APPENDIX

A SURFACE WATER REPORT

MILL CREEK AGGREGATES PIT SURFACE WATER

APPENDIX A OF THE 2022 COORDINATED MONITORING REPORT

DUFFERIN AGGREGATES, A DIVISION OF CRH CANADA INC.

PROJECT NO.: 111-52958-14
DATE: MARCH 29, 2023

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March 29, 2023

DUFFERIN AGGREGATES, A DIVISION OF CRH CANADA INC.
P.O. Box 5400
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Attention: **Martin Bradley, Site Manager**
Mill Creek Pit

Dear Sirs,

Subject: Mill Creek Aggregates Pit Surface Water
Appendix A of the 2022 Coordinated Monitoring Report

We are pleased to submit our 2022 Annual Surface Water Monitoring Report for the Mill Creek Aggregates Pit. This report was prepared to satisfy operating license conditions 21(1), 21(C), 23 and 25.

The report provides the results of the surface water monitoring program for 2022 and an interpretation of those results within the context of previously collected data at the property. Technical data are appended to the report for reference purposes.

We trust that this annual report is satisfactory for your purposes at this time. Please contact our office if there are any questions.

Yours truly,
WSP Canada Inc.

[redacted]

Greg R. Siiskonen, P.Eng.
Director, Earth & Environment

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

1.1 BACKGROUND

The University of Guelph owns approximately 185.5 ha of land situated in Part Lot 24, Concession 1, and Part Lots 21, 22, 23, and 24, Concession 2, Township of Puslinch, in the County of Wellington. Dufferin Aggregates, a division of CRH Canada Group Inc., leases the property from the University of Guelph. The property, called the Mill Creek Aggregates Pit (Site), is licenced by the Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) as a Category 3 Class 'A' Pit Below Water for extraction of the aggregate resource from above and below the water table (Licence #5738).

The northwest corner of the property is traversed by Mill Creek and by two tributary creeks, Galt Creek and Pond Creek. Various reaches of Mill Creek are documented as supporting naturally sustaining brown trout and brook trout populations. Brown trout spawning is documented as occurring in the section of Mill Creek on the Mill Creek Aggregates Pit property. Approximately half of the University property on the north side of Township Road 2 is within the regulatory flood line of Mill Creek. There is also a substantial area of wetland adjacent to Mill Creek and the tributary streams which is part of the larger Galt Creek Swamp, an area that is designated as a Provincially Significant Wetland (formerly a Class 1 Wetland) by the NDMNRF.

A surface water monitoring program is conducted to satisfy operating license conditions 21(a), 21(c), 23 and 25. This report presents the surface water monitoring results for the period of January 1 through December 31, 2022, including a comparison to long term trends and available historic data.

1.2 OBJECTIVE AND SCOPE

The principal objectives of the 2022 Annual Surface Water Monitoring Program are:

- To comply with the pertinent requirements of the surface water monitoring program;
- To provide an assessment of the potential effects of on-site aggregate extraction activities on the local surface water setting; and
- To document results in an annual monitoring report and use to prepare the annual coordinated report for the Mill Creek Aggregates operation.

This annual monitoring report includes the collation of the surface water monitoring data collected since 1993, a presentation of the results, and an analysis and discussion of the 2022 monitoring data. The accompanying summary document entitled "Mill Creek Coordinated Monitoring Report January 1 to December 31, 2022" integrates the monitoring results from the hydrogeology, surface water, and fisheries monitoring programs. This report forms Appendix A (Mill Creek Surface Water Monitoring Program) of the Coordinated Monitoring Report.

2 MONITORING PROGRAM

Figure 1, Surface Water Monitoring Locations, identifies the location of the surface water monitoring and air temperature stations at the Site. The 2022 monitoring program consisted of the following tasks, as outlined in Section 2, below.

2.1 CLIMATE DATA

Daily climate data are obtained from the Grand River Conservation Authority (GRCA) climate station located at Shade's Mills Conservation Area in the city of Cambridge, Ontario. In addition, automated air temperature data are measured using a barometric data logger at two locations on-Site (Air Temperature Stations 1 and 2), as shown in Figure 1. Measurements are recorded hourly using the data logger and the data are downloaded and reviewed monthly. The climate data from the GRCA Shade's Mills Conservation Area are used to verify the on-Site recorded air temperature data.

It is noted that the barometric data loggers installed at Air Temperature Stations 2 and 1 were discovered to have been taken by vandals in August and October 2022, respectively. Between September 9 and October 14, air temperature and barometric pressure data were recorded daily at the barometric data logger installed in monitoring well 92-13, which was historically installed for the groundwater monitoring program. On October 14, the frequency of data logging at the 92-13 barometric data logger was increased to hourly, to align with the surface water monitoring data loggers. In early 2023, barometric data loggers were re-installed at the Air Temperature Stations 1 and 2 locations.

2.2 MILL CREEK DISCHARGE MONITORING

Four surface water monitoring stations (SWM1, SWM2, SWM3 and SWM4) were established on the Site in 1993. The locations of these stations are shown on Figure 1. Water level data have been obtained from SWM1 and SWM2 continually since 1993, while approval to discontinue monitoring at SWM3 and SWM4 was granted by the NDMNRF in 2013. The original location of station SWM2 was on the north side of Concession Road 2; however, in 2012, the station was relocated to the south side of Concession Road 2 due to property access issues. A new rating curve was developed for the relocated station; and the assumption was that flow estimates from the relocated SWM2 monitoring station would be directly comparable to the estimates collected from the former SWM2 location, since the locations were in close proximity to each other, and no additional surface water inputs enter the creek between the two locations.

The surface water monitoring stations consist of a 5 cm (2 inch) diameter steel pipe, installed to a depth of approximately 1 m below the stream bed. The pipe which extends above the stream bed is perforated to allow pressure equalization. The pipe extends above the stream bed to a level below the low water level of the creek. Since the pipe remains submerged, potential for vandalism or tampering with the monitor is reduced.

2.2.1 WATER LEVEL DATA COLLECTION

Automated surface water levels at SWM1 and SWM2 are measured hourly using data loggers installed within the steel pipe. The data loggers rest on a stainless-steel bolt inserted through the pipe, so that the data logger sits

approximately at the elevation of the stream bed. The data are downloaded and reviewed monthly. The surface water level data are used to estimate stream discharge using rating curves.

The automated water level data are compensated for barometric pressure, using the atmospheric pressure data measured by the barometric data logger located at Air Temperature Station 1. Back-up barometric pressure data are also measured at Air Temperature Station 2.

Due to the vandalism of the Air Temperature Station barometric data loggers in 2022, the hourly automated water level data collected between September 9 and October 14 were compensated for barometric pressure using hourly atmospheric pressure data from Environment and Climate Change Canada's Kitchener/Waterloo climatological station. From October 14 onwards, the automated water level data were compensated for barometric pressure using data recorded at the barometric data logger installed on-Site in monitoring well 92-13.

2.2.2 MANUAL STREAM FLOW MEASUREMENTS

Rating curves for SWM1 and SWM2, which were previously developed, are continually updated to improve the accuracy of discharge calculations. In 2022, manual flow measurements at SWM1 and SWM2 were collected by WSP on the following dates, which cover a wide range of seasonal and flow conditions.

- January 7
- February 22
- March 25
- April 22
- May 25
- June 16
- July 15
- August 26
- September 9
- October 14
- November 25
- December 20

Stream flow measurements were measured at established stream transects at each surface water monitoring location. Evenly spaced measurements were recorded along each transect to obtain a cross-sectional profile of the wetted channel. The number of measurements at each cross-section was determined by dividing the width of the channel by 10. At each measurement location, the depth of water and velocity were recorded. Velocity measurements were obtained using a portable velocity meter. Where the measured water depth was equal to, or less than, 0.5 m, velocity measurements were recorded at 60% of the total depth above the stream bed. Where the measured water depth was greater than 0.5 m, velocity measurements were recorded at 20%, 60% and 80% of the total depth and the average of the velocity measurements was used to calculate stream discharge. To calculate stream discharge, the cross-sectional area between measurement points was multiplied by the velocity measurement for that area. The sum of each of the calculated flow values provided the total stream discharge.

The variability of stream discharge measurements using this method was evaluated by WSP in February 2022, by replicating discharge measurements at the same location immediately following the original measurement. In 2022, the observed variation observed using this method was +/- 3%.

2.2.3 RATING CURVE DEVELOPMENT

Rating curves for SWM1 and SWM2 have been developed using data collected since 2010 and 2014, respectively. Flow measurement data collected prior to 2014 at SWM2 have been excluded due to a change in data loggers at this monitoring station (Stantec, 2019).

The rating curves use the manual stream flow measurements and the water level data recorded by the data logger at the time of the stream flow measurement. An equation derived from the rating curves is used to convert the continuous depth readings from the data loggers to an estimate of stream flow.

2.3 MILL CREEK TEMPERATURE MONITORING

Hourly water temperature is recorded by the data loggers installed at SWM1, SWM2, SWM3 and SWM4. The water temperature data were downloaded monthly.

It is noted that the water temperature recorded at SWM4 between February 22 and 28, 2022, is unavailable due to failure of the data logger installed at SWM4. The data logger was replaced during the routine monitoring event completed on February 28, 2022.

3 ANNUAL MONITORING RESULTS

3.1 CLIMATE DATA

The 2022 daily climate data from the GRCA Shade's Mills climate station are presented in Table A-1 (Appendix A). Monthly climate data (2000 to 2022) from the GRCA Shade's Mills climate station are presented in Table A-2 (temperature) and Table A-3 (precipitation). Tables A-2 and A-3 include the 30-year climate normal temperature and precipitation data, which are calculated from the GRCA Shade's Mills climate station using climate data collected between 1991 and 2020.

3.1.1 AIR TEMPERATURE

Graphs of the 2022 air temperature data are provided in Appendix A. Figures A-1 to A-5 present the data recorded at on-Site with barometric data loggers, while Figures A-11 to A-15 present the data recorded at the GRCA Shade's Mills climate station.

A graph presenting the 2022 average monthly air temperature recorded at the GRCA climate station compared to the 30-year (1991-2020) climate normal monthly temperatures is presented in Figure 3-1, below. As shown in the figure, the average monthly air temperature values recorded in 2022 were typically warmer than the 30-year normal values, particularly in May and August. The average monthly air temperature value recorded in January was colder than the 30-year normal value. The average monthly air temperature values observed in February, April, June and October were similar to the 30-year normal values.

As shown in Table D-2 (Appendix D), the mean monthly air temperature in 2022 was 8.9°C, which is 0.6°C higher than the 30-year average (8.3°C).

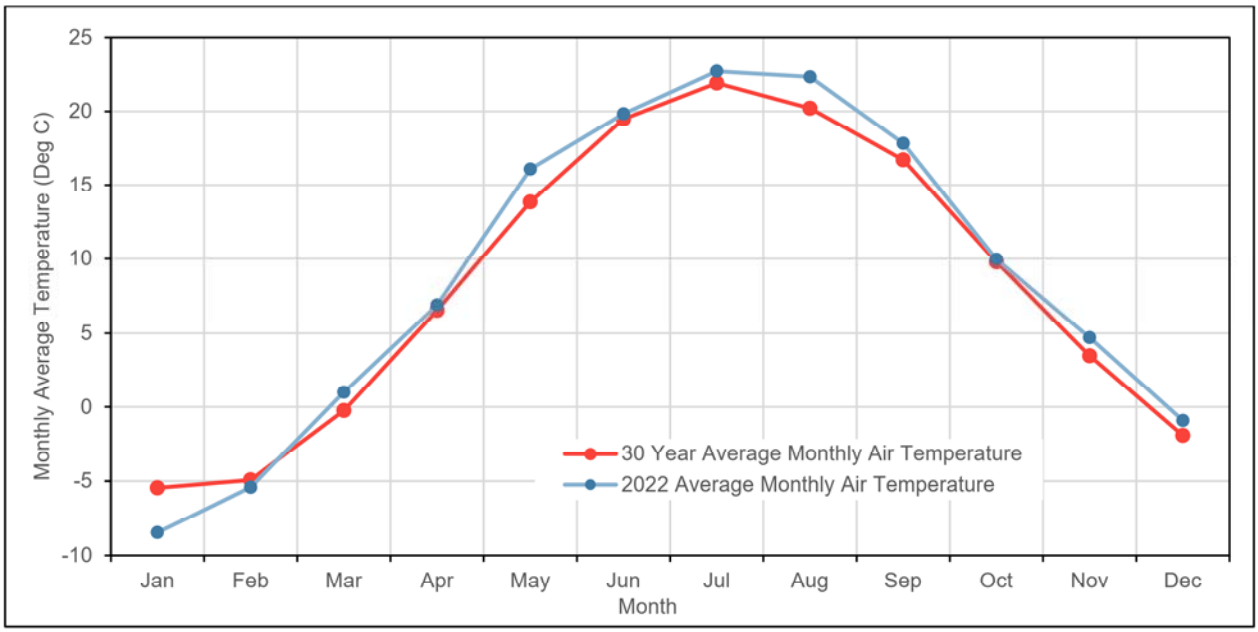


Figure 3-1: 2022 Monthly Air Temperature Compared to 30-Year Normal

3.1.2 PRECIPITATION

Graphs presenting the 2022 total daily precipitation recorded at the GRCA Shade's Mills climate station are presented in Figures A-6 to A-10 (Appendix A).

A graph of the 2022 total monthly precipitation compared to the 30-year average (1991-2020) monthly precipitation is presented in Figure 3-2, below. As shown in the figure, total monthly precipitation amounts received during March, August and December were similar to the 30-year normal, while considerably more precipitation was received in February compared to the 30-year normal value for February. During the remaining months of the year, the total amounts of precipitation received were appreciably lower than the 30-year normal values. The 2022 total monthly precipitation was less than the 30-year average for the month in eight months of the year.

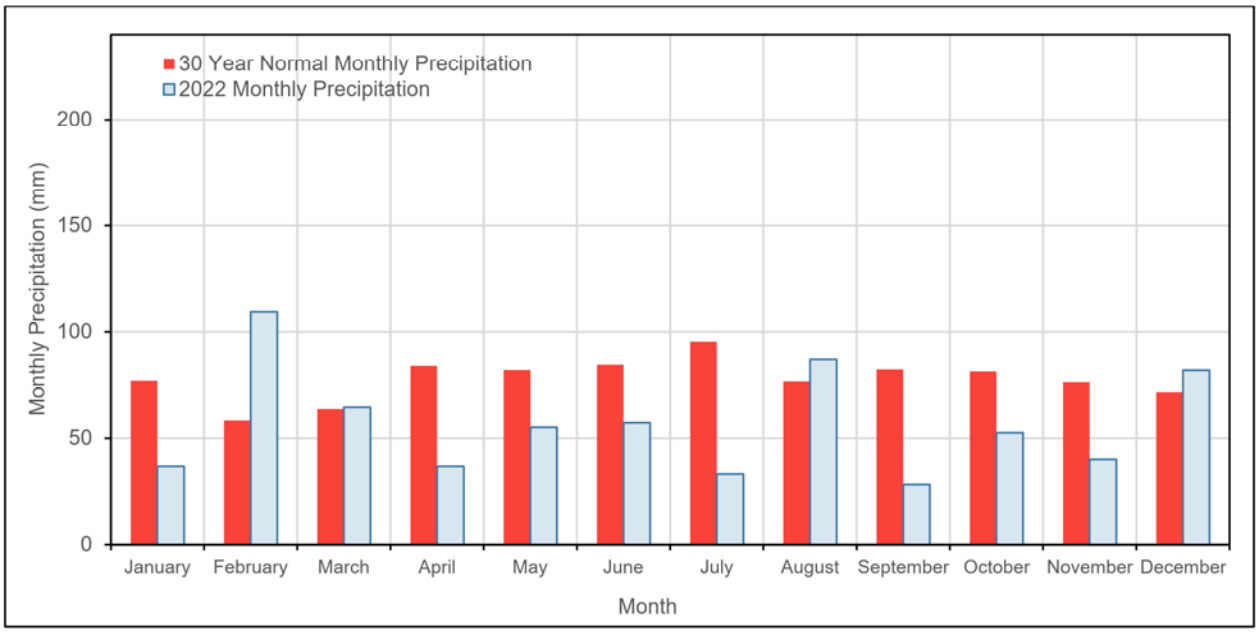


Figure 3-2: 2022 Total Monthly Precipitation Compared to 30-Year Normal

As shown in Table A-3, Appendix A, the total annual precipitation recorded at the GRCA Shade's Mills Climate Station in 2022 was 682 mm, which is 27% lower than the 30-year normal annual precipitation (935 mm) and considerably lower than the total precipitation received in 2021 (1,020 mm).

It is important to note that 2022 was an appreciably dry year. The annual precipitation recorded in 2022 (682 mm) was similar to the annual precipitation recorded in 2012 (679 mm), which was the lowest annual precipitation recorded since 1998. As reported in the 2021 Surface Water Report, persistent dry conditions were previously observed from early 2020 through summer 2021, and were followed by wetter conditions in the fall of 2021.

3.2 MILL CREEK DISCHARGE MONITORING

3.2.1 RATING CURVES

A table presenting the data used to prepare the SWM1 and SWM2 rating curves is provided in Appendix B. The rating curves for SWM1 and SWM2 are presented in Figures 3-3 and 3-4, respectively.

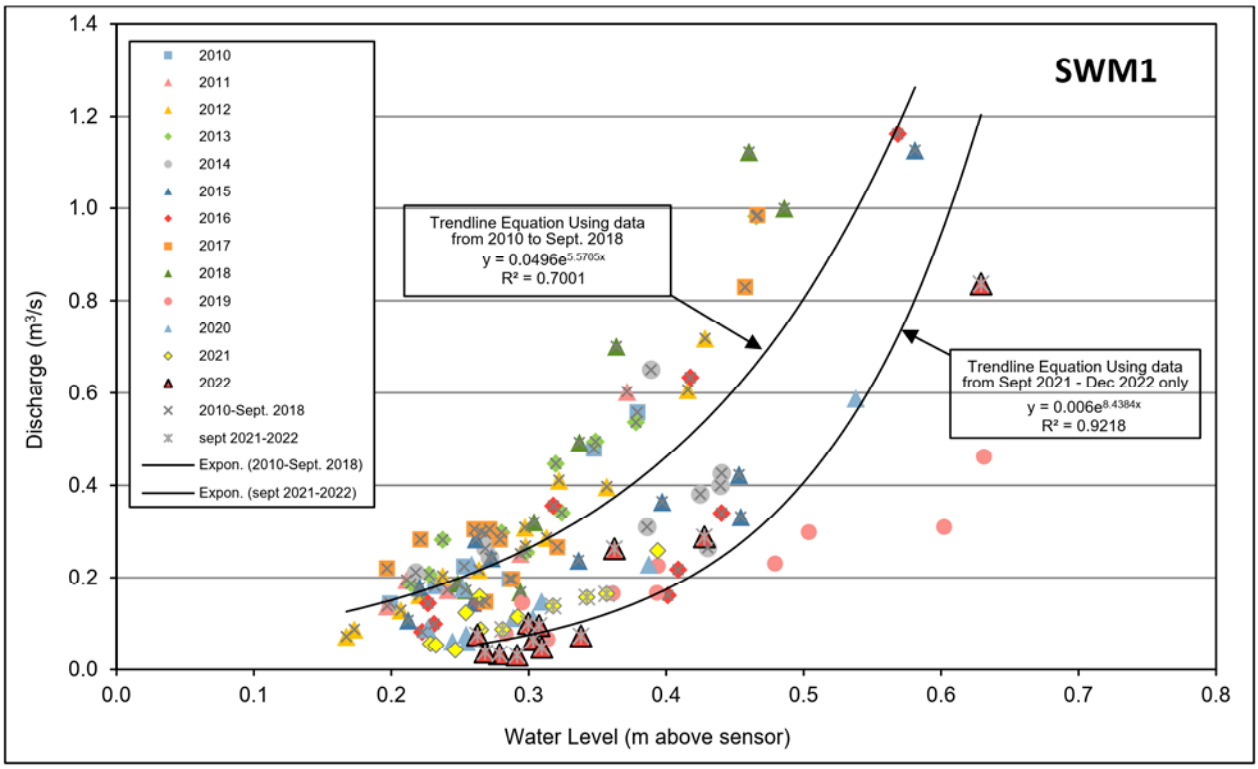


Figure 3-3: SWM1 Rating Curve

SWM1 is located at the farthest upstream monitoring location for the Site, within Mill Creek. A total of 129 manual stream flow measurements have been collected at SWM1 since 2001.

As noted in the 2019, 2020 and 2021Surface Water Reports (WSP, 2020, 2021 and 2022), a beaver dam located downstream of SWM1 was discovered in 2018 and was removed in September 2021. The beaver dam was interpreted to be causing unrepresentative water levels/discharge and, as such, the stream flow measurements collected while the beaver dam was present were inconsistent with the rating curves developed prior to the presence of the beaver dam. Since the dam was removed in September 2021, the manual stream flow data points continued to be shifted compared to the rating curve developed with data collected prior to October 2018. Since the previously established rating curve formula would result in an over-estimation of 2022 stream flow, a new rating curve formula was fitted to the manual stream flow data points collected since the beaver dam was removed (September 2021 through December 2022), as shown in Figure 3-3. Stream flow calculations based on the 2022 water level data were completed using the new formula.

As shown in Table B-1 (Appendix B), the depth of the water above the logger at SWM1 at the time of the manual flow measurements in 2022 ranged from 0.26 m to 0.63 m. Within this 0.37 m difference in water level, flow measurements ranged between 0.031 m^3/s and 0.836 m^3/s.

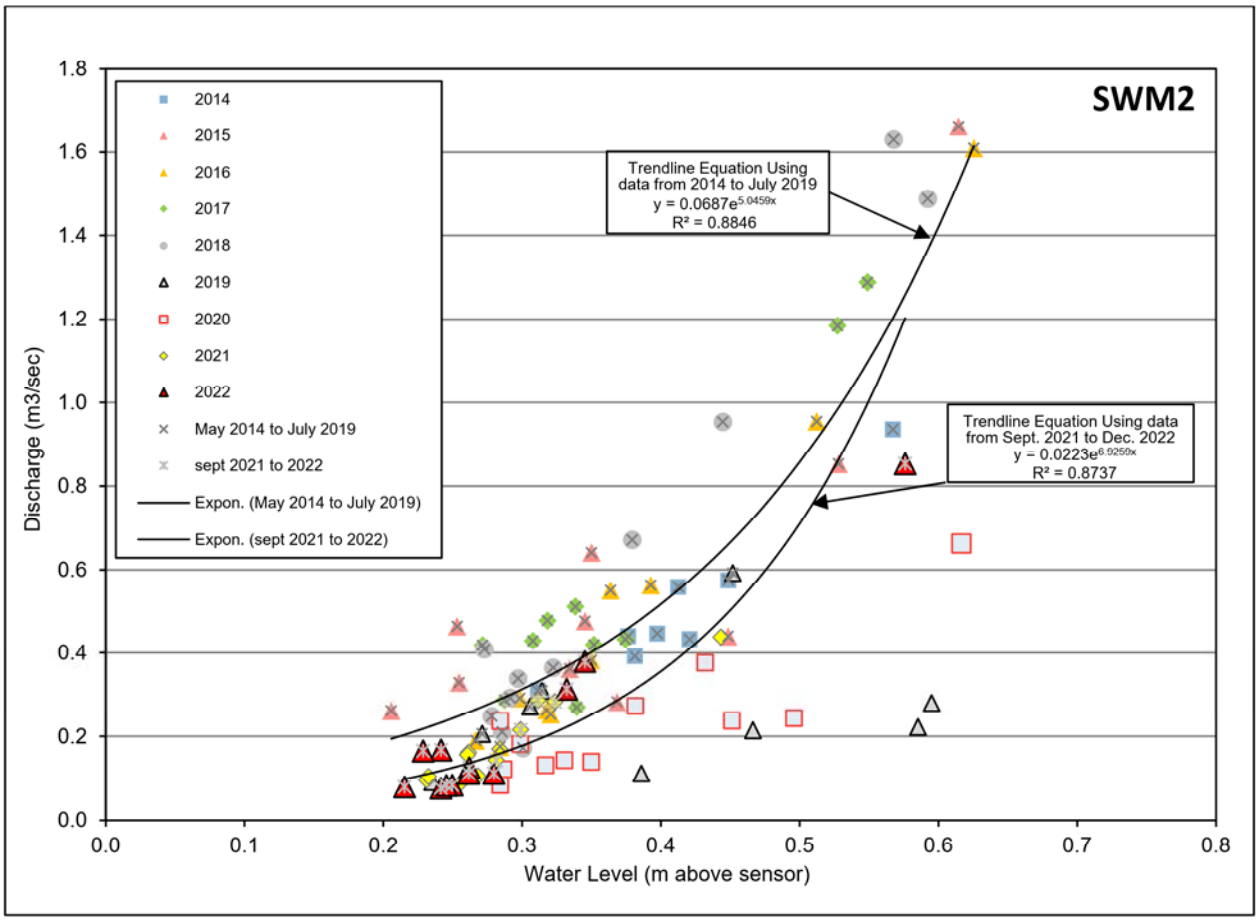


Figure 3-4: SWM2 Rating Curve

SWM2 is located within Mill Creek, at the downstream end of the Site. As shown in Figure 1, additional flow inputs from Galt Creek and Pond Creek enter Mill Creek between SWM1 and SWM2. A total of 94 manual stream flow measurements have been collected at SWM2 since 2014.

As noted in the 2019, 2020 and 2021 Surface Water Reports (WSP, 2020, 2021 and 2022), a beaver dam located downstream of SWM2 was discovered in 2019 and was removed in September 2021. The beaver dam was interpreted to be causing unrepresentative water levels/discharge and, as such, the stream flow measurements collected while the beaver dam was present were inconsistent with the rating curves developed prior to the presence of the beaver dam. Since the dam was removed in September 2021, the manual stream flow data points continued to be shifted compared to the rating curve developed with data collected prior to August 2019. Since the previously established rating curve formula would result in an over-estimation of 2022 stream flow, a new formula was fitted to the manual stream flow data points collected since the beaver dam was removed (September 2021 through December 2022), as shown in Figure 3-4. Stream flow calculations based on the 2022 water level data were completed using the new formula.

As shown in Table B-1 (Appendix B), the depth of the water above the logger at SWM2 at the time of the manual flow measurements ranged between 0.22 m and 0.58 m above the data logger. Within this 0.36 m difference in water level, the flow measurement ranged between 0.077 m^3/s and 0.853 m^3/s.

The formulas generated using the rating curves, which are used to estimate the flow rates for the 2022 water level data, are shown in Table 3-1, below. The table also includes the correlation (R^2 value) for the rating curves. R^2 values can range between 0 and 1, with a higher value indicating a better relationship between logger depth and stream flow.

Table 3-1: Rating Curve Formulas Used to Estimate Stream Discharge for 2022 Water Level Data

SWM1	SWM2
$y = 0.006e^{8.4384x}$ $R^2 = 0.9218$	$y = 0.0223^{e6.9259x}$ $R^2 = 0.8737$
n = 16	n = 16

3.2.2 QUALITY ASSURANCE AND QUALITY CONTROL

Stream discharge measurements and automated water level/temperature data were plotted on graphs to visually identify any potentially erroneous data. Periodically, an individual data logger measurement will be inconsistent compared to adjacent measurements, which typically corresponds to the data logger recording a reading while the data logger has been brought to ground surface for data download. In these instances, the individual data reading is excluded from the dataset.

Duplicate data loggers were maintained at several monitoring locations to ensure that a data back-up is available in the event of a data logger failure. In addition, if a data logger cannot be downloaded in the field and is required to be shipped to the manufacturer or returned to the office for maintenance/download, the duplicate data logger will continue to provide data during that time. As previously noted, the automated data logger installed at SWM4 failed in February 2022, which resulted in a loss of water temperature data between February 22 and 28, 2022. In addition, the barometric data loggers installed for the surface water monitoring program were removed by a vandal in 2022. As such, hourly barometric pressure and air temperature readings were not recorded on-Site between September 9 and October 14, 2022; however, replacement hourly data were available from an off-Site climatological station for this period. With the exception of the above-noted issues, the required hourly water level, water temperature and air temperature data were successfully collected in 2022.

3.2.3 MILL CREEK 2022 DISCHARGE TRENDS

The 2022 hourly discharge rates at SWM1 and SWM2, calculated using the 2022 rating curve formulas presented in Table 3-1, are presented in Figure 3-5, below. More detailed monthly figures are presented in Figures C-1 to C-24 (Appendix C). As observed historically at the Site, the calculated flow at SWM2 is typically greater than, and proportional to, the flow calculated at SWM1.

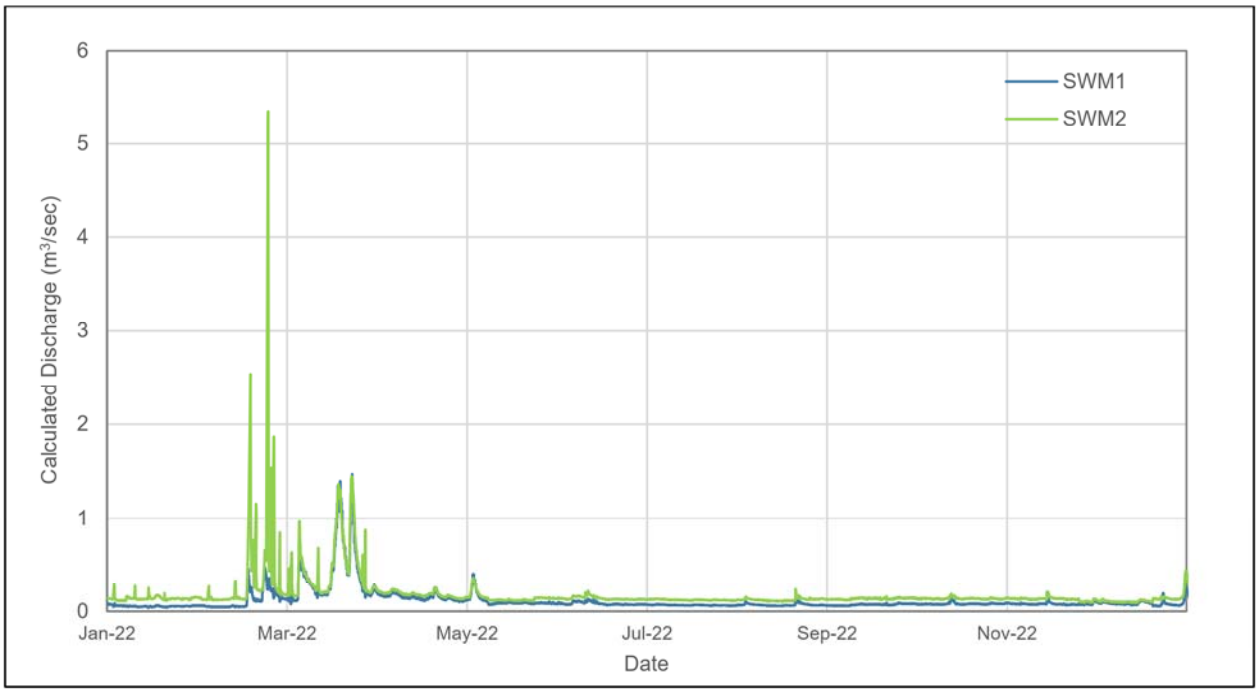


Figure 3-5: 2022 Calculated Hourly Stream Discharge at SWM1 and SWM2

The 2022 minimum and maximum calculated instantaneous stream discharge at stations SWM1 and SWM2, and the dates when these discharges occurred, are summarized in Table 3-2, below.

Table 3-2: 2022 Minimum and Maximum Instantaneous Stream Discharge Recorded at SWM1 and SWM2

	SWM1		SWM2	
	Discharge (m^3/s)	Date	Discharge (m^3/s)	Date
Minimum Stream Discharge	0.038	14-Jan	0.090	15-Dec
Maximum Stream Discharge	1.46	24-Mar	5.35	24-Feb

It is noted that the accuracy of flow estimates generated using rating curves decreases with higher flow levels because higher flow levels are typically greater than the range of flows measured to develop the rating curve. For example, as shown in Table B-1 (Appendix B), the maximum manual flows measured at SWM1 and SWM2 in 2022, which are used to develop the rating curve, are 0.836 m^3/s and 0.853 m^3/s, respectively, but the 2022 flow data presented in Figure 3-5 show occasions where the calculated flows are higher than these values.

3.2.4 EFFECTS OF PRECIPITATION ON MILL CREEK FLOW

Daily precipitation data recorded at the GRCA's Shade's Mills climate station are illustrated with the calculated average daily stream discharge at SWM1 and SWM2, in Figures 3-6 and 3-7, below. It is noted that the daily average flows shown below differ from the hourly flow measurements presented in Figure 3-5.

The plot of precipitation data with the flow data shows a strong correlation, as increased flows were often observed shortly after precipitation events. In the drier months, rainfall events did not always result in increases in discharge, which is likely attributed to higher soil infiltration and vegetative cover.

The maximum daily average flow at SWM1 in 2022 occurred on March 20, after 16 mm of precipitation occurred between March 16 and 20 and air temperatures rose above 0°C, which likely resulted in snow melt. The maximum daily average flow at SWM2 in 2022 occurred on February 22, which followed 63 mm of precipitation that fell between February 17 and 20 and air temperatures which rose above 0°C on February 22, which likely resulted in snow melt. The maximum average daily flow rates measured at SWM1 and SMW2 (1.26 and 2.64 m^3/s, respectively) are interpreted to be overestimated due to the lower accuracy of the rating curve formula at higher flows, as discussed in Section 3.2.3.

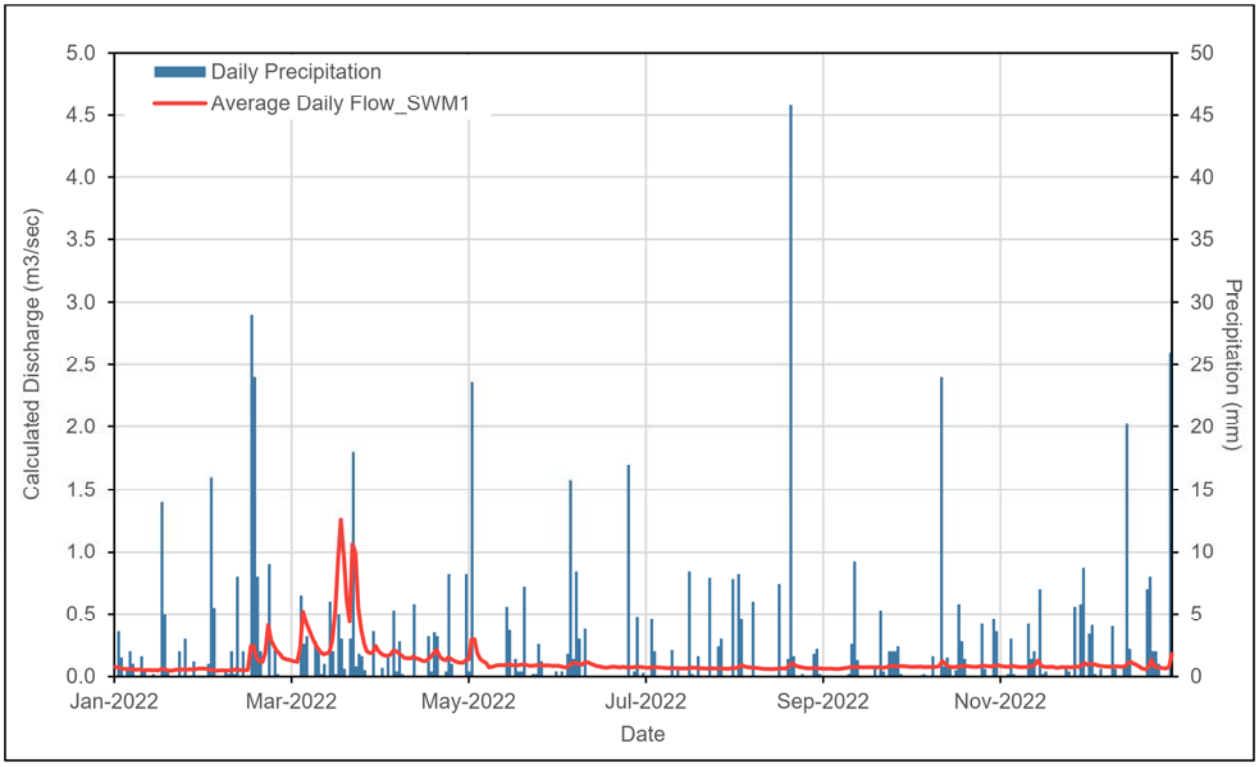


Figure 3-6: 2022 SWM1 Daily Average Flow and Daily Precipitation

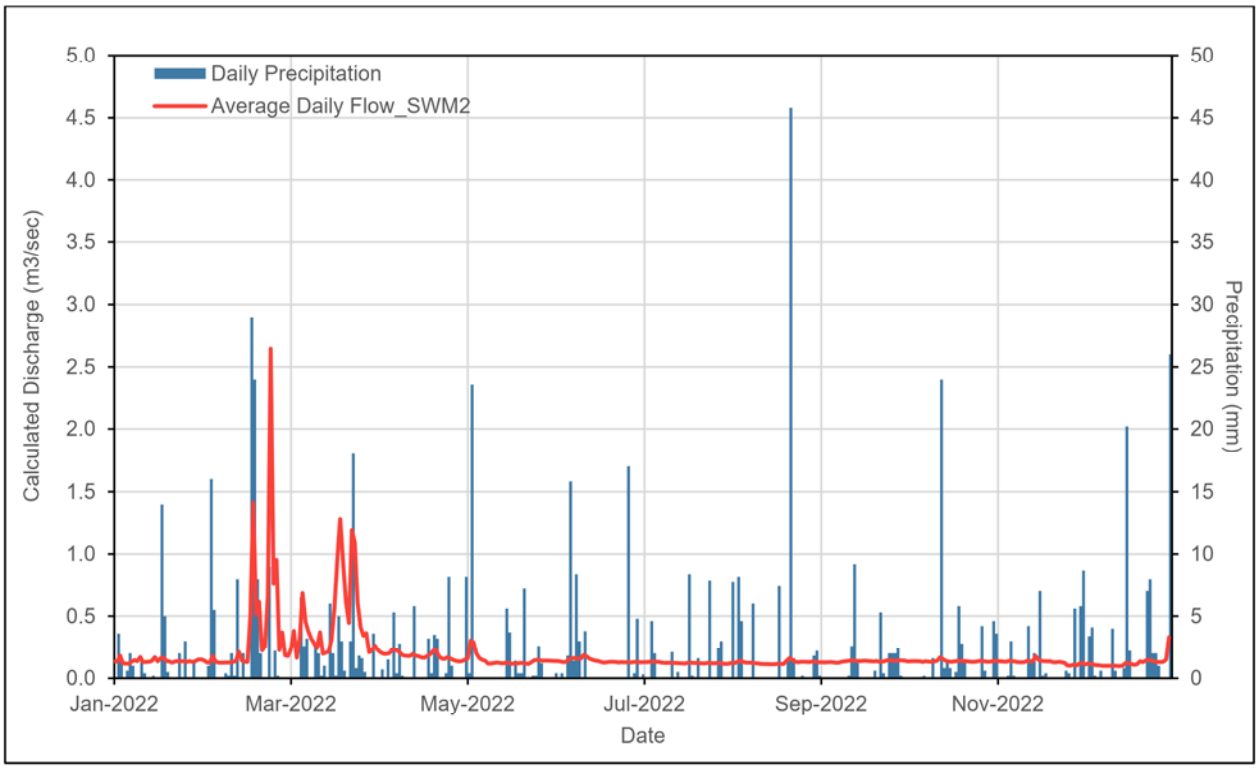


Figure 3-7: 2022 SWM2 Daily Average Flow and Daily Precipitation

3.2.5 LONG TERM FLOW

The 7-day low flow is a standard hydrological value which represents the average flow rate of the 7-day period of lowest flow for each year. The 7-day low flow at SWM2 is used to compare low flows over time for the Site. In 2022, the 7-day low flow at SWM2 was 0.098 m^3/s, which occurred from December 8 to 14. As discussed in Section 3.1.2 of this report, notably dry climatic conditions were observed during the months of April through July and September through November 2022, prior to the 7-day low flow at SWM2. In the absence of rainfall and runoff, the 7-day low flow likely represents baseflow conditions.

The SWM2 7-day low flow values since 2000 are presented in Figure 3-8, below. The 2022 7-day low flow at SWM2 is slightly lower than the 7-day low flow value from 2021 and 2007 and is the lowest value recorded since 2000. The average of the SWM2 7-day low flow values from 2000 to 2021 is 0.212 m^3/s. The 2022 7-day low flow of 0.098 m^3/s is considerably lower than the historic average. The lower 7-day low flow values recorded in 2020 and 2021 were attributed to the lower-than-normal amount of precipitation received in 2020 and the first five months of 2021. The low 7-day low flow value recorded in 2022 is attributed to the appreciably dry climatic conditions observed in 2022 and likely also reflects a cumulative impact from dry conditions in 2020 and 2021.

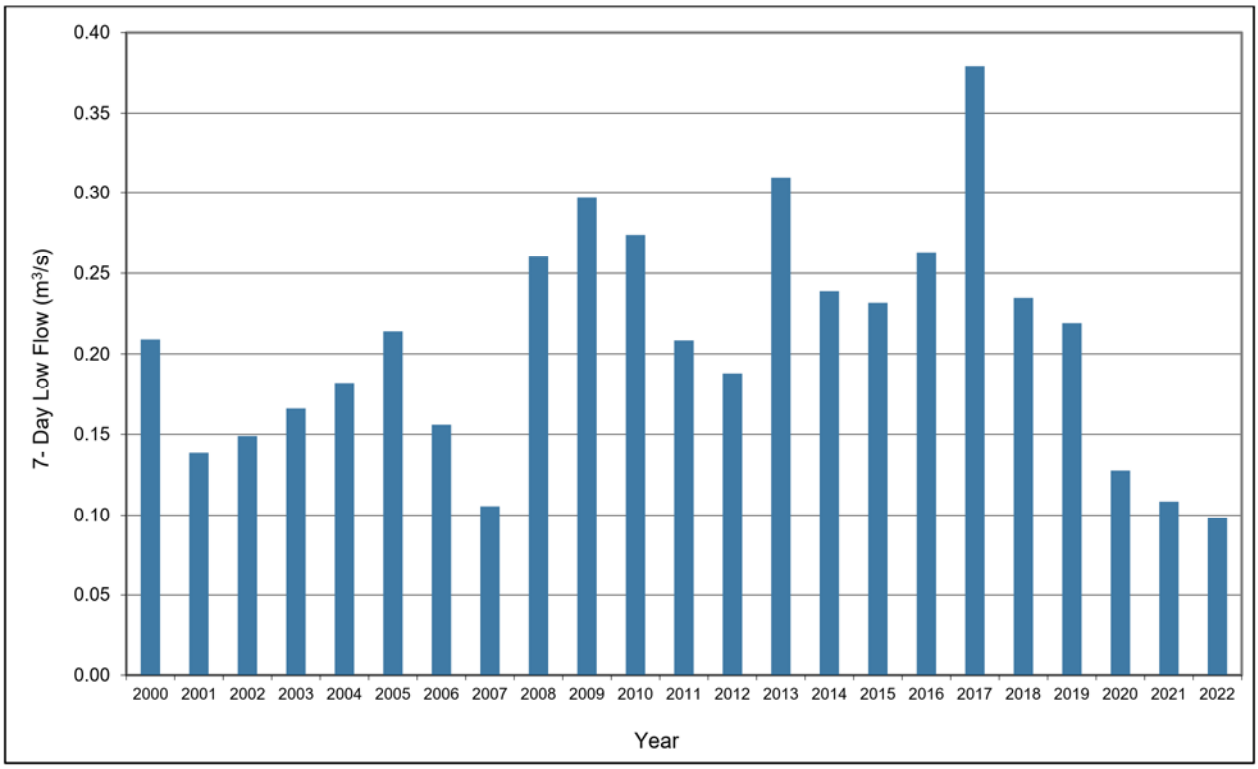


Figure 3-8: 7-Day Low Flow at SWM2 (2000-2022)

As in previous years, the 7-day low flow during the 2022 summer months (June 21 through September 22) was calculated. The summer 7-day low flow at SWM2 (0.113 m^3/s) occurred from August 12 to August 18 and was below the historic average (0.209 m^3/s). The 2022 summer 7-day low flow was higher than the full year 7-day low flow observed in December, which reflects the persistent dry climatic conditions observed between April and November 2022.

The historic summer 7-day low flow values from SWM2 are plotted with the total summer precipitation (June 21 through September 22) and average summer air temperature (mean of the daily mean temperatures from June 21 to September 22) in Figures 3-9 and 3-10, respectively.

As shown in Figure 3-9, there is an apparent relationship between total summer precipitation and summer 7-day low flow. A linear regression of the data presented in the figure (2000 to 2022) indicates that there is a positive correlation between stream flow and summer precipitation at SWM2 ($R^2 = 0.3324$).

