Summary of Columbia Lake Stewardship Society's 2023-24 Water Quantity Monitoring Program

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Executive Summary

2024 marked the eleventh year of operation of the Columbia Lake Stewardship Society's (CLSS) Water Quantity Monitoring Program. The Program is part of the Society's mission "to preserve the ecological health and water supply of Columbia Lake for present and future generations …".

The depth of the mountain snowpack was below the median of previous years. The start of active melt began around May 7, slightly later than usual. Once underway, the melt proceeded rapidly for nearly two weeks before cold weather intervened, halting the melt and even adding a small amount of new snow at high elevations. When the melt resumed, it resumed at a slower pace so that the overall melt period stretched out to almost a month, a period somewhat longer than usual.

In all, there were three periods of active melt and they resulted in three crests on Dutch Creek. An incremental rise in the level of Columbia Lake accompanied each crest with the lake ultimately reaching its highest level on July 2, later than usual and at a level below that of most previous years. Once the lake level began to decline, the rate of decline was unusually low so as the season progressed the lake reached normal water levels and by season end, a level consistent for that time of year.

Rainfall over the watershed was above previously recorded amounts. A substantial portion fell in August.

The periods of very warm weather during July elevated water temperatures. Water temperatures exceeding 24 Deg C were recorded at the lake outlet and in the Columere Marina between July 14 and July 20. Dead fish were observed near the Marina on July 22.

The year posed significant challenges for equipment. The water levels recorded by the proposed replacement water level station (RX2103) installed in 2022 deviated from levels recorded by the original station (COL) located nearby. The cause is under investigation but appears to have been due either to an incorrect setting of the reference level, an improper water density selection, or a combination of both. The station otherwise measured atmospheric pressure accurately and transmitted data to the internet as expected. Battery failures resulted in data losses at the Timber Springs Weather Station, and the WSC and Outlet stations. The suspension cable at the DC station broke, and the backup logger at the Outlet station was lost. Despite the issues, it was possible to reconstruct the missing data at nearly all stations except for Outlet.

The rain gauges at Spur Lake and Canal Flats failed during May. The outcome at those locations was not so favourable. It was not possible to reconstruct the missing record and thus data from those two locations for most of the summer season was lost.

1. Introduction

The Columbia Lake Stewardship Society's (CLSS) mission is "to preserve the ecological health and water supply of Columbia Lake for present and future generations …". This implies management and management in turn implies creating and implementing a plan to sustain the water resource. Components of most water resource management plans include the water source, water rights, development demands, water quality, policy, regulation, education and public awareness, conservation efforts, impact assessments, and more recently, climate change. The CLSS is engaged in all these areas (see www.columbialakess.com for further details) but the focus of this document is on the source sometimes more broadly known as water supply or water quantity.

The CLSS started water quantity monitoring activities in the Lake Columbia Watershed in the fall of 2014. This is the tenth in a series of annual reports and summarizes activities conducted during the 2023-24 water year, extending from November 1, 2023, to October 31, 2024.

Assessing the available water supply is a significant task. It requires identification of the water source or sources and an understanding of how water enters and leaves the lake. Long-term records reveal that the lake rises an average of about 0.9 metres each year. That rise is important. It maintains the water quality at a healthy level, provides drinking water for residents, irrigates crops, and supports the local tourism industry. It also provides a habitat that sustains wildlife and aquatic species. The demands for water to meet such a variety of needs are growing and are in conflict.

Most of the rise is attributable to overflow from Dutch Creek as the snowpack melts and runs off each spring, but it is not the only factor affecting lake level. Water also enters the lake directly from surface runoff, precipitation, and groundwater. The gains are offset by losses to evapotranspiration, consumptive use, and outflow. The monitoring program is aimed at determining how these gains and losses influence lake level and ultimately to help define a strategy to achieve the Society's mission.

2. The Watershed

For the convenience of measurement, the outflow point of the Columbia Lake Watershed is often regarded as a point on the Columbia River at the Highway 93/95 crossing near Fairmont Hot Springs. This is an oversimplification. The area of the drainage area above that point is 881 square kilometres. The bulk, 696 square kilometres, is contained in the Dutch Creek sub-basin.

A delta has formed near the mouth of Dutch Creek. The flow of Dutch Creek over its delta is braided and subject to change. In the present channel configuration, and when flow rates are low and unimpeded, the main channel flows directly across the delta to enter the Columbia River, a few tens of metres below the lake outlet. At this junction, the level of Dutch Creek is only a few tens of centimetres below that of the lake. This means that only a slight increase in the level of Dutch Creek results in a hydraulic head that favours flow into rather than out of the lake.

The main channel is continually shifting, and at times in the past flowed directly into the lake before reaching the river (see Jamieson, 2011). However, aerial photos and satellite images show that its location has undergone only slight change since 1975.

Thus, for most of the year the actual outlet from the lake is not at the Highway crossing but just over three kilometres upstream. However, for a few days or even weeks in some years following the freshet,

water from Dutch Creek does flow into the lake making the separation between the Dutch Creek and Columbia Lake drainage areas indistinguishable. In extreme years, the volume of inflow is so great that the lake rises above its banks submerging the normal outlet and spreads northward over a portion of the delta. During those instances, the point of outflow from the expanded lake is indeterminate and varies depending on the elevation achieved.

A series of small creeks enter the Columbia River downstream of the Dutch Creek junction constitute about nine square kilometres of the entire 881 square kilometre area. The area above the usual lake outlet is 176 square kilometres. The boundaries of the watershed are shown in the inset of Figure 1.

The overall watershed contains one active glacier. There are no significant control structures though minor structures impound or divert water on some inflowing creeks on the west side of the lake.

Figure 1 – Map showing station locations. The integrated watershed boundary is shown in the inset. Site abbreviations are provided in Section 4.1.

3. Antecedent and Concurrent Conditions

There are no weather stations within the entire watershed that have a continuous long-term climatological record. The closest station is Cranbrook Weather Station (Cranbrook A) located at the Cranbrook - Kimberley Airport, some 60 km south of Canal Flats.

The mean monthly temperatures at that location for the 2023-24 water year are shown in Figure 2. The corresponding long-term normal values based on records accumulated over the 30-year period 1981-2010 are superimposed for comparison. Two departures from normal are evident – a cold December and warm summer and fall. July was especially warm and gave rise to unusually warm water temperatures in the lake.

There are no snow monitoring stations located in the watershed but there is one just outside the watershed boundary (see Appendix B) that is deemed sufficiently close to represent the amount of water held in the local mountain snowpack. It is the Little Dragon avalanche monitoring station (elevation 2250 m) operated under the BC Ministry of Transport and Infrastructure's Avalanche and Weather Program. Snow depth is also measured on the nearby Panorama Mountain Resort ski hill but only until the end of the ski season so that no information is available during the critical melt period. The available data are nevertheless useful to corroborate those from the Little Dragon station. Another station is located on the Fairmont Hot Springs Resort Limited's ski hill (1485 m) and was installed in 2016 under the Cold Spring Creek Debris Flow Mitigation program. Analysis of data in previous years indicated that the elevation of the station is too low to provide useful information on the melting of the high mountain snowpack. Data from neither ski hill is included here.

The Little Dragon station was installed in the fall of 2017 so that seven seasons of measurements have accumulated. The recorded depths during all of the seasons are displayed in Figure 3. Except for a brief period in mid-March snow depths of 2023-24 remained below the median of the values of previous years. The start of active melt began near May 7, a bit later than usual, but once underway proceeded rapidly until May 18 when melt stopped, and more snow accumulated. The melt resumed but at a slower pace so that the overall melt period lasted nearly one month. By June 8 the pack had largely disappeared. The May 18 interruption had consequences for the Dutch Creek runoff and slowed the rate of the rise on Columbia Lake (see Figure 8).

Available accumulated rainfall amounts at the Timber Springs and Fairmont Ski Hill weather stations, and the Spur Lake and Canal Flats rain gauges, are shown in Figure 4. Both the Canal Flats and the Spur Lake stations stopped operating during May for reasons that will be noted. Southeastern BC was again subjected to forest fires in 2024 though none of significance was reported in the watershed. This may have been in part due to variations in the regional rainfall pattern. The Cranbrook Airport, for example, recorded only 65.4 mm over the same seven-month period.

