3.1 | 176.3 |
| 2002 | 0.8 | 0.8 | 0.8 | 2.4 | 6.9 | 9.4 | 8.4 | 4.9 | 3.5 | 1.8 | 1.3 | 1.4 | 3.5 | 203.2 |
| 2003 | 1.4 | 1.3 | 1.1 | 1.1 | 1.5 | 1.4 | 1.5 | 1.6 | 2.1 | 3.5 | 3.1 | 2.6 | 1.9 | 107.8 |
| 2004 | 2.8 | 2.5 | 2.5 | 4.1 | 8.5 | 8.9 | 5.0 | 3.0 | 8.6 | 9.5 | 6.7 | 4.7 | 5.6 | 321.5 |
| 2005 | 4.1 | 3.2 | 2.5 | 6.6 | 8.2 | 13.9 | 12.0 | 5.5 | 3.4 | 2.7 | 2.9 | 2.8 | 5.7 | 326.1 |

| Year | Streamflow ($m^3/s$) | | | | | | | | | | | | | Mean Annual Runoff (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean | |
| 2006 | 2.7 | 2.4 | 2.0 | 3.6 | 4.6 | 5.2 | 3.3 | 1.5 | 0.5 | 0.4 | 0.4 | 0.6 | 2.3 | 130.0 |
| 2007 | 0.9 | 0.9 | 1.0 | 2.1 | 5.4 | 18.8 | 12.8 | 5.1 | 3.0 | 3.8 | 5.3 | 4.3 | 5.3 | 304.6 |
| 2008 | 3.2 | 2.4 | 1.9 | 2.2 | 5.2 | 10.0 | 11.7 | 7.8 | 3.8 | 2.4 | 2.1 | 2.1 | 4.6 | 263.8 |
| 2009 | 2.1 | 2.0 | 1.8 | 2.8 | 9.7 | 10.9 | 7.7 | 15.9 | 12.3 | 4.7 | 2.6 | 1.9 | 6.2 | 358.6 |
| 2010 | 1.7 | 1.7 | 1.4 | 2.0 | 4.6 | 13.1 | 13.0 | 7.1 | 6.6 | 4.9 | 3.4 | 3.1 | 5.2 | 300.0 |
| 2011 | 2.5 | 2.3 | 2.1 | 3.1 | 8.5 | 11.3 | 6.0 | 2.2 | 0.9 | 0.5 | 0.4 | 0.4 | 3.4 | 192.9 |
| 2012 | 0.5 | 0.5 | 0.9 | 1.9 | 2.5 | 10.7 | 11.0 | 6.8 | 3.3 | 2.7 | 4.0 | 3.5 | 4.0 | 232.8 |
| 2013 | 3.0 | 2.6 | 2.1 | 1.6 | 5.1 | 6.1 | 4.0 | 2.3 | 2.1 | 2.4 | 1.5 | 1.6 | 2.9 | 164.7 |
| 2014 | 1.6 | 1.6 | 1.6 | 1.6 | 12.0 | 12.5 | 10.5 | 5.4 | 2.7 | 1.7 | 1.3 | 1.3 | 4.5 | 259.5 |
| 2015 | 1.3 | 1.4 | 1.2 | 1.4 | 3.2 | 3.8 | 4.7 | 6.5 | 4.8 | 2.3 | 2.8 | 4.4 | 3.2 | 183.0 |
| 2016 | 3.6 | 2.9 | 2.4 | 5.1 | 7.6 | 8.5 | 7.4 | 4.2 | 4.5 | 6.9 | 6.5 | 5.7 | 5.4 | 313.1 |
| 2017 | 4.5 | 3.4 | 2.8 | 4.7 | 4.6 | 3.3 | 2.1 | 1.1 | 1.0 | 2.3 | 1.9 | 2.0 | 2.8 | 161.2 |
| 2018 | 1.8 | 1.8 | 1.5 | 1.3 | 2.8 | 3.3 | 1.8 | 0.9 | 0.5 | 0.7 | 1.1 | 1.4 | 1.6 | 90.3 |
| 2019 | 1.6 | 1.7 | 1.6 | 2.0 | 3.6 | 2.6 | 1.4 | 0.8 | 1.0 | 7.8 | 6.8 | 4.4 | 2.9 | 169.4 |
| 2020 | 3.2 | 2.5 | 1.9 | 1.9 | 2.3 | 3.5 | 3.8 | 2.2 | 1.5 | 0.9 | 0.6 | 0.7 | 2.1 | 119.4 |
| 2021 | 0.8 | 0.8 | 0.8 | 1.0 | 1.4 | 1.9 | 1.1 | 0.7 | 0.6 | 0.3 | 0.4 | 0.7 | 0.9 | 49.8 |
| 2022 | 0.9 | 1.1 | 1.2 | 1.8 | 21.9 | 17.5 | 8.2 | 7.1 | 4.4 | 1.9 | 1.2 | 1.2 | 5.7 | 330.4 |
| 2023 | 1.4 | 1.2 | 1.0 | 1.4 | 3.1 | 2.2 | 0.9 | 0.6 | 0.5 | 0.7 | 0.6 | 0.6 | 1.2 | 69.1 |
| Mean | 2.0 | 1.8 | 1.6 | 2.5 | 6.1 | 7.2 | 5.9 | 3.9 | 3.0 | 2.8 | 2.6 | 2.3 | 3.5 | 200.0 |
| Median | 1.8 | 1.7 | 1.6 | 2.0 | 5.1 | 7.1 | 4.9 | 2.9 | 2.0 | 2.1 | 2.0 | 1.9 | 2.9 | 169.0 |
| 1st Percentile | 0.6 | 0.5 | 0.5 | 0.7 | 1.8 | 2.1 | 1.7 | 1.1 | 0.9 | 0.8 | 0.7 | 0.7 | 1.0 | 58.5 |
| 5th Percentile | 0.9 | 0.8 | 0.7 | 1.1 | 2.6 | 3.1 | 2.5 | 1.7 | 1.3 | 1.2 | 1.1 | 1.0 | 1.5 | 86.6 |
| 95th Percentile | 3.3 | 2.9 | 2.6 | 4.0 | 9.8 | 11.7 | 9.5 | 6.4 | 4.9 | 4.5 | 4.2 | 3.7 | 5.6 | 324.9 |
| 99th Percentile | 3.5 | 3.1 | 2.7 | 4.3 | 10.5 | 12.5 | 10.2 | 6.8 | 5.3 | 4.8 | 4.4 | 3.9 | 6.0 | 345.9 |
| 1:100 Dry Year | 0.5 | 0.4 | 0.4 | 0.6 | 1.4 | 1.6 | 1.3 | 0.9 | 0.7 | 0.6 | 0.6 | 0.5 | 0.8 | 44.8 |
| 1:20 Dry Year | 0.8 | 0.7 | 0.6 | 1.0 | 2.4 | 2.8 | 2.3 | 1.5 | 1.2 | 1.1 | 1.0 | 0.9 | 1.4 | 77.7 |
| 1:20 Wet Year | 3.6 | 3.2 | 2.8 | 4.4 | 10.8 | 12.8 | 10.5 | 7.0 | 5.4 | 4.9 | 4.5 | 4.1 | 6.2 | 356.0 |

| Year | Streamflow (m³/s) | | | | | | | | | | | | | Mean Annual Runoff (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean | |
| 1:100 Wet Year | 4.5 | 3.9 | 3.5 | 5.5 | 13.4 | 15.9 | 13.0 | 8.7 | 6.7 | 6.1 | 5.7 | 5.0 | 7.7 | 442.2 |

