

Vulnerability of northern water supply lakes to changing climate and Demand



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The Question

How much water do we have?



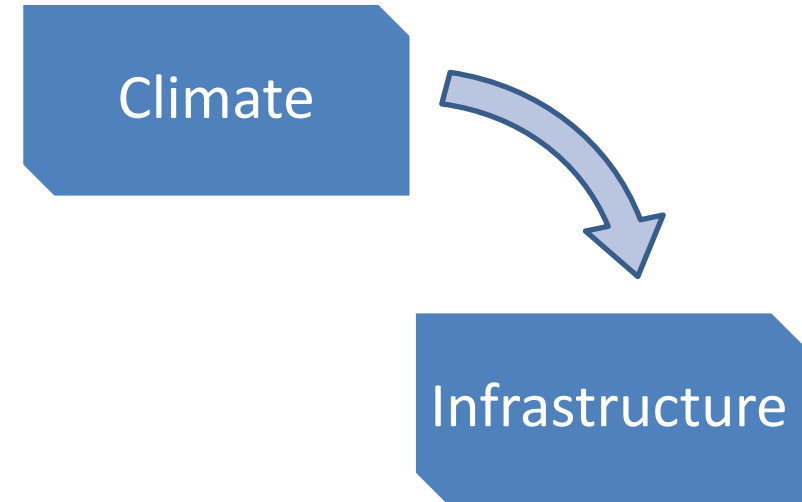
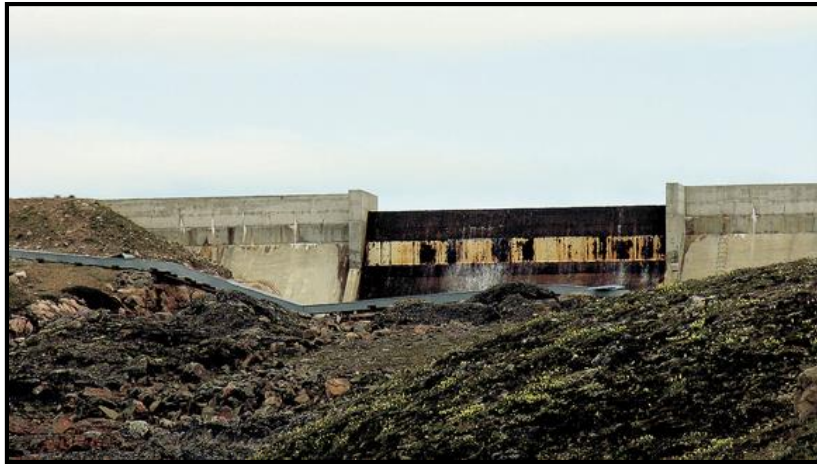
Factors

Climate



- Arctic amplification
 - Fluctuating Extremes
 - Higher evaporative stress
 - Lake Ice
 - Length Summer season
 - Freeze-up

Factors

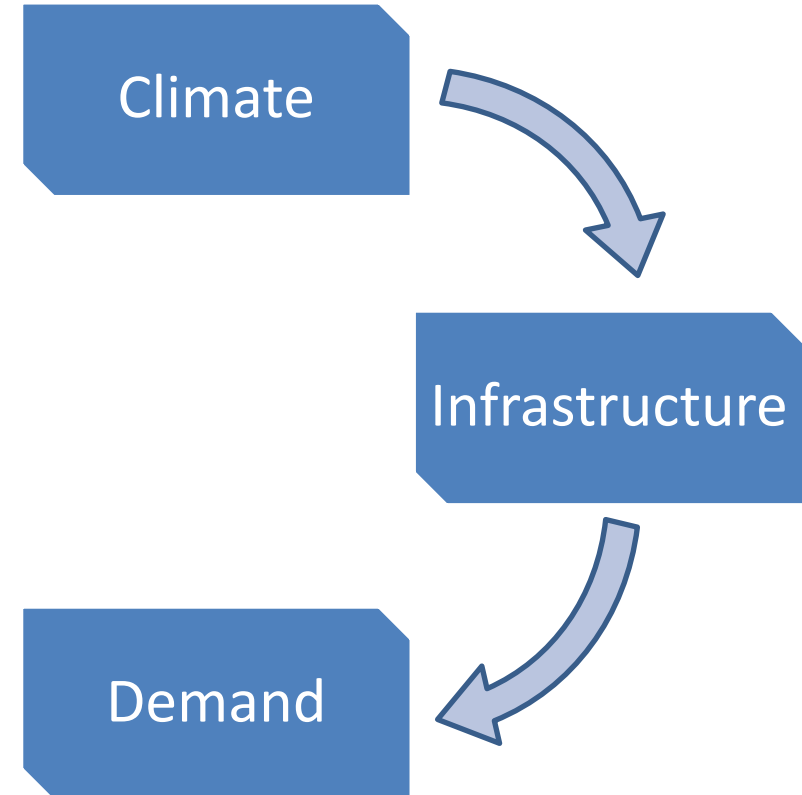


- Arctic engineering
 - Permafrost
 - Longevity, O&M
 - Costly Engineered Solutions
 - Human Capacity

