Slocan Integral Forestry Cooperative

Winlaw Creek 2020-2022
Stream Flow & Water Quality Monitoring

Prepared by:

Kootenay Environmental Innovations
Know Your Drainage

Slocan River Streamkeepers

July 2023

Table of Contents

Acronyms & Abbreviations

- A……Grade A Data
- B……Grade B Data
- BP……Grade 'Best Practices' Data
- C……Grade C Data
- CS……Citizen Scientist
- DI……Dilution
- D.O……Dissolved Oxygen
- E……Grade 'Estimated' Data
- FT……Flow Tracker
- GMT……Greenwich Mean Time
- KEI……Kootenay Environmental Innovations
- MM……Multi-Meter
- MX2001……A model of sensor which measures water level
- NTU……Nephelometric Turbidity Unit
- N/A……Not Applicable
- PT……Pressure Transducer
- Q……Discharge/Stream Flow
- QHR……Qualified Hydrometric Reviewer
- RISC……Resources Information Standards Committee
- SDR……Stage Discharge Relationship
- SG……Staff Gauge
- SIFCO……Slocan Integral Forestry Cooperative
- (S)FM……(Stream) Flow Measurement
- SRSKs……Slocan River Stream Keepers
- SW……Swoffer
- Temp……Temperature
- U…… Grade 'Unknown' Data
- WD……Wading (mid-section) Method

Disclaimer

The discharge data in this report has been collected per the BC Hydrometric RISC Standards v.2 (RISC Standards) released in 2019. All data grades assigned to the discharge data have been assigned by Rory Gallaugher, AScT, Principal of Kootenay Environmental Innovations (KEI). The data grades applied assist users of the discharge data in understanding KEI's considerations on how the data was collected and analyzed

and how the site conditions met the requirements presented in standards requirement criteria Table 1-1 of the RISC Standards.

Per the RISC Standards, grading hydrometric grading data is a subjective practice based on the Qualified Hydrometric Reviewer's (QHR's) interpretation of the RISC Standards and the data collected. In practice, each QHR may grade data differently based on their interpretation of the instrumentation, field procedures used, and data calculation and assessment. The RISC standards are intended to support data collection using calibrated equipment to provide standardization for review and audits and support the archiving of hydrometric data of known quality.

Further, data grades only apply for the period reported in the report. Changes to the creek morphology, watershed, or climate may change the water level and creek discharge in ways not reported by this data. Therefore it is recommended that should the data presented in this report be used for engineering purposes, where there is any chance of damage or harm to personal property or health, KEI expects that the engineer using the data apply their own data grade, based on their own interpretation of the data, and KEI will not be held liable for any damages that occurred due to the use of this data.

Water quality data is collected by third-party individuals the majority of the time and analyzed at accredited third-party labs. Though water quality data are presented in the report with an emphasis on the Province of British Columbia's Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia, KEI makes no representation as to the potability of the water. For questions regarding the potability of drinking water, KEI recommends contacting the water supplier and Interior Health.

Background

KEI was retained by the Slocan River Streamkeepers (SRSKs) to conduct the stream flow (i.e. discharge) monitoring at both Winlaw Creek and Trozzo Creek within the Slocan Valley for three years, starting in the spring of 2020.

The discharge monitoring at Winlaw and Trozzo Creeks was to be conducted as part of a more extensive study funded by the Slocan Integral Forestry Cooperative (SIFCo). The greater objective was to "collect data that can be compared to historical data collected by the Winlaw Watershed Committee to identify any long-term trends or changes to water quality, to monitor the impacts of controlled burns occurring in the watershed, and to monitor changes in the flow regime."

Study Objectives/Scope

Based on KEI's roles and responsibilities, KEI's objectives were to collect, analyze and report on discharge data per the BC Hydrometric RISC standards. The data is presented in a PDF report and in a comprehensive spreadsheet containing each calculation used to calculate the discharge data. This report presents the information for Winlaw Creek.

KEI also presented the water quality data associated with the drinking water indicators, turbidity and coliforms. Additional environmental data was also presented, which can be used to further understand the watershed's hydrological drivers, and physical and chemical data, which can be used to track the watershed's health as a drinking water source. These additional metrics include:

- specific conductance,
- water temperature,
- air temperature (Nelson CS weather station),
- precipitation (Nelson CS weather station),
- turbidity,
- verified E. coli,
- fecal (thermotolerant) coliforms, and
- total coliforms.
- nutrients and metals.

Methods

Discharge Data

The water level collected by a pressure transducer was corrected to a staff gauge using an offset to calculate continuous stage data (stage = water level data corrected to a staff gauge). When gaps in the stage data occurred due to sensor failures, a regional analysis was conducted using stage data from Anderson Creek, which is monitored by the Water Survey of Canada.

The stage data is then calculated into discharge by developing a stage-discharge relationship (SDR) for each site. The SDR is derived from a formula that draws a line between multiple discharge measurements conducted at varying stages throughout the monitoring period.

Discharge measurements were conducted using calibrated instruments, including a Swoffer, a Flow Tracker 2, and multi-metres which collect continuous conductivity. The

mid-section method was used where possible, but dilution measurements were conducted at high flows when the stream could not be waded.

Water Quality Data

The turbidity, specific conductance and coliform water quality samples were taken by SRSKs staff and processed at Passmore Laboratories. The water quality results are displayed alongside the discharge data to allow readers to identify correlations between the water quality and discharge data. Metal and nutrient sampling was also collected by SRSK and processed at CARO Analytical. Due to the large quantity of data, it has not been included in this report but is available in the accompanying spreadsheet.

Discussion

Water Level and Water Quality Sensor Challenges

The project suffered from two separate failures of water level sensors. The initial sensor consisted of a Hydros 21 water level and conductivity sensor, along with an experimental turbidity sensor. These sensors were connected to a Mayfly data logger, which can also be considered experimental. The data logger was programmed to work with the selected sensors.

This experimental route, which cost approximately $1,000 in equipment, was chosen to be used in place of industry-standard equipment (a multi-parameter sonde), which would have cost $7,000 to $8,000. The turbidity sensor was considered the most experimental and failed within the first months of deployment. The water level, conductivity sensors and Mayfly data logger proved much more robust, with the exception of one solder joint on a micro USB port.

The broken solder joint on the USB port proved challenging to troubleshoot as the solder would only fail when the circuit board flexed due to temperature fluctuations. The final data collected by the Mayfly data logger occurred in September 2020. However, multiple attempts were made to continue using the sensor over the winter of 2020/21.

In March 2021, a HOBO MX2001 water level sensor was purchased from ONSET to replace the Mayfly data logger. This sensor logged water levels continuously without issue through the summer of 2021. However, the MX2001 also suffered data losses in the winter of 2021/22. Though MX2001s have been reliable in the past, it appears that ONSET suffered quality control issues during the Covid-19 pandemic, leading to rapid battery consumption and unstable memory. The MX2001 was returned to ONSET under warranty, and no issues have occurred in the new MX2001.

Site Conditions and Data Accuracy

The site conditions at the Winlaw Creek station were favourable for collecting excellent data quality. Through the study's two and a half years, the stage-discharge relationship remained stable, indicating that the control (the features of the stream that determine the stage at the site) is also stable. This is partly because the station is located in a portion of the stream that is relatively less steep, and thus the energy of the discharge is relatively lower than in steeper creeks.

The station was limited to receiving a data grade of C due to the accuracy of the MX2001 0-4m model, which achieves a typical accuracy of +/- 6mm, and some flow measurements marginally exceeded the accuracy requirements of grade B data, which requires less than 15% deviation from the SDR. The station can likely collect grade B discharge data per the criteria outlined in Table 1-1 of the RISC Standards.

Recommendations

The site conditions of Winlaw Creek are favourable to collecting accurate discharge data and make the station economical to operate. Thus, the Winlaw Creek station should be a candidate for long-term monitoring.

Though the MX2001 has a typical accuracy of +/-6mm, and the RISC standards state that an accuracy of +/-5mm is needed to achieve grade B data, it is recommended that the MX2001 continue to be used as it is user-friendly, which can lead to lower operating costs.

It is recommended that water quality samples be taken at the following intervals:

- Total Coliforms, Fecal Coliforms and E.Coli.
  - 1 sample taken monthly (if budget allows)
  - 5 samples taken over 30 days, twice a year:
    - during the freshet, and
    - starting with the fall rains.
- Turbidity
  - Weekly from April 1st to November 30th.
  - Every other week from December 1st to March 31st.
  - Event-based, e.g., if the water looks visibly turbid.

Though KEI recommends that the above samples be taken, KEI will not state whether or not water is potable. For questions regarding the potability of drinking water, KEI recommends that interested parties consult with their water provider and Interior Health.

The sample intervals are only recommendations to collect a robust dataset for annual analysis regarding the suitability of the creek to act as a source of drinking water (to be determined by a third party). In addition, the sampling results can be used to determine if changes in the watershed have affected the water quality, such as (but not limited to):

- fires,
- logging,
- changes in land use,
- landslides, or
- events associated with climate change.

Additional samples, such as specific conductance, metals, nutrients, and full raw water analysis, may be recommended based on study objectives outside of KEI's scope.

Discharge & Water Quality Data Presented in BC Hydrometric RISC Forms

The remainder of the report consists of the metadata used to calculate the discharge data in the forms supplied in the appendix of the RISC standards. The forms are intended to be completed so that the Province of British Columbia, consultants or any other industry professional can evaluate the methods used to calculate the discharge data. Datasets which are not included in this report, but which are captured in the spreadsheet, include:

- flow measurements metadata,
- benchmark surveys,
- nutrient and metals sampling results, and
- time series data needed to create the graphs.

In addition to the metadata, the discharge, water quality and meteorological data associated with the site are displayed in graphs.

Hydrometric Station History

A station's historical records are an essential component of the station's metadata. The station history provides information such as site location, the station's purpose, the types of data collected, records of installations, the types of equipment deployed at the station, benchmarks and levels, etc. (2019, RISC p.18)

Included in the Hydrometric station history are the following sections:

i Station Watershed Image
ii Station Location
1) Station Maintenance
2) Records Collected
3) Benchmarks/Elevations
4) Staff or Reference Gauge
5) Recording Gauge
6) Rated Structure
7) Level Checks
8) Station Controls and Channel Description
9) Kootenay Boundary Water Tool Data
10) Site Plan/Site Sketch

