Regional Cumulative Effects Assessment
Clean Environment Commission Workshop

Thursday, June 15, 2017

8:30 am – 4:00 pm

3-307 & 308 - 360 Portage Ave

Agenda Topic	Time	Who
1. Introductions, Workshop Purpose and RCEA Terms of Reference	8:30 – 8:45 am	Tracey Braun
2. RCEA Methodology	8:45 - 9:15 am	Allison Zacharias
3. MH System Description	9:15 – 9:45 am	Nick Barnes
4. People	9:45 -10:45 am	Laura McKay
5. Break	10:45 – 11:00 am	
6. Physical Environment a. Water Regime b. Erosion & Sedimentation	11:00 – 11:45 am	Brian Giesbrecht & Wil DeWit
7. Water a. Intro, Water Quality b. Fish Community & Quality	11:45 am – 12:15 pm	North/South Consultants
8. Lunch (provided)	12:15 – 12:45 pm	

Agenda Topic	Time	Who
9. Water (cont'd) c. Sturgeon d. Mercury in fish e. Seals & Belugas	12:45 – 1:30 pm	North/South Consultants
10. Land a. Intro, Intactness and Terrestrial Habitat b. Waterfowl c. Moose d. Colonial Waterbirds e. Polar Bear f. Caribou g. Aquatic Furbearers	1:30 – 2:30 pm	ECOSTEM, Wildlife Resources Consulting, Joro
11. Break	2:30 – 2:45 pm	
12. Integrated Summary Report – Summary of aquatic & terrestrial effects	2:45 – 3:15 pm	Gary Swanson, Don MacDonald & Rachel Boone
13. Open Discussion	3:15 – 3:45 pm	All
14. Wrap up and Next Steps	3:45 – 4:00 pm	Shelley Matkowski

Regional Cumulative Effects Assessment

CEC Workshop

June 15, 2017

Tracey Braun – Manitoba Sustainable Development

Purpose of today's workshop

- Provide an overview of the RCEA process and key findings.

- Provide information to the CEC to assist with the public outreach process.

RCEA Background & Terms of Reference

RCEA Background

- CEC Bipole III Report, non-licensing Recommendation 13.2:

  "Manitoba Hydro, in cooperation with the Manitoba Government, conduct a Regional Cumulative Effects Assessment for all Manitoba Hydro projects and associated infrastructure in the Nelson River sub-watershed; and that this be undertaken prior to the licensing of any additional projects in the Nelson River sub-watershed after the Bipole III project."

Terms of Reference

- A Terms of Reference for the RCEA was developed and signed by MB and MH.

- The Terms of Reference provide the scope, study approach, challenges, end products, a process for collaboration between MB and MH and a project schedule.

Terms of Reference (cont'd)

More specifically, the Terms of Reference indicate:

- The final RCEA report will be retrospective in nature and will:
  - Identify, describe, and acknowledge the cumulative effects of past Hydro developments in the Region of Interest; and
  - Describe the current state of the environment in areas affected by Manitoba Hydro's developments within the Region of Interest.
- The RCEA will be based on a review and synthesis of past and ongoing studies and monitoring programs.

Terms of Reference (cont'd)

- The RCEA will include hydro-electric developments along the Nelson, Burntwood, and Churchill River systems.

- The area of study is larger than that requested by the CEC (Nelson River subwatershed).

- Commit MB and MH to determining public engagement.

RCEA Methodology

Allison Zacharias
Manitoba Hydro

RCEA Phased Approach

- Phase I (completed in May 2014)
  - Interim product to provide an early indication of the approach and documentation being employed to undertake the RCEA

- Phase II (completed in December 2015)
  - Quantitatively (where possible) or qualitatively described post-project cumulative effects of hydroelectric development on people, water, and land in the Region of Interest

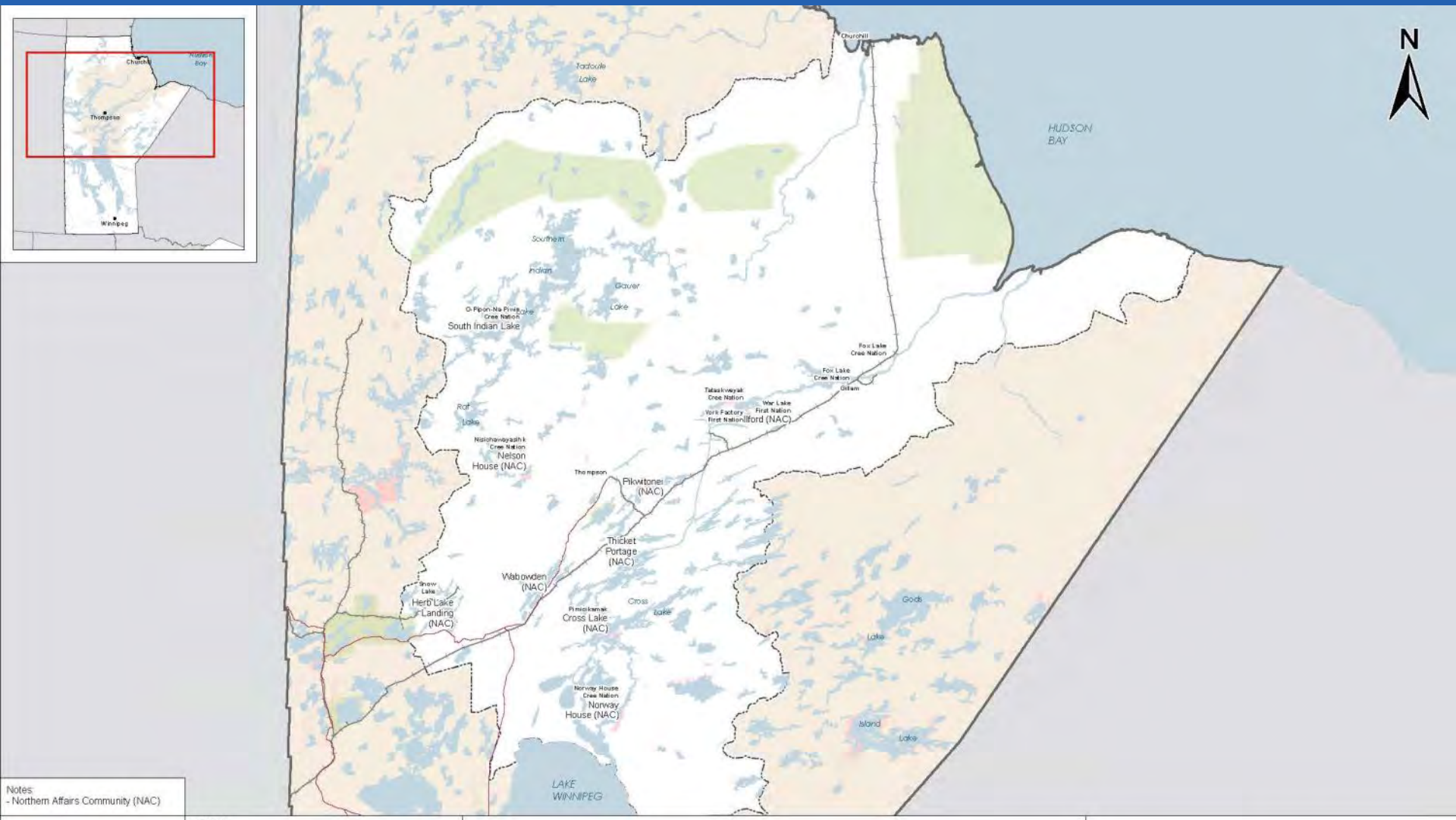
  - Described, to the extent possible, the current health of the ecosystem

Spatial Scope / Region of Interest

- The Region of Interest was selected to encompass the main areas directly affected by MH's hydroelectric developments associated with Lake Winnipeg Regulation (LWR) , Churchill River Diversion (CRD) and associated transmission and infrastructure projects
  - Includes Nelson, Burntwood and Churchill River systems

- This region encompasses a broader area of hydroelectric development than requested in CEC recommendation 13.2 in the Bipole III Report.
  - Nelson River subwatershed:
    - Jenpeg, Kettle, Longspruce, Limestone, BP I BP II, BP III and associated infrastructure
  - Recognition of CRD impacts and community concerns

- This region encompasses resource management areas (RMAs) and registered trap lines (RTLs) that have been directly impacted by hydroelectric development



Notes:
- Northern Affairs Community (NAC)

Manitoba Hydro
Regional Cumulative Effects Assessment

DATA SOURCE: Manitoba Hydro; Government of Manitoba; Government of Canada

CREATED BY: Manitoba Hydro - GIS Studies

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
NAD 1983 UTM Zone 14N	01-DEC-15	07-DEC-15
0 30 60 Kilometres / 0 25 50 Miles	VERSION NO: 1.0	GMGC:

Legend
- RCEA Region of Interest
- Highway
- Rail
- First Nation Reserve
- Park
- Waterbody

RCEA
Region of Interest

Scope

Information used for the RCEA:

- Available pre-development information to describe pre-development conditions
- Information on Hydro effects collected from the approximately 1950s to present.

Hydroelectric Developments:

- Existing developments; starting with Kelsey GS (1957) to present (2013).
- Developments currently under construction in the Region of Interest: Bipole III, Keewatinohk CS & Keeyask, to the extent possible

Non-hydroelectric projects and activities

  - e.g., mines, roads
  - e.g., commercial and domestic harvests, government policy
- Provided important context (e.g., confounding factors); and/or
- Additional information relevant to understanding the current state of the environment
  - e.g., habitat fragmentation

Scope and Methodology

- The retrospective study used (to extent possible) attributes of contemporary environmental effects assessment and post-project assessment methodology to meet objectives of Terms of Reference.

- The differences in EA requirements from 1960/70s to present has influenced the type and quantity of available data to conduct RCEA.
  - Over last six decades, hydro developments have met EA requirements of the time.
  - EA evolved from nearly absent in 1970s to VEC-based approach in 2000s.
  - These have influenced the methods being employed.

RCEA: Information Sources

The RCEA is based on review and analysis of environmental and socio-economic information: MH, Manitoba, Canada, affected FNs and others.

- Pre-development environmental and socioeconomic studies
- Site-specific studies addressing concerns of FNs and communities
- Long-term topic specific monitoring programs: mercury, fish populations, sturgeon
- Post-Project studies of existing facilities ; Post Project monitoring (e.g., Limestone)
- Recent EAs: Wuskwatim G&T, Bipole III, proposed Keeyask and Conawapa
- System-wide monitoring programs (CAMP)
- Community-led ATK studies / other community-based studies

Early studies (1970/80s) focused on issues identified by affected communities.

Studies in mid-1980s to 1990s conducted on a more regional scale.

Recent:

- System-wide, ecosystem-based approach to monitoring ecosystem health (CAMP)
- EA baseline studies for recent developments provide comprehensive information.

RCEA Challenges

- Challenges in the assessment of post-project cumulative effects. For example:
  - Quantitative pre-development data not always available: preclude pre/post comparisons
  - Data comparisons can be hindered by analytical/equipment changes over time.
  - Differences in "types" of studies conducted: makes comparisons difficult.
  - Ability to quantify effects of hydro may be masked by effects of other activities (e.g., fish harvested commercially/domestically, roads development) and policies (e.g., residential schools).

- RCEA typically undertaken by government to plan ahead for regional development.
  - CEC recommendation & TofR – past MH developments
  - Major decisions about use of area for hydro-electric development were made over 40 years ago.
  - Confusion with terminology

Phase II Structure

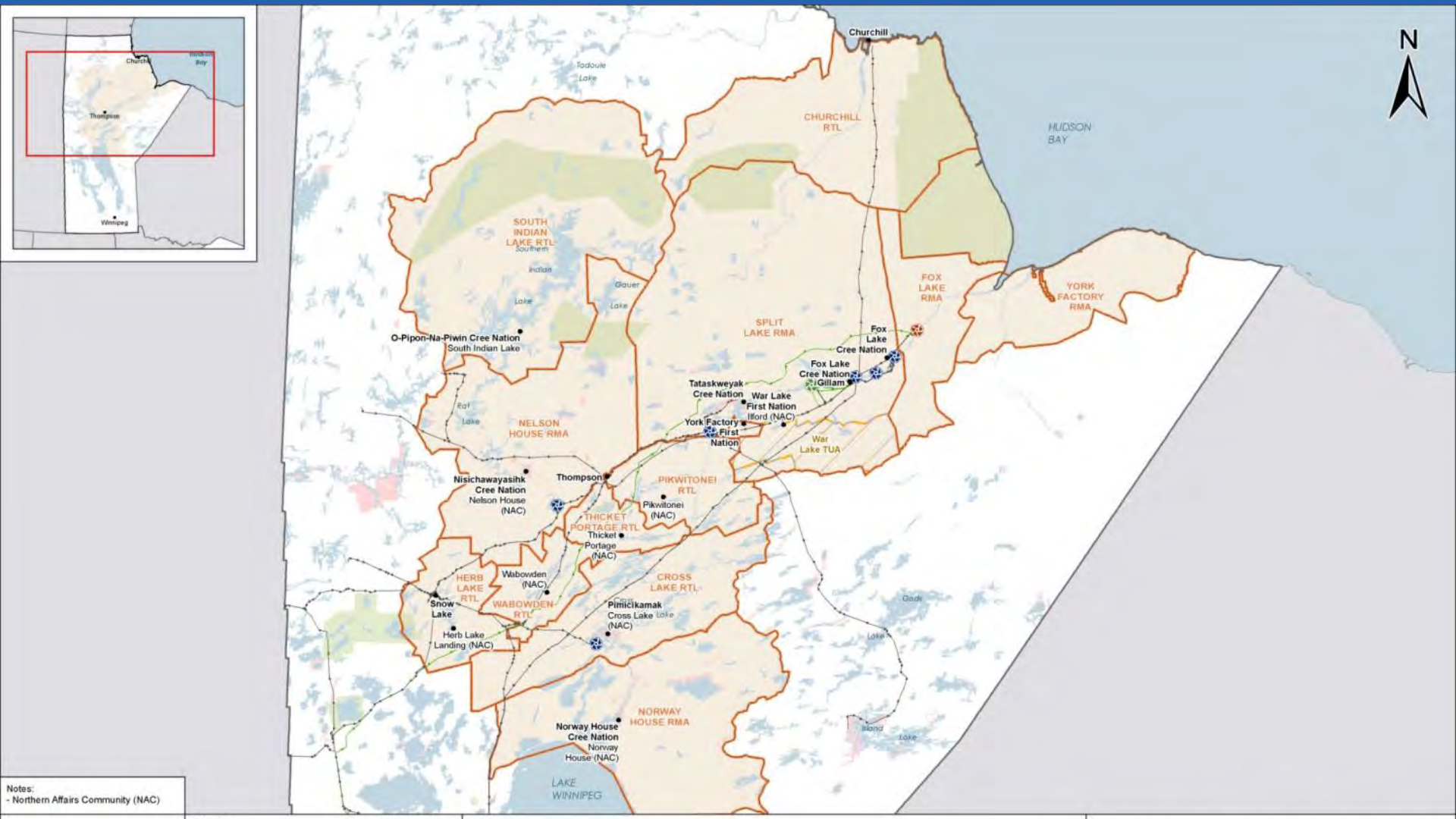
- Phase II report broken down as follows:
  - Introduction & Approach
  - Hydroelectric development descriptions in the ROI
  - People
  - Physical Environment
  - Water
  - Land

- Data gaps
  - Plan to include in PII
  - Concerns raised by communities
  - Will be considered after public outreach

General Approach

People section:

- Documents MB and MH's understanding of the socio-economic effects experienced by communities throughout the ROI by type of development
  - e.g.., GS vs transmission
- Provides a summary of key settlement agreements, programming, mitigation and remedial works established to address these effects



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NAD 1983 UTM Zone 14N	01-DEC-15	03-DEC-15
0 30 60 Kilometres / 0 25 50 Miles	VERSION NO: 1.0	GA/GC:

Legend

- RCEA Community
- RCEA Town
- Resource Management Area (RMA) \ Registered Trapline (RTL) Section
- Traditional Use Area (TUA)
- First Nation Reserve
- RCEA Region of Interest
- Generating Station (Existing)
- Generating Station (Under Construction)
- Generating Station (Potential)
- Transmission Line (Existing) 500KV - 69KV
- Transmission Line (Under Construction) 500KV - 69KV
- Park
- Waterbody

Resource Management Areas and Registered Trapline Sections

Overview

General Approach

Physical Environment section:

- Describes key changes to physical environment resulting from hydroelectric development including changes to:
  - Water Regime
  - Ice Regime
  - Erosion
  - Sedimentation
  - Area flooded
  - Terrestrial landscape

Manitoba Hydro

Regional Cumulative Effects Assessment

DATA SOURCE: Manitoba Hydro; Government of Manitoba; Government of Canada

CREATED BY: Manitoba Hydro - GIS Studies

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
NAD 1983 UTM Zone 14N	19-NOV-15	08-DEC-15
0 30 60 Kilometres / 0 25 50 Miles	VERSION NO: 1.0	QA/QC:

Legend

- Hydraulic Zone (HZ)
- RCEA Area
- RCEA Region of Interest
- Park

RCEA Areas and Hydraulic Zones Overview in the RCEA Region of Interest

General Approach

Water and Land sections:

- Provides an assessment of the effects of past hydroelectric developments on the aquatic and terrestrial environments
- Where possible, a quantitative description of the effects is provided and where sufficient data are not available, a qualitative description is provided

SELECTION OF REGIONAL STUDY COMPONENTS (RSCs)

- Regional Study Components (RSCs) were chosen to help focus the assessment for Land and Water

- Criteria for determining RSCs:
  - Importance/value to people;
  - Umbrella indicator for groups of species, ecosystem components;
  - Importance/value to overall ecosystem function; and
  - Susceptible to direct or indirect effects from hydroelectric developments.

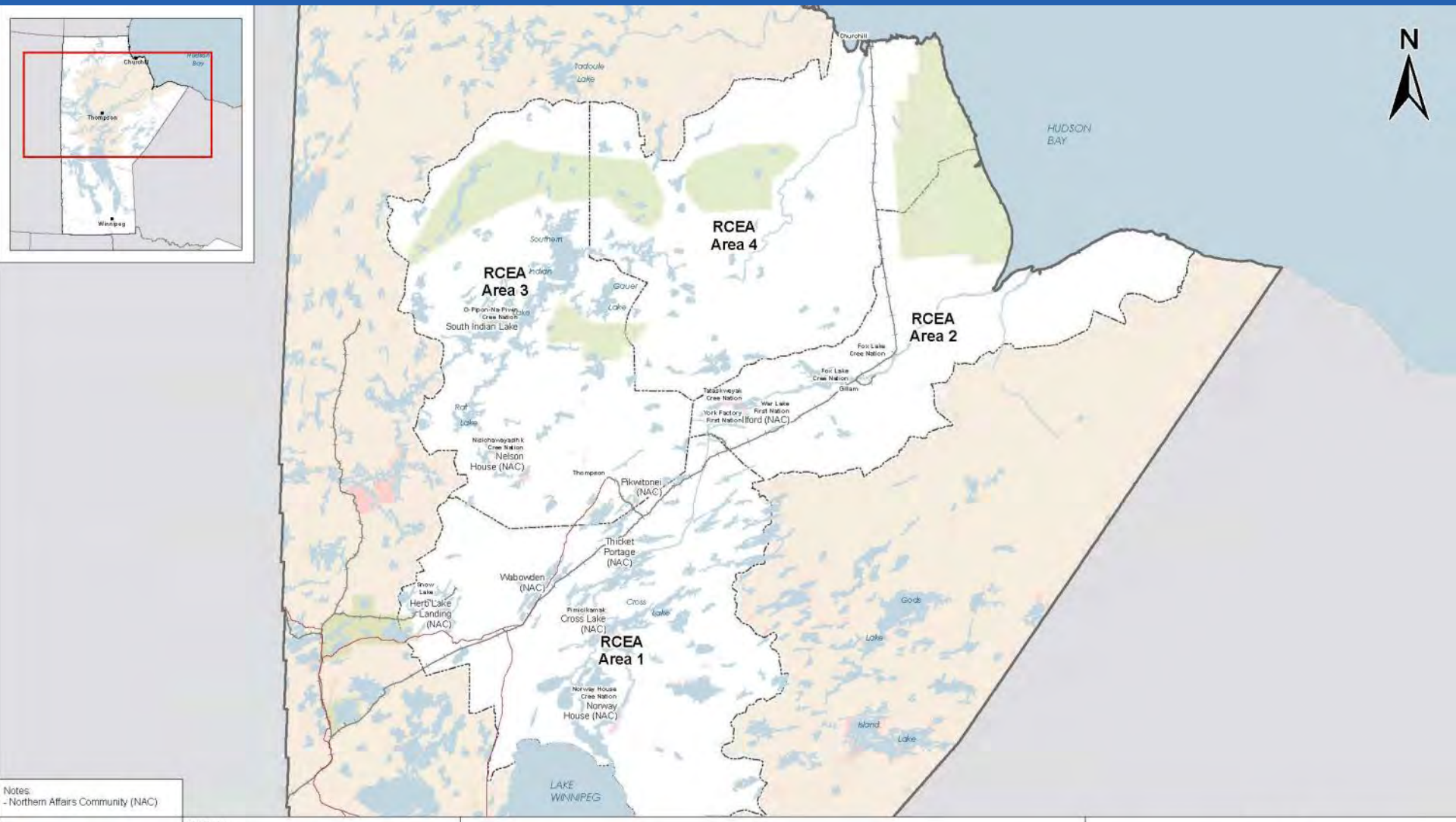
Regional Study Components

Water	Land
Water Quality	Terrestrial Habitat
Fish Community	Intactness
Lake Sturgeon	Colonial Waterbirds
Mercury/Fish Quality	Waterfowl
Beluga Whales	Aquatic Furbearers
Seals	Moose
	Caribou
	Polar Bear

Approach to Water and Land

- Both used a pathways of effects approach

- To provide for the most meaningful assessment, Water RSCs were broken down as follows:
  - Each RSC discussed by area -Areas 1-4
  - Areas further subdivided to provide most meaningful assessment
  - Described cumulative changes to the RCEA ROI as a whole



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Manitoba Hydro
Regional Cumulative Effects Assessment

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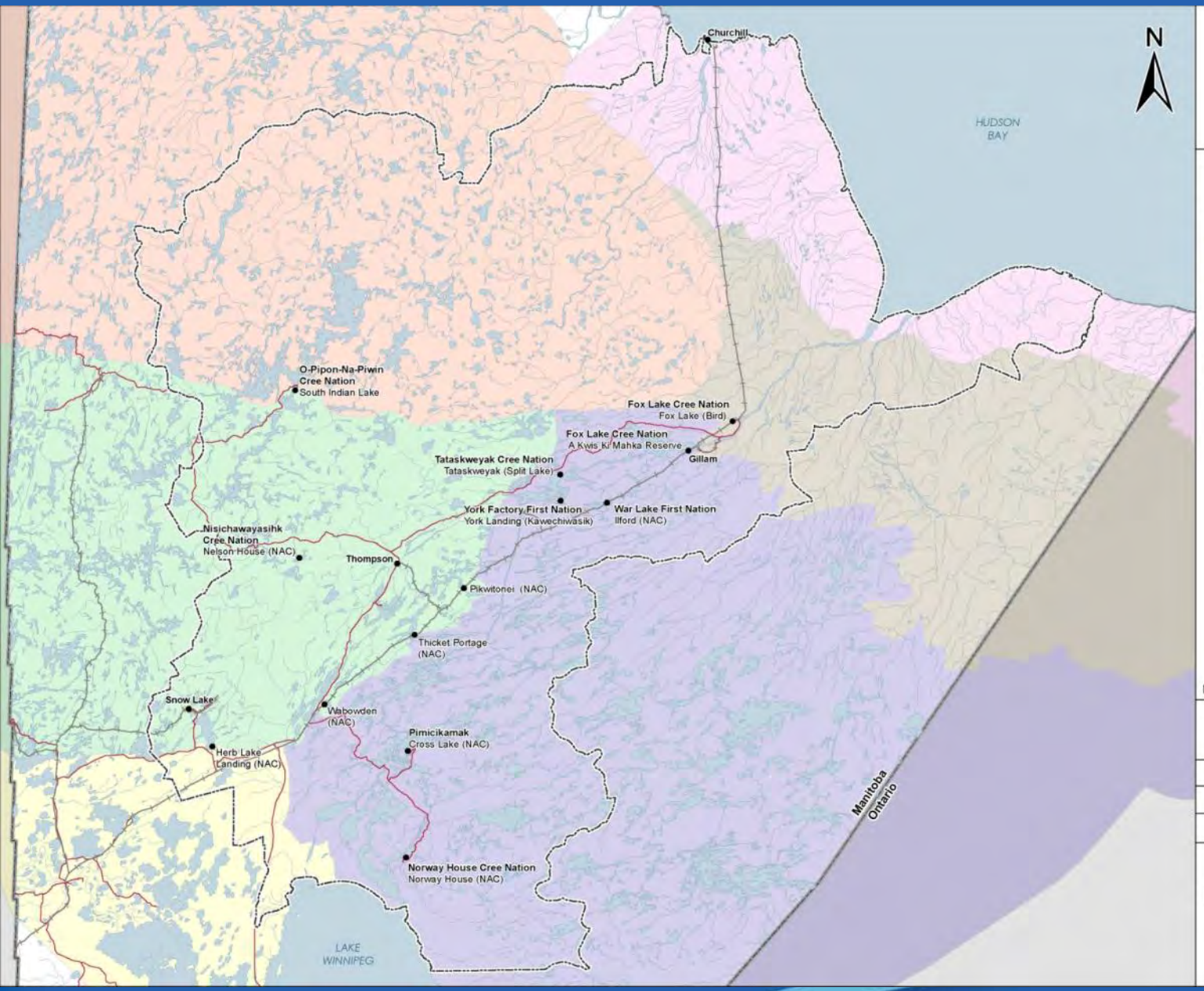
Legend
- RCEA Region of Interest
- Highway
- Rail
- First Nation Reserve
- Park
- Waterbody

RCEA
Region of Interest
Areas 1 to 4

Land Assessment

To provide for the most meaningful assessment, Land RSCs were broken down as follows:

- Six ecozones were identified in the RCEA ROI.
  - Ecozones further subdivided to terrestrial regions as ecozones too broad to assess effects.
- Assessment areas for wide-ranging populations that move well beyond the boundaries of the RCEA ROI were based on the population's range.
  - e.g., barren-ground caribou
- Given strong link between habitat, wildlife populations and resource use, RSCs examined at 2 scales:
  - Local effects
    - acknowledges substantial effects around GSs that would be masked on a regional scale
    - e.g., shorelines and resource harvesters
  - Regional effects
    - summarizes cumulative effects on terrestrial regions



