Planning for the Impact of Climate Change on the Edmonton Drinking Water Supply

Prairie Provinces Water Board Workshop, November 28, 2019

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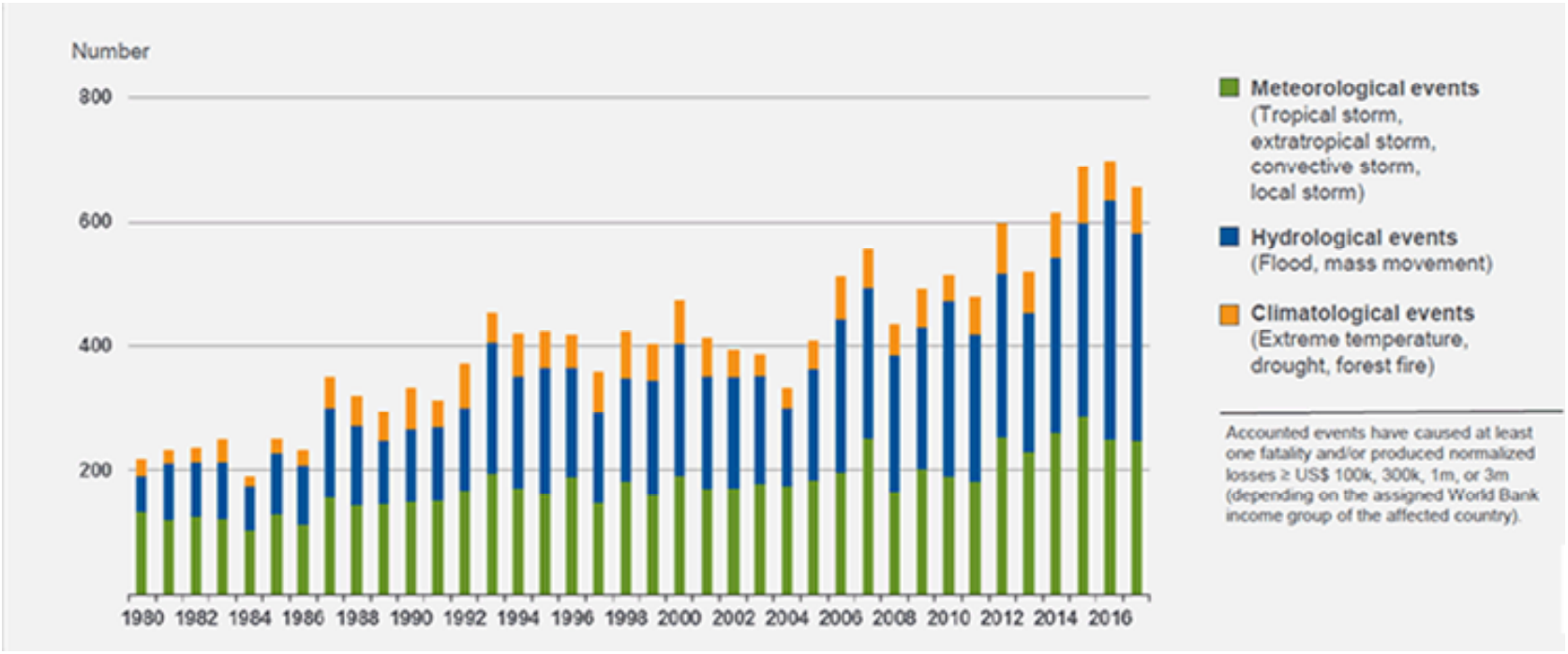
World Weather-Related Natural Catastrophes (1980 – 2017)



Source: © 2018 Munich Re, Geo Risks Research, NatCatSERVICE. As of January 2018

Topics

- The Edmonton Drinking Water System
- The North Saskatchewan River as the Water Supply for Edmonton
- Expected Impact of Climate Change on this Water Supply
- EPCOR’s Water Supply Climate Change Adaptation Plan