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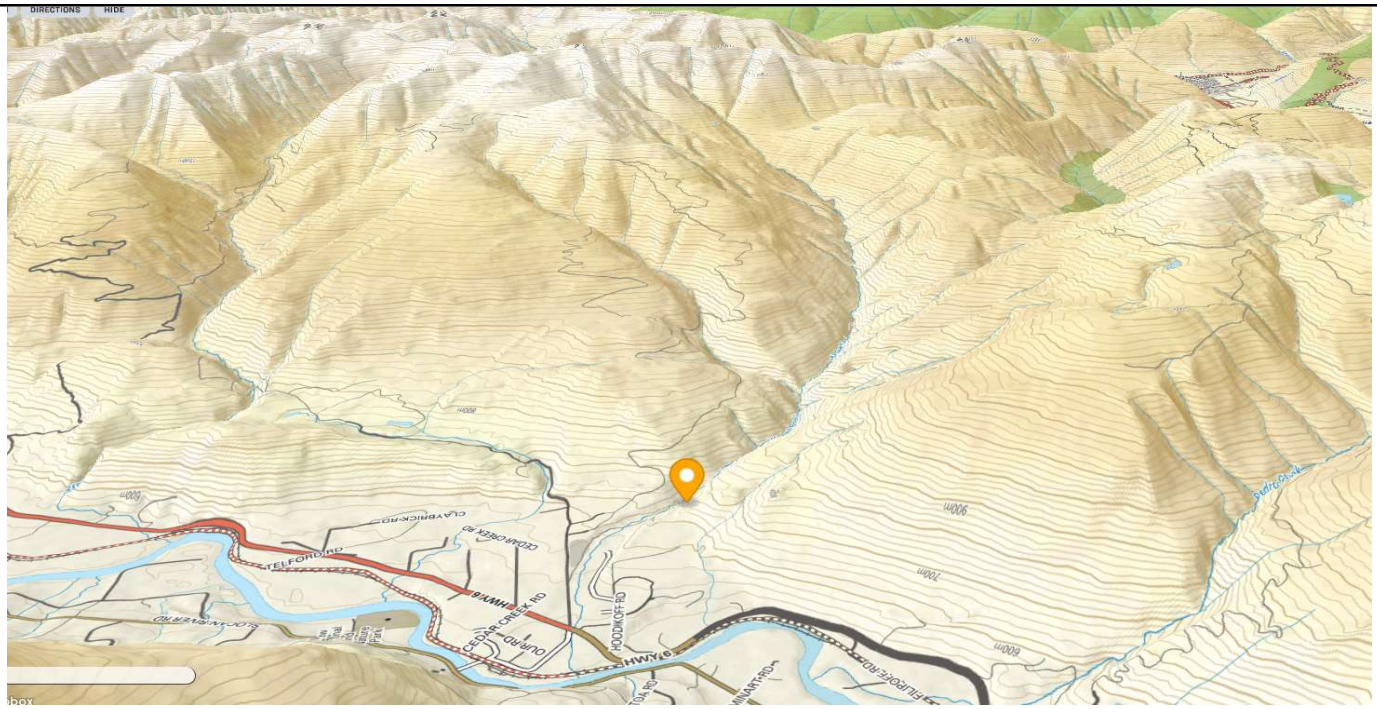
Hydrometric Station History

Station Identification Number: n/a

Station Name: Winlaw Creek SIFCo Installation

Gazetted Stream Name: Winlaw Creek

i) Station or Watershed Image



ii) Station Location

Latitude/Northing: 49.60356 **Longitude/Easting:** -117.54525 ± 4m

Georeferenced Source: NAD 83

Drainage Area Size[1]: ~40 km^2 **Allocations Vol.[1]:** 0.004 m^3/sec **Allocations %[1]:** 0.5%

Watershed Elv.[1] **Min:** 685 m **Mean:** 1390 m **Max:** 2113 m **Average Face Direction:** West

EMS ID. (if available): None **NESDIS ID (if available):** None

Description of Location: The station is a 15-20 minute hike beyond the end of Hoodikoff road. The station is located on the south bank ~100m beyond the upper most drinking water intake.

Location Type: ☐ Lake ☐ River ☑ Stream ☐ Other:

Station Type: ☐ Water Level Only ☑ Flow Only ☐ Both ☐ Other:

Stream Flow: ☐ Regulated ☑ Natural ☐ Other:

Upstream Allocation: ☐ Yes ☑ No ☐ Other:

Other Parameters Collected: ☑ Water Temp ☐ Air Temp ☑ Barometric Pressure
☑ Other: Water quality parameters are collected via grab samples. The grab samples include turbidity, specific conductivity and coliforms.

Station Description and Purpose: The project is funded by the Slocan Integral Forestry Cooperative (SIFCo), with funding secured by the Columbia Basin Trust. Funding for the stream flow and water quality monitoring is to identify any effects on Winlaw Creek in regards to controlled burns in the area.

Station Operating Agency/Firm: Kootenay Environmental Innovations

Contact Details: Rory Gallaugher, AScT, gallaugher.consulting@gmail.com

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Section 1. Station Maintenance

Action (Station Established, Relocated, Modified, Closed)	Date	Remarks	Updated By	
			Initial	Date
Established	2020-05-01	The stilling well and staff gauge were installed.	RJG	2022-06-01
Installed	2020-06-11	Hydros 21 Conductivity, Temperature, Depth (CTD) sensor was installed.	RJG	2022-06-01
Installed	2021-04-01	Onset MX2001 water level sensor was installed to replace the Hydros CTD sensor.	RJG	2022-06-01
Modified	2022-08-18	A 2" stilling well was installed to properly house the MX2001.	RJG	2023-05-30

Section 2. Records Collected

Sensor/Sample Type	Start Date	End Date	Remarks
Hydros CTD 21 & Onset MX2001 (0-4m)	2020-06-11	To Present	The CTD sensor records specific conductivity, water temperature and water level. The datalogger failed due to factory solder joints breaking during cold temperatures. The Hydros CTD sensor was replaced with a MX2001 unit on April 1, 2021.
Continuous Stream Flow	2020-06-11	To Present	Stream flow data is calculated for the entire reporting period, though regional analysis were used when sensor failures occurred.
Turbidity, Specific Conductance, Coliforms, E-coli	Unknown	To Present	Multiple water quality samples are collected regularly by the Slocan River Stream Keepers.

Section 3. Benchmarks/Elevations

Benchmark (BM) No.	Date Established	Datum [Local datum always set at zero meter] (m)	GSC Datum Elevation [if any] (m)	Description
Staff Gauge	2020-05-01	0		Zero datum is zero on the SG.
BM1	2020-05-01	0.9843		Rebar LB
BM2	2020-05-01	0.8468		Rebar LB
BM3	2020-05-01	1.2105		Rebar RB

Modifications of Benchmarks

Benchmark (BM) No.	Date Modified	Original Datum (m)	New Datum (m)	Reasons & Remarks	Updated By	
					Initial	Date

Section 4. Staff Gauge or Reference Gauge

Type	Date	Location Description	Zero Flow at Gauge Height (m)	Gauge reading Accuracy (mm)	Updated By	
					Initial	Date
Unknown staff gauge manufacturer	2020-05-01	South side of the stream in a calm area created by a large stump.	-0.095	2mm	RJG	2022-02-18

Section 5. Recording Gauge

Type and Make	Date Installed	Date Removed	Zero Flow at Gauge Height (m)	Accuracy and Range	Remarks	Updated By	
						Initial	Date
Hydros 21 CTD	2020-06-11	2020-09-10	-0.035	± 0.05% FSO ± 2.5mm	Sensor was reliable, datalogger failed.	RJG	2022-02-18
MX2001	2021 04-01	2021 12-31	-0.035	± 0.1% FSO ± 6mm typical	Batteries were prone to dying in cold temp.	RJG	2022-02-18

Section 6. Rated Structure

Type and Description	Date Installed	Date Removed	R.L. of Invert (m)	R.L. of Sensor Head [if any] (m)	Updated By	
					Initial	Date
None						

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Section 7: Level Checks

Note: See Site Records for offset calculations

Section 8: Station Controls and Channel Description

Description of Control:

The control consists of cobbles and boulders, which create an eddy at the station at low flows. At higher flows, the control consists of cobbles and boulders approximately three to five meters downstream of the site. Throughout 2020, 2021 and 2022 the control remained stable, though it may change in high flows.

Channel Description:

The channel is consistent in terms of its grade, stream bed makeup and flow direction in and around the station. The stream bed consists of cobbles and boulders and is on average approximately five meters wide The banks are approximately one meter in height on either side.

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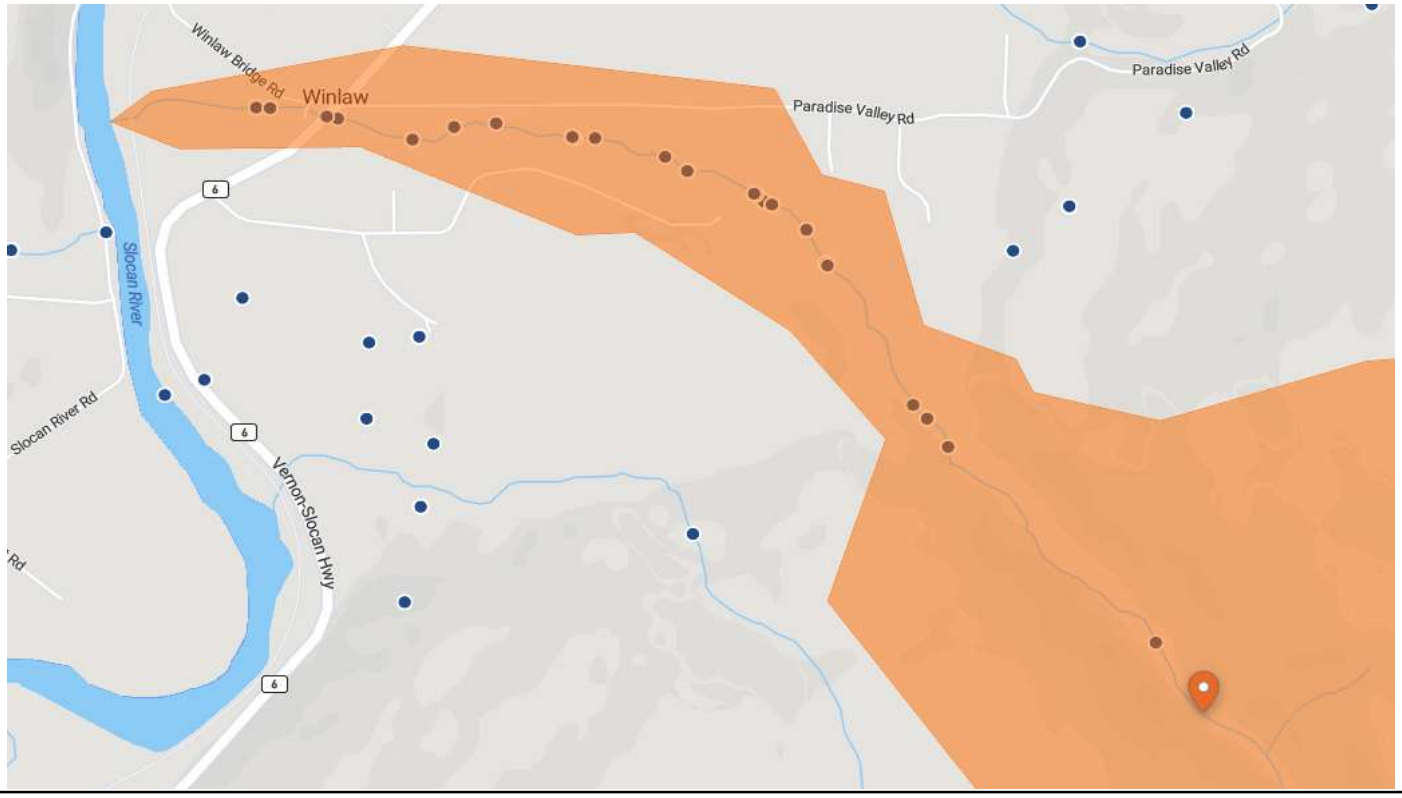
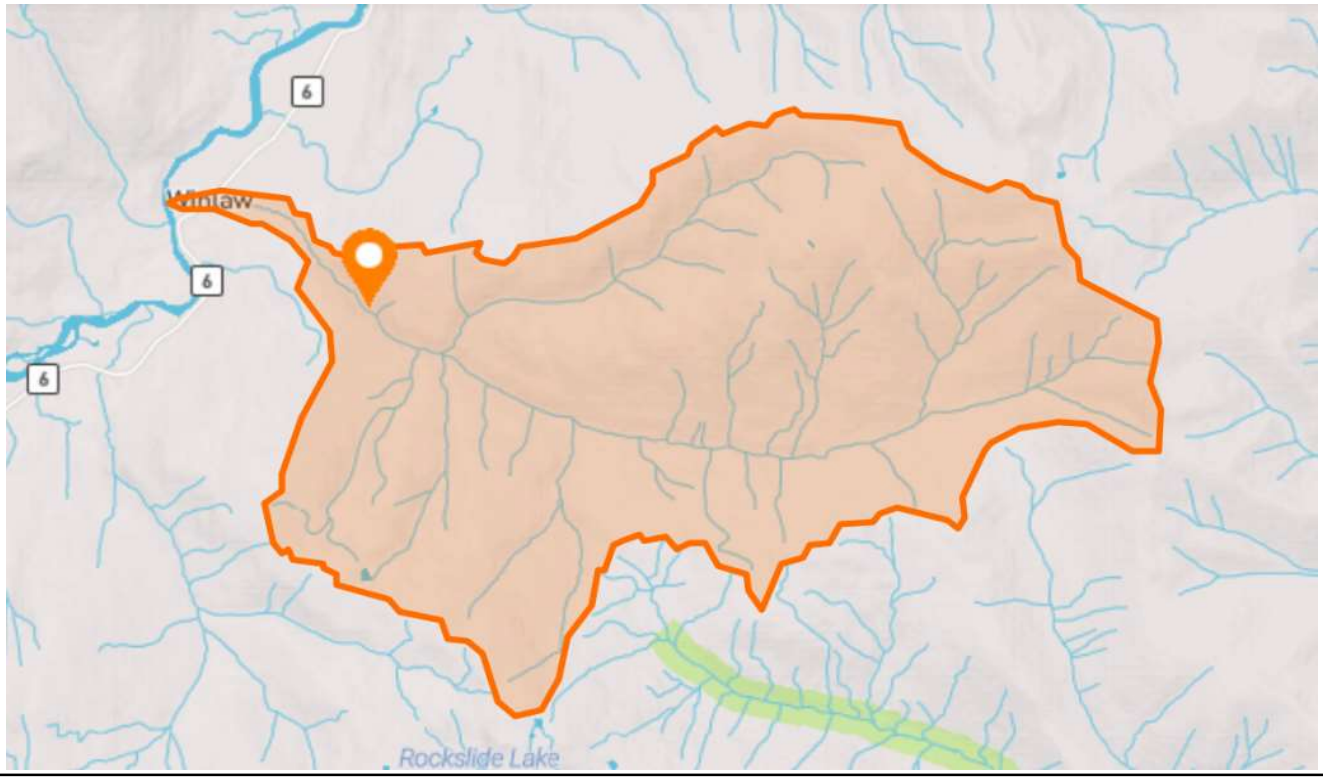
Section 9: Kootenay Boundary Water Tool Data[1]