Manitoba Hydro

Regional Cumulative Effects Assessment

Legend

- RCEA Region of Interest

Ecozones

- Boreal Plains
- Coastal Hudson Bay
- Eastern Boreal Shield
- Hudson Plains
- Taiga Shield
- Western Boreal Shield

Infrastructure

- Rail
- Highway

Note: Northern Affairs Community (NAC)

DATA SOURCE: Province of Manitoba, Government of Canada, Manitoba Hydro

CREATED BY: North/South Consultants

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
NAD 1983 UTM Zone 14N	15-MAY-15	10-NOV-15
	VERSION NO: 2.0	GAIGC:

Ecozones in the RCEA Region of Interest

Indicators, Metrics, Benchmarks

- Appropriate indicators, metrics and benchmarks were selected for each RSC

RSC	Indicator	Metric	Benchmark
Water Quality	Water Clarity	Total Suspended Solids	MBWQSOGs (25mg/L above background)

- Additional details provided in each RSC presentation

Summary Slide

- Submission of Phase II report fulfills the CEC's recommendation

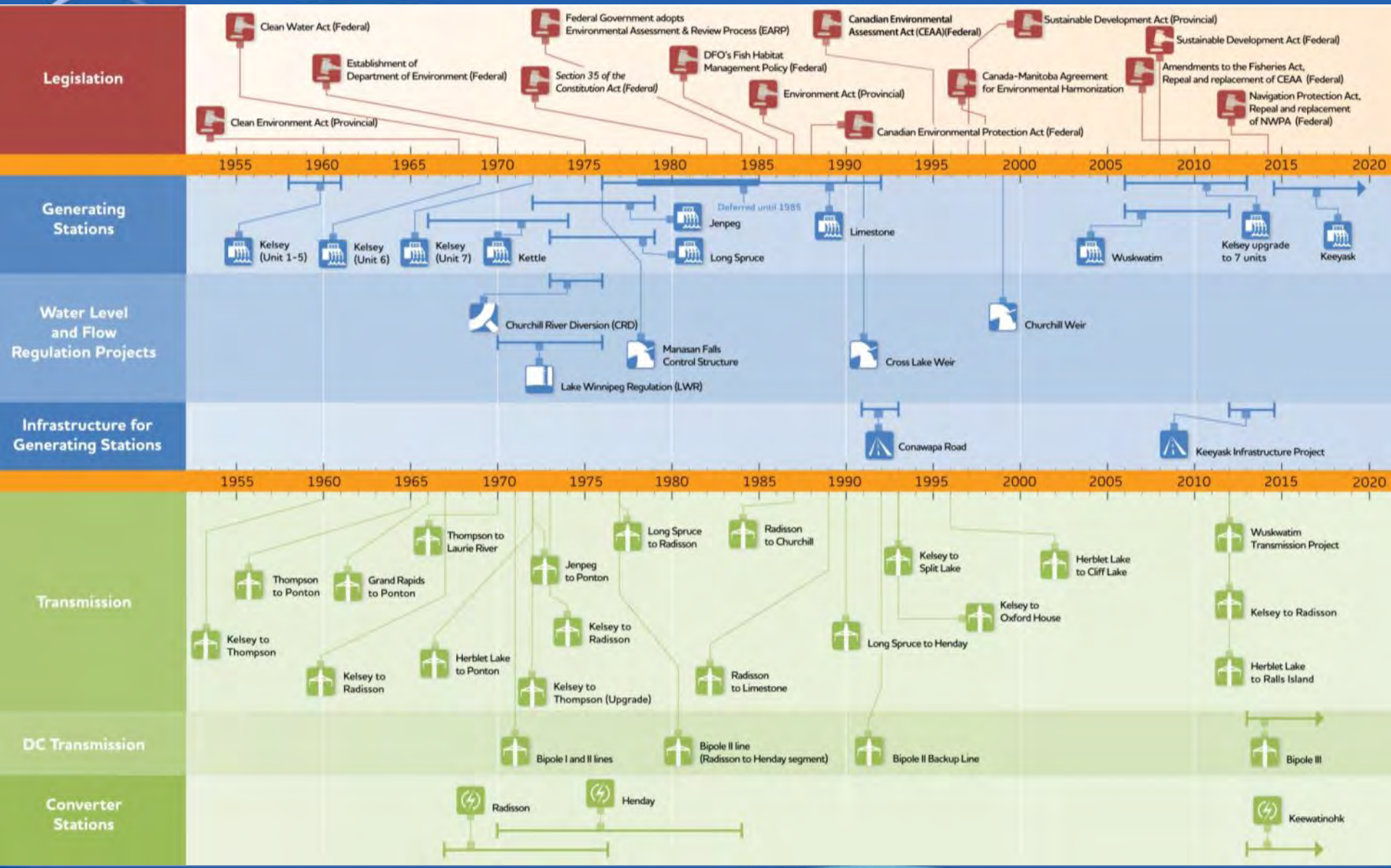
- At 5,000+ pages, the RCEA is:
  - a comprehensive collection of environmental data and community knowledge about the study area
  - is a resource for government and all Manitobans on the state of the environment in this part of province

- From it developed an integrated summary report

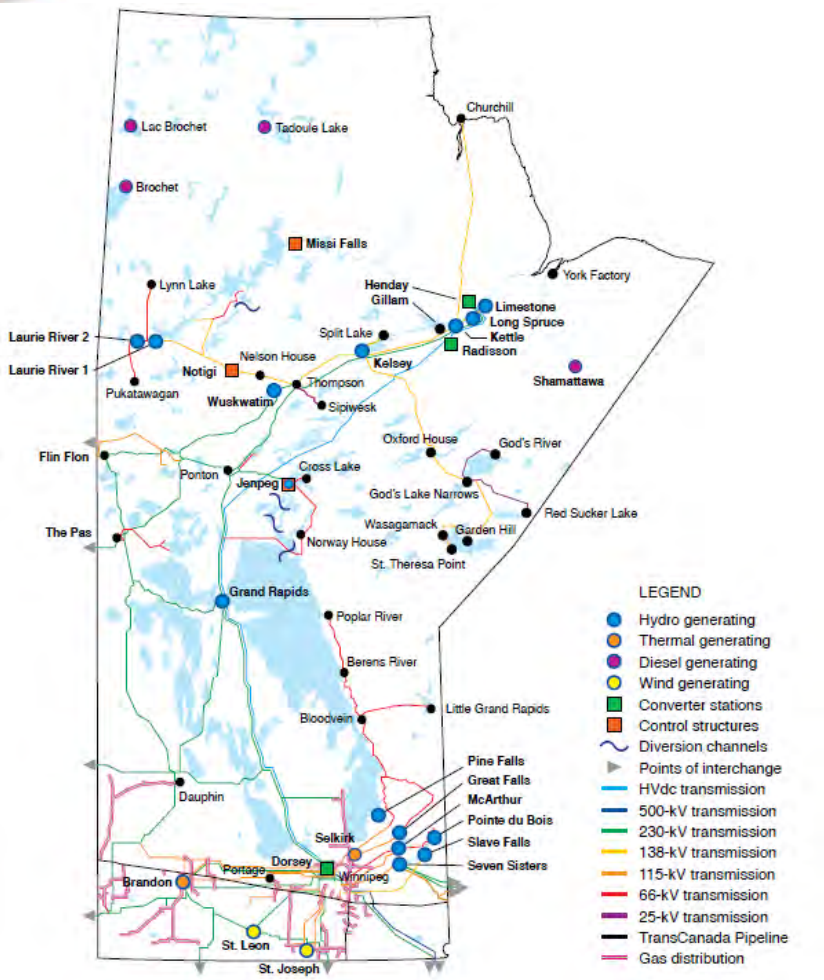
Questions?

History of Hydroelectric Development in the Region of Interest

Nick Barnes
Manitoba Hydro


Legislation
Clean Water Act (Federal)
Establishment of Department of Environment (Federal)
Clean Environment Act (Provincial)
Federal Government adopts Environmental Assessment & Review Process (EARP)
Section 35 of the Constitution Act (Federal)
DFO's Fish Habitat Management Policy (Federal)
Environment Act (Provincial)
Canadian Environmental Assessment Act (CEAA)(Federal)
Canadian Environmental Protection Act (Federal)
Canada-Manitoba Agreement for Environmental Harmonization
Sustainable Development Act (Provincial)
Sustainable Development Act (Federal)
Amendments to the Fisheries Act, Repeal and replacement of CEAA (Federal)
Navigation Protection Act, Repeal and replacement of NWPA (Federal)
1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020
Generating Stations
Kelsey (Unit 1-5)
Kelsey (Unit 6)
Kelsey (Unit 7)
Kettle
Deferred until 1985
Jenpeg
Long Spruce
Limestone
Wuskwatim
Kelsey upgrade to 7 units
Keeyask
Water Level and Flow Regulation Projects
Churchill River Diversion (CRD)
Manasan Falls Control Structure
Lake Winnipeg Regulation (LWR)
Cross Lake Weir
Churchill Weir
Infrastructure for Generating Stations
Conawapa Road
Keeyask Infrastructure Project
1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020
Transmission
Thompson to Laurie River
Thompson to Ponton
Grand Rapids to Ponton
Kelsey to Thompson
Kelsey to Radisson
Herblet Lake to Ponton
Jenpeg to Ponton
Kelsey to Radisson
Kelsey to Thompson (Upgrade)
Long Spruce to Radisson
Radisson to Churchill
Radisson to Limestone
Kelsey to Split Lake
Herblet Lake to Cliff Lake
Kelsey to Oxford House
Long Spruce to Henday
Wuskwatim Transmission Project
Kelsey to Radisson
Herblet Lake to Ralls Island
DC Transmission
Bipole I and II lines
Bipole II line (Radisson to Henday segment)
Bipole II Backup Line
Bipole III
Converter Stations
Radisson
Henday
Keewatinohk

Manitoba Hydro Current System



- Core generation is from water power - 15 integrated hydroelectric generating stations
  - 5,200 MW developed
  - 5,000 MW remaining potential
- 99% of electricity generated in Manitoba is renewable
- 260 MW contracted wind
- 2 thermal generating stations (primarily for backup)
- >18,000 km of transmission lines and 68,000 km of distribution lines
- 4 diesel stations for remote communities, gas pipelines

History of Hydroelectric Development

- Late 1800s – focus on Winnipeg electrification
  - e.g., Manitoba Electric & Gas Light Company, Northwest Electric Light & Power Company
- Early 1900s – development of Winnipeg River & rural electrification with locally-owned utilities
  - Manitoba Power Commission established by province to consolidate responsibility for system

History of Hydroelectric Development

- 1949 - Manitoba Hydro Electric Board established by province coordinate development planning
  - Further development of Winnipeg River

- 1961 - Manitoba Hydro formed from merger of Manitoba Power Commission & Manitoba Hydro Electric Board
  - Focused investigations to find ways to increase energy production to meet growing provincial demand

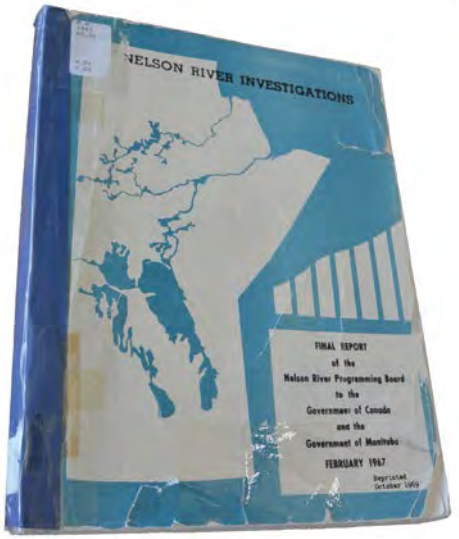
History of Hydroelectric Development in the ROI

- Two key Factors leading to Region of Interest:
  - Development of High Voltage Direct Current (HVdc) technology in early 1960s
    - less line loss over long distances than AC
  - Results of 1913 Dominion of Canada Department of Mines survey of Nelson and Churchill rivers
    - planning information on power potential

History of Hydroelectric Development in the ROI

- Manitoba and Canada formed Nelson River Programming Board (NRPB) in 1963

- NRPB recommended a plan consisting of:
  - Lake Winnipeg Regulation (LWR)
  - Diversion of flows from Churchill River into Nelson River (CRD)
  - A generating station at Kettle Rapids
    - Kettle GS
  - Construction of HVdc transmission line and converter stations



Pre-1976 Regulatory Requirements

- 1867 – Federal *Constitution Act*
  - Pre-1982 reforms addressing Aboriginal rights
- 1868 – Federal *Fisheries Act*
  - Pre-1986 fish habitat policy
- 1882 – Federal *Navigation Protection Act*
- 1968 – *Clean Environment Act* (Manitoba)
  - Focus on pollutants
- 1970 – Federal *Clean Water Act*
  - No Federal EA legislation

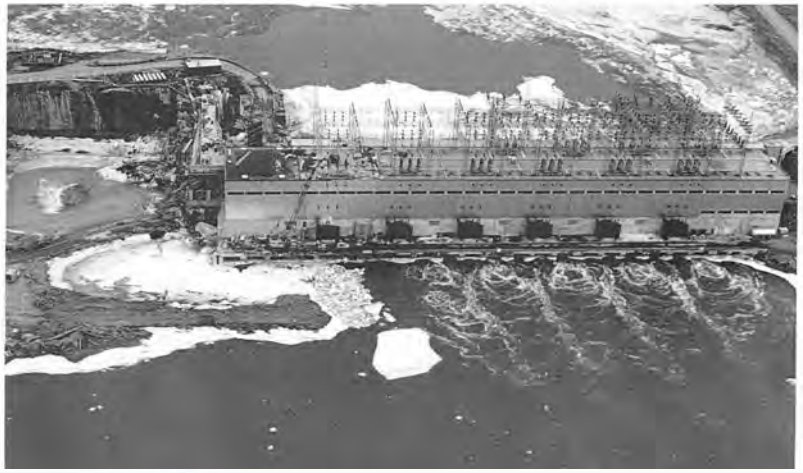
Non-Hydroelectric Development in the ROI

- Railways
  - Port Nelson 1917, Churchill 1929
- Commercial trapping/fishing
  - RTLs 1940
- Mining, roads, etc.

Remnants of Port Nelson (2006)

1950 to 1976

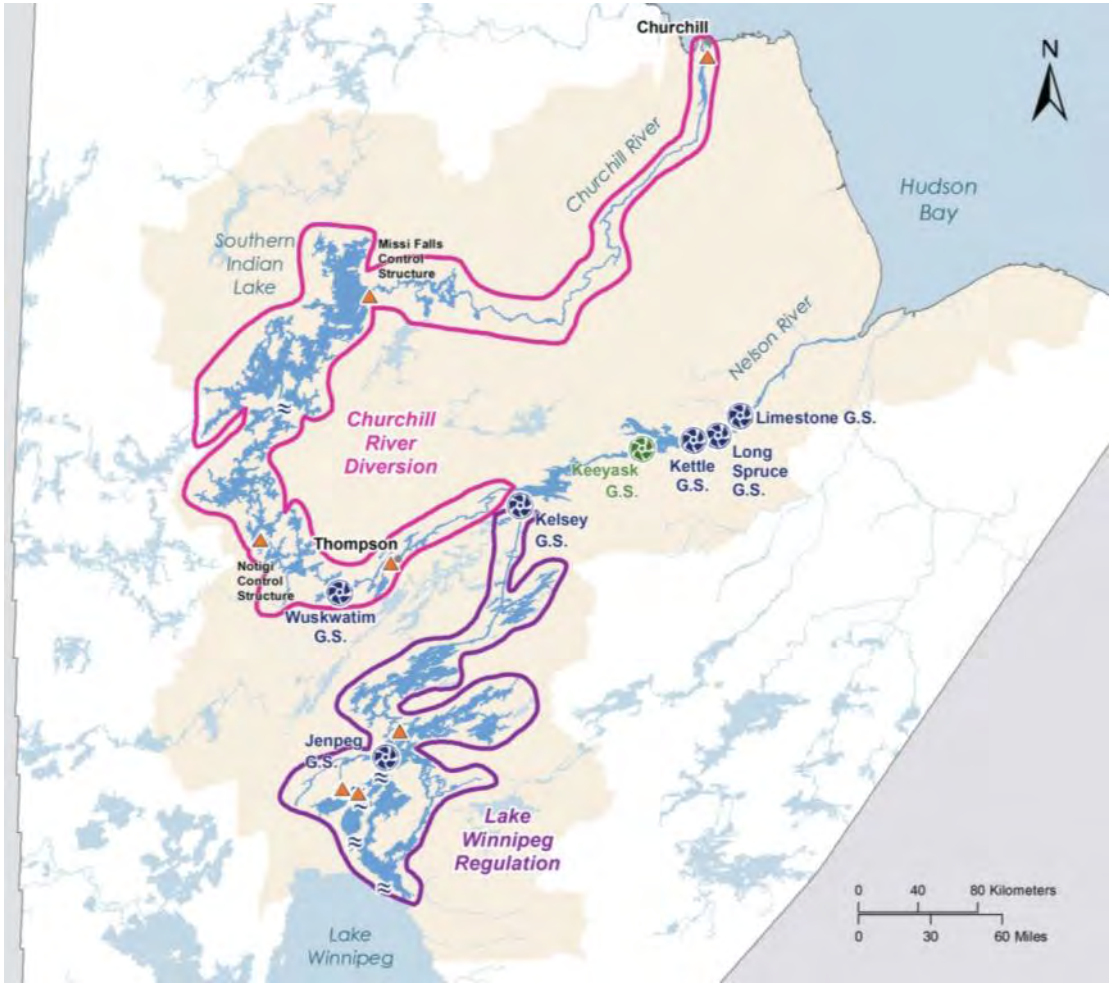
- Kelsey GS (292 MW) & associated transmission was constructed between 1958 – 1977
  - First generating station built on Nelson River to provide power to INCO
  - Built by MHEB
    - pre-Manitoba Hydro



Unit 7 construction

ROI Development 1950 - 1976

- All four projects recommended by Nelson River Programming Board (NRPB) were constructed between 1966 & 1976



1950 - 1976

- NRPB projects: Kettle GS (1,220 MW) & associated transmission constructed from 1966 - 1974

Powerhouse excavation at Kettle Generating Station (1967)

Kettle Generating Station (2015)

1950 - 1976

- NRPB projects: HVdc transmission
  - Bipole I HVdc was completed in 1971
  - Bipole II was initiated at the same time as Bipole I and all work was completed in 1977

1950 - 1976

- NRPB projects: Converter stations
  - To convert AC power to DC for transmission to southern MB
  - Radisson constructed between 1967 – 1977
  - Henday constructed between 1970 - 1985
  - Dorsey built near Winnipeg in 1968

Radisson

Henday

1950 to 1976

- NRPB projects: LWR (1970 – 1976)

Construction of the Jenpeg Generating Station

Two-Mile Channel looking towards Lake Winnipeg from Playgreen Lake

Eight-Mile Channel looking downstream towards Little Playgreen Lake (1976)

1950 to 1976

- NRPB projects: CRD (1973 – 1976), via Rat and Burntwood rivers into Split Lake

Notigi Control Structure looking upstream

Missi Falls Control Structure looking upstream

1950 - 1976

– The Long Spruce GS (980 MW) was constructed between 1973 – 1979

Post-1976 Regulatory Requirements

- 1982 – *Constitution Act* amended to deal with Aboriginal and Treaty rights (Section 35)
- 1984 – Federal EARP
- 1986 – DFO Fish Habitat policy
- 1987 – Manitoba's *Environment Act*
- 1992/95 – CEAA

Post-1976 Regulatory Requirements

- 2012 – *Federal Jobs, Growth and Long-Term Prosperity Act* (Bill C-38)
- Changes to:
  - CEAA
  - NPA
  - FFA

Development 1976 - 2014

- Limestone GS (1,350 MW) & associated Infrastructure
  - Construction began in 1976 - postponed in 1978 due to decreased load growth
  - Re-started in 1985 and completed in 1989

Development 1976 - 2014

- Wuskwatim GS (214 MW) & associated Infrastructure
  - Construction took place between 2006 – 2012

Projects under Development or Regulatory Review

- Bipole III, Riel, Keewatinohk & associated Infrastructure
- Bipole III - currently under construction
  - originating at new northern converter station (Keewatinohk)
  - ending at new (2014) Riel Converter Station in south

Lifting the first Bipole III Transmission Tower (2016)

Projects under Development or Regulatory Review

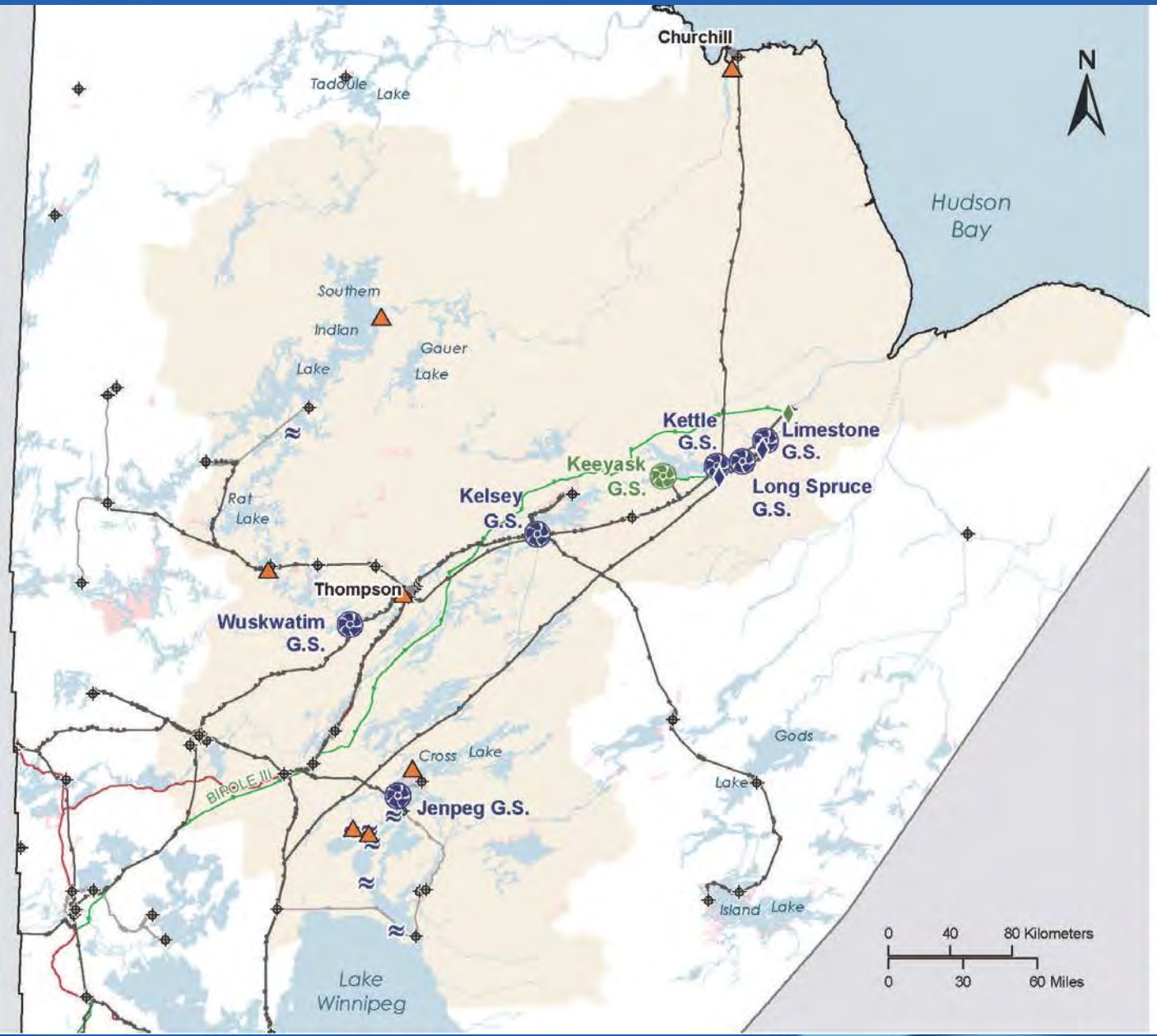
- Keeyask Infrastructure Project
  - Construction began in 2012
  - involved access road construction & camp development for Keeyask Generation Project

Projects under Development or Regulatory Review

- Keeyask GS (695 MW) and Transmission Projects
  - Construction is underway (2014-2021) for GS, transmission facilities and supporting infrastructure

Draft tube

Construction power facilities for switching station


Churchill
Tadoule Lake
N
Hudson Bay
Southern Indian Lake
Gauer Lake
Kettle G.S.
Limestone G.S.
Keeyask G.S.
Long Spruce G.S.
Kelsey G.S.
Rat Lake
Thompson
Wuskwatim G.S.
Cross Lake
BIPOLE III
Jenpeg G.S.
Gods Lake
Island Lake
Lake Winnipeg
0 40 80 Kilometers
0 30 60 Miles
Legend
Generating Station
Generating Station (Under Construction)
Control Structure
Diversion
Converter Station
Converter Station (Under Construction)
Transmission Distribution Station
Transmission Line 500KV - 69KV
Sub Transmission Line 66KV - 25KV
Transmission Line (Under Construction) 500KV - 69KV
Highway
First Nation Reserve
RCEA Region of Interest

Questions?

