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WATER ADVISORY COMMITTEE
Notice of Meeting on **Thursday, May 23, 2019 at 1:30 p.m.**
Goldstream Conference Room, 2nd Floor, 479 Island Highway, Victoria, BC

G. Baird	T. Krawczyk	M. Thompson
D. Blundon	P. Lennox	D. Timothy
M. Demeulenaere	C. Nowakowski	T. Wood
A. Gibson	J. Rogers	
R. Hunsinger	S. Sinclair	

AGENDA

1. Introductions
2. Election of Chair and Vice Chair
3. Approval of Agenda
4. Regional Water Supply Commission Chair, Rebecca Mersereau, Introduction and Remarks
5. Approval of the Minutes of the September 26, 2018 Meeting.....3

   Recommendation:

   That the Water Advisory Committee adopt the minutes of the September 26, 2018 meeting.
6. Chair's Remarks
7. Water Advisory Committee Terms of Reference.....7
8. 2019 Meeting Schedule and Membership List 10

   Recommendation:

   That the Water Advisory Committee receive the reports for information.
9. Regional Water Supply Orientation (presentation).....12
10. Regional Water Supply Strategic Plan (handout)
11. Regional Water Supply Commission Agenda and Reports, May 15, 2019 Meeting.....28

    Recommendation:

    That the Water Advisory Committee receive the reports for information.
12. Hotsheets from the Regional Water Supply Commission January to May 2019.....123

    Recommendation:

    That the Water Advisory Committee receive the Hotsheets for information.

To ensure a quorum, please call Denise Dionne at 250.360.3087 ***if you cannot attend****.*

IWSS-297445977-4932

13. Reports From Working Groups

14. Water Watch Reports January to May 2019.....131

Recommendation:

That the Water Advisory Committee receive the reports for information.

15. New Business

16. Adjournment

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MINUTES OF A MEETING OF THE WATER ADVISORY COMMITTEE
Held Wednesday, September 26, 2018 at 9 a.m. in the Goldstream Conference Room, 479 Island Highway, Victoria, BC

PRESENT: R. Mersereau (Chair); D. Blundon (Vice-Chair); A. Gibson; G. Orr (9:08); M. Williams; N. Banera; C. Nowakowski; R. Neuman, S. Sinclair (9:16)

Staff: T. Robbins, General Manager, Integrated Water Service (IWS); G. Harris, Senior Manager, Environmental Protection; T. Duthie, Manager Administration Services, IWS; D. Dionne (Recorder)
Absent: M. Demeulenaere; G. Logan; T. Wood; J. Rogers

The meeting was called to order at 9:03 a.m.

1. APPROVAL OF AGENDA

The following changes were made to the agenda.

That the Water Advisory Committee consider Item 8 before Item 7.

MOVED by M. Williams and **SECONDED** by A. Gibson,
That the Water Advisory Committee approve the agenda as amended.

CARRIED

2. ADOPTION OF MINUTES OF MARCH 7, 2018

MOVED by R. Neuman and **SECONDED** by D. Blundon,
That the Water Advisory Committee adopt the minutes of the March 7, 2018 meeting.

CARRIED

3. CHAIRS REMARKS

The Chair made the following remarks:

- The Chair advised that she is running for Saanich Council and the Capital Regional District. She asked the Committee if anyone had any concerns with her carrying on as Chair during the campaign period, there were none.
- While conducting some door knocking for her Saanich candidacy she received a comment from a member of the public that speaks to an unintended consequence of better water conservation in the region. This resident, a landscaper, has noticed that Garry Oak trees appear to be suffering/dying as a result of properties changing hands and new owners not watering the way previous owners had. The Chair noted this as an opportunity for municipalities to be cognizant of the needs of the native species.

Geoff Orr joined the meeting.

4. HOTSHEETS FROM THE REGIONAL WATER SUPPLY COMISSION

T. Robbins stated that there was a water conservation bylaw amendment presented at the September 19, 2018 meeting that may be of interest to this Committee.

He noted that a component of Bylaw No. 4099 was a ban on once-through cooling (OTC) equipment effective, January 1, 2019. He advised that staff became aware of changes to the BC Building Code (BCBC) that had the potential to affect some Capital Regional District (CRD) services.

Staff met with representatives from the Ministry of Municipal Affairs and Housing and learned that the Bylaw No. 4099 prohibition against OTC equipment was in conflict with the revised BCBC. In response to these provincial changes, Bylaw No. 4248 amends the existing Water Conservation Bylaw No. 4099 to remove definitions and sections related to OTC.

He advised that there will be more education and engagement activities around the once-through cooling systems. Work in this area will continue.

MOVED by A. Gibson and **SECONDED** by M. Williams,
That the Water Advisory Committee receive the Regional Water Supply Commission Hotsheets for information.

CARRIED

5. REPORTS FROM WORKING GROUPS

The Chair noted that the Committee held a working meeting in early July to discuss some municipal water data. As a result of that meeting there were a number of questions that arose and were forwarded to staff for follow up which will be discussed under Item 8.

S. Sinclair joined the meeting

There was follow up on questions around bottling water facilities in the Region and whether they have unique contracts that grant them rights beyond any other water user or municipality. She advised that, in discussion with T. Robbins, there are no special contracts in place with those entities.

Currently waiting for information from staff regarding emergency water supply planning and water value and conservation initiatives.

6. EMERGENCY WATER SUPPLY PLANNING UPDATE

T. Robbins provided the following update on the post-disaster water supply plan:

- The concept for the plan has been approved by the Regional Water Supply Commission. Staff are working with the three budgets (Regional Water Supply, Juan de Fuca Water Distribution and Saanich Peninsula Water Service) to implement the plan.
- The work planned for 2018 was for installation of the bulk water supply hydrants, six priority locations were identified and he reviewed the installation locations and process.
- There is a contract in place with Smith Cameron to build a fully mobile system to connect to these hydrants as well as a second unit is being built that will be housed in a SeaCan and will be pre-plumbed with quick connections. This will be a permanent installation at Panorama Recreation Centre as a demonstration. Staff are hoping to have both units by spring of 2019.

Discussion ensued with staff responding to questions regarding:

- the total number of bulk water hydrants being considered for installation
- consideration of locations in Sooke area
- redundancy
- the delivery plans for the SeaCan and how it will be mobilized
- resources required to staff the distribution points
- distinction of roles of the Municipalities and the public
- security

7. 2019 REGIONAL WATER SUPPLY SERVICE BUDGET OVERVIEW

This Item was considered after Item 8.

T. Robbins presented an overview of the Regional Water Supply Commission presentation.

Discussion ensued and staff responded to questions from the Commission regarding debt servicing and reaching sustainable level of cash funding through cash reserve.

8. MUNICIPAL WATER USE DATA – DISCUSSION REGARDING WATER ADVISORY COMMITTEE QUESTIONS

This Item was considered before Item 7.

The Water Advisory Committee forwarded questions to staff regarding municipal water data. Staff responded to the questions as follows:

Question 1 - How reliable is this data, how is it gathered, how can it be used and can it be accessed publically?

Staff have some degree of confidence in the data, however municipalities collect data differently. At this time staff rely on how the municipalities collect the data and how it's broken down. Staff are working out the overall water consumption profile. Once that data analysis is complete then municipalities will need to be engaged.

One of the key initiatives in the Regional Water Supply strategic plan is to reshape the demand management plan. There was no clear objectives for the program, no understanding of where we could look at reduction in different sectors. Getting better information from the municipalities, by category and sector, then look at focussing the Demand Management program.

Staff will be bringing forward a re-vamped program in a year or so with clear objectives and target areas.

Staff don't recommend sharing this data without framing it around the longer-term demand objectives. Once the new Demand Management program documentation is in place, the info will become more relevant.

Making data available publically provides a municipal comparison and would help the municipalities understand their demands. Staff can consider how to present the data publically.

Question 2 – When reviewing the different Municipalities and their water use there are some anomalies. For example there was a lot of high residential water use in Oak Bay, Central Saanich and North Saanich – do we know why that is? There is also some non-revenue water in some communities relative to others why would that be?

Staff are just starting to break that down. In Oak Bay for example there is not a lot of industrial/commercial, on the Peninsula there has typically been a lot of water flushing to maintain quality. Staff continue to review the data to understand what may be going on, once that is understood staff can work with each municipality on their variations. Staff are looking to get service agreements in place with the municipalities noting their maximum pinch point to encourage them to start thinking about planning to support growth.

Question 3 – Breaking down the Western Communities Electoral Areas.

Staff will expand the table to include the municipal breakdown through the Juan de Fuca water billing.

G. Harris left the meeting

9. 2018 / 2019 WATER ADVISORY COMMITTEE MEMBERSHIP LIST AND MEETING SCHEDULE

Staff noted expiring membership terms at the end of this year and a couple of vacancies and proposed advertising for new members following the Municipal elections.

Once the advertisement is available, staff will forward to Water Advisory Committee members for them to distribute to their contacts.

There will be no working meetings in the interim.

10. WATER WATCH

MOVED by R. Neuman and **SECONDED** by A. Gibson,
That the Water Advisory Committee receive the report for information.

CARRIED

11. NEW BUSINESS

There was no new business.

12. ADJOURNMENT

MOVED by M. Williams and **SECONDED** by R. Neuman,
That the Water Advisory Committee be adjourned at 10:53 a.m.

CARRIED

CHAIR

SECRETARY

DRAFT

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CAPITAL REGIONAL WATER DISTRICT

REGIONAL WATER SUPPLY, PROTECTION AND CONSERVATION ADVISORY COMMITTEE (WATER ADVISORY COMMITTEE)

TERMS OF REFERENCE

BACKGROUND

In 1997 the *Greater Victoria Water District Act* was repealed and replaced by the *Capital Regional Water Supply and Sooke Hills Protection Act* (Act). The implementation of the Act is governed by the Capital Regional Water Supply and Sooke Hills Protection Regulation (Regulation). Both the Act and the Regulation were enacted August 1, 1997.

Under the Regulation the Capital Regional District (CRD) must establish by bylaw a standing committee of the Regional Board known as the Regional Water Supply Commission (Commission). The Commission was established in September, 1997. The Regulation further requires the appointment of a Regional Water Supply, Protection and Conservation Advisory Committee (Committee) to provide advice to the Commission on water supply, water quality, the stewardship of lands held by the CRD for water supply purposes and water conservation measures.

COMMITTEE MEMBERSHIP

The Committee will have up to 16 members with representation from:

1. The Regional Water Supply Commission;
2. The Juan de Fuca Water Distribution Commission; and
3. The Saanich Peninsula Water Commission.

In addition each of the following groups will be invited to provide names of potential representatives.

1. The agriculture community;
2. Groups concerned with the protection of fish habitats;
3. First Nations;
4. Environmental groups;
5. Commercial and industrial water users;
6. Residents and ratepayers' associations;
7. Island Health;
8. The scientific community; and
9. Other bodies the Regional District Board considers appropriate.

TERM OF SERVICE

In order to ensure on-going opportunities to serve on the committee and to maintain continuity, half of the appointees will serve a term of one (1) year. Thereafter, public members of the Committee will serve for a period of two (2) years, to a maximum participation of three terms (i.e. six years)

The Committee may request that the Commission replace a member who has missed three consecutive meetings.

COMMITTEE MANDATE

The general mandate of the Committee is to provide advice to the Regional Water Supply Commission on water supply, water quality, the stewardship of the lands held by the Regional District for water supply purposes and water conservation measures.

The responsibilities of the Committee include:

1. Reviewing options for water supply, water quality, water conservation and the stewardship of catchment lands based on their technical and economic merit;
2. Taking into consideration the social and environmental impacts in the review of options;
3. Ensuring all relevant issues are being considered;
4. Advising on the development of a public consultation process;
5. Attending and participating, when required, in public meetings, open houses, etc.;
6. Communicating the issues being considered to groups represented by the Committee members and reporting comments/concerns back to the Committee;
7. Reaching consensus through constructive discussion on all issues; and
8. Formulating recommendations to be forwarded to the Regional Water Supply Commission.

GENERAL COMMITTEE OPERATIONS

1. The General Manager of Integrated Water Services will be the staff liaison for the Committee. Other staff and/or persons may be invited to participate in making presentations to the Committee in order to benefit from additional expertise pertaining to issues being considered.

2. Issues requiring consideration by the Committee will be identified by the Commission, staff or the Committee. Issues and recommendations for the Committee's consideration will be submitted to the Committee in the form of a staff report containing identification of the issue, background information on the issue, alternative solutions to the issue, implications of the alternatives, and a recommendation.

3. The first meeting of the Committee will be chaired by a representative from the Regional Water Supply Commission or their designate until the Committee elects a Chair from among its members. The nominee receiving the majority of votes from the Committee members then present shall be the Committee Chair. The Chair will call for nominations for Deputy Chair. The nominee receiving the majority of votes from the committee members then present shall be the Deputy Chair.

4. Committee meetings will be open to the public and the media. Members of the public will be permitted to make presentations, limited to a maximum of five minutes duration, at the beginning of each meeting, and a time will be set aside for the public to pose questions regarding committee business at the end of each meeting.

5. Regular meetings of the Committee will be set based on the need for consideration of issues identified by the Commission or staff, or at the call of the Committee Chair. At a minimum there will be two meetings per year.

6. Summary minutes of each meeting will be maintained, recording members present, the key points of discussion and action items. The committee's goal is to reach decisions by consensus, however where consensus is not possible, the Chair may call for a vote which will decide the issue by simple majority. Where a vote is taken, the number of votes for and against the motion will be recorded and this information will be provided to the Commission along with the recommendation. The duties of Secretary of the Committee will be undertaken by Integrated Water Services staff. Minutes of each meeting will be circulated to Committee members with the agenda of the next meeting. Minutes will be approved at the following meeting. Approved Committee minutes will be provided to the Commission.

7. Items to be included in the agenda must be received by the Committee secretary at least one week in advance of a meeting. Following review by the Chair, the agenda will be distributed. Items received from committee members after the agenda deadline may be added to the agenda at the meeting.

8. Reports and recommendations from the Committee will be forwarded to the Commission through the Committee Chair. Alternatively, where the Committee makes a recommendation to staff, the Committee's recommendation will be incorporated in a report by staff to the Commission.

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WATER ADVISORY COMMITTEE

2019 SCHEDULE OF MEETINGS

(All meetings the 4th Thursday of the month)
1:30 p.m.
Goldstream Conference Room
479 Island Highway

Business Meetings	Working Meetings
May 23, 2019	June 27, 2019
July 25, 2019	No meeting in August
September 26, 2019	October 24, 2019
November 28, 2019	No meeting in December

Capital Regional District – Integrated Water Services
Water Advisory Committee – Membership List 2019

Bylaw 2541 = One representative from RWSC, JWDC & SPWC (3)
One representative from each of the following: (9)

- Agricultural community
- Groups concerned with the protection of fish habitats
- First Nations
- Environmental groups
- Commercial and industrial water users
- Residents and ratepayers associations
- Capital Region Health Board (Island Health)
- Scientific community
- Other bodies the Regional District Board considers appropriate

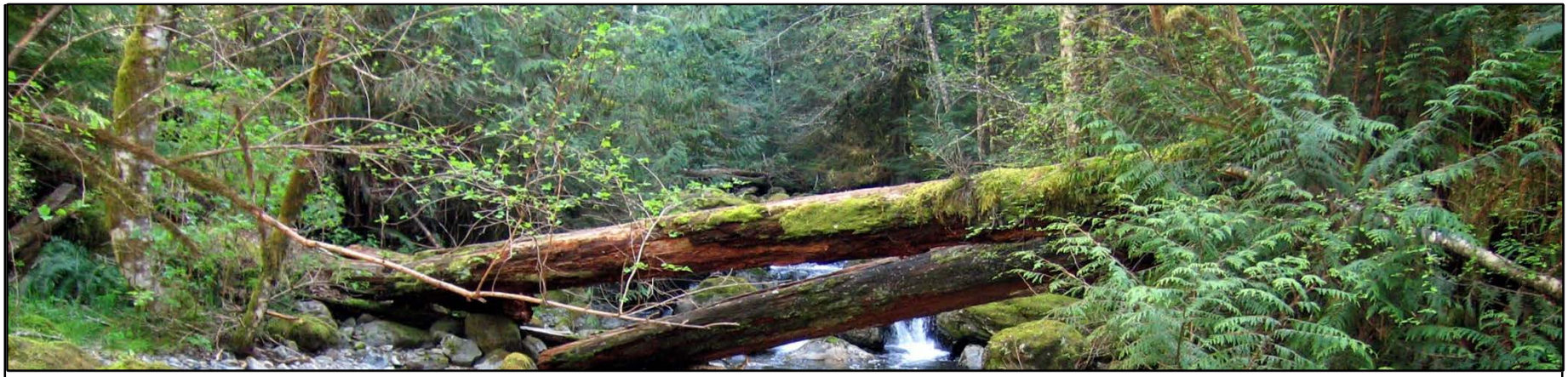
Terms of Reference:
The Committee will have up to 16 members with representation as noted in Bylaw 2541.

Term of Service:
In order to ensure on-going opportunities to serve on the committee and to maintain continuity, half of the appointees will serve a term of one year. Thereafter, public members of the committee will serve for a period of two years, to a maximum participation of three terms (6 years).

NAME	SECTOR/GROUP	EMAIL	TERM EXPIRY
Craig Nowakowski	Island Health	craig.nowakowski@viha.ca	Continuing position
Lt. Mathew Demeulenaere Planning Officer	Department of National Defense	mathew.demeulenaere@forces.gc.ca	Continuing position
Mike Thompson	Saanich Peninsula Water Commission	nanukconsulting@telus.net	Appointed by Commission
Gord Baird	Regional Water Supply Commission	gord.baird@gmail.com	Appointed by Commission
John Rogers	Juan de Fuca Water Distribution Commission	john.rogers007@shaw.ca	Appointed by Commission
Anne Gibson	Environmental	akg.victoria@gmail.com	2nd two-year term 2018/**2019**
Sandy Sinclair	Commercial / Industrial	sandysinclair@shaw.ca	2nd two-year term **2019/2020**
Ron Hunsinger	Residents/Ratepayers	ihunsinger@gmail.com	1st two-year term **2019/2020**
David Blundon	Residents/Ratepayers	blundond@camosun.bc.ca	2nd two-year term **2019/2020**
Tom Wood	Other Organizations	tom.wood@shaw.ca	3rd two-year term **2019/2020** (Final)
VACANT	First Nations		
David Timothy	Fish Habitat	dave.a.timothy@gmail.com	1st two-year term **2019/2020**
Patrick Lennox	Scientific	pclennox@shaw.ca	1st two-year term **2019/2020**
Tayler Krawczyk	Agriculture	tayler@hatchetnseed.ca	1st two-year term **2019/2020**

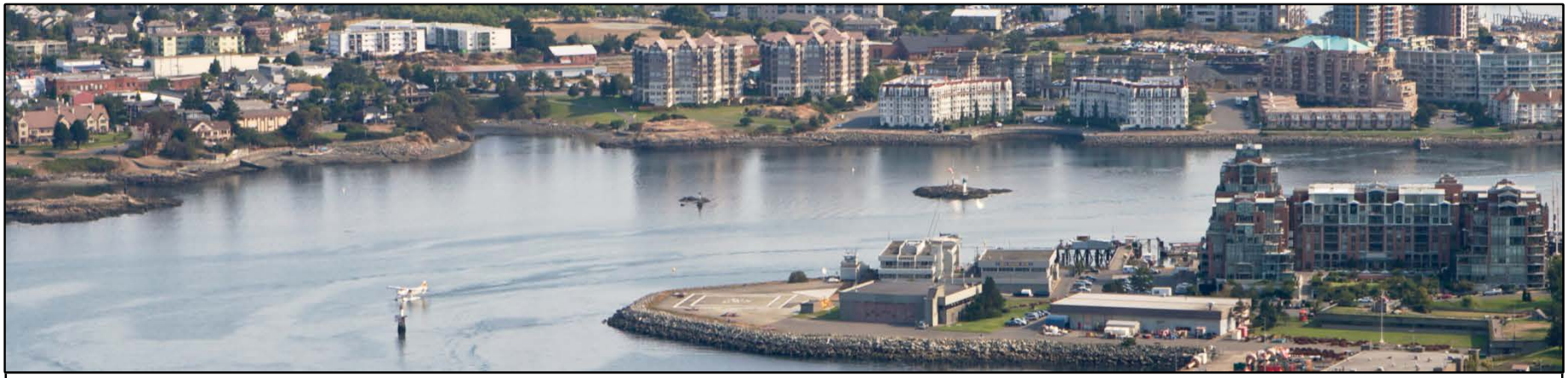
Regional Water Supply Service
Commission Orientation
January 16, 2019

Presentation Overview



- Service and Governance Framework
- Regional Water Supply Source and Infrastructure Overview
- Service Delivery - CRD Departmental Programs
- Service Budgets
- Water Demand & Rates
- Budget Factors & Upcoming Initiatives
- Service Staff Support

Service & Governance Framework



Provincial Act & Regulation & CRD Bylaws

- Capital Region Water Supply & Sooke Hills Protection Act 1997 – Service Establishment
- Capital Region Water Supply & Sooke Hills Protection Regulation 1997 – Commission Establishment
- CRD Bylaw No. 2537 – Water Supply Local Service Area Establishment Bylaw
- CRD Bylaw No. 2539 – Regional Water Supply Commission Bylaw
- CRD Bylaw No. 4186 – CRD Board Delegation Bylaw
- CRD Bylaw No. 2570 – Water Supply Fee & Charge Bylaw (Amending Bylaw 4270)
- CRD Bylaw No. 2739 – Adoption of Strategic Plan for Water Management

Service & Governance Framework

CRD Bylaws & Strategic Plan

- CRD Bylaw No. 2804 – Water Supply Area Protection Bylaw (Amending Bylaw 4050)
- CRD Bylaw No. 3061 – Water Conservation Bylaw (Amending Bylaw 4248)
- CRD Bylaw No. 3516 – Cross Connection Control Bylaw (Amending Bylaw 4047)
- CRD Policies – Procurement (& Delegation) Policy

- 2017 Strategic Plan for the Greater Victoria Water Supply System

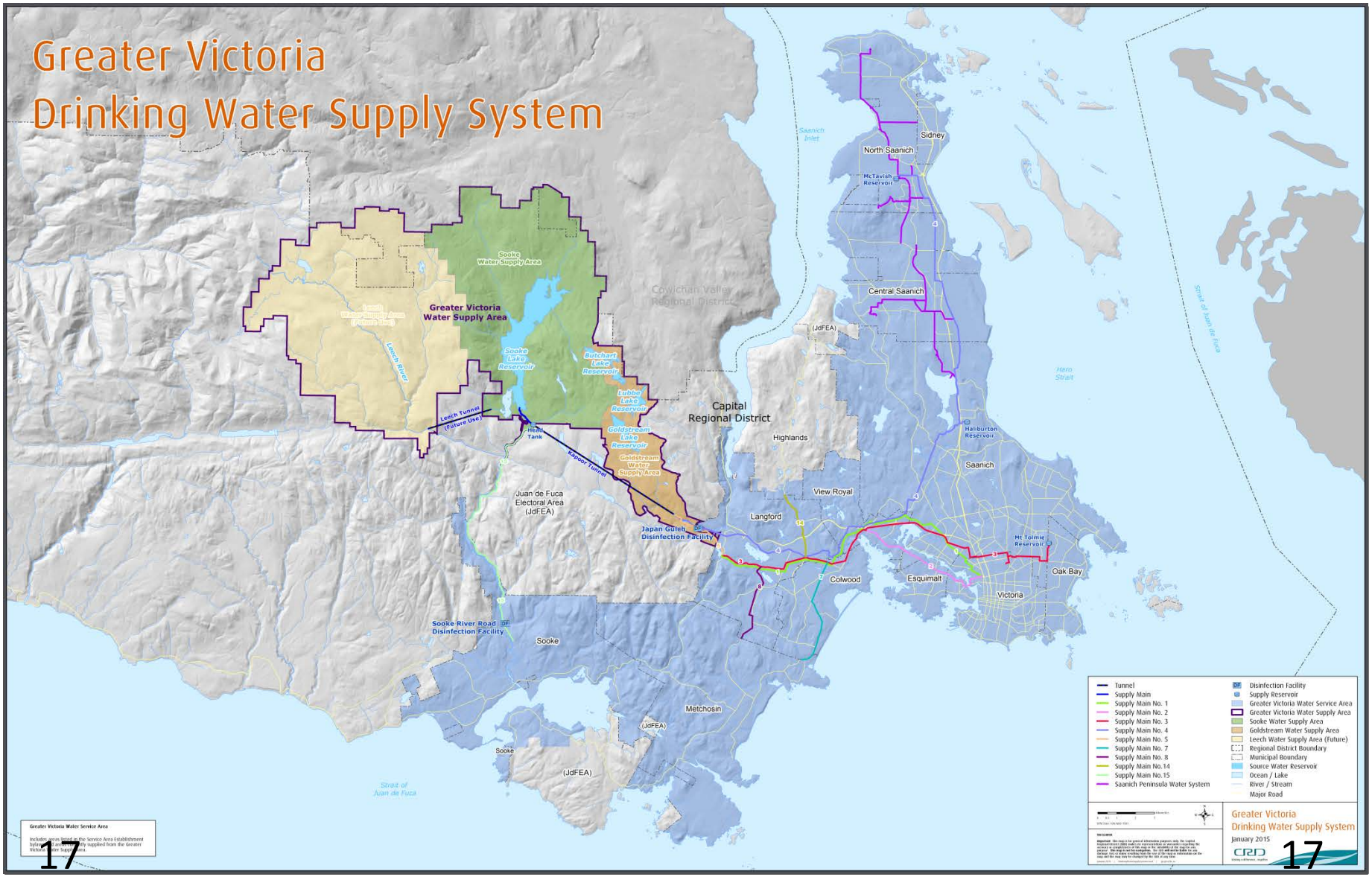
Service & Governance Framework

- CRD Board – Chair Colin Plant (2019)

- 2019 – 2022 Regional Water Supply Commission – Chair & Vice Chair TBD
  - Chris Graham, District of Central Saanich
  - Gordie Logan, City of Colwood
  - Tim Morrison, Township of Esquimalt
  - Gord Baird, District of Highlands
  - Mike Hicks, Juan de Fuca EA
  - Roger Wade, City of Langford
  - Lillian Szpak, City of Langford
  - Kyara Kahakauwila, District of Metchosin
  - Celia Stock, District of North Saanich
  - Eric Wood Zhelka, District of Oak Bay
  - Karen Harper, District of Saanich
  - Rebecca Mersereau, District of Saanich
  - Natalie Chambers, District of Saanich
  - Zac de Vries, District of Saanich
  - Ned Taylor, District of Saanich
  - Sara Duncan, Town of Sidney
  - Maja Tait, District of Sooke
  - Geoff Young, City of Victoria
  - Jeremy Loveday, City of Victoria
  - Ben Isitt, City of Victoria
  - Laurel Collins, City of Victoria
  - John Rogers, Town of View Royal

- Water Advisory Committee – Vice Chair represents Regional Water Supply Commission

System Infrastructure Overview



Water Supply Source &Treatment

- Greater Victoria Water Supply Area – 20,549 hectares
  - Sooke, Goldstream, Leech Watersheds
- 6 Lake Reservoirs & 11 Dams
- Sooke Lake Reservoir – Primary Supply Source
- Goldstream Reservoir System – Secondary Supply Source
- Unfiltered Source Water with 3-Step Disinfection Process
  - Primary Disinfection
    - Ultraviolet light – targets parasites (Giardia & Crypto)
    - Free chlorine – targets bacteria & viruses
  - Secondary Disinfection
    - Ammonia to produce chloramine – long-lasting disinfectant residual
  - Unfiltered Raw Source Water
    - Turbidity (cloudiness) typically < 1 NTU
    - E.Coli bacteria < 20 CFU/100 mL
- Average 130 million litres of water treated & delivered every day

System Infrastructure Overview

- Total length of water transmission mains across system: 110 kilometres

- Pipe diameters range from 400mm – 1067mm
- Pipe construction and material types:
  - Welded Steel 85%
  - Ductile Iron (DI) 7%
  - Kapoor Tunnel 8%

- Number of Revenue Meters: 48
- Number of Balancing Reservoirs: 3
- Number of Pressure Reducing Stations: 7

- Over $160 million invested in supply infrastructure renewal since 1995

Regional Water Supply Service Delivery – CRD Departmental Programs

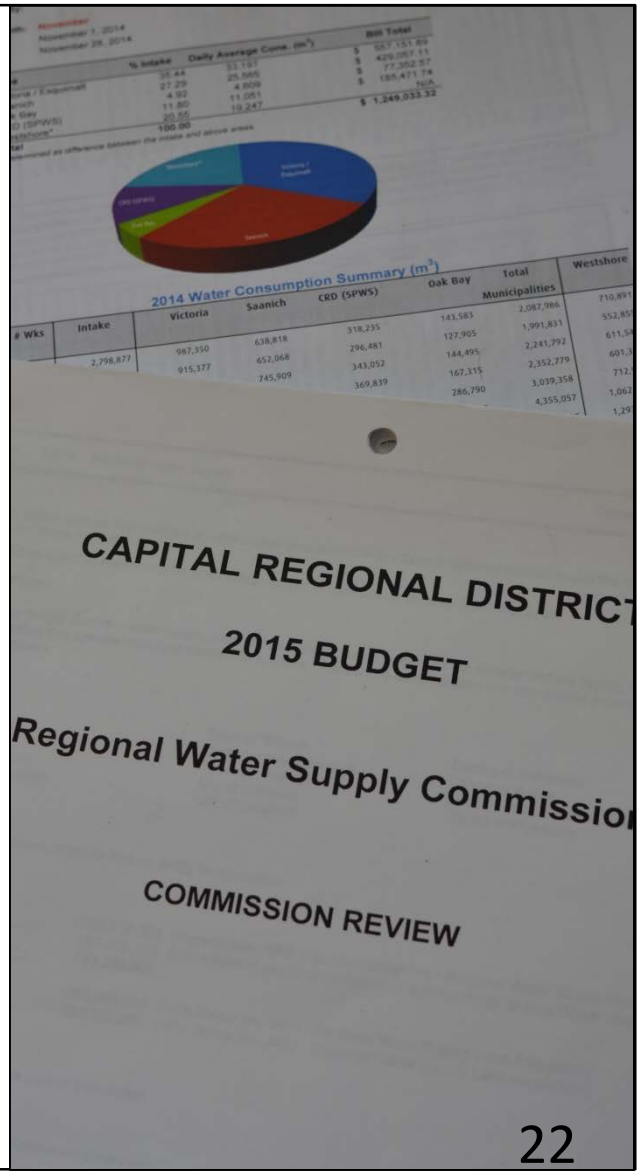
- Operations & Engineering
  - Water System Operation and Maintenance – Treatment and Transmission
  - Capital Project Delivery – IWS Construction Crew
  - Engineering Design & Project Management
  - System Infrastructure Planning & Asset Management
  - Emergency Response
- Plant Maintenance & Fleet Management
  - Preventive Maintenance Planning & Management for Operations
  - Fleet: Service Vehicles & Heavy Equipment
- Water Quality
  - Water Quality Sampling, Accredited Lab Testing, Reporting, Regulatory Compliance
  - Cross Connection Control

Regional Water Supply Service Delivery – CRD Departmental Programs

- Watershed Protection
  - Wildfire Management, Security, Emergency Response
  - Road & Facility O&M
  - Ecological Resource Planning
  - Silviculture & Forest Fuel Management
- Demand Management
  - Administration of Water Conservation Bylaw
  - Promotion of responsible water use through public outreach and education
- Customer Service
  - Field Response to Customer Concerns
  - Leaks, Pressure Issues, Meter Inquiries
- Water Metering & Billing
  - Municipal Meter Reading & Billing

Regional Water Supply Service Budgets

- Operating & Capital Budgets
  - Provides for all expenditures for Operation & Maintenance (O&M), administration of water service and capital projects
  - Utility Rate Model – Full Cost Recovery
- Operating, Capital Project Lists & Supplemental budget items considered by Commission annually in September for recommendation to CRD Board
- Service Funding
  - 100% of Operating & Supply Capital, including debt servicing, funded by sale of water



Regional Water Supply Budget Summaries

- 2019 Budgets:
  - Total Budget: $32.11 M
  - Total Supply Capital Project Budget: $13.56 M
  - RWSC – JDF Shared Capital: $1.32 M

- 2019 Budget Context:
  - Debt Servicing 27.9%
  - Capital Funding 25.6%
  - Supply System Operations 14.3%
  - Supply System Engineering 1.5%
  - Service Administration 1.0%
  - Watershed Protection Program 16.2%
  - Water Quality Program 4.8%
  - Cross Connection Control Program 2.3%
  - Demand Management Program 2.5%
  - Agricultural Water Rate Funding 3.9%

Total: 100%

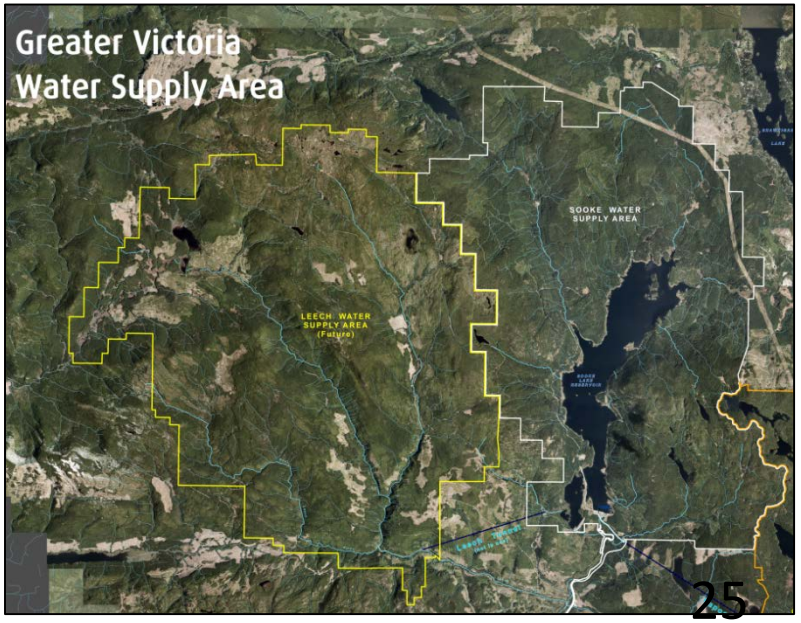
Water Demand & Rates

- 2019 Regional Water Supply Wholesale Water Rate: $0.6775 / cubic metre
- 2019 Agricultural Water Rate: $0.2105 / cubic metre
- 2019 Budget Water Demand: 46,500,000 cubic metres

Budget Factors & Upcoming Initiatives

2019 – 2023 Budget Factors

- Balancing Water Demand
- Debt Servicing & Retirement - $65 M Leech WSA
- Continuing Infrastructure Investment
  - Replace aging infrastructure
  - Improving resiliency and redundancy



Upcoming Initiatives

- Post Disaster Water Supply & Distribution
- Disinfection Plant & Dam Upgrades
- Strategic Plan Initiatives
  - Long term water demand
  - Long term infrastructure plans & financial plan including DCC
  - Long term supply service levels

Service Staff Support

- CRD Administration and Finance
  - Bob Lapham, CAO
  - Nelson Chan, CFO & GM, Finance & Technology
  - Ben Semmens, Accountant & Financial Analyst, Water Services

- Regional Water Supply Service - Operations, Engineering & Commission Support
  - Ted Robbins, GM, Integrated Water Services
  - Matt McCrank, Senior Manager, IWS Operations
  - Ian Jesney, Senior Manager, IWS Engineering
  - Annette Constabel, Senior Manager, Watershed Protection
  - Jan van Niekerk, Senior Manager, Customer & Technical Services
  - Tanya Duthie, Manager, IWS Administration
  - Denise Dionne, Administrative Coordinator & Commission Secretary

- Water Quality, Demand Management, Cross Connection Control Programs
  - Larisa Hutcheson, GM, Parks & Environmental Services
  - Glenn Harris, Senior Manager, Environmental Protection & Water Quality

Questions?

Capital Regional District

625 Fisgard St.,
Victoria, BC V8W 1R7

Notice of Meeting and Meeting Agenda
Regional Water Supply Commission

Wednesday, May 15, 2019 | **11:30 AM** | **6th Floor Boardroom**

R. Mersereau (Chair); G. Baird (Vice Chair); N. Chambers; L. Collins; Z. de Vries; S. Duncan; C. Graham; K. Harper; M. Hicks; B. Isitt; K. Kahakauwila; G. Logan; J. Loveday; T. Morrison; B. Parkinson; J. Rogers; C. Stock; L. Szpak; N. Taylor; R. Wade; E. Wood Zhelka; G. Young

1. APPROVAL OF THE AGENDA

2. ADOPTION OF MINUTES

2.1. 19-527 March 20, 2019 Minutes

Recommendation: That the Regional Water Supply Commission adopt the minutes of the March 20, 2019 Meeting.

Attachments: March 20, 2019 Minutes

3. REPORT OF THE CHAIR

4. PRESENTATIONS/DELEGATIONS

4.1 Presentations

4.11. 19-526 General Manager's Report: May 2019

1. Regional Water Supply Commission Webcasting and Use of Granicus
2. Disinfection Plant Tour, June 14, 2019
3. Water Advisory Committee Meeting, May 23, 2019

Recommendation: That the General Manager's report be received for information.

4.2 Delegations

5. ADMINISTRATION REPORTS

6. REPORTS OF COMMITTEES

6.1. 19-523 Fisheries Water Release Program

Recommendation: That the Regional Water Supply Commission:

1. Endorse the proposed Fisheries Water Release Plan as set out in Table 2 of Appendix 2;

2. Direct staff to engage with the T'Sou-ke Nation regarding the proposed Fisheries Water Release Plan and the (expired) 2002 Agreement;

3. Direct staff to seek approval of the proposed Fisheries Water Release Plan from the Federal Department of Fisheries and Oceans Canada and Provincial Ministry of Environment & Climate Change Strategy and Forests, Lands, Natural Resources Operations & Rural Development, as required; and

4. Direct staff to pursue amending the CRD's Provincial Conditional Water Licence for Goldstream River/Waugh Creek to include an authorization to store and release water for the purpose of conserving fish and fish habitat, in accordance with the release schedule in Table 2 (Appendix 2).

Attachments: Staff Report: Fisheries Water Release Program

Appendix 1: 2002 Agreement

Appendix 2: Tables

Appendix 3: Map

6.2. 19-513 Watershed Hydrology Monitoring Plan - Leech Water Supply Area

Recommendation: That the Regional Water Supply Commission endorse the staff report, Watershed Hydrology Monitoring Plan - Leech Water Supply Area.

Attachments: Staff Report Leech Hydrology Monitoring Plan

Appendix A Map 1, Existing Hydrology & Meteorology Stations in the Leech WS

Appendix B Leech Hydroloyg Monitory Plan

6.3. 19-524 Weekly Water Watch Report May 5, 2019 and Conservation Key Messages

Recommendation: That the Regional Water Supply Commission receive the Water Watch report and Conservation Key Messages for information.

Attachments: Weekly Water Watch Report May 5, 2019

Conservation Key Messages

7. BYLAWS

8. NEW BUSINESS

9. MOTION TO CLOSE THE MEETING

10. RISE AND REPORT

11. ADJOURNMENT

Next meeting: June 19, 2019

To ensure quorum, please contact Denise Dionne at ddionne@crd.bc.ca or 250.360.3087 if you or your alternate cannot attend.

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MINUTES OF A MEETING OF THE REGIONAL WATER SUPPLY COMMISSION
Held Wednesday, March 20, 2019 in the 6th Floor Boardroom, 625 Fisgard Street

PRESENT: **Commissioners**: R. Mersereau (Chair); G. Baird (V. Chair); N. Chambers; Z. de Vries; S. Duncan; K. Harper; M. Hicks, G. Logan; J. Loveday; T. Morrison; M. Sahlstrom (for R. Wade); T. St. Pierre (for B. Parkinson); L. Szpak; N. Taylor; G. Young

Staff: R. Lapham, CAO; T. Robbins, General Manager, Integrated Water Service (IWS); M. McCrank, Infrastructure Operations; I. Jesney, Infrastructure Engineering, B. Semmens, Senior Financial Analyst, A. Constabel, Watershed Protection; G. Harris, Environmental Protection; T. Urquhart, Communications Coordinator; D. Dionne, Administrative Coordinator; S. Orr (recorder)

NOT PRESENT: C. Graham, K. Kahakauwila; C. Stock; E. Zhelka, J. Rogers, L. Collins, B. Isitt

The meeting was called to order at 11:34 a.m.

Chair Mersereau provided a Territorial Acknowledgement to open the meeting.

1. **APPROVAL OF THE AGENDA**

MOVED by Commissioner Szpak, and **SECONDED** by Commissioner Morrison,
That the Regional Water Supply Commission approve the agenda.

CARRIED

2. **ADOPTION OF THE MINUTES OF FEBRUARY 20, 2019**

MOVED by Commissioner Taylor, and **SECONDED** by Commissioner Loveday,
That the Regional Water Supply Commission adopt the minutes of the meeting held February 20, 2019.

CARRIED

3. **CHAIR'S REMARKS**

The Chair welcomed Alternate Commissioners Sahlstrom (for Commissioner Wade) and St. Pierre (for Commissioner Parkinson) and noted that Commissioner Parkinson has been appointed to replace Commissioner Tate.

The Chair stated that starting in April, commission meetings will have two hour time slots. She inquired if there would be interest amongst the Commissioners in a special meeting, in addition to the usual monthly meeting, regarding further orientation to their roles as Commissioners. A show of hands indicated interest.

Commissioner Loveday inquired about opportunities for commissioners to tour the watershed and related facilities.

4. **PRESENTATIONS/DELEGATIONS**

There were no presentations/delegations.

5. **COMMISSION BUSINESS**

5.1 **RWSC 19-03 2018 Wildfire Season – Greater Victoria Water Supply Area**

A. Constabel introduced the report and provided highlights of the 2018 wildfire conditions, preparedness, prevention and response as provided in the report.

A discussion took place regarding wildfire services and preparedness and staff answered questions from the Commission.

MOVED by Commissioner Baird, and **SECONDED** by Commissioner Szpak,
That the Regional Water Supply Commission receive the staff report for information.

CARRIED

5.2 RWSC 19-10 Greater Victoria Water Supply Area Mining Access Requests

A. Constabel introduced the report and stated that she is seeking Commission approval for one miner to access and use their placer tenure in the water supply area. She advised the applicant has followed all application procedures and recommends the approval of the application, as provided in the report.

Commissioner Chambers left the meeting

MOVED by Commissioner Taylor, and **SECONDED** by Commissioner Harper,
That the Regional Water Supply Commission authorize access and special use to:

a) The mining tenure holder; and,

b) Accompanying agents and free miners whose status can be confirmed, and that meet CRD insurance requirements;

For the valid mining tenures held, subject to the conditions of the Access Agreement.

CARRIED

5.3 RWSC 19-11 Regional Water Supply Service – 2018 Financial Performance

T. Robbins introduced the report and summarized the 2018 year-end operating revenue and operating expenditures of the Regional Water Supply Service, as presented in the report.

Commissioner Chambers returned to the meeting

He answered questions from the commission.

MOVED by Commissioner Taylor, and **SECONDED** by Commissioner Logan,
That the Regional Water Supply Commission receive the staff report for information.

CARRIED

5.4 March 13, 2019 CRD Regional Board Resolution: Motion from Regional Water Supply Commission: Protection of Greater Victoria Water Supply Area

T. Robbins reported that the motion made at its February 20, 2019 Regional Water Supply Commission meeting, regarding opposition of highway infrastructure development in the water supply area, was forwarded to the Capital Regional District (CRD) Board at its March 13, 2019 meeting and was passed unanimously. He stated the CRD Board Chair has sent a letter to the Premier and various government officials stating the board's position.

MOVED by Commissioner Taylor, and **SECONDED** by Commissioner Chambers,

That the Regional Water Supply Commission receive the staff report for information.

CARRIED

5.5 Water Watch

T. Robbins stated that the weather is having a minor effect on Sooke Lake Reservoir levels and does not foresee any issues with the peak demand period.

MOVED by Commissioner Harper, and **SECONDED** by Commissioner Szpak,
That the Regional Water Supply Commission receive the Water Watch report for information.