Factors

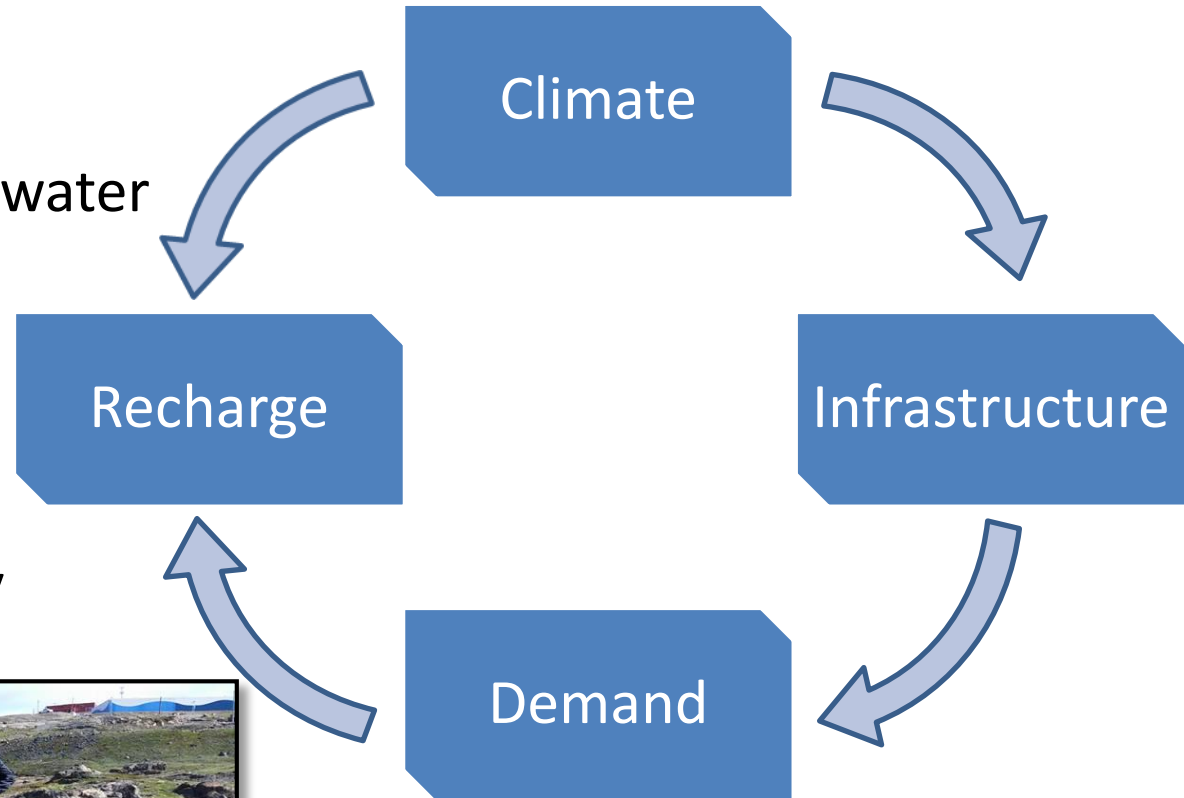


- Growing Demand
 - Population growth
 - Development
 - Distribution
 - Lifestyle improvements



Factors

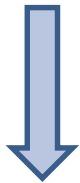
- Climate
 - Natural trajectory of water
- Demand
 - Reservoirs
 - Dams
 - Supplemental Supply



Water Resource Assessment

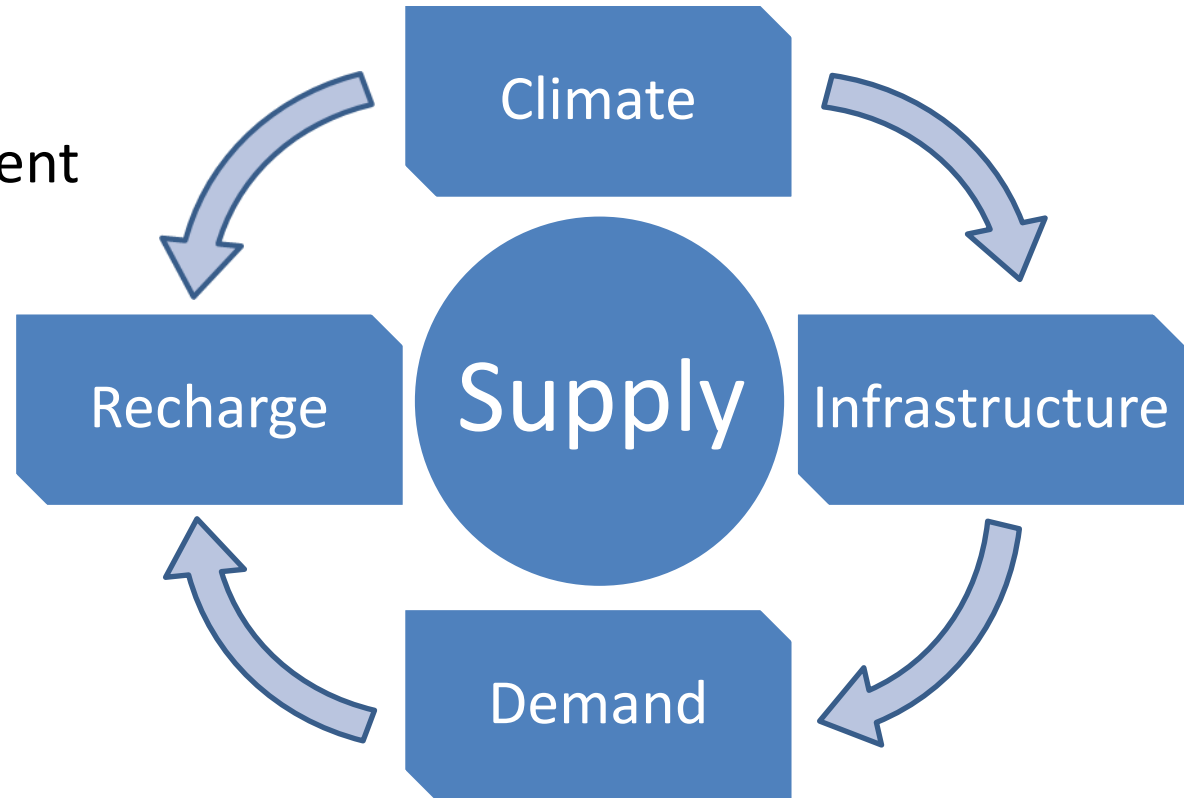
Answers Needed:

- Planning & Management
- Emergency Prep
- Water Safety
- Funding Priority



Hydrologic Modeling

- Simulations of climate and demand scenarios
- Proposed infrastructure



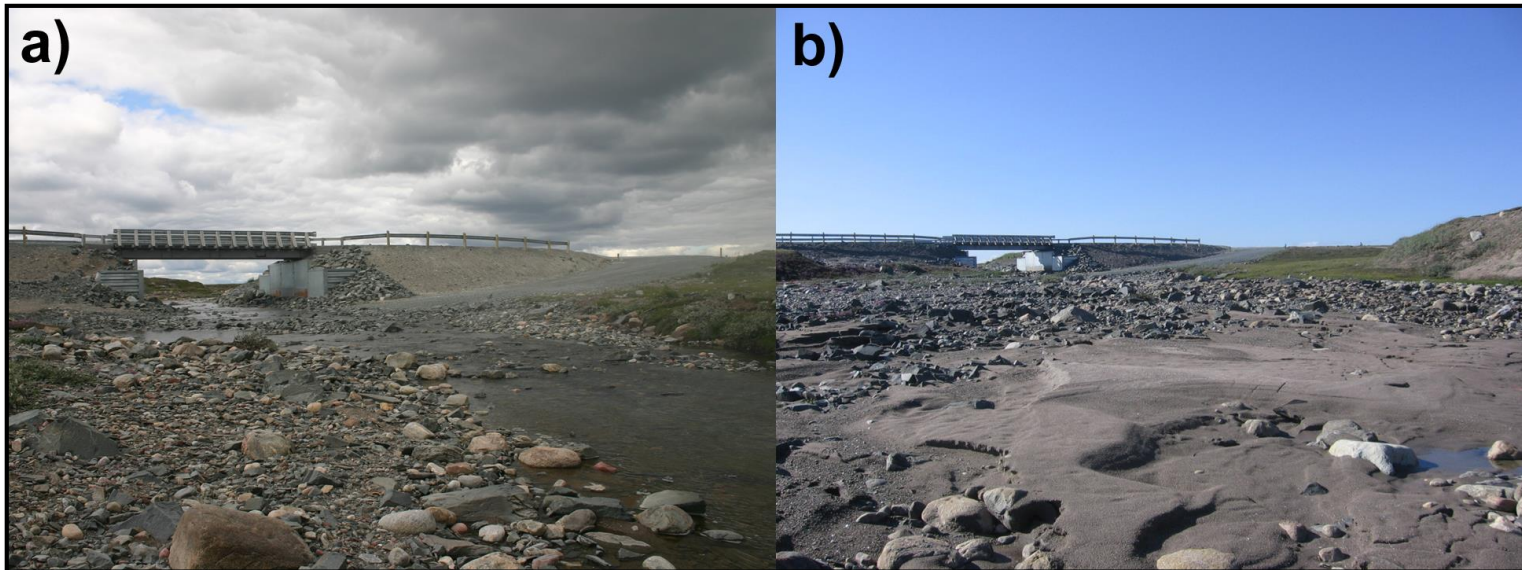
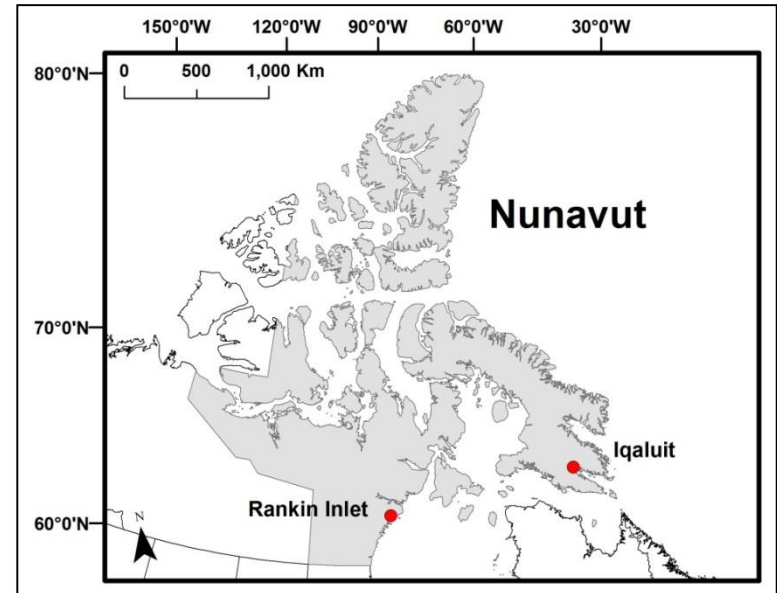
- System evaluation
- Climate adaptation

..... **account for the factors**

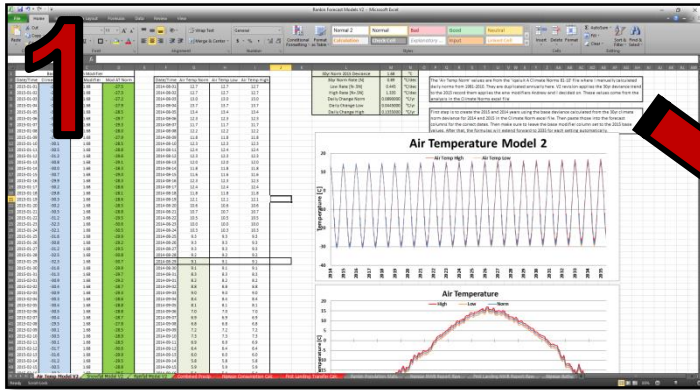
Water Resource Assessment

- Rankin Inlet and Iqaluit, NU
- High development pressures
- Diminishing supply
- Multiple proposed solutions

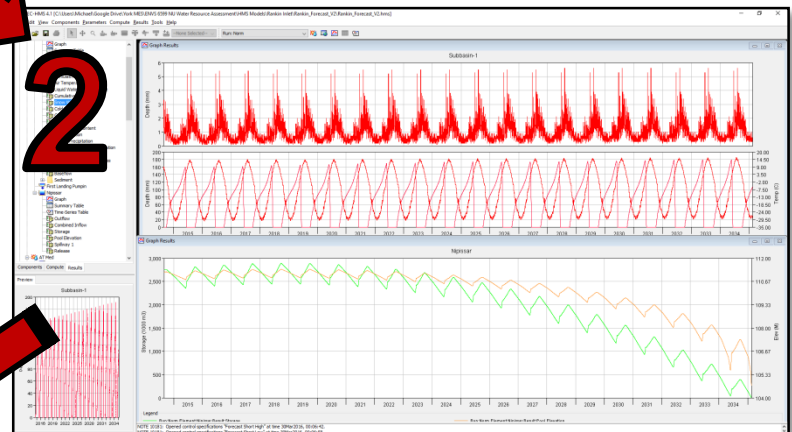
For example...