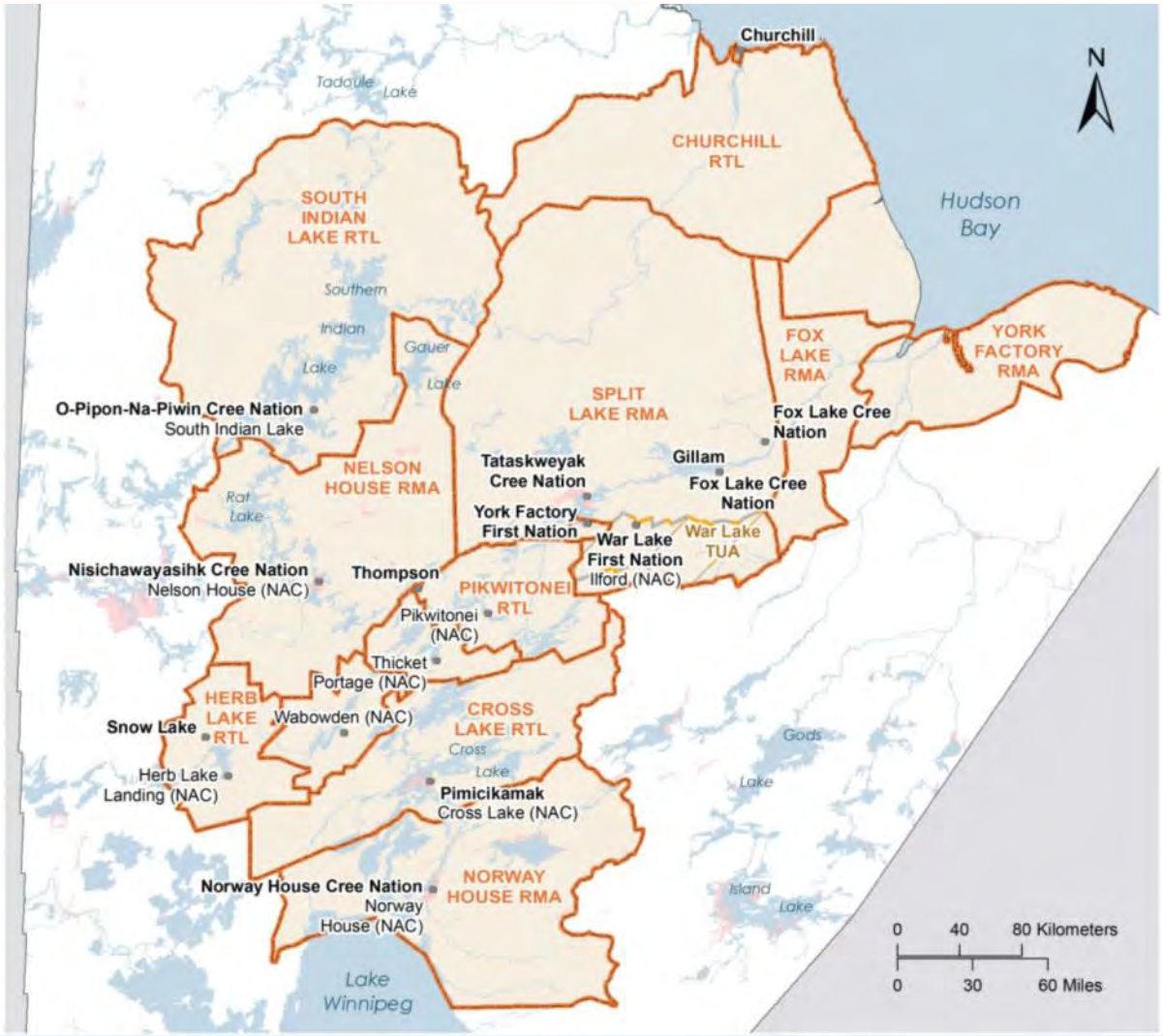
RCEA People

Laura McKay
Manitoba Hydro

Presentation Outline

- Communities in the ROI
- Approach to People
- Limitations and Challenges
- Summary of Key Effects and Compensation, Mitigation and Remediation

Communities in the ROI



Approach to People

- The Phase II People Part includes 5 chapters:
  - Introduction
  - Study Scope, Approach and Methodology
  - Regional Profile
  - Summary of Hydroelectric Effects on People and Key Mitigation, Remediation and Compensation Measures
  - Summary of Community Information

Approach to People

- Document perspectives and understandings of effects, as well as socio-economic trends observed in available information
- Factors influencing the approach to the People portion of the RCEA:
  - Hydroelectric development spans six decades
    - Many projects pre-date modern environmental assessment
  - Significant and substantial other developments and policies have impacted the ROI
  - Issues resolved through negotiated settlements
    - Absence of a mutually agreed upon record of effects

Approach to People

- The approach recognizes:
  - The significant history of interaction between MB, MH and the communities in the ROI
  - The complex history of settlement negotiations and agreements between the communities, MB, MH and in some cases Canada
  - Presence of divergent views on scope and magnitude of effects

Limitations and Challenges

- Regional Profile:
  - Had to be selective in what is in the history piece
  - Very little pre-project demographic data
    - what is available is generally random and spotty
  - Data suppression
    - e.g., select Census years, and NACs overall
- Summary of Effects, Compensation and Mitigation:
  - Missing historical data on agreements
  - Focus on MH processes
- Summary of Community Information:
  - Confidential materials
  - Variation in breadth of materials available by community
    - e.g., NCN versus Cross Lake
  - Information available from community documentation often predates compensation and mitigation measures

Limitations/Challenges

Resource Use:

- Incomplete/absent, record of harvest/ consumption to make pre- and post-comparisons
- Methodological differences among studies
- High annual variations in some species' abundance influences perceptions of effects and degree of post-development recovery
- Perceptions of fish and wildlife quality vary by individual
- Other economic, social and cultural factors have influenced resource harvest

Summary of Effects, Mitigation, Remediation and Compensation

- Overview of Settlement Agreement Process
- Areas of effect include:
  - Culture, Way of Life and Heritage Resources
  - Navigation, Transportation and Public Safety
  - Resource Use
  - Home Relocation
  - Worker Interaction
  - Loss of Reserve Land
  - Health Issues and Concerns
  - Personal Property Loss and Damage
  - Employment, Training and Business Opportunities
  - Benefits of Electrification

Settlement Agreements

- Various settlement processes to resolve grievances

  - Northern Flood Agreement
  - Comprehensive Implementation Agreements
  - Other Settlement Agreements

- Measures established to reduce, mitigate or compensate
- Understanding of effects and how to address informed by a long history of communication with First Nations, northern communities and groups

Northern Flood Agreement (NFA) signed by Canada, Manitoba, Manitoba Hydro and Northern Flood Committee

Northern Flood Agreement (NFA)

- Signed December 16, 1977
- Canada, Manitoba, Manitoba Hydro and the Northern Flood Committee
- Northern Flood Committee represented five First Nations:
  - Cross Lake First Nation (Pimicikamak Okimawin)
  - Nelson House First Nation (Nisichawayasihk Cree Nation)
  - Norway House Cree Nation
  - Split Lake First Nation (Tataskweyak Cree Nation)
  - York Factory First Nation

Northern Flood Agreement

- Framework for addressing adverse effects on lands, pursuits, activities & lifestyles
- Key provisions:
  - Land exchange
  - Notice/Consultation
  - Navigation
  - Policy Issues
  - Remedial and compensation measures
  - Fishing/ Trapping Programs
- Introduced the concept of community resource areas
- Reverse onus clause
- Arbitration process to resolve claim-related disputes

Northern Flood Agreement

- Not all effects known at the time the NFA was negotiated and signed
- Challenging to implement
- Much room for interpretation
- Many claims filed in the early 1980s
- While a number of agreements reached, many claims went to arbitration

Northern Flood Agreement (NFA) signed by Canada, Manitoba, Manitoba Hydro and Northern Flood Committee

Comprehensive Implementation Agreements (CIA)

- In 1986, Northern Flood Committee proposed global negotiations to address all outstanding claims under NFA
  - Global approach did not succeed, however individual CIAs were reached with;
  - Tataskweyak (1992)
  - York Factory (1995)
  - Nisichawayasihk (1996)
  - Norway House (1997)

Comprehensive Implementation Agreements

- Addressed outstanding grievances
- Resolved claims as one rather than on a claim by claim basis
- Included provisions for:
  - Compensation
  - Trust indentures
  - Land exchange
  - Resource Management Areas
  - Environmental monitoring
  - Consultation on Future Developments

NFA Implementation in Cross Lake

- From 1994 to 1997, negotiations to reach a CIA
- In 1997, CLFN decided to proceed within the specific terms of the NFA
- Action Plans developed to address NFA obligations

NFA Implementation in Cross Lake

- Manitoba Hydro working with CLFN/Pimicikamak, Manitoba and Canada to implement NFA

Other Settlement Agreements

- South Indian Lake (1992)
- Fox Lake (2004)
- War Lake (2005)
- Wabowden (1992)
- Cross Lake NAC (1990 and 2010)
- Nelson House NAC (2006)
- Norway House NAC (AIP 2003)
- Town of Churchill 1997
- City of Thompson (1976 and 1982)
- Agreements with various resource user groups
- Work ongoing with Thicket Portage, Pikwitonei and Norway House (NAC)
- Future Development Agreements
- Agreements with the Manitoba Metis Federation

Culture, Way of Life and Heritage Resources

- Interrelated with effects on resource use, navigation, and the way the landscape looks
- Described by communities as changes in connection to the land, ability to practice customs and traditions and ability to transmit traditional teachings across generations
  - M*ino pimatisiwin* – living the good life
- Loss of or reduced access to traditional spiritual sites, burial grounds (and exposure of human remains), meeting places, navigational markers, beaches and seasonal family campgrounds

Culture, Way of Life and Heritage Resources

- Measures to address the effect:
  - Archaeological programming
    - e.g., Sipiwesk Lake Archaeological Program, System Wide Archaeological Program
  - Settlement agreements
  - Shoreline protection
  - Cultural ceremonies
  - Heritage Resource Impact Assessments
  - Losses often cannot be replaced or substituted - place and connection is important

Navigation, Transportation and Public Safety

- Shoreline erosion and woody debris has inhibited access to shorelines and bays and created navigational hazards in the water

Navigation, Transportation and Public Safety

- Changes to water regime has
  - altered timing and quality of ice cover
  - adversely affecting winter travel

Navigation, Transportation and Public Safety

- Measures to address the effect:
  - Settlement agreements
  - Waterways Management Program, supports and promotes the safety of people travelling on affected waterways:
    - Boat Patrols
    - Debris Management Program
    - Safe Ice Travel
  - Water Level Forecast Notice Program

Waterways Management Video

Resource Use

- RCEA Considers:
  - Domestic and commercial harvest
  - Fishing, trapping, hunting and gathering
- Effects on:
  - Presence and abundance of resources
  - Increased access along transmission ROW/roads
  - Loss of access to shoreline for hunting and gathering and fewer safe landing sites
  - Navigational hazards on the water – increased risk and cost
  - Knowledge of the landscape and resource
  - Confidence and sense of pride in providing for one's family

Resource Use

- Hunting, Trapping and Gathering:
  - Changes to abundance and distribution of plant and animal communities
  - Changes to the patterns of animal movements
  - Concerns about reduced potency of medicines
  - Reduced reliability of knowledge about animals' location and behaviour

Resource Use

Considerations - Trapping:

- Effects can vary considerably by trapline:
  - dependent on proximity to affected waterway, right of way and/or infrastructure
- Strongly influenced by fur prices and species abundance
  - e.g., Marten reinhabiting its historical range
- Declined over time but remain important cultural activity

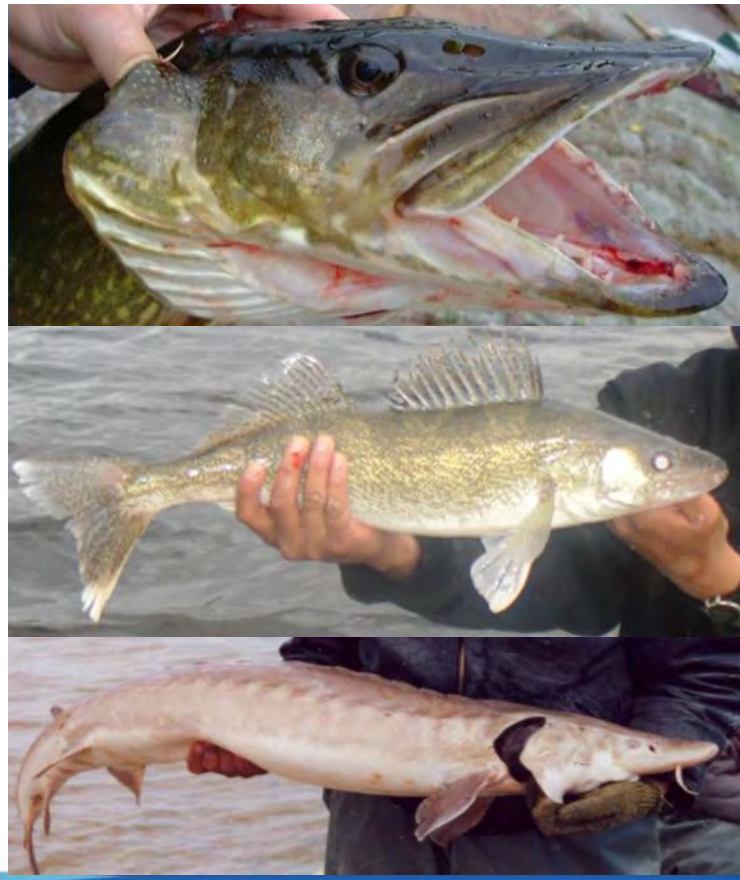
Resource Use

- Measures to address effects on hunting, trapping and gathering:
  - Settlement agreements – commercial and domestic trapping, community traplines
  - Registered Trapline Program (NFA)
  - Ongoing programming in the Cross Lake RTL

Resource Use

Domestic Fishing:

- Debris in nets causing net fouling and equipment damage
- Navigation challenges
- Changes in fish abundance and distribution
- Changes in knowledge of the resource
- Concerns - “soggy”, “thin” and poor tasting fish
- Fear of mercury and other pollutants in fish
- Resulting changes in traditional diet



Resource Use

Commercial Fishing:

- Affected in similar ways as domestic fishing
- Remains an important industry to northern communities
- Affected by other factors such as
  - fish prices
  - transportation costs
  - subsidies
  - market demand

Resource Use

- Measures to address effects on domestic and commercial fisheries:
  - Settlement agreements
  - Waterways Management Program
  - Ongoing process with O-Pipon-Na-Piwin Cree Nation
  - Sturgeon Boards and enhancement programs
  - Keeyask adverse effects programming
  - Coordinated Aquatic Monitoring Program

Home Relocation

- **South Indian Lake**
  - Relocation of approximately 40% of community households from west to east side of a narrows
  - Driven by navigation safety concerns related to post-CRD water regime in the narrows
  - About 96 lots developed as part of relocation
  - Ongoing community concerns led to NFA claims
    - Addressed in broader settlement agreement with the Community Association of South Indian Lake (1992)

Home Relocation

- **Gillam**
  - FLCN efforts to establish a reserve at Gillam since 1920
  - 1960s Gillam developed as a key MH operations and service center and as LGD of Gillam
  - FLCN families residing in Gillam viewed by government as “squatters”
  - FLCN homes demolished or moved, residents relocated
  - Bird established as a reserve in 1985
  - Small urban reserve legally recognized at Kettle Crescent in Gillam in 2010
  - Today collaborative community planning through Harmonized Gillam Development committee

Worker Interaction

- Associated with construction camps and more permanent settlements
- Influx of non local workers (permanent or transient) associated with range of social impacts
- Addressed in past settlement agreements
- Addressed in planning for Wuskwatim, Keeyask, Keewatinohk:
  - Measures to reduce work force off hour visits
  - Keeyask Worker Interaction Subcommittee
  - Harmonized Gillam Development process
  - Cultural awareness training

Loss of Reserve Land

- Inundation of Reserve Land due to flooding, and potential future loss of land due to erosion, addressed though the granting of an easement over land below a “severance” line
- Under NFA, reserve land taken compensated by replacement land at a ratio of 4:1
  - Under the CIAs the ratio substantially higher
- Shoreline protection along Reserve Land
- SSEA process used to route transmission lines away from Reserve Land

Health Issues and Concerns

- Establishment of new health infrastructure in Gillam
- Potable Water concerns raised by NFA communities
  - Issue resolved between the parties
  - Potable water the ongoing responsibility of INAC
- Mercury
  - Stress and anxiety
  - Changes to traditional food consumption
  - Mitigation measures include monitoring programs (fish and humans) and fish consumption guidelines

Health Issues and Concerns

- Specific community concerns raised regarding transmission lines include:
  - Electric magnetic fields – addressed through ongoing research and educational outreach
  - Audible noise – addressed by provincial guidelines
  - Herbicide use – addressed through public notifications, low disturbance clearing methods in sensitive areas, SSEA process

Personal Property Loss and Damage

- Damage from floating or submerged debris, exposed rock surfaces, slush and adverse ice conditions
- Damage to outboard motors, snowmobiles, boats, nets and traps
- Claims processes in the NFA, CIAs, other settlement agreements and in adverse effects agreements for Keeyask and Wuskwatim
- Property Compensation Policy for transmission lines

Employment, Training and Business Opportunities

- Short- and long-term employment and business opportunities
- Programs and policies to:
  - encourage and enhance Indigenous representation in projects and operational work force
  - promote participation of northern Indigenous businesses


Pre-project Training


Employment Opportunities

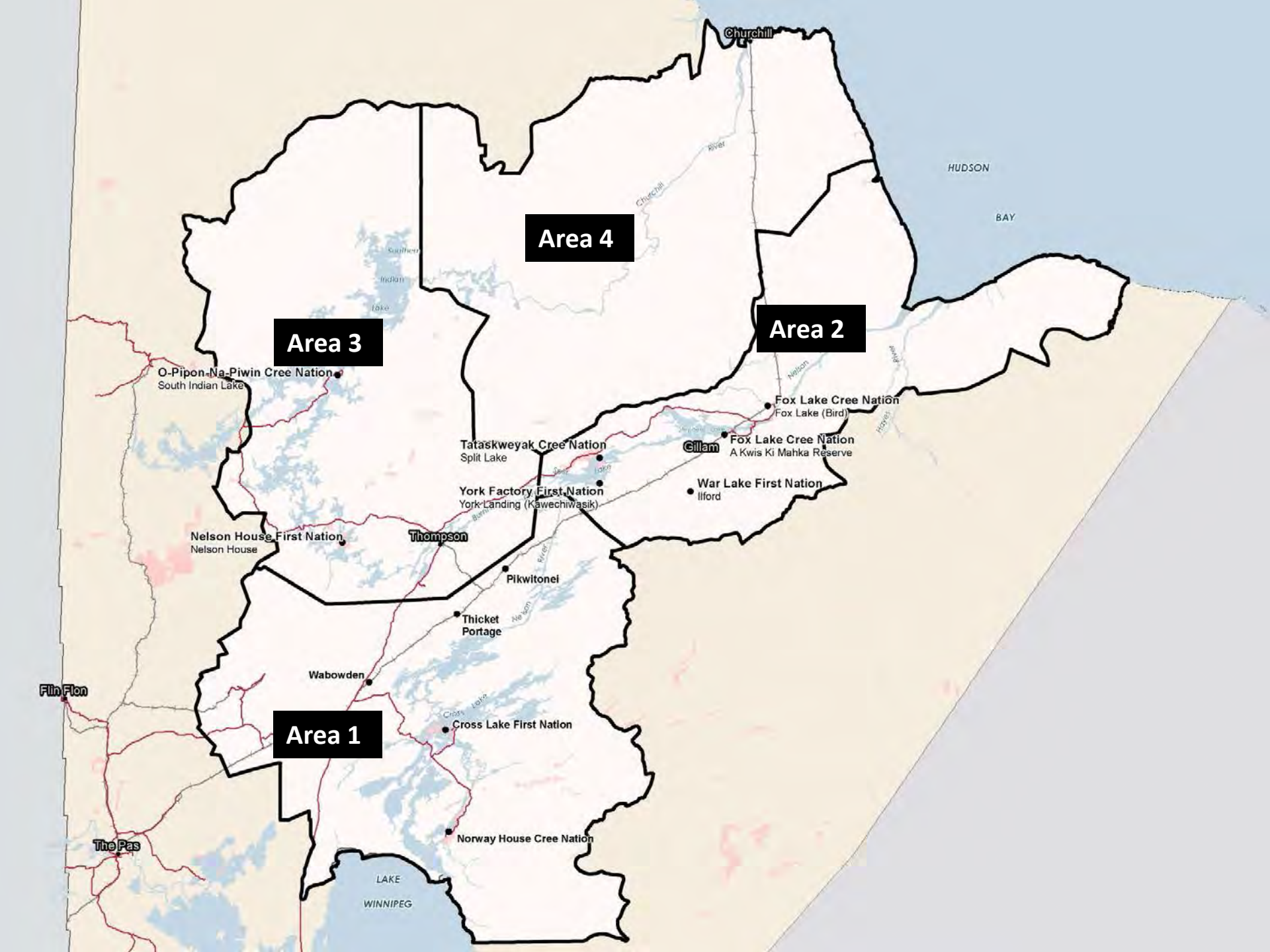
Business Opportunities

Benefits of Electrification

- Limited electrical service for many ROI communities in 1960s:
  - Small generators powered by diesel or gas
  - Electrical service often only for stores, nursing stations and government offices
- Many communities connected to provincial grid in 1970s:
  - Full electrical service
  - Elimination of environmental risks associated with transport and burning of diesel

RCEA - Erosion & Sedimentation

Wil DeWit
Manitoba Hydro


Churchill
HUDSON
BAY
Area 4
Area 3
Area 2
Area 1
O-Pipon-Na-Piwin Cree Nation
South Indian Lake
Fox Lake Cree Nation
Fox Lake (Bird)
Gillam
Fox Lake Cree Nation
A Kwis Ki Mahka Reserve
Tataskweyak Cree Nation
Split Lake
War Lake First Nation
Ilford
York Factory First Nation
York Landing (Kawechiwasik)
Nelson House First Nation
Nelson House
Thompson
Pikwitonei
Thicket Portage
Wabowden
Flin Flon
Cross Lake First Nation
Norway House Cree Nation
The Pas
LAKE
WINNIPEG

Approach & Methods

Erosion:

- Literature review & new analyses using LandSat satellite imagery & aerial photographs
- Consideration of erosion prior to hydroelectric development where information available and erosion since development to present day

Sedimentation:

- Review and summary of historical studies
- Consideration of more recent and intensive studies conducted for generation projects and CAMP

Limitations:

- Historical data generally sparse both spatially & temporally

Community Concerns

Erosion:

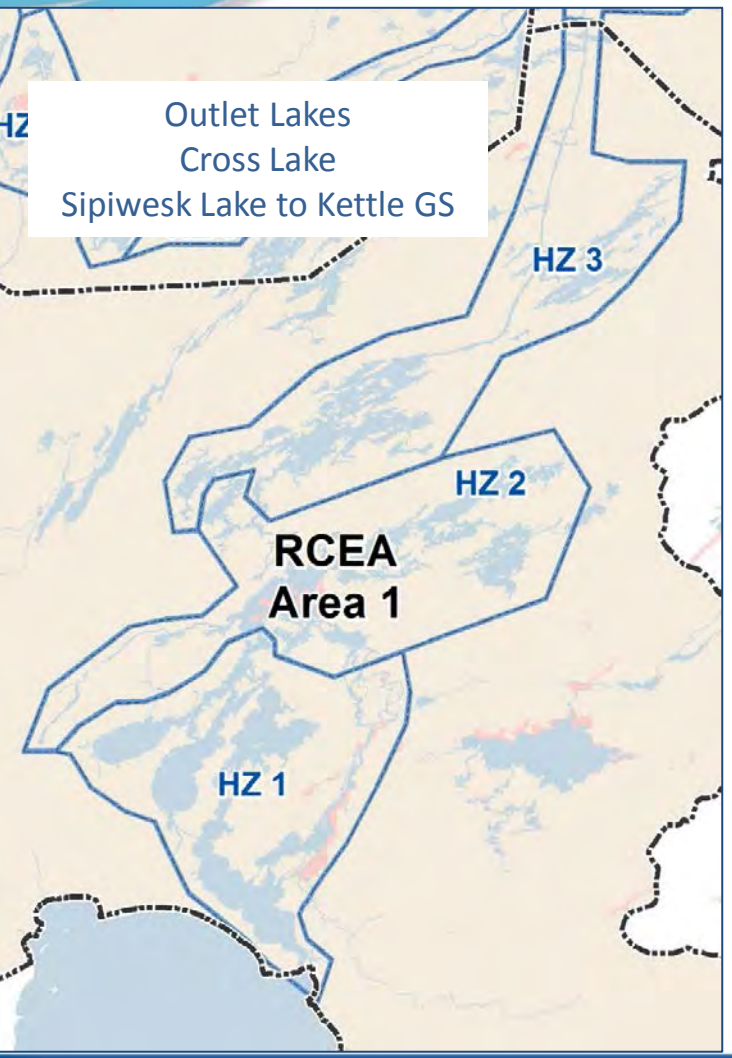
- Loss of traditional & treaty lands
- Impacts on infrastructure
- Shore access
  - resource use & wildlife
- Adds sediment to water
- Creation of woody debris
- Aesthetics

Sedimentation:

- Water reported to be murkier
- Water quality
  - drinking, swimming
- Effects on fish & fish habitat

Area 1: Upper Nelson River

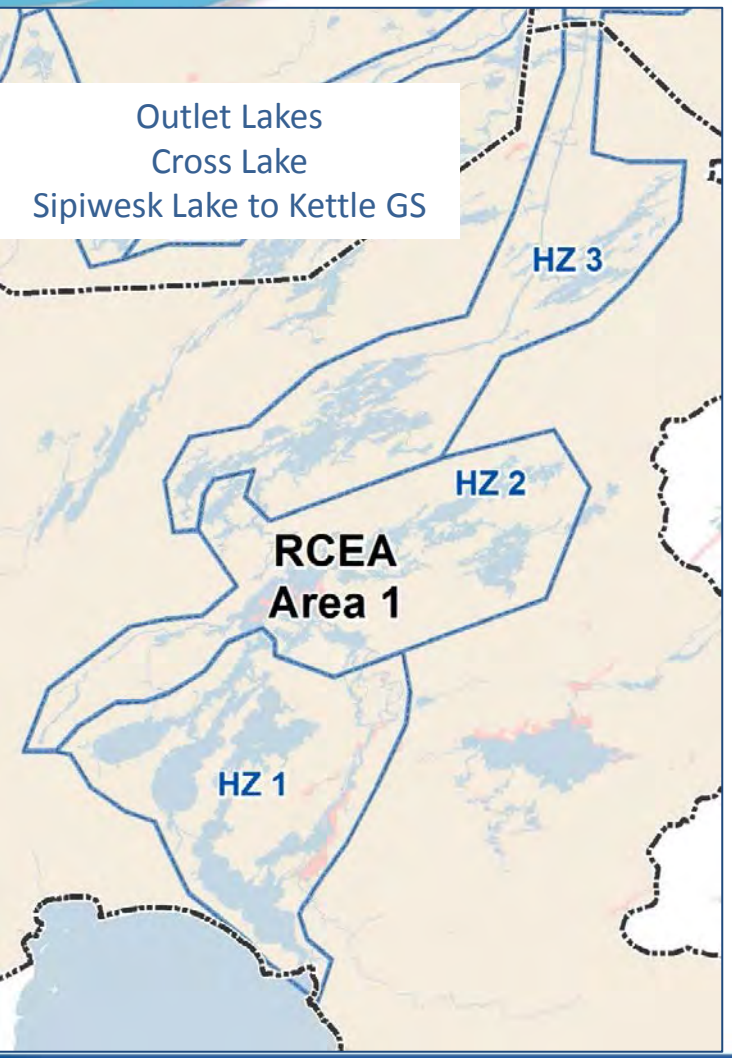
Erosion



- Extensive erosion/recession along N. shore L. Wpg & 2-Mile Channel entrance, W. shore Playgreen L. and Kikittogisu L. near 8-Mile Channel
- Erosion rates on N. shore L. Wpg and SW shore of Playgreen L. are similar pre/post LWR
- Jenpeg forebay erosion rates generally low but higher than pre-LWR
- Little effect on Cross L. erosion until recent high water levels caused concern near community
- Increase in erosion on Sipiwesk L. difficult to quantify due to lack of pre-Kelsey data, erosion is ongoing and appears to have increased with recent higher water levels