*Note: 1) Monthly flow statistics are distributed based on annualized values.*

*2) Return periods were calculated based on Pearson Type III distribution and streamflow record summarized above*

**Table C-2: Monthly and Annual Streamflow Statistics – Golden Creek near Red Lake (05QC006)**

| Year | Flow ($m^3/s$) | | | | | | | | | | | | | Mean Annual Runoff (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean | |
| 2010 | 0.05 | 0.03 | 0.07 | 0.41 | 0.95 | 1.18 | 1.19 | 1.36 | 1.37 | 0.34 | 0.36 | 0.14 | 0.62 | 338.9 |
| 2011 | 0.05 | 0.03 | 0.03 | 0.94 | 1.58 | 1.53 | 0.03 | 0.02 | 0.04 | 0.17 | 0.18 | 0.04 | 0.39 | 209.5 |
| 2013 | 0.03 | 0.03 | 0.87 | 0.69 | 0.54 | 1.63 | 0.51 | 0.73 | 0.11 | 0.70 | 0.29 | 0.11 | 0.52 | 283.0 |
| 2014 | 0.03 | 0.02 | 0.03 | 0.10 | 2.04 | 0.59 | 0.14 | 0.29 | 0.92 | 1.24 | 0.16 | 0.06 | 0.47 | 256.4 |
| 2015 | 0.02 | 0.02 | 0.02 | 0.50 | 2.72 | 0.48 | 0.44 | 0.19 | 0.63 | 0.65 | 0.73 | 0.07 | 0.54 | 294.4 |
| 2016 | 0.02 | 0.01 | 0.01 | 0.66 | 1.28 | 0.33 | 0.84 | 1.54 | 0.45 | 0.28 | 1.13 | 0.21 | 0.57 | 308.3 |
| 2017 | 0.06 | 0.04 | 0.09 | 2.06 | 0.85 | 0.60 | 0.37 | 0.29 | 2.42 | 1.01 | 0.64 | 0.18 | 0.71 | 387.3 |
| 2018 | 0.06 | 0.06 | 0.05 | 2.70 | 0.66 | 1.23 | 0.13 | 0.02 | 0.19 | 0.25 | 0.06 | 0.04 | 0.45 | 245.2 |
| 2019 | 0.02 | 0.01 | 0.01 | 0.34 | 0.95 | 1.01 | 0.07 | 0.04 | 0.30 | 1.11 | 0.90 | 0.07 | 0.40 | 218.3 |
| 2020 | 0.03 | 0.03 | 0.03 | 0.89 | 0.75 | 0.33 | 0.53 | 0.20 | 0.29 | 2.07 | 0.19 | 0.07 | 0.45 | 246.8 |
| 2021 | 0.05 | 0.04 | 0.04 | 0.51 | 1.20 | 1.27 | 0.20 | 0.75 | 0.20 | 0.51 | 0.44 | 0.23 | 0.46 | 247.4 |
| 2022 | 0.09 | 0.01 | 0.01 | 0.20 | 0.92 | 0.72 | 0.04 | 0.18 | 0.24 | 0.25 | 0.34 | 0.07 | 0.26 | 138.6 |
| 2023 | 0.01 | 0.00 | 0.01 | 0.12 | 6.68 | 0.62 | 1.60 | 0.55 | 0.14 | 0.08 | 0.07 | 0.06 | 0.84 | 456.9 |
| Mean | 0.04 | 0.03 | 0.09 | 0.74 | 1.57 | 0.85 | 0.44 | 0.44 | 0.53 | 0.66 | 0.43 | 0.12 | 0.50 | 270.4 |
| Median | 0.04 | 0.03 | 0.03 | 0.51 | 0.95 | 0.67 | 0.28 | 0.24 | 0.27 | 0.58 | 0.35 | 0.07 | 0.34 | 182.7 |
| 1st Percentile | 0.02 | 0.01 | 0.05 | 0.39 | 0.81 | 0.44 | 0.23 | 0.23 | 0.28 | 0.35 | 0.22 | 0.06 | 0.26 | 140.6 |
| 5th Percentile | 0.02 | 0.01 | 0.05 | 0.41 | 0.86 | 0.47 | 0.24 | 0.24 | 0.29 | 0.37 | 0.24 | 0.07 | 0.27 | 149.0 |
| 95th Percentile | 0.06 | 0.04 | 0.14 | 1.13 | 2.38 | 1.29 | 0.67 | 0.68 | 0.81 | 1.01 | 0.65 | 0.18 | 0.76 | 411.7 |
| 99th Percentile | 0.07 | 0.04 | 0.15 | 1.23 | 2.59 | 1.41 | 0.73 | 0.74 | 0.89 | 1.10 | 0.71 | 0.20 | 0.83 | 447.8 |
| 1:100 Dry Year | 0.02 | 0.01 | 0.04 | 0.33 | 0.70 | 0.38 | 0.20 | 0.20 | 0.24 | 0.30 | 0.19 | 0.05 | 0.22 | 121.1 |
| 1:20 Dry Year | 0.02 | 0.01 | 0.05 | 0.42 | 0.88 | 0.48 | 0.25 | 0.25 | 0.30 | 0.38 | 0.24 | 0.07 | 0.28 | 152.6 |
| 1:20 Wet Year | 0.06 | 0.04 | 0.14 | 1.15 | 2.43 | 1.32 | 0.69 | 0.69 | 0.83 | 1.03 | 0.67 | 0.18 | 0.77 | 419.8 |
| 1:100 Wet Year | 0.08 | 0.05 | 0.17 | 1.38 | 2.91 | 1.58 | 0.82 | 0.83 | 0.99 | 1.24 | 0.80 | 0.22 | 0.93 | 502.8 |

*Note: Monthly flow statistics are distributed based on annualized values.*

*2) Return periods were calculated based on Pearson Type III distribution and streamflow record summarized above.*

**Table C-3: Peak Flow Summary for WSC Hydrometric Stations**

| Peak Flow – Return Period | Peak Daily Flow ($m^3/s$) Long-Legged River Below Long-Legged Lake (05QE012) |
|---|---|
| 1:20 Year | 22.1 |
| 1:100 Year | 29.9 |