CARRIED

6. NEW BUSINESS

There was no new business.

7. MOTION TO CLOSE THE MEETING

In accordance with the Community Charter, Part 4, Division 3, 90(1) (g) litigation or potential litigation affecting the municipality; and 90(1)(a) personal information about an identifiable individual who holds or is being considered for a position as an officer, employee or agent of the municipality or another position appointed by the municipality.

MOVED by Commissioner Loveday, and **SECONDED** by Commissioner Szpak,
That the Regional Water Supply Commission close the meeting.

CARRIED

8. RISE AND REPORT

The Commission rose from its closed meeting without report.

9. ADJOURNMENT

MOVED by Commissioner Taylor, and **SECONDED** by Commissioner Loveday,
That the meeting of the Regional Water Supply Commission be adjourned at 12:27 p.m.

CARRIED

Chair

Secretary

DRAFT

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RWSC 19-05

REPORT TO REGIONAL WATER SUPPLY COMMISSION
MEETING OF WEDNESDAY, MAY 15, 2019

SUBJECT **FISHERIES WATER RELEASE PROGRAM**

ISSUE

To seek Regional Water Supply Commission (the Commission) endorsement of consolidating and formalizing the Fisheries Water Release Program and updating the water licence documents, and relevant agreements, accordingly.

BACKGROUND

The Sooke and Goldstream Rivers support a variety of fish species including chinook, coho, chum and sockeye salmon, as well as steelhead, rainbow and cutthroat trout. Fisheries enhancement activities have been conducted in the Sooke River watershed by the Sooke Salmon Enhancement Society (SSES) and by the British Columbia Ministry of Environment since 1977. Activities of the SSES have included rearing of coho and chinook salmon with juveniles released as fry or smolts at the Jack Brooks Hatchery since 1981 and at the Charters River Hatchery since 2009. The Goldstream Volunteer Salmonid Enhancement Association has been conducting salmon enhancement activities on the Goldstream River at the Howard English Hatchery since 1981.

As set out in the Capital Region Water Supply and Sooke Hills Protection Regulation (1997), the Commission is to consider the protection of fish habitats, guided by advice from the Regional Water Supply, Protection and Conservation Advisory Committee (Water Advisory Committee). The Capital Regional District (CRD) and, prior to the establishment of the Commission, the Greater Victoria Water District, have been providing fisheries water releases for many decades.

In 2002, with the raising of Sooke Lake Dam by six metres, the CRD, T'Sou-ke Nation and the Province (Ministry of Water, Land and Air Protection) entered into an agreement to release water for fish flows based on available storage in Sooke Lake Reservoir (considering total storage volume and reservoir inflow). Approximately 5.73 million cubic metres of storage in Sooke Lake Reservoir, or the approximate volume based on one vertical metre of storage volume at full pool, was to be allocated annually for fish flow releases, to meet the agreement requirements.

The requirement and authorization to store and release water for conservation and fish flow purposes is set out in the Sooke Reservoir Conditional Water Licence (C117626) issued by the Province in 2003. In addition, the CRD committed to providing 4.1 million cubic metres of storage at Deception Reservoir for water to be released into the Sooke River for fish flows, subject to the natural availability of water in the Reservoir. The requirement and authorization to store and release this volume of water for conservation and fish flow purposes is set out in the Deception Reservoir Conditional Water Licence (C117628) issued by the Province in 2003. The Goldstream Reservoir System Conditional Water Licence (C130779) does not allocate water storage for fish water releases.

Operationally, the CRD has been releasing water annually from the Sooke, Deception and Goldstream Reservoirs to enhance fish production and habitat. Releases commenced in 2003 at Deception Dam, 2004 at Sooke Lake Dam, 2011 at Charters River (via release of water from Supply Main No.15 upstream of the Sooke River Road Disinfection Facility) and in 1981 at Japan Gulch Dam.

Biological monitoring was conducted primarily on the Sooke River between 2003 and 2012 to assess the response of aquatic invertebrate and fish communities to the flow releases from the Sooke Lake and Deception Dams. In summary, the monitoring program determined that trout stocks in the Sooke River are reasonably healthy and that fry production is directly benefiting from the fish flow releases. Hydrologic analysis has demonstrated that flow releases from Sooke Lake and Deception Dams have beneficially increased summer base flows, particularly immediately downstream of the dams, beyond what would have occurred under a natural flow regime (prior to damming), providing a benefit to the Sooke River habitat.

Request for Increased Water Releases to Charters River Hatchery

As previously noted, since 2009 the SSES, in partnership with the Juan de Fuca Salmon Restoration Society (JdFSRS), has been operating a demonstration scale salmon hatchery and interpretive centre at Charters River with a supply of raw water from the CRD. Last fall, representatives of the JdFSRS approached the CRD to request additional raw water from the RWS system destined for the Juan De Fuca Water Distribution service. The request for additional water was for the purpose of rearing salmon at a new larger scale hatchery, to be built at the Charters River site, replacing the existing Jack Brooks Hatchery located on Demamiel Creek, also a tributary of Sooke River. Declining flows in Rock Creek, which supplies water to the Jack Brooks Hatchery can no longer support that hatchery operation.

To confirm that increased fisheries water releases to the Charters River Hatchery would not adversely affect available water supply capacity at the Sooke River Road Water Disinfection Facility, serving the District of Sooke, a theoretical and actual demand analysis was conducted, considering a 20 year water demand and population estimate. It was determined that a release flow rate of up to 100 liters per second (L/s), which is well in excess of the requested 50L/s flow rate for four months of the year (February, March, April and May), would not adversely affect the supply of raw water to the Sooke River Road Water Disinfection Facility for at least the next 20 years.

Proposed Fisheries Water Release Plan

The appended three tables (Appendix 2) present a consolidation of the current and proposed fisheries water releases (Table 1) that meets licenced volumes (Sooke and Deception), the operational needs of the fish hatcheries (Goldstream and Charters) (Table 2), the intent of the (expired) 2002 Agreement, and drinking water capacity requirements for at least the next 20 years based on current population and water demand forecasts.

The reservoir spill volumes (Table 3) have been included to highlight that typically through five or six months of the year, while water is being released for fisheries purposes, there is no impact on reservoir storage and the reservoir(s) are full while spilling.

For the foreseeable future, the Leech River flows will continue to flow naturally into the Sooke River and therefore, have not been considered in the plan.

ALTERNATIVES

Alternative 1
That the Regional Water Supply Commission:

1. Endorse the proposed Fisheries Water Release Plan as set out in Table 2 of Appendix 2;

2. Direct staff to engage with the T'Sou-ke Nation regarding the proposed Fisheries Water Release Plan and the (expired) 2002 Agreement;

3. Direct staff to seek approval of the proposed Fisheries Water Release Plan from the Federal Department of Fisheries and Oceans Canada and Provincial Ministry of Environment & Climate Change Strategy and Forests, Lands, Natural Resources Operations & Rural Development, as required; and

4. Direct staff to pursue amending the CRD's Provincial Conditional Water Licence for Goldstream River/Waugh Creek to include an authorization to store and release water for the purpose of conserving fish and fish habitat, in accordance with the release schedule in Table 2 (Appendix 2).

Alternative 2
That the Regional Water Supply Commission:

Not endorse the proposed Fisheries Water Release Plan and request additional information.

IMPLICATIONS

SOCIAL IMPLICATIONS
One of the objectives of the CRD's Water Conservation Bylaw (Parent Bylaw # 4099), and the implementation of Stage 1 Conservation between May 1 and September 30, is to conserve water for fisheries water release purposes during the period when precipitation and natural stream flows are at the lowest. Public conservation practices are well established and the proposed fisheries water release plan is not anticipated to have any social impacts with respect to water supply or use.

ENVIRONMENTAL IMPLICATIONS
There may be a requirement to demonstrate that fish water released via Supply Main No. 15 to the Charters River hatchery, then released to Charters River downstream of the hatchery, will not adversely affect licensees, riparian or private land owners on Charters River or Sooke River (downstream of Charters River confluence). The CRD will identify stakeholders and work with those parties to identify and resolve potential environmental issues.

The fisheries water release plan will result in direct and measurable benefits to the river, fish habitat and fish production (i.e. the number of fry reared at the two hatcheries).

ECONOMIC IMPLICATIONS
The request for increased water releases to the Charters River Hatchery does not result in any capital or new operational costs.

INTERGOVERNMENTAL IMPLICATIONS
It is recommended to engage with the T'Sou-ke Nation regarding the proposed Fisheries Water Release Plan with respect to the assertion of aboriginal rights and rights pursuant to the Douglas Treaty in the waters of the Sooke River and the intent of the expired 2002 Agreement.

CONCLUSION

The CRD has historically released water from its storage reservoirs to enhance fish habitat and the sustainability of a variety of fish species in the downstream rivers and provide water directly to two fish hatcheries. Annual volumes of water for fisheries benefit have been accounted for in the stored volumes within the many reservoirs.

An agreement was executed initially in 2002 to address the fisheries water release from Sooke Lake Reservoir, which has subsequently expired. The Juan de Fuca Salmon Restoration Society has requested seasonal releases of water from the Regional Water Supply system, between February and June of each year, to supplement water flows at the Charters River Hatchery.

It is proposed to consolidate and formalize the Fisheries Water Release Program, with stakeholder engagement, and obtain the necessary approvals and amend the Goldstream water licence accordingly.

RECOMMENDATIONS

That the Regional Water Supply Commission:

1. Endorse the proposed Fisheries Water Release Plan as set out in Table 2 of Appendix 2;

2. Direct staff to engage with the T'Sou-ke Nation regarding the proposed Fisheries Water Release Plan and the (expired) 2002 Agreement;

3. Direct staff to seek approval of the proposed Fisheries Water Release Plan from the Federal Department of Fisheries and Oceans Canada and Provincial Ministry of Environment & Climate Change Strategy and Forests, Lands, Natural Resources Operations & Rural Development, as required; and

4. Direct staff to pursue amending the CRD's Provincial Conditional Water Licence for Goldstream River/Waugh Creek to include an authorization to store and release water for the purpose of conserving fish and fish habitat, in accordance with the release schedule in Table 2 (Appendix 2).

Submitted by:	Ted Robbins, B.Sc., C.Tech., General Manager, Integrated Water Services
Concurrence:	Robert Lapham, M.C.I.P., R.P.P., Chief Administrative Officer

TR:dd

Attachments: 3
1. Appendix 1 - 2002 Agreement
2. Appendix 2 – Tables
3. Appendix 3 – Figure 1

AGREEMENT

THIS AGREEMENT dated as of the 15th day of OCTOBER, 2002.

BETWEEN:

CAPITAL REGIONAL DISTRICT
("CRD")

AND:

THE T'SOU-KE NATION
("T'SOU-KE")

AND:

HER MAJESTY THE QUEEN IN RIGHT OF CANADA
as represented by the Department of Fisheries and Oceans Canada
("DFO")

AND:

HER MAJESTY THE QUEEN IN RIGHT OF BRITISH COLUMBIA
as represented by the Minister of Water, Land and Air Protection
("WLAP")

WHEREAS:

A. T'Sou-ke asserts a special interest in the Sooke River, the management of its watershed, the maintenance of its fish populations and the maintenance of the ecosystem of the Sooke River Watershed;

B. T'Sou-ke asserts both aboriginal rights and rights pursuant to the Douglas Treaties in the waters of the Sooke River, in the Sooke Watershed generally and in the fisheries therein;

C. The Sooke Reservoir and associated facilities, including Deception Reservoir and the proposed Leech River Diversions are an important component of water supply infrastructure of the CRD;

D. These same facilities have had an effect on the flow of water in the Sooke River with some consequent effects on fish populations and habitat in the Sooke River;

E. The Parties have evaluated the impact of the expansion of the Sooke Reservoir on the habitat of indigenous fish in the Sooke Reservoir and its tributaries and in the Sooke River downstream of the Sooke Dam and have agreed on a schedule of water releases, as set out herein, for the management of water releases to the Sooke River;

F. The Parties acknowledge that funds will be applied for from the Federal Provincial Infrastructure Program (Green Municipal Fund) and other sources by the CRD working in association with the T'Sou-ke Nation for the development of the Water Management Plan and associated infrastructure;

G. The Parties acknowledge that this Agreement reflects the measures being taken by the CRD to comply with existing federal and provincial legislation and to address the concerns of T'Sou-ke;

H The Parties have each agreed, subject to meeting the requirements of existing federal and provincial legislation, that steps should be taken to maintain water flows for the conservation and restoration of fish populations and habitat in and around the Sooke River subject to essential public health and drinking water requirements;

I. The Parties have agreed that the effect on the Sooke River of the Sooke Dam, storage/release at Sooke and Deception Reservoir, and the future diversion of the Leech River must be carefully assessed and monitored;

THE PARTIES HEREBY AGREE AS FOLLOWS:

T'SOU-KE FUNDING

1. In order to facilitate T'Sou-ke's capacity to meaningfully participate in the carrying out of the various negotiations, discussions and planning processes described in this Agreement:

   (a) The CRD will pay T'Sou-ke $40,000 per year (for the purpose of paying for technical, legal and other advice related to carrying out these actions and to assist in flow monitoring) for each year this Agreement is in effect including the 12 month period commencing October 1, 2002 and the 12 month period following the effective date of early termination of this Agreement, but not for any period of time after September 30, 2007;

   (b) The CRD will pay T'Sou-ke $50,000 for past technical and legal services incurred in respect of the proposal of the CRD to raise the Sooke Reservoir;

   (c) The CRD will support T'Sou-ke in applications to third parties for any additional funding required for the services noted in (a); and

   (d) The CRD will continue to provide T'Sou-ke, without charge, copies of any technical reports, plans and other materials in the CRD's possession which may be necessary for carrying out such actions.

HERITAGE CONSERVATION ACT

2. T'Sou-ke acknowledges that the CRD has retained a qualified heritage consultant, Morley Eldridge of Millennia Research Limited, and approved by T'Sou-ke who has conducted and completed a heritage inspection and if recommended by Millenia Research Limited, to conduct a heritage investigation of all areas to be inundated by the raising of the Sooke Reservoir or affected by construction operations in relation thereto (including, without limitation, construction roads, marshalling or storage areas or

equipment yards) or in relation to the diversion of water from the Leech River. The CRD will bear all costs of such inspections and investigations (including the costs associated with obtaining permits under the *Heritage Conservation Act* and shall deliver a copy of the report arising from this investigation to T'Sou-ke. In the event the *Heritage Conservation Act* is repealed, the heritage inspection and investigation described herein shall be carried out in accordance with the standards that would be expected if such repeal had not occurred.

3. The CRD agrees that it will not apply for a Site Alteration Permit pursuant to the *Heritage Conservation Act* (or any successor legislation) in respect of any heritage resources identified by the inspection and investigation described in section 2 without the consent of T'Sou-ke as to the mitigative measures to be implemented in regard to such heritage resources, such consent not to be unreasonably withheld. In the event that the *Heritage Conservation Act* is repealed, the work in question shall not be carried out until the CRD and T'Sou-ke have agreed upon the mitigative measures to be implemented.

SHORT TERM RELEASES

4 (1) Until agreed otherwise by the Parties, the CRD will release water from the Sooke Reservoir into the Sooke River for fish flows in accordance with the following monthly criteria:

(i) subject to (iii), when total reservoir volume is greater than 95 million cubic metres, the release shall be 0.07m3/s + 0.14% of previous month's total inflow, released uniformly over the month;

(ii) subject to (iii) when the total reservoir volume is less than or equal to 95 million cubic metres and greater than or equal to 88 million cubic metres, then release shall be 0.04m3/s + 0.14% of the previous month's total inflow, released uniformly over the month;

(iii) when the total reservoir volume is less than 88 million cubic metres or when the CRD has imposed a complete lawn watering ban or when the cumulative inflow in Sooke Reservoir from October 1st to April 1st is less than 40 million cubic metres, the release shall be 0. 03m3/s.

(2) Unless otherwise agreed by the parties, and subject to the natural availability of water at Deception Reservoir, the CRD agrees to provide 4.1 million cubic metres of storage at Deception Reservoir for water to be released into the Sooke River for fish flows in accordance with a schedule of flows to be provided by T'Sou-ke and MWLAP.

CRD COMMITMENTS

5. The CRD makes the following commitments, subject to the appropriate regulatory approvals:

(1) **Sooke reservoir**

The CRD will:

(a) raise the Sooke Dam by six (6) metres in compliance with Federal and Provincial Environmental Assessment requirements by March 31, 2003, unless prevented from doing so by an authority having jurisdiction or by reason of force majeure;

(b) operate and maintain the facilities being used to manage flows on the Sooke River; and

(c) explore the feasibility of releasing additional winter flows while maintaining the 96% reliability criteria.

(2) Deception Reservoir

The CRD will:

(a) construct a spillway on Deception Reservoir by March 31, 2003; and

(b) operate and maintain the facilities used to release water from Deception Reservoir to Deception Creek in accordance with this Agreement.

(3) Leech River

The CRD will:

(a) undertake water quality research on the Leech River to determine the water quality impact of diverting the Leech River to the Sooke Reservoir;

(b) complete the Leech River Diversion to Deception and Sooke Reservoirs based on the reliability criteria adopted by the Regional Water Supply Commission, i.e. 96%, but not sooner than the year 2010 and no later than 2015; and

(c) explore the potential for activating the Leech Tunnel sooner for winter flows only to Deception Reservoir.

(4) Watering Restrictions:

The CRD will introduce watering restrictions as necessary to maintain conservation flows in accordance with this Agreement recognizing that water supply to the CRD for essential public health and drinking water requirements must be assured at all times.

(5) Funding

The CRD, in cooperation with T'Sou-ke, will apply for funding under the Green Municipal Funds Program.

(6) Licence Application

The CRD will apply for all the necessary licences under the Water Act.

T'SOU-KE COMMITMENTS

6. (1) T'Sou-ke agrees not to take any legal proceedings to enjoin or stop the raising of the Sooke Reservoir in accordance with section 5(1)(a), provided that such work is carried out in accordance with this Agreement.

(2) T'Sou-ke agrees that as long as this Agreement is in effect and the water releases into the Sooke River are maintained in accordance with section 4 it shall not commence any proceeding in respect of the then current releases.

WATER LEVEL MONITORING

7. Water level and any other monitoring will be carried out in accordance with the Fisheries and Oceans Authorization, and any provincial regulatory requirements.

8. (1) The results of the monitoring regime described in section 7 shall be reported to all parties in written form annually. The data collected by the monitoring regime shall be made available to the parties or their advisors upon request.

(2) T'Souke's involvement in monitoring activities is at their discretion and in accordance with section 7.

(3) The Parties shall meet three times per year or as mutually agreed to review the results of the monitoring program. Other interested government agencies may be invited to the meetings.

(4) The Parties may modify the releases established by section 4 based on the results of the monitoring program, taking into consideration the total available water release volume. The water releases shall not be any less than those described in section 4 or the *Fisheries Act* Authorization unless specifically approved by DFO.

APPLICATION FOR NEW AND AMENDED WATER LICENCES

9. (1) CRD shall apply for all necessary regulatory approvals.

(2) CRD shall apply to amend the existing licences for Deception Creek and Deception Reservoir, including but not limited to the following: to change the purpose from 'waterworks' to 'conservation' and to amend the existing licences for Sooke Reservoir from 'waterworks' to 'waterworks and conservation'.

(3) When applying to amend existing water licences or for new water licences, the CRD shall, to the fullest extent possible, apply to have the relevant terms of this Agreement form part of the conditions imposed on any amended or new water licence, in particular the releases set out in section 4, including any revision to these releases following completion of a Water Management Plan and receipt of the appropriate regulatory approvals in respect of that Plan or any modification to the Release Schedule under section 8(4).

WATER MANAGEMENT PLAN

10. The Parties agree that they shall as quickly as possible commence working toward a mutually agreeable Water Management Plan for the parts of the Sooke Watershed owned or controlled by the CRD. Subject to applicable regulatory approvals, this Water Management Plan is intended to comprehensively deal with all issues relating to the management and use of water flows and alterations and allocations thereof, and shall include the Sooke River, Deception Creek, Council Creek and the Leech River, and shall include, without limitation,

    (a) an analysis of what waterflows are necessary and can be maintained for the purpose of conserving and building fish stocks and habitat in the Sooke River;

    (b) an analysis of what steps are needed to ensure an adequate supply of water for the CRD;

    (c) a water release program as set out in section 4 hereof for the purpose of releasing water for fishery conservation and restoration in the Sooke River;

    (d) a monitoring program as set out in section 7 hereof; and

    (e) a detailed description of the principles to govern the management of water releases.

11. The Parties agree that they shall make best efforts to complete the Water Management Plan before September 30, , 2007.

12. After the completion of the Water Management Plan, the CRD shall apply to amend their water licences under the *Water Act* and the CRD shall, to the fullest extent possible, apply to have the relevant terms of the Water Management Plan form part of the conditions imposed on amended or new water licences.

WATERSHED MANAGEMENT PLAN

13. The Parties agree that they shall as quickly as possible commence working toward a Watershed Management Plan for the Sooke Watershed in co-operation with other landowners, licensees, tenure holders and interested agencies in the Sooke Watershed. This Watershed Management Plan shall include, without limitation,

    (a) the Water Management Plan;

    (b) a plan for land and resource use in the lands in Sooke Watershed; and

    (c) a plan for a process to adaptively manage the Sooke Watershed into the future.

CONSULTATION: WATER LEVELS

14. The CRD agrees to consult with T'Sou-ke and the parties in respect of situations not provided for in this Agreement such as unusually low or high water levels or other emergencies requiring action on the part of the CRD. Consultation shall proceed as follows:

(a) the CRD shall notify T'Sou-ke and the parties as quickly as practicable in the circumstances;

(b) it shall provided reasonable information requested by T'Sou-ke or its technical consultants;

(c) it shall arrange to meet with T'Sou-ke and the parties or such representatives as T'Sou-ke may appoint as soon as possible in the circumstances;

(d) it shall where feasible attempt to address T'Sou-ke and the parties' concerns in the circumstances; and

(e) in the event that such consultation will require T'Sou-ke to incur expenses not reasonably encompassed within the work expected to be carried out in fulfilling the other requirements of this Agreement:

(i) T'Sou-ke may apply to the CRD for the payment of these reasonable expenses;

(ii) the CRD shall consider such an application and shall not unreasonably refuse to pay such additional expenses, to a maximum of $5,000.00 per year during the term of this Memorandum of Agreement or any extension of that term.

OBLIGATIONS OF THE REGULATORY AGENCIES

15. DFO agrees, subject to regulatory requirements,

(a) to issue an Authorization that reflects this Agreement, subject to section 25; and

(b) to facilitate approval of raising the Sooke Reservoir by six (6) metres;

16. DFO and WLAP agree to

(a) review the threshold flow in the Sooke River at the Charters Creek hydrometric station which must currently be met or exceeded before water from the Leech River can be diverted into either Deception Reservoir or Sooke Reservoir. CRD agrees to submit an application to amend their water licence(s) under the Water Act if the review indicates that the threshold flow may be reduced;

and, in conjunction with the T'Sou-ke Nation, to the extent the T'Sou-ke Nation chooses to participate in such monitoring,

(b) monitor the fishery downstream of the Sooke Dam.

OBLIGATION TO CONSULT

17. T'Sou-ke agrees that this Agreement demonstrates consultation by the CRD within the meaning of s. 35(1) of the *Constitution Act, 1982* with respect to the Sooke River fishery. T'Sou-ke does not agree that such consultation is adequate or complete for any purpose except the raising of the Sooke Dam and the water releases under sections 4 and 8(4) in accordance with this Agreement.

NEW WATER LICENCES

18. Except as provided in sections 9, 5(6) and 12, the CRD shall not, without consulting with T'Sou-ke, apply for any amendment to its existing Water Licences or any new Water Licence, for or in respect of any of the Sooke Reservoir, the Deception Reservoir, the Leech River or any other river or body of water in the watershed of the Sooke River, until the Water Management Plan has been agreed upon. Nothing herein shall be construed as fettering the exercise of statutory discretion or statutory authority by a statutory decision maker.

ABORIGINAL AND DOUGLAS TREATY RIGHTS

19. The Parties agree that this Agreement does not in any way limit, suspend, modify, abrogate or derogate from such aboriginal or treaty rights as T'Sou-ke or its members may have, whether arising from the Douglas Treaties or otherwise.

20. For greater certainty, the parties acknowledge that T'Sou-ke, for the purpose of this Agreement or in relation to its dealings with the matters dealt with in this Agreement, has not been authorized to in any way limit, suspend, modify, abrogate or derogate in any way from the rights described in section 19.

21. T'Sou-ke agrees that any Party may refer to this Agreement for the purpose of demonstrating an attempt at consultation within the meaning of s. 35(1) of the *Constitution Act, 1982* but T'Sou-ke shall not be taken to have agreed that this Agreement or anything carried out pursuant to this Agreement is adequate consultation or constitutes consultation at all in respect of an issue, except as set out in section 17 hereof.

TERMINATION AND SURVIVAL OF OBLIGATIONS

22. This Agreement shall terminate, unless otherwise agreed by the Parties in writing, on the earlier of

    (i) September 30 , 2007, or

    (ii) the adoption by the CRD of the mutually agreed upon Water Management Plan after receiving the appropriate regulatory approvals.

23. The effect of termination shall be that each Party shall be relieved of all obligations under this Agreement, except where provided otherwise by section 24.

24. The Parties expressly agree that sections 1(a), 3, 17 to 21, and 23 will survive and remain enforceable after the termination of this Agreement, including the obligations of Section 4 that continue for 6 months after termination.

25. The Parties agree that this Agreement shall not fetter DFO issuing or enforcing an Authorization pursuant to the *Fisheries Act*. Nothing herein shall be construed as fettering the exercise of statutory discretion or statutory authority by any other statutory decision maker.

IN WITNESS the parties have signed and sealed this Agreement on the 15th day of October, 2002.

CAPITAL REGIONAL DISTRICT by its authorized signatories:

Chair

Corporate Secretary

SIGNED, SEALED AND DELIVERED by the **T'Sou-ke Nation** pursuant to the consent of the majority of the Councillors of the T'Sou-ke Nation present at a meeting duly convened at which authority was given for the **T'Sou-ke Nation** to enter into this Agreement as recorded in a Band Council Resolution.

Witness

10. Beach Drive

Address

Victoria V8S 2L2

Professional Engineer

Occupation

Councillor

Councillor

SIGNED **HER MAJESTY THE QUEEN IN RIGHT OF CANADA** as represented by the **Minister of Fisheries and Oceans** in the presence of

RON KADOWAKI
Area Director
Fisheries and Oceans Canada

Signed by **HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF BRITISH COLUMBIA** as represented by the Minister of Water, Land and Air Protection in the presence of:

NANCY WILKIN
Assistant Deputy Minister
Environmental Stewardship
Ministry of Water, Land and Air Protection

11-Oct-02/327 078/Agreement/LS/JR

CAPITAL REGIONAL DISTRICT

THE T'SOU-KE NATION

HER MAJESTY THE QUEEN IN RIGHT OF CANADA
as represented by the
Department of Fisheries and Oceans Canada

HER MAJESTY THE QUEEN IN RIGHT OF BRITISH COLUMBIA
as represented by the
Minister of Water, Land and Air Protection

AGREEMENT

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2nd Floor, 837 Burdett Avenue
Victoria, B.C.
V8W 1B3
Telephone: (250) 380-7744
Facsimile: (250) 380-3008
File: 327 078

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TABLE 1

CURRENT FISHERIES WATER RELEASES (ML) (2017-2018 Averages)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Sooke	711	631	688	748	581	237	131	88	148	102	187	457	4,709
Charters	-	-	-	-	10	75	74	82	77	88	41	9	456
Sub-total	711	631	688	748	591	312	205	170	225	190	228	466	5,165
Deception	132	119	132	134	146	348	522	886	857	157	109	129	3,671
Goldstream	76	-	-	-	69	205	434	424	404	750	586	245	3,193
Totals	919	750	820	882	806	865	1,161	1,480	1,486	1,097	923	840	12,029

TABLE 2

PROPOSED FISHERIES WATER RELEASES (ML)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Sooke	700	700	700	700	600	250	100	100	100	150	200	500	4,800
Charters	20	130	130	130	130	-	-	-	20	20	20	20	620
Sub-total	720	830	830	830	730	250	100	100	120	170	220	520	5,420
Deception	-	-	-	200	200	400	500	900	900	400	400	200	4,100
Goldstream	-	-	-	-	100	200	200	400	400	600	600	200	2,700
Totals	720	830	830	1,030	1,030	850	800	1,400	1,420	1,170	1,220	920	12,220

Sooke releases are estimates based on formula in 2002 Agreement

TABLE 3

RESERVOIR SPILL VOLUMES (ML) (2017-2018 Averages)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
Sooke	17,488	10,173	10,074	14,953	-	-	-	-	-	-	-	1,515	54,203
Deception	1,764	746	264	686	45	-	-	-	-	-	300	700	4,505
Totals	19,252	10,919	10,338	15,639	45	-	-	-	-	-	300	2,215	58,708

Goldstream reservoir system spill volumes not measured

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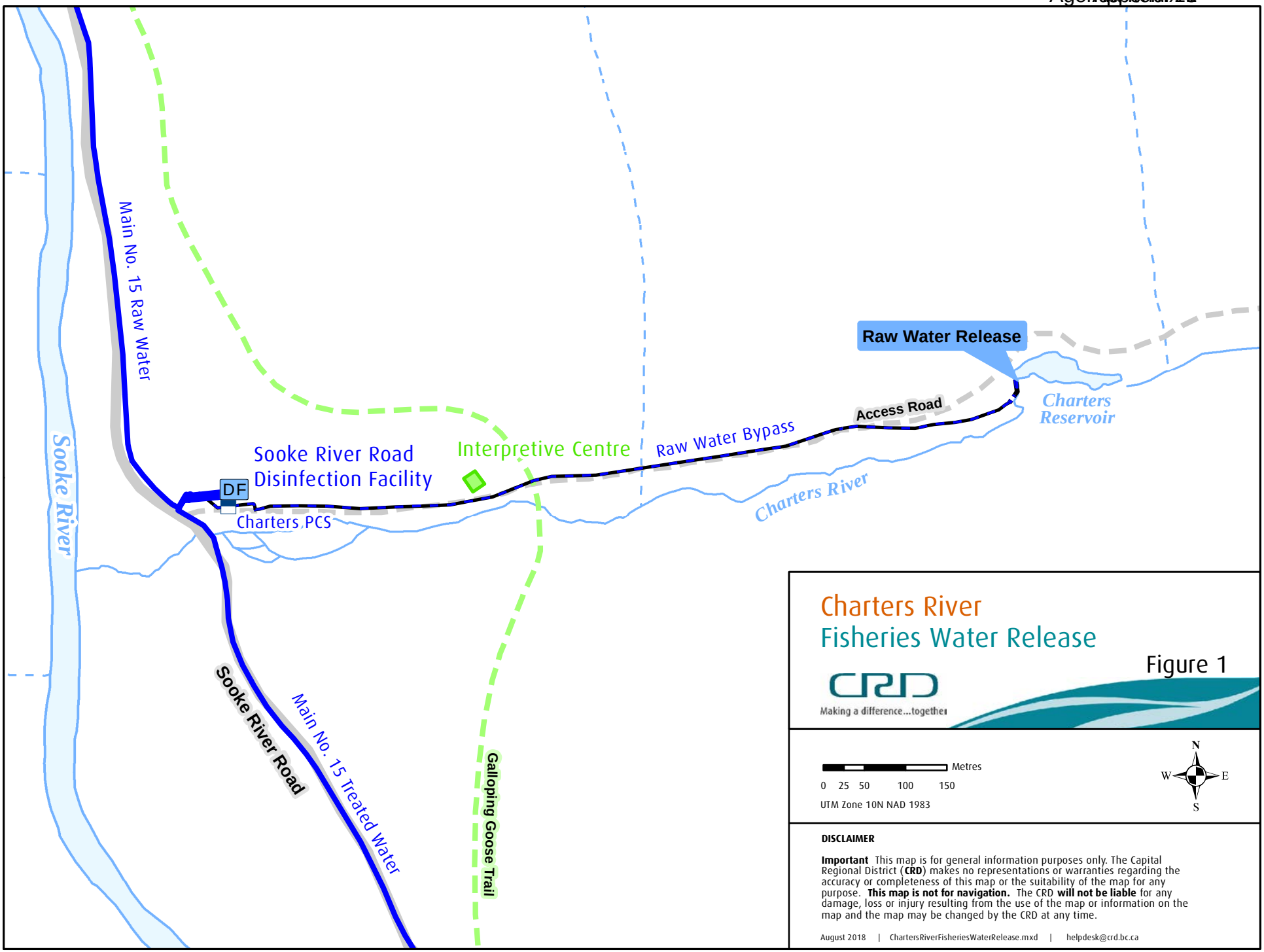
Main No. 15 Raw Water
Sooke River
Raw Water Release
Access Road
Charters Reservoir
Raw Water Bypass
Interpretive Centre
Sooke River Road
Disinfection Facility
DF
Charters PCS
Charters River
Sooke River Road
Main No. 15 Treated Water
Galloping Goose Trail
Charters River
Fisheries Water Release
Figure 1
Making a difference...together
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DISCLAIMER
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Making a difference...together

REPORT TO REGIONAL WATER SUPPLY COMMISSION
MEETING OF WEDNESDAY, MAY 15, 2019

SUBJECT **WATERSHED HYDROLOGY MONITORING PLAN – LEECH WATER SUPPLY AREA**

ISSUE

To report on a plan to monitor the watershed hydrology of the Leech Water Supply Area to inform preparation of the area for regional drinking water supply.

BACKGROUND

Leech Water Supply Area (Leech WSA)

The Leech WSA (9,623 hectares) was acquired by the Capital Regional District (CRD) in 2007 and 2010 from TimberWest Forest Ltd. and Western Forest Products Inc. At the time of purchase, the lands were already roaded, harvested and re-planted. The purchases resulted in 92% of the Leech River catchment, (watershed above the diversion tunnel), being owned and managed by the CRD for future water supply. With the assistance of long term capital funding, ($5.8 million over 17 years from the Regional Water Supply Service), the Leech WSA is being rehabilitated and the forests are slowly re-growing. The 2017 Regional Water Supply Strategic Plan calls for more intensive monitoring and assessment of Leech River source water to inform future treatability, timing and infrastructure needs prior to bringing Leech River water to Sooke Lake Reservoir.

The Leech WSA is located directly west of the Sooke WSA which supplies Greater Victoria's current water demand, but lies higher in elevation, has steeper terrain, different geology, ecology and younger forest cover. These watershed characteristics are all important factors in the hydrology, (movement, quantity and quality of water), of the Leech River that is to provide additional water for future regional water supply needs.

There are currently two weather stations in the Leech WSA, one at Martin's Gulch (since 2010) and the other at Chris Creek (since 2015). Until now, there has only been one hydrology monitoring station on the Leech River approximately one kilometer downstream from the diversion tunnel, (Map in Appendix A). Water level, flow, turbidity and water quality have been monitored at this station since 1995, with some data gaps.

Leech WSA Hydrology Monitoring Plan

A comprehensive meteorological (weather) and hydrological (water) monitoring program is required in the Leech WSA in order to:

1. gather baseline data for future decision making regarding the required infrastructure, water availability and treatment requirements for bringing Leech River water into the Regional Water Supply System.

2. gather baseline and ongoing data to inform land rehabilitation and watershed protection efforts, as well as monitor climate change in the Leech WSA.

3. provide data to inform future discussions with the Ministry of Environment regarding the water licence on the Leech River, *Water Sustainability Act* requirements and the water requirements for fish habitat values.

In early 2017, the CRD hired a senior hydrologist within the Watershed Protection division of Integrated Water Services. This position monitors, analyzes and provides technical advice on watershed hydrology of the Greater Victoria Water Supply Area (GVWSA). The position was tasked with assessing the Leech WSA and recommending a watershed hydrology monitoring program specific to the area and the data needs identified above.

The assessment and plan have been completed, (full report in Appendix B), and the plan recommends implementation of the following in the Leech WSA:

- Six primary hydrology and water quality stations in the major streams, including an automatic water sampling device just upstream of the entrance to the Leech Tunnel;
- Seven secondary hydrology stations in tributaries to the major streams;
- Two additional meteorology stations at Survey Mountain and in the West Leech River headwaters; and,
- Small meteorology stations under the forest canopy to better understand the effects of forest cover and soils on watershed hydrology.

The Map in Appendix A shows the location of the existing and planned hydrology and meteorology stations in the Leech WSA.

Primary and secondary hydrology stations will continuously measure water level, water flow, temperature, conductivity and turbidity, storing data in onsite data loggers that are manually downloaded on a monthly or biweekly basis, with plans in future years to remotely download data via radio or satellite communication. In collaboration with CRD Water Quality staff, water samples will also be collected in future to measure nutrients, metals, total and dissolved organic carbon and coliform bacteria.

Meteorology stations will measure air temperature, relative humidity, wind speed, wind direction, precipitation, snowpack, solar radiation, rainfall interception, stem flow and soil moisture. The two new meteorology stations will be located to ensure there is representation of the range of elevation and geographic variation within the Leech WSA.

Chris Creek Meteorology Station

West Leech River Hydrology Station (staff gauge visible on the left bank)

Implementation

The lower portions of the Leech River and its main tributaries are located in deep incised channels making access and logistics difficult. The chosen station locations balance existing access with best placement for hydrology and meteorology monitoring. In some cases short sections of road are required to be built, brushed out or upgraded in order to facilitate access to a station and there may be a need to fly in some equipment.

A plan to implement the monitoring plan was developed and implementation through support from the Regional Water Supply System Capital Plan has begun. Work is primarily being completed by the senior hydrologist with the help of additional CRD staff. The 2018 to 2021 capital portion of the implementation plan is summarized below. Although the program requires a sustained commitment to a program budget, the budget implications will be considered by the commission annually through the budget review process.

Implementation Plan:

Year	Activity	Funding
2018	• Install 4 primary hydrology (hydro) stations • Add instruments to the existing meteorology (met) stations • Prepare access • Prepare for new met stations	$85,000
2019	• Install 2 primary hydro stations • Add automatic water sampler upstream of the Leech Tunnel • Upgrade existing hydro station • Incorporate water quality instrumentation at primary stations • Install 7 secondary hydro stations • Install Survey Mountain met station	$285,000

	• Prep for West Leech met station	
2020	• Install West Leech met station • Additional work on primary hydro stations • Install remote access communications (first phase)	$70,000
2021	• Install remaining communications for remote data logger downloading	$15,000
Total	**13 new hydrology monitoring stations** **2 new meteorology monitoring stations**	**$455,000**

CONCLUSION

In order to prepare for future water supply from the Leech WSA, hydrological and meteorological baseline data is required to develop a hydrologic model from which to base future water yield, infrastructure and treatment decisions. A plan has been developed to install hydrology and meteorology monitoring stations to collect the necessary data, which will also inform watershed protection programs to maintain or improve water quality. Implementation is scheduled over a four-year period with data collection beginning in 2019. Funding to support implementation was requested through the Regional Water Supply Service Capital Plan.

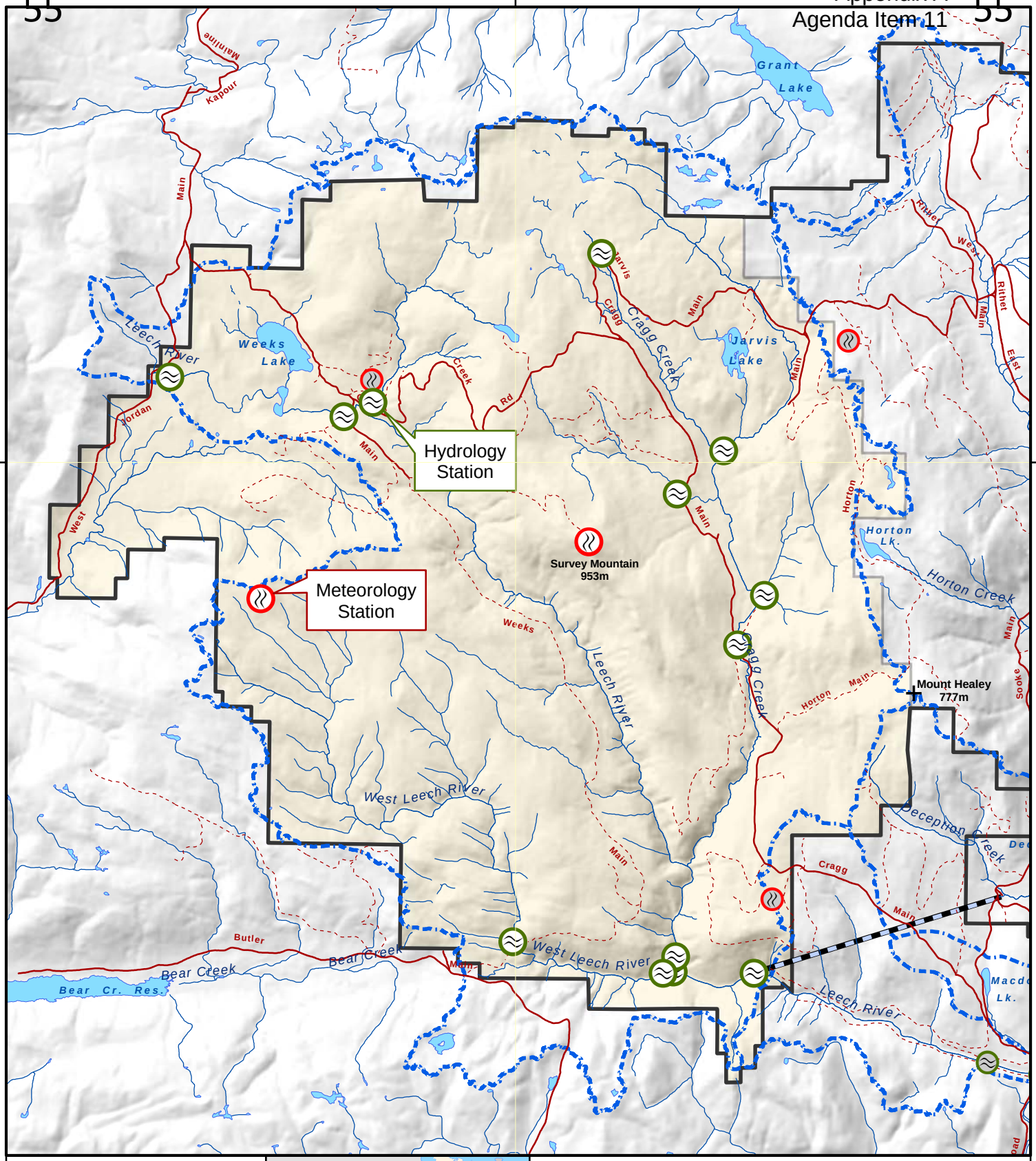
RECOMMENDATION

That the Regional Water Supply Commission endorse the staff report, *Watershed Hydrology Monitoring Plan – Leech Water Supply Area*.

Submitted by:	Annette Constabel, M.Sc., R.P.F, P.M.P, Senior Manager, Watershed Protection
Concurrence:	Ted Robbins, B.Sc., C.Tech., General Manager, Integrated Water Services
Concurrence:	Robert Lapham, M.C.I.P., R.P.P., Chief Administrative Officer

AC:TR:ad:dd:td

Attachments: 2
Appendix A Map 1, Existing Hydrology & Meteorology Stations in the Leech WSA
Appendix B Watershed Hydrology Monitoring Plan – Leech WSA



Existing and Planned Hydrology and Meteorology Monitoring Stations

Leech Water Supply Area

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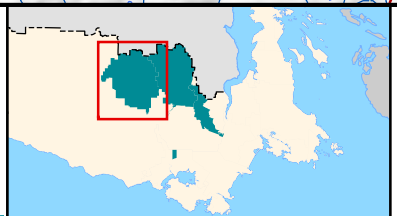

Nov 2018

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The Capital Regional District does not warrant the accuracy within this map, nor will it accept responsibility for errors or omissions. The CRD reserves the right to alter or update the information without notice. Maps should not be used as navigation tools.

