



**Department of Justice
Canada**

**Ministère de la Justice
Canada**

Security Classification/
Classification de sécurité :

Prairie Region
300, 10423 - 101 Street NW
Edmonton AB T5H 0E7

Région des Prairies
10423, rue 101 NO, bureau 300
Edmonton AB T5H 0E7

Telephone/Téléphone:
Facsimile/Télécopieur:
Email/Courriel:

<contact information removed>

<email address removed>

<email address removed>

Our File/Notre dossier: 2524675

Your file/Votre dossier: 65505

June 5, 2018

VIA ELECTRONIC MAIL: Frontier.Review@ceaa-acee.gc.ca

David Haddon – Panel Manager
Joint Review Panel Established to review the Teck Resources Ltd.
Frontier Oil Sands Mine Project

c/o Canadian Environmental Assessment Agency
160 Elgin Street, 22nd Floor, Place Bell Canada
Ottawa, Ontario
K1A 0H3

Attention: David Haddon

Dear Sir:

**Re: Teck Resources Ltd. – Frontier Oil Sands Mine Project
Joint Review Process - Reference Number: 65505**

Please find attached correspondence from Parks Canada and a copy of the Strategic Environmental Assessment for Wood Buffalo National Park World Heritage Site.

Please copy us with any correspondence seeking further information in respect of these documents.

Sincerely,
<Original signed by> 

 **Robert Drummond / James Elford**
Counsel
Prairie Region
Department of Justice Canada

Encls.



Parks
Canada

Parcs
Canada



4 June 2018

Joint Review Panel, Frontier Oil Sands Mine Project

Frontier.Review@ceaa.gc.ca

C/O Canadian Environmental Assessment Agency

160 Elgin Street, 22 Floor

Ottawa, ON, K1A 0H3

Subject: Submission of the Final Strategic Environmental Assessment for Wood Buffalo National Park

Parks Canada is pleased to deliver the final version of the Strategic Environmental Assessment (SEA) for Wood Buffalo National Park World Heritage Site (Attachment 1) to the Joint Review Panel for consideration during its review of the proposed Frontier Oil Sands Mine Project.

In July 2015, the World Heritage Committee requested that Canada undertake a SEA to assess the potential cumulative impacts of various developments (including hydroelectric dams, oil sands development, and mining) on the world heritage values of Wood Buffalo National Park World Heritage Site, and the Peace-Athabasca Delta (the PAD). In response, Parks Canada contracted a third party consultant to complete the SEA. The preparation of the SEA report involved consultation with Indigenous partners, government and the public, as well as workshops, meetings and a public comment period that closed on April 13, 2018.

The SEA brings together the best available information (Indigenous traditional knowledge and science) on activities and trends that may be having negative impacts on the environmental condition of the park and the PAD, and documents how the integrity and Outstanding Universal Value of Wood Buffalo National Park may be impacted by existing or proposed developments. The assessment is focused on cumulative effects on features and species that are relevant to the park's designation as a World Heritage Site. The SEA includes an extensive review of information and materials provided by experts, including representatives of Indigenous groups (leadership, knowledge holders, land-users, and advisors), researchers, industry, stakeholders, and government partners.

Thank you for taking this information into consideration in your review of the Frontier Oil Sands Mine Project. We will continue to provide updates to the Panel as additional material and reports become available. If the Panel requires clarification on any of the documents provided, please contact Leah de Montreuil ([\[email address removed\]](mailto:[email address removed])). Parks Canada requests this letter and the attached documents be posted on the public registry in the interest of transparency and for the information of other participants in the review process.

Sincerely,
<Original signed by>

Jonáh Mitchell

Superintendent, SW Northwest Territories Field Unit

Parks Canada

149 McDougal Road

PO Box 750

Fort Smith NT, X0E 0P0

Canada

VOLUME 1: MILESTONE 3 - FINAL SEA REPORT

Strategic Environmental Assessment of Wood Buffalo National Park
World Heritage Site



Independent Environmental Consultants (IEC)
70 Valleywood Drive, Suite 200, L3R 4T5

SLR



RAMBOLL
ENVIRON

Clifton Associates

May 2018

COVERING LETTER



Independent Environmental Consultants

70 Valleywood Drive, Suite 200

Markham, ON, L3R 4T5

Tel/Fax: 844-736-7369

PSX16-0057

30 May 2018

Parks Canada
Government of Canada
145 McDermot Avenue
Winnipeg MB R3B 0R9

Attention: Katherine Cumming
National Manager of Impact Assessment, Natural Resource Conservation Branch

RE: Final Strategic Environmental Assessment of Potential Cumulative Impacts of all Developments on the Outstanding Universal Value of Wood Buffalo National Park World Heritage Site

Independent Environmental Consultants (IEC) is pleased to submit this final Strategic Environmental Assessment (SEA) report. This two-volume report is being submitted in accordance with completion of Milestone 3 of the above noted Contract.

Yours very truly,

Independent Environmental Consultants

<Original signed by>

Donald M. Gorber, PhD, P. Eng.
President



ACKNOWLEDGEMENT

The journey to complete this Strategic Environmental Assessment has involved the gathering of a significant volume of available information, including both western science and Indigenous Traditional Knowledge. All of this has been accomplished through phone discussions with government staff, researchers, industrial associations and Non-Government Environmental Organizations, and face-to-face meetings with the local Cree, Dene and Métis representatives. This valuable and graciously provided information has made this report a more complete and holistic document.

In particular we valued the participation, cooperation, direct input, and review from the Indigenous groups in and around the Wood Buffalo National Park, including Mikisew Cree First Nation, Athabasca Chipewyan First Nation, Fort Chipewyan Métis Local 125, Little Red River Cree Nation, Salt River First Nation, Smith's Landing First Nation, K'atlodeeche First Nation, Deninu K'ue First Nation, and Northwest Territories Métis Nation (Hay River Métis Government Council and Fort Smith Métis, and Fort Resolution Métis Council). These groups have a generational commitment to the land, water and animals of the park and its surrounding area. They have lived there since long before the park was formed and, in remembering what it was like in the past, hope to restore it for future generations. They are proud and eloquent peoples with the ability to cut to the heart of the issue to develop powerful sayings such as "Water is Boss", which directly communicate their thoughts in a very meaningful way. The various meetings with Elders, councillors, land users and other community members were extremely valuable to this report. In spite of sharing their stories many times for similar studies, the land users were very generous with their time and participated in the SEA process in good faith. Each of the Indigenous groups were given an opportunity to review, edit and provide input to the report before it went out to others for review. For these generous and open contributions, we are extremely grateful.

There are many researchers working on environmental, social, cultural, Indigenous and engineering issues related to the park. Where there were alternative views on topics, we have tried to present both sides. We thank those researchers for their valuable input. To all members of the IEC team and all your valuable contributions, a heartfelt thanks. In particular, the endless hours put in by Lisa White and Cole Atlin in researching, writing, editing and meeting with the Indigenous peoples has to be recognized.

Lastly, this was a Parks Canada project. Their help in directing, coordinating, writing and editing the report, facilitating meetings with researchers, government partners, and Indigenous groups and providing guidance throughout the project was an extremely valuable contribution. Specifically, the extensive input and involvement by Katherine Cumming, Steve Oates, Patrick Yarnell, Stuart Macmillan, Cam Zimmer and Don Aubrey is greatly appreciated.

VOLUME 1: FINAL SEA REPORT

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SYMBOLS, ABBREVIATIONS AND ACRONYMS

~	approximately
<	less than
>	greater than
AB	Province of Alberta
ABF	Aboriginal Base Flow
ACFN	Athabasca Chipewyan First Nation
AERCB	Alberta Energy Resources Conservation Board
AFN	Assembly of First Nations
Al	aluminum
ANI	Aboriginal Navigation Index
ARB	Athabasca River Basin
As	arsenic
Avg	Average
AWBP	Aransas-Wood Buffalo Population of Whooping Cranes
AXF	Aboriginal Extreme Flow
BC	Province of British Columbia
BCA	Bison Control Area
C	Celsius
CAPMon	Canadian Air and Precipitation Monitoring Network
CAPP	Canadian Association of Petroleum Producers
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CEA	Cumulative Effects Assessment

CEAA 2012	<i>Canadian Environmental Assessment Act, 2012</i>
CEAA	Canadian Environmental Assessment Agency
CEMA	Cumulative Environmental Management Association
CH ₄	Methane
Cl	chloride
cm	centimetre
CMC	Cooperative Management Committee
CNPA	<i>Canada National Parks Act</i>
CBM	Community Based Monitoring
CFIA	Canadian Food Inspection Agency
CL-RAs	chlorinated resin acids
cm	centimetre
CO	carbon monoxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
Cr	chromium
CSS	Cyclic Steam Stimulation
CTMP	Chemical Thermo-Mechanical Pulping
Cu	copper
CWS	Canadian Wildlife Service
dam ³	cubic decametres
DBT	Dibenzothiopene
DFO	Fisheries and Oceans Canada
DKFN	Deninu K'ue First Nation
EA	Environmental Assessment
EARMP	Eastern Athabasca Regional Monitoring Program

ECCC	Environment and Climate Change Canada
EI	Ecological Integrity
EIS	Environmental Impact Statement
EMSD	Environmental Monitoring and Science Division
ENGOS	Environmental Non-Government Organisations
EROD	Ethoxyresorufin-O-deethylase
ETA	external tailings area
FA	Federal Authority
Fe	iron
FFT	fine fluid tailings
FPT	Federal, Provincial, Territorial
ft	feet
GHG	Greenhouse Gas
GIR	Government Industry Relations
GoA	Government of Alberta
GOWN	Groundwater Observation Well Network
GWh/year	Gigawatt hours per year
Ha	hectare
Hg	mercury
IAS	Invasive Alien Species
IEC	Independent Environmental Consultants
ITK	Indigenous Traditional Knowledge
IUCN	International Union for the Conservation of Nature
JOSM	Joint Oil Sands Monitoring
JPM	Jackpine Oil Sands Mine

JRP	Joint Review Panel
KFN	K'atl'odeeche First Nation
km	kilometer
km ²	square kilometre
L/s	litres per second
LAR	Lower Athabasca River
LARP	Lower Athabasca Regional Plan
LRRCN	Little Red River Cree Nation
m	metre
mm	millimetre
m ³	cubic metre
m ³ /year	cubic metres per year
m ³ /s	cubic metres per second
MAF	mean annual flood
Mb	molybdenum
MCBA	<i>Migratory Birds Convention Act</i>
MCFN	Mikisew Cree First Nation
MeHg	Methylmercury
Mg	magnesium
Mn	manganese
MOSR/A	Mineable Oil Sands Region/Area
MSES	Management and Solutions in Environmental Sciences
MW	Megawatt
N	nitrogen
Na	sodium

NAOS	Northern Athabasca Oil Sands area
n.d.	no date
ng/L	nanograms per litre
NH ₃	ammonia
Ni	nickel
NO	nitric oxide
NO ₂	nitrogen dioxide
NO _x	Nitrogen oxides
NMHCs	non-methane hydrocarbons
NRBS	Northern River Basins Study
NRCAN	Natural Resources Canada
NWT	Northwest Territories
O ₃	ozone
OSPW	Oil Sands Process-affected Water
OUV	Outstanding Universal Value
P	phosphorus
PAC	Polycyclic Aromatic Compounds
PAD	Peace-Athabasca Delta
PAH	Polycyclic Aromatic Hydrocarbon
PADEMP	Peace-Athabasca Delta Ecological Monitoring Program
Pb	lead
PBPAHs	products of biotransformation of PAHs
PBDEs	Polybrominated diphenyl ethers
PCA	Parks Canada Agency
PCBs	Polychlorinated Biphenyls

PM _{2.5}	particulate matter
PPPs	Policies, Plans, and Proposals
RAMP	Regional Aquatics Monitoring Program
RSEA	Regional Strategic Environmental Assessment
RFD	Reasonably Foreseeable Developments
RFP	Request for Proposals
RMM	Reactive Monitoring Mission
ROR	Run-of-River
SAGD	Steam-Assisted Gravity Drainage
SAOS	Southern Athabasca Oil Sands area
SARA	<i>Species at Risk Act</i>
Se	selenium
SEA	Strategic Environmental Assessment
SLFN	Smith's Landing First Nation
SO ₂	sulfur dioxide
SO ₃	sulfate
SRFN	Salt River First Nation
SWQMF	Surface Water Quantity Management Framework
TDS	Total Dissolved Solids
THC	Total Hydrocarbons
THg	Total Mercury
ToR	Terms of Reference
TP	Total Phosphorus
TRS	Total Reduced Sulfur
TSS	Total Suspended Solids

µg/L	Micrograms per Litre
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
US EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
V	vanadium
VC	Valued Component
VOC	Volatile Organic Compounds
WBEA	Wood Buffalo Environmental Association
WBNP	Wood Buffalo National Park of Canada
WHC	World Heritage Committee
WHS	World Heritage Site
WQI	Water Quality Index
Zn	zinc

DEFINITIONS

Aboriginal Base Flow (ABF)

A flow rate that “reflects a level on the Athabasca River and adjacent streams where MCFN members are able to practice their rights, and access their territories fully” (Candler et al., 2010).

Aboriginal Extreme Flow (AXF)

A flow rate that “reflects a level at which widespread and extreme disruption of Treaty and aboriginal rights occurs along the Athabasca river, delta, and tributaries due to a loss of access related to low waters” (Candler et al., 2010).

Bison Control Area (BCA)

An area created in 1987 to reduce the risk of tuberculosis or brucellosis spreading to uninfected bison in the Mackenzie, Nahanni and Hay-Zama (Alberta) populations. The BCA is managed as a bison-free zone designed to prevent bison from moving out of the Slave River Lowlands or WBNP area from coming into contact with uninfected populations.

Canadian Council of Ministers of the Environment (CCME)

Primary minister-led intergovernmental forum for collective action on environmental issues of national and international concern. It is comprised of the environment ministers from the Canadian federal, provincial, and territorial governments. The Council seeks to achieve positive environmental results, focusing on issues that are Canada-wide in scope and that require collective attention by a number of governments (Canadian Council of Ministers of the Environment, 2014a).

Critical Factors

Those characteristics of the environment essential to the integrity of important ecological, cultural or visitor experience resources that are likely to be affected by the proposal or activity. See also Valued Components.

Cumulative Effect

A change in the environment caused by multiple interactions among human activities and natural processes that accumulate across space and time (Canadian Council of Ministers of the Environment, 2014b).

Cumulative Effects Assessment (CEA)

A systematic process of identifying, analyzing, and evaluating cumulative effects (Canadian Council of Ministers of the Environment, 2014b).

Cumulative Effects Management

Identification and implementation of measures to control, minimize or prevent the adverse consequences of cumulative effects (Canadian Council of Ministers of the Environment, 2014b).

Cumulative Environmental Management Association (CEMA)

Multi-stakeholder group operating in the Regional Municipality of Wood Buffalo, Alberta that provides advice and recommendations to provincial and federal governments on management of cumulative impact of oil sands development in North-Eastern Alberta. The group has delivered management frameworks for Acid Deposition, Trace Metals, Nitrogen, Ecosystems and Water, and others parameters (Cumulative Environmental Management Association, 2012).

Cyclic Steam Stimulation (CSS)

Method applied to heavy-oil reservoirs to boost recovery during the primary production phase by injecting steam to thin the oil so it will more easily move through the formation to the injection/production wells (US Department of Energy, n.d.).

Ecological Integrity (EI)

A condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes. (s. 2(1) *Canada National Parks Act*)

Environment

Consistent with the Bellagio Principles of sustainable development, environment in this document adopts a holistic perspective and includes the biophysical and the human environment and their component interactions (Canadian Council of Ministers of the Environment, 2009).

Environmental Assessment (EA)

A generic term that is often used interchangeably as a qualifier for specific types of impact assessment, such as 'project-based' environmental assessment or 'strategic-based' environmental assessment (Canadian Council of Ministers of the Environment, 2009).

Indigenous Traditional Knowledge (ITK)

Commonly understood to refer to collective knowledge of traditions used by Indigenous groups to sustain and adapt themselves to their environment over time. This information is passed on from one generation to the next within the Indigenous group. Such Traditional Knowledge is unique to Indigenous communities and is rooted in the rich culture of its peoples.

Joint Oil Sands Monitoring (JOSM)

The Governments of Canada and Alberta have committed to implementing scientifically rigorous, comprehensive, integrated and transparent environmental monitoring of the oil sands region to ensure this important national resource is developed in a responsible way. Working together, the implementation of monitoring enhancements will ensure installation of necessary infrastructure and appropriate integration with existing monitoring activities in the region. Our efforts contribute to an improved understanding of the long-term cumulative effects of oil sands development (Government of Canada, 2017).

List of World Heritage in Danger

Properties which the World Heritage Committee has decided to include on the List of World Heritage in danger in accordance with Article 11 (4) of the World Heritage Convention (UNESCO- List of World Heritage in Danger, 2018).

Methodological Framework

A methodology is a higher-order activity—a framework or structure for organizing a process, a way by which SEA is performed, a system of conduct, a series of systematic steps (CCME, 2009).

Mineable Oil Sands Region (MOSR)

A 4,800 km² area north of Fort McMurray, AB where the top of the oil sands deposit lies less than 75 metres below the ground. This is the only area where surface mining has been deemed an appropriate extraction method (Alberta Environment and Parks, n.d.).

Outstanding Universal Value (OUV) (Also known as World Heritage Values)

The basis for a site's inscription on the World Heritage List, it is defined in paragraph 49 of the Operational Guidelines for the Implementation of the World Heritage Convention (WHC.15/01 8 July 2015) as "...natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole. The Committee defines the criteria for the inscription of properties on the World Heritage List" (WHC.15/01. July 2015).

Peace-Athabasca Delta Ecological Monitoring Program (PADEMP)

Initiated by Parks Canada in 2008, PADEMP is a multi-stakeholder group established to develop an integrated ecological monitoring program that can measure, evaluate and communicate the state of the Peace Athabasca Delta ecosystem including any changes to this ecosystem that result from cumulative regional development. PADEMP includes 11 Indigenous governments, 6 provincial, federal and territorial governments, and 2 non-governmental organizations.

Polycyclic Aromatic Compounds (PAC)

A group of more than 100 different chemicals that are released from burning coal, oil, gasoline, trash, tobacco, wood, or other organic substances such as charcoal-broiled meat. They can occur naturally when they are released from forest fires and volcanoes. Other activities that release PAHs include driving, agricultural burning, roofing or working with coal tar products, sound- and water-proofing, coating pipes, steelmaking, and paving with asphalt. PAHs are persistent organic pollutants. Polycyclic Aromatic Hydrocarbons (PAHs) are a type of PACs. (U.S. National Library of Medicine, 2018).

Project

For the purpose of this document, ‘project’ refers to physical actions, development activities, or physical works on the landscape as per the definition of ‘project’ under the *Canadian Environmental Assessment Act* (CCME, 2009).

Ramsar Convention

The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources (Ramsar website).

Regional Strategic Environmental Assessment (RSEA)

A process designed to systematically assess the potential environmental effects, including cumulative effects, of alternative strategic initiatives, plans, or programs for a region (CCME, 2009).

Reactive Monitoring Mission (RMM)

A component of statutory reporting on the state of conservation of specific properties that are under threat, as undertaken by the Secretariat and the Advisory Bodies to the World Heritage Committee. They are requested by the World Heritage Committee to ascertain, in consultation with the State Party concerned, the condition of the property, the dangers to the property and the feasibility of adequately restoring the property or to assess progress made in implementing such corrective measures, and include a reporting back to the Committee on the findings of the mission. The terms of reference of Reactive Monitoring Missions are proposed by the World Heritage Centre, in line with the decision adopted by the World Heritage Committee, and consolidated in consultation with the State Party and the relevant Advisory Body(ies) (WHC.15/01. July 2015).

State Party

States Parties are countries that adhere to the World Heritage Convention. In this context, Canada is the State Party, and as such, works with the provinces and territories in its implementation of the Convention. In the context of Decision 39 COM 7B.18, Canada as State Party, is working with Provincial and Territorial Governments with a role in approving or managing projects that may potentially generate impacts upon the OUV of WBNP. This includes the governments of Canada, British Columbia, Alberta, and the Northwest Territories. Parks Canada, as the federal agency responsible for implementation of

the World Heritage Convention in Canada, is taking a lead role to plan and host a Reactive Monitoring Mission whereby World Heritage Centre and IUCN representatives visit Canada at the request of the Committee to investigate the state of conservation of WBNP and the threats to its conservation status.

Strategic Environmental Assessment (SEA)

The systematic process of evaluating the potential environmental effects of proposed or existing policies, plans, and programs and their alternatives (CCME, 2009).