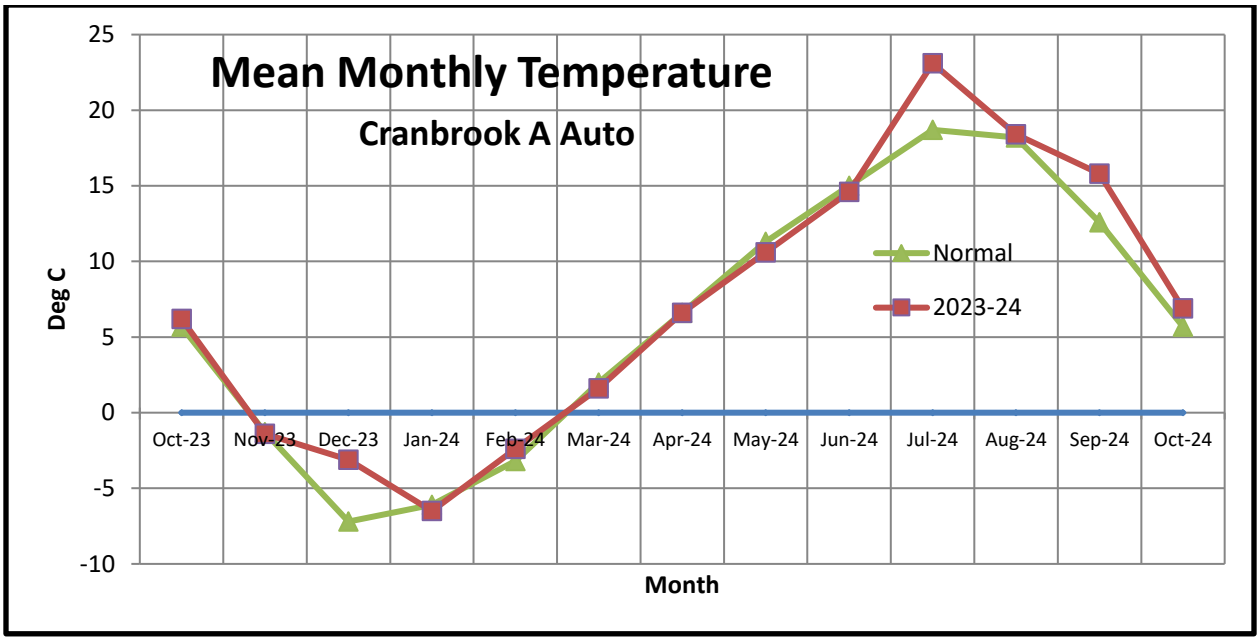

Figure 2 – Mean monthly temperatures at the Cranbrook- Kimberley Airport during the 2023-24 water year and the corresponding 1981-2010 long-term normal values.

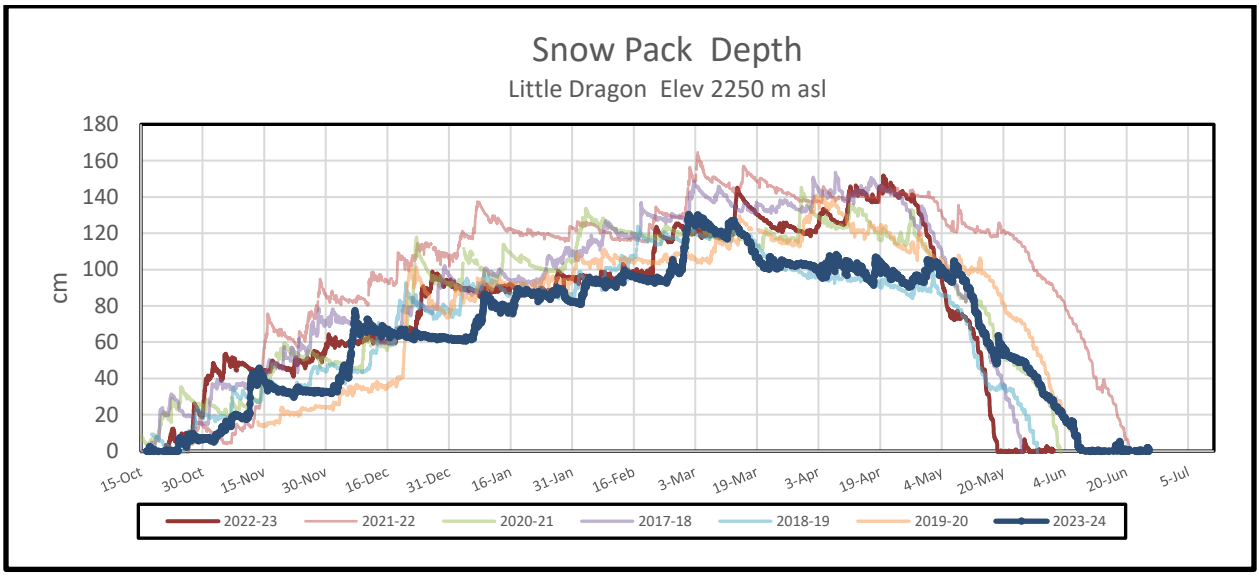

Figure 3 – Snow Depths recorded at the Ministry of Transportation and Infrastructure's Little Dragon Snow weather station located near Panorama during the 2023-24 and preceding six seasons.

4. 2023-23 Activities

4.1. Stations

The water level monitoring stations in operation were: Columere Marina (COL), Columbia River near Fairmont Hot Springs (WSC), Dutch Creek at the Highway 93/95 Bridge (DC), and (Outlet) located near the lake outlet. The locations are shown in Figure 1. DC only operated during the open water season. COL measures lake level. Backup sensors were installed at the COL, WSC, and Outlet sites though not all remained operative for the entire year. A logger was installed for part of the season at WSC to measure atmospheric pressure to back up the RX2103 atmospheric pressure sensor.

The Columbia Lake South Station that operated during the 2022-23 season was taken out of service and did not operate during 2023-24.

The Timber Springs weather station remained in operation and recorded wind speed and direction, temperature, relative humidity, and precipitation at hourly intervals.

The two HOBO tipping bucket rain gauges installed at Canal Flats and Spur Lake installed in 2022 failed during May 2024 so no data were available at either station beyond that month.

The Columbia Valley Airport Society, manager of the Fairmont Hot Springs Airport, continued to operate the airport weather station. The station broadcasts (but does not record) weather information via radio and telephone. These broadcasts were monitored at periodic intervals, and the altimeter settings were abstracted and converted to centimetres of water pressure to validate the accuracy of the RX2103 atmospheric pressure sensor.

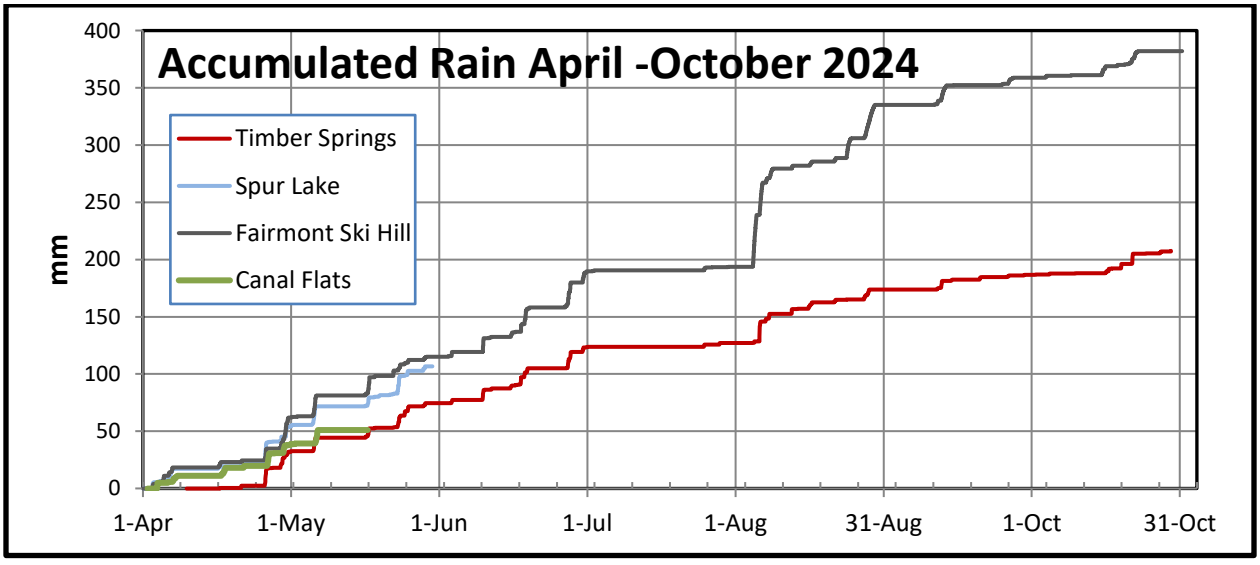

Figure 4 – Accumulated precipitation measured at Timber Springs (elevation 850 m asl), Spur Lake (1175), Fairmont Ski Hill (1480) and Canal Flats (820) during 2024.