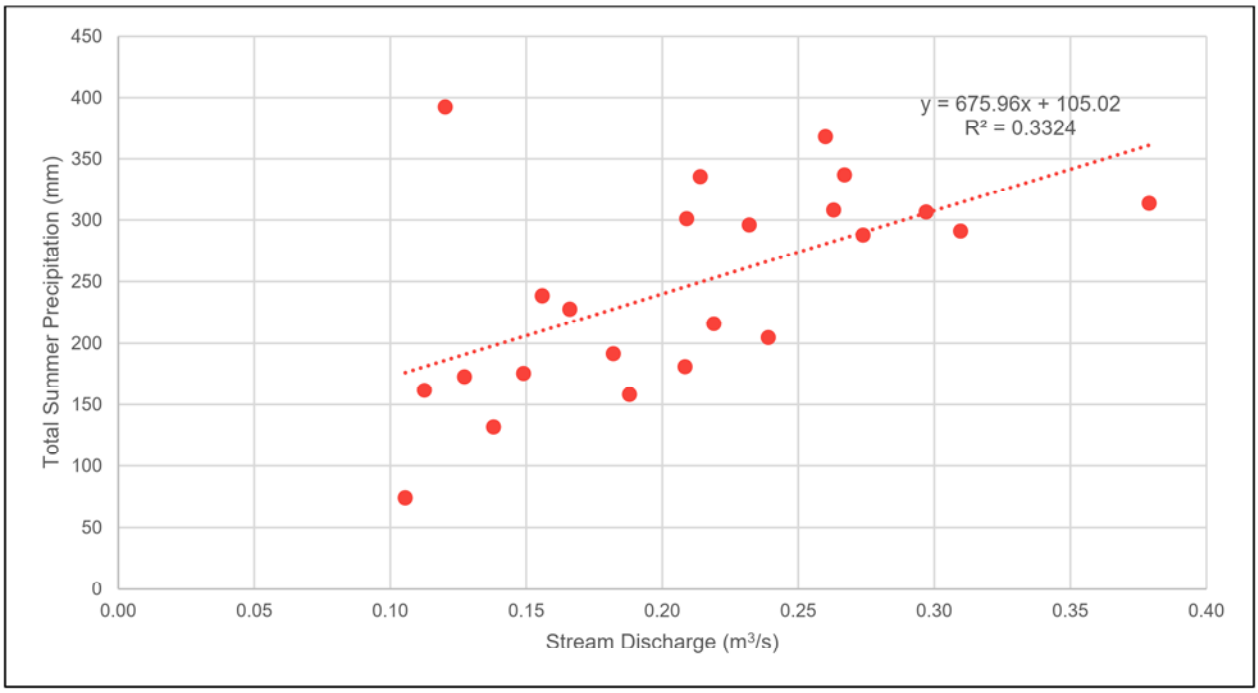


Figure 3-9: Total Summer Precipitation Versus Summer 7-Day Low Flow at SWM2 (2000-2022)

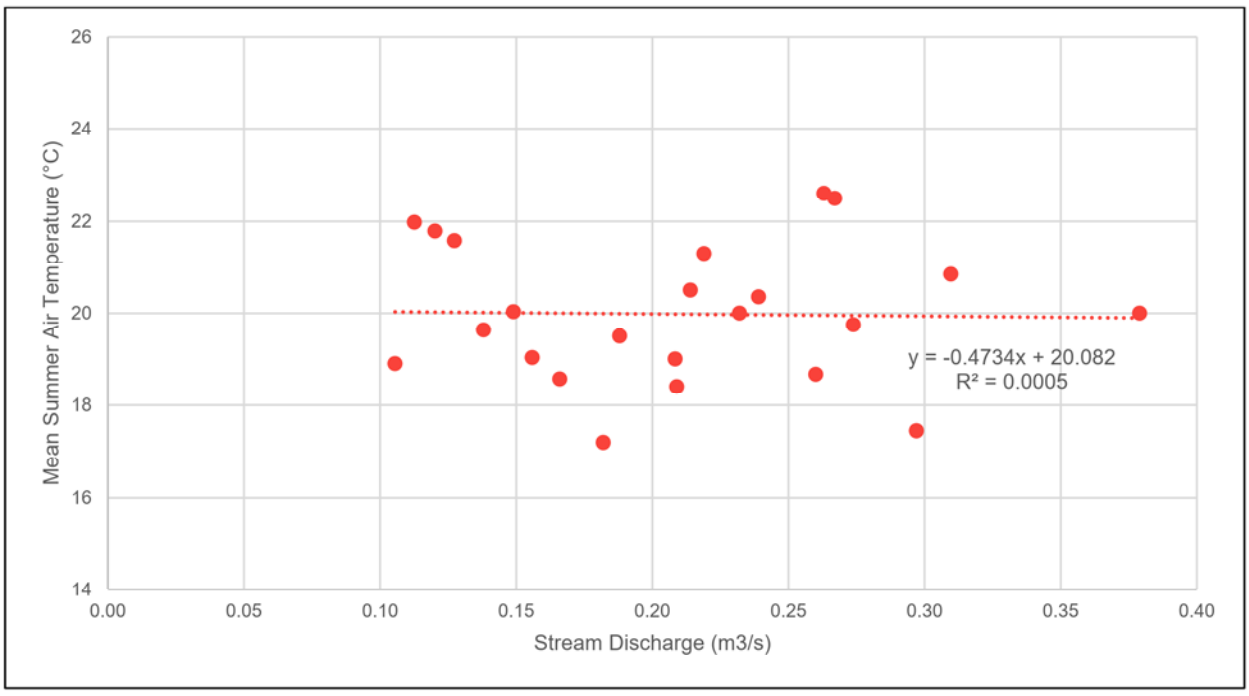


Figure 3-10: Mean Summer Air Temperature Versus Summer 7-Day Low Flow at SWM2 (2000-2022)

As shown in Figure 3-10, there is no apparent relationship between mean summer air temperature and summer 7-day low flow, which is confirmed by the linear regression of the data (R^2= 0.0005).

Regression analysis can identify potential relationships between the predictor variable (climate related variables) and the response variable (7-day low flow). Regression analysis includes calculating the P-value. A P-value of <0.05 is

indicative of a statistically significant relationship between variables. Regression plots and statistical data output for these relationships are provided in Appendix D. As shown in Appendix D, the calculated P-value for the relationship between summer stream flow and summer precipitation is 0.007, indicating a statistically significant relationship. The calculated P-value for the relationship between summer stream flow and summer temperature is 0.893, which does not indicate a statistically significant relationship. These analyses are consistent with previous observations that summer stream flow in Mill Creek is influenced by summer precipitation.

3.2.6 HISTORICAL MILL CREEK DISCHARGE TRENDS

The 2022 instantaneous minimum and maximum stream discharge values from SWM1 and SWM2 are presented in Table 3-2 in Section 3.2.3 and are presented graphically in Figures 3-11 and 3-12, respectively.

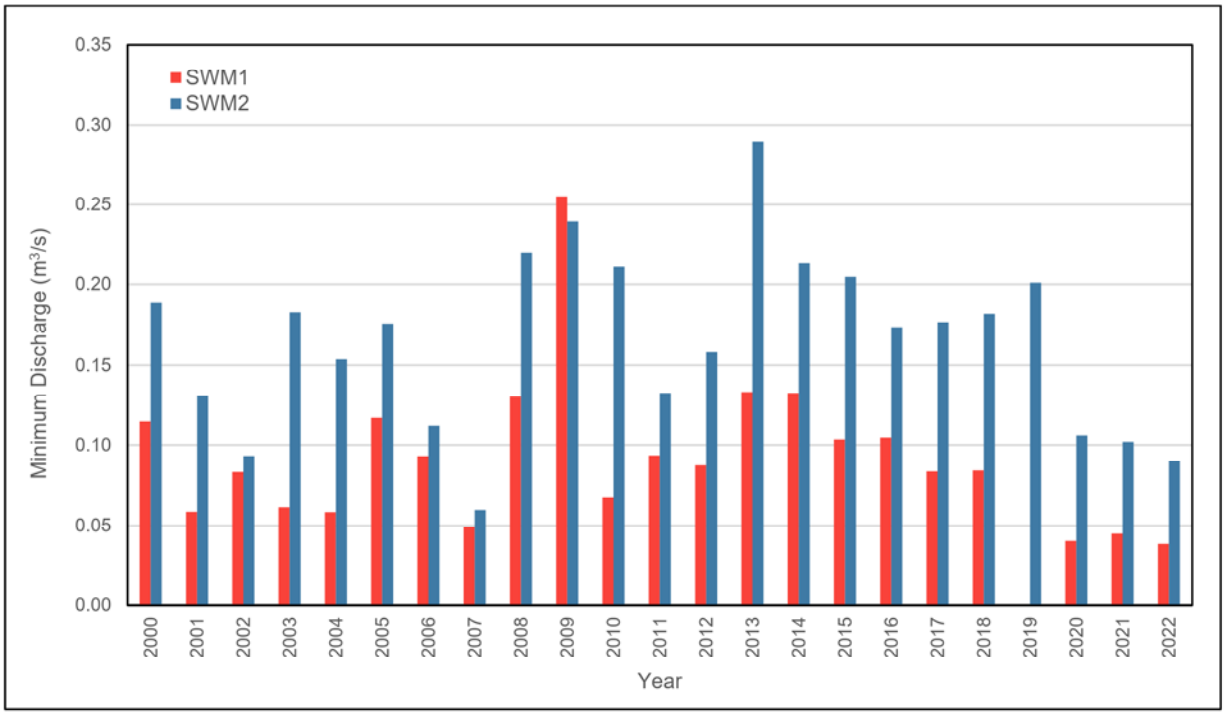


Figure 3-11: SWM1 and SWM2 Instantaneous Minimum Stream Discharge (2000-2022)

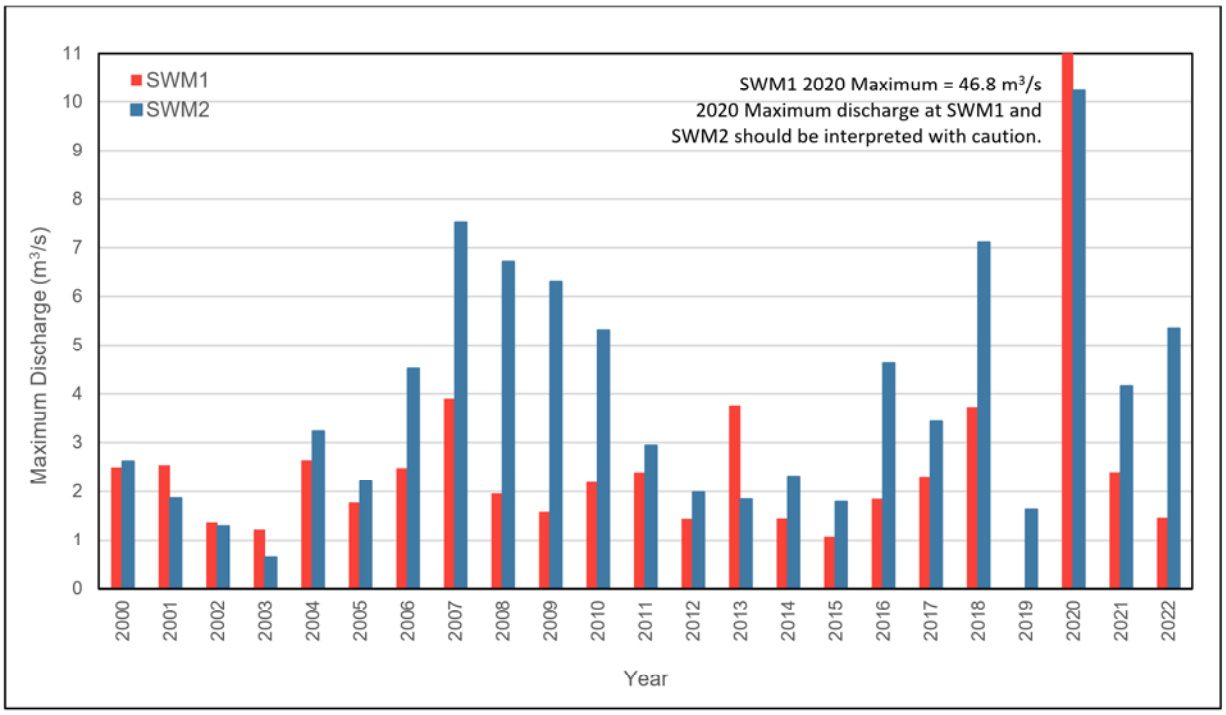


Figure 3-12: SWM1 and SWM2 Instantaneous Maximum Stream Discharge (2000-2022)

As shown in the figures, the 2022 minimum instantaneous stream discharge values at SWM1 and SWM2 are similar to the 2020 and 2021 minimum instantaneous stream discharge values. The 2022 minimum instantaneous stream discharge value at SWM1 is marginally lower than the historical range of values from SWM1, while the 2022 minimum instantaneous stream discharge value at SMW2 is within the historical range of values at SWM2, but the second lowest value recorded since 2000. The 2022 maximum instantaneous stream discharge values are within the historical range of values recorded since 2000.

A graph presenting the daily average stream discharge at SWM2 from 2003 to 2022 is provided in Figure 3-13, below.

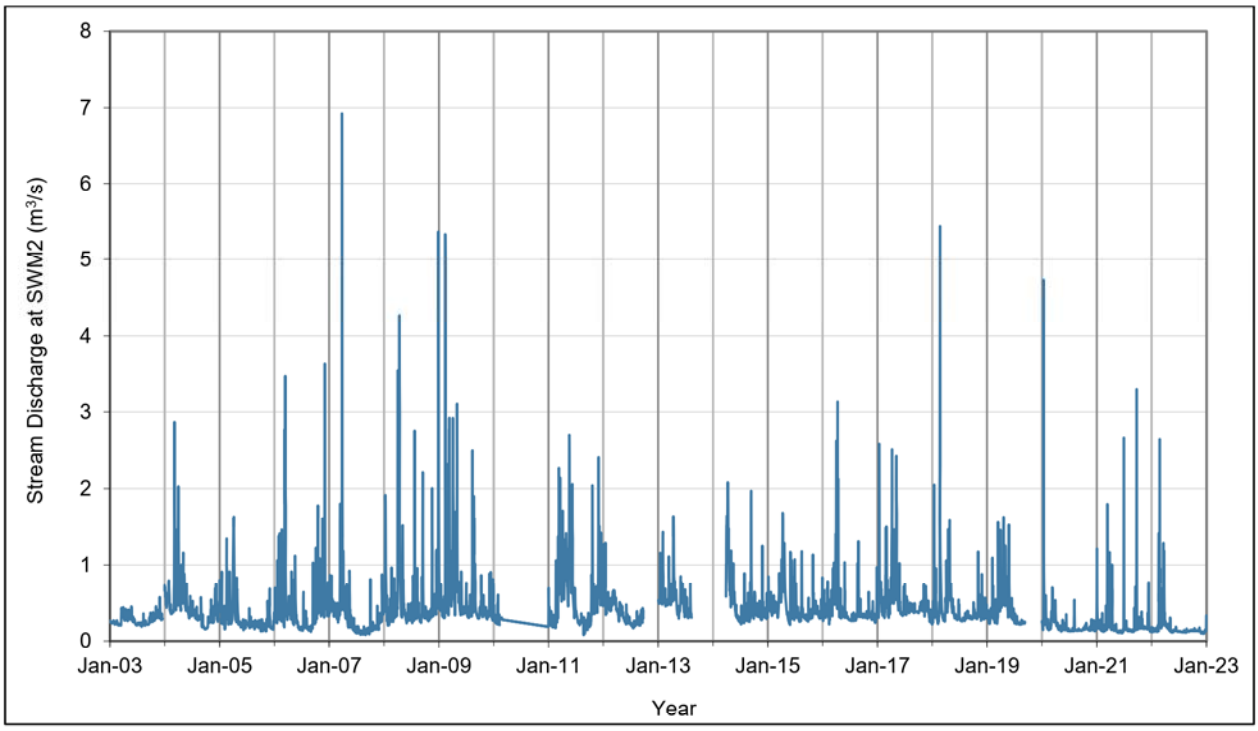


Figure 3-13: SWM2 Historical Daily Average Stream Discharge (2000-2022)

The daily average stream flow at SWM2 during the summer (June 21 to September 22) is presented in Figure 3-14 along with annual and summer precipitation data. The flow data are presented as log transformed, in a box and whisker plot (boxplot). Boxplots are useful when comparing two or more datasets and allow for the visualization of flow data between years. The data were log transformed because variability in flow is high and the data are not normally distributed. The log-transformation provides clearer data representations and facilitates interpretation.

In Figure 3-14, data within the box represent 50% of the summer daily average flows, and data outside the box represent those daily average flows in the upper and lower quartiles (maximum and minimum calculated flows). The horizontal line within the box represents the median flow for the summer months.

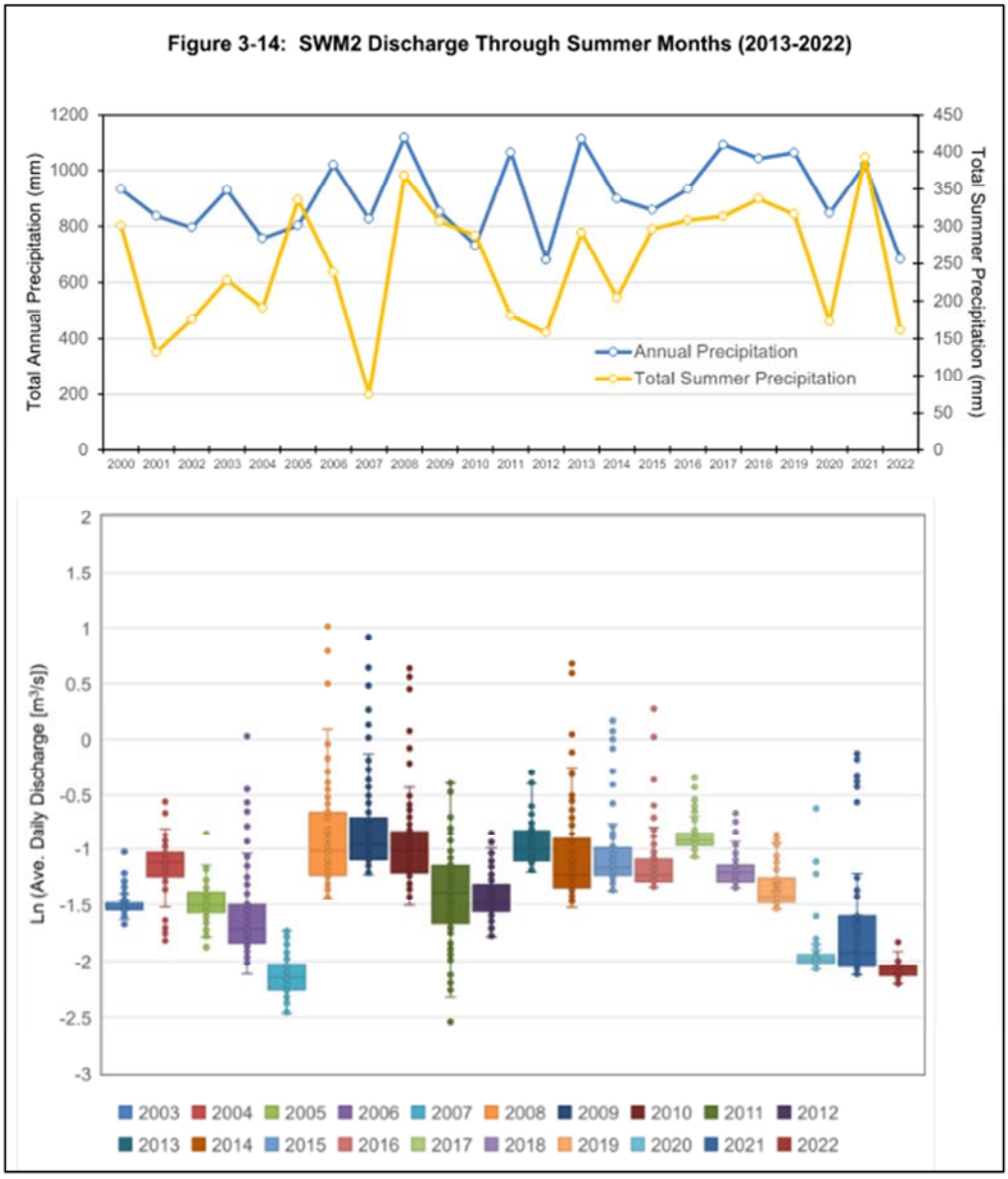


Figure 3-14: SWM2 Discharge Through Summer Months (2003-2022)

In 2022, the boxplot indicates that the daily average flow was often closer to the minimum flow recorded for the year. Figure 3-14 also shows that a long-term fluctuating trend in daily average summer flows has occurred in Mill Creek since 2003, rather than an increasing or decreasing trend. There is a general correlation between the summer precipitation and the average summer discharge at SWM2.

Based on the results of the 2022 and historical surface water monitoring program, there is no indication that aggregate extraction on the Dufferin Aggregates Mill Creek Pit Property, or the resulting ponds, are affecting stream flow in Mill Creek.

3.3 MILL CREEK TEMPERATURE MONITORING

Ongoing water temperature monitoring is important to ensure that fish habitat is not impacted by operations at the Mill Creek Pit. Fish habitat can be impacted by elevated water temperatures because higher temperatures will reduce the capacity of water to hold oxygen. These effects are further discussed in Technical Appendix C of the Mill Creek Coordinated Monitoring Report.

Table 3-3, below, presents the maximum water temperatures recorded at the four surface water monitoring stations between 2003 and 2022. As shown in the table, there is no evident increasing or decreasing trend of maximum surface water temperature over the long-term, although temperatures at SWM4 have shown an overall declining trend since 2013. The maximum temperatures recorded at SWM1, SWM2 and SWM3 in 2022 at each station are within 1 degree of the long-term average for each station. The maximum temperature recorded at SWM4 in 2022 was 3 degrees lower than the long-term average and was 1 degree lower than the maximum temperature recorded at SWM4 in 2020 and 2021. The lower temperatures recorded at SWM4 in the summer of 2020, 2021 and 2022 are attributed to lower precipitation amounts, as precipitation would tend to increase the water temperature in the groundwater-fed tributary. With the exception of the month of February 2022, the monthly precipitation amounts recorded in 2022 were similar to, or appreciably lower than, the 30-year normal amount.

Table 3-3: Maximum Recorded Surface Water Temperature (2003-2022)

MONITORING YEAR	SWM1		SWM2		SWM3		SWM4	
	TEMPERATURE (^{O}C)	DATE(S)	TEMPERATURE (^{O}C)	DATE(S)	TEMPERATURE (^{O}C)	DATE(S)	TEMPERATURE (^{O}C)	DATE(S)
2003	26	26-June	25	25-June	19	26-June	19	26-June
2004	24	20-July	23	3-Aug	17	13-May	19	4-July
2005	27	11-June	24	15-July	19	15-July	22	14-July
2006	27	1-Aug	25	1-Aug	16	15-July	19	1-Aug
2007	24	27-June 3-Aug	23	27-June	18	8-June	20	25-Aug
2008	25	9-June 17-July	23	9-June	19	8-June 24-July	19	9-June
2009	24	24-June	22	24-June	18	23-June	20	20-Aug
2010	26	8-July	24	8-July	18	23-July	20	24-July
2011	27	21-July	25	21-July	18	8-June	20	8-June
2012	25	17-July	22	6-July	17	19-June	18	21-June
2013	27	17-July	24	17-July	16	10-July	20	19-July
2014	24	30-June	22	30-June	17	10-Sept	18	10-Sept
2015	24	29-July	22	30-July	16*	15-Aug	17*	15-Aug
2016	25	13-July	23	22-July	19	25-Aug	19	25-Aug

MONITORING YEAR	SWM1		SWM2		SWM3		SWM4	
	TEMPERATURE (^{O}C)	DATE(S)	TEMPERATURE (^{O}C)	DATE(S)	TEMPERATURE (^{O}C)	DATE(S)	TEMPERATURE (^{O}C)	DATE(S)
2017	23	21-July	22	24-July	16	18-May	17	18-May
2018	26	1-July	24	1-July	14	6-Jul	17	30-June
2019	25	20-July	23	20-July	17	20-July	17	20-July
2020	26	09-July	23	09-July	16	2-Aug	16	27-July
2021	25	06-Jul	24	28-Jun	18	29-Jun	16	29-Aug
2022	24	07-Aug	23	22-Jun	17	22-Jun	15	21-Jul
Average	25		23		17		18	

* Temperature logger data displayed atypical daily variability. Temperature should be interpreted with caution (Stantec, 2019).
2003 through 2018 data obtained from 2018 Surface Water Monitoring Report (Stantec, 2019).

The 2022 hourly surface water temperature data recorded at the surface water monitoring stations are presented in Figures 3-15 and 3-16, below. These data are also presented on more detailed figures (monthly), which are provided in Appendix E.

As shown in Figure 3-15, below, the surface water at SWM1 is typically warmer than the water at SWM2 in the summer months, which is consistent with previous observations. This difference is attributed to additional surface water inputs from the two colder tributaries which enter Mill Creek between SWM1 and SWM2, groundwater input along this reach, and shade provided by dense vegetation along Mill Creek on the Site.

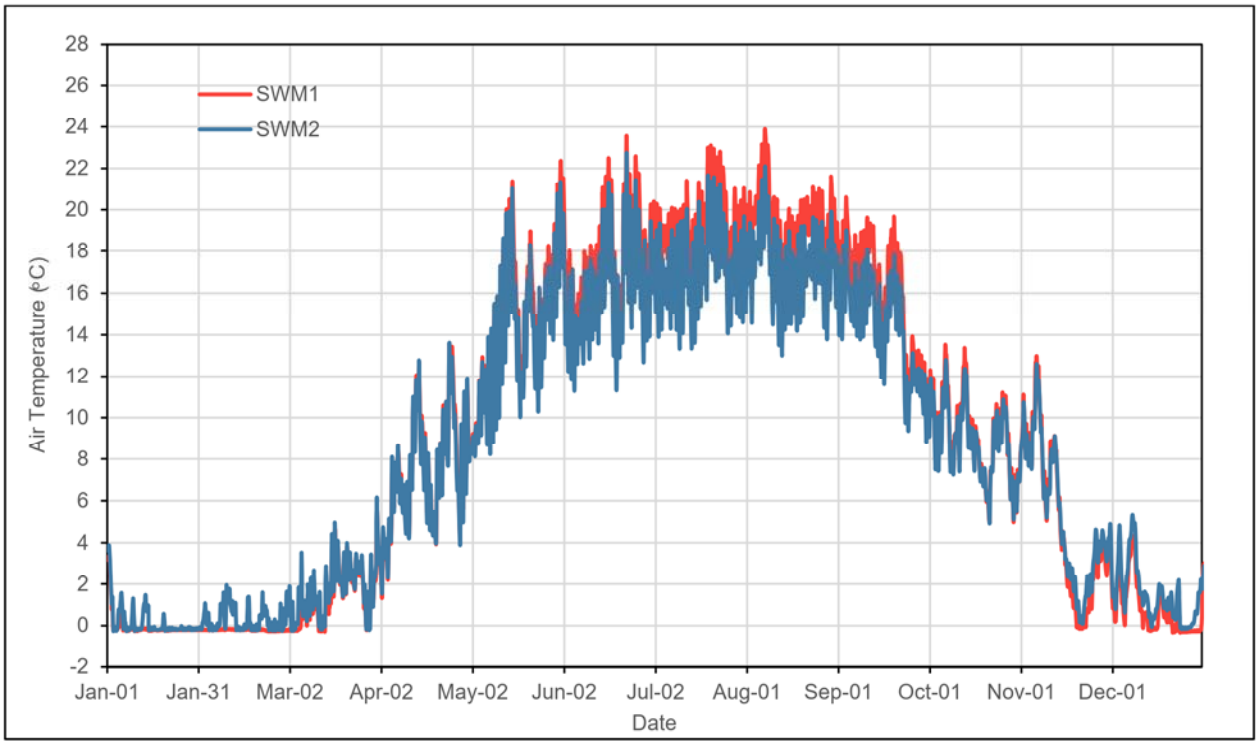


Figure 3-15: 2022 Hourly Water Temperature at SWM1 and SWM2

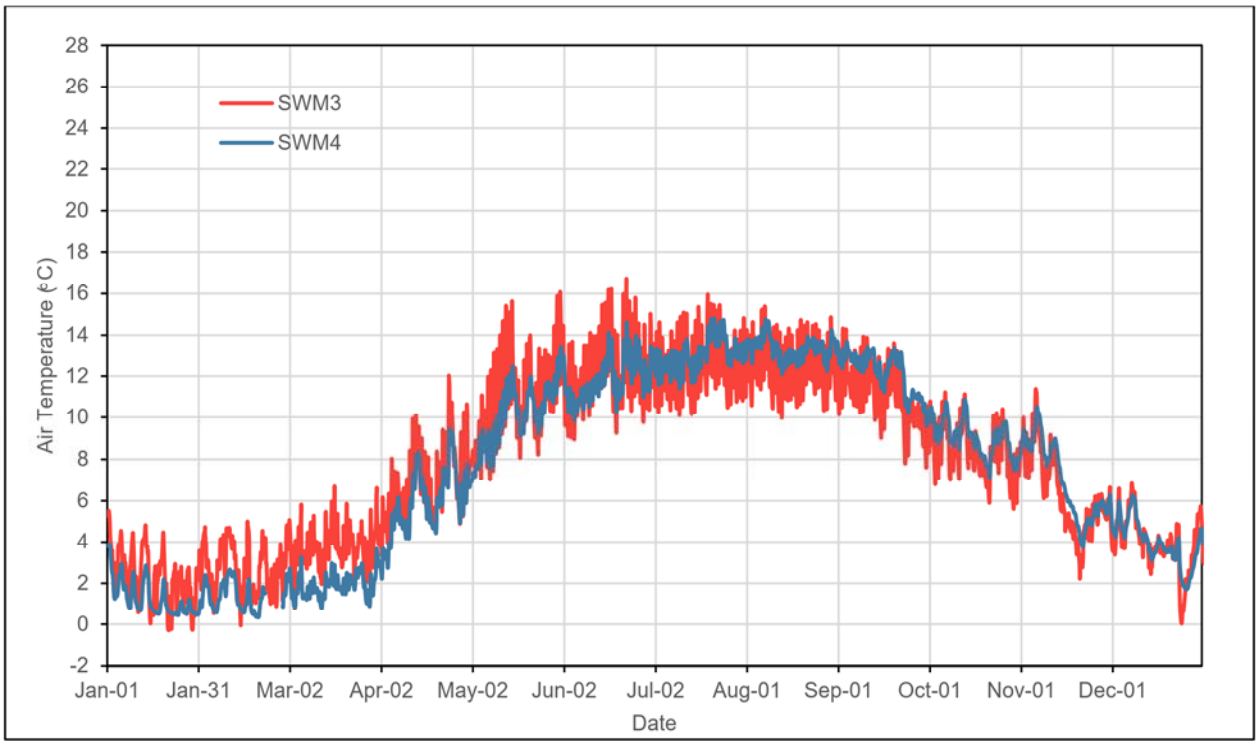


Figure 3-16: 2022 Hourly Water Temperature at SWM3 and SWM4

The water temperatures measured at SWM3 (Pond Creek) and SWM4 (Galt Creek) in 2022 (Figure 3-16) were more stable and showed less of an effect from air temperatures, compared to SWM1 and SWM2. This is consistent with historic results, where the maximum water temperatures observed at SWM3 and SWM4 are consistently lower than those observed at SWM1 and SWM2. The water temperatures recorded at SWM3 during the winter months are consistently warmer than those measured at SWM4, which is attributed to an increased groundwater influence in Pond Creek compared to Galt Creek.

Based on the 2022 monitoring data, there is no evidence that activities at the Mill Creek Pit have impacted water temperatures in Mill Creek.

The following four figures (Figures 3-17 to 3-20) present the 2022 hourly air temperature data from the on-Site barometric data logger with the hourly water temperatures at each respective surface water station.

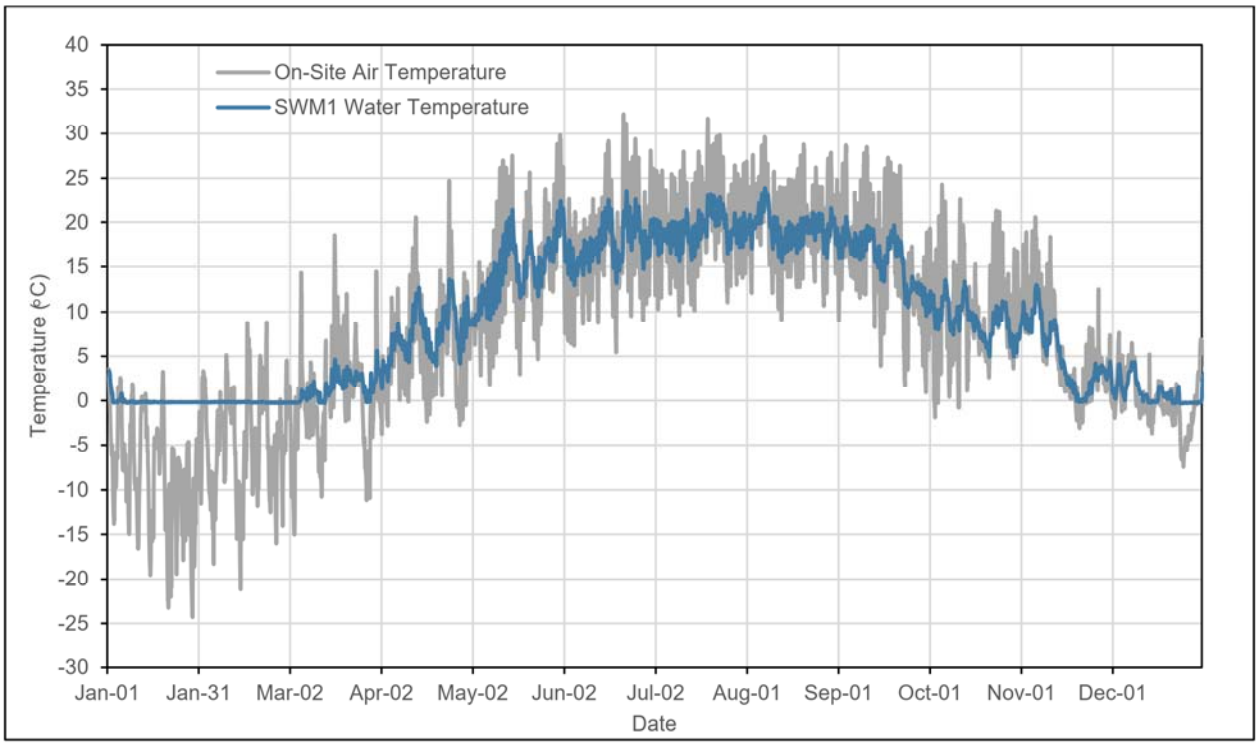


Figure 3-17: 2022 Air and Water Temperature at SWM1

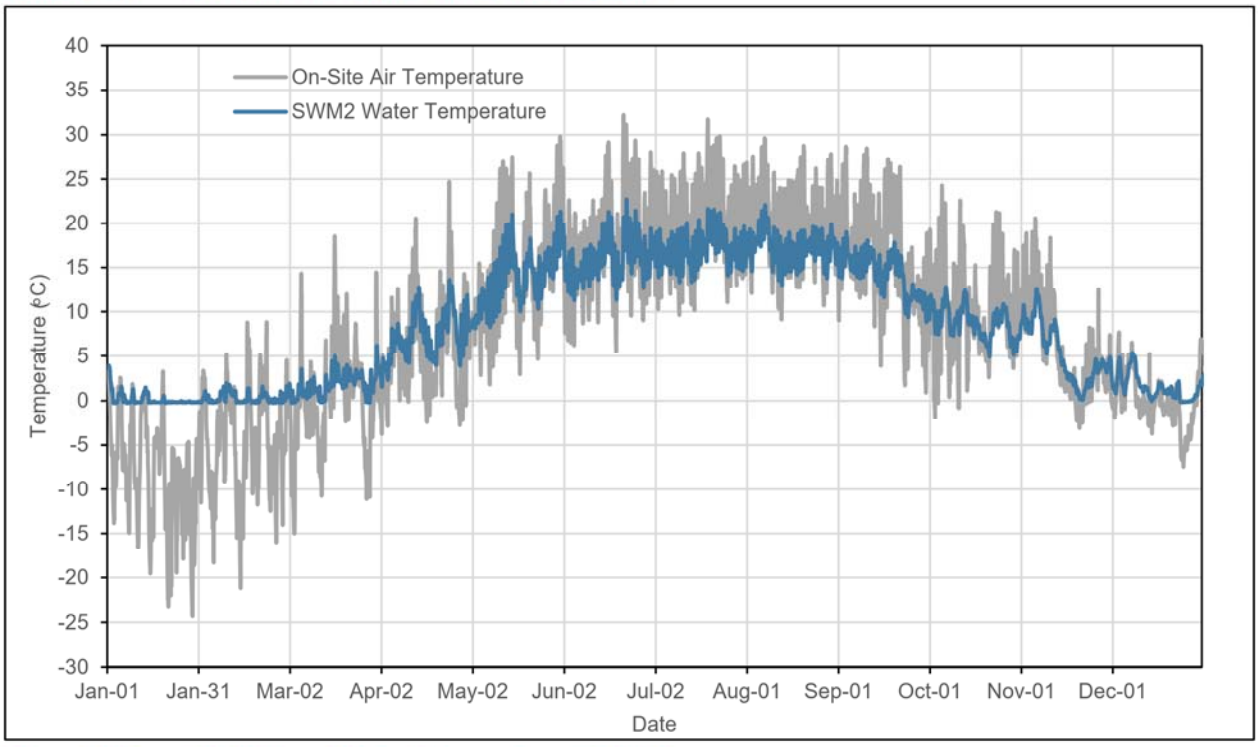


Figure 3-18: 2022 Air and Water Temperature at SWM2

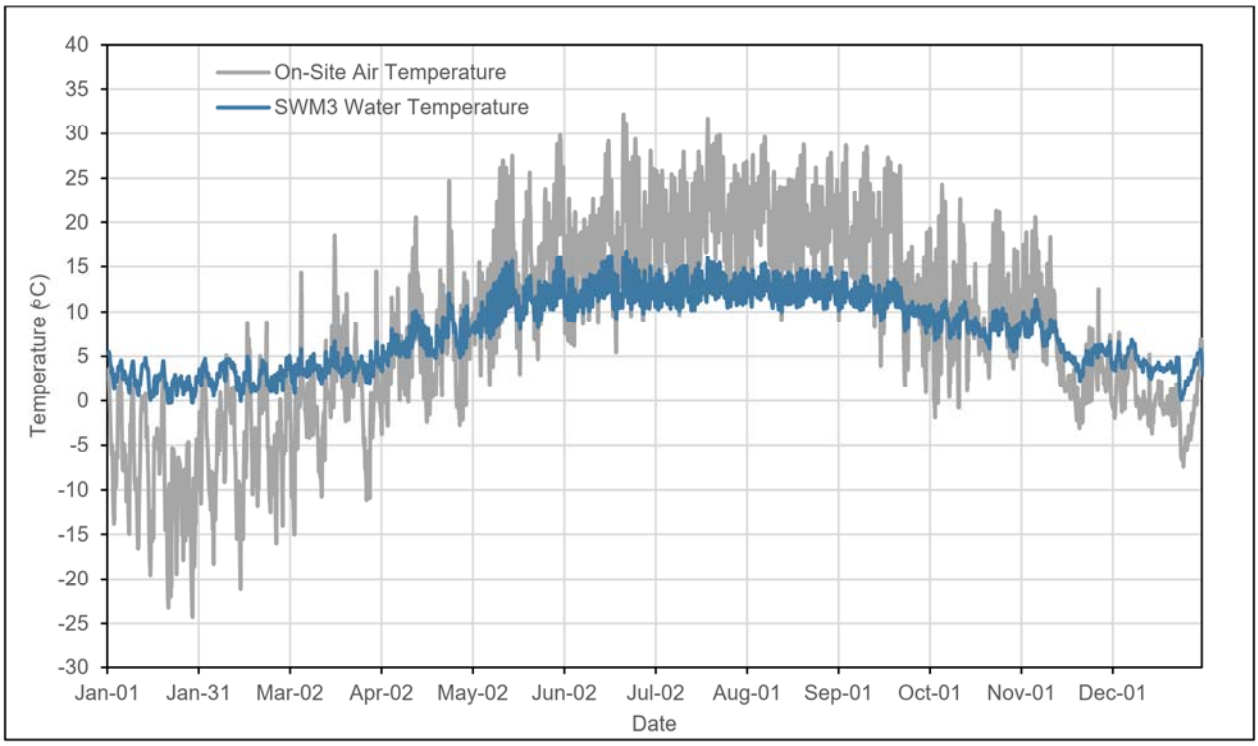


Figure 3-19: 2022 Air and Water Temperature at SWM3

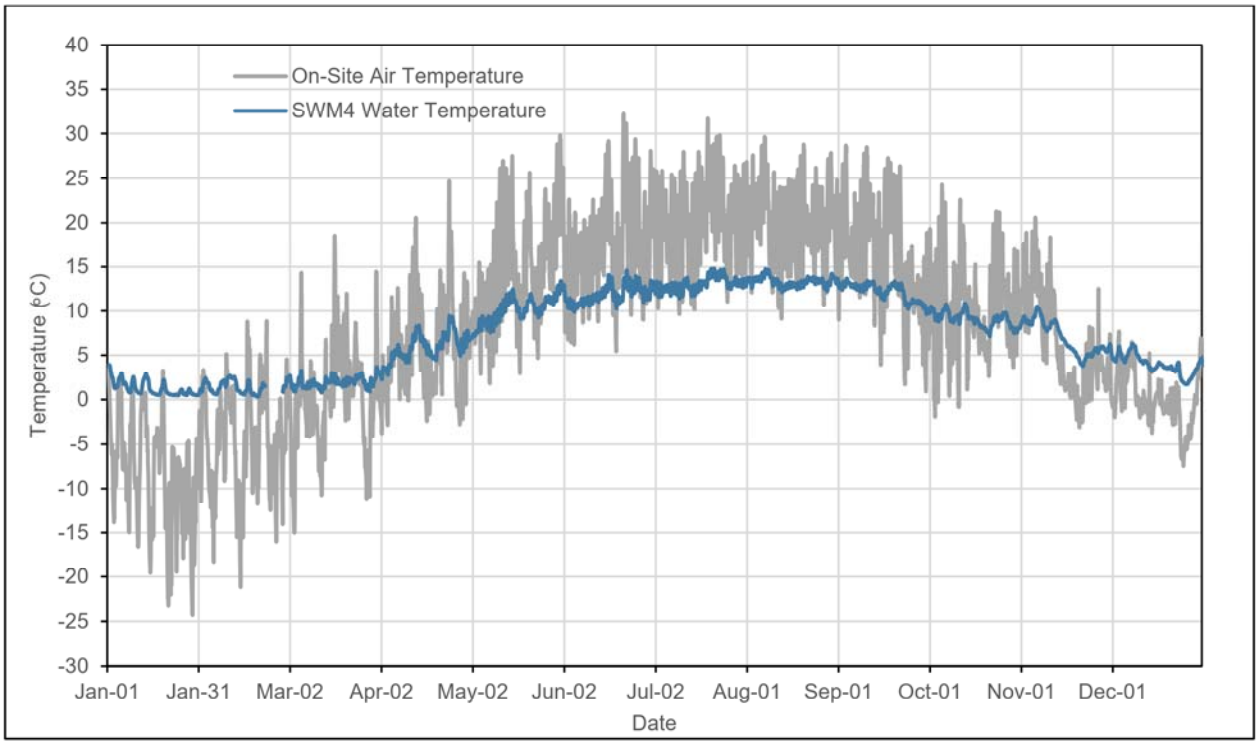


Figure 3-20: 2022 Air and Water Temperature at SWM4

The 2022 air temperature data recorded at Air Temperature Station 1 indicate that the maximum hourly temperature recorded in 2022 was 32.2ºC on June 21. The maximum temperature recorded at Air Temperature Station 2 in 2022 was 32.8ºC on June 21. The maximum temperature recorded at the GRCA Shade's Mills climate station was 36.0ºC, recorded on June 22.

4 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings presented in this report, the following conclusions are provided.

- The 2022 monitoring program was completed in accordance with the surface water monitoring program required by the monitoring conditions.
- Based on the results of the 2022 and historical surface water monitoring program, there is no indication that aggregate extraction activities on the Dufferin Aggregates Mill Creek Pit Property, or the resulting ponds, have affected stream flow or water temperatures in Mill Creek.
- Considering the extensive history of surface water monitoring data demonstrating a lack of surface water flow impacts by the pit operations, consideration should be given to reducing the surface water monitoring program.