Fire_General\FWX_Stations\FWAndHydrometStnLeechLetter_Planned.mxd

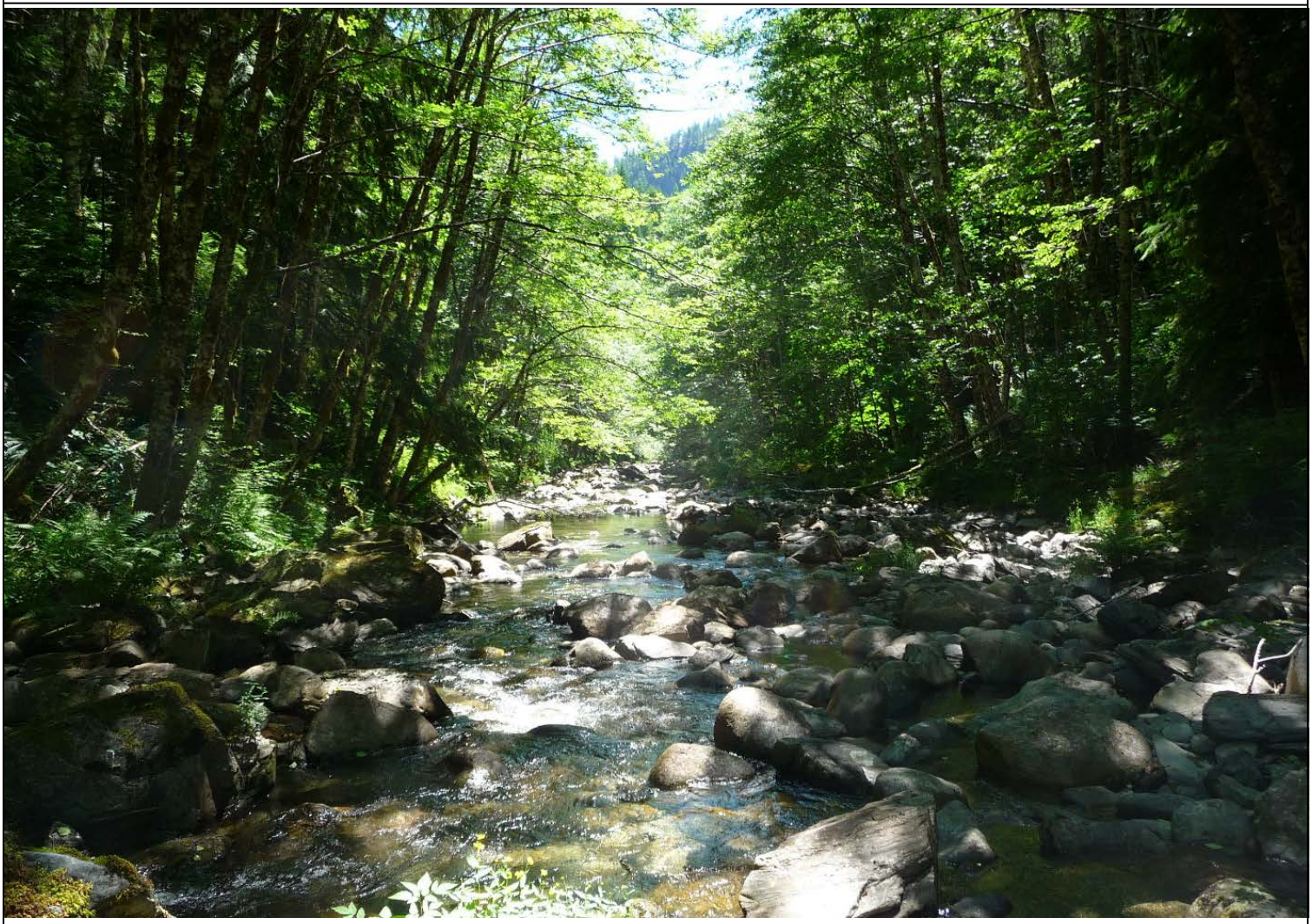
Planned Stations
- Hydrology Station
- Meteorology Station

Existing Stations
- Hydrology Station
- Meteorology Station

- Primary Road
- Secondary Road
- Leech Diversion Tunnel
- Stream
- Catchment Boundary
- Lake; Reservoir
- Leech WSA

Watershed Hydrology Monitoring Plan
Leech Water Supply Area

Capital Regional District | December 2018



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Executive Summary

A watershed hydrology monitoring program for the Leech Water Supply Area (LWSA) is provided in the following document. Watershed hydrology is the science of the movement, distribution and quality of water in a watershed including meteorological (precipitation/weather) and hydrological (surface and groundwater) processes. These processes combine to define the water yield of a watershed. Monitoring and analysis of watershed hydrological processes is required for stewardship of the Greater Victoria Water Supply Area (GVWSA) and to sustain our long-term drinking water supply.

The monitoring plan is based on the CRD's emphasis on the Leech River basin as a future water source. The plan is comprehensive in scope and is intended to build an understanding of the nature of water resources in the LWSA, as it relates to the questions of water quantity and water quality, and how these vary seasonally and over the long-term. The monitoring plan is guided by the expected data requirements to support future water supply decisions and by future climate change scenarios.

The Leech River is unique in the GVWSA because the hydrologic processes in the Leech basin are of a larger scale, are controlled by higher and steeper terrain, distinct geology, increased snowfall and snowpack, and a younger forest land cover. The larger hydrologic scale of the Leech basin, the stream characteristics, and access issues, collectively dictate that the monitoring stations in the LWSA will not be control structures as in the Sooke and Goldstream systems.

For the monitoring program to be useful for future analyses and queries regarding water supply, there is a need to implement more rigorous monitoring practices to align with provincial standards and to implement a comprehensive suite of hydro-meteorological monitoring techniques. This requires, the investment of staff time, the sustained commitment to a program budget, and implementation of additional instruments and consistent monitoring practices over time will be required.

Baseline climate and hydrology data time-series are required to support the following (among other needs):

- water supply modeling and forecasts, runoff modeling, water quality monitoring and modeling, and regulatory requirements such as water licenses and environmental flow needs.

If Leech River water is diverted to Sooke Lake Reservoir, baseline data from the river will be required for water yield and quality calculations, and dam safety assessments and design flood calculations.

In order to meet these demands, the following monitoring stations and measurements are recommended for the LWSA:

- Six "primary" hydrology monitoring stations in the major streams of the LWSA, including a paired hydrology-water quality automated sampler near the Leech River Tunnel intake
- Seven "secondary" hydrology monitoring stations in LWSA headwater tributaries;
- Meteorological stations at Survey Mountain and in the West Leech River headwaters, including:
    - snow pack monitoring (both snow depth and in particular snow water equivalent) via automated and manual survey methods;
    - soil moisture monitoring at new and existing met stations
    - rainfall Interception monitoring at new and existing met stations

The locations of these stations are shown in Figure 3.

One of the greater challenges of implementation of the monitoring program relates to annual access to the monitoring locations in the LWSA. There may be a need for new road work to some areas of the LWSA, or increased road maintenance may suffice. In light of these challenges, there is a need for coordination amongst different groups in Watershed Protection to facilitate access for instrument installations and on-going monitoring.

A phased implementation approach is recommended in order to best fit with the existing access limitations within the basin and to match existing resources. This process is described in Appendix 1. Furthermore, areas of efficiency (e.g., re-use of "retired" sensors from the Sooke basin) and coordination amongst IWS divisions will be required and realized as implementation proceeds.

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1 Introduction

In 2007 and 2010 the Capital Regional District (CRD) purchased a total of 9,271 ha of forested land within and adjacent to the Leech River basin and added it to the Greater Victoria Water Supply Area (GVWSA). The purpose of this acquisition was to protect about 92% of the river basin above the entrance to the Leech Tunnel. The purpose of the Leech Tunnel is to divert water from the Leech River to Sooke Lake Reservoir, the primary water supply source for Greater Victoria.

The CRD Integrated Water Services (IWS) department has been collecting data on water levels, flows, turbidity and water quality parameters at one station in Leech River downstream of the entrance to the Leech Tunnel since 1995. Two meteorological stations have also been established in the Leech WSA. While the data from these stations are useful, the complexity of the biophysical and ecological characteristics of the Leech WSA and the history of intensive forest harvest and road building require a comprehensive watershed-level monitoring program for water quantity and quality with a more extensive network of stations. An expansion of the hydrology monitoring program was a key recommendation of the assessment of the Leech Water Supply Area for source water protection and land management (CRD IWS, 2015).

The physical size and biogeoclimatic conditions of the Leech River basin are hydrologically-distinct and as a result, the monitoring approach used in the Sooke and Goldstream basins is not necessarily the best approach nor practical for hydro-meteorological monitoring in the Leech basin.

The purpose of hydro-meteorological monitoring in the Leech River basin is to quantify total water yield and to understand the nature of water resources in the Leech River to inform and support water supply decisions and water management plans.

Currently, the Leech River flows are not well defined and the available water supply is unknown. The existing limitations include significant data gaps associated with hydrological and meteorological processes in the Leech basin, access challenges, and budget resources.

The current challenges of determining the water yield of the Leech River basin are related to the lack of monitoring data within the basin that quantifies basic hydro-meteorological conditions, as well as the effect of land use and forest management practices on hydrologic conditions in the basin and over time.

A fundamental component of a hydro-meteorological monitoring network is that the network provides representative climate and hydrologic data of the basin. That is, the network should be well-instrumented

and distributed to characterize the full range of climatic and hydrologic conditions. With this as a guiding principle, the following sections describe the purpose of the monitoring plan, the existing conditions including the basis for monitoring, data gaps and limitations, description of monitoring sites and instrumentation, health and safety considerations, and a proposed schedule. Key takeaways regarding the hydro-meteorological monitoring needs in the LWSA are summarized at the end of the report. Implementation of the monitoring plan is described in detail in Appendix 1. This includes installation plans through 2021 and estimated budget requirements. A review of hydrometric monitoring practices and standards including station design and data quality control measures is included in Appendix 2.

A more thorough review of other monitoring programs is beyond the scope of this plan. In several instances there is potential to establish partnerships with other agencies to achieve common monitoring goals. Although these potential opportunities are not detailed here, in the future, there may be opportunities to enhance the proposed monitoring plan through inter-agency partnerships.

2 Purpose and Content

The primary goal of the monitoring program is to initiate comprehensive hydro-meteorological data collection and monitoring within the Leech River basin to obtain baseline data that covers a full range of conditions in the Leech Water Supply Area (LWSA). Hydrologic monitoring in a watershed must be coupled with meteorological monitoring because watershed hydrology is dependent on the spatial and seasonal changes of the prevailing meteorological conditions.

In a general sense, a baseline hydro-meteorological data set is required to understand *the nature of water resources* in the basin. This includes the seasonal variability of runoff and how it changes with elevation and spatially in the LWSA. This information will help address questions regarding the nature of extreme conditions associated with water resources in the LWSA and in a changing climate and therefore will inform water management. Specifically, the data set is required to support the following water resource objectives:

- water supply and water quality calculations for water yields, concentrations and loadings,
- seasonal and event-based forecasts for stream flows, water supply and water quality,
- hydrological modeling, including calibration and model verification
- sediment and nutrient budgets,
- frequency and magnitude of flood and low flow conditions,
- temperature and precipitation conditions including evaporation and interception loss,
- climate change monitoring,
- water licensing,

- environmental flow needs assessments,
- inform water releases required to support aquatic ecology (fisheries releases).

In addition, if Leech River flows are transferred to the Sooke watershed, the additional flow input has potential implications for dam safety as it relates to design flood calculations, for water treatment requirements, and for water supply infrastructure.

In the future, hydro-meteorological information will be needed for surface water – groundwater interactions and to support decision-making regarding the potential of groundwater as a supplementary water source.

For most of the objectives noted above, advanced watershed modeling will be needed to provide the detailed and robust analysis required of these objectives. In some cases, predictions of future hydrologic conditions will be needed, for example, for long-term estimates of available water in the LWSA. In other cases, seasonal forecasts will be required, for example, to address what the summer water supply will be given the preceding winter precipitation.

The appropriate modeling approach in most cases, is to use fully-distributed physically-based numerical models that account for the spatial and seasonal variability of hydro-meteorological processes in the GVWSA. For this reason, the monitoring program requires a more thorough suite of watershed monitoring than is currently in place in the GVWSA.

Secondary uses of the hydro-meteorological baseline data include forest sustainability, fire weather indices and/or refining the indices at a local scale within the GVWSA, watershed aquatic ecology and land-based ecology and related watershed habitat and health assessments.

The proposed monitoring sites and instrumentation align with the BC Provincial hydrometric monitoring standards and maintain the anticipated commitments in the Climate Related Monitoring Program (CRMP) Agreement regarding instrumentation quality at meteorological stations.

3 Leech River Basin

3.1 Leech River Basin Overview

The Leech watershed has an elevation range from approximately 140m at the mouth of the Leech River to 950m at Survey Mountain. The drainage area is approximately 100km^2. Rainfall is plentiful in the fall and winter seasons and a seasonal snow pack is likely prevalent in the higher elevations of the basin in

typical winters. It is likely that winter precipitation accounts for roughly 35 to 45% of annual total precipitation and summer season precipitation is less than 10% of annual total precipitation.

There is relatively low lake storage in the headwaters of the basin, aside from Weeks Lake and its connected wetlands in the northwest. However, the majority of the basin is fluvially-dominated. The nature of water movement and storage in the LWSA indicates the basin may be classified as primarily lotic compared to the lentic ecosystem of the Sooke and Goldstream. There are three major sub-basins in the LWSA. These are the Leech River (main stem), the West Leech River, and Cragg Creek.

Sub-basin areas are often used as an indicator of the relative flow contribution for a given watershed. For instance, the Leech River at the Leech River Tunnel represents 93% of the total Leech River basin area; the Leech River upstream of the West Leech is 70% of the total Leech basin; the West Leech River upstream of the Leech River is 21% of the total Leech basin, and Cragg Creek upstream of the Leech River is 37% of the total Leech basin area. Thus each of the three main sub-basins are significant contributors to the entire Leech River flow. Notable tributaries include Chris Creek, the Weeks Lake wetland complex, and Jarvis Creek due to their basin size and proximity to the basin headwaters. Other drainages of note include the major tributaries that drain the east side of Survey Mountain and the west side of Horton Ridge as these originate at high elevation locations and are likely to be the first streams to see impacts of climate change.

In terms of biogeoclimatic zones, the Coastal Western Hemlock Montane Moist Maritime (CHWmm2) zone comprises 43% of the LWSA, the Coastal Western Hemlock Submontane Moist Maritime (CHWmm1) covers 38% of the LWSA, and lower elevation terrain in the Coastal Western Hemlock Very Dry Maritime (CHWxm2) is 17% of the LWSA. In the Sooke basin, CWHxm1 (57%) and CWHxm2 (41%) are the primary biogeoclimatic zones.

Land cover in the LWSA is forest (approximately 97%), predominantly with Douglas fir and other coniferous tree species. Of this forest cover, 61% of the basin is younger than 40 years of age, and 8% is greater than 100 years of age. The Sooke basin has 21% forest cover that is younger than 40 years of age and 46% greater than 100 years of age.

In comparison to the Sooke and Goldstream basins, the LWSA is of greater scale including larger drainage area, higher elevation, greater relief, distinct geology and soils, and a younger forest cover. Due to the relatively distinct ecosystem distribution, forest cover, and the different physiographic aspects of the Leech basin, the basic hydrological processes in the Leech are distinct from the Sooke basin.

3.2 Review of Existing Meteorological and Hydrology Monitoring

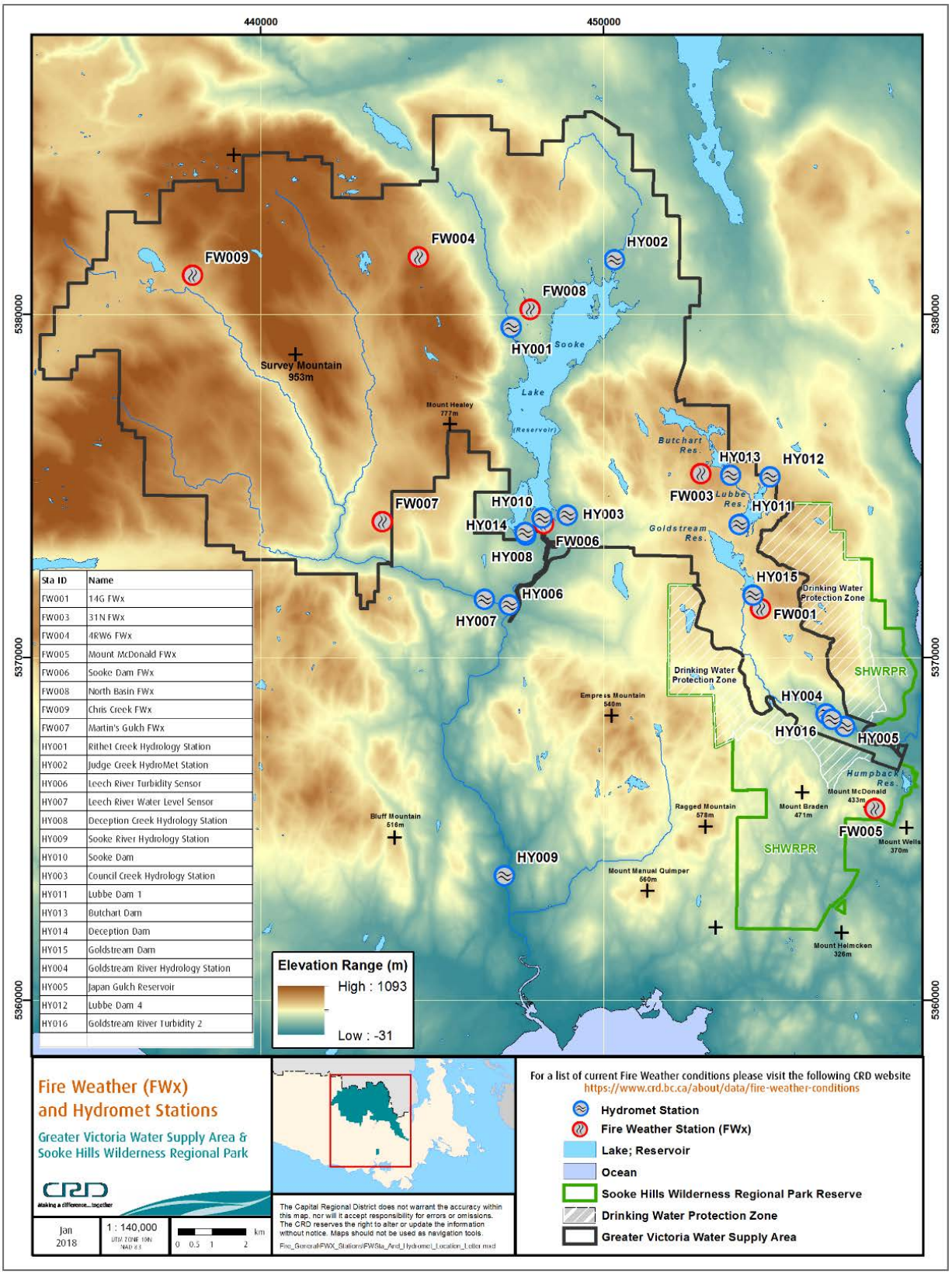
3.2.1 Review of Existing Meteorological and Hydrology Monitoring

- The GVWSA is instrumented with eight Fire-Weather meteorological stations and 15 hydrology/water level monitoring stations. The meteorology stations are situated between 172m (Sooke Dam) and 660m (4RW6). Average station elevation is 462m, although five of the stations are between 400m and 600m. The primary purpose of the stations is to support Fire-Weather indices and some stations provide rainfall data to support reservoir operations in the GVWSA.
- The hydrology stations are primarily situated at existing Dam sites or flow control stations (i.e., weirs or flumes). In the Leech basin, there is a hydrology monitoring station in the lower Leech River near the confluence with the Sooke River (Figure 1).
- Currently, there are two weather stations in the LWSA: Chris Creek (561m) and Martins Gulch (512m). These mid-elevation stations are located in the upper Leech basin (Chris Creek) and lower Leech basin (Martin's Gulch) respectively (Figure 1). The Martin's Gulch station was installed in 2010 and Chris Creek station was installed in 2015.
- The Chris Creek station is located in the CHWmm1 and the Martin's Gulch station in CWHxm2 biogeoclimatic zones. The 4RW6 station is located near the drainage boundary with the Sooke drainage basin and is located in CHWmm2.

3.2.2 Monitoring Gaps - Meterology

The meteorological stations have been installed largely to support wildfire management. These stations have been designed following the station standards of the Canadian Forest Service (CFS). The CFS design standards are similar to other agencyies standards and stipulate that stations should be located in cleared areas with clearing diameter of no less than 10 times the height of surrounding trees and to avoid ridge tops. The GVWSA stations are located in cleared areas with grass, shrubs or hers as ground cover.

Collectively, the footprint of the GVWSA weather stations is 0.84 hectares on average (0.03% of total area), while the primary land cover of the GVWSA is approximately 93% forest. Currently there are no meteorological monitoring stations in the West Leech basin nor at higher elevations (i.e., higher than 800m) in the LWSA, nor in the Coastal Western Hemlock Montane Moist Maritime (CHWmm2).



Sta ID	Name
FW001	14G FWx
FW003	31N FWx
FW004	4RW6 FWx
FW005	Mount McDonald FWx
FW006	Sooke Dam FWx
FW008	North Basin FWx
FW009	Chris Creek FWx
FW007	Martin's Gulch FWx
HY001	Rithet Creek Hydrology Station
HY002	Judge Creek HydroMet Station
HY006	Leech River Turbidity Sensor
HY007	Leech River Water Level Sensor
HY008	Deception Creek Hydrology Station
HY009	Sooke River Hydrology Station
HY010	Sooke Dam
HY003	Council Creek Hydrology Station
HY011	Lubbe Dam 1
HY013	Butchart Dam
HY014	Deception Dam
HY015	Goldstream Dam
HY004	Goldstream River Hydrology Station
HY005	Japan Gulch Reservoir
HY012	Lubbe Dam 4
HY016	Goldstream River Turbidity 2

Figure 1 – Fire Weather and Hydrology Stations in the GVWSA

A primary objective of any hydro-meteorology monitoring program is to provide spatial coverage to characterize the typical range in meteorological conditions for a given area, on an annual basis. For monitoring in forested, mountainous terrain there are several basic considerations for station locations. These include the following:

1. The stations should be situated in the headwaters to record meteorological conditions where precipitation is expected to be highest.
2. The stations should be situated at elevations that encompass as much of the elevation range of the basin as possible to account for the orographic influence on precipitation.
3. It is important to instrument terrain that reflects the primary land cover and land uses in the basin.
4. The stations should be well distributed to account for spatial gradients that exist due to rain-shadow effects.

In the context of forest hydrology, the existing configuration of the weather stations in the GVWSA present several issues. With respect to spatial coverage in the Leech watershed and specifically, stations in the headwaters, the Chris Creek station is near the Leech River headwaters while the Martin's Gulch station is located below the Leech River intake tunnel in the lower area of the basin.

Secondly, in areas of notable relief, orographic effects result in greater precipitation totals for locations at higher elevation. This effect varies by location and follows a non-linear, asymptotically positive trend with elevation. Regional data from the Olympic Range in Washington shows that the rate of precipitation change with elevation is most pronounced between 0 and 1,000m asl (Dingman, 2008, Figures 4 to 9). In other words, the orographic effect on precipitation is most prominent from sea level to approximately 1000m, where precipitation totals range by approximately 1000mm/yr. In the GVWSA, all stations are located at low or mid-elevations and the Chris Creek and Martin's Gulch stations in the LWSA are close to the same elevation (561m and 512m respectively). The current meteorological station network does not account for the range in precipitation because there are no stations at high elevation (i.e., >800m) in the GVWSA. Generally it is not feasible to transpose rainfall totals from low elevation to higher elevation terrain because of the variable nature of factors that affect the orographic effect on rainfall.

The potential orographic influence on precipitation as it relates to the current meteorological station configuration in the GVWSA can be demonstrated by basin hypsometry. Basin hypsometry quantifies the areal distribution of elevation in a given basin. Normalized data allow for basin to basin comparisons. Figure 2 depicts the hypsometric curve of the Leech basin, which shows the proportion of area higher than or lower than a given elevation (Figure 2A) in the basin and the normalized area and elevation respectively (Figure 2B).

The Leech basin hypsometric data demonstrate that approximately 67% of the area is elevated above the Chris Creek weather station (561 m) (Figure 2A) and 64% of the normalized basin area is higher than the Chris Creek station (Figure 2B). In this respect, large proportions of the LWSA remain un-gauged. Figure 2B also demonstrates the Leech basin is very different from the hypsometry of the Sooke basin. This difference reflects the different terrain, basin elevation, and the Sooke reservoir.

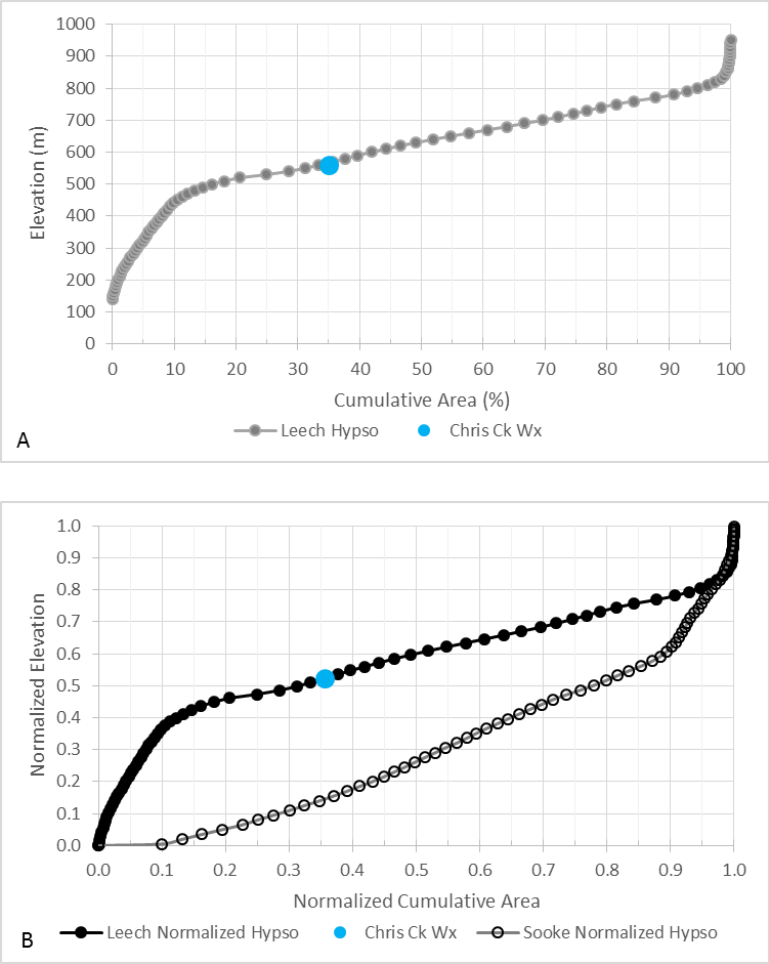


Figure 2A and 2B – Hypsometric Data of the Leech River basin. *A) Cumulative Area expressed as a percentage compared with Basin Elevation; and B) Normalized Area versus Normalized Elevation; the blue dot is the location of the Chris Creek weather station, grey plot shows Sooke basin. Each plot demonstrates that a substantial area of the Leech basin (both spatially and with elevation) is un-gauged.*

Although the existing GVWSA stations are fairly close in elevation, analysis of the average annual rainfall totals at those stations indicates the orographic rate is approximately 2mm per 100m elevation gain. Even

if it is assumed that the orographic rate decays asymptotically through the elevation range in the LWSA (i.e., Dingman, 2008), applying an orographic rate of 1mm to 2mm per 100m indicates that precipitation totals at the highest areas of the LWSA are 400mm to 800mm greater on average annually than the Chris Creek station. This indicates a significant data gap in the existing monitoring network.

Thirdly, forest management practices have a substantial effect on watershed runoff processes for a number of reasons. In heavily forested terrain, trees significantly impact runoff processes due to precipitation interception by the canopy and stemflow, which slows the transfer of precipitation to the soil.

Interception may result in substantial precipitation "loss" relative to total precipitation measured at a station outside of the forest and stemflow slows precipitation on the tree trunk, potentially increasing precipitation loss via evaporative processes. In combination, interception and stemflow significantly affect rainfall-runoff processes and are important components of watershed hydrology.

As forests age and canopy closure increases, the proportion of precipitation loss increases substantially. This is important where surface runoff is the primary water supply and is required on a long-term basis because the available supply will change in time. This is the case in the GVWSA where large portions of the forests are regenerating.

Studies of precipitation loss at Carnation Creek on the southwest side of Vancouver Island have demonstrated that the partition of interception and stemflow may be 30% of annual precipitation totals in old-growth forests (Spittlehouse, 2014). Given that about 3% of the area of the LWSA is not forested, a substantial data gap exists related to precipitation loss via interception and stemflow. In the GVWSA, precipitation loss may range from 20 to 30% given the age and development of the existing forests.

While the amount of precipitation loss varies on a storm-by-storm basis for several reasons, on a seasonal basis, the importance of precipitation loss increases significantly in the summer period and can account for up to 50% of total precipitation in the summer months (Spittlehouse, 2014). This indicates that in the driest period, the measured rainfall at the existing stations is likely over-estimated when applied to the GVWSA. This may have implications for both water supply and fire-weather indices.

In the context of water supply, the forests of the GVWSA are aging and climate change models indicate the summer periods will be longer as the climate changes. These trends suggest there will be increasing precipitation loss as the forests age. Therefore, it is important to measure and monitor interception and stemflow losses in the GVWSA to address longer-term water supply forecasts.

Finally, snow pack data are collected at the Chris Creek, Martin's Gulch and 4RW6 weather stations. However, the data records are fairly short or the quality is lacking, and there is no information regarding

the seasonal snowpack at the highest elevations in the LWSA. Additionally there is no information on snow water equivalent (SWE) in the GVWSA. For water supply and runoff forecast purposes, SWE information is required.

Summary

Although meteorological station siting standards present limitations to record true hydrologic processes, the current configuration of stations does not represent high elevation terrain nor forested terrain nor are the spatial gradients of the Leech basin accounted for by just the Chris Creek station. In addition, the existing snow monitoring in the LWSA does not measure SWE and does not measure the seasonal snowpack.

3.2.3 Monitoring Gaps - Hydrology

Currently, the Leech River is monitored near its' confluence with the Sooke River near the Boneyard Road Bridge. Water level, water temperature, and turbidity are monitored at this location and flows are calculated based on an old rating curve.

Monitoring at the lower Leech River location should continue to help determine potential flow changes for the lower Leech and Sooke rivers under a scenario where the Leech River is partially diverted for water supply purposes. This will be required for water license purposes and environmental flow needs assessments.

The Leech River rating curve has not been verified in several years, which is out of compliance with Provincial Hydrometric monitoring standards. The existing turbidity station set up has been compromised and is at risk of failing and will have to be moved to another location, potentially at the north side of the bridge.

The main tributaries of the Leech River (West Leech River and Cragg Creek) account for about 50% of the total area of the basin. However, neither of these sub-basins are instrumented and there is no water quantity or quality monitoring at the Leech River intake location.

The lack of soil moisture information is a significant data gap for watershed forest hydrology, particularly for a water supplier. Soil moisture information is required to support all hydrologic modeling calculations and in particularly for basin-scale runoff calculations (e.g., Tayfur et al, 2014) and to refine channelized flow modeling (i.e., culvert sizing). Soil moisture information also has an important role in basin-scale sediment and nutrient budgeting and post-wildfire erosion models. Soil moisture sensors help determine the rate of infiltration and soil-moisture movement. In the context of watershed hydrology, infiltration and

soil-water movement are the most important hydrologic processes because the rate and amount of water available is determined by infiltration and soil-water movement in a basin. Soil moisture also controls the rate and amount of evapotranspiration and groundwater recharge (Dingman, 2008).

Summary

Due to the limited length of data from the current Leech River station, the lack of a viable rating curve at the existing station and no monitoring upstream, the true hydrologic conditions in the Leech basin are not fully defined. In part, this is due to a lack of information on fundamental basin properties such as soils and soil moisture.

These are significant knowledge gaps because accurate hydrometric and meteorological data are required for a range of reasons including: water supply calculations, water supply forecasting, basic stream metrics required for permitting and modeling purposes, support for the existing water license or requests for new licenses, approval of water diversion, water quality calculations and estimates, water routing and dam safety calculations in the Sooke basin (assuming water is diverted), environmental flow needs in the Leech and Sooke rivers, low flow calculations and water restrictions.

3.3 Climate Change Considerations

Regional climate change projections consistently indicate that extreme precipitation events are likely to increase in frequency and magnitude. That is, wetter storm events with great frequency and drier and longer drought conditions. Climate change modeling specific to the GVWSA has shown that the expected trends are for greater seasonal variability and extreme conditions, however, the local-scale impacts of climate change are beyond the resolution of the existing climate change models. Climate change adaption plans raise awareness of changing conditions and provide recommendations for management plans. However, these two components are not truly able to quantify the impacts to hydrological processes and to water supply in the GVWSA.

To date the water management approach in the GVWSA has yet to fully appreciate the implications of changing climate conditions on water supply. In part, this is due to lack of required baseline data (e.g., soils and soil moisture dynamics, seasonal hydrological variability) that would inform and support detailed, local-scale watershed modeling under different climatic scenarios. Secondly, the prevailing approach to water supply for the CRD; if the reservoir is full it is assumed supply demands will be met; could be considered a vulnerable strategy in light of the expected changes to climate. Goldstream Reservoir as a back-up supply is constrained by seasonal conditions and limited total supply. These limitations are possibly exacerbated with climate change. In the future, with change in population in the CRD and with greater climatic stress on the GVWSA, the assumptions regarding water availability in the GVWSA may need to be revisited. In addition, an expected impact of climate change is increased risk of wildfire. The effects of a

wildfire in the GVWSA may cause significant short-term and long-terms impacts on water quality and quantity.

Therefore, there is a need to initiate monitoring programs to inform the basic assessments required for the long-term sustainability of the water supply. Modeling based on assumed soil moisture conditions can provide an answer to the question of long-term water supply, however, these assumptions may render the precision of the modeling results unsatisfactory.

4 Leech River Monitoring Locations and Instrumentation

4.1 Hydrology Monitoring

Hydrology monitoring in the LWSA is required to address questions regarding water supply, water quality, and seasonal changes in the flow regime. Assuming the Leech River is a future water source for the GVWSA, there is an immediate need for hydrometric instrumentation upstream of the current station.

The recommended hydrology monitoring locations are classified as "primary" or "secondary", which indicates the level of instrumentation at each site and their relative importance to the monitoring program. Primary locations are required to meet the objectives of the monitoring program and in particular to assess water yield and water quality upstream of the Leech River tunnel. Secondary locations also support the monitoring program objectives, however, these sites are typically located in lower-order streams closer to the headwaters of the three main sub-basins of the Leech River.

Secondary stations are important to understand the seasonal changes in runoff conditions in the Leech River headwater locations and in this way, are required to inform runoff modeling to support seasonal water yield. These stations also provide a basis to assess long-term climate change because lower order streams are considered most vulnerable to the expected changes to watershed hydrology under most climate change scenarios.

The instruments at the primary stations will be similar to the existing hydrology monitoring stations in the Sooke basin. However, due to the notable differences in stream size, flow magnitude, and limitations of access, it is not feasible to install control structures (i.e., weirs) such as those in the Sooke and Goldstream basins. Therefore, the recommended monitoring stations will be installed in the streams without control features, with sensors secured to the river bank or bed as needed. The locations of the primary sites have already been assessed in the field to determine the suitability of the sites for instrumentation.

The hydrology monitoring station locations have been selected based on the scope of the data required following the objectives of the monitoring program, by the proportion of the basin that the station would capture, and by the relative ease of instrumentation at the sites (see Figure 3 and accompanying wall map).

The primary hydrology stations include:

- Leech River upstream of the West Leech River (map reference HY020)
- West Leech River upstream of the Leech River (HY021)
- Leech River downstream of the West Leech River (HY019)
- Leech River at the Leech Tunnel Intake (HY017)
- Cragg Creek at the Cragg Main Bridge (HY018)
- Jordan Meadows outflow at Weeks Main Road (HY022)

The secondary hydrology stations include:

- West Leech River above West Leech Falls (HY029)
- Chris Creek at Chris Creek Road (HY026)
- East Survey Mountain Creek (HY024)
- Jarvis Creek upstream of Cragg Creek (HY025)
- West Horton Ridge Creek (HY023)
- Jordan Meadows Tributary (HY027)
- Cragg Creek Headwaters at Jarvis Main Bridge (HY028)

The locations of the primary stations follow standard watershed hydrology monitoring protocols to fully quantify the major tributaries. The focus of primary stations near the confluence of the Leech and West Leech rivers is intended to quantify the contribution of the West Leech River and similarly quantify the Leech River upstream of the West Leech River. The Cragg Creek gauge location at the Cragg Main Bridge is a compromise because the Leech River and Cragg Creek confluence is not accessible. The location draining the Jordan Meadows wetland complex at Weeks Main Road is important because water quality and hydrologic conditions are likely unique relative to the remainder of the LWSA. The Leech River station near the Leech Tunnel Intake is an important location because this is the point of diversion for future use of the Leech River for water supply.

Due to the importance of the Leech River Tunnel Intake site, an automated water quality sampler will be added to the station to develop a paired time-series of streamflow and water quality conditions. These datasets will inform decisions on when and how to utilize the Leech River Intake Tunnel in the future, in a similar sense as is planned on the Goldstream system where hydrologic and turbidity data are paired.

For example, changes in streamflow or water level in response to a given rain event, will typically cause an increase of turbidity above acceptable water quality drinking standards. With a coupled dataset, it may be possible to derive streamflow-turbidity "rule-curves" to support decisions on water diversion through the tunnel. Runoff modeling and flow forecasts, derived from the proposed monitoring network in the LWSA, would be able to provide forecasts of expected poor water quality conditions in advance of a storm.

In this respect, the monitoring locations are of interest to the water quality monitoring objectives of the CRD.

Secondary stations may be instrumented with fewer parameters (i.e., water level and water temperature and potentially dissolved organic carbon or conductivity probes) and generally are "basic" stations. Specifics of the instrument set up at Secondary sites will be determined in winter 2019. (Figure 3 and accompanying wall map show the monitoring locations in the LWSA)

Table 1 lists the instrumentation at the monitoring stations including measurements and future instrumentation needs and access issues. Each station has been assigned a Station ID and large-scale maps are available as Maps 1 through 12 referenced below (in Table 1).