Retrieval Date: 2022-06-01

1) Water Licences[1]



2) Watershed Delineation[1]



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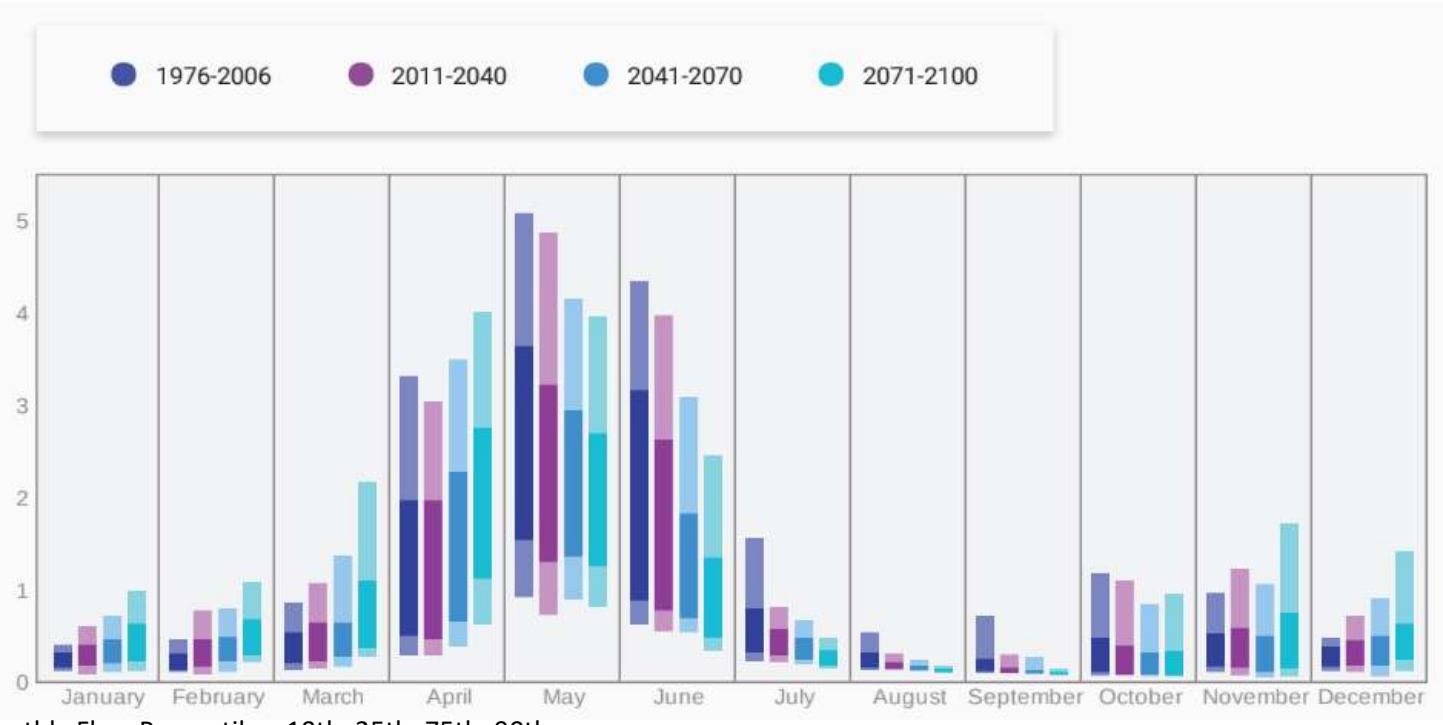
Section 9: Kootenay Boundary Water Tool Data[1]

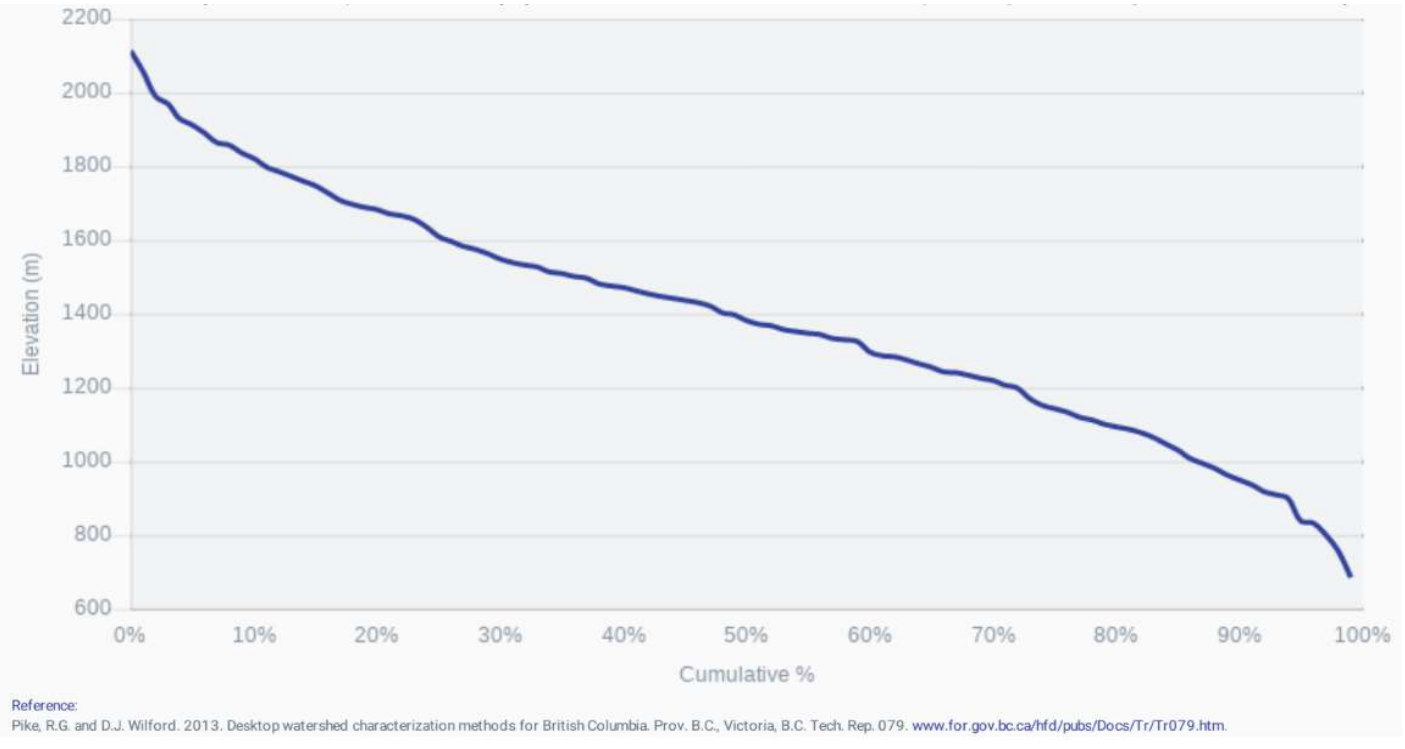
Retrieval Date: 2022-06-01

3) Current & Future Hydrologic Variability[1]



Monthly Flow Percentiles: 10th, 25th, 75th, 90th

4) Topography[1]