Edmonton Water System Overview

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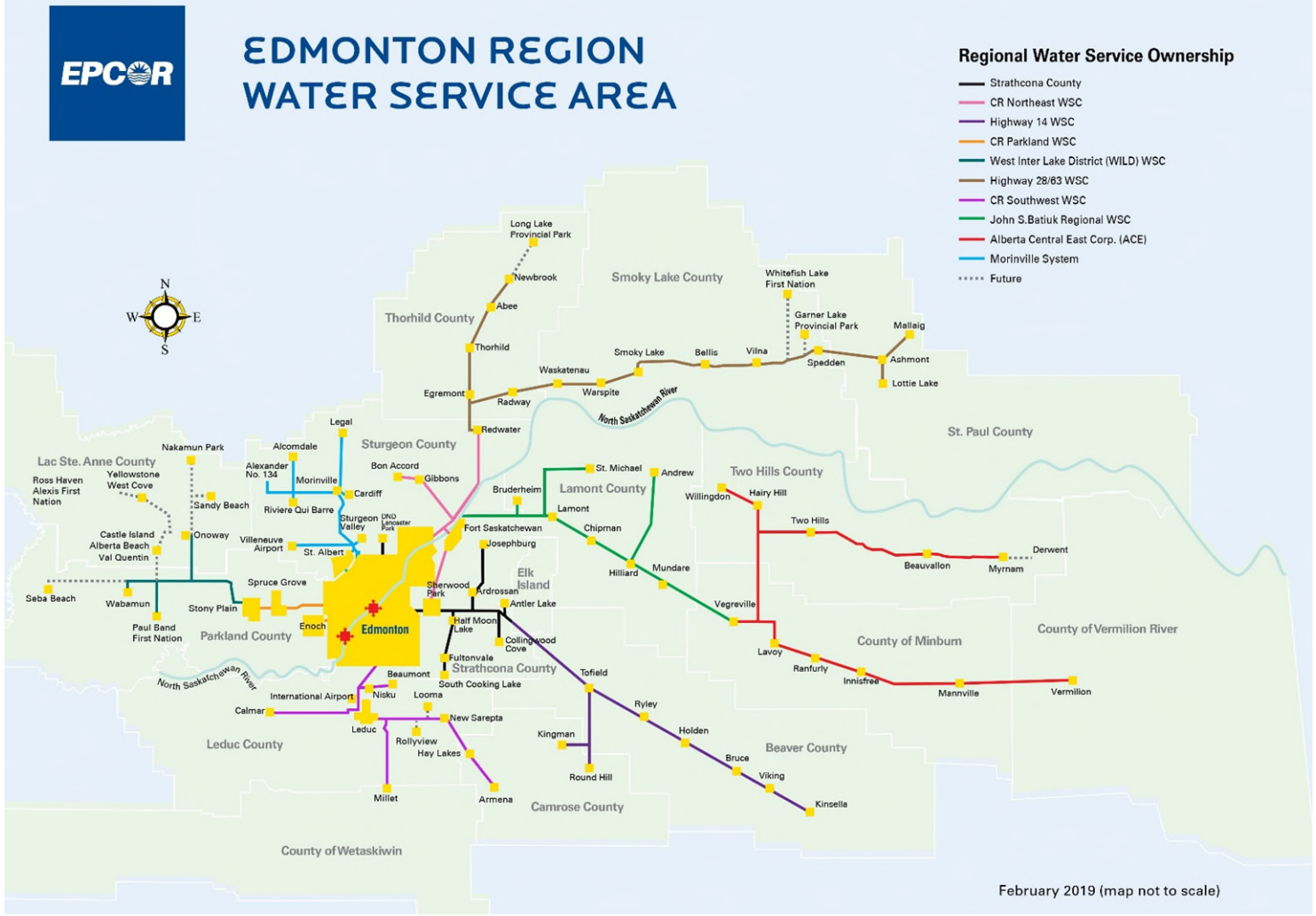
Edmonton Water Treatment Plans

- Source: North Saskatchewan River
- Treatment processes: alum coagulation, flocculation, dual-media filtration and Cl_2 disinfection, chloramine, UV, seasonal PAC
- Combined Production capacity: 650 MLD

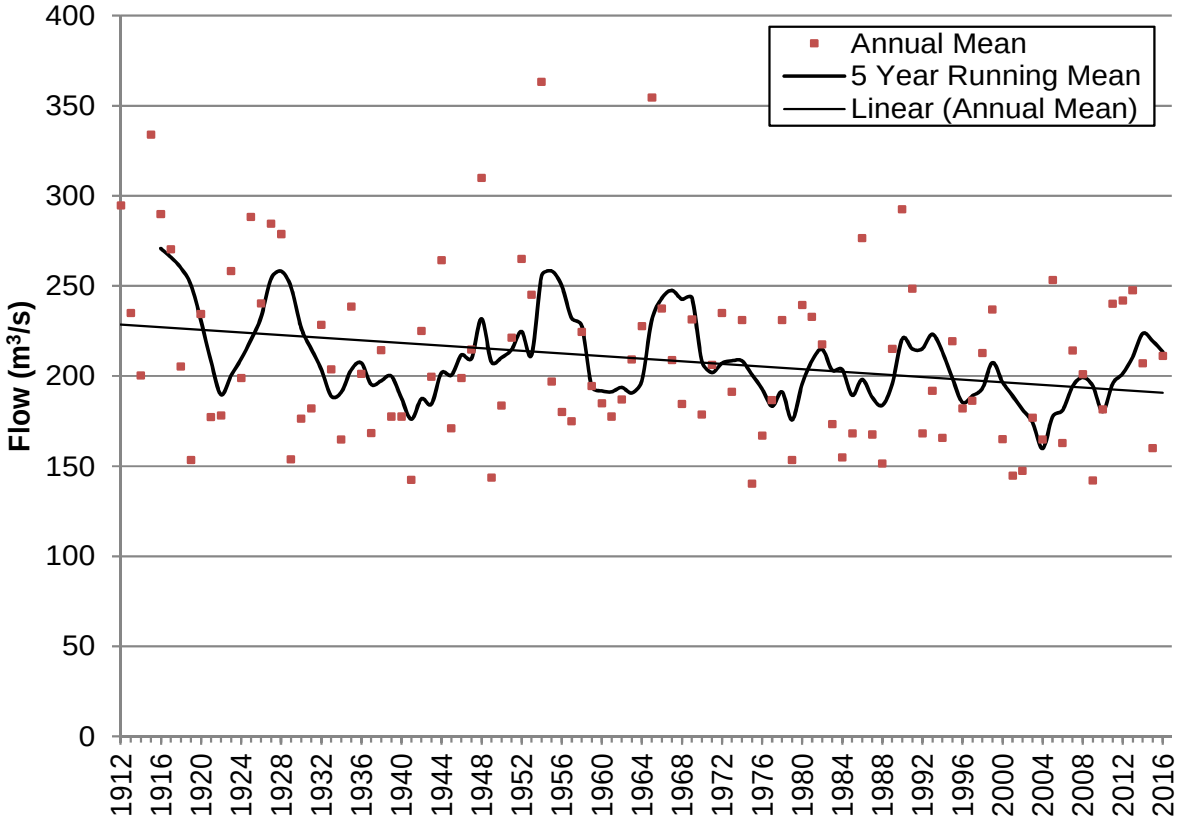
EDMONTON REGION WATER SERVICE AREA



February 2019 (map not to scale)