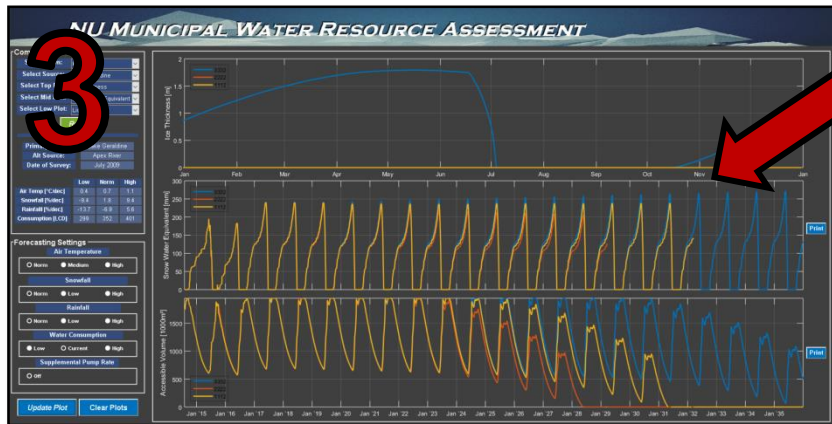
Process



Produce Climate & Demand
Forecasts



Hydrological Simulation



Analysis Software

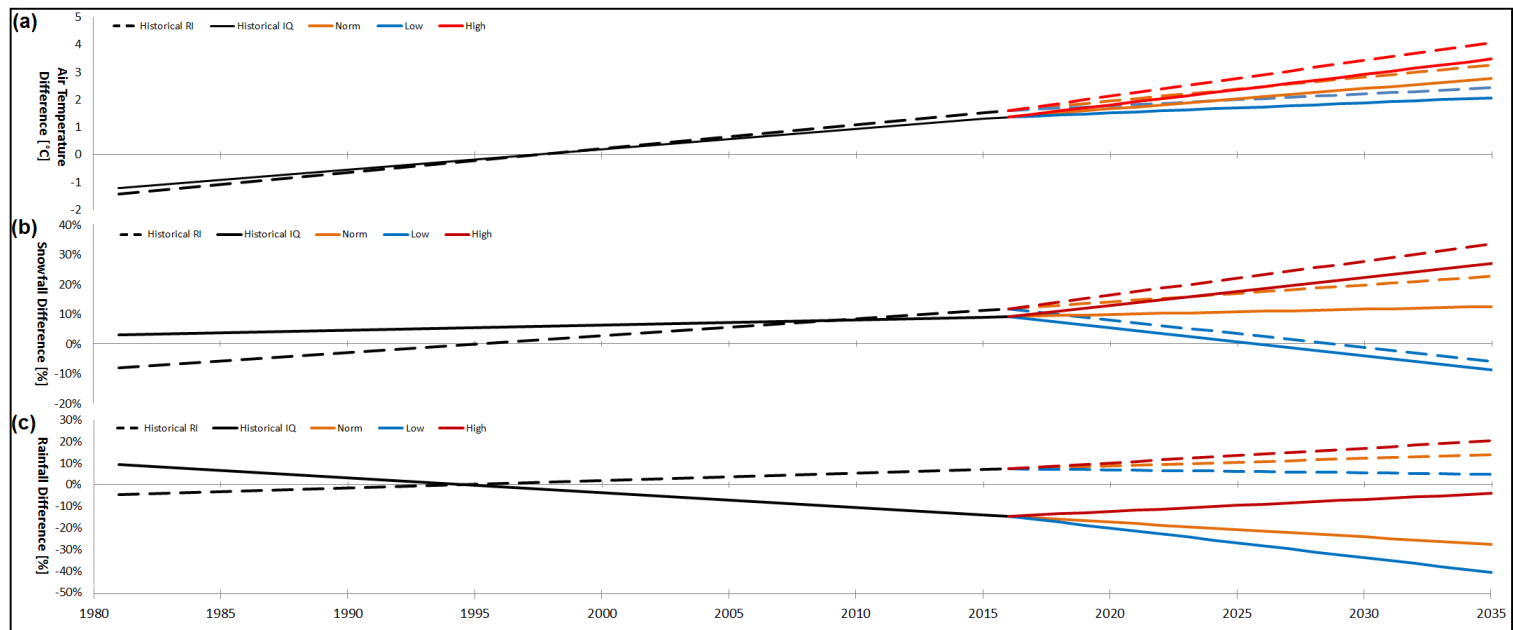
Climate Forecasts

- 3 Climate Parameters
- Based on 30yr climate records
- High/Norm/Low levels
- Generate 27 climate forecast scenarios

