

The Need to Monitor and Report Ecosystem Service Change for the Keeyask Generation Project

PROVIDED TO THE CLEAN ENVIRONMENT COMMISSION FOR THE
KEYYASK GENERATION PROJECT PROCEEDINGS

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Purpose of Presentation

- **Provide CEC information to aid in decision-making**
 - **Describe ecosystem services**
 - **Establish public interest for ecosystem services monitoring and reporting frameworks in development decisions with regard to water quality and biodiversity for the Keeyask Generation Project**
 - **Based on ecology, human health and well-being**
 - **Keeyask EIS and Monitoring Programs Review**
 - **Conclusions**
 - **Recommendations**
 - **All references cited in CEC report**

What are Ecosystem Services?

- **Based on holistic management of environmental systems**
 - **Humans are part of systems**
- **Both humans and non-humans depend on complex interactions of abiotic (i.e., environment) and biotic (i.e., species) ecosystem components**
 - *Contribute to, and provide life support for the social and ecological functions we depend on*
- **Ecosystem functions encompass habitat, biological, or systems properties or processes of ecosystems**
 - *Functioning ecosystems deliver specific services in perpetuity that sustain and improve human and non-human life*
 - *Human well-being relies on the contributions of functioning ecological systems*
- **Contributions = Ecosystem Services**

Ecosystem Services: Goods and Services

- **Market and non-market ecosystem benefits individuals, households, communities and economies receive from ecosystems**
- **Delivered as goods and services**
 - *Goods: clean water, food, shelter, electricity medicine, etc.*
 - *Services: purifying drinking water, waste decomposition, flood regulation, climate regulation, recreation, etc.*
- **Most basic service example: Clean Water**
 - *Good: daily supply of clean fresh water*
 - *Services: terrestrial and freshwater systems provide the services of gathering, purifying, providing, and delivering the good*
 - *Local and regional terrestrial and aquatic ecosystem services in the Keeyask Generation Station region contribute to the provision of food for local people*
 - **Collectively referred to as Ecosystem Services**

- **Millennium Ecosystem Assessment (MEA): 4 categories**
 - **Production or Provisioning Services**
 - **Regulating Services**
 - **Cultural Services**
 - **Supporting Services**
- **Provisioning Services**
 - **Produce or provide many goods to society as food, extractable renewable raw materials, freshwater, biological resources that aid in supporting human health, and non-renewable raw materials.**
 - *Food: fish, grains, wild game, fruit, vegetables*
 - *Renewable raw materials: fuel, fiber, fodder*
 - *Freshwater supply: use and storage for consumption and non-consumption (e.g. power and transport)*
 - *Biological resources: biochemicals that can be developed as pharmaceuticals for medicine or commercial use*
 - *Abiotic resources: metals, rock, stone, lime*

Millennium Ecosystem Assessment (MEA): 4 Categories

- **Regulating Services**
 - Ecosystems processes are naturally regulated and the services provide a habitable environment as the benefit
 - *Natural air and water filtration*
 - *Water treatment and regulation*
 - *Climate regulation*
 - *Disease regulation*
 - *Water purification*
 - *Buffering flood flows*
 - *Erosion control through water /land interactions*
 - *Flood control*
 - *Flushing flows*
- **Cultural Services**
 - Nonmaterial benefits obtained from ecosystems
 - *Cultural heritage; significant sites, historic sites;*
 - *Sense of place;*
 - *Spiritual and religious;*
 - *Aesthetics;*
 - *Recreation and ecotourism;*
 - *Inspirational; and*
 - *Educational*
- **Supporting Services**
 - Provide for the production of all other ecosystem services
 - Enable ecosystems to flourish
 - Biodiversity facilitates these services in surrounding ecosystems by supporting resistance and resilience
 - Biodiversity
 - Soil formation
 - Nutrient cycling
 - Primary Production

Biodiversity and Water Provide Ecosystem Services

- **Biodiversity and ecosystem services are inherently connected**
 - **Biodiversity plays an important role in the creation, support and maintenance of all ecosystem services**
 - **Land and water ecosystem services also conserve biodiversity**
- **Water Quality and Biodiversity not services themselves**
 - **Reduction in services = reduction and biodiversity and visa versa**
 - **Directly related to both aquatic and terrestrial ecosystem services**
- **Climate Change and Resilience**
 - **Rapid change requires that ecosystems adapt and remain resilient**

Ecosystem Services Provide and Sustain Human Well-being

- **Ecosystem Services Provide and Sustain Human Well-being**
 - **Economic value of services is essential to global economy**
 - **Vital to climate change adaptation and mitigation**
- **Sustain Human Well-being: Social**
 - **Social and psychological impacts of ecological degradation**
 - *Loss of identity or “sense of place”*
 - *Depression*
 - *Emotional stress*
- **Human Well-being: Physical**
 - **Risk to crop pollination**
 - **Loss of potential pharmaceuticals**
 - **Loss of wild food crop relatives**
 - **Increase in zoonotic diseases**

- **Ecosystem Services Provide and Sustain Human Nutrition**
- **Aquatic and terrestrial wildlife populations are important dietary source of micro and macro nutrients**
 - *Populations without wild meat consumption, children had:*
 - **Higher risk of iron deficiency anemia**
 - *Sickness and death from infectious disease*
 - **Reduction in IQ and learning ability**
 - **Reduced capacity for physical activity**
- **Human Well-being: Ecosystem Services and Nutrition**
 - *Degradation of services can cause nutritional crisis*
 - **Fish don't taste as good in Keeyask region**
 - **If wildlife and fish are no longer sufficient to support harvest of human nutrition, then**
 - *What will be the substitute?*
 - *How will it be substituted?*
 - *Does substitution have same nutritional value?*
 - *What will this cost?*

