

Columbia Update: April 2019

FY18

- ✓ **Kootenay Flood Risk**
- ✓ **Dry Summer**
- ✓ **Record Forest Fires**

FY19

- ✓ **Higher Kootenay Flood Risk**
- ✓ **Drier and Hotter Summer**
- ✓ **More Record Forest Fires**
- ✓ **Gas Failure**
- ✓ **High MDC Prices**
- ✓ **Record Cold Feb and Early Mar**
- ✓ **Lower Reservoir Levels**

FY20

- ✓ **Below Average Snowpack**
- ✓ **...?**

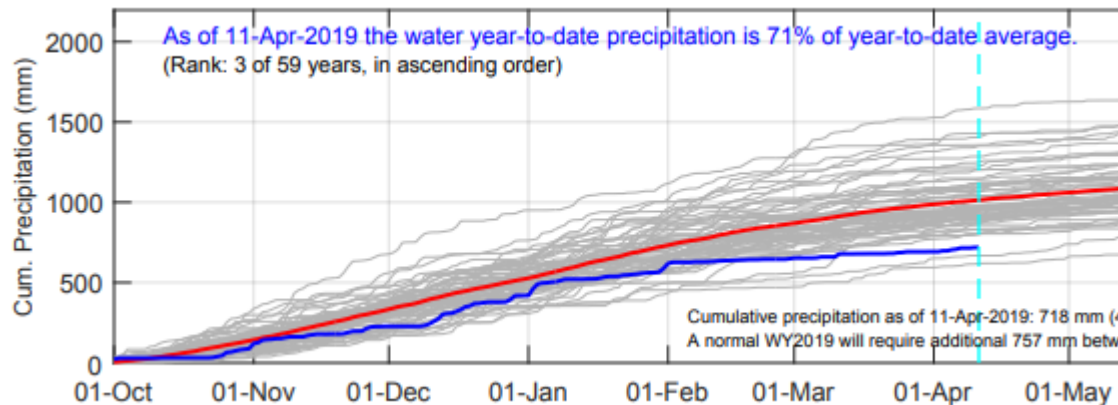
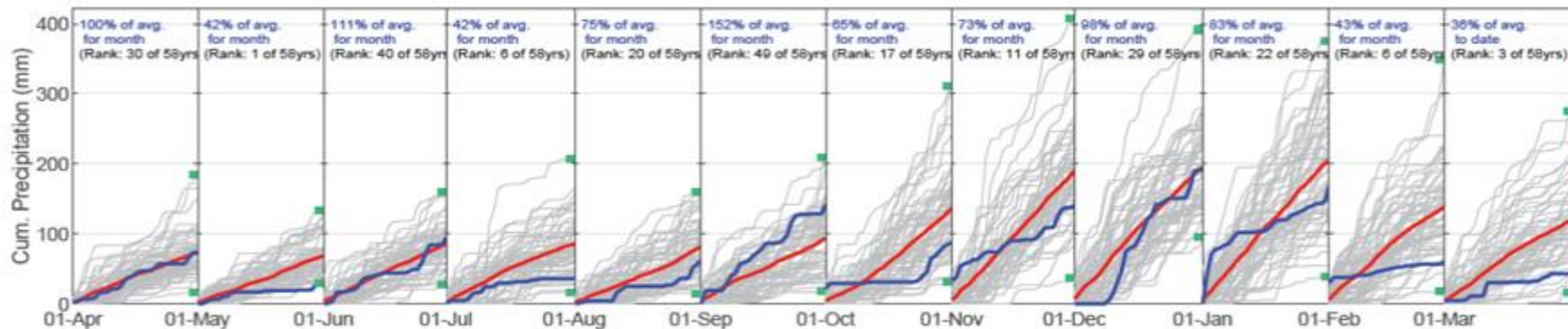


Basin Inflows: Tracking Below Average

Mica

Current Year starts on 2018-04-01

Updated 16-Apr-2019 07:57:07



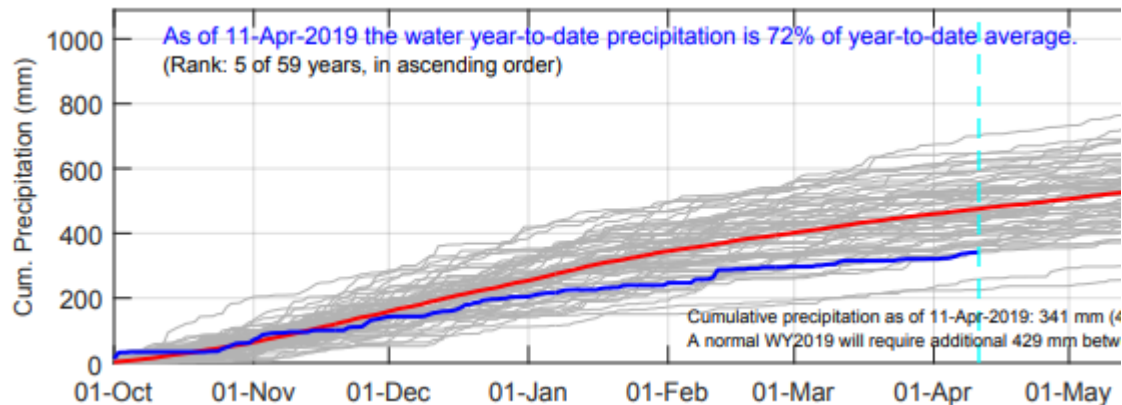
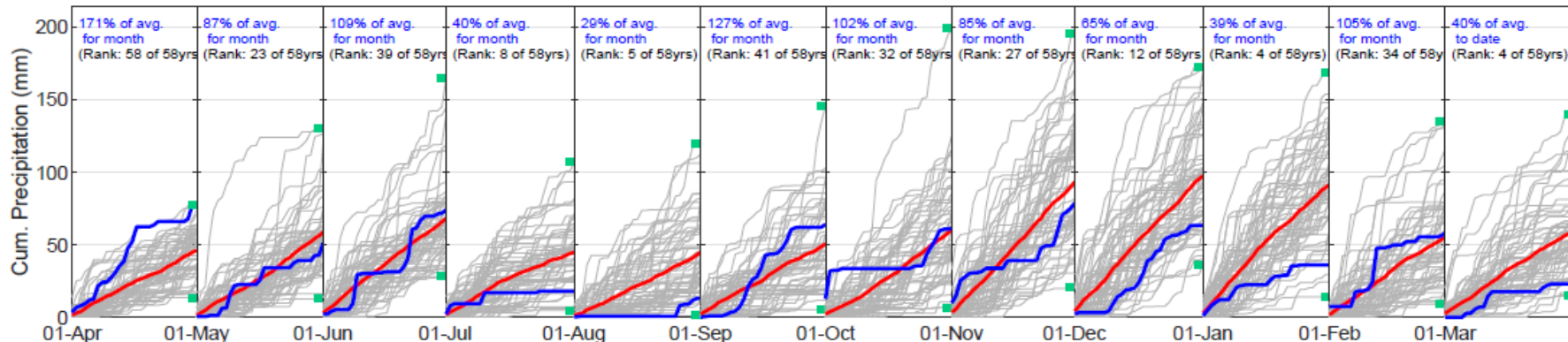
- Below average precip:
 - May: Lowest on record
 - Jul, Oct, Nov, Jan, Feb, and Mar.

Basin Inflows: Tracking Below Average

Kootenay

Current Year starts on 2018-04-01

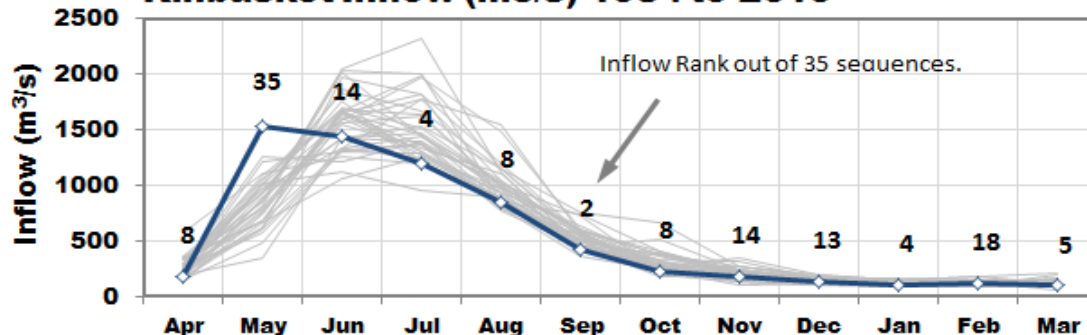
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- Below average precip:
 - Jul, Aug, Nov, Dec, Jan, and Mar.

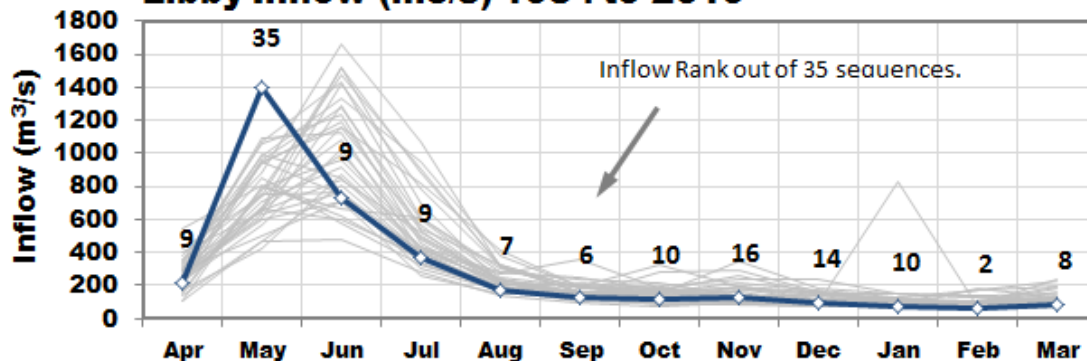
Basin Inflows: Tracking Below Average

Kinbasket Inflow (m³/s) 1984 to 2019



- Well below average inflows, all months, except May.
- May, with the above average temp and short intense snow melt, was record high.
- Similar pattern in most BC Hydro basins, except Coastal and Lower Mainland.