Air Temp

Snowfall

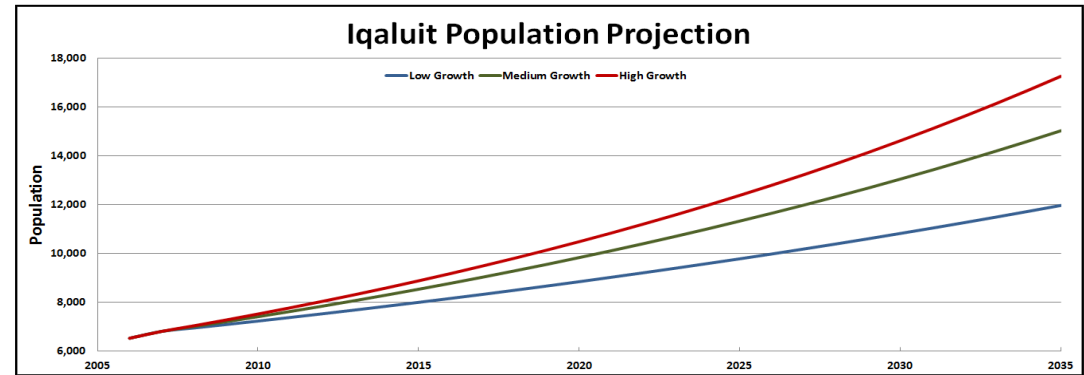
Rainfall



Demand Forecasts

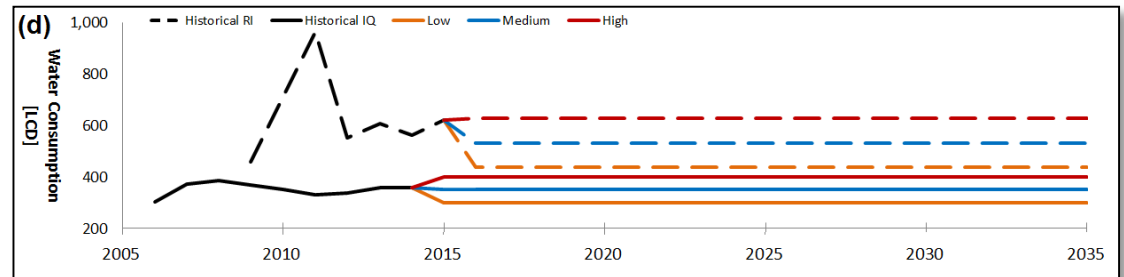
POPULATION GROWTH

- NU Stats Bureau projections
- High/Medium/Low



WATER CONSUMPTION

- NWB Annual Reports
- High/Medium/Low

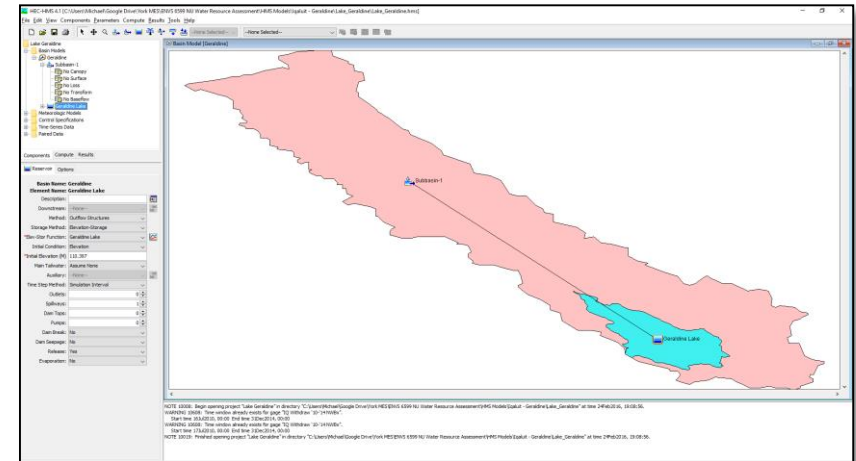
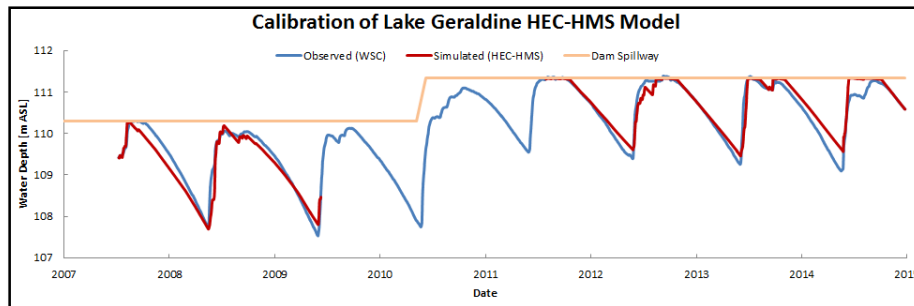


Simulation & Calibration

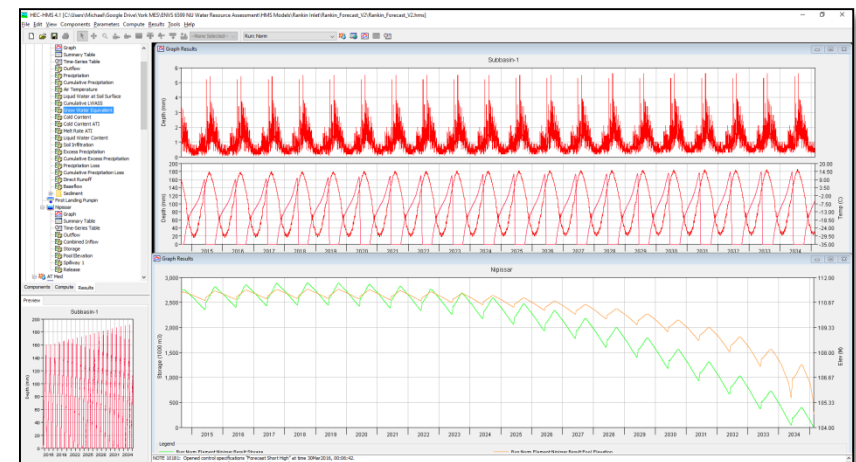
– Inputs:

- Reservoir bathymetry
- Watershed area
- Dam/spillway configuration
- Geological characteristics
- Replenishment/reservoir specs
- **81** combos of **Climate & Demand**

