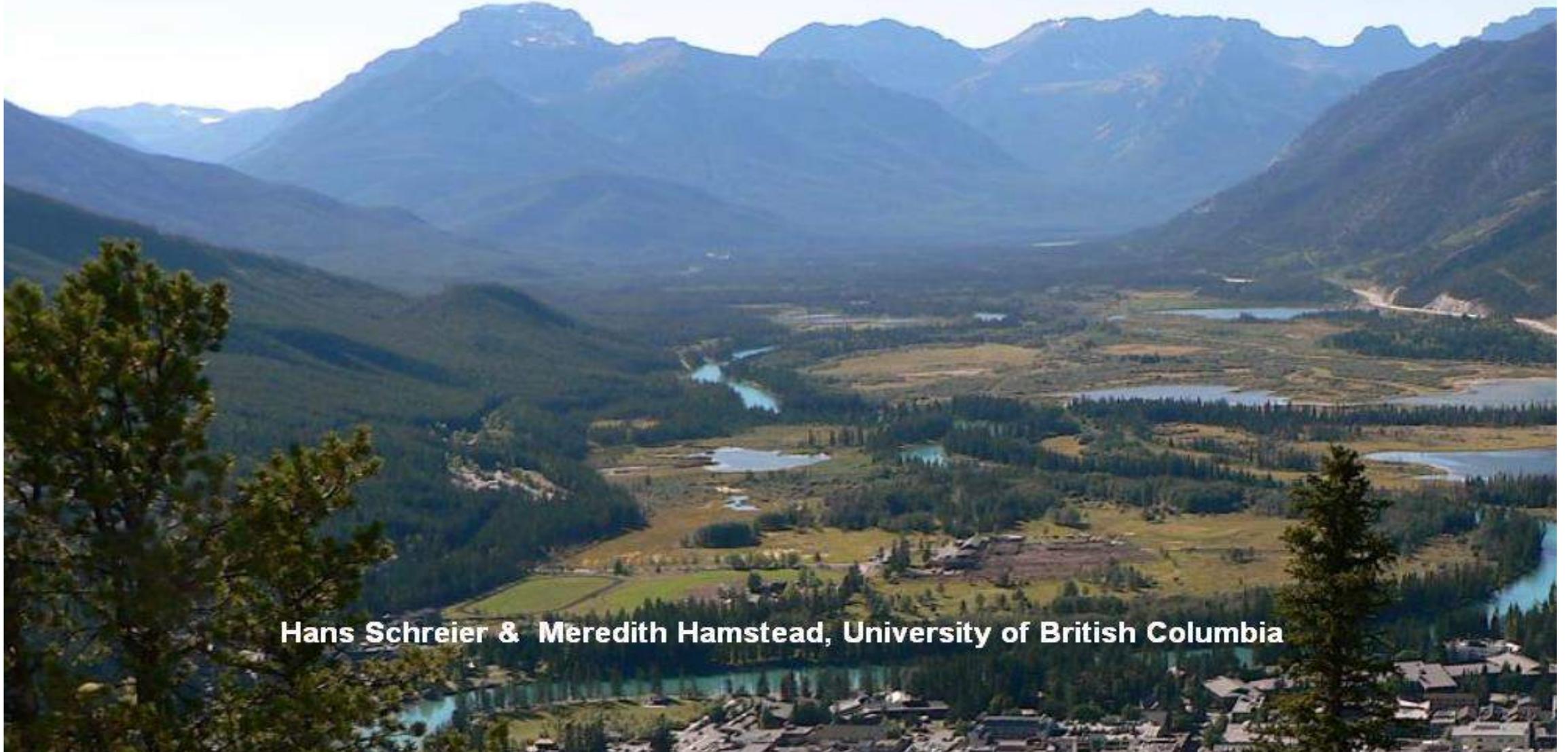


MtnClim: Mountains Without Snow Session

Water Conservation Challenges in Mountain Communities in the Columbia Basin in Canada

Hans Schreier & Meredith Hamstead, University of British Columbia



Water Consumption in Mountain Communities in the Columbia Basin in Canada

Based on a Reconnaissance Survey in 2005 it was noted that Mountain Communities in the Columbia Basin use very large amounts of water but this was based on very unreliable data

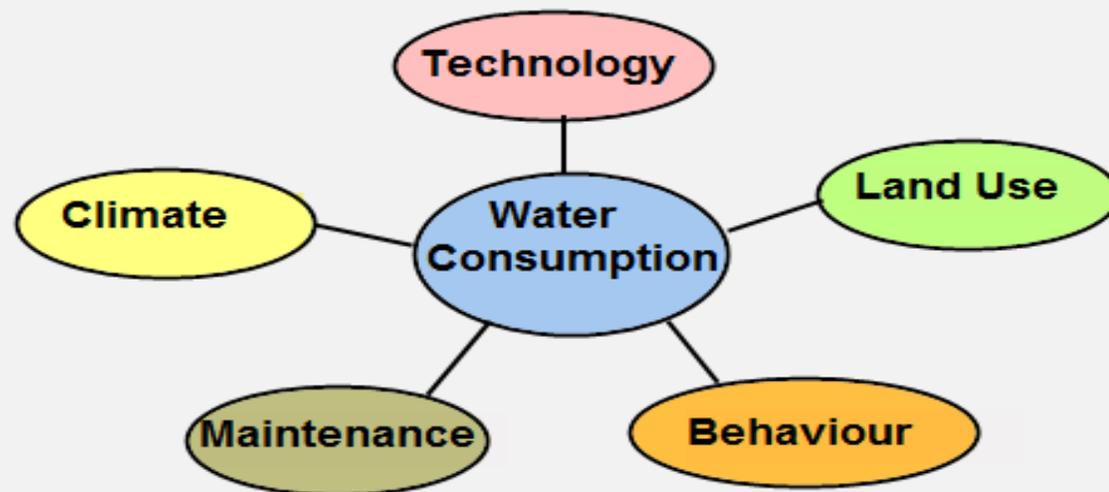
- The Columbia Basin Trust (CBT) Initiated the Water-Smart Conservation Program in 2009**
- 20 Communities Participated in the Program and pledged to reduce their Water Consumption by 20% between 2009 and 2015**
- 14 Communities had comparable data**
- 12 Climate Stations were used to compare conservation results**

14 Participating Communities



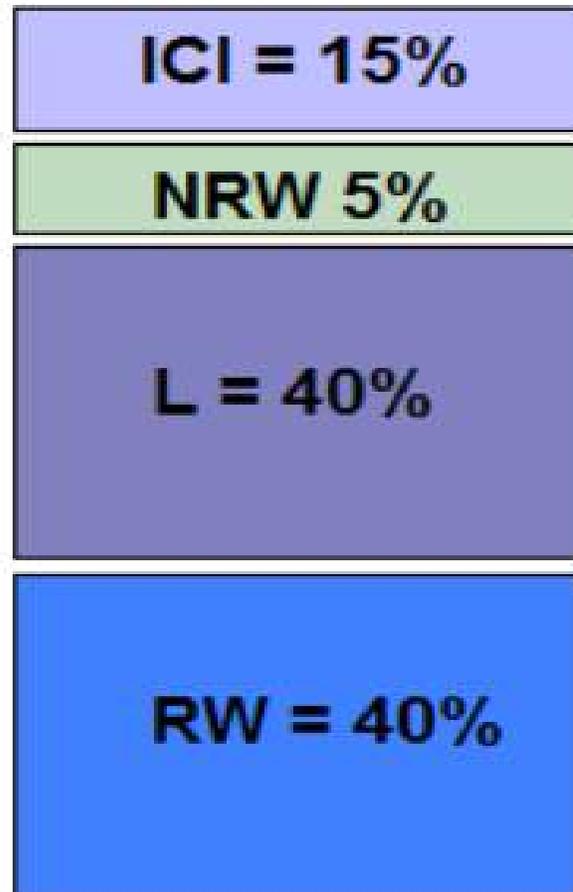
Key Factors that Influence Domestic Water Consumption & Use

Factors	Details
Climate	Temperature & Precipitation
Land Use	Indoor vs. Outdoor Use, Commercial & Industrial
Human Behaviour	Beliefs, Habits, Incentives & Regulations
Management	Capacity & Skills to Maintain Infrastructure
Technology	Type of Infrastructure, Quality, Longevity

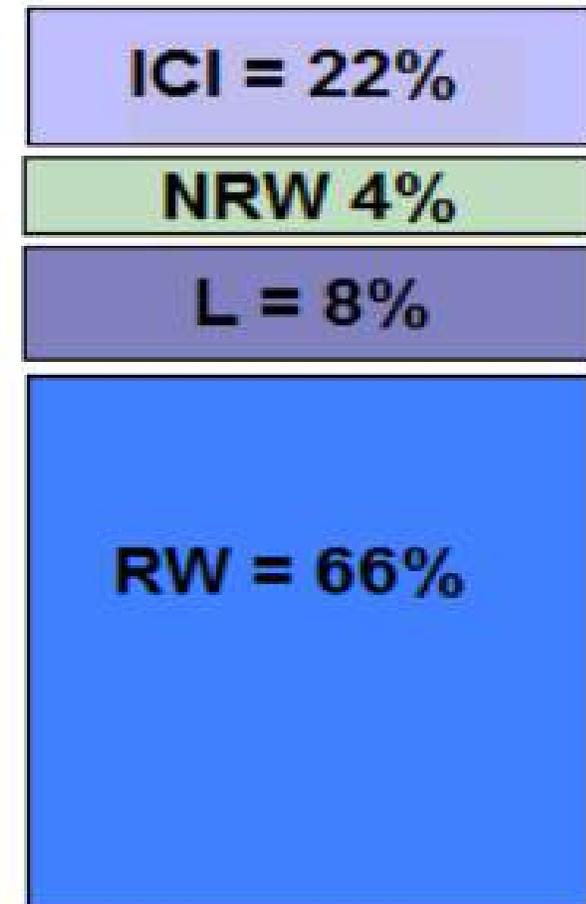


Water Use Differs in each Community due to Technical Factors, Type of Use Behaviour and Climatic Conditions

Community A



Community B



Institutional
Commercial
Industrial Water

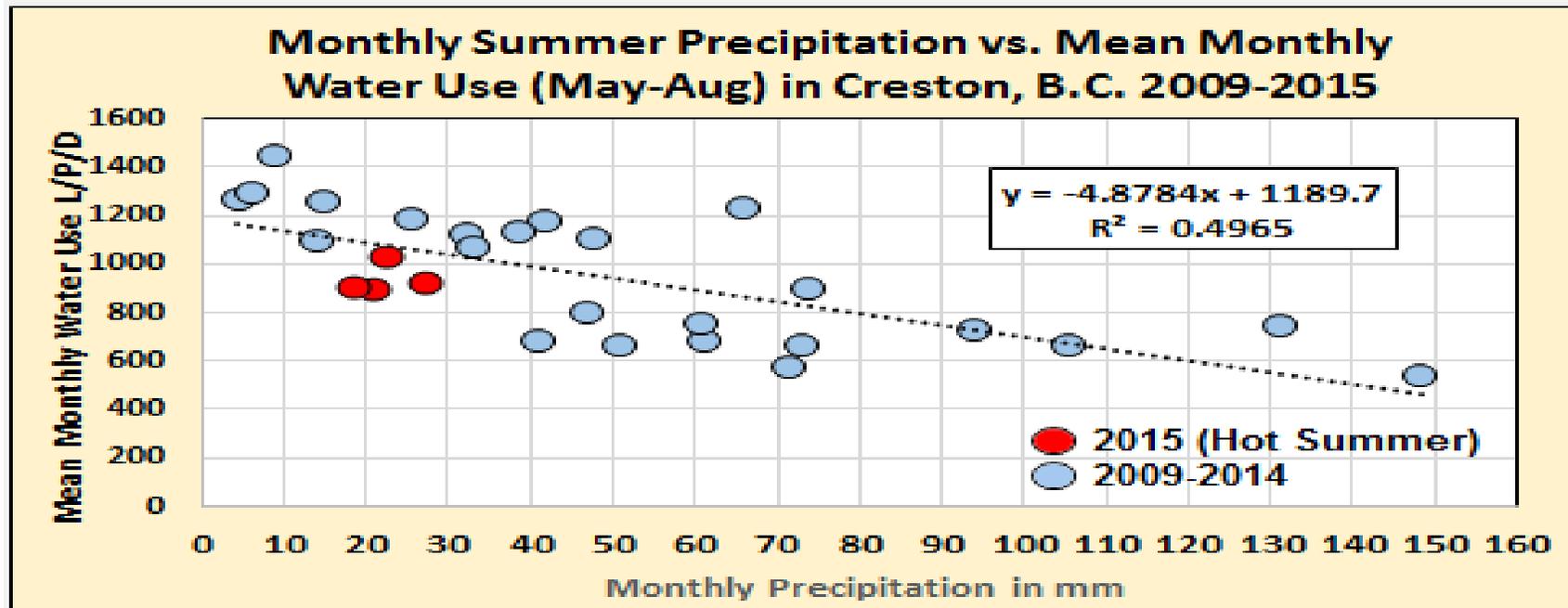
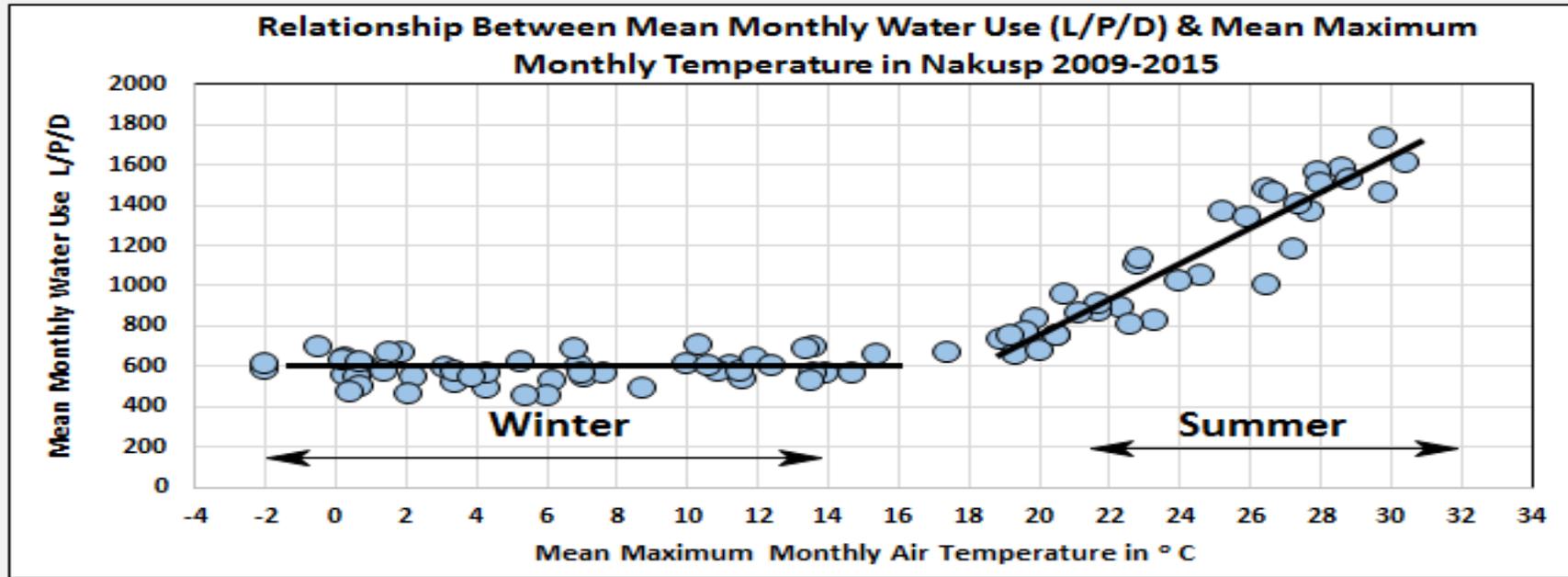
Non Revenue Water