Steam-Assisted Gravity Drainage (SAGD)

High-temperature steam is injected underground through a horizontal well to melt the bitumen, allowing it to flow to an adjacent horizontal well. From there, it is pumped to the surface for further processing. Steam injection and oil production happen continuously and simultaneously. The resulting mixture of bitumen and water (which is condensed from the steam) is then piped from the producing well to a nearby upgrading plant, where the bitumen is separated from the water and treated. The produced water is then recycled to steam generators to generate new steam, which then travels through above-ground pipelines back to the wells for injection (ConocoPhillips Canada, 2018)

Valued Components (VCs)

Components of the environment (biophysical and human) that are identified as important ecologically, socially, or economically and are the focus of attention in environmental assessment (CCME, 2009).

World Heritage Convention

The World Heritage Convention, (Full title: "The Convention Concerning the Protection of the World Cultural and Natural Heritage"), was adopted by UNESCO in 1972 and signed by Canada in 1976. As of August 15, 2014 there are 191 countries ("State Parties") that are party to The Convention. Through this instrument nations of the world agree to inventory, recognize, and protect unique and irreplaceable properties of universal value.

World Heritage Site

Exceptional places around the world that are considered to have Outstanding Universal Value. As such, they are part of the common heritage of humankind. "State Parties," such as Canada, which have ratified UNESCO's 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage, have pledged to ensure the identification, protection, conservation, presentation and transmission to future generations of World Heritage sites in their territory and to avoid deliberate measures that could damage World Heritage in other countries (Parks Canada, 2017).

World Heritage Values (Also known Outstanding Universal Value (OUV))

The basis for a site's inscription on the World Heritage List, it is defined in paragraph 49 of the Operational Guidelines for the Implementation of the World Heritage Convention (WHC.15/01 8 July 2015) as "...natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent

protection of this heritage is of the highest importance to the international community as a whole. The Committee defines the criteria for the inscription of properties on the World Heritage List” (WHC.15/01. July 2015).

EXECUTIVE SUMMARY

Wood Buffalo National Park (WBNP) was established in the 1920s to protect the last remaining herds of bison in northern Canada. Straddling the boundary of northern Alberta and southern Northwest Territories, WBNP is the largest national park in Canada with an area of 44,807 square kilometres. In 1983, the global significance of WBNP was recognized with its designation as a world heritage site. The addition



of WBNP to the World Heritage List recognizes the international importance of the landscapes and species that the park protects. The world heritage values include: salt plains, gypsum karst, Great Plains boreal grasslands, wolf-bison predator prey relationship, migratory waterfowl, and the Peace-Athabasca Delta (PAD).

In 2014, Mikisew Cree First Nation (MCFN) petitioned the World Heritage Committee to have WBNP added to the List of World Heritage in Danger. For Indigenous groups that rely on the Peace-Athabasca Delta (PAD), their way of life, who they are, is interconnected with the world heritage values, specifically with maintaining healthy relationships between water, vegetation, birds, animals and people. Following their obligations as stewards of their territory, MCFN's petition described observations by MCFN Elders and land-users, and other evidence that existing upstream developments have driven the waters, lands and resources in the PAD – and MCFN's way of life – to a point of crisis. In 2015, the World Heritage Committee responded to the petition by asking Canada to undertake a Strategic Environmental Assessment (SEA) of the cumulative impacts of all developments (including hydroelectric dams, oil sands development, and mining) on the world heritage values of WBNP World Heritage Site. The results of the SEA are reported in this document.

Considering the pace, scale and complexity of potential threats to WBNP, the overall objective of the SEA is to assess the cumulative impacts of all developments on the world heritage values of WBNP in a way that is inclusive of Indigenous Traditional Knowledge and science. Specific objectives are:

- To improve the identification, recognition, and management of cumulative effects impacting WBNP;
- To inform the scope and support the effectiveness of project-level environmental assessments; and,
- To influence the development and implementation of the Action Plan for the protection of the world heritage values of WBNP.

These objectives are for the interconnected purposes of protecting the world heritage values of the site, maintaining or restoring ecological integrity of WBNP, and maintaining or restoring Indigenous ways of life.

SEA Methods

As a 15-month strategic assessment that will inform ongoing action, the SEA did not initiate any new studies, either science or Indigenous Traditional Knowledge. The SEA relied on an extensive review of information and materials provided by experts, including representatives of Indigenous groups (leadership, knowledge holders, land-users, and advisors), researchers, industry, stakeholders, and federal and provincial governments. The assessment was challenged by the complexity of the ecosystem it evaluated, the volume of information, as well as by the relatively short timeline for completion of the project. The assessment was further limited because no data was collected or analysed (ITK or science). All findings are subject to the limitations of available information, much of which was originally collected in order to meet other goals.

The SEA begins by identifying desired outcomes for WBNP's world heritage values. Achievement of these outcomes is central to protecting the world heritage values, the ecological integrity (EI) of WBNP, and Indigenous ways of life. The SEA then uses existing scientific information and Indigenous Traditional Knowledge to describe the current status of the world heritage values, the pathways of effects likely to influence those values, and the current trends that have been observed. It then examines the potential impacts of reasonably foreseeable developments, and climate change, on the pathways of effects. The SEA concludes with 44 recommendations to restore objectives that are not being met and address gaps in information.

Current status, trends and pathways of effects

Migratory waterfowl from four continental flyways converge in great numbers on WBNP, especially in the PAD which provides critical wetland habitat for migrating, breeding, molting and staging birds. The spring and fall migratory waterfowl are very important to the Indigenous groups, peoples and communities social, economic, cultural, and spiritual needs. Indigenous Traditional Knowledge indicates populations of waterfowl that have typically stopped in WBNP during migration have shifted their migration route to other areas. Changes in hydrological regime have also decreased the quantity and quality of habitat for waterfowl. As a result, the ability of Indigenous groups, peoples and communities to practice their traditional way of life is being negatively impacted, and desired outcomes for the world heritage values are not being met.



Evidence suggests that the desired outcomes for the karst, salt plains and Great Plains boreal grasslands are being achieved. Stable, neutral trends have been observed for these world heritage values. One observed exception to this trend is the grasslands which support bison. These grasslands are declining in extent or quality as a result of changes to the amount of water recharge occurring in the PAD. Whooping cranes are not yet at the desired population goals, but their populations are increasing so the



trend is positive. More analysis is needed to understand the current status of the wolf-bison population dynamics, but bison at their current population and distribution do not adequately support Indigenous ways of life.

The PAD is one of the world's largest inland deltas and arguably the largest boreal delta in the world. It is formed by a unique system of waterways created by the convergence of the Peace and Athabasca Rivers, along with many smaller rivers and creeks, on the west side of Lake Athabasca. The Indigenous peoples of

Fort Chipewyan introduce the PAD, or *Ayapaskaw* in Cree, in a much different way. Their stories about the PAD make it clear that the PAD is their home, their grocery store, their classroom, their medicine cabinet, their church, their highway, their photo album, and the place where their happiest memories live. For many Elders and land-users, how they think and how they see the world comes from the PAD.

We were all born in different areas out on the land...[in] the delta, that's why I love the delta so much...this is where you're born and it's such a beautiful feeling when you go out there. It's like going home.

In the PAD, with the exception of one unknown trend and one mixed trend, all pathways of effects and valued components are showing negative trends. In particular, flow rates in the Peace River have become less variable due to flow regulation on the river and (past) climate change, resulting in decreased summer flows and increased winter flows. Seasonal flows in the Athabasca River have declined over the past fifty years due to a combination of increased water withdrawals and (past) climate change. Flow rate changes on the Peace and reduced seasonal flows on the Athabasca, in conjunction with climate change, have decreased water levels and the extent of open water in the PAD.

While science monitoring of water quality over 6 years has shown a stable trend, Indigenous land-users in the PAD report noticeable changes in the qualities of surface water in the rivers and lakes of the PAD over the last five or six decades. Many land users who used to dip a cup into the water and drink it, now refuse to. Without the springtime flush of water through the PAD, water bodies can become stagnant. In addition, land-users are concerned about the contamination that may be coming down the rivers from municipal, agricultural and industrial development. They are also seeing deformed fish, which the people will not eat when they catch them, and mercury has also been found in high levels in fish and bird eggs, so consumption limits were set by the government, further limiting access to food sources and further eroding confidence in local food sources.

Future development, climate change and management of cumulative effects



In order to assess the effects stemming from future development on the world heritage values of WBNP, future developments with the potential to affect the park were identified. These included existing, and reasonably foreseeable developments such as: hydroelectric development, oil sands development, pulp and paper facilities, industrial mines, forestry activities, and municipal development.

With respect to climate change, the majority of relevant literature reviewed indicated future climate changes in the PAD over the next thirty-plus years will likely cause less surface water to be available, and what will be available will reach PAD water bodies earlier in the spring than at present. Increased temperatures will potentially produce thinner snowpack in the headwater and tributary areas of the PAD, which in turn will result in reduced average annual peak, spring peak, and summer flows. Anticipated increases in air temperature may also produce mid-winter thaws, which could cause winter flows to increase from current levels and have a negative impact on ice quality both in terms of safe travel across and in the structural quality of the ice and its ability to contribute to ice jam flooding events.

Predictions for trends combining the past trends, predicted developments and climate changes were only possible for migratory waterfowl, the PAD and Whooping Crane. With the PAD and migratory waterfowl desired outcomes already not being met and predicted negative trends, the predicted trends of these desired outcomes is negative. The trend of Whooping Crane population related desired outcomes were expected to continue to be positive.

The analysis was conducted within the context of the cumulative effects tools currently being used to manage the pathways of effects. The existence of such a broad suite of cumulative effects and other environmental effects management tools is evidence of the evolving sophistication of management of cumulative effects. Only a decade ago, this breadth of tools was not available. The SEA found that though these tools were mitigating impacts to the WBNP world heritage values, many tools had either not been completed or fully implemented, or were developed without analysis to ensure they were protective of the WBNP World Heritage Values.

Conclusions

The PAD, in particular, is a very complex ecosystem and as a result, there will always be unanswered questions. However, by applying the precautionary principle, a lack of information should not prevent action. Adaptive management solutions must be advanced with the involvement of Indigenous peoples and Indigenous Traditional Knowledge. Furthermore, collaborative approaches involving all parties will be necessary to develop the best possible mitigations and increase the likelihood of success. In particular, collaboration with Indigenous peoples will be important because it is Indigenous peoples who experience the impacts most directly given their intrinsic connection to the land.

The call for immediate action was repeated throughout the course of developing this SEA, in particular from Indigenous communities who rely on the PAD. While ecological monitoring and ITK have shown that with shifts in flooding, for example, ecosystems can rebound, permanent changes to the delta environment are possible and undesirable. Permanent changes could put at risk the world heritage values of the PAD and its ecological integrity, and would be particularly undesirable for Indigenous people who transfer cultural knowledge and skills to the next generation on the land in the context of carrying out traditional activities. When this knowledge is not passed down, communities risk losing their culture and connections to the land. The more time with lack of access, or changes to the quantity and quality of resources, the higher the risk that this transfer of knowledge is interrupted or prevented.

The recommendations in this report are put forward as considerations for the responsible jurisdictions in the multi-jurisdictional Action Plan that is presently being developed for WBNP.

1.0 CHAPTER 1: ASSESSMENT SCOPE AND FOCUS

The opening chapter of this report provides background about world heritage, defines strategic environmental assessment (SEA) and explains why and how a SEA is being applied to Wood Buffalo National Park (WBNP) World Heritage Site (WHS). The concepts described in this chapter include the purpose of the SEA and its guiding principles, as well as the impact of feedback from partners and stakeholders which influenced the structure and analysis of the report.

1.1 THE WORLD HERITAGE CONVENTION

Canada is party to the International Convention Concerning the Protection of World Cultural and Natural Heritage (the World Heritage Convention). The convention falls under United Nations Educational Scientific Cultural Organization (UNESCO) and is implemented by the World Heritage Committee, which meets annually, with the World Heritage Centre providing a secretariat function. By ratifying the convention, Canada has pledged to care for its world heritage sites. On behalf of Canada as a State Party to the convention, Parks Canada is the lead agency for responding to matters related to world heritage.

Based on the global significance of its landscape and the species it supports, WBNP is designated as a world heritage site (further detail on the criteria related to the inclusion of WBNP on the World Heritage List is presented in s. 2.2).

1.1.1 Initiating Petition

The SEA is part of a larger World Heritage process that was initiated through a December 2014 petition by Mikisew Cree First Nation (MCFN) to have the World Heritage Committee include WBNP on the List of World Heritage Sites in Danger. MCFN's way of life is interconnected with the Peace Athabasca Delta (PAD) in WBNP and MCFN Elders are traditional stewards of that area. According to MCFN, its petition is rooted in the Cree term, *kitaskina owicita*, which describes MCFN's obligation to see that the PAD is managed in a way that supports MCFN's way of life. MCFN's petition described observations by MCFN's Elders, community members and other evidence that existing upstream developments have driven the lands, waters and resources in the PAD – and MCFN's way of life – to a point of crisis. It also described MCFN's concerns that governments are not doing enough to respond to the existing and future threats to WBNP and MCFN's way of life (Candler et al., 2015b; Candler et al., 2010; Carver, 2013; MCFN, 2016a). In the words of MCFN's chief at the time when describing MCFN's petition:

We are simply asking for certainty for the Delta. Certainty that it will no longer be forgotten and certainty that Canada will stop ignoring its promises to MCFN and to the United Nations to protect this Delta (MCFN testimony to Reactive Monitoring Mission, Day 1)

In workshops related to development of the SEA, MCFN Elders and leadership have continued to stress how the concerns of MCFN have “fallen on deaf ears” and how inaction continues to put the PAD and MCFN's way of life in peril (MCFN, 2018b). Other Indigenous communities reliant on the Peace-Athabasca Delta in the southern part of WBNP supported MCFN's petition and have expressed similar concerns. This includes Athabasca Chipewyan First Nation (ACFN), and Fort Chipewyan Métis Local 125, both also located in Fort Chipewyan, as well as Smith's Landing First Nation (SLFN), all of which provided

letters of support for the petition. Little Red River Cree Nation (LRRCN) has raised similar concerns (“provided filing cabinets worth of information over the years”) about the impacts of flow regulation on the Peace River (LRRCN, 2018). Communities located north of WBNP on Great Slave Lake share similar concerns about the Slave River and its delta. MCFN’s petition was also supported by numerous environmental groups and researchers, including former Parks Canada officials.

Not all of the eleven Indigenous communities that work with WBNP on a regular basis were involved with the petition, nor support MCFN’s approach, or share MCFN’s concerns about the health of WBNP (CMC, 2017; SRFN, 2018). However, all groups have met with Parks Canada and the contractor about the SEA, and 10 of the 11 communities have contracts with Parks Canada to support their involvement with the SEA. Several Indigenous communities located south of WBNP have also expressed support for MCFN’s concerns and expressed interest in the SEA and Action Plan. Additional information on Indigenous perspectives and involvement with the SEA are provided in Section 2.3.

Following its annual meeting in July 2015, the World Heritage Committee posted Decision 39 COM 7B.18 which outlines several initiatives that Canada is requested to undertake as a result of the Committee’s review of MCFN’s petition. Included within that request, Canada must “undertake a Strategic Environmental Assessment (SEA) to assess the potential cumulative impacts of all developments on the OUV of the property, including hydroelectric dams, oil sands development, and mining, in line with IUCN’s [International Union for the Conservation of Nature] World Heritage Advice Note on Environmental Assessment.”

1.1.2 Request for an SEA

In its decision requesting that Canada undertake this SEA (Decision 39 COM 7B.18), the World Heritage Committee noted that there were concerns about the ecological integrity of the PAD. The request to conduct a SEA indicates that, from the viewpoint of protecting the global significance of WBNP’s landscapes for future generations, the possibility exists that increased development around WBNP has resulted in negative environmental impacts on the world heritage values and warrants attention.

As Canada’s representative for the World Heritage Convention, Parks Canada issued a Request for Proposals, and in December 2016, Independent Environmental Consultants (IEC) was retained to carry out the SEA.

1.1.3 Reactive Monitoring Mission

Also within its 2015 decision, the World Heritage Committee requested a field investigation. Parks Canada had the lead role for planning and hosting a Reactive Monitoring Mission (RMM) whereby representatives of the World Heritage Committee and the International Union for the Conservation of Nature (IUCN) would jointly visit Canada to investigate the state of conservation of WBNP and the potential threats to its world heritage values. After a postponement due to wildfires in the region, the RMM took place from September 25 to October 4, 2016. Its public report was issued March 10, 2017. The RMM report is separate from this independent SEA, but provides insight into the international concerns about how the changing nature and scale of development around WBNP may be impacting the site’s world heritage values.

The RMM noted that many of the values justifying WBNP's World Heritage status are concentrated in the PAD. The mission highlighted that the PAD is both disproportionately important and disproportionately vulnerable from the perspective of both conservation values and values to Indigenous peoples. The RMM concluded that cumulative impacts on WBNP directly impact Indigenous peoples.

The RMM determined that the concerns about the PAD described by MCFN and others were not overstated and that documented changes can be linked to decades of industrial development along the Peace and Athabasca river corridors. Ultimately, the RMM concluded that the threats to WBNP's OUV have reached a point that major and timely actions are urgently needed to ensure the park's ecological integrity.

1.1.4 Request for Action Plan

The state of conservation of WBNP was again discussed at the World Heritage Committee's July 2017 meeting. At that meeting the World Heritage Committee rendered Decision 41 COM 7B.2, wherein it requested Canada respond to the recommendations of the 2017 RMM report by developing an Action Plan. This decision noted the pace, scale and complexity of development around WBNP. The Action Plan is due December 1, 2018 and will outline a coordinated, multi-jurisdictional approach for addressing concerns about the world heritage values of WBNP. The SEA results will inform the development of this Action Plan and this report includes recommendations regarding research, monitoring, and management.

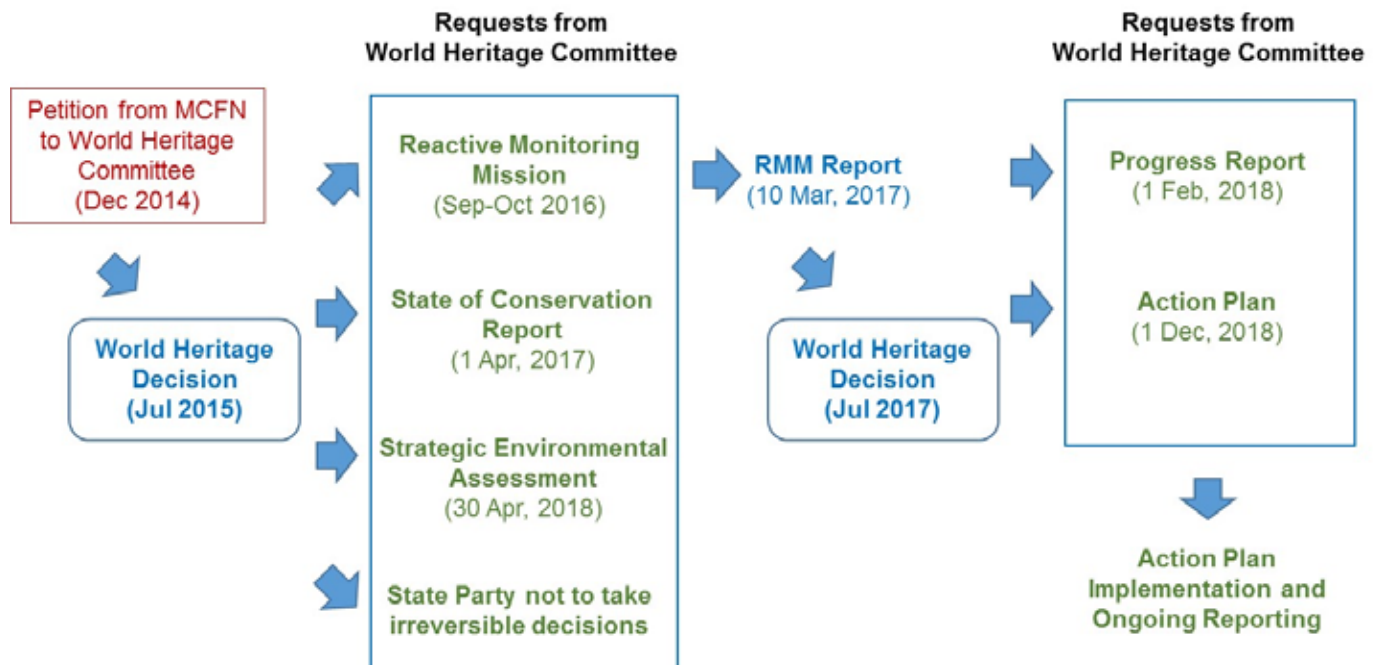


Figure 1-1 illustrates the connections between the petition and the subsequent requests from the World Heritage Committee.

Figure 1-1: Connections Between the Petition and the Requests from the World Heritage Committee.

The request from the World Heritage Committee indicates that attention to the world heritage values of WBNP needs to involve decision makers from multiple jurisdictions and sectors, and needs to include Indigenous rights-holders and stakeholders. The Action Plan will build on the shared understanding of the values, impacts and indicators developed through the SEA. The use of SEA for this project, as requested by the World Heritage Committee, aligns well with concerns brought forward in the petition and in subsequent meetings and workshops. Elders from the delta are not questioning whether environmental changes are happening, but they are seeking answers and urgent action (MCFN, 2018a). In separate meetings with representatives of each of the Indigenous groups based in Fort Chipewyan, individuals wondered if SEA and Action Plan “may be 40 years too late” (Métis Local 125, 2018a; ACFN, 2018a).