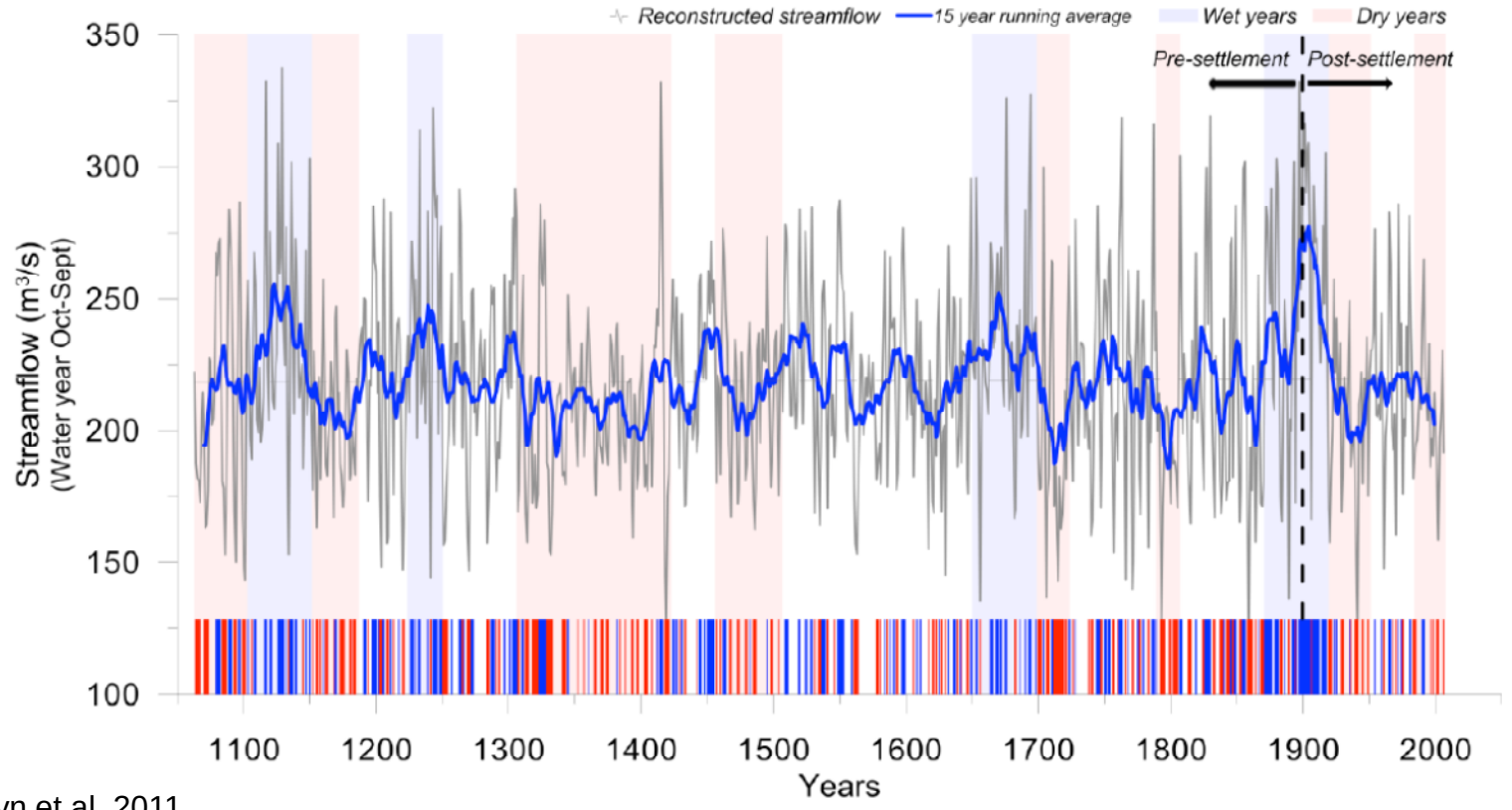

The North Saskatchewan River as The Water Supply For Edmonton
Photo: AirScapes

Gauge Flow Trends in the NSR



1.4 % decrease in flow per decade over last 100 years

950 Year Reconstruction of NSR Flows