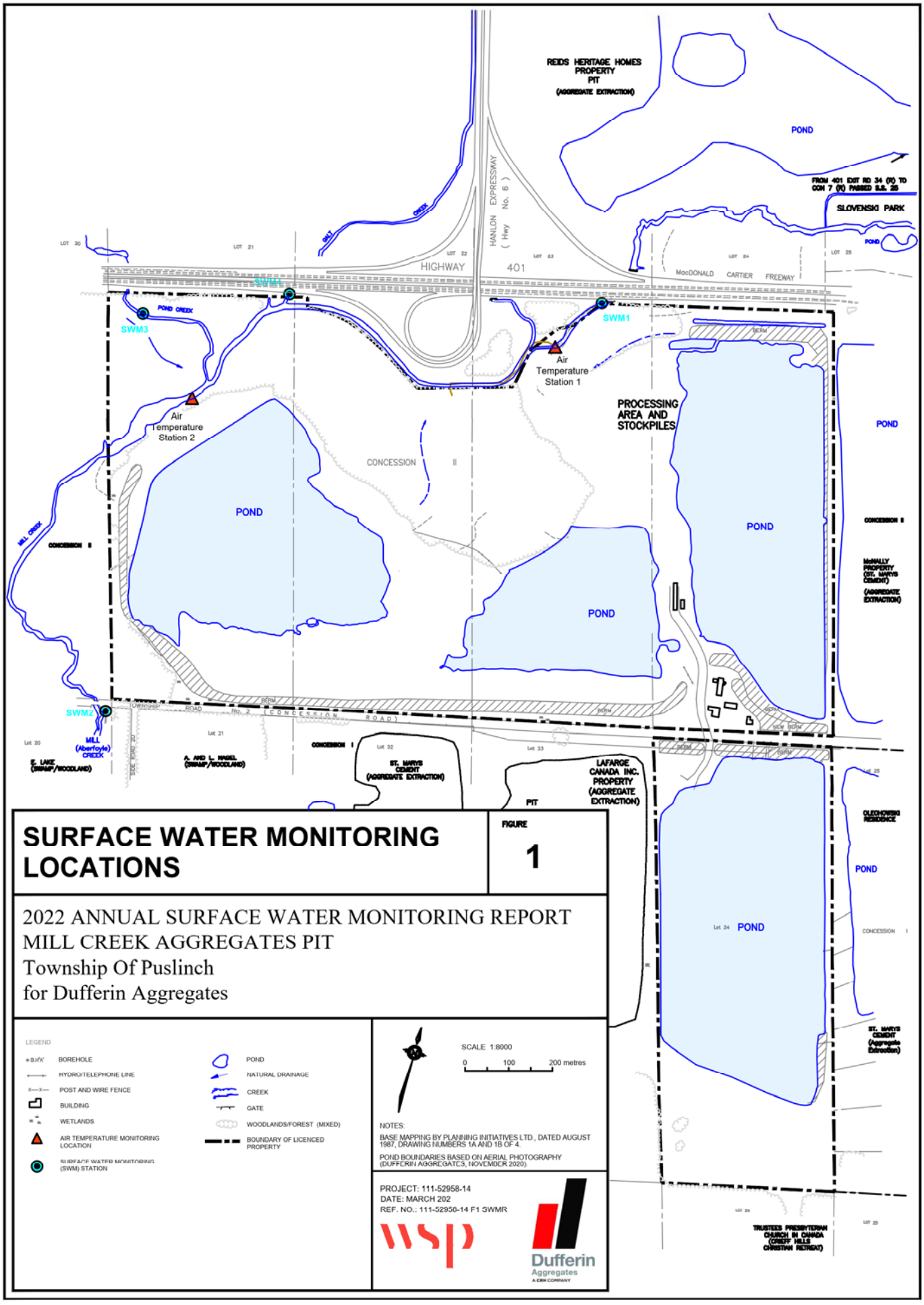
5 REFERENCES

Stantec Consulting Ltd., March 28, 2019. Technical Appendix A of the Mill Creek Coordinated Monitoring Report: 2018 Surface Water Monitoring Report. Final Report.

WSP Canada Inc., March 25, 2021. Appendix A of the 2020 Coordinated Monitoring Report: Mill Creek Aggregates Pit Surface Water. For Dufferin Aggregates, a CRH Company.

WSP Canada Inc., March 28, 2022. Appendix A of the 2021 Coordinated Monitoring Report: Mill Creek Aggregates Pit Surface Water. For Dufferin Aggregates, a Division of CRH Canada Inc.

FIGURES



SURFACE WATER MONITORING LOCATIONS

FIGURE 1

2022 ANNUAL SURFACE WATER MONITORING REPORT
MILL CREEK AGGREGATES PIT
Township Of Puslinch
for Dufferin Aggregates

LEGEND

- BH/X BOREHOLE
- HYDRO/TELEPHONE LINE
- POST AND WIRE FENCE
- BUILDING
- WETLANDS
- AIR TEMPERATURE MONITORING LOCATION
- SURFACE WATER MONITORING (SWM) STATION
- POND
- NATURAL DRAINAGE
- CREEK
- GATE
- WOODLANDS/FOREST (MIXED)
- BOUNDARY OF LICENCED PROPERTY

SCALE 1:8000
0 100 200 metres

NOTES:
BASE MAPPING BY PLANNING INITIATIVES LTD., DATED AUGUST 1987, DRAWING NUMBERS 1A AND 1B OF 4.
POND BOUNDARIES BASED ON AERIAL PHOTOGRAPHY (DUFFERIN AGGREGATES, NOVEMBER 2020).

PROJECT: 111-52958-14
DATE: MARCH 202
REF. NO.: 111-52958-14 F1 SWMR

wsp

Dufferin Aggregates
A CRH COMPANY

APPENDIX

(TECHNICAL APPENDIX A – 2022 SURFACE WATER REPORT)

A CLIMATE DATA

Table A-1: 2022 Daily Climate Data from GRCA Shade's Mills Climate Station

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Daily Temperature (°C)	Rain (mm)	Snow (cm)	Total Precipitation (mm)
01-Jan-22	7	2	4.5	0	0	0
02-Jan-22	4	-5	-0.5	0	3.6	3.6
03-Jan-22	4	-17	-6.5	0	1.5	1.5
04-Jan-22				0		0
05-Jan-22	4	-7	-1.5	0.6	0	0.6
06-Jan-22	3	-8	-2.5	2	0	2
07-Jan-22	-4	-11	-7.5	0	1	1
08-Jan-22	-8	-16	-12	0	0	0
09-Jan-22	2	-15	-6.5	0	0	0
10-Jan-22	2	-12	-5	0	1.6	1.6
11-Jan-22	-9	-17	-13	0	0.4	0.4
12-Jan-22	0	-16	-8	0	0	0
13-Jan-22	1	-2	-0.5	0	0	0
14-Jan-22	2	-5	-1.5	0.2	0	0.2
15-Jan-22	-5	-21	-13	0	0	0
16-Jan-22	-12	-21	-16.5	0	0	0
17-Jan-22	-3	-16	-9.5	0	14	14
18-Jan-22	-2	-8	-5	0	5	5
19-Jan-22	2	-8	-3	0	0.5	0.5
20-Jan-22	4	-14	-5	0	0	0
21-Jan-22	-10	-24	-17	0	0	0
22-Jan-22	-8	-24	-16	0	0	0
23-Jan-22	-5	-22	-13.5	0	2	2
24-Jan-22	-6	-21	-13.5	0	0	0
25-Jan-22	-5	-13	-9	0	3	3
26-Jan-22	-7	-18	-12.5	0	0	0
27-Jan-22	-6	-16	-11	0	0	0
28-Jan-22	-4	-15	-9.5	0	1.2	1.2
29-Jan-22	-10	-26	-18	0	0	0
30-Jan-22	-8	-25	-16.5	0	0	0
31-Jan-22	-12	-4	-8	0	0	0
01-Feb-22	0	-6	-3	0	0	0
02-Feb-22	5	-8	-1.5	1	0	1
03-Feb-22	4	-5	-0.5	8	8	16
04-Feb-22	-5	-12	-8.5	0	5.5	5.5
05-Feb-22	-8	-15	-11.5	0	0	0
06-Feb-22	-6	-15	-10.5	0	0	0
07-Feb-22	-1	-8	-4.5	0	0	0
08-Feb-22	2	-5	-1.5	0	0.4	0.4
09-Feb-22	-1	-10	-5.5	0	0.2	0.2
10-Feb-22	6	-6	0	0	2	2
11-Feb-22	1	-3	-1	0	0.2	0.2
12-Feb-22	3	-6	-1.5	6	2	8
13-Feb-22	-5	-17	-11	0	0	0
14-Feb-22	-8	-22	-15	0	2	2
15-Feb-22	-10	-22	-16	0	0	0
16-Feb-22	-2	-10	-6	0	0	0
17-Feb-22	10	-2	4	29	0	29
18-Feb-22	6	-10	-2	10	14	24
19-Feb-22	-2	-10	-6	0	8	8
20-Feb-22	-8	-10	-9	0	2	2
21-Feb-22	6	-8	-1	0	0	0
22-Feb-22	7	-2	2.5	0	0	0
23-Feb-22	10	-5	2.5	9	0	9
24-Feb-22	-4	-14	-9	0	0	0
25-Feb-22	-5	-11	-8	0	2.2	2.2
26-Feb-22	-3	-15	-9	0	0.2	0.2
27-Feb-22	-2	-14	-8	0	0	0
28-Feb-22	0	-15	-7.5	0	0	0

Table A-1: 2022 Daily Climate Data from GRCA Shade's Mills Climate Station

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Daily Temperature (°C)	Rain (mm)	Snow (cm)	Total Precipitation (mm)
01-Mar-22	-3	-15	-9	0	0	0
02-Mar-22	6	-5	0.5	0	0	0
03-Mar-22	3	-10	-3.5	0	0	0
04-Mar-22	4	-14	-5	0	0	0
05-Mar-22	1	-10	-4.5	0	0	0
06-Mar-22	12	-2	5	6.5	0	6.5
07-Mar-22	17	0	8.5	2.6	0	2.6
08-Mar-22	2	-4	-1	3.2	0	3.2
09-Mar-22	2	-5	-1.5	0	0	0
10-Mar-22	3	-4	-0.5	0	0	0
11-Mar-22	4	-3	0.5	0	2.8	2.8
12-Mar-22	0	-8	-4	0	2	2
13-Mar-22	-4	-11	-7.5	0	0.2	0.2
14-Mar-22	1	-12	-5.5	0	1	1
15-Mar-22	10	-8	1	0	0	0
16-Mar-22	0	-2	-1	3	3	6
17-Mar-22	12	-2	5	2	0	2
18-Mar-22	22	0	11	0.2	0	0.2
19-Mar-22	18	-4	7	5	0	5
20-Mar-22	11	-2	4.5	3	0	3
21-Mar-22	12	-3	4.5	0.6	0	0.6
22-Mar-22	14	-3	5.5	0	0	0
23-Mar-22	7	-1	3	3	0	3
24-Mar-22	8	0	4	18	0	18
25-Mar-22	10	2	6	0.8	0	0.8
26-Mar-22	5	2	3.5	1.8	0	1.8
27-Mar-22	5	-5	0	0.6	1	1.6
28-Mar-22	-6	-11	-8.5	0	0.5	0.5
29-Mar-22	-6	-10	-8	0	0	0
30-Mar-22	0	-5	-2.5	0		0
31-Mar-22	13	-2	5.5	3.6	0	3.6
01-Apr-22	18	0	9	0	0	0
02-Apr-22	5	-3	1	0	0	0
03-Apr-22	8	-3	2.5	0.2	0.5	0.7
04-Apr-22	4	-4	0	0	0	0
05-Apr-22	7	2	4.5	1.5		1.5
06-Apr-22	15	3	9	0	0	0
07-Apr-22	14	5	9.5	5.3	0	5.3
08-Apr-22	16	0	8	0.4	0	0.4
09-Apr-22	10	0	5	2.8	0	2.8
10-Apr-22	6	0	3	0	0.2	0.2
11-Apr-22	10	-2	4	0	0	0
12-Apr-22	10	2	6	0	0	0
13-Apr-22	20	14	17	0	0	0
14-Apr-22	24	10	17	5.8	0	5.8
15-Apr-22	14	2	8	0	0	0
16-Apr-22	14	-1	6.5	0	0	0
17-Apr-22	8	-3	2.5	0	0	0
18-Apr-22	8	-3	2.5	0	0	0
19-Apr-22	8	0	4	0	3.2	3.2
20-Apr-22	3	1	2	0.4	0	0.4
21-Apr-22	12	2	7	3.5	0	3.5
22-Apr-22	17	2	9.5	3.2	0	3.2
23-Apr-22	16	4	10	0	0	0
24-Apr-22	16	5	10.5	0	0	0
25-Apr-22	24	9	16.5	0.4	0	0.4
26-Apr-22	25	5	15	8.2	0	8.2
27-Apr-22	10	0	5	1	0	1
28-Apr-22	2	-3	-0.5	0	0	0
29-Apr-22	10	-2	4	0	0	0
30-Apr-22	16	-2	7	0	0	0

Table A-1: 2022 Daily Climate Data from GRCA Shade's Mills Climate Station

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Daily Temperature (°C)	Rain (mm)	Snow (cm)	Total Precipitation (mm)
01-May-22	16	6	11	0	0	0
02-May-22	11	5	8	8.2	0	8.2
03-May-22	13	6	9.5	0.4	0	0.4
04-May-22	14	8	11	23.6	0	23.6
05-May-22	18	3	10.5	0	0	0
06-May-22	17	8	12.5	0	0	0
07-May-22	16	6	11	0	0	0
08-May-22	17	0	8.5	0	0	0
09-May-22	15	7	11	0	0	0
10-May-22	22	6	14	0	0	0
11-May-22	26	6	16	0	0	0
12-May-22	30	10	20	0	0	0
13-May-22	30	10	20	0	0	0
14-May-22	30	13	21.5	0	0	0
15-May-22	30	15	22.5	0	0	0
16-May-22	30	12	21	5.6	0	5.6
17-May-22	19	6	12.5	3.7	0	3.7
18-May-22	17	5	11	0	0	0
19-May-22	17	9	13	1.4	0	1.4
20-May-22	23	10	16.5	0.4	0	0.4
21-May-22	28	15	21.5	0.4	0	0.4
22-May-22	29	14	21.5	7.2	0	7.2
23-May-22	19	5	12	0	0	0
24-May-22	16	5	10.5	0	0	0
25-May-22	20	8	14	0.2	0	0.2
26-May-22	21	13	17	0.2	0	0.2
27-May-22	28	17	22.5	2.6	0	2.6
28-May-22	26	12	19	1.2	0	1.2
29-May-22	22	12	17	0	0	0
30-May-22	28	15	21.5	0	0	0
31-May-22	32	18	25	0	0	0
01-Jun-22	34	20	27	0	0	0
02-Jun-22	29	10	19.5	0.4	0	0.4
03-Jun-22	22	8	15	0	0	0
04-Jun-22	26	7	16.5	0.4	0	0.4
05-Jun-22	22	7	14.5	0	0	0
06-Jun-22	26	12	19	1.8	0	1.8
07-Jun-22	23	14	18.5	15.8	0	15.8
08-Jun-22	22	10	16	1.4	0	1.4
09-Jun-22	24	13	18.5	8.4	0	8.4
10-Jun-22	23	11	17	3	0	3
11-Jun-22	24	11	17.5	0	0	0
12-Jun-22	24	13	18.5	3.8	0	3.8
13-Jun-22	25	10	17.5	0	0	0
14-Jun-22	27	10	18.5	0	0	0
15-Jun-22	28	15	21.5	0	0	0
16-Jun-22	34	20	27	0	0	0
17-Jun-22	33	19	26	0	0	0
18-Jun-22	28	10	19	0	0	0
19-Jun-22	21	8	14.5	0	0	0
20-Jun-22	24	13	18.5	0	0	0
21-Jun-22	24	13	18.5	0	0	0
22-Jun-22	36	23	29.5	0	0	0
23-Jun-22	34	13	23.5	0	0	0
24-Jun-22	30	11	20.5	0	0	0
25-Jun-22	32	16	24	0	0	0
26-Jun-22	34	16	25	0	0	0
27-Jun-22	31	14	22.5	17	0	17
28-Jun-22	21	10	15.5	0	0	0
29-Jun-22	27	12	19.5	0.4	0	0.4
30-Jun-22	25	12	18.5	4.8	0	4.8

Table A-1: 2022 Daily Climate Data from GRCA Shade's Mills Climate Station

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Daily Temperature (°C)	Rain (mm)	Snow (cm)	Total Precipitation (mm)
01-Jul-22	31	19	25	0	0	0
02-Jul-22	31	13	22	0.3	0	0.3
03-Jul-22	29	13	21	0	0	0
04-Jul-22	28	13	20.5	0	0	0
05-Jul-22	32	19	25.5	4.6	0	4.6
06-Jul-22	28	13	20.5	2	0	2
07-Jul-22	25	13	19	0	0	0
08-Jul-22	29	16	22.5	0	0	0
09-Jul-22	29	13	21	0	0	0
10-Jul-22	27	11	19	0	0	0
11-Jul-22	30	12	21	0	0	0
12-Jul-22	32	19	25.5	2.1	0	2.1
13-Jul-22	28	15	21.5	0	0	0
14-Jul-22	24	13	18.5	0.5	0	0.5
15-Jul-22	28	15	21.5	0	0	0
16-Jul-22	30	15	22.5	0	0	0
17-Jul-22	32	16	24	0	0	0
18-Jul-22	31	19	25	8.4	0	8.4
19-Jul-22	30	21	25.5	0.2	0	0.2
20-Jul-22	35	22	28.5	0	0	0
21-Jul-22	33	19	26	1.6	0	1.6
22-Jul-22	32	23	27.5	0	0	0
23-Jul-22	32	21	26.5	0	0	0
24-Jul-22	32	19	25.5	0	0	0
25-Jul-22	31	18	24.5	7.9	0	7.9
26-Jul-22	24	12	18	0	0	0
27-Jul-22	28	14	21	0	0	0
28-Jul-22	29	12	20.5	2.4	0	2.4
29-Jul-22	30	14	22	3	0	3
30-Jul-22	29	16	22.5	0	0	0
31-Jul-22	28	15	21.5	0	0	0
01-Aug-22	32	16	24	0	0	0
02-Aug-22	30	18	24	7.8	0	7.8
03-Aug-22	28	13	20.5	0	0	0
04-Aug-22	32	19	25.5	8.2	0	8.2
05-Aug-22	28	20	24	4.6	0	4.6
06-Aug-22	31	18	24.5	0	0	0
07-Aug-22	32	11	21.5	0	0	0
08-Aug-22	34	22	28	0	0	0
09-Aug-22	30	16	23	6	0	6
10-Aug-22	25	13	19	0	0	0
11-Aug-22	29	16	22.5	0	0	0
12-Aug-22	27	11	19	0	0	0
13-Aug-22	27	10	18.5	0	0	0
14-Aug-22	27	15	21	0	0	0
15-Aug-22	28	15	21.5	0	0	0
16-Aug-22	30	14	22	0	0	0
17-Aug-22	30	16	23	0	0	0
18-Aug-22	29	14	21.5	7.4	0	7.4
19-Aug-22	29	13	21	0	0	0
20-Aug-22	32	14	23	0	0	0
21-Aug-22	32	22	27	1.4	0	1.4
22-Aug-22	25	18	21.5	45.8	0	45.8
23-Aug-22	27	17	22	1.6	0	1.6
24-Aug-22	30	14	22	0	0	0
25-Aug-22	30	17	23.5	0	0	0
26-Aug-22	28	19	23.5	0.2	0	0.2
27-Aug-22	28	11	19.5	0	0	0
28-Aug-22	26	12	19	0	0	0
29-Aug-22	31	22	26.5	0	0	0
30-Aug-22	31	19	25	1.8	0	1.8
31-Aug-22	27	15	21	2.2	0	2.2

Table A-1: 2022 Daily Climate Data from GRCA Shade's Mills Climate Station

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Daily Temperature (°C)	Rain (mm)	Snow (cm)	Total Precipitation (mm)
01-Sep-22	27	10	18.5	0.2	0	0.2
02-Sep-22	26	13	19.5	0	0	0
03-Sep-22	30	17	23.5	0	0	0
04-Sep-22	33	22	27.5	0	0	0
05-Sep-22	19.5	15	17.25	0	0	0
06-Sep-22	22	14	18	0	0	0
07-Sep-22	26	13	19.5	0	0	0
08-Sep-22	27	12	19.5	0	0	0
09-Sep-22	29	11	20	0	0	0
10-Sep-22	30	15	22.5	0	0	0
11-Sep-22	31	17	24	0.2	0	0.2
12-Sep-22	26	21	23.5	2.6	0	2.6
13-Sep-22	24	10	17	9.2	0	9.2
14-Sep-22	23	12	17.5	1.3	0	1.3
15-Sep-22	25	6	15.5	0	0	0
16-Sep-22	22	10	16	0	0	0
17-Sep-22	28	8	18	0	0	0
18-Sep-22	30	16	23	0	0	0
19-Sep-22	28	20	24	0	0	0
20-Sep-22	28	14	21	0.6	0	0.6
21-Sep-22	28	14	21	0	0	0
22-Sep-22	28	12	20	5.3	0	5.3
23-Sep-22	17	3	10	0.4	0	0.4
24-Sep-22	18	5	11.5	0	0	0
25-Sep-22	19	7	13	2	0	2
26-Sep-22	20	10	15	2	0	2
27-Sep-22	14	9	11.5	2	0	2
28-Sep-22	15	10	12.5	2.4	0	2.4
29-Sep-22	16	6	11	0.2	0	0.2
30-Sep-22	18	3	10.5	0	0	0
01-Oct-22	20	4	12	0	0	0
02-Oct-22	20	12	16	0	0	0
03-Oct-22	17	0	8.5	0	0	0
04-Oct-22	19	2	10.5	0	0	0
05-Oct-22	22	3	12.5	0	0	0
06-Oct-22	27	8	17.5	0.1	0	0.1
07-Oct-22	24	7	15.5	0.2	0	0.2
08-Oct-22	11	1	6	0	0	0
09-Oct-22	12	1	6.5	0	0	0
10-Oct-22	17	6	11.5	1.6	0	1.6
11-Oct-22	17	2	9.5	0	0	0
12-Oct-22	25	5	15	0	0	0
13-Oct-22	20	10	15	24	0	24
14-Oct-22	14	3	8.5	0.8	0	0.8
15-Oct-22	15	4	9.5	1.5	0	1.5
16-Oct-22	11	4	7.5	0.8	0	0.8
17-Oct-22	16	6	11	0	0	0
18-Oct-22	8	3	5.5	0.5	0	0.5
19-Oct-22	6	3	4.5	5.8	0	5.8
20-Oct-22	9	2	5.5	2.8	0	2.8
21-Oct-22	6	-2	2	1.4	0	1.4
22-Oct-22	18	1	9.5	0	0	0
23-Oct-22	23	6	14.5	0	0	0
24-Oct-22	23	2	12.5	0	0	0
25-Oct-22	22	4	13	0	0	0
26-Oct-22	23	6	14.5	0	0	0
27-Oct-22	16	1	8.5	4.2	0	4.2
28-Oct-22	11	1	6	0.6	0	0.6
29-Oct-22	11	-2	4.5	0	0	0
30-Oct-22	18	-2	8	0	0	0
31-Oct-22	18	0	9	4.6	0	4.6

Table A-1: 2022 Daily Climate Data from GRCA Shade's Mills Climate Station

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Daily Temperature (°C)	Rain (mm)	Snow (cm)	Total Precipitation (mm)
01-Nov-22	15	7	11	3.6	0	3.6
02-Nov-22	17	4	10.5	0	0	0
03-Nov-22	20	2	11	0	0	0
04-Nov-22	16	4	10	0	0	0
05-Nov-22	21	13	17	0.2	0	0.2
06-Nov-22	26	11	18.5	3	0	3
07-Nov-22	18	8	13	0.2	0	0.2
08-Nov-22	12	-2	5	0	0	0
09-Nov-22	11	-1	5	0	0	0
10-Nov-22	18	3	10.5	0	0	0
11-Nov-22	14	7	10.5	0	0	0
12-Nov-22	14	5	9.5	4.2	0	4.2
13-Nov-22	6	0	3	1.4	0	1.4
14-Nov-22	2	-2	0	2	0	2
15-Nov-22	2	-0.5	0.75	0	0	0
16-Nov-22	1	-2	-0.5	0	7	7
17-Nov-22	1	-3	-1	0	0.2	0.2
18-Nov-22	2	-3	-0.5	0	0.4	0.4
19-Nov-22	-0.5	-6	-3.25	0		0
20-Nov-22	-2	-7	-4.5	0		0
21-Nov-22	-3	-8	-5.5	0	0	0
22-Nov-22	6	-5	0.5	0	0	0
23-Nov-22	8	-4	2	0	0	0
24-Nov-22	7	-2.5	2.25	0		0
25-Nov-22	10	-1	4.5	0.6		0.6
26-Nov-22	7	-2	2.5	0.4	0	0.4
27-Nov-22	14	1	7.5	0	0	0
28-Nov-22	6	1	3.5	5.6	0	5.6
29-Nov-22	2	0	1	0	0	0
30-Nov-22	10	1	5.5	5.8	0	5.8
01-Dec-22	10	-4	3	7.7	1	8.7
02-Dec-22	0	-7	-3.5	0	0	0
03-Dec-22	10	0	5	3.4	0	3.4
04-Dec-22	10	-6	2	4.1	0	4.1
05-Dec-22	6	-2	2	0.2	0	0.2
06-Dec-22	6	-2	2	0	0	0
07-Dec-22	6	4	5	0.6	0	0.6
08-Dec-22	8	3	5.5	0	0	0
09-Dec-22	4	-4	0	0	0	0
10-Dec-22	0	-3	-1.5	0	0	0
11-Dec-22	0	-3	-1.5	0	4	4
12-Dec-22	1	-3	-1	0	0.6	0.6
13-Dec-22	2	-9	-3.5	0	0	0
14-Dec-22	1	-9	-4	0	0	0
15-Dec-22	0	-6	-3	0.8	0	0.8
16-Dec-22	1	-1	0	19.2	1	20.2
17-Dec-22	3	-3	0	1.6	0.6	2.2
18-Dec-22	0	-4	-2	0	0	0
19-Dec-22	0	-4	-2	0	0	0
20-Dec-22	-1.5	-3.4	-2.45	0	0	0
21-Dec-22	0	-5	-2.5	0	0	0
22-Dec-22	0	-4	-2	0	0	0
23-Dec-22	0	-1	-0.5	6	1	7
24-Dec-22	0	-16	-8	0	8	8
25-Dec-22	-6	-15	-10.5	0	2	2
26-Dec-22	-8	-10	-9	0	2	2
27-Dec-22	-6	-9	-7.5	0	1	1
28-Dec-22	0	-7	-3.5	0	0	0
29-Dec-22	5	-3	1	0	0	0
30-Dec-22	12	4	8	0	0	0
31-Dec-22	12	8	10	26	0	26

Table A-2: Mean Monthly Air Temperature at GRCA Shade's Mills Climate Station (2000-2022)

Year	Mean Monthly Air Temperature (°C)												Annual Average (°C)
	January	February	March	April	May	June	July	August	September	October	November	December	
2000	-7	-4	4	6	14	18	19	18	14	10	2	-9	7
2001	-5	-4	-2	7	13	19	19	21	15	9	6	0	8
2002	-2	-3	0	6	10	18	22	20	18	7	2	-4	8
2003	-10	-9	-3	5	11	17	19	20	15	7	4	-2	6
2004	-10	-6	1	6	12	16	19	17	16	9	4	-5	6
2005	-8	-6	-4	6	10	21	21	20	16	10	4	-5	5
2006	-1	-5	0	7	13	18	21	18	14	7	4	0	8
2007	-5	-10	-1	5	13	19	19	19	16	12	1	-4	7
2008	-4	-7	-4	8	10	18	20	18	15	8	1	-4	8
2009	-11	-5	0	7	12	16	17	19	15	7	5	-4	7
2010	-6	-5	3	9	14	18	21	20	14	9	3	-5	8
2011	-10.2	-7.8	-3.6	5.5	12.6	16.6	21.4	19.0	15.0	8.9	4.8	-1.3	7.5
2012	-3.9	-2.5	5.5	5.0	14.8	18.3	21.7	18.5	13.8	8.6	1.6	-0.7	8.4
2013	-3.5	-6.9	-1.3	5.4	15.4	19.3	22.6	20.7	16.5	10.8	2.0	-4.1	8.1
2014	-9.5	-9.8	-5.9	6.2	14.3	20.7	20.4	20.0	16.5	10.3	1.0	-0.4	7.0
2015	-9	-14	-3	7	17	18	22	20	20	10	6	4	8
2016	-4.5	-3.0	2.4	4.7	14.9	19.7	23.4	23.8	19.1	11.8	6.3	-2.0	9.7
2017	-2.2	-0.3	-0.3	9.2	12.5	19.5	21.6	20.4	18.8	13.1	3.1	-4.9	9.2
2018	-6.9	-2.5	-0.3	3.0	17.9	19.7	23.4	23.3	19.4	9.5	1.6	0.4	9.0
2019	-6.7	-4.8	-1.5	5.9	12.8	18.8	23.7	21.3	17.8	10.6	0.9	-0.9	8.2
2020	-1.4	-3.6	2.4	5.8	12.7	20.5	25.0	22.2	16.1	9.3	6.4	-0.6	9.6
2021	-2.7	-6.1	3.4	8.9	14.1	22.1	21.3	23.8	17.5	13.9	3.6	0.9	10.1
2022	-8.4	-5.4	1.0	6.9	16.1	19.8	22.7	22.3	17.8	10.0	4.7	-0.9	8.9
30-Year Normal *	-5.5	-4.9	-0.2	6.5	13.8	19.5	21.9	20.2	16.7	9.8	3.5	-1.9	8.3

Notes: * 30-year normal average temperature calculated from GRCA Shade's Mills climate station data between 1991-2020

Table A-3: Total Monthly Precipitation at GRCA Shade's Mills Climate Station (2000-2022)

Year	Total Monthly Precipitation (mm)												Annual Total (mm)
	January	February	March	April	May	June	July	August	September	October	November	December	
2000	39.9	48.5	45.0	75.2	145.3	150.0	98.0	53.0	95.5	21.1	70.3	91.1	933
2001	43.8	110.9	42.5	45.5	88.2	53.7	21.5	57.8	87.9	131.3	91.9	62.0	837
2002	64.3	66.5	64.4	110.1	105.9	95.8	69.0	10.7	80.7	55.7	57.0	16.0	796
2003	31.1	52.0	57.0	62.0	97.6	39.1	65.3	123.5	105.5	70.6	146.9	79.4	930
2004	37.5	22.0	84.5	63.5	116.5	60.5	86.0	45.0	27.0	70.5	66.0	77.5	757
2005	59.5	59.5	17.0	52.0	27.0	36.0	190.5	109.0	80.5	36.0	103.0	33.0	803
2006	93.8	85.0	62.8	69.5	93.5	18.0	182.5	38.0	141.0	45.0	105.4	85.6	1020
2007	73.3	65.0	53.4	103.8	103.0	25.5	66.5	56.5	45.6	61.6	83.3	89.0	827
2008	98.5	57.4	85.5	64.6	86.1	81.6	131.3	120.7	119.3	68.4	103.1	100.4	1117
2009	30.5	68.0	59.0	113.5	79.0	84.0	114.5	108.0	32.0	72.5	33.0	58.5	853
2010	20.5	14.5	47.0	57.7	67.1	130.7	129.3	27.7	112.6	76.2	33.2	14.2	731
2011	47.6	58.2	86.1	100.7	113.3	87.0	31.9	158.6	76.1	128.9	90.5	85.5	1064
2012	46.8	32.0	31.0	30.0	28.2	64.6	30.4	62.6	106.2	127.3	40.2	79.9	679
2013	80.5	71.2	40.6	123.8	102.0	122.3	130.9	69.5	142.9	142.9	33.7	52.2	1113
2014	90.7	70.5	45.0	87.2	79.1	51.6	127.9	25.2	144.2	71.8	78.2	27.3	899
2015	35.0	56.3	14.0	98.9	69.4	160.3	69.7	85.0	72.6	84.0	54.4	59.2	859
2016	44.8	52.4	99.5	90.8	31.8	42.2	93.0	183.3	68.8	45.8	67.6	113.5	934
2017	110.2	77.1	93.4	120.3	137.1	78.9	92.6	138.0	25.5	76.6	88.7	53.4	1092
2018	87.4	81.5	32.5	139.7	57.3	86.5	71.1	165.5	51.1	92.9	121.4	55.3	1042
2019	74.7	66.4	73.4	99.3	123.3	79.8	143.0	64.6	79.5	141.1	62.4	55.6	1063
2020	130.9	38.6	83.4	43.3	52.7	61.7	58.9	72.6	46.4	91.4	57.7	110.0	848
2021	32.6	54.2	53.4	64.9	33.0	132.2	95.3	83.5	222.7	129.7	46.1	72.4	1020
2022	36.6	109.7	64.4	36.6	55.1	57.2	33	87.2	28.2	52.5	39.7	82.1	682
*30-Year Normal	77.2	58.2	63.6	84.2	82.2	84.7	95.4	76.9	82.5	81.6	76.6	71.4	935

Notes: * 30-year normal average precipitation calculated from GRCA Shade's Mills climate station data between 1991-2020

Figure A-1: 2022 Air Temperature at On-Site Monitoring Locations

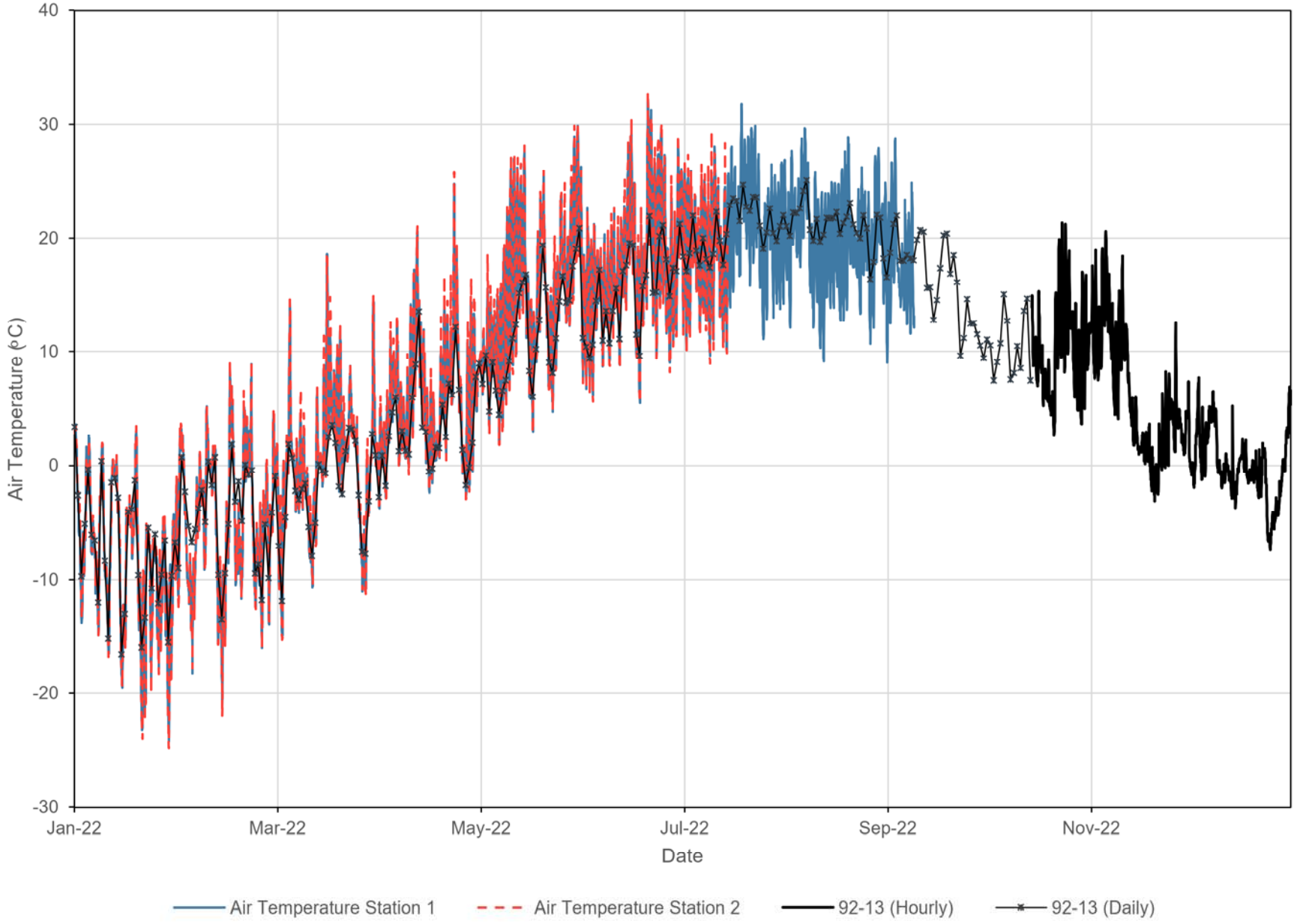


Figure A-2: 2022 Air Temperature at Two On-Site Monitoring Locations
January to March 2022

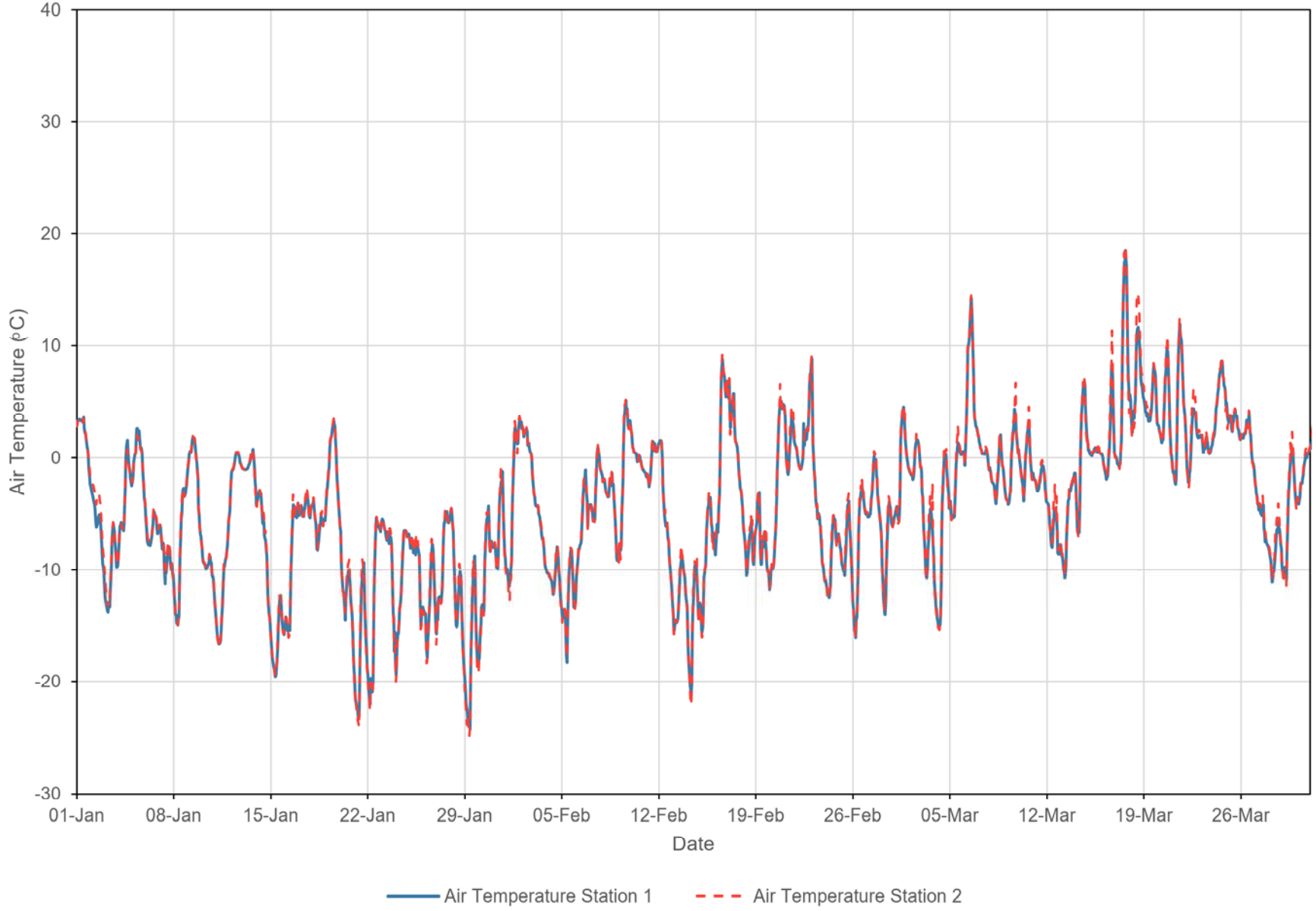


Figure A-3: 2022 Air Temperature at Two On-Site Monitoring Locations
April to June 2022

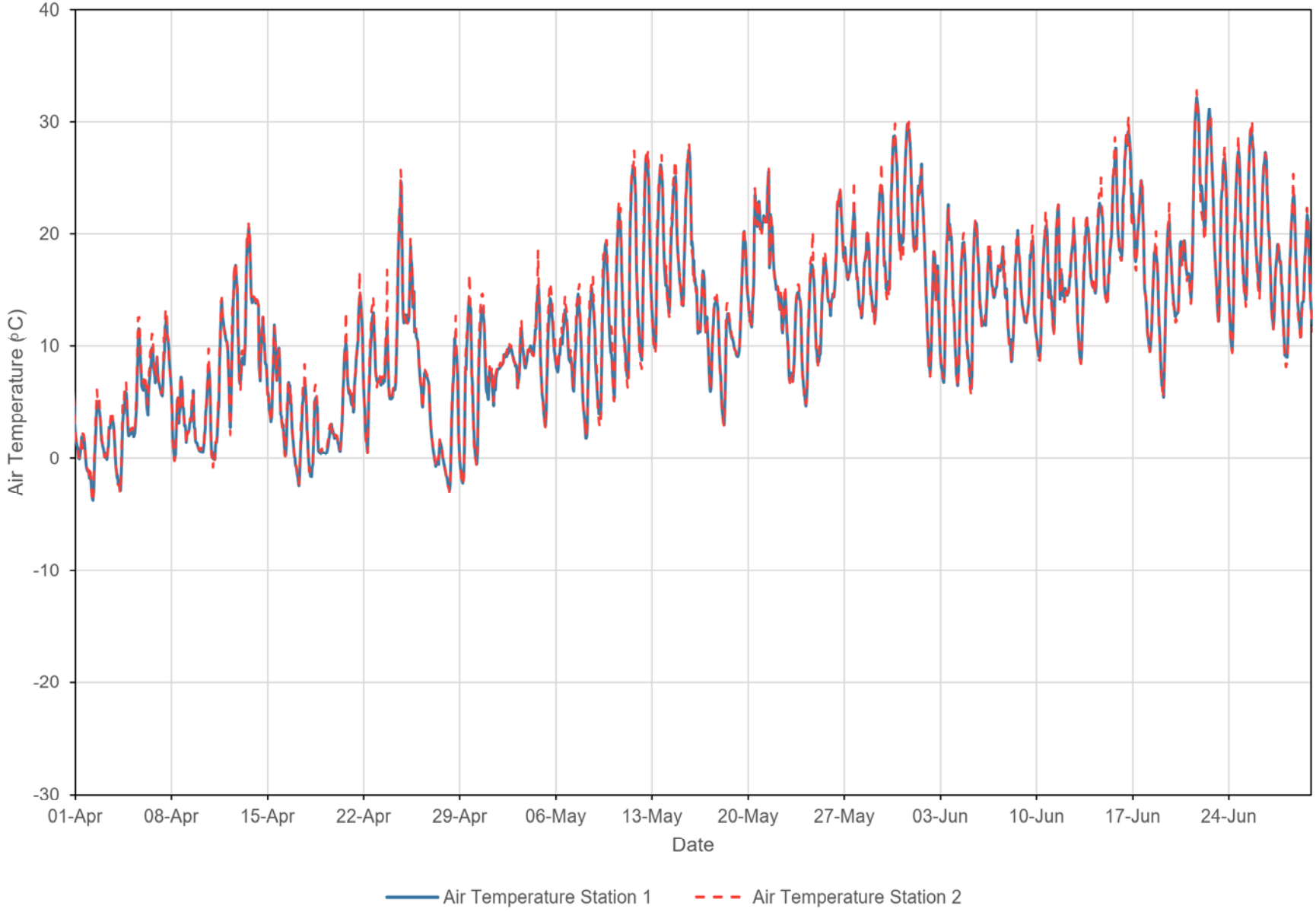


Figure A-4: 2022 Air Temperature at Two On-Site Monitoring Locations
July to September 2022