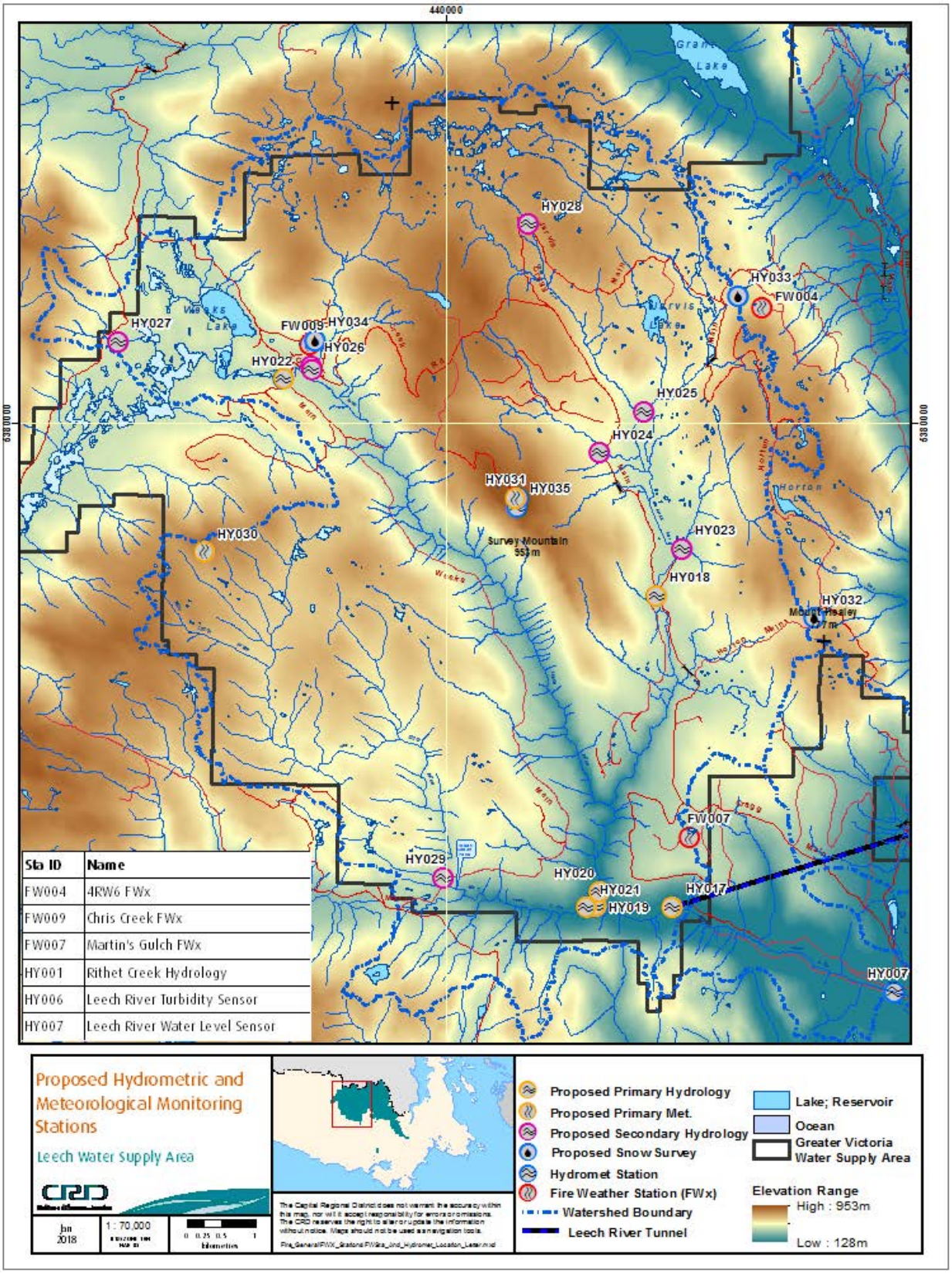


Figure 3 – Proposed Monitoring Locations in the LWSA

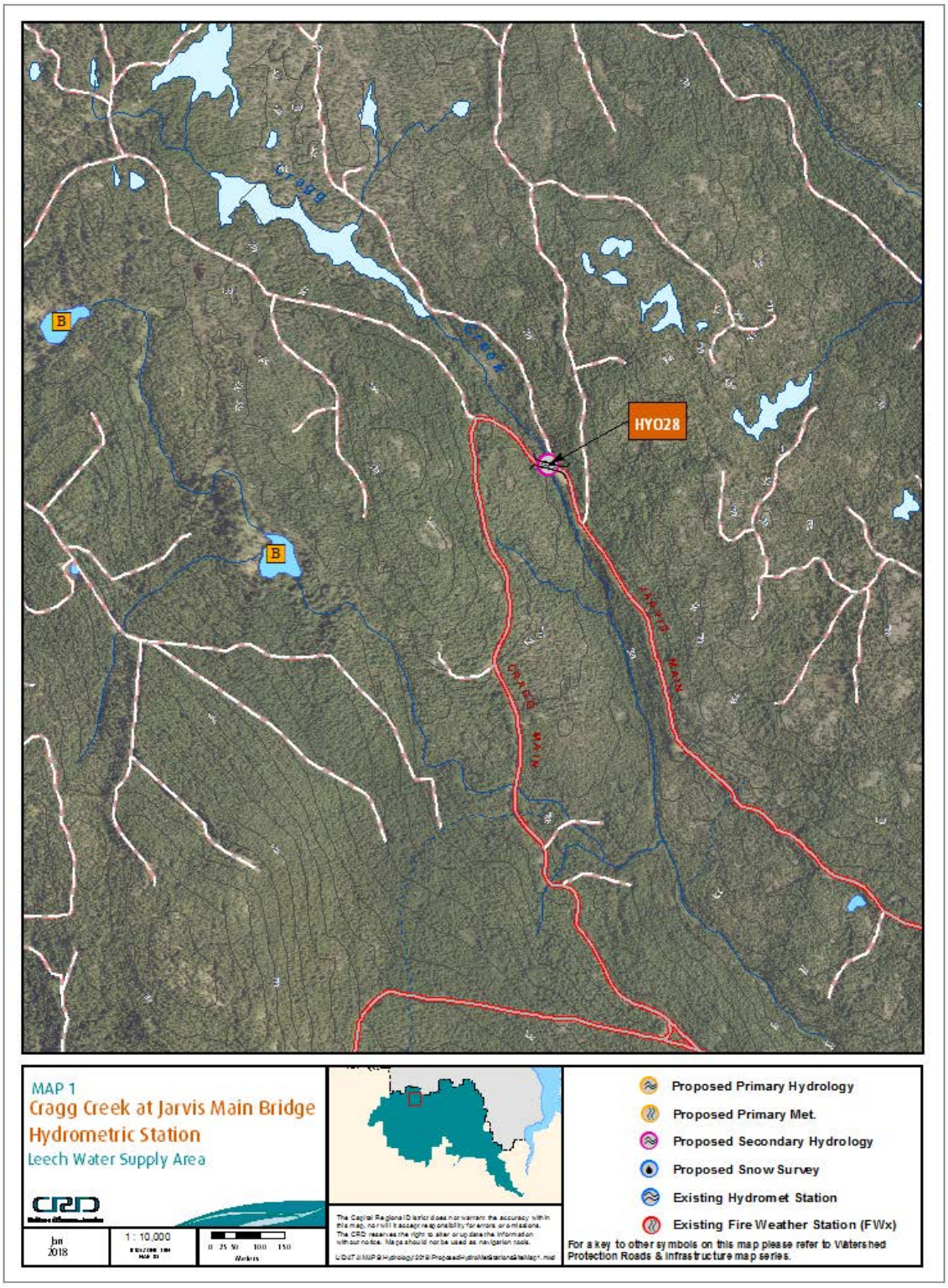
Table 1 – Hydrology Monitoring

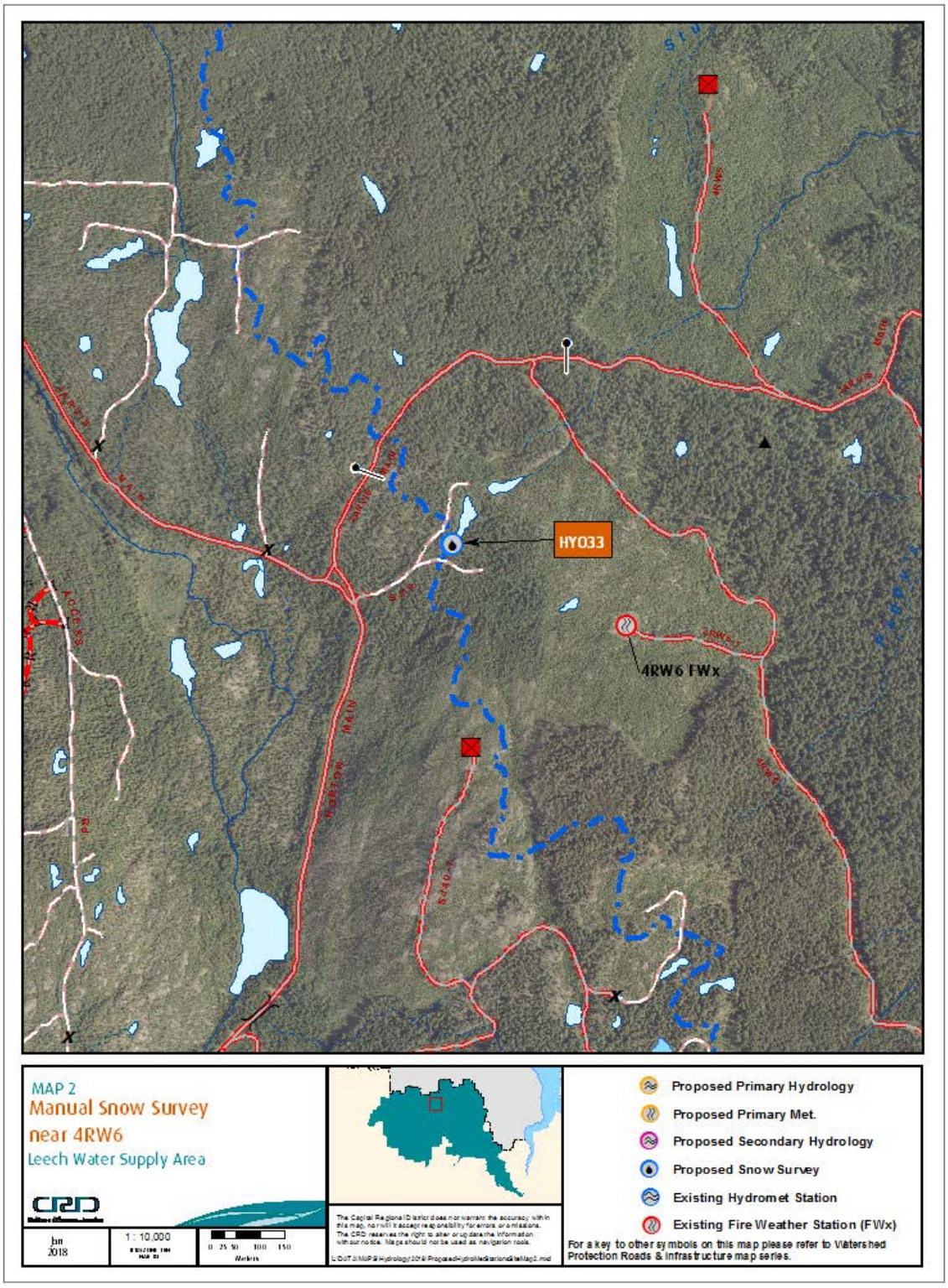
Station ID / Map Reference	Primary Stations	Instrumentation	Measurements	Future Instrumentation	Access	Schedule	Comment
HY021 Map 8	*West Leech River u/s Leech River*	Staff gauge(3x), water level & temp, turbidity, data logger, enclosure, battery(2x), solar panel; tagline	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr); channel profile (1/yr)	RQ-30 w/ instrument boom; GOES or radio; Antenna; Sensor and battery maintenance	Open# - WLM and WLM-1 trail	2018	Road assessment required; deploy from bank
HY020 Map 8	*Leech River u/s WLR*	Staff gauge(2x), water level & temp, turbidity, data logger, enclosure, battery(2x), solar panel; tagline	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr); channel profile (1/yr)	Sensor and battery maintenance	Open# - WLM and WLM-1 trail or C-50 trails	2018	Road assessment required; deploy from bank
HY019 Map 8	*Leech River d/s WLR*	Staff gauge(4x), water level & temp, turbidity, data logger, enclosure, battery(2x), solar panel; tagline	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr); channel profile (1/yr)	GOES or radio; Antenna; Sensor and battery maintenance; RQ-30 w/ instrument boom;	Open# - WLM and WLM-1 trail	2018	Road assessment required; deploy from bank
HY018 Map 4	*Cragg Creek at Cragg Main Bridge*	Staff gauge(3x), water level and temp, turbidity, data logger, enclosure, battery(2x), solar panel	Streamflow***** (3-7/yr); Benchmark survey (1-2/yr); channel profile (1/yr)	RQ-30 w/ instrument boom, GOES or radio; Antenna; Sensor and battery maintenance	Open - Cragg Main	2018	Deploy u/s bridge
HY017 Map 12	*Leech River u/s Intake*	Staff gauge(4x), water level & temp, turbidity, rain gauge, auto water quality sampler (TSS/general chemistry), data logger, enclosure,	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr); channel profile (1/yr)	RQ-30 w/ instrument boom; GOES or radio; Antenna; Sensor and battery maintenance	Open - Leech River Tunnel Access road	2019	Possible road assessment required; deploy from bank

		battery(2x), solar panel, tagline					
HY022 Map 10	*Jordan Meadows Drainage at Weeks Main (L504)*	Staff gauge(3x), water level & temp, EC, turbidity, DOC, data logger, enclosure, battery(2x), solar panel	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr); channel profile (1/yr); water quality	Multi-probe water quality sensor	Open – Weeks Main road	2019	Leech source WQ; collaboration with forWater
	Secondary Stations	**Instrumentation**	**Measurements**	**Future Instrumentation**	**Access**	**Schedule**	**Comment**
HY027 Map 11	Jordan Meadows Tributary	Staff gauge(3x), water level & temp, EC, DOC, data logger, enclosure, battery(2x), solar panel	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr); channel profile (1/yr)		Open – West Jordan Main	2019	Leech source WQ; collaboration with forWater; forestry effects
HY028 Map 1	Cragg Creek at Jarvis Main Bridge	Staff gauge(3x), water level & temp, EC, DOC, data logger, enclosure, battery(2x), solar panel	Streamflow, water quality	Multi-probe water quality sensor	Open – Jarvis Main / Cragg Main	2019	Leech source WQ; collaboration with forWater
HY029 Map 7	West Leech River u/s West Leech Falls	Staff gauge(3x), stilling well, water level & temp, EC	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr);	Mobile Auto-salt, Sensor maintenance	Open - Weeks Main	2019-2020	Access dependent; deploy from bank
HY026 Map 10	Chris Creek at Chris Creek Road	Staff gauge(3x), stilling well, water level & temp, DOC, EC	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr);	Mobile Auto-salt, Sensor maintenance	Open – Chris Creek Road	2018-2019	Deploy u/s bridge; Chris Creek sub-basin & Worley Lake
HY024 Map 3	East Survey Mountain Creek	Staff gauge(3x), stilling well, water level & temp, DOC, EC	Streamflow***** (7-12/yr); Benchmark survey (1-2/yr);	Mobile Auto-salt,, Sensor maintenance	Open – Cragg Main	2018-2019	Deploy d/s bridge; east side
HY025 Map 3	Jarvis Creek u/s Cragg Creek	Staff gauge(3x), stilling well, water level & temp, DOC, EC	Streamflow***** (7 - 12/yr); Benchmark survey (1-2/yr);	Sensor maintenance	Open – off Cragg Main / foot trail	2018-2019	Deploy from bank; Jarvis & Lazar sub-basins

HY023 Map 4	West Horton Ridge Creek	Staff gauge(3x), stilling well, water level & temp, DOC, EC	Streamflow***** (7 - 12/yr); Benchmark survey (1-2/yr);	Sensor maintenance	Open – C140 road	2018-2019	Deploy from bank; West Horton ridge sub-basin

pending road assessment and potential upgrades, DT assessment
*****Streamflow measurements are 7 to 12 per year or until rating curve established, 3 to 7 per year after rating curve established to calibrate sensor or rating curve
WLM – West Leech Main road
WLR – West Leech River
u/s – upstream; d/s – downstream
DOC – dissolved organic carbon; EC – conductivity
TBD – To be determined


HYO28
B
B
MAP 1
Cragg Creek at Jarvis Main Bridge
Hydrometric Station
Leech Water Supply Area
CRD
Jan
2018
1 : 10,000
0 25 50 100 150
Metres
The Capital Regional District does not warrant the accuracy within this map, nor will it accept responsibility for errors or omissions. The CRD reserves the right to alter or update the information without notice. Maps should not be used as navigation tools.
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.


HY033
4RW6 FWx
MAP 2
Manual Snow Survey
near 4RW6
Leech Water Supply Area
CRD
Jan
2018
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Metres
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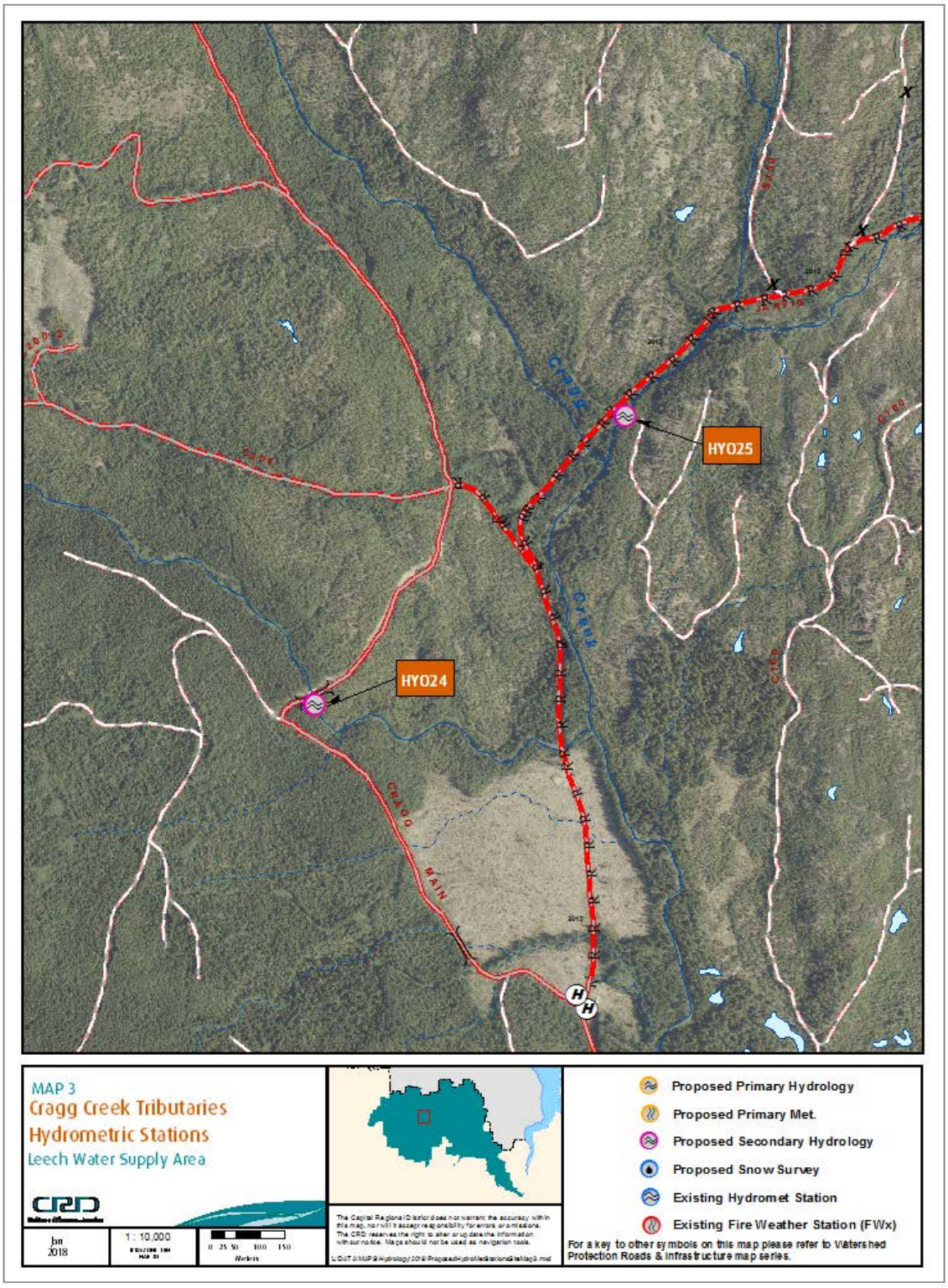
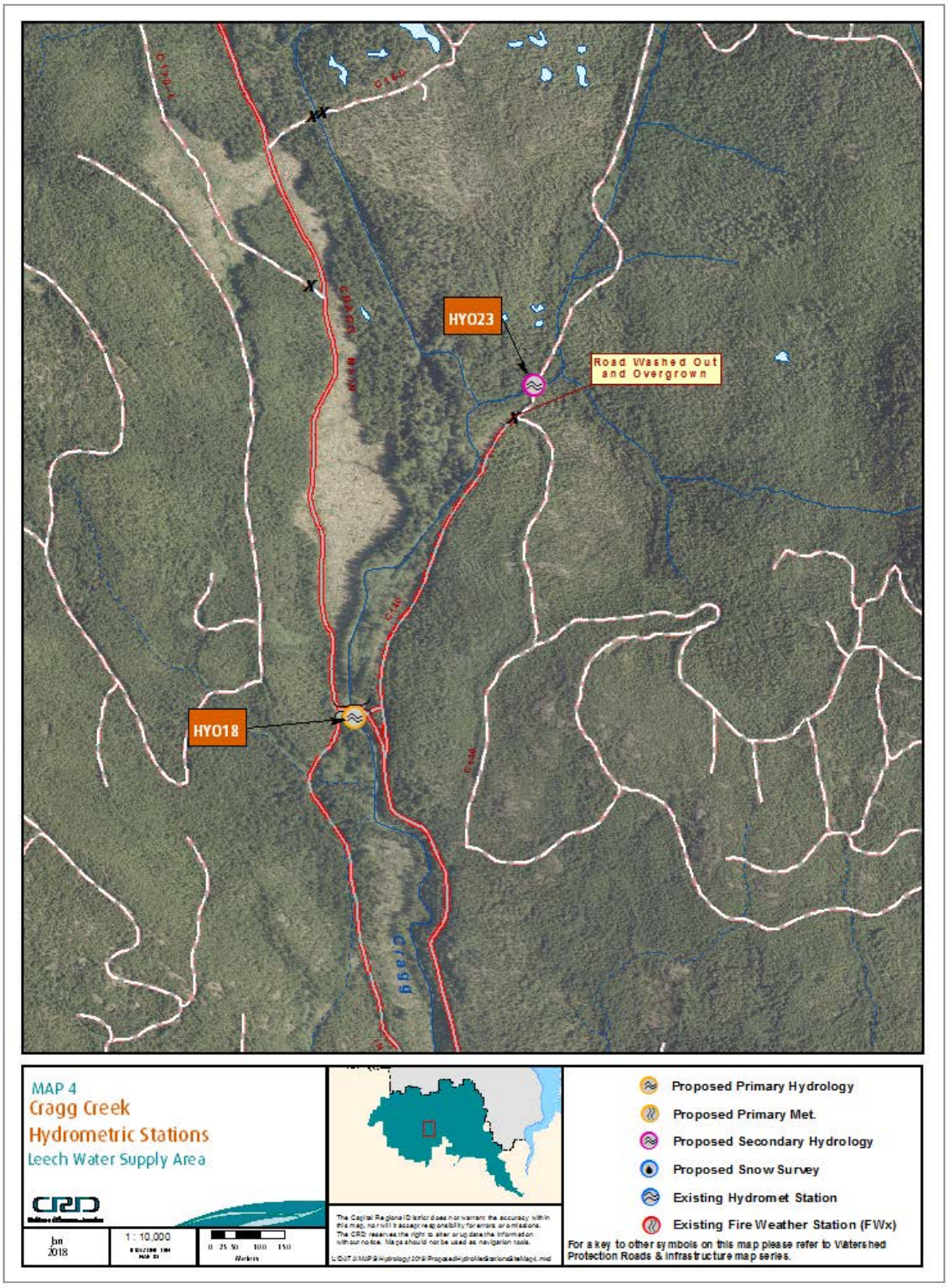
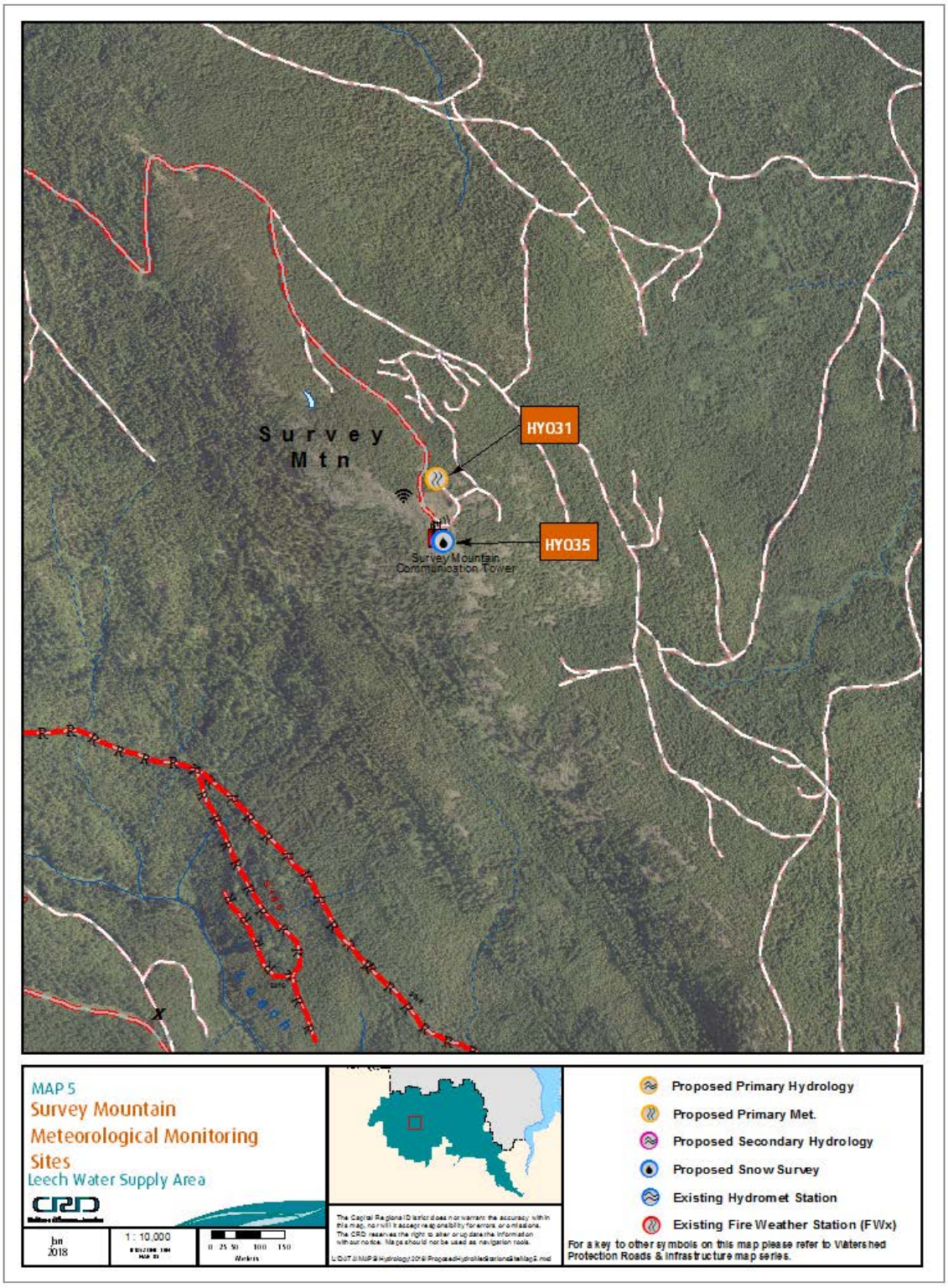
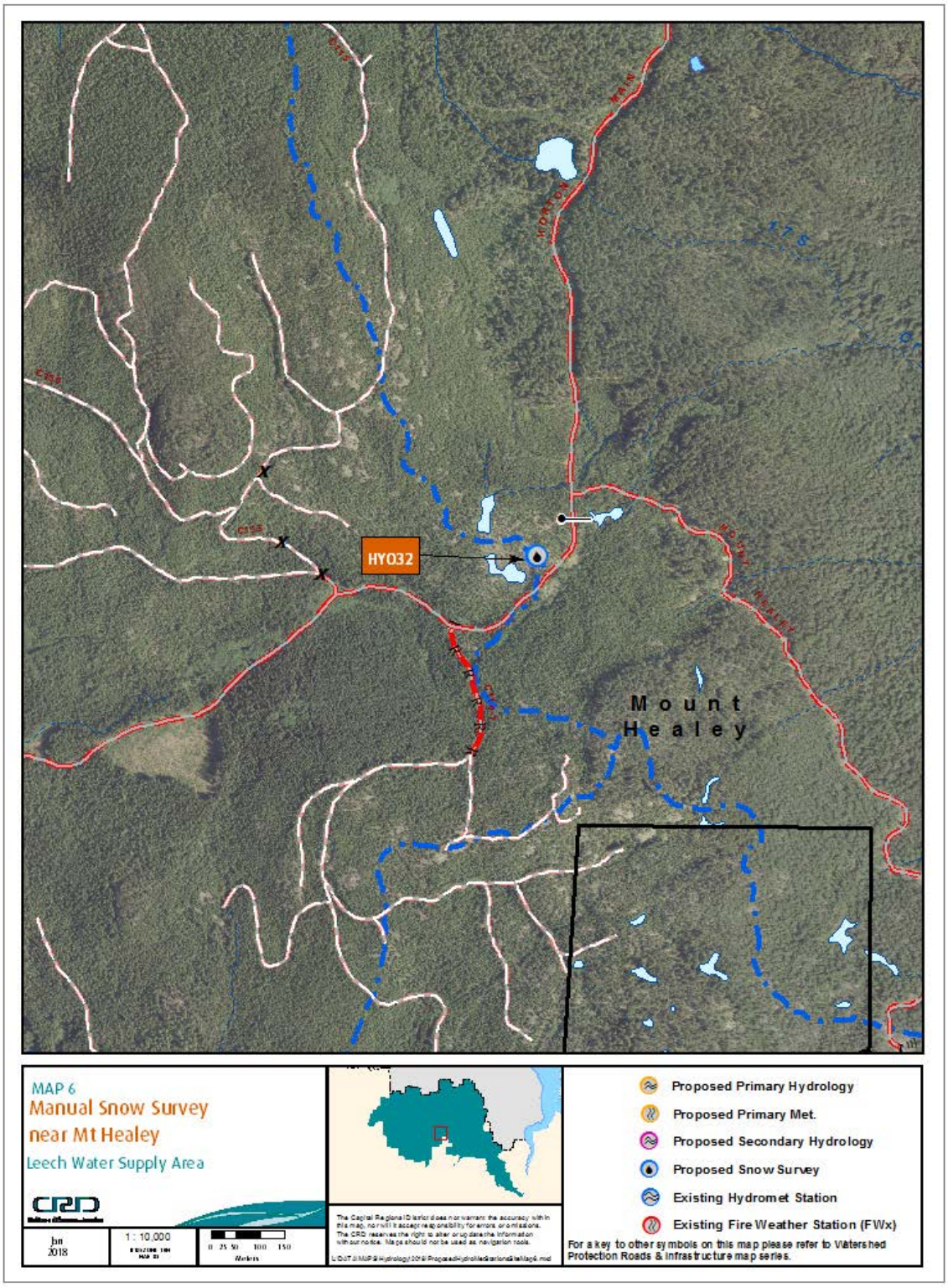
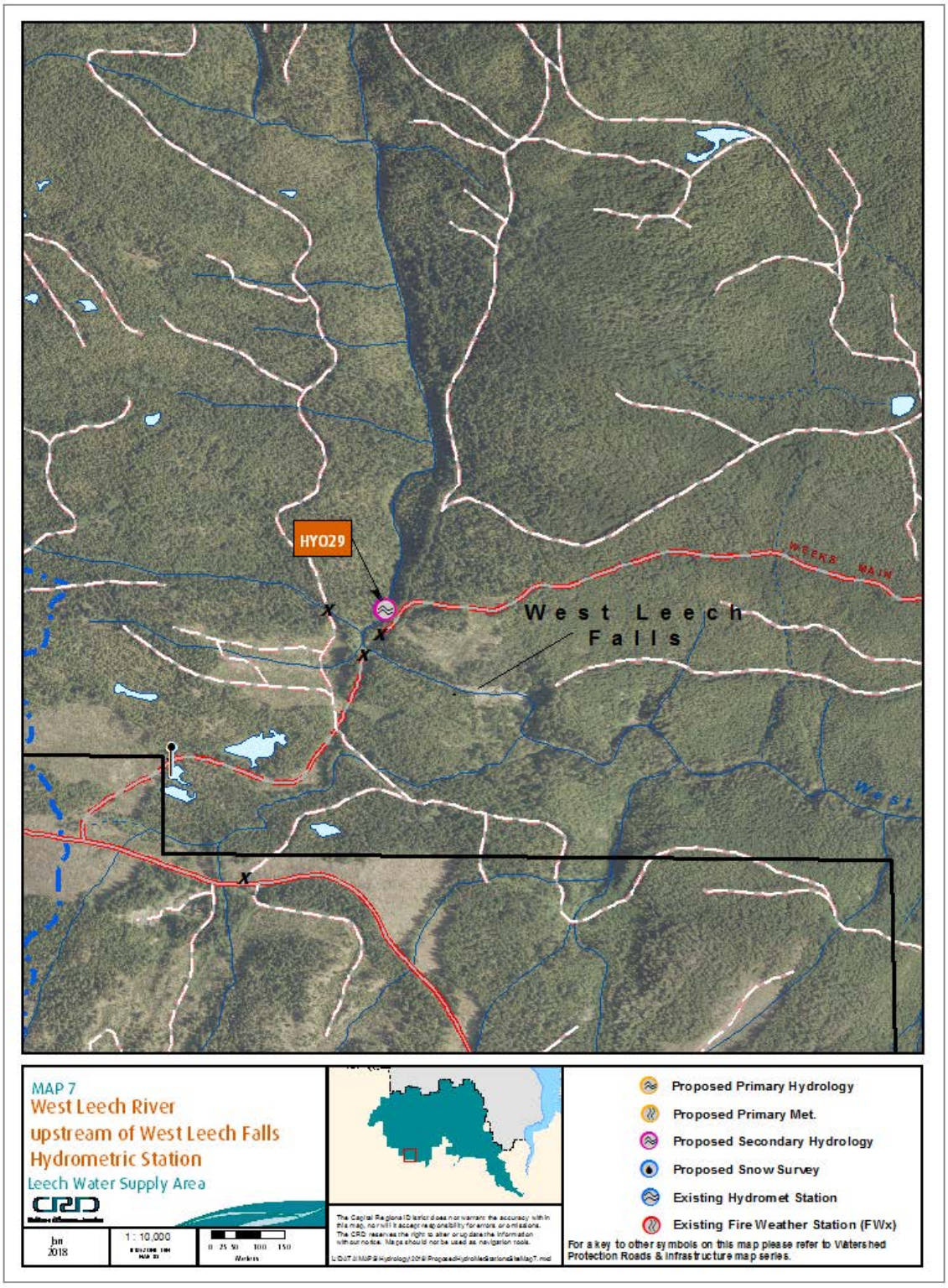
L:\DoT\MAPS\Hydrology\2018\ProposedHydrometStations\MAP2.mxd
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.

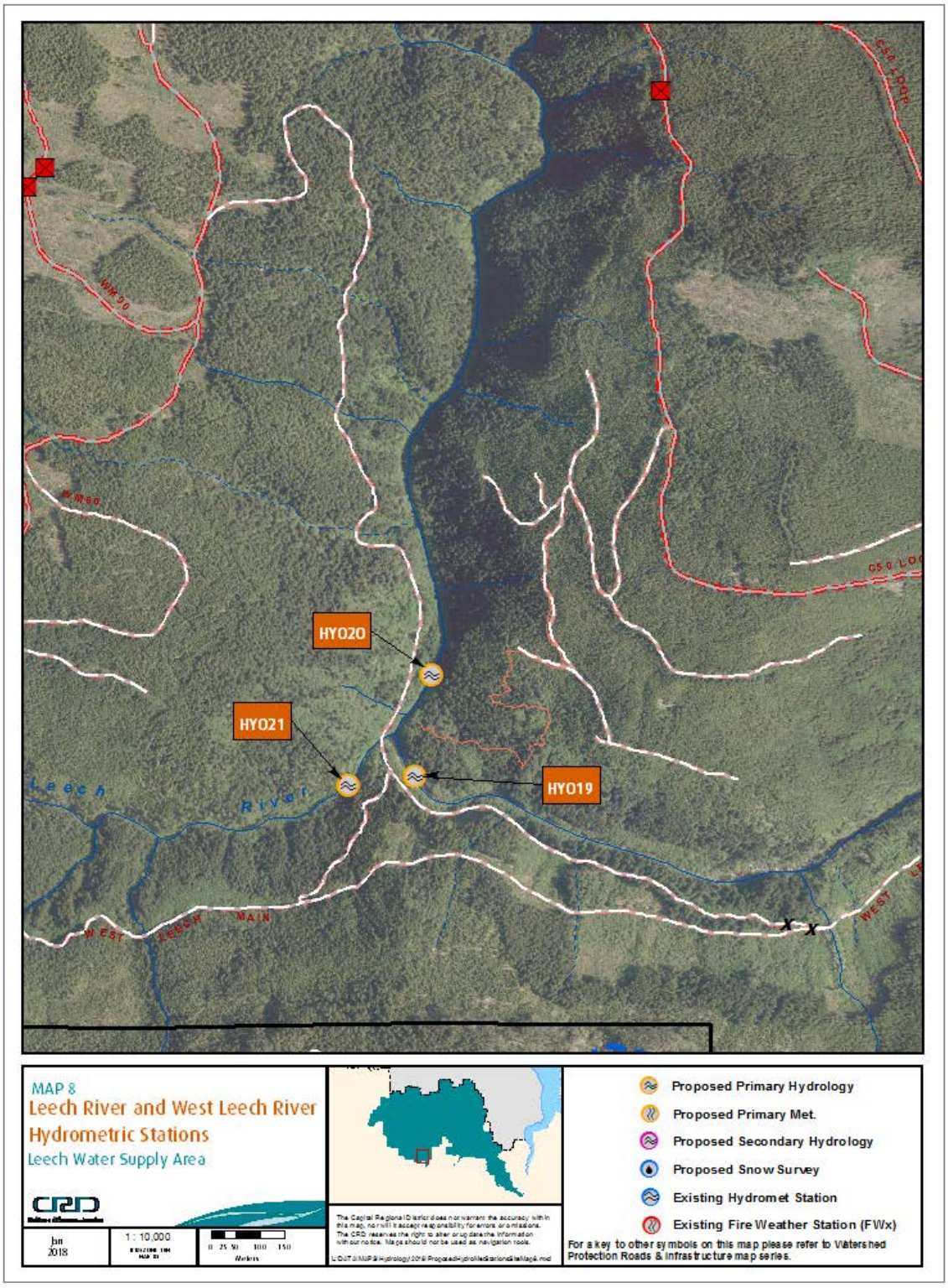

HY025
HY024
Cragg Creek
CRAGG MAIN
MAP 3
Cragg Creek Tributaries
Hydrometric Stations
Leech Water Supply Area
CRD
Jan 2018
1 : 10,000
0 25 50 100 150
Metres
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.

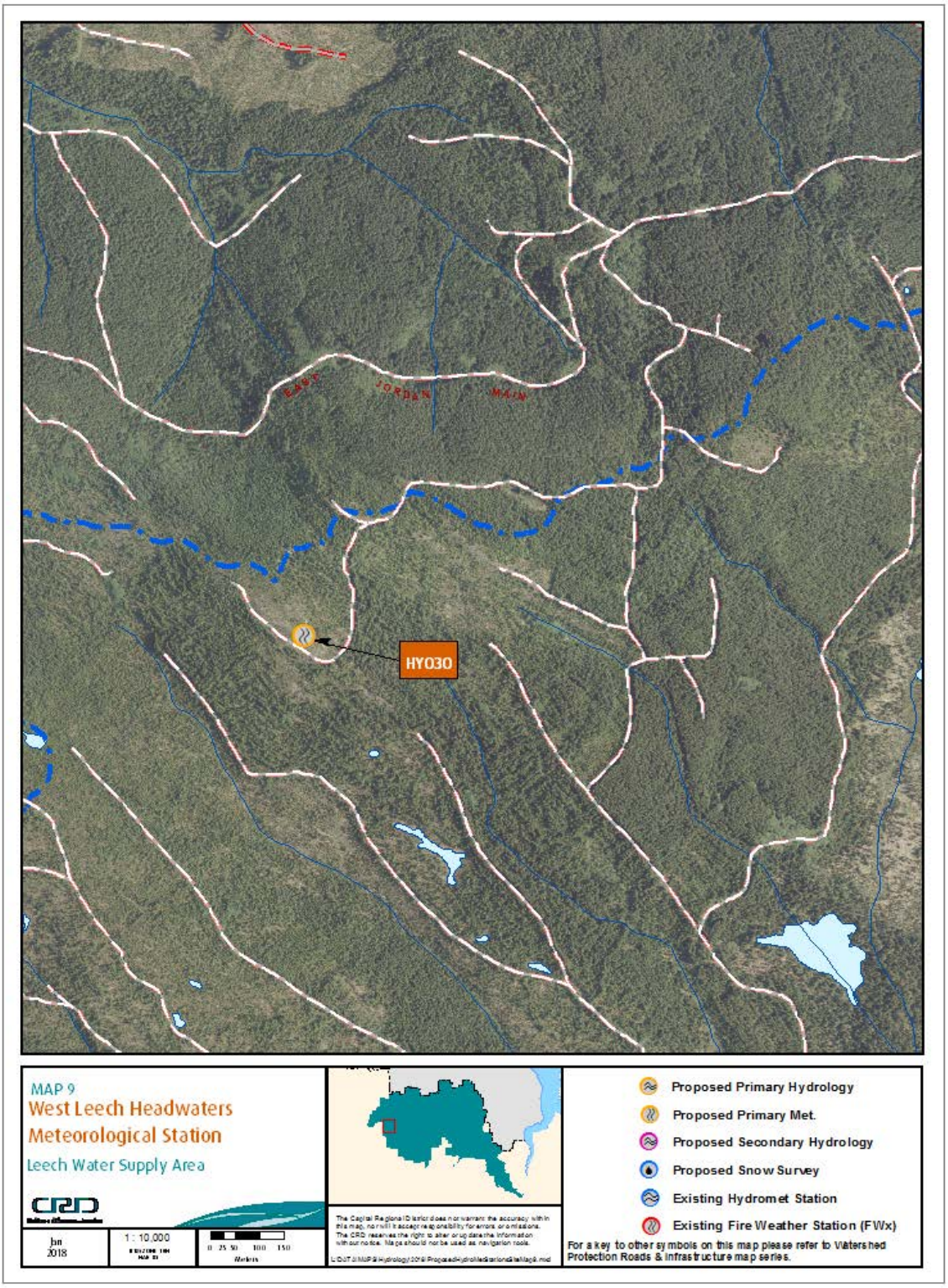

HYO23
Road Washed Out and Overgrown
HYO18
Cragg Creek
MAP 4
Cragg Creek
Hydrometric Stations
Leech Water Supply Area
Jan 2018
1 : 10,000
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.

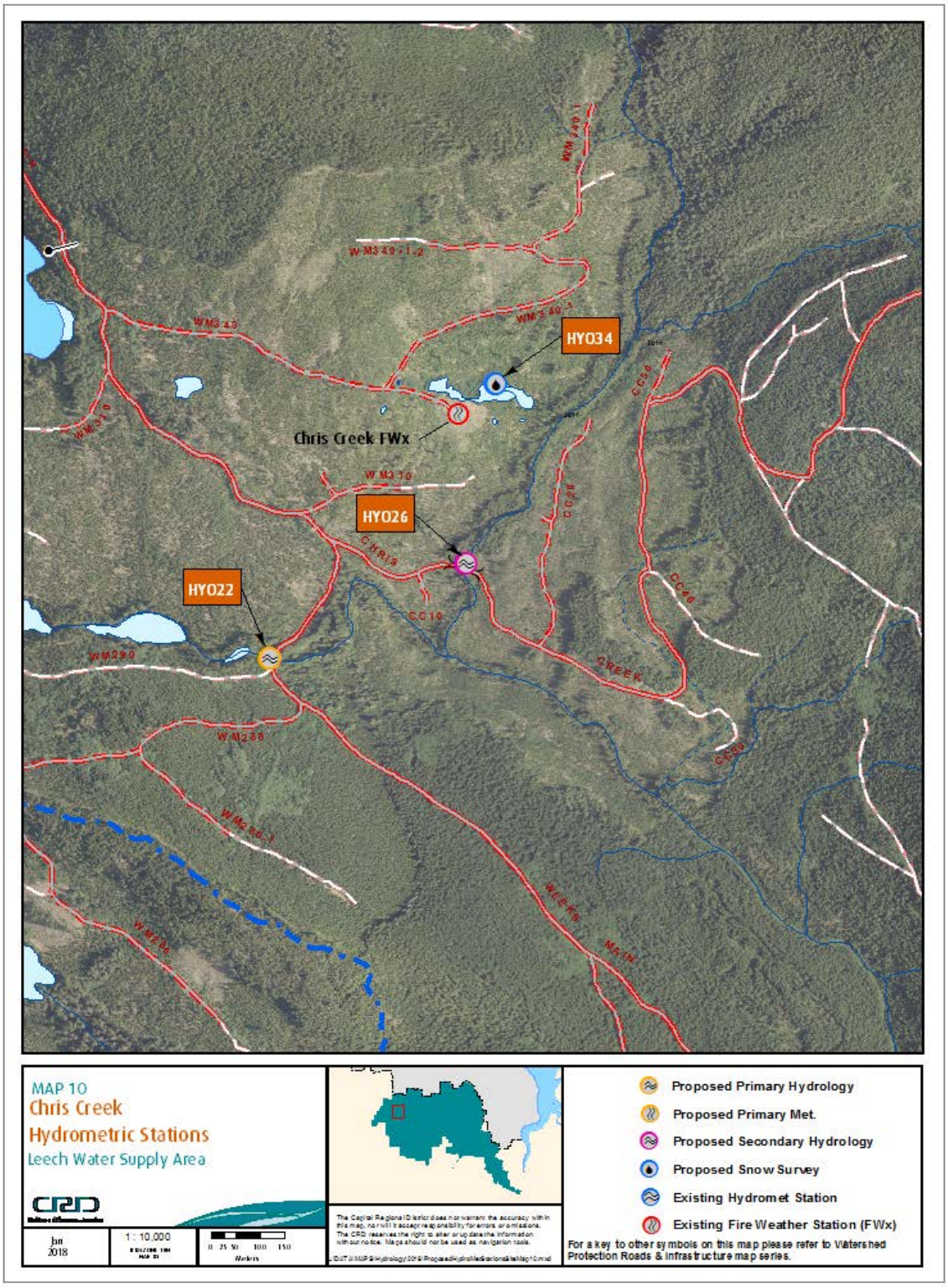

Survey
Mtn
HY031
HY035
Survey Mountain
Communication Tower
MAP 5
Survey Mountain
Meteorological Monitoring
Sites
Leech Water Supply Area
CRD
Jan
2018
1 : 10,000
0 25 50 100 150
Metres
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.

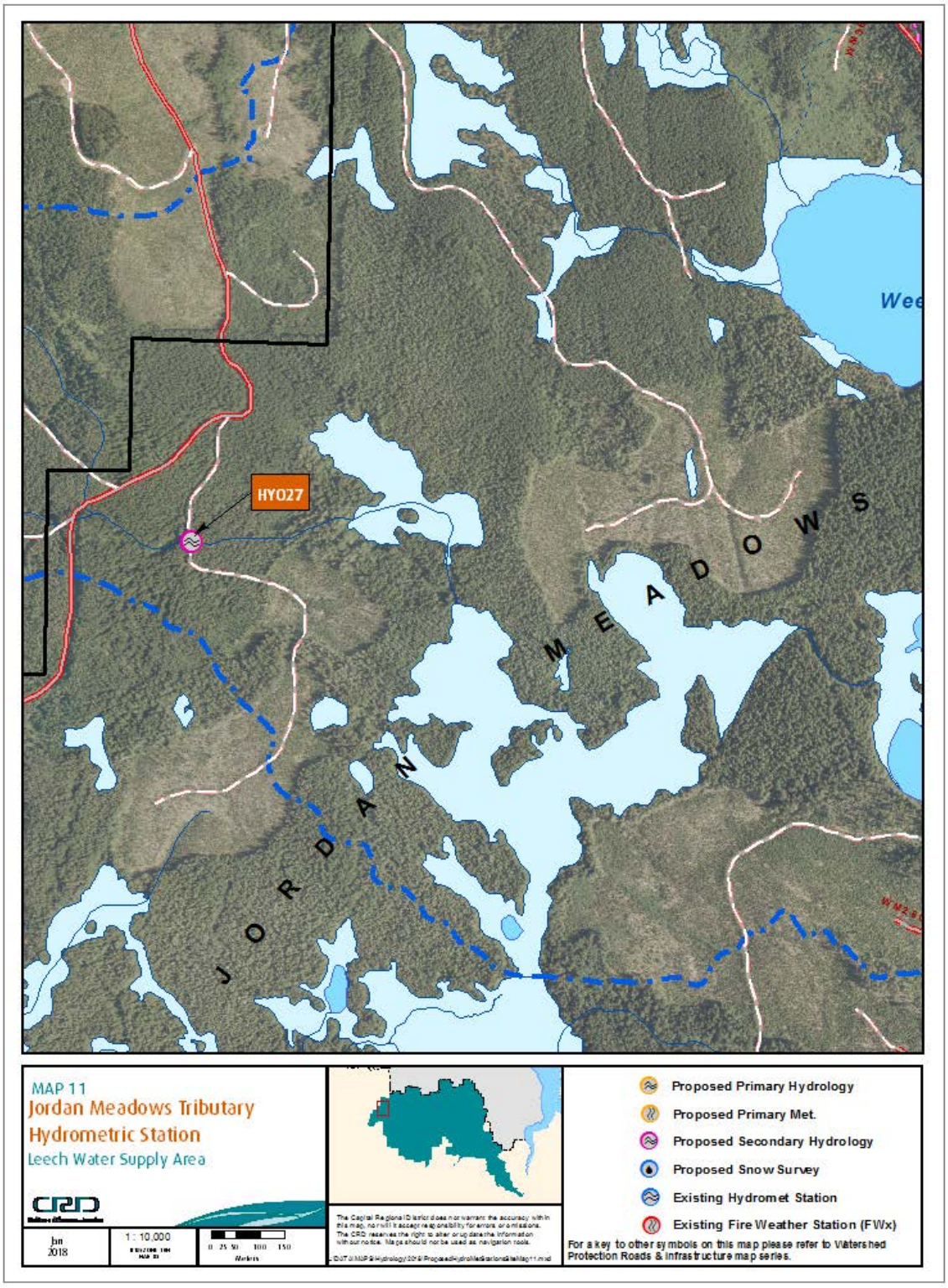

HY032
Mount Healey
MAP 6
Manual Snow Survey
near Mt Healey
Leech Water Supply Area
CRD
Jan 2018
1 : 10,000
0 25 50 100 150
Metres
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.