4.2 Equipment Purchases

No equipment was purchased though the batteries in two loggers were replaced near the end of the season.

4.3. Data Collection and Management Issues

The year 2023-24 posed significant challenges for equipment.

The upgraded station (RX2103) in the Columere marina reliably collected and transmitted data but the water level measurements during the summer deviated from those measured at the nearby original station (COL). The cause is under investigation but appears to have been due either to an incorrect setting of the reference level, an improper water density selection, or a combination of both. In the meantime, the expected transition to this station as the primary Columere marina station did not take place and COL remained as the primary station. The RX2103 has two sensors, one measures barometric pressure and the second water pressure. The issue was with the water pressure sensor or the related software. There was no issue with the barometric pressure sensor and its data was used to remove the atmospheric pressure component from the total pressure measured at all other water level stations.

There were additional issues. At COL, the battery weakened and by January 22 had fallen to a level such that many erroneous water level entries were beginning to appear. Owing to the ice cover, the logger could not be replaced until April 9. All water level data collected during the intervening period were discarded and replaced by reconstituted water levels derived by regression on known accurate water levels recorded by the RX2103. The water temperatures were accepted.

This did not end the problems. The batteries in the RX2103 station died on March 22 leaving the Columere marina without water level or atmospheric pressure measurements until April 11 when the batteries were replaced. Atmospheric data from the WSC site was substituted during this period enabling water level computations to be made at other sites.

Elsewhere, the suspension cable at the WSC site was lengthened by four centimetres to reset the zero reading to correspond with the level of the end of the intake pipe. The reason for the difference is unknown but may have been partially due to the introduction of a new logger having a different buoyancy. The data recorded during the period July 15 to August 11 were lost. Data from the backup logger was substituted.

At the Dutch Creek site, the suspension cable broke on July 15 causing the logger to fall to the bottom of the stilling well where it became lodged. Other loggers were introduced until the original could be dislodged. Once freed, the missing data was reconstituted by regression on the records of the substituted loggers.

At Outlet, the last complete download of data was July 15, and no data could be recovered beyond that time due to a dead battery. The cable tethering the backup logger was later found severed and the logger lost. The last data recorded was April 12.

The performance of the loggers is evaluated twice a year, with steps taken and corrective actions applied as detailed in Appendix A.

As previously noted, the tipping bucket rain gauges at the Canal Flats and Spur Lake sites ceased functioning in May. At the Canal Flats station, the funnel was found detached, likely blown off by strong

winds occurring during May. It was replaced but later again found not functioning due to a cocoon that had attached to the tipping mechanism, obstructing its operation. At Spur Lake, the readout cable had become dislodged and also interfered with the tipping bucket preventing its movement.

There were two data losses at the Timber Springs weather station during July when animals entered the area and severed power cables. Temperature and precipitation from nearby instruments were substituted.

5. Water Temperature and Level

5.3. Winter 2023-24

The winter water temperatures recorded at five stations; COL, CF, WSC, DC, and Outlet are shown in Figure 5. The logger at the Dutch Creek station operated only a few days at the beginning of the winter season before being removed due to the threat of frost damage. The mean daily air temperatures recorded at Timber Springs are superimposed for comparison and show that the local area was subject to an outbreak of very cold air just before Christmas. Less intense outbreaks followed near January 30 and February 24.

The water levels recorded at the same stations plus Lansdowne are shown in Figure 6. Freezing of the intake pipe at the WSC site during periods of cold weather in the past does not seem to have been an issue during 2023-23. The record is continuous and without significant deviations. It is therefore judged to be an accurate reflection of water levels including those very low levels recorded during late February and March.

5.2 Open Water Season 2024

5.2.1 Water Temperature

The water temperatures recorded during the open water season at the COL, WSC, Dutch Creek, and Outlet stations are shown in Figure 7. In previous years the Outlet temperatures were an indicator of the direction of flow in the lake outlet channel and that trend was repeated in 2024. From May 1 until June 15 the water temperatures were near those of Dutch Creek inferring flow into the lake. From June 15 to June 28 the temperatures approached those of the lake indicating outflow. From June 28 until about July 2 the temperatures approximated those of Dutch Creek again indicating inflow. After July 3, the lake level began to decline and outflow predominated.

Lake water temperatures at Outlet reached 24 Deg C on July 14 and at COL on July 20. Dead fish were observed near the Columere Marina on July 22.

Air temperatures recorded at Timber Springs are superimposed for reference.

5.2.2 Water Level

The recorded water levels at the DC, Outlet, WSC, and COL stations are shown in Figure 8. The levels represent the depth of water above a local reference and are unrelated to any known elevation standard.

The fluctuations in the melt rate noted above had a direct impact on the water levels in Dutch Creek and, as a result of the inflows, on the lake level. The water level in Dutch Creek rose in unison with the melt rate until mid-May, then fell as the cold weather invaded, and then rose again eventually peaking near June 11. A third crest followed near June 23 indicating that although all of the snow had disappeared at Little Dragon, snow remained at higher elevations, in tree-covered areas, and on shaded slopes. The impact on the lake level is less apparent but the level can be seen to increase following each of the crests further confirming the entry of water from Dutch Creek into the lake.

Hourly rainfall amounts are superimposed. August was a wet month.

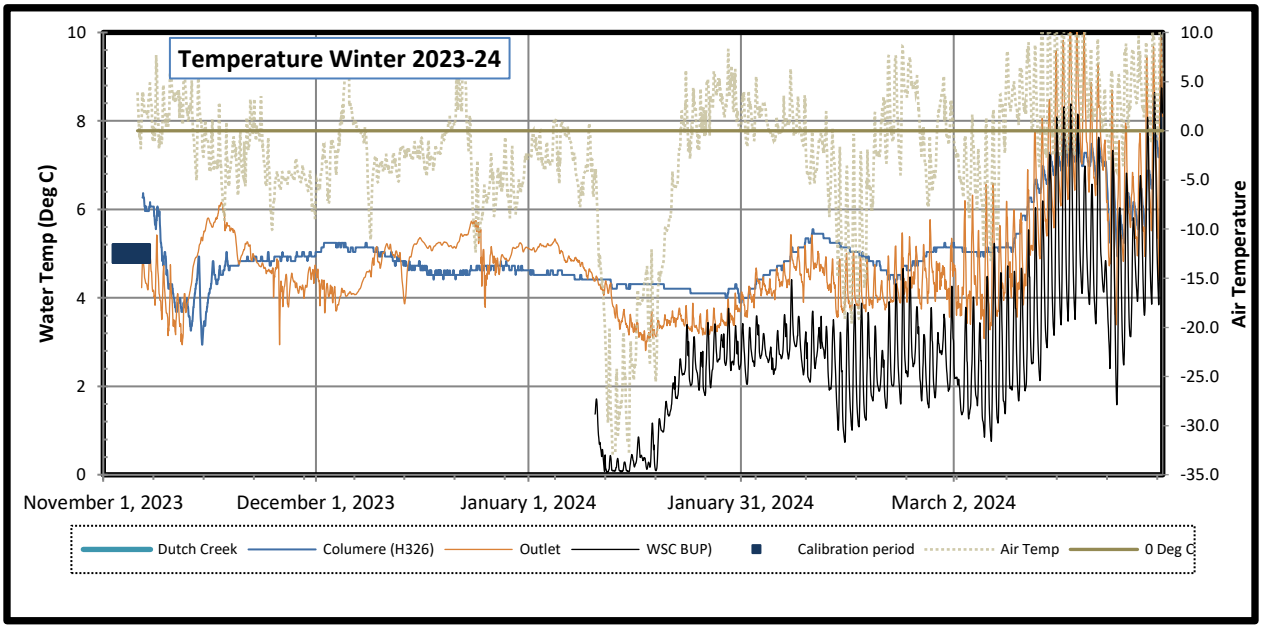

Figure 5 – Winter water temperatures. Air temperatures recorded at Timber Springs are superimposed.