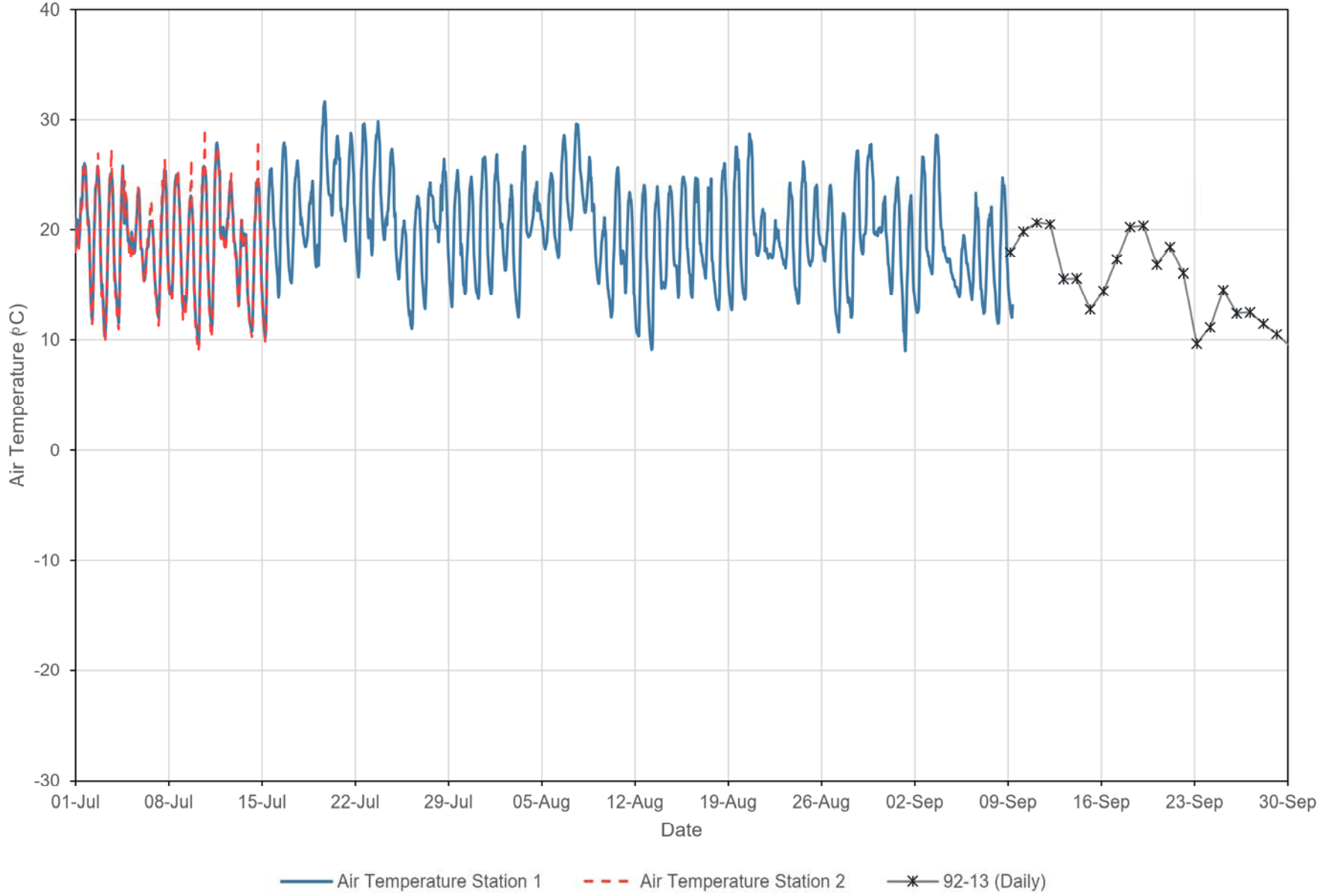


Figure A-5: 2022 Air Temperature at Two On-Site Monitoring Locations
October to December 2022

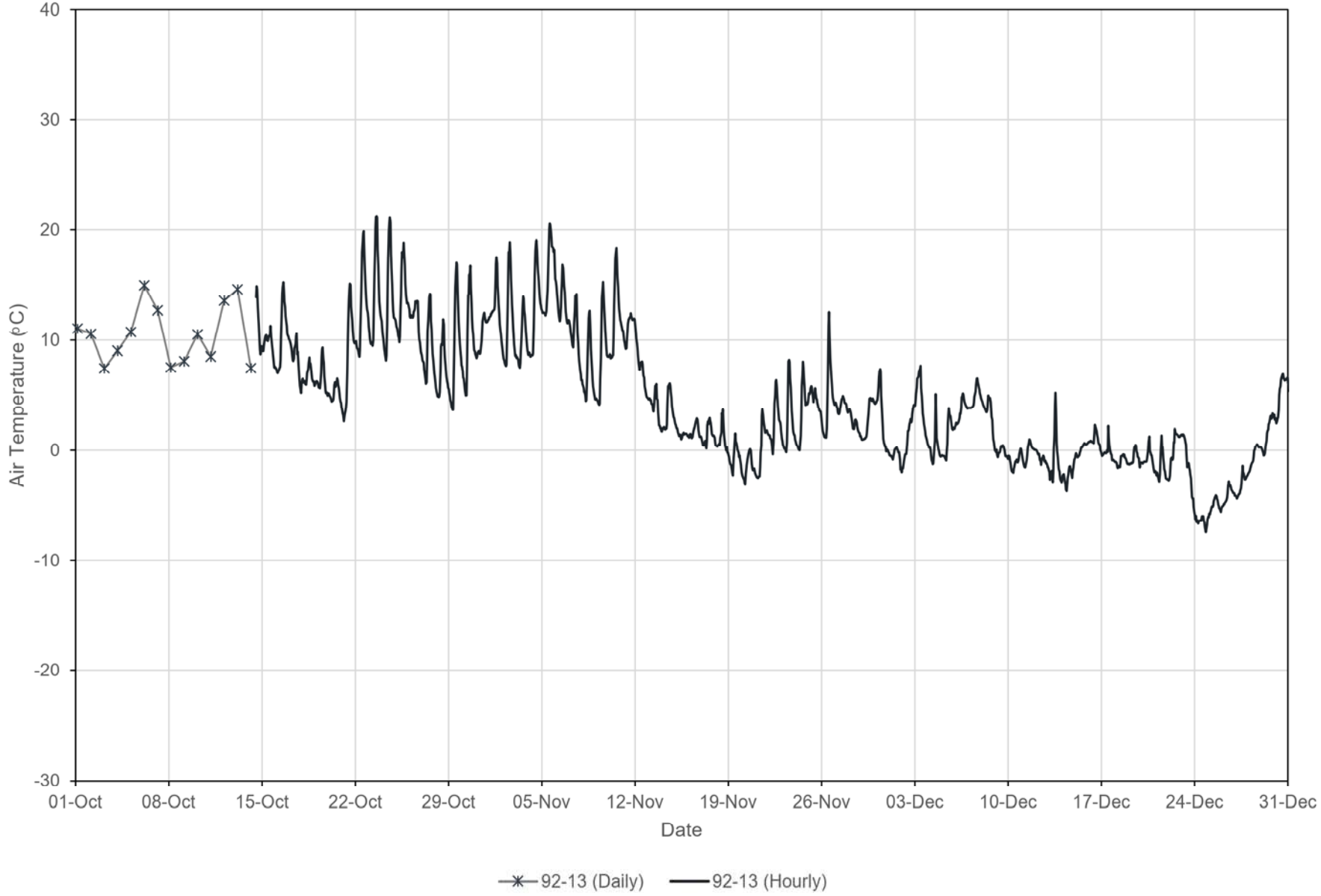


Figure A-6: 2022 Daily Precipitation at GRCA Shade's Mills Climate Station

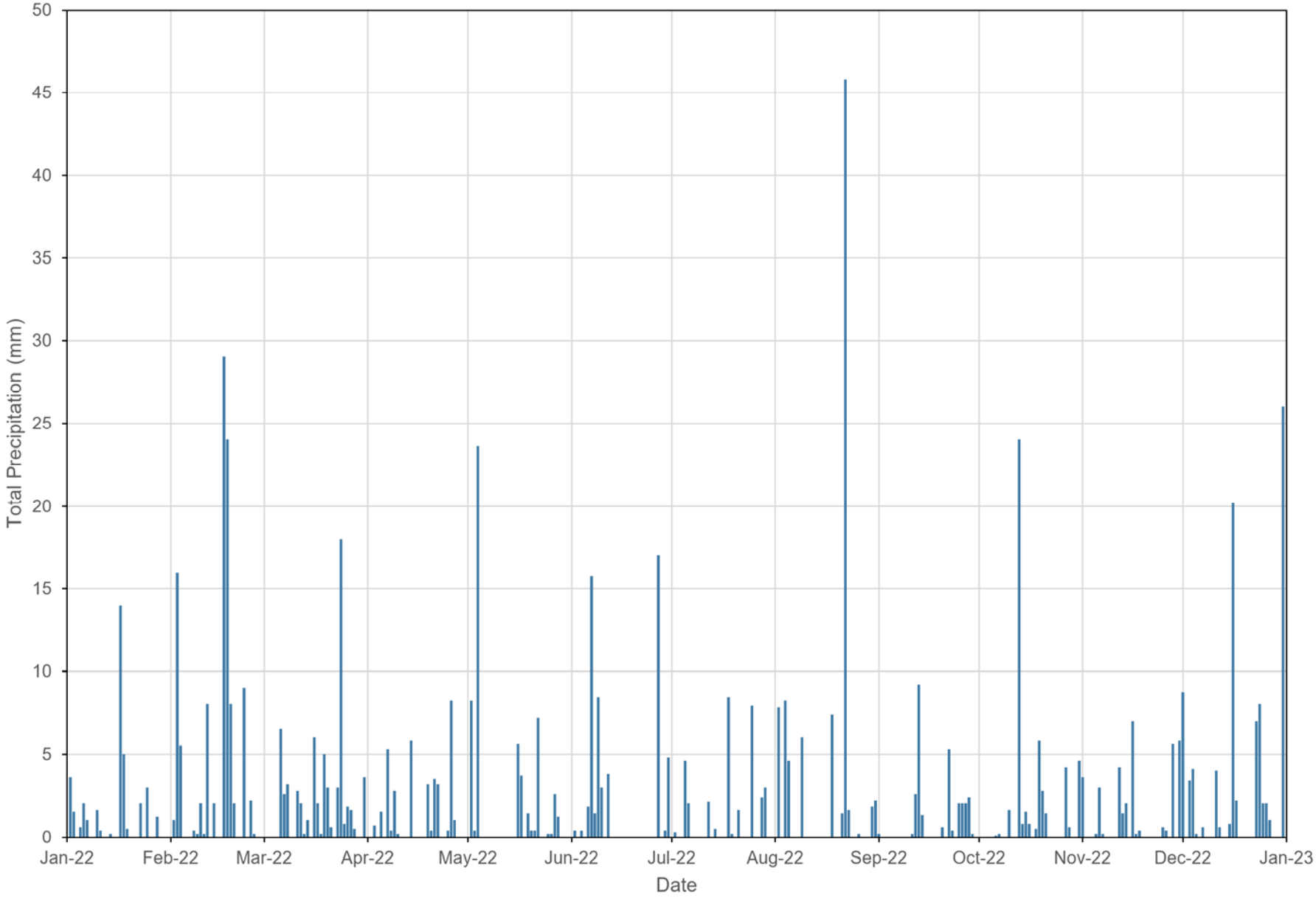


Figure A-7: 2022 Daily Precipitation at GRCA Shade's Mills Climate Station
January to March 2022

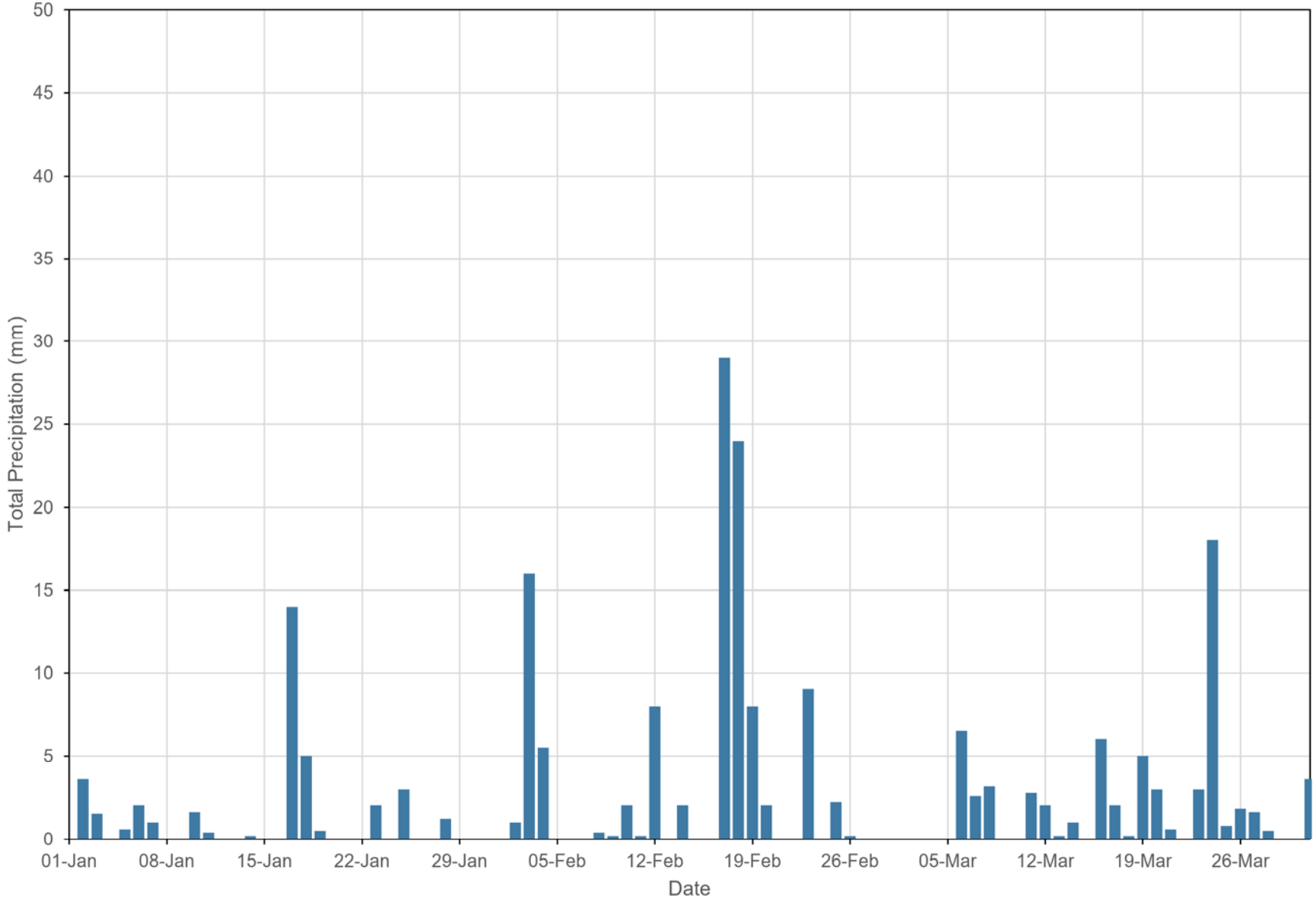


Figure A-8: 2022 Daily Precipitation at GRCA Shade's Mills Climate Station
April to June 2022

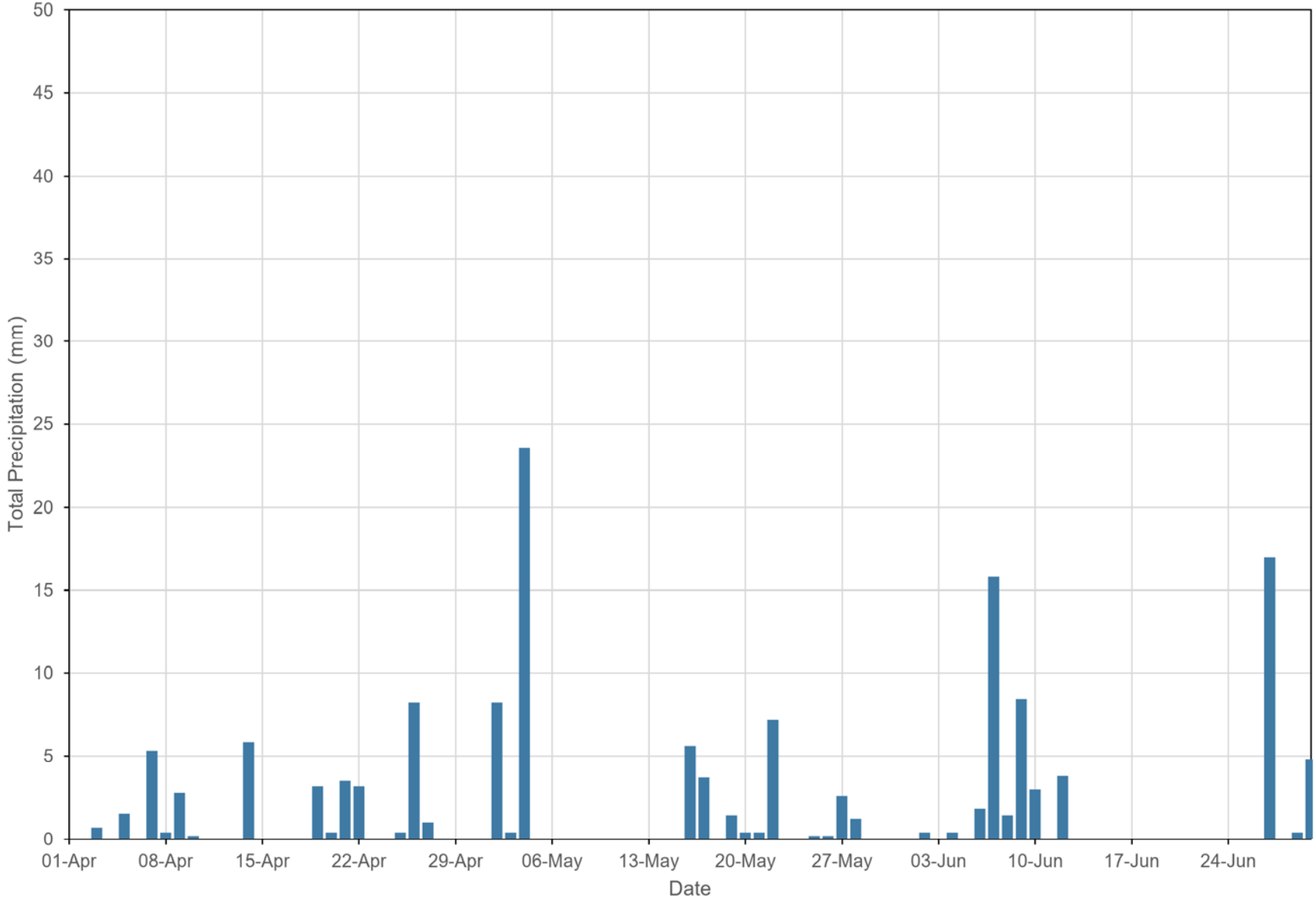


Figure A-9: 2022 Daily Precipitation at GRCA Shade's Mills Climate Station
July to September 2022

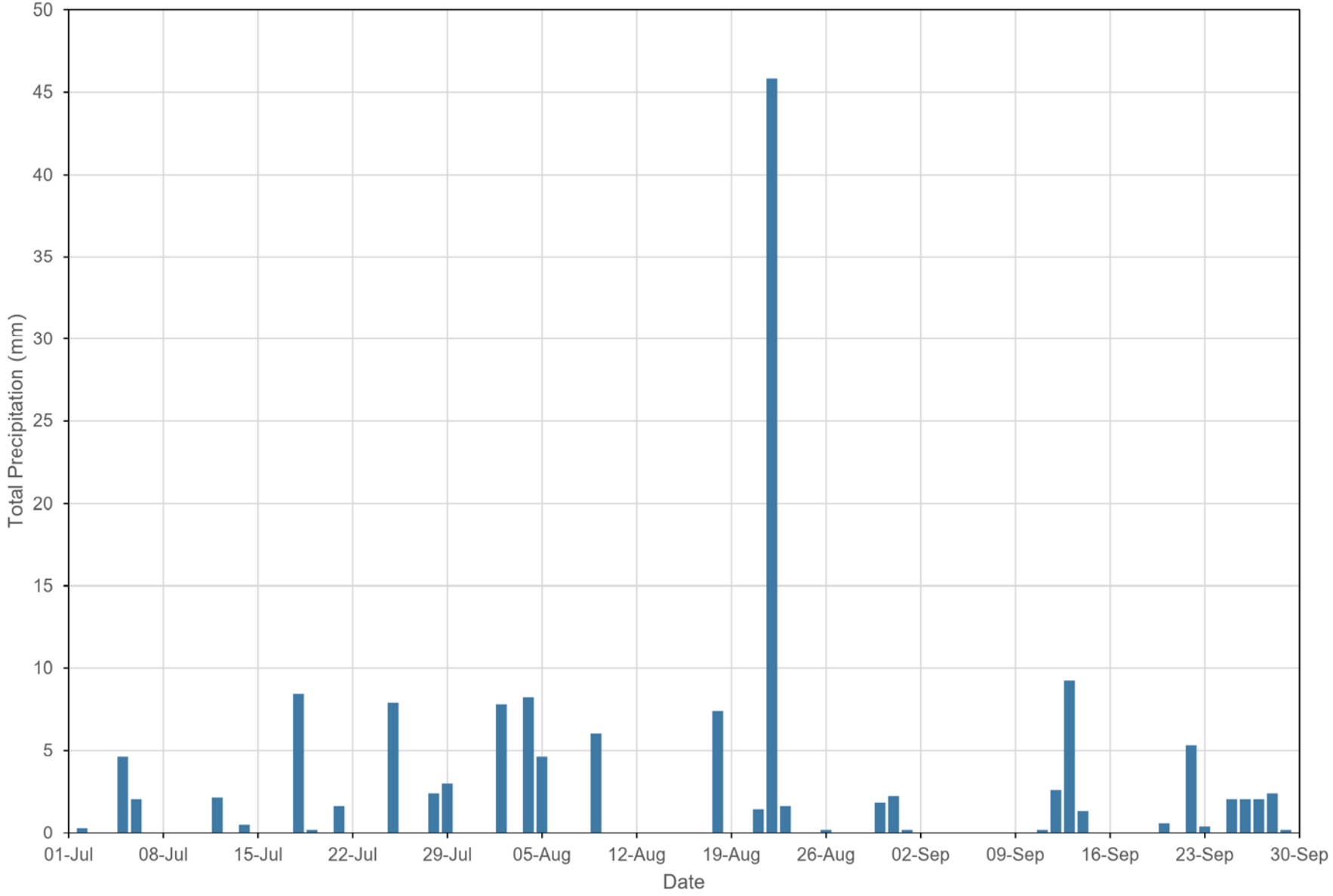


Figure A-10: 2022 Daily Precipitation at GRCA Shade's Mills Climate Station
October to December 2022

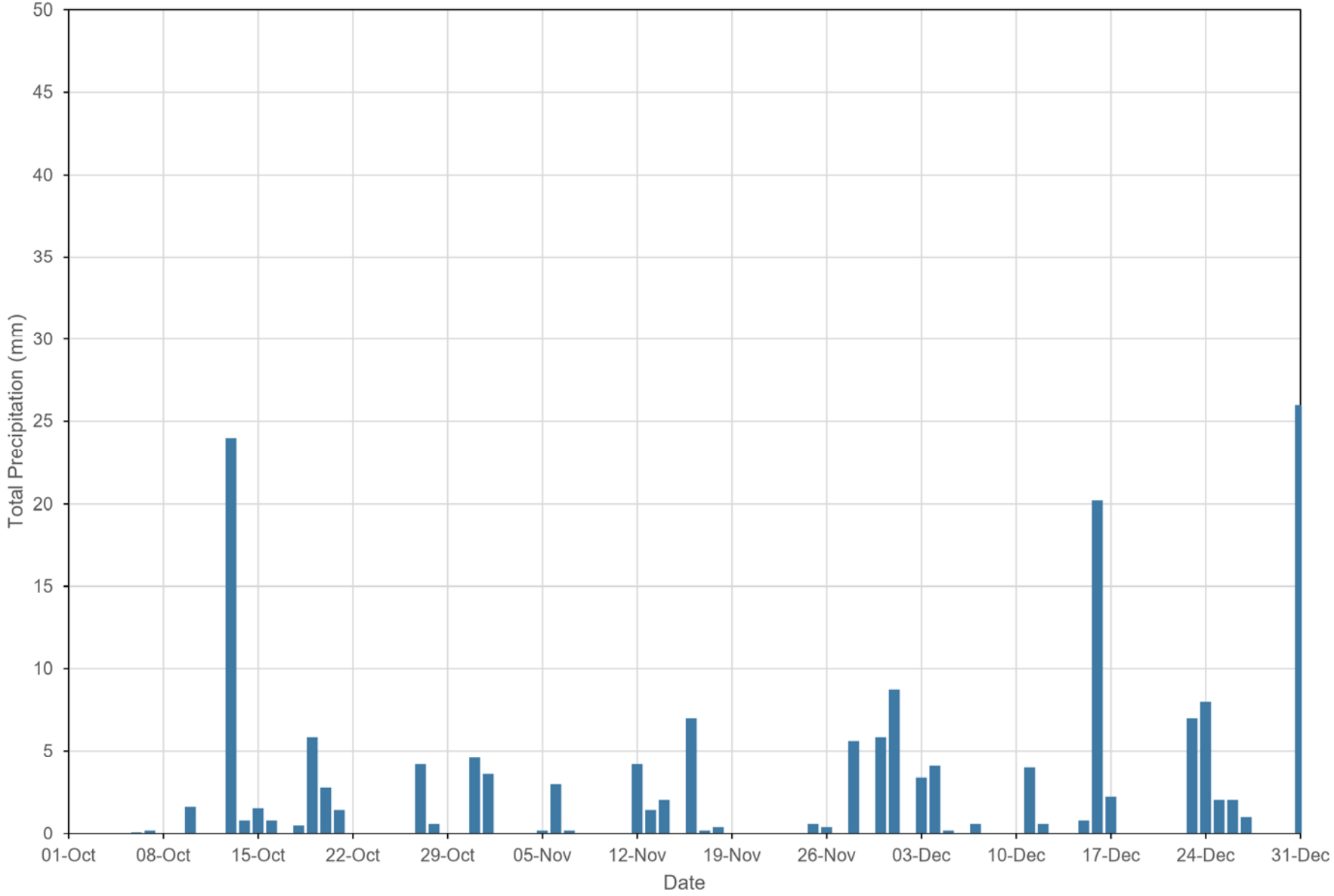


Figure A-11: 2022 Air Temperature at GRCA Shade's Mills Climate Station

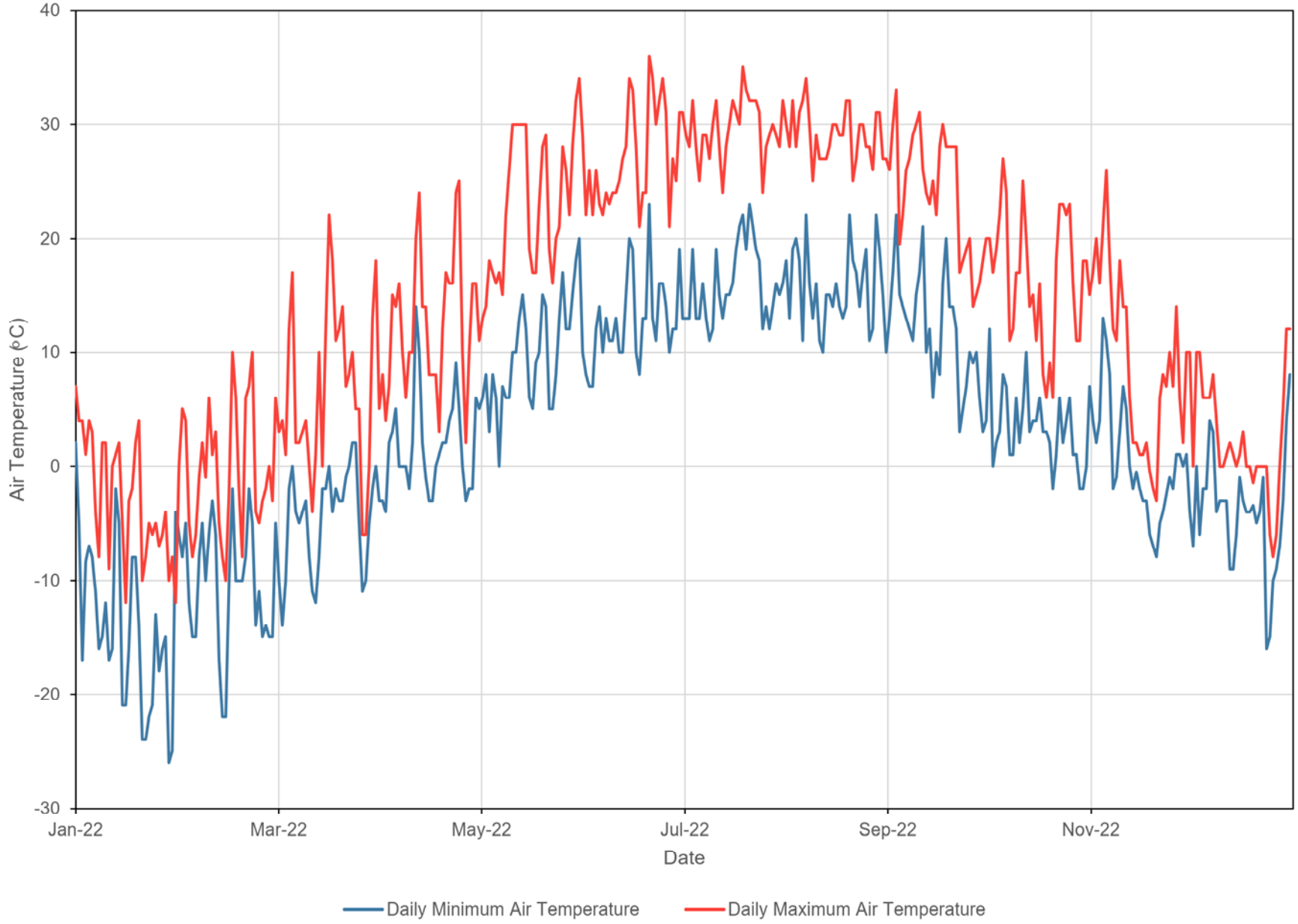


Figure A-12: 2022 Air Temperature at GRCA Shade's Mills Climate Station
January to March 2022

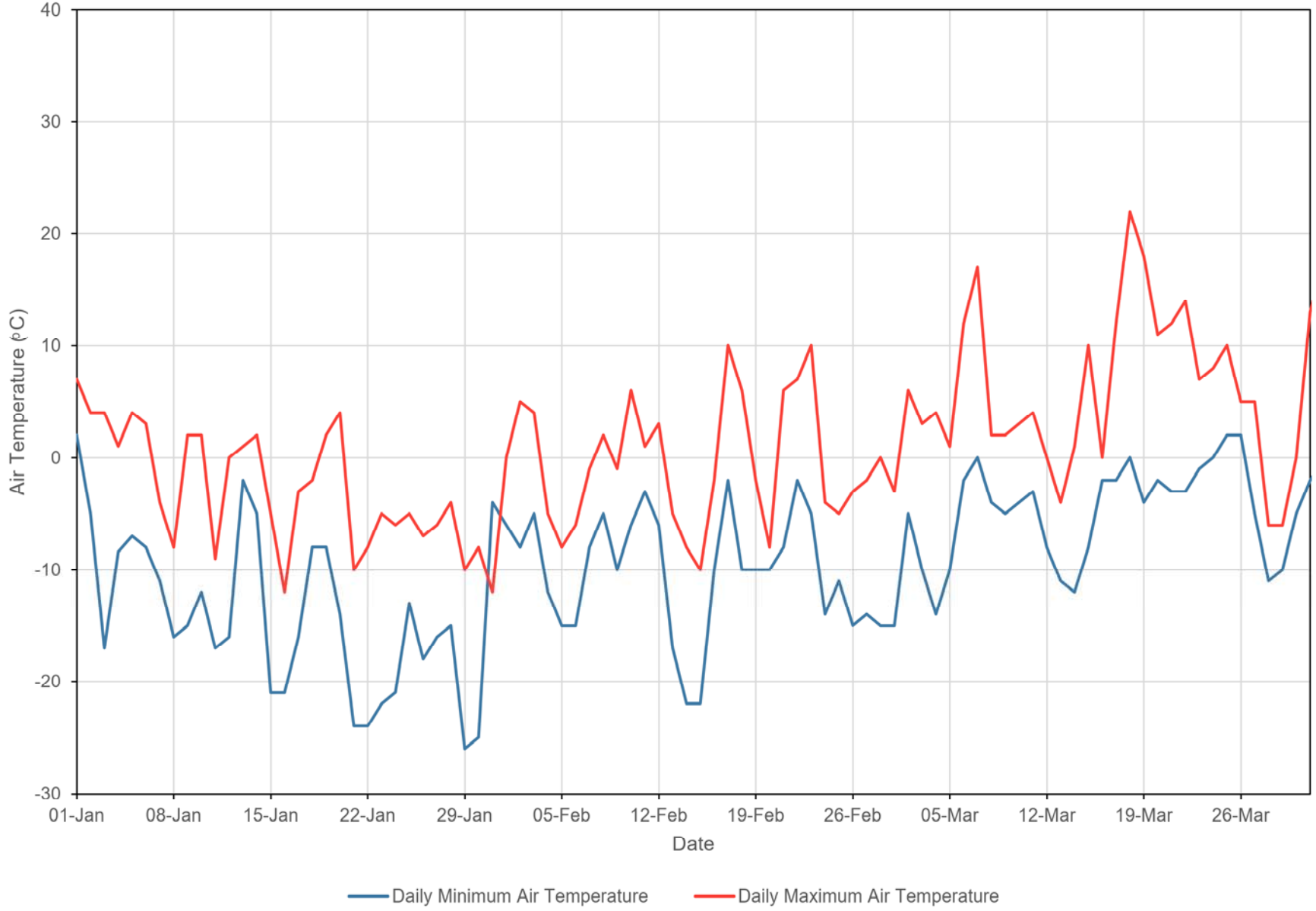


Figure A-13: 2022 Air Temperature at GRCA Shade's Mills Climate Station
April to June 2022

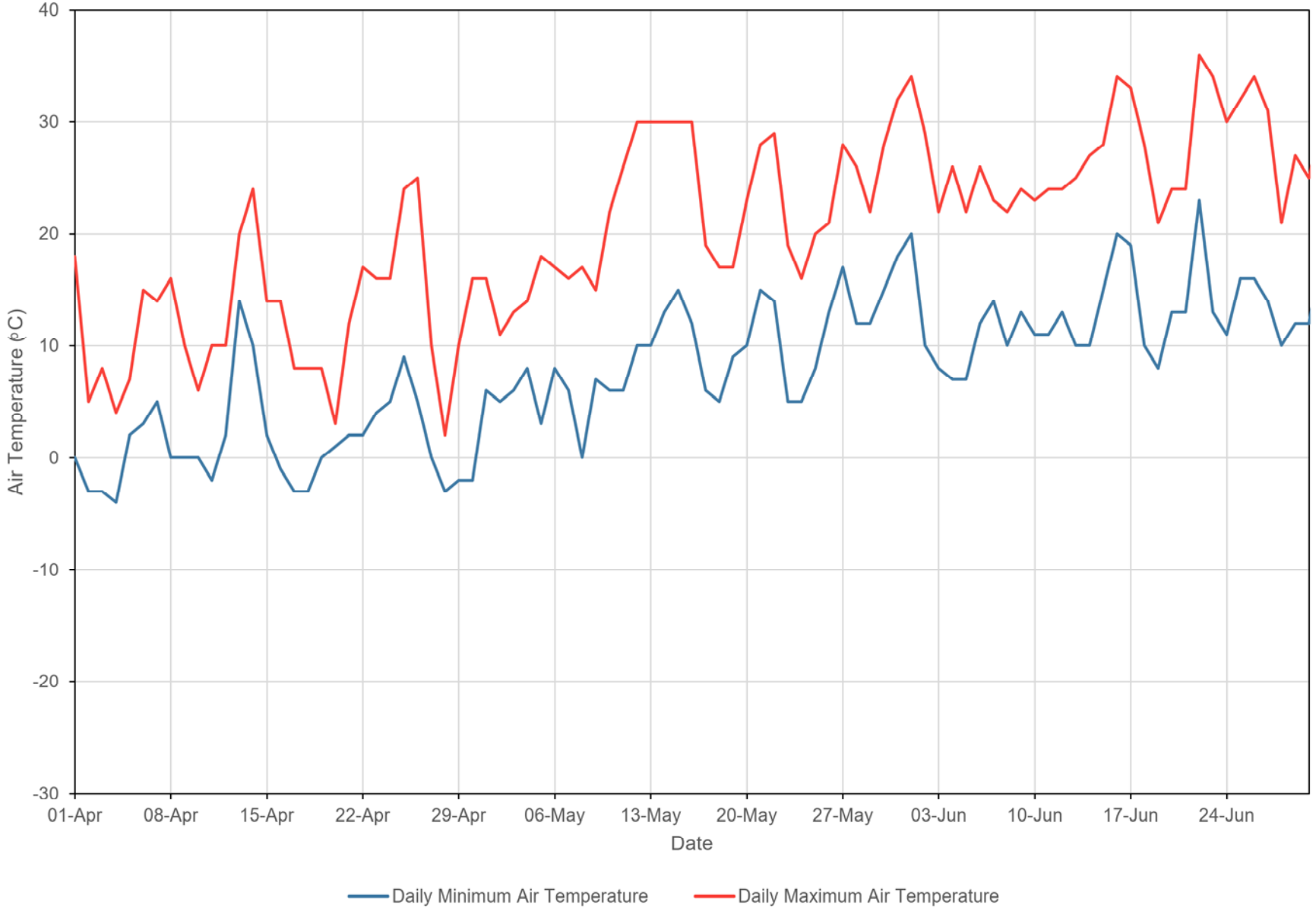


Figure A-14: 2022 Air Temperature at GRCA Shade's Mills Climate Station
July to September 2022

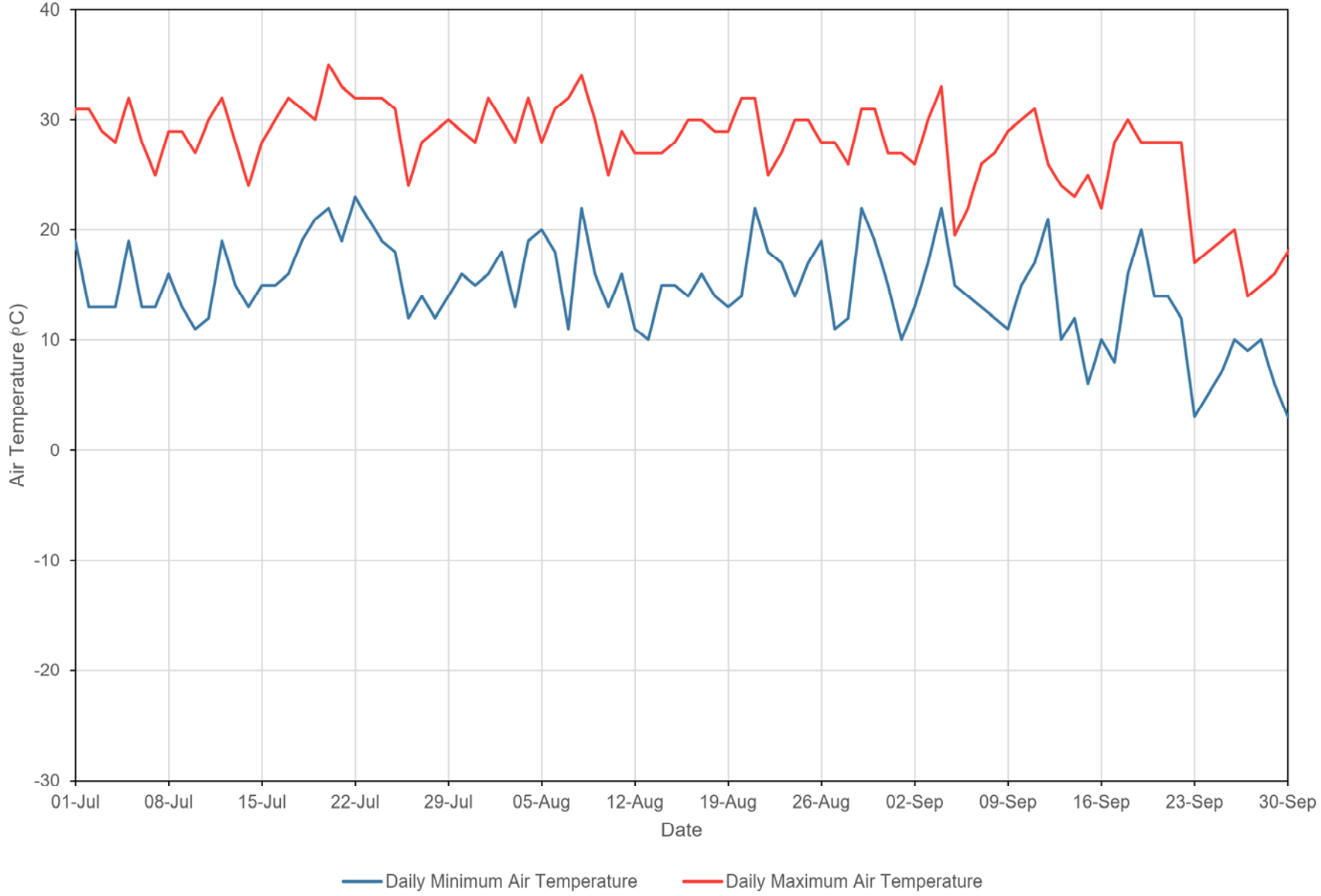
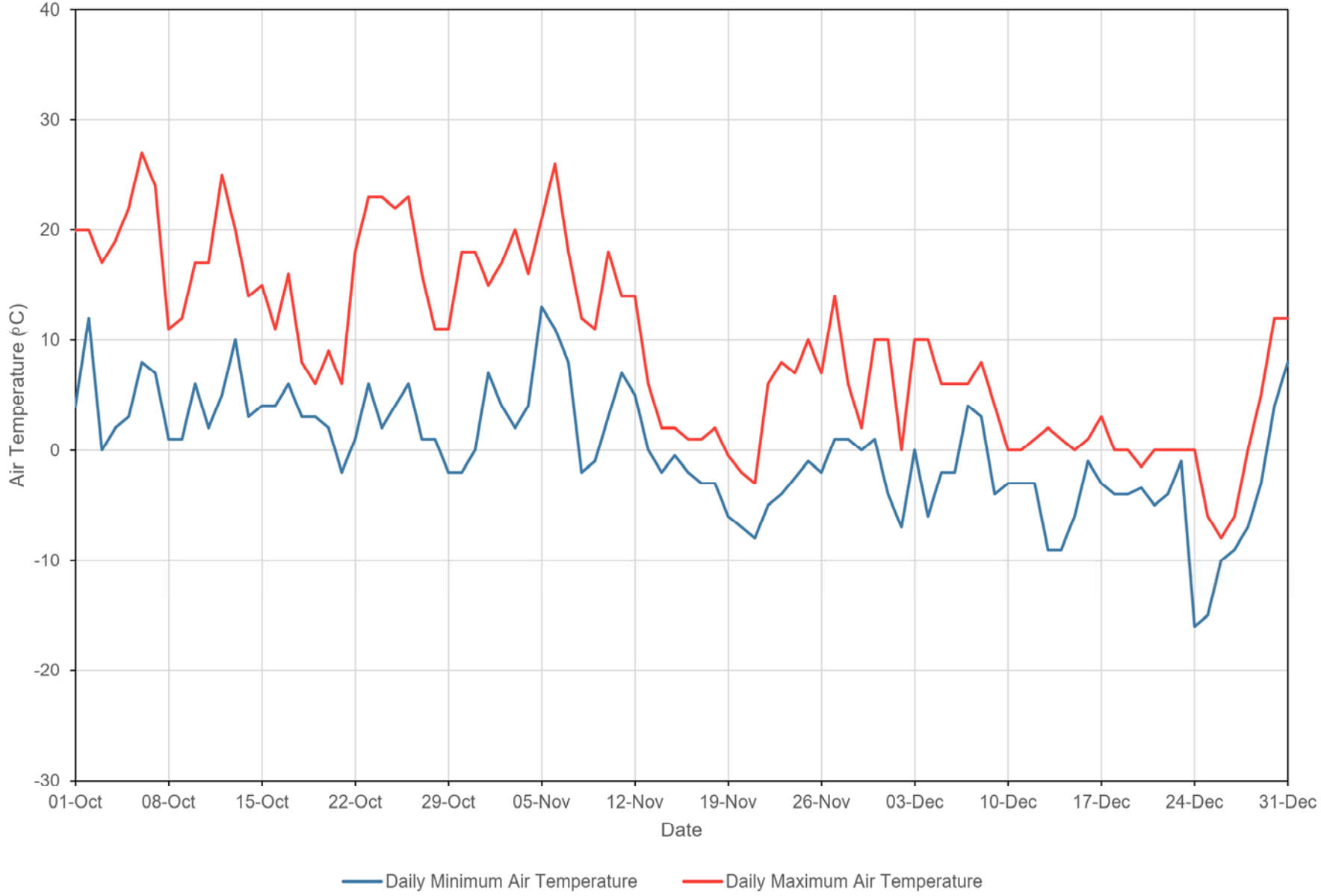