Leakages

Residential Water

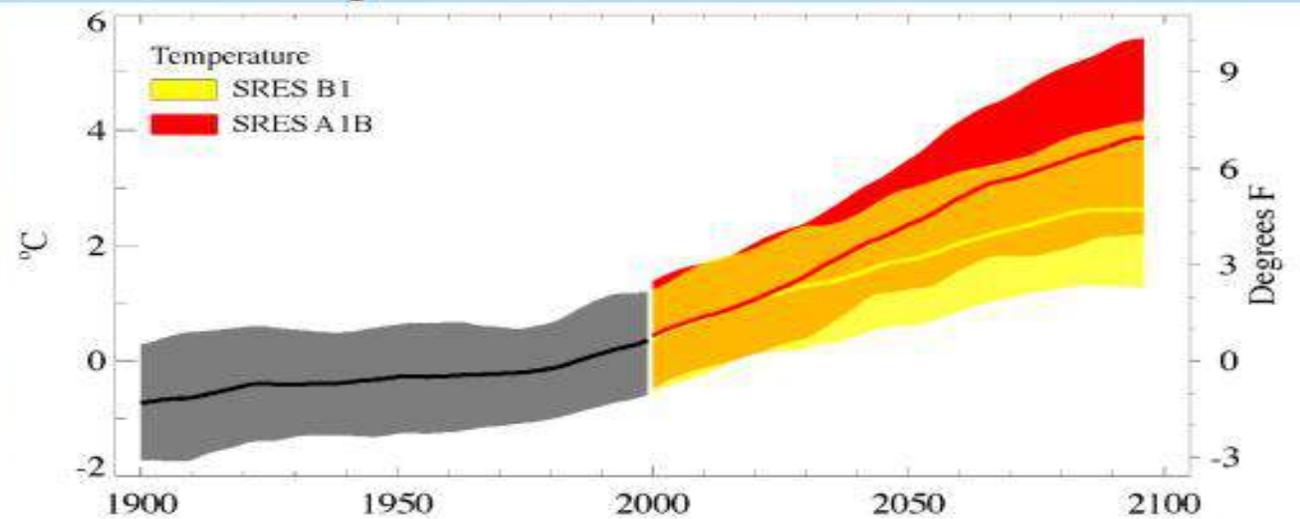
Temperature Impact on Water Consumption During Winter & Summer