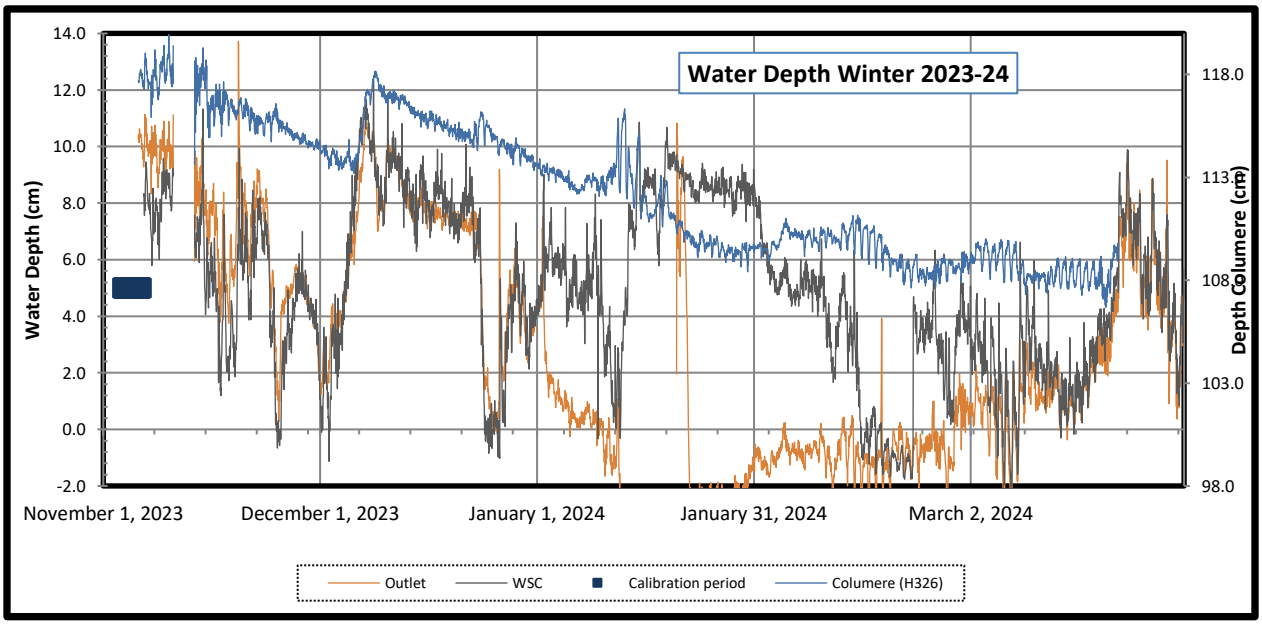

Figure 6 – Winter water depths recorded by loggers.

5.2.3 Comparison with Previous Seasons

The timing of the onset of the rise of the lake level was not unusual when compared to previous years as shown in Figure 9 but the ensuing protracted delay meant that the peak was reached later than in most previous years and at an unusually low level. Once the peak had passed and the lake level began to decline, the drawdown proceeded at a rate less than that observed in most previous years keeping lake levels relatively high late into the open water season. By season end they were near the highest levels recorded by the CLSS.

6. Local Water Exchanges

6.1 Rating Curves

Only one flow measurement was made during the year. It was conducted at the WSC site on April 9.

This one measurement did not provide sufficient information to update rating curves and therefore updates were not made.

6.2 Water Balance

No progress was made in improving estimates of the lake water balance. Previous attempts to establish balance have assumed that the level of Columbia Lake remained constant at or near 808.5 metres above sea level (asl) and parameters such as surface area and lake volume were tied to that elevation and did change. Recent CLSS monitoring has shown that the parameters do change as the lake rises and the changes in surface area and volume, in particular, are substantial. Both are critical for water balance calculations and the changes must be taken into account. Relationships between them and lake elevation do not exist and need to be established, adding further complexity to water balance calculations.

7. Columbia River Flows

Owing to the above normal rainfall over the basin during the season water levels measured at the WSC site had returned to near normal by season end and helped to alleviate the risk of drought that existed at the end of the previous season.

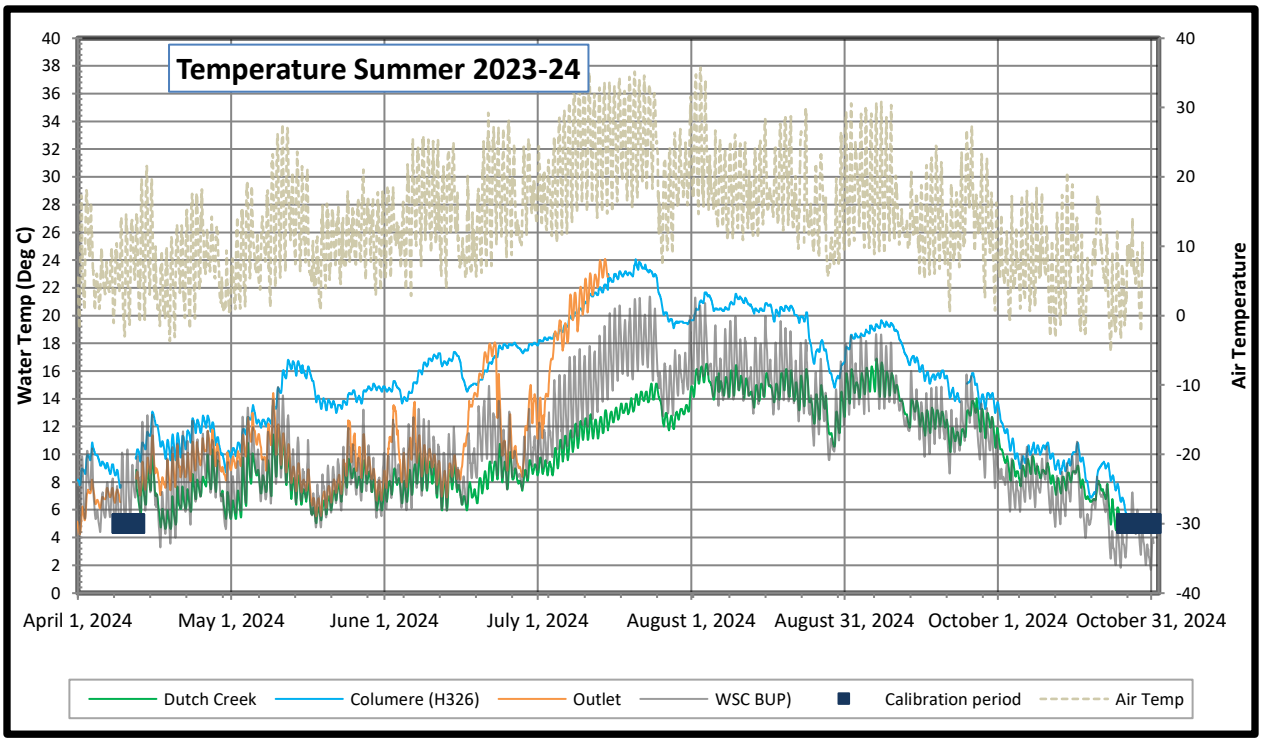

Figure 7 – 2023 water temperatures. Air temperatures at Timber Springs are superimposed.

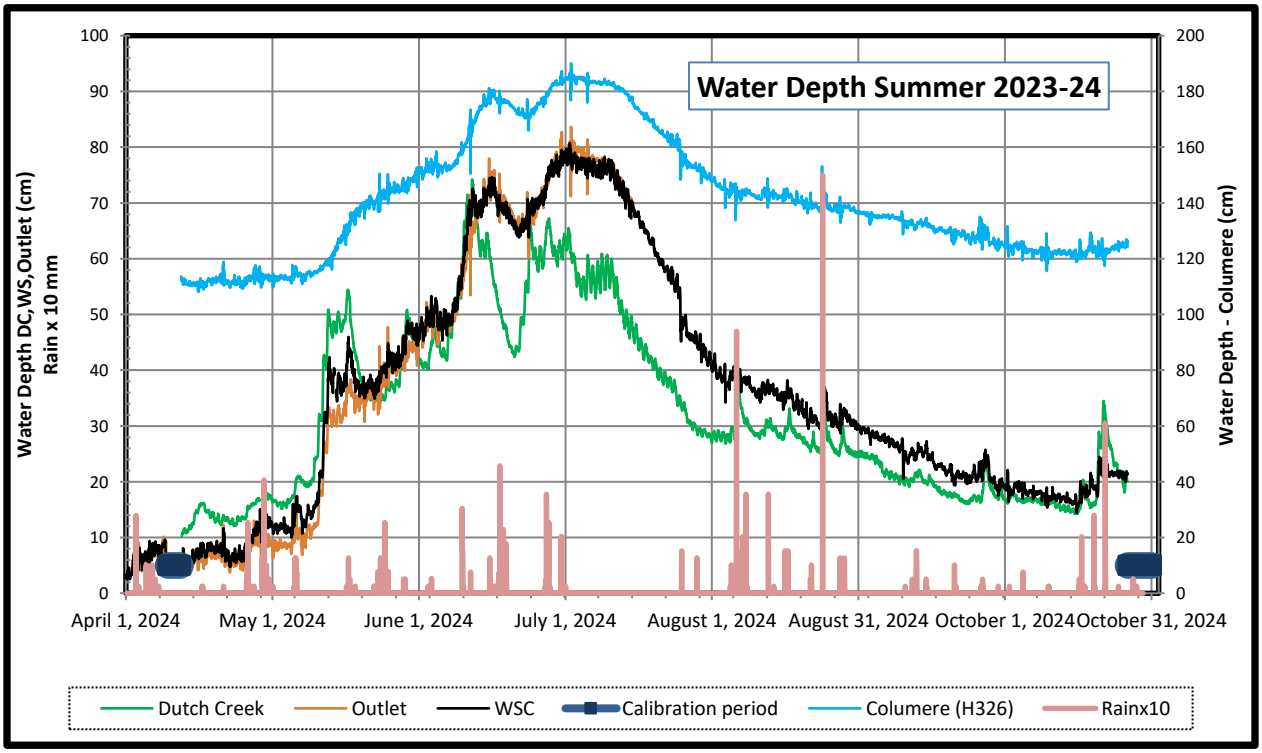

Figure 8 – Hourly water depths in centimetres. Depths are as recorded by loggers and do not relate to a common reference level. Hourly rainfall amounts are in tenths of millimetres.