Figure A-15: 2022 Air Temperature at GRCA Shade's Mills Climate Station
October to December 2022



APPENDIX

(TECHNICAL APPENDIX A – 2022 SURFACE WATER REPORT)

B

SWM1 AND SWM2 RATING CURVE DATA

Table B-1: SWM1 and SWM2 Rating Curve Data (2010-2022)

DATE	SWM1		SWM2	
	Water Level (m above logger)	Discharge (m^3/s)	Water Level (m above logger)	Discharge (m^3/s)
2010-Apr-01	0.3791	0.5578		
2010-Aug-30	0.1991	0.1440		
2010-Aug-04	0.2320	0.1810		
2010-Jun-11	0.3474	0.4786		
2010-Mar-05	0.2530	0.2244		
2010-Oct-13	0.2860	0.1970		
2011-Jun-02	0.3715	0.6025		
2011-Jul-12	0.2112	0.1950		
2011-Aug-22	0.1970	0.1380		
2011-Oct-12	0.2410	0.1730		
2011-Nov-08	0.2940	0.2520		
2012-Jan-11	0.3220	0.4106		
2012-Feb-01	0.4283	0.7185		
2012-Mar-05	0.4157	0.6063		
2012-Apr-11	0.2638	0.2173		
2012-May-02	0.2972	0.3090		
2012-Jun-06	0.2374	0.2035		
2012-Jul-10	0.1731	0.0873		
2012-Aug-03	0.1673	0.0720		
2012-Sep-06	0.2069	0.1291		
2012-Oct-02	0.2205	0.1621		
2012-Oct-25	0.3568	0.3969		
2012-Nov-26	0.2977	0.2689		
2012-Dec-14	0.3130	0.2868		
2013-Jan-08	0.2980	0.2557		
2013-Feb-07	0.3240	0.3409		
2013-Mar-20	0.3780	0.5361		
2013-Apr-17	0.4656	0.9823		
2013-May-09	0.2652	0.2998		
2013-Jun-13	0.3196	0.4461		
2013-Jul-22	0.2374	0.2822		
2013-Aug-26	0.2143	0.1867		
2013-Sep-16	0.2275	0.2069		
2013-Nov-19	0.3486	0.4941		
2013-Dec-16	0.2802	0.2977		
2014-Jan-20	0.4403	0.4256	BD	BD
2014-Mar-18	0.4394	0.3991	BD	BD
2014-May-07	0.3890	0.6505	0.5672	0.9354
2014-Jun-11	0.2685	0.2634	0.3764	0.4403
2014-Jul-15	0.2179	0.2112	0.3114	0.3092
2014-Aug-13	0.2688	0.2951	0.4125	0.5586
2014-Sep-30	0.2717	0.2431	0.3813	0.3921
2014-Oct-16	0.4248	0.3809	0.4486	0.5746
2014-Nov-17	0.4302	0.2647	0.3974	0.4467
2014-Dec-10	0.3861	0.3102	0.4207	0.4331
2015-Jan-20	0.3362	0.2373	0.3344	0.3616
2015-Mar-18	0.4530	0.4224	0.5280	0.8527
2015-Mar-26	0.3970	0.3646	0.3500	0.6412
2015-Apr-09	0.5810	1.1258	0.6145	1.6619

Notes: BD - Beaver Dam located downstream; therefore, water level and discharge data not used
N/A - Water level/discharge measurement not available due to frozen/inaccessible conditions

Table B-1: SWM1 and SWM2 Rating Curve Data (2010-2022)

DATE	SWM1		SWM2	
	Water Level (m above logger)	Discharge (m^3/s)	Water Level (m above logger)	Discharge (m^3/s)
2015-May-19	0.2206	0.1786	0.2546	0.3285
2015-Jun-19	0.2616	0.2838	0.3453	0.4763
2015-Jul-20	0.2730	0.2424	0.2532	0.4641
2015-Sep-15	0.2123	0.1071	0.3684	0.2821
2015-Oct-14	0.2594	0.1453	0.2057	0.2608
2015-Nov-16	0.4542	0.3319	0.4484	0.4401
2016-Feb-03	0.4175	0.6335	0.5123	0.9543
2016-Mar-04	0.4403	0.3401	0.3638	0.5504
2016-Apr-07	0.5685	1.1611	0.6255	1.6094
2016-May-04	0.3179	0.3561	0.3927	0.5631
2016-Jun-13	0.2267	0.1441	0.2983	0.2908
2016-Jul-05	0.2311	0.0991	0.2667	0.1903
2016-Aug-10	0.2225	0.0816	0.2841	0.1756
2016-Sep-27	0.2641	0.1452	0.3206	0.2525
2016-Oct-21	0.4087	0.2177	0.3499	0.3823
2016-Nov-18	0.4011	0.1612	0.3177	0.2624
2017-Jan-31	0.2605	0.3052	0.3385	0.5113
2017-Feb-16	0.1968	0.2204	0.2874	0.2869
2017-Mar-17	0.2212	0.2830	0.2716	0.4186
2017-Apr-12	0.4574	0.8291	0.5273	1.1843
2017-May-09	0.4664	0.9847	0.5489	1.2875
2017-Jun-12	0.2790	0.2830	0.3078	0.4290
2017-Jul-24	0.2879	0.1967	0.3518	0.4196
2017-Sep-21	0.2685	0.1475	0.3394	0.2692
2017-Oct-16	0.3208	0.2664	0.3745	0.4327
2017-Dec-08	0.2714	0.3052	0.3183	0.4778
2018-Jan-12	0.4859	0.9995	0.5923	1.4876
2018-Feb-09	N/A	N/A	0.2728	0.4086
2018-Mar-01	0.3637	0.7010	0.4446	0.9534
2018-Apr-04	0.4602	1.1219	0.5677	1.6301
2018-May-10	0.3368	0.4921	0.3793	0.6719
2018-Jun-18	0.2483	0.1872	0.2781	0.2478
2018-Jul-06	0.2542	0.1726	0.2856	0.2101
2018-Aug-09	0.3039	0.3207	0.3224	0.3643
2018-Sep-13	0.2940	0.1686	0.3006	0.1727
2018-Oct-30	BD	BD	0.2915	0.2919
2018-Nov-21	BD	BD	0.2971	0.3381
2019-Jan-03	BD	BD	0.4517	0.5925
2019-Feb-28	N/A	N/A	N/A	N/A
2019-Mar-20	0.6022	0.3100	N/A	N/A
2019-Apr-23	0.6312	0.4612	N/A	N/A
2019-May-23	0.4792	0.2310	0.3057	0.2708
2019-Jun-20	0.3611	0.1657	0.2712	0.2060
2019-Jul-18	0.3939	0.2256	0.3143	0.3089
2019-Aug-23	0.2833	0.0781	0.2352	0.0913
2019-Sep-25	0.3137	0.0661	0.3859	0.1123
2019-Oct-29	0.5038	0.2988	0.5950	0.2795

Notes:

BD - Beaver Dam located downstream; therefore, water level and discharge data not used

N/A - Water level/discharge measurement not available due to frozen/inaccessible conditions

Grey shading indicates measurements may be impacted by beaver dam activity downstream of monitoring locations

Table B-1: SWM1 and SWM2 Rating Curve Data (2010-2022)

DATE	SWM1		SWM2	
	Water Level (m above logger)	Discharge (m^3/s)	Water Level (m above logger)	Discharge (m^3/s)
2019-Nov-27	0.3932	0.1666	0.5852	0.2220
2019-Dec-18	0.2952	0.1460	0.4663	0.2144
2020-Jan-07	0.3094	0.1479	0.4959	0.2434
2020-Feb-28	0.2522	0.1763	0.4512	0.2370
2020-Mar-12	0.5379	0.5878	0.6165	0.6633
2020-Apr-16	0.2584	0.2285	0.3816	0.2722
2020-May-28	0.2889	0.1124	0.2987	0.1819
2020-Jun-25	0.2623	0.0816	0.2843	0.2364
2020-Jul-22	0.2545	0.0760	0.2867	0.1223
2020-Aug-25	0.2264	0.0891	0.3169	0.1318
2020-Sep-21	0.2445	0.0608	0.2843	0.0843
2020-Oct-30	0.3029	0.1116	0.3305	0.1435
2020-Nov-26	0.3874	0.2289	0.4319	0.3762
2020-Dec-18	0.2548	0.0594	0.3498	0.1399
2021-Jan-13	0.2920	0.1147	0.2840	0.1698
2021-Feb-26	0.2542	0.1239	0.2614	0.1618
2021-Mar-29	0.3938	0.2587	0.4433	0.4380
2021-Apr-29	0.2643	0.1587	0.2606	0.1563
2021-May-27	0.2285	0.0560	0.2314	0.0962
2021-Jun-22	0.2325	0.0531	0.2325	0.1045
2021-Jul-30	0.2650	0.0865	0.2682	0.1063
2021-Aug-13	0.2466	0.0422	0.2552	0.0880
2021-Sep-30	0.2810	0.0874	0.2813	0.1436
2021-Oct-25	0.3422	0.1572	0.3114	0.2854
2021-Nov-18	0.3177	0.1382	0.2990	0.2154
2021-Dec-15	0.3566	0.1645	0.3236	0.2829
2022-Jan-07	0.2627	0.0754	0.2416	0.1679
2022-Feb-22	0.3623	0.2631	0.3321	0.3126
2022-Mar-25	0.6290	0.8359	0.5760	0.8530
2022-Apr-22	0.4278	0.2887	0.3452	0.3789
2022-May-25	0.2996	0.1002	0.2286	0.1654
2022-Jun-16	0.3074	0.0957	0.2619	0.1256
2022-Jul-15	0.2786	0.0338	0.2414	0.0768
2022-Aug-26	0.2915	0.0308	0.2496	0.0840
2022-Sep-09	0.2682	0.0376	0.2454	0.0837
2022-Oct-14	0.3379	0.0731	0.2796	0.1121
2022-Nov-25	0.3031	0.0650	0.2615	0.1123
2022-Dec-20	0.3094	0.0479	0.2153	0.0800

Notes:

BD - Beaver Dam located downstream; therefore, water level and discharge data not used

N/A - Water level/discharge measurement not available due to frozen/inaccessible conditions

Grey shading indicates measurements may be impacted by beaver dam activity downstream of monitoring locations

APPENDIX

(TECHNICAL APPENDIX A – 2022 SURFACE WATER REPORT)