Sauchyn et al. 2011

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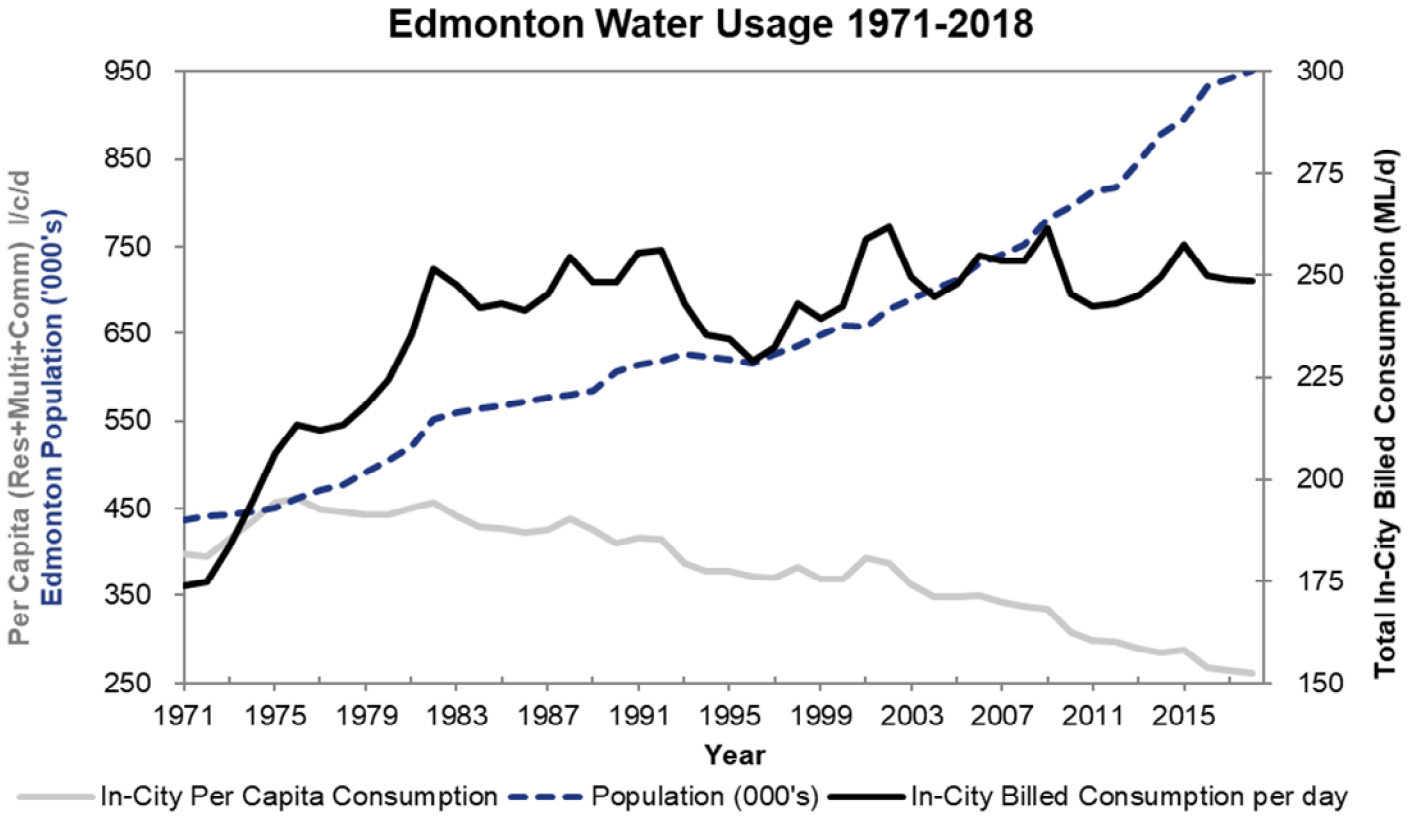
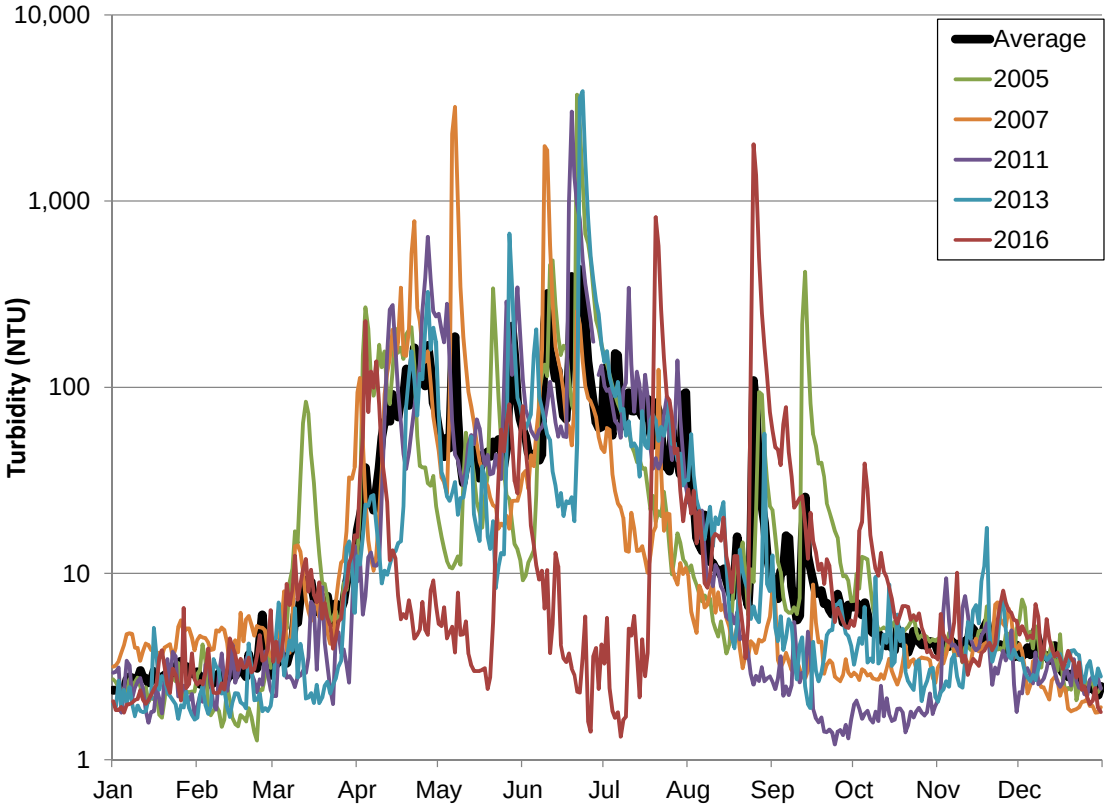
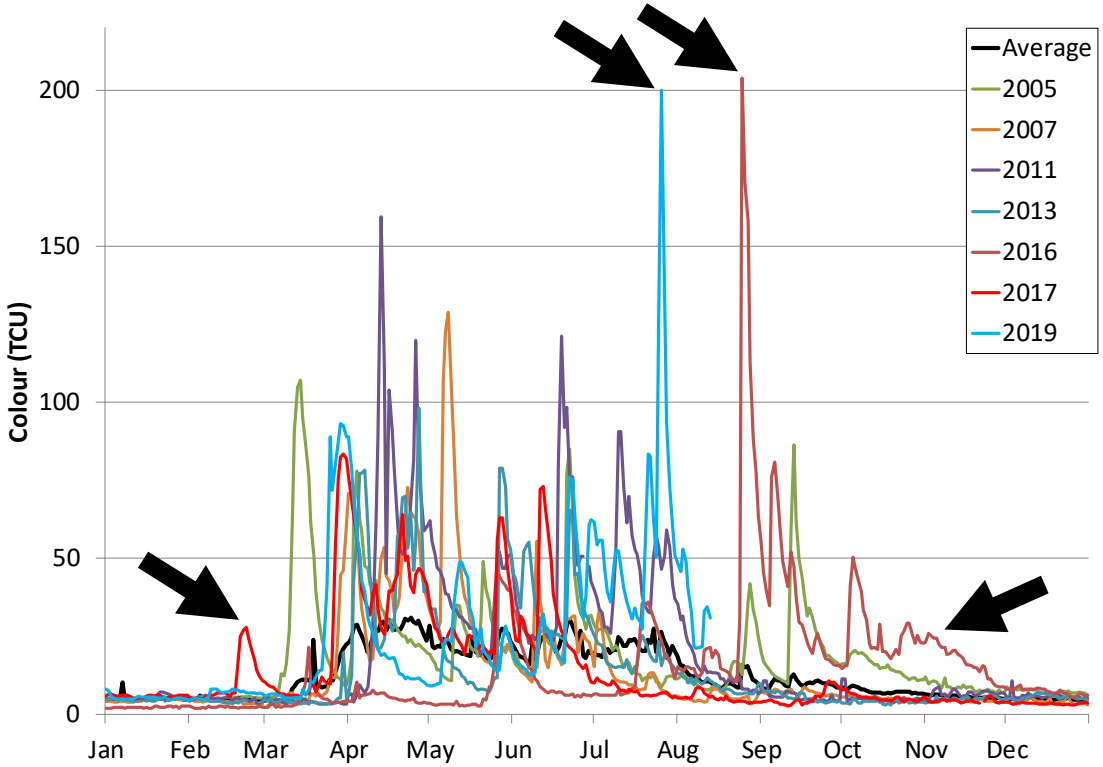
Edmonton Water System Demand