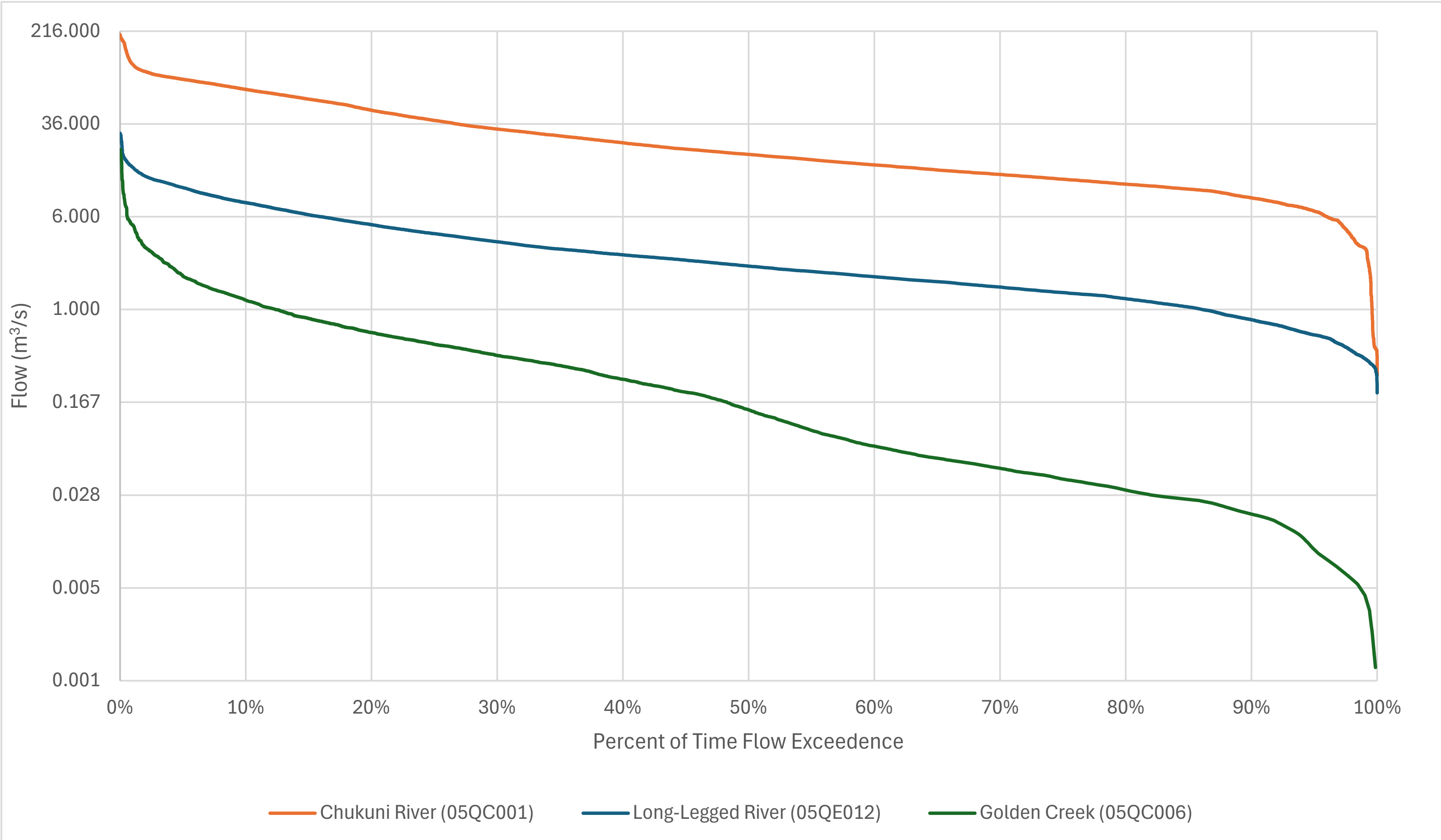
*Note: Peak flows were calculated based on Pearson Type III distribution and streamflow record summarized above.*

**Table C-4: Low Flow Summary for WSC Hydrometric Stations**

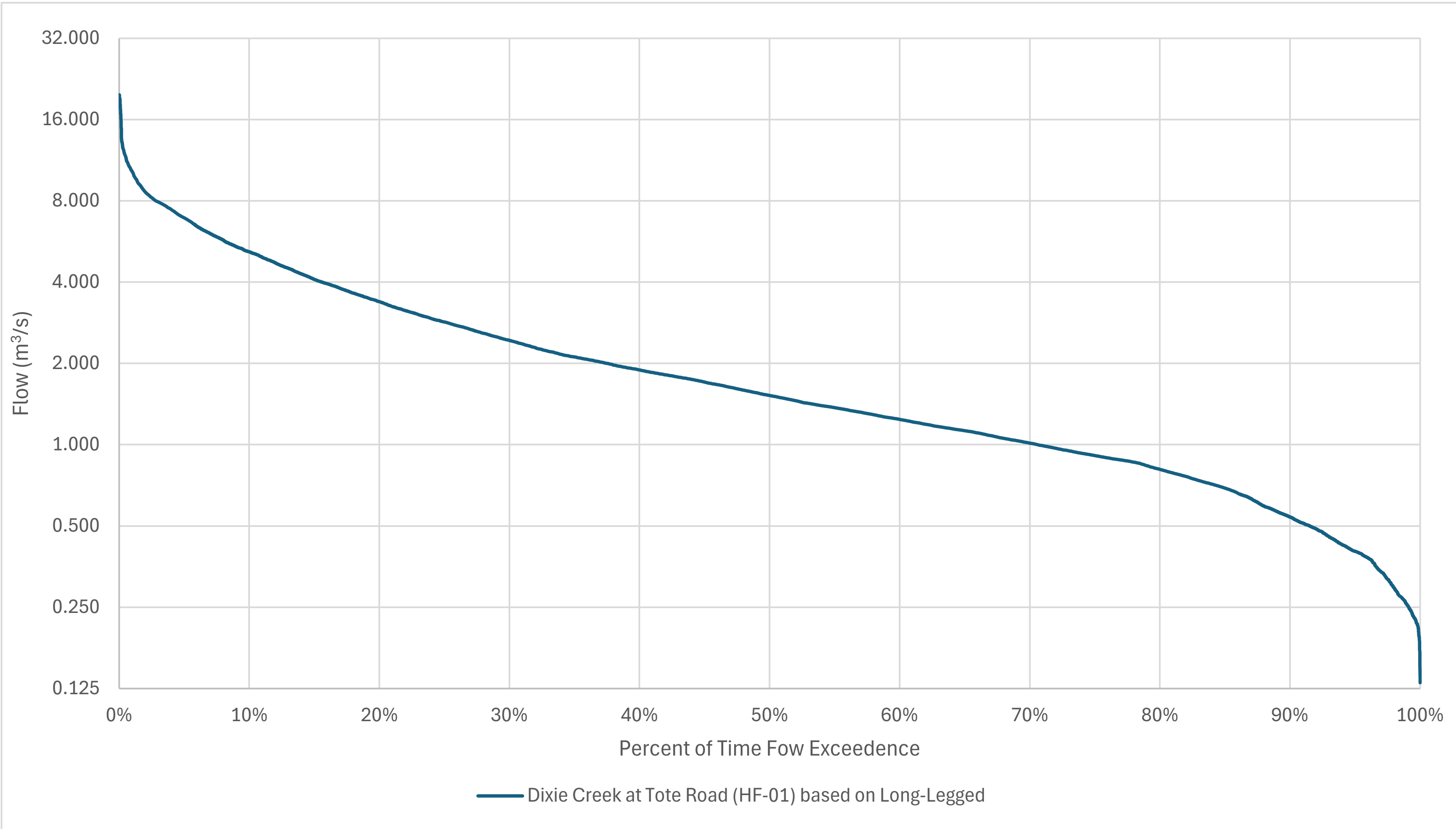
| 7-Day Average Low Flows | Minimum 7-Day Average Flow ($m^3/s$) | |
|---|---|---|
| | Long-Legged River Below Long-Legged Lake (05QE012) | Golden Creek Near Red Lake (05QC006) |
| 7Q2 | 0.84 | 0.013 |
| 7Q5 | 0.49 | 0.005 |
| 7Q10 | 0.38 | 0.003 |
| 7Q20 | 0.32 | 0.002 |

*Note: Low flows were calculated based on Pearson Type III and Weibull distributions and streamflow record summarized above.*