Global Acceptance of Ecosystem Services

- **Contributions of biodiversity and ecosystem services are recognized and paramount**
- **The UN Millennium Ecosystem Assessment (MEA)**
 - *1,360 experts from 95 countries*
 - *Evaluated State of the World's Ecosystems*
 - *Conclusion: “any progress achieved in addressing the Millennium Development Goals of poverty and hunger eradication, improved health, and environmental sustainability is unlikely to be sustained if most of the ecosystem services on which humanity relies continue to be degraded,”*
- **Director General - World Health Organization**
 - *“Nature’s Goods and Services are the ultimate foundations of life and health,”*
- **Ecosystem services are now accepted and a priority**

Call for Monitoring and Reporting on Ecosystem Services

- **International research on ecological monitoring**
 - **Critical need to gather ecosystem service data**
 - **Inform environmental decisions at various spatial and temporal scales**
- **Need to move away from traditional reductionist approaches**
- **Adaptive monitoring**
- **Paradigm shift underway**
 - **Evaluating changes to ecosystem services**
 - **Most socially and technically acceptable method to conduct environmental risk evaluations**

Call for Monitoring and Reporting on Ecosystem Services

- **United Nations General Assembly**
- **United Nations Humans Rights Council**
- **United Nations Environment Program World Conservation Monitoring Center (UNEP-WCMC)**
- **United Nations Development Program (UNDP)**
- **World Health Organization (WHO)**
- **International Institute for Sustainable Development (IISD)**
- **World Resources Institute (WRI)**
- **The GLOBE International Commission on Land Use Change and Ecosystems**
- **International Union for Conservation of Nature (IUCN)**
- **World Business Council for Sustainable Development**
- **World Wildlife Fund (WWF)**
- **The Nature Conservancy (TNC)**
- **Environment Canada**
- **Canadian Council of the Ministers of the Environment (CCME)**
- **NSERC Canada**
- **Ducks Unlimited Canada**
- **US Environmental Protection Agency (USEPA)**
- **US Department of Agriculture (USDA)**
- **US Agency for International Development (USAID)**

Why Monitor and Report on Ecosystem Services?

- **Global Ecosystem Health and Integrity is Declining**
 - **Current standards of practice for projects and mitigation**
 - *Not halting decline in biodiversity, ecological integrity and ecosystem health*
 - **Benefits from nature are in decline**
 - **More pronounced with freshwater ecosystems as water quality is degraded**
 - **The MEA tells us that biodiversity of freshwater ecosystems has been degraded more than any other ecosystem, including tropical rainforests**
 - **The majority of the world's people live within 50km of a water source that is impounded, diverted, polluted or running dry and has consequently been classified as impaired**
 - **By 2030, 1/2 global population will be under severe water stress**
 - *Will communities in Keeyask region be a part of that statistic?*

Freshwater Ecosystem Health and Biodiversity is Declining

- **More than 2/3 of all freshwater flowing into oceans is obstructed by hydropower**
 - **>45,000 large dams, ~750,000 small dams**
 - **Functional freshwater ecology is compromised**
- **Water storage projects have both positive and negative effects**
 - **Costs**
 - **Benefits**
- **Valuation of ecosystem services (TEEB)**
 - **Who benefits and depends on these services?**
 - **Are the services at risk?**
 - *What are costs of losing or degrading services?*
 - **How do policies and development decisions affect the value of existing Natural Capital and supply of ecosystem services?**
- **Ecosystem services are not valued in today's economic paradigm and decision-making frameworks**
 - **Values are real**

Valuation of Ecosystem Goods and Services

- **Most ecosystem services are not currently captured in market economy**
- **Rarely accounted for in day to day decisions**
 - *Business*
 - *Personal*
 - *National accounting*
- **Implied value of ZERO or nothing**
 - *The UNDP recognizes “Methods of accounting for national wealth usually fail to reflect the value of biodiversity and ecosystem services to the economy, and the potential cost of replacing these if they are lost or damaged...”*
- **Without incorporation of value of ecosystem services, Millennium Development Goals will be compromised**
 - *No ability to sustain ecosystem services society and all of life depend upon*
- **Keeyask Generation Project is implicated in this compromise**

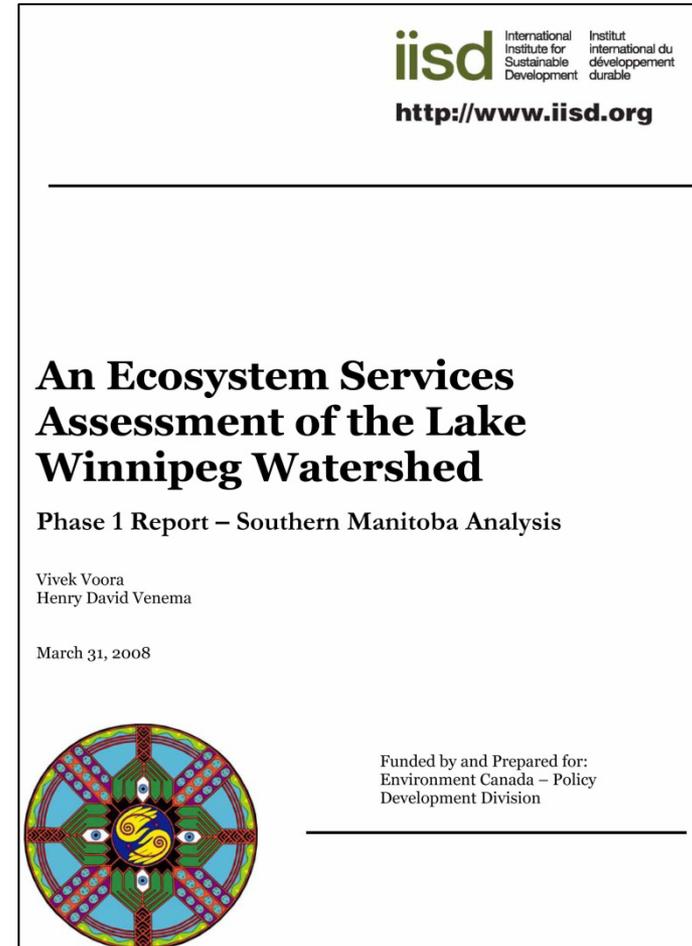
- **Mitigation is most widely utilized global practice in hydroelectric projects**
- **Mitigation, Restoration and Rehabilitation efforts don't work**
 - **World Commission on Dams**
 - *Not effective*
 - *Costly*
- **Fish passage fails or only works sporadically**
- **Only 20% ecosystem impacts mitigated effectively**
 - *Significance? Cumulative effects?*
- **Failed mitigation ultimately costs society money**