…But, a Naturally Highly Variable River: Turbidity



… and Colour



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Impacts of Climate Change of the NSR as a Water Supply

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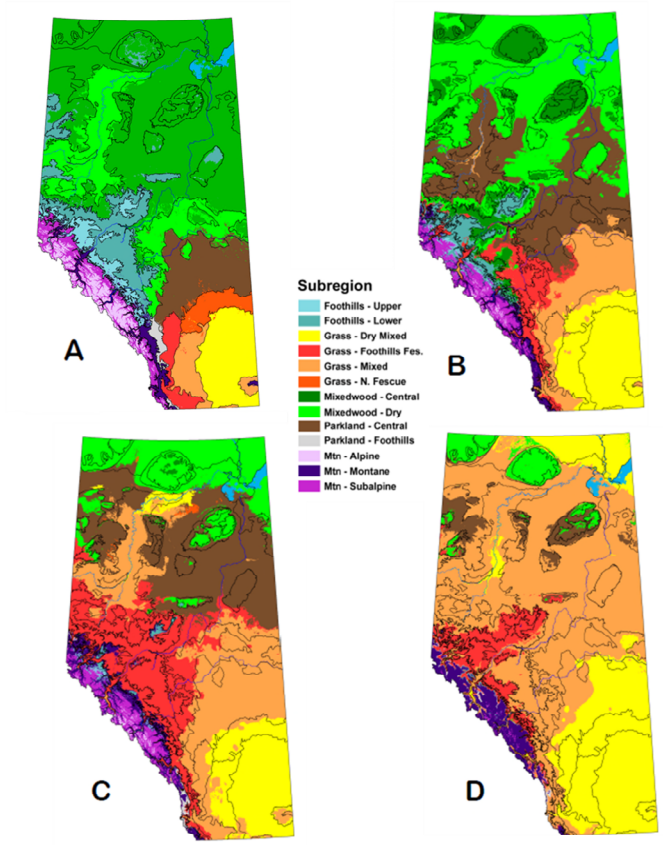
Future Climate Predictions for the NSR Region

Variable	Projection
Annual temperature	Increase by 1.3 to 4.5 °C by 2050
Annual precipitation	Increase 4.3 to 12.5 % by 2050
Timing of precipitation	Increase in winter and spring, decreases in summer and fall
Storm events	Increase of frequency intensity of short duration storms
Snow pack in headwaters	Increase of precipitation as rain, earlier spring melt, decreases of water storage in snow pack
Soil moisture	Increase in winter and spring, decreases in summer and fall
Landscape changes	Increase of forest fires, decrease of forested areas, increase of grasslands, agricultural changes, decreased wetlands