– Calibrated with WSC lake level gauge

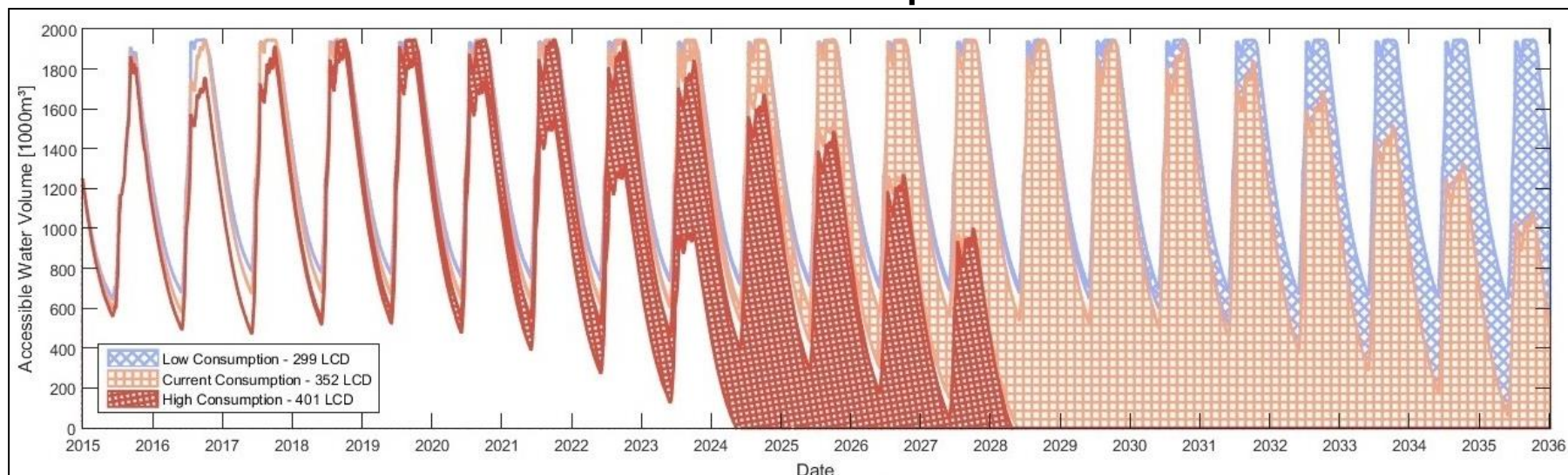


HEC-HMS Software Screenshot of Input Screen



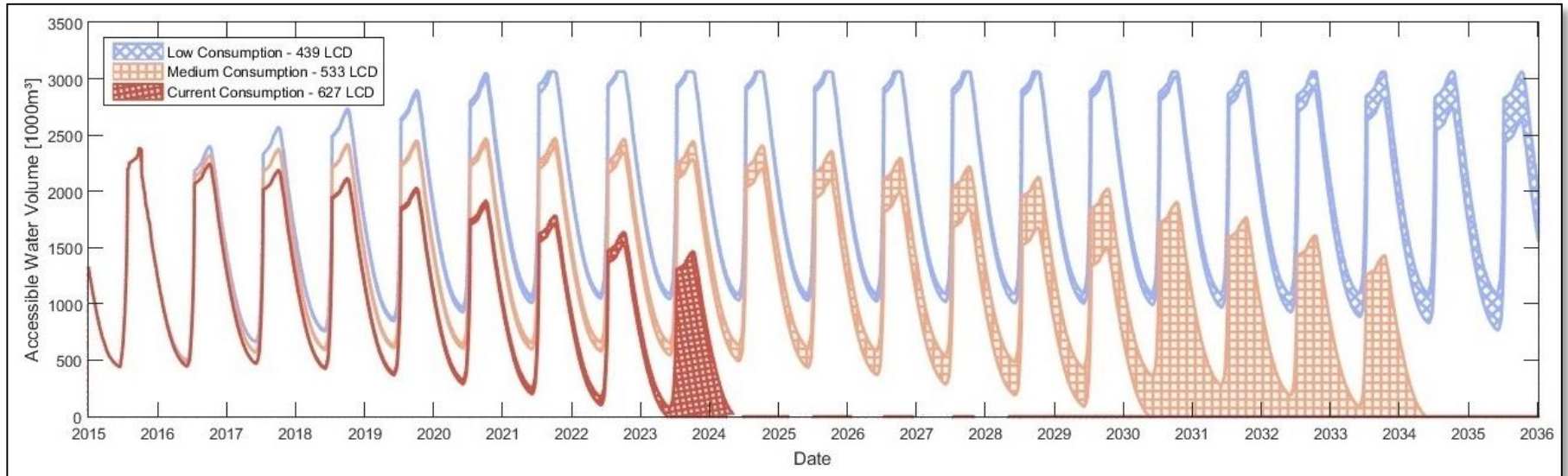
HEC-HMS Software Screenshot of Results

Lake Geraldine - Iqaluit



- 3 colour areas of **Demand**
- **27 Climate** scenarios each color
- High Consumption: Shortages in **2024**

Lake Nipissar – Rankin Inlet

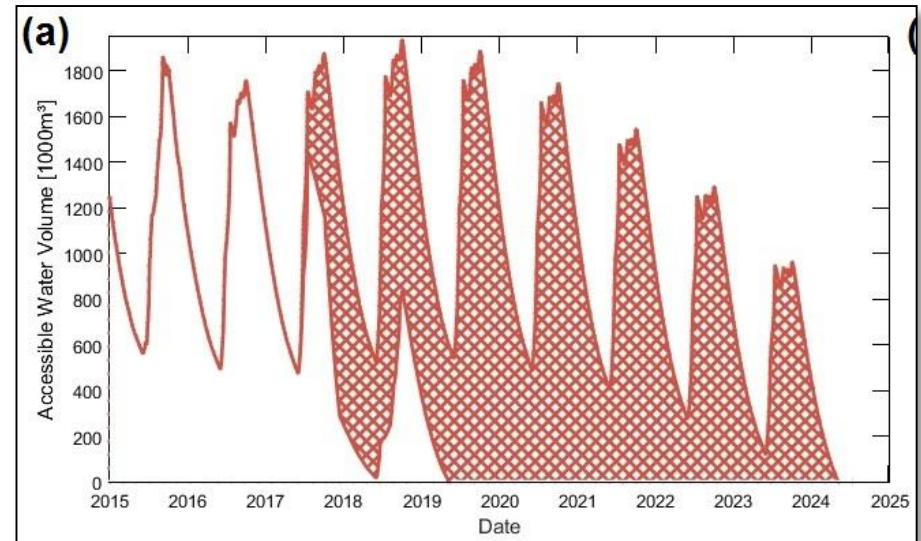


- **Current** Consumption: Shortages in **2023**
- Results include *seasonal replenishment pipeline*