C MONTHLY HYDROGRAPHS

Figure C-1: 2022 Calculated Stream Flow at SWM1
January 2022

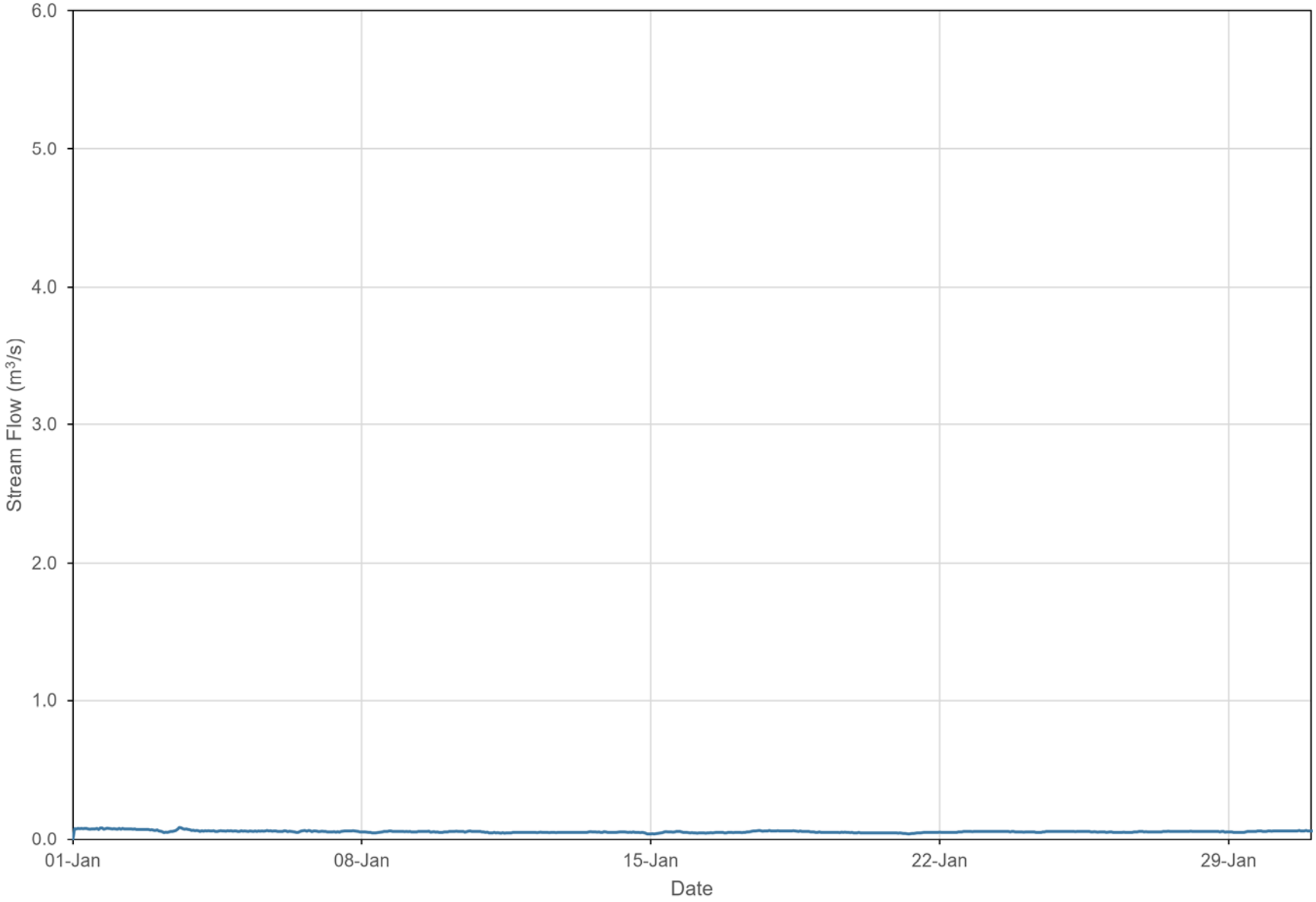


Figure C-2: 2022 Calculated Stream Flow at SWM1
February 2022

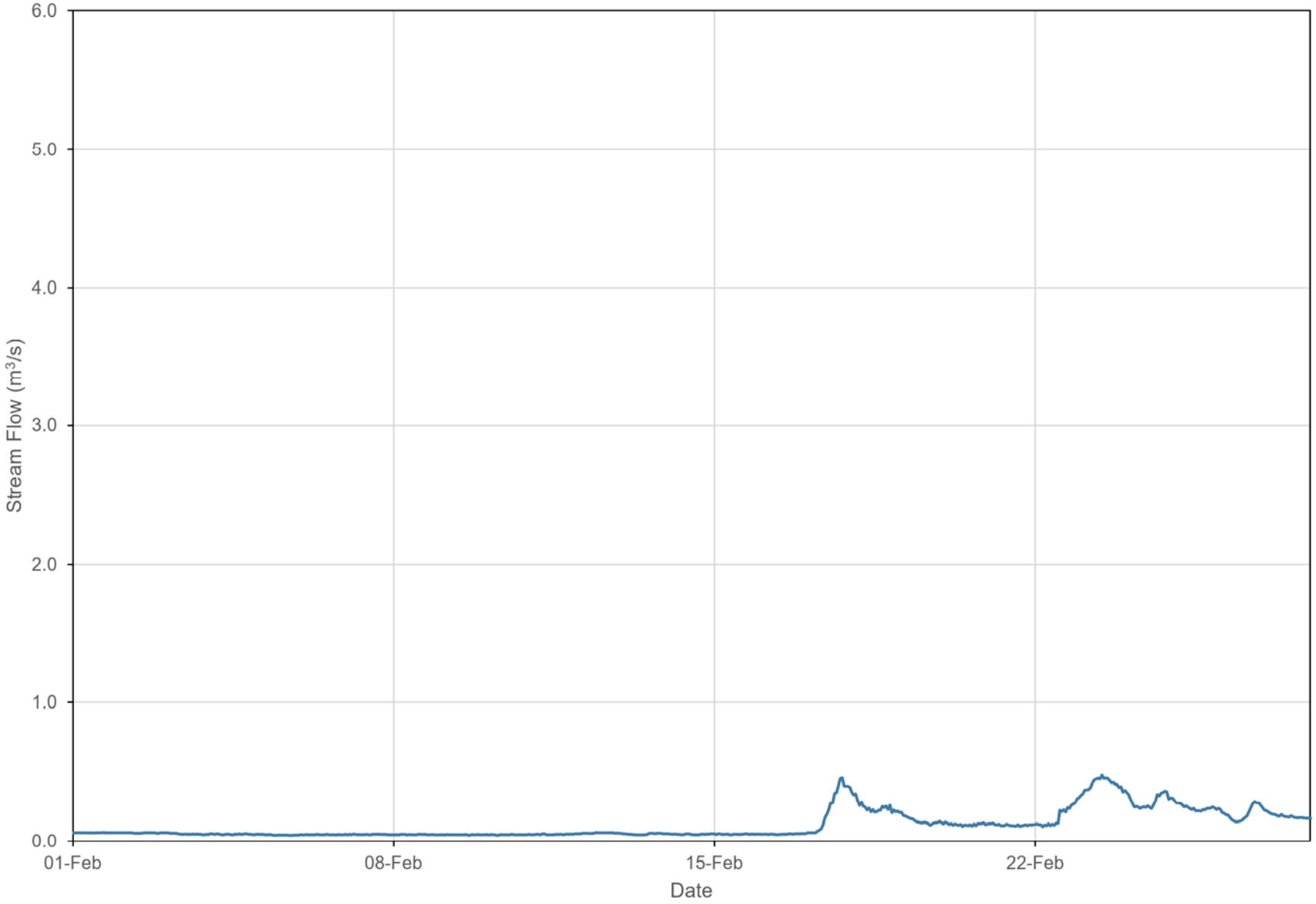


Figure C-3: 2022 Calculated Stream Flow at SWM1
March 2022

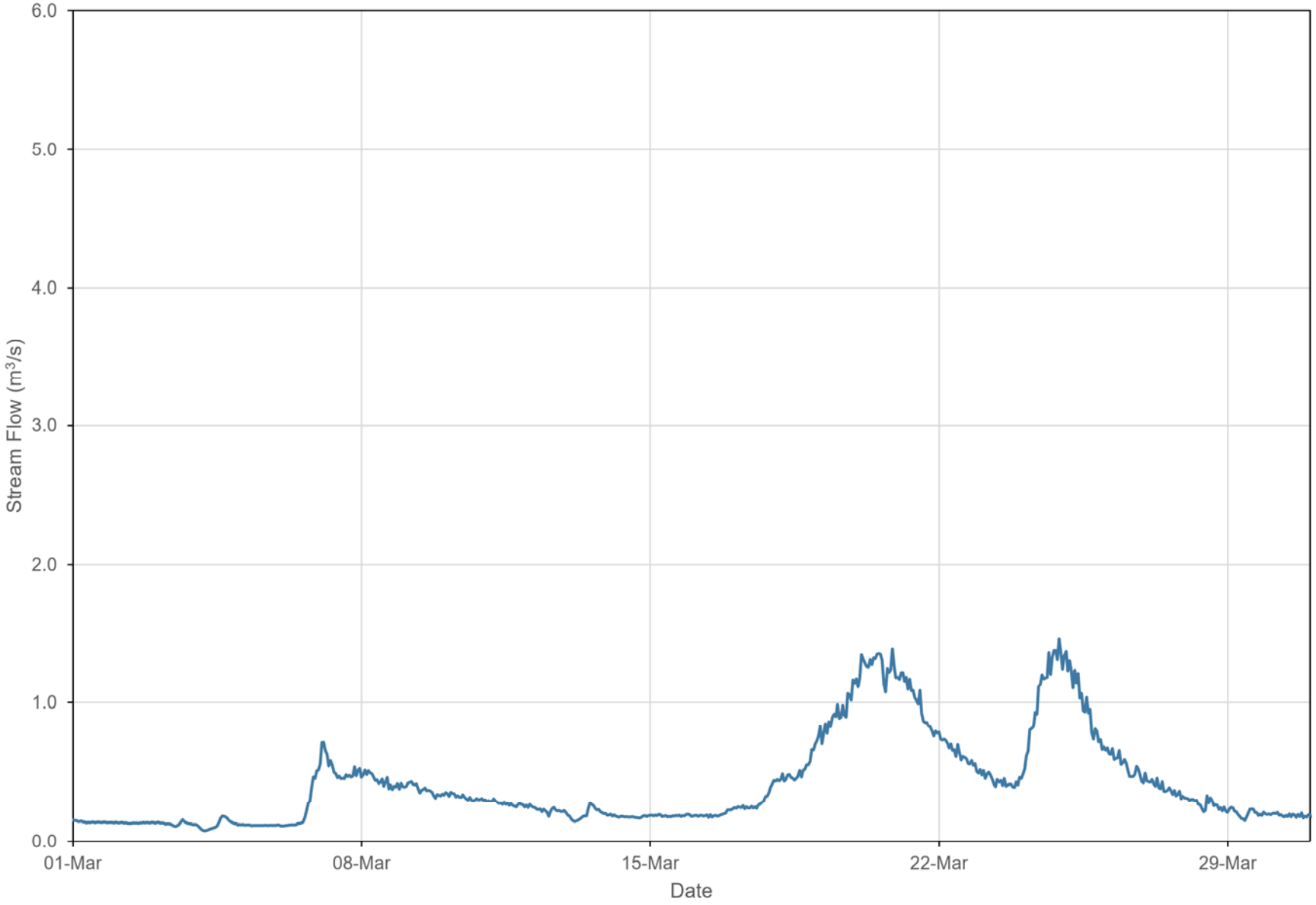


Figure C-4: 2022 Calculated Stream Flow at SWM1
April 2022

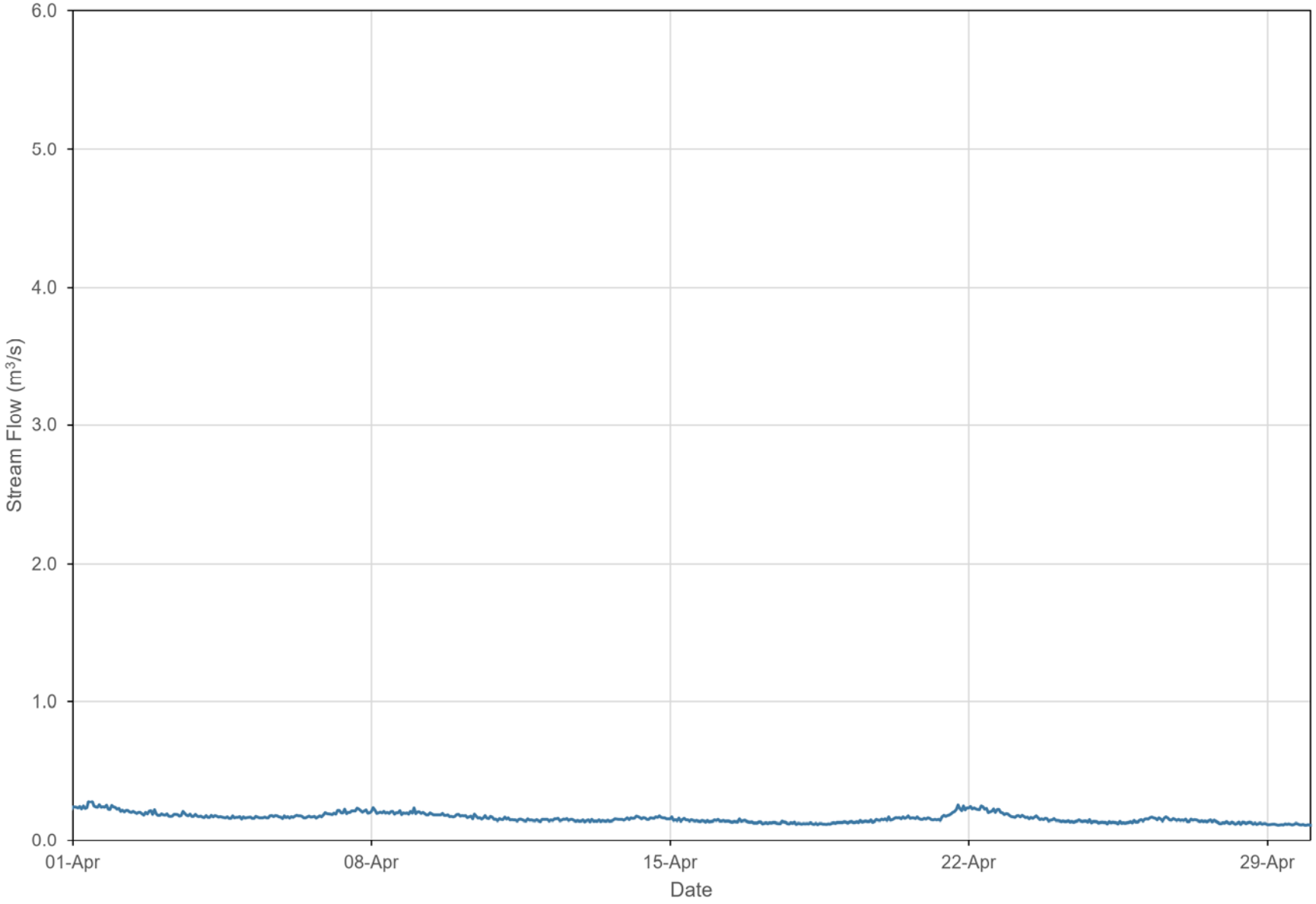


Figure C-5: 2022 Calculated Stream Flow at SWM1
May 2022

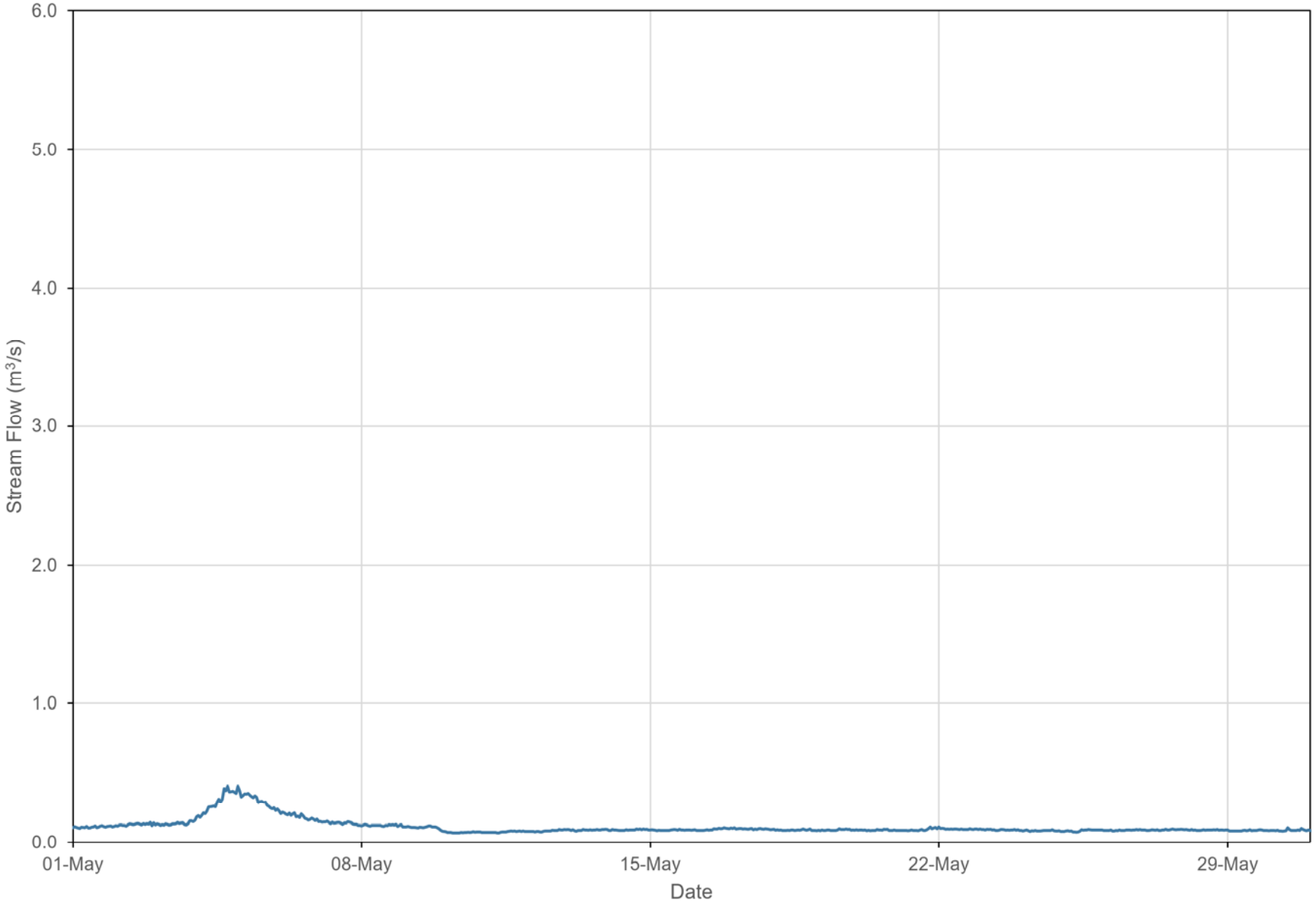


Figure C-6: 2022 Calculated Stream Flow at SWM1
June 2022

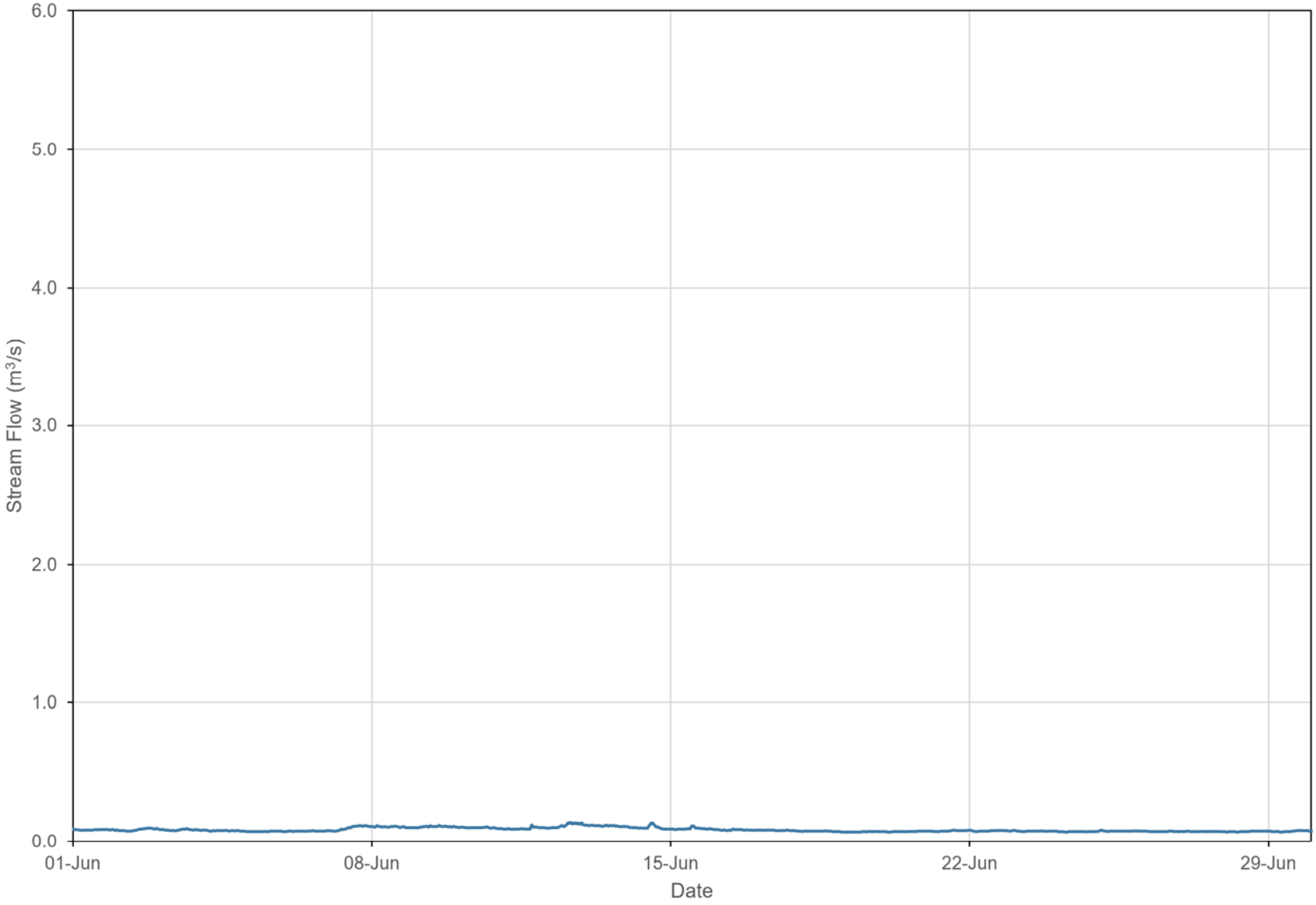


Figure C-7: 2022 Calculated Stream Flow at SWM1
July 2022

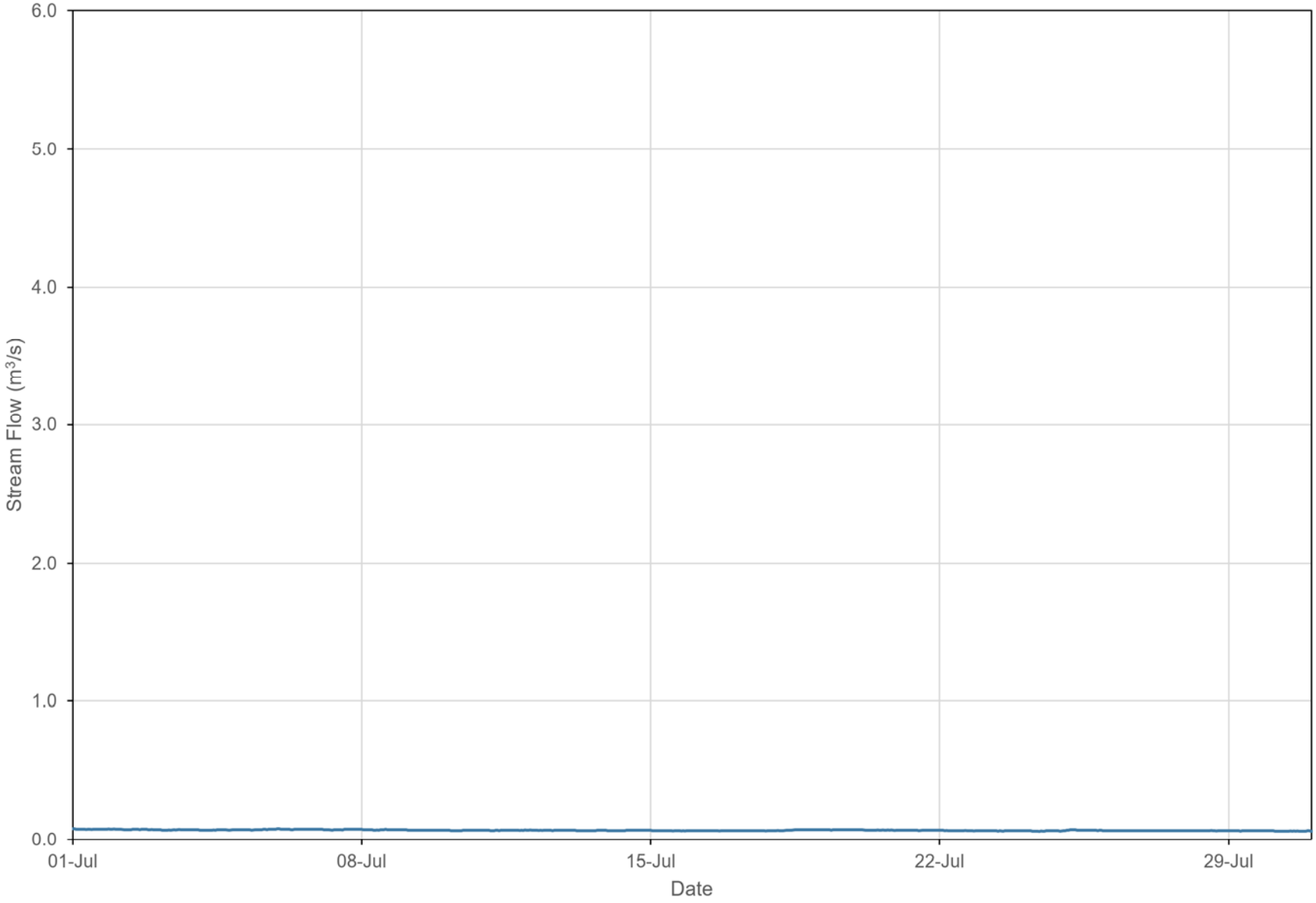


Figure C-8: 2022 Calculated Stream Flow at SWM1
August 2022

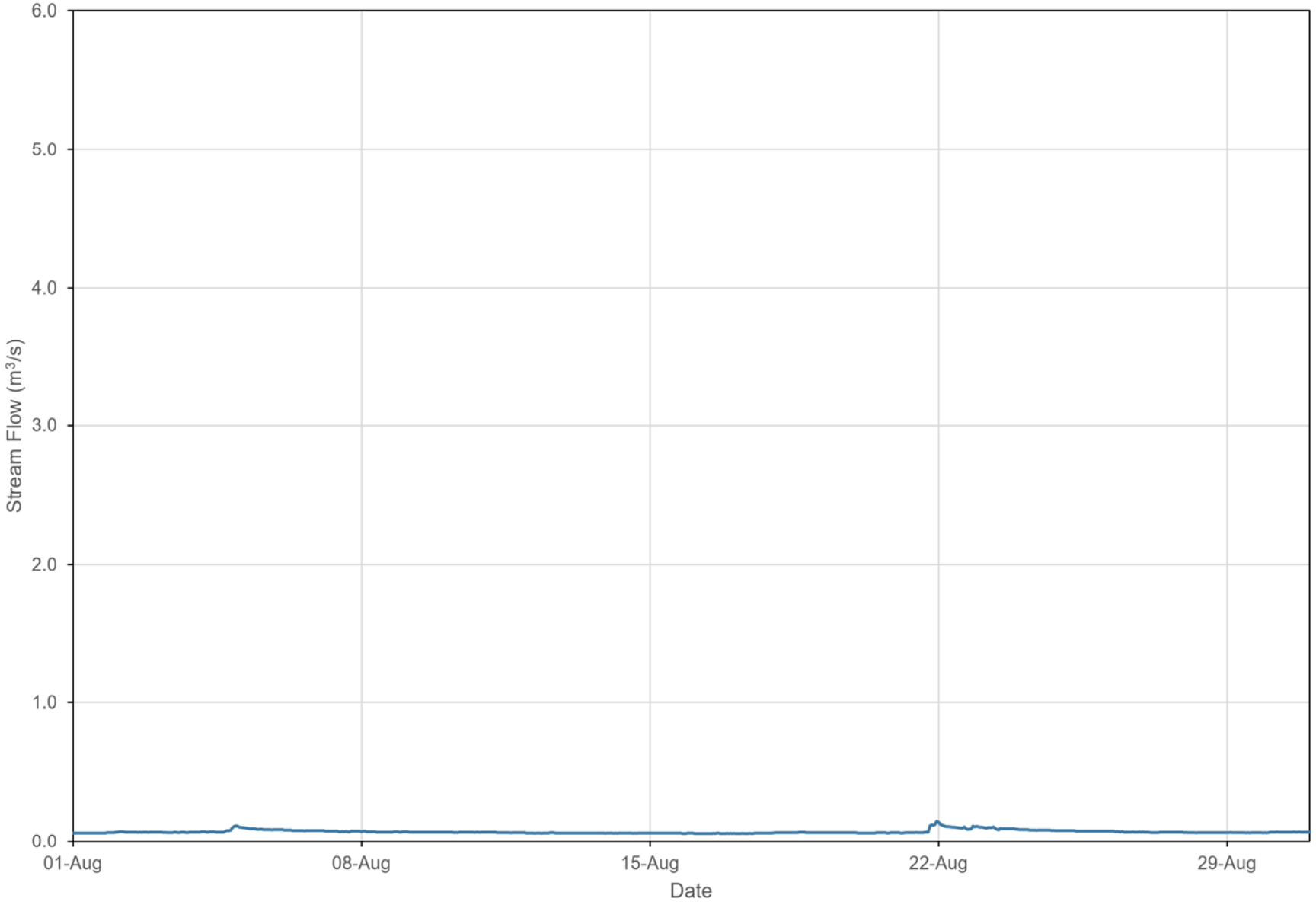


Figure C-9: 2022 Calculated Stream Flow at SWM1
September 2022

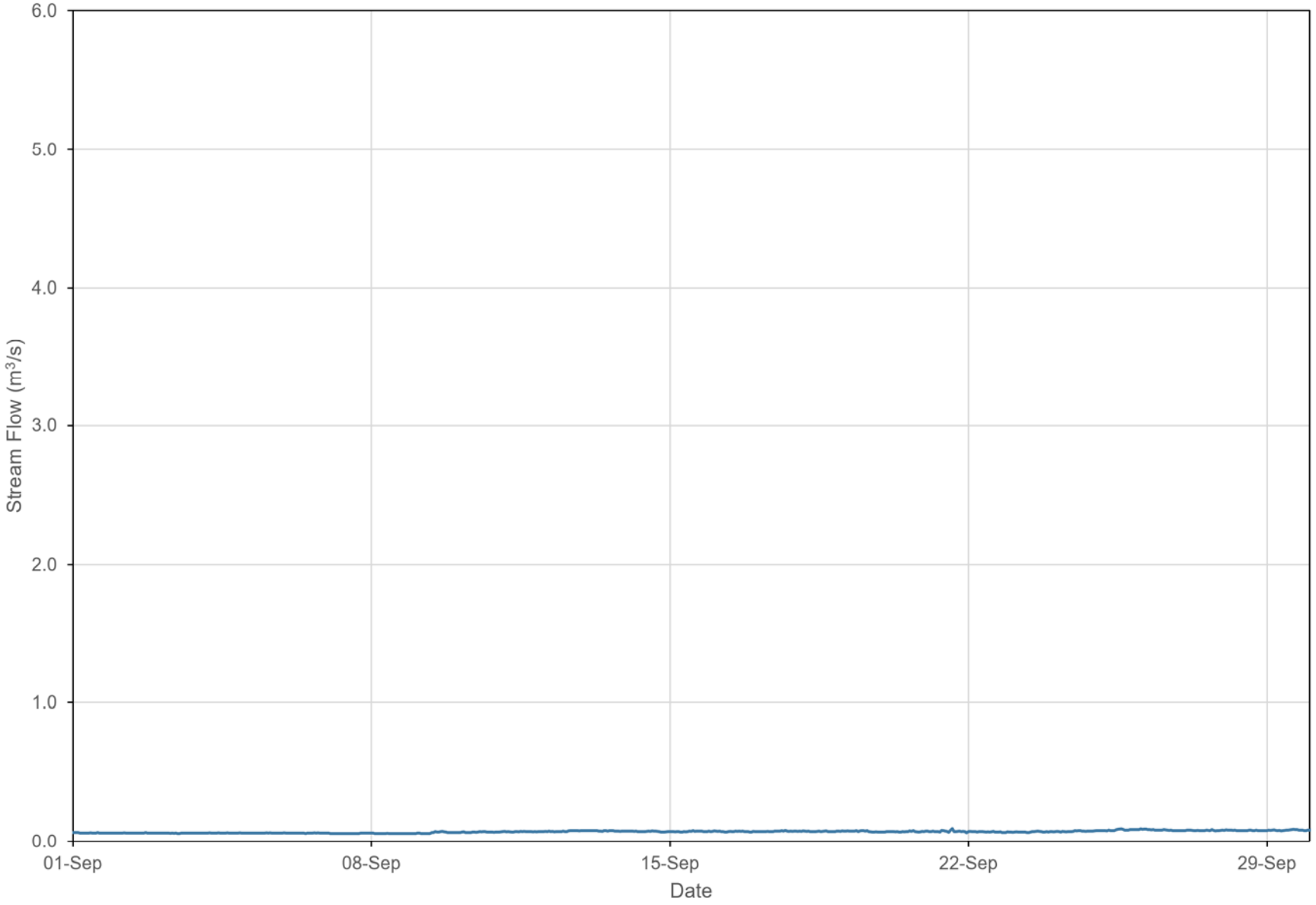


Figure C-10: 2022 Calculated Stream Flow at SWM1
October 2022

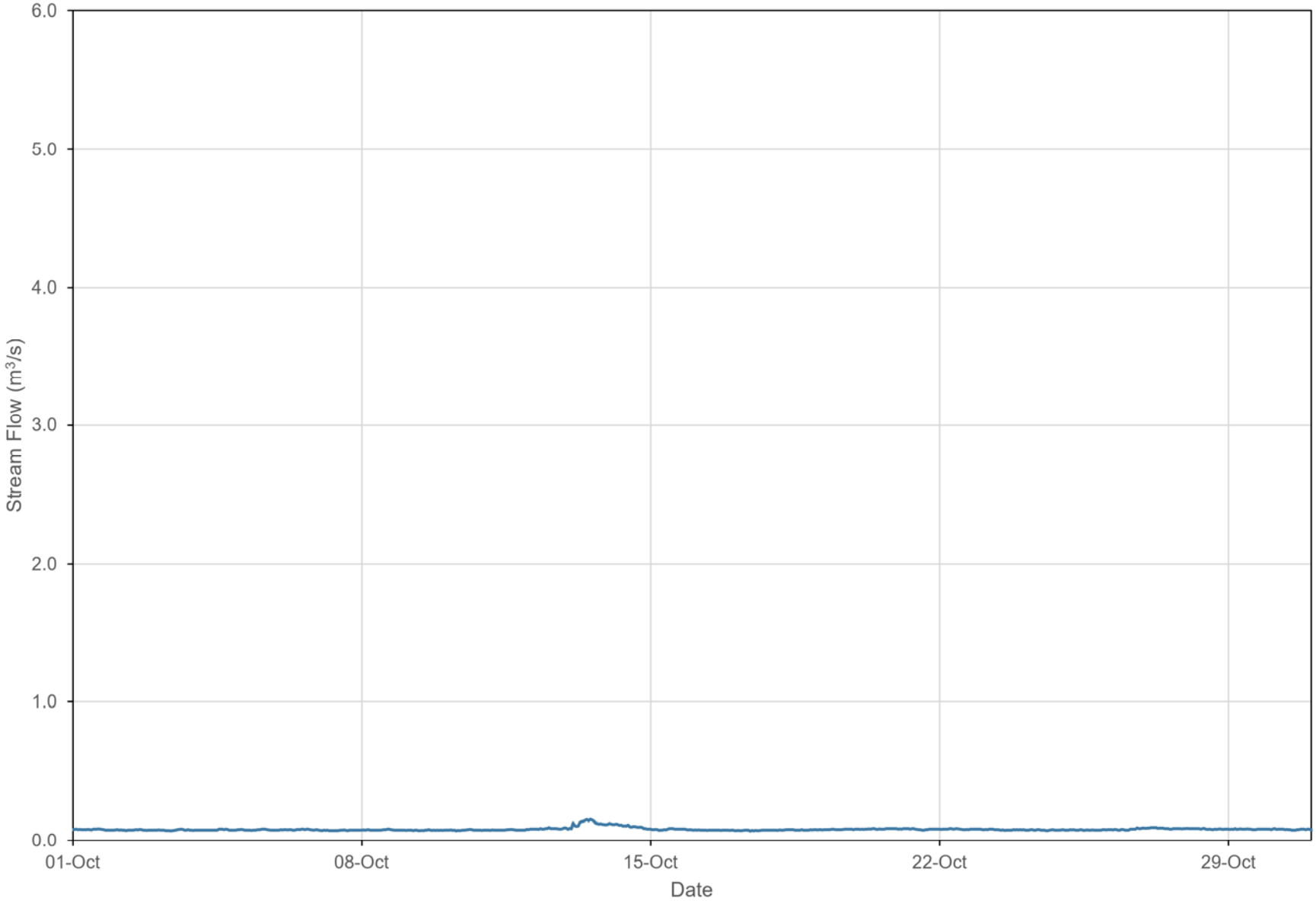


Figure C-11: 2022 Calculated Stream Flow at SWM1
November 2022

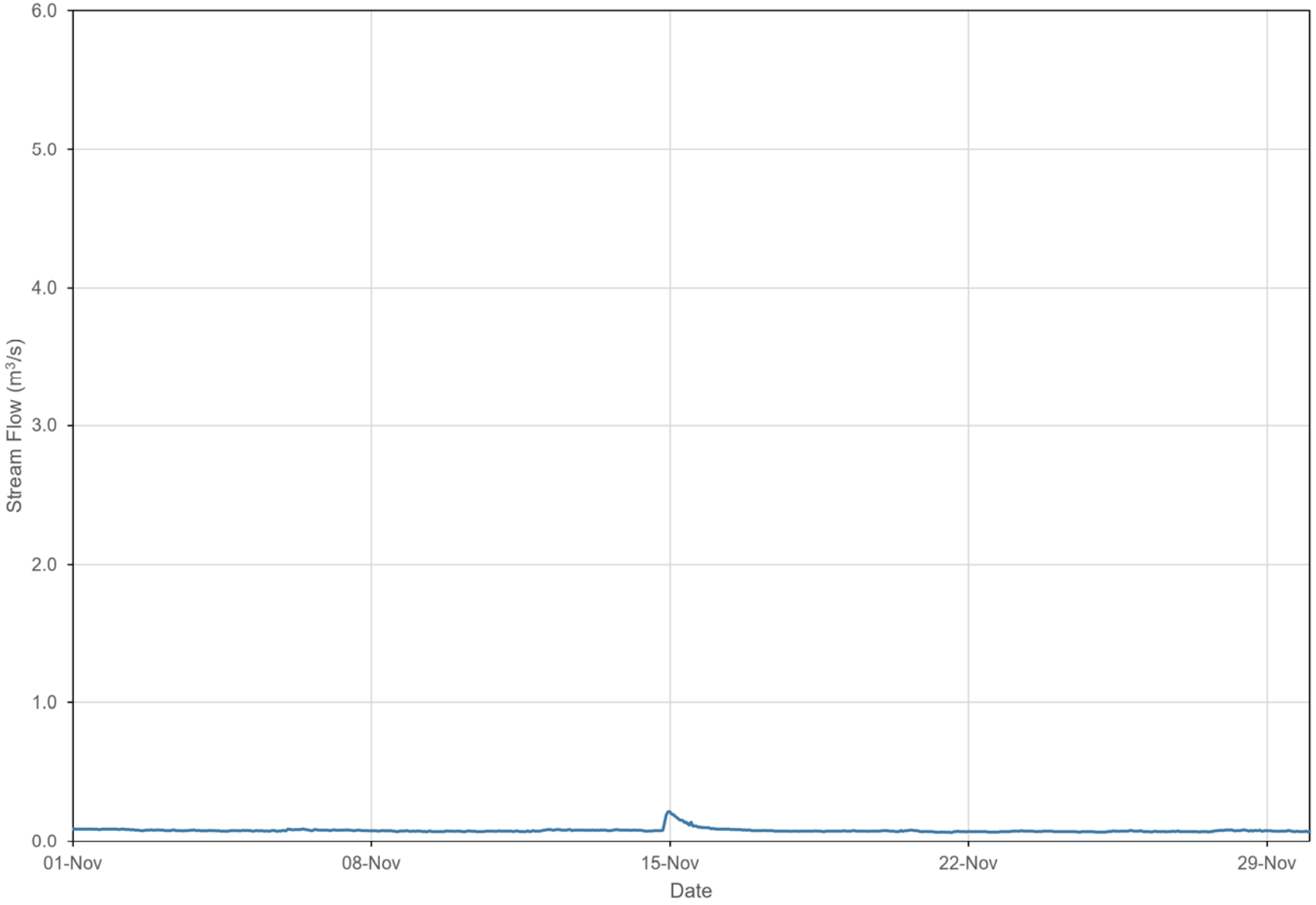


Figure C-12: 2022 Calculated Stream Flow at SWM1
December 2022

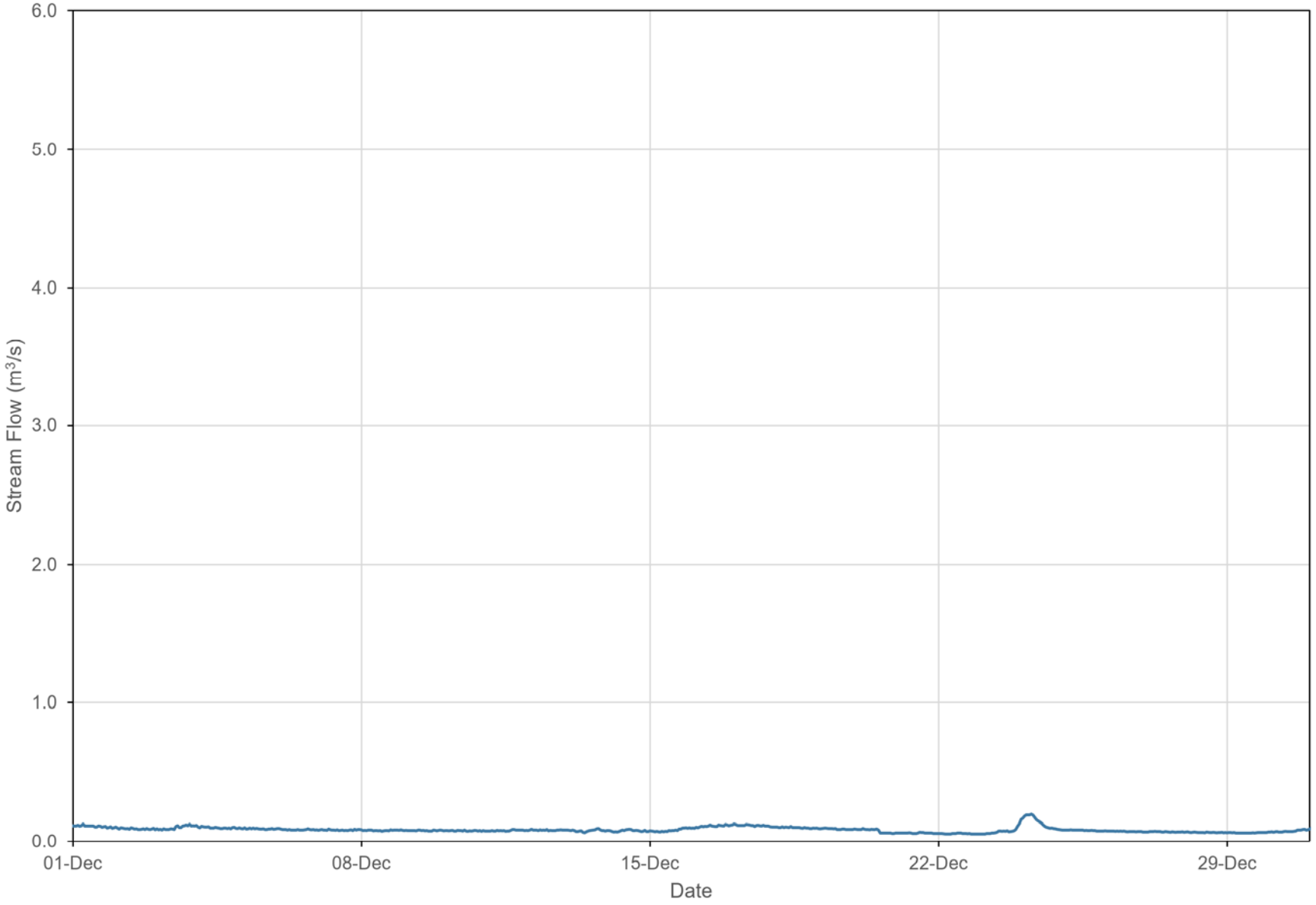


Figure C-13: 2022 Calculated Stream Flow at SWM2
January 2022

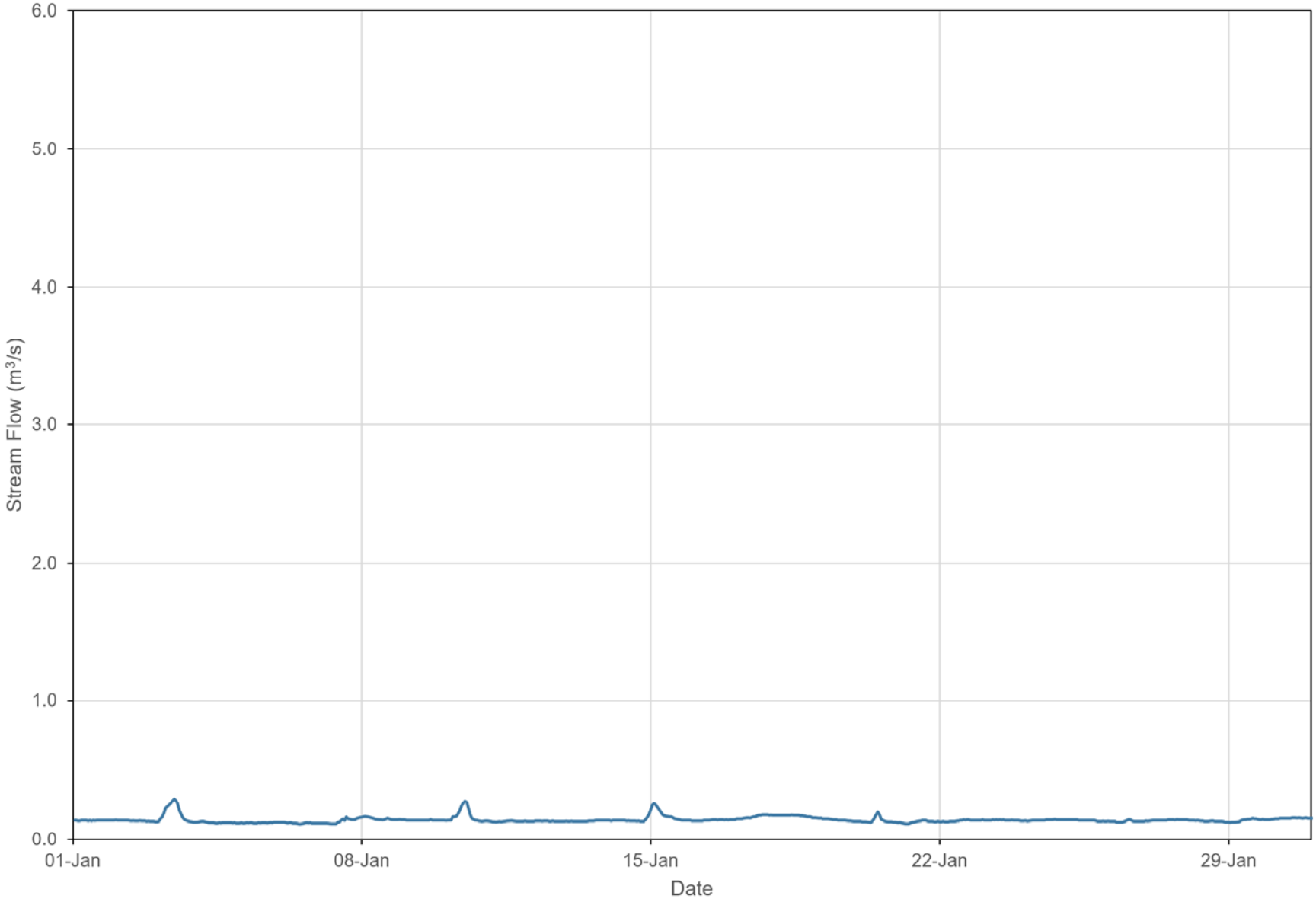


Figure C-14: 2022 Calculated Stream Flow at SWM2
February 2022

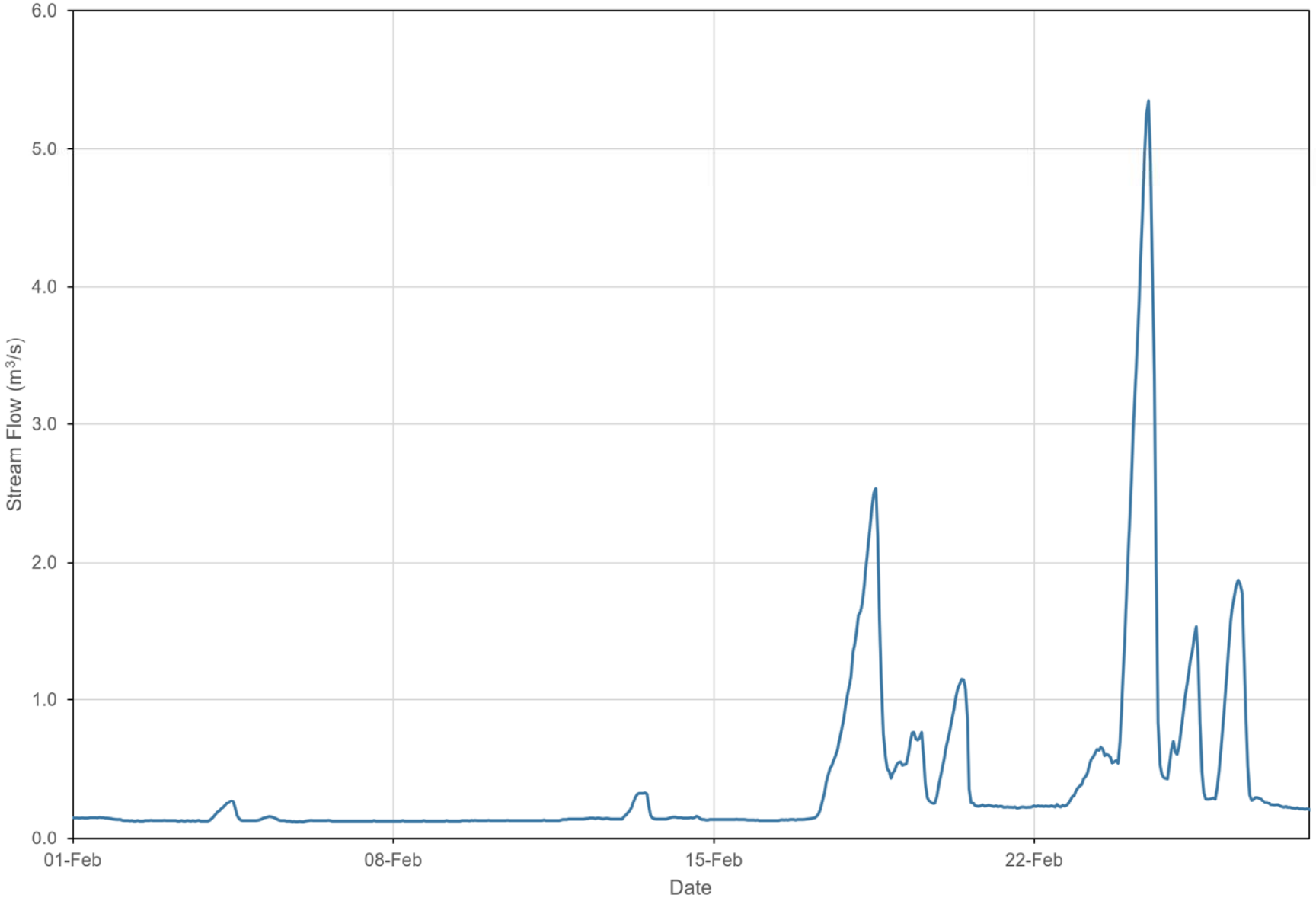


Figure C-15: 2022 Calculated Stream Flow at SWM2
March 2022

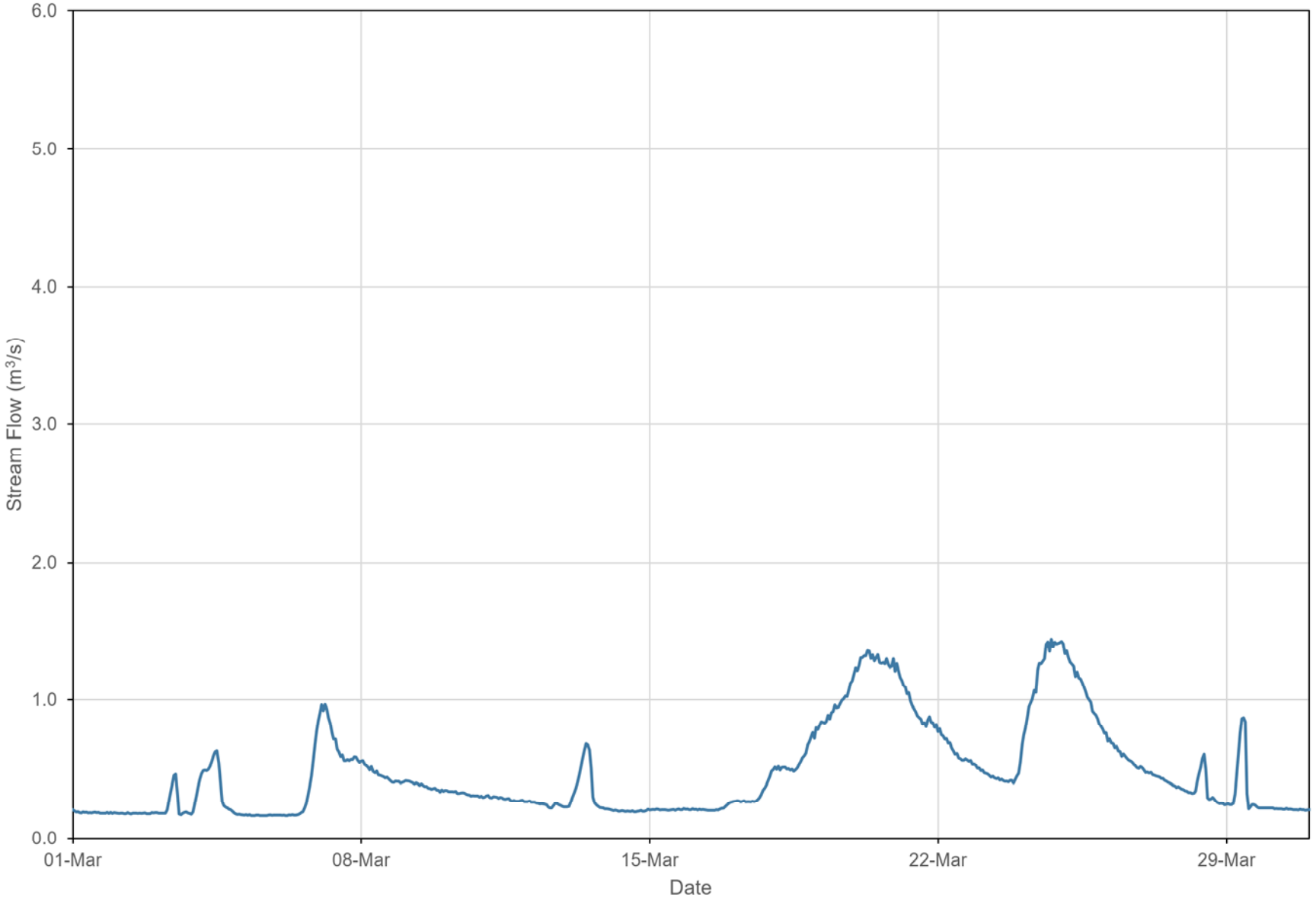


Figure C-16: 2022 Calculated Stream Flow at SWM2
April 2022

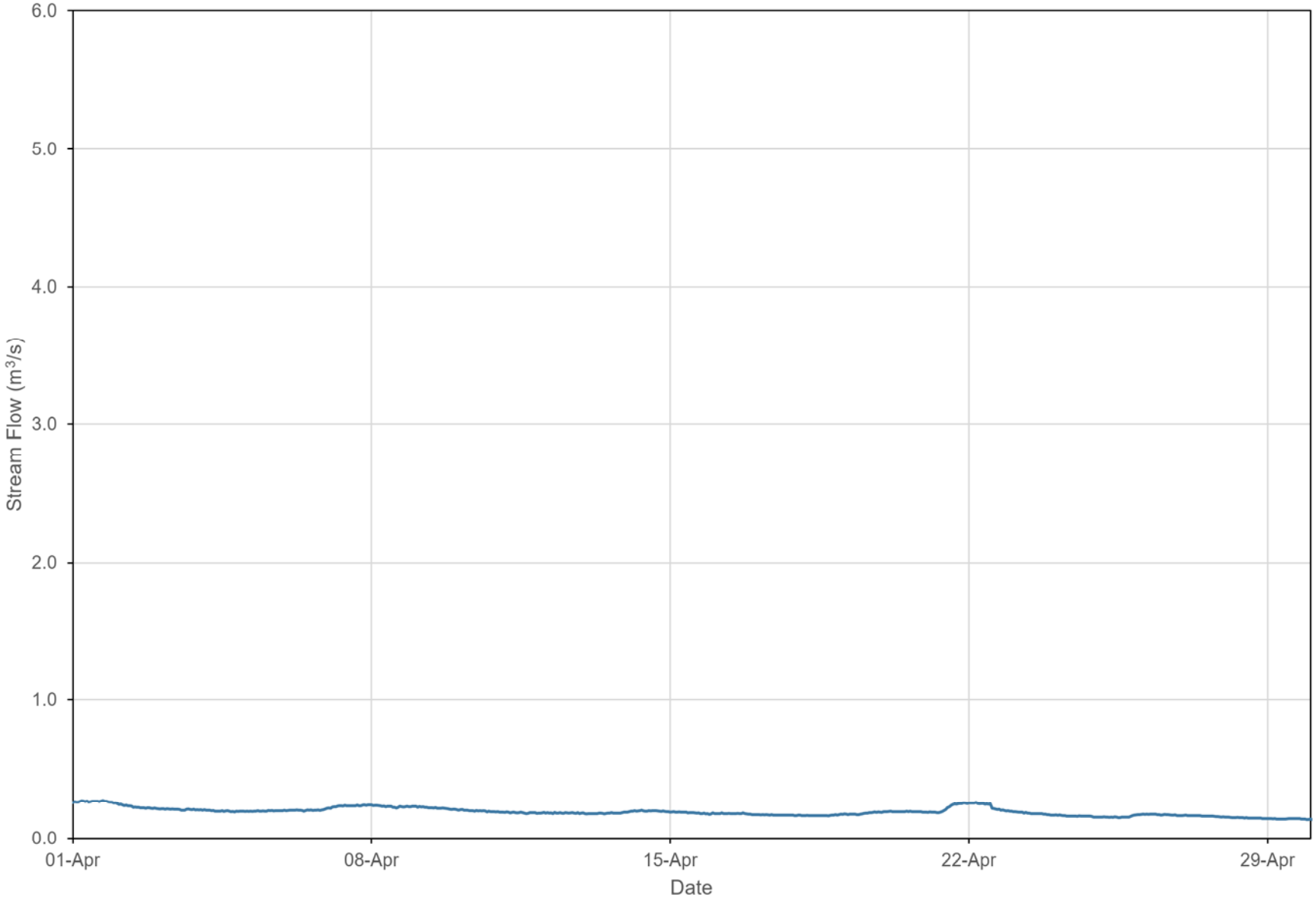


Figure C-17: 2022 Calculated Stream Flow at SWM2
May 2022

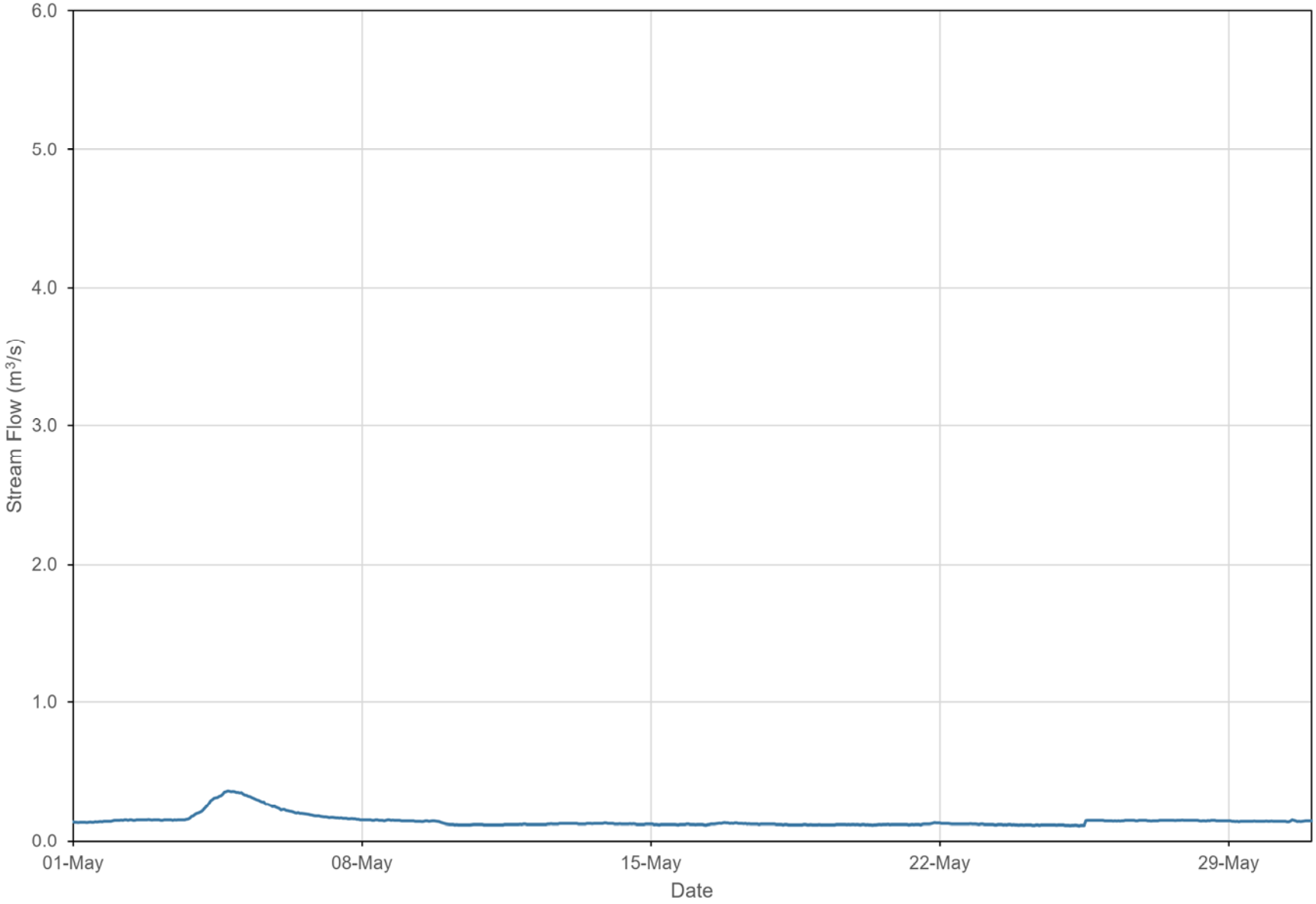


Figure C-18: 2022 Calculated Stream Flow at SWM2
June 2022

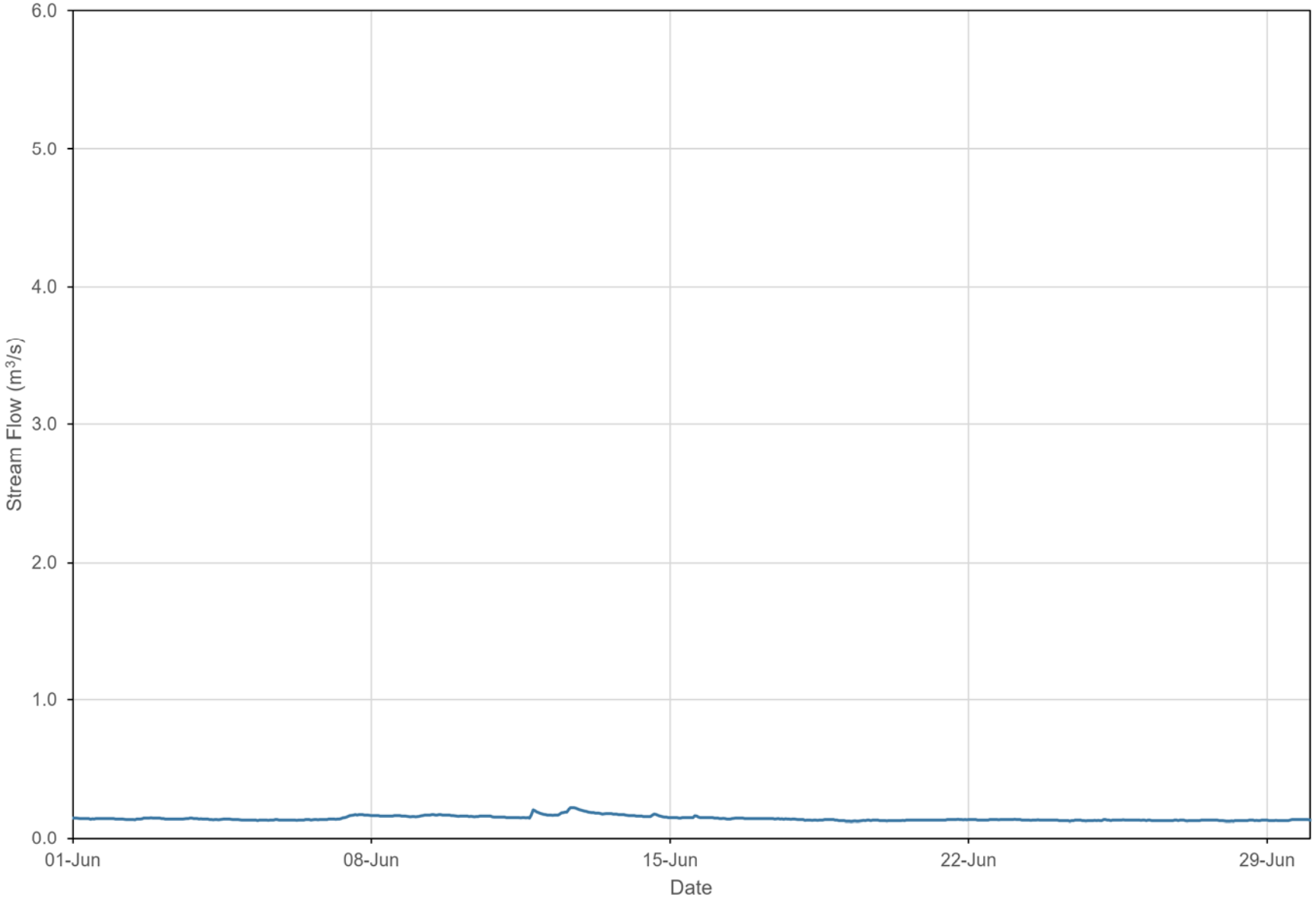


Figure C-19: 2022 Calculated Stream Flow at SWM2
July 2022

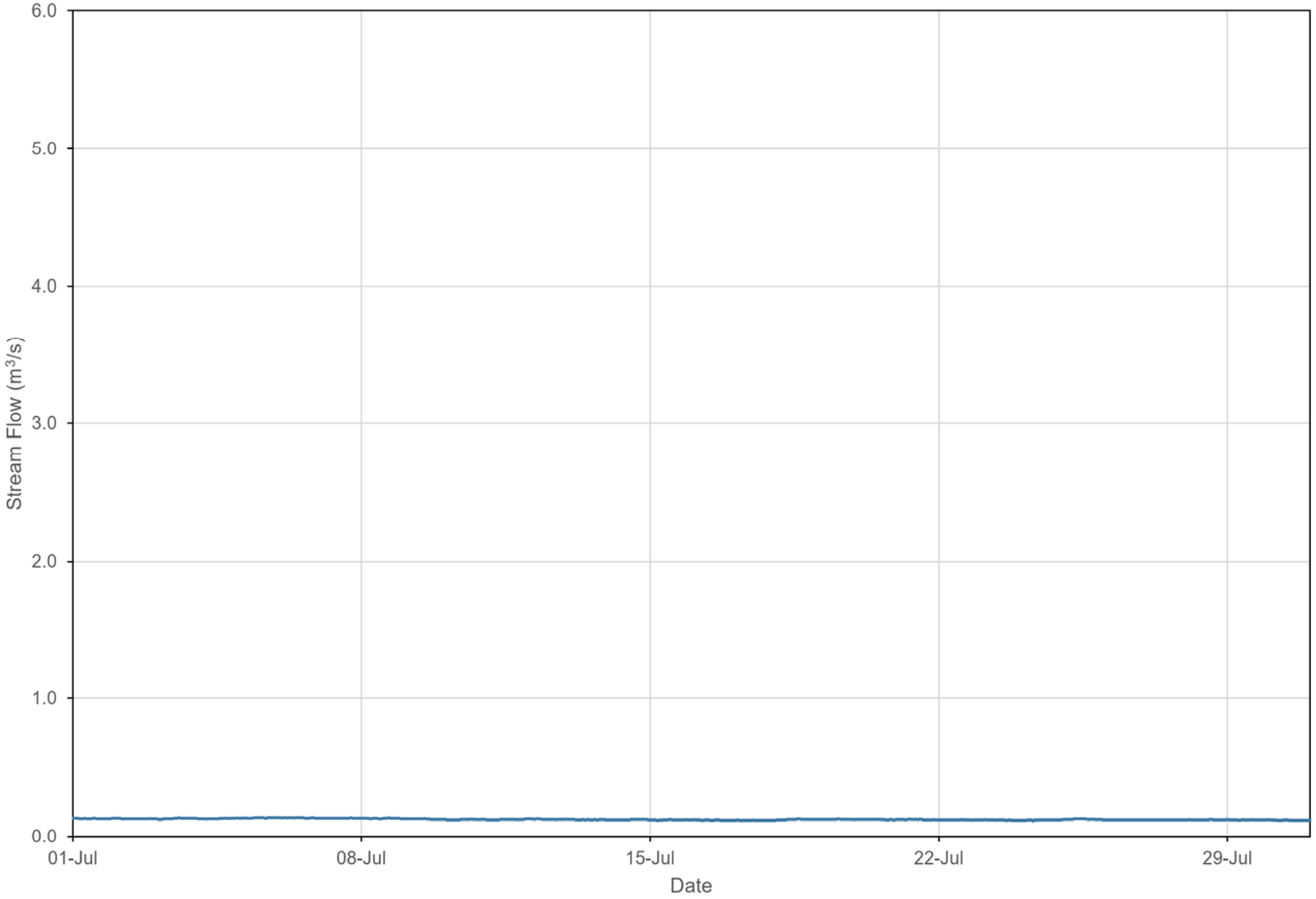


Figure C-20: 2022 Calculated Stream Flow at SWM2
August 2022

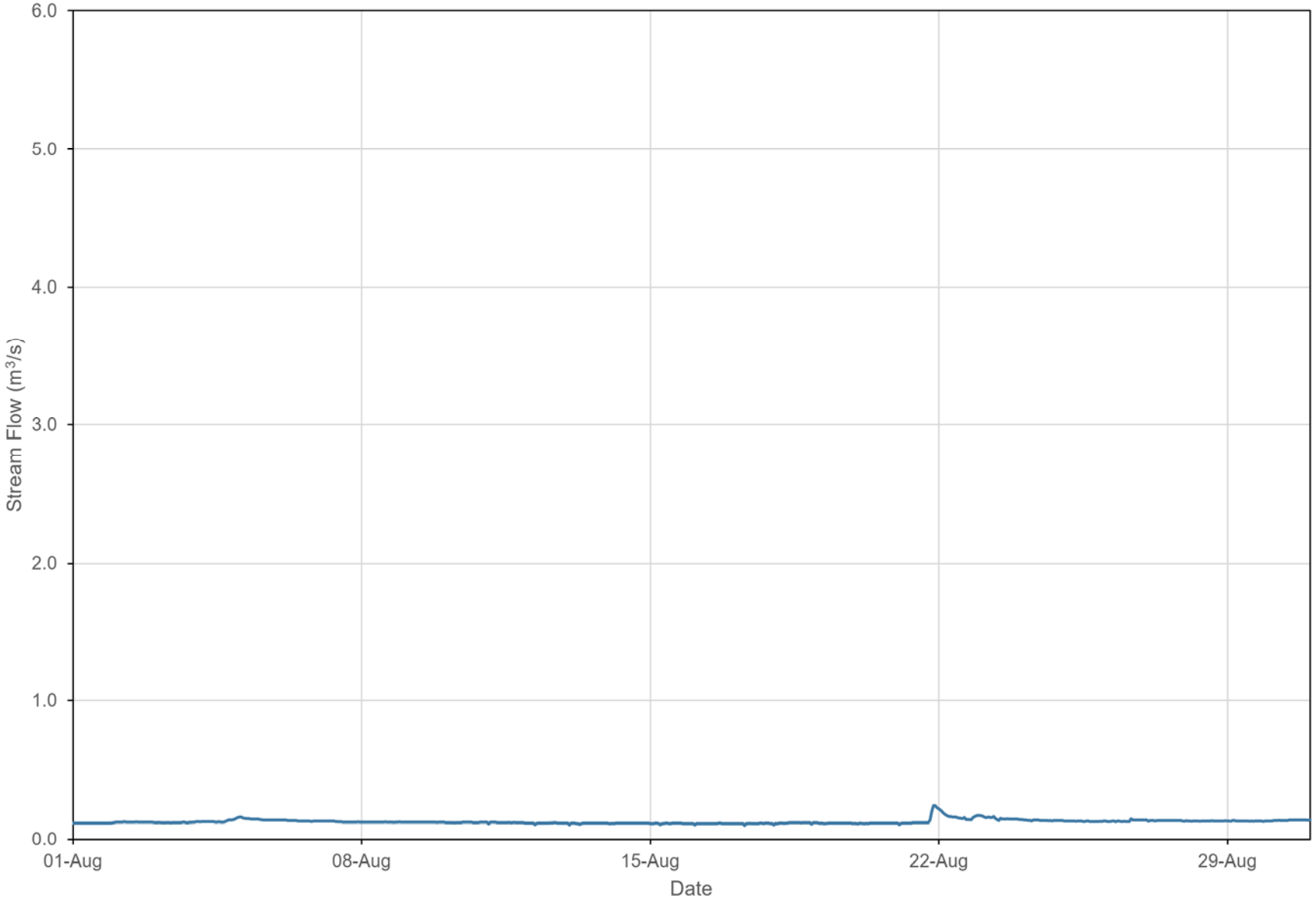


Figure C-21: 2022 Calculated Stream Flow at SWM2
September 2022

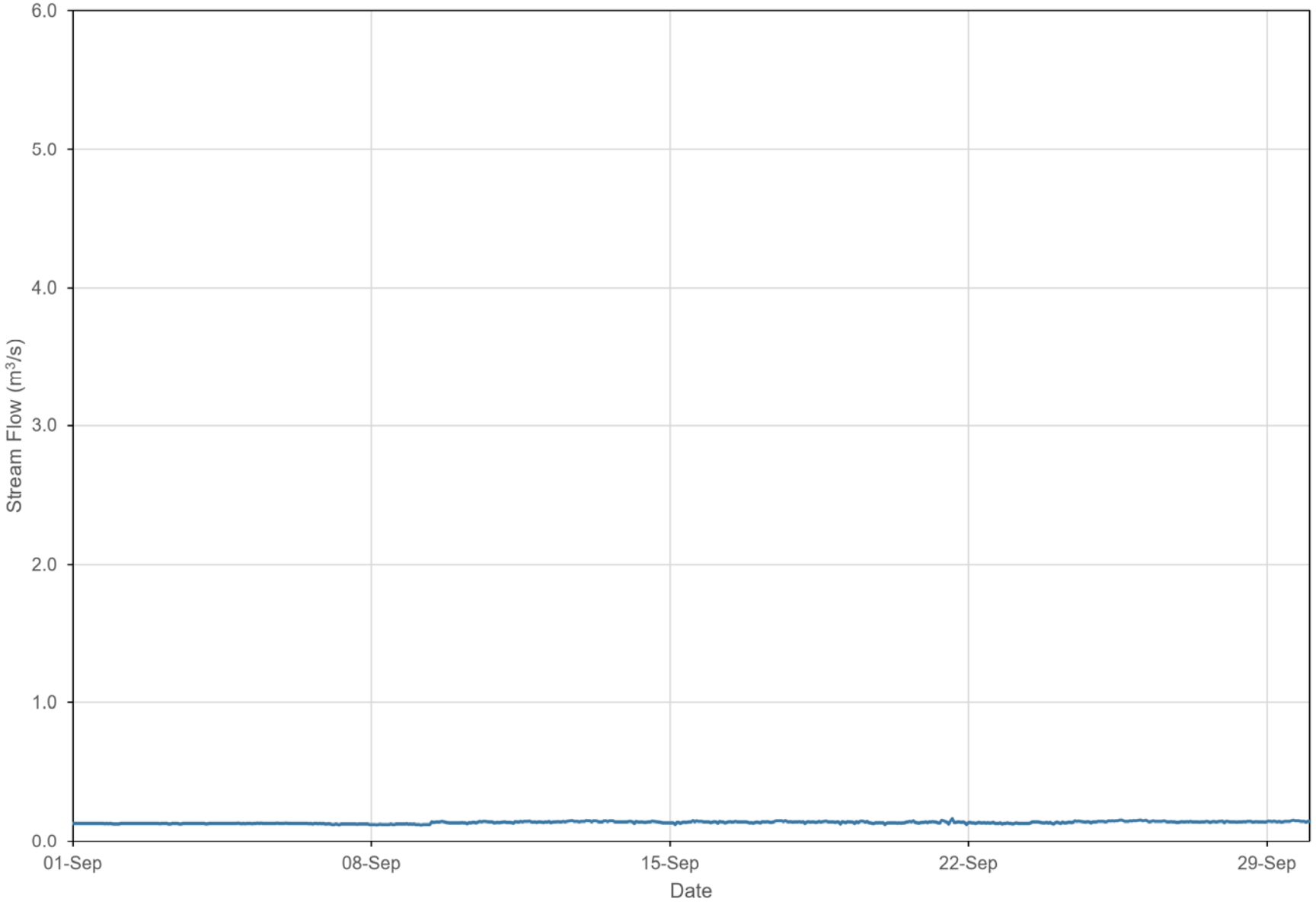


Figure C-22: 2022 Calculated Stream Flow at SWM2
October 2022

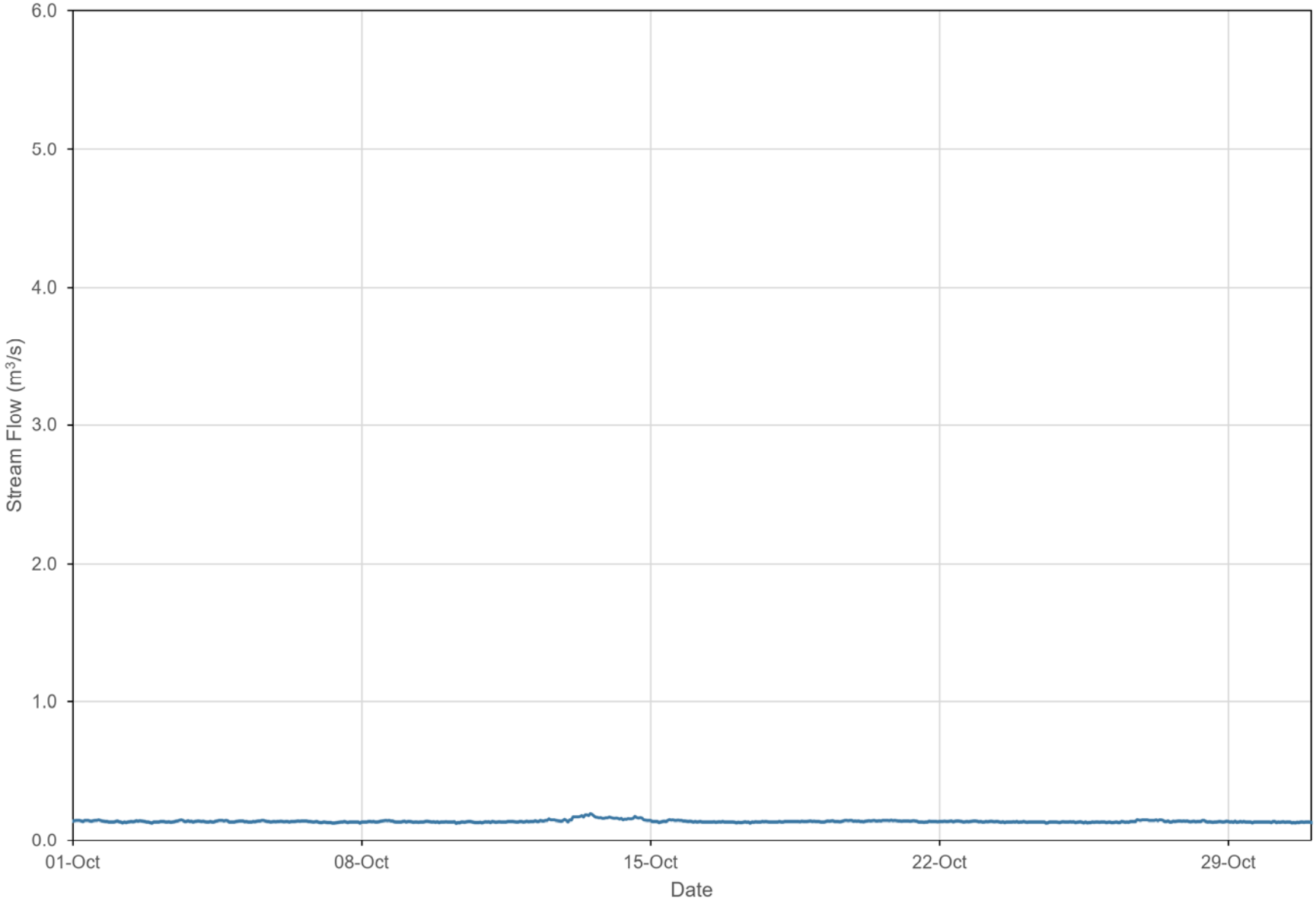


Figure C-24: 2022 Calculated Stream Flow at SWM2
November 2022

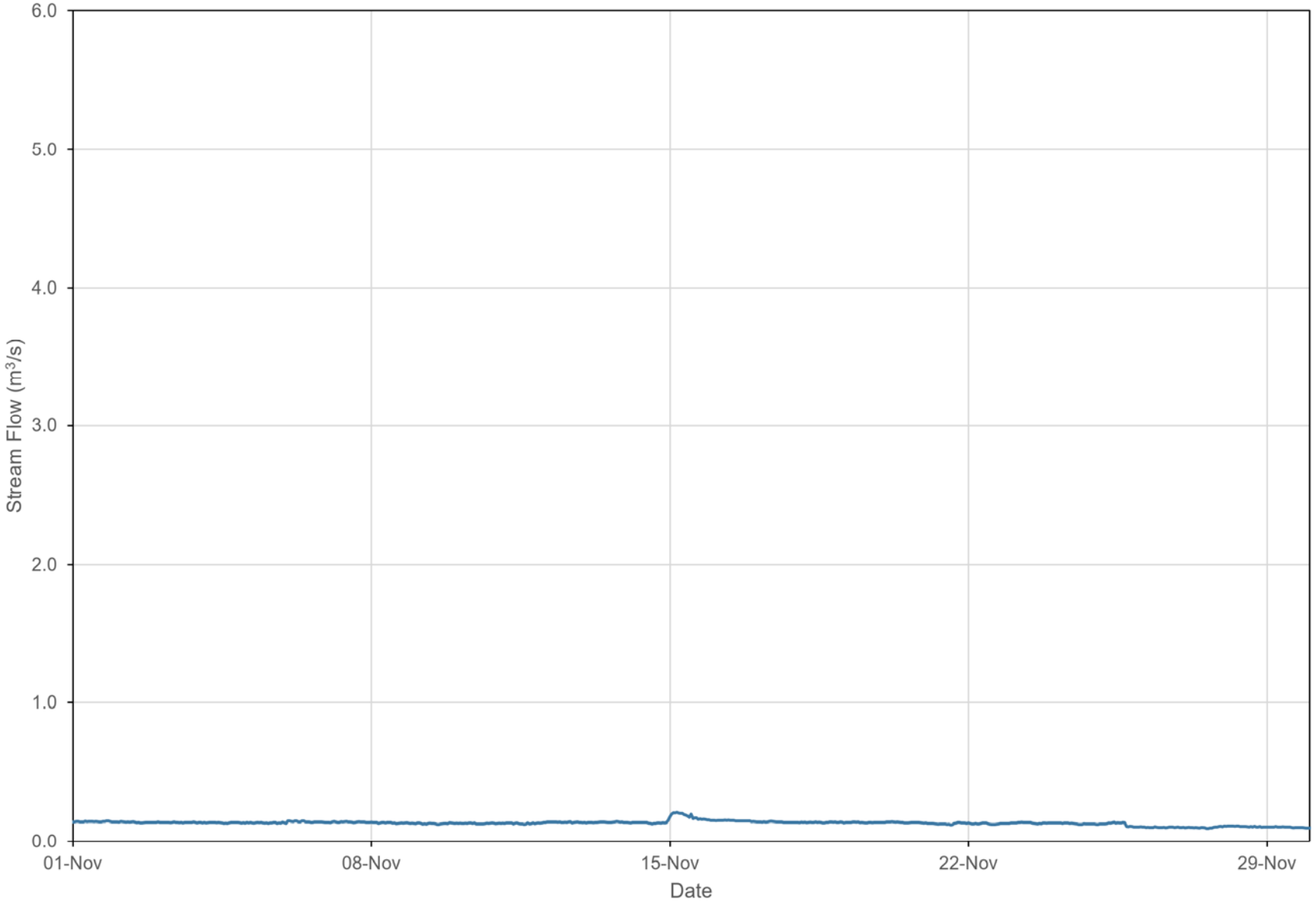
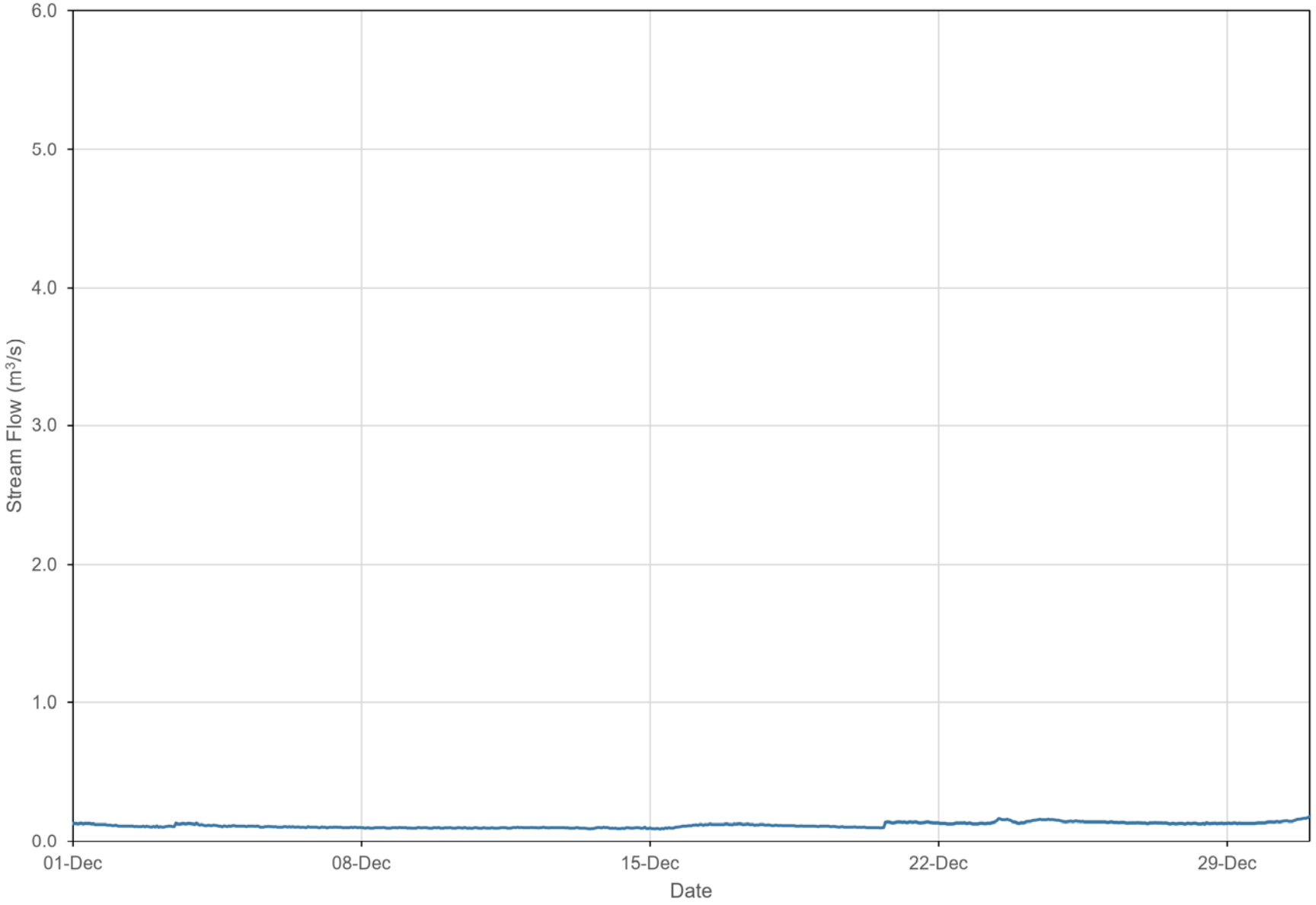


Figure C-24: 2022 Calculated Stream Flow at SWM2
December 2022



APPENDIX

(TECHNICAL APPENDIX A – 2022 SURFACE WATER REPORT)

D

REGRESSION PLOTS FOR AIR TEMPERATURE AND PRECIPITATION VS. FLOW

Figure D-1: Regression Analysis Summary Output