Area 1: Upper Nelson River

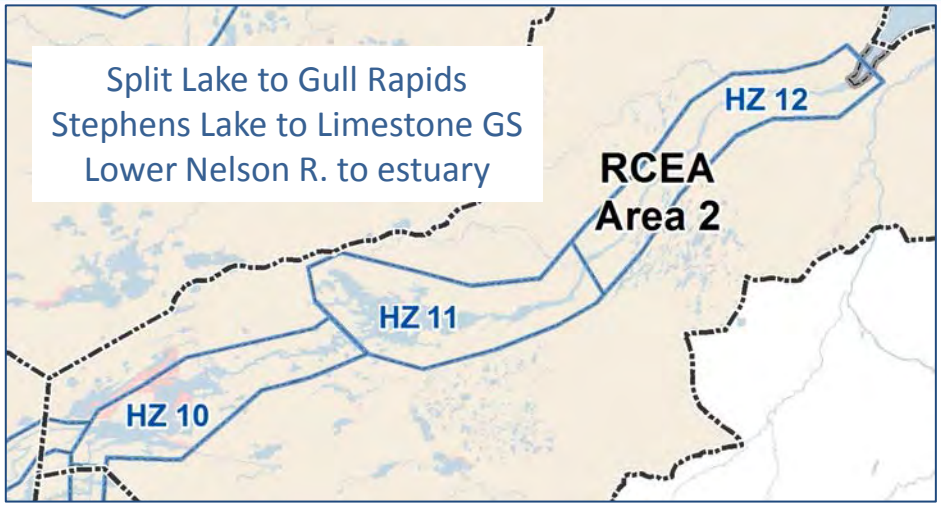
Sedimentation



- 2-Mile Channel transports additional sediment from N. shore of L. Wpg and alters sediment movement in Playgreen L.
- Water from 2-MC generally clearer than water along W. shore of Playgreen L.
- L. Wpg sediment appears to largely remain suspended and pass through Playgreen L.
- Suspended sediment / turbidity are similar pre/post LWR in outlet lakes
- 2-MC & 8-MC have altered the sediment transport dynamics in Playgreen & Kiskittogisu lakes.
- LWR generally caused higher turbidity in east part of Cross L. and reduced it in west Cross L. along the main flow path
- Suspended sediment concentrations are similar pre/post LWR for the Sipiwesk Lake to Kelsey area – lack of pre-Kelsey data

Area 2: Lower Nelson River

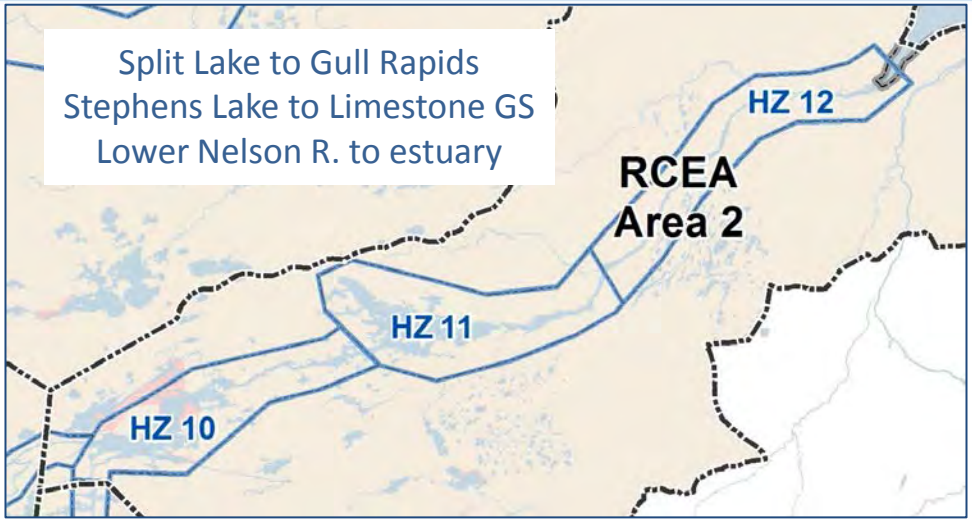
Erosion



- Little erosion information prior to Kelsey, Kettle, LWR/CRD
- Split L. to Gull Rapids generally erosion resistant shorelines pre/post LWR/CRD and low erosion from 1978-2003 except in localized areas
- Recent high water levels caused erosion concerns near communities on Split L.
- Extensive shoreline recession in Stephens L. after impoundment
- High initial erosion rates in forebays were followed by gradual decline in erosion rates over time – localized areas of ongoing large erosion
- Stable shoreline conditions below Limestone since at least the 1950s

Area 2: Lower Nelson River

Sedimentation

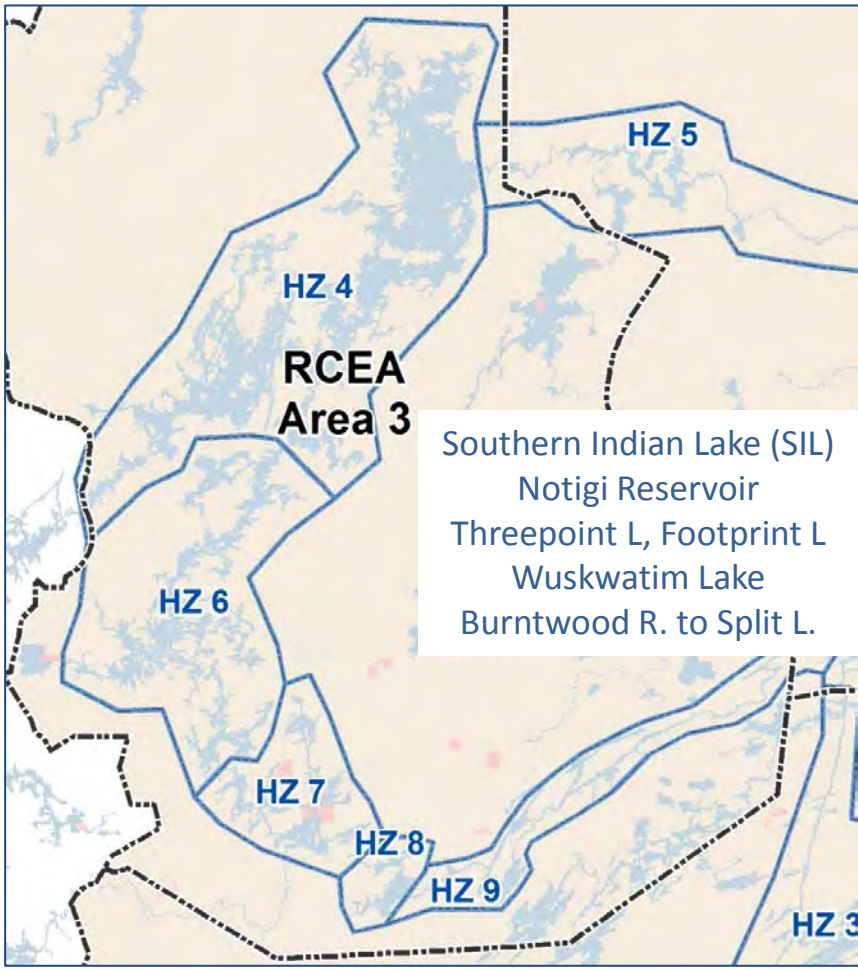


- No apparent change in Split L. suspended sediment / turbidity in initial years after LWR/CRD, but more recent levels higher than pre-LWR/CRD
- CRD increased Burntwood R. sediment load & deposition in Split L. near mouth
- Stephens L. suspended sediment/turbidity conditions relatively unchanged since the 1970s and N. arm clearer than S. arm
- Nelson R. sediment decreases through Stephens L. due to deposition
- High suspended sediment at times in winter due to ice effects
- Recent study found suspended sediment varied over wider range with higher average concentration in winter vs. summer

Area 3: Southern Indian Lake

Erosion & Sedimentation

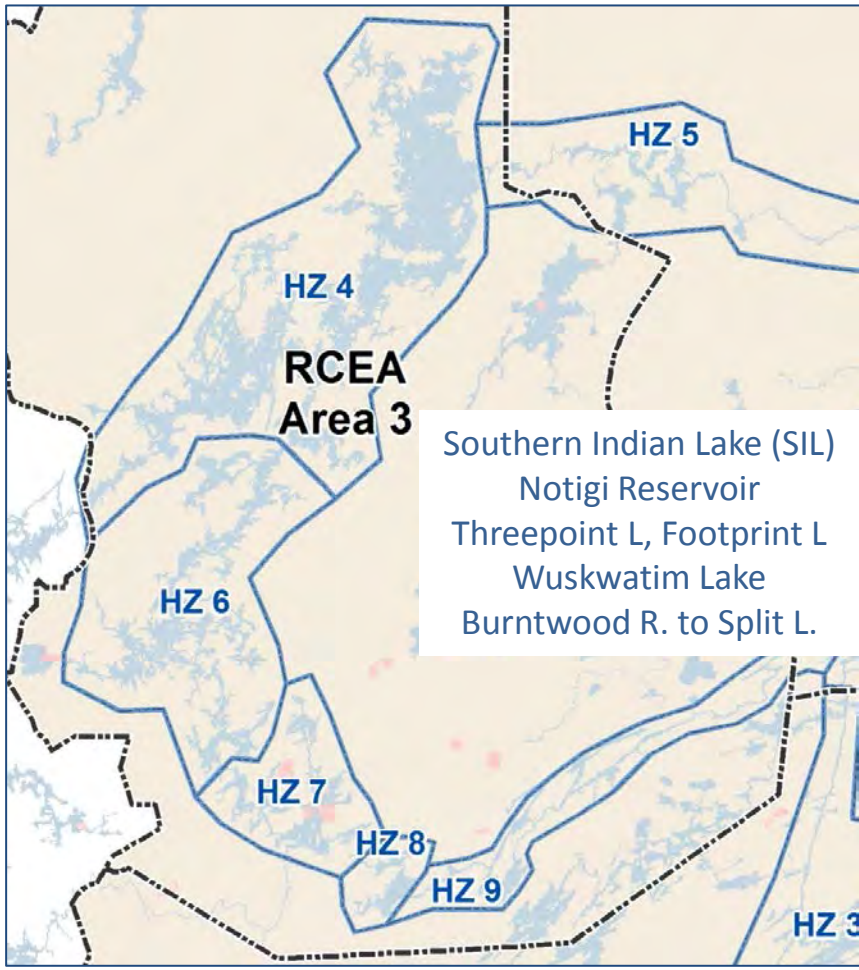
- SIL had very low erosion pre-CRD and extensive erosion and peat disintegration post-CRD, notably in N. part of SIL and South Bay area
- Highest rates of erosion soon after CRD and generally declining over time
- Suspended sediment concentrations and CRD effects vary spatially in SIL
- In the vicinity of South Bay and Missi CS the suspended sediment initially increased due to diversion but recent data (2008-2013) is similar to pre-CRD conditions although turbidity was generally higher from 1993-2013



Area 3: Churchill R. Diversion

Erosion

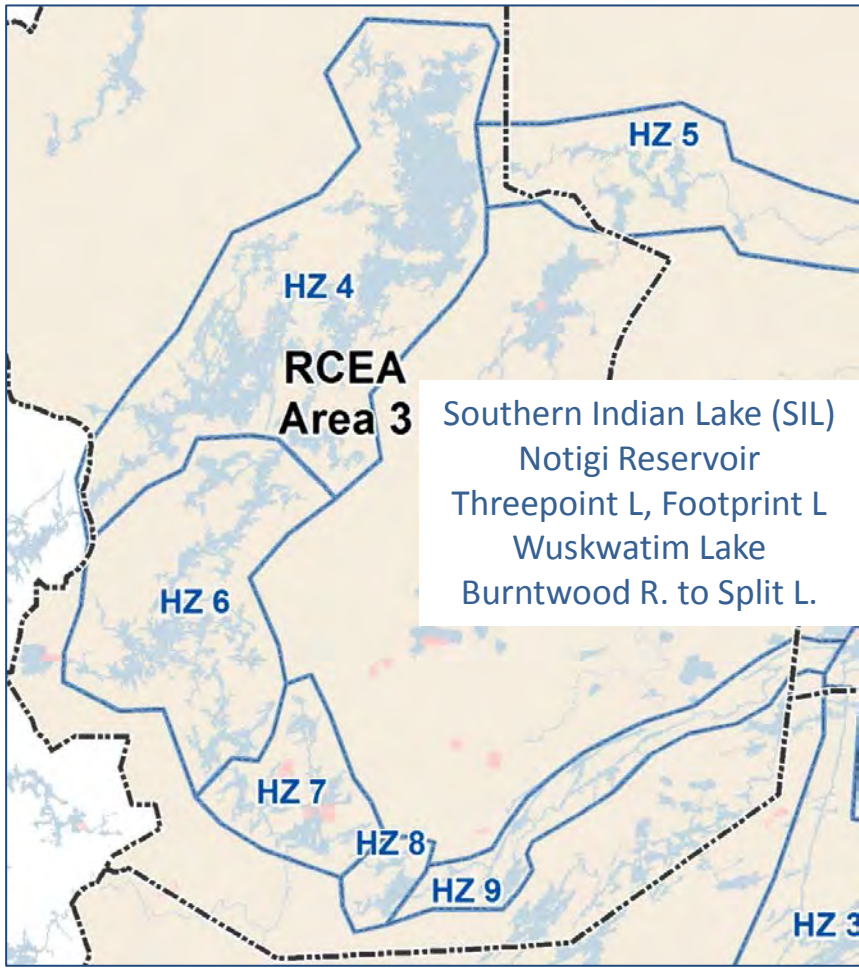
- Extensive erosion and peat disintegration post-CRD from SIL to Notigi particularly in Isset L. and areas upstream of Notigi L.
- From Notigi to Wuskwatim areas of larger erosion are generally less extensive and are scattered
- Below Wuskwatim areas of greater erosion are relatively few and localized, typically near major rapids
- Highest rates of erosion soon after CRD and generally declining over time, although some ongoing large erosion continues to occur, particularly above the Notigi CS



Area 3: Churchill R. Diversion

Erosion

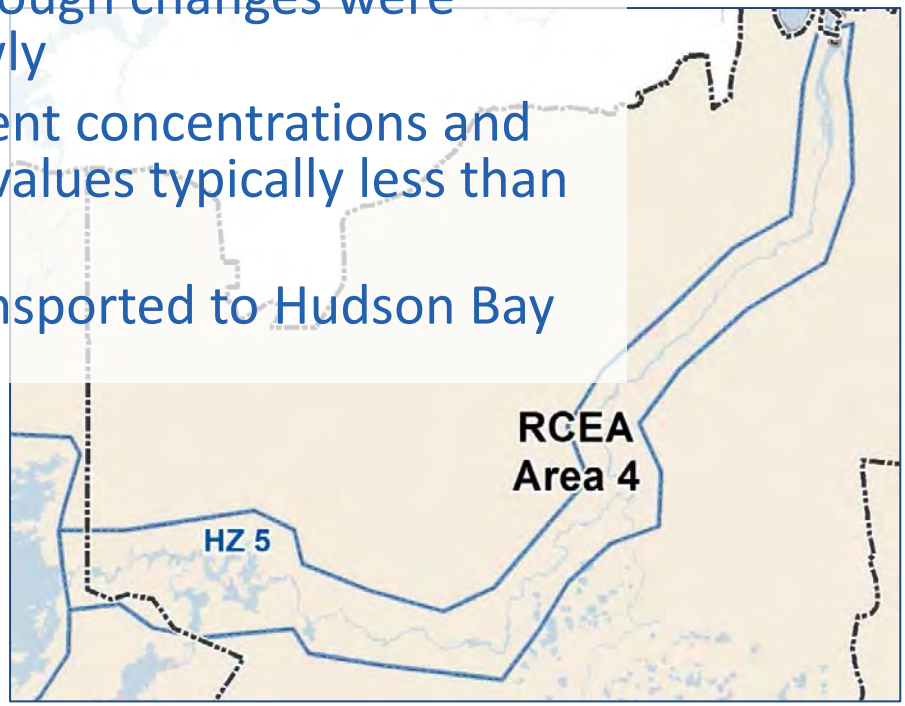
- Limited suspended sediment data from SIL to Notigi indicated an initial increase due to CRD but followed by a return to pre-CRD conditions
- Limited data from Notigi to Wuskwatim L suggest post-CRD turbidity is higher and suspended sediment is similar compared with pre-CRD
- Turbidity and suspended sediment generally increase downstream in riverine sections and decrease through lakes indicating deposition in the lakes
- Conclusions in previous studies of CRD effects (at Thompson) have varied but more recent monitoring suggests more turbid conditions post-CRD
- Much larger sediment load is delivered annually into Split L. post-CRD



Area 4: Lower Churchill River

Erosion & Sedimentation

- Channel width has decreased due to flow diversion
- At tributary mouths the size of alluvial fans generally increased due to exposure of river bottom and deposition
- Channel incision and some increased bank erosion were previously noted at the tributaries though changes were generally minor and progressing slowly
- Pre- and post-CRD suspended sediment concentrations and turbidity levels were low with mean values typically less than 10 mg/L or NTU
- Large reduction in sediment load transported to Hudson Bay



Conclusion

Erosion:

- Increased water levels due to hydro-electric created new shorelines in erodible materials causing increased rates of shoreline erosion
- Highest erosion rates soon after individual developments completed then decline over time as shorelines stabilize
- Long term erosion rates may be greater than existed prior to development
- Some areas of ongoing, large erosion persist in some reservoirs, particularly where erodible shorelines are exposed to large wind-driven waves
- Recent high water levels due to persistent high flows since about 2005 have caused some increases in erosion and concerns in communities

Conclusion

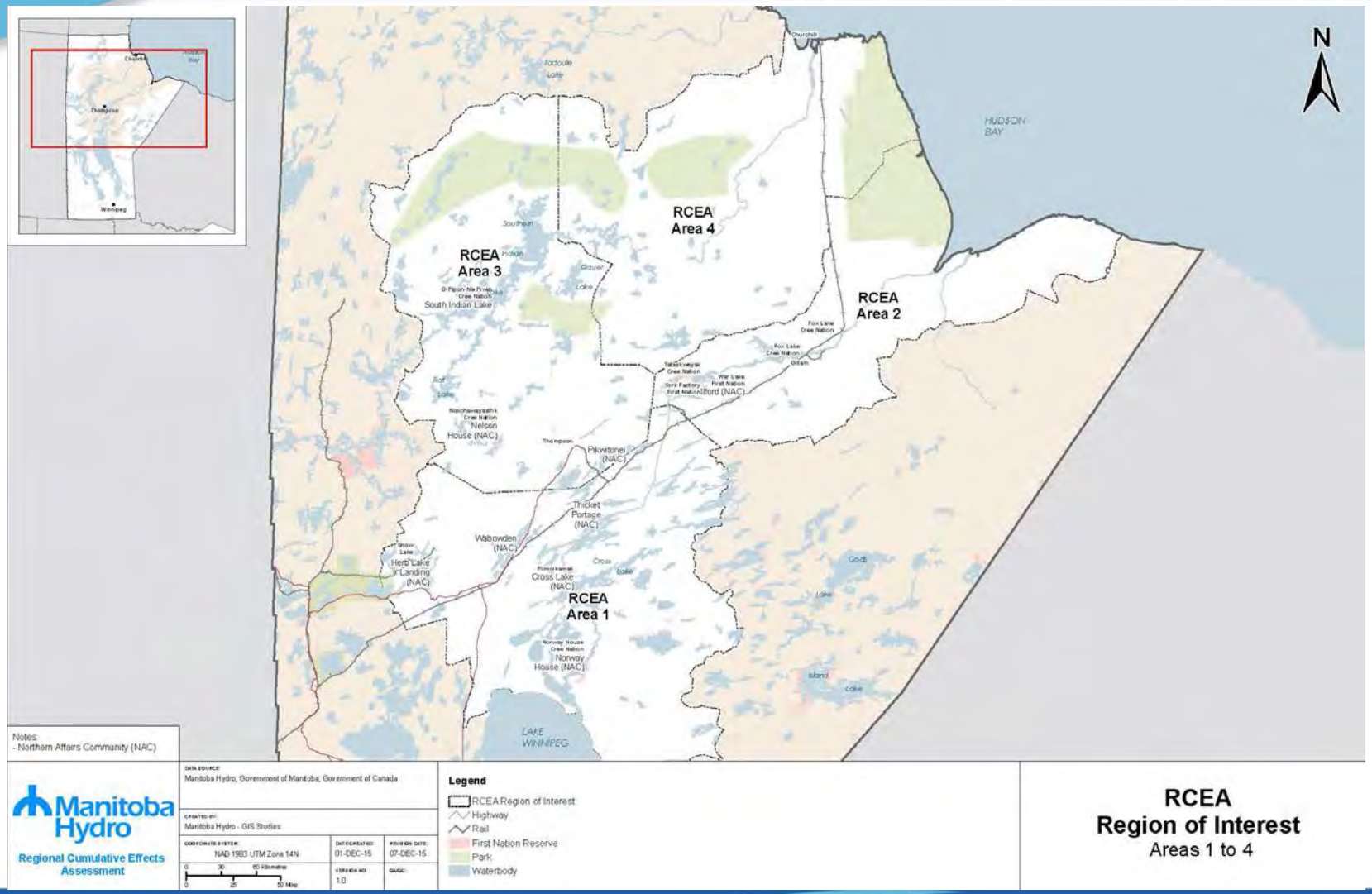
Sedimentation:

- Increases in suspended sediment / turbidity were more pronounced in early years after reservoirs were impounded and flows diverted
- In most areas considered, the more contemporary suspended sediment and turbidity conditions have been similar to pre-development conditions
- While erosion is greater in reservoirs than occurred before development, much of the resulting sediment tends to be retained within the reservoirs
- Flow diversions (2-MC, 8-MC, CRD) substantially altered patterns of sediment transport
- CRD significantly reduced the sediment load transported down the Churchill R., increased the load in the Burntwood and lower Nelson, and caused substantial sediment deposition in Split L.

RCEA Water Introduction

Megan Cooley
North South Consultants

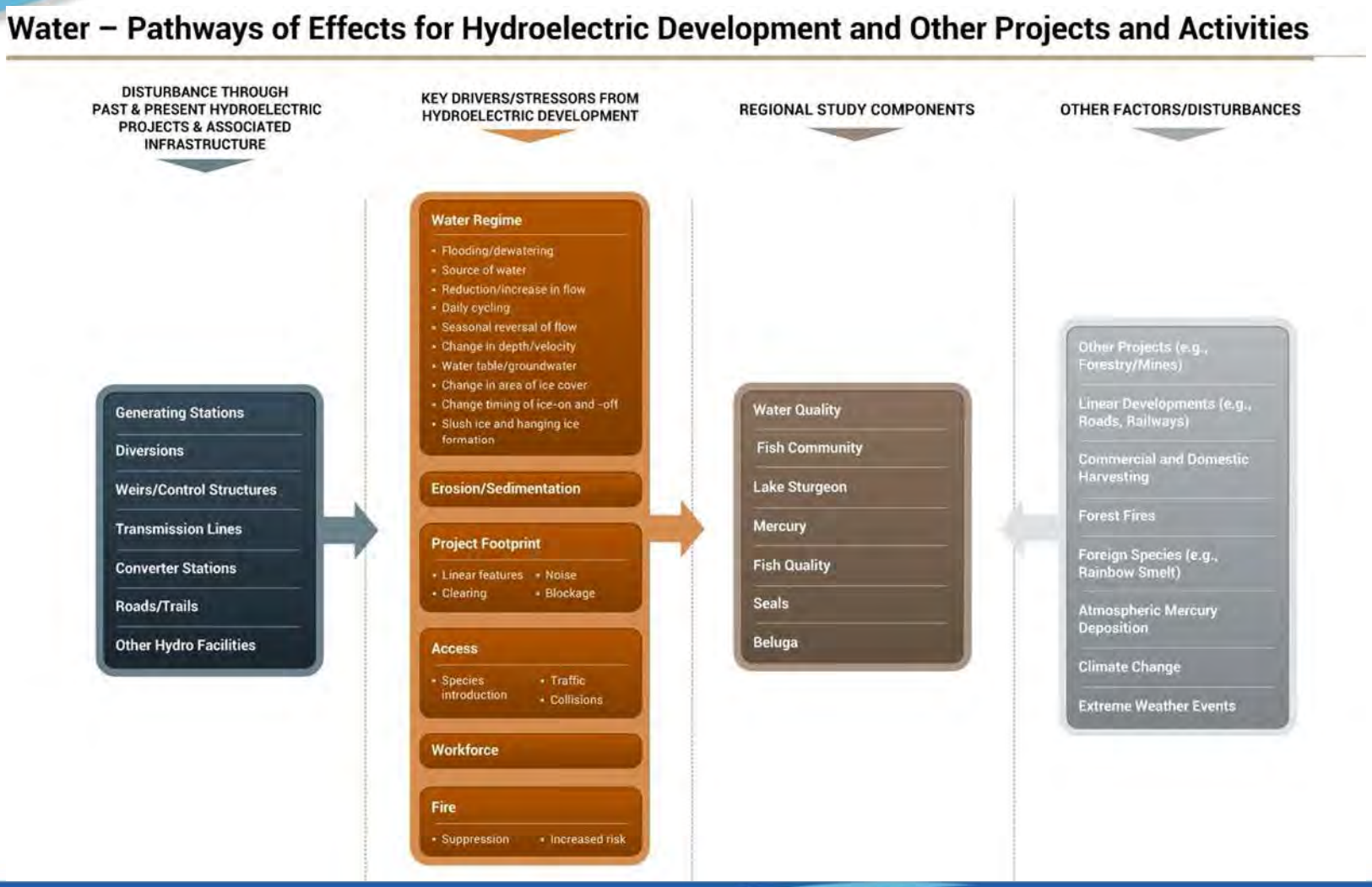
Region of Interest



Regional Study Components

Regional Study Component	Rationale
Water Quality	• Supports aquatic life • Important to people (potability, transport, recreation, aesthetics)
Fish Community	• Indicator of habitat changes • Important to commercial/domestic fisheries (focus on Walleye and Whitefish)
Lake Sturgeon	• Culturally important to First Nations • Species of conservation concern • Particularly sensitive to hydroelectric development
Mercury / Fish Quality	• Risk to human health (mercury) • Affects marketability of commercial catches • Important to acceptability of domestic fisheries to communities
Beluga / Seals	• Important to variety of stakeholders • Species of conservation concern (beluga)

Pathways of Effects



RCEA Water Quality

Megan Cooley
North South Consultants

Approach / Limitations

- Approach:
  - Compilation of available data and literature
  - Quantitative assessments: key indicators/metrics
  - Temporal and spatial comparisons (raw data)
  - Comparison to WQ guidelines
- Limitations:
  - Differences in sampling and/or analytical methods
  - No, or limited, pre-hydro data (and post-hydro data for some sites)
  - Episodic effects (e.g., high wind and erosion events) may not be captured.