Costs to Society: Environmental Costs

- **UN Development Program**
 - **Annual global ecosystem service loss at USD \$740 billion**
- **TEEB Report (The Economics of Ecosystems and Biodiversity) TruCost,2013**
 - **Assessment of total unpriced costs of global region sectors**
 - **Costs based on 6 categories of unpriced natural capital consumption**
 - *Water use, greenhouse gas (GHG) emissions, waste, air pollution, land and water pollution, and land use.*
 - *None of top 20 industrial sectors would be profitable if environmental costs were included*
- **Investments in mitigation and infrastructure are only capturing part of costs**
- **Management, mitigation and restoration interventions need to be budgeted during project planning.**
- **Costs are displaced**
 - **From project planning, construction, operation into the future**
 - **Long-term costs are often permanent**
 - **Costs would further need to be included in monitoring and auditing during construction and operation phases for the project**

Lake Winnipeg Ecosystem Services Assessment

- **Estimated costs for loss of ecosystem services to Manitoba citizens millions every year**
 - *IISD tells us that if pre-settlement landscapes could be re-created, they would provide, on an annual basis, between \$500 million and \$3.1 billion of ecosystem services*
 - *“Having the means to value ecosystem services can help justify spending to preserve and restore these natural environments, rather than often more expensive hard infrastructure investments.”*
- **Billions of dollars could be gained by restoring natural environments**
 - *Nature does a better job*
 - Natural systems clean and purify water at far cheaper costs than engineered systems



But How Much?

- **Journal *Nature* Publication (November 2013)**
- **Federal Fisheries Act gutted**
 - **No more habitat protection**
- **University of British Columbia Professor Dr. Taylor**
 - **“This change is going to create a gap now where things are only going to be protected when they're already in trouble...it's going to cost us way more money in the long run.”**
- ***But exactly how much money?***
 - **We don't know because we currently aren't measuring and reporting environmental costs**



Relevant Standards, Guidelines, Laws and Regulations

- **Clean Water is a Human Right**
- **People depend on clean water**
- **Journal *Climate Change*: Cozzetto et al 2013**

“Water is sacred. This is tradition. In contrast to the non-tribal utilitarian view of water, Native Americans revere water and water is life. It is integral to many Native American practices such as purification and blessing rituals and is used to acknowledge all relations and to establish connection to Mother Earth and Father Sky. Water is a holistic and integrating component connecting continents, humans, animals, and plants through a continuous cycle of liquid, solid, and vapor states. Without water, life would not exist as we know it. Water is the one thing we all need, all of us, all of life. As Native Americans, we honor and respect the tradition of water and must protect it always.”

Relevant Standards, Guidelines, Laws and Regulations

- **Clean Water is a Human Right**
- **People depend on clean water**
- **Gerald Michel, Land and Resources Councillor**
 - *Nxwisten (St'at'imc Nation, British Columbia) 2008*

“Water is the most important element for life. Good quality, good quantity is needed for all life forms. Most water sources are known to the St'at'imc, be it springs, streams and lakes. Many food items were found near water. Plants, food, medicines and technology (fiber for baskets, rope, nets), fish animals and use by people, campsites and trails – all this we incorporated with water.”

Internationally Relevant Standards and Resolutions

- **International : Clean Water is recognized as a human right**
 - **United Nations**
 - *General Assembly*
 - *Human Rights Council*
 - *Rio+20 Conference on Sustainable Development*
 - **World Health Organization**
 - **National (Canada)**
 - **Provincial (Manitoba)**

- **United Nations**

- **UN General Assembly: Resolution 64/292 (2010)**

- *Human Right to Water and Sanitation*

- *“The General Assembly recognizes the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights.” – UN General Assembly, 2010*

- **UN Human Rights Council: binding Resolution A/HRC/RES/18/1**

- *Reaffirming the human rights to water and sanitation.*

- **World Health Organization (WHO) (2011)**

- **Resolution 64/24**

- *Drinking Water, Sanitation and Health*

- *“To ensure that national health strategies contribute to the realization of water- and sanitation-related Millennium Development Goals while coming in support to the progressive realization of the human right to water and sanitation*

- **Rio +20 UN Conference on Sustainable Development**

- **The Future We Want: Our Common Vision (2012)**

- *Formal recognition of the human right to clean drinking water and sanitation*
- *UNDP's mandate to maintain biodiversity, ecosystems and the provision of ecosystem services*

- Sections 121-124 directly relevant

122. We recognize the key role that ecosystems play in maintaining water quantity and quality and support actions within the respective national boundaries to protect and sustainably manage these ecosystems

123. We underline the need to adopt measures to address floods, droughts, and water scarcity, addressing the balance between water supply and demand including where appropriate non-conventional water resources, and to mobilize financial resources and investment in infrastructure for water and sanitation services, in accordance with national priorities.

124. We stress the need to adopt measures to significantly reduce water pollution and increase water quality, significantly improve wastewater treatment, and water efficiency and reduce water losses. In order to achieve this end we stress the need for international assistance and cooperation.