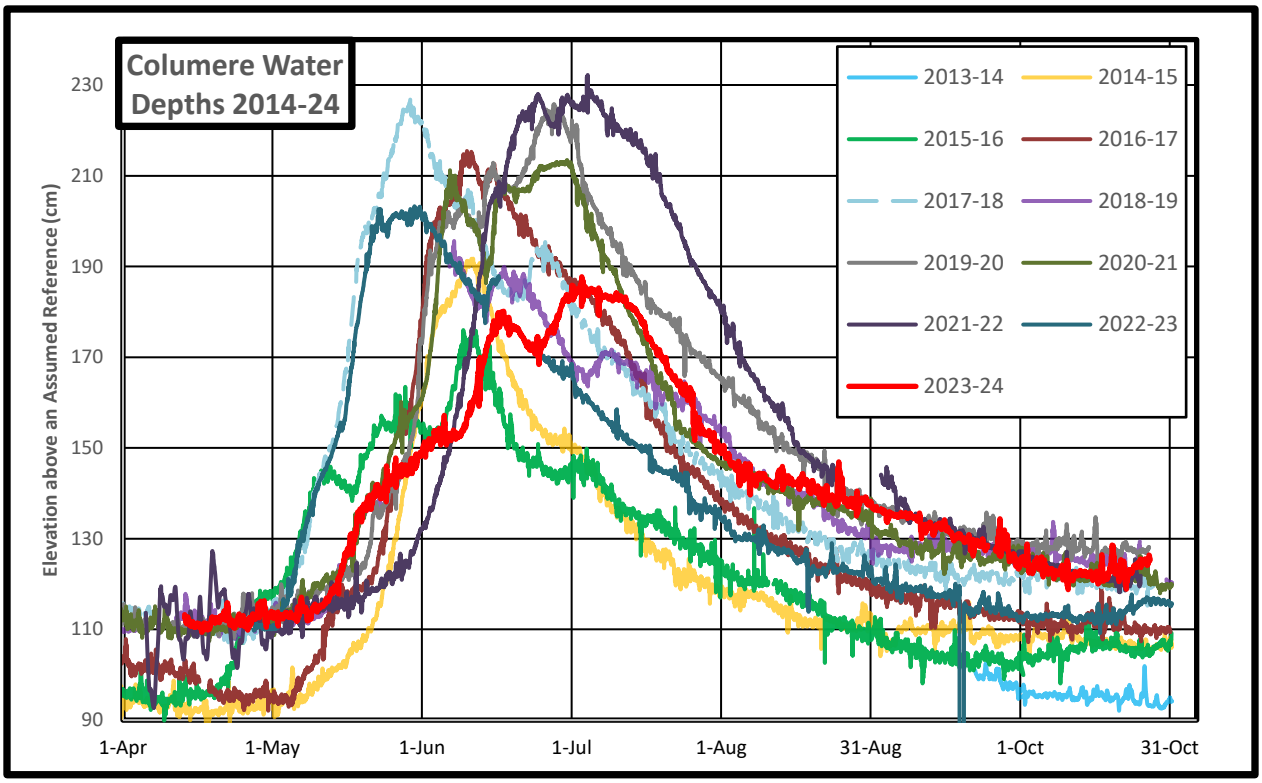

Figure 9 – 2024 Columbia Lake water levels compared with water levels recorded during the 2014 to 2023 open water seasons.

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9. Acknowledgements

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BC Hydro
Environment and Climate Change Canada
Columbia Valley Airport Society
Columbia Valley Local Conservation Fund
Regional District of East Kootenay
Lake Windermere Ambassadors
Living Lakes Canada
Columere Marina
Fairmont Hot Springs Resort Ltd.
Panorama Mountain Resort
Village of Canal Flats
Columbia Ridge Community Association
Columere Park Community Association
Spirits Reach Strata
BC Lake Stewardship Society
Nature Conservancy of Canada
Fairmont Creek Debris Flow Mitigation Project
All donors whose contribution made the purchase of monitoring equipment possible.

Appendix A

Appendix A - Accuracy of Measurements

The integrity of an analysis depends on accurate measurements. The following describes the steps taken to evaluate equipment performance and minimize errors.

A1 -Water Level

Water information is collected using data loggers. The loggers measure pressure and temperature and record them in internal memory. The loggers are programmed to record every hour on the hour. Loggers from two different manufacturers, Van Essen (Diver) and Onset (HOBO), are in use.

All loggers are non-vented. This means that the sensor measures the pressure exerted by the column of water above the logger plus that of the atmosphere. The atmospheric pressure must be removed to obtain the pressure exerted by the water alone. Once removed, the water depth can be calculated from the water pressure (a water density of one was assumed). Atmospheric pressure is measured using a separate logger mounted at lake level. Most stations are located at lake level (808.5 metres asl) so an elevation adjustment is not required. An exception is the Dutch Creek station, which is twenty-four metres above lake level. Two cm of water pressure was added to the recorded pressure to bring it into alignment.

The primary source of atmospheric pressure was the barometer contained in the HOBOlink RX2103 hydrometric station mounted in the Columere marina. Its accuracy was periodically verified against the barometer located on the nearby Fairmont Hot Springs Airport (CYCZ) used to broadcast altimeter settings to incoming and outgoing aircraft. A comparison of measurements from the two sources is shown in Figure A1. A secondary source of atmospheric pressure was a logger mounted in the stilling well at the WSC site. It was in operation from November 2023 until April 2024.

All loggers are taken out of service twice during the year, once at the beginning and again at the end of the open water season and collocated for a period of a few days. The pressures recorded during those periods are shown in Figures A2 and A3. The pressure sensors are seldom in agreement thereby necessitating an offset adjustment. The mean offsets from the barometer in RX2103 were calculated and are shown in Table A1, the offsets were applied during the six-month period following the comparison tests.

No correction was made for the effects of temperature on water density or on logger performance.

The locations at which the loggers were deployed are shown in Table A2.

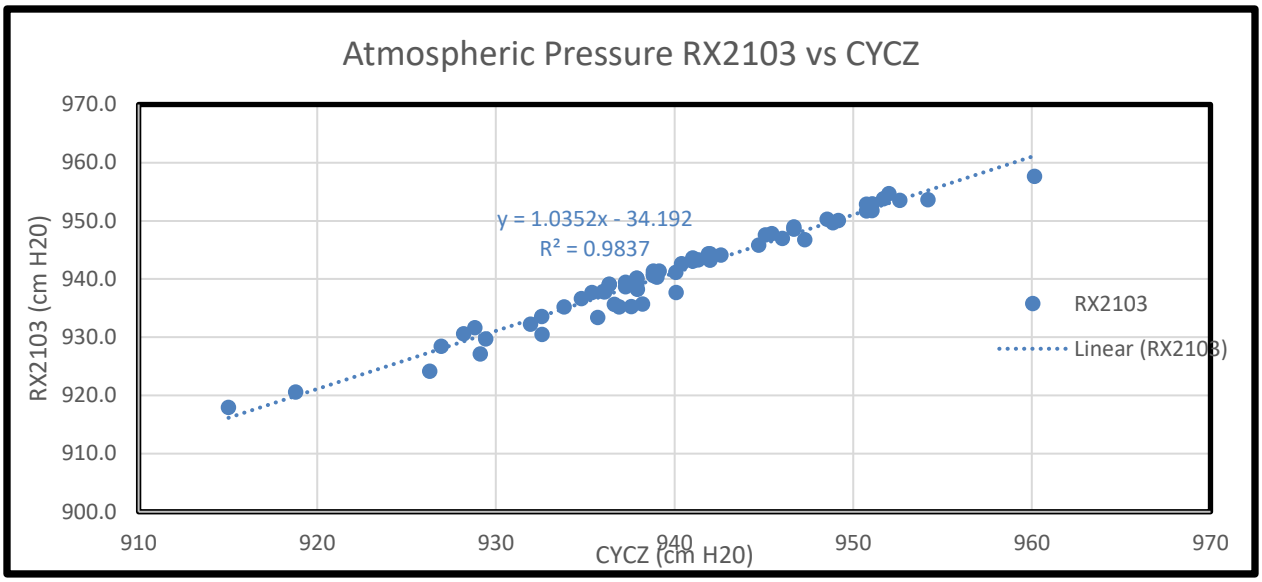


Figure A1 – XY plot showing the relationship between atmospheric pressures by recorded by the RX2103 station and the barometer at the Fairmont Hot Springs Airport. Line of best fit is superimposed.