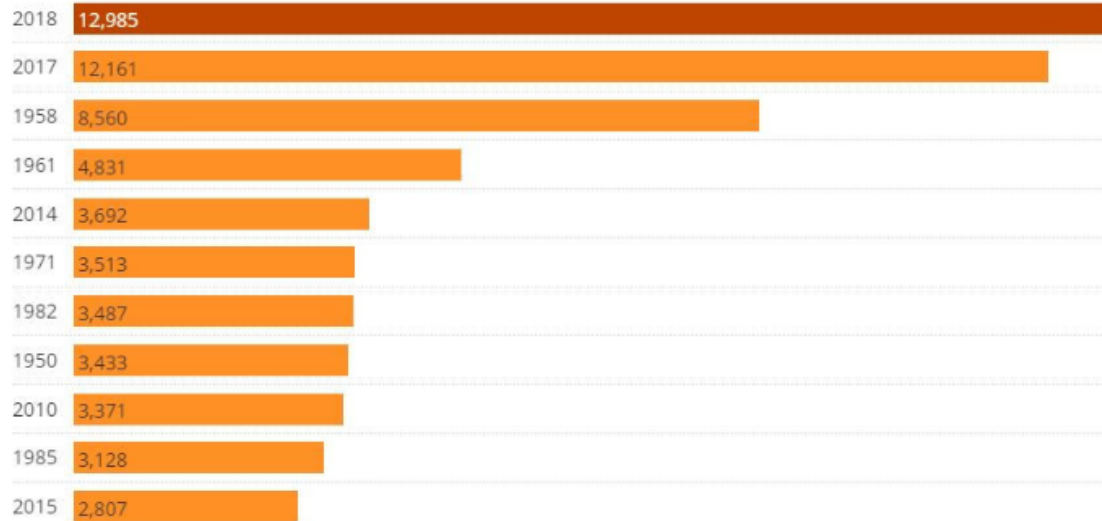
Libby Inflow (m³/s) 1984 to 2019



Wildfires FY19

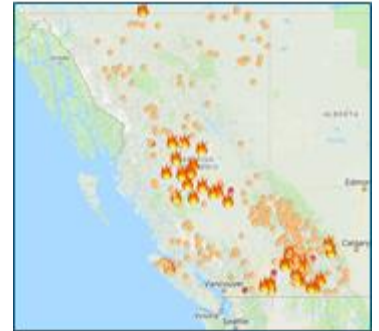
Top 10 fire seasons in B.C. since 1950

Chart shows number of square kilometres burned in wildfires each season. Does not include false alarms, nuisance fires or training fires.



2018 data is current as of Aug. 29

Source: BC Wildfire Service Sept 5, 2018



Dec/Jan Coastal and Lower Mainland

'Most damaging' storm by the numbers

750,000 Number of customers affected

900 Personnel needed for repairs

1,900 Spans of wire **390** Power poles

700 Cross-arms **230** Transformers



December storm 'most damaging' in BC Hydro's history, report says

750,000 BC Hydro customers lost power after winds ripped through South Coast

CBC News · Posted: Jan 02, 2019 5:56 AM PT | Last Updated: January 2



Firefighters survey damage in Maple Ridge during the storm on Dec. 20. (Shane Mackichan)

Cold February

Average daily temp was just 0.3 C compared to 30 year average of 4.9 C

CBC News - Posted: Mar 01, 2019 1:19 PM PT | Last Updated: March 1

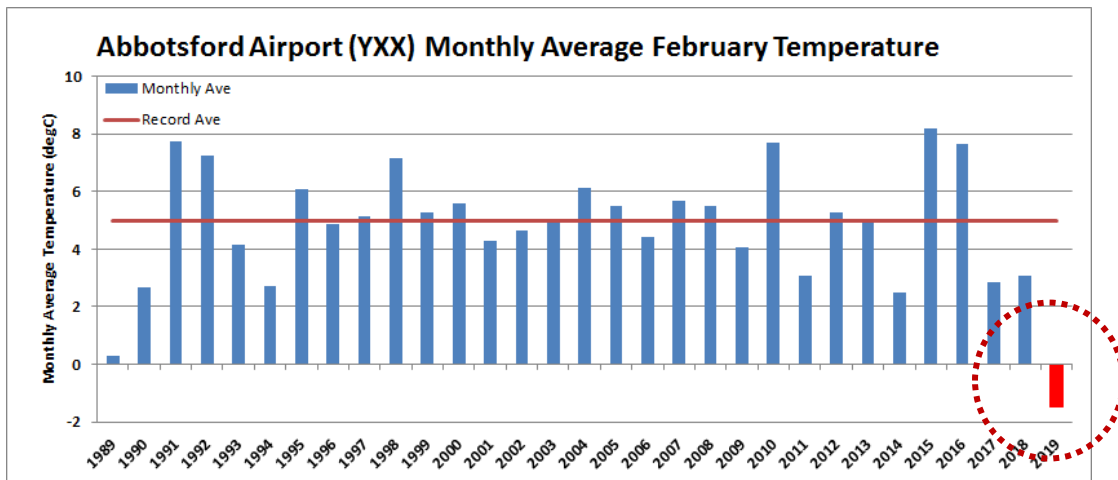


COMMENTS



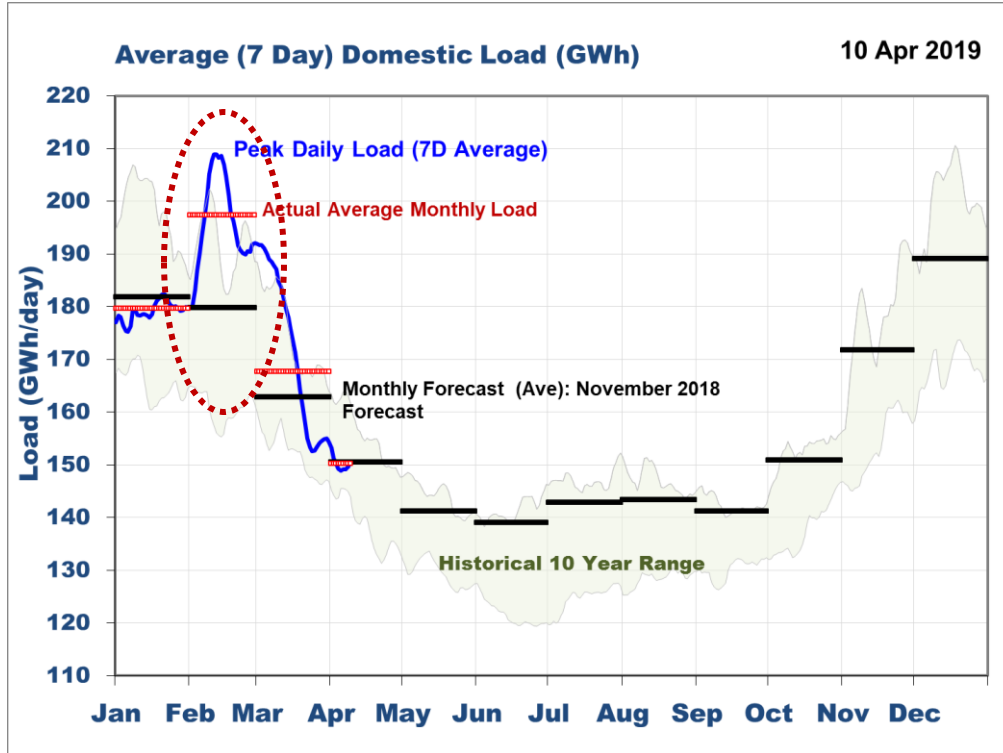
Dean Soiland · 1 month ago

It's tough to feel sorry for the lower mainlanders they get a bit of snow and turn the streets into a demolition derby party it gets cold people complain about -5c temps and how it's the coldest they've ever been.



- Despite general consensus (in January) that Feb and Mar would likely see above average temperatures because of El Nino... All the weather forecasters and models in the Pacific North West turned out to be wrong.
- February and first weeks of March well below average and record low in many load centers.
- Some of the coldest winter days this year in the Kootenays were observed in March .