- **Canadian Council of the Ministers of the Environment**
 - **CCME: Strategic Directions for Water (2009)**
 - *Prioritize valuation of biodiversity and ecosystem services*
 - *Two reports recommend monitoring and service valuation to aid in decision – making*
 - **CCME: Selected Tools to Evaluation Monitoring Networks for Climate Change Adaptation (2011)**
 - *Climate change planning, adaptation and mitigation*
 - *Specific to hydrological systems*
 - *Are monitoring programs providing the right data?*
 - *Sets priorities for Canadian water monitoring networks for climate change adaptation*
 - The first priority: conduct basic valuation methods for ecosystem services
 - *Basic valuation methods are flexible*
 - *Applicable at all scales*
 - *Do not require a lot of expertise*
 - *Require a limited amount of data*

- **CCME Water Valuation Guidance Document (2010)**
 - *“The CCME Water Valuation Guidance Document (2010) is a Canada wide reference document designed for water resource decision makers...to help establish how water valuation can assist in addressing water management issues, particularly in relation to conservation actions, infrastructure investment, water quality standard setting, water pricing, water allocation and compensation for use or damage... It is intended to enable decision-makers to determine:*
 - *How and when water valuation might be appropriate*
 - *Which valuation method(s) should be applied*
 - *How to interpret water valuation evidence”*

- **Council of the Federation: Water Charter 2010**
 - **Government of Manitoba pledge to observe it**
 - **Implementation: Water Stewardship Council**
 - *Initiative focused on the Value of Water*
- *“Value of Water: Many Canadians lack understanding about water's contribution to their health, security and prosperity, and its role in supporting critical ecosystems that lay the foundation for their livelihoods and thriving communities. Outreach materials that present a broad picture of water will help raise awareness of the value and importance of water, as well as the associated costs and challenges.”*

- **Water Protection Act, Province of Manitoba**
- *“Whereas an abundant supply of high quality water is essential to sustain all ecological processes, life-support systems and food production, and is paramount to the environmental, economic and social well-being of Manitoba now and in the future.”*
 - **High water quality and aquatic ecosystems require protection**
 - **Licenses can be denied or suspended to ensure protection and maintenance of aquatic ecosystems**
 - *Protect ecosystems, means protect the services*
 - *Laws apply to ecosystem services*
- **Purpose of the Act, Section 2**
 - *(a) that Manitoba’s social and economic well-being is dependent upon the sustained existence of a sufficient supply of high quality water*
 - *(c) that water resources and aquatic ecosystems require protection to ensure the high quality of drinking water sources*
 - *(d) the importance of applying scientific information in decision-making processes about water, including the establishment of standards, objectives and guidelines*
- **Protecting and Maintaining Aquatic Ecosystems – Section 9**
 - **9.1 (2) The minister may refuse to issue a license if...the action authorized by the license would negatively affect an aquatic ecosystem**
 - **9.2 The minister may suspend or restrict the rights under a license for a specified period if**
 - **(a) in the minister’s opinion, (i) a groundwater level,(ii) a water body level, or(iii) an in-stream flow, is insufficient to ensure that aquatic ecosystems are protected and maintained**
 - **(b) the minister’s opinion is based on scientific information about protecting and maintaining an aquatic ecosystem of the type under consideration**

- **Manitoba Water Strategy and Policy**
 - **Watershed Planning Framework**
 - **Essential drinking water sources should be preserved**
 - **Principles of Sustainable Development as a guide**
 - **Conservation is a priority**
 - **Manitoba Water Policies are a Foundation**
 - *“Protect and enhance our aquatic ecosystems by ensuring that surface-water and ground water quality is adequate for all designated uses and ecosystem needs.”*
 - **Participation of Manitoba Hydro, the resources sector, agricultural producers, industry and others essential**
- **Manitoba Water Quality Standards, Objectives and Guidelines**
 - **Policy 1.1: Keeyask region could be designated as ‘high quality’ or ‘exceptional value’ because it supports populations of rare or endangered flora or fauna (e.g., Lake Sturgeon).**
 - **Policy 1.2: water quality should be enhanced through management**
 - *Now law in Water Protection Act, 2011*

- **Manitoba Sustainable Development Act and Keeyask**
 - **Schedule B, *Guidelines for Sustainable Development*, requires resources be used efficiently**
 - **Section 1) (b) that projects must “employ full-cost accounting to provide better information to decision-makers.”**
 - **CEC Keeyask Generation Station Terms of Reference,**
 - **Section: Mandate of Hearings**
- **Full cost-accounting defined by Act:**
 - *“...accounting for the economic, environmental, land use, human health, social and heritage costs and benefits of a particular decision or action to ensure no costs associated with the decision or action, including externalized costs, are left unaccounted for.”*

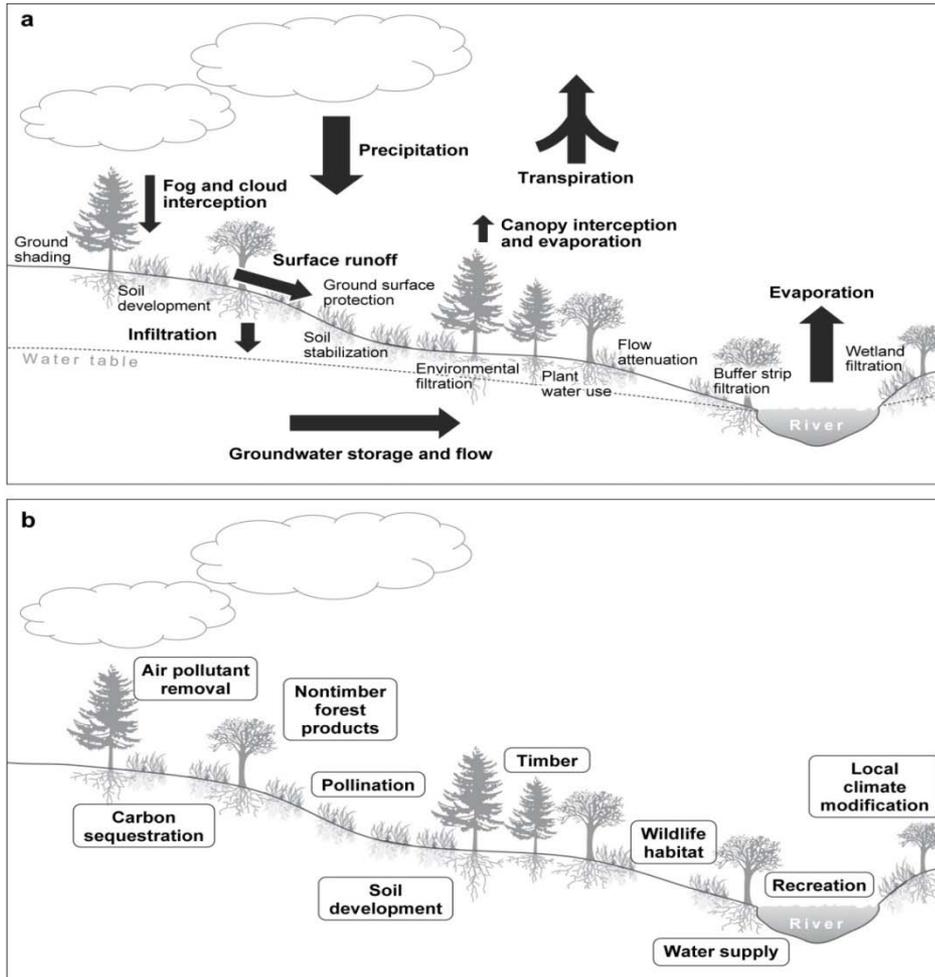
- **Expert witness Dr. Robert B. Gibson (CAC-Manitoba)**
 - **Proposed a set of evaluation and decision criteria for the Keeyask Generation Project**
 - **Consistent with concept of ecosystem services**
 - **Framework identified ecological services and regulation as a priority for evaluation and decision criteria:**
 - *“Topic: Improving the ecological basis of our livelihoods and wealth*
 - *Goal: Build human-ecological relations to establish and maintain the long-term integrity of socio-biophysical systems and protect the irreplaceable life support functions upon which human as well as ecological well-being depends.*
 - *Theme: Maintenance of ecological services and regulation”*