Mean Summer Precipitation versus Summer 7-day Low Flow (2000-2022)

Regression Statistics	
Multiple R	0.549279765
R Square	0.30170826
Adjusted R Square	0.268456272
Standard Error	70.3779227
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	44940.97374	44940.97374	9.073390246	0.006634053
Residual	21	104014.0921	4953.052004		
Total	22	148955.0658			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	123.6433711	45.73446331	2.703505456	0.013306042	28.533348	218.7533941	28.533348	218.7533941
X Variable 1	619.5758249	205.6883378	3.012206873	0.006634053	191.8235098	1047.32814	191.8235098	1047.32814

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	253.1347185	47.86528153
2	209.1448349	-77.34483491
3	215.960169	-40.46016898
4	226.492958	1.407041999
5	236.4061712	-44.9061712
6	256.2325976	79.26740241
7	220.2971998	18.20280025
8	189.3184085	-114.8184085
9	284.7330855	83.26691446
10	307.6573911	-1.157391057
11	293.4071471	-5.707147086
12	252.5151426	-71.61514265
13	240.1236261	-82.12362615
14	315.7118768	-24.71187678
15	271.7219932	-67.02199322
16	293.4071471	2.592852914
17	286.591813	21.50818699
18	358.4626087	-44.9626087
19	289.0701163	47.82988369
20	259.3304767	56.66952328
21	202.5153736	44.65962642
22	197.9924701	194.5075299
23	184.5476747	-22.94767466

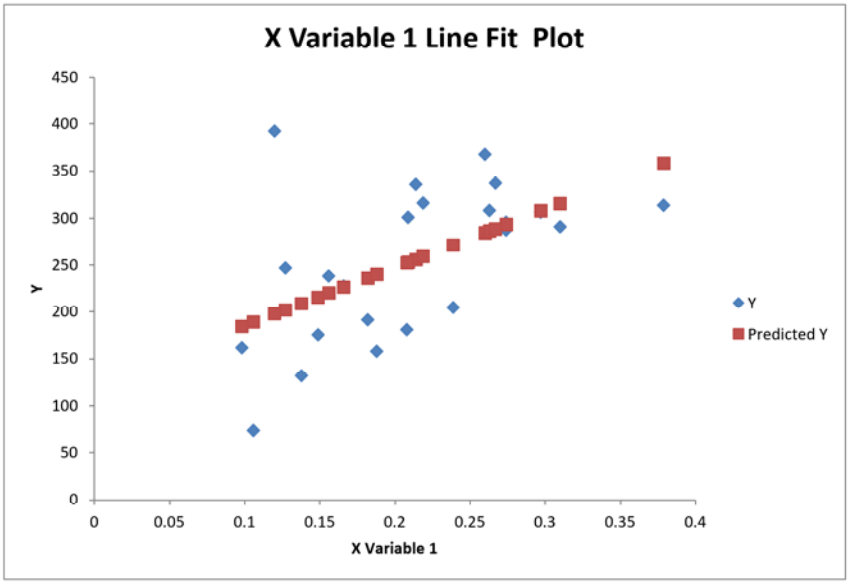


Figure D-2: Regression Analysis Summary Output
Total Summer Temperature versus Summer 7-day Low Flow (2000-2022)

Regression Statistics	
Multiple R	0.029753828
R Square	0.00088529
Adjusted R Square	-0.046691601
Standard Error	1.49890971
Observations	23

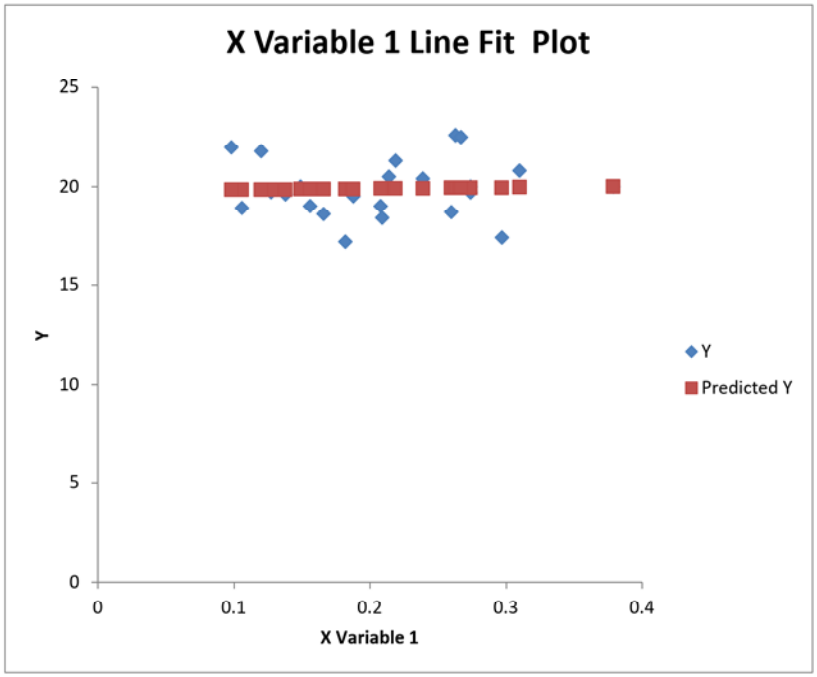
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.041806189	0.041806189	0.018607569	0.892796772
Residual	21	47.1813367	2.246730319		
Total	22	47.22314289			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	19.76903654	0.974053062	20.29564641	2.79637E-15	17.7433823	21.79469077	17.7433823	21.79469077
X Variable 1	0.597576507	4.380752301	0.136409563	0.892796772	-8.512696628	9.707849642	-8.512696628	9.707849642

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	19.89393003	-1.493930026
2	19.85150209	-0.251502094
3	19.85807544	0.141924564
4	19.86823424	-1.268234237
5	19.87779546	-2.677795461
6	19.89691791	0.603082091
7	19.86225847	-0.862258471
8	19.83237965	-0.932379646
9	19.92440643	-1.224406428
10	19.94651676	-2.546516759
11	19.9327725	-0.232772499
12	19.89333245	-0.89333245
13	19.88138092	-0.38138092
14	19.95428525	0.845714746
15	19.91185732	0.488142678
16	19.9327725	0.067227501
17	19.92619916	2.673800842
18	19.99551803	0.004481967
19	19.92858946	2.571410536
20	19.89990579	1.400094209
21	19.84510803	-0.13284612
22	19.84074572	1.949254283
23	19.82777831	2.152221693



APPENDIX

(TECHNICAL APPENDIX A – 2022 SURFACE WATER REPORT)