Key Conclusions/Findings

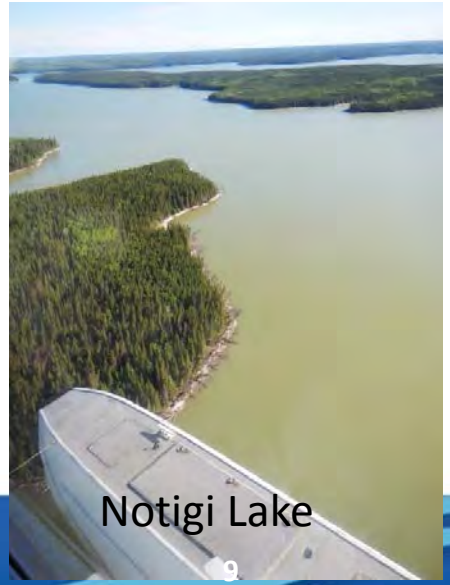
- Some effects were short-term and/or localized; others were wide-spread and permanent
- Differences reflect different pathways of effect (e.g., flooding vs. diversion)
- Post-hydroelectric monitoring indicates conditions suitable for aquatic life for most sites and time periods

Key Conclusions/Findings : Area 1

- Most temporal changes did not show any clear relationship to Kelsey or LWR
- WQ generally does not change notably along UNR from outlet of LWPG to Kelsey, and reflects the outflow from LWPG
- Some temporary changes observed or likely to have occurred in some areas
  - e.g., ↑ turbidity due to erosion
  - ↓ DO in Cross Lake

Key Conclusions/Findings : Area 3

- Permanent changes relate to the diversion of the UCR water (e.g., which was softer and had lower dissolved solids), into the Rat/Burntwood River system
- Temporary effects generally related to flooding (e.g., ↑ nutrients) – biggest effect in Notigi Lake during impoundment.
- Water clarity ↓ in some areas due to erosion/resuspension (e.g., SIL Area 6).



Key Conclusions/Findings : Area 2

- Absence of pre-hydroelectric data and construction of multiple developments affect ability to assess effects
- CRD/LWR: key change observed reflects the diversion of the UCR (which differed prior to CRD – e.g., was softer).
- Kettle – North Arm of Stephens Lake:
  - responses typically associated with flooding (↑ nutrients, ↓ O2, and ↓ clarity)
- Kettle, Long Spruce, and Limestone - main flow of LNR
  - negligible, short-term, and/or effects not captured in monitoring programs

Key Conclusions/Findings: Area 4

- Changes in WQ largely reflect the reduced influence of UCR
  - some WQ metrics differed from local drainages before CRD
- Key changes were also observed upstream at Missi Falls
  - e.g., ↑ hardness
  - effects of CRD on inflow contributed to observed downstream changes


Lower Churchill River

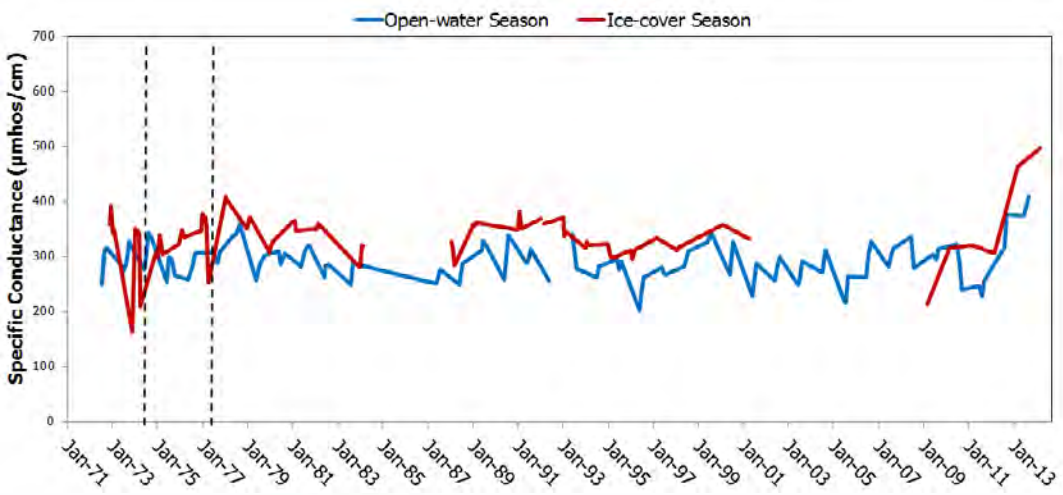

Northern Indian Lake

New Findings

Extension of period of record/new data analyses reveals:

- Some differences in conclusions relative to earlier assessments
  - e.g., no change in TP for a number of sites
- Changes (or lack thereof) since last detailed analyses (1993+)
  - e.g., > turbidity SIL, BR, & Split Lake; > conductivity NR;
- Some very recent changes
  - e.g., > conductivity UNR
- WQ pattern along UNR
- i.e., reflects LWPG outflow
- Relative influence of UNR on LNR WQ
  - proportional contribution effect

Cross Lake



Importance to Communities

- Water clarity decreased in some areas post-hydro
  - e.g., Area 3
- Some changes may have affected aquatic life
  - e.g., ↓ DO at Cross Lake
- Where phosphorus ↑, effects were temporary
- Post-hydro monitoring indicated conditions suitable for aquatic life for most sites and time periods


Cross Lake


Nelson House

RCEA Fish Community

Richard Remnant
North /South Consultants

Approach / Limitations

- Approach
  - Compilation of available data, re-analysis into relevant time periods for quantitative comparisons
  - Quantitative assessments: indicators/metrics, index gillnetting
  - Focal species: Lake Whitefish, Walleye
- Limitations
  - Majority of the ROI has no little to no pre-hydro data
  - Changes in sampling methods/locations often preclude direct comparison of data

Key Conclusions/Findings: Area 1

- Playgreen Lake:
  - no comparable pre- data; comparison between 1980s and current data shows an > in total catch and Walleye CPUE, some shift in species composition
- Cross Lake:
  - small amount of pre-LWR data; adverse effect on CPUE partially mitigated by the weir but whitefish have not recovered
- Sipiwesk Lake:
  - small amount of pre- and post-LWR data; some shift in species composition

Key Conclusions/Findings: Area 2

- Split Lake:
  - no pre- data; comparison of 1980s to current data shows total catch and whitefish CPUE is ↓; Walleye CPUE is ↑
- Stephens Lake:
  - no pre-hydro data; impoundment by Kettle GS has caused large changes in FC in both river and lake habitats
- Nelson River below Kettle GS:
  - each station resulted in changes in forebay FC and changes in movements; Brook Trout ↓; Cisco also ↓

Key Conclusions/Findings: Area 3

- SIL Area 4:
  - whitefish are old, slow-growing, small, with low condition factors, although whitefish CPUE remains highest of SIL areas
- SIL:
  - fairly consistent SIL-wide ↓ in CPUE of total catch, whitefish and Walleye; possible causes are poor egg survival due to drawdown, emigration, sedimentation, lack of food, and fishery
- CRD route:
  - no pre-CRD data; effects since 1980s include shifts in species comp (↓ whitefish, ↑ Walleye), and blockage of US movements at Notigi

Key Conclusions/Findings : Area 4

- No pre-CRD data
- Substantial reduction in fish habitat but fish communities remain despite reduced flows and habitat loss
- Fish CPUE in upstream lakes are somewhat ↓ than that of nearby off-system lake
- Fish CPUE in area above Churchill Weir has recently ↑, largely driven by whitefish

New Findings

- Comparisons of quantifiable FC metrics for different time periods (where data were available) had not previously been conducted for most areas
- New findings include:
  - An increase in the frequency of occurrence of Walleye and a decrease in whitefish in many waterbodies from the 1980s to current

Importance to Communities

- The abundance of key commercial species has changed
  - Walleye (currently important to commercial fisheries) is presently ↑ in many areas
  - Whitefish (historically important species to domestic fisheries and preferred by Elders) is ↓ in many areas

RCEA - Fish Quality

Richard Remnant
North/South Consultants

Approach / Limitations

- Approach
  - Palatability Indicators: acceptability to harvesters and results of scientific tests
    - e.g., U of M studies
  - *T. crassus* Indicator: RI expressed as the number of cysts per 100 lb (45.4 kg) of dressed commercial whitefish
    - e.g., FFMC protocols
- Limitations
  - Fish taste is very subjective
  - No pre-hydro studies on fish palatability so comparisons can only be made with off-system lakes
  - Pre-hydro RI data available only for few waterbodies
  - Quantity and quality of data inconsistent

Key Conclusions/Findings

- Palatability
  - No known scientific study directly linking changes to palatability with hydro development in ROI
  - However, hydro development can cause changes to fish diet, water quality, algae, and growth rates which can all affect taste and texture
  - Tests conducted by DFO on fish from Playgreen Lake:
    - all fish passed
  - Tests done by U of M at Nelson House, Split Lake, York Landing and Bird:
    - no statistically significant differences between on- and off-system fish
  - Many FN members still feel that taste and texture have changed

Key Conclusions/Findings

- *T. crassus* rate of infestation (RI) in Lake Whitefish
  - Increased RI in several waterbodies (e.g., SIL), but not others (e.g., Wuskwatim Lake)
  - Pathways of effect vary between waterbodies, but include changes to abundance or distribution of any of the three hosts for the parasite

Importance to Communities

- Palatability affects domestic consumption
  - resource users shift harvesting to unaffected lakes
- *T. crassus* RI affects marketability of whitefish and viability of commercial fisheries

RCEA - Lake Sturgeon

Cam Barth
North/South Consultants

Approach / Limitations

- Purpose to evaluate/assess how populations have changed over time relative to cumulative effects of hydroelectric development on Nelson, Burntwood, and Churchill rivers
- Approach
  - Three indicators (abundance, growth and condition factor) were selected to quantify change over time
  - Compilation of available data
  - Semi-quantitative assessments based on historical and contemporary data sets
- Limitations
  - Data sets were not comparable; sampling methods/locations often preclude direct comparison of data
    - i.e., aging adult sturgeon
  - Majority of ROI has little to no pre-hydro data

Area 1

- Lake Sturgeon (LS) historically abundant
  - Harvest records date back to 1832 (isinglass to HBC)
  - Commercial fishery (1902 – 1992) closed and opened several times until permanently closed in 1992
  - Each time it reopened, harvest quantities were substantially less than the previous period
  - Domestic fishing also documented
- LS numbers low prior to Kelsey and Jenpeg based on commercial production
- Populations remain in Area 1
  - stocking helping recovery

Area 1

- Key conclusions and data gaps:
  - Impossible to assess impact of hydro on LS in Area 1 given lack of data and confounding effect of harvest
  - There are not enough fish to know how hydro has/is affected/ing their habitat
    - i.e., can't determine effect on spawning habitat if there are no spawning fish

Area 2

- Commercial harvest thought to be lower relative to Area 1
- Abundance prior to Kelsey, Kettle, Long Spruce and Limestone unknown
- Since 1985, LS in Area 2 have received considerable study
- Populations remain, but at low abundances, with the exception of DS of the Limestone GS
- For similar reasons as Area 1 impacts of hydroelectric development on LS cannot be quantified

Area 3

- This area (both historically and currently) is not known to support a LS population
- Data discussed in the RCEA were from upstream of Opachuanau Lake
- CRD likely did not affect LS in Southern Indian Lake or other parts of Area 3 as they were either not present or existed at low abundances prior to hydro development

Area 4

- Based on limited information abundance of LS in Area 4 was thought to be low prior to 1976
- After CRD, LS only present in a short reach which includes the confluence with the Little Churchill River
- Similar to Areas 1 and 2 impacts of hydro development cannot be quantified

Overall Summary and Data Gaps

- Hydro development significantly altered LS habitat along both Nelson and Churchill rivers
  - How habitat alterations affected populations is poorly understood given that in most cases LS were nearly extirpated/low abundance prior to developments
  - How recovery of populations is being affected by hydro remains unknown
    - barriers to movement, entrainment, water level fluctuations, changes to spawning habitat, would all affect LS
  - How productive capacity of these rivers has been affected by hydro remains unknown

Importance to Communities

- Sturgeon are important to communities for several reasons including:
  - Important to the First Nations from a cultural perspective
  - Important to the First Nations from an historical perspective:
    - commercial sale of sturgeon including isinglass was an important economic activity
  - Important as part of their domestic harvest
    - sturgeon are considered a delicacy

RCEA - Fish Mercury

Wolfgang Jansen
North/South Consultants

Approach/Limitations

- Fish mercury data from various sources (DFO, CFIA) were compiled into a single database for all of Manitoba
- Metric: total mercury [Hg] in axial muscle
- since 1969: >54,000 analyses of [Hg] for 23 species from >200 waterbodies in the ROI
- 24 focal waterbodies: on-system; reference
- Focal species: Lake Whitefish (17%), Walleye (30%), and Northern Pike (32%) account for almost 80% of the data
- Quantitative assessment: standard means
- Comparison to benchmark: Health Canada standard of 0.5 ppm for retail fish

Approach\Limitations

- The main findings regarding effects of hydroelectric development on fish [Hg] are well established and remain unaffected by existing data gaps:
  - The primary data gap is lack\ paucity\nature of pre-development data for all waterbodies
  - For most waterbodies
    - sampling frequency is insufficient (mostly ≥3 year interval)
    - fish sample size is often too low to reconstruct a timeline of [Hg] that includes onset and duration of maximum [Hg]

Key Findings

- Standard mean [Hg] increased rapidly after flooding to reach a short-lived maximum
- [Hg] then declined
  - relatively quickly at first, more gradually later
- Magnitude and duration of increase varied depending on:
  - amount of flooding
  - fish's trophic position

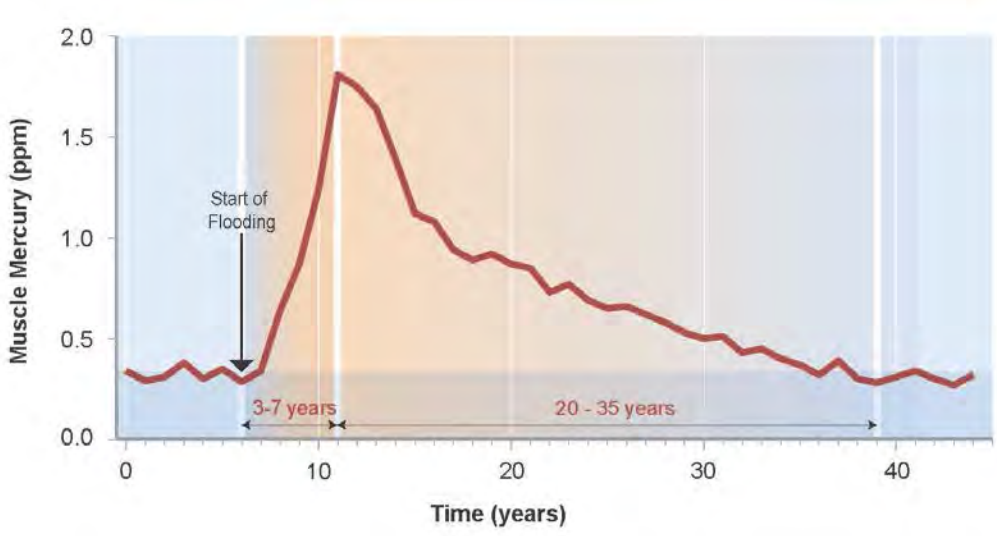
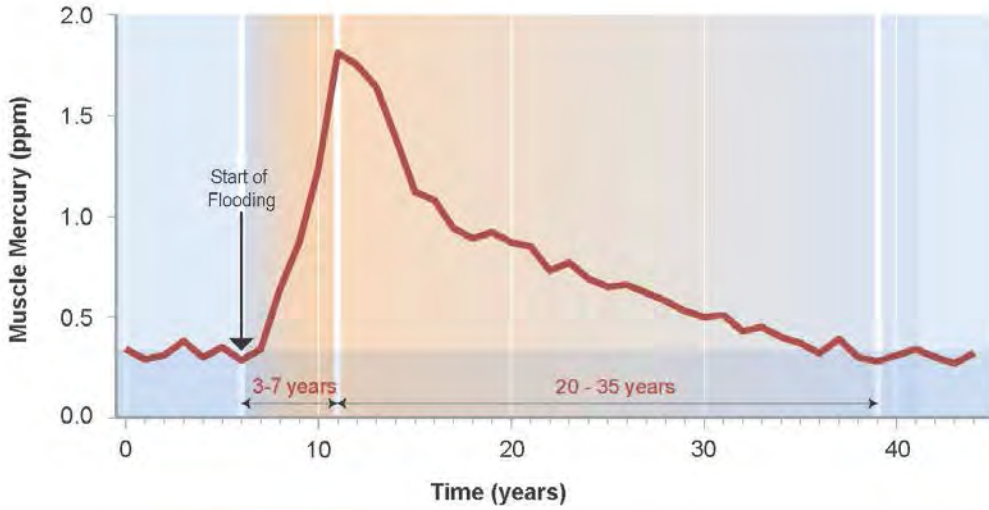


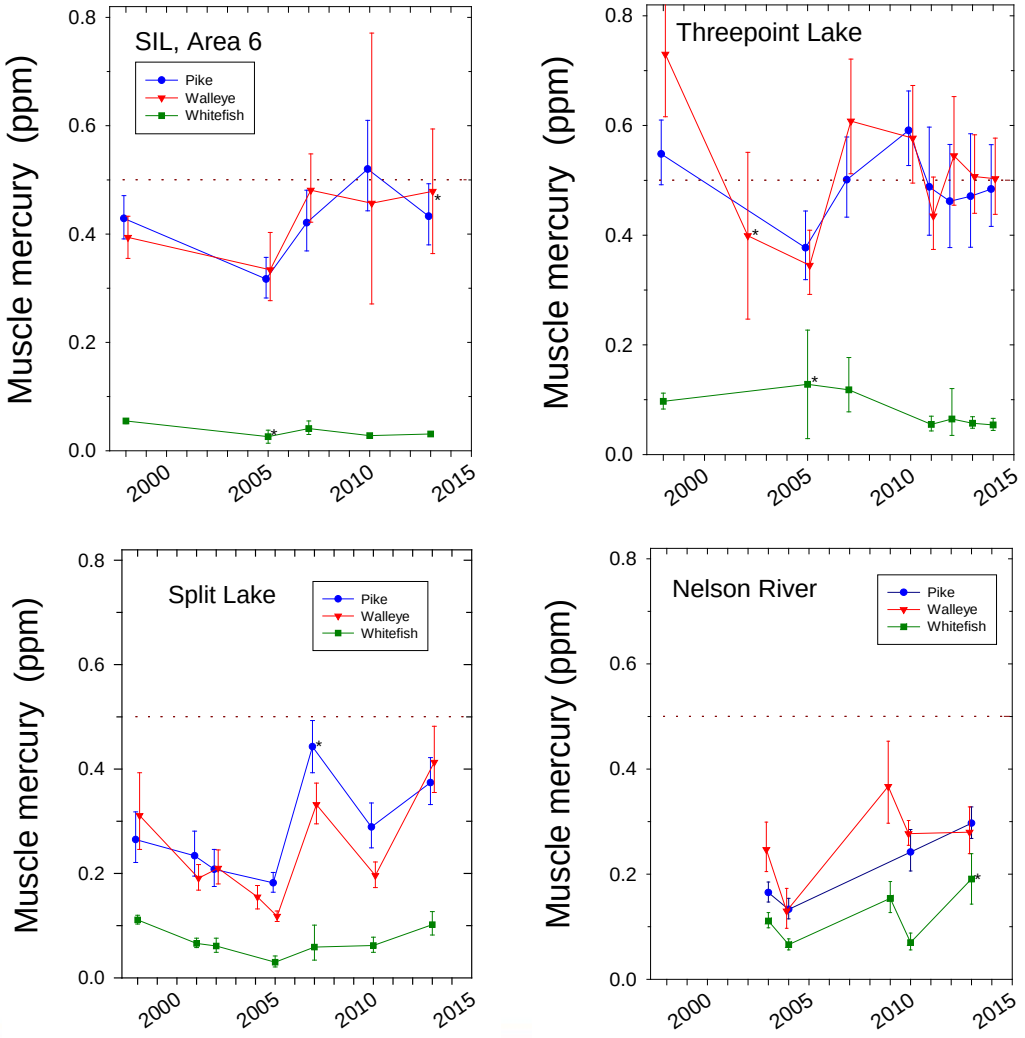
Figure 1: Generalized timeline of changes in fish [Hg] based on results from reservoirs and flooded lakes in ROI

Key Findings

- Maximum mean [Hg] in piscivores from extensively flooded lakes reached ≥2 ppm;
- Maxima of other species did not exceed 0.6 ppm and remained ≤0.3 ppm in whitefish;
- Maxima represented a 1.4-8.7 fold increase in concentrations compared to pre-flood years;
  - Maxima were usually reached within 3-9 years post-flood
    - in whitefish, pike, and Walleye
  - Mean [Hg] in 2002-2014
  - Were mainly below 0.5 ppm Health Canada standard for retail fish
    - But generally higher than from off-system lakes



New Findings



- Mostly statistically significant increases in [Hg] have been observed for on-system waterbodies since 2005, when minimum concentrations for the entire record were reached
- The increases occurred consistently in pike and Walleye
- Most of whitefish populations did not respond similarly or had small sample sizes for post-2005 years

Figure 2: Mean (95% CL) length standardized [Hg] of Pike, Walleye, and whitefish from SIL-Area 6, Threepoint Lake, Split Lake, and the lower Nelson River for 1998-2014.

New Findings

- Post-2005 increases in fish [Hg] were associated with several years of low flows in Churchill/Nelson River drainage for most of the open water season, followed by exceptionally high flows (water levels) in 2005/2006
- Re-flooding of exposed shorelines and fringing wetlands flushes existing MeHg and increases mercury methylation rates
- Increases in environmental [Hg] after a transient rise in water levels are known from both regulated and non-regulated systems in scientific literature;
- Resent increasing trend in fish [Hg] in northern Manitoba is being closely monitored

Figure 3: Split Lake water levels (m) in years 2002-2005 compared to maximum and minimum levels for the entire record (1954-2014); Source: EC Wateroffice website

Importance to Communities

- Commercial fisheries have been closed for several lakes throughout ROI in 1970s due to 'elevated' fish [Hg]
  - some individuals with >0.5 ppm
- Mercury was translated as 'metal poison' in Cree and consumption advisories were issued
- As a result, many northern First Nation communities reduced their consumption of fish and even today express anxiety about eating fish from many waterbodies

Questions?