Does Keeyask Meet Standards and Regulation and Guidelines?

- **Information on ecosystem services needs to be incorporated into adaptive monitoring and management**
- **Keeyask Generation Project may not be fully consistent with the purpose and provisions of:**
 - **Manitoba Water Strategy**
 - **Manitoba Water Policies**
 - **Manitoba Water Quality Guidelines**
 - **Manitoba Water Protection Act**
 - **Manitoba Sustainable Development Act**
 - **CEC Terms of Reference**
 - **International Resolutions**
 - **National Guidelines**
 - **CCME**
 - **Recommended Sustainability Assessment Criteria and Framework**

Ecosystem Services Relevant to Keeyask Generation Station

Figure 1: Examples of Ecosystem Services Generated by the Water Cycle



- Many and varied
- benefits households, communities and economies receive from nature
- Support and maintain human life and all life
- Arguably all of above
- Examples in Figure 1.
 - A) water related
 - B) terrestrial

Ecosystem Services Relevant to Keeyask Generation Station

Table 1: Examples of Direct Drivers (Adapted from Millennium Ecosystem Assessment Program 2005)

Human Activity (Direct Driver)	Impact on Ecosystems	Examples of Services at Risk
Dam, Generation Station construction	alters timing, level and quantity of river flows. May create reservoir, Water temperature, nutrient and sediment transport, delta replenishment, blocks fish migrations, fragmentation by roads	provision of habitat for native species, subsistence and commercial fisheries, maintenance of deltas or large water bodies and their economies, productivity of estuarine fisheries, supporting services of lake or river if reservoir is created
Dike and levee construction	destroys hydrologic connection between river and lake habitat, maintains reservoir, GHG emissions, fragmentation by roads	habitat, subsistence and commercial fisheries, natural riverine and lake fertility, natural flood control, diminishes flushing flows
Diversions	changes river and stream flow, changes river stem into reservoirs, inundation, disturbs water system shores and river beds, releases GHGs	habitat, subsistence and commercial fisheries, recreation, pollution dilution, flushing flows, water quality, water supply, hydropower, transportation
Draining or flooding of wetlands	eliminates key component of aquatic ecosystem	natural flood control, habitat for fish and waterfowl, recreation, natural water purification
Deforestation/land use	alters runoff patterns, inhibits natural recharge, fills water bodies with silt, debris and sediment	Water supply quality and quantity, fish, birds, and wildlife water habitat, transportation, flood control
Release of polluted water effluents	diminishes water quality	water supply, water quality, habitat, subsistence and commercial fisheries, recreation
Overharvesting	depletes species populations, changes migration patterns, replacement patterns of species, etc.	Subsistence and commercial fisheries, waterfowl, other biotic populations
Introduction of exotic species	eliminates native species, alters production and nutrient cycling, changes natural predator prey cycles	subsistence fisheries,, water quality, fish and wildlife habitat, transportation
Release of metals and acid forming pollutants into the atmosphere water and land	alters chemistry of rivers and lakes	habitat, fisheries, recreation, water quality , affects diet, adds human health risks
Emission of climate altering air pollutants	potential for changes in ice patterns from increase in water temperature and changes in precipitation	water supply, hydropower, transportation, fish and wildlife habitat, pollution dilution, recreation, fisheries, flood control

- **Determine to what extent ecosystem services were included in the Keyask Generation Station EIS**
 - **Water quality**
 - **Biodiversity**
- **Documents reviewed include:**
 - **Response to EIS Guidelines**
 - **Environmental Monitoring Programs**
 - **Aquatic Effects Monitoring Plan**
 - **Terrestrial Effects Monitoring Plan**
 - **Physical Effects Monitoring Plan**
 - **Cumulative Effects Assessment Summary**

- **Supplement and clarify review**
- **Typical Inquiries:**
 - *Which ecosystem services were identified as being relevant to Keeyask Generation Project?*
 - *How were ecosystem services used to form conclusions in the EIS?*
 - *Did the Response to EIS Guidelines prove that Keeyask Generation Project would not have significant adverse environmental effects on ecosystem services relevant to water quality and biodiversity?*
 - *How were/are/ will ecosystem services be monitored or incorporated into monitoring programs?*
 - *Was a cost-benefit analysis, using ecosystem services or environmental valuation, conducted or included in the EIS?*
 - *Which data could be used to inform an ecosystem services assessment of the Project, watershed, and cumulative effects assessment?*