Based on 7 Year Data 2009-2015 & Mean Maximum Monthly Air Temperatures

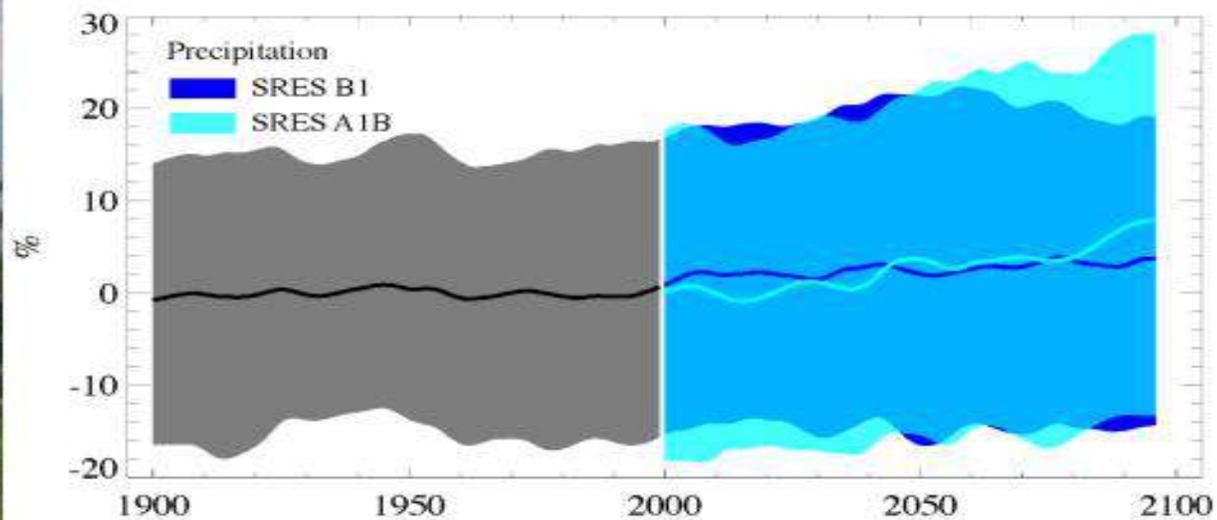


Climate Projections for the Pacific North-West

Temperature

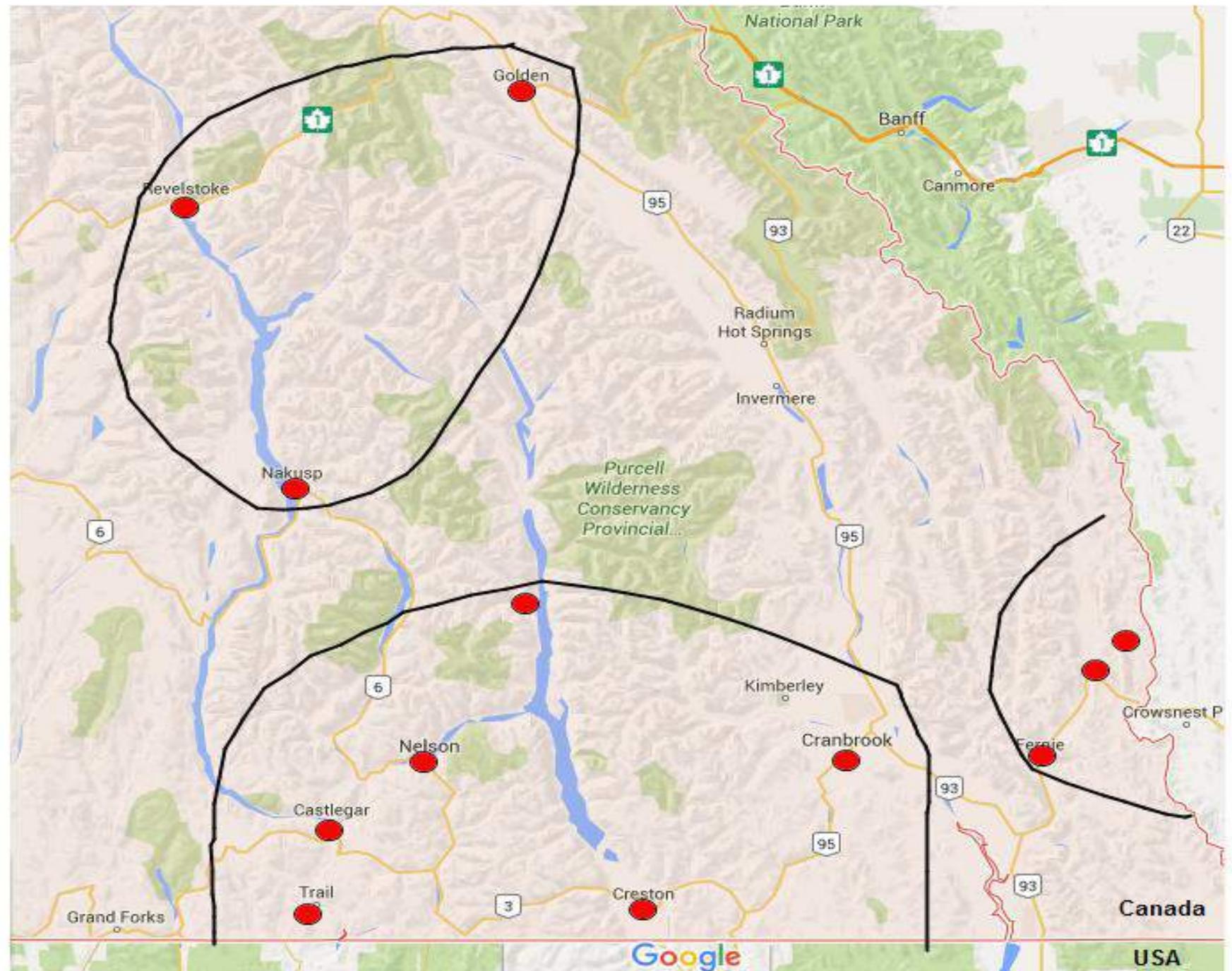


Precipitation



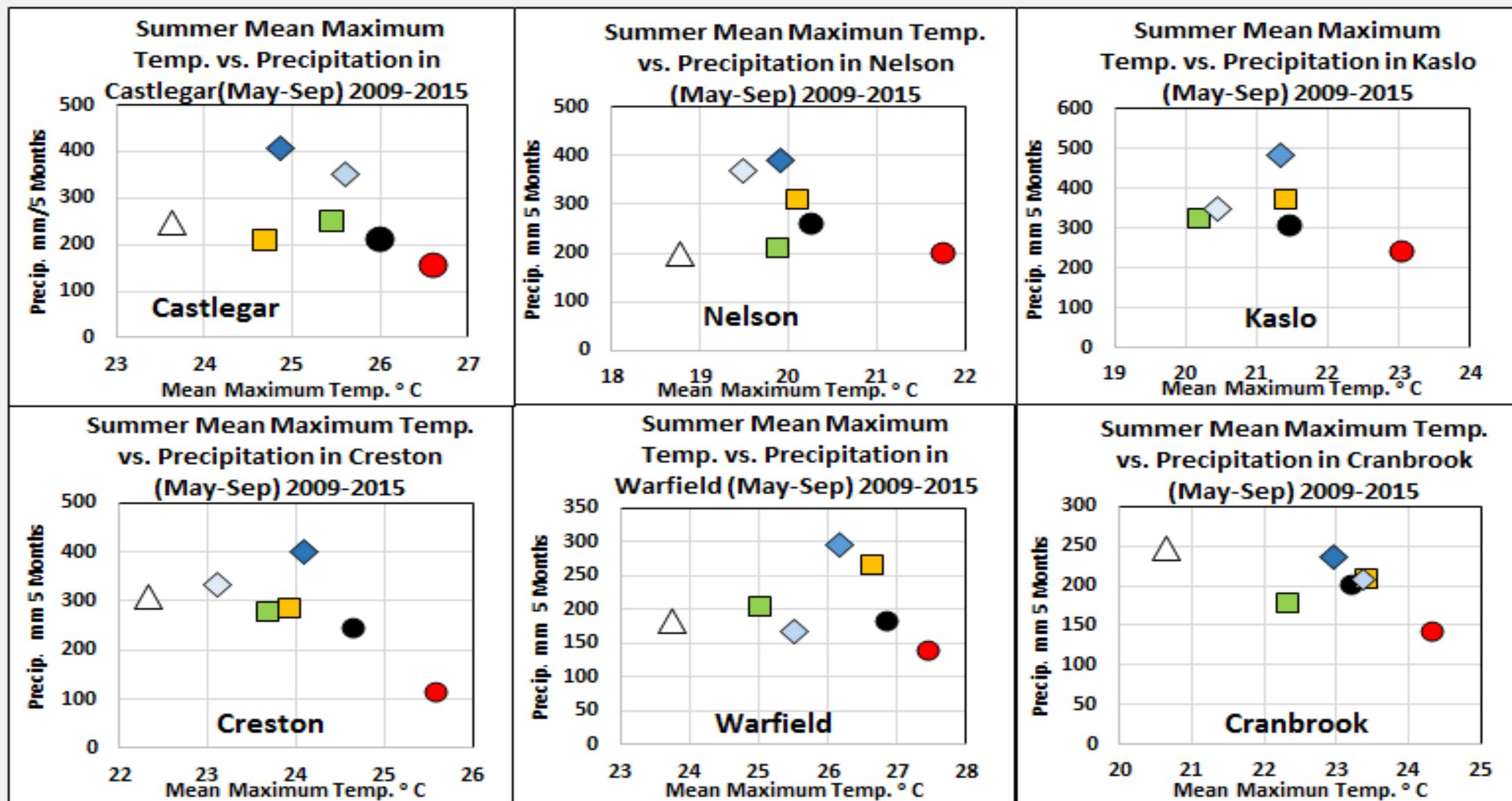
Source: Alan Hamlet 2013

Grouping of Climate Stations in the Canadian Portion of the Columbia Basin

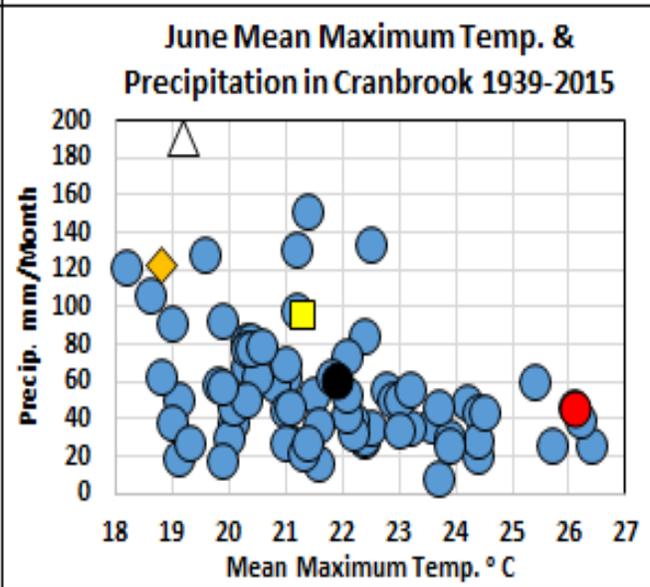
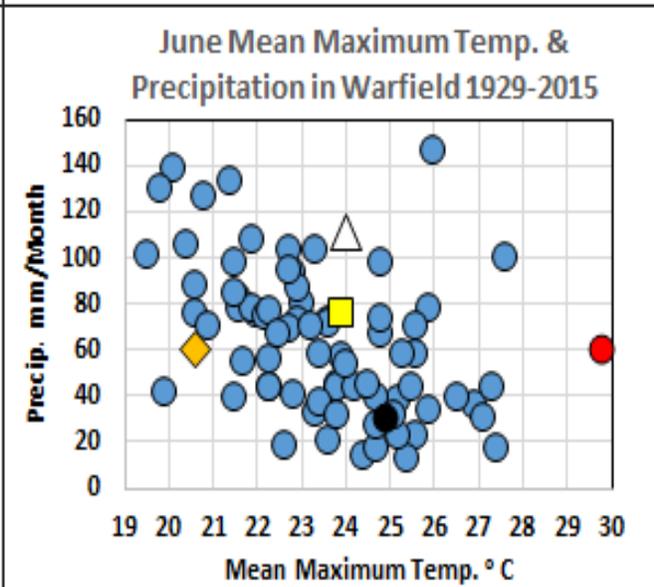
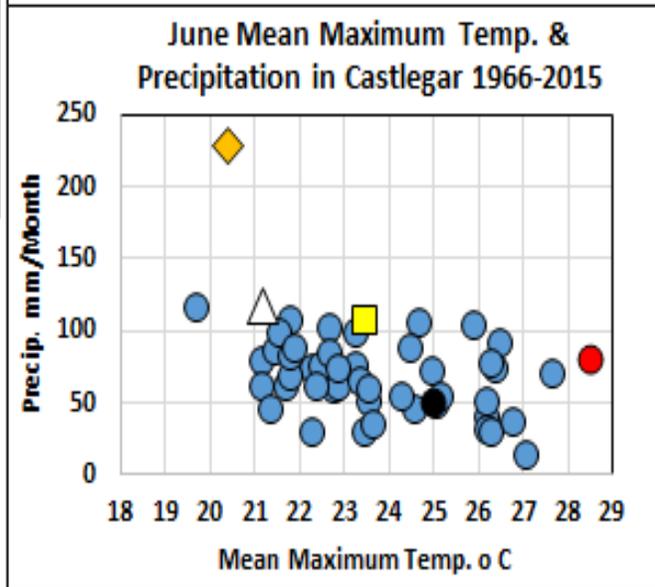
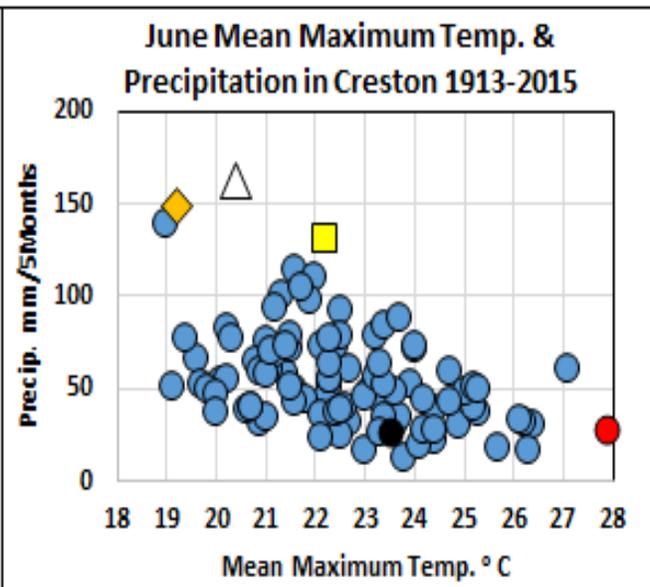
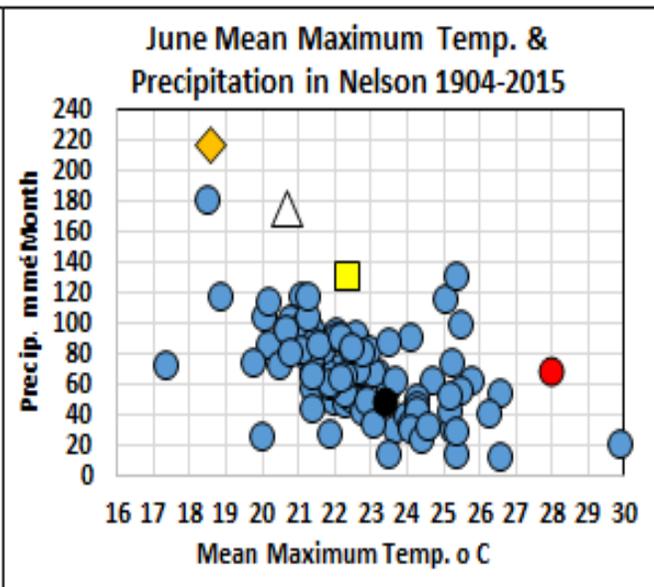
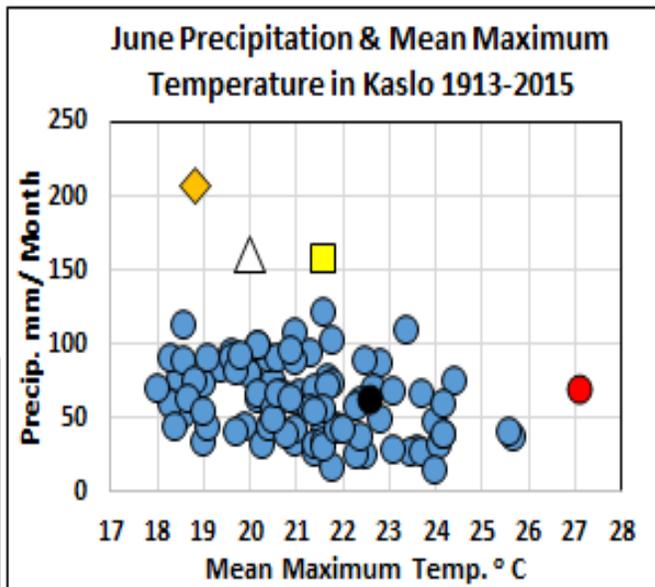
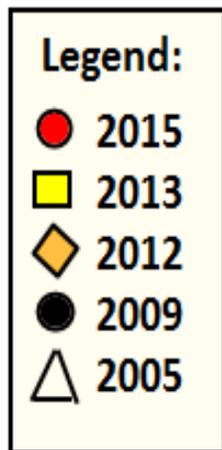


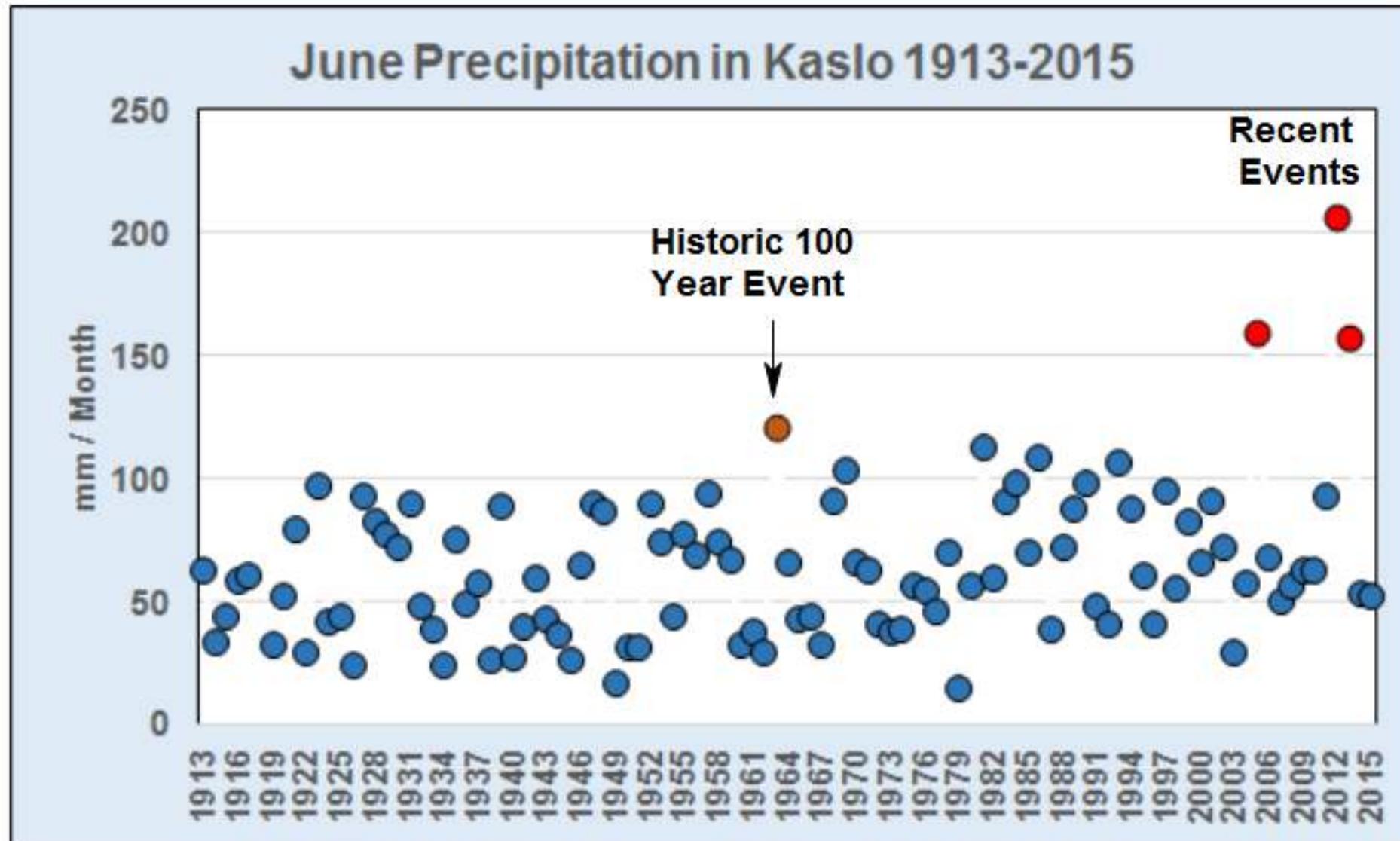
Summer Precipitation and Temperatures over the 2009-2015 Study

Communities in Southern Portion of the Columbia Basin



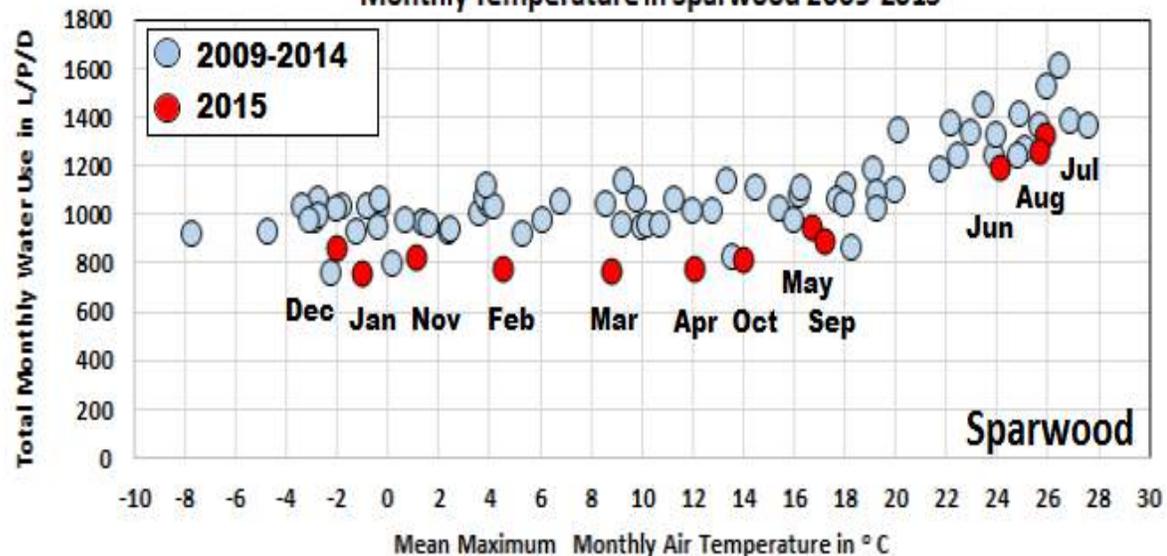
June Temperature & Precipitation Changes over Historic Records



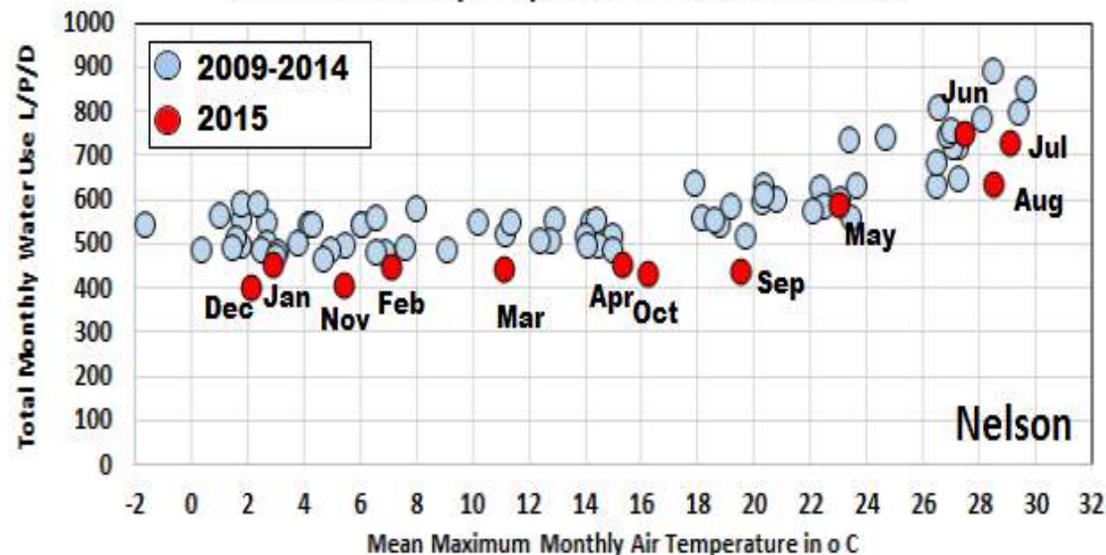


The Precipitation in June in 2005, 2012 and 2013 produced 30-70% more rain than in any other June since records stated in 1913.