A2- Water Temperature

Beginning and end-of-season comparisons of the temperature sensors were made in a similar fashion. The records are displayed in Figures A3 and A4, respectively.

In general, the loggers measure temperature accurately and the differences are frequently less than one degree. However, they are sensitive to solar radiation and when exposed to sunlight, even in small amounts, the differences are much larger. The exposure of the loggers to sunlight was not well controlled, especially during the Oct-24 run, accounting for some recording slightly warmer temperatures than others. Otherwise, good agreement is shown.

Except for those mounted in stilling wells, the loggers are not shielded when in operation.

A3- Other

Other steps were taken to ensure the integrity of the data. Manual measurements of water level were taken at each location periodically during the season to verify the accuracy of the recorded pressure measurements. The stilling wells and intake pipes at each of the stream sites were back flushed twice per year, once before and again after the freshet.

The current meter was calibrated by the manufacturer prior to purchase and has not been further calibrated.

Table A1 – Measured Offsets from H325 during comparison trials

Nov-23			Apr-24			Oct -24		
Logger	**cm H2O**	**Diff fm RX2103**	**Logger**	**cm H2O**	**Diff fm RX2103**	**Logger**	**cm H2O**	**Diff from RX2103**
RX2103[1]	931.0	0.0	RX2103	938.7	0.0	RX2103	932.8	0.0
1366[2]	N/E		1366	933.3	-5.4	1366	Dead	battery
BARO	Temp	only	BARO	Temp	only	BARO	Temp	only
U5972[2,3]	N/E		U5972[2,3]	Temp	only	U5972[2,3]		
AV083	931.4	0.4	AV083	N/E		AV083	N/E	
H012	932.1	1.1	H012	938.0	-0.7	H012	931.8	-1.0
H013	934.3	3.3	H013	939.7	1.0	H013	933.8	1.0
H325	Dead	battery	H325	Dead	battery	H325	933.2	-1.7
H326	928.5	-2.5	H326	933.8	-4.9	H326	926.5	-7.9
H109	928.8	-2.2	H109	933.0	-5.7	H109	932.8	0
H691	935.2	4.2	H691	939.9	1.2	H691	933.5	0.7
			RX2103 W	971.8	33.1	RX2103 W	985.6	52.8

[1] RX2103 atmospheric pressure sensor replaced H325, RX2103 water sensor not evaluated.

[2] Loggers 1366 and U5972 were both located at Outlet and not removed for evaluation.

[2,3] Pressure sensors in Loggers U5972 and BARO failed in 2023 and were only used to measure temperature thereafter, BARO also known as 1601.

Table A2 – Logger Deployment During 2023-2024 Water Year

U5972	Outlet Nov 1 to July 15. Cable severed after July 15 and the logger lost. No pressure.
1366	Outlet Nov 1 to July 15 when the battery died.
BARO (1601)	Woodshed. Measured temperature only.
H109	WSC atmospheric Nov 6 - Apr 29, DC Apr 29 - May 27, DC Jul 16 - Sep 5, Col Sep 23-34
H326	Columere until April 12 when the battery failed, data from mid-January onward suspect. Battery replaced Oct 30.
H325	Out of service due to weak battery. Battery replaced Oct 30.
H012	WSC Nov 1, 2023, to October 31, 2024.
H013	H013 - Dutch Creek Nov 1-3, 2023, April 12 - 29, DC May 14 - Oct 26
H691	Columere April 12 onward.
AV083	Backup at WSC Jan 10 to Oct 31.

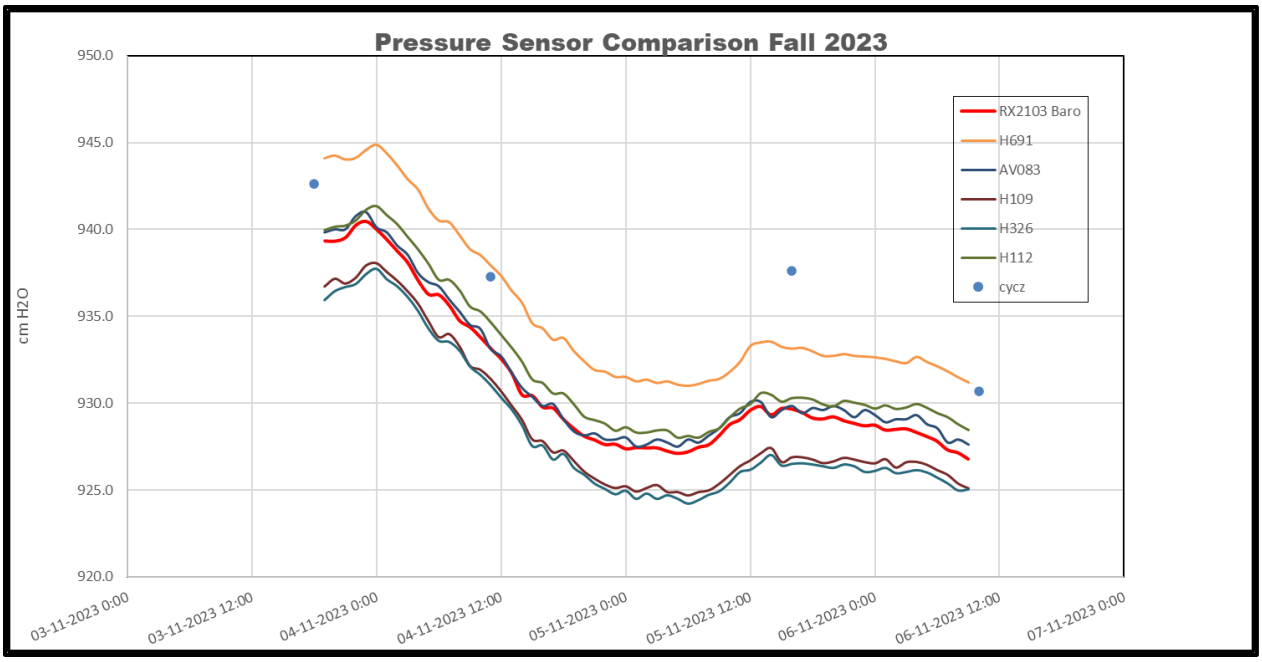


Figure A2 – Pressure readings from all loggers in relation to H325 in Fall 2023. Note that RX2103 was not collocated. It remained in operation at the Columere Marina at an elevation of 808.5 metres asl and at a level of about 50 metres below the collocated loggers. Its pressure was adjusted to the level of the test site by subtracting 5.5 cm H2O, an estimated value based on the elevation and temperature difference, and the elevation of the station above sea level. The elevation of the Fairmont Hot Springs Airport (CYCZ) is 811 metres asl. The spot pressures shown have not been adjusted to correct for the 2.5 metre elevation difference between the Airport and lake level.