1.2 INTRODUCTION TO STRATEGIC ENVIRONMENTAL ASSESSMENT

SEA is a separate type of environmental assessment, different from the environmental impact assessments that examine the effects of a single proposed project. Project-level assessments are more common and have an established methodology, while SEA practice has been more flexible (Noble & Storey, 2001; Noble, 2009). The focus of a project assessment is outward from the proposed activities that may impact the environment (i.e., looking “downstream” to the environment), but the focus of this SEA is outward from the environment, based on observed changes in environmental conditions (including looking “upstream” and to broader influencers of change). Project-level assessments tend to consider a much smaller scale or scope, such as the project footprint and its vicinity, and tend to be focused on the decision about the proposed project, while SEAs are applied to larger areas and can inform a range of decisions by multiple decision makers at the policy and regional, as well as project levels.

An SEA process can address broad goals and objectives, and lead to a proactive strategy for action by providing information to help answer the question “what is the preferred future?” (Noble & Storey, 2001). As a higher-level approach, advantages include that SEA facilitates proper attention to cumulative effects, increases transparency, and improves the information base for decision making (Caratti, Dalkmann, & Jiliberto, 2004). In the case of this SEA, the preferred future is the protection of WBNP world heritage values.

The specific focus of this SEA is the potential threats to the “world heritage values” of WBNP. The site’s world heritage values (technically referred to as the Outstanding Universal Value or OUV) relate to the reasons why WBNP was designated a world heritage site. In general, these globally significant values are the landscape-level features that represent unique and important conservation opportunities at the world scale. In the current case these include the salt plains, karst landscape, relatively undisturbed boreal forest, and the Peace-Athabasca Delta (PAD) ecosystem, and some specific threatened and important wildlife they support, including migratory waterfowl, Whooping Crane, bison and wolves. Further detail on the criteria related to WBNP’s designation as a world heritage site is provided in Section 2.2.

1.2.1 Cumulative Effects and SEA

SEAs are particularly relevant in regions with extensive potential, planned or existing industrial and resource development (Harriman & Noble, 2008). Complex development pressures have the potential to result in cumulative effects, meaning “changes to the environment that are caused by an action in combination with other past, present and future human actions” (Hegmann et al., 1999), for which existing policy frameworks may be unprepared. Combined actions may not only be additive, but may combine to create new effects or effects that are unexpectedly severe.

SEA recognizes that effects can combine in a number of different ways, and that “ideally, cumulative effects should be assessed relative to a goal in which the effects are managed on a regional basis.” (Hegmann et al., 1999, p. 7). SEA is designed to consider cumulative effects, and overlapping jurisdictions. The benefit of a SEA process is to “systematically evaluate cumulative effects of multi-sector land uses and surface disturbances in a region – evaluating past, present and alternative future scenarios and conditions of development, (and) asking ‘what if’ questions about cumulative change to inform regional sustainable development” (Noble, 2009).

WBNP as a national park allows only limited infrastructure and activities. However, it is located downstream from hydroelectric dams, oil sands mines, forest land tenures, and expanding municipal and agricultural activities, among other developments. Within WBNP, the PAD is a place where waters combine from the Peace River from the west and the Athabasca River from the south, and Lake Athabasca and its tributaries from the east, into one vast, complex, interconnected system of delta environments. The large scale of the basins that feed the PAD, and the varied types of land use through which these waters flow on their way to the PAD make this an obvious case for the possibility of cumulative effects (**Figure 1-2**).

Typical project-level assessments define cumulative effects in a limited way, following the identification of “residual effects” based on a proponent’s analysis of the impacts of specific activities on the environment, and the ability to avoid or manage those impacts. The residual effects are those impacts that remain after mitigation measures have been employed, and the potential cumulative effects of these residual impacts are then considered. In the case of this SEA however, the potential cumulative effects include the changes that have been observed in the receiving environment over a period of time. These observations of changes to the environment started with Indigenous Traditional Knowledge (ITK) and the SEA seeks to collect and compare all available ITK, government monitoring results, academic research and other sources of information to present a full, balanced, independent assessment of changes, including what activities or trends may be combining to cause the changes, and what management alternatives could be considered in the future to avoid or reduce cumulative effects.

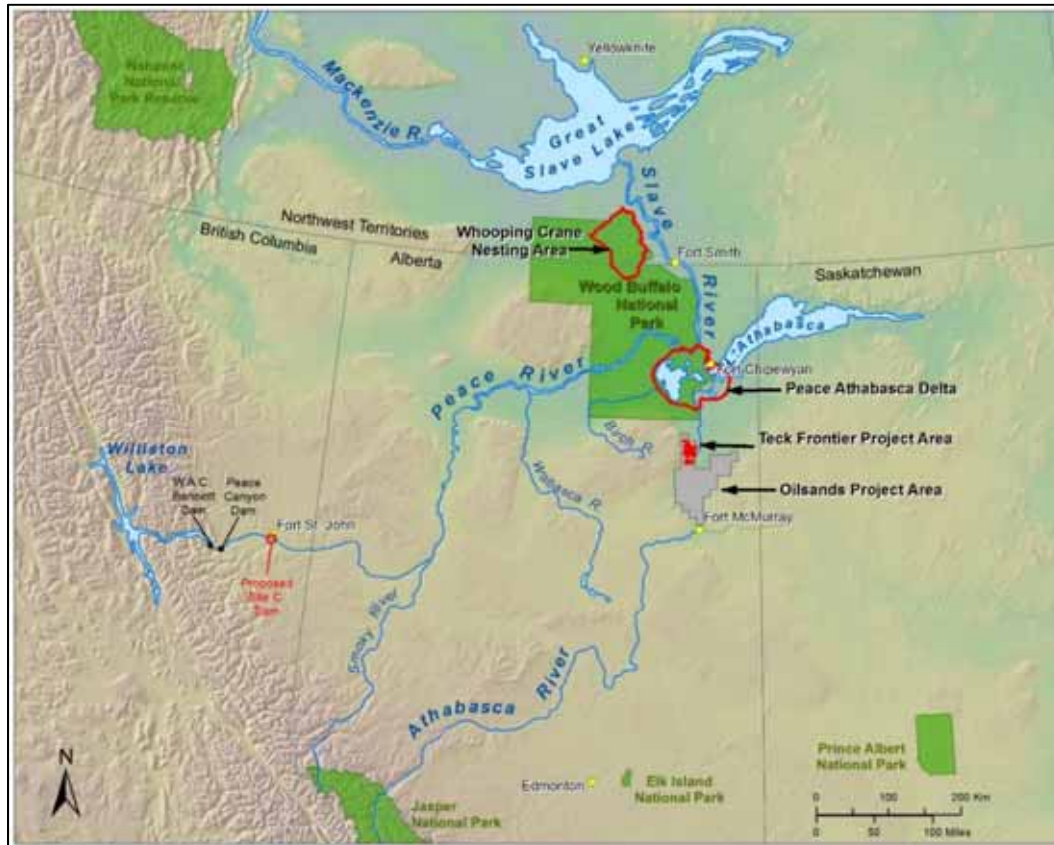


Figure 1-2: Location of WBNP at the Confluence of the Peace and Athabasca Rivers

1.2.2 Cumulative Impacts to Indigenous Ways of Life

In recent years, the global conservation community has acknowledged the injustices to Indigenous ways of life caused by traditional approaches to conserved areas. These approaches separated conservation values and Indigenous peoples cultural, spiritual and other values. The World Heritage Committee has encouraged State Parties to involve Indigenous communities in the monitoring and evaluation of the state of conservation of World Heritage Properties. These acknowledgements and recommendations have clear implications for evaluations like this SEA.

At every stage of this SEA, Indigenous peoples clearly articulated that the interconnected relationship between their ways of life and WBNP meant that this SEA must both incorporate their ITK and consider cumulative effects on their ways of life. This SEA acknowledges the inseparable links between the Indigenous communities of WBNP and WBNP's conservation values. Indigenous knowledge systems provide another source of information, and an alternative framework of hypothesis, understanding, social rules, and relationships that produce critical insight into ecological and cultural relationships. As traditional stewards of WBNP's lands and waters, Indigenous land-users in WBNP, and especially the PAD, are able to provide specific examples of changes have experienced in their lives that are understood to have resulted from cumulative effects, and such examples will be expanded upon throughout the SEA report. For example:

- combined effect on changes to water levels in the delta related to changes to flow patterns from both rivers, including volume and timing;
- combined impacts on water quality related to lower water levels and concerns about increasing contaminants;
- combined effects on the break-up of Peace River ice related to higher flows in the winter and reduced peak flows in the spring;
- combined impacts of industrial light and noise south of the park (deflecting birds away from the park) with vegetation changes in the PAD and outside the park (the PAD becoming relatively less attractive to the birds); and,
- environmental and access limitations (because birds and animals don't use as many places and/or because land-users can no longer get to certain places) can cause a higher level of travel and harvesting in more concentrated areas, which can cause further changes in the behaviours of animals and people.

Also, Elders and land-users explain that everything is connected: every environmental change can “break a chain” in the ecosystem and have additional effects, making natural cycles less predictable, and traditional activities more uncertain or impossible to undertake. This is acutely the case in the PAD, where Indigenous communities say “water is boss” and “water is everything”, *nipî tapîtum* in Cree, meaning that changes to water quantity and quality reverberate and amplify through the entire PAD ecosystem and the Indigenous communities that rely on the PAD. For example:

- lower water and longer periods without flooding cause vegetation to change (lakes, wetlands and grasslands change into dry areas with thistle and old willow);
- wetland vegetation provides the habitat and food for geese, ducks, muskrat, moose and bison, etc. so the birds and animals no longer come to dry areas; and,
- predator-prey relationships can change because wolves have an easier time hunting in dry areas than in water, and if bison no longer come to an area, wolves may hunt more moose.

Indigenous peoples of WBNP are also able to provide evidence of how these environmental changes combine to impact the ability of Indigenous peoples to exercise their rights and remain connected to their lands and culture. For example:

- low water on rivers and lakes makes travel difficult, limiting access to camps and wildlife;
- the need to carry drinking water (extra weight) due to concerns about pollution adds to the difficulty of travel;
- access challenges increase the efforts, time, costs and risks associated with traditional activities, causing stress for land-users;
- due to access challenges, costs and risks, cabins become difficult to maintain;

- access challenges combined with a less reliable supply of birds, eggs, moose, muskrats, etc. make traditional activities less inviting/rewarding (effort is increasing, success is decreasing);
- people consume less country foods, increasing costs and diminishing connections to the land;
- families can be separated from areas of spiritual significance, where they have rights, stories, and access to country foods, creating loss of confidence and pride, and social challenges as access/territories shift;
- cultural norms such as sharing within the community before filling your own freezer can be altered; and,
- Elders lose the opportunity to teach future generations, while youth lose the opportunity to learn cultural stories and skills.

This connection between impacts to place and people is illustrated by the words of one former councillor and Elder:

I may be alive, but if I can't practice my culture, if I can't enjoy being a Cree, what am I? If I can't enjoy being a Cree out on the land, what am I? And like I said, when we were born, when we were raised out there [in the Delta], it was the most happiest times. Those times, those feelings...never leave you. So how could I be somebody else different when that's who I am? That's my connection there. I never, ever knew I'd be talking like this. Seriously, never. To fight for who you are in this day and age. Never thought that...We're not asking them to change the whole Wood Buffalo National Park. We're not asking them to change the whole Alberta. We're asking them to make sure that you keep our Delta clean the way it used to be...It's not like we're asking for the end of the world...It's just maintaining our way of life, that's all.

Connections between a healthy environment and Indigenous ways of life in the PAD are described in s. 1.4.3, and further examples will be shared throughout the SEA.

1.2.3 Benefits of SEA

By working with a diverse range of representatives from Indigenous communities, federal and provincial governments, industry, and environmental non-governmental organizations (ENGOS), this SEA endeavors to provide a balanced and independent assessment of changes to the environment in and around WBNP based on the best available information. The first step in better management of cumulative effects in the region is to gain a better understanding of the activities and impact pathways that are affecting the world heritage values of WBNP. This SEA is focused on improving that understanding, and to the extent possible, creating a shared understanding, through a balanced assessment of past and present environmental conditions at the site. In addition, the SEA offers a first look at what possible future conditions and cumulative effects may manifest themselves, given continued expansion of industrial activities in the region and the influences of climate change.

The potential for cumulative effects in and around WBNP are of concern when considered in conjunction with projected industrial and municipal development in the region and the additive effects possible from

climate change (addressed in Chapter 6). Other considerations include: not all development pressures undergo project-level environmental assessments (e.g. municipal and agricultural expansion); some older projects may not have undergone rigorous assessment (e.g. the W.A.C. Bennett Dam in the 1960s); and, the pace, scale and complexity of development in areas surrounding WBNP have increased dramatically since the park was added to the World Heritage List in 1983. Additional detail on increased development pressures around WBNP are provided in Section 2.4 and throughout the analysis.

In summary, while previous project-level assessments outside WBNP have found that individual projects may have significant effects on particular local areas, or on particular limited aspects of the regional environment, the focus of this SEA is on the accumulation of large and small impacts coming from different places and different activities that may combine to impact the world heritage values of WBNP.

1.3 PURPOSE OF THE SEA

The original purpose of this SEA was to determine the cumulative impacts of all developments (including hydroelectric dams, oil sands development, and mining) on the world heritage values of WBNP. The objective of the project, as stated in Parks Canada's Request for Proposals (October 2016) was:

...to assess the cumulative impacts of present and proposed industrial development projects located outside WBNP upon the Outstanding Universal Value of Wood Buffalo National Park. The SEA requirements outlined in the UNESCO [United Nations Educational, Scientific and Cultural Organization] WHC decision document (Decision 39 COM 7B.18) are the primary requirement that must be fulfilled in this contract. Methods employed in undertaking this work will be based on scientific analysis using the best existing information available, not on primary investigations, or field work.

A number of comments received on the Draft Scoping Report (during September 2017), indicated that this purpose was limited in its breadth and considerations. As a result of the consultation, the purpose of the SEA was expanded as follows:

Considering the pace, scale and complexity of potential threats to WBNP, the overall objective of the SEA is to assess the cumulative impacts of all developments (including but not limited to hydroelectric dams, oil sands development, and mining) on the world heritage values of WBNP in a way that is inclusive of Indigenous knowledge and science.

Specific objectives are:

- To improve the identification, recognition, and management of cumulative effects impacting WBNP;
- To inform the scope and support the effectiveness of project-level environmental assessments; and,
- To influence the development and implementation of the Action Plan for the protection of the world heritage values of WBNP.

These objectives are for the interconnected purposes of protecting the world heritage values of WBNP, maintaining or restoring ecological integrity, and maintaining or restoring Indigenous ways of life.

The goal of the SEA is to inform the Action Plan for WBNP and regional land-use policies and decisions. As described in the *IUCN World Heritage Advice Note on Environmental Assessment*, “ultimately, the aim of environmental assessment is to equip decision-makers with the information necessary to preserve these exceptional sites for future generations” (IUCN, 2013). This SEA provides an independent assessment of the activities and trends that may threaten the park’s world heritage values and the Indigenous ways of life that depend on many of those values. It endeavors to present a collective view of the cumulative impacts, and the findings of the SEA can be used by decision makers and affected parties to focus their individual and collective responses to the protection of WBNP’s world heritage values.

1.4 GUIDING PRINCIPLES

The updated purpose statement provided guidance on how to move forward with the SEA. In addition, feedback on the Draft Scoping Report broadened the scope of assessment and improved the process of the assessment to consider more information and to make more transparent the way various sources were used. Further details on the changes made as a result of comments on the Draft Scoping Report are provided in Section 1.5.2.

The SEA’s purpose statement provides three guiding principles as focal points for the analysis:

- world heritage values,
- ecological integrity, and
- Aboriginal rights and Indigenous ways of life.

In the analysis, effects were considered in terms of how they related to those concepts, and recommendations needed to determine how the adherence to these principles could be achieved. In the following sections, the guiding principles are defined.

1.4.1 World Heritage Values

The world heritage values, or outstanding universal values (OUVs), are the basis for a site’s inscription on the World Heritage List and is defined by UNESCO as “natural significance, which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole” (UNESCO, 2006). Ensuring the maintenance and continuance of this international standing is a foundational component of this assessment.

1.4.2 Ecological Integrity

Another primary focus underpinning this SEA is the ecological integrity of WBNP.

The *Canada National Parks Act* (CNPA) defines ecological Integrity as a “first priority” which is notable both as a conceptual framework and as a legal obligation. The CNPA defines ecological integrity as:

A condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes.

This concept of ecological integrity and its relation to Parks Canada’s mandate are central to each stage in this assessment and provides guiding direction for the SEA.

1.4.3 Indigenous Rights and Ways of Life

The presence and health of natural features and wildlife (i.e., the world heritage values), are inseparable from Indigenous ways of life and the constitutional rights of Indigenous peoples. Many Elders who contributed to the SEA by sharing their stories of environmental change were born on the land in WBNP. They have shared their knowledge of how environment and culture are intertwined. Given the connections between healthy landscapes supporting strong populations of plants and animals (world heritage values) and the ability of land-users to continue their culture and exercise their treaty and Aboriginal rights, the SEA cannot assess one without considering the other. What scientists who work in environmental assessment call “pathways of impacts”, Indigenous land-users - with intimate connections to the sights, sounds, smells and tastes of the environment and knowledge of a pre-development baseline – have called their “stories of change” (MCFN, 2017b).

WBNP is a national park and a world heritage site, but to the Dene, Cree and Métis communities in and around the park, it is also home. Land-users in the PAD describe the park as their grocery store, their kitchen, their school, and their photo album, and the place where they have their happiest memories of family and nature (MCFN, 2018a; MCFN, 2018b). The PAD has also been referred to as the heart of the park and the region. The idea that “everything is connected” also applies downstream from the PAD, and management of the Peace and Athabasca Rivers and the PAD is also of interest to communities on the Slave River and Great Slave Lake (NWT Métis, 2018).

Based on meetings with representatives of Indigenous groups during the development of the SEA, Parks Canada prepared the diagram in **Figure 1-3**. The figure is an attempt to capture how ITK informs resource management, and how resource quantity and quality, including the importance of access to resources, affect Indigenous ways of life. This is consistent with Parks Canada’s resource guide *Promising Pathways* which expresses how access and continued traditional use create stronger ITK, and how ITK and strong relationships create healthier communities and better management decisions (Parks Canada, 2014, p. 18).

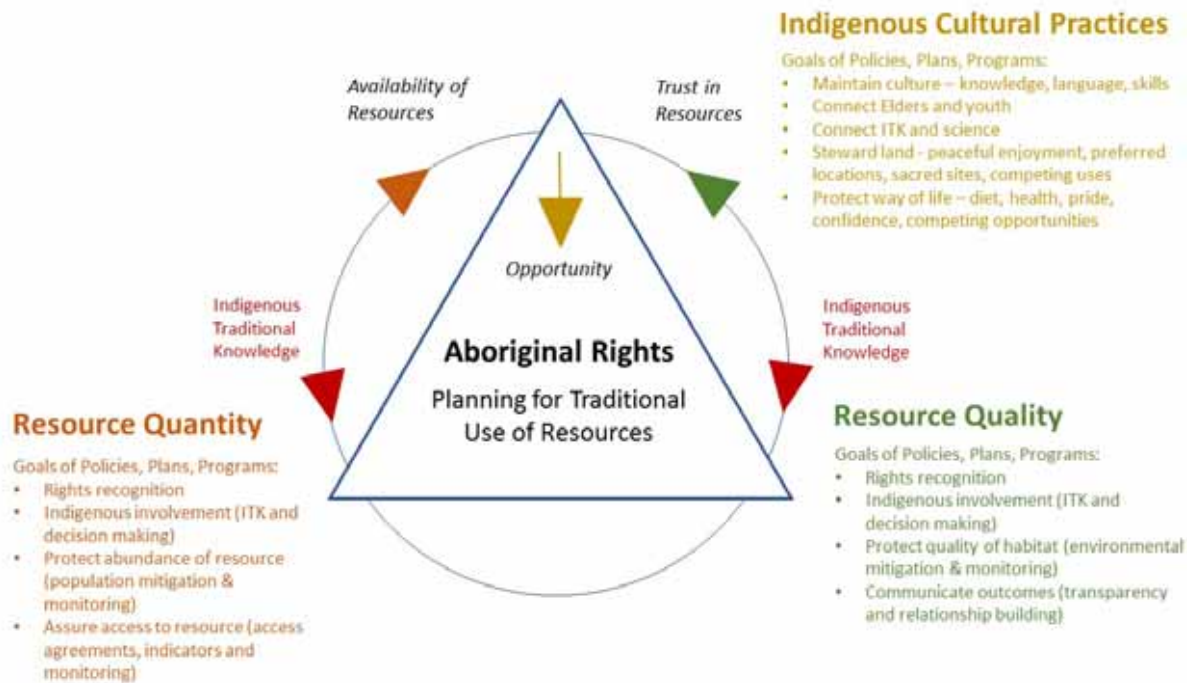


Figure 1-3: Connections Between Indigenous Ways of Life and Access to Resources (Parks Canada, 2018)

Further detail on Indigenous perspectives is provided in Chapter 2 and throughout the SEA analysis. The concept of inter-dependence (“everything is connected”) and the importance of ITK and Indigenous access to resources are central to the SEA.