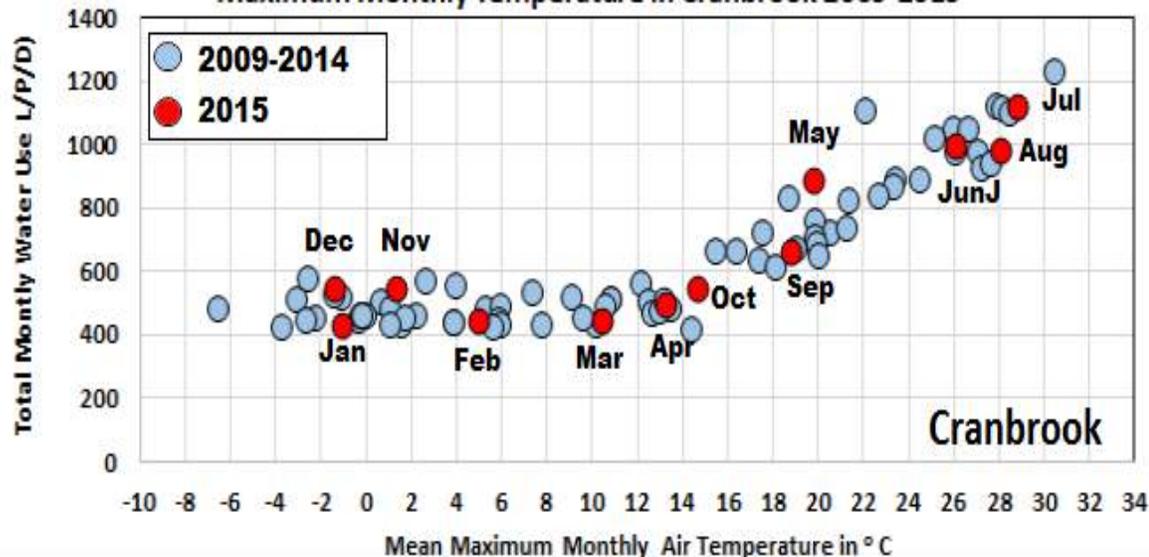
Relationship Between Total Monthly Water Use (L/P/D) & Mean Maximum Monthly Temperature in Sparwood 2009-2015



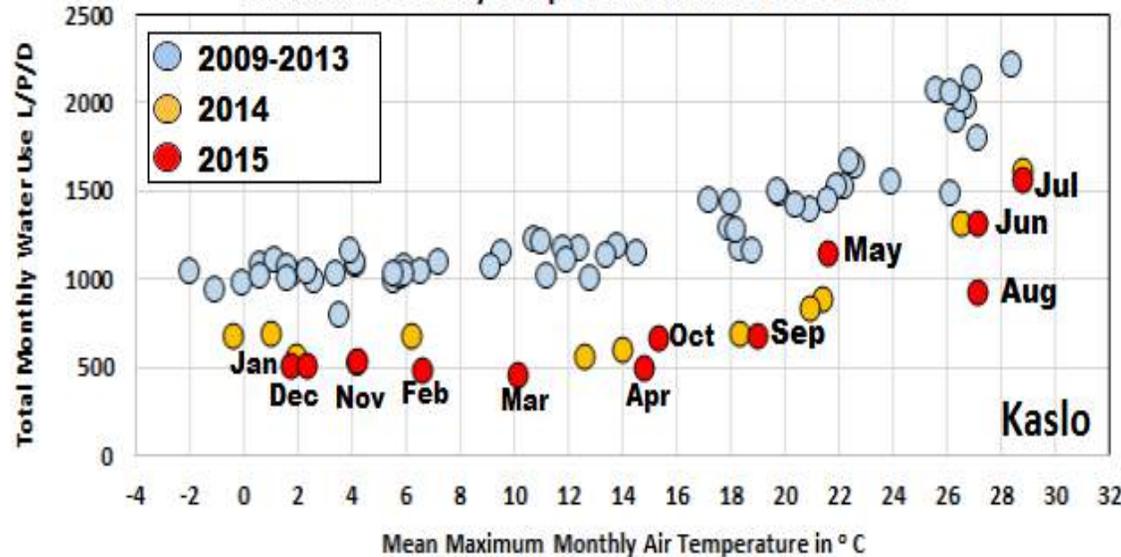
Relationship Between Total Monthly Water Use (L/P/D) & Mean Maximum Monthly Temperature in Nelson 2009-2015



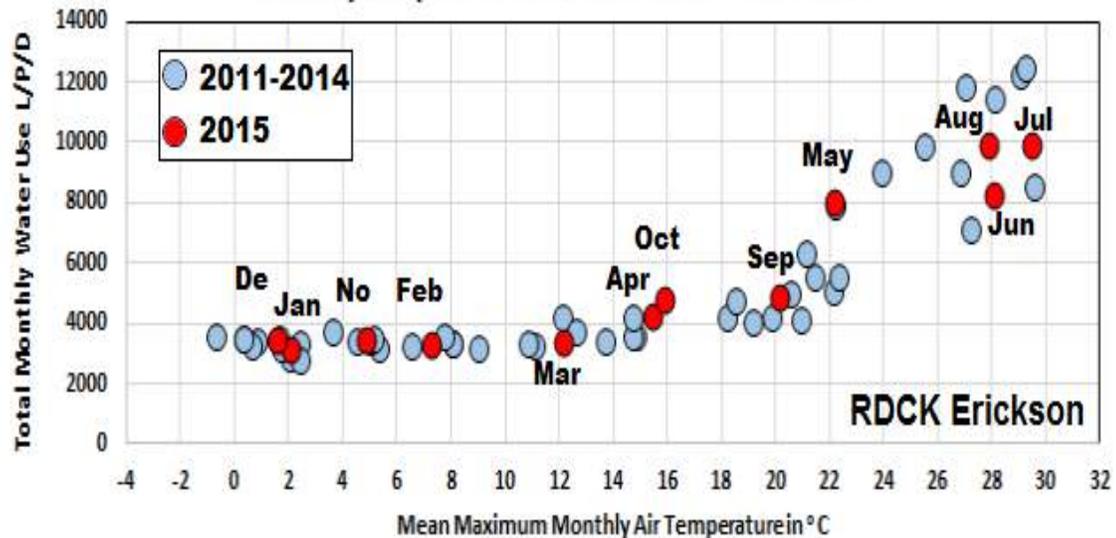
Relationship Between Total Monthly Water Use (L/C/D) & Mean Maximum Monthly Temperature in Cranbrook 2009-2015



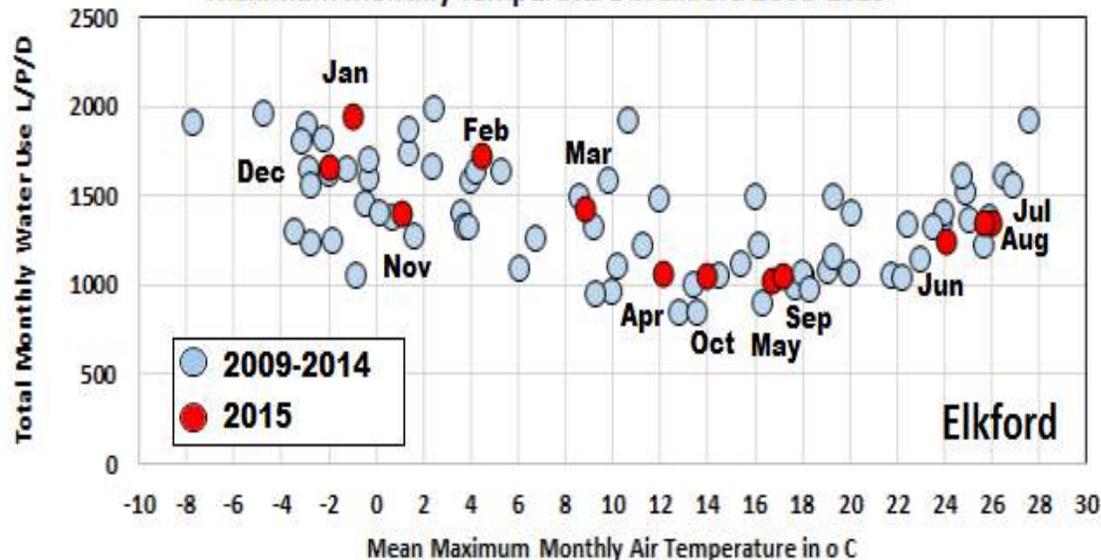
Relationship Between Total Monthly Water Use (L/P/D) & Mean Maximum Monthly Temperature in Kaslo 2009-2015



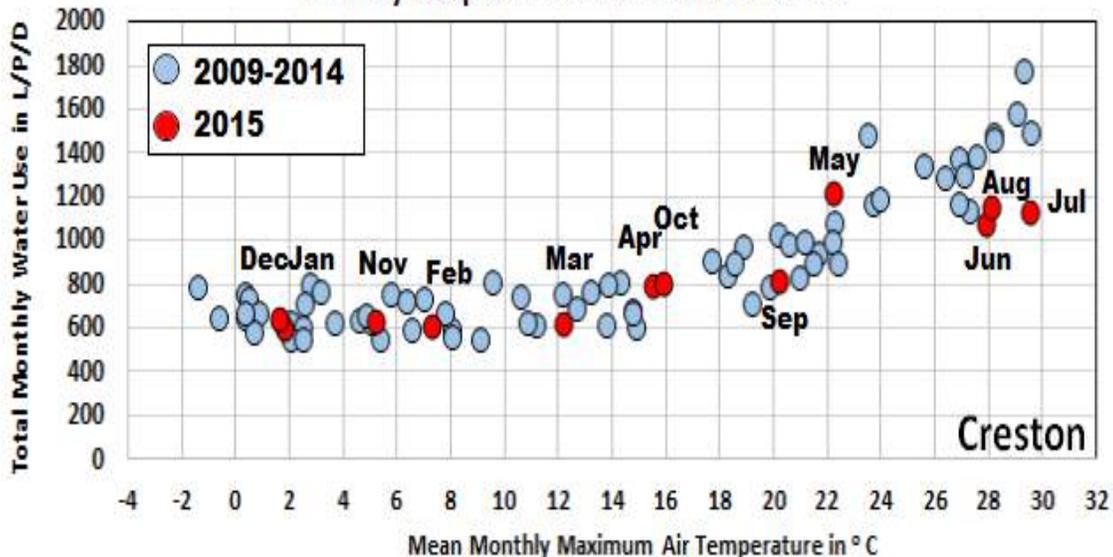
Relationship Between Total Monthly Water Use (L/P/D) & Mean Maximum Monthly Temperature in RDCK-Erickson 2011-2015



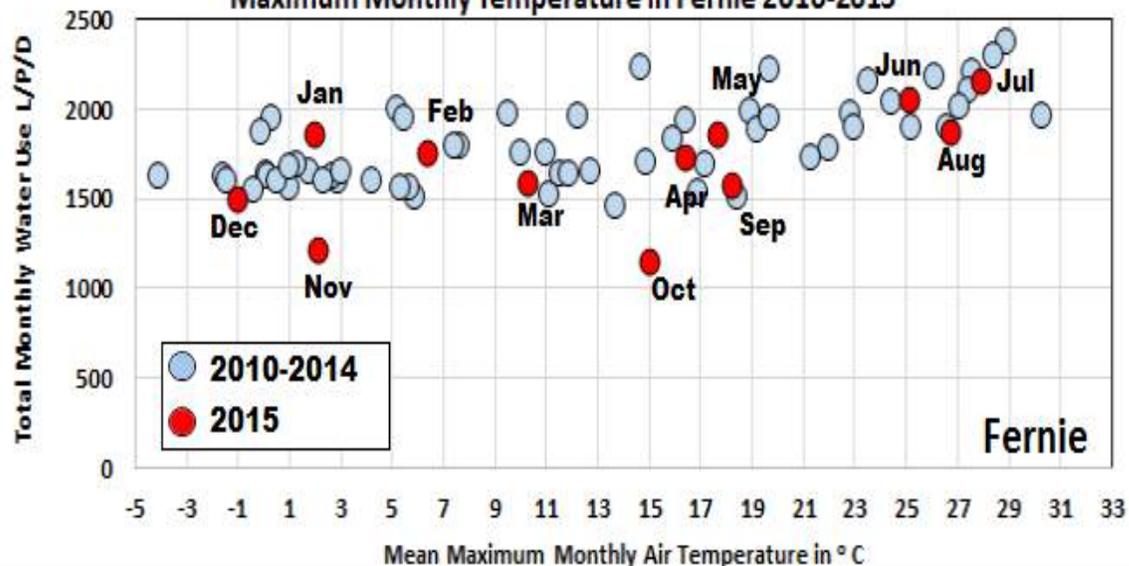
Relationship Between Total Monthly Water Use (L/P/D) & Mean Maximum Monthly Temperature in Elkford 2009-2015



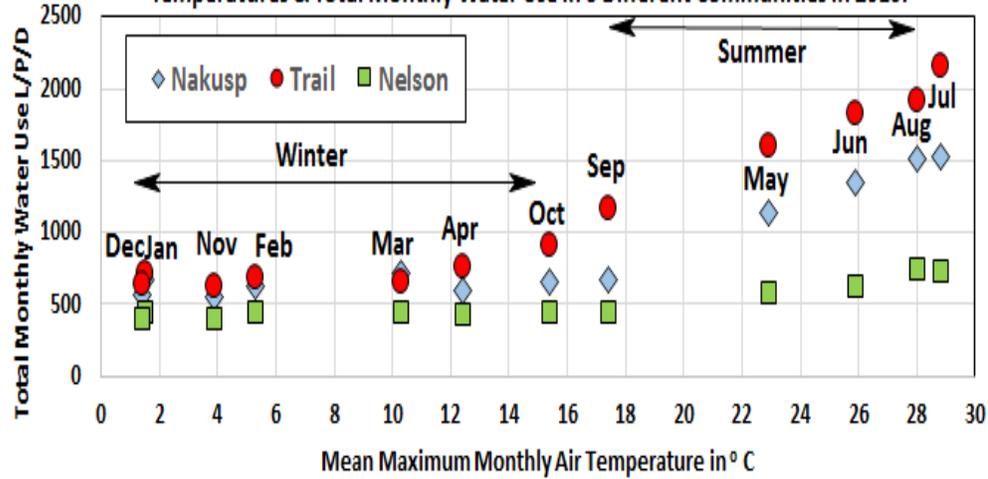
Relationship Between Monthly Water Use (L/P/D) & Mean Maximum Monthly Temperatures in Creston 2009-2015