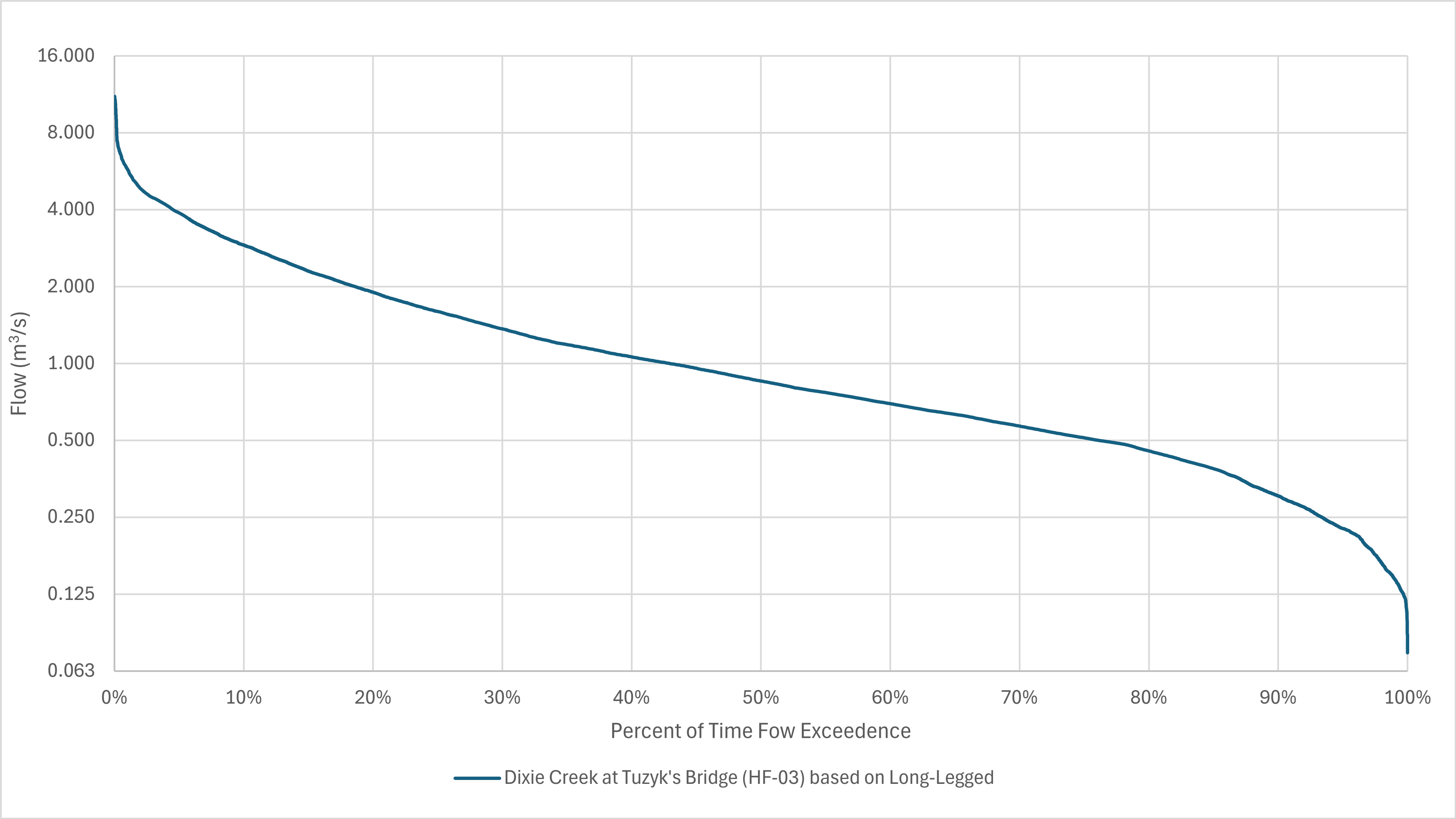
# Appendix D:
# Water Survey of Canada Stations Flow Duration Curves