Responses to Information Requests

TABLE 2: EXAMPLES OF PARTNERSHIP RESPONSES TO INFORMATION REQUESTS REGARDING ECOSYSTEM SERVICES RELEVANT TO KEYASK GENERATION PROJECT

Information Request	Response
<p>CEC Round 1</p> <p>MB-Wildlands-0026a</p>	<p>“As discussed in the AE SV Section 2.3.1, existing water quality conditions were compared to Manitoba Water Quality Standards Objectives and Guidelines and the Canadian Council of Ministers of the Environment guidelines for the protection of aquatic life (PAL) to describe the suitability for aquatic life.</p> <p>“For the purposes of the EIS, the effect of water quality on functions [and ecosystem services] such as water regulation, water supply, erosion control and sediment retention and waste treatment was not relevant.”</p>
<p>CEC Round 1, Round 2</p> <p>CAC-0011</p>	<p>“The bio-physical and socio-economic VECs that were selected (along with supporting topics) capture the services provided by nature that are of benefit to people. Human benefits (i.e., ecosystem services) are either directly or indirectly represented by the KCNs evaluations or the socio-economic and resource use VECs and supporting topics.</p> <p>“For the purposes of the regulatory assessment, cumulative effects to ecosystem services are captured through the overall effects assessment for each VEC.”</p>
<p>CEC Round 2</p> <p>MB Wildlands-0095</p>	<p>“As discussed in CEC Rd 1 MB Wildlands-0025, the Partnership has completed its assessment of the potential environmental effects of the project and the development of long-term mitigation and monitoring plans, in accordance with guidelines issued by the regulatory authorities and standard environmental assessment methodology. The assessment guidelines do not require the partnership to specifically provide an ecosystem services assessment...”</p>
<p>CEC Round 1</p> <p>MB Wildlands-0031</p>	<p>“The assessment guidelines do not require the partnership to undertake an economic valuation of natural capital within the project area, nor is this standard environmental assessment practice. Similarly, the Partnership has not completed a Cost-Benefit Analysis or a Cost-Benefits Loss Analysis for the Project. It is possible that information collected through the monitoring programs could inform a valuation of natural capital for the project area; however the programs have not been designed for this purpose. The utility of the information collected through these programs for economic valuation purposes would need to be assessed by those interested in undertaking such an analysis.”</p>

- **Concerns**
 - **Ecosystem services not specifically considered in the EIS**
 - **Not considered relevant to regulatory assessment**
 - **Valuation stated to be not relevant**
 - **No cost benefit or cost-benefit loss analysis**
 - *Costs to degrading ecosystem services not included*
 - **Valued Environmental Components**
 - *Do not inherently capture all relevant ecosystem services*
 - *Need to be explicitly linked to services*
 - End points, service providing units, measures of account
 - *Mapping that shows trade-offs of services*
 - No evidence of assessment of water quality trade-offs for ecosystem services
 - **Conclusion of no significant adverse effects supported?**

- **Cumulative Effects Assessment**
 - **No cumulative effects assessment to ecosystem services in EIS**
 - **Mitigating cumulative effects to VECs**
 - **Intactness and Ecosystem Diversity**
 - *“Go with Nature”*
 - *Method not documented*
 - **Offsetting Wetlands**
 - *Ecosystem services not identified*
 - *So how can they be offset?*
 - *Especially in long term (100 years?)*
- **Climate Change**
 - **Effects to ecosystem services were not analyzed**

- **Adaptive Monitoring**
 - *“The most effective and productive scientific monitoring is adaptive, and is based on assessment endpoints that comprise ecosystem services, in other words, the benefits of Nature to human beings.”*
-Peter Chapman, 2012
 - **The purpose of monitoring:**
 - **Ensure that ecosystem services and goods are maintained**
 - **Expose a problem if one occurs in project planning, construction or operation.**
 - **If problem, then management intervention**
 - *to minimize or mitigate observed environmental effects*
 - **Improve planning, construction and operation practices**

Effects-based Monitoring

- **Effects-based monitoring**
 - **Effects-based monitoring (e.g. the state of an ecosystem in terms of SPU (Service Providing Unit) values compared to reference or baseline conditions**
- **Programs reviewed within Environmental Mgmt. Plan:**
 - **Aquatic Effects Monitoring Program (AEMP)**
 - **Physical Effects Monitoring Program (PEMP)**
 - **Terrestrial Effects Monitoring Program (TEMP)**
 - **Resource Use Monitoring Program (RUMP)**
 - **Socio-Economic Monitoring Program (SEMP)**

- **Effects –based monitoring for ecosystem services:**
 - **How do human activities, or the activities of the proposed Keeyask Generation Project, affect ecosystem service production in the RSA and LSA, and larger upstream and downstream regions?**
 - **How have ecosystem services changed relative to pre-hydro baseline and current conditions?**
 - **How will ecosystem services change with the proposed Keeyask Generation Project?**
- **None of these questions were asked or answered in EIS**
 - **See Table 3 (next slide)**
- **Reporting**
 - **Annual Data Reports**
 - **Periodic synthesis**

Effects-based Monitoring

TABLE 3: POTENTIAL PROBLEMS WITH KEYYASK GS PROPOSED MONITORING PROGRAMS

Characteristic Reviewed	Potential Problem
Ecosystem Services	<ul style="list-style-type: none"> Not included in EIS No ecosystem inventory conducted No baseline or reference conditions No plan to integrate ecosystem services into long-term monitoring Essential flows of ecosystem services not established No changes to ecosystem services established No modelling of project effects on ecosystem services No spatially explicit models of ecosystem services were
VECs	<ul style="list-style-type: none"> No VEC discussion in relation to ecosystem services Not explicitly inclusive of ecosystem services Not encompassing of all essential services Assessments and monitoring plans do not recognize that some VECs are proxies for services VECs not directly linked to final ecosystem services, or end points in assessment No physical environment component VECs identified or assessed in cumulative effects
Timeframe	<ul style="list-style-type: none"> Baseline conditions used already altered environmental state 30 years is stated time-frame in EIS; however current monitoring timeframes are short and inconsistent No long term mitigation or management interventions in proposed program
Integration and Scale-ability	<ul style="list-style-type: none"> No ability to scale up to a regional, or watershed ecosystem services assessment No ability to integrate ecosystem services into local or regional cumulative effects assessment No stated plans to integrate into regional or other monitoring programs in EIS that assess ecosystem services
Data	<ul style="list-style-type: none"> Metrics for ecosystem services not included, or not obvious No direct links stipulated from ecosystem function to ecosystem service provision No environmental valuation in assessment or planned Not designed for valuation techniques No trade-offs modelled explicitly using ecosystem services
Reporting	<ul style="list-style-type: none"> No comprehensive reporting on effects to ecosystem services No way to assess effects to human well-being Not readily assessable