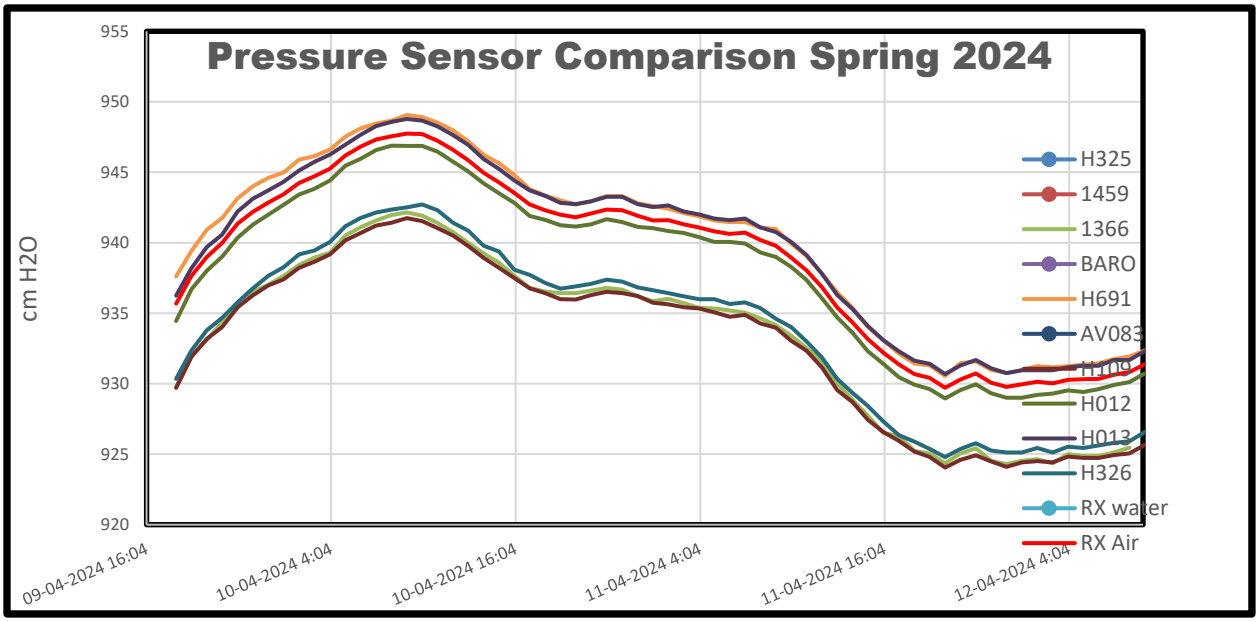


Figure A3 – Pressure readings from all loggers Spring 2024. Loggers were co-located.

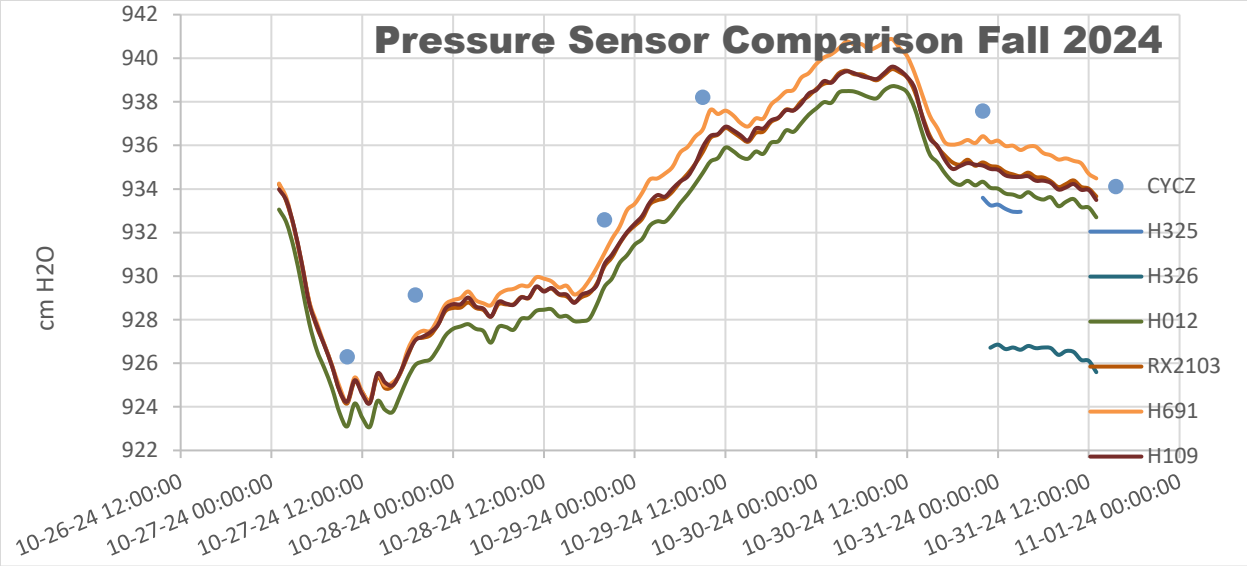


Figure A4 – Pressure readings from all loggers in relation to RX2103 during October 2024. The elevation of the Fairmont Hot Springs Airport (CYCZ) is 811 metres asl and roughly 40 metres below the evaluation site. About 4 cm H2O should be subtracted from its values to be comparable. The batteries in loggers H325 and H326 were being replaced so that the loggers were not available at the beginning of the evaluation.

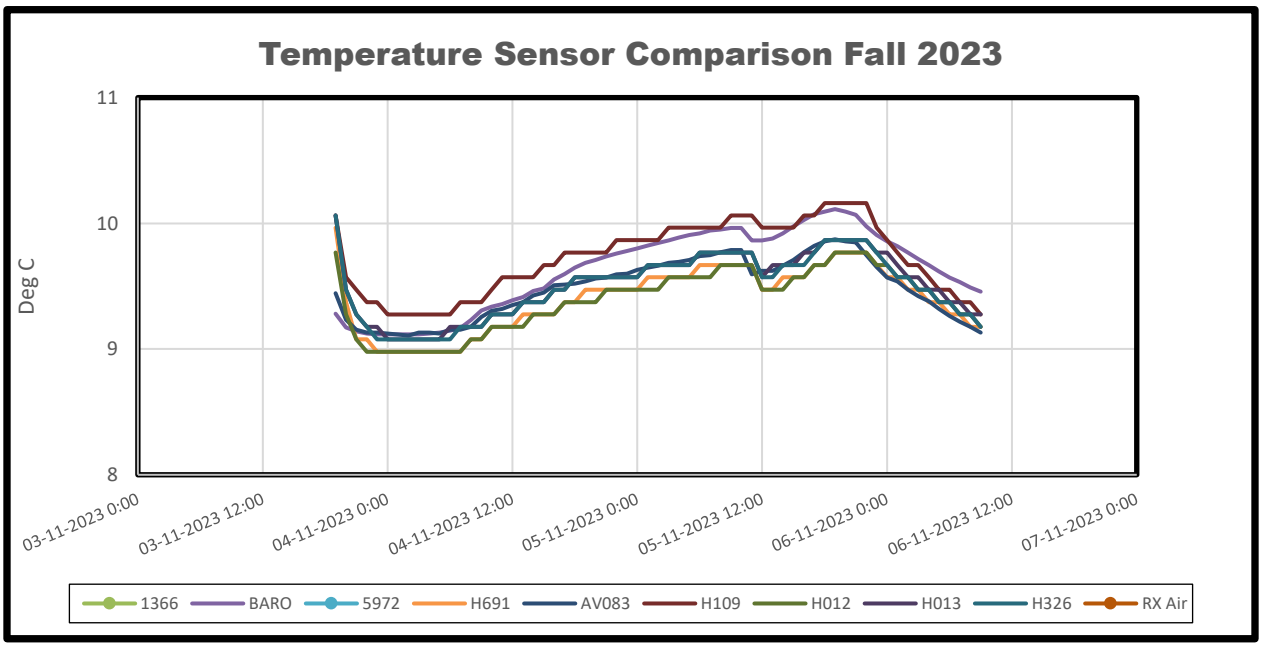


Figure A5 – Logger temperature comparison Fall 2023

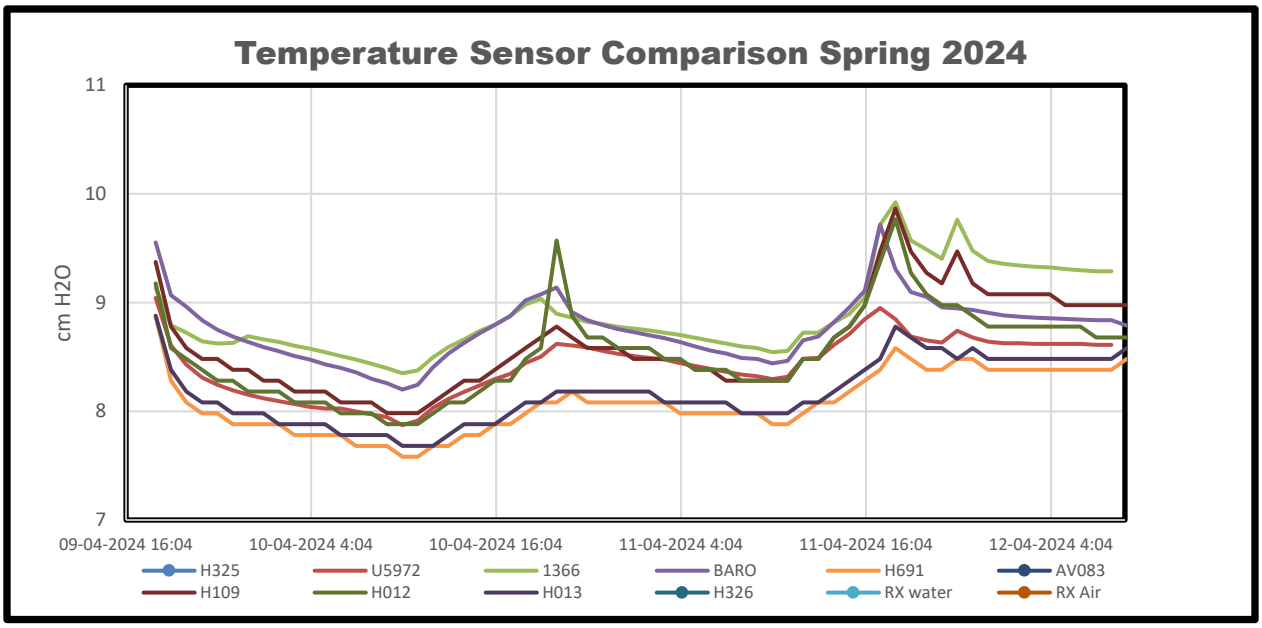


Figure A5 – Logger temperature comparison Spring 2024.