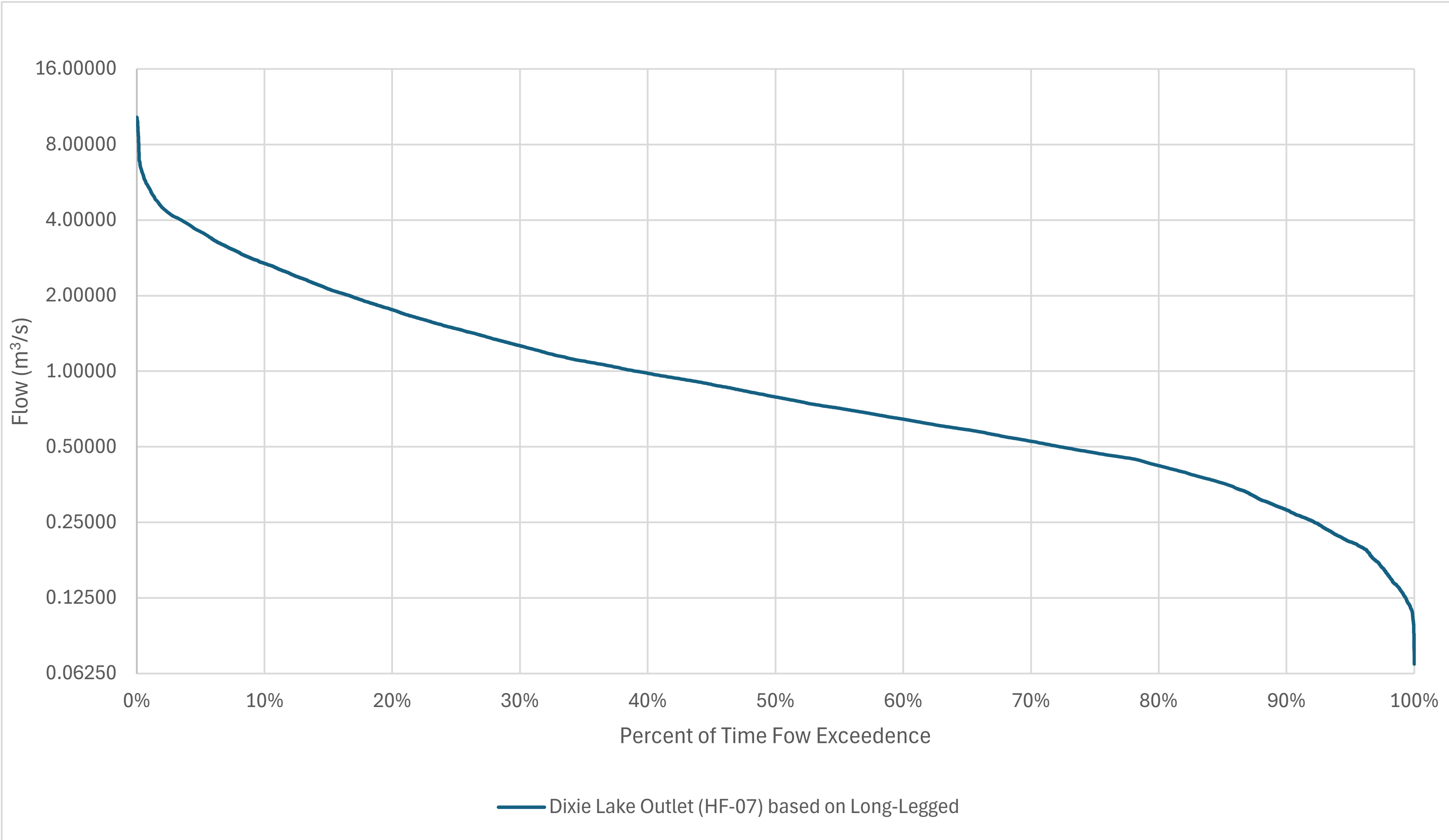

Appendix D-1: WSC Flow Duration Curves



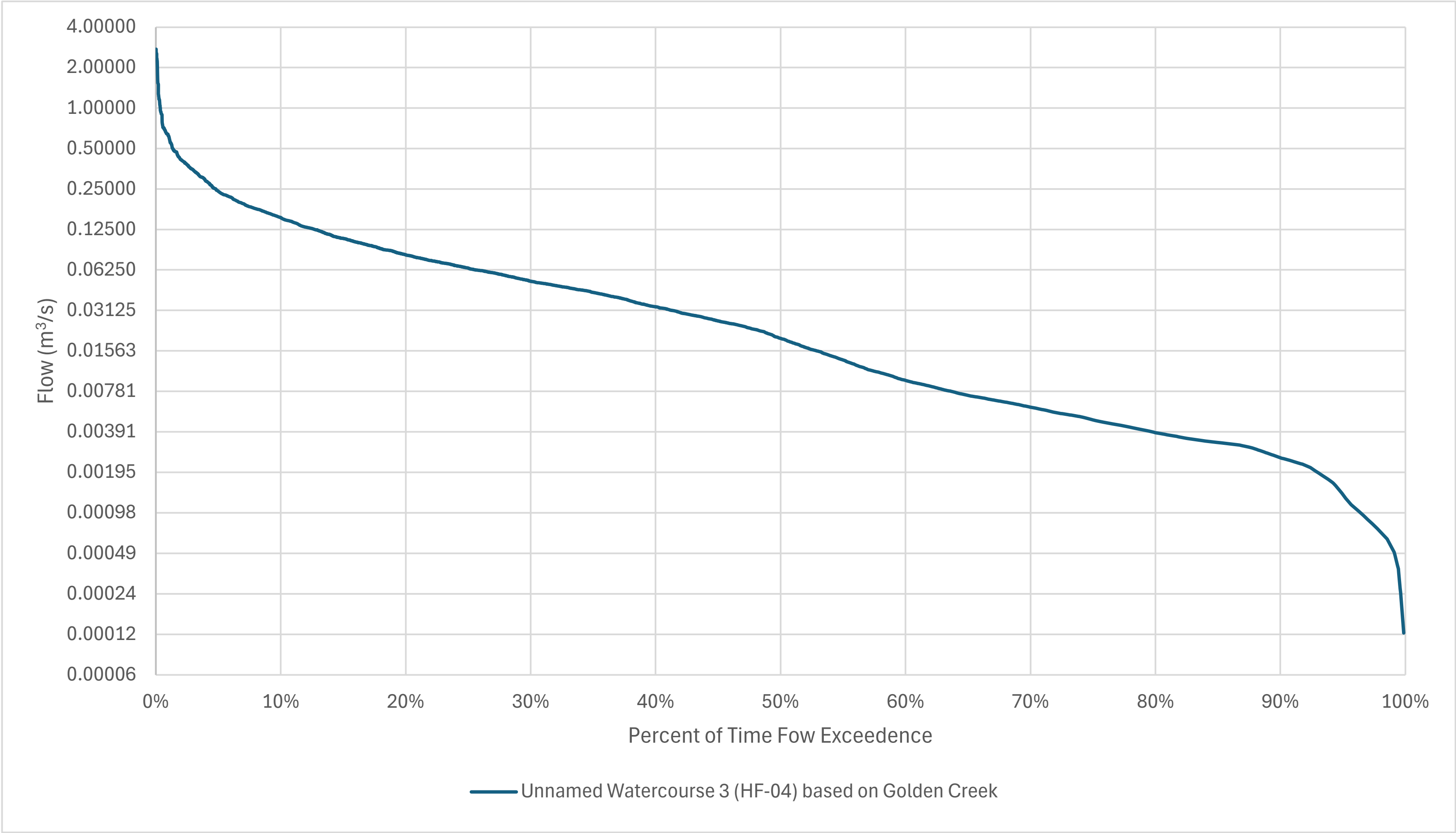

Appendix D-2: Dixie Creek at Tote Road (HF-01)



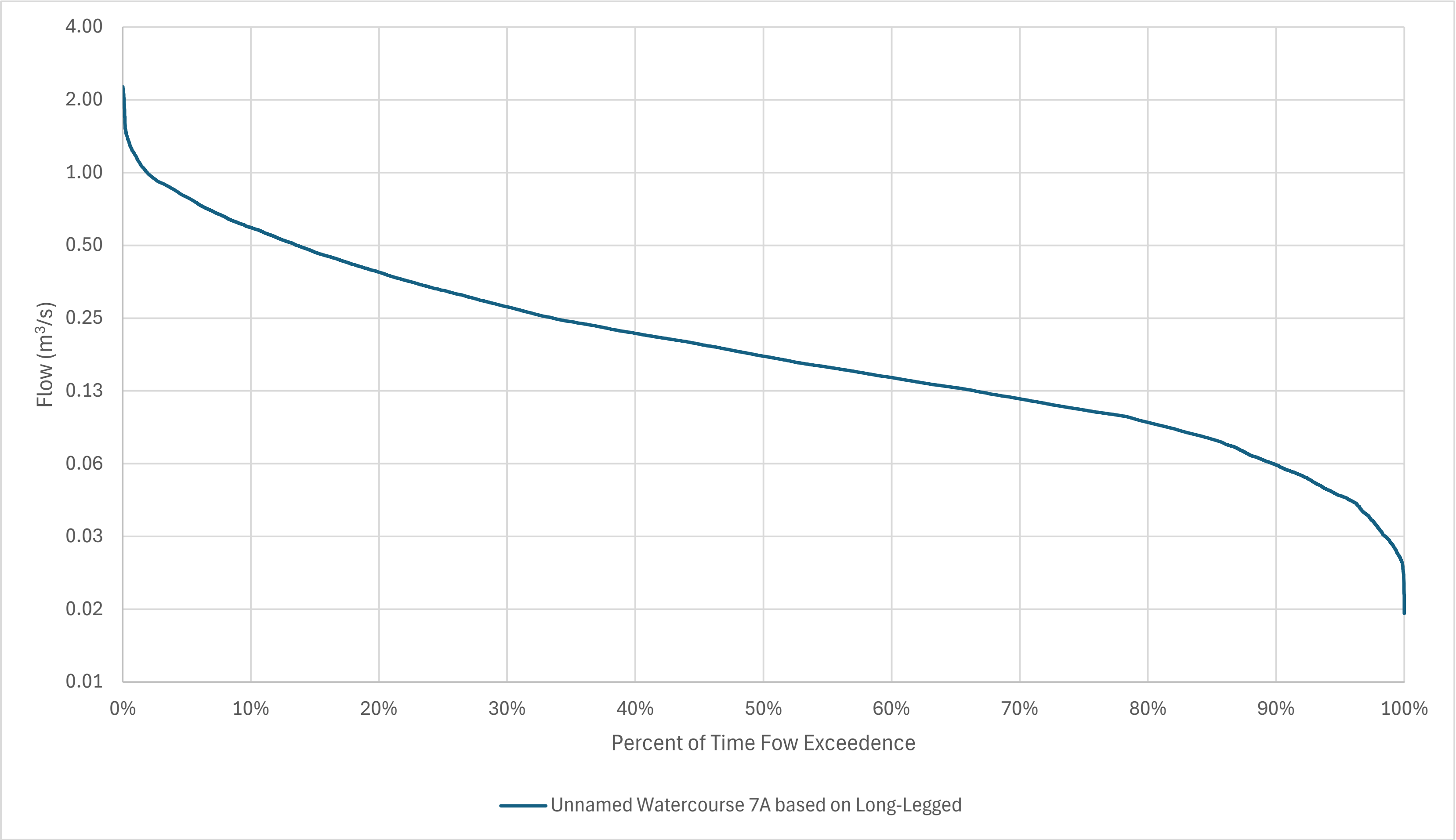

Appendix D-3: Dixie Creek at Tuzyk's Bridge (HF-03)