RCEA – Seals and Belugas

Chandra Chambers
North/South Consultants

Approach / Limitations

- Approach
  - Compilation of available data, re-analysis into relevant time periods for quantitative comparisons
  - Quantitative assessments:
    - aerial/boat-based surveys (population/density data)
- Limitations
  - Majority of ROI has no little to no pre-hydro data
  - Changes in sampling methods/locations often preclude direct comparison of data

Key Conclusions: Area 2

- Seals:
  - Potential displacement of haul-out sites further d/s
    - ↑ discharge; water level changes
- Beluga:
  - Potential changes in estuary use unknown

Key Conclusions: Area 4

- Seals:
  - Potential ↑ abundance in lower Churchill River
    - ↓ flow/water levels;↑ haul-out sites
  - Minor shift (<1 km) in haul-out sites downstream
- Beluga:
  - Potential changes in estuary use unknown
  - No detectable change in distribution as a result of the Churchill Weir

New Findings

- No additional information available for seal or beluga populations in ROI

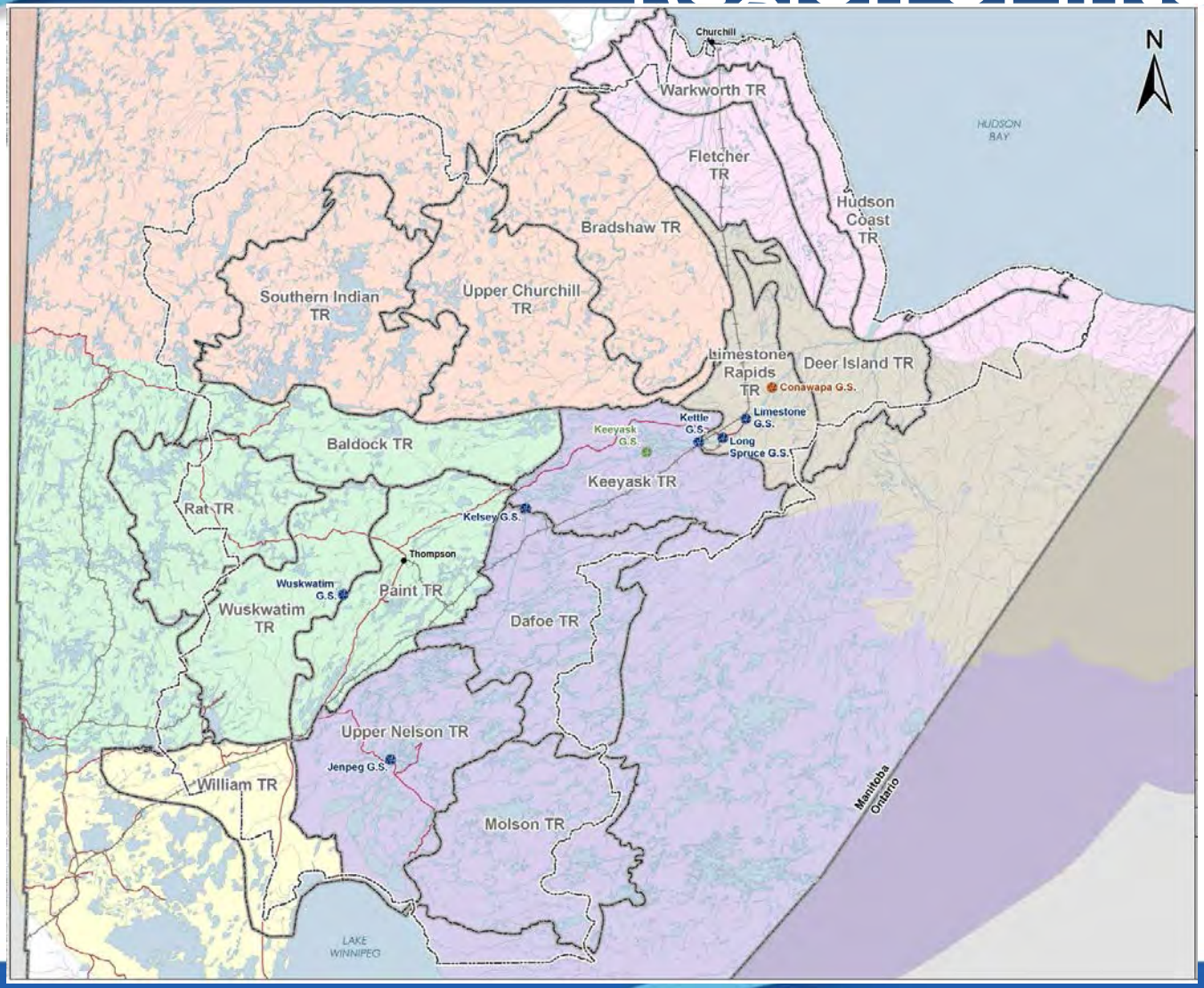
Importance to Communities

- Seals:
  - Domestic harvests within ROI (minimal)
- Beluga:
  - Domestic harvests within, and outside of ROI
  - Tourism (Churchill)

RCEA – Land Introduction

James Ehnes
ECOSTEM

Region of Interest

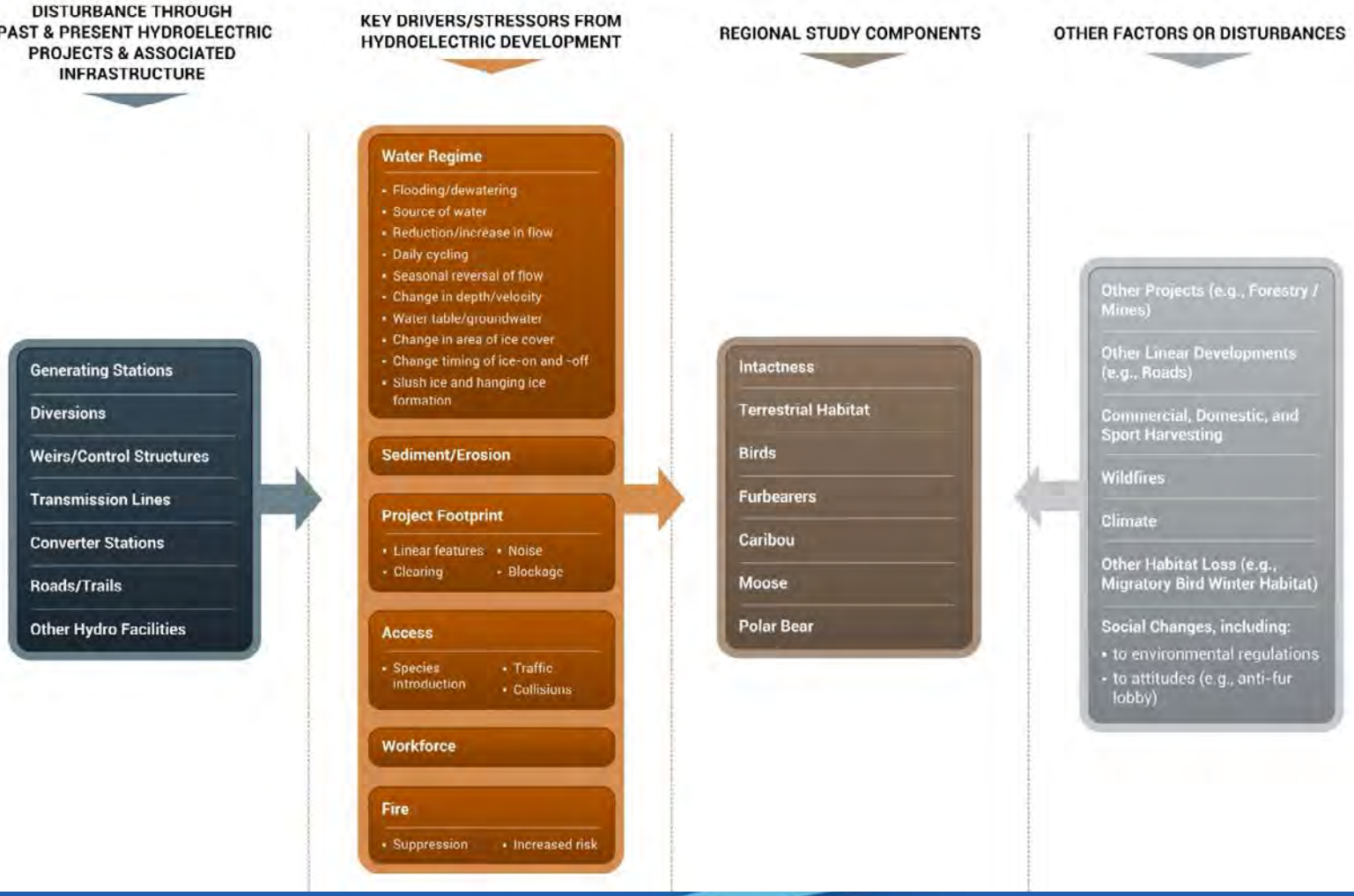


Regional Study Components

Regional Study Component	Rationale
Terrestrial Habitat	• Some habitat especially important for social and ecological reasons • Human induced changes key pathway for terrestrial ecosystem
Intactness	• Overall indicator of cumulative effects on ecosystem and on assessment and monitoring of wildlife habitat
Birds	• Important to resource harvesters (waterfowl) • Some species rare (colonial waterbirds)
Furbearers	• Important to communities for income and food
Caribou	• Sensitive to disturbance • Species of conservation concern
Moose	• Important to First Nations
Polar Bear	• Species of conservation concern

Pathways of Effects

Land – Pathways of Effects for Hydroelectric Development and Other Factors or Disturbances



RCEA – Intactness

James Ehnes
ECOSTEM

Approach / Limitations

- Approach
  - Map existing human infrastructure in Region of Interest (ROI)
  - Subdivide vast ROI (198,300 km2) into 17 regions
  - Report on how human footprint, linear density and undisturbed habitat blocks (core areas) changed over time
- Limitations
  - No major ones at regional level
  - Little published Aboriginal traditional knowledge or local knowledge for effects on intactness

Key Conclusions / Findings

- Regional cumulative effects of hydroelectric and other development on intactness are low in ROI
  - Human infrastructure footprint is small (1.2% of ROI land area)
    - 82% from hydroelectric development
  - Linear density is low (0.08 km of linear features per km^2 of ROI)
    - 33% from hydroelectric development
  - Core areas larger than 1,000 ha still cover 99% of land area

- Regional cumulative effects are low because:
  - Size of combined human footprint is small
  - Most footprints are situated near other existing developments and/or natural features that had already fragmented regional ecosystem

New Findings

- Cumulative effects on intactness are low in each of 17 terrestrial regions
  - Total human infrastructure footprint ranged from 0.02% to 3.8% of regional land areas
- Core area loss was highest in south and central terrestrial regions
- Effects much higher in localized areas
  - e.g., around generating stations

Importance to Communities

- “Specifically, our lands and waters should be whole and healthy, both of which are the prerequisites of a peaceful existence. This concept of wholeness is expressed in one simple sentence, “everything is connected.”” (FLCN 2012)
- Hydroelectric development seen to increase stresses on plant and animal populations and possibly increase resource harvesting by outsiders
- Although fragmentation in ROI is relatively low, areas affected are generally those most extensively by resource harvesters

RCEA - Terrestrial Habitat

James Ehnes
ECOSTEM

Approach

- Terrestrial habitat is ecologically important.
- Also an umbrella indicator for ecosystem health and components not assessed
  - Most of the wildlife RSC assessments are based on terrestrial habitat changes as there is limited historical population and other data
- Regional cumulative effects assessment focused on ecosystem diversity, wetland function and shoreline ecosystems
- Generally evaluated combined effects of hydroelectric and non-hydroelectric development since these often cannot be separated
  - particularly where features are in same general area

Limitations

- Little published Aboriginal traditional knowledge or local knowledge regarding effects on terrestrial habitat
- Numerous data limitations given the enormous size of the overall RCEA mapping area (585,000 km^2), amount of shoreline that was mapped (30,000 km) in time available
- While these limitations do not affect overall conclusions
  - they reduce what can be reported for specific river reaches

Key Conclusions / Findings

- Over all terrestrial regions, cumulative effects of hydroelectric and other development on terrestrial habitat have been low for most indicators
  - About 1% of all native habitat in ROI has been lost
  - Regional effects generally higher in southern and western portions of ROI
  - Reasons for low effects similar to those for intactness
  - Effects much higher in localized areas
- Hydroelectric development dramatically altered large river shoreline ecosystems
  - Effects are ongoing in many areas

New Findings

- Compared with what was there before hydro, native habitat loss ranged from 0.02% to 3.6% of total historical area in each region
  - Hydroelectric development contribution to total habitat loss in a region ranged from none to 99%
- Several habitat types had high magnitude effects or were completely lost due to effects on large rivers
    - e.g., shrub vegetation on riparian peatlands

New Findings

- Dramatic effects on 3 large river ecosystems:
  - Highly altered bank and beach characteristics
  - Much less marsh and riparian peatland
  - Wide bands of tall shrub less frequent
  - Shore debris became widespread and heavy in places
  - Effects vary considerably by reach

Importance to Communities

- Hydroelectric development effects were much higher in some local areas than regionally
  - Particularly for largest river systems
  - Also varies within large river system
- Strong sense of dislocation and disorientation as areas that had been well-known became unrecognizable
  - Dramatic changes in shoreline ecosystems a contributor
- Resource harvesting areas have been lost

RCEA – Wildlife

Rob Berger
Wildlife Resource Consulting Services

Manitoba

WATERFOWL

Approach/Limitations

- Approach
  - Regional and local changes in amount and distribution of habitat
  - On-system and regional effects identified
- Limitations
  - Population data not available at a localized scale, so population could only be a secondary indicator behind habitat
  - Very few published ATK or local knowledge reports in some areas
  - Little information on waterfowl before hydroelectric development
  - Difficulty in consistently mapping waterfowl habitat
  - Some monitoring data from major projects not yet available

Key Conclusions / Findings

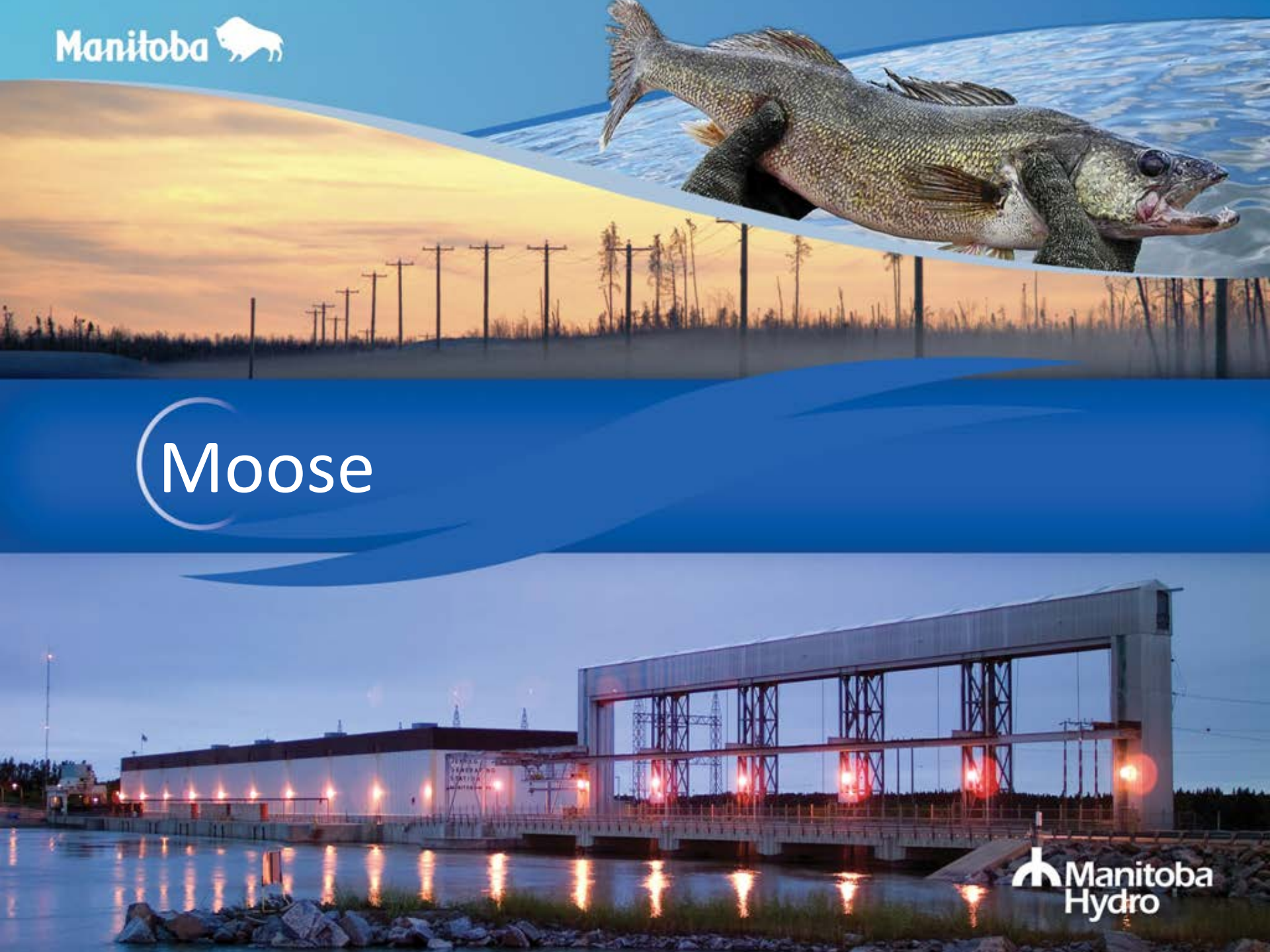
- Overall impact on waterfowl population is low to moderate
  - Local populations affected
  - Many regulated rivers important staging, not breeding areas
- Amount of regional habitat decreased by about 2% in ROI

New Findings

- Effects on waterfowl habitat largely described by previous ATK
- Populations appear to be stable
- Shift in habitat use by local waterfowl populations
- Reduced water-level variation, continued erosion, and reversed seasonal flows reduce potential for marsh habitat regeneration
- Over time, habitat has re-developed in some locations
  - e.g., N. Indian L. on dewatered lower Churchill

Importance to Communities

- Reduced habitat has caused a shift in some local populations of waterfowl
  - Substantially lowered harvest opportunities in some areas
    - e.g., Southern Indian Lake, Outlet Lakes
  - Regional waterfowl populations appear to be stable in northern Manitoba


Manitoba
Moose
Manitoba Hydro

Approach/Limitations

- Approach
  - Regional and local changes in five indicators were assessed
  - On-system and off-system effects identified
- Limitations
  - Limited population size and recruitment for portions of ROI (i.e., GHAs 1,2,3 and 3a)
  - Limited quantitative information on moose harvest
  - Few published ATK or local knowledge reports

Key Conclusions / Findings

- Populations in ROI generally stable
- 1% of moose habitat in ROI lost
  - Mostly due to hydroelectric development
- Disease, harvest and predation also contribute to population changes
- Changes to shorelines have reduced moose habitat and limited access due to debris

New Findings

- On-system habitat changes revised for Rat-Burntwood, Nelson and Churchill rivers
- Fire suppression and access may be important influences in more southerly terrestrial regions

Importance to Communities

- Northern moose population mainly OK
- Degradation of riparian areas
- Changes in habitat use and movement patterns
- Increased harvest pressure and loss of harvest opportunities

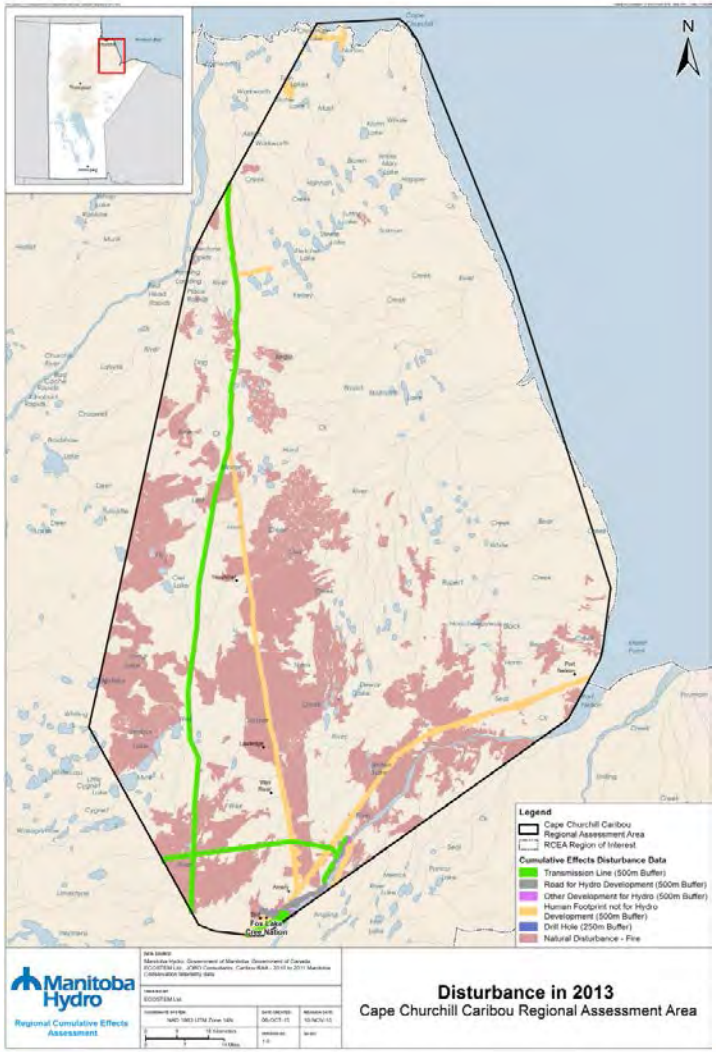

Manitoba
Coastal Caribou
Manitoba Hydro

Approach/Limitations

- Approach
  - Three indicators used to assess effects of hydroelectric development and other forms of human-caused disturbance
  - Caribou ranges = RAAs
- Limitations (in pre-hydroelectric period)
  - Lower certainty in population estimates
  - Natural Disturbance (as % of RAA)

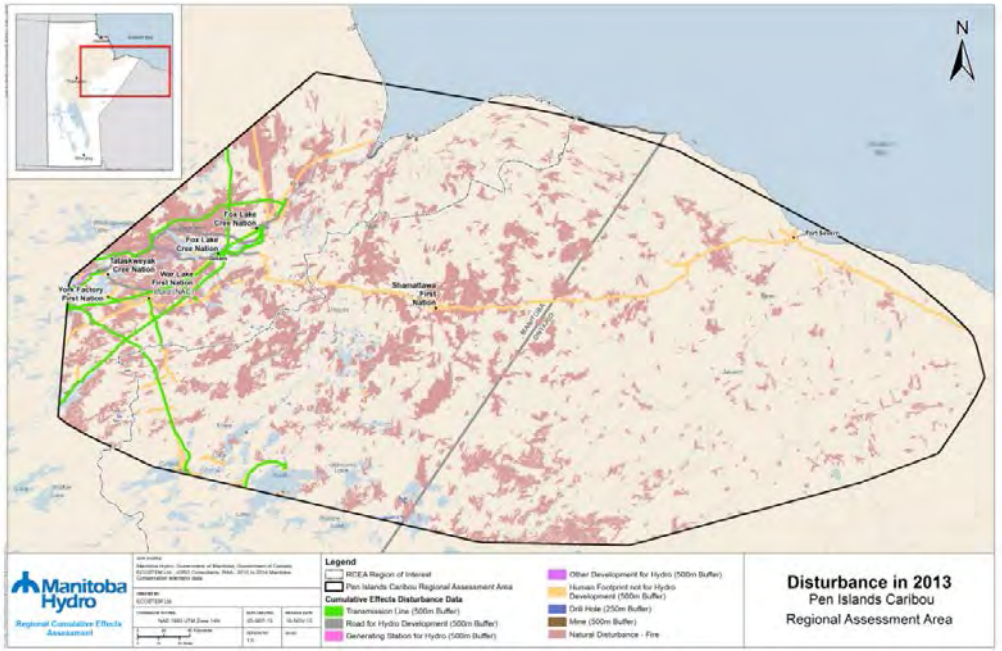
Key Conclusions / Findings

- Cumulative effects appear to be low
- Low levels of fragmentation and disturbance in both RAAs
  - Hydroelectric development contributes roughly half of linear features



New Findings

- Pen Islands herd exhibiting some changes in range use characteristics
- Most range disturbance due to fires



Importance to Communities

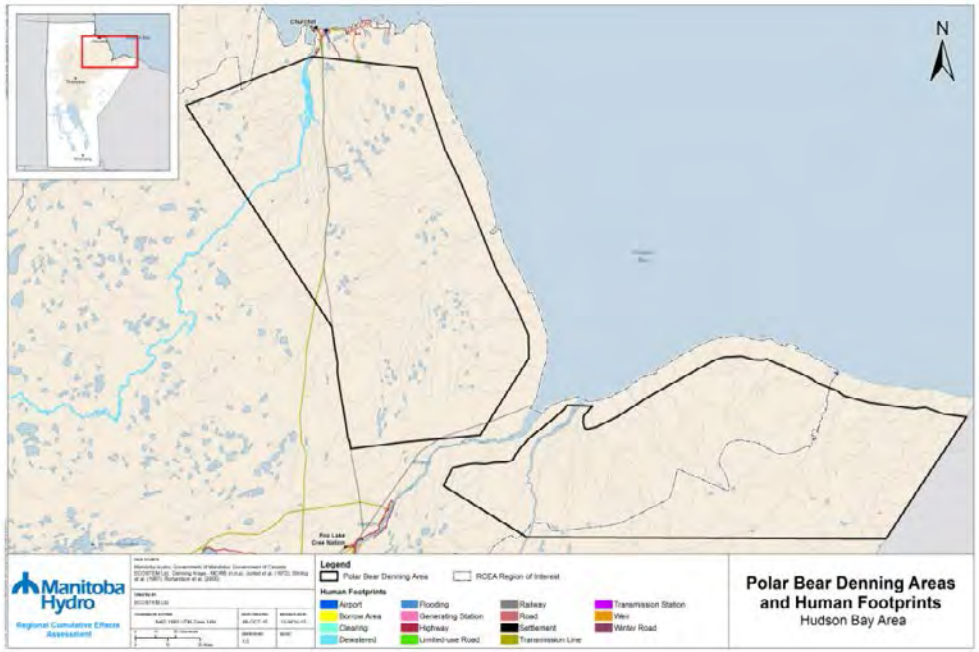
- Caribou populations remain available for harvest
- Some avoidance of hydroelectric generating stations expected
- Summer resident caribou at increased risk of habitat loss


Manitoba
OTHER RSCs
Manitoba Hydro

Colonial Waterbirds

- Cumulative effects of hydroelectric development low
  - No appreciable effect
- Colonial waterbirds still abundant in ROI
- Some nesting colony habitat flooded, other potential habitat created
  - Suitable nesting locations found elsewhere in ROI

Polar Bear

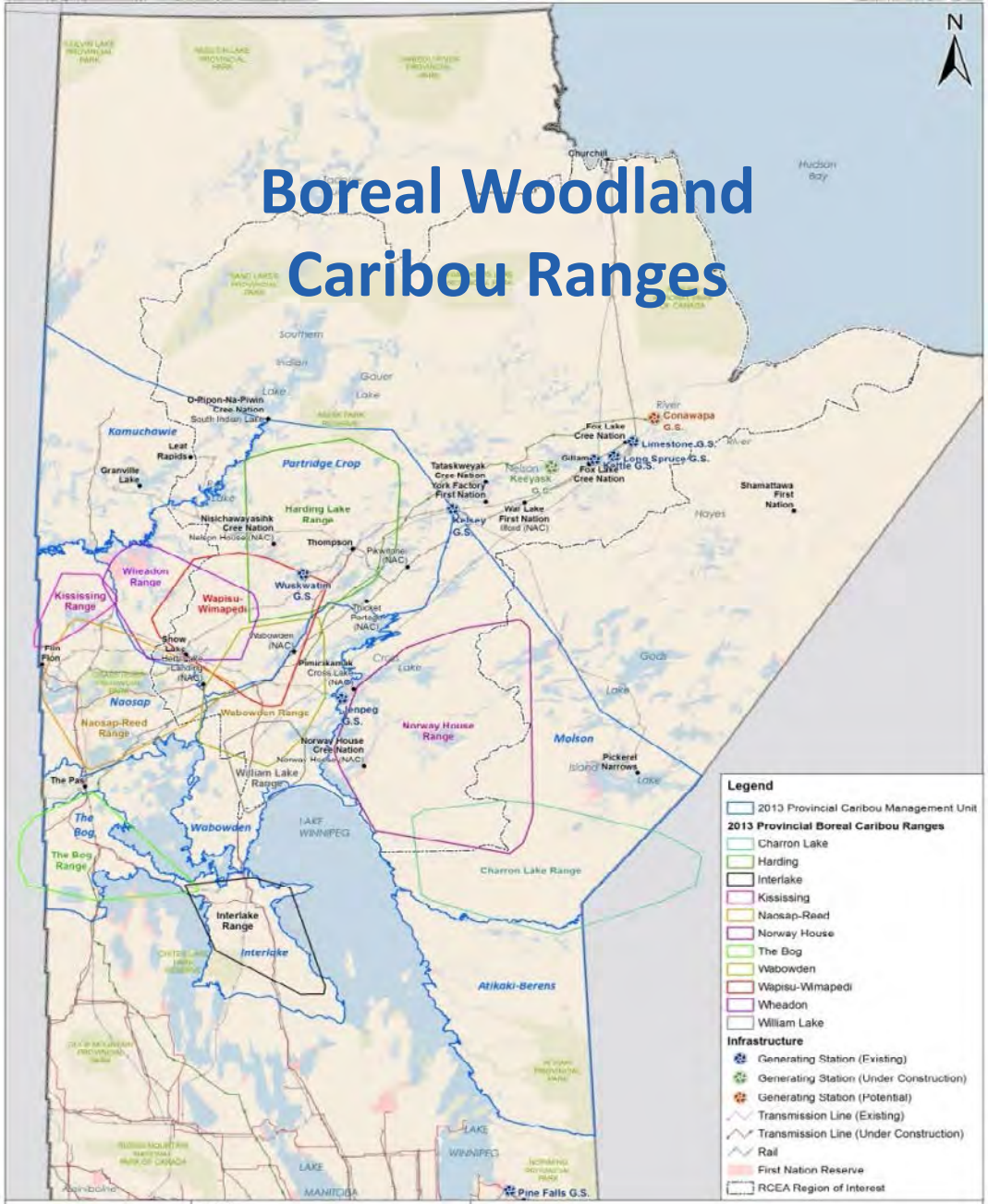


- No apparent links between fluctuations of Western Hudson Bay population and hydroelectric development
- No appreciable effect on the population

RCEA - Boreal Woodland Caribou

Doug Schindler
Joro Consultants

Boreal Woodland Caribou Ranges



Manitoba Hydro
Regional Cumulative Effects Assessment

DATA SOURCE
Government of Canada, Province of Manitoba
Manitoba Hydro: Provincial Boreal Caribou Management Units and Provincial Boreal Caribou Ranges obtained from the Manitoba Boreal Woodland

CREATED BY: Jono Consultants Inc.