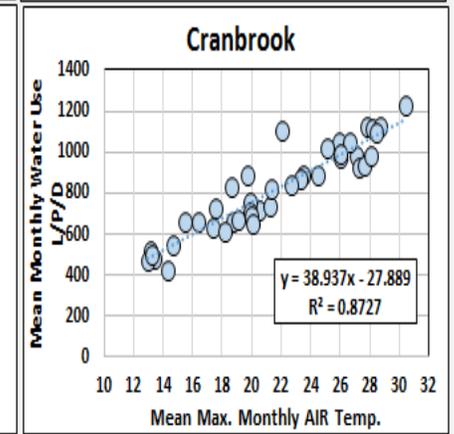
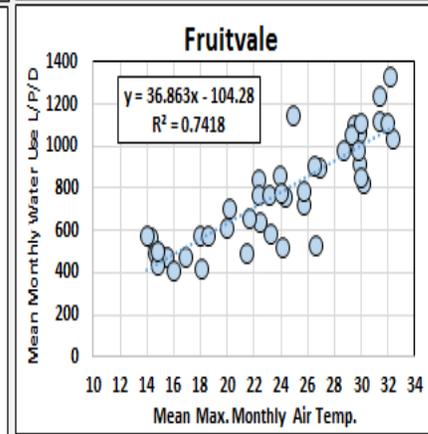
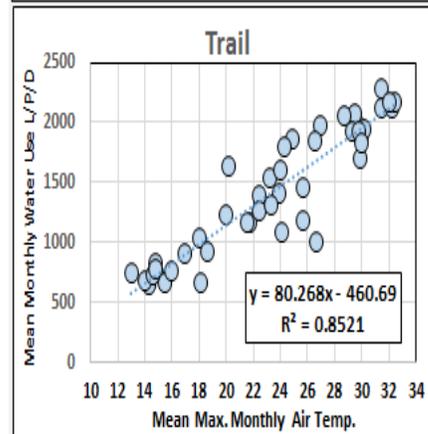
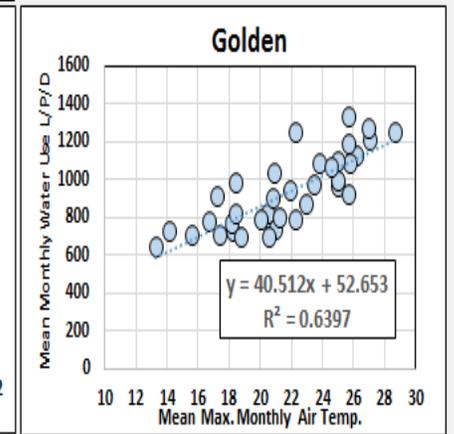
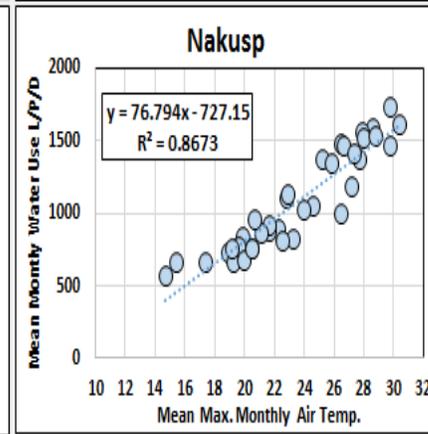
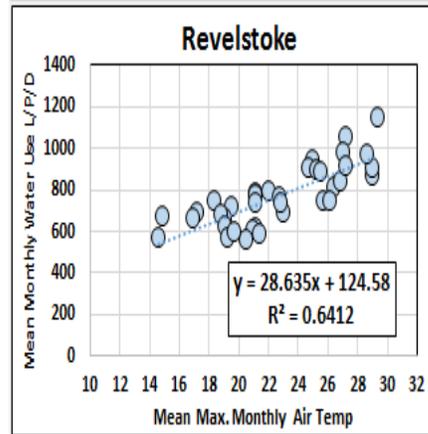
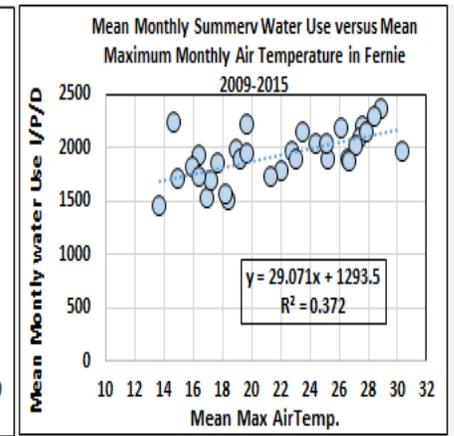
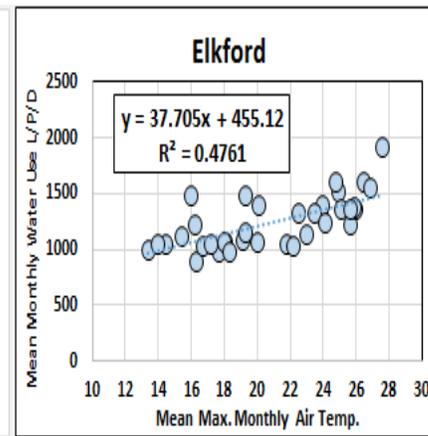
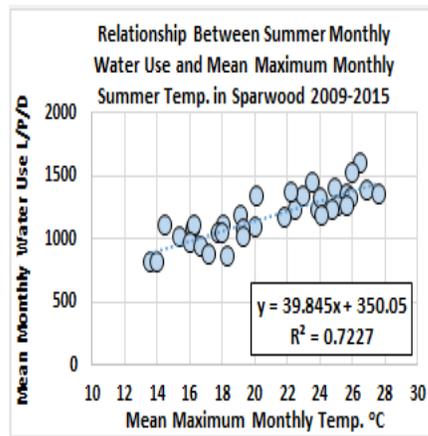
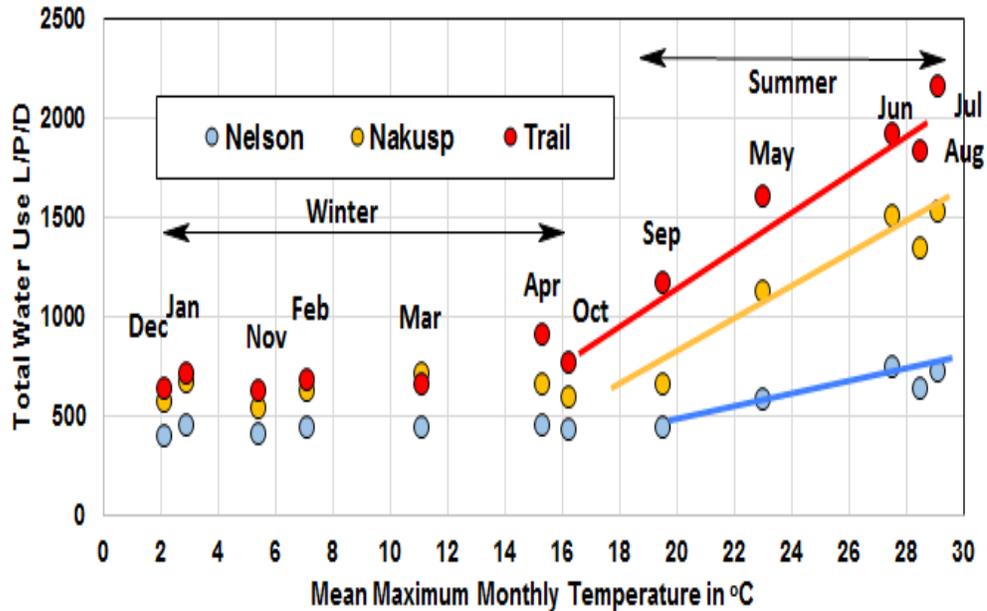
Relationship Between Total Monthly Water Use (L/P/D) & Mean Maximum Monthly Temperature in Fernie 2010-2015



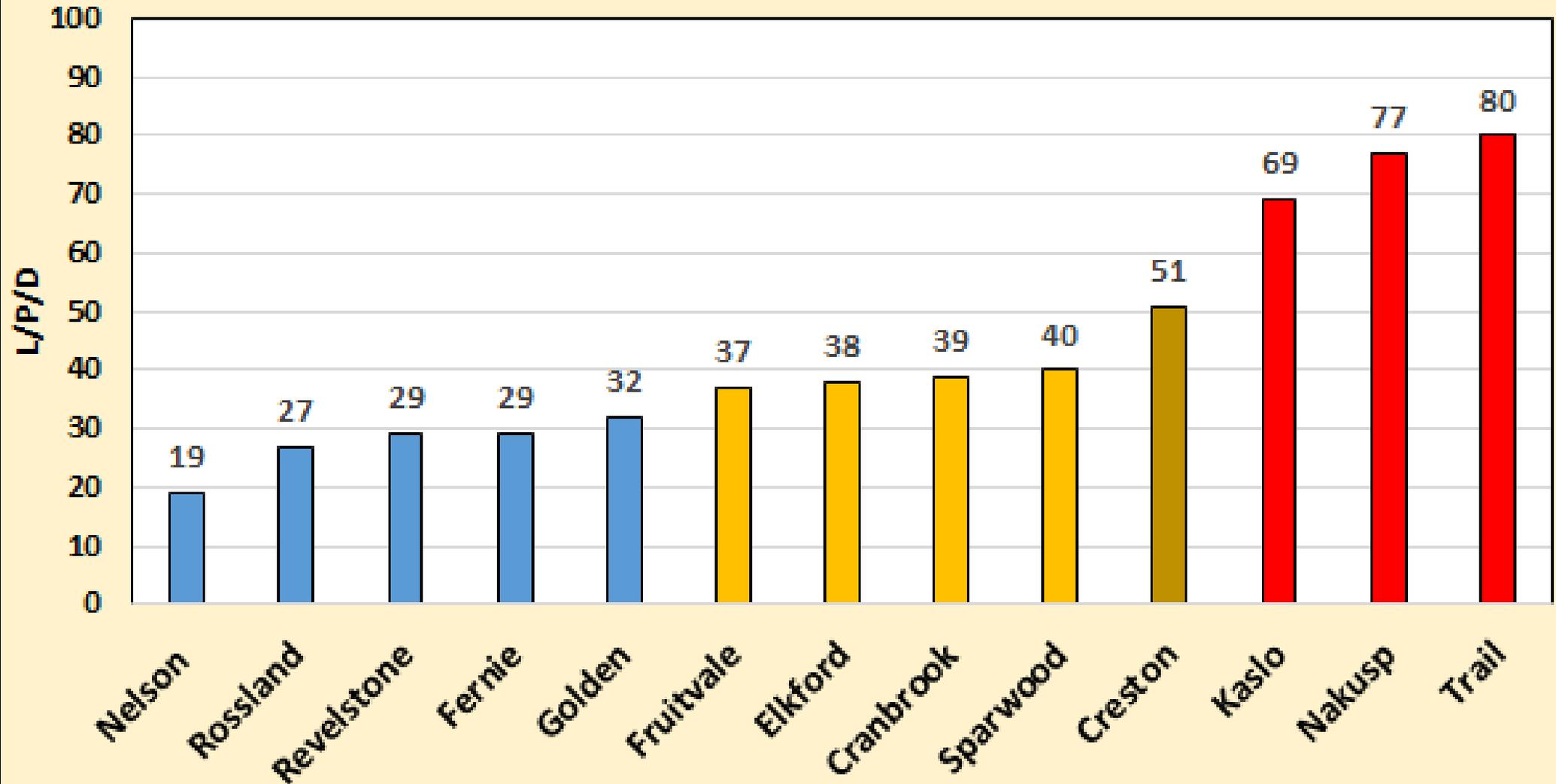
Differences in the Relationship Between Mean Maximum Monthly Air Temperatures & Total Monthly Water Use in 3 Different Communities in 2015.



Differences in Relationships Between Mean Monthly Total Water Use and Mean Monthly Maximum Air Temperature in 3 Communities in 2015



Summer Water Consumption in L/P/D for every 1 Degree Increase above 14° Mean Maximum Air Temperature



% Reduction in Total Water Use in 2014 & 2015 Compared to 2009 (N & W)

	Cranbrook		Fernie		Elkford		Sparwood		Golden		Revelstoke		Nakusp	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Jan	-22	-25	-18	-2	5	7	-6	-19	-3	-17	-23	-16	5	5
Feb	-23	-25	-16	-9	17	3	-4	-17	-2	-22	-17	-11	13	11
Mar	-23	-20	-14	-17	10	-21	-3	-18	-7	-18	-18	-14	14	18
Apr	-16	-12	-14	-9	26	-31	-9	-24	-20	-20	-13	-10	23	16
May	-27	6	-22	-14	27	-12	-10	-9	-32	-14	-21	3	-10	35
June	-25	-10	-9	-5	10	-8	-24	-8	-30	-20	-27	-3	-25	11
July	25	12	25	17	31	-6	-4	-3	-4	-9	-20	-15	-16	-11
Aug	7	1	5	-10	23	4	0	5	-9	-19	-21	-16	-25	-15
Sep	-27	-25	4	-16	-27	-21	-30	-26	-3	-16	-24	-15	7	-26
Oct	-22	2	6	-29	-20	0	-16	-14	-5	-7	-22	-10	14	0
Nov	-11	12	11	-20	4	3	-20	-15	-20	-10	-16	-3	3	0
Dec	-8	13	19	-5	14	4	-25	-12	-16	-14	-15	-8	7	-2
Total	-13	-5	-3	-10	11	-7	-12	-12	-14	-16	-20	-10	-5	1