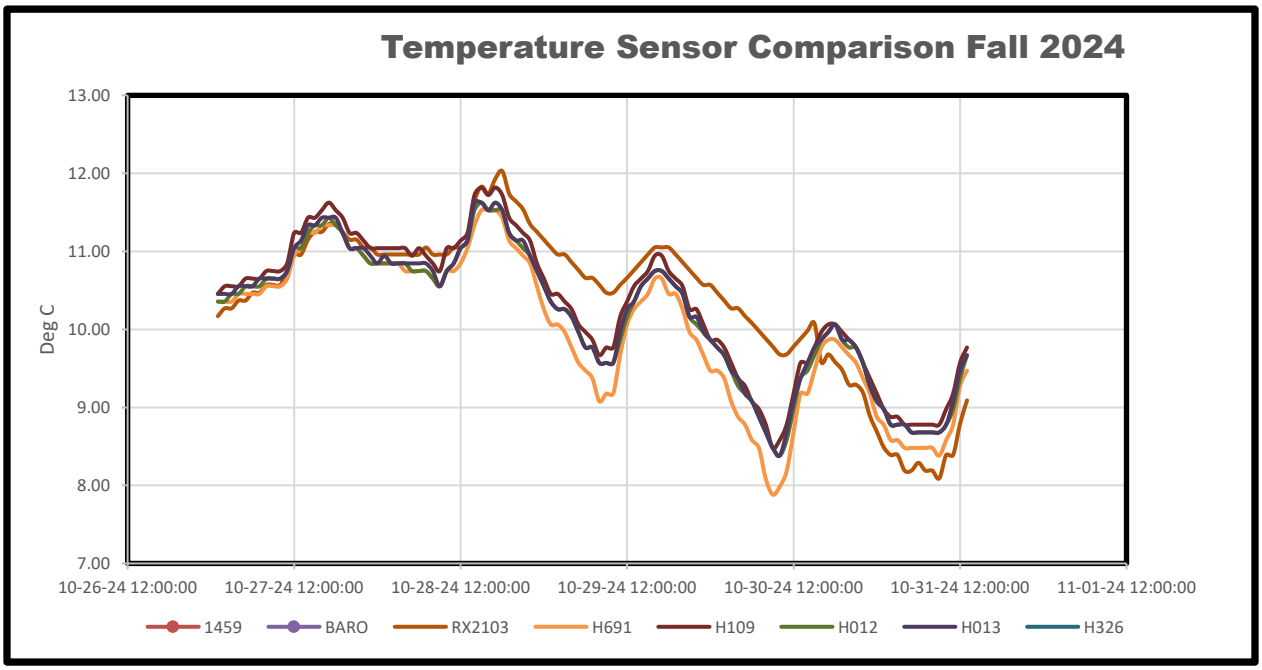
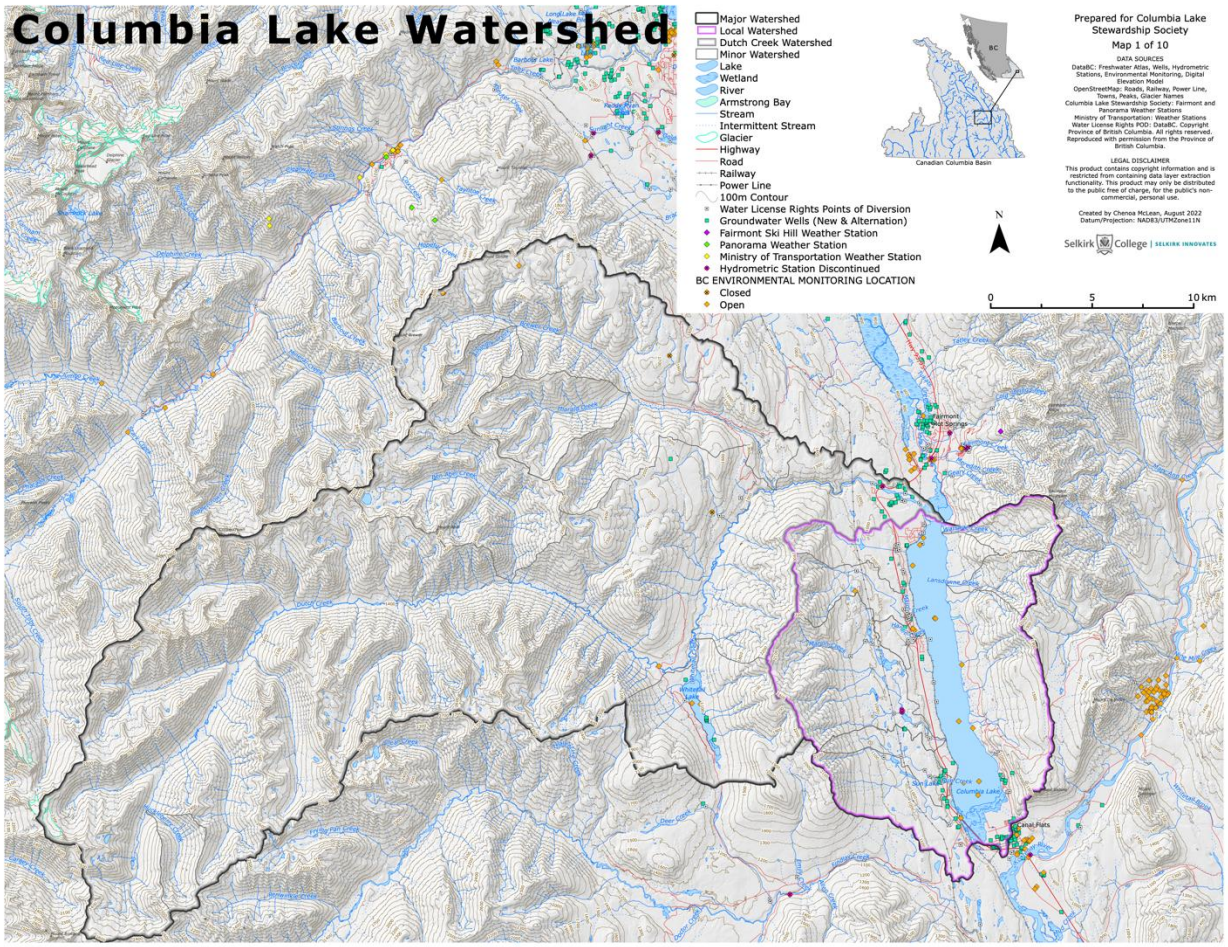


Figure A6 – Logger temperature comparison Fall 2024.

APPENDIX B


Columbia Lake Watershed
Major Watershed
Local Watershed
Dutch Creek Watershed
Minor Watershed
Lake
Wetland
River
Armstrong Bay
Stream
Intermittent Stream
Glacier
Highway
Road
Railway
Power Line
100m Contour
Water License Rights Points of Diversion
Groundwater Wells (New & Alternation)
Fairmont Ski Hill Weather Station
Panorama Weather Station
Ministry of Transportation Weather Station
Hydrometric Station Discontinued
BC ENVIRONMENTAL MONITORING LOCATION
Closed
Open
BC
Canadian Columbia Basin
N
0
5
10 km
Prepared for Columbia Lake Stewardship Society
Map 1 of 10
DATA SOURCES
DataBC: Freshwater Atlas, Wells, Hydrometric Stations, Environmental Monitoring, Digital Elevation Model
OpenStreetMap: Roads, Railway, Power Line, Towns, Peaks, Glacier Names
Columbia Lake Stewardship Society: Fairmont and Panorama Weather Stations
Ministry of Transportation: Weather Stations
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