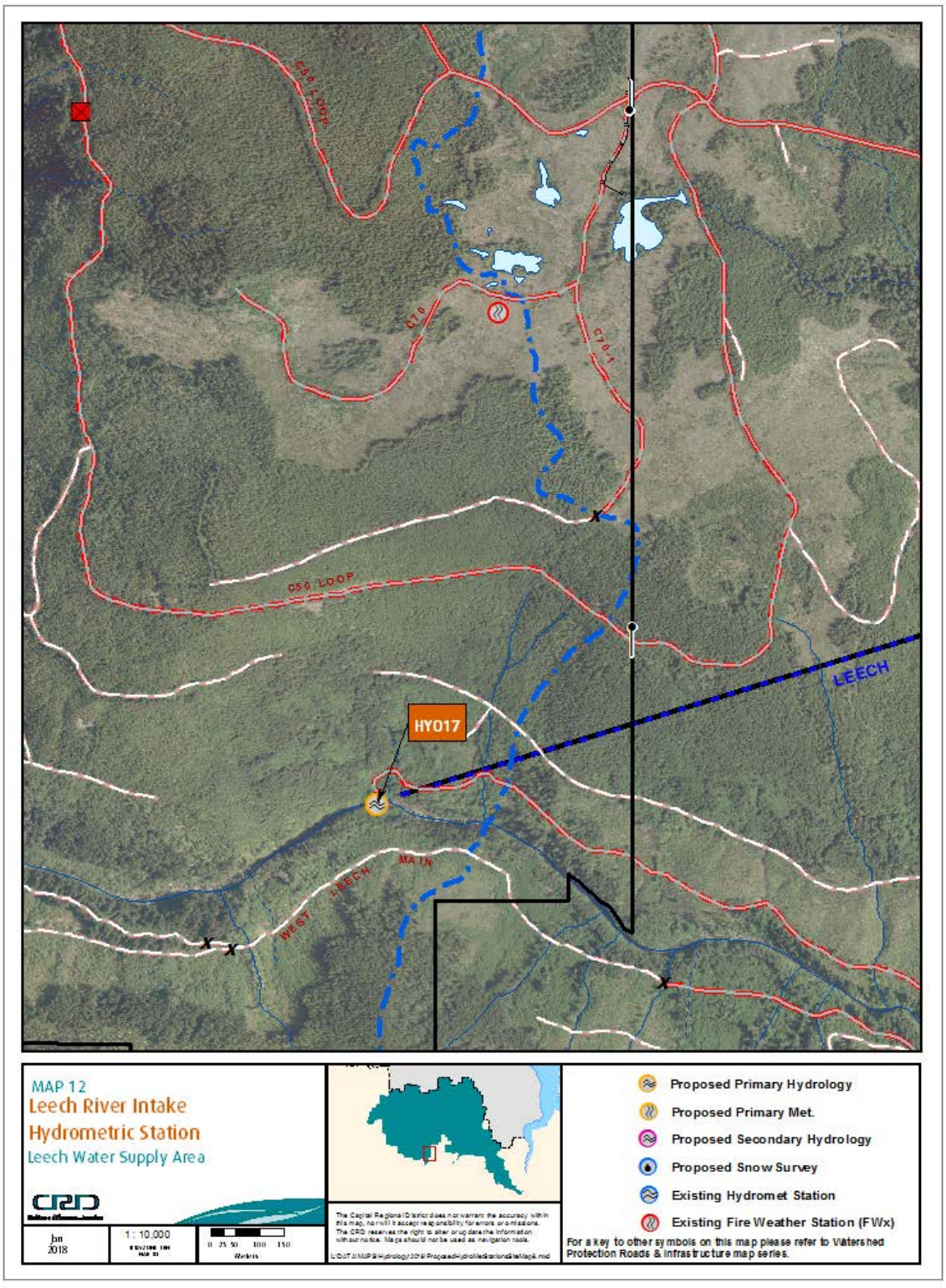

HYO29
West Leech Falls
WEEKS MAIN
MAP 7
West Leech River
upstream of West Leech Falls
Hydrometric Station
Leech Water Supply Area
CRD
Jan 2018
1 : 10,000
0 25 50 100 150
Meters
The Capital Regional District does not warrant the accuracy within this map, nor will it accept responsibility for errors or omissions. The CRD reserves the right to alter or update the information without notice. Maps should not be used as navigation tools.
L:\DoT\MAPS\Hydrology\2018\ProposedHydrometStationsMap7.mxd
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.


HYO20
HYO21
HYO19
Leech River
WEST LEECH MAIN
MAP 8
Leech River and West Leech River Hydrometric Stations
Leech Water Supply Area
CRD
Jan 2018
1 : 10,000
0 25 50 100 150
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.


EAST
JORDAN
MAIN
HY030
MAP 9
West Leech Headwaters
Meteorological Station
Leech Water Supply Area
Jan
2018
1 : 10,000
0 25 50 100 150
Metres
The Capital Regional District does not warrant the accuracy within this map, nor will it accept responsibility for errors or omissions. The CRD reserves the right to alter or update the information without notice. Maps should not be used as navigation tools.
L:\DoT\IMAP\Hydrology\2018\ProposedHydrometStationsMap9.mxd
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.


HYO34
Chris Creek FWx
HYO26
HYO22
MAP 10
Chris Creek
Hydrometric Stations
Leech Water Supply Area
Jan
2018
1 : 10,000
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.


HY027
JORDAN MEADOWS
MAP 11
Jordan Meadows Tributary
Hydrometric Station
Leech Water Supply Area
CRD
Jan 2018
1 : 10,000
0 25 50 100 150
Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.


C48 LOOP
C70
C70-1
C50 LOOP
LEECH
HY017
WEST LEECH MAIN
MAP 12
Leech River Intake
Hydrometric Station
Leech Water Supply Area
CRD
Jan
2018
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Meters
The Capital Regional District does not warrant the accuracy within this map, nor will it accept responsibility for errors or omissions. The CRD reserves the right to alter or update the information without notice. Maps should not be used as navigation tools.
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Proposed Primary Hydrology
Proposed Primary Met.
Proposed Secondary Hydrology
Proposed Snow Survey
Existing Hydromet Station
Existing Fire Weather Station (FWx)
For a key to other symbols on this map please refer to Watershed Protection Roads & Infrastructure map series.

4.2 Meteorology Monitoring

Two meteorological stations are recommended based on the data gaps described earlier. These sites are at Survey Mountain and in the West Leech River headwaters (see Figure 3 and accompanying wall map). The Survey Mountain station will be instrumented with a similar design as the Chris Creek meteorological station in addition to a snow scale, soil moisture, and throughfall and stemflow instrumentation, located nearby in the forest. Access to this site is currently open and a limited amount of ground clearing would be required at the site, located to the north of the existing infrastructure.

Table 2 lists the instrumentation at the meteorological monitoring stations including measurements and future instrumentation needs and access issues. Each station has been assigned a Station ID and large-scale maps are provided in Maps 1 through 12 as referenced in Table 2.

The second meteorological station is to be located in the West Leech River headwater region near the drainage basin boundary. This station would include a similar instrumentation design as the Chris Creek station, but with a 3m tower. Additional sensors include soil moisture and throughfall and stemflow instrumentation, located nearby in the forest. Access to this area is currently limited to foot or ATV and advance planning will be required with the Operations group to determine the most feasible access to the site.

Additional instrumentation at Chris Creek and 4RW6 stations include soil moisture sensors and throughfall and stemflow instrumentation located nearby in the forest. A snow scale is also recommended for 4RW6 (Table 2).

A snow scale is recommended for the 4RW6 and Survey Mountain stations to derive snow water equivalent (SWE) data. Without SWE data, accurate water supply forecasts and runoff modeling are not possible. In addition, recent external reports on the Design Flood Scenarios for the Sooke Dam and Goldstream Dams demonstrated that the lack of SWE data in the GVWSA greatly affects the calculations of design flood conditions (KWL 2016 and 2017).

Field-based manual snow measurements are recommended to assess the spatial variability of SWE in the GVWSA and to calibrate the snow scales. Concurrent manual snow measurements at the automated snow scales are recommended for 8 to 9 years of overlap (BC HYDRO, 2018). However, because no manual measurements have been recorded previously in the GVWSA, it is recommended that manual measurements follow the sampling strategy outlined below and on a seasonal basis for calibration purposes at the snow scales.

Manual snow surveys follow a standardized methodology (BC ENV, 1981) and require monthly measurements of snowpack at high elevation locations. Several sampling locations have already been assessed and the recommended manual sampling locations include:

- 4RW6 – represents the northern extent of the drainage boundary between Sooke and Leech basins
- Mt Healey – represents the southern extent of the drainage boundary between Sooke and Leech basins
- Survey Mountain – highest elevation in the GVWSA
- Chris Creek – Leech River headwaters

Manual snow surveys are completed during the first week of the winter months to capture the snowpack data at consistent monthly intervals. Manual surveys typically occur from January through to March or April depending on the conditions. Sampling frequency and protocol would match BC ENV standards and includes a 10-point survey (or 4 point survey at snow scales) at the sites noted above. An on-going project using satellite imagery to assess the spatial distribution of snow cover in the GVWSA at monthly intervals from 2000-2016 will inform the manual snow sampling strategy.

Soil moisture sensors are recommended to determine the proportion of precipitation that is potentially stored in the soil. This information is critical to water balance models and quantifies seasonal water storage in the GVWSA and will inform water supply assessments, particularly in the context of climate change and post-fire water quality assessments. Soil moisture probes are easily added to the existing stations and require minor ground disturbance to set the sensor.

Throughfall is measured under canopy using an array of stainless steel troughs (i.e., eaves troughs) coupled with tipping bucket-style rain gauges and a basic data logger. The rain gauges will be supplied via partnership with the Department of Geography at the University of Victoria and potentially from "retired" gauges from the existing fire weather network. An array of 25 rainfall storage bins is also deployed in a 5m by 5m grid pattern near the troughs. The sites are visited periodically to download data and to measure and empty the rain storage bins.

Stemflow is measured at tree trunks with a garden hose that is split in half, secured to the trunk and spiralled twice around the trunk to collect stem flow. The hose spills into a tipping bucket with a basic data logger to measure total flow. The total volume of water is multiplied by stand density and divided by a unit area to derive stemflow in mm. The proposed throughfall and stemflow instrumentation will be similar to the sensor design used by the BC ENV at Carnation Creek (Spittlehouse, 2014).

Table 2 – Meteorological Monitoring

Station ID / Map Reference	Location	New Monitoring Instrumentation	Instrumentation Upgrades	Power	Tower	Other	Schedule	Access
HY031, HY035 Map 5	Survey Mountain	T/RH, PP, rain Ws, Wd, PYR, SnD, SnSc, MSS, SoilM, TF/SF; FTS H2 Logger; or CR1000	GOES or radio, antenna	12V (x2); 50-100W solar; 12V (x1), 20W solar	5m	Space for snow scale; Instrument housing; trail cam; 4-point snow survey TF-SF instrumentation	2018-2019	Open with minor veg clearing, DT assessment
HY030 Map 9	West Leech Headwaters	T/RH, rain, Ws, Wd, PYR, SnD, SoilM, TF/SF FTS H2 Logger; or CR1000	GOES or radio, antenna	12V (x2); 50-100W solar; 12V (x1), 20W solar	3m	Instrument housing; trail cam; TF-SF instrumentation	2019	TBD, veg clearing, DT assessment
HY034, FW009 Map 10	Chris Creek	SoilM, TF/ SF, MSS	Stainless Steel PP gauge, wind shade at rain gauge	Existing	Existing	TF-SF instrumentation; realign solar panels, 10-point snow survey	2018-2019	Open
HY033, FW004 Map 2	4RW6	SoilM, TF/ SF, SnSc, MSS	Stainless Steel PP gauge, wind shade at rain gauge	Existing	Existing	Space for snow scale, 4-point snow survey, TF-SF instrumentation	2018-2019	Open
HY032 Map 6	Mt Healey	MSS	n/a	n/a	n/a	10-point snow survey	2018-2019	Winter Access

T = temperature
RH = relative Humidity
PP = all seasons gauge, stainless steel
Rain = tipping bucket, with wind shade
PYR = solar radiation
Ws = wind speed
Wd = wind direction
SnD = snow depth
SnSc = snow scale
MSS = manual snow survey
SoilM = soil moisture
TF/SF = through flow and stemflow

4.3 Schedule and Logistics

Installation of long-term hydrology instrumentation began in 2018. The Leech Hydrologic Monitoring Plan will ramp up, over the 2019 to 2021 period for several reasons. First, a staged implementation is more easily managed from both a human- and fiscal-resources perspective. Given the scope of the proposed installations, as well as existing logistical constraints in accessing the Leech watershed, substantial planning and coordination will be required among Watershed Protection and Operations staff and there is potential for substantive road work to gain vehicle access to monitoring locations.

Second, program scoping has now provided a suitable approximation of the existing hydro-meteorological conditions, from which the long-term monitoring program design can be based. In other words, initial data collection and observations in 2017 and 2018 will inform the type and scale of long-term instrumentation that is feasible given the existing hydro-meteorological conditions and channel geomorphology.

The proposed implementation process is described in Appendix 1.

4.4 Monitoring Strategy

Until remote connections are established at the monitoring stations, the stations should be visited monthly to ensure the instrumentation is functioning properly, to download data, for station maintenance, and where needed, for field measurements (e.g., flow measurements or manual snow measurements).

Given the complexity of developing a rating curve at new hydro-meteorological stations (see Appendix 2), site visits to hydrology stations are expected to be fairly frequent over the first 3 years and taper off afterwards as a rating curve is developed for a given station and as remote data access becomes available (estimated annual site visit frequencies for hydrology stations are provided in Table 1).

Automated flow measurement technologies (e.g., RQ-30 or auto-salt instruments) can greatly reduce the time to develop a comprehensive rating curve and are “contact-less” techniques that reduce the risk typically associated with in-stream flow measurements. The drawbacks of these approaches include costs and the robustness of the technologies. For example, a RQ-30 costs approximately $15,000 for the instrument alone and a complete auto-salt instrument costs from $15,000 to $20,000. Both technologies hold promise to enable more efficient data collection and rating curve development. It is recommended that these technologies be used were possible.

As noted above, there may be opportunities to share resources to achieve monitoring objectives with the CRD Water Quality program. Sharing resources may include cross-training staff on data or sample collection techniques or to help staff the respective programs’ monitoring needs.

Existing partnerships with the BC Ministry of Environment support hydro-meteorological monitoring because these allow for technological innovation through shared expertise and potentially access to shared resources or funding via the CRMP which could support additional instrumentation.

5 Limitations and Other Challenges

As with any monitoring program, the design phase may be complicated by a range of limitations that must be addressed for the success of the program. These issues range from a simple recognition of the existing data gaps, which generally provide the motivation for the program, to operational challenges of the watershed, to security and budget concerns, and data management and staffing. These issues are summarized below to encourage a wider discussion regarding the implementation of the Hydrology Monitoring Program in the LWSA.

5.1 Data Gaps

Currently, there are significant data gaps in the majority of the LWSA. No hydrological information exists above the Leech River Bridge. The existing hydrologic monitoring at the Leech River Bridge has not been maintained to provincial standards due to lack of resources. The existing meteorological monitoring stations in the LWSA are not sufficient to support hydrological assessments of the LWSA. No information exists regarding the influence of the forest cover on the basic hydrologic processes.

In order to determine the potential water supply of the Leech River basin the following data gaps should be addressed to meet the requirements of a water supply assessment for both technical (i.e., supply and timing) and regulatory (i.e., water license, environmental flow needs) considerations.

5.1.1 Existing Data Gaps

- Snow pack and SWE data, spatially in the GVWSA and temporally due to short datasets at the Chris Creek, Martin's Gulch and 4RW6 met stations.
    - An on-going project to assess snow coverage based on satellite imagery may help quantify the seasonal persistence of snow cover in the GVWSA but will not provide SWE info
    - Instrumentation to monitor SWE at the higher elevation stations is proposed (see below)
- High elevation meteorological conditions
    - High elevation stations are proposed (see below)
- Climate and Hydrology of the Leech WSA
    - Annual precipitation

- Snowpack depth
- SWE
- Annual flows and seasonality of extreme conditions on major streams and tributaries, above the Leech Tunnel
- Environmental flow needs assessment of Leech River
- Soil Moisture – applicable to watershed modeling, drought indices and fire danger indices
- Determination of precipitation loss in water balance
- Runoff modeling to support water supply forecasts

- Water License requirements
  - Baseline and modeled data are required for intra-basin water diversion

5.2 Operational Challenges

In the GVWSA there are several operational challenges that may limit the efficient instrumentation of the Leech River basin. Many of the issues relate to accessing to the monitoring sites, while others relate to security or budget and there are also health and safety protocols to develop and training to attain.

5.2.1 Access

While the Leech River basin has an extensive network of historic roads, the current state of some of the roads is a limitation due to either issues of upkeep and safety and/or access to areas that require instrumentation. All-year access to the monitoring locations is required and improvements to road conditions, and/or additional options for access (i.e., helicopter or tracked ATVs in winter) are required. An initial road reconnaissance field trip indicates that the primary access for the hydrology stations is best done via the West Leech Main Road and WLM-1 trail. The trails off of the C-50 Loop road are not feasible as a primary access route.

The following is a list of requirements for site access:

- Assessment of road conditions for West Leech Main,
- Road and trail improvements/maintenance as needed (WLM and WLM-1)
- Danger tree assessment and DT falling as needed,
- Heli pad, tag lines across West Leech and Leech rivers

With an additional meteorological station planned for the West Leech River headwaters, access to that area will need to be planned in summer 2019, after an appropriate monitoring site is determined.

5.2.2 Security

Areas where monitoring locations are proposed are likely to be traversed by miners and local First Nations through existing access agreements, and possibly by unauthorized users. It is important to inform authorized users of the general nature of the monitoring program through letters and meetings so that they are aware of any changes in the areas that they use.

While the instrumentation will be protected by fencing in some cases (i.e., weather stations), other security protocols would likely be beneficial. Instrument houses will be locked and secured at each monitoring location and CRD branding and contact information should also be provided.

5.3 Remote Data Access

Future remote data collection protocols and infrastructure are anticipated, but are not included in the initial installations. Given that the monitoring program in the Leech, at this time, does not truly affect operational decisions in the GVWSA, consideration should be given to the GOES satellite communications for remote data collection. The rationale for using the GOES system include:

- As a regional government, the service is free and the infrastructure is relatively inexpensive with no on-going fees for a subscription
- A local hydro-meteorological equipment supplier has transitioned to fully support GOES technology also manufactures one of the best transceivers on the market,
- The local supplier has discontinued technical support for the RMX platform used for the existing hydro-meteorological monitoring network in the GVWSA,
- Most other agencies are transitioning to or currently using the GOES technology for remote data collection, there may be opportunities for pooled or shared resources (e.g. BC ENV, MetroVan, WSC)
- Power demands are likely less than the RMX requirements
- Data retrieval can be cloud-based from NOAA or from a ground station (i.e., similar to existing RMX set up)

Potential drawbacks related to the GOES system include:

- Internal CRD challenges transitioning/accommodating an alternative data collection method
- No two-way communications available - although most data collection adjustments typically require a site visit regardless
- "Near real-time" reporting, delays are on the order of 1 to 3 hours
- Data logger reconfiguration, although the local supplier would provide support on this
- Field of View limitations for antenna – as with most antenna-based communications

5.4 Data Management

High quality hydro-meteorological data is of importance for any data analysis that supports the many technical and strategic uses of the data. For example, inadequate streamflow measurements or imprecise flow measurements degrade the quality of the rating curve for a given hydrology station. A poor rating curve may render the water level data inadequate for water supply forecasts, modeling, or any other task where continuous streamflow time series' are required. Therefore it is important that high-quality flow measurements be completed over the full range of flows in order to build a robust rating curve. Further details regarding hydrology data collection standards are provided in Appendix 2.

Data quality may be affected by many factors including:

- Monitoring site conditions – e.g., stream geomorphology, topography
- Frequency of data collection – e.g., manual flow measurements for rating curve development
- Quality of monitoring equipment – e.g., calibrated instruments
- Data collection methods – e.g., adhering to proper stream flow measurement techniques
- Station controls – e.g., benchmarks and leveling procedures

The BC Resource Information Standards Committee (RISC) standards for hydro-meteorological monitoring provide the basis for hydro-meteorological station installation and data collection (BC MoE, 2009). Climate monitoring protocols and data collection standards are provided by various agencies including Environment Canada, the Canadian Forestry Service and the BC Ministry of Environment via the Climate Related Monitoring Program (CRMP). The CRD is a partner in the CRMP as of April 2018.

Database management protocols with the new LWSA data should be developed. Annual data quality control procedures should be developed to address erroneous data and maintain a consistent dataset. The BC RISC standards provide a basis for meta-data collection, station maintenance records, data control procedures and data grading.

5.5 Budget

For the LWSA monitoring program, the field and data collection components (i.e., no modeling, data analysis, annual reports, etc.) include data management, data quality control, station design, set up and maintenance, and field data collection.

The budget for hydro-meteorological installations at the Leech-West Leech River confluence have been approved as capital projects (see Appendix 1).

While there is currently an annual Capital budget source for station maintenance needs and equipment upgrades of the existing hydro-meteorological system in the GVWSA, this budget will likely need to be expanded in several years to include the new stations in the Leech. The anticipated costs associated with implementing the monitoring program such as road assessments, access, potential upgrades and maintenance and site prep (i.e., Danger Tree Assessments, etc.) are not included.

6 Health and Safety

Safe work procedures will be developed to include flow monitoring procedures and snow data collection. Training specific to the monitoring program for applicable staff should include the following:

- Access: chainsaw, ATV training, Danger Tree awareness;
- Water safety: Swiftwater Rescue – three-day course based from Nanaimo or Squamish, ~$500/person.

Personal protective equipment typically required for hydro-meteorological monitoring includes the following:

- Inflatable personal floater device (class 3 or 5)
- Throw bag
- Water-sports helmet
- Floater suit or dry suit
- Neoprene or wading boots
- Chest waders
- Tagline (safety line across the river/stream)

7 Discussion

It is apparent that comprehensive watershed planning is difficult to accomplish if all parties are not informed of the needs of water supply management. The issue is not solely an "engineering problem" (i.e., as it relates to water volume and water storage facility management) because the water supply is dependent on watershed hydrology and the processes that supply high quality water within the GVWSA. The issues are integrated between sustainable resource management, water storage, hydrological and water quality monitoring, and land management (forest and soils management in particular). In this respect, the mandate to provide water requires an integrated approach to sustainable watershed management projects. These projects need input from the different divisions within the IWS that can provide expertise in the various aspects of planning and implementation of the monitoring program.

7.1 Future Outlook

In the future, there will be a need to quantify the available water supply in the LWSA. The proposed monitoring network will assist in this pursuit. Hydrologic analysis done to inform water supply or forecasting questions, for example, requires a lengthy dataset to derive statistically-meaningful results. For hydrological modeling, a dataset of 30 years or more is preferred due to the statistical power and assumed independence of the dataset. However, a dataset of 20 years (or greater) is acceptable and greater than 10 years of data may suffice, depending on the purpose of the modeling.

For hydrologic modeling with less than 30 years of input data, the statistical independence of any analysis may be questionable and therefore any modeled information (i.e., flow estimates) require a quantified accuracy of the model result. This accuracy information indicates the potential error of the modeled result and informs the user of the degree of risk of relying on the model output.

The value in a long-term hydrologic dataset is also evident when considering the potential future water yield from the GVWSA. Water yield from a basin in its true definition inherently includes groundwater because ground and surface water are a single resource. However, to date, groundwater conditions in the GVWSA have not been addressed, possibly due to the view that these are separate resources since the reservoir stores surface runoff. However, most surface water supply comes from groundwater at some point and medium and long-term inflows to the reservoir rely on groundwater supply.

The groundwater conditions in the GVWSA may be a critical component to address future water supply. For example, subsequent data analysis of the Leech River hydrology data coupled with hindcasts of hydrologic conditions in previous years where water supply in the GVWSA has been low will inform questions of the actual water supply in the LWSA, particularly in years of drought and in the context of climate change. The results of this analysis may indicate that water supply in the LWSA may be limited in

quantity or seasonally, or both. Thus there may be implications for LWSA in the context of the existing water license on the Leech River, water quality concerns, or environmental flow needs for aquatic ecology downstream of the GVWSA.

If the LWSA water use is limited by these factors, groundwater may be a potential option to supplement water supply. However, there is an absence of groundwater information in the GVWSA. A groundwater monitoring program typically requires three to five times the start-up costs of a surface water program and has greater environmental risk compared to a surface water program (i.e., due to groundwater well installation).

To assess the potential for groundwater as a supplementary source, an advanced surface water-groundwater modeling study would be required as an initial step to assess the feasibility of groundwater as a supply option. This modeling, in the absence of groundwater data, would rely on surface flow data (particularly at low flows) to inform the model.

8 Summary

Given the long-term importance of the LWSA, a comprehensive hydro- hydro-meteorological monitoring program is recommended. The details and rationale of the monitoring program have been described in Section 2 and 3. The recommended monitoring program will provide a baseline dataset that will help define the nature of water resources in the LWSA, will support future detailed hydrologic modeling required to inform water management decisions, and will provide the basis for climate change monitoring and provide a start on the potential of groundwater as a supplementary source.

The LWSA represents a unique area, of greater scale, distinct biogeophysical conditions, and with greater challenges than the Sooke and Goldstream basins.

The following is a summary of the station instrumentation:

- Six "primary" hydrology monitoring stations in the major streams of the LWSA, including a paired hydrology-water quality automated sampler near the Leech River Tunnel intake
- Seven "secondary" hydrology monitoring stations in LWSA headwater tributaries;
- Meteorological stations at Survey Mountain and in the West Leech River headwaters, including:
    - snow pack monitoring (both snow depth and in particular snow water equivalent) via automated and manual survey methods;
    - soil moisture monitoring at new and existing met stations
    - rainfall Interception monitoring at new and existing met stations

Further details of those installations are found in Tables 1 and 2, and monitoring locations are shown in Figure 3, the accompanying wall map, and Maps 1 through 12.

The monitoring program requires an investment in resources because of the scale of the Leech basin, the need for more comprehensive instrumentation, thorough monitoring practices to align to provincial standards, and health and safety training.

One of the major challenges of the program will be to establish the necessary access to parts of the LWSA. Access improvements may be significant or relatively manageable.

9 References

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10 Appendices

Appendix 1 – Proposed Implementation Process and Budget

Expansion of the Hydrology and Meteorological Monitoring Network in the Leech WSA

Given the scope of the proposed system of meteorological and hydrology stations in the Leech WSA, the installation of these stations will need to be carried out in phases, but will be a major priority in 2018-2021. Table A1 below provides a summary of the costs for the installation of these stations.

Phase 1 - 2018

2018 Priorities:

- Establish four of the six primary hydrology monitoring stations,
- Establish instrumentation below the forest canopy at the existing meteorological stations in the Leech WSA,
- Prepare for the establishment of a full meteorological station at Survey Mountain in 2019,
- Begin snow surveys in the Leech WSA,
- Determine overall road requirements to access the West Leech and use this information to choose one of the potential sites for a meteorological station in the upper portion of the West Leech drainage area, and
- Move sensors at existing Leech River hydrology station

Establish Primary Hydrology Stations

Sites for these stations have been identified.

The required equipment and supplies for monitoring and installation have been identified.

The requirements for road access using West Leech Main have been determined. Sections of this road required danger trees to be assessed and removed, brush removed to allow vehicle access, and three cross drains were installed to address drainage issues.

Safety procedures have been developed for hydrology work in streams and related training is required for staff. Safety lines will be installed at locations where staff are required to cross streams.

The hydrology monitoring stations were installed.

A year or two of data will be assessed to determine which station(s) would be best to set up for remote downloading of information. If radio paths cannot reach the stations, the feasibility of satellites systems for downloading data can be explored.

Install Instrumentation under the Forest Canopy

Suitable sites in forests near existing and planned meteorological stations will be identified.

A professor in the Geography Department at the University of Victoria is interested in collaborating in under canopy measurements and is able to secure equipment for measuring precipitation under the canopy (and hence canopy interception).

Ideally two under canopy instrumentation sites will be considered in 2018 near the two existing meteorological stations (Chris Creek and Martin's Gulch).

The basic instrumentation for these under canopy stations is not compatible with the existing radio network so manual data downloads are required. As with the hydrology stations, another alternative that could be investigated in the future is to use satellite systems to download data remotely.

Begin Snow Surveys in the Leech WSA

Each site in the Leech WSA where snow surveys are planned were visited to identify and mark 10 sampling sites (as per the provincial protocol).

Snow sampling at each site was undertaken each month during the winter. Data on other meteorological parameters can be downloaded from data loggers at the time of the visit if the site is not connected to radio network for remote data access.

A number of methods may be needed to access the sites depending upon winter road access. Logistics and costs associated with these surveys will be reviewed to identify the most efficient access method(s). Helicopter access can be provided if necessary.

Prepare for the Installation of a Meteorological Station on Survey Mountain

Locations were determined for both a full meteorological station and an under forest canopy instrumentation site.

A portable station that has already been purchased can be set up to collect data until the full station can be installed in 2019.

This station will need to be connected to the existing radio system for downloading station data remotely.

The funds for the installation of the new station and under canopy instrumentation for the Survey Mountain meteorology station are in the 2019 -2023 Capital budget request for Regional Water Supply.

Determine Location and Road Access for West Leech Meteorological Station

Several potential sites for the location of a meteorological station in the West Leech drainage have been identified. A review of other access requirements was undertaken in 2018 to identify where roads will be upgraded/constructed in the West Leech so the location of the station can be finalized.

Road access will need to be provided prior to the station being installed. It is likely that this will not occur until 2020.

Move Sensors at Existing Leech River Station

Due to the deterioration of the access and housing for the existing flow and turbidity sensors at the Boneyard Road Bridge over the Leech River, the sensors and data logger will be moved to the opposite side of the river.

Phase 2 – 2019

In 2019 the priorities are to:

- Install a hydrology monitoring station with an automated water sampler and a boom structure to suspend sensors in the channel just upstream of the entrance to the Leech Tunnel
- Install a hydrology monitoring station with added water quality sensors at the Jordan Meadows outflow (timing is pending culvert replacement at the road crossing)
- Install seven 'secondary' hydrology sampling stations in headwater streams in the Leech WSA
- Install continuously recording water quality sensors at three primary hydrology monitoring stations.
- Review the performance of the four hydrology monitoring stations installed in 2018 and identify additional instrumentation or upgrades needed to ensure effective operation and access
- Install a meteorology station and under canopy instrumentation at Survey Mountain
- Install one under canopy meteorology station and eight under canopy precipitation monitoring stations in the forest stands adjacent to hydrology monitoring stations.

Funds for these projects have been added to the 2019-2023 Capital Budget for Regional Water Supply.

Install Hydrology Monitoring Station at the Leech Tunnel

There is existing road access to the entrance of the Leech Tunnel, although there may be some minor improvements (e.g., brushing) required prior to access for installation.

This hydrology station differs from the other primary sites in that an automated sampler is included in addition to water level and turbidity sensors. The automated station can be set to take samples based on the water level conditions, such as at high flows. In this way, samples can be taken at specified intervals when the river is rising to determine water quality during rain events.

A boom will be added to the station to suspend the sensors in the stream channel. A precipitation gauge can also be incorporated into the station to link the amount and intensity of rainfall to the trigger for the start of the automated sampler.

There are capital funds available for installation of stations in the 2019 -2023 Capital Budget.

Install Hydrology Monitoring Station at the Jordan Meadows outflow

There is existing road access to the site along Weeks Main. Annual road brushing would be required. The culvert at the location is to be replaced by a bridge in 2019; installation of hydrology monitoring equipment will be completed following the bridge installation

This hydrology station differs from the other primary sites in that there will be an additional water quality multi-probe sensor at the site. The purpose is to assess water quality discharged from the Weeks Lake and wetland complex in the Leech River Headwaters.

Install Seven Secondary Hydrology Stations

The sites for these stations have been identified. There is existing road or foot access to all sites.

Basic instrumentation – water level and temperature - will be installed at these sites. A sensor for measuring dissolved organic carbon will be installed at the secondary station at Jordan Meadows. The data will be downloaded manually every one to two months.

Water Quality Sensors

The data loggers at all primary hydrology stations have the capability to accommodate sensors in addition to those to be installed for hydrology measurements. Given the need to integrate flow and water quality data, an additional sensor array will be installed at three primary hydrology stations to continuously measure key water quality parameters.

Review the Performance of Primary Hydrology Stations

After a winter of high flows in the Leech and West Leech River and Cragg Creek, there may be additional work required at the primary hydrology stations installed in 2018. This may include repairs, adding additional instrumentation, and/or improvements to the attachment of sensors.

Cost estimates for any needed work will be added to the 2020-2024 Capital budget if required.

Install a Meteorology Station on Survey Mountain

A full meteorological station, including a snow scale, will be installed on Survey Mountain in 2019. This will include a nearby site where instrumentation for under canopy measurements will be installed.

Since Survey Mountain has a radio communications tower and winter access could be very difficult, the meteorological station will be integrated to the existing radio network for downloading data.

Under Canopy Stations

One under canopy meteorological station and eight under canopy precipitation sensors will be installed in forest stands near the hydrology monitoring stations in 2019. The decision about the locations will be made closer to the installation date.

Phase 3 – 2020 and 2021

The priority for 2020 is to install a meteorology station in the West Leech and address any issues identified with the existing stations.

Budget Estimates

See table A1 below for a summary of the budget estimate for the 2018 to 2021 program capital implementation.

Table A1. Budget for the Installation of Hydrology and Meteorological Stations in the Leech WSA 2019-2021

Primary Hydrology Stations		2018	2019	2020	2021
HY021	West Leech	$14,000	$23,000	$7,000	$5,000
HY020	Leech upstream of West Leech	$14,000			
HY019	Leech downstream of West Leech	$14,000		$23,000	$5,000
HY018	Cragg Creek	$37,000			
HY017	Leech Intake		$55,000	$5,000	
HY022	L504 - Jordan Meadows		$16,000		

Secondary Hydrology Stations					
HY027	Jordan Meadows Tributary		$16,000		
HY029	West Leech River upstream of West Leech Falls		$8,500		
HY026	Chris Creek		$8,500		
HY024	East Survey Mountain Creek		$8,500		
HY025	Jarvis Creek upstream of Cragg Creek		$8,500		
HY028	Cragg Creek upstream of Jarvis Creek		$8,500		
HY023	West Horton Ridge Creek		$8,500		
	Upgrade existing Leech River Station	$4,000			
	Water Quality Sensors		$45,000		
Meteorology Stations					
HY031	Survey Mountain		$53,500		
HY030	West Leech			$35,000	$5,000
	Under canopy precipitation stations	$2,000	$5,500		
	Under canopy weather station		$5,000		
	Installation Funds		$15,000		
	Totals	$85,000*	$285,000	$70,000	$15,000

* Includes $5,000 carryover from previous year.

Appendix 2 - Hydrometric Monitoring

Background on Hydrometric Data, Monitoring, Analysis

Hydrologic data and analysis are required to support water resource management. In particular, the management of water supply relies on long-term time-series' of accurate hydrometric data. A hydrometric monitoring program should follow the BC RISC standards (BC ENV, 2009) in order to provide a robust dataset that can be objectively graded and from which the baseline conditions can be determined, and changes in ecosystems and trends in long-term conditions may be detected. For a water supply, a robust hydrometric monitoring program is required to assess the short- and long-term sustainable water resource and to address any issues of compliance with the applicable regulatory frameworks.

The basic hydrometric monitoring network includes the collection of water level and streamflow measurements, referencing a continuous water level record to a known/assumed datum, and deriving an empirical relationship between water level and flow (i.e., a rating curve) (Hutchinson and Hamilton, 2010). The goal is to produce a hydrometric time series of water level and streamflow data.

The quality of the monitoring and of the data can be assessed relative to the guidance provided in the RISC standards (BC ENV, 2009). Data collection by the CRD is considered "non-integrated", based on the provincial standards. This means that the data fall outside of Canada-BC monitoring agreement and associated standards. However, data should adhere to the BC RISC standards (BC ENV, 2009).

In part, the RISC standards are required to affirm the credibility of hydro-meteorological data for a given application that requires regulatory approval and/or scientific-rigor, such as, water licensing, baseline data reporting, water supply estimates and forecasts, inflow design calculations, environmental flow needs, etc.

Rating Curves

The rating curve (or rating table) of a hydrometric station is a fundamental component of any hydro-meteorological monitoring program. The curve represents the empirical relationship between water level and flow at the gauging station. This relationship is used to calculate continuous flow time-series, which provide the basis for fundamental hydrologic analysis.

The quality of the station and its utility for hydro-meteorological analysis is reflected by the quality of the rating curve. Rating curves are built over time based on concurrent water level and flow measurements over the full range of flows conditions (BC ENV, 2009; Hutchinson and Hamilton, 2010). The RISC hydrometric standard required to develop an acceptable rating curve is a minimum of ten discharge measurements that cover the full range of flows. Typically this means the minimum number of flow

measurements per year is from 5 to 7. This frequency may decrease after the rating curve has been established and is stable and if the channel bed is stable.

Changes to channel geometry where the gauging site is located will result in changes to the rating curve. This means that old rating curves should not be applied to current conditions if it is known that the channel has changed (e.g., due to major flood events, sedimentation, bed or bank erosion, channel migration, increased aquatic vegetation, poor site maintenance, etc.) indicating that the curve is out of date. If a channel changes geometry (i.e., position, width, depth, bed roughness) further flow measurements are required to determine the extent of the changes and an appropriate shift in the rating curve and re-establish the empirical relationship at the site.

Hydrology Station Design

The BC Hydrometric Standards (BC ENV, 2009) provide detailed instructions and guidance on the installation of hydrologic monitoring stations.

The main procedures for establishing and maintaining a hydrology station are listed below:

1. Map and field-based reconnaissance
2. Selection of gauging site and Instrumentation
3. Gauge Construction
    a. Installation
        i. Staff gauge, stilling well, and support
    b. Bench Marks
    c. Establish Gauge Datum
    d. Instrumentation and Power Supply
    e. Gauge Leveling
    f. Gauge Documentation
4. Stage Measurements
5. Discharge Measurements
    a. Techniques
        i. Current Meters
        ii. Rated Structures
        iii. Volumetric
        iv. Dilution
6. Establish Rating Curve and Computing Discharge
    a. Develop Rating Curve
    b. Zero Flow Gauge Height

    c. Rating Curve maintenance
        i. Rating Curve shift
    d. Station and Data Analysis
7. Hydrometric Data Review
8. Station Maintenance
    a. Upkeep
    b. Instrumentation
    c. Flow measurements
    d. Gauge Leveling

Details of each of these steps are provided in the RISC standards manual. The RISC standards require that a gauging station is stable under the full range of expected flow conditions. Most of the control structures in the GVWSA are rated structures that meet this criteria. However, it is unclear the degree to which the ratings have been confirmed recently.

In general, gauging stations at rated control structures have better long-term data quality than gauging stations in alluvial channels without a rated structure. Natural gauging stations may require more station upkeep and the rating curve is usually more difficult to establish compared with rated structures where the rating has been confirmed in the lab post-manufacturing and confirmed after installation.

However, it is important to keep in mind that station maintenance at natural and rated structure stations is critical to maintaining a robust data set. Station maintenance includes site visits for flow measurements to establish the rating curve for the station (see details below), as well as data collection from the logger, instrumentation upgrades and repairs as needed, and site upkeep. The latter may be overlooked due to lack of time or resources. However, station upkeep is critical to the station data quality because systematic errors associated with water level measurement bias can result in significant uncertainty that renders the flow data unuseable for further analysis. For example, Rees et al (2004) demonstrate how a minor systemic error of 10mm caused by algal growth at a weir crest can translate to major errors of up to 100% of computed flows, particularly at low flows.

Data Quality

Broadly speaking there are two major issues that control the usefulness of hydro-meteorological data:

- The length of the data series
- The accuracy of the data

Most hydrologic analyses rely on fundamental statistical rules regarding the independence of the data. That is, with a sufficiently long time-series, assumptions regarding bias may be met. However, the power

of these statistical requirements may not be apparent for time series less than 30 years in duration. Thus with shorter time series, the accuracy of the hydrologic analysis may not be as strong compared to a longer time series. Inaccurate hydro-meteorological data has potentially negative implications for water supply management, dam safety consideration, baseline characterization, environmental flow requirements, and low flow analysis.

Standardized monitoring sites where a suite of hydro-meteorological and water quality parameters are measured at a high frequency over sufficient time scales enhances the statistical power of any analyses applied to identify trends, or the baseline conditions of the area (Matrix Solution, 2013). Any hydrological analysis relies on accurate data. Therefore a fundamental component of hydro-meteorological monitoring is to ensure that the observed data are accurate and reliable and reflect the actual river flow conditions (Rees et al, 2004).

Data accuracy is dependent on both the quality of the instrumentation and measurements as well as the temporal resolution of the data collection. A standard data collection interval for hydro-meteorological data is 15 minute averages of 60 second scans. However, more recently, there has been a shift to data collection at 5 minute intervals (e.g., the Standard Procedures of the Water Survey of Canada). In some cases, very fine resolution data collection is required, such as in the case of dilution-based streamflow measurements where data collection is recorded every 1 to 5 seconds (per current industry practice).

As it relates to the analyses and hydrologic characterization of a given stream, these relatively fine-scale temporal measurements are required to calculate basic hydrologic statistics and metrics such as derivation of mean daily flows, flow duration curves, instantaneous peak, daily low flows, daily water yield, and even water quality index and concentrations. In other words, it is a standard operating procedure to collect data at a 5 to 15 minute interval in order to support basic hydrologic analyses. Finer resolution data helps eliminate random errors in computed daily mean flows (Herschy, 1995).

The BC RISC Hydrometric standards include data grading criteria that allow data collectors to objectively assess the quality of the hydro-meteorological data. Data quality is graded based on four criteria associated with water level and discharge data collection and data management. The criteria include:

- *instrumentation* (quality of instruments, instrument accuracy/resolution, data collection resolution),
- *stream channel condition* (e.g., control structures through to minor/major hydraulic problems related to instability),
- *field procedures* (e.g., streamflow measurement procedures, gauge installation, etc.),
- *data calculation and assessment* (frequency of data collection, standard protocols followed, calculations are correct, etc.)