Planning & Management Analyses

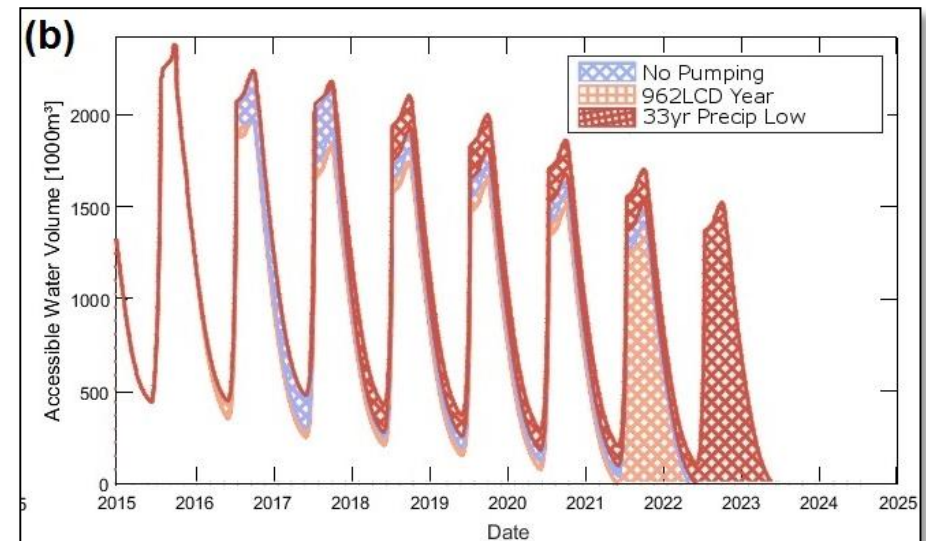
Lake Geraldine - Iqaluit

- Climate anomalies: 33yr precip low
- Shortages in **2018**



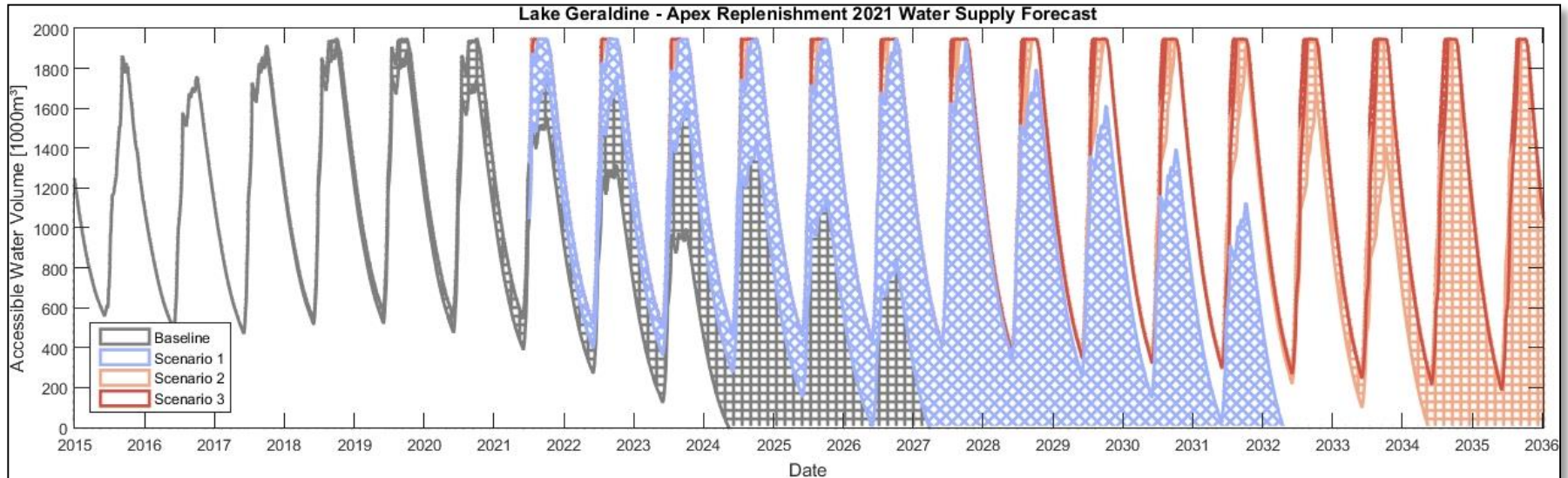
Lake Nipissar – Rankin Inlet

- Climate anomalies, pumping interruption, extreme consumptions
- Shortages in **2021**