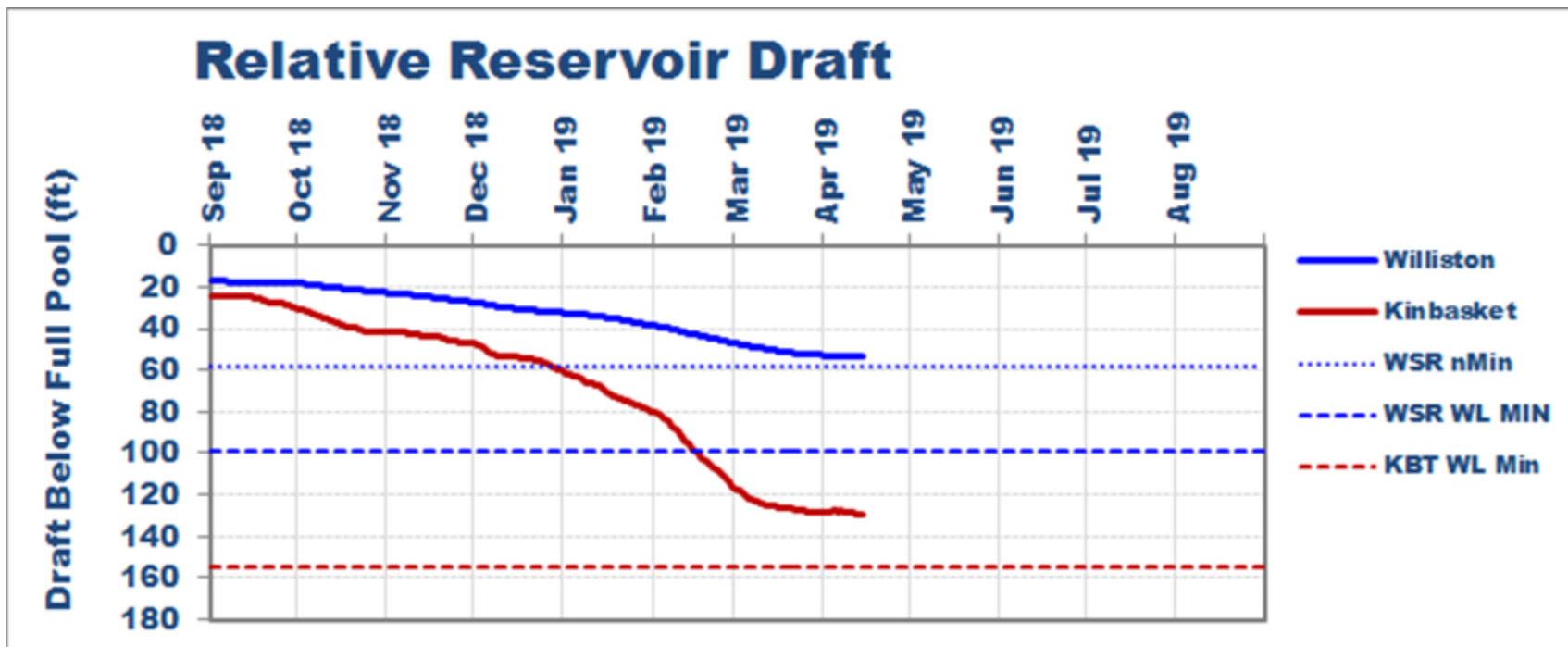
Cold Feb (and EMarch) = Increased Load



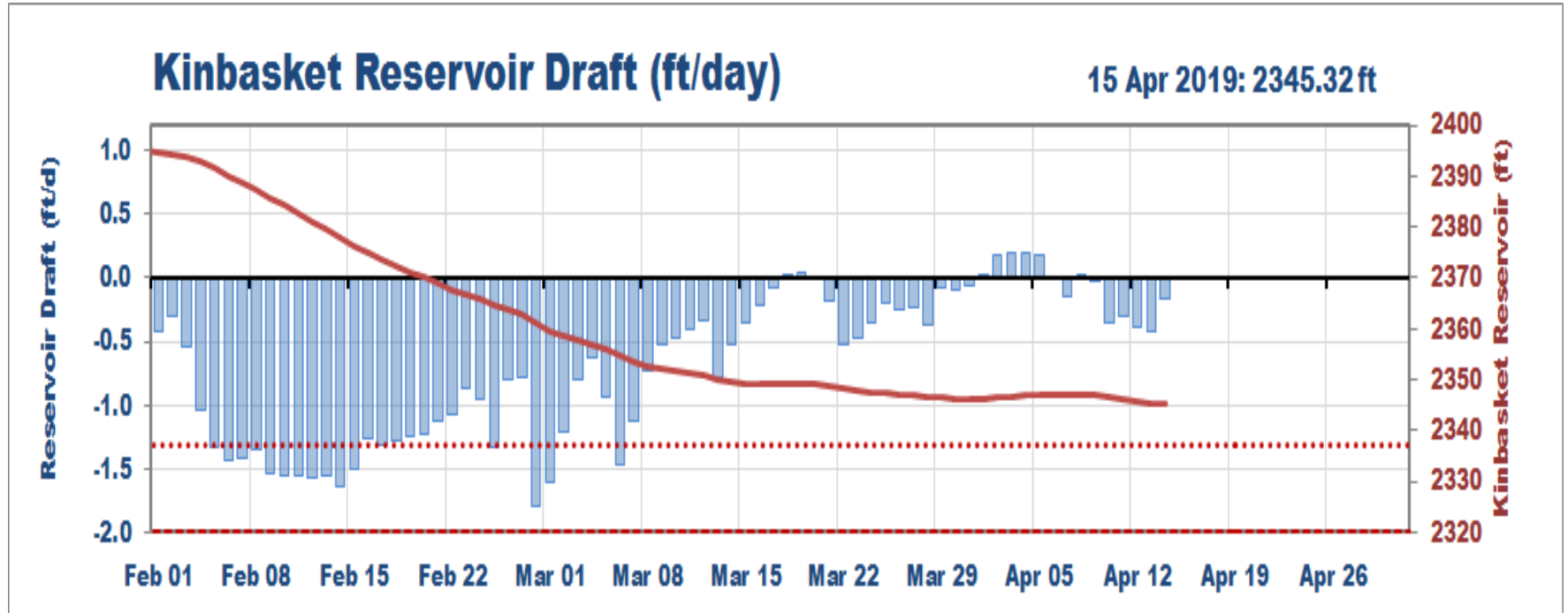
Colder weather manifested in several outcomes that affected the Columbia Basin:

- Loads much higher than forecast.
- MidC Prices much higher than forecast.
- System Energy inflow to Coastal basins at or near record lows. Peace and Columbia inflows also below average.
- BC Hydro and IPP Run of River Projects freeze up.
- Resulted in deeper reservoir drafts in Williston and Kinbasket.
- **Record monthly draft at Kinbasket: ~35 ft.**

Williston and Kinbasket Spring Operations



Mica



Kinbasket



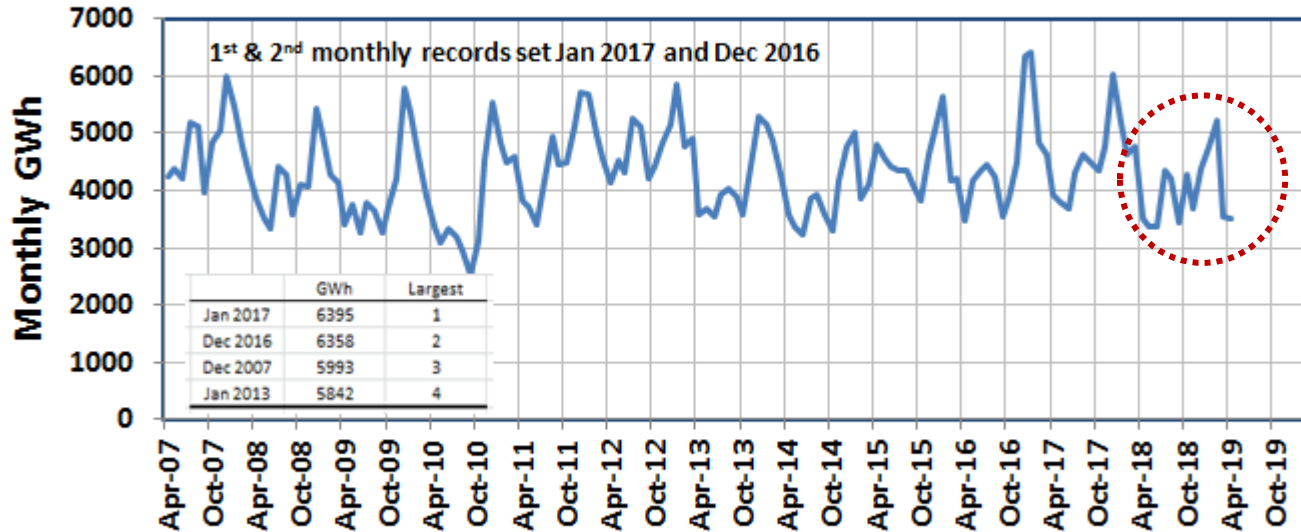
Kinbasket

- 19 Mar: 2349.2 ft
- 26 Mar: 2347.0 ft
- 28 Mar: 2346.6 ft
- 4 Apr: 2347.2 ft
- 13 Apr: 2345.5 ft

System Generation

Monthly Hydro Generation (GWh)

Physical energy production from BC Hydro owned and dispatched hydro facilities

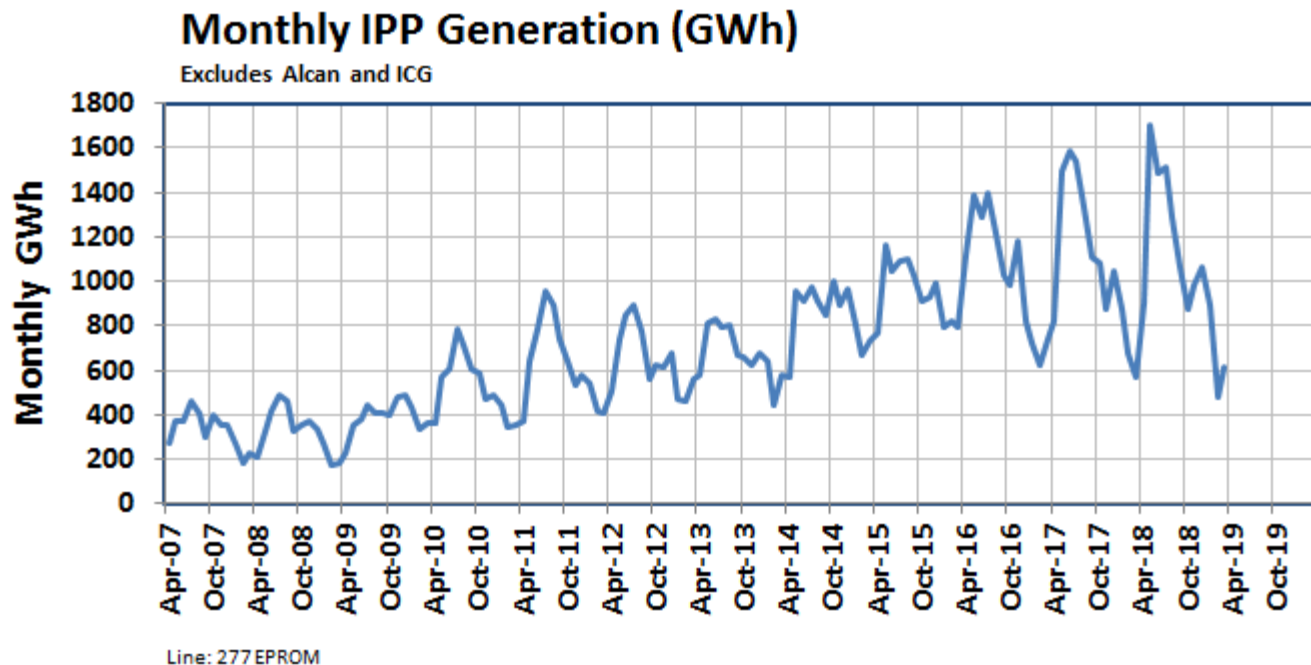


BC Hydro dispatched hydro (ALH, COR, UBO, LBO, SLC, BRD, BRX, WAN (100%), WAX) physical (not EPA).

Generation 2007 to Present

- Lowest Jul/Aug generation since 2014.
- Lowest Nov Generation
- Lowest Dec Generation
- Lowest Jan Generation
- **Highest Feb Generation**
- Lowest Mar Generation

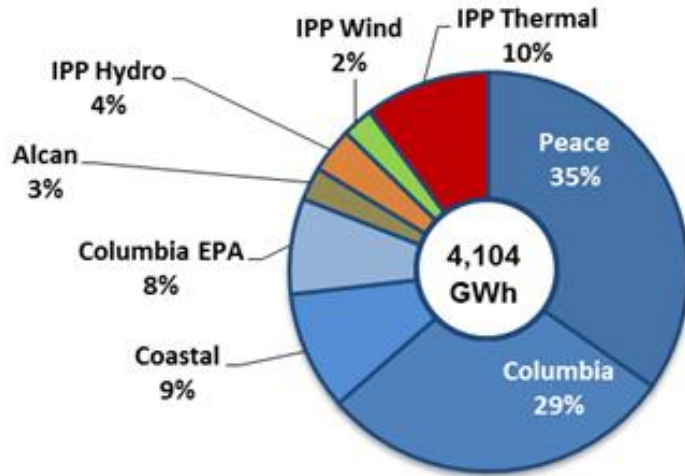
Evolving IPP Contribution & Planning



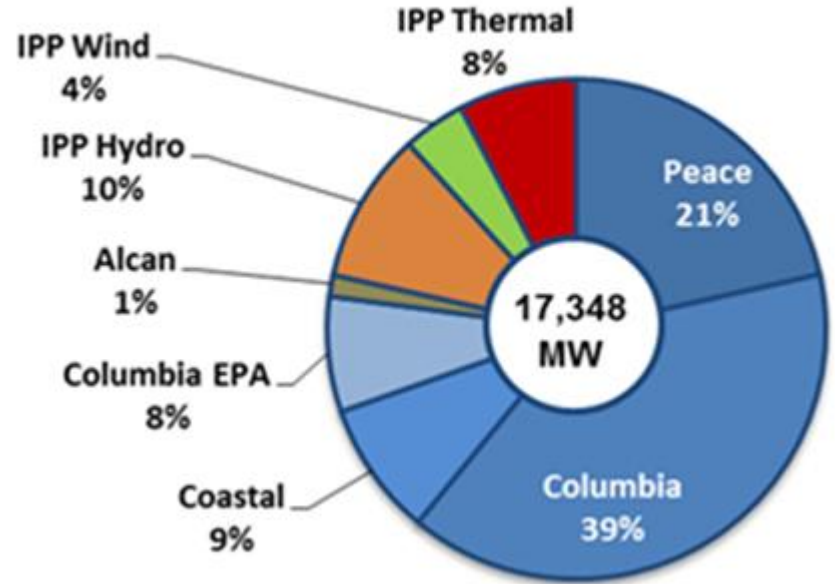
- Record High IPP generation May 2018.
- Feb IPP generation lowest observed since 2014.
- Largest variability between FY High (May 2018) and FY Low (Feb 2019) on record: ~1200 GWh
 - May/Jun Freshet 3200 GWh
 - Feb/Mar Winter 1100 GWh