For each criteria there are five grades: A, B, C, E (estimated), and U (unknown). Most procedures and guidance in the RISC standards support Grade A levels. For automated stations, Grades A or B are likely sufficient depending on the operating conditions. Grade C applies to manual stations which cannot attain higher grades by default. Grade E data represent stations operated following the RISC standards but data are estimated due to instrument or rating curve anomalies or data gaps. Grade U data is of unknown quality and generally reflects unsatisfactory data collection techniques or poor data management. Unknown data quality indicates the hydro-meteorological station has not received proper attention in time. This may be the result of missing documentation, lack of station maintenance or upkeep, lack of flow monitoring measurements, unsatisfactory rating curve calibration or adjustments, poor instrumentation, or insufficient data collection. As noted above, unsatisfactory data at a hydro-meteorological station may render the entire dataset unusable for further hydrologic analyses.

Control structures may be graded as Grade A/RS assuming the structure was properly installed and the rating at the structure is maintained through time. Station records that demonstrate proper installation and maintenance at the structure are required to achieve this grade level. Where these records are not available, the structure was not installed properly or structure maintenance is not completed, a lower grade or unknown grade would be assigned.

Hydro-meteorological monitoring requires consistent and detailed installation and maintenance practices to ensure the station meets the Provincial standards. Generally, it is maintenance that typically lags behind provincial standards due to limited resources devoted to on-going monitoring programs. However, for long-term monitoring programs, any subsequent analysis must be based on accurate data. The RISC standards provide a means to objectively assess the dataset accuracy and precision, both at station installation and with on-going maintenance at the station.

The value in following the RISC guidelines and standards is that the approach lends confidence in the station design and data so that systematic errors are eliminated and random errors are minimized and can be corrected through quality control measures. High quality data is important to meet provincial standards and to ensure subsequent data analysis can be assessed with confidence and without bias introduced from the baseline data.

References

British Columbia Ministry of Environment (BC ENV). 2009: Manual of British Columbia Hydrometric Standards. Resources Information Standards Committee Report: 204 pp.

Herschy (1995). *Streamflow Measurement.* Chapman & Hall, London

Hutchinson, D. and Hamilton, S. (2010). *Water Quantity – Streamflow*. In Chapter 17 Watershed Measurement Methods and Data Limitations, Compendium of forest hydrology and geomorphology in British Columbia. R.G. Pike, T.E. Redding, R.D. Moore, R.D. Winkler, and K.D. Bladon (Eds). BC Forest Science Program.

CAPITAL REGIONAL DISTRICT - INTEGRATED WATER SERVICES

Water Watch

Issued May 06, 2019

Water Supply System Summary:

1. Useable Volume in Storage:

Reservoir	May 31 5 Year Ave		May 31/18		May 5/19		% Existing Full Storage
	ML	MIG	ML	MIG	ML	MIG	
Sooke	87,987	19,357	88,210	19,406	91,426	20,114	98.6%
Goldstream	8,123	1,787	8,123	1,787	5,754	1,266	58.6%
Total	96,110	21,144	96,333	21,193	97,180	21,380	94.8%

2. Average Daily Demand:

For the month of May	145.0 MLD	31.89 MIGD
For week ending May 05, 2019	141.4 MLD	31.11 MIGD
Max. day May 2019, to date:	157.7 MLD	34.69 MIGD

3. Average 5 Year Daily Demand for May

Average (2014 - 2018)	148.4 MLD [1]	32.64 MIGD [2]

[1]MLD = Million Litres Per Day [2]MIGD = Million Imperial Gallons Per Day

4. Rainfall May:

Average (1914 - 2018):	47.9 mm
Actual Rainfall to Date	0.0 mm (0% of monthly average)

5. Rainfall: Sep 1- May 5

Average (1914 - 2018):	1,511.9 mm
2018 - 2019	1,413.5 mm (93% of average)

6. Water Conservation Action Required:

CRD's Stage 1 Water Conservation Bylaw is now in effect through to September 30, 2019.
Visit www.crd.bc.ca/water for scheduling information.

If you require further information, please contact:

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or
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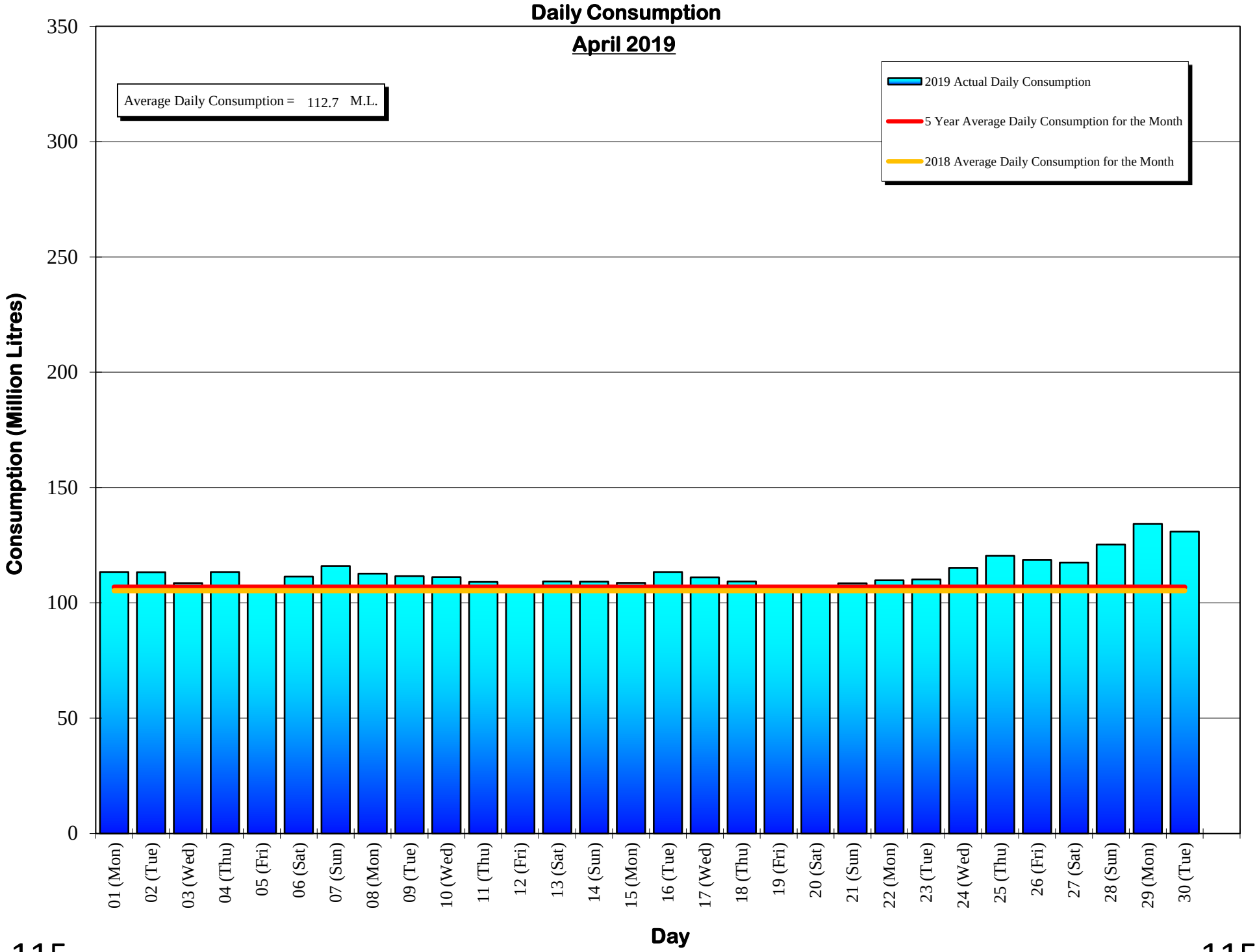

Daily Consumption
April 2019
Average Daily Consumption = 112.7 M.L.
2019 Actual Daily Consumption
5 Year Average Daily Consumption for the Month
2018 Average Daily Consumption for the Month
Consumption (Million Litres)
350
300
250
200
150
100
50
0
01 (Mon)
02 (Tue)
03 (Wed)
04 (Thu)
05 (Fri)
06 (Sat)
07 (Sun)
08 (Mon)
09 (Tue)
10 (Wed)
11 (Thu)
12 (Fri)
13 (Sat)
14 (Sun)
15 (Mon)
16 (Tue)
17 (Wed)
18 (Thu)
19 (Fri)
20 (Sat)
21 (Sun)
22 (Mon)
23 (Tue)
24 (Wed)
25 (Thu)
26 (Fri)
27 (Sat)
28 (Sun)
29 (Mon)
30 (Tue)
Day

Daily Consumptions: - April 2019

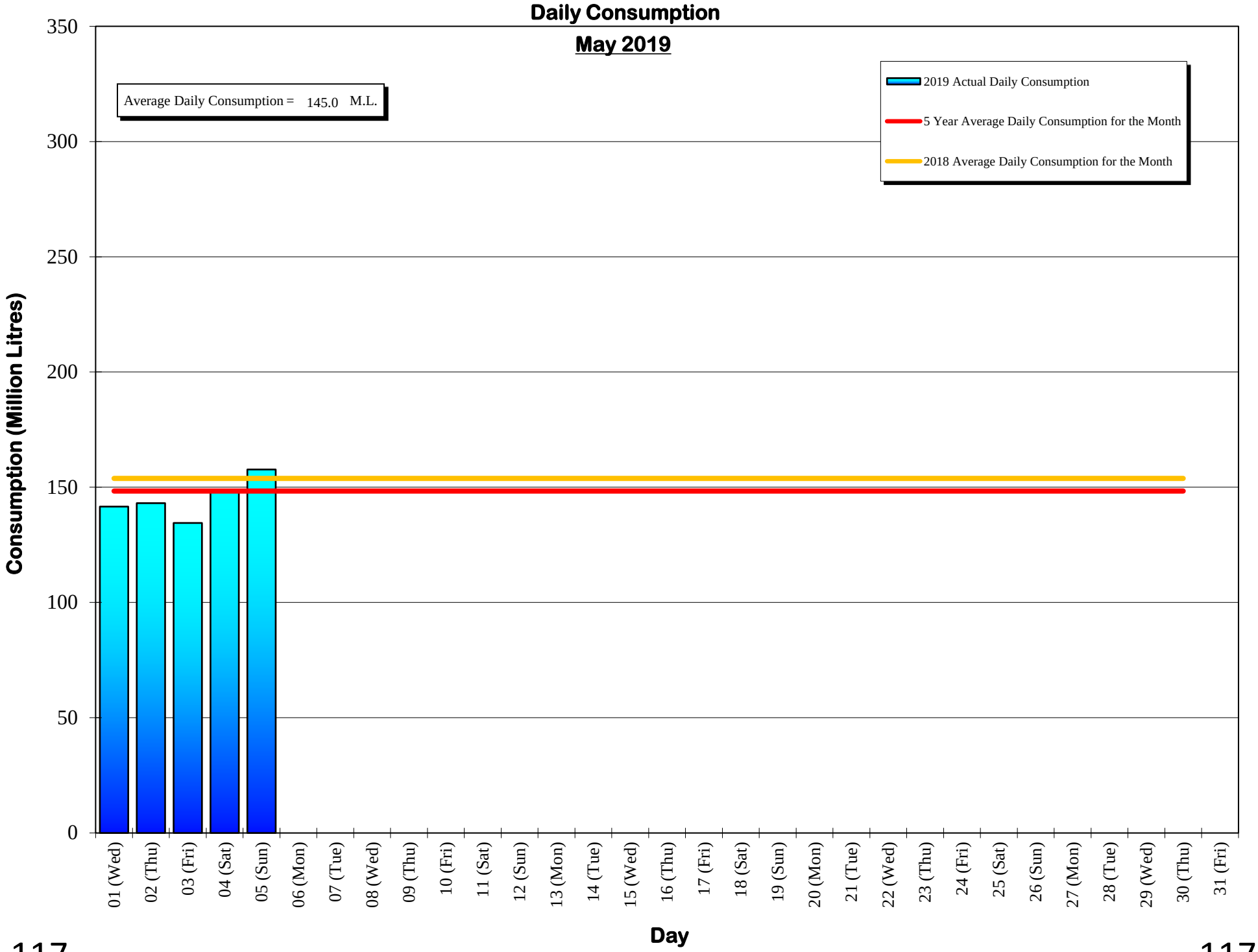
Date	Total Consumption (ML) [1.]		Total Consumption (MIG) [2.]	Air Temperature @ Japan Gulch High (°C)	Air Temperature @ Japan Gulch Low (°C)	Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am Rainfall (mm)	Precipitation @ Sooke Res.: 12:00am to 12:00am Snowfall [3.] (mm)	Precipitation @ Sooke Res.: 12:00am to 12:00am Total Precip.
01 (Mon)	113.4		25.0	18	4	Sunny / P. Cloudy	0.0	0.0	0.0
02 (Tue)	113.3		24.9	19	7	Sunny / P. Cloudy / Showers	0.5	0.0	0.5
03 (Wed)	108.6		23.9	12	8	Cloudy / Showers / P. Sunny	6.6	0.0	6.6
04 (Thu)	113.4		25.0	14	7	Sunny / P. Cloudy / Showers	0.8	0.0	0.8
05 (Fri)	107.2		23.6	14	6	Sunny / P. Cloudy / Showers	1.3	0.0	1.3
06 (Sat)	111.4		24.5	10	5	Cloudy / Showers / P. Sunny	8.6	0.0	8.6
07 (Sun)	116.0		25.5	13	3	Sunny / P. Cloudy / Showers	0.5	0.0	0.5
08 (Mon)	112.7		24.8	10	4	Cloudy / Rain	16.3	0.0	16.3
09 (Tue)	111.6		24.5	12	5	Sunny / P. Cloudy / Showers	0.3	0.0	0.3
10 (Wed)	111.2		24.5	11	6	Cloudy / Showers	2.5	0.0	2.5
11 (Thu)	109.1		24.0	9	5	Cloudy / Showers	3.3	0.0	3.3
12 (Fri)	106.1	<=Min	23.3	12	6	Cloudy / Showers	0.3	0.0	0.3
13 (Sat)	109.3		24.0	8	5	Cloudy / Rain	16.0	0.0	16.0
14 (Sun)	109.2		24.0	8	3	Cloudy / Showers	0.3	0.0	0.3
15 (Mon)	108.7		23.9	11	3	Cloudy / P. Sunny	0.0	0.0	0.0
16 (Tue)	113.4		24.9	12	4	Cloudy / Showers / P. Sunny	0.5	0.0	0.5
17 (Wed)	111.1		24.4	15	7	Cloudy / Showers / P. Sunny	2.0	0.0	2.0
18 (Thu)	109.3		24.0	12	9	Cloudy / Rain	21.1	0.0	21.1
19 (Fri)	106.3		23.4	17	7	Cloudy / Showers / P. Sunny	1.5	0.0	1.5
20 (Sat)	106.4		23.4	17	5	Sunny / P. Cloudy	0.0	0.0	0.0
21 (Sun)	108.5		23.9	16	5	Sunny / P. Cloudy	0.0	0.0	0.0
22 (Mon)	109.8		24.1	10	7	Cloudy / Showers	7.9	0.0	7.9
23 (Tue)	110.2		24.2	14	5	Sunny / P. Cloudy / Showers	0.5	0.0	0.5
24 (Wed)	115.2		25.3	14	5	Sunny / P. Cloudy	0.0	0.0	0.0
25 (Thu)	120.4		26.5	16	3	Sunny	0.0	0.0	0.0
26 (Fri)	118.6		26.1	13	5	Sunny / P. Cloudy	0.0	0.0	0.0
27 (Sat)	117.5		25.9	12	3	Cloudy / P. Sunny	0.0	0.0	0.0
28 (Sun)	125.3		27.6	16	1	Sunny	0.0	0.0	0.0
29 (Mon)	134.3	<=Max	29.6	17	3	Sunny	0.0	0.0	0.0
30 (Tue)	130.9		28.8	18	4	Sunny	0.0	0.0	0.0
TOTAL	3267.5 ML		718.87 MIG				90.8	0	90.8
MAX	134.3		29.55	19	9		21.1	0	21.1
AVE	**112.7**		24.92	13.3	5.0		3.0	0	3.0
MIN	106.1		23.34	8	1		0.0	0	0.0

1. ML = Million Litres 2. MIG = Million Imperial Gallons 3. 10% of snow depth applied to rainfall figures for snow to water equivalent.

Average Rainfall for April (1914-2018)	89.5 mm
Actual Rainfall: April	90.8 mm
% of Average	101%
Average Rainfall (1914-2018): Sept 01 - May 05	1,511.9 mm
Actual Rainfall (2018-2019): Sept 01 - May 05	1,413.5 mm
% of Average	93%

Number days with precip. 0.2 or more
19

Water spilled at Sooke Reservoir to date (since Sept. 1) = 5.38 Billion Imperial Gallons
= 24.50 Billion Litres


Daily Consumption
May 2019
Average Daily Consumption = 145.0 M.L.
2019 Actual Daily Consumption
5 Year Average Daily Consumption for the Month
2018 Average Daily Consumption for the Month
Consumption (Million Litres)
350
300
250
200
150
100
50
0
01 (Wed)
02 (Thu)
03 (Fri)
04 (Sat)
05 (Sun)
06 (Mon)
07 (Tue)
08 (Wed)
09 (Thu)
10 (Fri)
11 (Sat)
12 (Sun)
13 (Mon)
14 (Tue)
15 (Wed)
16 (Thu)
17 (Fri)
18 (Sat)
19 (Sun)
20 (Mon)
21 (Tue)
22 (Wed)
23 (Thu)
24 (Fri)
25 (Sat)
26 (Sun)
27 (Mon)
28 (Tue)
29 (Wed)
30 (Thu)
31 (Fri)
Day

Daily Consumptions: - May 2019

Date	Total Consumption (ML) [1.]		(MIG) [2.]	Air Temperature @ Japan Gulch High (°C)	Low (°C)	Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am Rainfall (mm)	Snowfall [3.] (mm)	Total Precip.
01 (Wed)	141.6		31.2	15	4	Sunny	0.0	0.0	0.0
02 (Thu)	143.1		31.5	14	6	Sunny / P. Cloudy	0.0	0.0	0.0
03 (Fri)	134.5	<=Min	29.6	14	5	Sunny / P. Cloudy	0.0	0.0	0.0
04 (Sat)	148.0		32.6	18	6	Sunny	0.0	0.0	0.0
05 (Sun)	157.7	<=Max	34.7	20	7	Sunny	0.0	0.0	0.0
06 (Mon)									
07 (Tue)									
08 (Wed)									
09 (Thu)									
10 (Fri)									
11 (Sat)									
12 (Sun)									
13 (Mon)									
14 (Tue)									
15 (Wed)									
16 (Thu)									
17 (Fri)									
18 (Sat)									
19 (Sun)									
20 (Mon)									
21 (Tue)									
22 (Wed)									
23 (Thu)									
24 (Fri)									
25 (Sat)									
26 (Sun)									
27 (Mon)									
28 (Tue)									
29 (Wed)									
30 (Thu)									
31 (Fri)									
TOTAL	724.9 ML		159.47 MIG				0.0	0	0.0
MAX	157.7		34.69	20	7		0.0	0	0.0
AVE	**145.0**		31.89	16.2	5.6		0.0	0	0.0
MIN	134.5		29.59	14	4		0.0	0	0.0

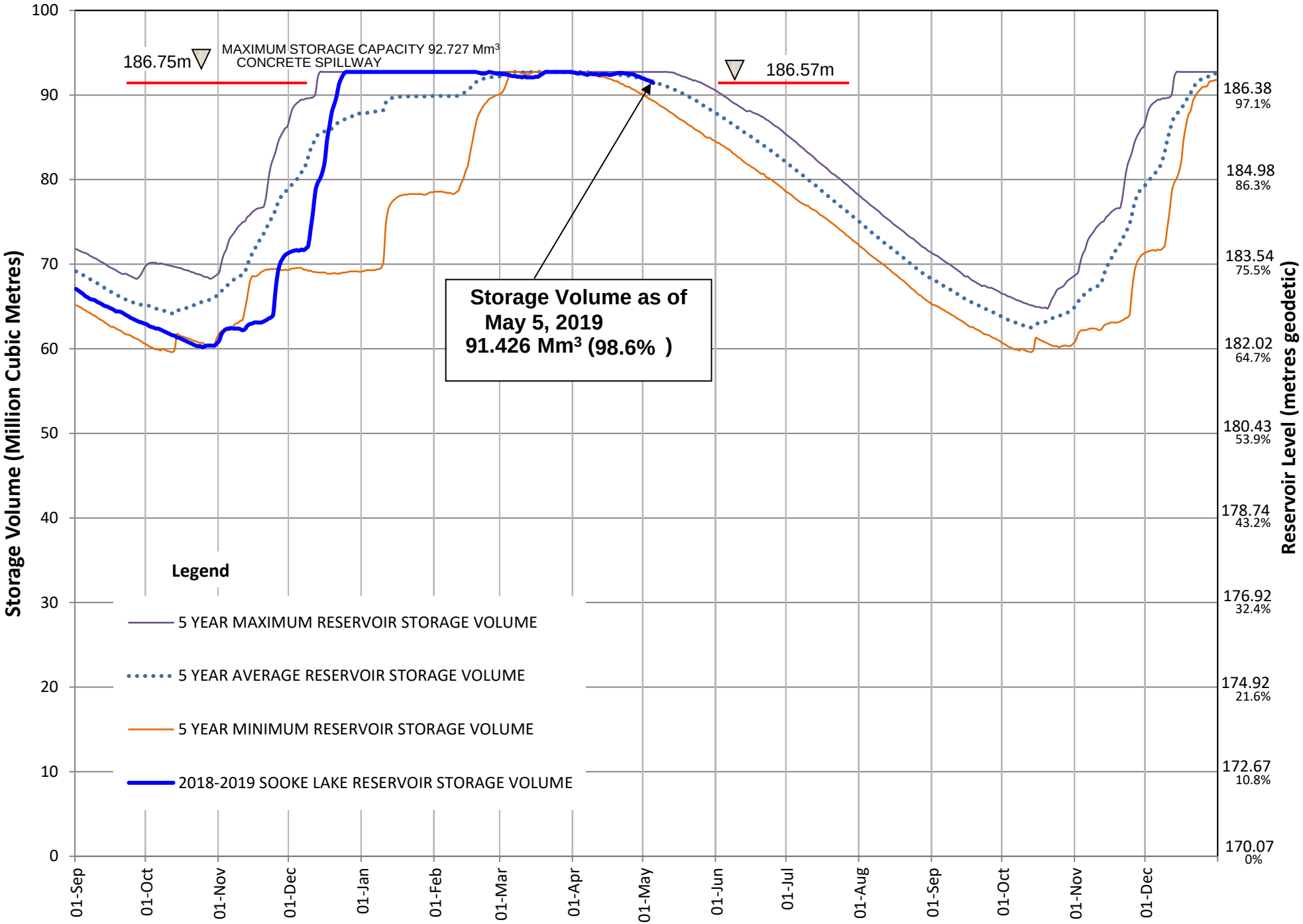
1. ML = Million Litres 2. MIG = Million Imperial Gallons 3. 10% of snow depth applied to rainfall figures for snow to water equivalent.

Average Rainfall for May (1914-2018)	47.9 mm
Actual Rainfall: May	0.0 mm
% of Average	0%
Average Rainfall (1914-2018): Sept 01 - May 05	1,511.9 mm
Actual Rainfall (2018-2019): Sept 01 - May 05	1,413.5 mm
% of Average	93%

Number days with precip. 0.2 or more
0

Water spilled at Sooke Reservoir to date (since Sept. 1) = 5.38 Billion Imperial Gallons
= 24.50 Billion Litres

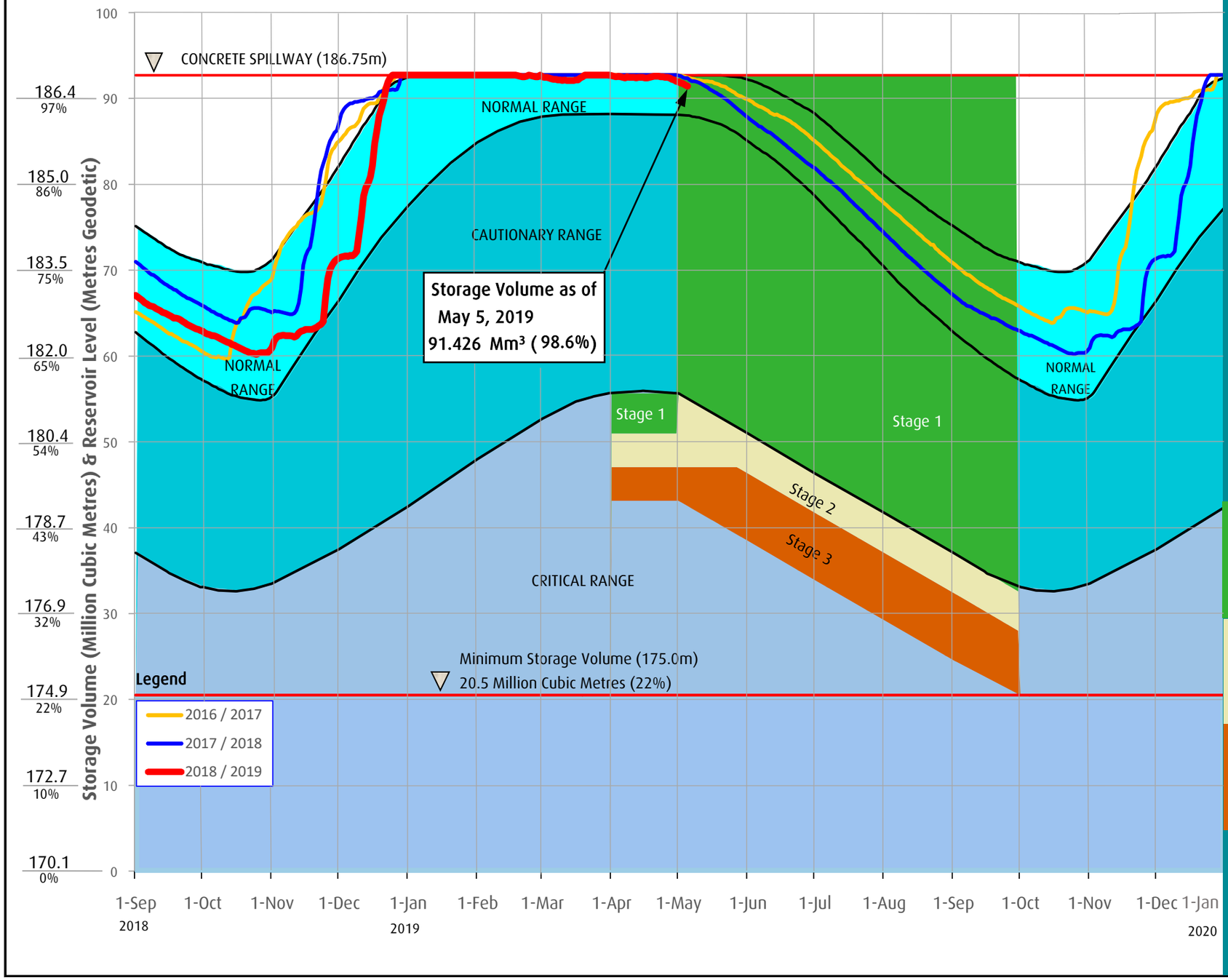
SOOKE LAKE RESERVOIR STORAGE SUMMARY
2018 / 2019



119

Sooke Lake Reservoir Storage Level

Water Supply Management Plan



FAQs

How are water restriction stages determined?

Several factors are considered when determining water use restriction stages, including,

1. Time of year and typical seasonal water demand trends;
2. Precipitation and temperature conditions and forecasts;
3. Storage levels and storage volumes of water reservoirs (Sooke Lake Reservoir and the Goldstream Reservoirs) and draw down rates;
4. Stream flows and inflows into Sooke Lake Reservoir;
5. Water usage, recent consumption and trends; and customer compliance with restriction;
6. Water supply system performance.

The Regional Water Supply Commision will consider the above factors in making a determination to implement stage 2 or 3 restrictions, under the Water Conservation Bylaw.

At any time of the year and regardless of the water use restriction storage, customers are encouraged to limit discretionary water use in order to maximize the amount of water in the Regional Water Supply System Reservoirs available for nondiscretionary potable water use.

Stage 1 is normally initiated every year from May 1 to September 30 to manage outdoor use during the summer months. During this time, lawn watering is permitted twice a week at different times for even and odd numbered addresses.

Stage 2 Is initiated when it is determined that there is an acute water supply shortage. During this time, lawn water is permitted once a week at different times for even and odd numbered addresses.

Stage 3 Is initiated when it is determined that there is a severe water supply shortage. During this time, lawn watering is not permitted. Other outdoor water use activities are restricted as well.

For more information, visit www.crd.bc.ca/drinkingwater

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Conservation Key Messages

GENERAL

- Stage 1 of the Water Conservation Bylaw Use Schedule is in effect May 1 through September 30, each and every year, unless more stringent water conservation measures are required.
- The CRD Water Conservation Bylaw applies to any customers of the regional water supply system receiving drinking water from the Sooke Lake Reservoir in the Greater Victoria area.
- Greater Victoria is currently under Stage 1 Water Conservation under the bylaw.
- Right now, Sooke Lake Reservoir is 99 per cent full (as of May 3, 2019).
- Given that the current levels are high, the CRD is not considering a higher level of conservation at this time
- But as summer progresses, and the weather potentially becomes drier, staff will continue to closely monitor the supply outlook and the potential need to increase conservation efforts.

WHY CONSERVE

- In summer months, outdoor water use accounts for almost 50% of water used around the average home in the CRD.
- Given the recent declaration of a Climate Emergency by the CRD, we ask that everyone water wisely as a precautionary measure and respect the watering schedule.
- By reducing discretionary outdoor water use, we maximize the amount of water in the reservoirs (which can be used for future use, releases to support fish habitat, and/or potential fire protection if required).
- The CRD appreciates your water saving efforts and would like to thank all residents in the Capital Region for your continued support.

WATERING SCHEDULE

- If you have an even address number, you can water your lawn on Wednesday and Saturdays, between 4 and 10 am AND 7 and 10 pm.

- If you have an odd address number, you can water your lawn on Thursday and Sundays, during the same timeframes (between 4 and 10 am AND 7 and 10 pm).
- For multi-unit properties, the street address applies, not the individual unit number.

TIPS FOR CONSERVATION

- There are a numbers of things you can do to conserve water this summer:
- Go Golden. Lawns naturally go dormant in the summer months and return with Fall rains.
- You can also sweep outdoor surfaces such as driveways or decks with a broom instead of using a hose or power washing.
- And you can reduce indoor water use by doing things like turning off the tap when brushing your teeth or washing dishes, take shorter showers and run full loads in the washing machine and dishwasher.
- For other conservation tips and information, check out the CRD website at crd.bc.ca.

DETERMINING CONSERVATION LEVEL

- The CRD considers a number of factors in determining the conservation level including:
  - Time of year and typical seasonal water demand trends
  - Precipitation and temperature conditions and forecasts
  - Storage levels and storage volumes of water reservoirs (Sooke Lake Reservoir and the Goldstream Reservoirs) and draw down rates
  - Stream flows and inflows into Sooke Lake Reservoir
  - Water usage, recent consumption and trends, and customer compliance with restrictions on water use under the bylaw
  - Regional Water Supply System performance
  - Impacts of climate change
- The CRD has not implemented Stage 2 Water Conservation since the Sooke Lake Reservoir dam was raised in 2002.

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CAPITAL REGIONAL DISTRICT REGIONAL WATER SUPPLY COMMISSION
Wednesday, January 16, 2019 at 11:30 AM

MEETING HOTSHEET (ACTION LIST)

The following is a quick snapshot of the FINAL Regional Water Supply Commission decisions made at the meeting. The minutes will represent the official record of the meeting.

2. ELECTION OF CHAIR AND VICE-CHAIR

Commissioner Mersereau was elected as Chair of the Regional Water Supply Commission for the term ending December 31, 2022 by acclamation.

Commissioner's Stock and Baird accepted nominations for Vice Chair.

Ballots were distributed and collected by D. Dionne and T. Duthie. The ballots were counted and the Chair declared Commissioner Baird Vice-Chair of the Regional Water Supply Commission for the term ending December 31, 2022.

Recommendation: That the ballots be destroyed.

CARRIED

4. ADOPTION OF THE MINUTES OF SEPTEMBER 19, 2018

Recommendation:
That the Regional Water Supply Commission adopt the minutes of the meeting held September 19, 2018.

CARRIED

8. COMMISSION BUSINESS

8.1. *Regional Water Supply Commission Orientation*

Recommendation:
That the presentation be received for information.

CARRIED

8.2. ***RWSC 19-02*** *Greater Victoria Water Supply Area Mining Access Requests*

ACTION: The Commission requested that the topic of procedures around delegated authority to staff for mining access requests be brought forward to a future meeting for discussion.

ACTION: Going forward, the Commission requested to have copies of the redacted applications available at the meeting, not contained within the agenda package, and that the staff report highlight any anomalies.

Recommendation:
That the Regional Water Supply Commission:

1. authorize access and special use to:
   A. the mining tenure holders;
   B. their agents for which the agency can be confirmed; and,
   C. other accompanying persons already under access agreement with the CRD,

as listed in Table 1 and Table 2 of the report, subject to the conditions of their Access Agreement, for the valid mining tenures they hold;

2. not authorize the overnighting request.

CARRIED

~~***8.3. EEP 19-01*** *Water Quality Report for Sooke Lake Reservoir September to December 2018*~~

Item was postponed to the February meeting.

8.4. RWSC 19-07 *Lubbe Dam Construction and Budget Update*

Recommendation:
That the Regional Water Supply Commission:

1. direct Capital Regional District (CRD) staff to amend the 2019 Regional Water Supply Capital Plan, Project 16-15, to reflect a budget increase of $581,000; and

2. recommend to the CRD Board to amend the 2019 financial plan accordingly.

CARRIED

~~***8.5.*** *Appointment of Regional Water Supply Commission Representative to the Water Advisory Committee and Status of Committee Appointments*~~

Item was postponed to the February meeting.

~~***8.6.*** *Water Watch*~~

Item was postponed to the February meeting.

10. MOTION TO CLOSE THE MEETING

In accordance with the Community Charter, Part 4, Division 3, 90(2)(b) the consideration of information received and held in confidence relating to negotiations between the regional district and a provincial government or the federal government or both, or between a provincial government or the federal government or both and a third party.

CARRIED

RISE AND REPORT

The Commission rose from its closed meeting without report.

Making a difference...together

CAPITAL REGIONAL DISTRICT REGIONAL WATER SUPPLY COMMISSION
Wednesday, February 20, 2019 at 11:30 AM

MEETING HOTSHEET (ACTION LIST)

The following is a quick snapshot of the FINAL Regional Water Supply Commission decisions made at the meeting. The minutes will represent the official record of the meeting.

2. ADOPTION OF THE MINUTES OF JANUARY 16, 2019

Recommendation:

That the Regional Water Supply Commission adopt the minutes of the meeting held January 16, 2019.

CARRIED

5. MOTIONS WITH NOTICE

5.1. Protection of Greater Victoria Water Supply Area

Recommendation:

That the Regional Water Supply Commission:

1. Place itself on record opposing highway infrastructure development in the Greater Victoria Water Supply Area and the Drinking Water Protection Zone.

2. Recommend that the CRD Board assume the same position and accordingly place itself on record as opposing such development outlined by the CRD RWS.

3. Recommend that the CRD Chair write on behalf of the CRD Board, to the Premier of British Columbia, copying the ministers responsible for Environment and Transportation as well as Members of the Legislative Assembly representing constituencies on Vancouver Island, advising the Provincial government that the CRD has no interest in pursuing highway infrastructure development in the Greater Victoria Water Supply Area or the Drinking Water Protection Zone

CARRIED

6. CORRESPONDENCE

That the Regional Water Supply Commission receive the correspondence as presented for information.

CARRIED

8. COMMISSION BUSINESS

8.1. **RWSC 19-08** Greater Victoria Water Supply Area Access and Special Use Request and Approval Policy and Procedures

Recommendation:

That the Regional Water Supply Commission receive the report for information and make no changes to the Water Supply Area Access and Special Use Request and Approval Policy and Water Supply Area Access and Special Use Request and Approval Procedure.

CARRIED

8.2. **RWSC 19-09** Greater Victoria Water Supply Area Mining Access Requests

Recommendation:

That the Regional Water Supply Commission:

1. Authorize access and special use to:
   A. the mining tenure holders;
   B. their agents for which the agency can be confirmed; and,
   C. other accompanying persons already under access agreement with the CRD,

as listed in Table 1 of the report, subject to the conditions of their Access Agreement, for the valid mining tenures they hold.

CARRIED

8.3. **EEP 19-01** Water Quality Report for Sooke Lake Reservoir- September to December 2018

Recommendation:

That the Regional Water Supply Commission receive the Sooke Lake Reservoir monitoring results for September to December 2018 for information.

CARRIED

8.4. Water Watch

Recommendation:

That the Regional Water Supply Commission receive the Water Watch report for information.

CARRIED

Making a difference...together

CAPITAL REGIONAL DISTRICT REGIONAL WATER SUPPLY COMMISSION

Wednesday, March 20, 2019 at 11:30 AM

MEETING HOTSHEET (ACTION LIST)

The following is a quick snapshot of the FINAL Regional Water Supply Commission decisions made at the meeting. The minutes will represent the official record of the meeting.

2. ADOPTION OF THE MINUTES OF FEBRUARY 20, 2019

Recommendation:
That the Regional Water Supply Commission adopt the minutes of the meeting held February 20, 2019.

CARRIED

5. COMMISSION BUSINESS

5.1. RWSC 19-03 2018 Wildfire Season – Greater Victoria Water Supply Area

Recommendation:
That the Regional Water Supply Commission receive the staff report for information.

CARRIED

5.2. RWSC 19-10 Greater Victoria Water Supply Area Mining Access Requests

Recommendation:
That the Regional Water Supply Commission authorize access and special use to:
a) The mining tenure holder; and,
b) Accompanying agents and free miners whose status can be confirmed, and that meet CRD insurance requirements;
For the valid mining tenures held, subject to the conditions of the Access Agreement.

CARRIED

5.3. RWSC 19-11 Regional Water Supply Service – 2018 Financial Performance

Recommendation: That the Regional Water Supply Commission receive the staff report for information.

CARRIED

IWSS-297445977-4873

5.4. March 13, 2019 CRD Regional Board Resolution:

Recommendation: That the Regional Water Supply Commission receive the staff report for information.

CARRIED

5.5. WATER WATCH

Recommendation: That the Regional Water Supply Commission receive the Water Watch report for information.

CARRIED

7. MOTION TO CLOSE THE MEETING

In accordance with the Community Charter, Part 4, Division 3, 90(1)(g) litigation or potential litigation affecting the municipality; and **90(1)(a)** personal information about an identifiable individual who holds or is being considered for a position as an officer, employee or agent of the municipality or another position appointed by the municipality.

CARRIED

Making a difference...together

CAPITAL REGIONAL DISTRICT REGIONAL WATER SUPPLY COMMISSION
Wednesday, May 15, 2019 at 11:30 AM

MEETING HOTSHEET (ACTION LIST)

The following is a quick snapshot of the FINAL Regional Water Supply Commission decisions made at the meeting. The minutes will represent the official record of the meeting.

2 ADOPTION OF THE MINUTES OF MARCH 20, 2019

Recommendation:

That the Regional Water Supply Commission adopt the minutes of the meeting held March 20, 2019.

CARRIED

5 GENERAL MANAGERS REPORT

Recommendation:

That the Regional Water Supply Commission receive the General Managers report for information.

CARRIED

6 COMMISSION BUSINESS

6.1 RWSC 19-05 Fisheries Water Release Program

Recommendation:

That the Regional Water Supply Commission:

1. Endorse the proposed Fisheries Water Release Plan as set out in Table 2 of Appendix 2;
2. Direct staff to engage with the T'Sou-ke Nation regarding the proposed Fisheries Water Release Plan and the (expired) 2002 Agreement;
3. Direct staff to seek approval of the proposed Fisheries Water Release Plan from the Federal Department of Fisheries and Oceans Canada and Provincial Ministry of Environment & Climate Change Strategy and Forests, Lands, Natural Resources Operations & Rural Development, as required; and
4. Direct staff to pursue amending the CRD's Provincial Conditional Water Licence for Goldstream River/Waugh Creek to include an authorization to store and release water for the purpose of conserving fish and fish habitat, in accordance with the release schedule in Table 2 (Appendix 2).

CARRIED

6.2 RWSC 19-01 Watershed Hydrology Monitoring Plan – Leech Water Supply Area

Recommendation:

That the Regional Water Supply Commission receive the staff report, *Watershed Hydrology Monitoring Plan – Leech Water Supply Area*, for information.

CARRIED

Action Item:
Staff to provide available historical reports regarding contaminants in the Leech Water Supply for the commission's information.

6.3 Weekly Water Watch Report May 5, 2019

Recommendation:
That the Regional Water Supply Commission receive the Water Watch report for information.

CARRIED

Action Item:
Key messaging about water conservation, with respect to climate change, be discussed at an upcoming Water Advisory Committee meeting.

CAPITAL REGIONAL DISTRICT - INTEGRATED WATER SERVICES

Water Watch

Issued January 28, 2019

Water Supply System Summary:

1. Useable Volume in Storage:

Reservoir	January 31 5 Year Ave		January 31/18		January 27/19		% Existing Full Storage
	ML	MIG	ML	MIG	ML	MIG	
Sooke	89,882	19,774	92,727	20,400	92,727	20,400	100.0%
Goldstream	8,584	1,888	8,584	1,888	5,886	1,295	59.9%
Total	98,466	21,662	101,311	22,288	98,613	21,695	96.2%

2. Average Daily Demand:

For the month of January	97.4 MLD	21.43 MIGD
For week ending January 27, 2019	97.8 MLD	21.52 MIGD
Max. day January 2019, to date:	101.7 MLD	22.38 MIGD

3. Average 5 Year Daily Demand for January

Average (2014 - 2018)	95.6 MLD [1]	21.04 MIGD [2]

[1]MLD = Million Litres Per Day [2]MIGD = Million Imperial Gallons Per Day

4. Rainfall January:

Average (1914 - 2018):	271.2 mm
Actual Rainfall to Date	310.5 mm (115% of monthly average)

5. Rainfall: Sep 1- Jan 27

Average (1914 - 2018):	1,027.2 mm
2018 - 2019	1,243.9 mm (121% of average)

6. Water Conservation Action Required:

If each of us saves a little, together we can save a lot.
Check our website at www.crd.bc.ca/water for more information.