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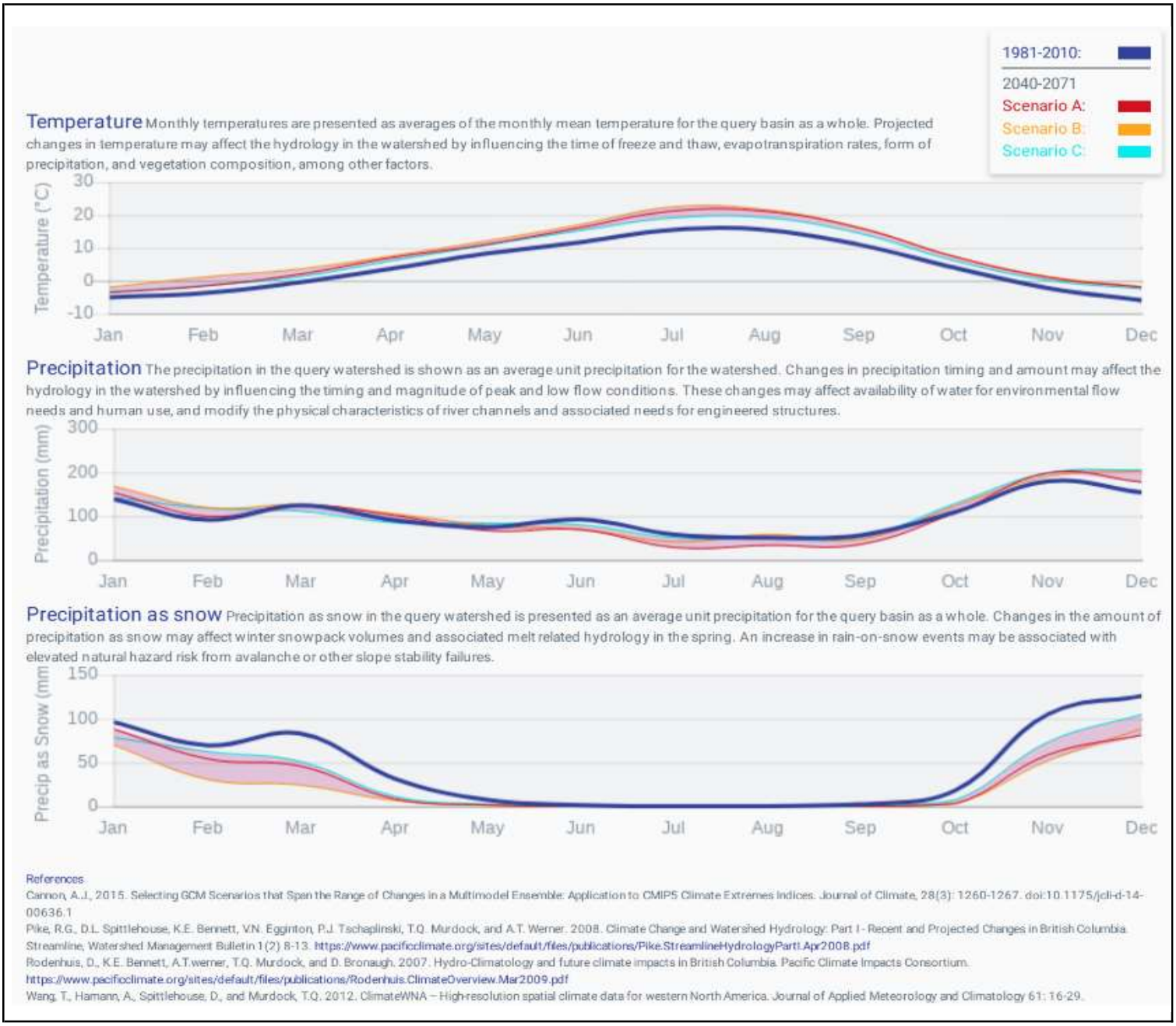
Section 9: Kootenay Boundary Water Tool Data[1]

Retrieval Date: 2022-06-01

5) Current & Future Climate Variability[1]



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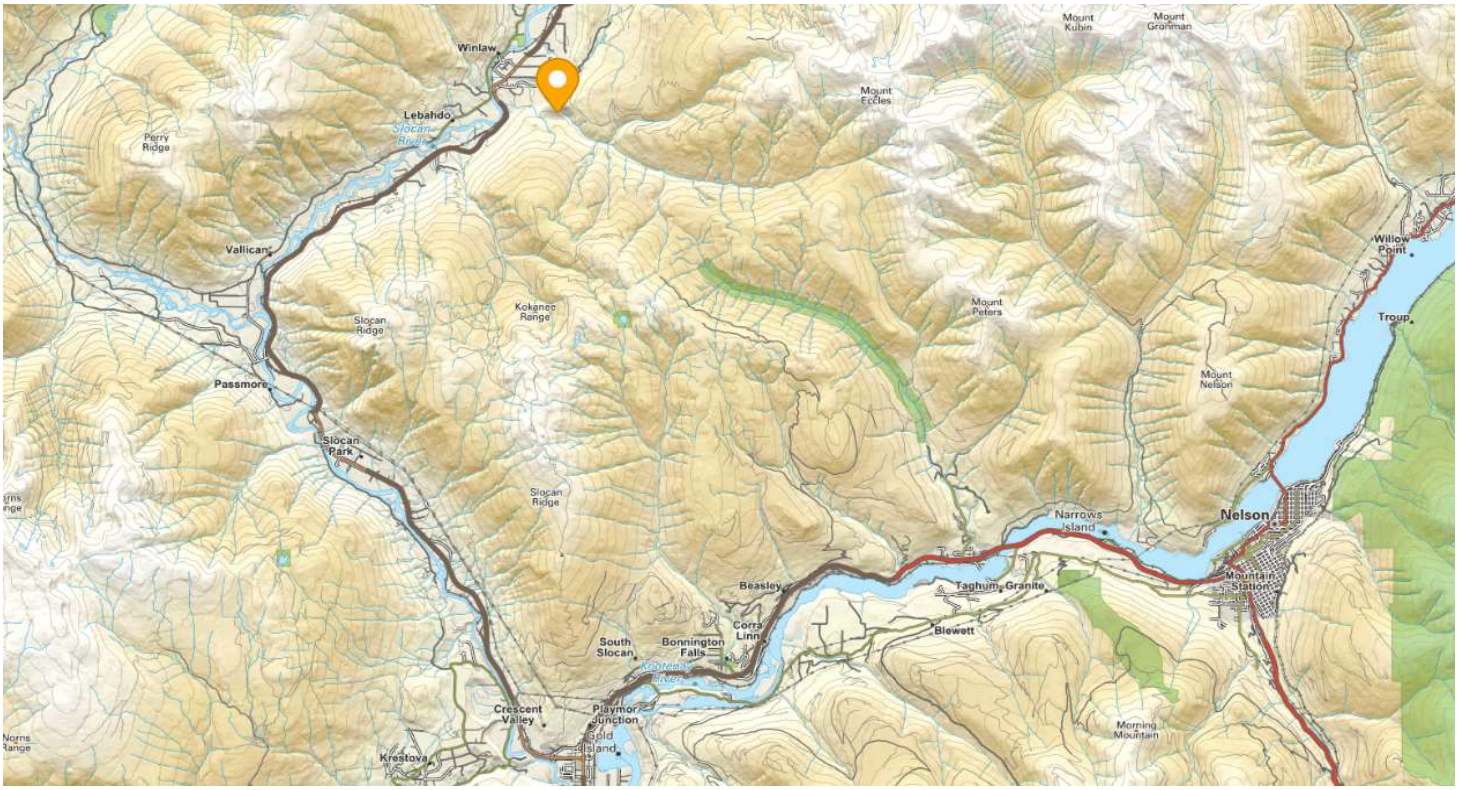
Section 10: Site Plan/Site Sketch

Site Plan

Drawn by: R.Gallaugher Date: 2022-06-01

Regional location showing nearest communities/points of interest



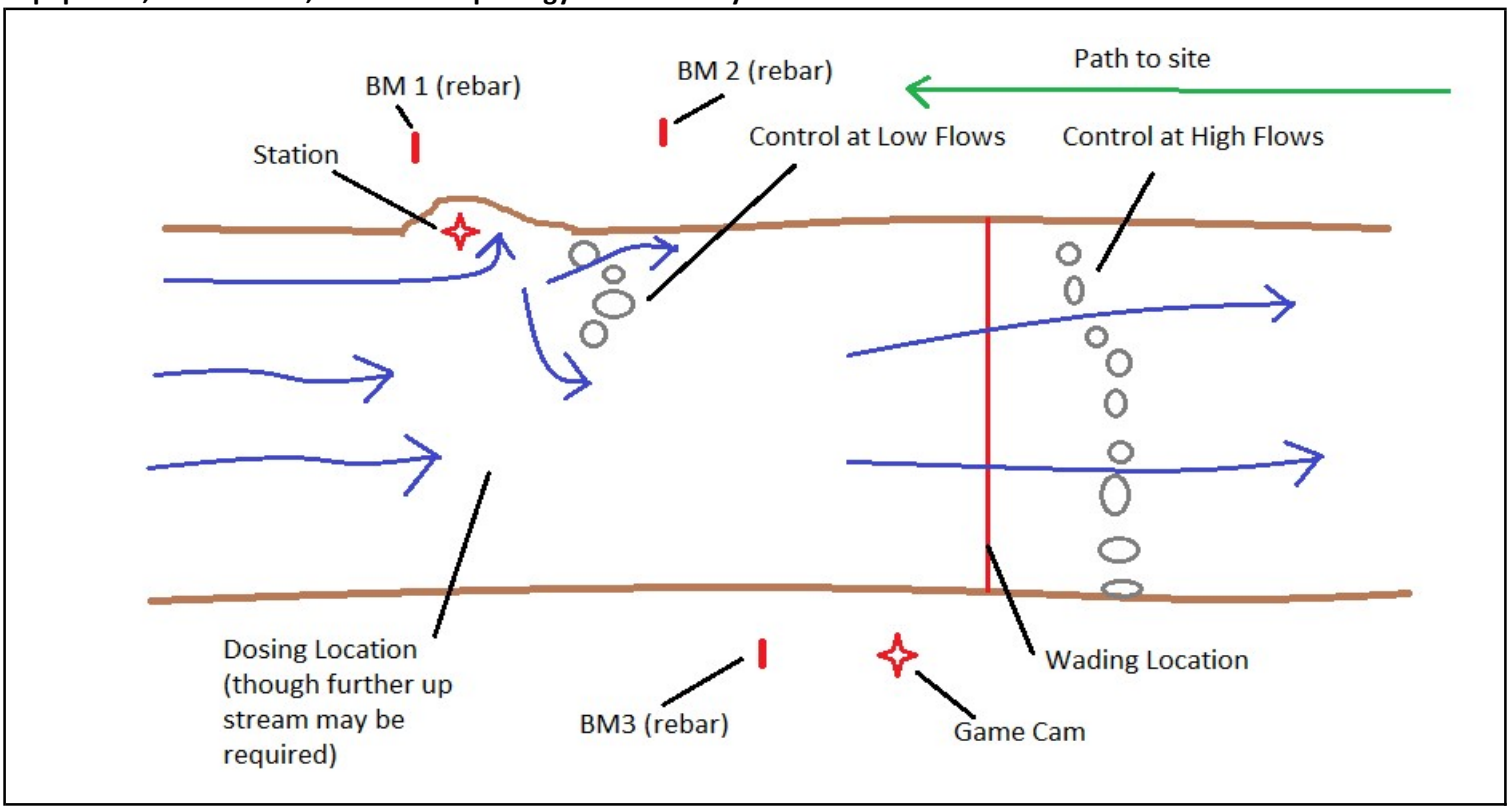
Location showing access and nearby landmarks

The access and site are located on private property. No trespassing is permitted.

Section 10: Site Plan/Site Sketch

Site Plan

Equipment, benchmarks, channel morphology in the vicinity of the station



Station construction

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Section 10: Site Plan/Site Sketch

Site Plan

Station at high flow

Station at low flow

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Section 10: Site Plan/Site Sketch

Site Plan

Dilution at high flow

Dilution at low flow

Hydrograph, Stage & Water Quality

The following pages show the hydrograph, stage and water quality data over the current and past reporting periods.