COORDINATE SYSTEM	DATE CREATED	REVISION DATE
NAD 1983 UTM Zone 14N	29-MAY-15	13-OCT-15
0 25 50 Kilometers / 0 25 50 Miles	VERSION NO: 2.0	BASIC

Provincial Boreal Caribou Ranges and Management Units
RCEA Region of Interest

Manitoba
Manitoba Hydro

Approach / Limitations

- Approach
  - Adopted Environment Canada Threshold of Disturbance
  - Contribution of hydroelectric development (footprint)
  - Telemetry data – core areas, seasonal use
- Limitations
  - Limited published ATK information available on boreal woodland caribou
  - Lack of historical information on distribution and population
  - Lack of predator (wolf and bear) numbers or density estimates
  - No telemetry data for Norway House, Naosap and William Lake ranges
  - Little historic and current information on population size, recruitment and mortality

Key Conclusions / Findings

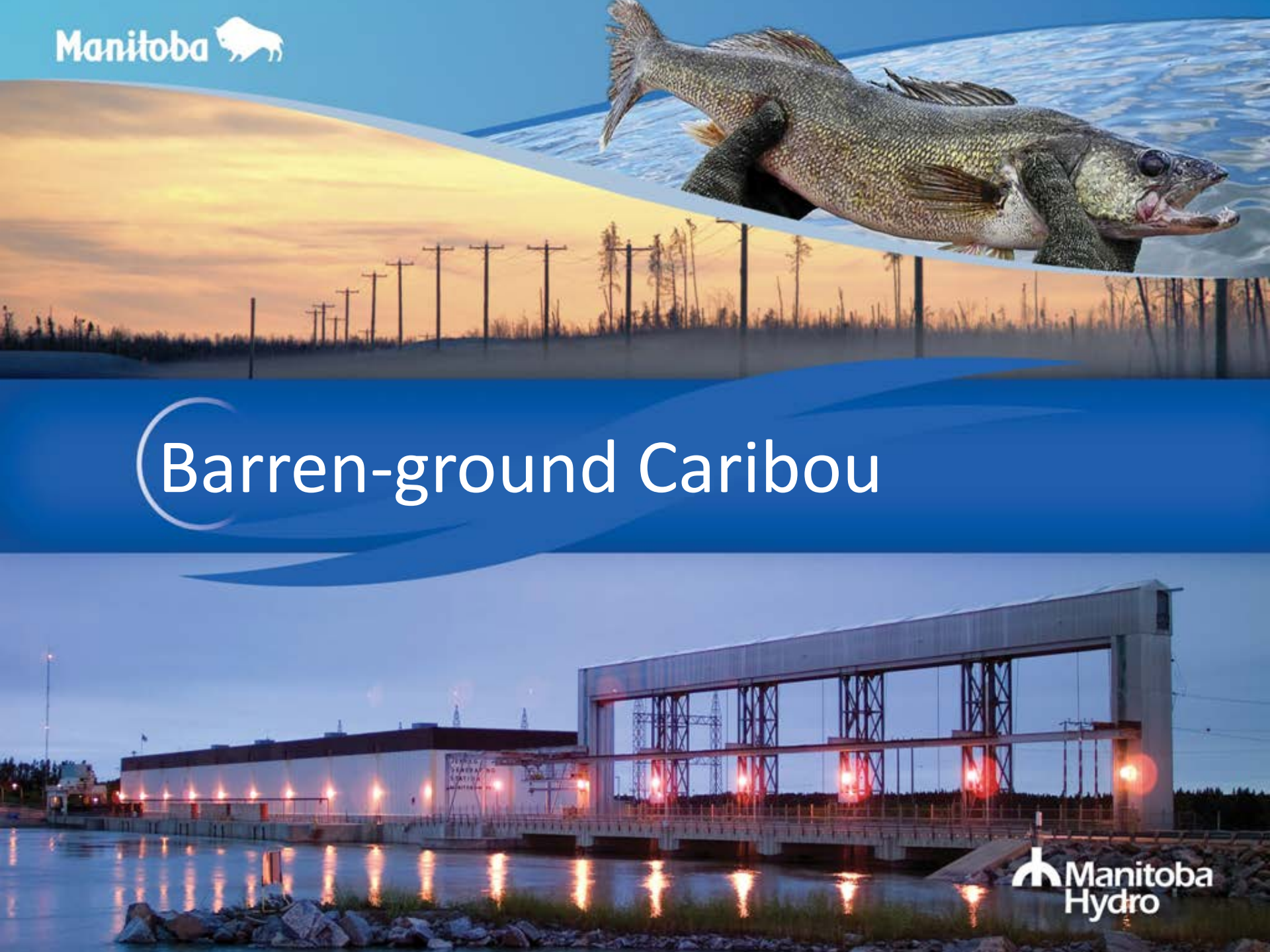
- Population status indicates that populations are acceptable within ROI
  - some uncertainty regarding population trends
- Linear features (e.g., transmission lines) seldom intersect with core use areas (e.g., identified calving areas) at range level
- Harding, Wheadon ranges slightly above disturbance threshold
- Naosap-Reed , and Norway House (no hydroelectric development) ranges exceed EC disturbance threshold;
  - Natural disturbance (fire) = main source
- Hydroelectric disturbance is minor for all boreal woodland caribou ranges within ROI

New Findings

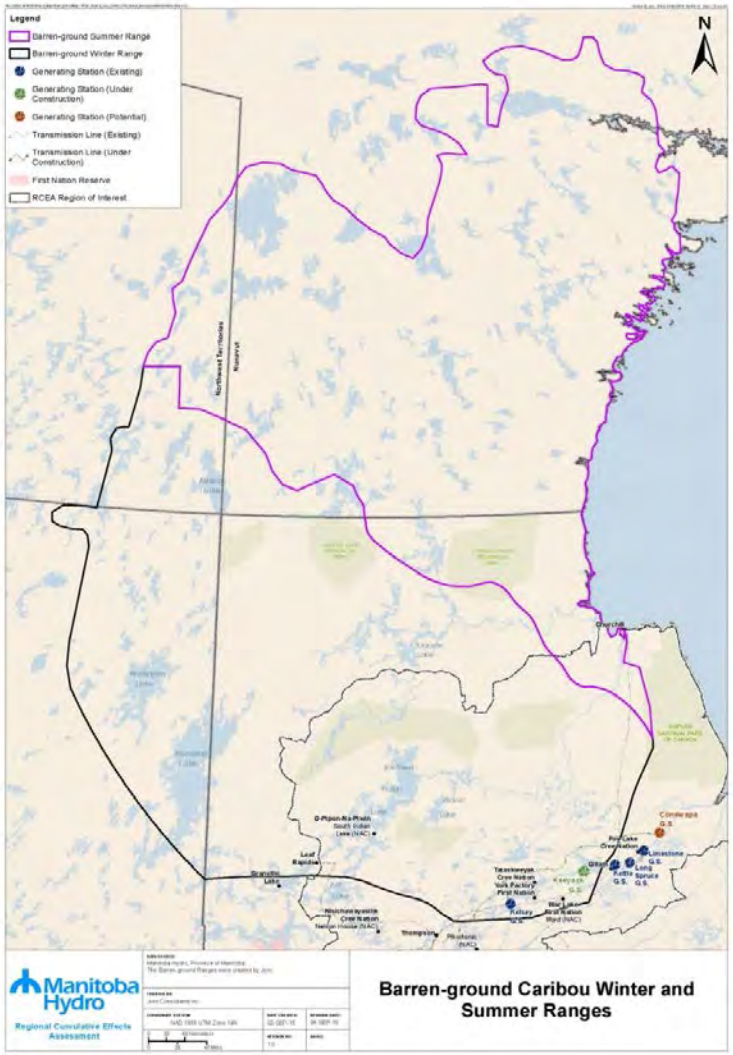
- Human development as a disturbance metric is low
- Hydroelectric development is a small contribution
- Fire is largest disturbance factor for all ranges
- For ranges that exceed EC's threshold
  - until habitat re-grows,
  - additional large-scale disturbance could increase uncertainty of these ranges' capacity to support self-sustaining populations

Importance to Communities

- Boreal woodland caribou have been harvested historically in low numbers
- Not a dependable or reliable source for harvest
- First Nations value boreal woodland caribou and consider stewardship important


Manitoba
Barren-ground Caribou
Manitoba Hydro

Barren-Ground Caribou



Approach / Limitations

- Approach
  - Disturbance analysis on winter range (human footprint)
  - Population trends
- Limitations:
  - Scant literature on effects of anthropogenic activity on winter range for barren-ground populations in Canada
  - Limited fire disturbance data available for pre-hydroelectric period
  - Telemetry studies relate mainly to summer calving and post-calving aggregation surveys
    - resulting in very small sample sizes and a lack of habitat use and movement data to assess use of winter range
  - Limited ATK

Key Conclusions/Findings

- Most current population estimate is 265,000
  - which indicates a declining population from 2008 (348,000)
  - contrasts with pre-1980 estimates (30,000 – 50,000)
- Hydroelectric development accounts for less than 1% of total disturbance within Qamanirjuaq barren-ground caribou winter range
  - fire disturbance is 51%
- Overall, population seems healthy and little-affected by hydro development,
  - while subject to periodic population fluctuations over time

New Findings

- Cumulative effects of hydroelectric development on winter range are considered negligible

Importance to Communities

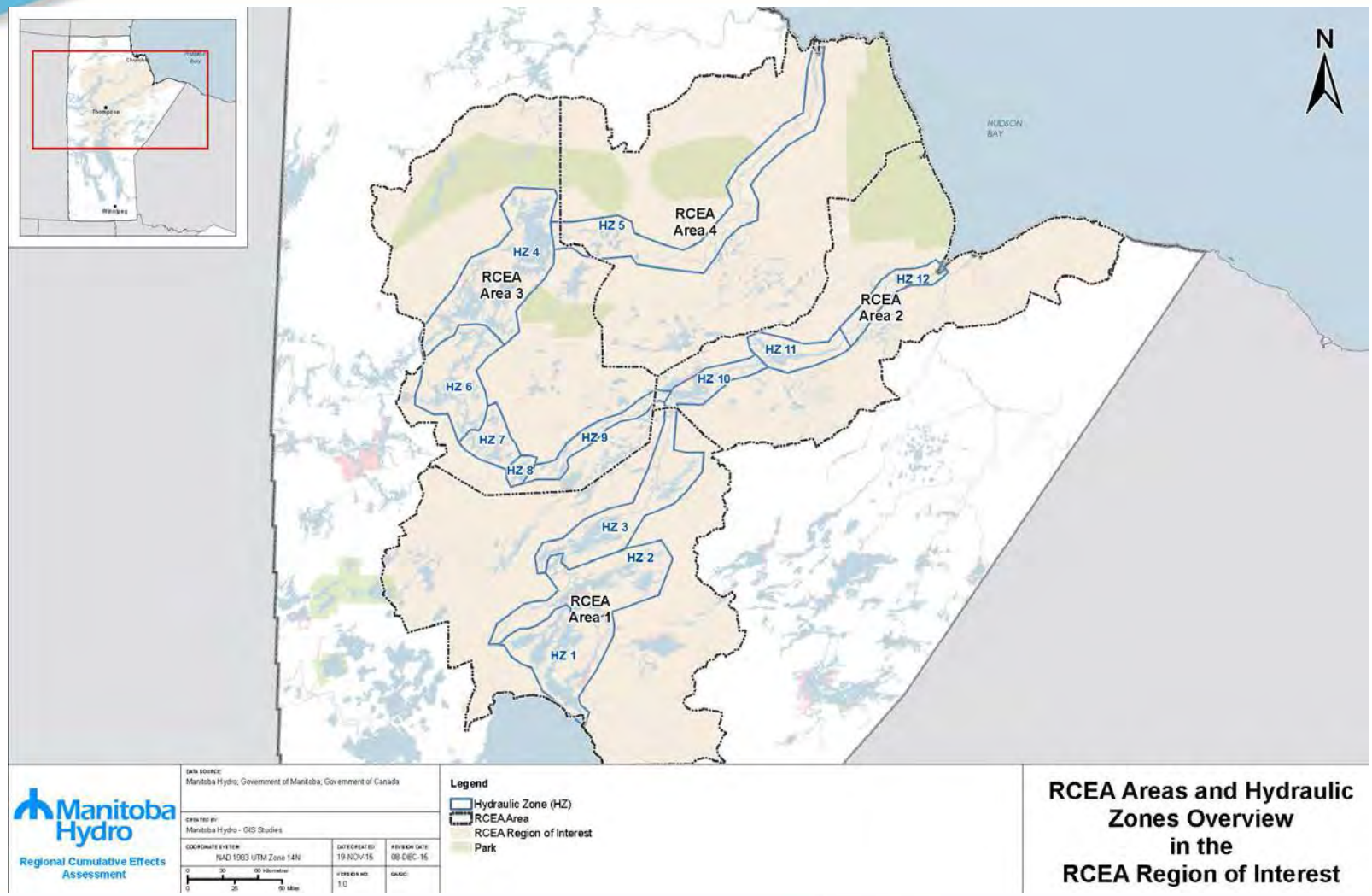
- Barren-ground caribou are culturally significant
- Winter migrations into RAA through time have provided valuable sustenance to communities
- Concern that hydroelectric development has altered migration patterns
  - water regime through flooding, flows and ice conditions

RCEA – Aquatic Furbearers

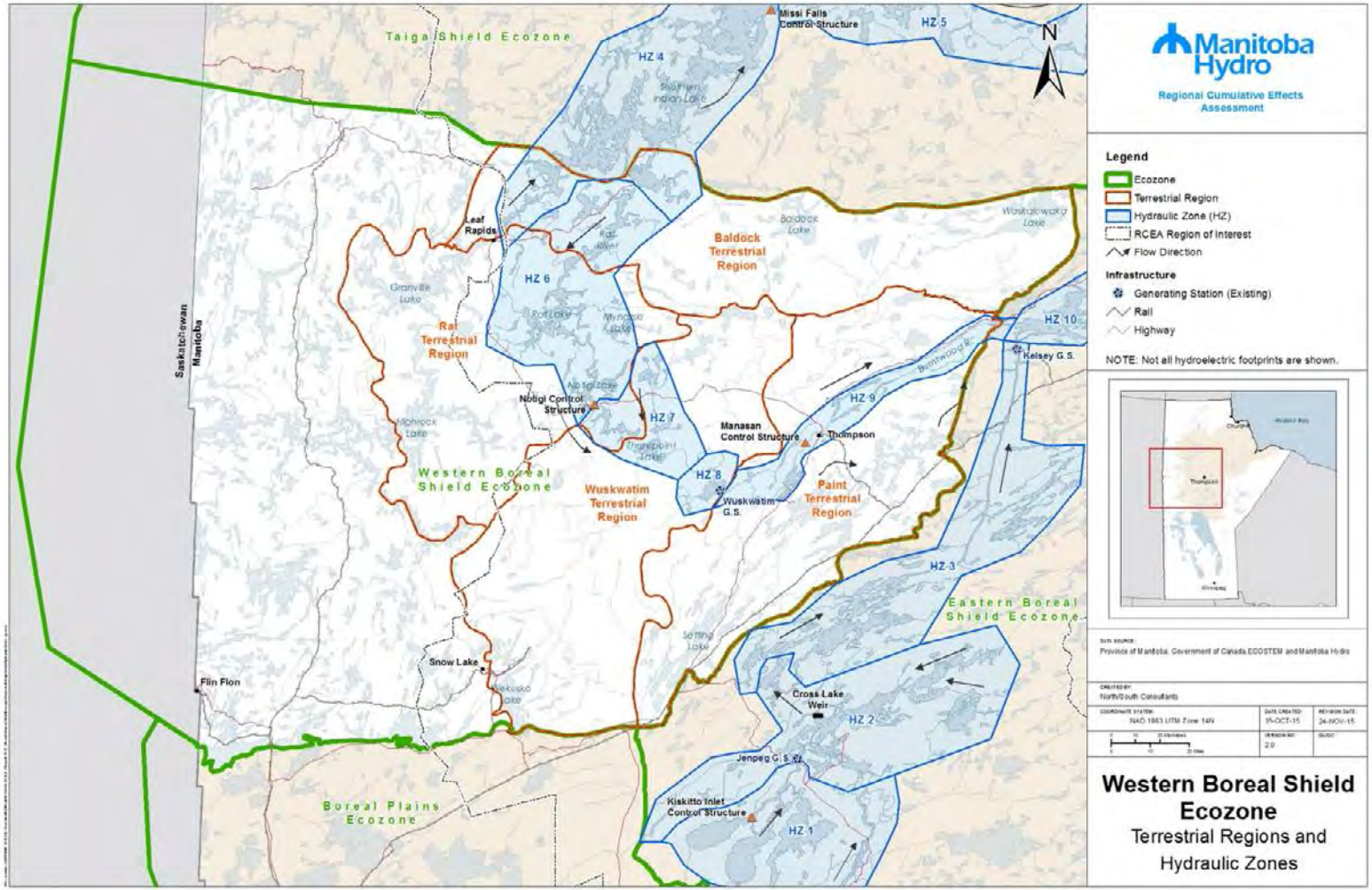
Approach / Limitations

- Approach
  - On-system shoreline modeling (pre- and post km)
  - Regional habitat modeling by Terrestrial Region/Ecozone (pre- and post km^2)
- Limitations
  - On-system (shoreline) habitat data for pre- and post-hydroelectric development are derived from various sources, scales and resolution
    - Overlapping data were limited
  - Historic and current beaver census data are limited
  - Very little published ATK or local knowledge available for beaver in ROI

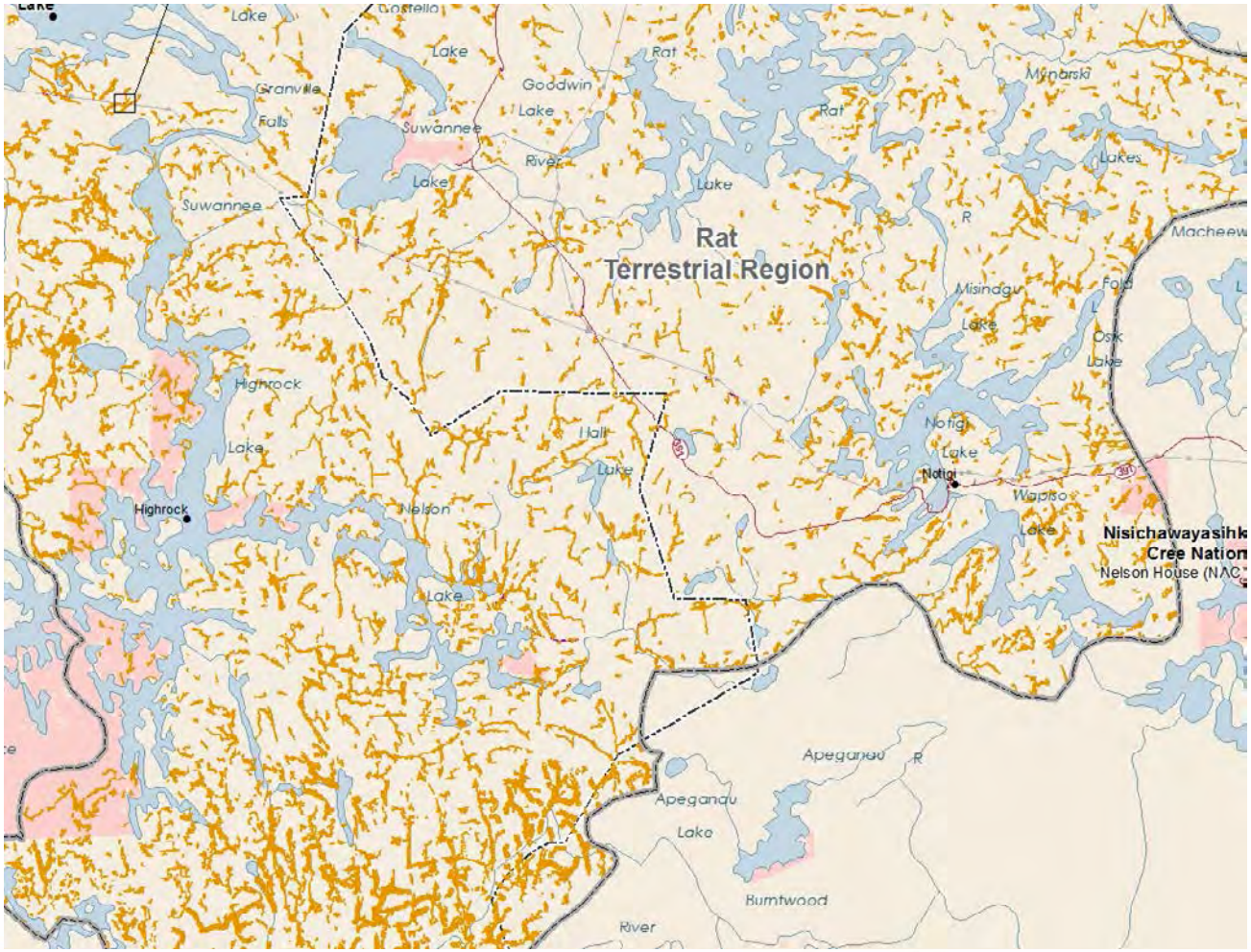
Ecozones and Hydraulic Zones



Ecozones and Hydraulic Zones



Off-System Habitat Availability



Key Conclusions/Findings

- Habitat and population status remained stable on a regional basis after hydro development
- Modelled off-system primary habitat showed relatively small changes between pre- to post-hydro development
- Overall populations in ROI have not been substantially affected by hydro development
- On-system primary beaver habitat modelling indicated lower quality habitat after hydro development
  - ATK, local knowledge, and on-system beaver habitat modeling all indicate that there were negative local effects to on-system beaver populations

New Findings

- Some on-system areas contained little primary modelled beaver habitat, either pre- or post-hydroelectric development
- On-system effects do not appear to be universally offset by new habitat being created as a result of additional flooding

Importance to Communities

- Beaver are culturally significant
  - food and income
- Are a measure of environmental health and indicator of other aquatic furbearers
- While beaver may be common regionally,
  - local on-system effects reduce numbers near on-system communities
  - on-system conditions (ice, current) may hamper access

RCEA Integrated Summary Report

Gary Swanson & Rachel Boone - Manitoba Hydro

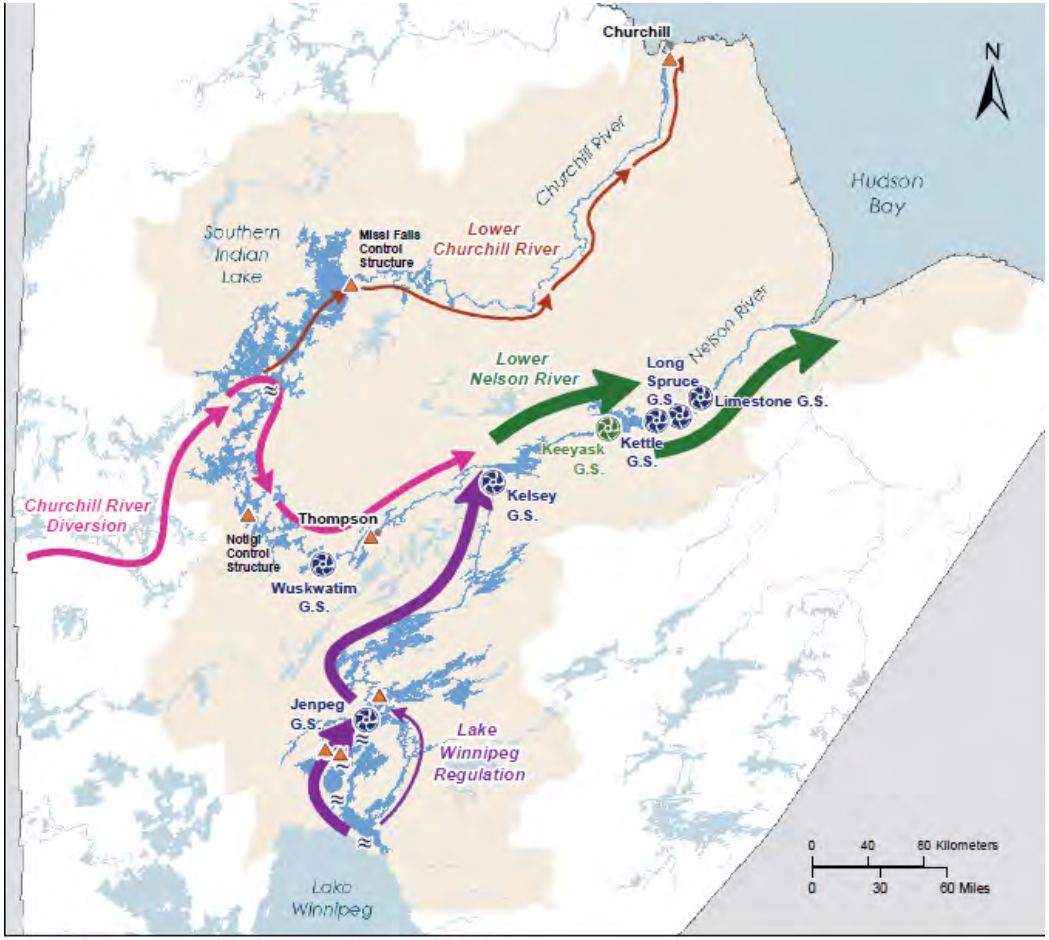
Don Macdonald – Manitoba Sustainable Development