If you require further information, please contact:

Ted Robbins, B.Sc., C.Tech
General Manager, CRD - Integrated Water Services
or
Glenn Harris, Ph D., RPBio
Senior Manager - Environmental Protection

Capital Regional District Integrated Water Services
479 Island Highway
Victoria, BC V9B 1H7
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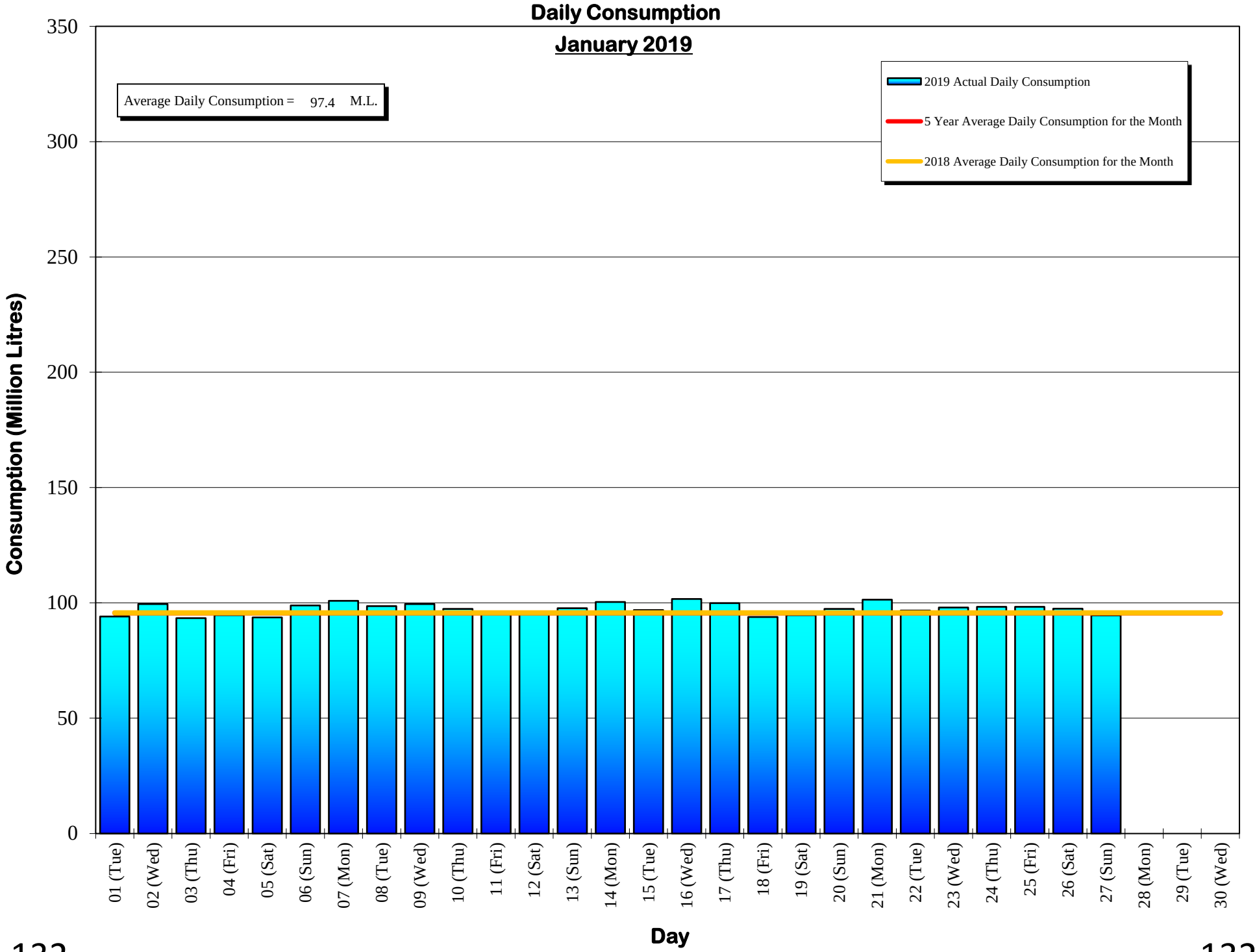

Daily Consumption
January 2019
Average Daily Consumption = 97.4 M.L.
2019 Actual Daily Consumption
5 Year Average Daily Consumption for the Month
2018 Average Daily Consumption for the Month
Consumption (Million Litres)
350
300
250
200
150
100
50
0
01 (Tue)
02 (Wed)
03 (Thu)
04 (Fri)
05 (Sat)
06 (Sun)
07 (Mon)
08 (Tue)
09 (Wed)
10 (Thu)
11 (Fri)
12 (Sat)
13 (Sun)
14 (Mon)
15 (Tue)
16 (Wed)
17 (Thu)
18 (Fri)
19 (Sat)
20 (Sun)
21 (Mon)
22 (Tue)
23 (Wed)
24 (Thu)
25 (Fri)
26 (Sat)
27 (Sun)
28 (Mon)
29 (Tue)
30 (Wed)
Day

Daily Consumptions: - January 2019

Date	Total Consumption (ML) [1.]		(MIG) [2.]	Air Temperature @ Japan Gulch High (°C)	Low (°C)	Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am Rainfall (mm)	Snowfall [3.] (mm)	Total Precip.
01 (Tue)	94.1		20.7	5	1	Sunny / P. Cloudy	0.0	0.0	0.0
02 (Wed)	99.5		21.9	4	2	Cloudy / Rain	36.1	0.0	36.1
03 (Thu)	93.4	<=Min	20.5	10	4	Heavy Rain	125.2	0.0	125.2
04 (Fri)	94.7		20.8	9	5	Cloudy / Showers	14.7	0.0	14.7
05 (Sat)	93.7		20.6	7	5	Cloudy / Showers	2.3	0.0	2.3
06 (Sun)	98.9		21.8	6	1	Cloudy / Rain	15.5	0.0	15.5
07 (Mon)	100.9		22.2	3	0	Cloudy / P. Sunny	0.0	0.0	0.0
08 (Tue)	98.6		21.7	5	1	Cloudy / Showers	10.9	0.0	10.9
09 (Wed)	99.5		21.9	7	4	Cloudy / Showers	6.8	0.0	6.8
10 (Thu)	97.4		21.4	9	6	Cloudy / Showers	1.8	0.0	1.8
11 (Fri)	95.7		21.1	9	4	Sunny / P. Cloudy	0.0	0.0	0.0
12 (Sat)	96.0		21.1	8	3	Sunny / P. Cloudy	0.0	0.0	0.0
13 (Sun)	97.7		21.5	6	2	Sunny	0.0	0.0	0.0
14 (Mon)	100.4		22.1	5	1	Sunny	0.0	0.0	0.0
15 (Tue)	96.9		21.3	4	-1	Sunny	0.0	0.0	0.0
16 (Wed)	101.7	<=Max	22.4	7	0	Sunny / P. Cloudy	0.0	0.0	0.0
17 (Thu)	99.9		22.0	9	3	Cloudy / Rain	16.0	0.0	16.0
18 (Fri)	93.9		20.7	7	5	Cloudy / Showers	10.9	0.0	10.9
19 (Sat)	94.7		20.8	8	4	Cloudy / Rain	25.4	0.0	25.4
20 (Sun)	97.4		21.4	6	1	Sunny / P. Cloudy	0.0	0.0	0.0
21 (Mon)	101.4		22.3	5	1	Cloudy / Showers / P. Sunny	1.0	0.0	1.0
22 (Tue)	96.7		21.3	6	3	Cloudy / Rain	40.1	0.0	40.1
23 (Wed)	98.0		21.6	9	5	Cloudy / Showers / P. Sunny	3.8	0.0	3.8
24 (Thu)	98.3		21.6	7	5	Cloudy / P. Sunny	0.0	0.0	0.0
25 (Fri)	98.3		21.6	7	3	Sunny / P. Cloudy	0.0	0.0	0.0
26 (Sat)	97.5		21.5	7	2	Sunny / P. Cloudy	0.0	0.0	0.0
27 (Sun)	94.6		20.8	7	1	Cloudy / P. Sunny	0.0	0.0	0.0
28 (Mon)									
29 (Tue)									
30 (Wed)									
31 (Thu)									
TOTAL	2629.8 ML		578.56 MIG				310.5	0	310.5
MAX	101.7		22.38	10	6		125.2	0	125.2
AVE	**97.4**		21.43	6.7	2.6		11.5	0	11.5
MIN	93.4		20.54	3	-1		0.0	0	0.0

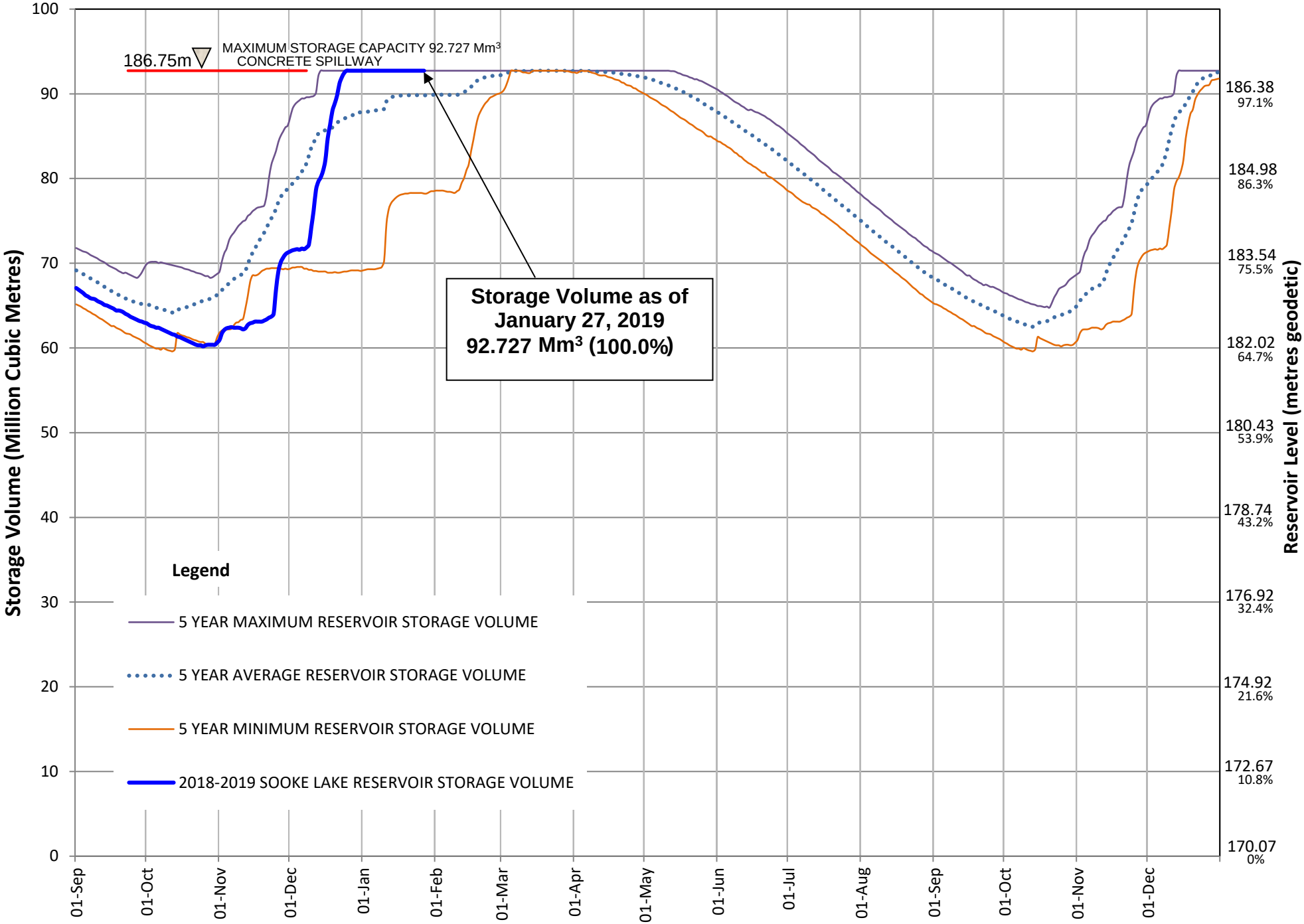
1. ML = Million Litres 2. MIG = Million Imperial Gallons 3. 10% of snow depth applied to rainfall figures for snow to water equivalent.

Average Rainfall for January (1914-2018)	271.2 mm
Actual Rainfall: January	310.5 mm
% of Average	115%
Average Rainfall (1914-2018): Sept 01 - Jan 27	1,027.2 mm
Actual Rainfall (2018-2019): Sept 01 - Jan 27	1,243.9 mm
% of Average	121%

Number days with precip. 0.2 or more
14

Water spilled at Sooke Reservoir to date (since Sept. 1) = 4.92 Billion Imperial Gallons
= 22.30 Billion Litres

SOOKE LAKE RESERVOIR STORAGE SUMMARY
2018 / 2019



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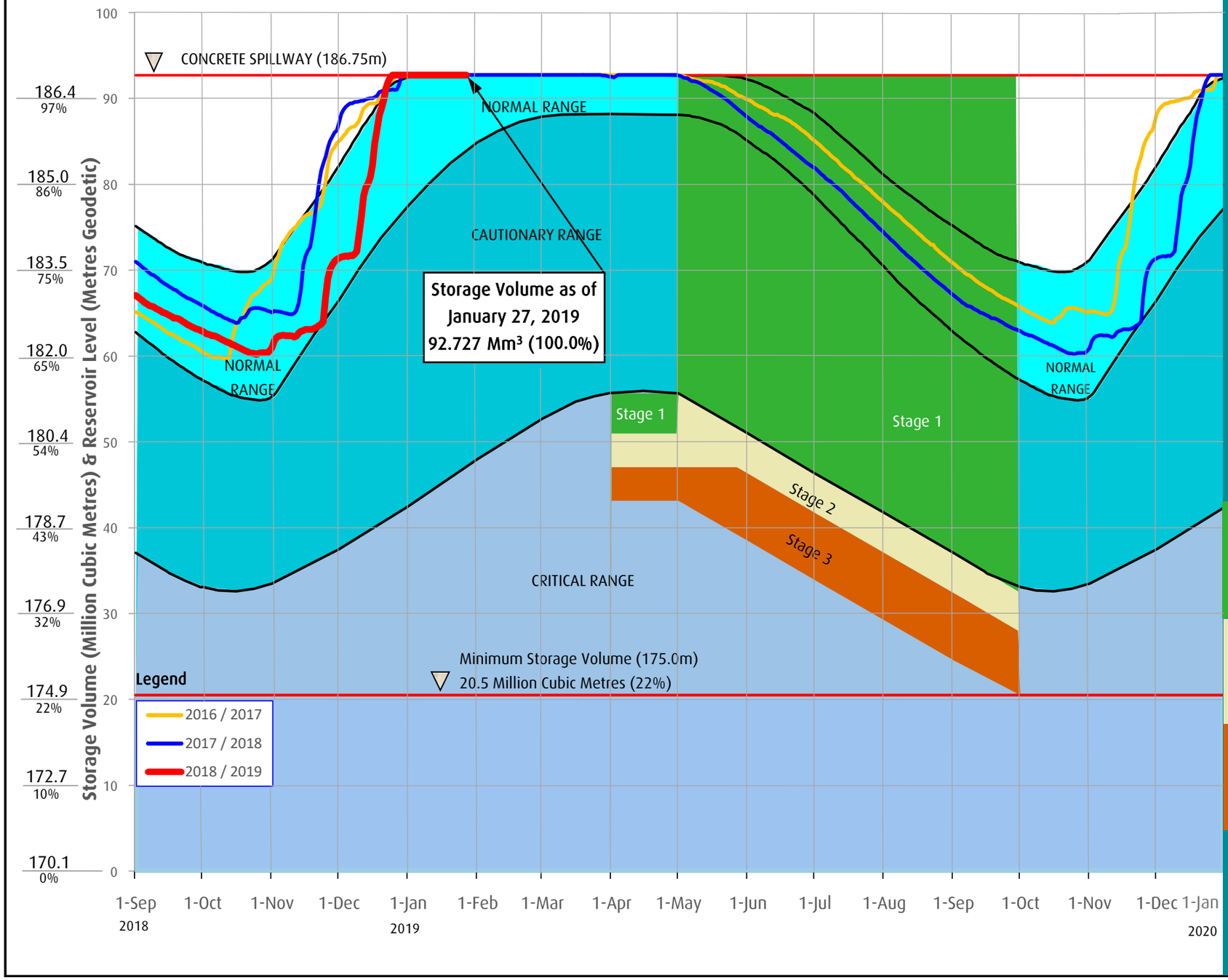
Sooke Lake Reservoir Storage Level

Water Supply Management Plan



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2. Precipitation and temperature conditions and forecasts;
3. Storage levels and storage volumes of water reservoirs (Sooke Lake Reservoir and the Goldstream Reservoirs) and draw down rates;
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Stage 3 Is initiated when it is determined that there is a severe water supply shortage. During this time, lawn watering is not permitted. Other outdoor water use activities are restricted as well.

For more information, visit www.crd.bc.ca/drinkingwater

Making a difference...together

CAPITAL REGIONAL DISTRICT - INTEGRATED WATER SERVICES

Water Watch

Issued February 25, 2019

Water Supply System Summary:

1. Useable Volume in Storage:

Reservoir	February 28 5 Year Ave		February 28/18		February 24/19		% Existing Full Storage
	ML	MIG	ML	MIG	ML	MIG	
Sooke	92,188	20,281	92,727	20,400	92,727	20,400	100.0%
Goldstream	8,700	1,914	8,700	1,914	5,675	1,248	57.8%
Total	100,889	22,195	101,427	22,314	98,402	21,648	96.0%

2. Average Daily Demand:

For the month of February	100.9 MLD	22.19 MIGD
For week ending February 24, 2019	101.5 MLD	22.33 MIGD
Max. day February 2019, to date:	105.8 MLD	23.28 MIGD

3. Average 5 Year Daily Demand for February

Average (2014 - 2018)	96.4 MLD [1]	21.20 MIGD [2]

[1]MLD = Million Litres Per Day [2]MIGD = Million Imperial Gallons Per Day

4. Rainfall February:

Average (1914 - 2018):	191.8 mm
Actual Rainfall to Date	55.2 mm (29% of monthly average)

5. Rainfall: Sep 1- Feb 24

Average (1914 - 2018):	1,225.0 mm
2018 - 2019	1,301.7 mm (106% of average)

6. Water Conservation Action Required:

If each of us saves a little, together we can save a lot.
Check our website at www.crd.bc.ca/water for more information.

If you require further information, please contact:

Ted Robbins, B.Sc., C.Tech
General Manager, CRD - Integrated Water Services
or
Glenn Harris, Ph D., RPBio
Senior Manager - Environmental Protection

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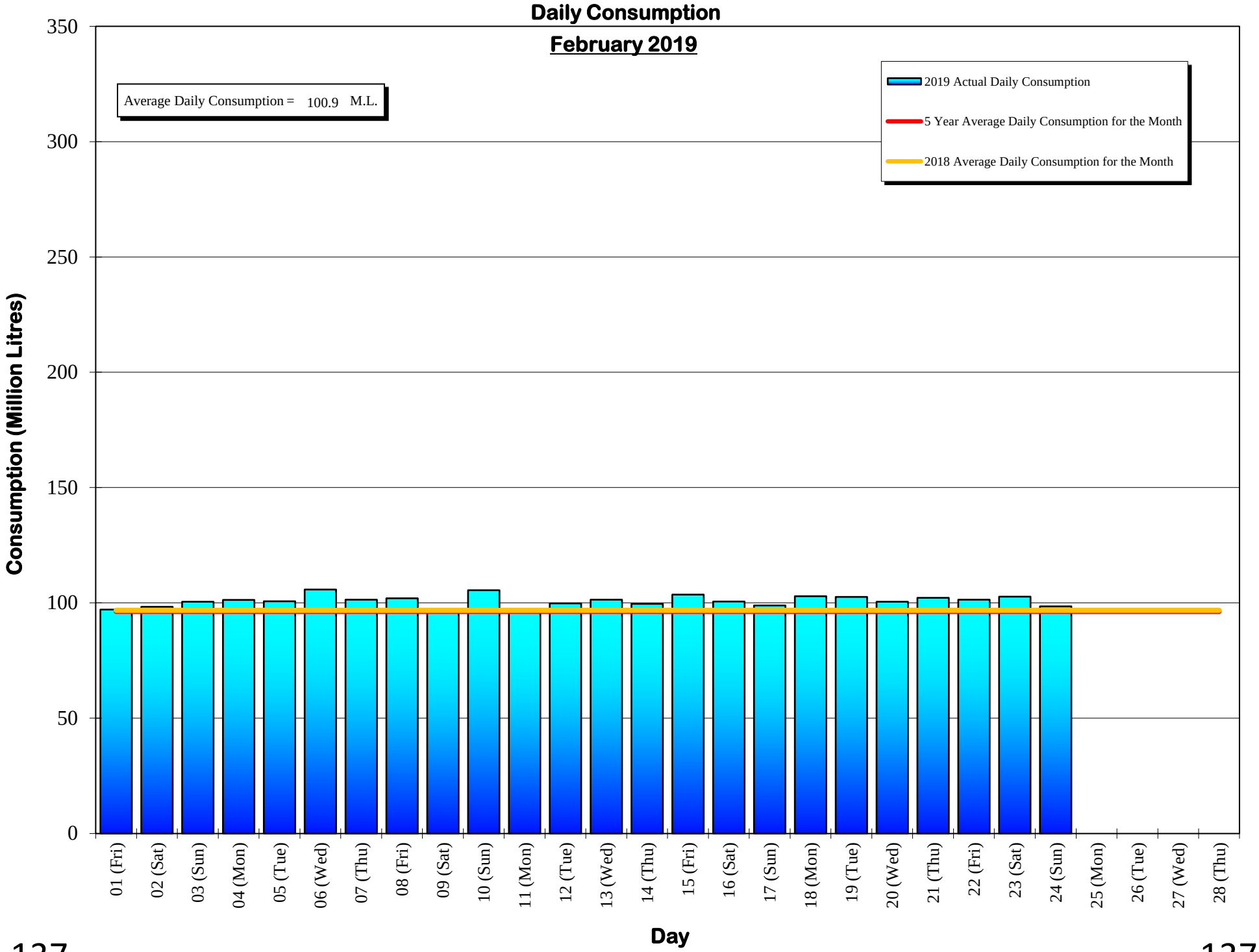
Daily Consumption
February 2019
Average Daily Consumption = 100.9 M.L.
2019 Actual Daily Consumption
5 Year Average Daily Consumption for the Month
2018 Average Daily Consumption for the Month
Consumption (Million Litres)
350
300
250
200
150
100
50
0
01 (Fri)
02 (Sat)
03 (Sun)
04 (Mon)
05 (Tue)
06 (Wed)
07 (Thu)
08 (Fri)
09 (Sat)
10 (Sun)
11 (Mon)
12 (Tue)
13 (Wed)
14 (Thu)
15 (Fri)
16 (Sat)
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19 (Tue)
20 (Wed)
21 (Thu)
22 (Fri)
23 (Sat)
24 (Sun)
25 (Mon)
26 (Tue)
27 (Wed)
28 (Thu)
Day

Daily Consumptions: - February 2019

Date	Total Consumption (ML) [1.]		Total Consumption (MIG) [2.]	Air Temperature @ Japan Gulch High (°C)	Air Temperature @ Japan Gulch Low (°C)	Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am Rainfall (mm)	Precipitation @ Sooke Res.: 12:00am to 12:00am Snowfall [3.] (mm)	Precipitation @ Sooke Res.: 12:00am to 12:00am Total Precip.
01 (Fri)	97.1		21.4	8	5	Cloudy / Rain	17.8	0.0	17.8
02 (Sat)	98.3		21.6	7	2	Cloudy / Showers / P. Sunny	0.3	0.0	0.3
03 (Sun)	100.5		22.1	2	-5	Cloudy / Showers / P. Sunny	1.0	0.0	1.0
04 (Mon)	101.3		22.3	-2	-6	Cloudy / P. Sunny	0.0	0.0	0.0
05 (Tue)	100.7		22.2	0	-6	Sunny	0.0	0.0	0.0
06 (Wed)	105.8	<=Max	23.3	1	-6	Sunny	0.0	0.0	0.0
07 (Thu)	101.4		22.3	2	-5	Sunny / P. Cloudy	0.0	0.0	0.0
08 (Fri)	102.0		22.4	1	-5	Snow	0.3	10.1	1.3
09 (Sat)	97.0		21.3	0	-5	Cloudy / P. Sunny	0.0	0.0	0.0
10 (Sun)	105.5		23.2	1	-8	Snow / P. Sunny	0.0	55.8	5.6
11 (Mon)	96.7	<=Min	21.3	-2	-5	Snow	0.0	38.1	3.8
12 (Tue)	99.8		22.0	1	-2	Cloudy / Flurries	0.0	15.1	1.5
13 (Wed)	101.4		22.3	2	-4	Cloudy / Flurries / P. Sunny	0.0	17.7	1.8
14 (Thu)	99.6		21.9	2	-4	Cloudy / Flurries	0.0	50.7	5.1
15 (Fri)	103.6		22.8	2	0	Cloudy / P. Sunny	0.0	0.0	0.0
16 (Sat)	100.6		22.1	5	-1	Cloudy / P. Sunny	0.0	0.0	0.0
17 (Sun)	98.9		21.7	6	-1	Cloudy / P. Sunny	0.0	0.0	0.0
18 (Mon)	102.9		22.6	5	-1	Cloudy	0.3	0.0	0.3
19 (Tue)	102.6		22.6	4	0	Sunny / P. Cloudy	0.3	0.0	0.3
20 (Wed)	100.5		22.1	4	-1	Sunny / P. Cloudy	0.0	0.0	0.0
21 (Thu)	102.2		22.5	6	-1	Sunny / P. Cloudy	0.0	0.0	0.0
22 (Fri)	101.4		22.3	5	0	Cloudy / Flurries	7.1	2.5	7.4
23 (Sat)	102.7		22.6	5	0	Cloudy / Flurries	3.5	2.5	3.8
24 (Sun)	98.5		21.7	4	-1	Cloudy / Showers / P. Sunny	5.3	0.0	5.3
25 (Mon)									
26 (Tue)									
27 (Wed)									
28 (Thu)									
TOTAL	2421.0 ML		532.64 MIG				35.9	193	55.2
MAX	105.8		23.28	8	5		17.8	56	17.8
AVE	**100.9**		22.19	2.9	-2.5		1.5	8	2.3
MIN	96.7		21.28	-2	-8		0.0	0	0.0

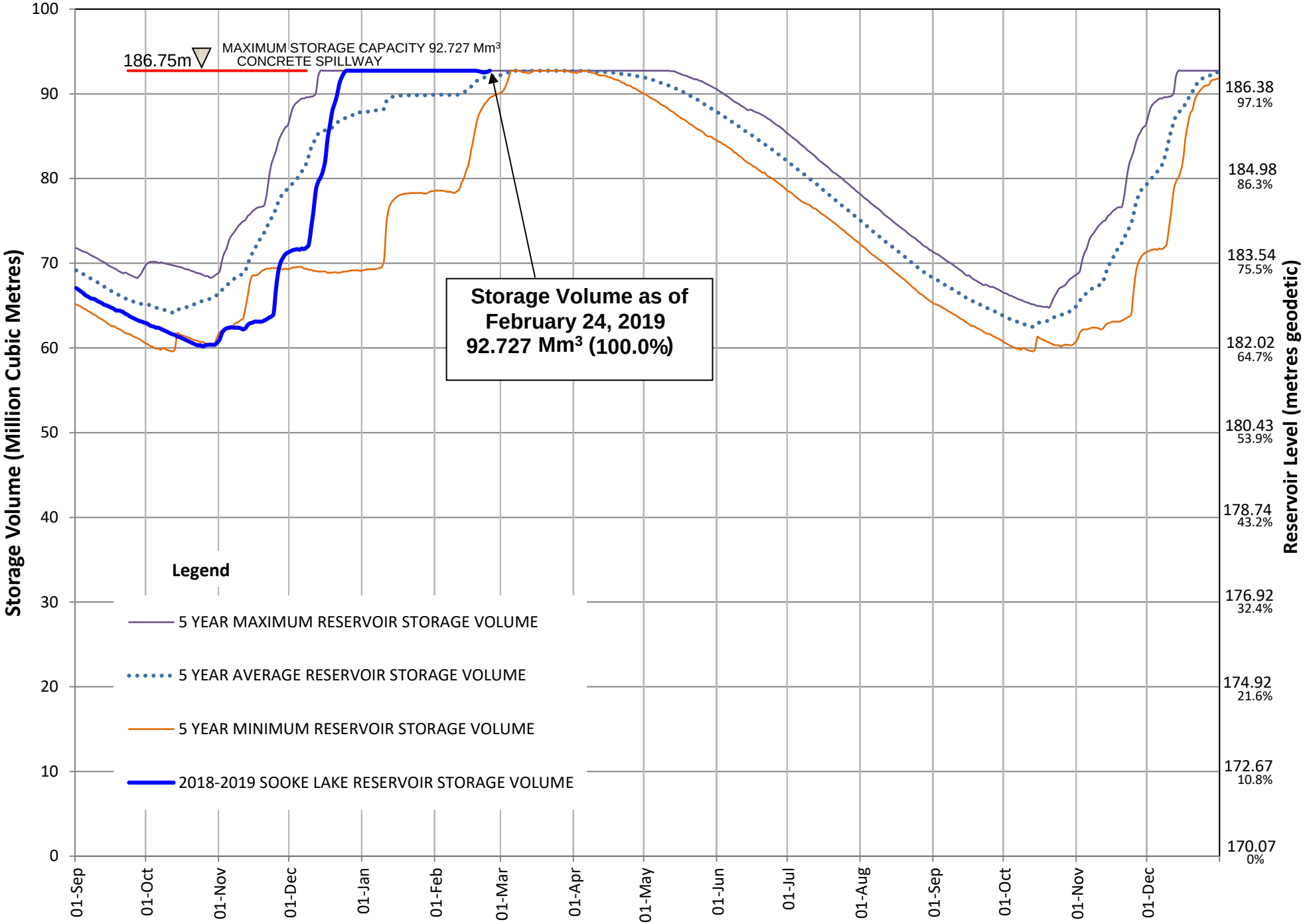
1. ML = Million Litres
2. MIG = Million Imperial Gallons
3. 10% of snow depth applied to rainfall figures for snow to water equivalent.

Average Rainfall for February (1914-2018)	191.8 mm
Actual Rainfall: February	55.2 mm
% of Average	29%
Average Rainfall (1914-2018): Sept 01 - Feb 24	1,225.0 mm
Actual Rainfall (2018-2019): Sept 01 - Feb 24	1,301.7 mm
% of Average	106%

Number days with precip. 0.2 or more
14

Water spilled at Sooke Reservoir to date (since Sept. 1) = 5.30 Billion Imperial Gallons
= 24.10 Billion Litres

SOOKE LAKE RESERVOIR STORAGE SUMMARY
2018 / 2019



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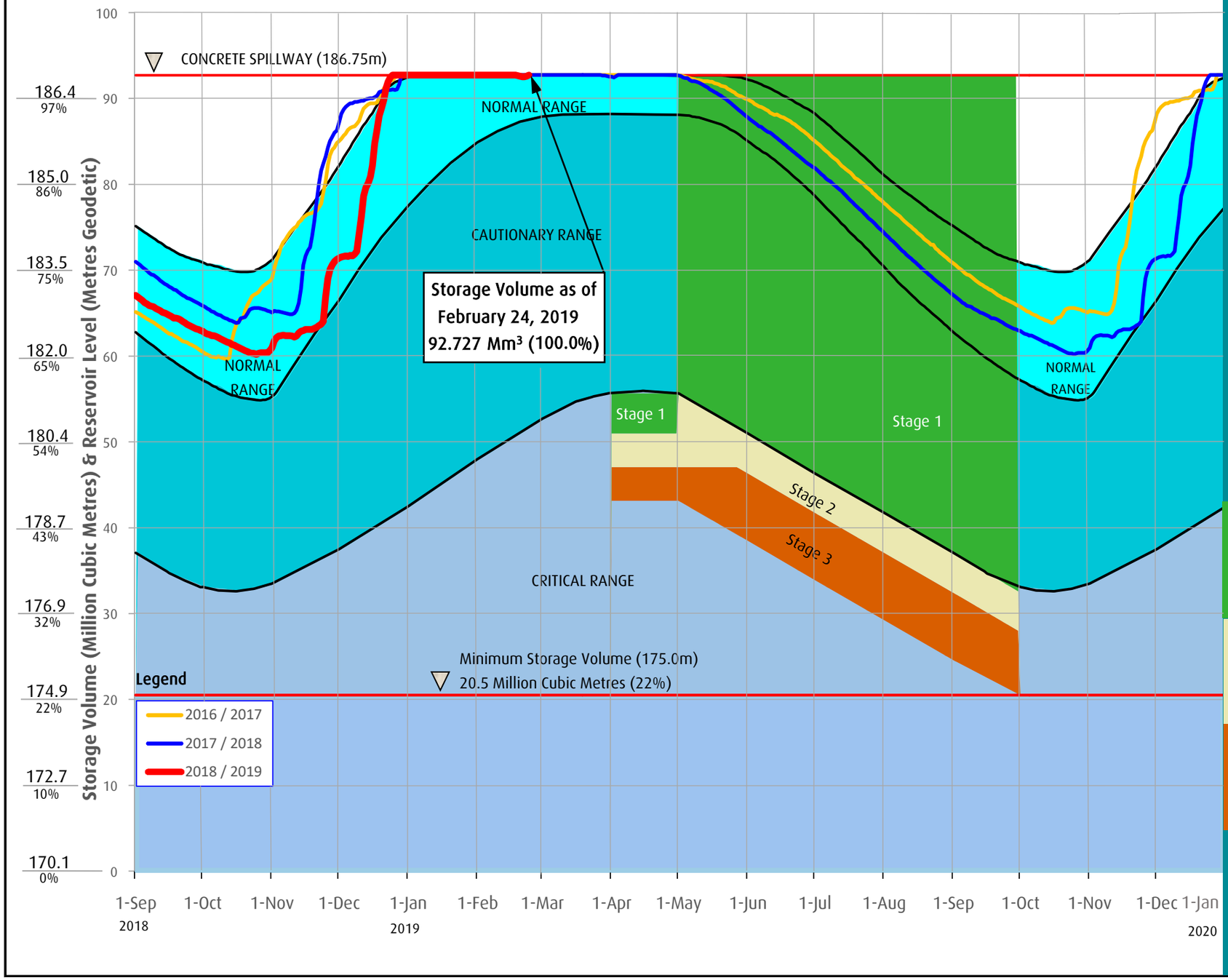
Sooke Lake Reservoir Storage Level
Water Supply Management Plan



FAQs

How are water restriction stages determined?

Several factors are considered when determining water use restriction stages, including,

1. Time of year and typical seasonal water demand trends;
2. Precipitation and temperature conditions and forecasts;
3. Storage levels and storage volumes of water reservoirs (Sooke Lake Reservoir and the Goldstream Reservoirs) and draw down rates;
4. Stream flows and inflows into Sooke Lake Reservoir;
5. Water usage, recent consumption and trends; and customer compliance with restriction;
6. Water supply system performance.

The Regional Water Supply Commision will consider the above factors in making a determination to implement stage 2 or 3 restrictions, under the Water Conservation Bylaw.

At any time of the year and regardless of the water use restriction storage, customers are encouraged to limit discretionary water use in order to maximize the amount of water in the Regional Water Supply System Reservoirs available for nondiscretionary potable water use.

Stage 1 is normally initiated every year from May 1 to September 30 to manage outdoor use during the summer months. During this time, lawn watering is permitted twice a week at different times for even and odd numbered addresses.

Stage 2 Is initiated when it is determined that there is an acute water supply shortage. During this time, lawn water is permitted once a week at different times for even and odd numbered addresses.

Stage 3 Is initiated when it is determined that there is a severe water supply shortage. During this time, lawn watering is not permitted. Other outdoor water use activities are restricted as well.

For more information, visit www.crd.bc.ca/drinkingwater

Making a difference...together

CAPITAL REGIONAL DISTRICT - INTEGRATED WATER SERVICES

Water Watch

Issued April 01, 2019

Water Supply System Summary:

1. Useable Volume in Storage:

Reservoir	March 31 5 Year Ave		March 31/18		March 31/19		% Existing Full Storage
	ML	MIG	ML	MIG	ML	MIG	
Sooke	92,702	20,395	92,604	20,373	92,727	20,400	100.0%
Goldstream	8,863	1,950	8,863	1,950	5,702	1,254	58.0%
Total	101,566	22,344	101,467	22,323	98,429	21,654	96.0%

2. Average Daily Demand:

For the month of March	103.3 MLD	22.87 MIGD
For week ending March 31, 2019	108.8 MLD	23.94 MIGD
Max. day March 2019, to date:	111.1 MLD	25.88 MIGD

3. Average 5 Year Daily Demand for March

Average (2014 - 2018)	97.5 MLD [1]	21.45 MIGD [2]

[1]MLD = Million Litres Per Day [2]MIGD = Million Imperial Gallons Per Day

4. Rainfall March:

Average (1914 - 2018):	162.7 mm
Actual Rainfall to Date	21.0 mm (13% of monthly average)

5. Rainfall: Sep 1- Mar 31

Average (1914 - 2018):	1,412.3 mm
2018 - 2019	1,322.7 mm (94% of average)

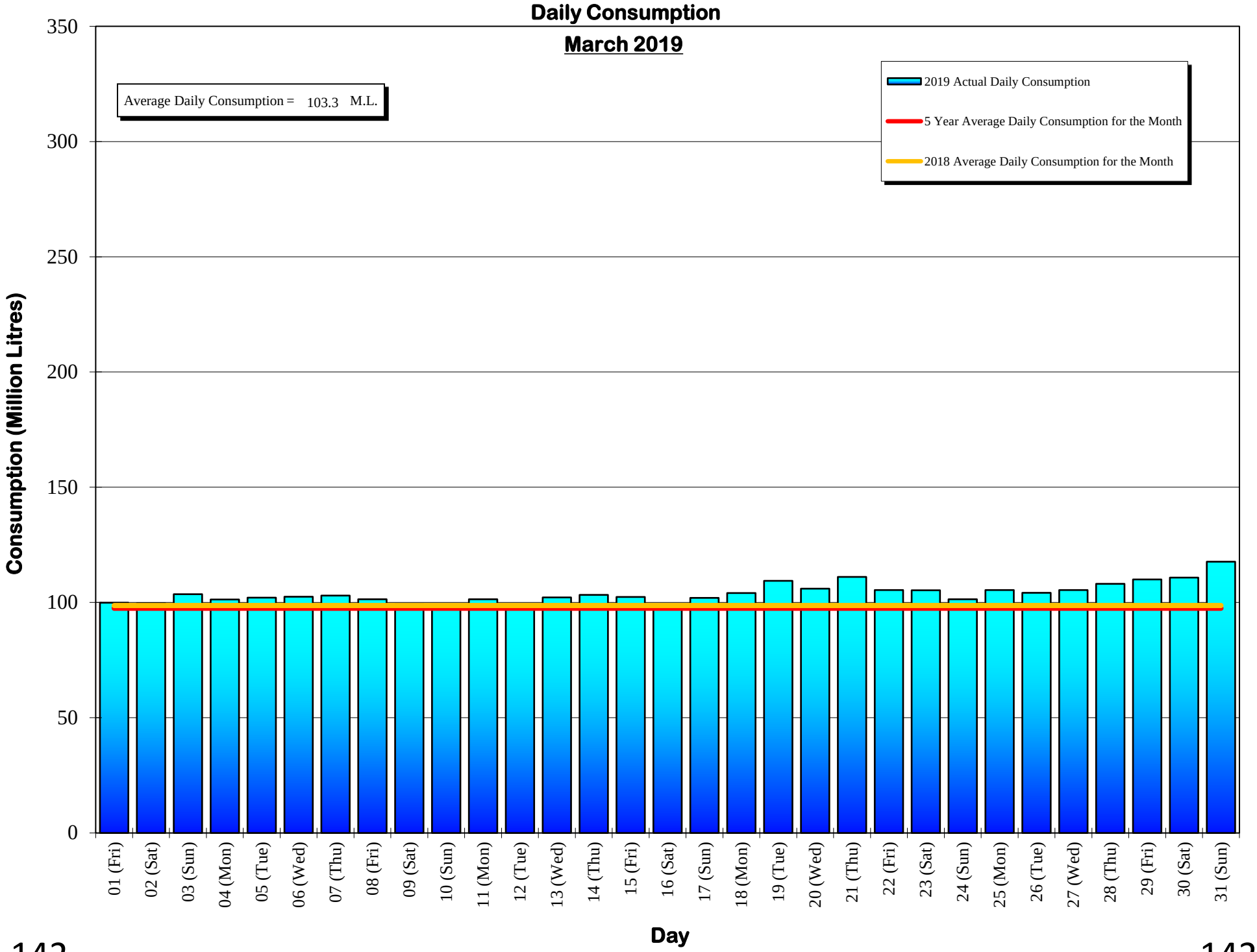
6. Water Conservation Action Required:

If each of us saves a little, together we can save a lot.
Check our website at www.crd.bc.ca/water for more information.

If you require further information, please contact:

Ted Robbins, B.Sc., C.Tech
General Manager, CRD - Integrated Water Services
or
Glenn Harris, Ph D., RPBio
Senior Manager - Environmental Protection

Capital Regional District Integrated Water Services
479 Island Highway
Victoria, BC V9B 1H7
(250) 474-9600


Daily Consumption
March 2019
Average Daily Consumption = 103.3 M.L.
2019 Actual Daily Consumption
5 Year Average Daily Consumption for the Month
2018 Average Daily Consumption for the Month
Consumption (Million Litres)
350
300
250
200
150
100
50
0
01 (Fri)
02 (Sat)
03 (Sun)
04 (Mon)
05 (Tue)
06 (Wed)
07 (Thu)
08 (Fri)
09 (Sat)
10 (Sun)
11 (Mon)
12 (Tue)
13 (Wed)
14 (Thu)
15 (Fri)
16 (Sat)
17 (Sun)
18 (Mon)
19 (Tue)
20 (Wed)
21 (Thu)
22 (Fri)
23 (Sat)
24 (Sun)
25 (Mon)
26 (Tue)
27 (Wed)
28 (Thu)
29 (Fri)
30 (Sat)
31 (Sun)
Day

Daily Consumptions: - March 2019

Date	Total Consumption			Air Temperature @ Japan Gulch		Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am		
	(ML) [1.]		(MIG) [2.]	High (°C)	Low (°C)		Rainfall (mm)	Snowfall [3.] (mm)	Total Precip.
01 (Fri)	99.9		22.0	6	-2	Sunny / P. Cloudy	0.0	0.0	0.0
02 (Sat)	99.7		21.9	7	-2	Sunny / P. Cloudy	0.0	0.0	0.0
03 (Sun)	103.6		22.8	4	-2	Sunny	0.0	0.0	0.0
04 (Mon)	101.3		22.3	4	-3	Sunny	0.0	0.0	0.0
05 (Tue)	102.1		22.5	5	-2	Sunny / P. Cloudy	0.0	0.0	0.0
06 (Wed)	102.5		22.5	5	-3	Cloudy / P. Sunny	0.0	0.0	0.0
07 (Thu)	103.0		22.7	7	-2	Cloudy / Flurries / P. Sunny	0.0	12.7	1.3
08 (Fri)	101.4		22.3	5	-2	Sunny / P. Cloudy	0.0	0.0	0.0
09 (Sat)	99.3		21.8	6	-2	Sunny / P. Cloudy	0.0	0.0	0.0
10 (Sun)	99.1		21.8	9	-2	Sunny	0.0	0.0	0.0
11 (Mon)	101.4		22.3	6	0	Cloudy / Showers	14.7	0.0	14.7
12 (Tue)	98.2		21.6	8	0	Cloudy / P. Sunny	0.0	0.0	0.0
13 (Wed)	102.2		22.5	8	0	Cloudy / Showers / P. Sunny	0.3	0.0	0.3
14 (Thu)	103.3		22.7	9	1	Cloudy / Showers / P. Sunny	1.3	0.0	1.3
15 (Fri)	102.4		22.5	12	2	Cloudy / Showers / P. Sunny	0.3	0.0	0.3
16 (Sat)	97.4	<=Min	21.4	13	1	Sunny / P. Cloudy	0.0	0.0	0.0
17 (Sun)	102.0		22.4	15	1	Sunny	0.0	0.0	0.0
18 (Mon)	104.1		22.9	19	3	Sunny	0.0	0.0	0.0
19 (Tue)	109.4		24.1	19	3	Sunny	0.0	0.0	0.0
20 (Wed)	106.0		23.3	21	4	Sunny	0.0	0.0	0.0
21 (Thu)	111.1		24.4	18	4	Sunny / P. Cloudy	0.0	0.0	0.0
22 (Fri)	105.4		23.2	13	5	Sunny / P. Cloudy	0.0	0.0	0.0
23 (Sat)	105.3		23.2	13	4	Cloudy / Showers / P. Sunny	0.3	0.0	0.3
24 (Sun)	101.4		22.3	14	2	Sunny / P. Cloudy	0.0	0.0	0.0
25 (Mon)	105.4		23.2	12	3	Cloudy / Showers / P. Sunny	1.5	0.0	1.5
26 (Tue)	104.2		22.9	12	2	Cloudy / Showers / P. Sunny	1.3	0.0	1.3
27 (Wed)	105.4		23.2	14	2	Cloudy / P. Sunny	0.0	0.0	0.0
28 (Thu)	108.1		23.8	15	4	Sunny / P. Cloudy	0.0	0.0	0.0
29 (Fri)	110.0		24.2	16	3	Sunny	0.0	0.0	0.0
30 (Sat)	110.8		24.4	16	3	Sunny	0.0	0.0	0.0
31 (Sun)	117.7	<=Max	25.9	17	4	Sunny	0.0	0.0	0.0
TOTAL	2994.6 ML		658.8 MIG				19.7	13	21.0
MAX	111.1		25.88	21	5		14.7	13	14.7
AVE	**103.3**		22.87	11.2	0.9		0.6	0	0.7
MIN	97.4		21.42	4	-3		0.0	0	0.0

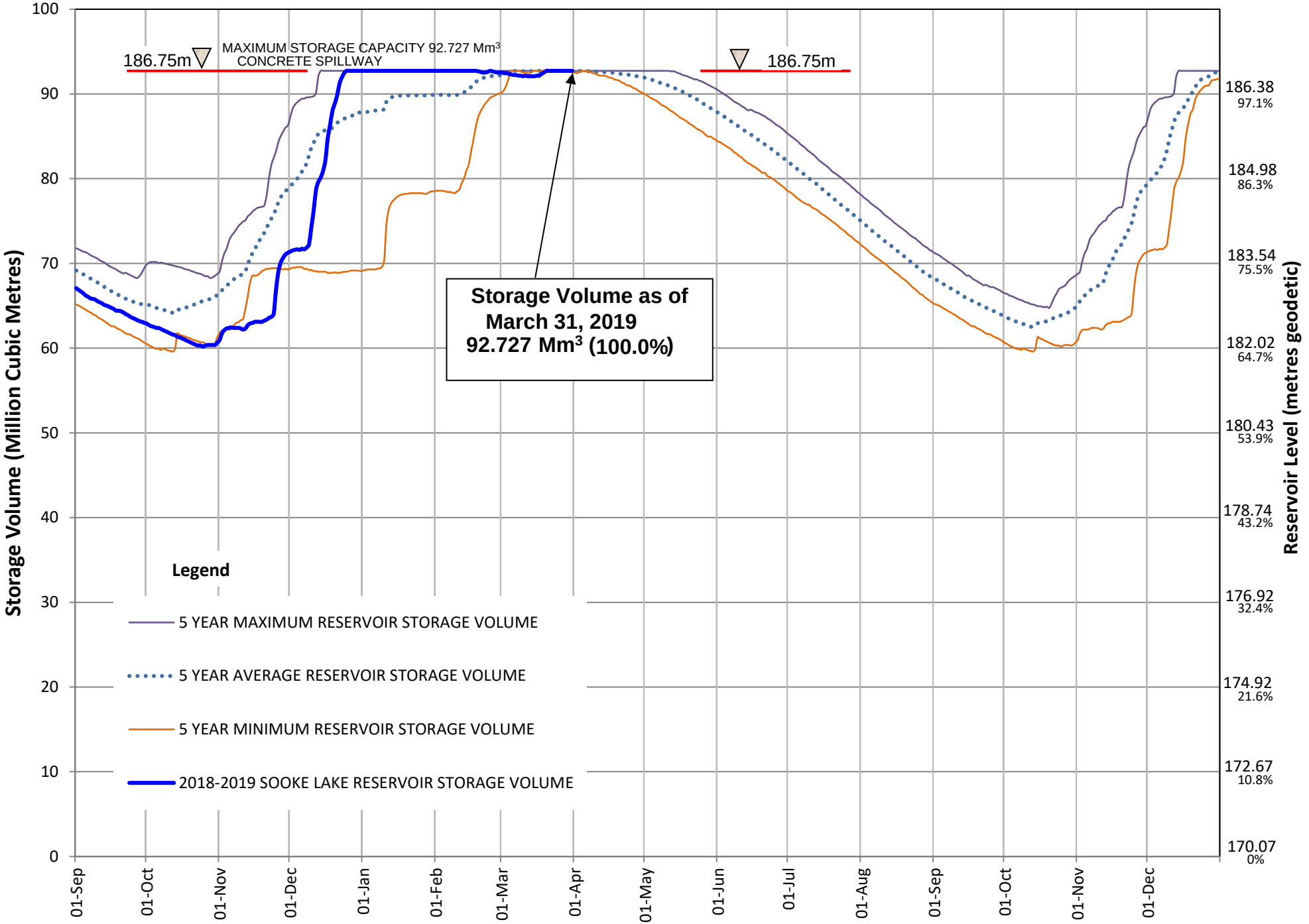
1. ML = Million Litres 2. MIG = Million Imperial Gallons 3. 10% of snow depth applied to rainfall figures for snow to water equivalent.