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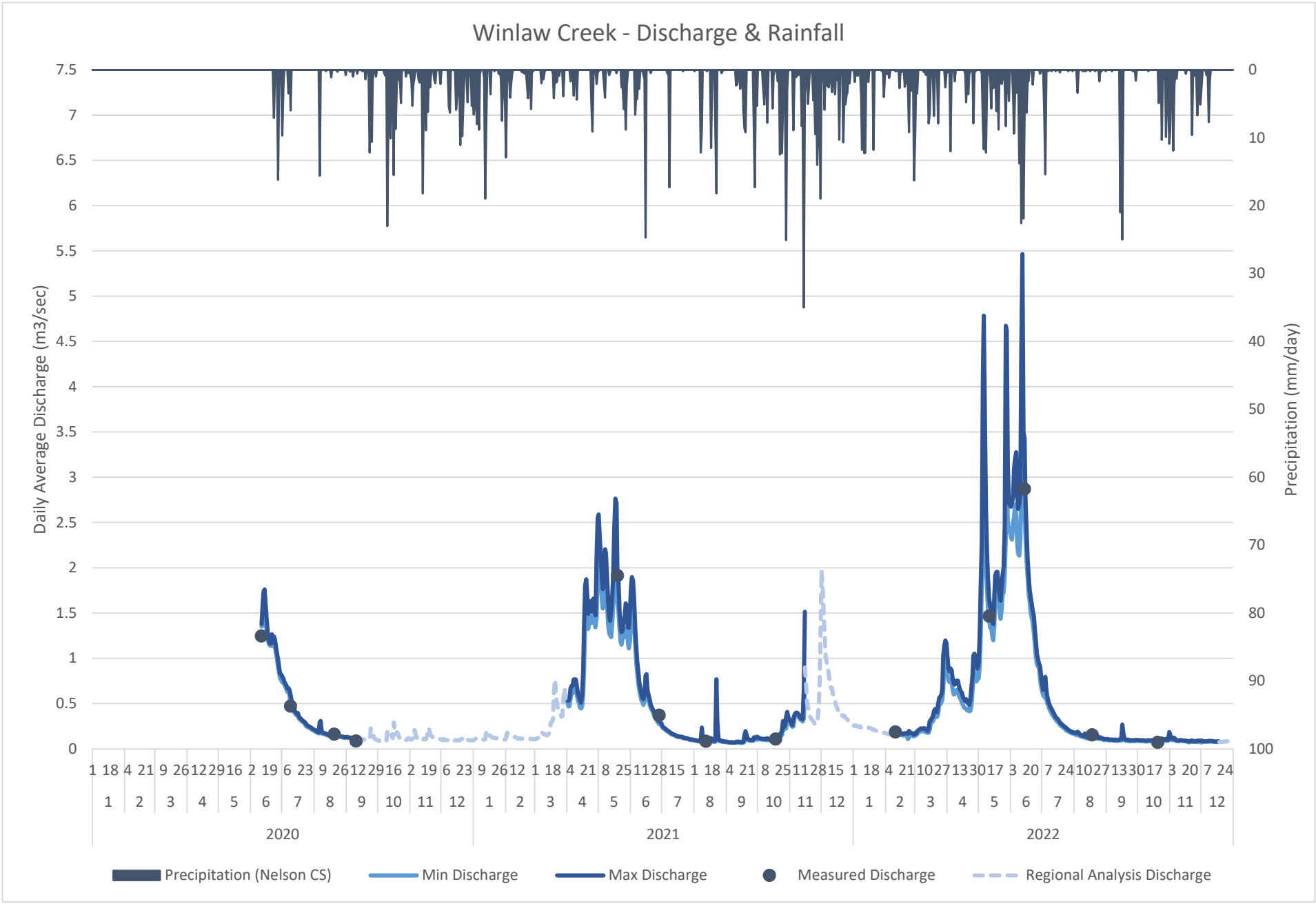

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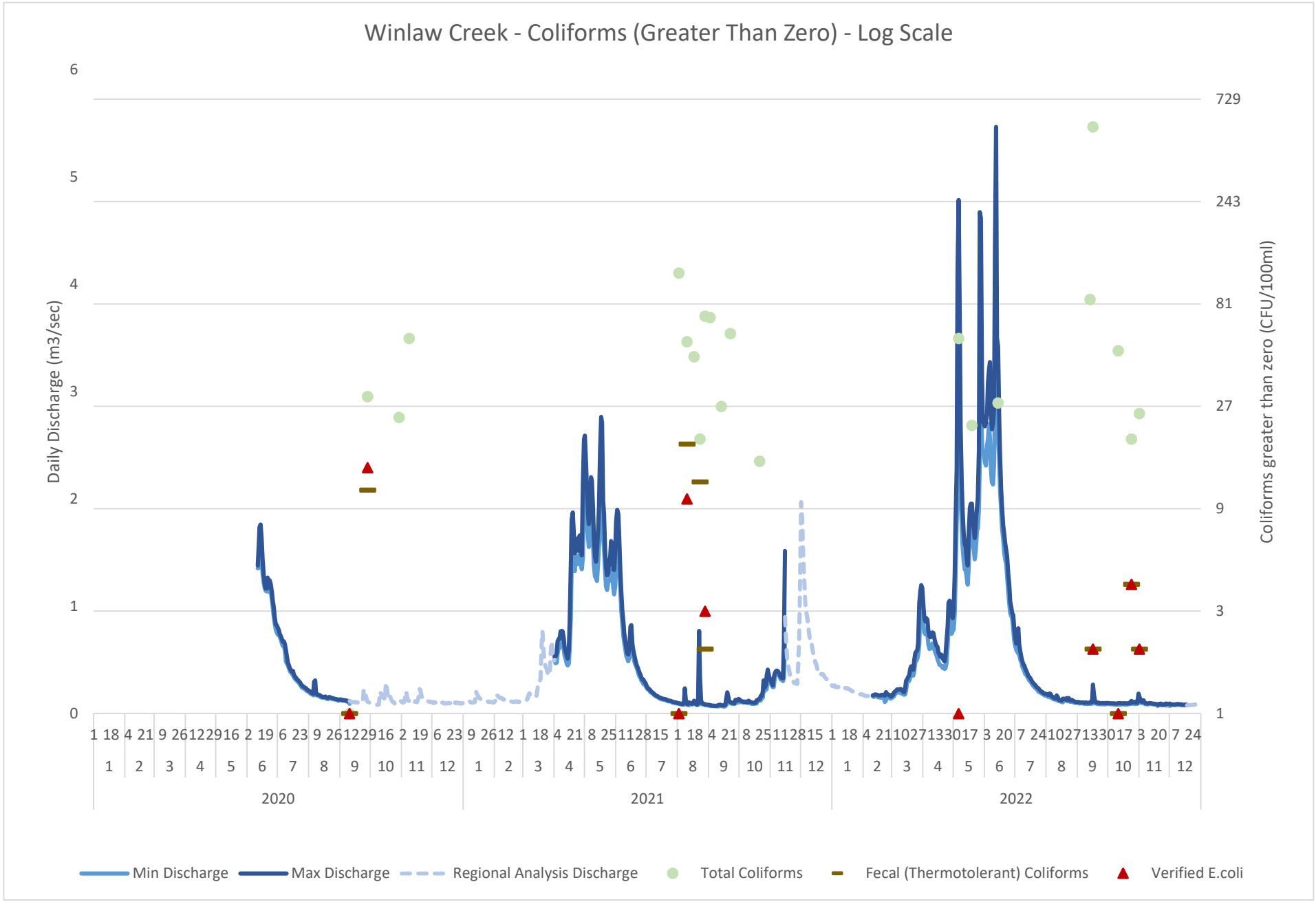

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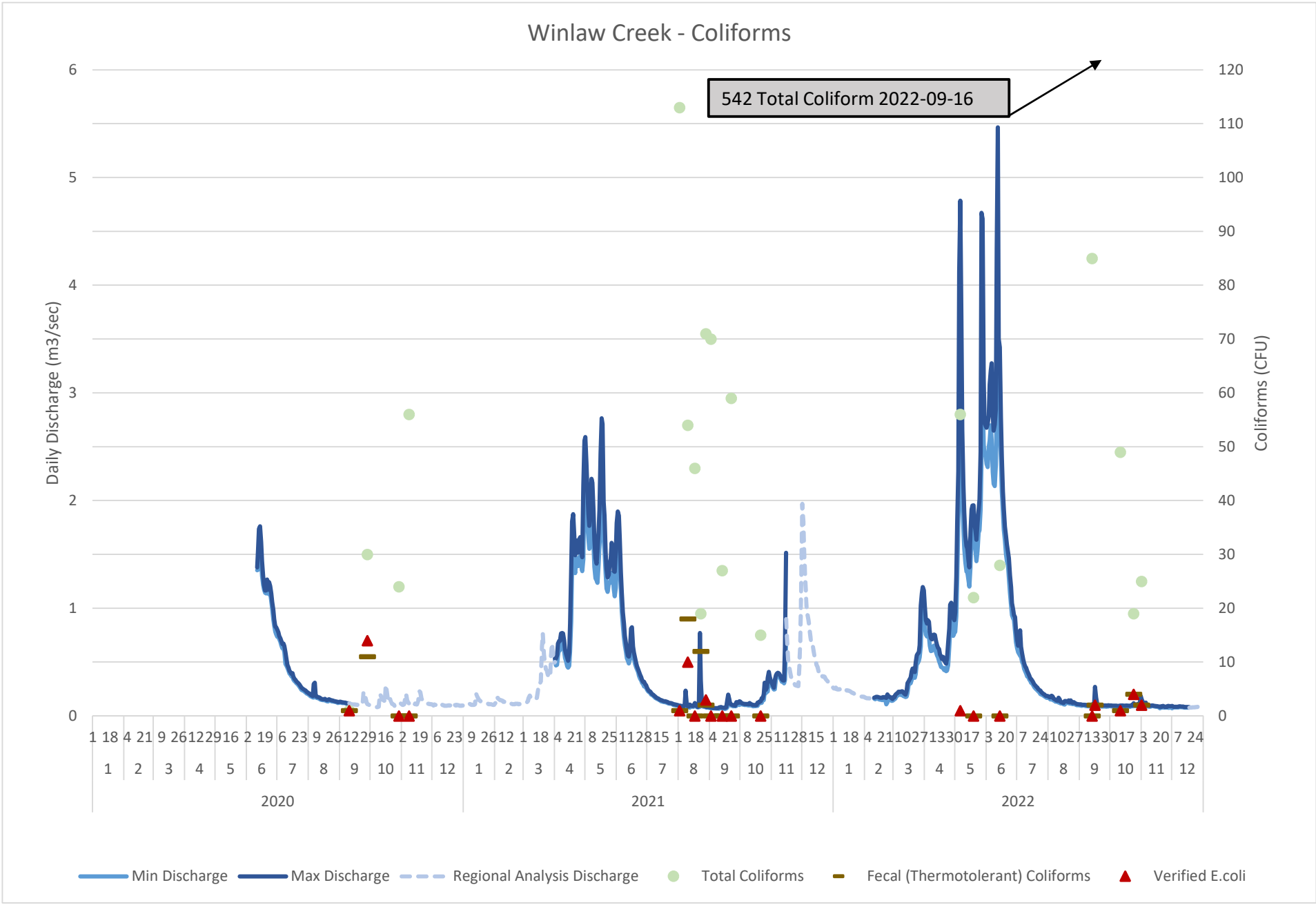