1.5 APPROACH TO THE SEA

The SEA begins with consideration of all of WBNP’s world heritage values (the features for which the park is globally significant). An early focus of the assessment was to identify which elements warranted greater attention. The starting point of the SEA was the observed changes in environmental conditions reported by MCFN land-users in the PAD. The RMM report and requests from the World Heritage Committee supported this focus on the PAD. This SEA continues the focus on the PAD, and after careful and independent review of available data, including the consideration of sources and comments provided by a broad range of interested parties (from different Indigenous communities, government, industry and ENGOs), the SEA reaches its own conclusions.

A SEA is ideally undertaken prior to major physical development as a means to anticipate development trajectories, adverse effects, and to determine mitigation strategies and identify alternatives. This SEA differs in that it is taking place mid-stream, with major developments already in place and operating upstream of WBNP, with some large scale developments approved and in construction or about to begin operations and other projects in the application stage. It is anticipated that further large scale developments will be proposed in the near and long term. For the region in which WBNP is situated, economic development and land management objectives have been determined by various levels of

government and these objectives largely focus on oil sands, hydropower, agriculture and other types of developments persisting and expanding. This SEA cannot alter history and does not have a legal basis to require change to any government objective, policy, plan or approval. The results it generates however can be used for collaborative planning processes and other discussions going forward.

A challenge for the SEA is to determine how cumulative effects of pre-existing development combine to influence the current state of the ecosystem, and how they are likely to do so in the future. Factors that contribute to this challenge include: gaps in availability of monitoring data, a range of views on appropriate baselines, a wide range of activities contributing to numerous types of human-induced changes in the environment, and a very dynamic and complex ecosystem that is challenging to conclusively understand. This SEA, however, assesses the extent of overall change that has been observed in the environment through ITK and western science information regarding changes to among other aspects, flow regime, water levels, water quality, lake and vegetation cover, and wildlife health and abundance. This SEA therefore assesses what cumulative effects may have resulted in observed changes in the world heritage values, based on the above information (current and historic data provided through ITK and scientific papers), determines whether world heritage value objectives are currently being met, and assesses the direction of change for WBNP from existing cumulative effects. The SEA then anticipates what direction of change is likely for WBNP's world heritage values, given foreseeable development and climate change and trends without further action.

The SEA recognizes that observed changes in WBNP and the PAD are multi-faceted, and all parties, including federal, provincial and territorial governments, different Indigenous governments and communities, industry in different sectors, ENGOs, and academic researchers have crucial roles to play in ensuring the protection of WBNP's world heritage values. As noted by representatives of MCFN, "solutions must be cumulative as well" (MCFN, 2017a).

1.5.1 Study Limitations

The assessment was challenged by the complexity of the ecosystem it evaluated, the volume of information, as well as by the relatively short timeline for completion of the project (December 2016 – April 2018). The assessment is further limited because no new data collection or analysis (ITK or science) was possible within the scope and timeframe available. All findings are subject to the limitations of available information, much of which was originally collected in order to meet other goals.

The challenge of distilling the vast amount of available information into this report was met by using a systematic method focused on collecting information from credible sources and evaluating the relevance of the information based on the SEA's objectives. Aided by guidance from representatives of Indigenous communities, government scientists, and other experts, this SEA represents best efforts to synthesize the substantial body of existing information.

Numerous industrial sectors are considered within the SEA as potential contributors to cumulative effects in the PAD. Due to the complexity of the ecological systems involved, this report does not delineate specific contributions that any given activity or project has on environmental conditions.

This SEA reflects the information available to date. However, major research and monitoring projects are on-going that may identify many of the knowledge gaps. New information can be carried forward and into the Action Plan process for WBNP.

1.5.2 Changes Based on the Review of the Draft Scoping Report

A Draft Scoping Report (MILESTONE 1: SCOPING REPORT Strategic Environmental Assessment of Wood Buffalo National Park available in Appendix A.1) was made available in August 2017 and input from partners, stakeholders and the public was invited during September 2017. Comments were received from a wide spectrum of reviewers including federal government departments and agencies, provincial and territorial governments, Indigenous communities, industry and industrial associations, and ENGOS. Based on the submissions received, it is apparent there is a keen interest in the SEA and the issues it is addressing, along with other issues concerning the adequacy of scientific information, governance, consultation and engagement.

Comments on the Draft Scoping Report were grouped into 5 categories:

- Data Sources,
- Indigenous Traditional Knowledge,
- Assessment Approach,
- Governance Framework, and
- Consultation.

Some of the comments received were contrary to others (e.g. different perspectives on the influence of human-induced changes compared to natural variation, and different preferences for what sources of information are relied upon); as such, the SEA report endeavors to reflect differing or opposing points of view where possible. The input received was considered for three different forms of response: refining the information and approach used for the SEA; informing the multi-jurisdictional Action Plan being coordinated by Parks Canada; and sharing comments with the relevant decision-makers.

The comments that were integrated to inform the SEA have broadened the scope of the assessment and improved transparency. In response to feedback received during the scoping phase, the broadened scope of this SEA has resulted in an expansion of the assessment approach. Going beyond what was presented in the Draft Scoping Report, "pathways of effects" methods were used to demonstrate the relationships between important ecological components within the PAD, including their connections to world heritage values, ecological integrity, and Indigenous ways of life. The methods initially presented in the Draft Scoping Report have been strengthened through increased engagement and expansion of the scope of the SEA.

Details on the comments that were received and how they have been included in the SEA and/or Action Plan processes are available in an Addendum to the Draft Scoping Report, which is included as Appendix A.2 of this SEA report.

1.5.3 Structure of the SEA

This report is structured to systematically consider the impacts of industrial development on the world heritage values of WBNP, ecological integrity, and traditional land use. The report contains a review of all WBNP's world heritage values, with emphasis on the PAD. Other world heritage values are reviewed to examine their current status with respect to potential threats and long term protection. These evaluations were developed through literature review and discussions with representatives of Indigenous communities, government, industry, ENGOs, and academic researchers. In summary, the report is structured as follows:

- **Chapter 2** provides the context of the site as a national park, world heritage site and a homeland for Indigenous peoples.
- **Chapter 3** describes the methodology used in the analysis and report.
- **Chapters 4 and 5** provide an assessment of the pathways of effects or stories of change for impacts to each element of the world heritage values. These chapters also assess the current status and trend of the elements. Chapter 4 assesses other world heritage values, and Chapter 5 is focused on the PAD.
- **Chapter 6** describes the current and reasonably foreseeable developments that may impact the world heritage values of WBNP. It also describes predicted impacts of climate change and concludes with an assessment of the future trend to the WBNP world heritage values in the future.
- **Chapter 7** concludes with recommendations to address the risks that were identified. The recommendations from the SEA will be considered in the subsequent multi-jurisdictional Action Plan for the protection of WBNP's world heritage values.

An extensive bibliography is included within the appendices, and source documents are available from Parks Canada. Overviews of the information collected and analyzed are provided in the appendices, including issues about WBNP that were raised by affected parties but have been excluded from the main body of the SEA due to the lack of a direct relationship with world heritage values (i.e., issues that are not connected to the reasons for which the park is designated as a world heritage site). These concerns have been noted because they may have value for future research and for consideration in WBNP operations (e.g. development of the next management plan).

2.0 CHAPTER 2: SITE CONTEXT

This chapter provides an introduction to WBNP and the Indigenous peoples who reside in the area, and presents additional detail about its designation as a world heritage site. The world heritage values of the park provide the focus for this SEA.

2.1 WOOD BUFFALO NATIONAL PARK

Wood Buffalo National Park spans the Alberta/Northwest Territories boundary and at 44,807 square kilometres, it is the largest national park in North America. The land that WBNP occupies has been inhabited for at least 2500 years, and likely much longer. The park is located within the bounds of Treaty 8 and in Métis homelands. The treaty was signed in 1899 and it guarantees the hunting, fishing and trapping rights of signatory First Nations, to support and maintain traditional livelihoods. Métis communities are not signatories to the treaty, but have Aboriginal rights in WBNP.



Wood Bison Herd, WBNP. Photo: Parks Canada

For generations, the Cree, Dene and Métis peoples have depended upon the ecosystems that are now part of WBNP as an integral part of their identity, culture and well-being. Within the park, maintaining a functional ecosystem is critical for the cultural, spiritual and physical health of these communities (Candler et al., 2010). This report acknowledges that healthy lands and resources, including access to resources, are critical to supporting and maintaining traditional livelihoods.

WBNP was first created in 1922 to protect the last free roaming herds of wood bison (historically called the 'wood buffalo') in northern Canada, and in 1926 its boundary was extended south of the Peace River to encompass a large portion of the Peace-Athabasca Delta (Parks Canada, 2010). The global significance of WBNP was recognized in 1983 when the park was designated a UNESCO World Heritage Site

The Parks Canada Agency is responsible for managing WBNP, while the Province of Alberta and the Northwest Territories have jurisdiction immediately outside the park boundaries.

Conservation values of particular note include:

- Some of the largest relatively undisturbed and least fragmented boreal forest, grassland and wetland ecosystems in North America, including one of the largest inland freshwater deltas in the world (the PAD);
- Increasingly rare ongoing large-scale ecosystem processes with limited human interference, including the comparatively natural fire regime;

- Significant populations of migrating, nesting, breeding and moulting waterfowl at an intersection of four major bird migration flyways - among many other significant wildlife populations;
- Some of the finest examples of gypsum karst landforms in North America and extensive, unique salt plains, both with associated extraordinary plant communities;
- Two Wetlands of International Importance under the Ramsar Convention – the PAD and the last remaining natural nesting area for the endangered Whooping Crane; and,
- The world’s largest Dark Sky Preserve since 2013.

For Indigenous peoples, the history of WBNP is more complicated. Further explanation of this history is set out in Section 2.3.3 below.

2.2 WORLD HERITAGE VALUES

World heritage sites are designated based on criteria established by the World Heritage Convention. The criteria are used by the UNESCO World Heritage Committee to define a site’s world heritage values, which are expressed in terms of its OUV. OUV or World heritage values are the basis for a site’s inscription on the World Heritage List, and OUV is defined by UNESCO as: “natural significance, which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole” (UNESCO, 2006).

WBNP was inscribed as a world heritage site under three world heritage criteria. These criteria are presented below along with the rationale for their selection, as defined by the World Heritage Committee:

Criterion (vi): to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

The great concentrations of migratory wildlife are of world importance and the rare and superlative natural phenomena include a large inland delta, salt plains and gypsum karst that are equally internationally significant.

Criterion (ix): to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;

WBNP is the most ecologically complete and largest example of the entire Great Plains- Boreal grassland ecosystem of North America, the only place where the predator-prey relationship between wolves and wood bison has continued, unbroken, over time.

Criterion (x): to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

WBNP contains the only breeding habitat in the world for the Whooping Crane, an endangered species brought back from the brink of extinction through careful management of the small number of breeding pairs in the park. The park's size, complete ecosystems and protection are essential for conservation of the Whooping Crane.

2.3 INDIGENOUS PERSPECTIVES ON THE SEA

It is important to note there is no single "Indigenous perspective" on WBNP or the SEA. The distance between the park's northwest corner near Buffalo Lake and the community of Hay River, NWT to the community of Fort Chipewyan, AB and the park's southeast corner below the PAD is about 500km (Figure 2-1). Across such a distance, and across different landscapes (salt plains in the northwest, the PAD in the southeast, and boreal forest in between), the observations of different land-users cannot be expected to be consistent. This became clear during meetings with the eleven groups during development of the SEA.

Given that Indigenous use of the park includes different cultures, different communities and different families using different resources in different areas, it is not surprising that not all Indigenous groups share the same concerns. During development of the SEA, it was noted that concerns about the effects of dams and industry were generally highest among Indigenous peoples who are dependent on the PAD for access to their territory within the park. For example, a land-user accessing upland forest environments using roads in the northern half of WBNP may not raise the same concerns as a land-user travelling by boat through the PAD. Leaders and representative land-users from a First Nation based in the central portion of WBNP have stated they do not see the negative impacts from development, and do not feel the park's world heritage values are at risk (CMC, 2017; SRFN, 2018). The perspectives presented by different communities are reflected in the sections of the SEA that address the relevant world heritage values (e.g. the Whooping Crane nesting area in the north, Chapter 4; and the PAD in the south, Chapters 5 and 6).

The long-standing concerns of MCFN were well articulated in their December 2014 petition and associated materials, and supported by the other communities reliant on the PAD. However, not all Indigenous groups with interests in WBNP welcomed the MCFN petition, or the subsequent involvement of UNESCO in WBNP matters (CMC, 2017; SRFN, 2018). All WBNP Indigenous communities had an opportunity to share their knowledge to influence the development of the SEA, including reviewing the Draft Scoping Report and reviewing drafts of the SEA, and all of the communities also have the ongoing opportunity to submit follow-up reports to Parks Canada that will present their perspectives on the completed SEA.

Each of the eleven Indigenous communities that work with WBNP, including communities with Dene/Chipewyan, Cree and Métis backgrounds, have their own unique histories and their own perceptions and priorities. Additional information on the cultural history of WBNP is available on the park's website (<http://www.pc.gc.ca/en/pn-np/nt/woodbuffalo/decouvrir-discover/natcul2>), or from the communities directly.

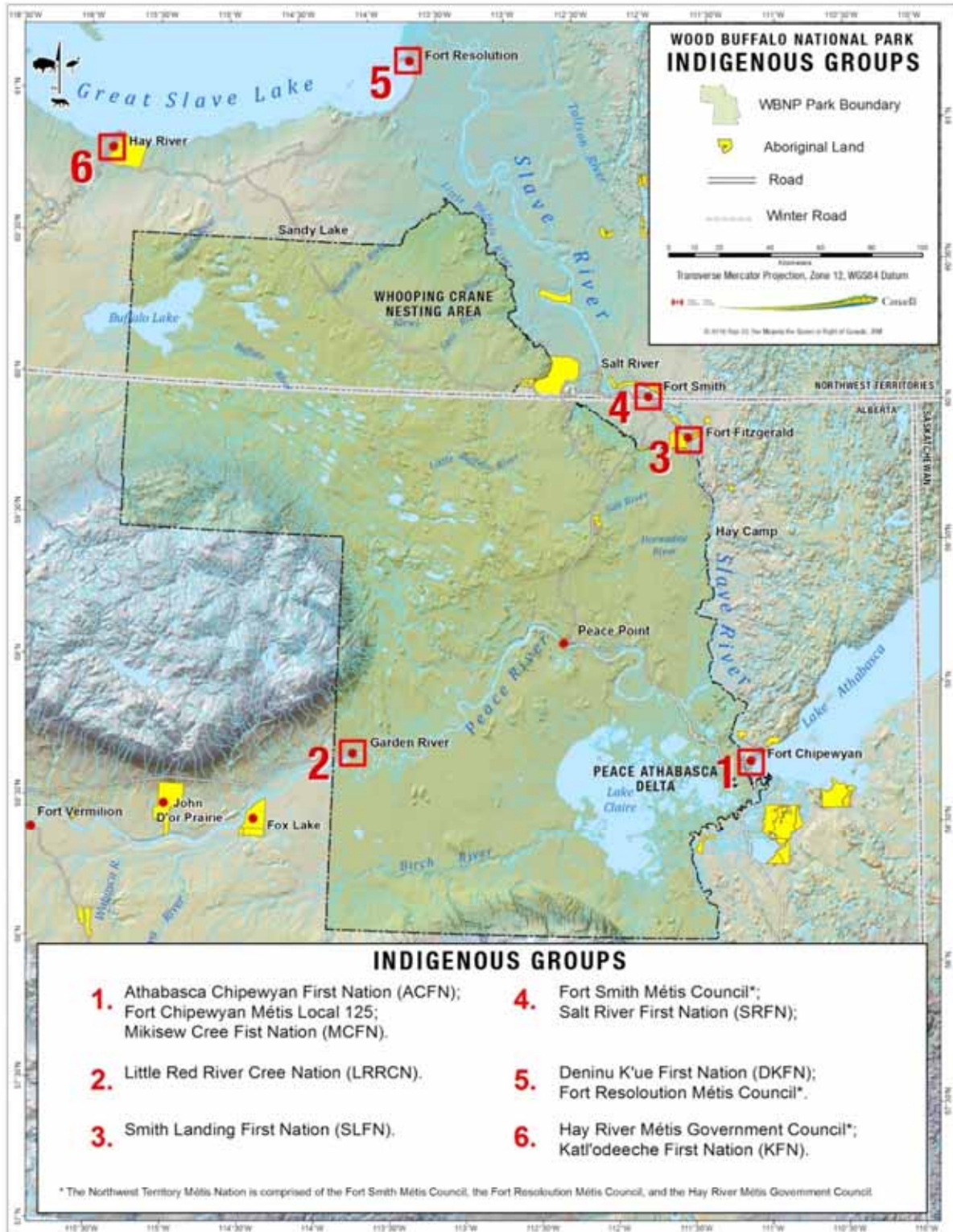


Figure 2-1: The Location of Indigenous Communities Around WBNP

2.3.1 Indigenous Perspectives on World Heritage Values

Representatives of different Indigenous communities highlighted that the designation of WBNP as a world heritage site was carried out without consultation, and that the criteria for world heritage values were developed without Indigenous input. Given the lack of Indigenous involvement in the establishment of the criteria and designation process, it has been pointed out that the nature-based world heritage values for WBNP do not relate very well to the more holistic Indigenous perspective. Specifically, from an Indigenous perspective based on meetings and workshops related to the SEA, the following considerations are important to Indigenous peoples, and are not explicitly included in WBNP's world heritage values:

- Recognition of treaty and Aboriginal rights;
- Access to healthy lands and resources for the peaceful exercise of rights;
- WBNP as a cultural landscape and a homeland to Indigenous peoples;
- The health and welfare of Indigenous peoples;
- The role of Indigenous peoples in ecosystem relationships;
- The role of other species (e.g. vegetation and moose) in relation to bison and wolves;
- The role of other areas of the park in safeguarding the world heritage values; and
- Inter-connections among all species (e.g. vegetation, bugs, frogs, mice, bats, birds, etc., and Indigenous peoples).

2.3.2 Concerns about Water Levels in the PAD

In general, the concerns raised by the three communities based in the PAD (MCFN, Athabasca Chipewyan First Nation, and Fort Chipewyan Métis Local 125) were consistent, which aligns well with the concerns noted by the World Heritage Committee and the SEA's emphasis on the world heritage values associated with the PAD.

For the Indigenous peoples who depend on the PAD, water replenishes life and connects to the vegetation, bugs, frogs, birds, mammals and people of the delta (MCFN, 2018a). In raising their concerns about changes to the annual pattern of water flows in the Peace River following development of the W.A.C. Bennett Dam (hereafter "Bennett Dam"), it was the parents of today's Elders who coined the term "Water is Boss" (nipî tapîtam) (MCFN, 2017a).

At several workshops, participants expressed how often knowledge holders have been asked to share these stories over the years. They emphasized that, on behalf of their ancestors and future generations, Elders and land-users continue to share their knowledge in good faith, with a combination of frustration and hope (ACFN, 2018a; MCFN 2018a). The feelings expressed at workshops on the SEA made it clear that the Indigenous peoples in the PAD see the need for urgent action, and that they need to be part of the solution and want everybody who affects the PAD to work together (MCFN 2018a; MCFN 2018b).

2.3.3 Negative Histories Between Parks Canada and Indigenous Peoples

In materials provided during SEA, and in workshops with Indigenous communities, it was not uncommon for participants to point out that their ancestors were using these lands long before WBNP was established, and that WBNP has a dark history with Indigenous peoples. Indigenous communities explained how the existence and management of the park interfered with Indigenous ways of life through enforcement activities that at times resulted in either the expulsion of Indigenous land-users from the park, or their incarceration for participating in activities central to their ways of life. Indigenous land-users also speak of a culture of fear created due to park management practices and have many stories about how they were not allowed to exercise their Aboriginal or Treaty rights freely, and about the negative relationship with Parks Canada wardens (e.g. Indigenous people hiding their guns, removing feathers from their hats, etc.). The legacy created due to land user's fear of reprisal continues to be felt by a number of individuals that participated in the SEA workshops. Several participants in the SEA workshops explained that they do not feel that the management of WBNP adequately respects their rights and explained that the relationship between Indigenous groups and Parks Canada remains difficult (MCFN, 2017a; 2017b; 2018a).