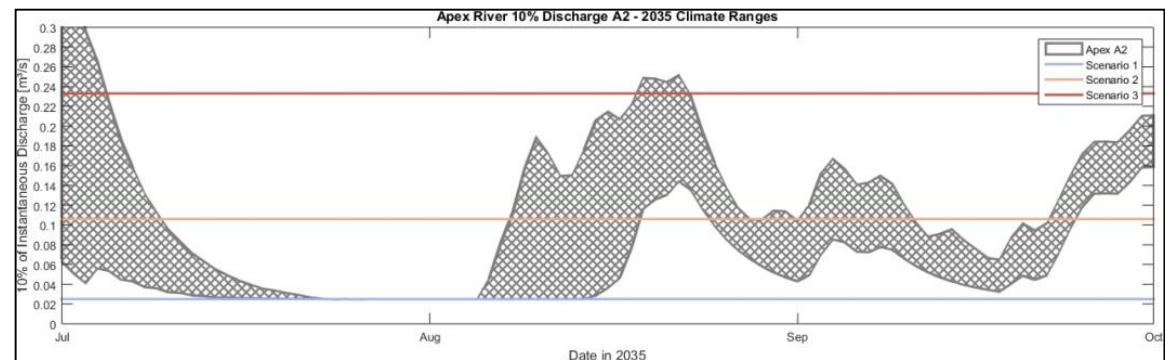


Apex Seasonal Replenishment

Lake Geraldine – Apex Replenishment

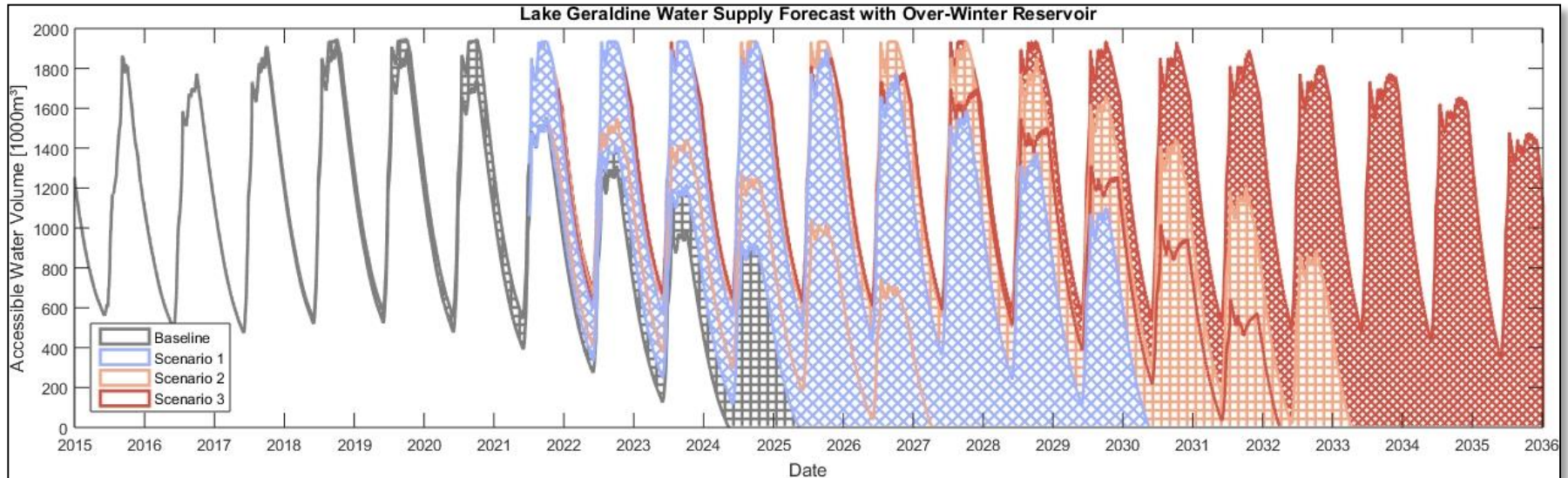


- Protocol can easily be expanded to evaluate infrastructure proposals
- Forecasting method reveals impact of Apex replenishment on Iqaluit water supply



Over-Winter Reservoir

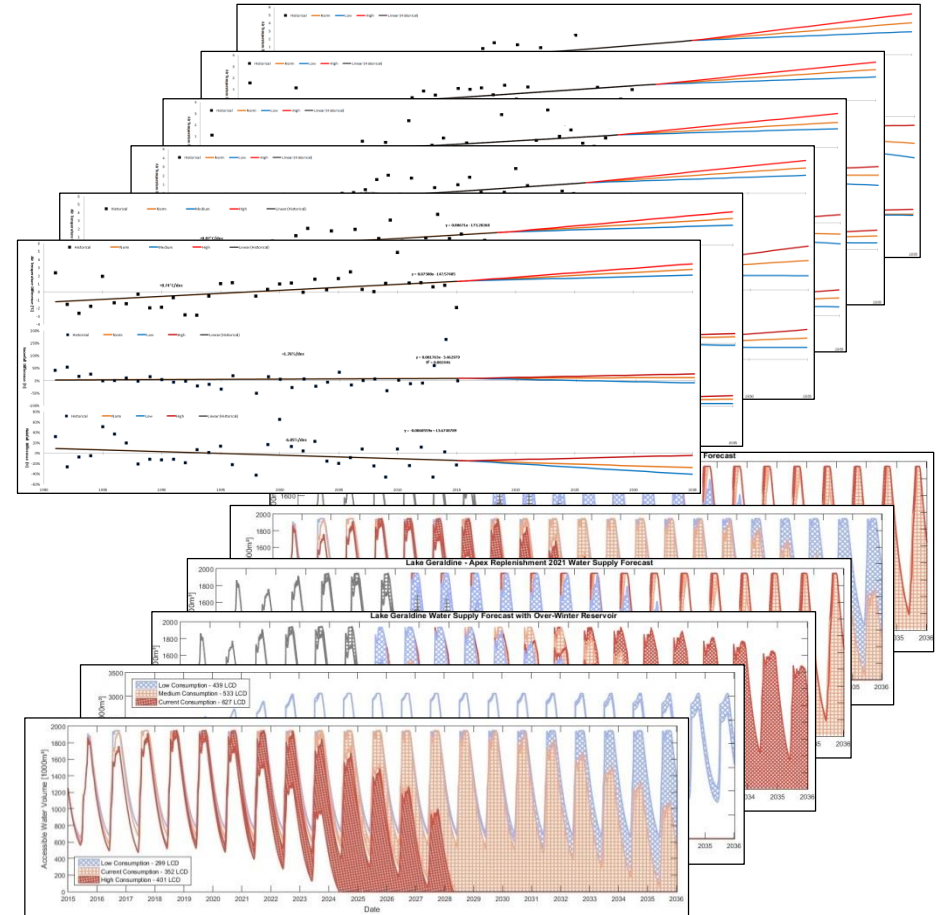
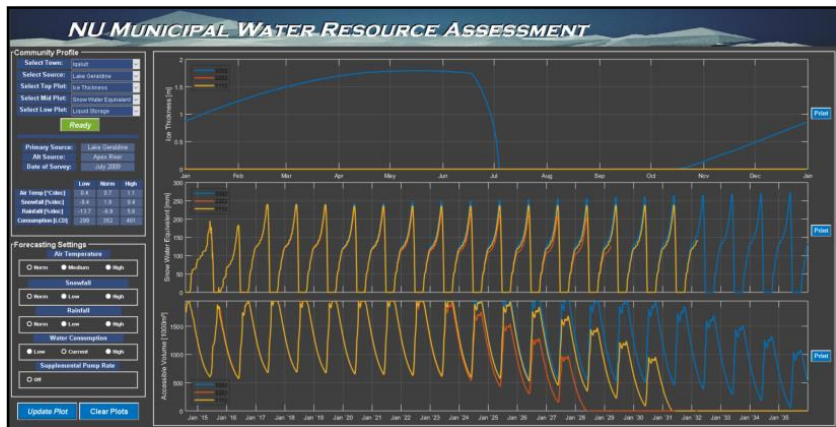
Lake Geraldine – Over-winter Reservoir



- Protocol can easily be expanded to evaluate infrastructure proposals
 - Scenario 1: 105,000m³
 - Scenario 2: 210,000m³
 - Scenario 3: 500,000m³

Water Strategy Development

- Full suite of preliminary supply forecasts for all communities
- Deploy to evaluate current infrastructure proposals
- Advance understanding of Water Security for Northern regions
- Establish real-time monitoring & forecasting



Questions to YOU

- When was the last time your resources were assessed?
- How will climate change impact your water supply?
- **How long will your supply last?**
- Let us work together!

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References

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2. Nunavut Bureau of Statistics. (2014, Dec 7). *Population Projections*. Retrieved Dec 01, 2015, from Nunavut Bureau of Statistics: <http://www.stats.gov.nu.ca/en/Population%20projections.aspx>
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5. Budkewitsch, P., Prevost, C., Pavlic, G., and Pregitzer, M. 2011a. Description of Water Depth Survey Datasets from Rankin Inlet, Nunavut. Ottawa: Geological Survey of Canada.
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