Appendix D-4: Dixie Lake Outlet (HF-07)

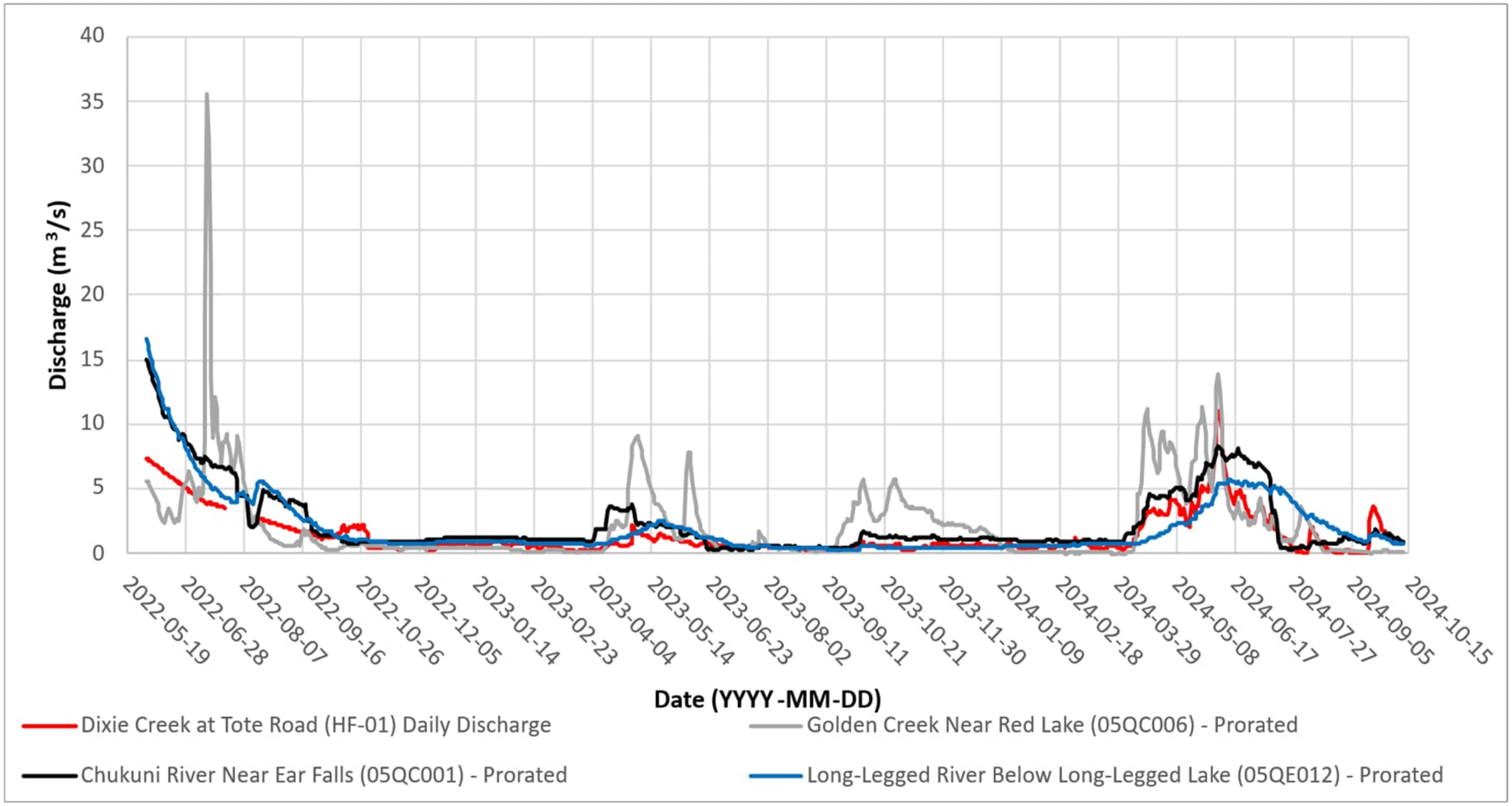



Appendix D-5: Unnamed Watercourse 3 (HF-04)