System Generation: Q4

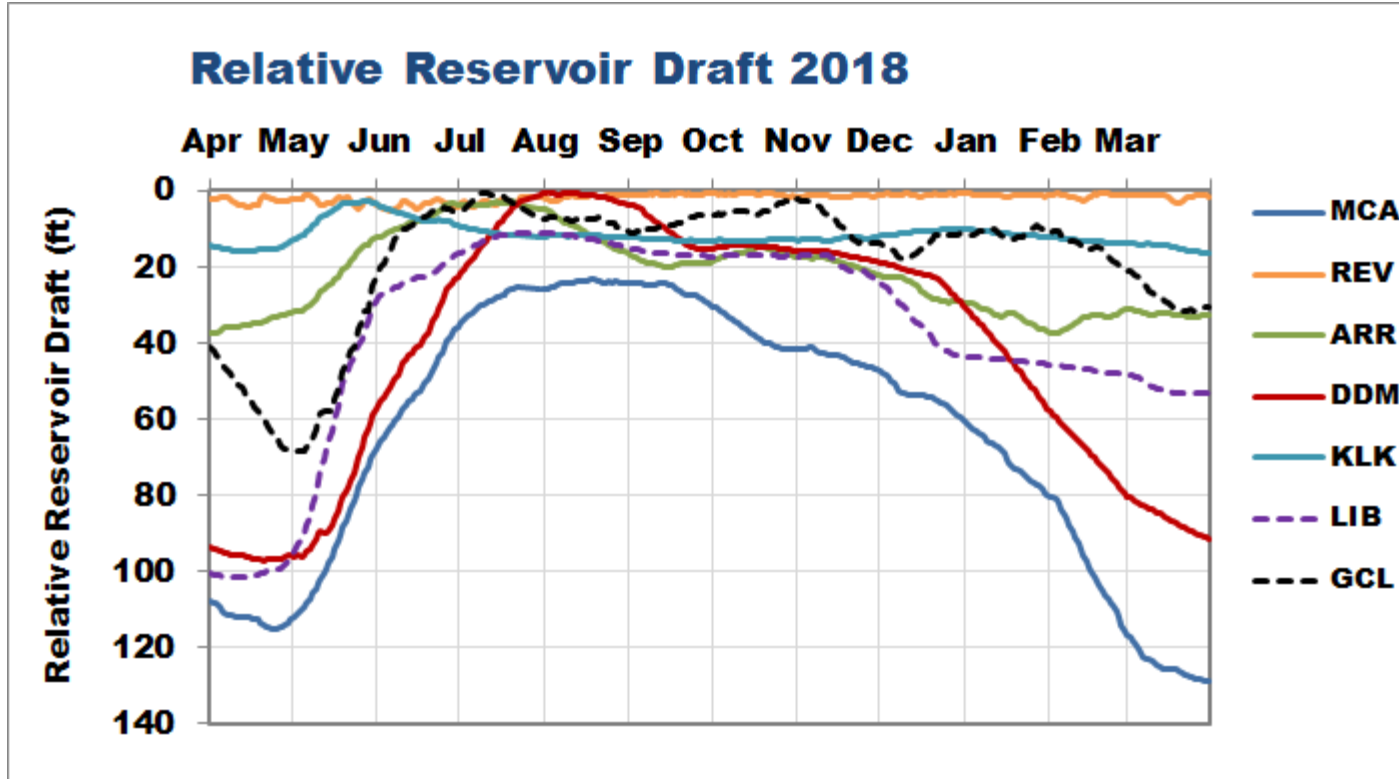
March 2019 Energy Production, GWh



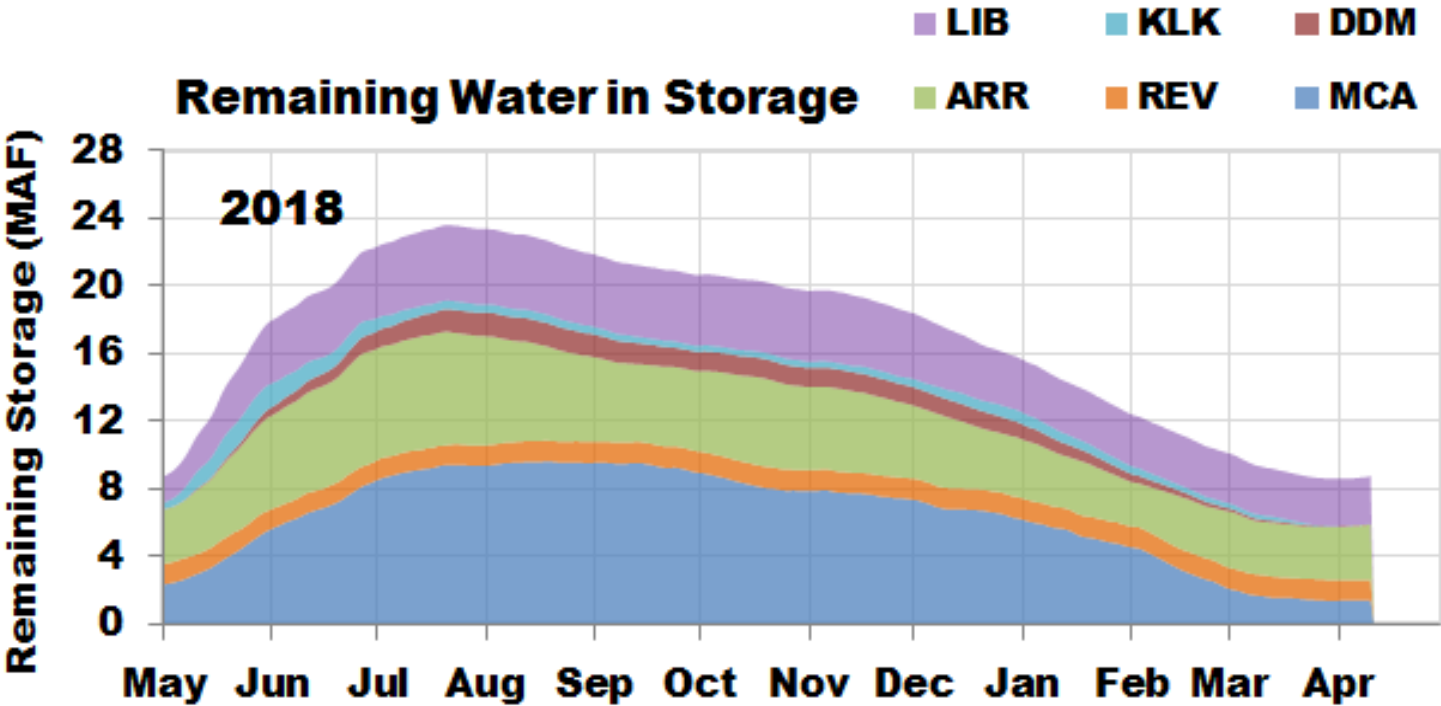
Installed Capacity, MW



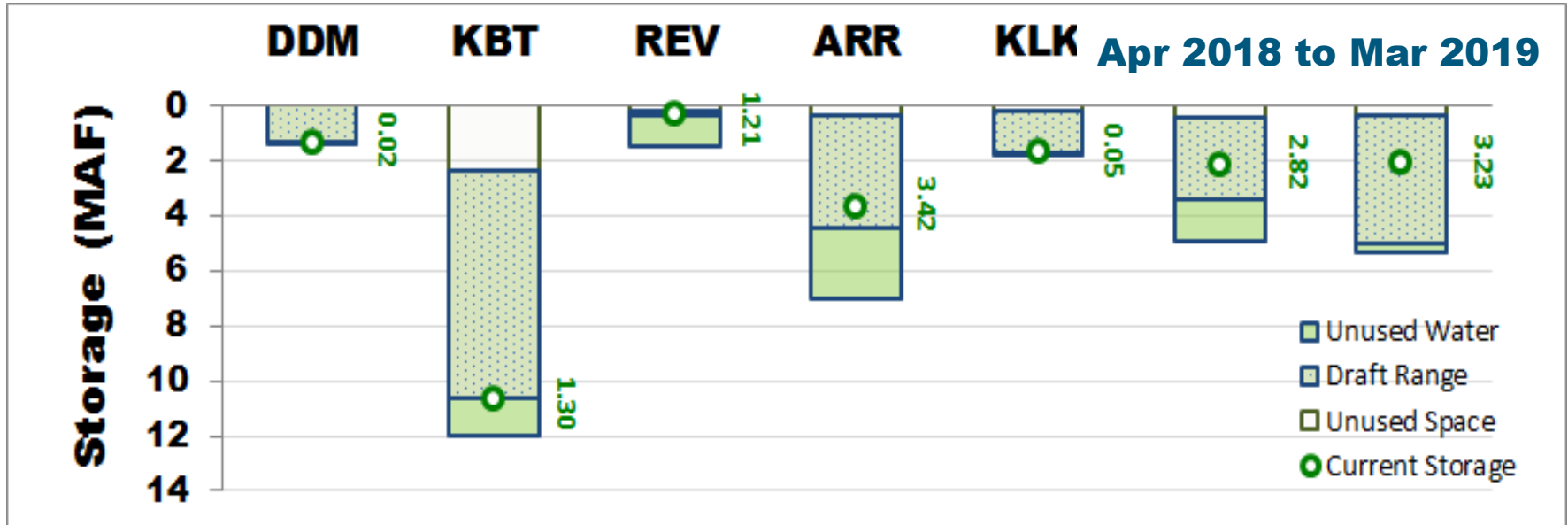
Relative Reservoir Drawdown



System Storage Summary



System Storage Summary



FY19 Emergency Operation Center (EoC)