Sources: Vance et al. (1995), Barrow and Yu (2005), Golder (2008), Kienzle et al. (2012), Weaver (2017), Schneider (2013)

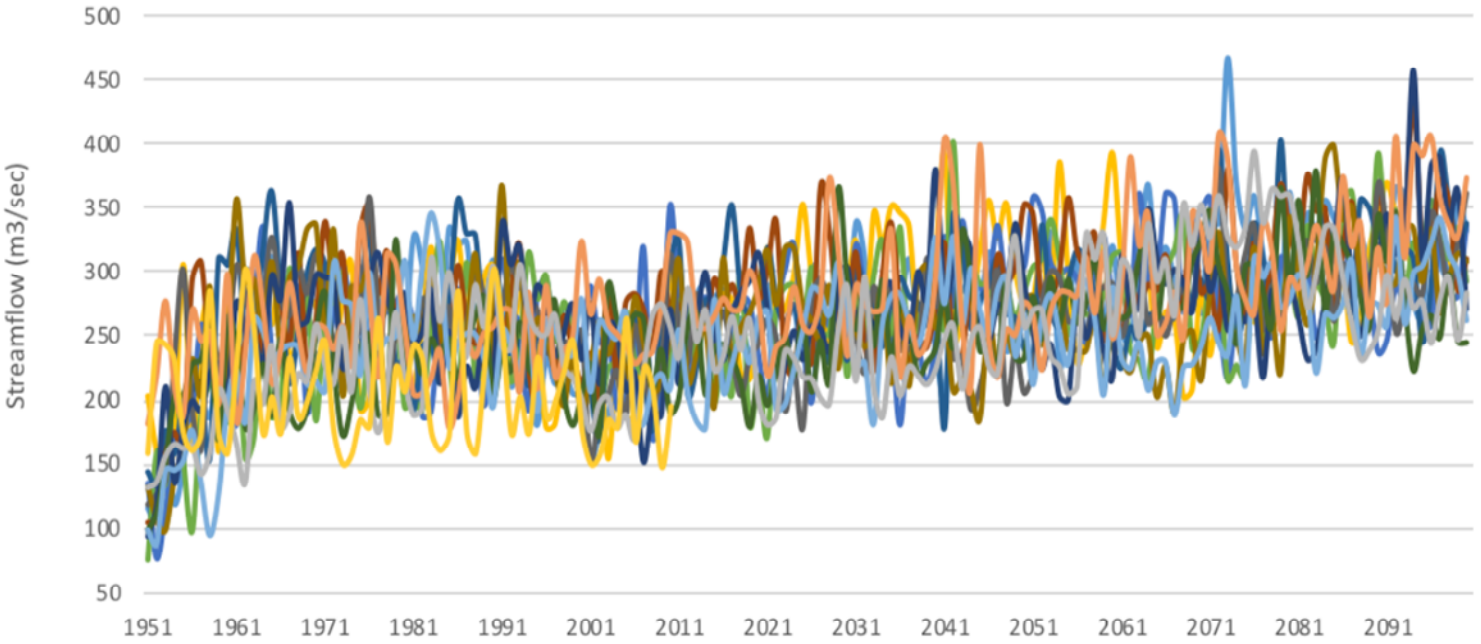
Predicted Ecosystem Subregion Shifts



A = 1961 – 1990
B = 2080 “Cool”
C = 2080 Median
D = 2080 “Hot”

Schneider 2013

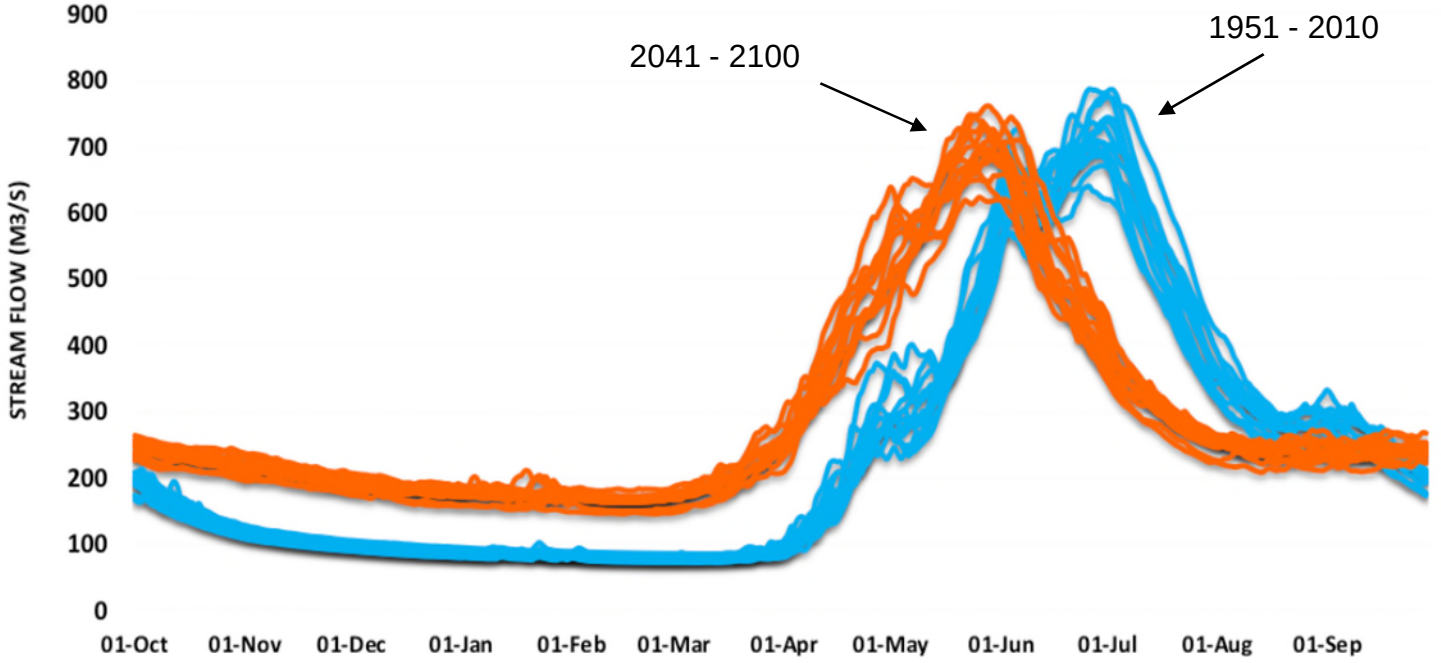
Climate Change Predictions for Flows in NSR