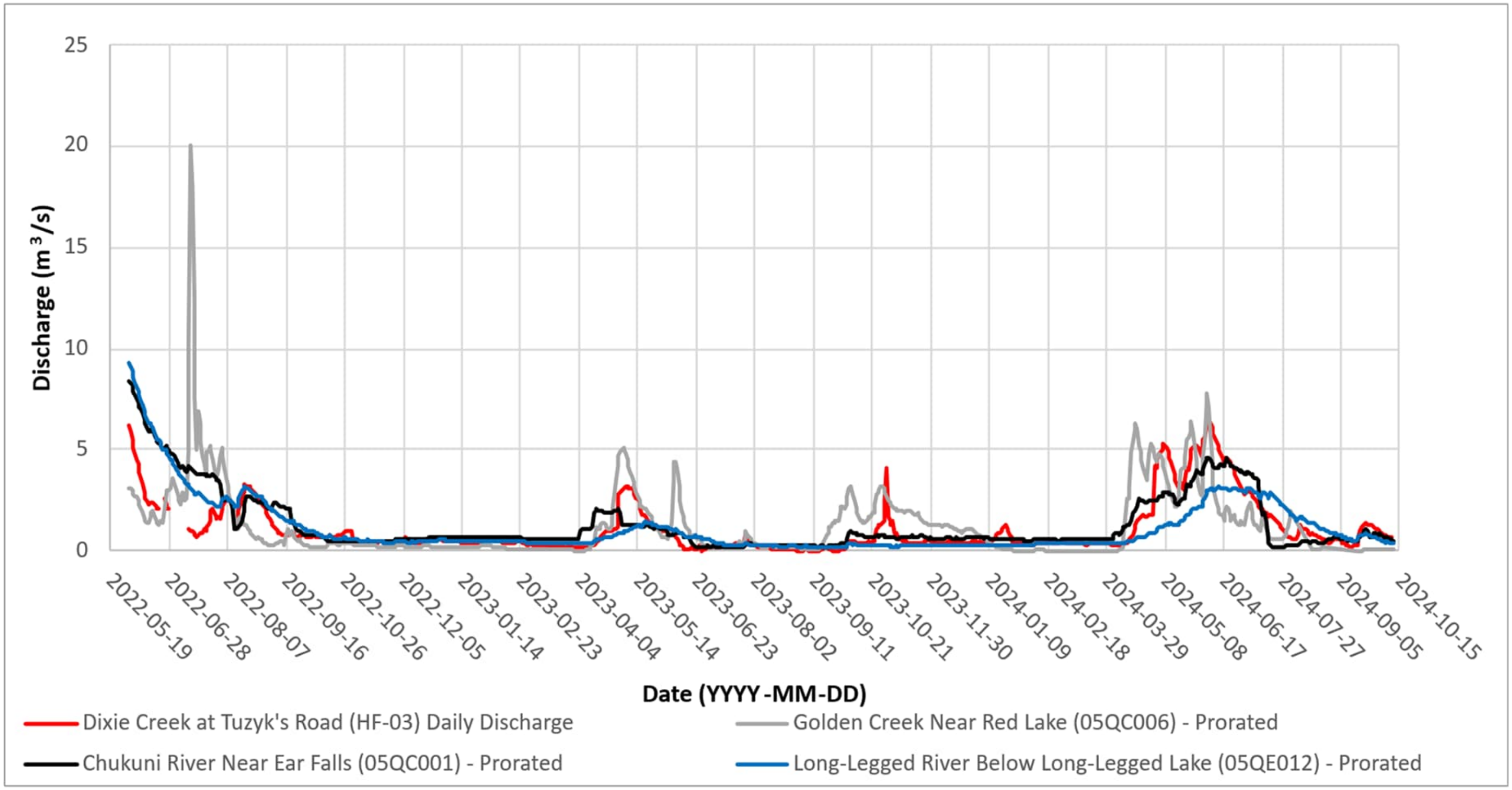

Appendix D-6: Unnamed Watercourse 7A (HF-11)

# Appendix E:
# Regional and Onsite Hydrometric Data Graphical Comparison



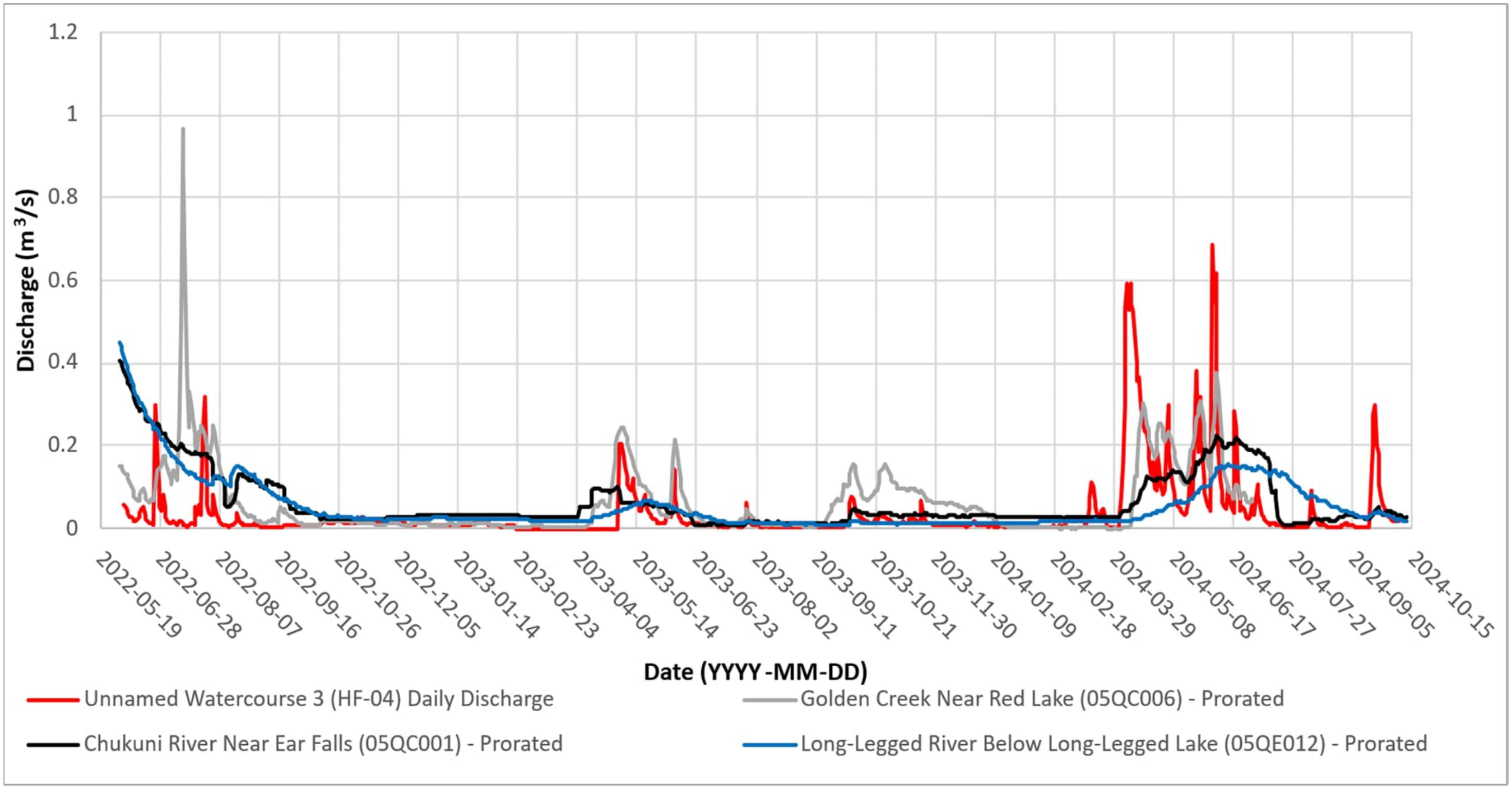

*Note: The discharge from the three WSC gauges presented were prorated using the Dixie Creek at Tote Road (HF-01) watershed area (360 km$^2$). Further details are provioded in Section 4.3.2.1 of the WSP 2025 Hydrology Baseline Report.*

Figure E-1: Dixie Creek at Tote Road (HF-01) and Regional WSC Station Daily Average Flow Comparison