MH System & Regional Effects

- The terms of reference dictate that within Region of Interest the RCEA was to:
  - Describe hydroelectric development effects
  - Describe state of the environment within broader regional context
- Accordingly, the Integrated Summary Report (ISR)
  - describes the on-system effects to the water and shorelines in MH's system using a Pathway of Effects (PoE) approach
  - and then broadly describes the regional / land effects by ecozone

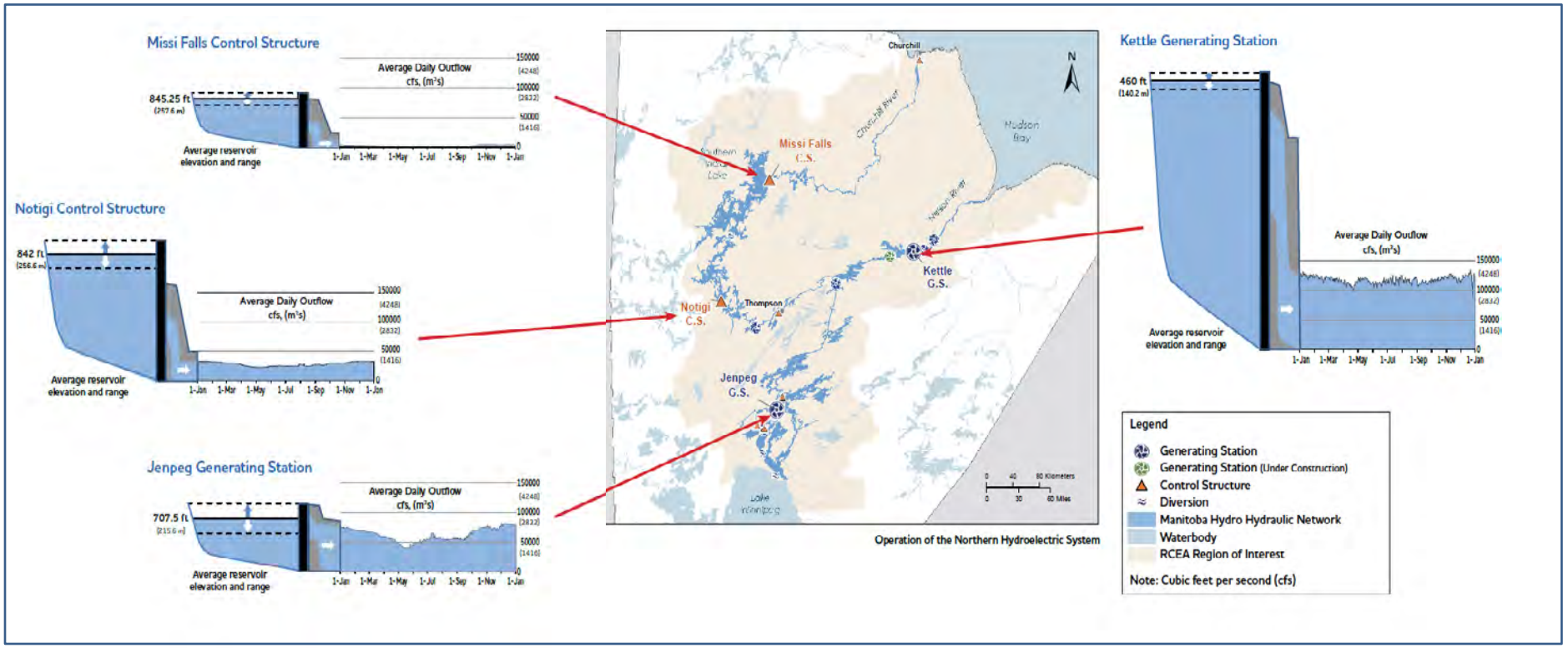
Water & Shorelines

- Manitoba Hydro's system was developed to provide upstream water management for downstream power generation



Churchill River Diversion and Lake Winnipeg Regulation Flow

Water & Shorelines



PoE Framework

Area	Playgreen L to Kelsey GS (LWR)		SIL to Churchill R. Estuary & SIL to Split Lake (CRD)				Split Lake to Nelson R. Estuary		
	U/S of Jenpeg	D/S of Jenpeg	U/S of Missi CS (SIL)	D/S of Missi CS (lower Churchill R)	U/S of Notigi CS (Rat Lake/ Notigi Forebay)	D/S of Notigi CS (	Split Lake	U/S Kettle GS	D/S Kettle GS
Projects and Purpose									
Communities affected									
Water Regime									
Physical Habitat Effects									
Water Quality									

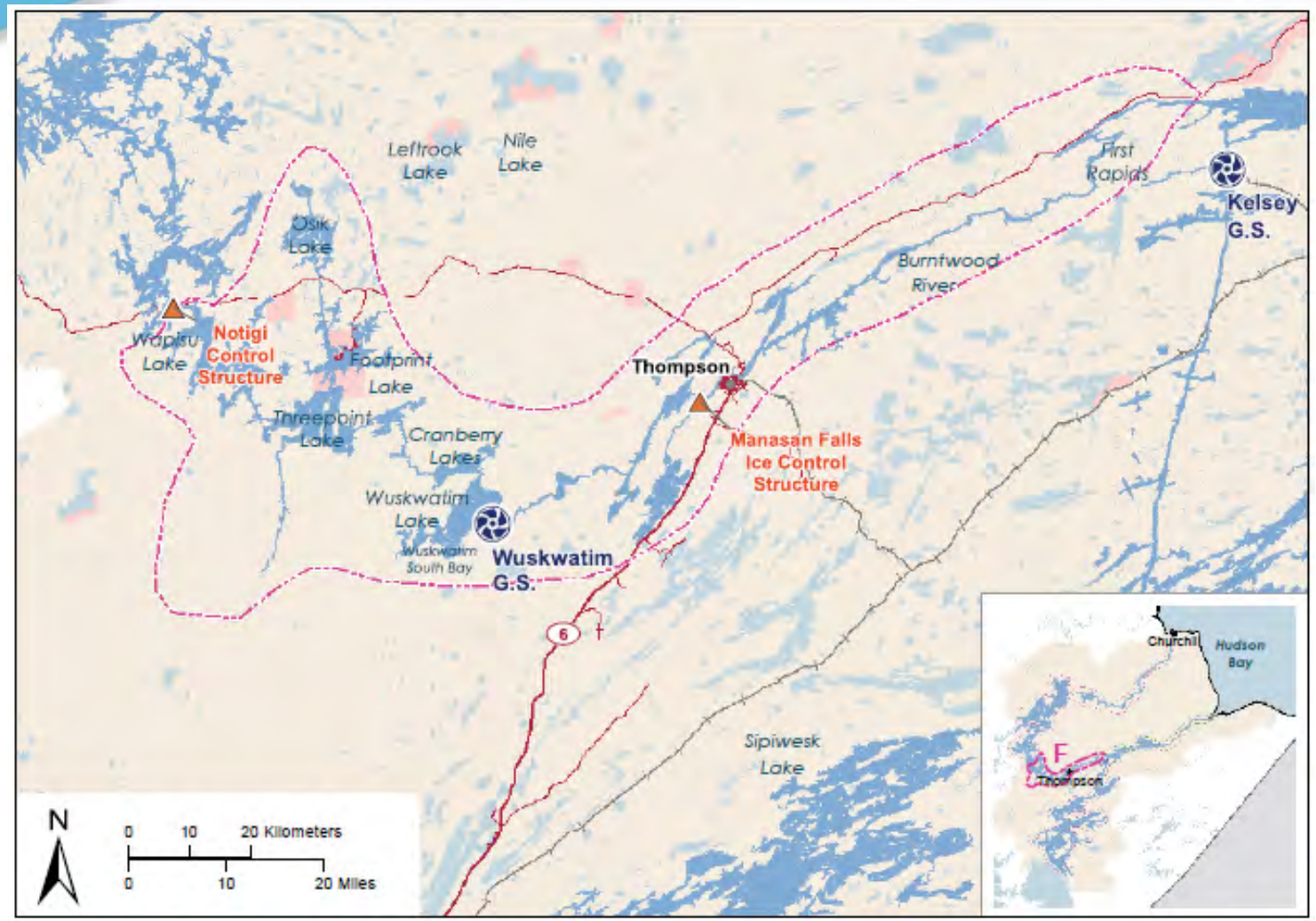
PoE Framework

Area	Playgreen L to Kelsey GS		SIL to Churchill R. Estuary & SIL to Split Lake				Split Lake to Nelson R. Estuary		
	U/S of Jenpeg	D/S of Jenpeg	U/S of Missi CS (SIL)	D/S of Missi CS (lower Churchill R)	U/S of Notigi CS (Rat Lake/ Notigi Forebay)	D/S of Notigi CS (	Split Lake	U/S Kettle GS	D/S Kettle GS
Fish Community									
Lake Sturgeon									
Fish Mercury									
Fish Quality									
Fishery									

PoE Framework

Area	Playgreen L to Kelsey GS		SIL to Churchill R. Estuary & SIL to Split Lake				Split Lake to Nelson R. Estuary		
	U/S of Jenpeg	D/S of Jenpeg	U/S of Missi CS (SIL)	D/S of Missi CS (lower Churchill R)	U/S of Notigi CS (Rat Lake/ Notigi Forebay)	D/S of Notigi CS (	Split Lake	U/S Kettle GS	D/S Kettle GS
Shoreline Habitat									
Waterfowl									
Beaver									
Moose									

For Example …



Downstream of the Notigi Falls Control Structure

Churchill River Diversion

Downstream of Notigi Falls Control Structure

EROSION & SEDIMENTATION:

- Erosion was localized
  - near rapids and scattered lakeshore sites
- Turbidity & suspended solids increased in river portions with deposition occurring in lakes
- Most eroded material is deposited near its source
- Increased flows result in a much larger sediment load being transported to Split Lake

Churchill River Diversion

Downstream of Notigi Falls Control Structure

WATER QUALITY:

- Both permanent and temporary changes
- Introduction of Churchill River water permanently changed chemical makeup of water in this area

Churchill River Diversion

Downstream of Notigi Falls Control Structure

FISH COMMUNITY:

- Relative abundance has changed in some waterbodies over time
- Immediately post-CRD Lake Whitefish and/or Cisco dominated the catch, now Walleye and/or White Sucker dominate
- Footprint, Threepoint & Wuskwatim lakes have exhibited a declining trend, while total catch has been relatively constant in other lakes

Churchill River Diversion

Downstream of Notigi Falls Control Structure

MERCURY IN FISH:

- Less flooding than other areas but still enough to cause substantial increases in fish mercury
- Mercury levels declined over time
- Monitoring continues under CAMP

Churchill River Diversion

Downstream of Notigi Falls Control Structure

FISHERY

- Domestic fishery important pre-CRD. Concerns about mercury, taste and texture resulted in a shift in harvest to Leftrook (off-system)
- Commercial fishery was small scale and intermittent pre-CRD
- Fisheries continue post-CRD and appear stable

Churchill River Diversion
Downstream of Notigi Falls Control Structure

SHORELINE EFFECTS:

- Marsh wetlands and riparian peatlands were reduced considerably and replaced with areas of shallow open water or submerged marsh and peatlands
- Shore zone vegetation is not typical, and where bedrock was exposed it does not provide substrate for wetland habitat to develop.
- Narrow tall shrub bands have increased in some areas and been eliminated in others
- Shoreline debris has increased
- Each of these contributes to a loss of shoreline habitat for wildlife

Overview of Study Findings

PHYSICAL CHANGES:

- Physical structures and flow increases caused flooding, shoreline erosion & debris
- Seasonal flow patterns were changed to meet winter power demands with increased winter flows & water level fluctuations contributing to slush ice & hanging ice conditions
- These changes affect water quality, near-shore fish habitat, shoreline wildlife habitat, aesthetics and use of shoreline by residents and harvesters

Overview of Study Findings

PHYSICAL CHANGES:

Specifically:

- CRD dewatered parts of the lower Churchill River affecting water quality, shorelines, fish habitat & fish access to tributaries
- LWR diversion channels altered flow patterns and created new paths for sediment & debris to move between waterbodies

Overview of Study Findings

WATER QUALITY:

- Where reservoirs flooded land nutrients increased.
- Water quality meets the Protection of Aquatic Life (PAL) guidelines with a few localized / temporary exceptions:
  - aluminum and phosphorus exceed PAL however this is also observed in lakes that are not affected by Hydro
  - Eroding shorelines are related to changes in turbidity and suspended solids

Overview of Study Findings

FISH COMMUNITY:

- Different physical changes resulted in different changes in fish community
- Reservoir creation typically changed species
  - from those that prefer rivers (e.g. Longnose Sucker)
  - to those that prefer lakes (e.g. Walleye and White Sucker)
  - often accompanied by reductions in Lake Whitefish and Cisco
- Other factors also contributed to fish population changes including:
  - commercial fish prices, fishing effort, invasion of Rainbow Smelt and climate change

Overview of Study Findings

LAKE STURGEON:

- Hydroelectric development altered Lake Sturgeon habitat
- However, it is difficult to separate this from impact of historical harvest

- Nelson River studies show that sufficient habitat remains to sustain Lake Sturgeon populations
- In lower Churchill River habitat was substantially reduced with only recruiting population near confluence of Little Churchill River

Overview of Study Findings

FISH MERCURY:

- Flooding of soils and vegetation resulted in mercury accumulating in food web
  - amount and timing of increases in fish mercury depended on amount of flooding and fish species
- In general fish mercury concentrations increased 3-9 years after flooding after which concentrations declined for 10–30 years
- Ongoing monitoring shows concentrations have fluctuated but generally declined to minimum levels in early 2000s
- Overall, levels are much lower than the maximum recorded soon after impoundment

Overview of Study Findings

FISHERY:

- Almost all larger commercial fisheries are affected by hydroelectric development
  - e.g. Playgreen, Cross, Sipiwesk, Split and Southern Indian lakes
- Physical changes to shorelines have affected access & fishing success
- Fish populations continue to be sustainable & are either generally healthy or variable due to a mix of factors

Overview of Study Findings

SHORELINES:

- Considerable amount of shoreline wetlands was lost
  - largely replaced by shallow open water, and disintegrating or sunken peatlands
- This affected wildlife that rely heavily on shorelines
  - e.g. moose, waterfowl or beaver
- Distributions shifted inland to where suitable habitat is still abundant
  - however this generally makes them less available to local hunters

Effects on Land

Regional / Land Effects

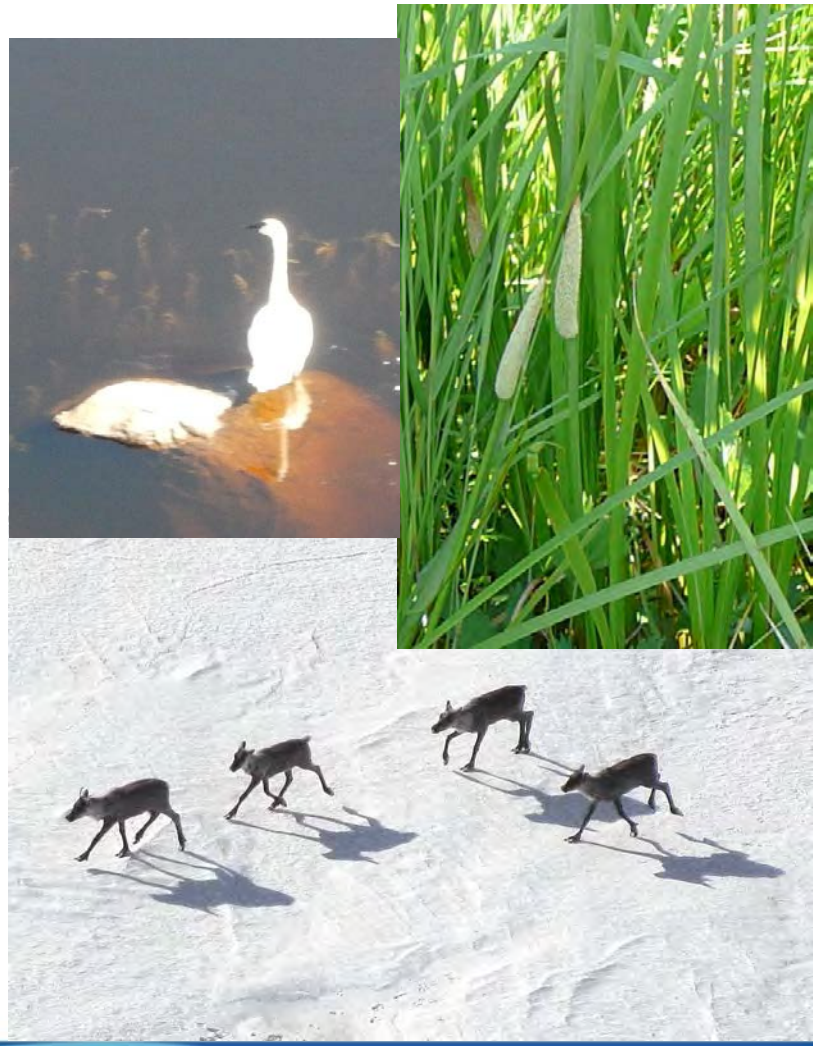
- In addition to shoreline impacts, hydroelectric development can result in physical impacts to the land:
  - Vegetation clearing
  - Borrow area development
  - Access road construction
  - Permanent infrastructure
- Regional land assessment included both shoreline areas and other land areas away from the regulated system

Regional / Land Effects

- Phase II Land assessment was focused on:
  - Terrestrial regions (sub-divisions of Ecozones)
  - Ranges for caribou and polar bear
- Integrated Summary Report (ISD) provides overview of study findings for Land assessment:
  - By ecozone (6 broad land areas)
  - Overall, across RCEA ROI

↓

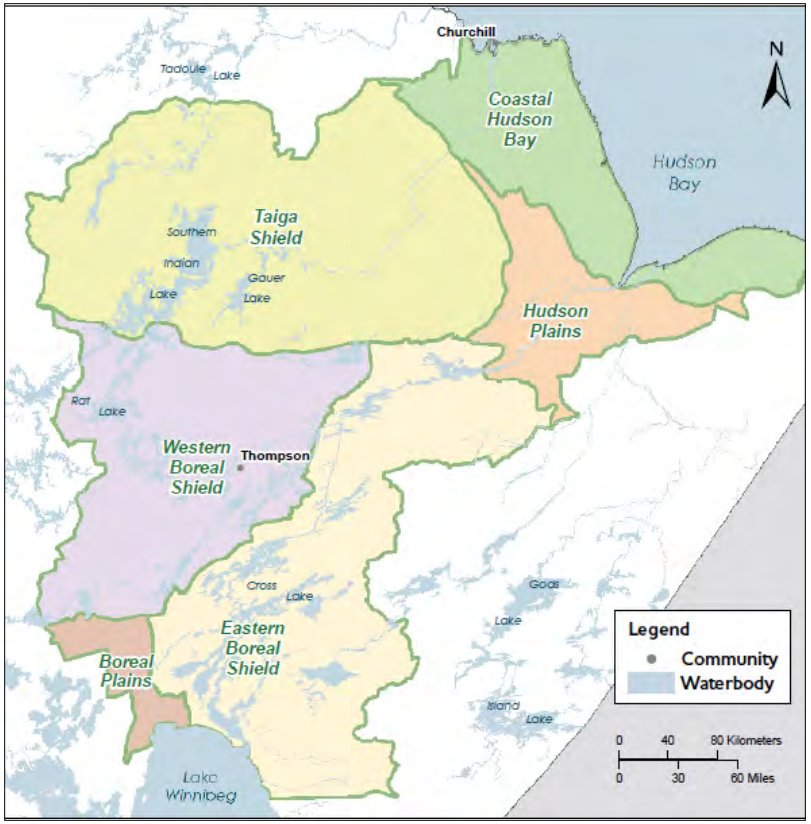
Overview of study findings for Land



Overview of Study Findings - Land

GENERAL:

- Other developments also impacted land in RCEA ROI, including:
  - Municipal infrastructure, forestry, mining and gravel/sand extraction for road construction
- Development is more densely concentrated near communities, and decreases gradually from southwest portion of region towards northeast



Overview of Study Findings - Land

GENERAL:

- Effects to land were along shoreline areas and in inland areas
  - shoreline and upland habitats
- Effects on shorelines tended to be more pronounced than on adjacent land areas
- Shoreline impacts have been concentrated along large river systems, historically used by First Nations members for transportation and resource use

Overview of Study Findings - Land

HABITAT:

- Overall, cumulative effects of development on terrestrial habitat within RCEA ROI have been low
  - About 1% loss of total land area
  - As of 2013, nearly 170,000 km^2 remains undisturbed
- Considerable changes to most of the shorelines along affected rivers, and large effects on shoreline marsh wetlands in certain areas

Overview of Study Findings - Land

FRAGMENTATION:

- Land fragmentation was low across RCEA ROI, with exception of the land region around Thompson
- Regional cumulative effects on fragmentation typically remained small as many features (e.g., transmission lines) were placed near other existing footprints (e.g., roads)

Overview of Study Findings - Land

WATERFOWL:

- Regionally, loss of 2% of waterfowl habitat in the RCEA ROI
- Overall impact on populations was:
  - Low to moderate, affecting some local populations
  - No apparent effect on regional populations
- Many river systems were important staging areas for migrating waterfowl prior to hydroelectric development
  - but not important breeding or brood-rearing areas

Overview of Study Findings - Land

COLONIAL WATERBIRDS:

- While some nesting habitat was lost, other habitat was created or remained abundant in surrounding areas
- Cumulative effects in RCEA ROI are low and do not appear to have had an effect on populations
- Recent environmental monitoring shows that colonial waterbirds are still abundant in the region, both on and off the regulated system

Overview of Study Findings - Land

BEAVER:

- Availability of habitat varied across the region before development
  - e.g., fast-flowing rivers with steep banks provide little suitable habitat
- Habitat loss in some areas, but large amounts of alternate, suitable beaver habitat present
- Loss of habitat and limited population data suggest some local impacts, but overall populations in the RCEA ROI have not been substantially affected

Overview of Study Findings - Land

MOOSE:

- Populations generally remain stable across RCEA ROI, with decreases in some areas and increases in others
- Regionally, 1% of moose habitat has been lost
- Changes to shorelines have reduced valued moose habitat, and limited shoreline access due to debris in many areas
- Moose activity has shifted to other inland areas where habitat is largely intact

Overview of Study Findings - Land

CARIBOU: Boreal woodland caribou

- Eight ranges intersect RCEA ROI
- Within these, habitat availability and use of habitat does not appear to have been measurably affected
- Regionally, overall fragmentation is very low
- Disturbance (mostly from wildfire) in 4 of the ranges exceeds Environment Canada disturbance threshold
  - Hydroelectric development contributes less than 6% of total disturbance in these ranges

Overview of Study Findings - Land

CARIBOU: Coastal caribou

- Overall, cumulative effects on Pen Islands and Cape Churchill herds are low
- Low levels of fragmentation and disturbance in the ranges of both coastal caribou herds, with hydroelectric development contributing about half of the linear features
- Both coastal caribou herds have stable to growing populations

Overview of Study Findings - Land

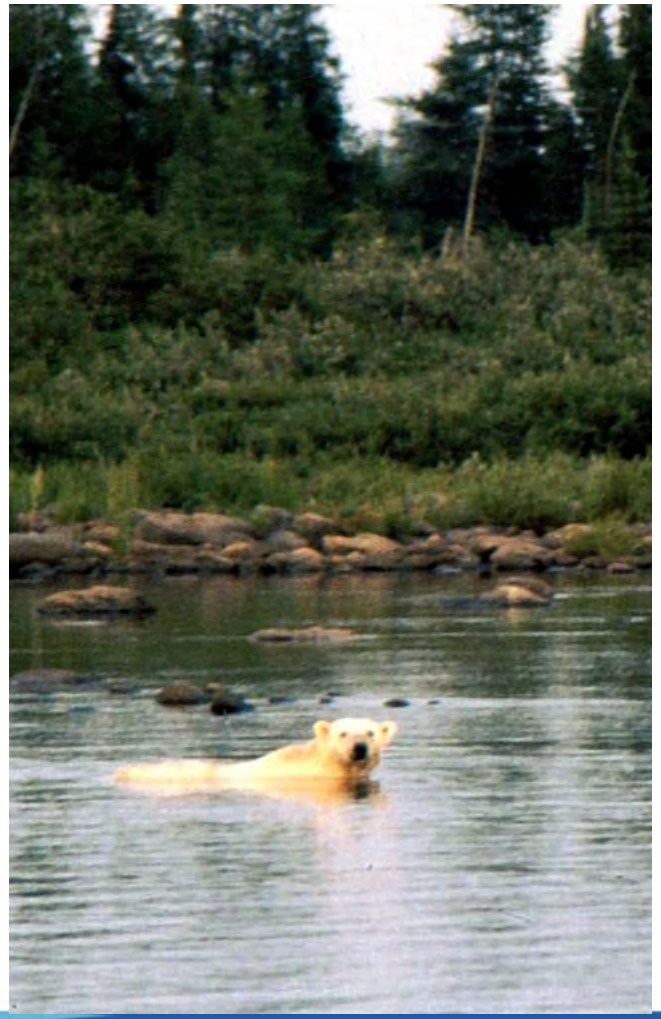
CARIBOU: Barren-ground caribou

- Current population of the Qamanirjuaq herd is trending downward (based on a 2014 survey)
- Hydroelectric development accounts for less than 1% of disturbance in its winter range
  - as such, effects on Qamanirjuaq herd have likely been negligible

Overview of Study Findings - Land

POLAR BEAR:

- Do not appear to be any links between fluctuations of the Western Hudson Bay polar bear population and hydroelectric development
- There has been no appreciable effect on this population within RCEA ROI



RCEA – Wrap Up and Next Steps

Shelley Matkowski
Manitoba Hydro

Wrap Up

Today we've shared information on the RCEA:

- Background and Terms of Reference;
- Overall approach to the RCEA, as well as approach and limitations for each study component;
- Key findings and new findings resulting from the Phase II assessment; and
- Approach and findings for the Integrated Summary Report.

Next Steps

- The CEC is currently carrying out public outreach

- Following public outreach, Manitoba and MH are committed to reviewing the RCEA, outcomes of public outreach, and current monitoring and planning initiatives and consider the next steps