- **MAY**
 - Duncan/Kootenay Lake: Inflow and Flooding
- **MAY – OCT**
 - Provincial Fires
- **DEC – JAN (Across Christmas and New Years)**
 - Flooding
 - Power Outages
- **MAR**
 - Spillimacheen: Uncontrolled Water Release



Forecasts: Apr 2019 to Mar 2020



Revelstoke Generating Station

Snow Pack: Tracking Below Average

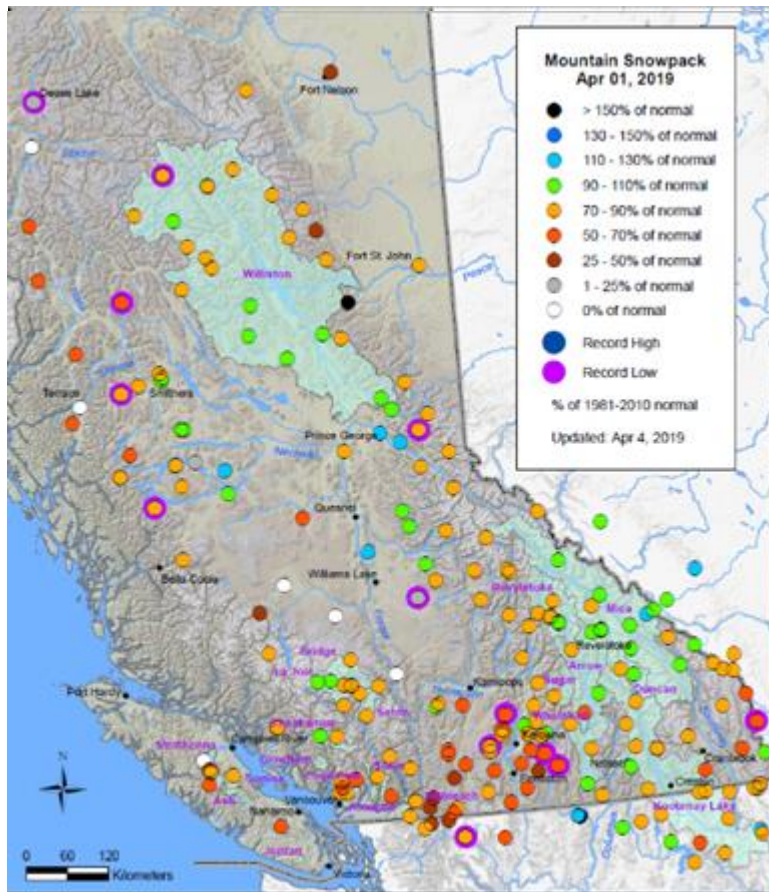
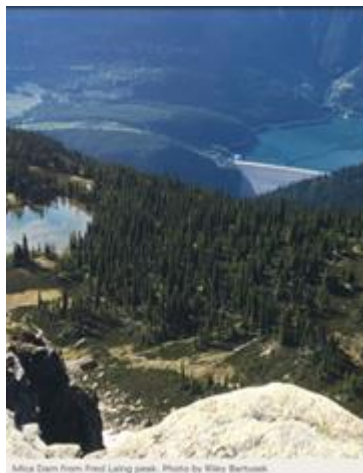


Table 1: April 2019 Feb-Sep Water Supply Forecast summary with confidence bounds, expressed as % normal.

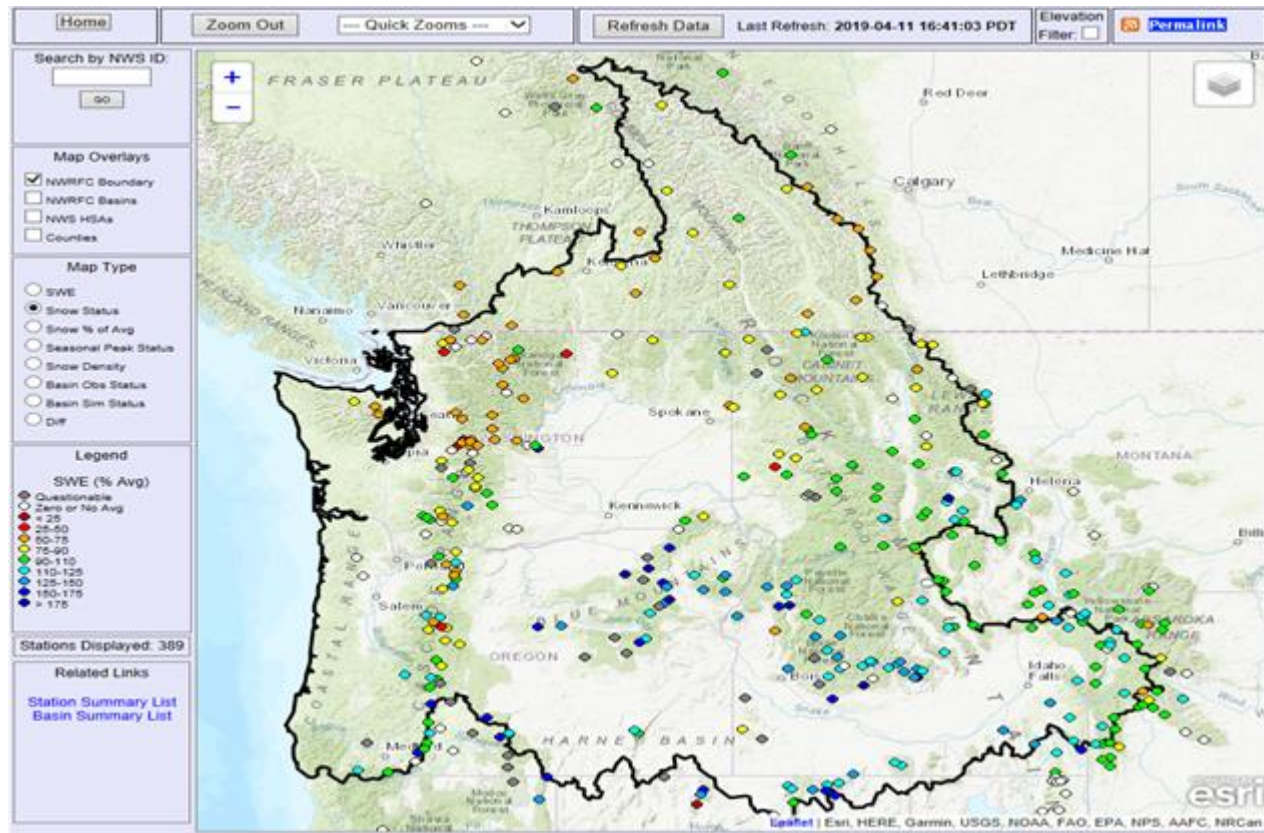
BASIN	± 2 standard errors							
	10% and 90% exceedance probabilities							
	± 1 standard error							
	nominal							
Williston *	74.4	81	83.0	91.6	100.2	103	108.8	
Mica *	85.7	88	88.8	91.9	95.0	96	98.1	
Revelstoke *	82.8	85	86.0	89.2	92.4	94	95.6	
Arrow Local *	78.9	81	82.0	85.1	88.2	90	91.3	
Combined Usable Inflow	75.9	n/a	82.2	88.5	94.8	n/a	101.1	

* Forecast based on UBC Watershed Model-based Ensemble Streamflow Prediction (ESP) technique



U.S. Columbia Snowpack

- Mixed Snowpack Depths
- The U.S. Columbia primarily in the northern basin, saw similar drier conditions and below average snowpack levels.
- Recent storm events brought unprecedented amounts of precipitation and snow accumulation predominantly in the southern Snake basin.

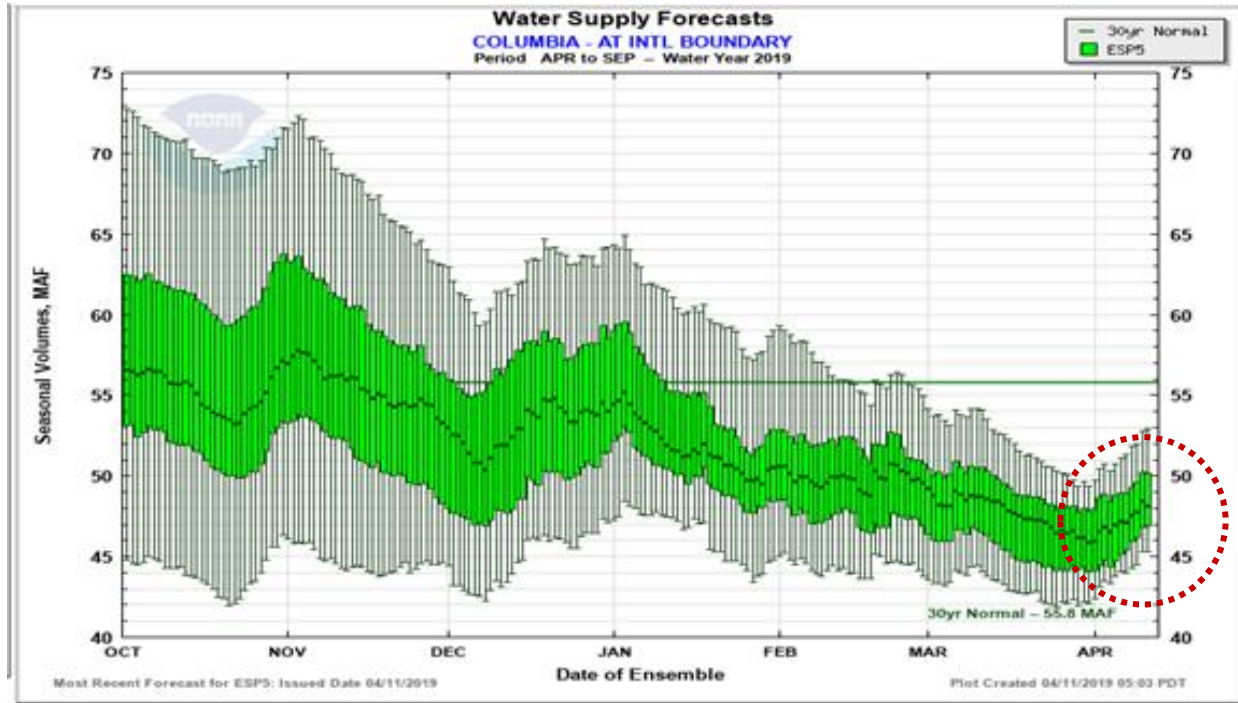


Canadian Runoff

Apr 1st (official) Feb-Sep 2019 Inflow Forecast

- Mica: 92% of normal
- Revelstoke: 89%
- Arrow: 85%
- Duncan: 88%
- Kootenay L: 81%