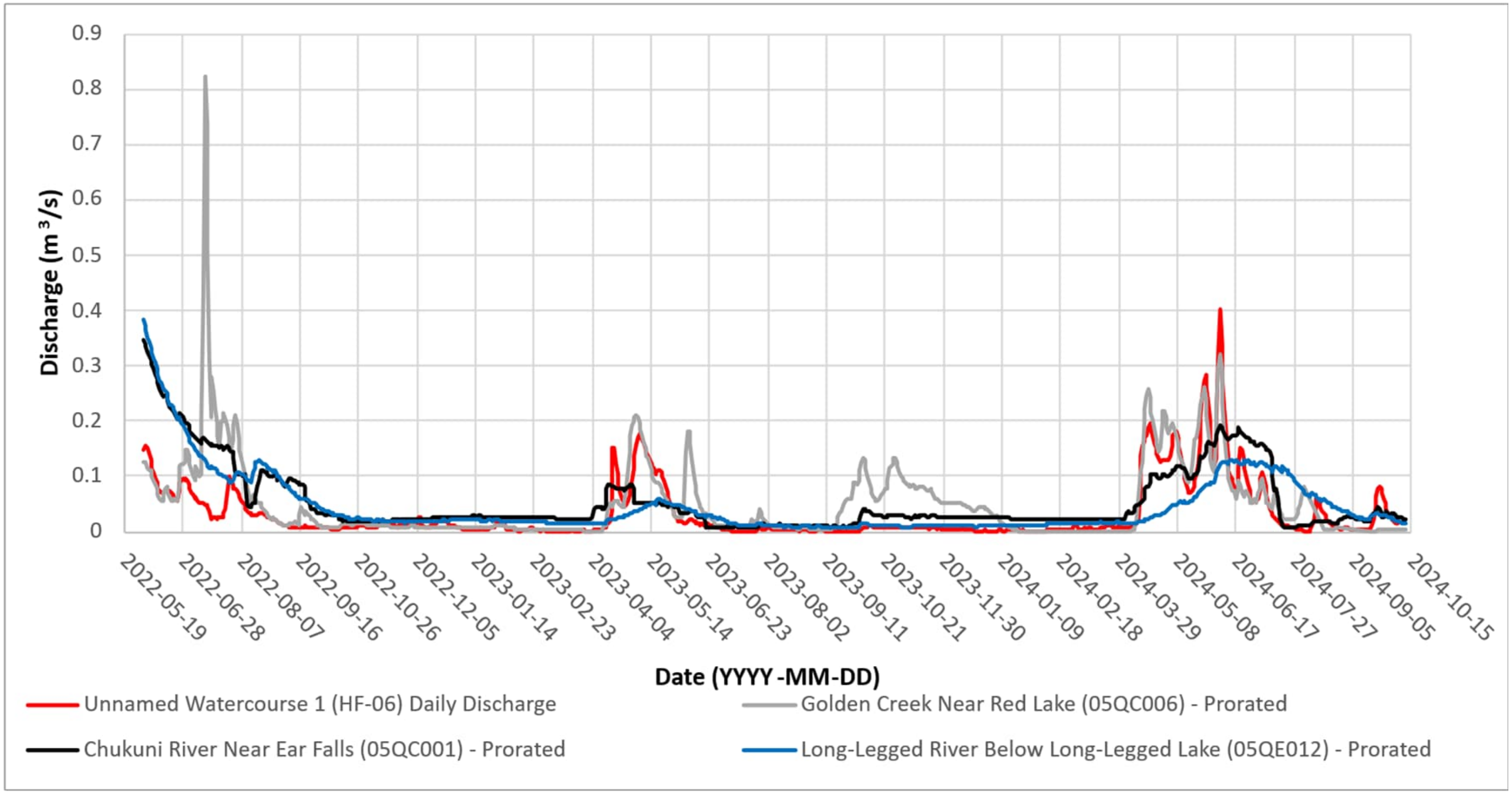

*Note: The discharge from the three WSC gauges presented were prorated using the Dixie Creek at Tuzyk's Road (HF-03) watershed area (202 $km^2$). Further details are provioded in Section 4.3.2.1 of the WSP 2025 Hydrology Baseline Report.*

Figure E-2: Dixie Creek at Tuzyk's Road (HF-03) and Regional WSC Station Daily Average Flow Comparison



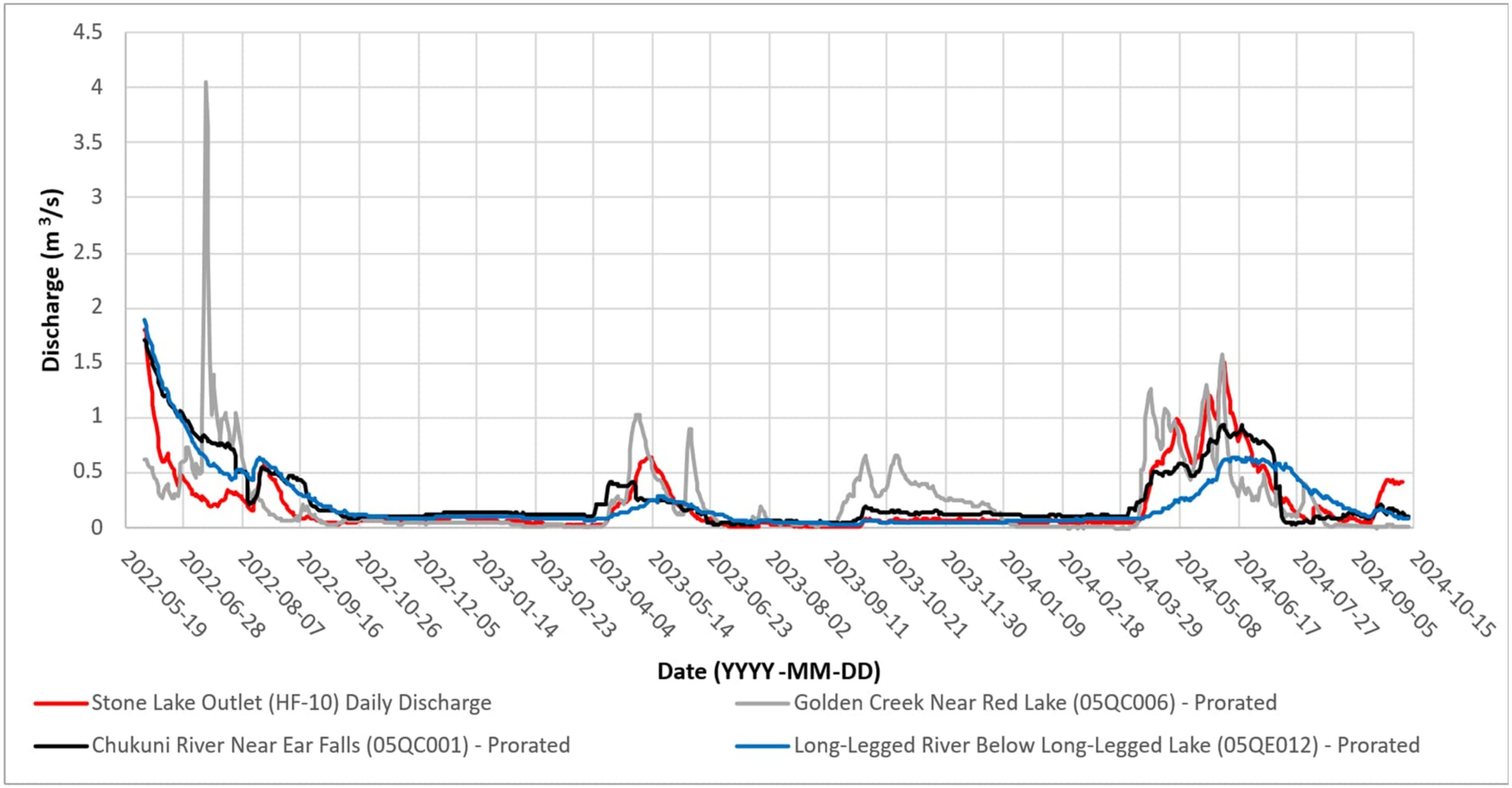

*Note: The discharge from the three WSC gauges presented were prorated using the Unnamed Watercourse 3 (HF-04) watershed area (9.8 $km^2$). Further details are provioded in Section 4.3.2.1 of the WSP 2025 Hydrology Baseline Report.*

Figure E-3: Unnamed Watercourse 3 (HF-04) and Regional WSC Station Daily Average Flow Comparison




*Note: The discharge from the three WSC gauges presented were prorated using the Unnamed Watercourse 1 (HF-06) watershed area (8.3 $km^2$). Further details are provioded in Section 4.3.2.1 of the WSP 2025 Hydrology Baseline Report.*

Figure E-4: Unnamed Watercourse 1 (HF-06) and Regional WSC Station Daily Average Flow Comparison




*Note: The discharge from the three WSC gauges presented were prorated using the Stone Lake Outlet (HF-10) watershed area (40.7 km$^2$). Further details are provioded in Section 4.3.2.1 of the WSP 2025 Hydrology Baseline Report.*

Figure E-5: Stone Lake Outlet (HF-10) and Regional WSC Station Daily Average Flow Comparison