Representatives of Indigenous communities pointed out that these histories have not been acknowledged by Parks Canada in WBNP; that WBNP's visitor information makes the park ("vast, undisturbed expanses of boreal wilderness") sound healthier and better protected than it is; and that Parks Canada maps show vast areas of blue (water) on their maps of the delta that hide the actual drying conditions within the wetlands. Several participants at different workshops stated that in the interest of reconciliation, Parks Canada needs to acknowledge the negative histories of the park, so that everyone is able to build trust and move forward together. Stories of negative histories with Parks Canada were one thing that communities had in common from the south, west, north and east parts of the WBNP (ACFN, 2018a; LRRCN 2018; Métis Local 125, 2018a; MCFN, 2017a; 2017b; 2018a). While it is beyond the scope of the SEA to recommend solutions to the historical and current challenges between Parks Canada and the Indigenous communities of WBNP, it is clear that work remains to be done.

At various stages of the process for developing the SEA, representatives of a few communities noted that this engagement process has been a continuation of some negative relationships and practices. For example, communities pointed out the following in relation to the SEA:

- they needed more capacity support to enable meaningful participation;
- more lead time needed for planning meetings and reviewing documents;
- more visuals and better use of plain language in writing; and,
- SEA did not include a process for the proper, respectful collection of ITK.

2.3.4 Recommendations on Genuine Partnerships

The park's current management plan (2010) identifies building stronger relationships with Indigenous partners as a key strategy, and since 2014 the park has been convening a Cooperative Management Committee (CMC). However, the concerns raised by MCFN, the subsequent responses from other

communities, and the stories shared at workshops, underscore the limitations of WBNP's approach to cooperative management, and that, at times, each Indigenous group will need bi-lateral relations with Parks Canada, and may need to act according to its own vision and principles for its territory, activities and history within WBNP. The RMM recommendations that are to be addressed through the Action Plan include several items related to cooperative management and partnerships with Indigenous communities.

2.4 DEVELOPMENT PRESSURES AROUND WBNP

As referenced in Chapter 1, this SEA was preceded by a petition from MCFN, based on observed changes to environmental conditions in the PAD, and was subsequently requested of by the World Heritage Committee. A key element of the background to the SEA and Action Plan is the pace, scale and complexity of development that has been taking place around WBNP in recent decades (Decision 41 COM 7B.2), as was raised by many reviewers during the comment period on the Draft Scoping Report.

At the time of WBNP's designation as a world heritage site in 1983, the park's world heritage values were relatively well protected because of the park's remoteness and large size. However, given the pace, scale and complexity of development in the region and upstream, the concerns raised by MCFN and others, and the requests of the World Heritage Committee to complete an SEA and develop an Action Plan, decision makers are now being asked to work together to re-assess the protection and management framework for the world heritage values of WBNP.

3.0 CHAPTER 3: METHODOLOGY

This chapter describes the methods that were used to undertake the SEA.

3.1 METHODOLOGY USED IN THE SEA

Due to the complexity of the environment being assessed, and the large volume of information collected, a variety of assessment methods were used. These methods combined to provide a good understanding of the status and trends for all of WBNP's world heritage values. The assessment was carried out using the following steps:

- 1) Step 1 -- Define SEA Approach, Objectives and Desired Outcomes
 - a) Develop Assessment Framework for World Heritage Values
 - b) Determine Desired Outcomes and Objectives for Those Values
- 2) Step 2 – Assess Current Status and Trend of World Heritage Values (Chapter 4 and 5)
 - a) Set Geographic and Temporal Boundaries
 - b) Define Information Gathering Approach
 - c) Identify Pathways of Effects
 - d) Identify Valued Components for the PAD
- 3) Step 3 – Project Future Trends for World Heritage Values (Chapter 6)
 - a) Define Cumulative Effects Assessment Approach
 - b) Identify Potential Effects from Reasonably Foreseeable Development
 - c) Identify Potential Effects from Future Climate Change
 - d) Assess Trend Resulting from Reasonably Foreseeable Development and Climate Change in the Context of Cumulative Effects Management
- 4) Step 4 – Develop Recommendations to Mitigate or Reverse Trends or Address Information Gaps (Chapter 7)

The complete list of world heritage criteria for WBNP provided the initial bounding for the SEA. The assessment methods highlighted components of the site that were deemed particularly vulnerable, or have a well-documented body of information supporting the view that they are vulnerable to outside influences. Although each of the world heritage values are assessed in the SEA, particular focus is given to the PAD. Each step listed here is described in greater detail in the next section of the SEA report.

3.2 STEP 1 -- DEFINE SEA APPROACH, OBJECTIVES AND DESIRED OUTCOMES

3.2.1 Develop Assessment Framework for World Heritage Values

An important first step for the assessment was determining how to convert the world heritage criteria statements which describe the values of WBNP in broad terms (e.g. “great concentrations of migratory wildlife”), into elements or components that are measurable and could be more easily evaluated. This was accomplished using a method developed by Jon Day that was employed for a similar evaluation of the Great Barrier Reef World Heritage Site.

Day refers to the world heritage values statements for properties as “somewhat high level and nebulous, or (managers) do not understand how it might assist or help to prioritize their planning and management efforts” (Day, 2015). In order to make the world heritage statements more assessable, Day developed the following method:

- 1) To “break the complex Statement of OUV into smaller more understandable components. This involved breaking down the full approved Statement text into smaller ‘excerpts’ for each of the natural criteria and integrity”;
- 2) Sequentially to:
 - a) “identify key examples of values or attributes against each Statement excerpt”
 - b) “identify the factors affecting those values”
 - c) “prioritize the highest priority threats”
 - d) “consider what are the priority management needs to address the highest priority threats” (Day, 2015)

As described by Day, the advantages to this approach are that it “helps them more readily identify the key values or attributes for their property and prioritize their management actions”, “helps to directly link the property’s values to management operations”, “clarifies the research priorities for the property” and “ensures that the committees themselves are focusing on the world heritage values of the property when giving advice” (Day, 2015).

Day’s methodology was used to break individual OUV criterion statements for WBNP into constituent elements. The results of the exercise were captured in a summary table (Table 3-2). The process was of great value, as it provided a much higher level of clarity and focus for the SEA by more clearly identifying the individual features or systems that are nested within the broader language of individual world heritage criterion statements. The findings from this exercise were carried forward and helped to focus all the subsequent steps in the SEA process. They also will inform the Action Plan initiative that has recently commenced, and the next park management planning exercise for WBNP, which is likely to begin in the next few years.

3.2.2 Determine Desired Outcomes and Objectives for World Heritage Values

This SEA employed a “desired outcomes” based approach. The world heritage value elements listed in Table 3-2 of this report were the starting point in the process. Once the key elements were identified using the methods developed by Jon Day as described in Section 3.2 of this report, the focus shifted to determining the desired outcome(s) for each element. Desired outcomes provide benchmarks against which impacts can be measured. Although all the world heritage values for WBNP are based on world heritage criteria, the desired outcomes also reflect the importance of these elements to Indigenous ways of life in WBNP.

The overall desired outcome is to protect the world heritage values of WBNP, and maintain or enhance the ecological integrity of the national park. Achievement of those desired outcomes will assist local Indigenous peoples in continuing to practice traditional ways of life. Preliminary valued components and associated indicators were identified during the SEA process. It is anticipated they will be further refined during the development and implementation of the Action Plan as additional collaboration takes place and new information comes to light.

3.3 STEP 2 – ASSESS CURRENT STATUS AND TREND OF WORLD HERITAGE VALUES (SEE CHAPTER 4 AND 5)

3.3.1 Set Geographic and Temporal Boundaries

Identification of suitable geographic and temporal boundaries for the SEA posed some challenges given the long time frame since the park was established (1922), the extent of change in land use surrounding the park since its establishment, and the large size of the drainage basins (i.e., Peace River, Athabasca River) which flow into the park and influence ecosystem states at the site. Boundary setting was further complicated by the need to incorporate the effects of climate change into the SEA. Based on a review of information collected from a wide variety of sources, as well as engagement and review process comments, the following geographic and temporal boundaries were identified.

Geographic Boundary: The geographic boundaries of WBNP are well defined and enshrined in legislation within Schedule 1 (National Parks of Canada) of the *Canada National Parks Act*. The PAD is primarily fed by the waters of the Peace and Athabasca rivers whose basins lie largely outside the boundary of the park. For this assessment, the starting point for the geographic boundary is the entire world heritage site, whose boundary is the same as Wood Buffalo National Park. The geographic boundaries of the assessment of individual world heritage values vary with the nature of the specific value being assessed. For the PAD, the entirety of the PAD (the portion of the PAD that lies within WBNP is 80%), and these two rivers systems are included as part of the PAD system. Impacts on the Slave River will be briefly considered to recognize that the state of the environment in the PAD can influence downstream environments in the Slave River basin. The geographic boundary of the SEA was also influenced by the decisions of the world heritage committee. These decisions outlined the types of projects that were to be assessed including flow regulation on the Peace River, and oil sands mining and upgrading in the Athabasca River basin.

Temporal Boundary: ITK recorded in project level environmental assessment documents (e.g. Teck Frontier Oil Sands Mine), and academic literature indicate the important temporal boundary for the

Peace River to be pre-1968, before construction and operation of the W.A.C. Bennett Dam. Relevant hydrological monitoring records for the Athabasca River are from the 1950s onward. Commercial oil sands mining started in the Fort McMurray region in the 1960s. Although the site was designated in 1983, an earlier temporal boundary was appropriate because the cumulative effects from after designation have added to those that began before designation. In order to understand the full extent of cumulative effects, all of the effects needed to be included. In addition, some of the effects of prior development were only just beginning to be felt and understood at the time of designation. Therefore, the implications of those effects on the world heritage values wasn't understood at the time of designation.

Climate change modelling typically reliably predicts up to about 30 years in the future. Therefore, the temporal boundary was initially proposed to start in 1950 and extend to 2050. However, in undertaking the SEA it was found that there is valuable information available in the 100 years prior to 1950 and in the far distant past. Where available and applicable this information was incorporated into the SEA.

3.3.2 Define Information Gathering Approach

After identifying desired outcomes for all world heritage value elements, literature reviews and engagement were used to evaluate the current status, trends and the pathways of effects for each element. The literature review and engagement process that made this possible are described here.

3.3.2.1 Literature Review of Available Information

This report is a desktop study: no new research was initiated, for either the collection of scientific information or ITK. In addition, no data analysis was done. Research supporting the SEA included an extensive literature review supplemented by in-person and teleconference meetings, and email exchanges. The foundation of this report is the extensive review of information and materials provided by experts, including representatives of Indigenous groups, researchers, industry, stakeholders, and government.

During the initial information gathering process, the primary focus was on cumulative effects in the PAD. While engaging with various groups, it quickly became apparent that the scope of the assessment needed to expand to include all elements of the world heritage values. Additional changes were made to the SEA methods to increase the level of engagement and integration of Indigenous perspectives and to develop recommendations in the SEA based on the results of the investigation. Information was gathered and reviewed for all of WBNP's world heritage values. Information sources included climate projection reports and papers; environmental monitoring reports; project-level environmental assessments; regional, provincial, territorial, and federal legislation and policies; and reports from Indigenous groups, industry, researchers and consultants.

The snowball method was used to gather peer reviewed papers and published reports. The approach built on Parks Canada's relationships with Indigenous communities, industry, and government experts. Documents, research and contacts for other individuals to collaborate with were developed during each meeting. From there, the network expanded to include additional researchers and the materials they recommended. All of the information gathered was assessed for relevance to the issues at hand. Some

materials were not deemed appropriate or relevant to the issues in the report, and as a result, were not included. A full list of materials reviewed is provided in a bibliography appended to this report.

With a few exceptions, information contained in project-level impact assessment or supporting technical documents or other documents submitted as part of environmental assessment review processes were not included for three reasons.

First, project level assessments tend to inadequately assess cumulative effects. In 2006, Duinker and Greig reported a number of problems with cumulative effects assessment (CEA) in Canada, one of which is the ineffective application of CEA in project-level EA. The main problem stems from the fact that project-level environmental assessment (EA), as practiced currently, is focused on identifying and mitigating specific incremental impacts from the proposed project under review, rather than assessing and managing the full scope of human activities and other stressors on valued components of an ecosystem. The focus is on what the project might do to the valued component, rather than asking what human activities and other stressors could do to the valued component, which “is difficult to adopt when a proponent is focused on getting a project approved, and regulators are focused on making sure that the impacts of the project are acceptably small” (Duinker and Greig, 2006, p. 155).

This problem is exemplified by the environmental baseline chosen for assessing cumulative impacts from the proposed project. In most cases, the current (at the time of the assessment) condition of the biophysical environment (i.e., air, water, land) is used as a baseline against which potential impacts from the proposed project are assessed. Rarely is the pre-industrial baseline presented to describe the state of the system before experiencing impacts from industrial projects. As a result of this approach, most EAs completed to date for relevant projects in the WBNP area have determined they will have a negligible effect on the PAD system. This is due to the fact that the environmental effects from single proposed developments with the potential to affect the WBNP are assessed on individual ‘post-development’ river systems, rather than as incremental and cumulative pressures on the WBNP system in the context of both past and future development. This approach prevents the accurate projection of cumulative effects on the world heritage values of the WBNP, particularly in the absence of a pre-industrial baseline.

Second, project-level impact assessment documents such as Environmental Impact Statements (EIS), and supporting technical documents submitted as part of environmental assessment review processes are evaluated through environmental assessment reviews; contain a range of views and opinions on the matters under review; and typically do not present final conclusions, but instead represent the materials for the decision-making authorities to consider when reaching conclusions and making project approval decisions. Referring to one document and the counter argument in another document as part of this SEA would lead to a replication of the whole environmental assessment review process.

Third, most project level environmental assessment reviews undertaken to date have not required an assessment of the impacts on world heritage values within WBNP so contain no analysis of the impacts of project activities upon the world heritage site and are therefore of limited value to the SEA.

3.3.2.2 Engagement

The engagement process employed for the SEA was managed by Parks Canada. Parks Canada and representatives from IEC, both collectively and independently, participated in calls, meetings and workshops with representatives of each of the eleven Indigenous communities that regularly work with WBNP, as well as other Indigenous groups south of the park. In many cases, depending on the approach taken by the Indigenous group, engagement included meeting with elected leadership, Elders, land users, knowledge holders, technical staff and external experts/consultants. In addition to calls and in-person meetings/workshops, many Indigenous groups provided written submissions outlining their views on the draft scoping report, as well as the draft final report. Further submissions to Parks Canada are anticipated following these group's review of the final SEA report.

Parks Canada also produced newsletters and posted information on WBNP's web site describing its responses to the World Heritage Committee requests (http://www.pc.gc.ca/en/pn-np/nt/woodbuffalo/info/SEA_EES). This information was circulated to other Indigenous groups south of the WBNP and to representatives of industry and ENGOs, and was available to the public. Parks Canada and IEC also communicated directly by phone and/or in person with several industry and ENGO representatives during the development of the SEA. The draft scoping report, and the draft SEA report were also posted on the Consulting Canadians website in September 2017 and April 2018 respectively.

Representatives of Indigenous groups, researchers, government departments and agencies, industries and industrial associations, and ENGOs provided information but also offered guidance on how to move forward, how to fill information gaps, and where they felt time and energy should be focused in the SEA.

"The Mikisew Cree First Nation (MCFN) Elders and Land Users were brought to the table to participate and tell their stories regarding their Traditional Territory/Homeland within the Wood Buffalo National Park. We were invited to share this information to help with the Strategic Environmental Assessment (SEA) of Wood Buffalo National Park, led by Parks Canada, as directed by UNESCO. As noted, story-telling is the oral tradition and holds a different perspective/method from society's way of documentation, which leads to a final technical report. With the wealth of knowledge within the group of Elders and Land Users, I decided to offer my experience to help facilitate the work in understanding two different perspectives in a way that does not diminish either, and that honours both. Drafts of the SEA were provided to the Elders and the MCFN Technical team to review as the work progressed. We then realized the drafts were not capturing the true reflection of our stories and words. Parks then made the attempt to include the voices by identifying quotes by the Elders. Through the help of the MCFN Technical team, we went to work to ensure the quotes had a name attached, as a way of showing respect along with the context of the quote to tie the quote to the section of the report. The Elder's short profile was included to validate his/her experience as an expert on the subject."

Source: Alice Martin

About Alice Martin: Alice was born on the land within MCFN Traditional Territory, which is within Wood Buffalo National Park. Alice's experience on the land and her passion for her 'Way of Knowing' is the premise of her work today. Alice is still an active land user and goes out on the land for fall hunting trips and moose camps with her boat. Passing on the Cree Way of Knowing through on the land experience with her sons and grandchildren is very important.

The recommendations of this SEA will carry forward to inform the next park management plan for WBNP (with a focus on the eleven Indigenous communities that partner with WBNP), and the development of the Action Plan for the World Heritage Committee (being prepared in cooperation with other federal, provincial and territorial initiatives and including involvement of a broader group of Indigenous communities).

Representatives of Indigenous Groups: Parks Canada and IEC engaged with Indigenous groups in and around WBNP, by means of in-person meetings in Fort Chipewyan, Fort Smith, High Level, and Edmonton, and through written materials provided by Indigenous groups. In total, eleven Indigenous groups participated in various group or individual meetings with the SEA consultants and Parks Canada staff, and others also provided comment and/or discussed the project with Parks Canada (see Table 3-1). Tours of the PAD to understand changes and impacts (MCFN, 2017a), dialogue at community events, and specific meetings to explain the SEA process and results to leaders, Elders, land users and knowledge holders were important aspects of this assessment.

Open dialogue between Indigenous group community members and Parks Canada was a priority, and much useful information was made available for use in the SEA through this process. Draft SEA content was also reviewed by Indigenous groups and their experts to ensure that available ITK and stories of change were accurately and appropriately included in the SEA document. This was a valuable feedback loop and helped ensure that Indigenous perspectives shared through this project were reported respectfully and accurately. Not all concerns identified by Indigenous groups representatives were integrated into the SEA report, as some issues and concerns raised were outside the scope of the project (i.e., not related to WBNP world heritage criteria). These issues were captured and are listed in Volume 2: Appendix A.5. This SEA has attempted to fairly and accurately record and integrate Indigenous knowledge, stories and perspectives throughout the report.

We are the scientists. We are the specialists. We know what it was and we are the ones who have seen the changes.

Quote context: *The land users and trappers and traditional users on the land, we see the changes. We are out there every day. Growing up as young people, it was our store, fresh drinking water, and our fresh food. We start seeing changes animals, finding dead muskrats, fish kills. That tells us something is wrong. And the western science now is backing up what we are saying. We all agree something is happening and something needs to be done to save it!*

Source: Ron Campbell

About Ron Campbell: *I was born in Fort Chip. I have and still do spend a lot of time in the delta. I've been trapping muskrats since I was a kid. And I do spring hunts and moose hunting etc. Everything I got was once natural and country food. We spent a lot of time in the bush, and learned about life from the traditional users.*

Table 3-1: Summary of Trips for In-person Engagement with Representatives of Indigenous Groups

Dates of Trips	Location	Description of Events	SEA Representatives
May 24 - 25, 2017	Fort Smith	Meeting of WBNP Cooperative Management Committee	Parks Canada
August 14 - 18, 2017	Fort Chip	- Boat and Aerial Tour of PAD; Elders' retreat and workshop with MCFN - Meetings with representatives of ACFN and Fort Chip Métis	Parks Canada IEC
September 12 - 14, 2017	Fort Smith	Meetings with representatives of DKFN, SLFN	Parks Canada IEC
October 19, 2017	Edmonton	Meeting with representatives of MCFN	Parks Canada
November 22, 2017	Edmonton	Workshop with representatives of MCFN	Parks Canada IEC
January 22, 2018	Fort Smith	Meeting with representatives of SLFN	Parks Canada
January 28 - February 2, 2018	Fort Chip, Fort Smith, Edmonton	Workshops/meetings with representatives of Indigenous groups: MCFN, ACFN, Fort Chip Métis, SLFN, SRFN, DKFN, KFN, NWT Métis, and LRRCN	Parks Canada IEC
March 4 - 11, 2018	Fort Chip, High Level	Workshops/meetings with representatives of MCFN, ACFN, Fort Chip Métis, and LRRCN	Parks Canada IEC
March 12 - 15, 2018	Fort Smith	Meetings with representatives of NWT Métis, DKFN, and SLFN	Parks Canada
April 17-18, 2018	Fort Chip	Meetings with representatives of MCFN and ACFN	Parks Canada and IEC

Researchers: Over the course of the project, there was communication with a number of researchers who have present and/or past involvement in studies relevant to the issues being assessed in the WBNP SEA project. Materials provided include peer reviewed papers, published reports, grey literature, initial results of current investigations, and expert opinions in a wide variety of disciplines and subject areas. These include surface hydrology and flooding, ecosystems and habitat, wildlife, migratory waterfowl, contaminants and effluents, governance approaches, and management approaches. The information shared by these researchers was crucial to gaining a more complete understanding of cumulative effects impacting the world heritage values within WBNP, as well as for predicting potential impacts.