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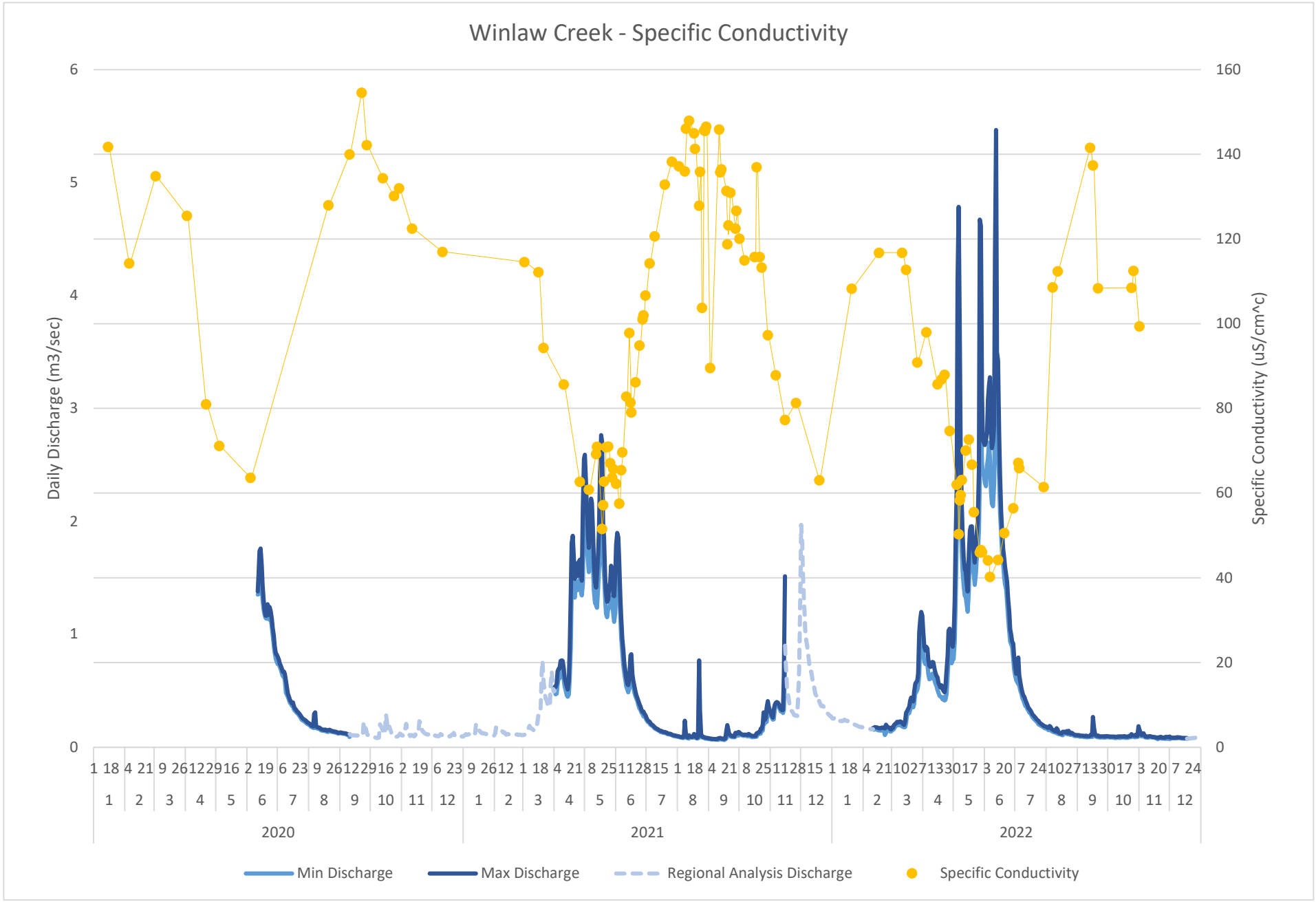

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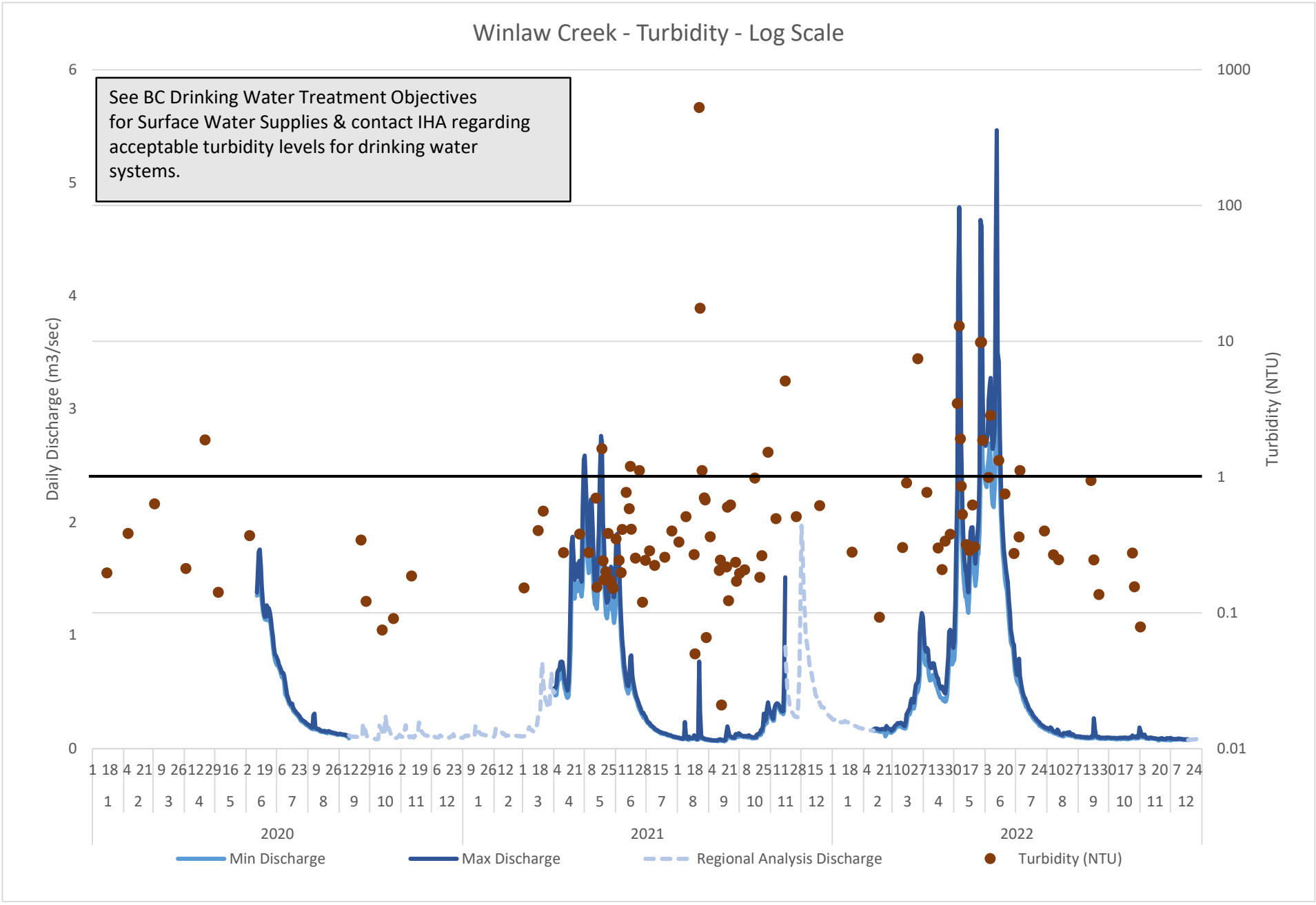

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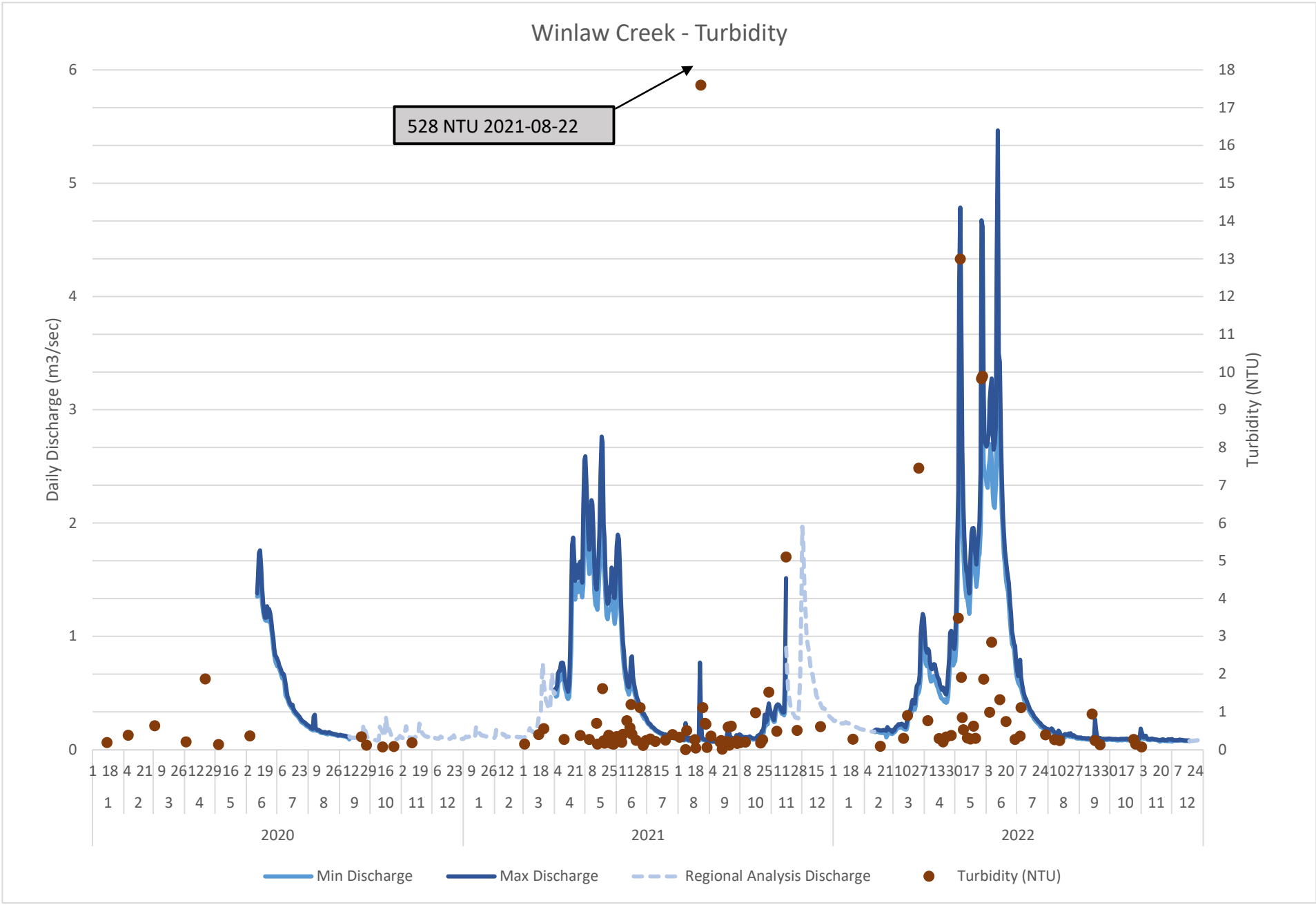