Normal is based on 1981 - 2010

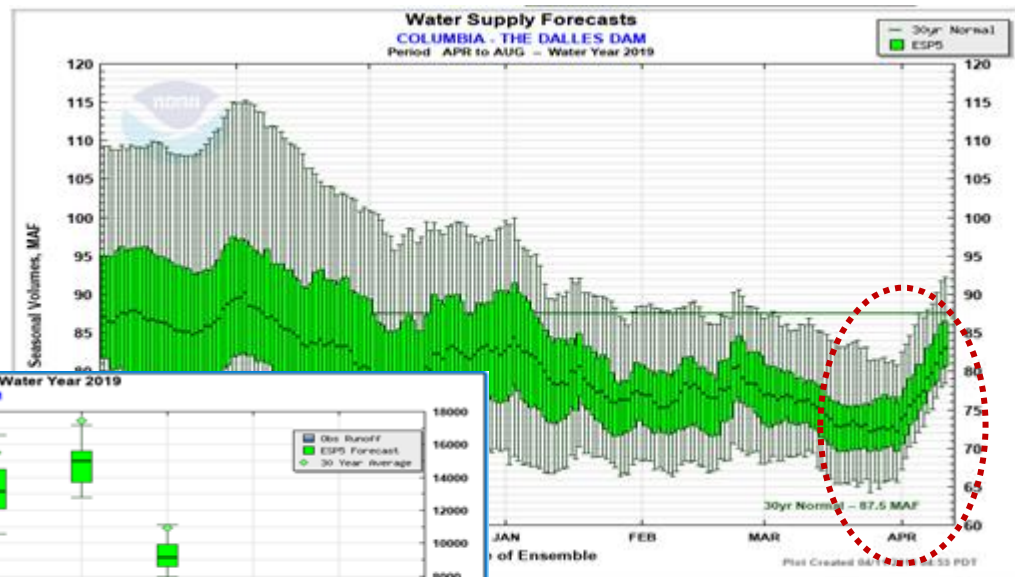
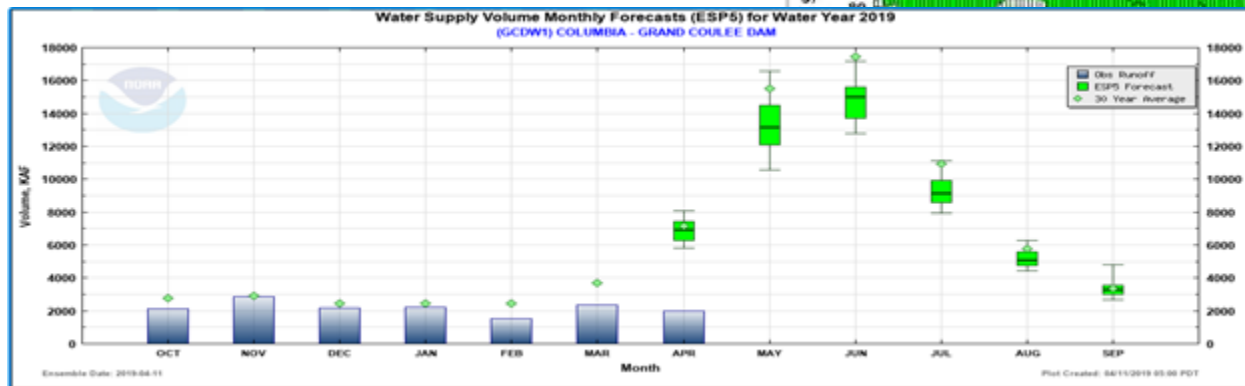


United States Runoff

Apr 11th Apr-Aug 2019 Inflows Forecast

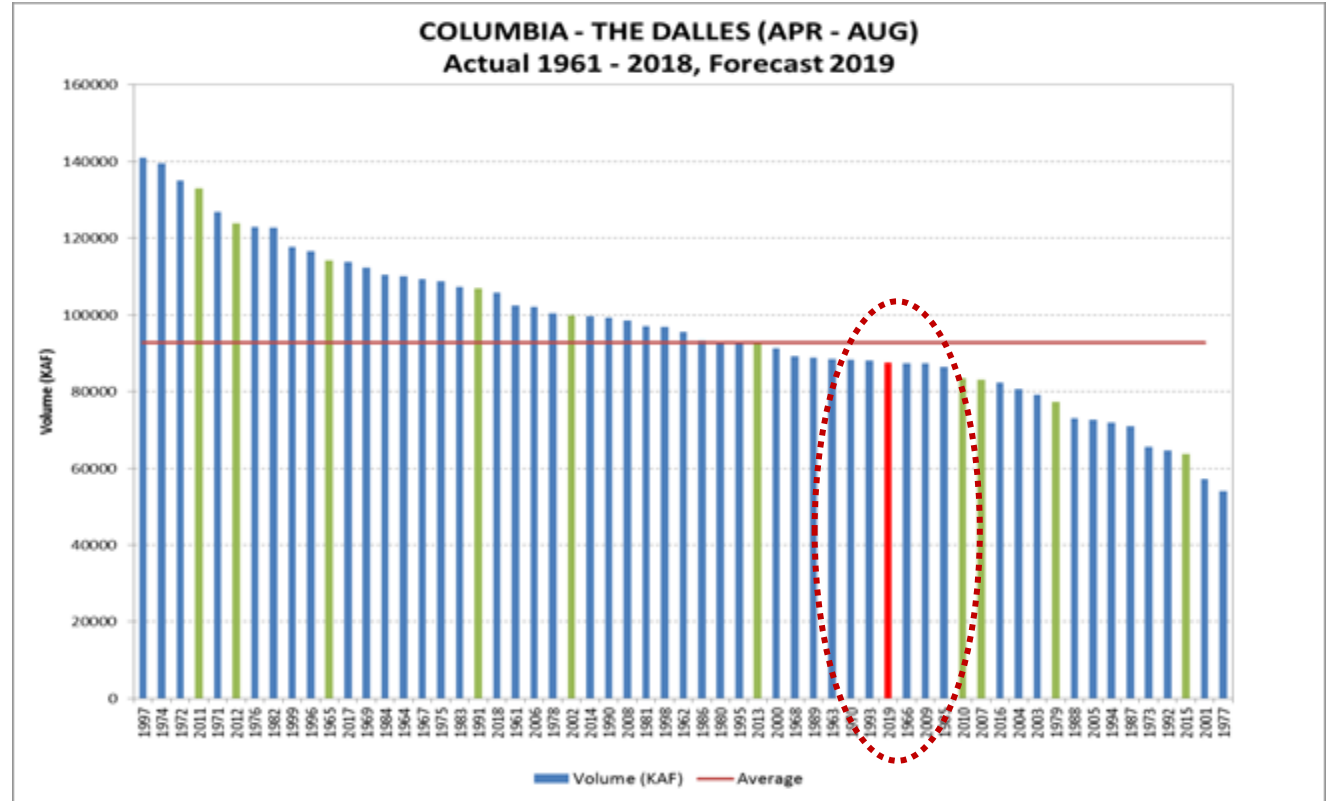
- Grand Coulee: 87% of normal
- Libby: 75%
- Lower Granite: 116%
- The Dalles: 95%

Normal is based on 1981 - 2010



2019 Forecast Ranking

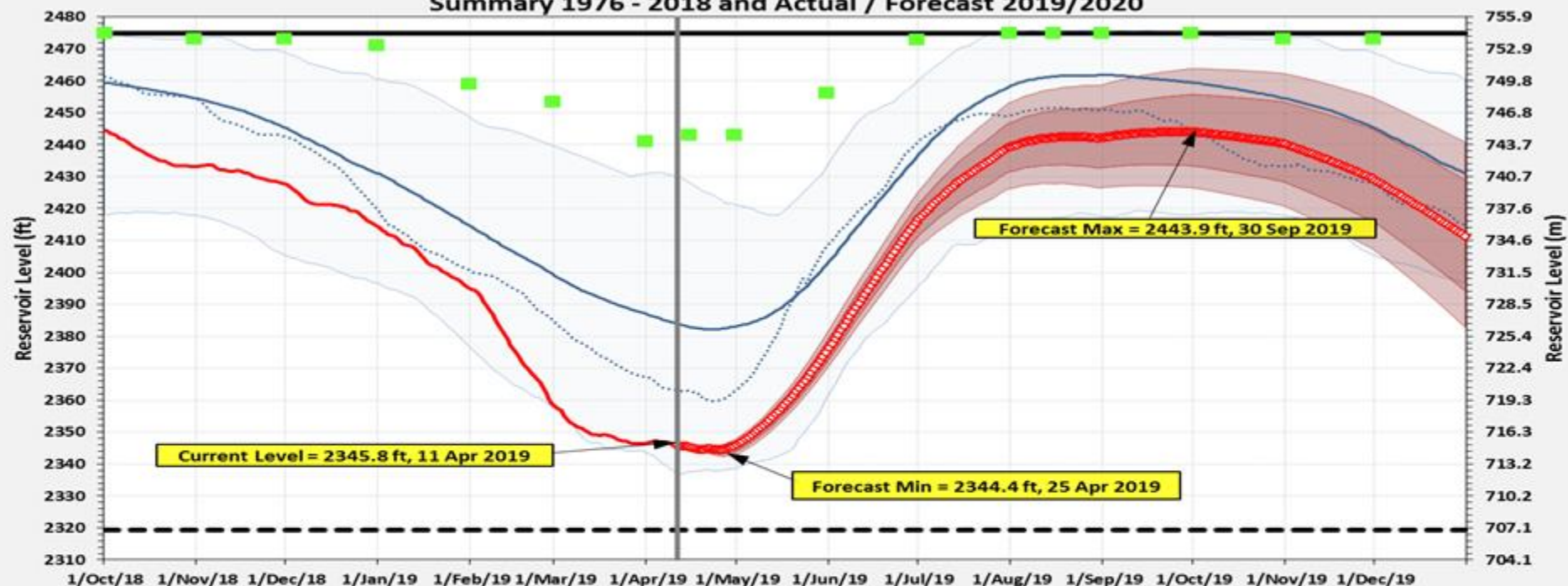
- Columbia Basin at The Dalles is 83 MAF or about a 30th percentile low year.
- The forecast increased about 10 Maf in the past 10 days due to wetter than normal conditions predominantly in the U.S. portion of the basin.