Government Departments and Agencies: Many of the issues affecting the state of conservation of WBNP world heritage values are trans-boundary in nature. The Parks Canada Agency manages WBNP within the boundaries. The Province of Alberta manages the land around the southern portion of the boundary and Northwest Territories manages the land around the northern portion of the boundary. This means that decisions made by jurisdictions managing lands adjacent to WBNP and further upstream have the potential to affect the state of conservation of the world heritage site. It is therefore obvious

that jurisdictions and government bodies other than Parks Canada can play an important role in maintaining the integrity of the site. Over the course of the SEA, numerous federal and provincial government departments and agencies provided useful information for the assessment. These agencies and departments provided reports and recommendations. They also provided detailed and comprehensive comments on the Draft Scoping Report and other draft SEA documents.

Industry and Industrial Associations: Industry plays an important role in the development and operation of projects in the region. Federal and provincial government mandates include monitoring and measurement of various environmental parameters, such as air and water quality to detect changes in the regional ambient environment related to development activities. Collection of monitoring data is, therefore, part of project approvals for many new development projects. In recognition of this, the Governments of Canada and Alberta launched a comprehensive Joint Oil Sands Monitoring (JOSM) initiative in 2012. JOSM was established to consolidate and integrate a variety of existing monitoring programs into a single integrated program. Monitoring reports from various industries were made available for the SEA.

ENGOS: The feedback and support of ENGOS aided in refining the approach of the SEA. Groups recommended broadening the scope of the assessment by widening the timeframe, assessing additional types of impacts, and made additional suggestions to improve methodology. Given the international and local significance of WBNP, the materials from ENGOS provided additional context and guidance for the consideration of future management approaches in the region.

3.3.3 Identify Pathways of Effects

A pathway of effects model was used in the SEA. This tool is useful when assessing systems where cause and effect relationships are very complex or involve uncertainties. The method is based upon exploring the degree to which one factor in the system impacts another factor or factors. It is a means of overcoming the shortcomings that occur when individual elements in an ecosystem are considered in isolation. This method is particularly useful when trying to gain insights into the myriad interactions that occur in a complex system such as the Peace-Athabasca Delta.

Systems mapping is often undertaken when utilizing “Pathways of Effects” models. Pathways of effects methods are used to visually represent the interactions between individual impact sources and environmental receptors to provide insights into the possible scope and extent of impacts and cumulative effects that may occur. Several Indigenous groups described cumulative effects as “stories of change”, when explaining the differences, they had observed in the natural world in their lifetime. Additionally, systems-based diagrams show the integration of these pathways across time, space and scale by generating a web where all the pathways are connected. These models will be able to identify opportunities and challenges for future management.

The model developed by Fisheries and Oceans Canada (DFO) has the capacity to illustrate cumulative change across a system by demarcating pathways. This approach has been used widely across the federal government. In addition, it allows for differentiation between activity, pressure, stressor and end point. The results of the systems mapping are captured in Section 5.15.2.

3.3.4 Identify Valued Components for the PAD

The need to focus substantial effort on understanding the observed changes and complexities of the PAD became clear through the scoping exercise, literature review and engagement processes. The PAD has been subject to numerous and continual human-induced changes over the last 60 years. The vulnerable and complex nature of the delta means that all forms of change can generate unintended consequences across the ecosystem. As a result, the PAD provides an excellent example of the challenges associated with identifying and managing cumulative effects. Each development, in and of itself, only generates a small effect. However, when many small effects combine, the magnitude of the impact increases.

An extensive review of available literature was conducted to determine the issues of concern and current trends being experienced in the PAD resulting from stressors outside the WBNP, including industrial, commercial, and municipal development, as well as climate change over the past 60 plus years. Issues and challenges specifically facing the PAD were initially identified through interviews with relevant provincial and federal government personnel, as well as local Indigenous groups, who highlighted areas of concern and described the changes observed over time. These groups provided relevant literature, including peer-reviewed scientific literature, non-peer reviewed 'grey' literature, government reports and documents, stakeholder reports and documents, monitoring reports, JOSM monitoring information, Environmental Impact Statements and Joint Review Panel reports for projects in the region, as well as government and stakeholder presentations. Based on the review of literature provided, additional relevant literature was also found through internet and database searches, as well as follow-up meetings and conversations with a variety of experts.

The stressors and trends in the PAD, as identified through interviews and available literature, were grouped by area of concern and the relevant information compiled and presented in a logical format. This resulted in the identification of a series of valued components, including ice jam recharge, Athabasca River water quality, Peace River flow rates, habitat for water birds and wildlife, contaminant levels in fish water, and local Indigenous people's access. The trends observed in the PAD were linked to potential sources (stressors) of change and a determination made as to the direction of change being observed. The complexity of hydrologic and ecological processes in the PAD prevented the definitive linkage of individual stressors to trends being observed. A number of the trends observed in the PAD could be linked to changes in other aspects of the PAD, hence pathways of effects were developed for a number of PAD valued components.

3.4 STEP 3 – PREDICT FUTURE TRENDS FOR WORLD HERITAGE VALUES (SEE CHAPTER 6)

Cumulative effects analysis, as with predictive analysis in all kinds of environmental assessment (EA), is an exercise of applied systems analysis (see Beanlands, et al., 1983; Munn, 1979). The goal is to understand the mechanisms by which multiple stressors, both natural and human made (anthropogenic), affect a measured component, and/or the ability to achieve a desired outcome for that component. This understanding is then used to adjust the stressors acting on the component using an adaptive management approach. This is typically achieved through application of mitigation measures or collaborative management approaches so that the integrity of the component is not compromised by human action (Duinker & Greig, 2006). Monitoring of the effectiveness of mitigation measures and

management approaches is an important means of determining what works well, and what needs to be improved. Cumulative effects assessment (CEA) is integrated into the SEA such that it takes into account the entirety of development in the area, rather than individual projects, at an appropriate temporal and spatial scale, using best available information. The approach to CEA is focused on land-use planning and environmental management, where the cumulative effects of human activity are also taken into account. A high-level, qualitative cumulative effects assessment was undertaken in order to gain an understanding of the potential effects on the desired outcomes for the WBNP over the next thirty years from likely future changes in climate, along with proposed and reasonably foreseeable development in the region. Current stressors and trends already being observed in WBNP were used as the baseline to which the potential cumulative effects of future development and climate change were added.

In order to evaluate the impact of potential cumulative effects on the desired outcomes for the WBNP, it was first necessary to determine the level and types of industrial, commercial, and municipal development already present in the region. Existing development in the region included hydroelectric dams and oil sands mines and processing plants, as well as pulp and paper facilities, industrial mines, forestry activities, and municipal development. Following this, relevant approved, planned, proposed, and reasonably foreseeable future projects in the region with the potential to affect the desired outcomes for the WBNP were identified. Information on relevant development projects was obtained from a number of sources, including government websites and literature, as well as industry websites and literature. Secondly, a summary of the projected effects from future climate change over the next thirty years specifically related to the PAD were compiled. Projections from available literature were examined in order to gain an understanding of the magnitude and direction of potential impacts on the PAD valued components from future climate change in the region, within the context of existing trends already being observed in the PAD.

Finally, the future trend was identified by examining the pathways of effects previously identified and determining how climate change and reasonably foreseeable developments would affect those pathways. To complement this analysis, existing mechanisms to manage cumulative effects were described. These mechanisms mainly involve environmental management and land use planning frameworks established by the federal and various provincial governments. Taking into account the current trends for pathways of effects, the contributions of climate change and reasonably foreseeable developments, a final projection was then made as to the likely future direction of the trends on the desired outcomes for the WBNP.

3.5 STEP 4 – DEVELOP RECOMMENDATIONS TO REVERSE OR MITIGATE TRENDS (CHAPTER 7)

Recommendations were generated based on the current status and projected trends related to the desired outcomes for the WBNP and the pathways of effects where changes have or may occur. Given that there are specific recommendations from the RMM which must inform the development of an Action Plan for protecting the world heritage values of Wood Buffalo National Park, the recommendations of this SEA were organized in this context. Recommendations from the SEA were therefore grouped under the RMM recommendations for consideration by the lead jurisdiction responsible for leading the related component of the Action Plan. The executive summary of the SEA and associated materials is posted at: https://www.pc.gc.ca/en/pn-nt/woodbuffalo/info/SEA_EES/bulletin.

Table 3-2: Elements of the OUV

Criterion – OUV Statement (verbatim text)	OUV excerpts of primary importance	Listing of Individual OUV Elements for this criterion	Interpreted meaning	Desired Outcomes	Draft Valued Components (These will be further developed and refined during the Action Plan Implementation)	Potential indicators (These will be further developed and refined during the Action Plan Implementation)
Criterion (vii): “The great concentrations of migratory wildlife are of world importance and the rare and superlative natural phenomena include a large inland delta, salt plains and gypsum karst that are equally internationally significant.”	1. Great concentrations of migratory wildlife of world importance.	i. Great concentrations of migratory wildlife of world importance	Migratory wildlife means migratory waterfowl* populations which make seasonal use of WBNP. Migratory waterfowl from four continental flyways converge in great numbers on the PAD for staging and breeding habitat. *Waterfowl is understood in this context to include water birds, gulls, shorebirds, cormorants.	- Great concentrations of viable, healthy populations of migratory waterfowl species continue to use WBNP seasonally. - Adequate quantity and quality habitat, unimpaired by contamination, is available for migratory waterfowl to fulfil all key life cycle stages while present in WBNP. - Indigenous groups are able to maintain traditional harvest of waterfowl species and practice their way of life with confidence in healthy, sustainable and accessible populations of waterfowl.	Populations of waterfowl	Waterfowl survey
					Waterfowl habitat quantity	Remote sensing extent of habitat types
					Waterfowl habitat quality	Mercury and PAH levels in eggs, water, air testing
					Travel routes for Indigenous people available (Mamawi, Hay River, Pelican Creek, Lake Claire) Waterfowl harvest rates (indicative of perception and cultural/community capacity)	Waterfowl harvest by Indigenous people
	2. Rare and superlative natural phenomena including a large inland delta, salt plains and gypsum karst that are equally internationally significant.	ii. Large inland delta (Peace Athabasca Delta (PAD))	Portion of the Peace Athabasca Delta within WBNP (80%), with consideration of the portion of the PAD outside of the park. The Delta is understood to include the ecological functions and ecosystems it supports, including vegetation, wildlife and Indigenous communities within the Delta.	- Flow regimes and water quality into the PAD maintain the ecological function of the ecosystem - Flow regimes and water quality into the PAD sustain vegetation communities and healthy and abundant populations of key ecological and cultural species including waterfowl, muskrat, fish, bison and wolves. - Indigenous groups have access to the PAD and are confident enough in the health of the PAD to maintain traditional use and way of life through hunting, fishing, gathering, and cultural activities.	Indigenous access & enjoyment of the PAD	- Stream flow analysis - Assessment of vegetation communities’ health and composition - Invasive plants such as Canadian thistle within acceptable thresholds - Assessment of key species’ health and extent - TEK, TLU Interviews confirm groups’ confidence in health of PAD and ability to exercise traditional use and way of life. Indigenous peoples
					Intact ecological function of the PAD, incl. Ice Jam & Open Water Recharge	
					Sufficient water for Indigenous people to navigate safely in the exercise of their Treaty and Aboriginal Rights	
					Peace River Seasonal Flows; Peace River Sedimentation; Athabasca River Annual & Seasonal Flows	

FINAL REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

Criterion – OUV Statement (verbatim text)	OUV excerpts of primary importance	Listing of Individual OUV Elements for this criterion	Interpreted meaning	Desired Outcomes	Draft Valued Components (These will be further developed and refined during the Action Plan Implementation)	Potential indicators (These will be further developed and refined during the Action Plan Implementation)
					Lake Athabasca Water Levels; Central PAD Lake Water Levels	are able to “dip a cup” in PAD waters for drinking purposes again.
					Vegetation Quality & Quantity	• Recharged perched basins
					Fish Habitat, Quality & Quantity	• Frequent PAD flood events
					Migratory Bird Quality & Habitat	• Abundant muskrats, and waterfowl
					Wildlife Quantity & Habitat	• Water quality, (salinity, evaporation, PAHs and metals)
					Air Quality	• Fish quality (Hg and other metals)
					Groundwater Quality & Quantity	• Berry quality & abundance
		iii. Salt plains	Salt plains area within WBNP	• The salt plains remain aesthetically, ecologically and geologically unique in Canada, providing habitat for salt tolerant plants, grazing bison and nesting / staging waterfowl.	Extent of salt plains	Non-native species extent
		iv. Gypsum karst	Gypsum karst topography within WBNP		Ecological representative	
				• Gypsum karst topography in WBNP remains intact and functioning within natural parameters.		
				• The karst landforms in the Park continue to provide some of the finest examples of collapse and pond sinkholes in the world.		

FINAL REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

Criterion – OUV Statement (verbatim text)	OUV excerpts of primary importance	Listing of Individual OUV Elements for this criterion	Interpreted meaning	Desired Outcomes	Draft Valued Components (These will be further developed and refined during the Action Plan Implementation)	Potential indicators (These will be further developed and refined during the Action Plan Implementation)
Criterion (ix): “Wood Buffalo National Park is the most ecologically complete and largest example of the entire Great Plains-Boreal grassland ecosystem of North America, the only place where the predator-prey relationship between wolves and wood bison has continued, unbroken, over time.”	1. Great Plains-Boreal grassland ecosystem – the largest and most ecologically complete example in North America.	i. Ecologically complete Great Plains – Boreal grassland ecosystem	The boreal forests and vast sedge meadows of the PAD (the largest undisturbed grasslands in North America) and smaller but numerous meadows north of the Peace River.	• All species and community representatives of the Great Plains-Boreal grassland are present and functioning. • These grasslands continue to provide important grazing and calving areas for Wood Bison.	Vegetation communities’ health and composition	Assessment of vegetation communities’ health and composition
						Survey of species and community representatives of Great Plains-Boreal grassland ecosystem
					Quantity of bison habitat	Area of bison habitat
	2. Predator-prey relationship between wolves and wood bison – the only place where this relationship has continued, unbroken, over time.	i. Intact predator-prey relationship between wolves and wood bison	Intact predator-prey relationship between wolves and wood bison. Includes all bison herds that spend time in the park.	• The predator-prey relationship between wolves and wood bison that spend time in the Park remains intact and within natural ranges of variation • Populations of both species remain viable, evolve as naturally as possible and support Indigenous traditional use and ways of life.	Bison population Alternate prey populations	Bison population Calf survival rates With observed change: predation rates Moose populations in the area of the bison
					Wolf population	Wolf population With observed change: predation rates
Criterion (x): “Wood Buffalo National Park		1. Whooping crane breeding habitat		• Habitat continues to support recovery strategy goals for breeding pairs and	Whooping crane habitat	Prey availability Habitat hydrology

Criterion – OUV Statement (verbatim text)	OUV excerpts of primary importance	Listing of Individual OUV Elements for this criterion	Interpreted meaning	Desired Outcomes	Draft Valued Components (These will be further developed and refined during the Action Plan Implementation)	Potential indicators (These will be further developed and refined during the Action Plan Implementation)
<i>contains the only breeding habitat in the world for the Whooping Crane, an endangered species brought back from the brink of extinction through careful management of the small number of breeding pairs in the Park. The Park's size (4.5 million ha), complete ecosystems and protection are essential for in-situ conservation of the Whooping Crane."</i>	1. Only breeding habitat in the world for the Whooping Crane.		Whooping crane habitat within the WBNP. Includes habitat and population.	demonstrates resilience to climate change impacts. - Whooping crane population reaches recovery strategy goal. - Recovery and down listing from endangered status.	Whooping crane population	Whooping crane population Breeding pairs

4.0 CHAPTER 4: WBNP WORLD HERITAGE ELEMENTS EXCLUDING THE PAD

In this chapter, the pathways of effect, status and trends of salt plains, karst, boreal-grassland communities, migratory waterfowl, bison predator-prey relationship and Whooping Crane are evaluated.

4.1 SALT PLAINS

The WBNP Salt Plains are defined as “The inland saline wetlands (that) occupy periodically-flooded flats or terminal basins where alkali salts concentrate by evaporation” (Timoney, 2001). Alkali salts include sodium, magnesium, and calcium sulphates and chlorides. They are located on the north-eastern border of WBNP (**Figure 4-1**).



The salt marshes are typically featureless. They can contain plants such as slender wheat grass (*Calamagrostis stricta*), rush (*Juncus*), *Hordeum jubatum* meadows, and samphire (*Salicornia europaea*) flats. Importantly, these wetlands contain a high proportion of rare or uncommon plants due to their unique chemical environment. For example, *Carex mackenziei*, a circumpolar coastal species, is found in the salt plains. Prairies wetlands plants rare in Northern Alberta, such as *Scirpus paludosus*, *Atriplex subspicata*, and *Aster pauciflorus* are also found in the salt plains (Timoney, 2001).

The salt plains are rich in bird life. Canada Geese (*Branta canadensis*), Sandhill Cranes (*Grus canadensis*), Least Sandpipers (*Calidris minutilla*), Western Sandpipers (*Calidris mauri*), and American White Pelicans (*Penecanus erythrorhynchos*) can be found here. Additionally, abundant aquatic invertebrates have been observed. The salt plains lack bryophytes and fen species, which are characteristic of marshes (Timoney, 2001).

4.1.1 Pathways of Effects on the Salt Plains

Potential pathways of effects on the salt plains are climate change and invasive species. Due to the unique geological formations of groundwater replenishing the plains, the salt plains could be vulnerable to changes in temperature, precipitation, and other factors as a result of climate change, but no research has been conducted on this.

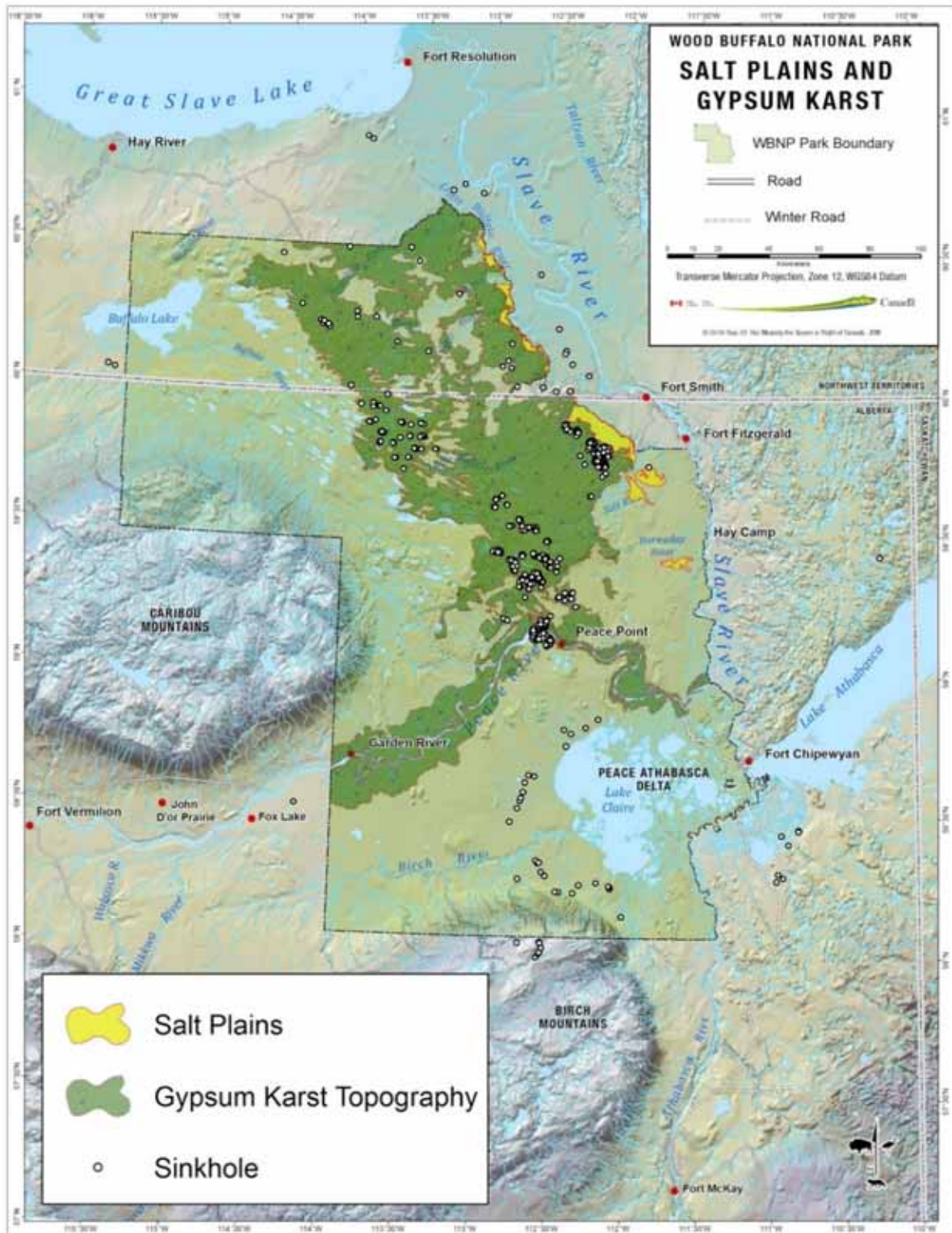


Figure 4-1: Salt Plains and Gypsum Karst Topography of WBNP (Parks Canada, unpublished data)

Invasive species that thrive in saline environments could be introduced to the ecosystem. In 2016, a large population of established Perennial Sow Thistle (*Sonchus arvensis*), was located along the northern treed boundary of the Salt Plains, within walking distance of the Salt Plain's Look-out Point. Hayward (2016) reports that, "...this non-native plant spreads rapidly through its heavily seeded pappus (seed head), with thousands of seeds being released at one time and their wind and water borne capability. This, along with their underground rhizomes, which reproduce themselves if broken-off, makes it extremely difficult to eradicate." However, the saline environment of the Salt Plains seems to act as a natural barrier to the spread of the less-salt-tolerant weed species (Hayward, 2016).