E MONTHLY WATER TEMPERATURE DATA

Figure E-1: Water Temperature at SWM1 and SWM2
January 2022

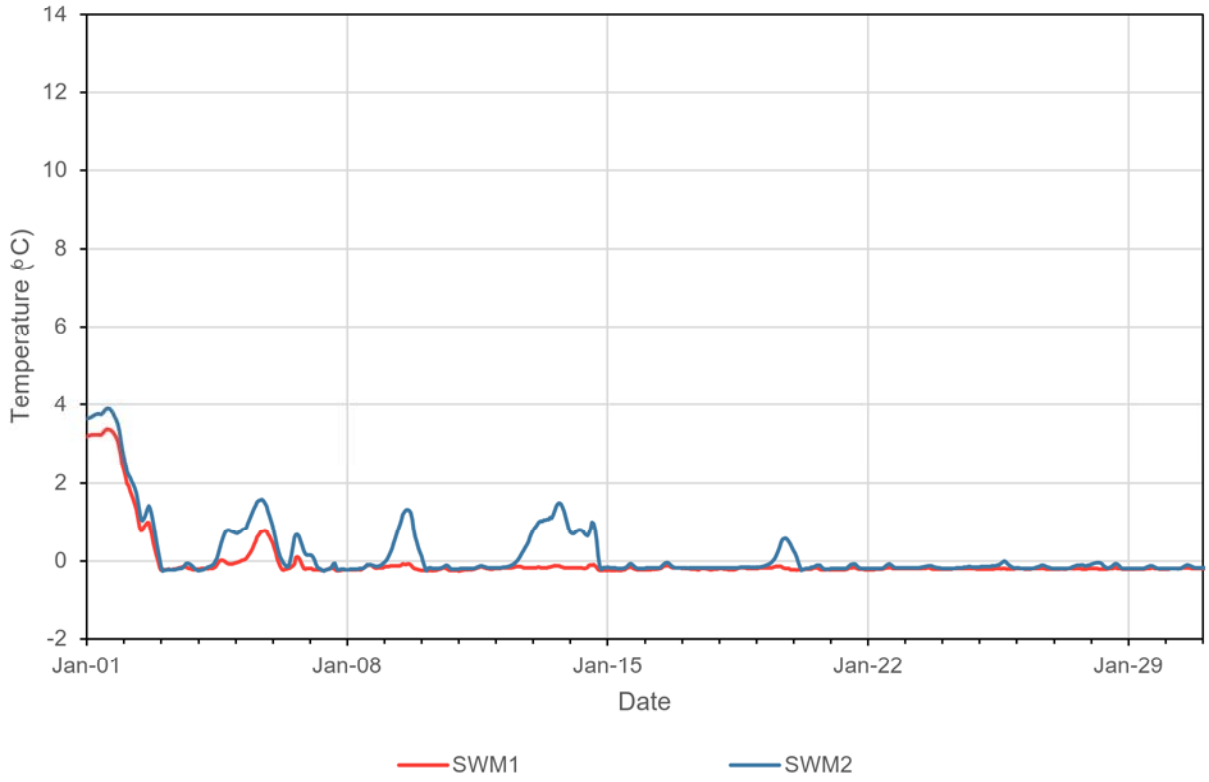


Figure E-2: Water Temperature at SWM3 and SWM4
January 2022

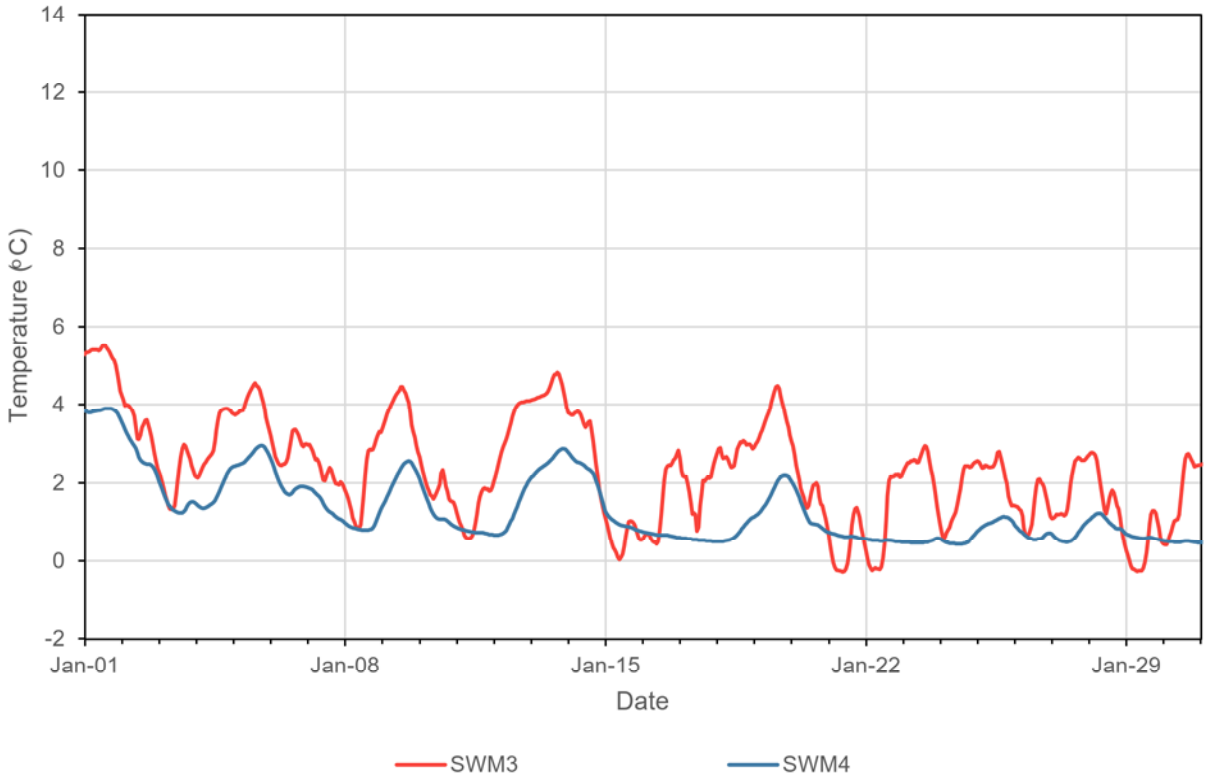


Figure E-3: Water Temperature at SWM1 and SWM2
February 2022

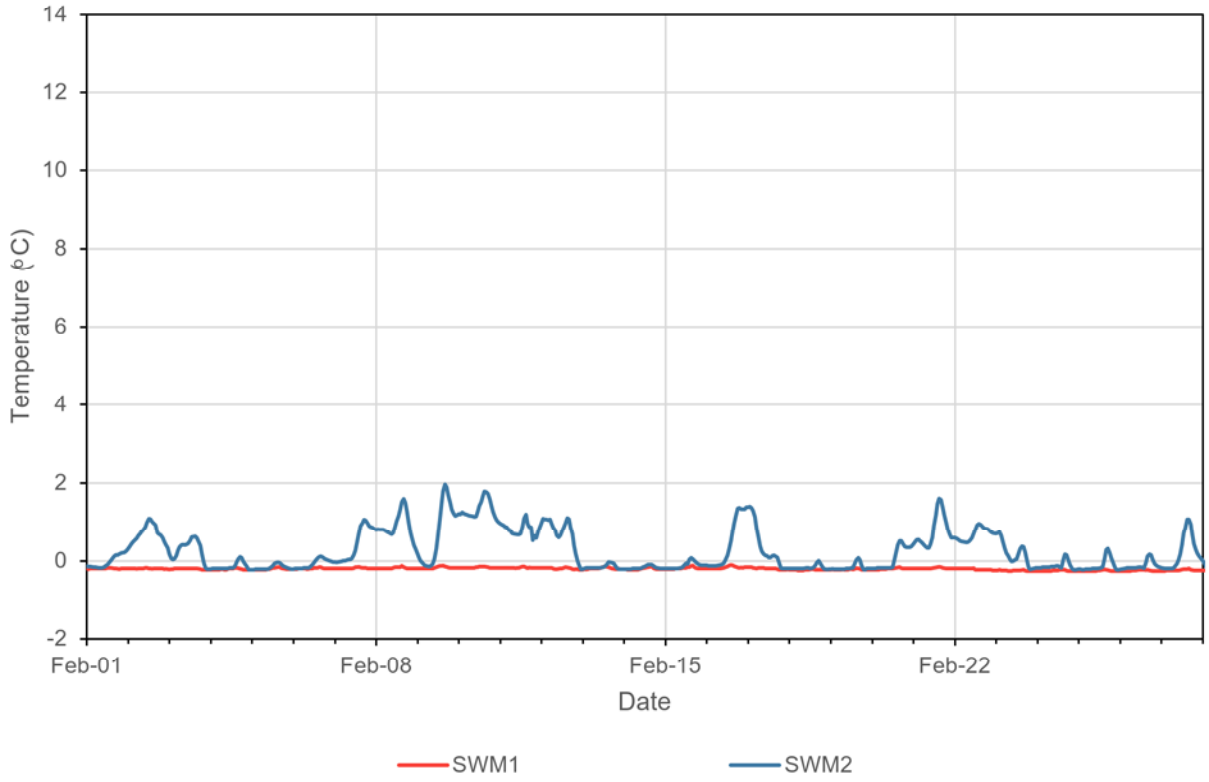


Figure E-4: Water Temperature at SWM3 and SWM4
February 2022

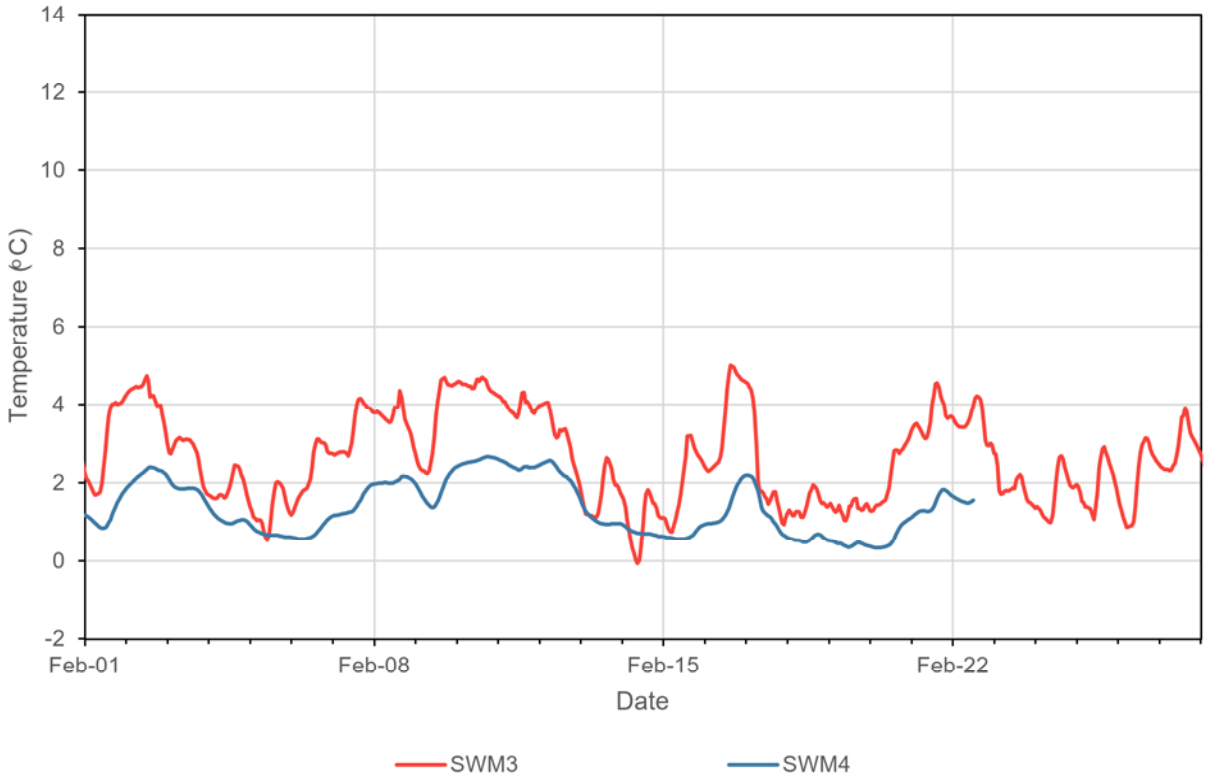


Figure E-5: Water Temperature at SWM1 and SWM2
March 2022

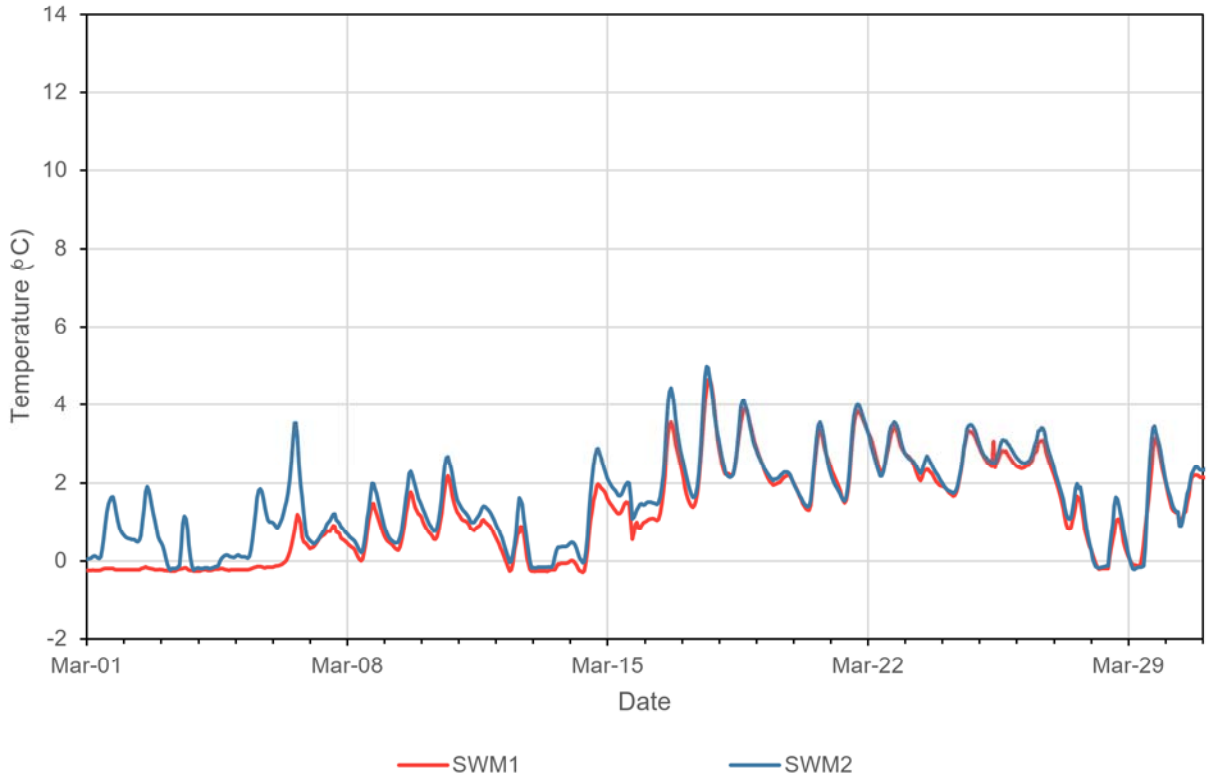


Figure E-6: Water Temperature at SWM3 and SWM4
March 2022

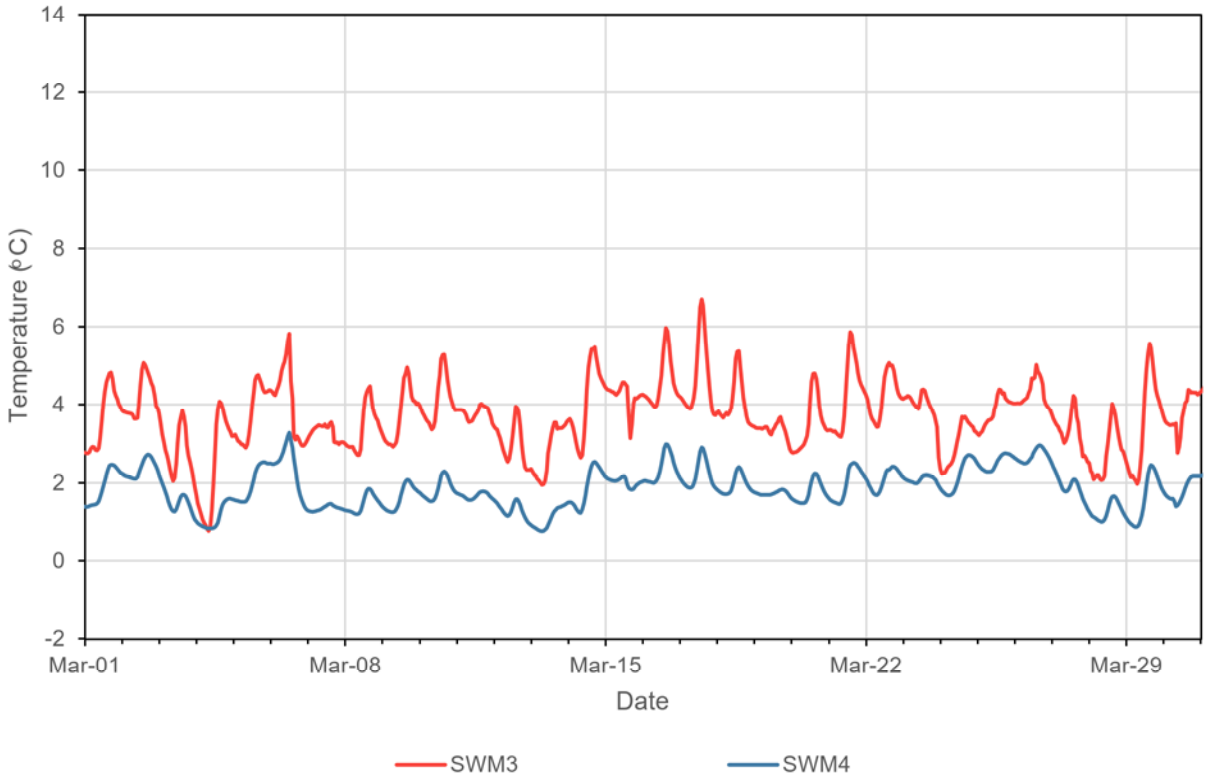


Figure E-7: Water Temperature at SWM1 and SWM2
April 2022

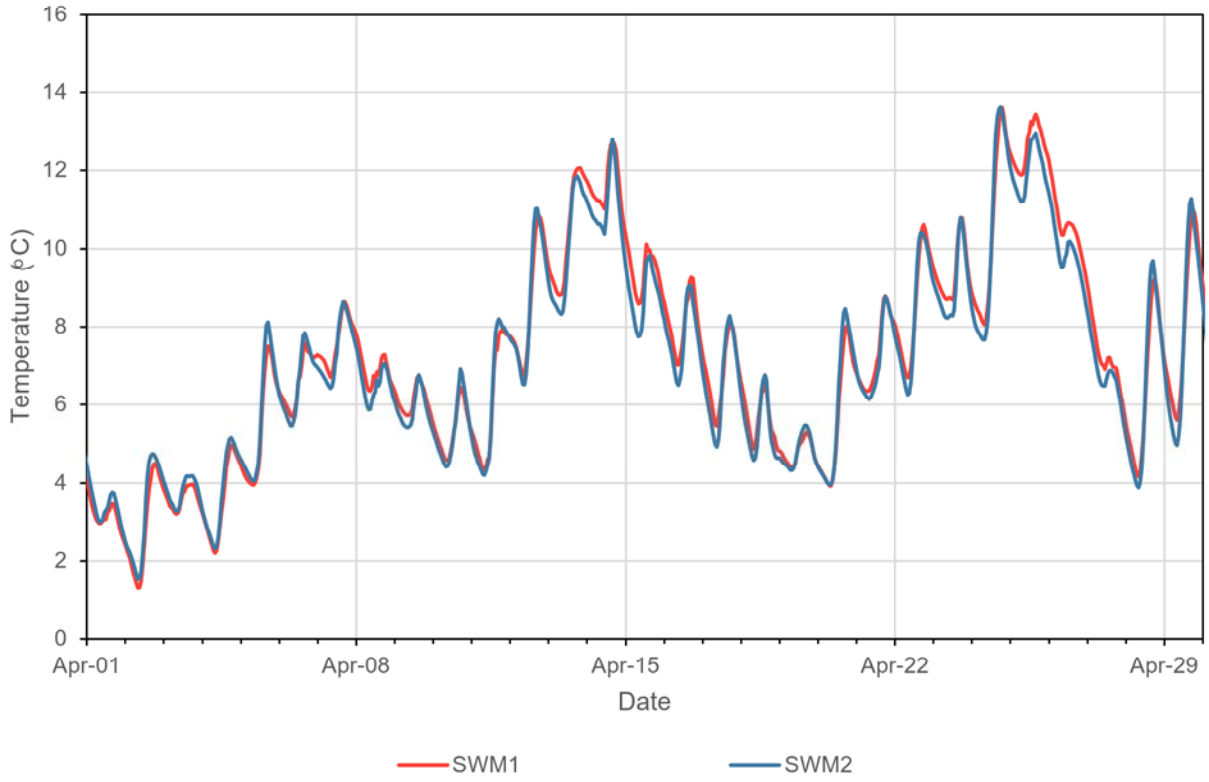


Figure E-8: Water Temperature at SWM3 and SWM4
April 2022

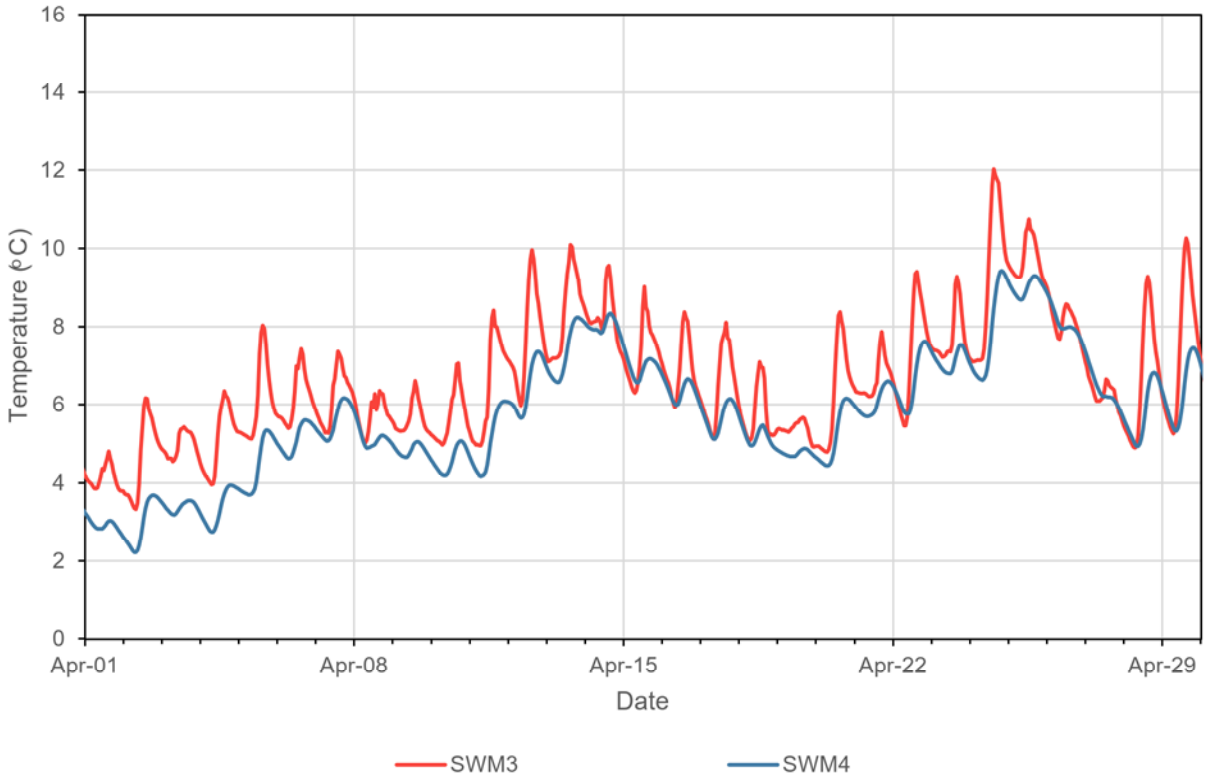


Figure E-9: Water Temperature at SWM1 and SWM2
May 2022

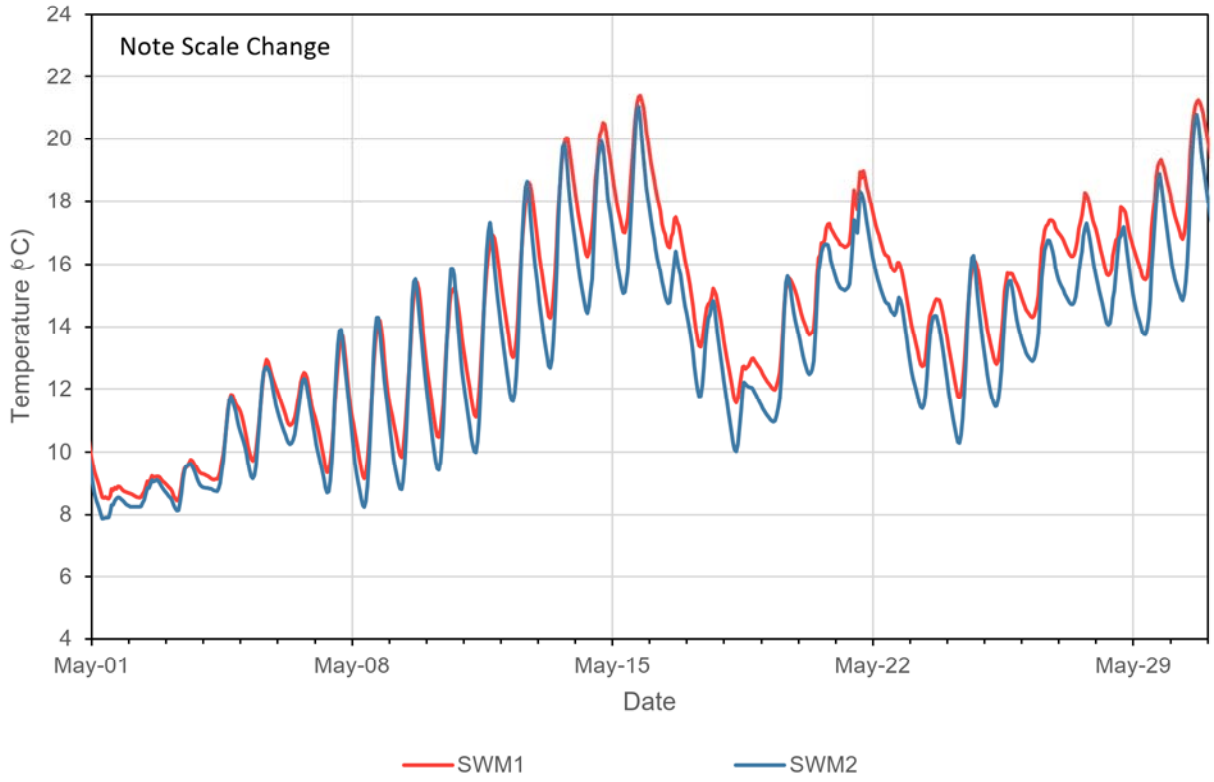


Figure E-10: Water Temperature at SWM3 and SWM4
May 2022

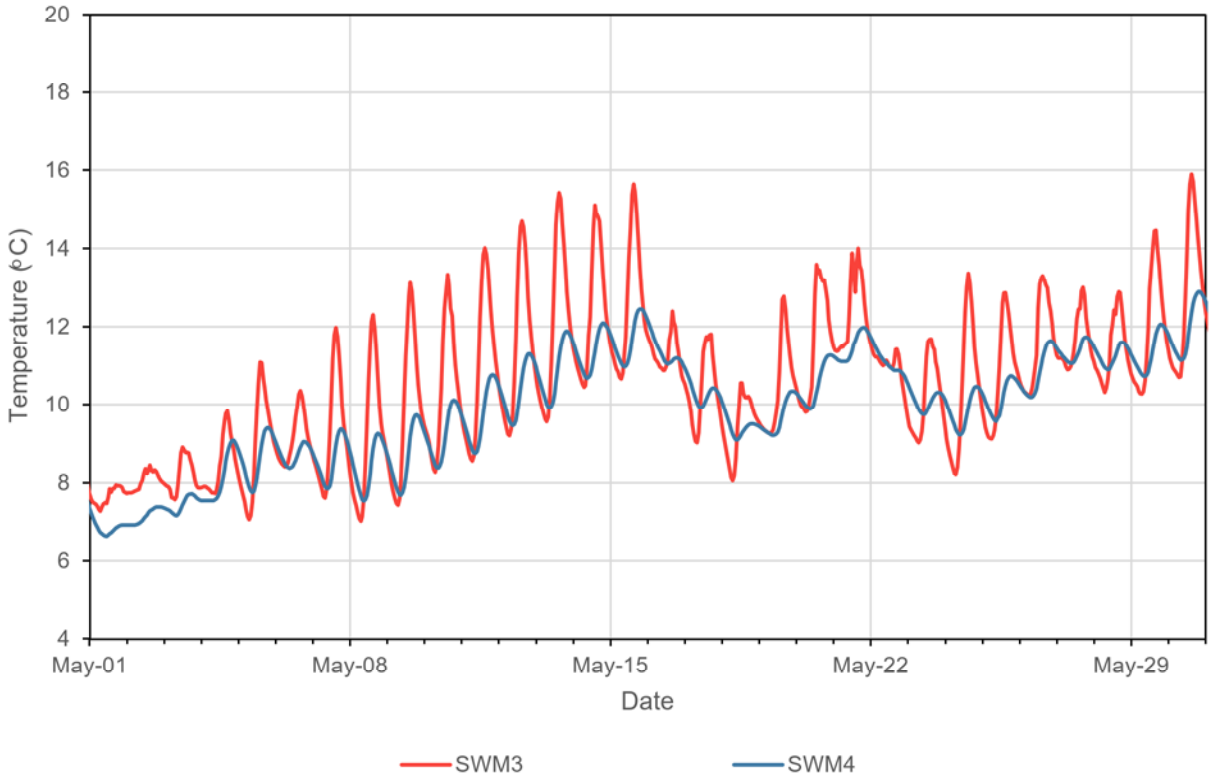


Figure E-11: Water Temperature at SWM1 and SWM2
June 2022

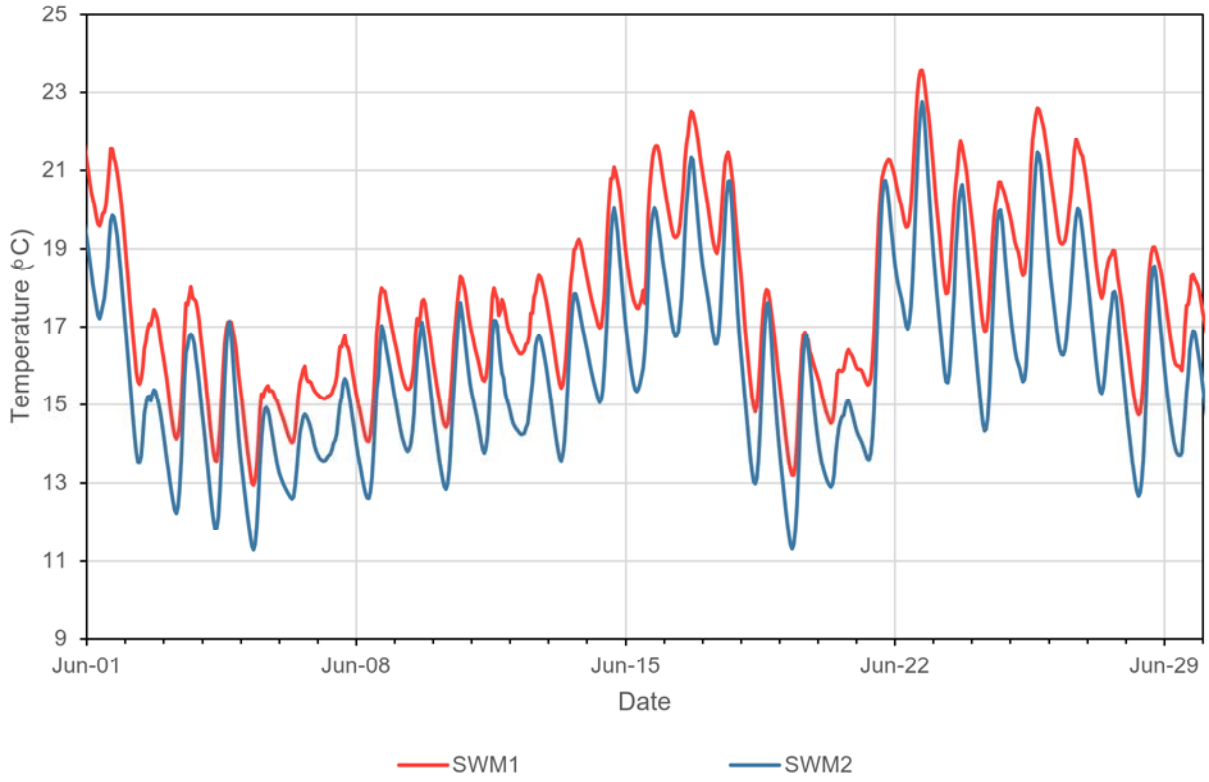


Figure E-12: Water Temperature at SWM3 and SWM4
June 2022

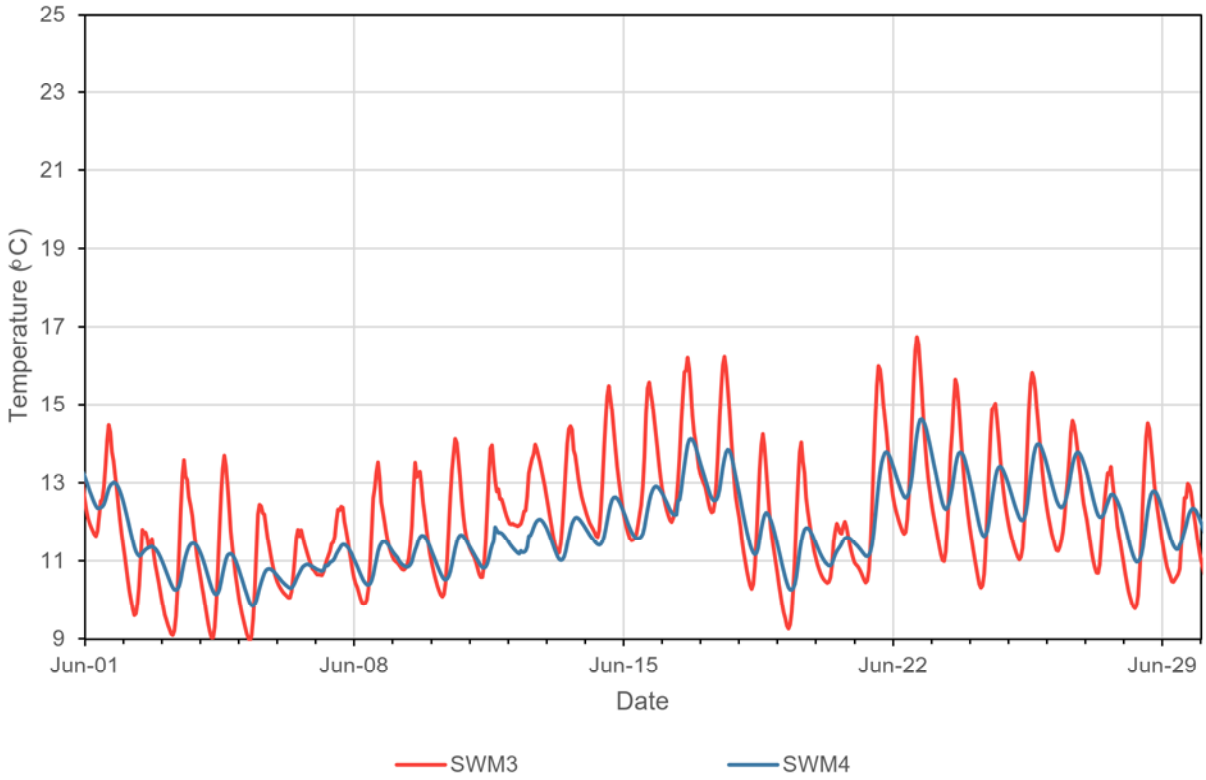


Figure E-13: Water Temperature at SWM1 and SWM2
July 2022

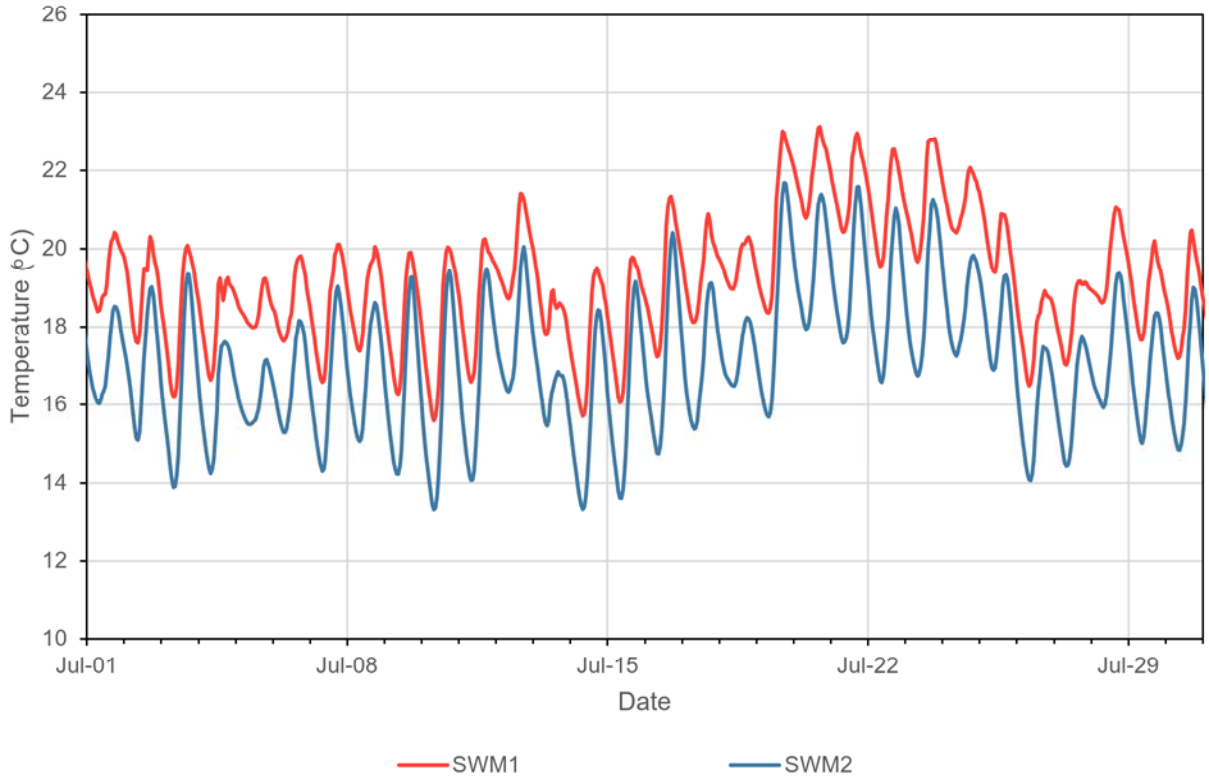


Figure E-14: Water Temperature at SWM3 and SWM4
July 2022

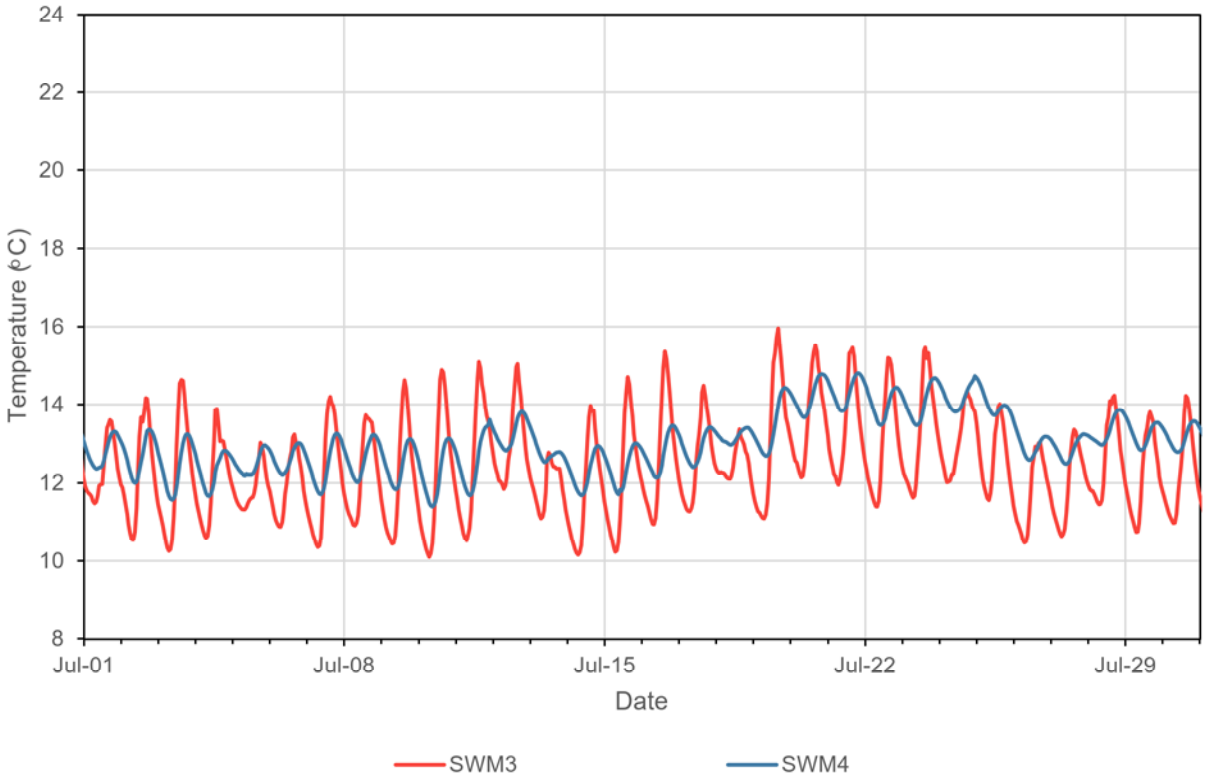


Figure E-15: Water Temperature at SWM1 and SWM2
August 2022

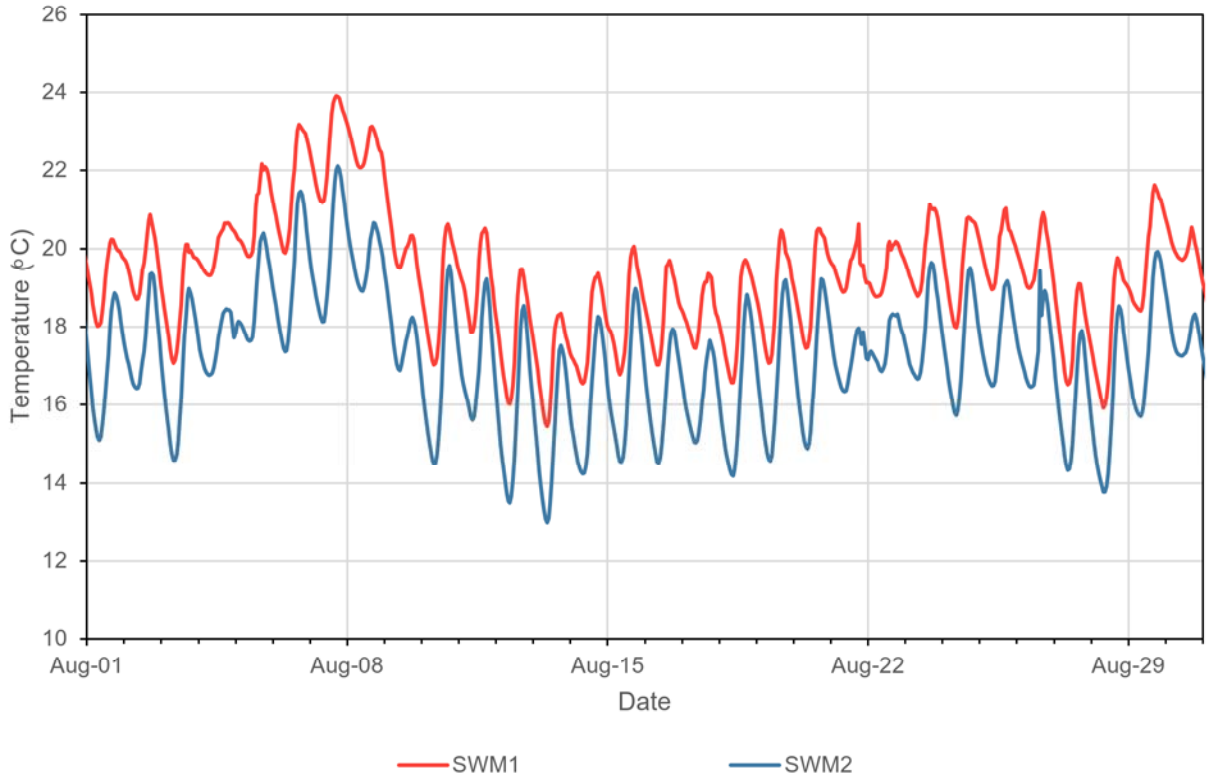


Figure E-16: Water Temperature at SWM3 and SWM4
August 2022

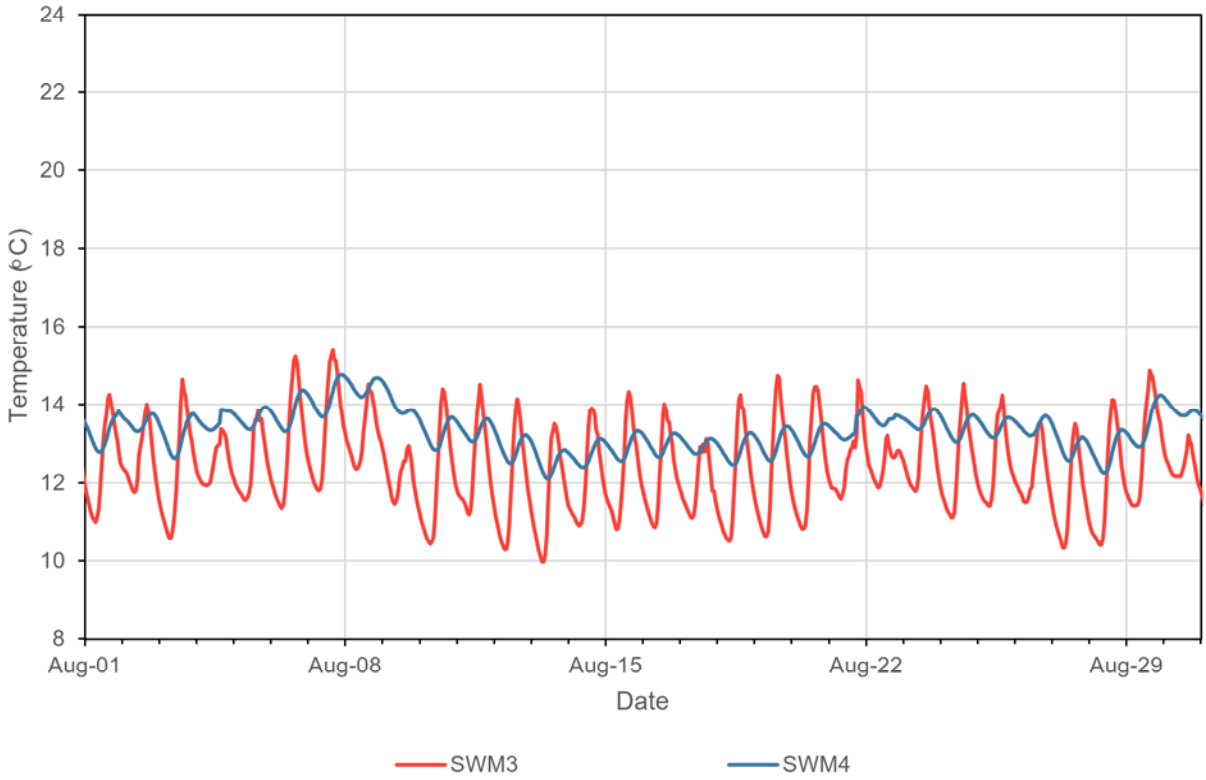


Figure E-17: Water Temperature at SWM1 and SWM2
September 2022

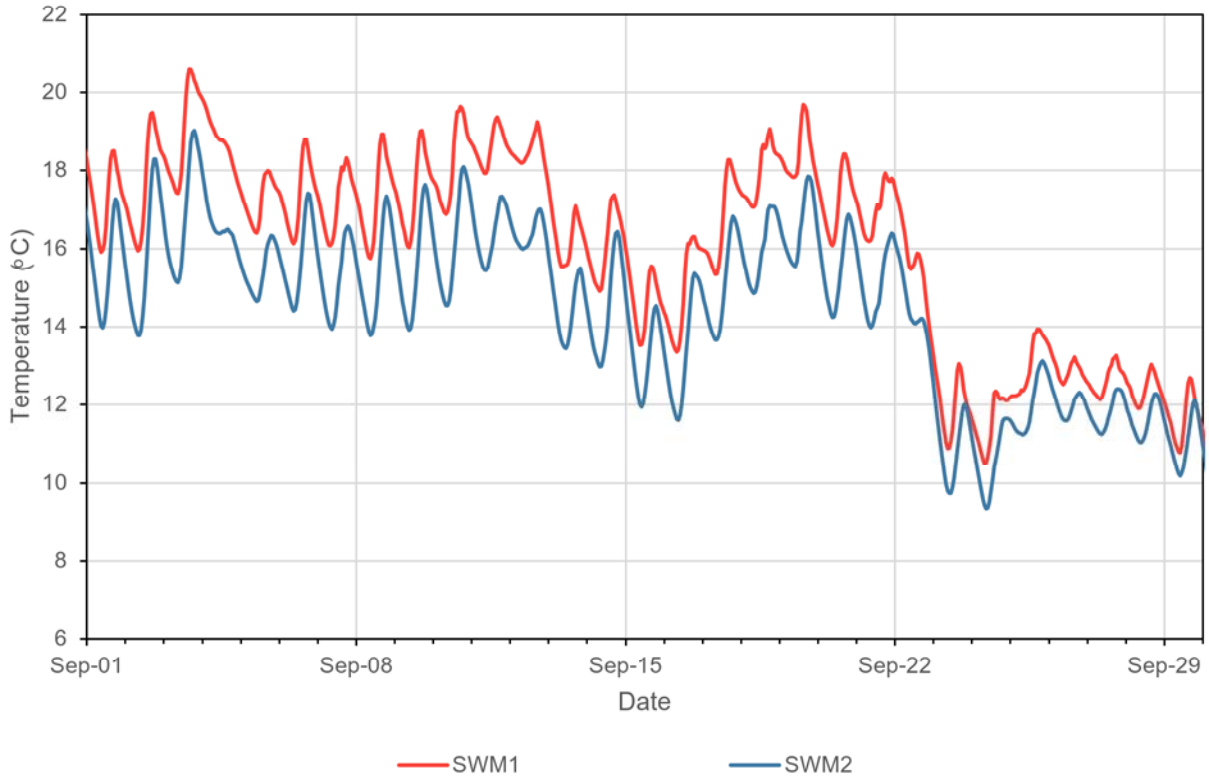


Figure E-18: Water Temperature at SWM3 and SWM4
September 2022

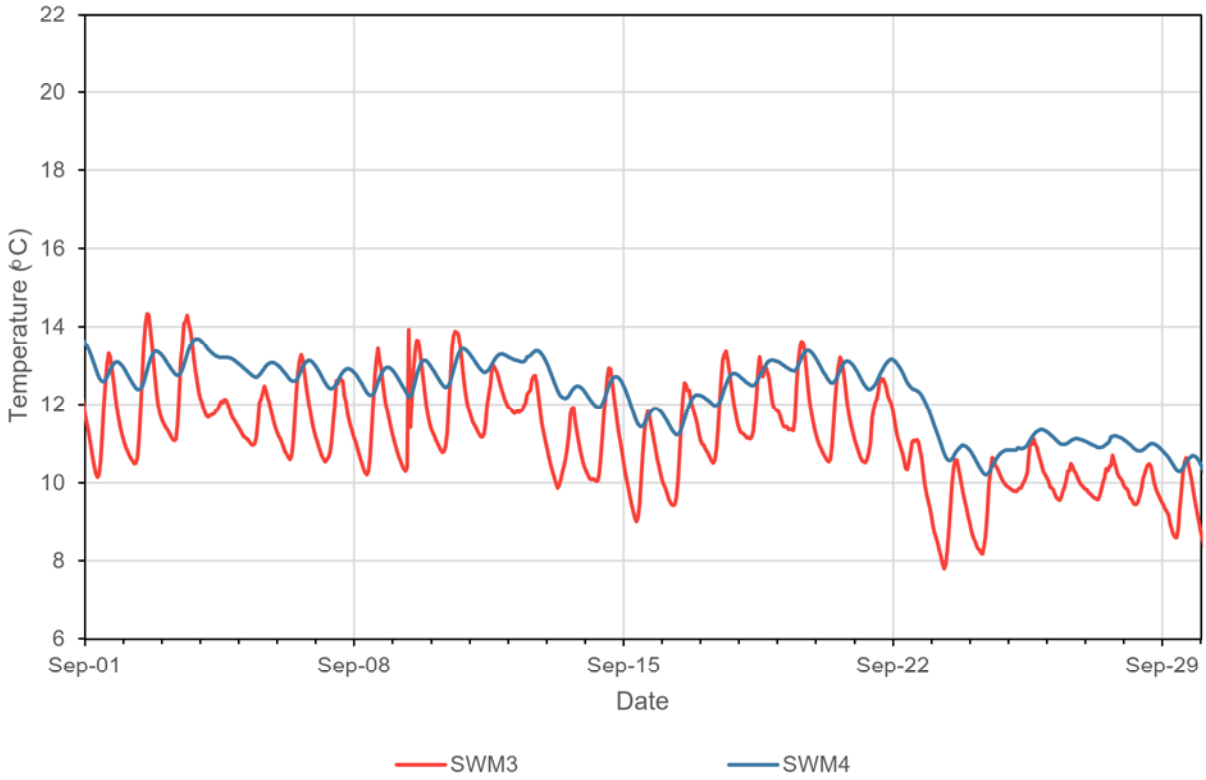


Figure E-19: Water Temperature at SWM1 and SWM2
October 2022

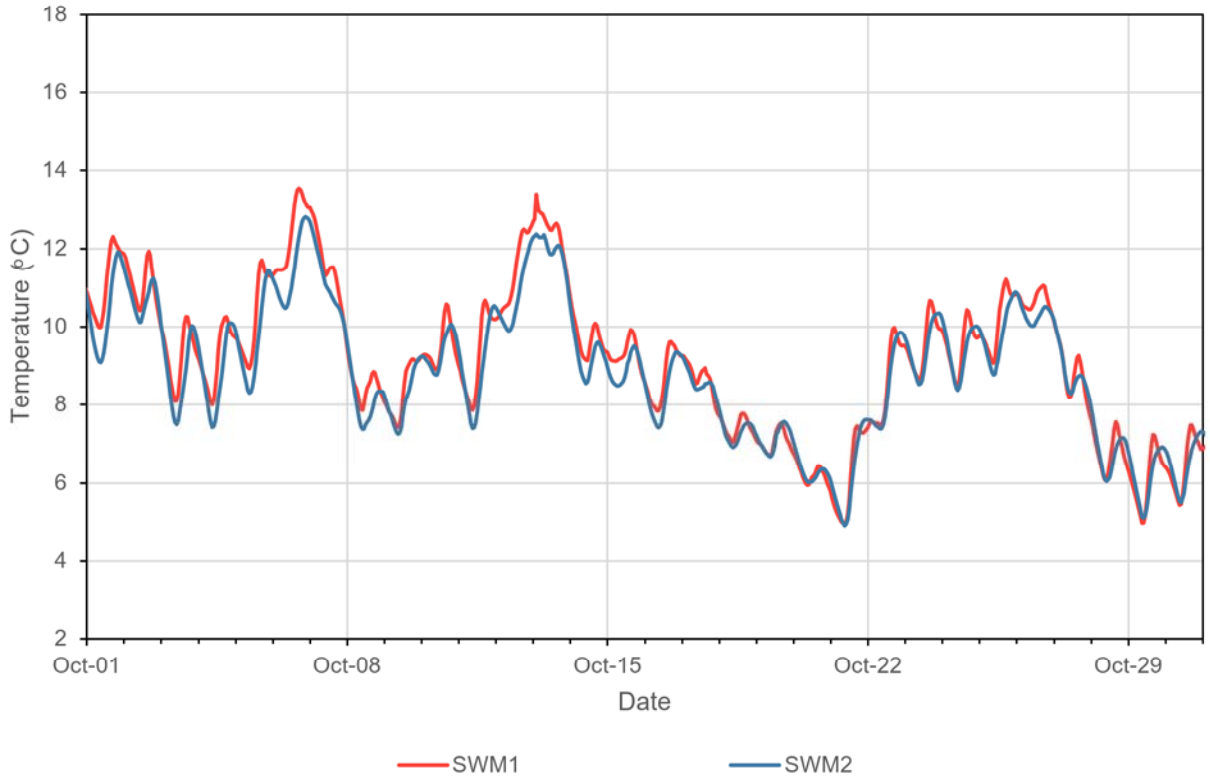


Figure E-20: Water Temperature at SWM3 and SWM4
October 2022

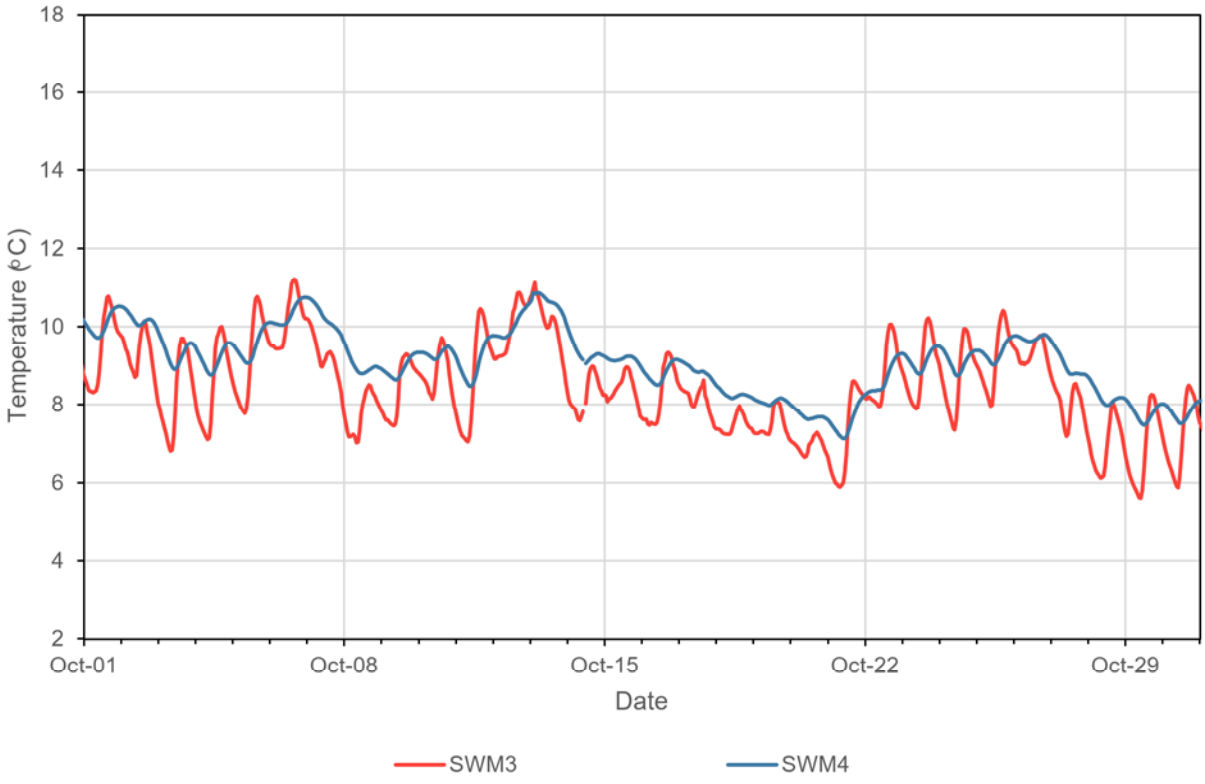


Figure E-21: Water Temperature at SWM1 and SWM2
November 2022

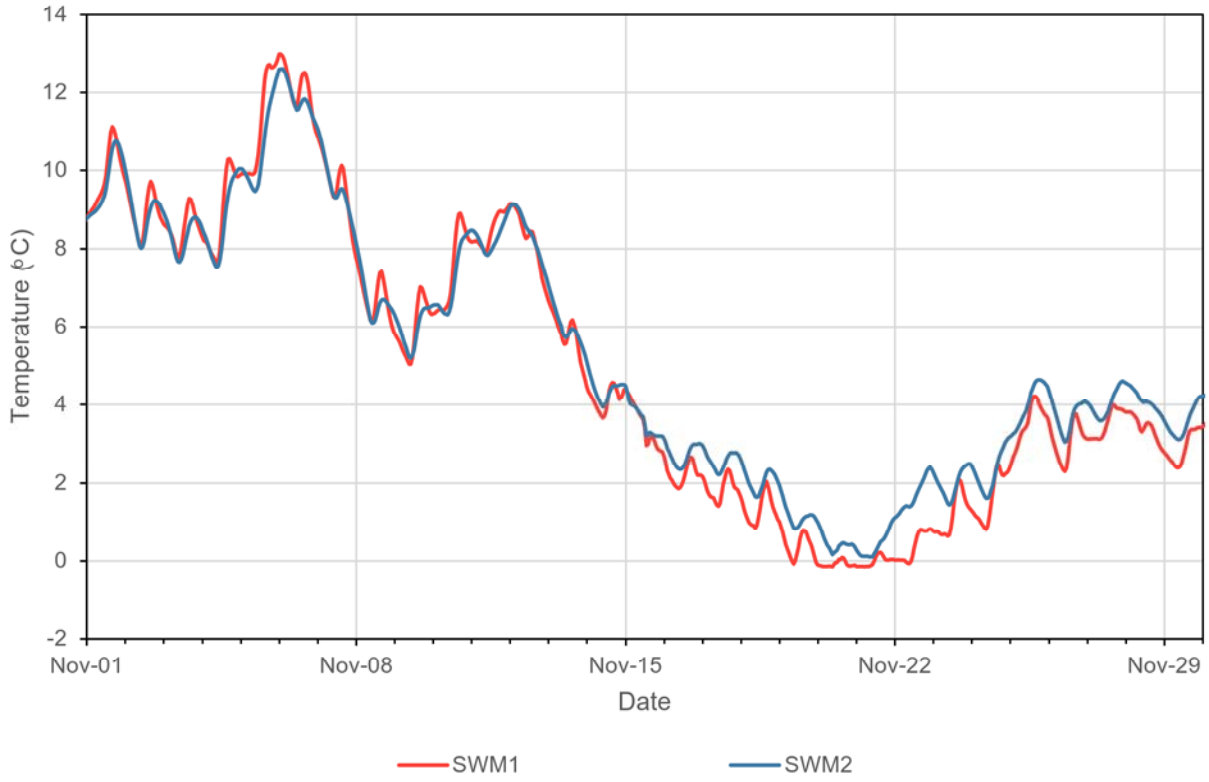


Figure E-22: Water Temperature at SWM3 and SWM4
November 2022

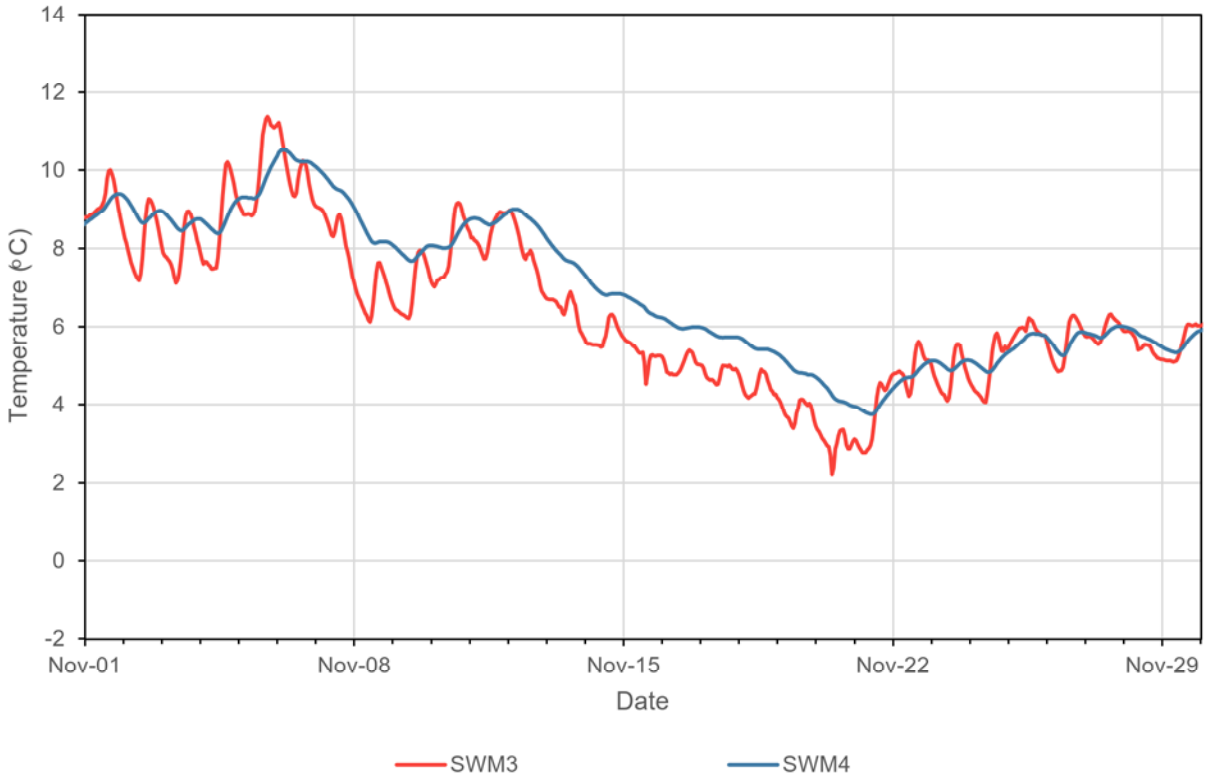


Figure E-23: Water Temperature at SWM1 and SWM2
December 2022

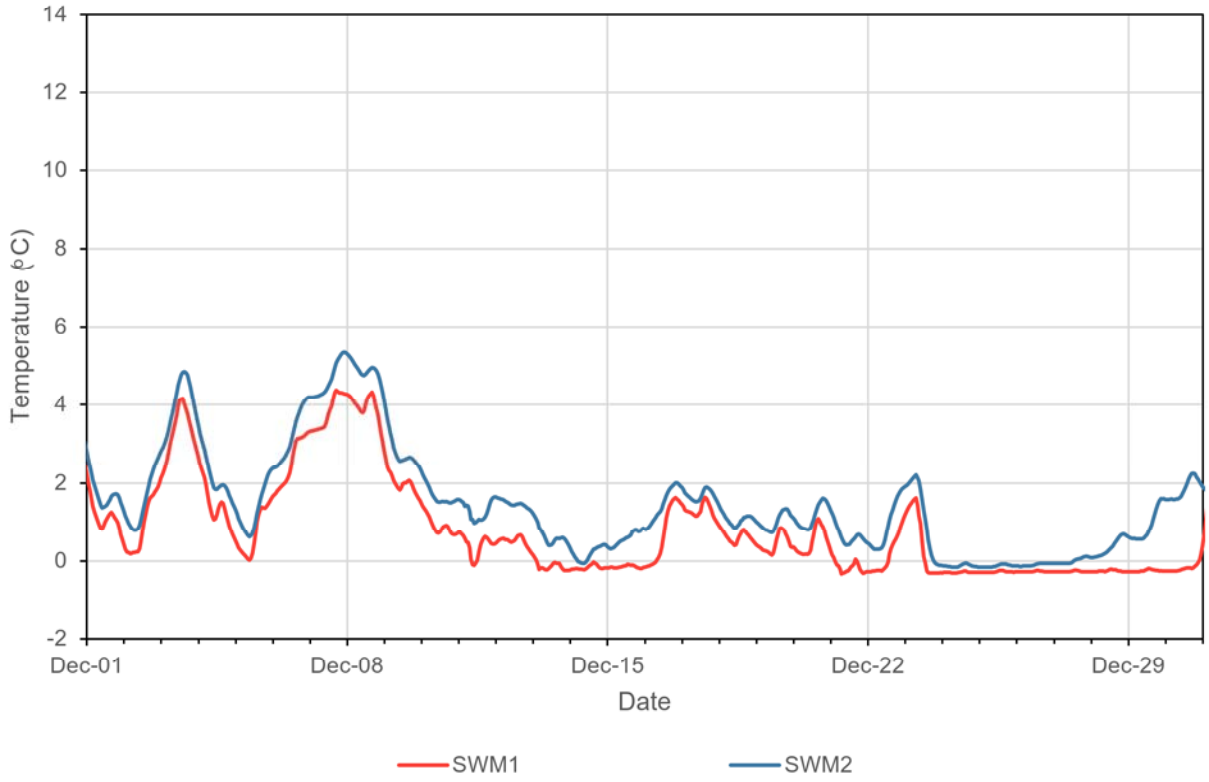


Figure E-24: Water Temperature at SWM3 and SWM4
December 2022