EIS Process is Not Facilitating Informed Decisions

- **Compliance with regulations, rather than science or ecology, was found to be the driving factor influencing selection of indicators**
 - **Not useful for informing decisions**
 - **Often not based on ecological principles**
- **Case studies: Biodiversity, ecosystem functions and services are not being protected**
 - **35 EIS in South Saskatchewan River Watershed**
 - **Several Environmental Impact Assessments, US Case Studies**
 - **Indicators do not capture ecosystem services**
 - **No ability to scale up**
 - **EIS Guidelines do not capture stress placed on watersheds and rivers**
 - **Lack of information impedes informed decision-making**
- **How can projects identify significant adverse environmental effects?**
- **Reviews echo critical need to monitor, report ecosystem services**
 - **Project level**
 - **Regional level**
 - **Over space, time**
 - **Transparent**

Monitoring and Assessing Endpoints

- **Key considerations for monitoring and assessing endpoints:**
 - **Ecological relevance**
 - **Susceptibility to the stressor**
 - **Have clear management relevance and necessity**
 - **Be transparent, technically defensible, and subject to periodic review**
 - **Be integrative (internally and externally, linking with regional or other relevant monitoring programs)**
- **Linked to ecosystem services**
 - **Some services will have direct benefit over others**
 - **Translated into ecosystem service loss**
 - **Losses should be part of trade-off analyses**
- **Monitoring programs should aim to provide data to support evaluating trade-offs that affect flow of ecosystem services**

Baseline Data for Keeyask Generation Project

- **Baseline data for ecosystem services not included in Keeyask Generation Station EIS**
- **Baseline conditions used already impacted water-quality**
 - **Is this appropriate?**
 - **Perhaps, if the project focuses on mitigation and restoration**
- **Baseline conditions of pre-altered aquatic and terrestrial ecosystems should also included**

Metrics: Is Keeyask Collecting the Right Data?

- **Should comprise endpoints**
- **Final ecosystem services**
 - **Components of nature directly enjoyed consumed or used to yield human well-being**
- **Ecosystem function needs to directly relate to service**
- **Spatially explicit**
 - **Mapped using GIS and integrated databases**
 - **Identity trade-offs**
- **Serviceshed (Natural Capital Project)**
 - **Geographic area that provides a specific ecosystem service to a specific beneficiary**
 - **Catchment area upstream of where benefits are realized**
 - **Helps identify who is benefiting, and who is impacted**
- **Service Providing Units (SPUs)**
 - **Breaking services into measurable, standard units of account**
- **So, is Keeyask Collecting the Right Data?**
 - **Hard to say, based on current reporting and EIS**
 - **Probably some, yes**
 - **Is it accessible?**
 - **Is it transparent?**
 - **Is it scalable?**
 - **Response to IR says they have some data, but not readily available**

- **Effective monitoring programs need to incorporate up to date information in reporting**
- **Inform decisions and facilitate adaptive management**
 - **Convey relevant information to decision-makers**
 - **Implement management interventions and revise decisions**
- **Reporting is submitted based on regulatory requirements**
 - **Submitted annually to regulator for review**
 - *Annual technical reports*
 - *Periodic synthesis reports*
 - **Reported in an appropriate manner**
- **Issues**
 - **Regulations are often not clearly linked to ecology**
 - **Not linked to particular ecosystem functions and ecosystem services**

- **What is Appropriate?**
- **Hasn't been defined**
 - **But, it should look something like:**
 - **Explicitly link VECs to relevant ecosystem services**
 - **Link direct and indirect project effects to relevant ecosystem services**
 - **Facilitates evaluating the relative change in ecosystem service provision over time and space**
 - **Cumulative effects of ecosystem service change for the Keeyask Generation Project**
 - **Facilitates adaptive management by incorporating monitoring results into actions and decisions**
 - **Facilitates integration of Keeyask Generation Project data with cumulative watershed assessments**
- **Possibly examples:**
 - **State of the Nelson-Churchill Watershed Ecosystem**
 - **Nelson River Ecosystems Assessment**

Local and Global Examples of Frameworks

Table 4: Examples of TOOLBOXES, GUIDES, and METHODS for ecosystem services accounting and valuation techniques

Framework	Tool Description
The Economics of Ecosystems and Biodiversity (TEEB)	“A report on the fundamental concepts and state-of-the-art methodologies for economic valuation of biodiversity and ecosystem services;”
TEEB for Business Coalition: The Economics of Ecosystems and Biodiversity in Business and Enterprise	“Provides important evidence of growing corporate concern about biodiversity loss, and offers examples of how leading companies are taking action to conserve biodiversity and restore ecosystems.”
World Business Council for Sustainable Development	Guide to Corporate Ecosystem Valuation
Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES)	“A tool specifically focusing on biodiversity and ecosystem services, by providing assistance to countries in meeting their commitments to the three Rio Conventions and other multilateral environmental agreements. It targets improving the interface between science, policy and implementation...similar platform to the IPCC on Climate Change”
World Bank Wealth Accounting and Valuation of Ecosystem Services (WAVES)	“Seeks to promote sustainable development by ensuring that the national accounts used to measure and plan for economic growth include the value of natural resources. “
SEEA–Water, System of Environmental Accounting for Water. United Nations Statistics Division (UNSD)	Describe use and non-use valuation techniques for water: “An estimate of the total value of water should include all the use and non-use values. Use values refer to the use of water to support human life and economic activity. The values include (a) the direct use of water as a resource, (b) the indirect support provided by water ecosystem services, and (c) the value of maintaining the option to enjoy the direct or indirect use of water in the future (option values). Non-use values include the value of knowing the intrinsic value of water ecosystems (existence value) and that water and water ecosystems will be available to future generations (bequest value).”