KINBASKET RESERVOIR (MCA) LEVELS

Summary 1976 - 2018 and Actual / Forecast 2019/2020

Forecast Date: Apr 11, 2019



This forecast is confidential and is the property of BC Hydro. The forecast is subject to change at any time without notice. Distribution of the forecast to any third party or use by any unintended recipient is prohibited without BC Hydro's written consent. Notes:

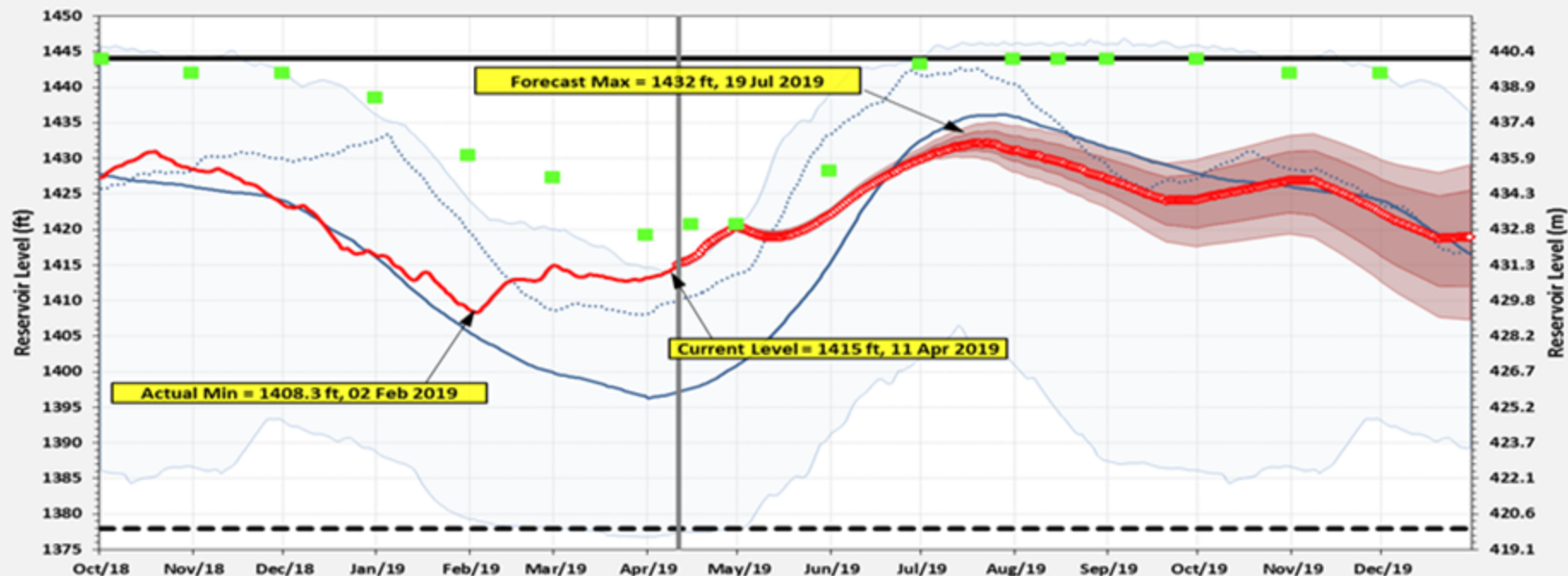
- Reservoir levels up to 2476' may be required for flood risk management in the Canadian portion of the Columbia basin or for the U.S. under the Columbia River Treaty.
- Reservoir level forecasts are subject to change due to changes in projected weather, snowpack, and runoff patterns in the Columbia basin, BC Hydro's load and generation requirements, provisions of the Columbia River Treaty, and other variables during this period.
- BC Hydro expressly disclaims any warranties or representations with respect to this forecast. BC Hydro accepts no liability arising from the use of this forecast. BC Hydro will make reasonable efforts, but is not obliged, to provide updates when the forecast changes.



ARROW LAKES RESERVOIR (ARD) LEVELS

Summary 1968 - 2018 and Actual / Forecast 2019/2020

Forecast Date: Apr 11, 2019



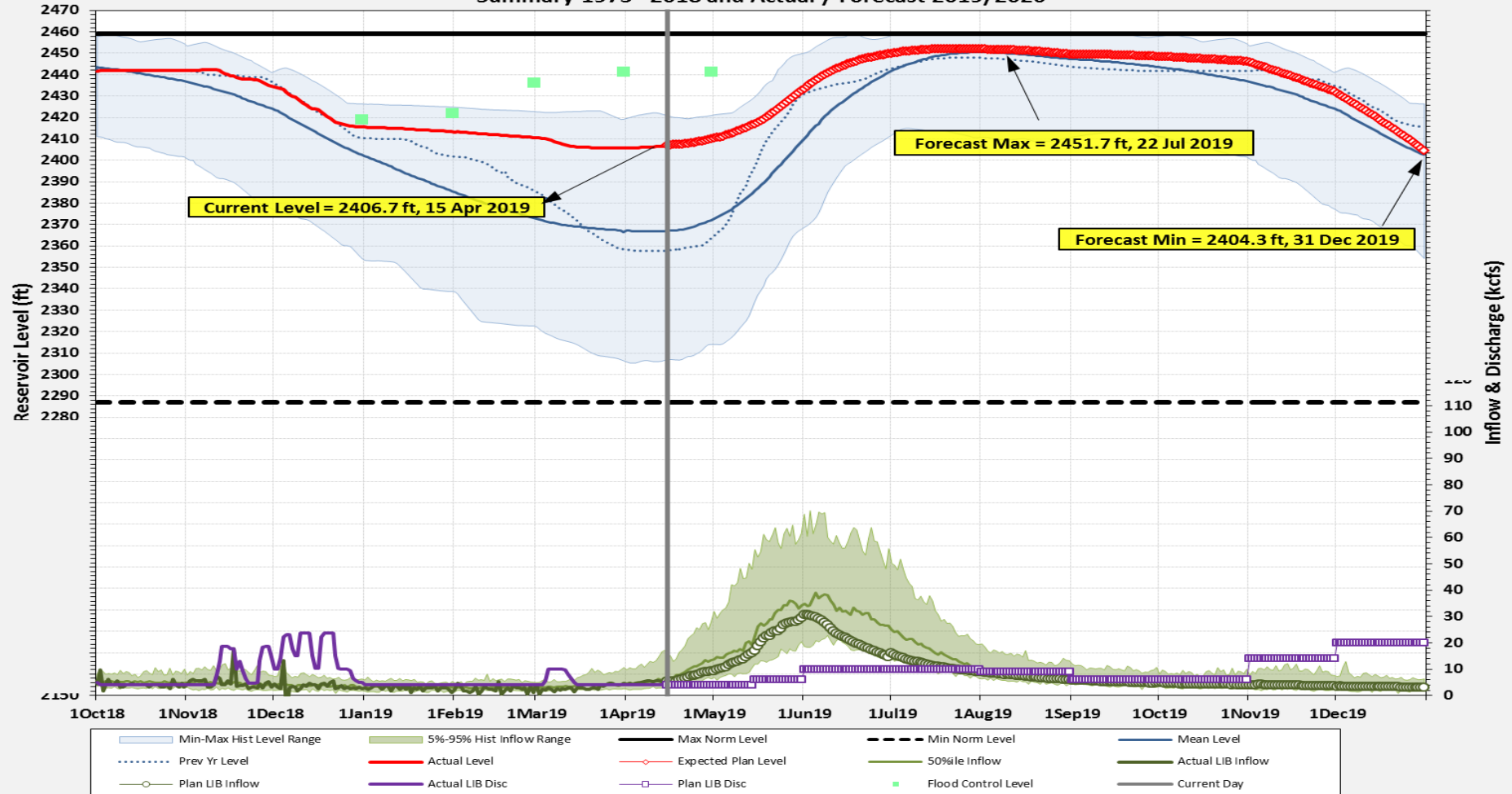
This forecast is confidential and is the property of BC Hydro. The forecast is subject to change at any time without notice. Distribution of the forecast to any third party or use by any unintended recipient is prohibited without BC Hydro's written consent. Notes:

- Reservoir levels up to 1446' may be required for flood risk management in the Canadian portion of the Columbia basin or for the U.S. under the Columbia River Treaty.
- Reservoir level forecasts are subject to change due to changes in projected weather, snowpack, and runoff patterns in the Columbia basin, BC Hydro's load and generation requirements, provisions of the Columbia River Treaty, and other variables during this period.
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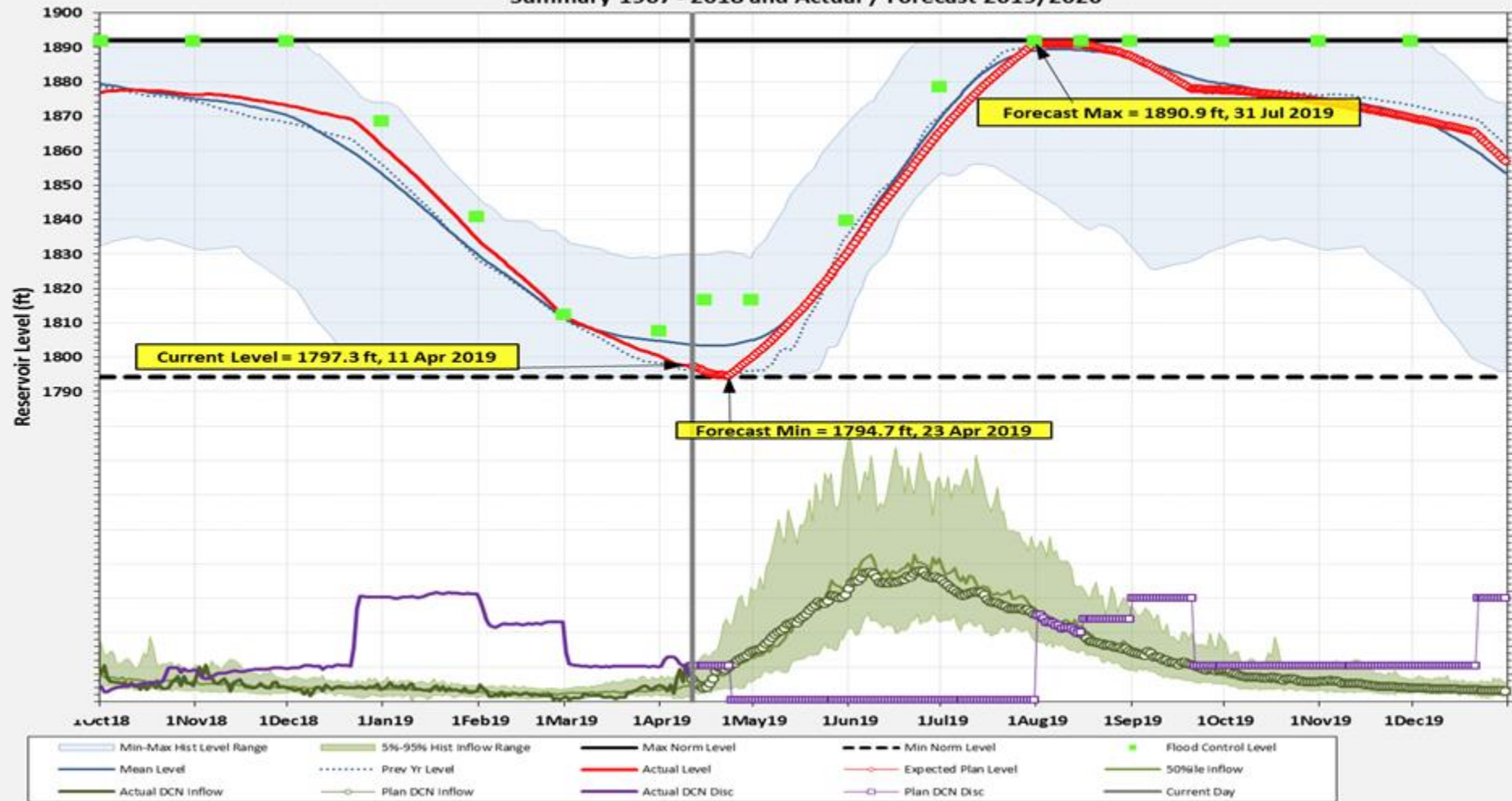
LIBBY RESERVOIR (LIB) LEVELS & FLOWS