Yellow = Increases

Blue = Reductions

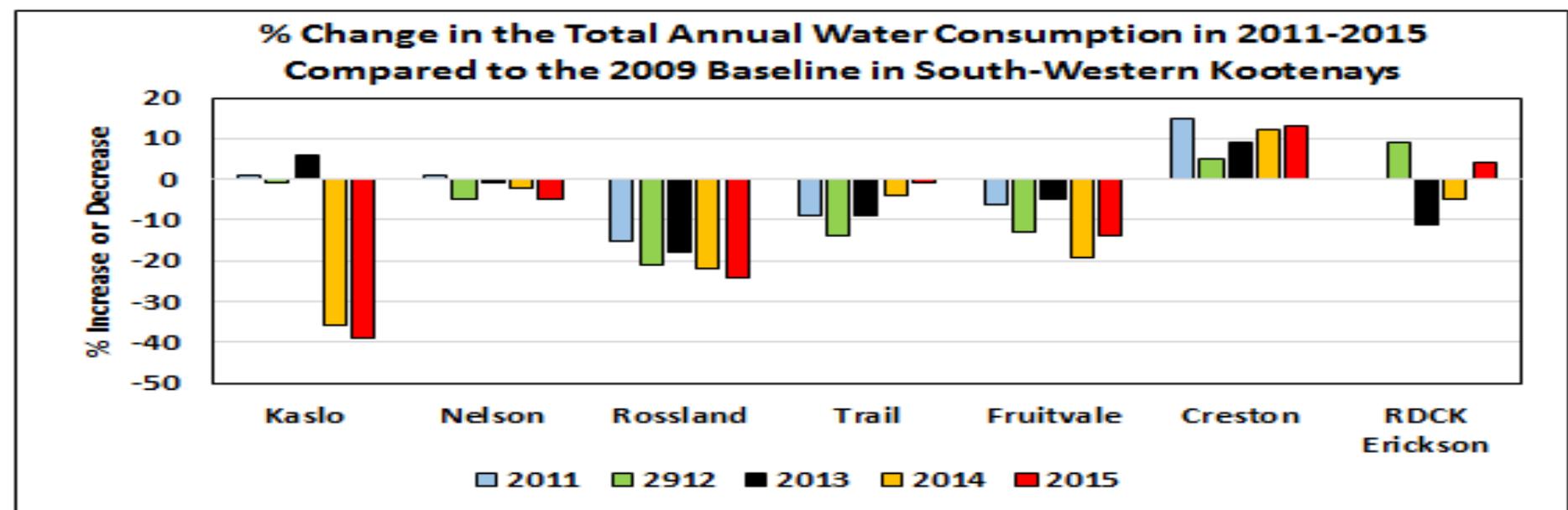
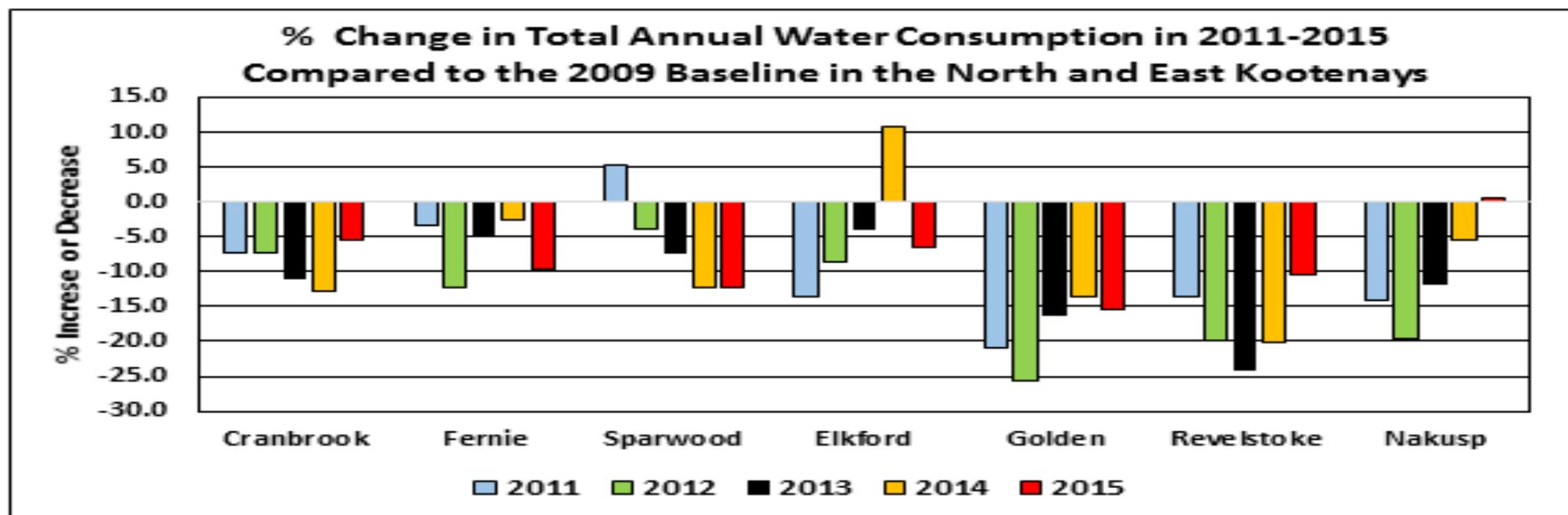
% Reduction in Total Water Use in 2014 & 2015 Compared to 2009 (S)

	Nelson		Kaslo		Roseland		Trail		Fruitvale		Creston		RD-Erickson	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Jan	-10	-12	-29	-47	-21	-24	4	1	-19	-16	5	22	-19	1
Feb	-4	-10	-14	-40	-25	-31	20	7	-18	-22	25	14	1	-2
Mar	-4	-11	-31	-53	-23	-26	38	20	-22	-13	28	20	8	4
Apr	-5	-10	-44	-50	-24	-17	28	39	-24	-15	19	40	9	31
May	-9	7	-41	-2.2	-29	-10	-8	35	-28	9	0	55	1	95
June	-16	11	-45	-19	-31	-11	-18	3	-33	-14	-20	-13	15	81
July	17	10	-18	-21	-16	-16	10	9	-2	5	42	-10	27	1
Aug	11	-4	-30	-51	-9	-23	-8	-12	-25	-21	1	0	-27	-32
Sep	9	-6	-45	-55	-14	-48	-28	-35	-23	-35	-3	-11	-39	-46
Oct	-6	-14	-47	-41	-18	-27	-13	-14	1	-16	16	42	0	17
Nov	-10	-18	-51	-49	-26	-25	-9	-20	-15	-23	38	33	3	4
Dec	-8	-20	-46	-51	-31	-25	-23	-23	-16	-21	10	18	1	9
Total	-2	-5	-36	-39	-22	-23	-5	-2	-20	-14	12	13	-5	4

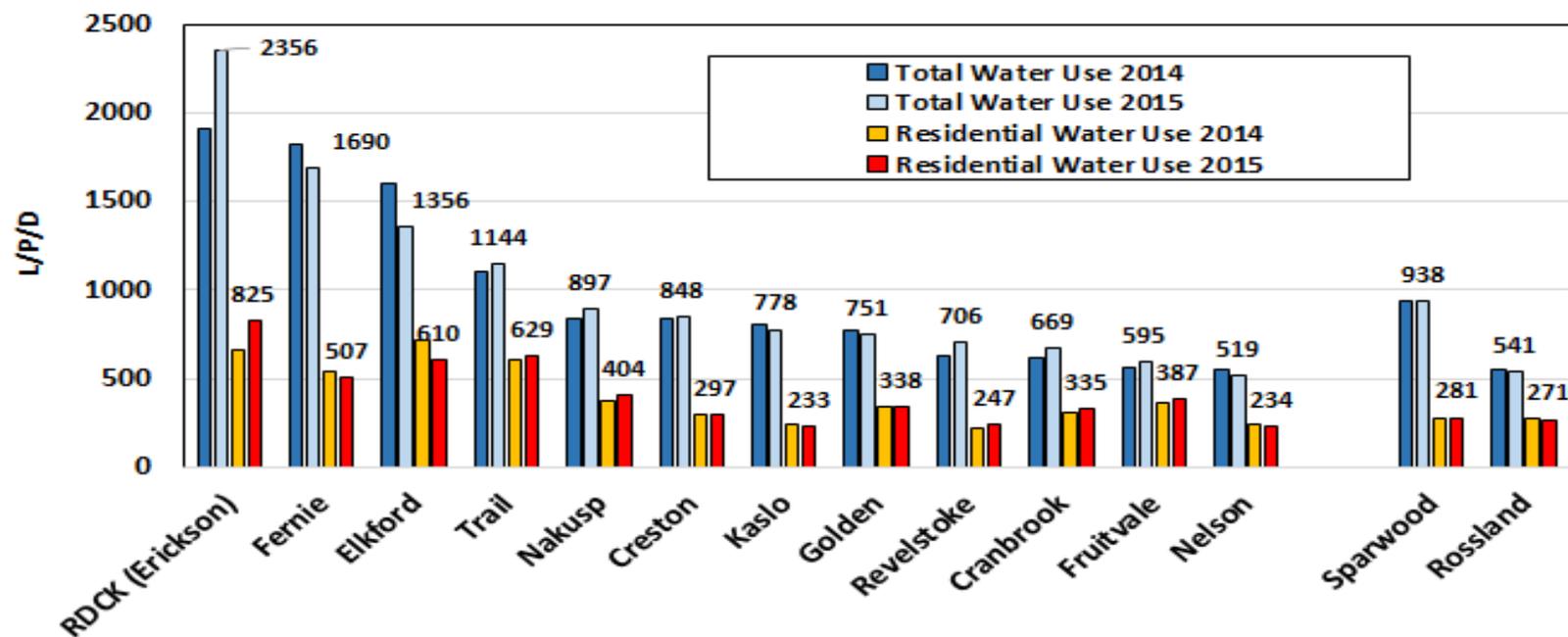
Yellow = Increases

Blue = Reductions

Overall Conservation Performance 2011-2015



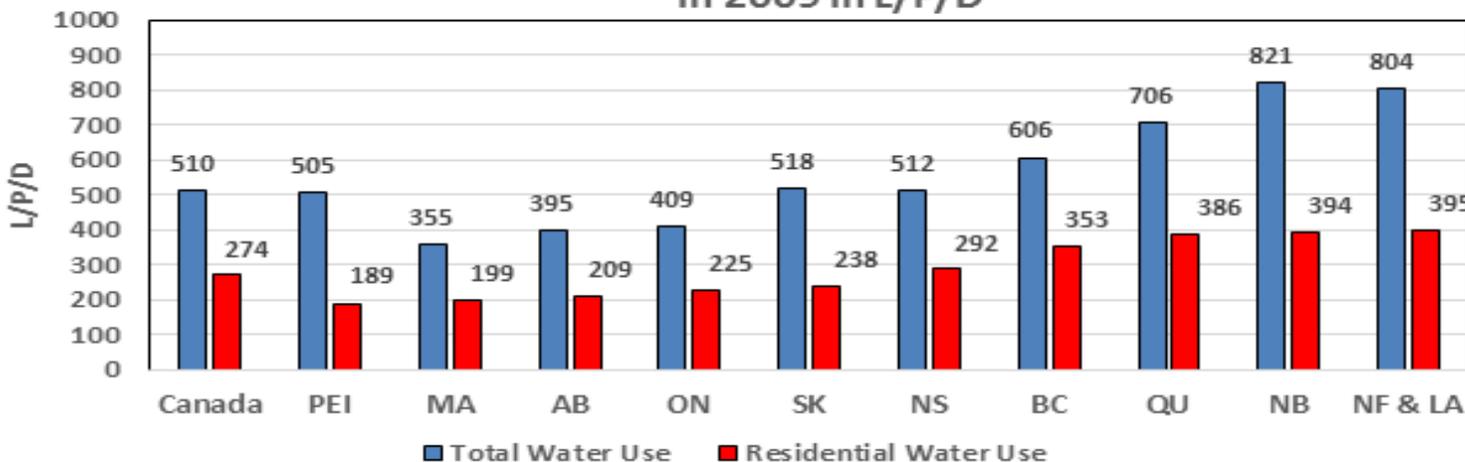
Total and Residential Water Use in L/P/D 2014 and 2015



Range of Residential Rates in the Columbia Basin in 2015:

233-610 L/P/D

Average Total and Residential Water Use in Canadian Provinces in 2009 in L/P/D

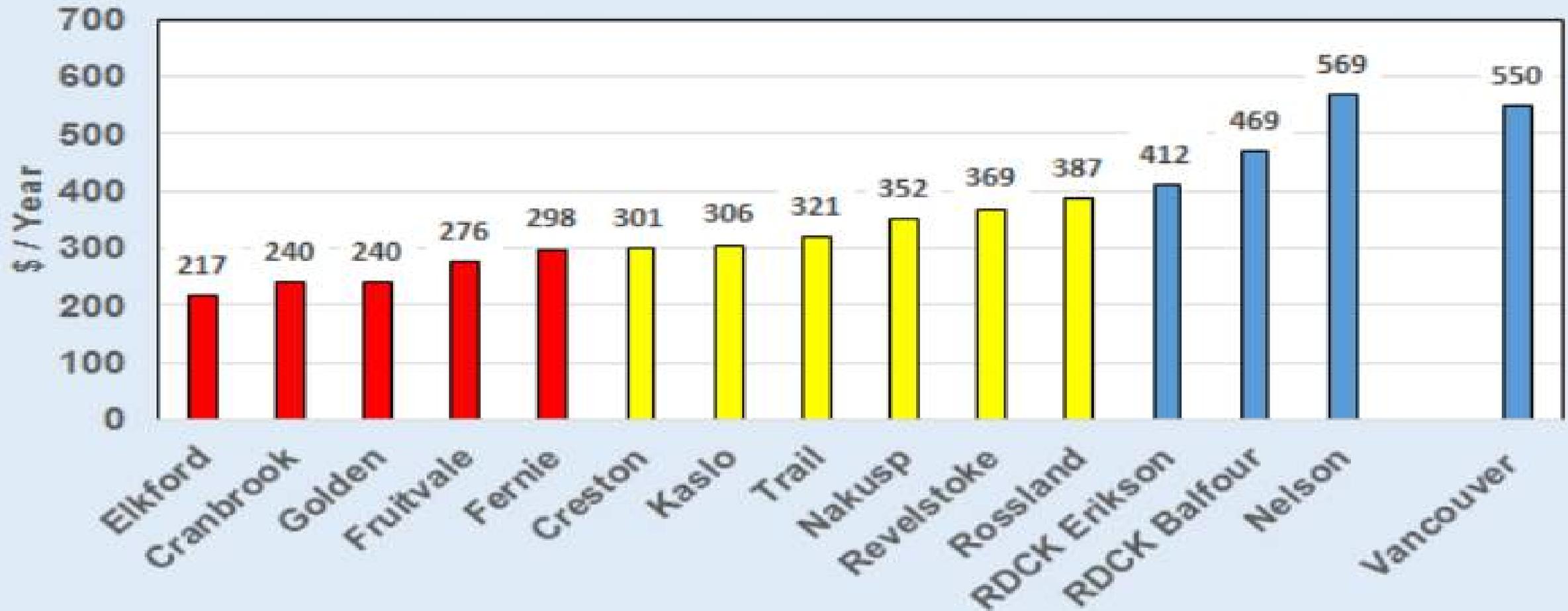


Range of Residential Rates in the Canadian Provinces:

2009: 189-395 L/P/D

Flat Annual Water Rates 2014-15 For Single Residential Houses in Communities in the Columbia Basin (\$ / Year)

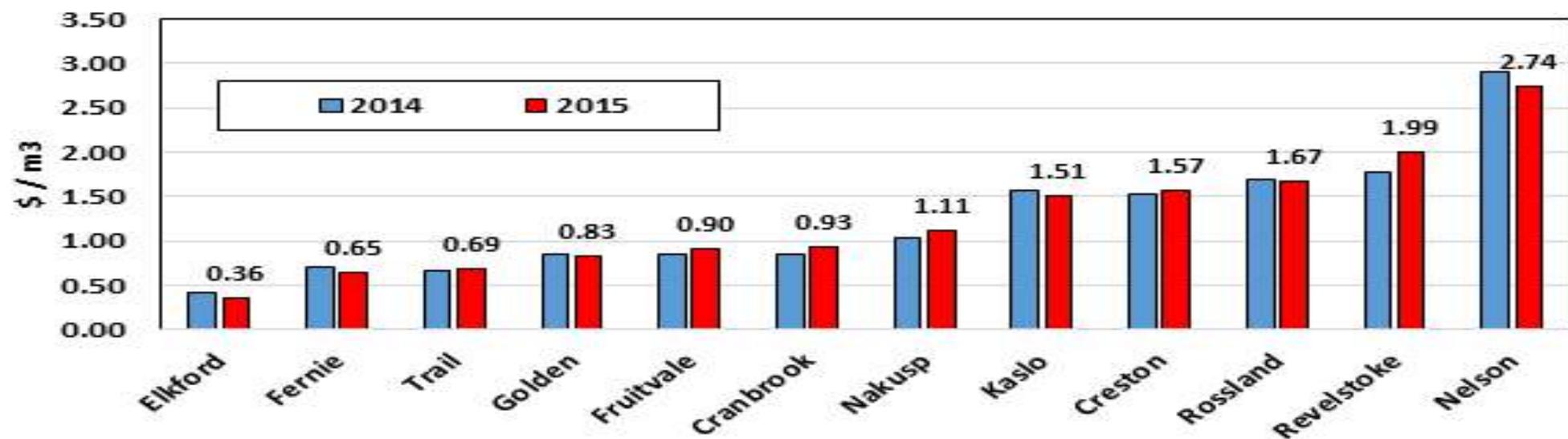
Flat Annual Water Rates Per House In Communities in the Columbia Basin 2014-2015 (\$ / Year)