Local and Global Examples of Frameworks

Table 4: Examples of TOOLBOXES, GUIDES, and METHODS for ecosystem services accounting and valuation techniques

Framework	Tool Description
NSERC Canadian Network for Aquatic Ecosystem Services (CNAES)	“The funding, from the Natural Sciences and Engineering Research Council ... encourages large-scale, multidisciplinary, collaborative research projects that could improve Canada’s economy, society and environment within the next decade. The CNAES is a consortium of 27 researchers from 11 universities, Canadian government scientists, industrial partners and environmental and technology associations that conducts research and training in aquatic ecosystems. The project applies the principles of Ecosystem-Based Adaptation—working to protect ecosystems and maintain essential ecosystem services in order to reduce the vulnerability of people to climate change impacts.”
Canadian Council of the Ministers of the Environment (CCME)	-Water Valuation Guidance Document (2010); -Selected Tools to Evaluation Monitoring Networks for Climate Change Adaptation (2011)
US EPA Eco Health Relationship ‘Browser	-Web based tool that shows the relationship between ecosystem services and human health: http://www.epa.gov/research/healthscience/browser/index.html
Natural Capital Project: InVEST	“ InVEST is a free and open-source software suite to inform and improve natural resource management and investment decisions. InVEST quantifies, maps, and values the goods and services from nature that contribute to sustaining and fulfilling human life.”
Natural Capital Project: RIOS	“The Natural Capital Project designed RIOS to provide a standardized, science-based approach to watershed management in contexts throughout the world. It combines biophysical, social, and economic data to help users identify the best locations for protection and restoration activities in order to maximize the ecological return on investment, within the bounds of what is socially and politically feasible.”
Natural Capital Project: Servisesheds	-The Serviseshed approach presents a method to analyze mitigation potential, from the perspective of people and incorporates natural capital mitigation into infrastructure projects;
SECoRA- Sediment-ecosystem Regional Assessment	Apitz,(2012) examines the role of sediments and pesticides in aquatic and terrestrial ecosystem services and provide examples of relevant Service Providing Units (SPUs).

Key Findings of Keeyask Generation Project Review

- **The EIS does not prove the project will have no significant adverse environmental effects on ecosystem services relevant to:**
 - **Water quality**
 - **Biodiversity**
 - **Other services necessary to sustain all of life**
- **Baseline information or reference conditions explicitly for ecosystem services for the RSA and LSA not included**
- **Trade-offs and alternatives for minimizing and mitigating effects to ecosystem services not considered**
 - **Ecosystem services not explicitly used in modeling**
- **The current project plans and mitigation efforts will affect current water and biodiversity related ecosystem services**
 - **However EIS does not appear to quantify effects**
 - **If they are quantified it is not reported in a way that information is readily available**
- *Therefore it is impossible to determine how Keeyask Generation Project will affect changes to ecosystem services over space and time*

Opportunities for Keeyask Generation Project

- **Manitoba Hydro and Keeyask Limited Partnership have an excellent opportunity!**
 - **Opportunity to conduct cumulative effects assessment on ecosystem services for Nelson River, or Nelson-Churchill Watershed**
 - **Opportunity to combine and assess all hydro projects**
 - **We do not recommend specific indicators**
 - *Provides examples of metrics and frameworks*
 - *Developed at local level*
 - *Relevant to local ecology, people and management decisions for Keeyask*

- **Recommendations to CEC regarding Keeyask Generation Project**
 - *Conduct an Ecosystem Services Inventory for project and region*
 - Identify measurable, quantifiable parameter end points that comprise the relevant ecosystem services
 - Establish a baseline of information, or reference conditions regarding ecosystem services and directly and explicitly link to VECs
 - *Assess and predict changes to ecosystem services and service loss within the project, region and cumulative effects assessment*
 - *Establish the true costs of Keeyask Generation Project by conducting an environmental valuation of ecosystem services*
 - *Incorporate ecosystem services into transparent, adaptive, long-term monitoring programs by directly linking ecosystem functions to services and service end points*
 - *Report on the status of ecosystem services and integrate information into watershed plans, assessments and cumulative effects assessments*
 - *Incorporate data from ecosystem services inventory, assessments, monitoring and reporting into management and policy decisions with the goal of sustaining and improving the flow of ecosystem services in the region*

THANK YOU. QUESTIONS?

Ecosystem Function vs. Ecosystem Services

The Value of the World's Ecosystem Services and Natural Capital (Costanza et al. 1997)

- **“Functions refer to the habitat, biological, or systems properties or processes of ecosystems”**
- **“Ecosystem goods and services represent the benefits human populations derive, directly or indirectly, from ecosystem functions”**
- **In some cases a single ecosystem service is the product of two or more ecosystem functions whereas in other cases a single ecosystem function contributes to two or more ecosystem services.**
- **Interdependent nature of many ecosystem functions**

The Value of the World's Ecosystem Services and Natural Capital (Costanza et al. 1997)

- **Capital: stock of material or information at a point in time**
- **Capital stock generates a flow of services to transform materials or enhance human welfare**
- **Use of stock may deplete it over time and space**
- **3 types and they interact to produce benefits**
 - **Natural: e.g., trees, minerals, energy, ecosystems, etc.**
 - **Manufactured: buildings, cities, machines**
 - **Human: bodies, culture, etc.**
- **How do changes in natural capital and ecosystem services affect human welfare?**
 - **Changes in ecosystem services will affect *maintenance of human wellbeing***
 - *Change benefits*
 - *Change costs*
 - **For project appraisal, ecosystem services lost must be weighed against the benefits of a specific project**