Summary 1975 - 2018 and Actual / Forecast 2019/2020



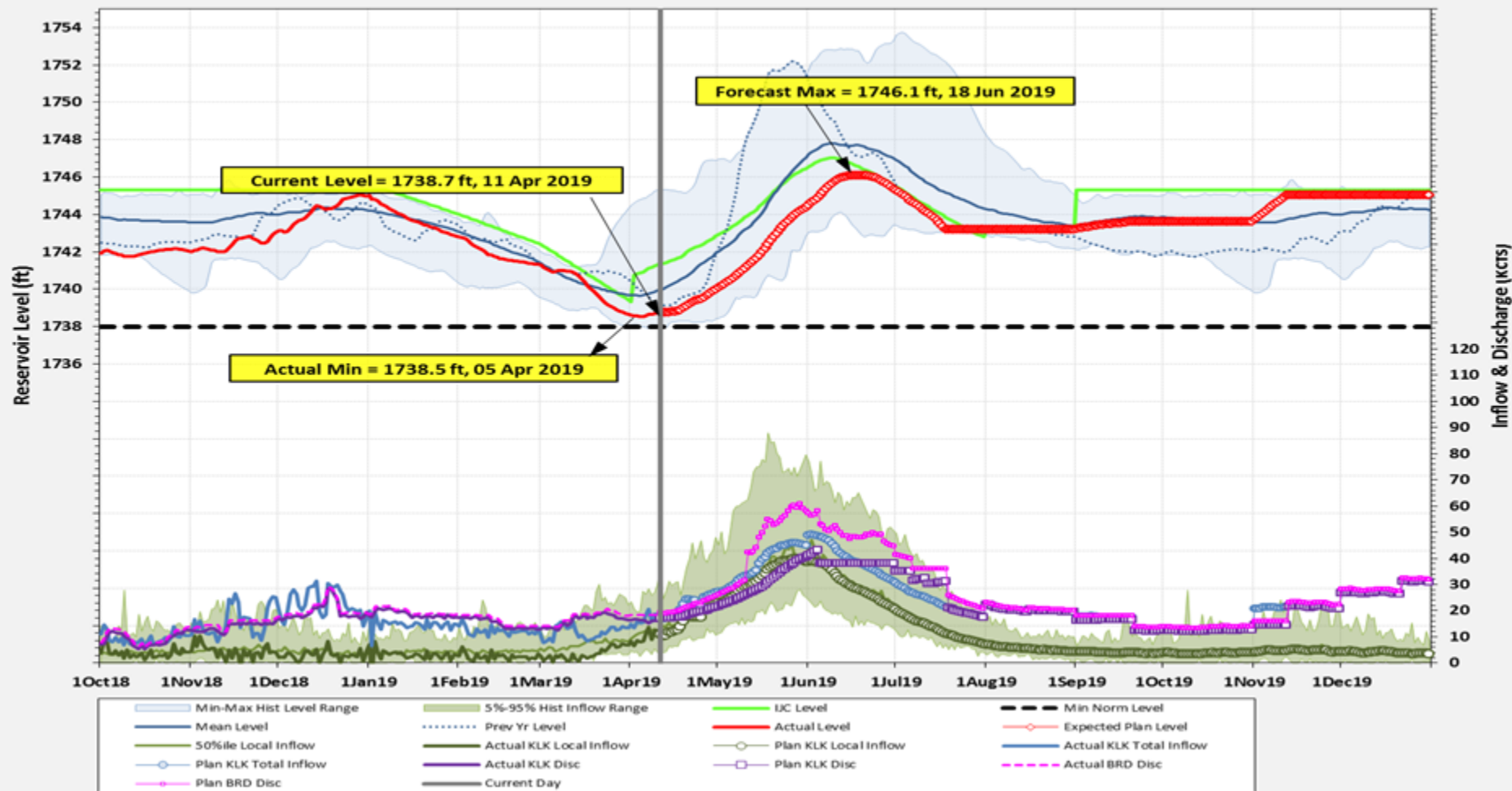
DUNCAN RESERVOIR (DCN) LEVELS & FLOWS

Summary 1967 - 2018 and Actual / Forecast 2019/2020

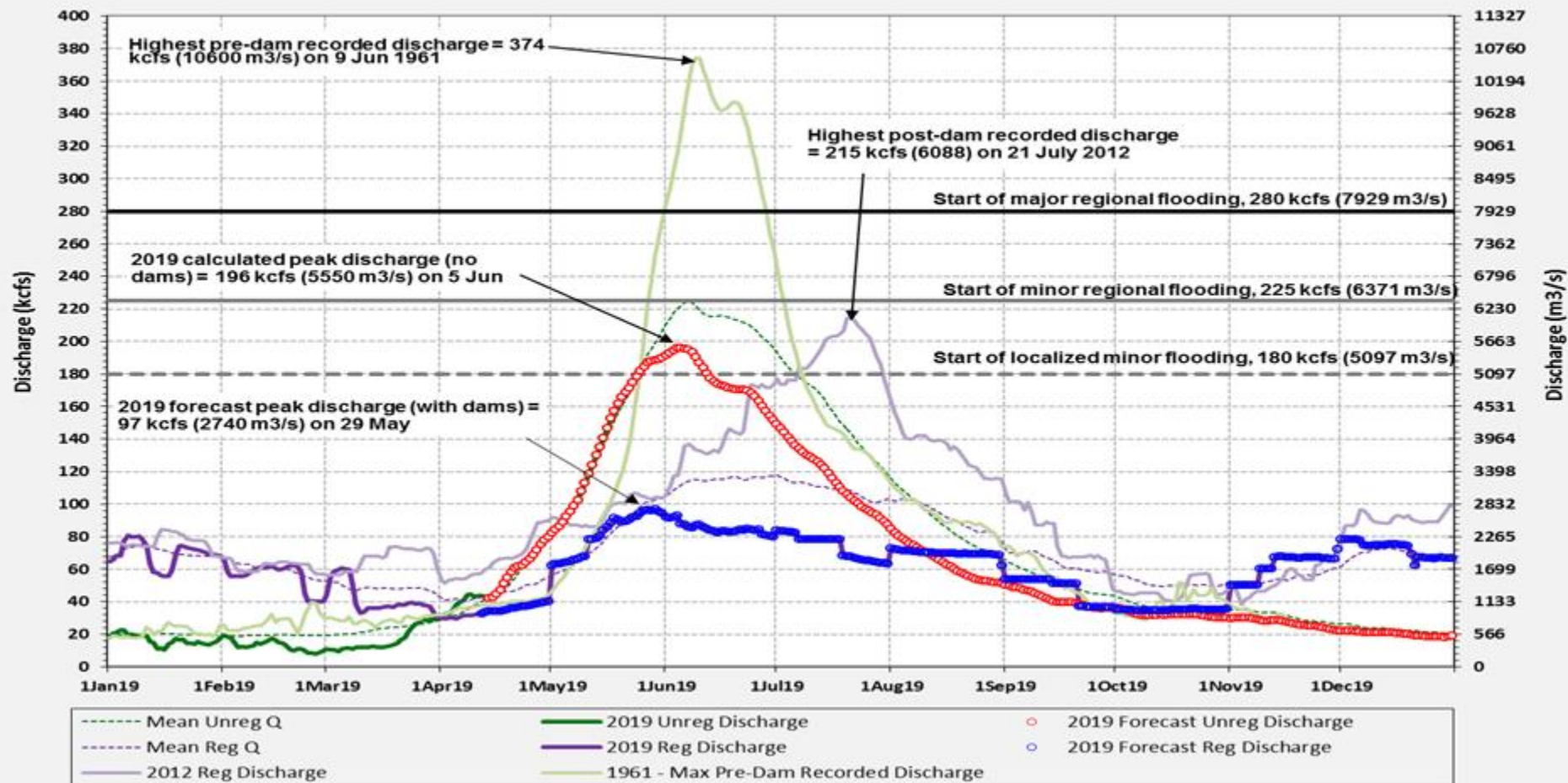


KOOTENAY LAKE RESERVOIR (KLK) LEVELS & FLOWS

Summary 1984 - 2018 and Actual / Forecast 2019/2020



COLUMBIA RIVER AT BIRCHBANK AVERAGE DAILY DISCHARGE (Brilliant Project + Brilliant Expansion + Brilliant Spill + Arrow Lakes Hydro + Hugh Keenleyside)



BC Hydro provides reservoir water level forecasts by email each week. To receive these updates, please contact daye.hopp@bchydro.com.

Near real time water level information for various locations around our reservoirs is available online at: bchydro.com/energy-in-bc/operations/transmission-reservoir-data/previous-reservoir-elevations/columbia.htm BC Hydro's toll-free reservoir information line **1 877 924 2444** also provides up-to-date reservoir elevation and river flow information. The recording is updated every Monday, Wednesday and Friday and includes:

- **Current Elevation Levels:** Arrow Lakes Reservoir, Duncan Dam Reservoir, Kinbasket Reservoir, Kootenay Reservoir, Kootenay Lake, Revelstoke Reservoir, Sugar Lake Reservoir and Whatshan Lake Reservoir.
- **Current Flows:** Columbia River at Birchbank, Duncan River at the Lardeau Confluence, Shuswap River and the flow downstream from Wilsey Dam at Shuswap Fall.

Questions? Please contact:

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Hugh L. Keesleyside Dam. Photo by Thane Isart