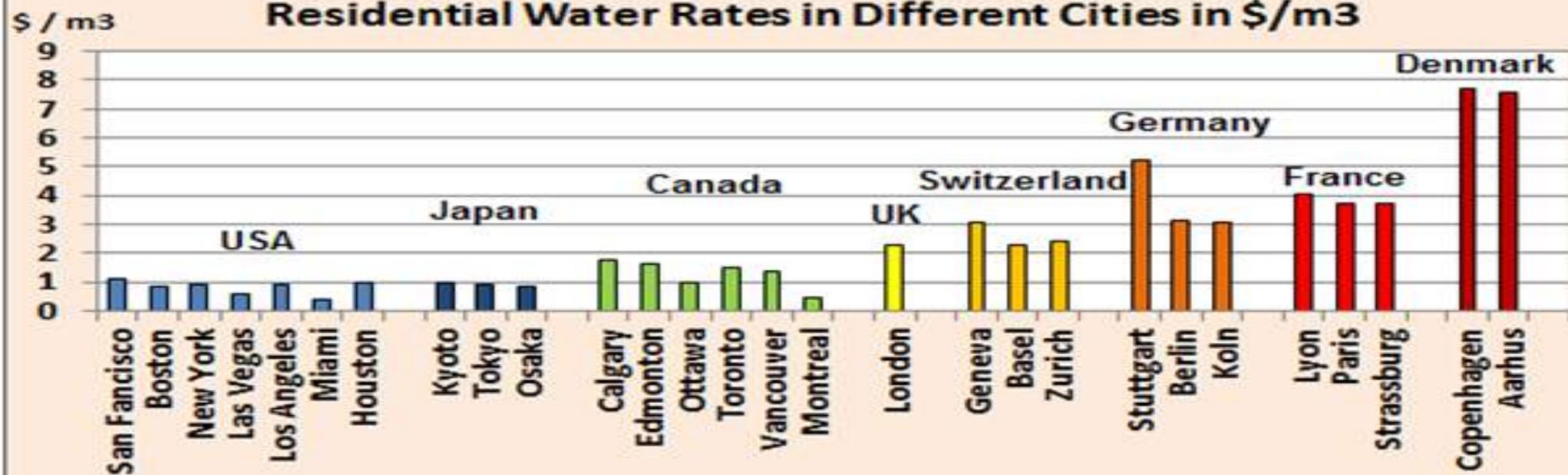
Comparison of Flat Annual Water Rates Between Different Communities (Commercial versus Residential Rates)

Commercial Water Use Rates			Range
Type of Water Use	No. of Communities	Average Water Rates	Water Rates \$/Year
Hotels/Motels / Room	12	\$ 131 /Year	66 - 203
Car Wash / Bay	8	\$ 534 /Year	343 - 773
Laundromate /Unit	6	\$ 158/Year	90 - 257
Garage/ Repair Shop	10	\$ 377 /Year	106 - 546
Church	5	\$ 346 /Year	209 - 665
School / Room	9	\$ 205 /Year	104 - 310
Swimming Pools	8	\$ 181 /Year	51 - 665
Light Commercial (Offices. Shops)	10	\$ 261/Year	224 - 420
Residential (Single House)	14	\$ 298 /Year	215 - 569

Estimated Cost in \$/m³ of Domestic Water Use



Residential Water Rates in Different Cities in \$/m³



What Was Accomplished ?

1. Proper Water Accounting is a Complex Task
2. Requires System Monitoring and Calibration of System Metering
3. Universal Metering is Critical but Initial Cost Concerns (Can save 18-58% of Water)
4. Water Loss Management = Greatest Problem (old Infrastructure)
(Detection issues Nov. or Feb between 1am & 4 am at Night)
5. Need for Asset Inventory and Replacement Planning
6. Equitable Water Pricing (Difficult without Metered Data)
7. Source Water Inventory, Planning & Protection
8. Education Program (Ambassador Program for Water Conservation)
9. Food Security and Irrigation

- Only 2 of the 15 Communities were unable to reduce their water Consumption in 2014 & 2015 (as opposed to the 2009 Baseline)
- All others Communities achieved a 3-39% reduction
- Leakages is the Greatest Problem (30-70%)
- The hot & dry 2015 Summer created new Challenges for Several Communities
- Some Successfully Addressed the Demand by initiating Summer Water Restriction

Conservation Options

Basic Conservation for all Seasons

1. Meter all water users. It saves at least 30% of water and with Smart water meters accounting can be done remotely.
2. Charge rates that account for full cost and use block rates based on volumetric use
3. Have a universal toilet replacement program for all houses
4. Encourage water recycling and use of grey water for toilet flushing
5. To change behaviour requires massive public education

Winter Water Use

1. Repair Leaks within the distribution System
2. Inventory of all the piping infrastructure and develop a comprehensive pipe replacement plan
3. Insulate pipes to prevent bleeding of water during cold winters to prevent water from freezing in pipes

Summer Water Use

Reduce summer peak water use by:

1. Use rainwater or grey water for outdoor use
2. Reduce lawn area & replace it with xeriscaping
3. Don't irrigate lawns in July and August, the grass will come back in the fall
4. If you maintain a lawn make sure you have at 30 cm of topsoil before laying out the turf
It reduces irrigation requirements by > 30%
5. Make sure automated irrigation systems are efficient & only operate during dry periods

Options for Dealing with the Uncertainty of Water Supplies in Mountains Communities



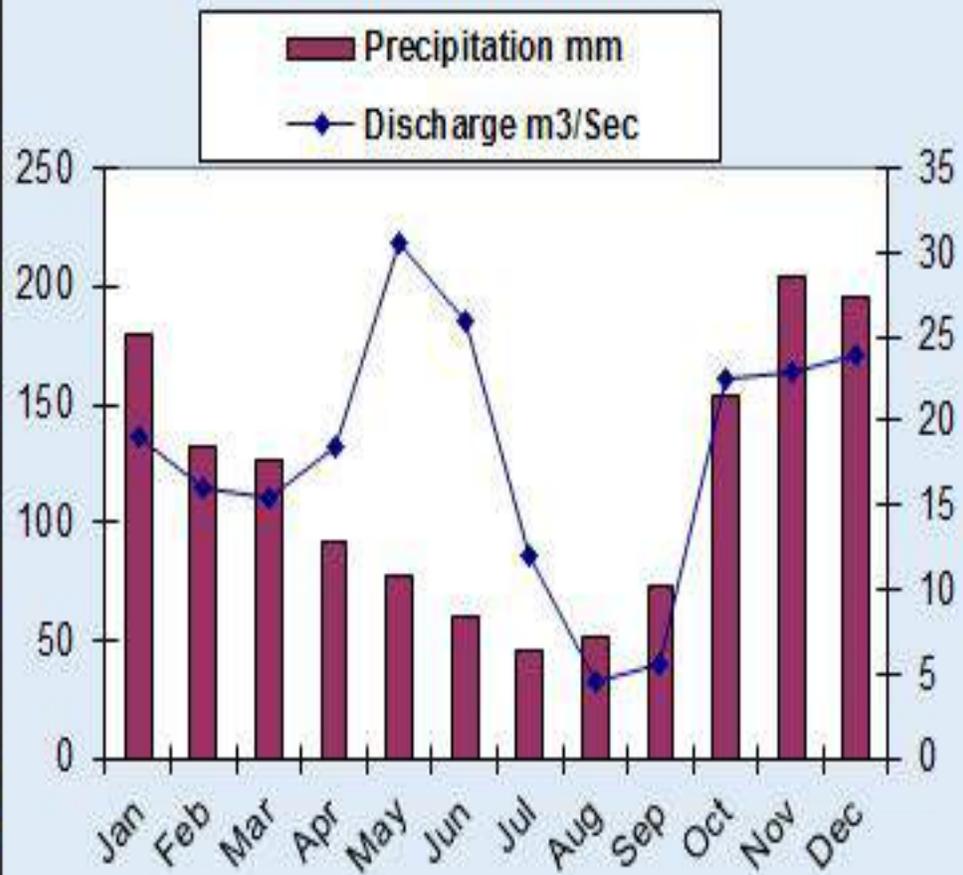
Coastal Mountains (Elevation 1400 m)

Chapman Creek Reservoir: Water Supply for the Sunshine Coast (25000 People)





Precipitation and Discharge in Chapman Creek



Chapman Creek Reservoir, Sunshine Coast, B.C.