4.1.2 Status and Trend of Salt Plains

No ITK was provided related to the salt plains. Invasive species are not known to have invaded the salt plains (Hayward, 2016). Anecdotal observations and limited evidence suggest that the salt plains in WBNP meet, with a neutral trend, the desired outcome:

- The salt plains remain aesthetically, ecologically and geologically unique in Canada, providing habitat for salt tolerant plants, grazing bison and nesting / staging waterfowl.

4.2 GYPSUM KARST

A karst topography is generally formed by the dissolving of soluble rocks, such as gypsum. As a result of gypsum's minimal load bearing capacity, solution-pitted gypsum cavern roofs tend to collapse, particularly where there are thick deposits or other rocks on top. Spectacular looking collapse sink holes results from these large underground solution hollows that are formed in the gypsum and the overlying limestone collapses into the cave below.

In WBNP, these formations occur discontinuously along the Salt and Little Buffalo rivers, the escarpment west of the Salt River, and within dolines, caves, and waterfalls behind the escarpment in the Northeastern region of the park (**Figure 4-1**). The most complete sections of karst occur along the Little Buffalo River (Tsui & Cruden, 1984).

These formations provide valuable habitat to numerous species, including bears, and bats, such as little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), and big brown bats (*Eptesicus fuscus*) (Reimer et al., 2014), among other wildlife. The hydrogeology in this region forms the diatom ponds which provide the Whooping Crane habitat (Timoney et al., 1997). Some of the WBNP caves are ice caves (Rollins, 2004).

4.2.1 Pathways of Effects on the Gypsum Karst

Impacts to the gypsum karst from development around the park could be possible through changes to hydrology; however, the hydrological connections have not been researched to understand the degree



to which this pathway is possible. The warming climate means ice trapped within the caves could melt, changing cave ecosystems.

4.2.2 Status and Trend of Gypsum Karst Topography

Indigenous Knowledge holders did not provide any information about the karst. Anecdotal observations suggest that the gypsum karst topography in WBNP meets, with a neutral trend, the two desired outcomes:

- Gypsum karst topography in WBNP remains intact and functioning within natural parameters.
- The karst landforms in park continue to provide some of the finest examples of collapse and pond sinkholes in the world

4.3 GREAT PLAINS BOREAL GRASSLAND

The Great Plains Boreal Grassland is an eco-region within the Boreal Plains Ecozone. The Boreal Plains Ecozone lies just north of the Prairies Ecozone and is 84% forested with both coniferous and deciduous trees. However, there are intermittent patches of grassland within this Ecozone (Shorthouse, 2010). WBNP is the national park representing the Northern Boreal Plains and Southern Boreal Plains & Plateau natural regions as identified by Parks Canada. The mix of boreal forest and grasslands support crucial habitat and forage for bison, as well as deer, caribou and moose.



4.3.1 Pathways of Effects on the Great Plains Boreal Grassland

The three pathways of effects that are most likely to alter the Great Plains Boreal Grasslands are those related to the dominant ecological processes: fire suppression, changes to water regime, and grazing. In addition, invasive species have the potential to bring changes to the ecosystems in the Great Plains Boreal Grasslands.

- **Fire Suppression:** Fire risks within WBNP have increased due to a transition towards more upland forest ecosystem. The total flammable biomass accumulated, climate change and historic fire suppression could cause large wildfire in the future (Thompson et al., 2017). Fire could increase the available grasslands regionally (Strong & Gates, 2009).

- **Changes to Water Regime:** Impacts to the water regime have increased willow coverage as a result of drying conditions (K. Timoney, 2006). Additionally, ITK has indicated that invasive thistles have also become dominant species in grassland ecosystems within the delta (Candler et al., 2015a). Evidence exists that quaking aspen (*Populus tremuloides*) has also invaded some grasslands in WBNP over the last 60 years (Schwarz & Wein, 1997). See Chapter 5.0 for more details.
- **Grazing:** Bison, moose, and caribou graze on vegetation in WBNP. Changes to grazing patterns are not known, but not are expected to be a significant a pathway and therefore were not further considered.
- **Invasive Species:** The incursion of natural vegetation communities by invasive plant species is widely recognized as a considerable risk associated with land disturbance (White et al., 1993). As land disturbance increases around the park, the risk of invasive species coming into the park increases.

4.3.2 Status and trend of Great Plains Boreal Grassland

Using the Area Burned Condition Class methodology in the National Fire Monitoring Guide (Parks Canada Agency, 2010b) the forest fire regime is in good condition (Figure 4-2). Recent research has indicated that Boreal grassland areas are decreasing. Evidence from early in the 20th century suggests how much more extensive grasslands were around WBNP, including within the Peace Point region (Schwarz & Wein, 1997; Strong & Gates, 2009).

The first desired outcome is:

- All species and community representatives of the Great Plains-Boreal grassland are present and functioning.

There is no evidence of species or communities being lost and, with fire being the most dominant process of change on the landscape over the largest area, this objective is being met with a neutral trend.

The second desired outcome is:

- These grasslands continue to provide important grazing and calving areas for Wood Bison.

It's willowed in all over, shrunk and there is thistle on one side. The few buffalo that come in eat have to around the thistle and then they are gone again. Buffalo may eat willow for a few years when the willows are small. But when the willows get bigger, the buffalo don't bother.

Quote context: Willow, even what they (buffalo) do now is not normal. Buffalo don't usually bother with willow. The last 5 or 6 years that is when they are getting into the willow and in areas willows weren't growing before. A lot of the places where they used to eat the grass are now covered in thistle. These places are all getting smaller. One time they were lakes, and then they become prairie. The moose are leaving, the beaver, and the buffalo too. They are having a hard time and they sense the changes.

Source: Matthew Lepine

About Matthew Lepine: I've been on this land most of my 69 years. I was born in Fort McMurray. I lived in the bush until it got to a point. Even when I went to work in Fort McMurray I still kept up all the work. I used to come up here on weekends. The changes that have happened over 60 years are a lot. I am living on the land still. I'm going back tomorrow morning.

In the PAD, there are concerns about the ability of grasslands to provide important grazing and calving areas for Wood Bison because of changes to shrubs and invasive species (see Section 4.5). While, at this point this factor is unlikely to limit the bison population, there is a negative trend associated with this desired outcome. ITK indicates that there has been an effect on the grasslands and as a result, this desired outcome is currently understood to not be met. Further research on this aspect would be helpful to understand the extent of the problems.

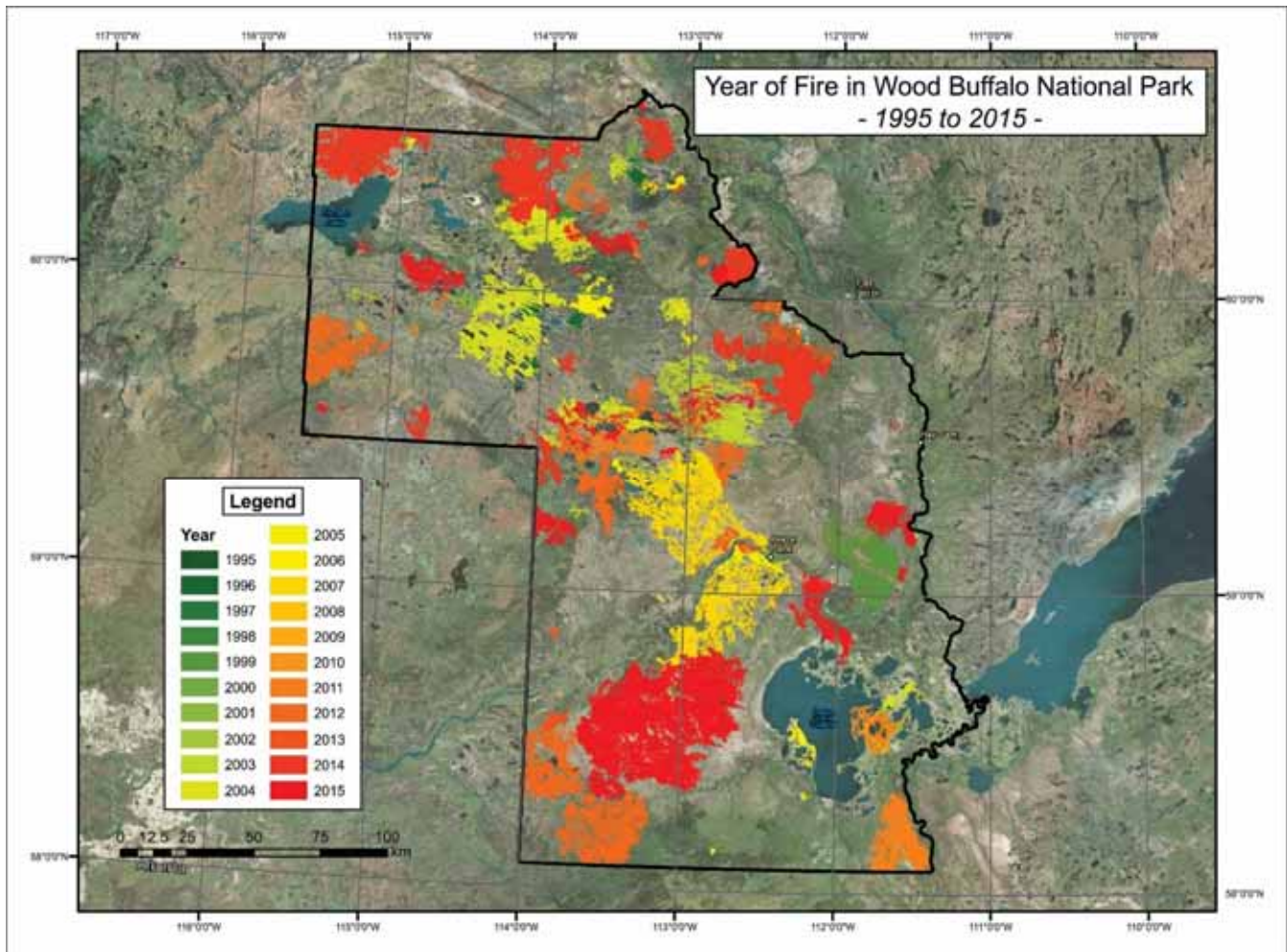


Figure 4-2: Year of Fire in WBNP (Parks Canada, Unpublished Data)

4.4 MIGRATORY WATERFOWL

Migratory waterfowl is understood in this context to include birds that are primarily associated with open water (waterbodies, watercourses) and wetland habitats – collectively known as waterbirds. These include dabbling waterfowl (e.g. ducks, geese and swans), diving birds (e.g. loons, grebes, cormorants and scaup), waders (e.g. herons, cranes, rails and shorebirds), and surface-feeders (e.g. gulls, terns). Migratory waterfowl from four continental flyways converge in great numbers on WBNP, especially the PAD, which provides critical wetland habitat for migrating, breeding, molting and staging birds, including numerous species of conservation concern (Figure 4-3).

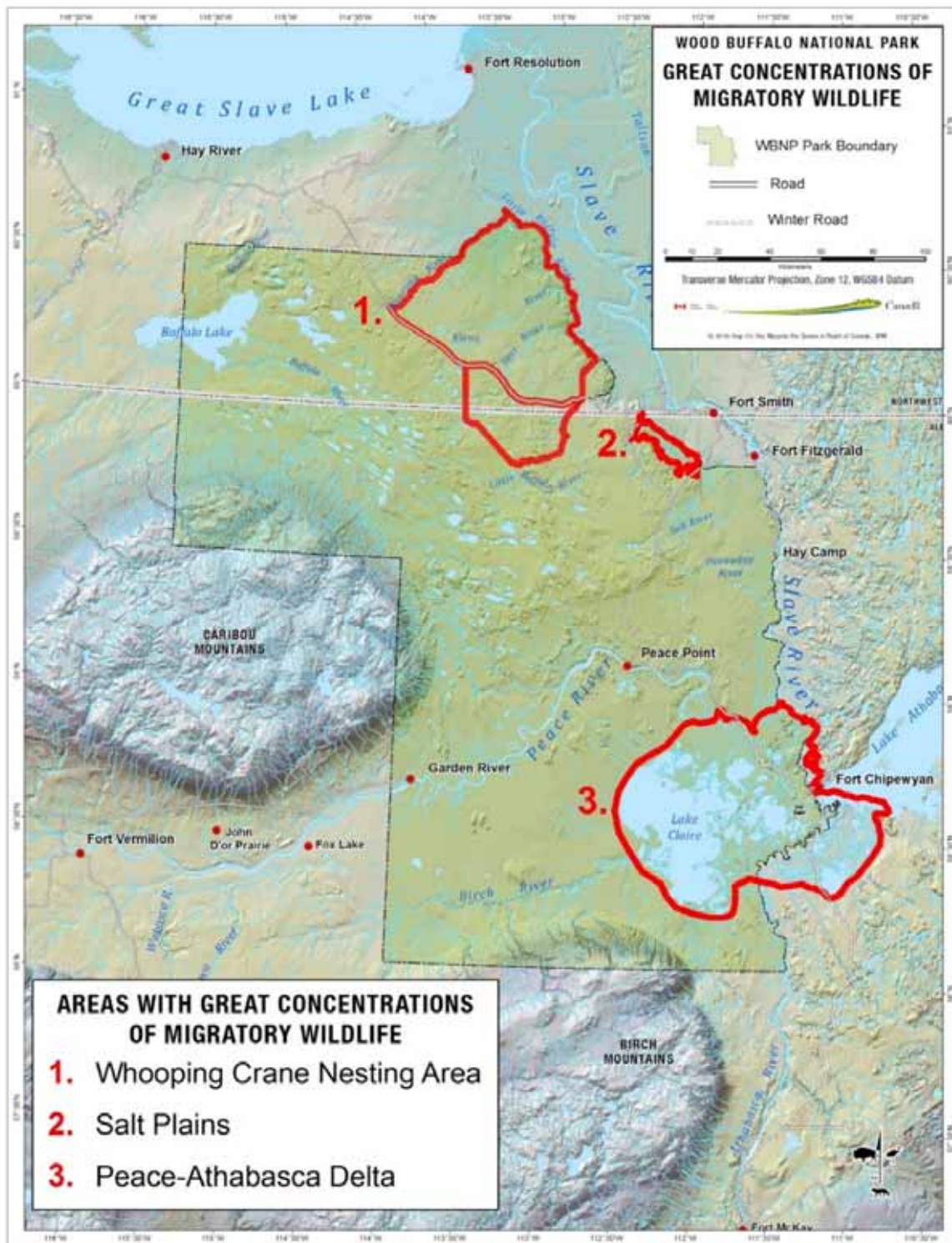


Figure 4-3: Locations of Concentrations of Migratory Waterfowl Within WBNP (Parks Canada, Unpublished Data)

4.4.1 Pathways of Effects on Migratory Waterfowl

WBNP has a high diversity of bird species with a total of 227 bird species having been recorded within the park (Parks Canada, 2010). Within WBNP, the PAD has been recognized as one of the most important waterbird areas in North America (Soper, 1951; Butterworth et al., 2002), and most research on waterfowl abundance, occurrence and diversity in WBNP is focused specifically on the PAD. Species commonly reported in the PAD include a diverse range of waterfowl (ducks, geese, swans), shorebirds, rails, herons, loons, terns, grebes, gulls, pelicans, cormorants, songbirds, and raptors. High species richness is believed to be due to the diversity and abundance of wetland habitats in the PAD (Timoney, 2013; Soper, 1951), with birds distributed according to specific habitat foraging guild requirements, and seasonal requirements for migration, breeding, brood-rearing, molting and fall staging habitats.

There are 51 species considered to be annually common and can be expected to be abundant in suitable habitat at various points during the breeding season (Timoney, 2013). For Ross's goose (traditionally known as "galoots" to local land users), the PAD is the most important migratory stopover site in Canada (Thomas, 2002). Migratory waterfowl, especially ducks and waxies (a term used to describe large groups of Lesser Snow Geese), are highly valued traditional resources for ACFN and MCFN and are harvested for food and clothing (feathers) and eggs are harvested in the spring (Candler et al., 2015a). Surveys also indicate that the PAD is regionally important for numerous species of shorebirds (Beyersbergen, 2004). Similarly, for Yellow Rails, designated as Special Concern and listed on Schedule 1 of SARA, recent surveys showed that this species is present in the PAD and that habitat around Lake Claire and Mamawi Lake may be significant for the species in Alberta (Maclean and MCFN, 2016).

Migratory waterfowl in WBNP and the PAD experience numerous natural and anthropogenic stressors throughout their annual life cycle, including overwintering, migration, and summer breeding/nesting periods, that may impact health, fitness and survival. Stressors that impact overwinter survival (outside WBNP) and fitness may act cumulatively to affect waterfowl populations in WBNP. Figure 4-4 is a diagram developed by MCFN Traditional Knowledge holders of trends and stressors for migratory waterfowl in the areas of the park in and around the PAD, including the effects on indigenous traditional use and ways of life (MCFN, 2018a). Local anthropogenic stressors to birds in WBNP and the PAD include risks associated local migratory habitat (the Mineable Oil Sands Region (MOSR)), immediately south of WBNP. Five key stressors and local pathways of effect for migratory bird in WBNP have been identified:

- Changes in habitat and food availability in the PAD
- Exposure to contaminants in water, food and sediments in the PAD
- Short-term exposures to contaminants in local migratory habitat
- Changes to habitat and food availability in local migratory habitat
- Changes in local migration routes

These key stressors, some of which originate outside of WBNP, can have direct or indirect impacts on migratory waterfowl in WBNP and can act cumulatively. Mechanisms of effect are discussed below.

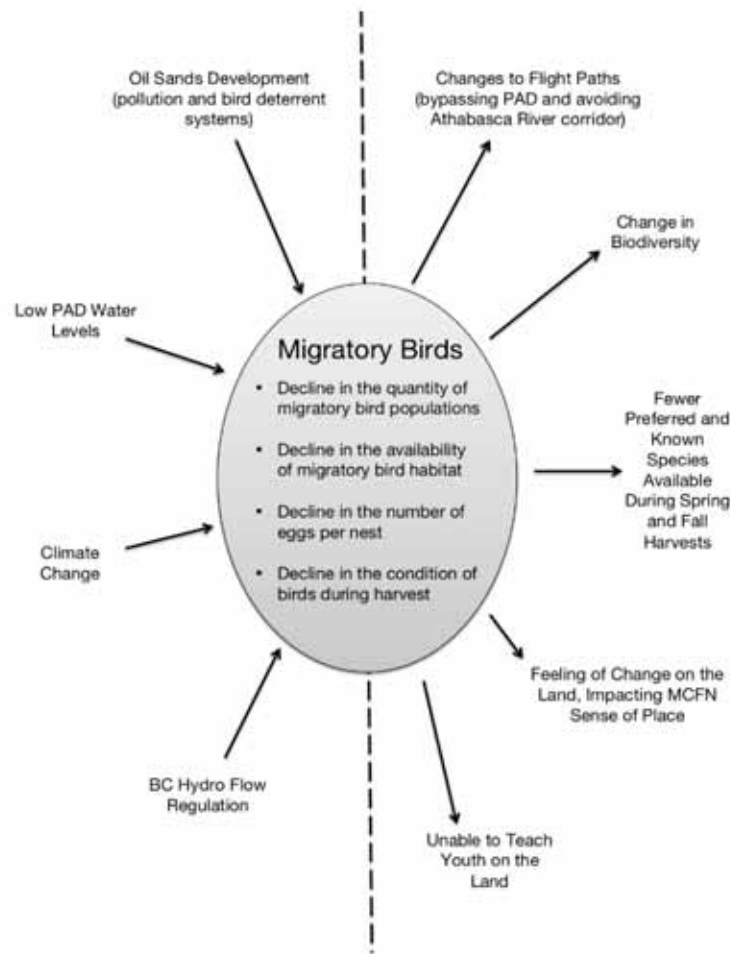


Figure 4-4: Migratory Waterfowl – Key Stressors, Conditions, and Outcomes Based on MCFN IK (MCFN, 2018a)

4.4.1.1 Changes in Habitat and Food Availability in PAD

The composition and distribution of vegetation in the PAD is principally determined by differences in moisture regime. Variations in the hydrological state of PAD water bodies, whether from natural or human causes, directly influence the amount and quality of wetland habitat and consequently the abundance, occurrence, and diversity of migratory waterfowl dependent on these habitat types (Nieman and Dirschl, 1973; Timoney, 2013). Reduced water levels can lead to a pronounced reduction in the extent of open water, shallow marsh, emergent vegetation, and wet meadow habitats used by migratory waterfowl, and the replacement of these wetland habitats by communities dominated by more upland species such as willows (Timoney, 2013) (See also Section 5.11). Hydrological changes can also result in

shallower, warmer lake conditions, with subsequent effects on water chemistry, productivity, and increases in algal blooms (Timoney, 2013).