Mean annual flow at Edmonton using MESH model and 13 versions of bias-corrected climatology from CRCM4 and boundary conditions derived from GCM MPI RCP 8.5

Prairie Adaptation Research Council (2019)

Climate Change Predictions for Flows in NSR



Water year hydrograph at Edmonton using MESH model and 13 versions of bias-corrected climatology from CRCM4 RCP 8.5

Prairie Adaptation Research Council (2019)

Projected Climate Change Impacts on Source Water

- Quantity
  - Increased flows during winter and spring
  - Decreased flows in summer and fall
  - Possible increased frequency of floods
- Quality
  - More intense runoff, more frequent high colour/turbidity events
  - Potential impact of wildfire (colour, nutrients, metals)
  - Increase growth of algae and aquatic plants
- **Lots of uncertainty** in these general projections

EPCOR's Climate Change Adaptation Strategy for Water Supply

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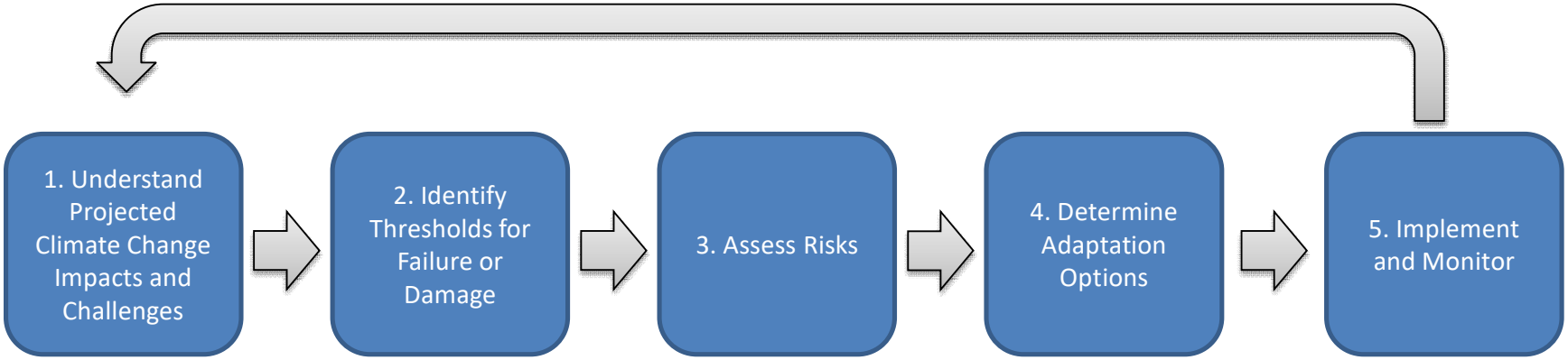
Iterative Process for Adaptation Planning



Adapting to Change & Building Resiliency

Modified from US EPA 2015 Adaption Strategies Guide for Water Utilities

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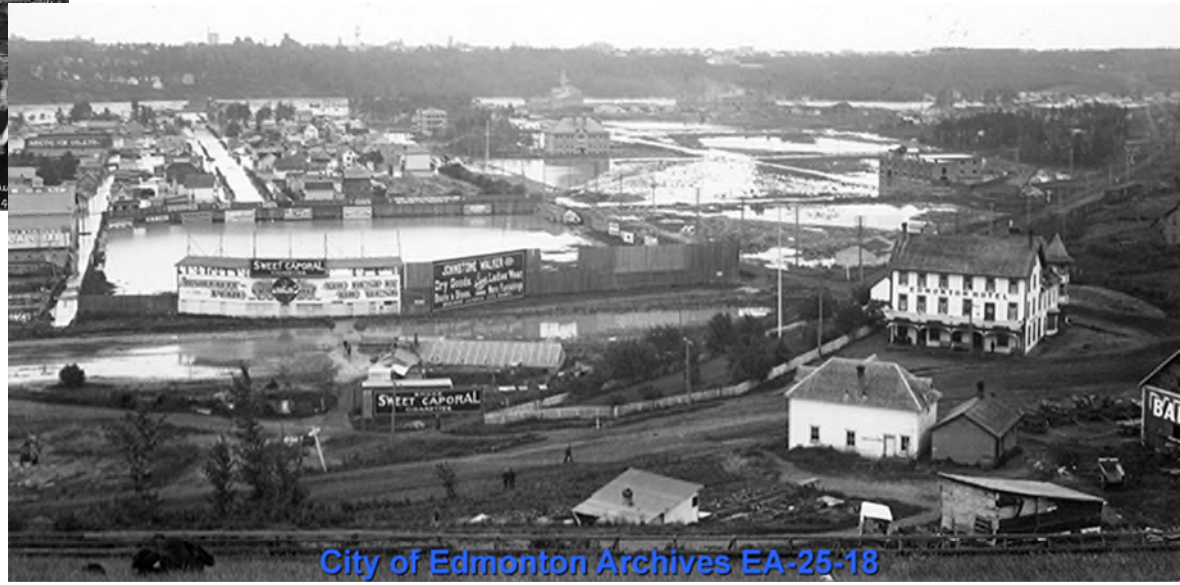
Example Risk: River Flooding