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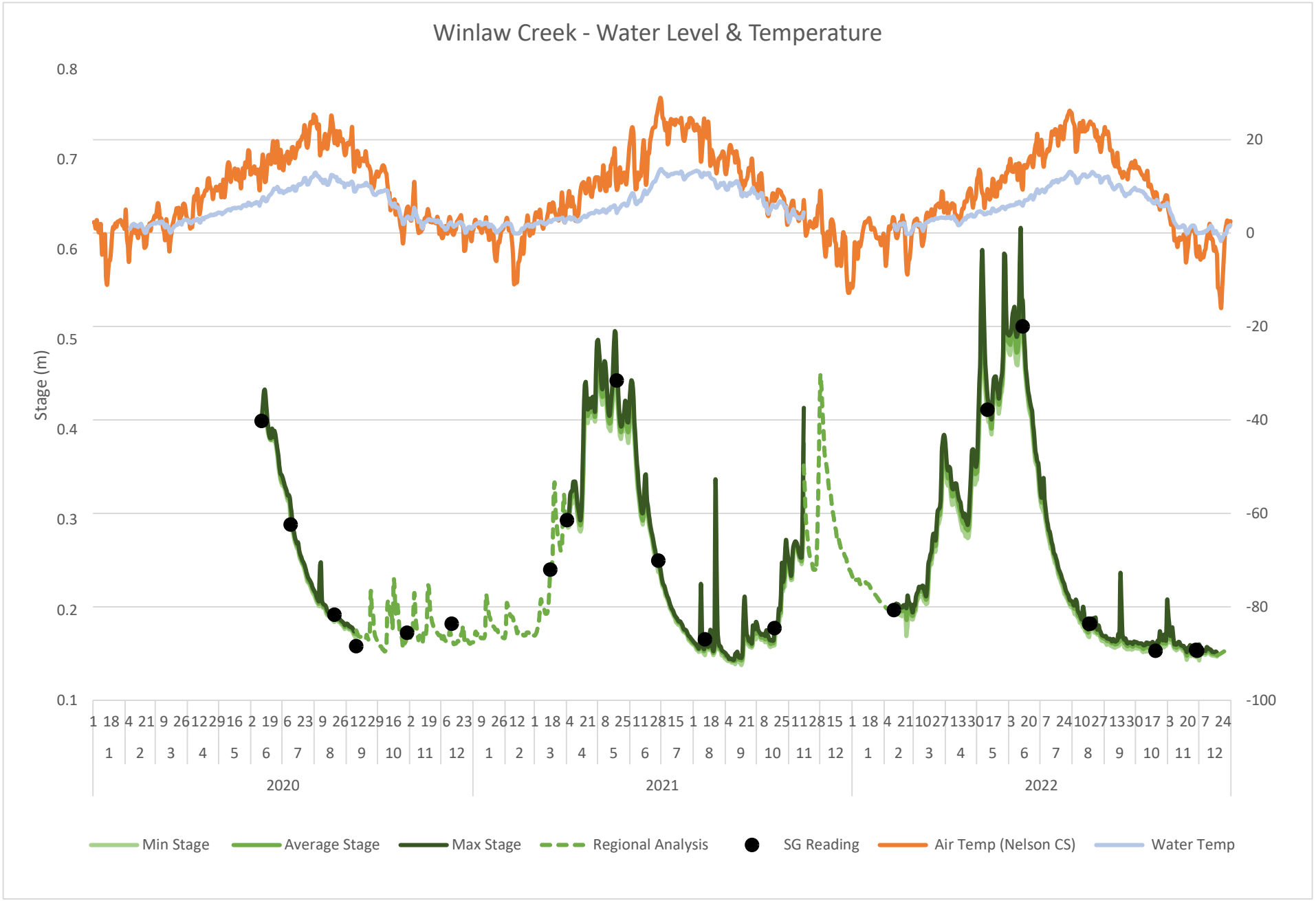

Water Stage Log

The Water Stage Log, which is usually posted within the instrument shelter, may be used for systematically recording the gauge reading, time and date, and other information during a site visit. This information is particularly useful in support of data corrections (e.g., sensor drift). This form also provides a ready reference to the operating history of the station. (2019, RISC p.39)

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Water Stage Log

Station ID # n/a **Station Name:** Winlaw Creek SIFCo Installation **Gazetted Stream Name:** Winlaw Creek

Station Operation Agency/Firm: Kootenay Environmental Innovations

Contact Details: Rory Gallaugher, AScT, gallaugher.consulting@gmail.com

Date	Arrival					Departure					Offset Drift (cm)	Stage Read Error (±cm)	Remarks
	Time -8GMT		Gauge Height/Stage			Time -8GMT		Gauge Height/Stage					
	Watch	Data Logger	SG (m)	Logger (m)	Offset (cm)	Watch	Data Logger	SG (m)	Logger (m)	Offset (cm)			
2020-06-11						16:20	16:00	0.410	0.366	4.4		0.50	Installed the station
2020-07-09	10:24	10:00	0.295	0.269	2.6	11:46	12:00	0.295	0.270	2.5	-1.9	0.20	
2020-08-20	12:54	14:00	0.195	0.165	3.0	14:35	15:00	0.195	0.159	3.6	0.6	0.20	
2020-09-10	11:57	12:00	0.160	0.137	2.3						-1.3	0.20	Data became corrupted due to a broken solder joint.
2020-10-29	9:54		0.175			11:48		0.175				0.20	Data Corrupted
2020-12-11	12:00		0.185			13:18		0.185				0.20	Data Corrupted
2021-03-16	11:52		0.245			12:40		0.245				0.20	Data Corrupted
2021-04-01	18:08		0.300			18:08	18:00	0.300	3.003	-270.3		0.20	Installed MX2001
2021-05-19	13:53	13:45	0.455	3.140	-268.5	14:44	15:00	0.455	0.454	0.1	1.8	0.50	
2022-06-28	13:15	13:00	0.255	0.245	1.0	13:35	14:00	0.255	0.243	1.2	0.9	0.50	
2022-08-12	11:26	11:00	0.170	0.140	3.0	15:15	15:00	0.165	0.138	2.7	1.8	0.20	
2022-10-18	10:22	10:00	0.180	0.132	4.8	11:20	11:00	0.180	0.133	4.7	2.1	0.20	
2022-02-10	12:50	13:00	0.200			16:15	16:15	0.200	0.200	0.0		0.20	MX2001 failed due to warranty issue.
2022-05-11	10:56	11:00	0.425	0.424	0.1	12:03	13:00	0.420	0.421	-0.1	0.1	0.20	
2022-06-14	17:13	17:15	0.515	0.525	-1.0	17:13	17:15	0.515	0.525	-1.0	-0.8	0.50	
2022-08-17	15:50	0.573	0.185	0.185	0.0	15:50	15:00	0.185	0.185	0.0	1.0	0.20	
2022-08-18	12:29	11:45	0.185	0.182	0.3	12:39	13:00	0.185	0.184	0.1	0.3	0.20	
2022-10-20	11:40	12:30	0.155	0.131	2.4	13:01	14:00	0.155	0.154	0.1	2.3	0.20	
2022-11-28	11:05	11:00	0.156	0.150	0.6	12:24	12:15	0.156	0.156	0.0	0.5	0.20	
2022-11-29	9:15	9:15	0.155	0.159	-0.4	9:50		0.155			-0.4	0.20	

Summary of Discharge Measurements and SDR

The stage-Discharge Relationship (SDR) page is where the SDR is created and has the ability to show multiple curves. This may be beneficial as curves that were under consideration or past curves can be shown.

Kootenay Environmental Innovations

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Nelson BC

Summary of Discharge Measurements

Station ID # n/a **Station Name:** Winlaw Creek SIFCo Installation **Gazetted Stream Name:** Winlaw Creek

Station Operation Agency/Firm: Kootenay Environmental Innovations

Contact Details: Rory Gallaugher, AScT, gallaugher.consulting@gmail.com

Date	Time (-8 GMT)	Measured By	Codes				Profile				Stage/Discharge							Accur.		SDR 1 Max 16%			Remarks
			Meas. Type	Meas. Meth.	Meter Cal.	Meter Field Ver.	Width (m)	No. of Verticals	Total Area (m^2)	Mean Vel. (m/sec)	Stage Accuracy (±m)	Mean Stage (m)	Q (m3/sec) Yr. 1	Yr. 2	Yr. 3	Yr. 4	Abandoned	DI Q Diff. (%)	Data Grade	Calc'd. Q (m^3/sec)	Use in SDR (Y/N)	SDR Accuracy (%)	
2020-06-11	15:55	RJG	SW	16	1	1	5.3	22	1.59	0.78	0.005	**0.410**	**1.246**						C	1.352	y	8%	
2020-07-09	10:30	RJG	SW	16	1	1	4.6	22	1.07	0.44	0.002	**0.290**	**0.471**						C	0.461	y	2%	
2020-08-20	14:05	RJG	SW	16	1	1	4.5	23	0.71	0.23	0.002	**0.195**	**0.162**						C	0.150	y	7%	
2020-09-10	12:08	RJG	SW	16	1	1	2.1	22	0.35	0.25	0.002	**0.160**	**0.088**						C	0.090	y	2%	
2021-05-19	14:25	RJG	SW	16	1	1	5.7	27	2.12	0.90	0.005	**0.455**	**1.916**						C	1.896	y	1%	
2021-06-28	13:24	RJG	SW	16	1	1	4.6	23	1.03	0.36	0.002	**0.255**		**0.373**					U	0.316	y	15%	
2021-08-12	14:40	RJG	SW	16	1	1	4.5	32	0.52	0.16	0.002	**0.165**		**0.084**					B	0.097	y	16%	
2021-10-18	11:02	RJG	SW	16	1	1	4.5	22	0.60	0.18	0.002	**0.180**		**0.113**					U	0.122	y	8%	Calibration changed.
2021-08-12	n/a	RJG	Survey								n/a	**0.000**		**0**					n/a	0.002	n		Survey of Control.
2022-02-10	13:19	RJG	DI	14	1	1					0.002	**0.200**			**0.188**			16%	BP/C	0.161	y	15%	
2022-05-11	16:20	RJG	DI	14	1	1					n/a	**0.418**					**1.467**	28%	U	1.438	n		Metadata was lost.
2022-06-14	17:21	RJG	DI	14	1	1					0.005	**0.515**			**2.869**			n/a	BP/C	2.857	y	0%	Only one dose used.
2022-08-18	12:31	RJG	DI	14	1	1					0.002	**0.185**			**0.155**			0%	BP/A	0.131	y	16%	
2022-10-20	12:20	RJG	FT	5	1	1	4.4	26	0.48	0.15	0.002	**0.155**			**0.072**				A	0.083	y	16%	
2023-03-22	12:47	RJG	FT	5	1	1	4.5	22	0.58	0.21	0.002	**0.181**				**0.121**			A	0.123	y	2%	

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Stage-Discharge Relationship (SDR) Construction