Photo Sources:
Monte Staats 2014

July 2012



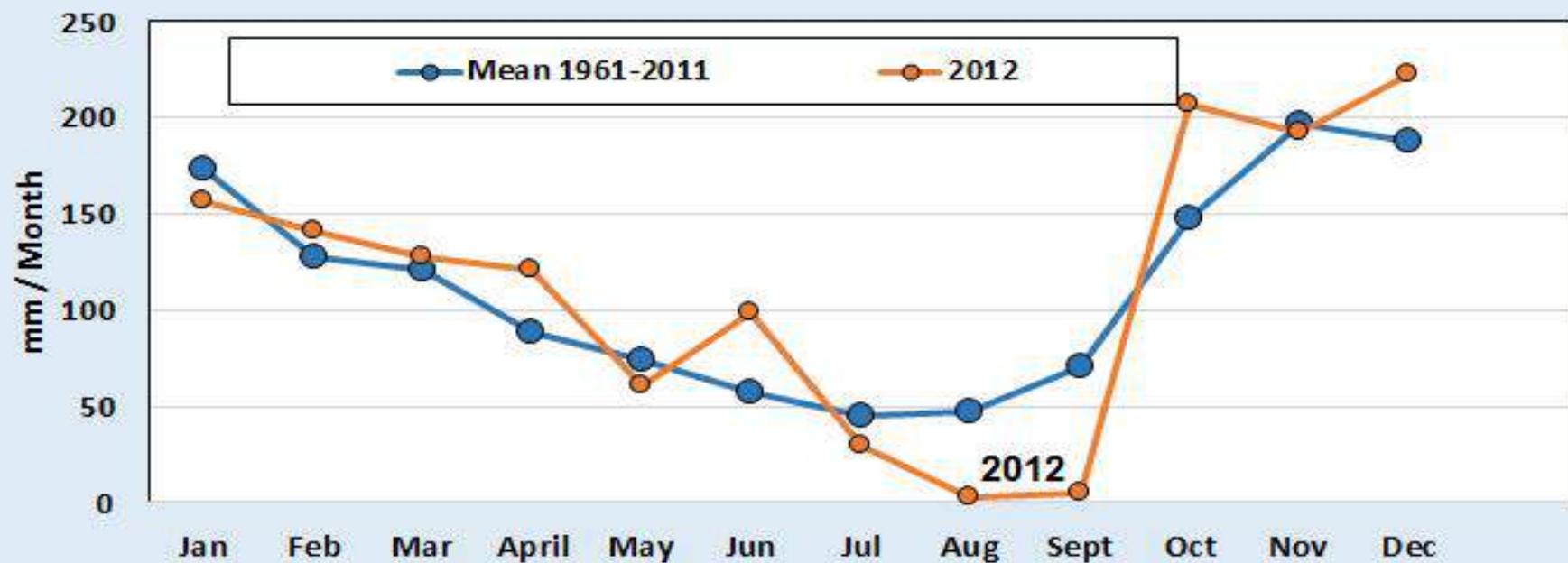
September



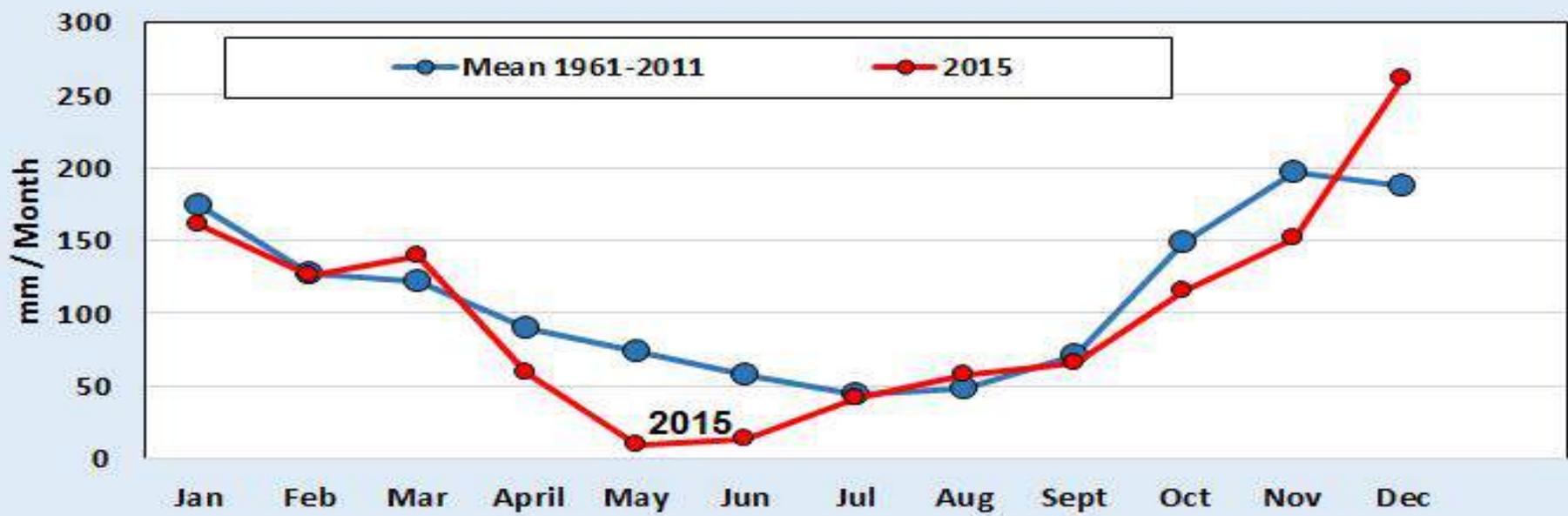
October



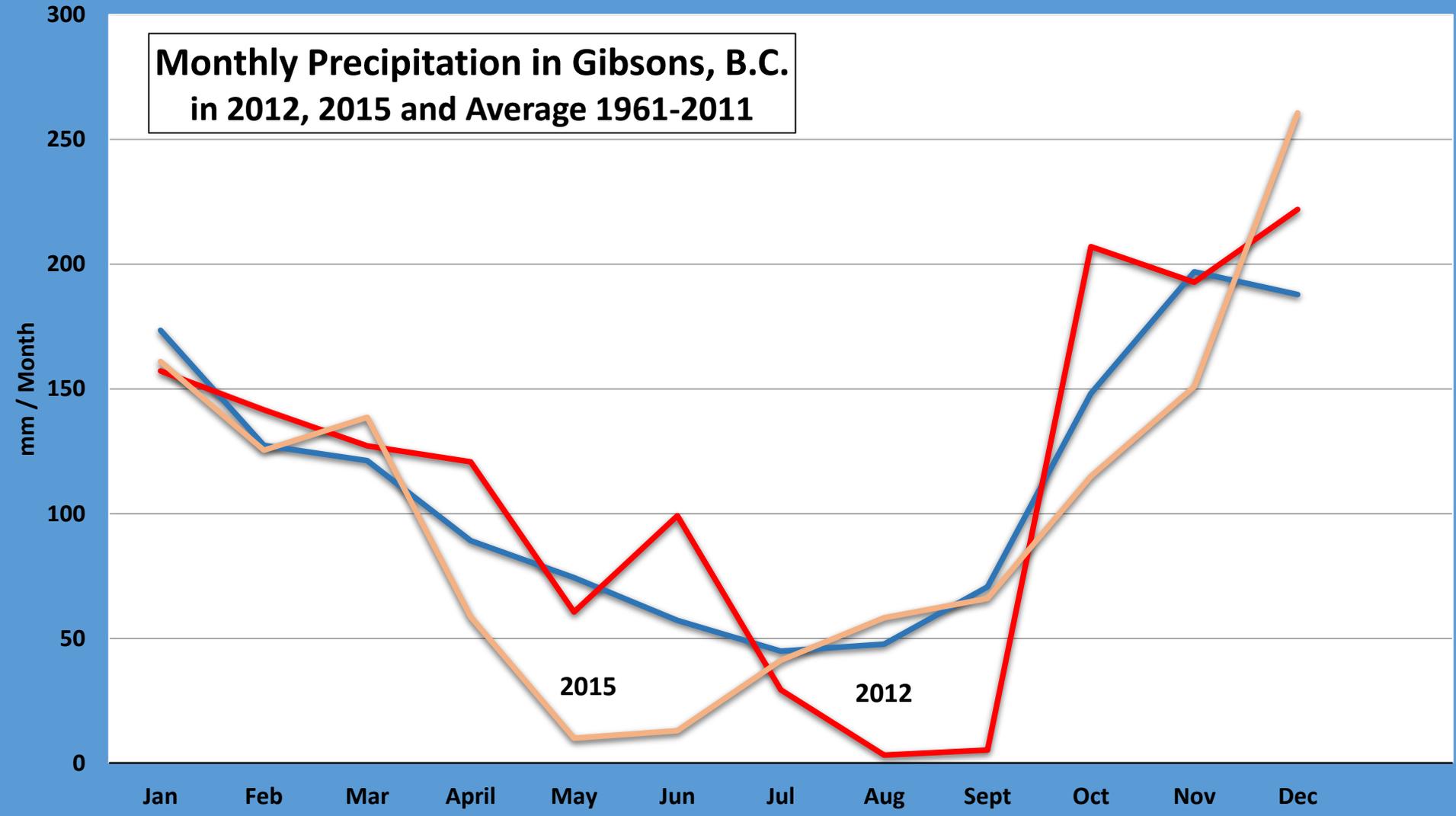
Monthly Precipitation in Gibsons, B.C. in 2012, 2015 and Average 1961-2011



Monthly Precipitation in Gibsons, B.C. in 2012, 2015 and Average 1961-2011

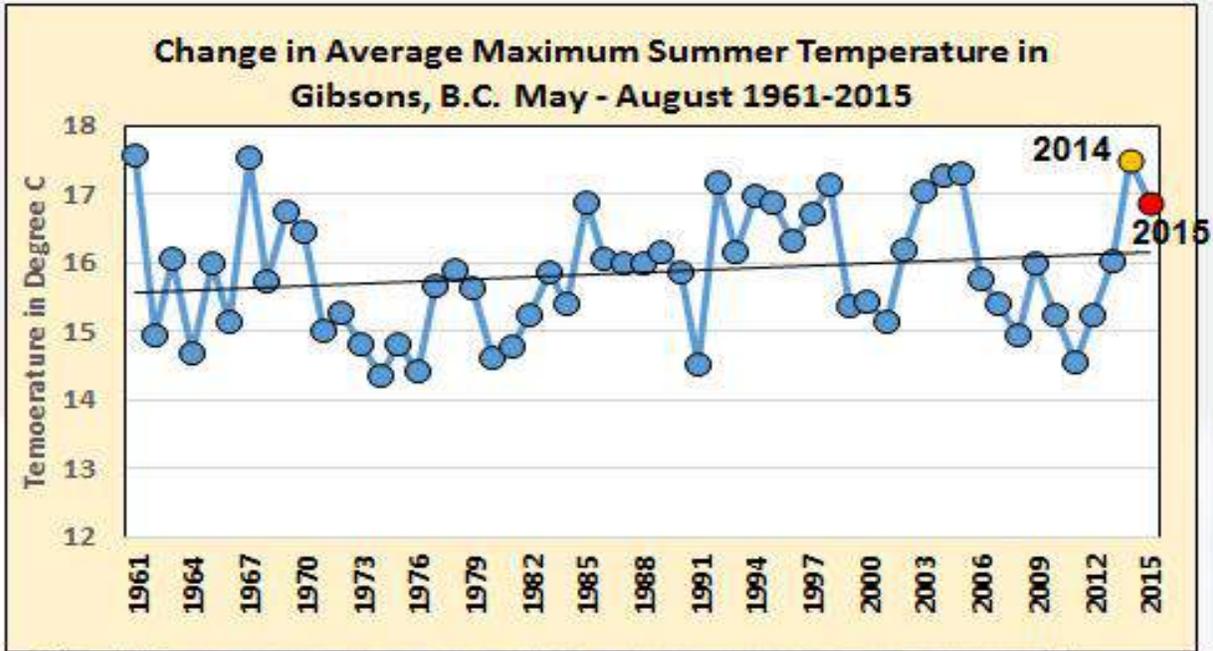


**Monthly Precipitation in Gibsons, B.C.
in 2012, 2015 and Average 1961-2011**

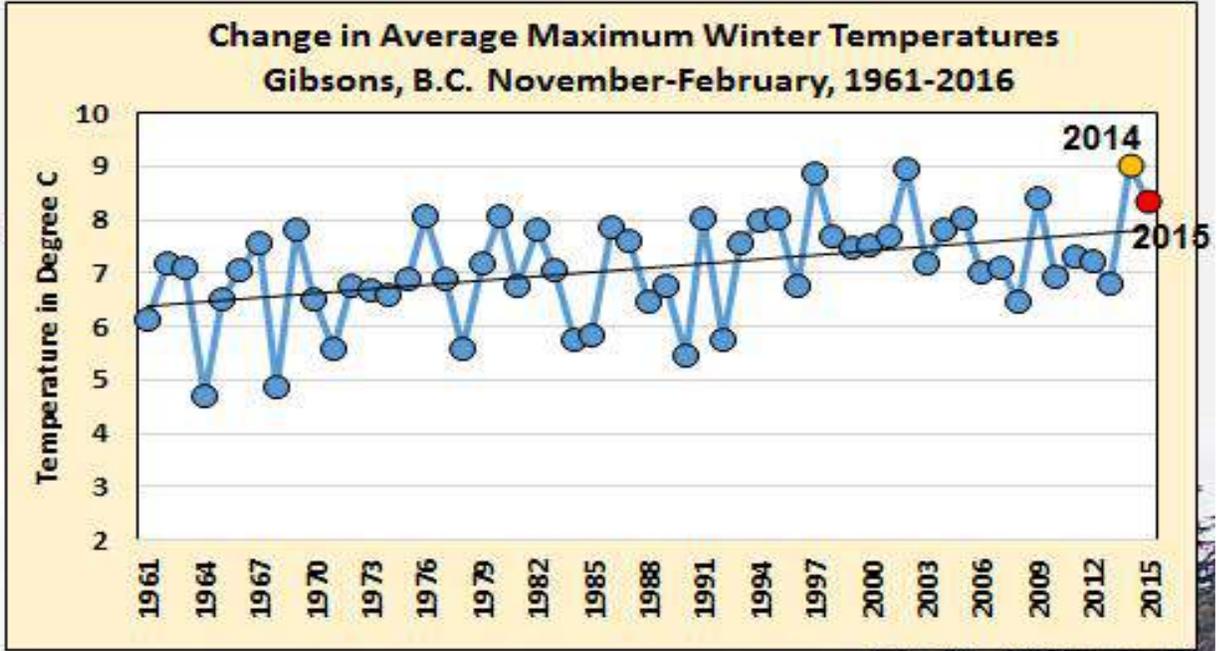


— Mean 1961-2011 — 2012 — 2015

Average Summer Maximum Temperature

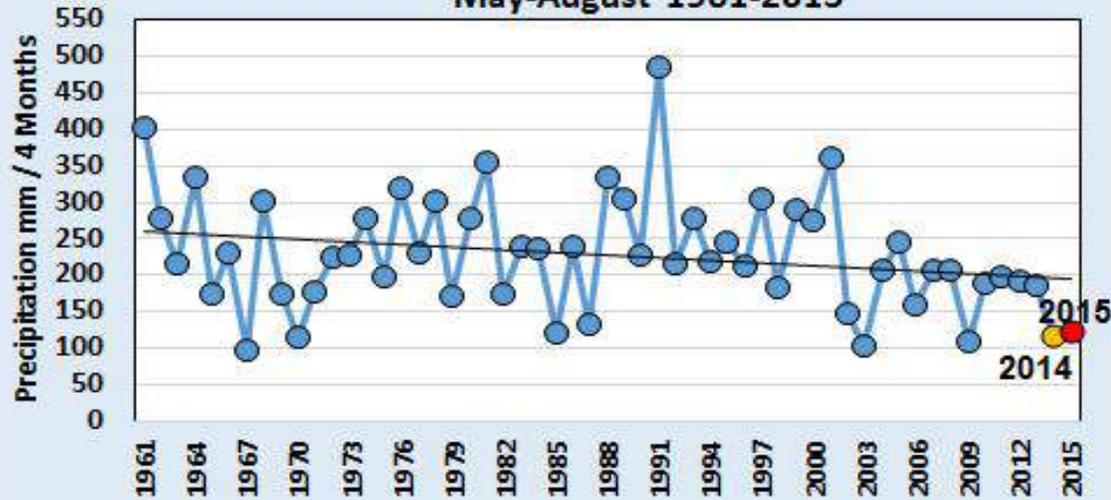


Average Winter Maximum Temperature



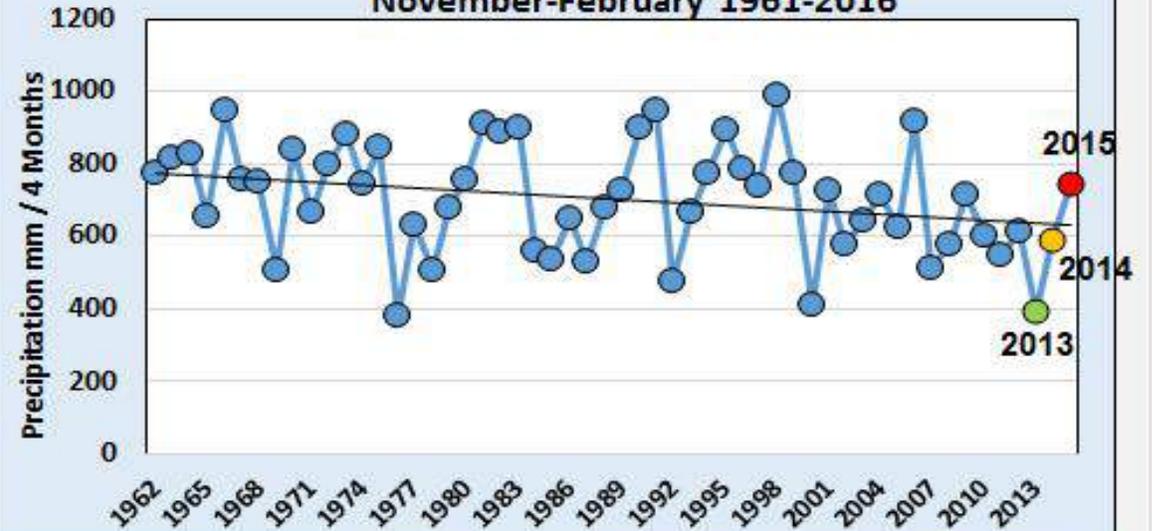
Summer Precipitation

Changes in Summer Precipitation in Gibsons, B.C.
May-August 1961-2015



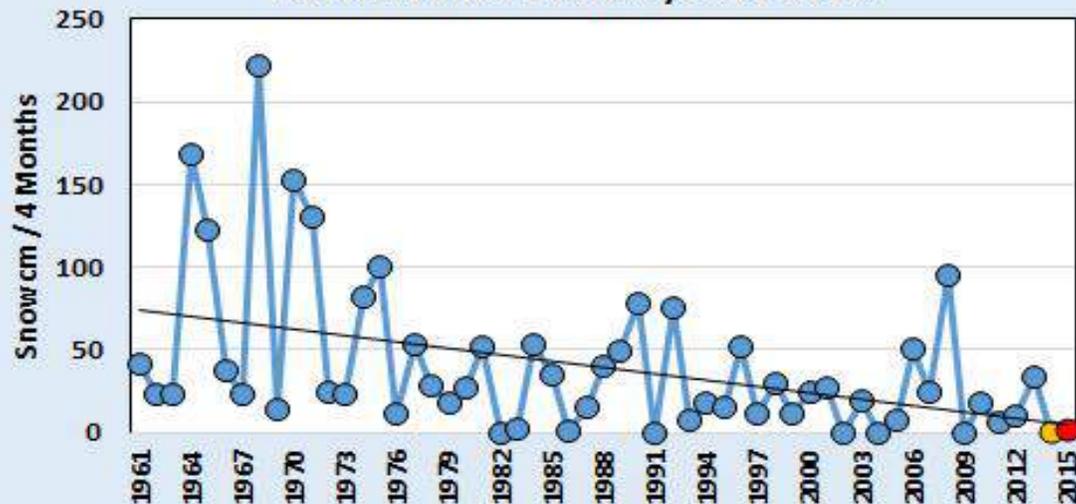
Winter Precipitation

Change in Winter Precipitation in Gibsons, B.C.
November-February 1961-2016



Winter Snow Accumulation

Changes in Winter Snow Accumulation in Gibsons, B.C.
November-February 1961-2016





THANK YOU !