Average Rainfall for March (1914-2018)	162.7	mm
Actual Rainfall: March	21.0	mm
% of Average	13%	
Average Rainfall (1914-2018): Sept 01 - Mar 31	1,412.3	mm
Actual Rainfall (2018-2019): Sept 01 - Mar 31	1,322.7	mm
% of Average	94%	

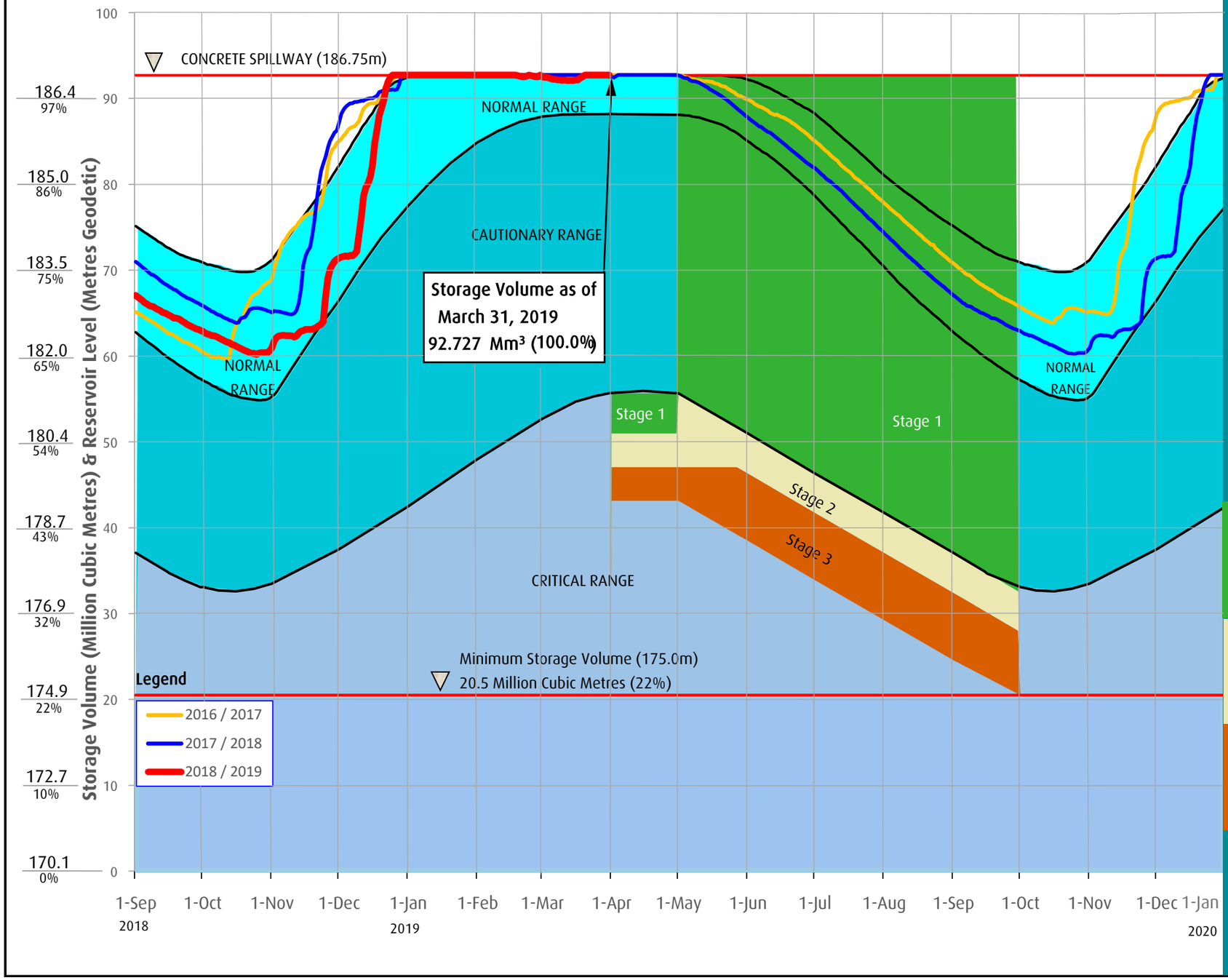
Number days with precip. 0.2 or more
8

Water spilled at Sooke Reservoir to date (since Sept. 1) = 5.38 Billion Imperial Gallons
= 24.50 Billion Litres

SOOKE LAKE RESERVOIR STORAGE SUMMARY
2018 / 2019



Sooke Lake Reservoir Storage Level
Water Supply Management Plan



FAQs

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3. Storage levels and storage volumes of water reservoirs (Sooke Lake Reservoir and the Goldstream Reservoirs) and draw down rates;
4. Stream flows and inflows into Sooke Lake Reservoir;
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Stage 1 is normally initiated every year from May 1 to September 30 to manage outdoor use during the summer months. During this time, lawn watering is permitted twice a week at different times for even and odd numbered addresses.

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Making a difference...together

CAPITAL REGIONAL DISTRICT - INTEGRATED WATER SERVICES

Water Watch

Issued April 29, 2019

Water Supply System Summary:

1. Useable Volume in Storage:

Reservoir	April 30 5 Year Ave		April 30/18		April 28/19		% Existing Full Storage
	ML	MIG	ML	MIG	ML	MIG	
Sooke	91,972	20,234	92,727	20,400	92,235	20,292	99.5%
Goldstream	8,651	1,903	8,651	1,903	5,748	1,265	58.5%
Total	100,623	22,137	101,378	22,303	97,984	21,556	95.5%

2. Average Daily Demand:

For the month of April	111.9 MLD	24.62 MIGD
For week ending April 28, 2019	116.7 MLD	25.67 MIGD
Max. day April 2019, to date:	125.3 MLD	27.56 MIGD

3. Average 5 Year Daily Demand for April

Average (2014 - 2018) 106.8 MLD [1] 23.50 MIGD [2]

[1]MLD = Million Litres Per Day [2]MIGD = Million Imperial Gallons Per Day

4. Rainfall April:

Average (1914 - 2018): 89.5 mm

Actual Rainfall to Date 90.8 mm (101% of monthly average)

5. Rainfall: Sep 1- Apr 28

Average (1914 - 2018): 1,495.7 mm

2018 - 2019 1,413.5 mm (95% of average)

6. Water Conservation Action Required:

If each of us saves a little, together we can save a lot.
Check our website at www.crd.bc.ca/water for more information.

If you require further information, please contact:

Ted Robbins, B.Sc., C.Tech
General Manager, CRD - Integrated Water Services
or
Glenn Harris, Ph D., RPBio
Senior Manager - Environmental Protection

Capital Regional District Integrated Water Services
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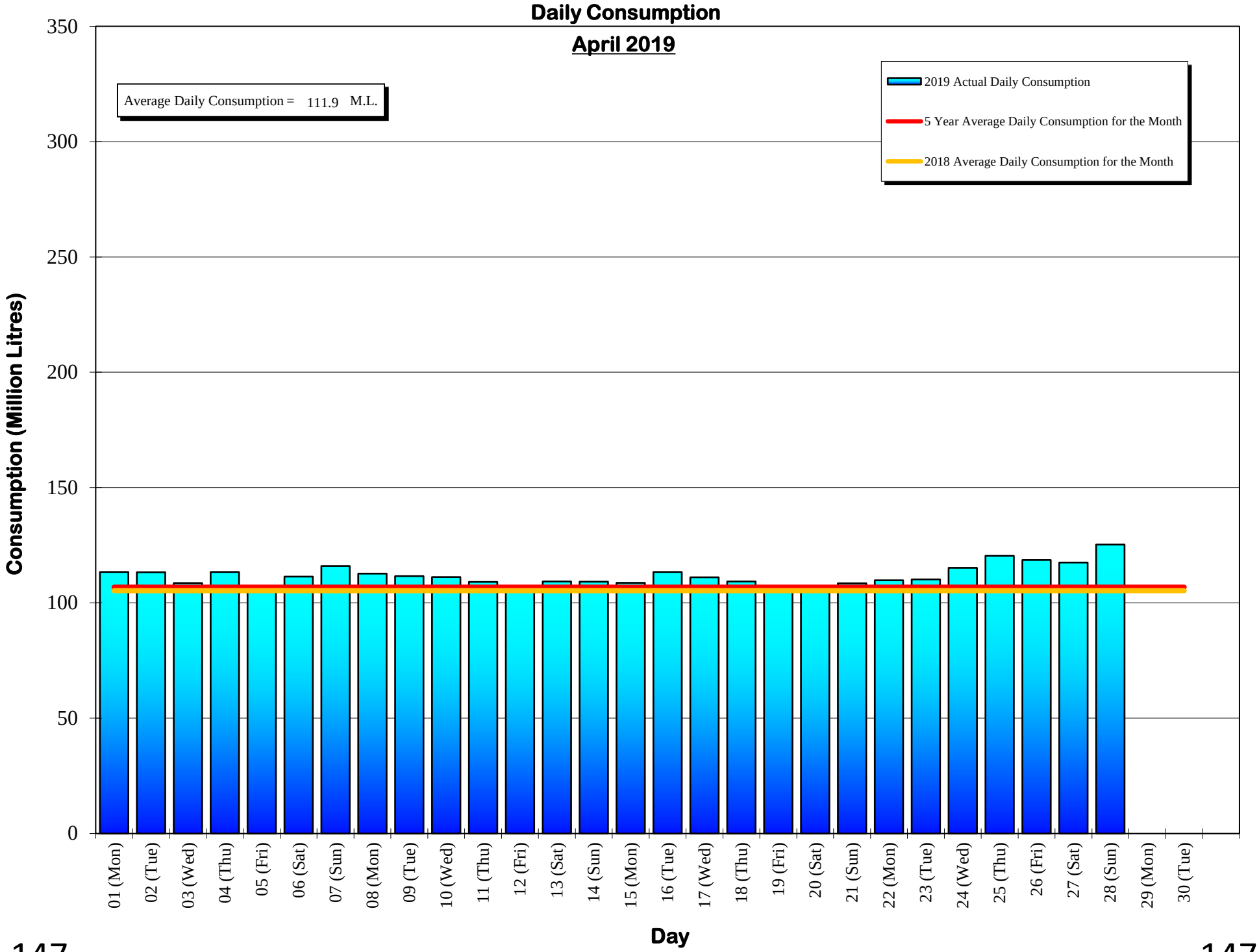
Daily Consumption
April 2019
Average Daily Consumption = 111.9 M.L.
2019 Actual Daily Consumption
5 Year Average Daily Consumption for the Month
2018 Average Daily Consumption for the Month
Consumption (Million Litres)
350
300
250
200
150
100
50
0
01 (Mon)
02 (Tue)
03 (Wed)
04 (Thu)
05 (Fri)
06 (Sat)
07 (Sun)
08 (Mon)
09 (Tue)
10 (Wed)
11 (Thu)
12 (Fri)
13 (Sat)
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15 (Mon)
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18 (Thu)
19 (Fri)
20 (Sat)
21 (Sun)
22 (Mon)
23 (Tue)
24 (Wed)
25 (Thu)
26 (Fri)
27 (Sat)
28 (Sun)
29 (Mon)
30 (Tue)
Day

Daily Consumptions: - April 2019

Date	Total Consumption (ML) [1.]		Total Consumption (MIG) [2.]	Air Temperature @ Japan Gulch High (°C)	Air Temperature @ Japan Gulch Low (°C)	Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am Rainfall (mm)	Precipitation @ Sooke Res.: 12:00am to 12:00am Snowfall [3.] (mm)	Precipitation @ Sooke Res.: 12:00am to 12:00am Total Precip.
01 (Mon)	113.4		25.0	18	4	Sunny / P. Cloudy	0.0	0.0	0.0
02 (Tue)	113.3		24.9	19	7	Sunny / P. Cloudy / Showers	0.5	0.0	0.5
03 (Wed)	108.6		23.9	12	8	Cloudy / Showers / P. Sunny	6.6	0.0	6.6
04 (Thu)	113.4		25.0	14	7	Sunny / P. Cloudy / Showers	0.8	0.0	0.8
05 (Fri)	107.2		23.6	14	6	Sunny / P. Cloudy / Showers	1.3	0.0	1.3
06 (Sat)	111.4		24.5	10	5	Cloudy / Showers / P. Sunny	8.6	0.0	8.6
07 (Sun)	116.0		25.5	13	3	Sunny / P. Cloudy / Showers	0.5	0.0	0.5
08 (Mon)	112.7		24.8	10	4	Cloudy / Rain	16.3	0.0	16.3
09 (Tue)	111.6		24.5	12	5	Sunny / P. Cloudy / Showers	0.3	0.0	0.3
10 (Wed)	111.2		24.5	11	6	Cloudy / Showers	2.5	0.0	2.5
11 (Thu)	109.1		24.0	9	5	Cloudy / Showers	3.3	0.0	3.3
12 (Fri)	106.1	<=Min	23.3	12	6	Cloudy / Showers	0.3	0.0	0.3
13 (Sat)	109.3		24.0	8	5	Cloudy / Rain	16.0	0.0	16.0
14 (Sun)	109.2		24.0	8	3	Cloudy / Showers	0.3	0.0	0.3
15 (Mon)	108.7		23.9	11	3	Cloudy / P. Sunny	0.0	0.0	0.0
16 (Tue)	113.4		24.9	12	4	Cloudy / Showers / P. Sunny	0.5	0.0	0.5
17 (Wed)	111.1		24.4	15	7	Cloudy / Showers / P. Sunny	2.0	0.0	2.0
18 (Thu)	109.3		24.0	12	9	Cloudy / Rain	21.1	0.0	21.1
19 (Fri)	106.3		23.4	17	7	Cloudy / Showers / P. Sunny	1.5	0.0	1.5
20 (Sat)	106.4		23.4	17	5	Sunny / P. Cloudy	0.0	0.0	0.0
21 (Sun)	108.5		23.9	16	5	Sunny / P. Cloudy	0.0	0.0	0.0
22 (Mon)	109.8		24.1	10	7	Cloudy / Showers	7.9	0.0	7.9
23 (Tue)	110.2		24.2	14	5	Sunny / P. Cloudy / Showers	0.5	0.0	0.5
24 (Wed)	115.2		25.3	14	5	Sunny / P. Cloudy	0.0	0.0	0.0
25 (Thu)	120.4		26.5	16	3	Sunny	0.0	0.0	0.0
26 (Fri)	118.6		26.1	13	5	Sunny / P. Cloudy	0.0	0.0	0.0
27 (Sat)	117.5		25.9	12	3	Cloudy / P. Sunny	0.0	0.0	0.0
28 (Sun)	125.3	<=Max	27.6	16	1	Sunny	0.0	0.0	0.0
29 (Mon)									
30 (Tue)									
TOTAL	3133.2 ML		689.32 MIG				90.8	0	90.8
MAX	125.3		27.56	19	9		21.1	0	21.1
AVE	**111.9**		24.62	13.0	5.1		3.2	0	3.2
MIN	106.1		23.34	8	1		0.0	0	0.0

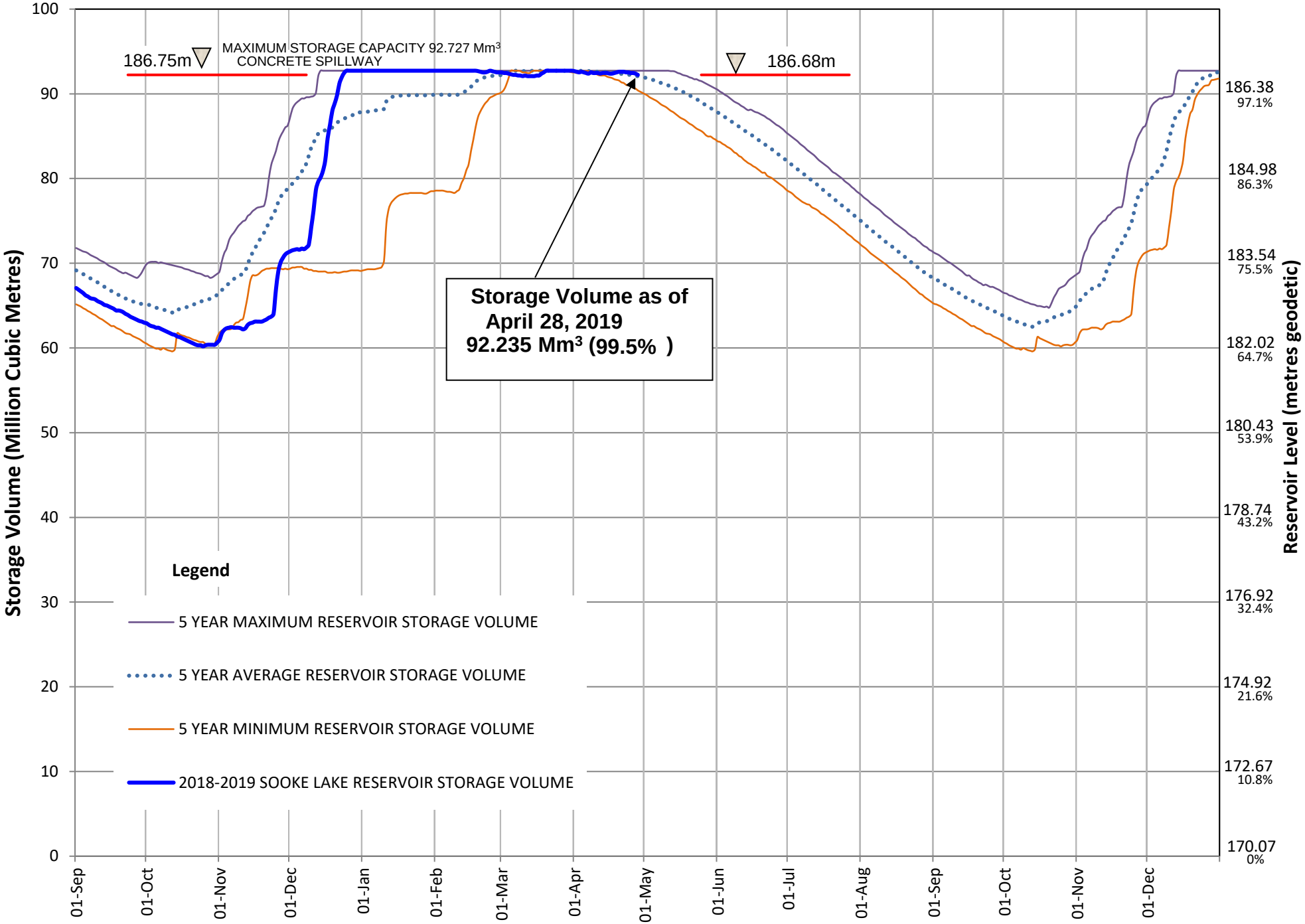
1. ML = Million Litres 2. MIG = Million Imperial Gallons 3. 10% of snow depth applied to rainfall figures for snow to water equivalent.

Average Rainfall for April (1914-2018)	89.5	mm
Actual Rainfall: April	90.8	mm
% of Average	101%	
Average Rainfall (1914-2018): Sept 01 - Apr 28	1,495.7	mm
Actual Rainfall (2018-2019): Sept 01 - Apr 28	1,413.5	mm
% of Average	95%	

Number days with precip. 0.2 or more
19

Water spilled at Sooke Reservoir to date (since Sept. 1) = 5.38 Billion Imperial Gallons
= 24.50 Billion Litres

SOOKE LAKE RESERVOIR STORAGE SUMMARY
2018 / 2019



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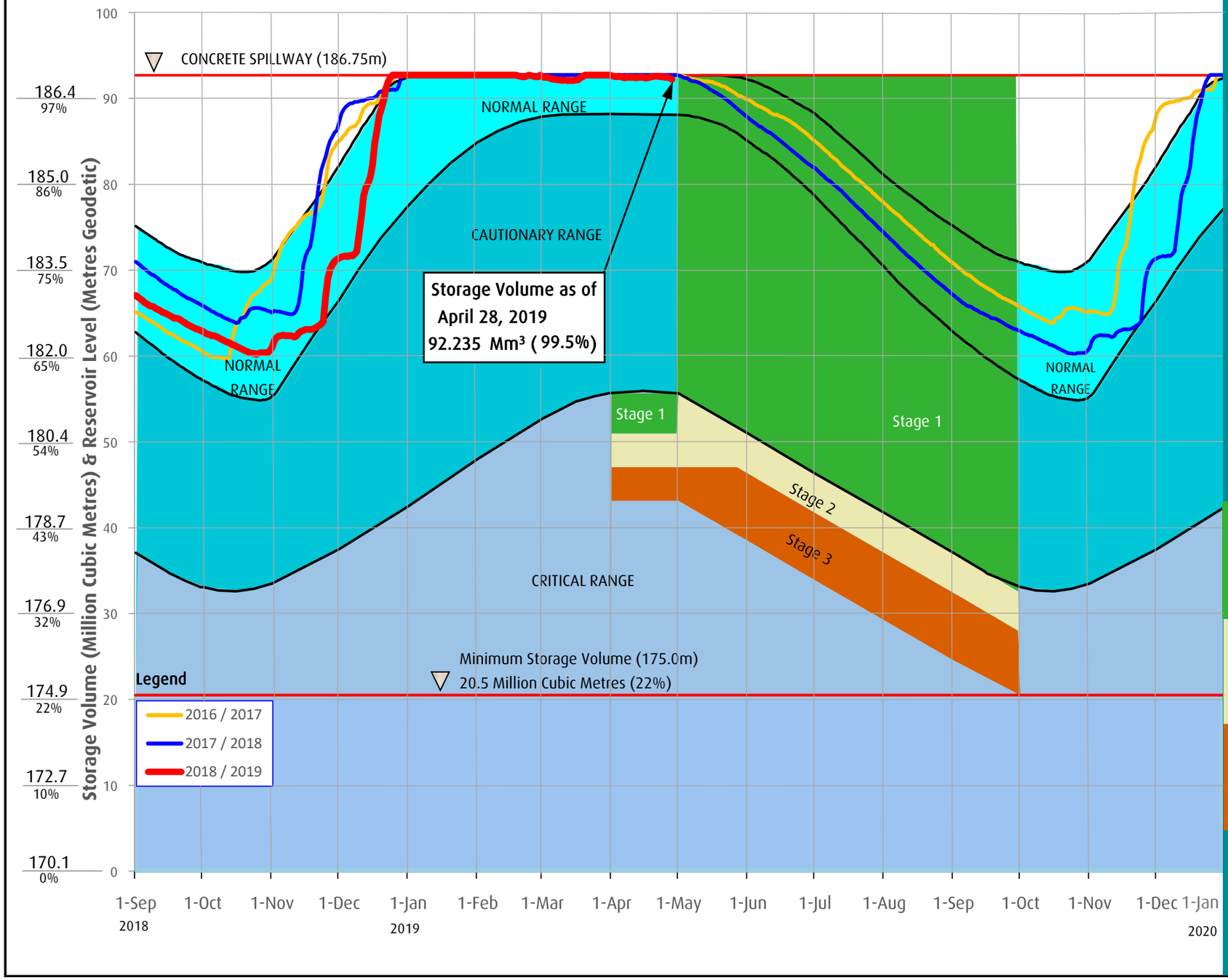
Sooke Lake Reservoir Storage Level

Water Supply Management Plan



FAQs

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CAPITAL REGIONAL DISTRICT - INTEGRATED WATER SERVICES

Water Watch

Issued May 13, 2019

Water Supply System Summary:

1. Useable Volume in Storage:

Reservoir	May 31 5 Year Ave		May 31/18		May 12/19		% Existing Full Storage
	ML	MIG	ML	MIG	ML	MIG	
Sooke	87,987	19,357	88,210	19,406	90,179	19,839	97.3%
Goldstream	8,123	1,787	8,123	1,787	5,743	1,263	58.5%
Total	96,110	21,144	96,333	21,193	95,922	21,103	93.5%

2. Average Daily Demand:

For the month of May	170.4 MLD	37.48 MIGD
For week ending May 12, 2019	188.5 MLD	41.47 MIGD
Max. day May 2019, to date:	199.8 MLD	43.96 MIGD

3. Average 5 Year Daily Demand for May

Average (2014 - 2018)	148.4 MLD [1]	32.64 MIGD [2]

[1]MLD = Million Litres Per Day [2]MIGD = Million Imperial Gallons Per Day

4. Rainfall May:

Average (1914 - 2018):	47.9 mm
Actual Rainfall to Date	0.0 mm (0% of monthly average)

5. Rainfall: Sep 1- May 12

Average (1914 - 2018):	1,521.1 mm
2018 - 2019	1,413.5 mm (93% of average)

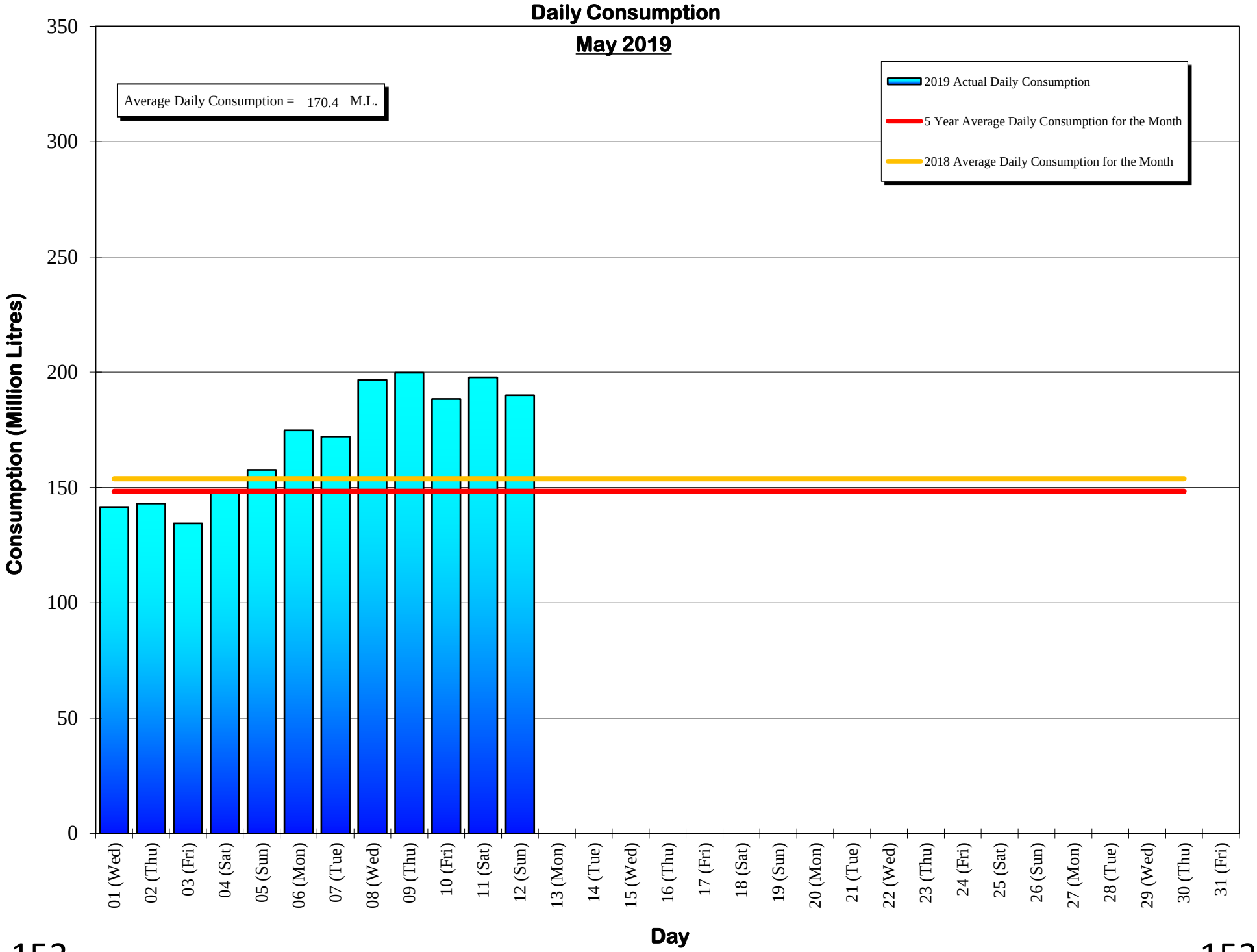
6. Water Conservation Action Required:

CRD's Stage 1 Water Conservation Bylaw is now in effect through to September 30, 2019.
Visit www.crd.bc.ca/water for scheduling information.

If you require further information, please contact:

Ted Robbins, B.Sc., C.Tech
General Manager, CRD - Integrated Water Services
or
Glenn Harris, Ph D., RPBio
Senior Manager - Environmental Protection

Capital Regional District Integrated Water Services
479 Island Highway
Victoria, BC V9B 1H7
(250) 474-9600


Daily Consumption
May 2019
Average Daily Consumption = 170.4 M.L.
2019 Actual Daily Consumption
5 Year Average Daily Consumption for the Month
2018 Average Daily Consumption for the Month
Consumption (Million Litres)
350
300
250
200
150
100
50
0
01 (Wed)
02 (Thu)
03 (Fri)
04 (Sat)
05 (Sun)
06 (Mon)
07 (Tue)
08 (Wed)
09 (Thu)
10 (Fri)
11 (Sat)
12 (Sun)
13 (Mon)
14 (Tue)
15 (Wed)
16 (Thu)
17 (Fri)
18 (Sat)
19 (Sun)
20 (Mon)
21 (Tue)
22 (Wed)
23 (Thu)
24 (Fri)
25 (Sat)
26 (Sun)
27 (Mon)
28 (Tue)
29 (Wed)
30 (Thu)
31 (Fri)
Day

Daily Consumptions: - May 2019

Date	Total Consumption (ML) [1.]		Total Consumption (MIG) [2.]	Air Temperature @ Japan Gulch High (°C)	Air Temperature @ Japan Gulch Low (°C)	Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am Rainfall (mm)	Precipitation @ Sooke Res.: 12:00am to 12:00am Snowfall [3.] (mm)	Precipitation @ Sooke Res.: 12:00am to 12:00am Total Precip.
01 (Wed)	141.6		31.2	15	4	Sunny	0.0	0.0	0.0
02 (Thu)	143.1		31.5	14	6	Sunny / P. Cloudy	0.0	0.0	0.0
03 (Fri)	134.5	<=Min	29.6	14	5	Sunny / P. Cloudy	0.0	0.0	0.0
04 (Sat)	148.0		32.6	18	6	Sunny	0.0	0.0	0.0
05 (Sun)	157.7		34.7	20	7	Sunny	0.0	0.0	0.0
06 (Mon)	174.8		38.4	22	7	Sunny	0.0	0.0	0.0
07 (Tue)	172.1		37.9	22	8	Sunny	0.0	0.0	0.0
08 (Wed)	196.7		43.3	23	9	Sunny	0.0	0.0	0.0
09 (Thu)	199.8	<=Max	44.0	26	11	Sunny	0.0	0.0	0.0
10 (Fri)	188.4		41.4	27	11	Sunny	0.0	0.0	0.0
11 (Sat)	197.8		43.5	28	12	Sunny	0.0	0.0	0.0
12 (Sun)	190.0		41.8	19	9	Sunny / Overcast	0.0	0.0	0.0
13 (Mon)									
14 (Tue)									
15 (Wed)									
16 (Thu)									
17 (Fri)									
18 (Sat)									
19 (Sun)									
20 (Mon)									
21 (Tue)									
22 (Wed)									
23 (Thu)									
24 (Fri)									
25 (Sat)									
26 (Sun)									
27 (Mon)									
28 (Tue)									
29 (Wed)									
30 (Thu)									
31 (Fri)									
TOTAL	2044.5 ML		449.78 MIG				0.0	0	0.0
MAX	199.8		43.96	28	12		0.0	0	0.0
AVE	**170.4**		37.48	20.7	7.9		0.0	0	0.0
MIN	134.5		29.59	14	4		0.0	0	0.0

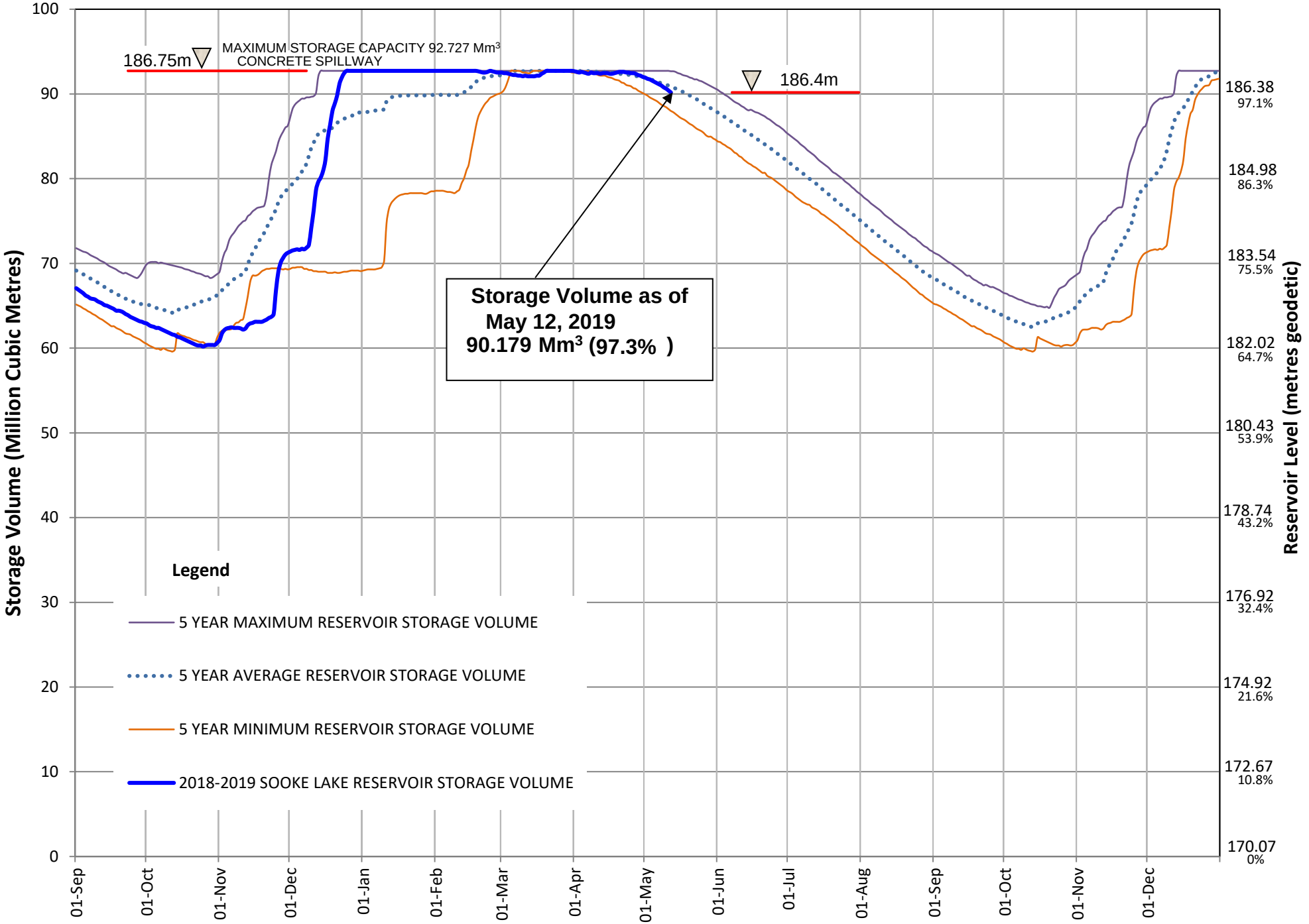
1. ML = Million Litres 2. MIG = Million Imperial Gallons 3. 10% of snow depth applied to rainfall figures for snow to water equivalent.

Average Rainfall for May (1914-2018)	47.9	mm
Actual Rainfall: May	0.0	mm
% of Average	0%	
Average Rainfall (1914-2018): Sept 01 - May 12	1,521.1	mm
Actual Rainfall (2018-2019): Sept 01 - May 12	1,413.5	mm
% of Average	93%	

Number days with precip. 0.2 or more
0

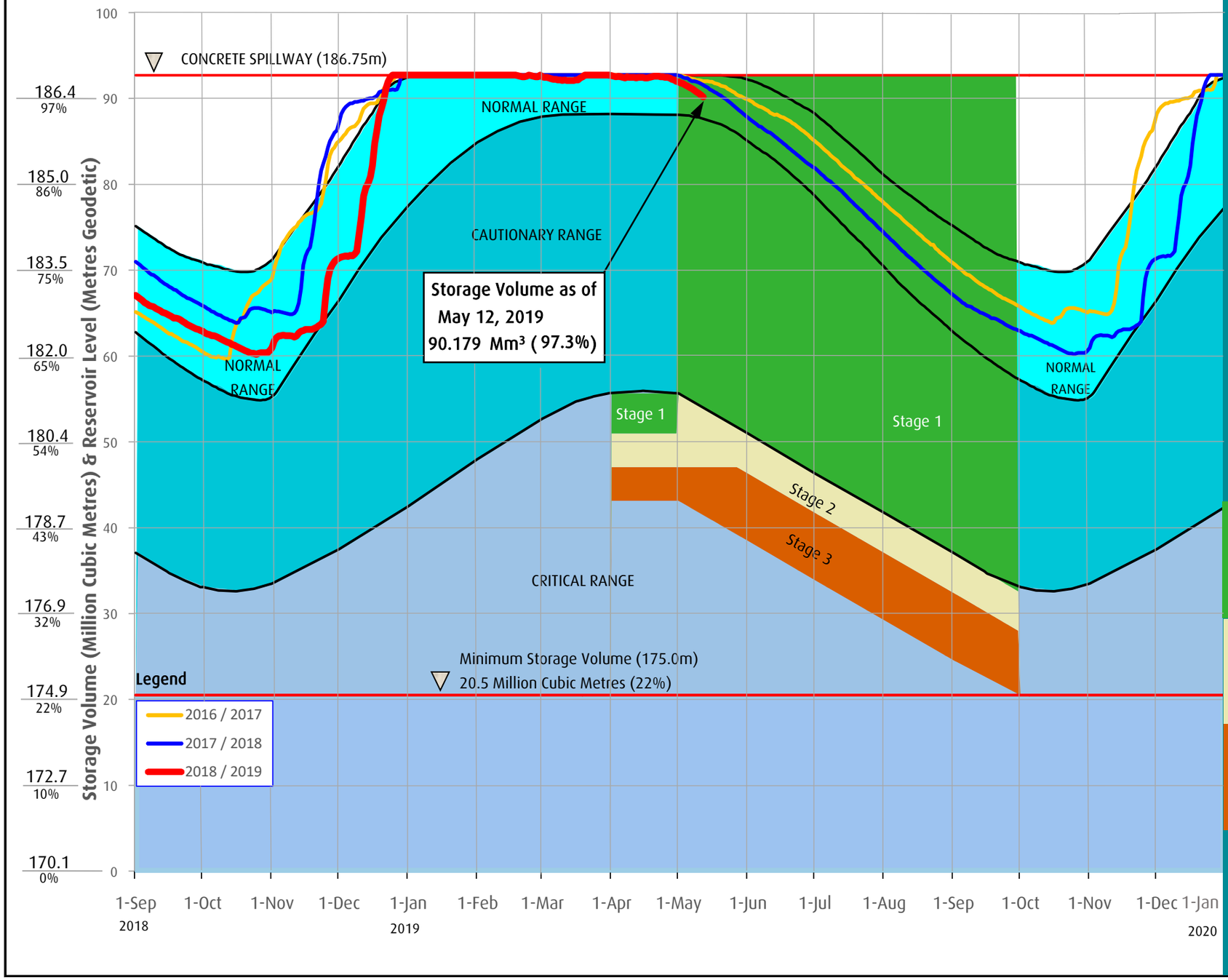
Water spilled at Sooke Reservoir to date (since Sept. 1) = 5.38 Billion Imperial Gallons
= 24.50 Billion Litres

SOOKE LAKE RESERVOIR STORAGE SUMMARY
2018 / 2019



Sooke Lake Reservoir Storage Level

Water Supply Management Plan



FAQs

How are water restriction stages determined?

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