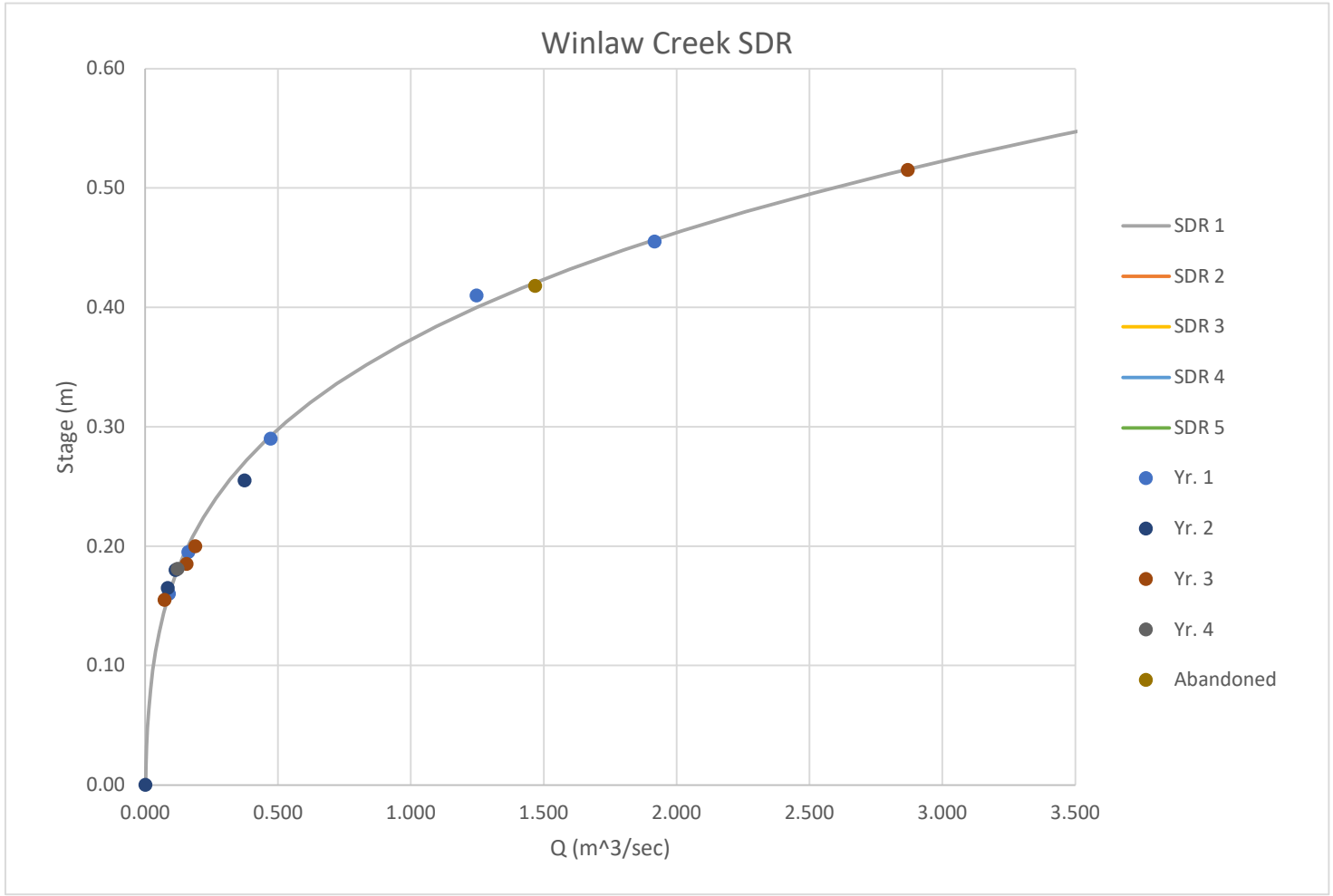
SDR Stage Start (m) **0.00**
SDR Stage End (m) **0.80**

SDR Formulas

SDR #	C	h_o	b	Display (Y/N)
1	20.25	-0.095	3.96	y
2				
3				
4				
5				

SDR Descriptions

The SDR is considered to produce Grade C data as all flow measurements are within 25% of the SDR, but some are greater than 15%. The largest areas of error in the SDR come from trying different methodologies at the lower section of the curve and the possibility of small changes in the control over time.



Stage-Discharge Relationship Sign-Off

Daily or continuous discharge data cannot practically be obtained directly. It is however possible to obtain daily or continuous water level/stage data and from those a continuous discharge record can be estimated based on this relationship of water level and flow. The result is a correlation called the stage-discharge relationship. A history of the relationship evolves over time, as each discharge measurement and corresponding stage is plotted, and a smooth curve is drawn that best represents these points (2019, RISC p.90).

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Stage-Discharge Relationship Sign-Off

Station Identification Number: n/a **Gazetted Stream Name:** Winlaw Creek
Station Name: Winlaw Creek SIFCo Installation
Station Operation Agency/Firm: Kootenay Environmental Innovations
Contact Details: Rory Gallaugher, AScT, gallaugher.consulting@gmail.com
SDR Curve No.: 1 **Date Created:** 2023 Jun-12
SDR Revised (Y/N): No **Date of SDR Revision:** n/a
Number of points used to generate the curve: 13
Curve Period: **From** 2020-06-11 **To** 2022-12-31
Highest Measured Discharge (m3/sec): 2.869 **At Stage (m):** 0.515
Lowest Measured Discharge (m3/sec): 0.072 **At Stage (m):** 0.155
Stage at Zero Flow (m): -0.095 **Approximate Bank Elevations (either bank overtopped) (m):** 0.801

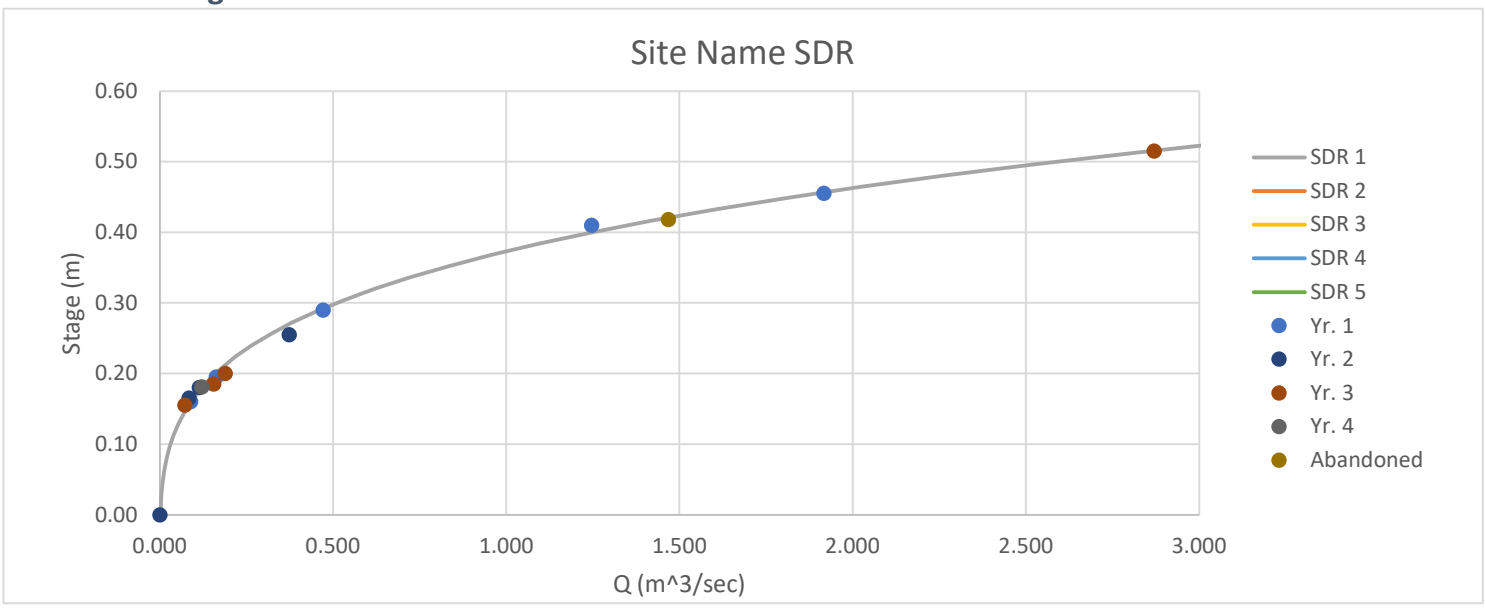
Date Grades

Data Grade	Estimated	Grade B	Grade C	Best Practices	Estimated
Flow (m^3/sec)	0 → 0.071	n/a	0.072 → 1.916	1.917 → 2.869	2.870 → and Up
Stage (m)	-0.095 → 0.154	n/a	0.155 → 0.455	0.455 → 0.515	0.516 → and Up

SDR Formula:

$Q=C_o*(H-h_o)^b \longrightarrow Q=20.2518*(H--0.095)^{3.9622}$

SDR Curve Image:



Remarks: The SDR is considered to produce Grade C data as all flow measurements are within 25% of the SDR, but some are greater than 15%. The largest areas of error in the SDR come from trying different methodologies at the lower section of the curve and the possibility of small changes in the control over time.

Computed By: R.Gallaugher **Date:** 2023-06-12
Checked By: R.Gallaugher **Date:** 2023-06-12

Station Analysis

The Station Analysis form describes the complete analysis of data collected, procedures used in processing the data, and the logic upon which the computations are based (2019, RISC p.9).

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Station Analysis for the Period:

From: 2020-06-11 **To:** 2022-12-31

[Note: This form must be signed by hydrometric data approver with appropriate professional seal and submitted both original and a PDF copy to the database administrator to capture in provincial water database]

Station Identification Number: n/a **Gazetted Stream Name:** Winlaw Creek
Station Name: Winlaw Creek SIFCo Installation
Station Operation Agency/Firm: Kootenay Environmental Innovations
Contact Details: Rory Gallaugher, AScT, gallaugher.consulting@gmail.com

Number of Level Checks Made Per Year: ☐ **2 or more** ☑ **1 or more** ☐ **None/undefined**
☑ **Gauge Correction NOT Required**
☐ **Gauge Correction Requited (see table below):**

Date and Time (-8:00 GMT)	Correction (m)	Remarks
		No correction required

Discharge Record (Instantaneous)

Discharge (m^3/sec)		% Diff.	Stage (m)	Stage Diff (m)	Date and Time (-8:00 GMT)
Max. Calculated Discharge	5.467	48%	0.625	0.110	2022-06-12 02:00
Max. Measured Discharge	2.869		0.515		2022-06-14 17:21
Min. Calculated Discharge	0.064	11%	0.112	0.043	2021-09-16 11:00
Min. Measured Discharge	0.072		0.155		2022-10-20 12:12

Number of Manual Flow Measurements Per Year:
☐ **5 or more** ☑ **3 or more** ☐ **2 or more** ☐ **Less than 2/ Undefined**

Missing Period of Discharge Record		Reason
From	To	
2020-09-10	2021-04-01	A solder joint on the Mayfly datalogger separated in cold weather.
2021-11-15	2022-02-10	The MX2001 failed due to a warranty issue.
2022-12-19	2022-12-31	Ice backed up water at the control.

Stage-Discharge Relationship

	Curve No.	Start Date	End Date	Cause for the Shift
Previous Year				
Present Year	1	2020-06-11	2022-12-31	First year of curve, so no shift occurred.

Remarks: Discharge estimates for missing periods derived by graphical comparison to: Anderson Creek

Climate Station(s): Nelson CS Weather Station @ Nelson Airport

Other Hydrometric Station(s): Anderson Creek Near Nelson, monitored by Water Survey of Canada

Standard procedures followed for hydrometric operation:

☑ **RISC Standards (i.e., Manual of British Columbia Hydrometric Standards)**

☐ **None/Unknown** ☐ **Other, Specify:**

Instruments & methods used for hydrometric operation were appropriate for field conditions (Y/N): ☑

All metadata, field notes and calculations were reviewed for anomalies (Y/N): ☑

Results were compared with other stations and/or other years for consistency (Y/N): ☑

Reviewed time series water level and discharge data with associated meta data were submitted to the Provincial Database (Y/N): ☐

Data can be made available to public (Y/N): ☐

DATA DECLARATION

I, Rory Gallaugher AScT. have reviewed all data and operating information for this hydrometric station. Data Grades have been assigned as per standards requirement criteria as defined by the Manual of British Columbia Hydrometric Standards.

Date	Professional Seal/Signature	Designation	Professional/Technological Association
2023-06-12		Applied Science Technologist (AScT)	Applied Science Technologists & Technicians of British Columbia (ASTTBC)