1915 Flood in Edmonton
1:180 Return Period



Example: River Flood Risk

Risk Statement	• River flooding impacts WTPs
Impact on Operations	• Cannot produce potable water • Critical infrastructure damaged
Risk Mitigation Strategy	• Flood protection plans and procedures for facilities
Specific Actions	• Update flood hazard maps for WTPs • Identify critical assets at risk • Capital plans for protecting critical assets • Review, update and exercise flood ERPs • Alternative drinking water distribution plan

Climate Change Adaptation Strategy: Sudden Onset Risks

- River flooding impacts WTPs
- River flooding results in a loss of power to WTPs
- Intense rain in Edmonton results in overland flooding at WTPs
- Poor water quality after intense rain causes treatment challenges
- Wildfire in the watershed impacts water quality
- Increased frequency/ severity of freezing rain, ice storms & wind storms impacts power grid
- Frazil ice formation results in challenges abstracting water for treatment

Climate Change Adaptation Strategy: Slow Onset Risks

- Low flow in river limits water supply
- Hotter temps in summer months results in increased water demand
- Earlier spring run-off impacts direct filtration operation at WTPs
- More freeze-thaw cycles increases frequency of water main breaks
- Increased water temperature results in increased nitrification and difficulty maintaining chlorine residual
- Increased water temperature results in plant and algae growth in river and other invasive species
- Regional drought conditions adversely impact water quality

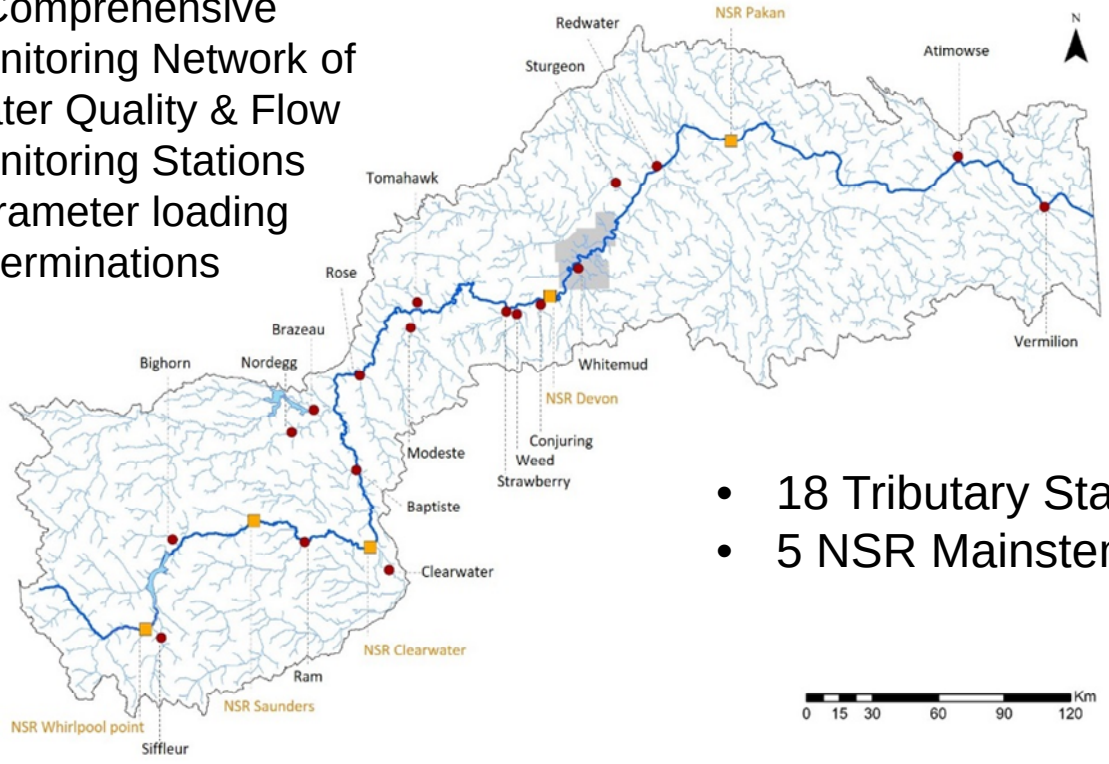
Future Work

Future Directions

- Implement Flood Protection Plan capital projects at Rossdale and E.L. Smith Water Treatment Plants
- Improve predictions of projected flows in the river by continuing work with U. of Regina on dendrohydrology (Tree Ring studies) couple with regional climate modelling
- Characterization of natural organic matter in the North Saskatchewan River in conjunction with U of Waterloo and U of Alberta to inform treatment process modifications
- Support for U of A led study: *Groundwater contributions to the North Saskatchewan River and Edmonton region water resources (*2019-2022, Froese et al*.)*

WaterSHED Monitoring Program

- A Comprehensive Monitoring Network of Water Quality & Flow Monitoring Stations
- Parameter loading determinations



- 18 Tributary Stations (red circles)
- 5 NSR Mainstem (orange squares)

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Thank You
&
Questions?