Migratory bird occurrence and distribution in the PAD appears to correlate with specific habitat and foraging guild requirements, and seasonal requirements for migration, breeding, brood-rearing, molting and fall staging habitats. Nest site availability and suitability are largely impacted by emergent vegetation and water levels. Molting birds require habitat that provides adequate water body size and depth and the presence of dense stands of emergent vegetation for avoiding/escaping predators during flightless period. For brood rearing, waterfowl need access to areas that have stable water levels. In some situations, spring breeding habitat may become sub-optimal by mid-summer due to lack of water.

Staging areas are sites where migratory waterfowl prepare themselves physiologically for their next migration flight. Staging can occur in both fall and spring seasons and habitats for staging must provide reliable and abundant food sources. The PAD is typically used for staging by migratory waterfowl at the beginning of fall migration as they prepare for long flights south (Hennan & Munson, 1979). Overall, abundance and diversity of waterfowl are greatest during years when waterbodies are abundant, shorelines are extensive, and water levels are neither too high nor too low and do not change significantly over the breeding period (Timoney, 2013). In the PAD, the optimum habitat conditions need to persist from May to July for maximum waterfowl breeding success (Hennan, 1972). Therefore, changes in the PAD hydrologic regimes (natural or human-made) will impact the location and the number of breeding pairs of waterfowl, as well as numbers of staging and moulting migrating birds (Dirschl, 1972; Butterworth et al., 2002; Timoney, 2013).

All the water that shows up on these maps, half the water isn't in there now. Some of these lakes are all willows, poplars. Once we had birds landing and now it's full of willows. Where are they going to land?

Quote Context: *I can't go into Gull River now because it's grown in because of low water. Every year there is less water. That is what is happening. It's not only muskrats that we are trying to get the water for, it's our transportation. But now the water is too shallow sometimes you can't even go to Hay River. You can't go to Lake Mamwai, unless you push your boat up. That is what is happening. For birds, the bottom is growing up from the water, vegetation. Now the willows grow on top now, instead of the grass it used to have. The willows are taking over, replacing the grassy area. The lake that used to be a #1 hunting area, now there is different grass and hay.*

Source: George Martin

About George Martin: *I'm 76. I started trapping at 12 by myself. I've been here all my life. This is my area. I killed my first caribou at 8 years old. We had to learn in the bush.*

4.4.1.2 Exposure to Contaminants in Water, Food and Sediments in PAD

Several of the contaminants of concern that are affecting surface waters in the MOSR and downstream in the PAD are the same as those highlighted as contaminants of concern in Oil Sands Process-affected Water (OSPW), including metals and PAHs, and PAH derivatives such as dibenzothiophene (DBT). The potential modes of transport of the contaminants from oil sands developments to the Athabasca River and downstream to the PAD include atmospheric deposition (to snow, soils, water) and waterborne transport (shallow groundwater, streams and wetlands to rivers moving downstream). Within each of these transport pathways, contaminants can be associated with airborne particulates, dissolved in water, associated with suspended sediments, or incorporated within animals and plants. Contaminants, especially organic compounds like PAHs, can also be modified or degraded during this transport process,

There are less nesting areas in the Delta than there used to be. I go out in May to get eggs, May 15 to end of May, and now I find more of two yolks in the one egg. It can be as many as one in three will have two yolks. That is different to me in past couple of years. Also nests used to have 12-15 eggs but now I'm lucky to get 6. The nests are not as full.

Quote context: Maybe it's because of the feed, what is in the water. Maybe there is not enough of their food they normally get on the delta, the bugs and vegetation. You can't even go there now these years with a boat. I have collected eggs since I could remember. It used to be that it was unusual and I got happy when see two yokes long ago. Now I ask how come there are two yolks in one egg all the time. It's just about every second egg now has two yolks. This must be again from what the birds are eating. We have found rabbits that have two private parts. It's scary. I wonder if I should eat the eggs. And even just to go show you or anyone how to pick eggs, it's hard if there is nothing out there. It's a loss of way of life. We can't pass it on.

Source: Jocelyn Marten

About Jocelyn Marten: I have been on the land probably since I was born, 1970. I grew up with my grandparents and two uncles GM and Sammy. We lived in Doghead, in a shack, a house. Then I remember living on the Athabasca River. That is where I spent my winters, trapping with buying fur, with my whole family. I called it Embarras house, they called it Snowbird's. I saw ice break ups and jams. It was a small community like 10 families there. There was a store across the river. In spring time we'd move to Frog Creek, in the beginning of April as there was so much snow, water, and overflow. And all we had was dog teams to move with. I am still out on the land and I take my family. I help with GM's cabin. It's not experience, it was (and still is) my way of life and how I was brought up.

and may bioaccumulate or biomagnify in biota, making source attribution challenging. Additionally, the PAD landscape is a complex system of interacting biotic and abiotic factors in a hydrologically dynamic ecosystem making toxicology studies in this environment difficult. Other upstream and regional contaminant sources that may act cumulatively with those from the oil sands include pulp and paper mills, forestry, agriculture and municipal effluent.

Local land users are seeing changes in the PAD that they attribute to contaminants coming from upstream sources, especially oil sands development. For example, land users are seeing sick and skinny birds, deformities in animals and eggs, slime in water, sheen in boiled water, etc. (MCFN, 2018a). Land users also state that *"We look at the animals to gauge the water...If fish are dying and fish are deformed, that has to affect the animals as well. And that scares people who eat traditional foods. And it means they may not be able to pass their knowledge on to future generations because of that fear and that has an impact too."* (MCFN, 2018a). Indigenous communities are also concerned about consumption advisories on fish and on gull and tern eggs in the PAD that were put in place in 2014 due to high mercury (Hg) levels (GoA, 2014a). This impacts their ability to harvest traditional foods (MCFN, 2018a).

Recent comprehensive measurements of contaminant concentrations and characteristics from multiple environmental components (biotic and abiotic) across a broad range of ecosystems in the Athabasca River and the PAD have attempted to determine the sources, form, and fate of oil sands-derived contaminants. This includes work by a Community Based Monitoring (CBM) Program which has tracked changes to water and terrestrial resources in the traditional areas of MCFN and ACFN, as well as directed studies on hunter/trapper harvested animals (including furbearers, fish, ducks and bird eggs). Results from some of this research are only recently available, but there is evidence emerging from numerous sources to indicate that exposure to some environmental contaminants, e.g. mercury, may be elevated in the PAD (Hebert et al., 2011, 2013; Dolgova et al., 2018).

In the PAD, research has focused primarily on two contaminants of key concern for bird health: metals (particularly mercury) and PAHs. Mercury bioaccumulates and biomagnifies as it is transmitted to higher food web levels in the environment and can be taken up by migratory waterfowl through foraging activities. In birds, mercury can impair reproduction and immune function, and cause detrimental behavioural changes (Whitney and Cristol, 2018). For PAHs, there is significant evidence that exposure triggers an array of pathological effects in organisms and can have teratogenic (changes to embryo/fetal development), mutagenic (changes to genetic material) and carcinogenic (cancer causing) effects in fish, amphibians, mammals and birds (Eisler, 1987). PAHs have also been identified as endocrine disruptors (Lintelmann et al., 2003) and, in birds, cause inflammation, immunosuppression, and oxidative damage to cells (Leighton, 1993; Briggs et al., 1997; Albers, 2003). In terms of the ingestion pathways of contaminants for birds in the PAD, recent data indicates that mercury and PAHs are present in water, sediments, and fish and in some cases, occur in relatively high concentrations in aquatic ecosystems in the Athabasca River and the PAD (Kelly et al., 2009; Radmanovich, 2013; Evans et al., 2016; Dolgova et al., 2018), but more data are required regarding contaminant loads in aquatic plants and invertebrates in these regions.

Mercury can be taken up from water, sediment, and food by aquatic organisms to varying degrees, depending on the type of organism, its growth rate and trophic position (Boening, 2000; Ward et al. 2010; Sandheinrich et al., 2011; Karimi et al., 2016). There is evidence that mercury is accumulating in aquatic organisms in the MOSR, some of which are food sources for migratory waterfowl that use the PAD. For example, mean total mercury concentration in an aquatic benthic invertebrate (caddisflies, *Trichoptera*) in the Athabasca River was significantly higher downstream of oil sands development compared to sample sites immediately adjacent to oil sands development or in the PAD, indicating a potentially local influence of oil sands development on the mercury burden in these invertebrates (Radmanovich, 2013). Preliminary results from a joint Environment and Climate Change Canada (ECCC) and Mikisew Cree CBM study of minnows in the Athabasca River (both up and downstream of oil sands surface mines), the PAD, and Lake Athabasca found that mercury levels were highest in minnows collected in the Athabasca River downstream of Fort McMurray and oil sands operations, and remained somewhat elevated in Mamawi Lake fish, and were lower in Lake Claire and western Lake Athabasca. However, minnows from all of these locations had higher mercury levels than fish from a reference location upstream of Fort McMurray (near Athabasca, AB) on the Athabasca River (Dolgova et al., 2018). Minnows are good indicators of local contaminant sources (Suns et al., 1993; Scheider et al., 1998) and are an important food source for many piscivorous migratory waterfowl, including gulls and terns. Concerns around the exposure of birds to contaminants in the PAD were first triggered following the reporting of mercury concentrations in gull/tern eggs in the PAD (Hebert et al., 2011, 2013). In response to these findings, the Government of Alberta issued a consumption advisory for these eggs from Lake Athabasca and Mamawi Lake in 2014 (GoA, 2014a). Research on gull and tern eggs has also led to insights into temporal and spatial trends in mercury in this region. For example, mercury concentrations in gull eggs collected at Egg Island in western Lake Athabasca are greater now than they were in 1977 (a period prior to most oil sands development). In addition, mercury in eggs from sites in receiving waters of the Athabasca River, i.e. PAD and lake Athabasca, were higher than in eggs collected from a number of other sites located further north and south in Alberta (Dolgova et al., 2018). The authors concluded that mercury appears to be more available at sites downstream of the Athabasca River, hence riverine transport of mercury is likely an important factor regulating mercury levels in birds nesting downstream

in the PAD and Lake Athabasca. However, more work needs to be done to determine if these higher mercury levels are solely the result of greater mercury supply from river-associated sources of Hg (e.g. oil sands), or whether other factors, such as enhanced mercury methylation in PAD wetlands, are also important in regulating mercury availability to birds.

For PACs in the Athabasca River in 2008, concentrations were mostly undetectable or low in the river in winter and in summer. This was the case except at sites near oil sands upgrading facilities, near oil sands tailings ponds, and at sites downstream of new oil sands developments. At these locations, concentrations were elevated during certain seasons (Kelly et al., 2009). In 2015, total alkylated PAH concentrations in water in the Athabasca River and in the PAD were higher at all but one of 13 test sites near to and downstream of oil sands developments compared to a single baseline site located upstream of the oil sands on the Athabasca River (note that additional baseline data would help determine spatial trends) (RAMP/JOSM, 2016). Therefore, similar to the above noted trends in mercury in the Athabasca River, elevated alkylated PAH levels near to and downstream of the MOSR, indicate an influence of oil sands developments on regional water quality. In addition, Evans et al. (2016) found that total PAH and DBT concentrations in surface sediments were generally low and have declined over time in the Lower Athabasca River (LAR) but have increased over time in the Athabasca River Delta (part of the PAD). There is also very recent evidence of accumulation of PACs in birds from a joint ECCC and CBM program (ECCC, 2018). Researchers with ECCC have presented preliminary findings indicating that juvenile ducks (mallards, northern shovelers, American widgeons and green winged-teal) collected near bitumen upgraders in Fort McMurray and the PAD had elevated concentrations of PACs in their livers compared to juvenile ducks collected near reference sites at Lac La Biche, AB (ECCC, 2018).

Contaminant levels in food sources for migratory waterfowl in the PAD, such as aquatic plants or benthic invertebrates, have not been studied. However, there is recent evidence that metals and PAHs are negatively impacting benthic invertebrate populations in the Athabasca River and its tributaries. Gerner et al. (2017) found that benthic invertebrate communities, with long generation times, and therefore sensitive to organic contaminants, were negatively correlated with calculated PAH-related toxic units in water. These results indicate that current water PAH guidelines (which are for specific individual parent PAHs rather than total or alkylated PAHs) for the protection of aquatic life appear not to be sufficiently protective in some cases, so that relying on these guidelines as regulatory goals may be inadequate.

4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat

Many of the migratory waterfowl that converge annually on the PAD and WBNP fly directly over the MOSR. Bitumen surface mining operations in Alberta use hot water to process, separate and extract bitumen (a heavy, biodegraded form of crude oil) from oil sands which also contain large amounts of sand and clay (Masliyah et al., 2004). The resulting process-affected water is alkaline, slightly brackish, and acutely toxic to aquatic biota due to high concentrations of organic acids that leach from the bitumen during extraction (Allen, 2008, Li et al., 2017). The term 'oil sands process-affected water' (OSPW) is used to classify all fluids at a mine site that have been in contact with bitumen as part of the extraction process. OSPW typically contains numerous complex organic and inorganic compounds that are a concern for biotic receptors, including unrecovered bitumen, aromatic hydrocarbons (including PAHs and PACs, benzene, phenols and toluene), naphthenic acids, ammonia, metals and other dissolved compounds such as salts (Allen, 2008; Mahaffey and Dube, 2017; Li et al., 2017). Oil sands mines are not

currently permitted to discharge OSPW directly into the environment due to its composition and toxicity, resulting in the need for on-site storage. The volume and area of containment ponds at oil sands mines (known as ‘tailings ponds’) has grown over the past 40 years to include over one billion cubic metres (m³) of OSPW accumulated on lease sites to date (Mahaffey and Dube, 2017). Mine sites also produce and store other types of industrial wastewater, defined as fluids that have not been directly used in the bitumen extraction process, but that may contain oils, grease and other chemicals, which pose a risk to birds on contact (e.g. basal water ponds, sumps, dumps, coke and sulphur runoff collection ponds, process ponds, thickener tanks, sedimentation ponds, etc.).

The risk to migratory waterfowl in the oil sands region is escalating due to the increasing size and number of tailings ponds and industrial waterbodies on the landscape. While the average pond size is 134 ha, some tailings ponds in the oil sands are over 10 km² (1000 hectares, or 1000 ha) in size and, in some cases, constitute the largest waterbodies in a given area (St. Claire, 2014; Wells et al., 2008; Ronconi, 2006). Government data on total fluid tailings at all currently operating oil sands project sites shows that in 2013, the total active fluid tailings area was 88 km² (AEMERA portal: <http://aemeris.alberta.ca/library/Dataset/Details/542>. Accessed 01/10/2018). Since the initial development of surface mining in the oil sands, both industry and government biologists recognised the threat of placing tailings ponds along an internationally significant migratory bird corridor and expressed the urgent need to protect migratory waterfowl from exposure to tailings ponds (Schick & Ambrock, 1974; Hennan & Munson, 1979). To migrating waterbirds, the open water, banks, and shorelines of tailings ponds can appear as appropriate stopover habitat and can attract large numbers of migrating birds heading to and from northern breeding grounds, such as the PAD. At night, migrating birds can be attracted to the lights at a mine site and become disoriented (St. Clair, 2014). Both migrating and resident birds appear most at risk for landing on tailings ponds during early spring, when warm effluent keeps tailings ponds open while adjacent water bodies are likely still frozen, and in late autumn, when winter storms could force abrupt landing events (Ronconi, 2006; St. Clair 2014). Despite the implementation of extensive bird deterrent programs at mine sites, to date no system exists that can reliably and consistently deter all birds from landing on tailings ponds, especially during weather events (Ronconi and St. Clair, 2006; St. Clair et al., 2011; St. Clair, 2014). Overall, there is mounting evidence that current mitigation methods to protect migratory waterfowl in the MOSR are only partially effective, and the risks of exposure to contaminants remains.

Current estimates report that as many as 200,000 bird contacts or landings every year on industrial waterbodies at oil sands mines in the MOSR (St. Clair, 2014). Data also indicate that at least 60 species of migratory waterbird have landed and, in some cases, have become oiled at oil sands mine sites. The populations for some duck species that have landed on the ponds are at or above the long-term average for the population. On the other hand, species designated as endangered, threatened, or special concern under the *Species at Risk Act*, Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or the Alberta *Wildlife Act*, or listed within Alberta as at risk, may be at risk, or sensitive. Additionally, at least 50 species of migratory non-waterbirds, including species of conservation concern (e.g. Horned lark), have landed and/or died at tailings ponds to date in Alberta (Timoney and Ronconi, 2010; Ronconi and St. Clair, 2006; OMEI, 2016). Importantly, some of North America’s most endangered (Whooping Crane) or rapidly declining (Lesser scaup) bird species are among those that migrate over the MOSR. Scaups have experienced a 66% population decline in boreal plains ecozone, including Alberta,

since the 1970s (Fast et al., 2011), and are one of the most widely reported casualties of tailings ponds in Alberta (Wells et al., 2008; OMEI 2015, 2016). While the mortality of scaups may cumulatively contribute to population declines, some have suggested that the long term survival rates are declining primarily as a result of fecundity (Arnold et al., 2016). Many of the birds most impacted by industrial waterbodies in the MOSR in terms of mortalities are also species of traditional importance to ACFN and MCFN in the PAD.

Although tailings ponds are recognized as the largest industrial waterbodies at an oil sands mine and likely pose the highest risk to migratory waterfowl, the numerous other external storage facilities for industrial wastewater at mine sites also pose additional risks. Very little information is provided regarding the composition and toxicity of the various industrial waterbodies at a mine site. As a result of this information gap, a comprehensive assessment of risks to migratory waterfowl posed by the various waterbodies at oil sands mines is not currently possible. In recent years, the number of studies looking at chemical constituents and toxicity of wastewater produced by the oil sands industry, especially the various forms of OSPW, has surged (reviewed by Mahaffey and Dube, 2017 and Li et al., 2017) but there is no consistent and/or standard sampling and assessment program for composition and toxicity of oil sands OSPW. This makes risk assessment an ongoing challenge.

Short-term, controlled exposure studies looking at effects of oil and OSPW on biotic receptors (including invertebrates, fish, amphibians, birds and mammals) indicate that exposure can lead to direct mortality or to adverse, sub-lethal, physiological changes ranging from compromised immunological function, developmental delays, impaired reproduction, endocrine system disruptions, to higher prevalence of abnormal pathologies (reviewed by Li et al., 2017). However, these studies may not be directly applicable to wild migratory bird populations because negative health outcomes resulting from exposure to OSPW are strongly influenced by age, body condition, and migratory and reproductive status at the time of contact. Environmental conditions (weather, food availability, habitat availability and quality) also appear to act cumulatively and synergistically to increase the risk of contaminant exposures and degree of physiological stress (Gentes et al. 2006; Gentes et al. 2007b). The few field studies completed in the MOSR involving exposure by resident birds to OSPW are limited in scope to aged OSPW, mostly at reclamation wetlands or recycled water ponds rather than tailings ponds (Beck et al., 2015). The level of contaminant exposure in these studies is also not comparable to that of migratory waterbirds that land on tailings ponds. Importantly, many of the studies on aged OSPW still indicate toxic effects to birds (e.g. King and Bendell-Young, 2000; Gurney et al., 2005; Gentes et al., 2006, 2007a,b; Harms et al., 2010). The potential additive and/or synergistic effects of different toxic components present in OSPW and an individual bird's body condition, age, migratory and reproductive status, along with environmental conditions, are a critical knowledge gap related to effects of OSPW exposure on migratory waterfowl.

Migrants face myriad or numerous ecological and physiological challenges during long-distance migrations. Birds arriving in the MOSR in the spring having flown thousands of kilometers and may already be under physiological stress from resource depletion. In addition to the energetic cost of flight, birds must find stopover sites to rest and refuel, cope with unfavorable weather, and deal with uncertainties of resource abundance and availability, intra- and interspecific competition, and predation pressures, all within the context of unfamiliar environments (Maggini et al., 2017). These challenges, along with broad scale anthropogenic changes in habitats and landscapes along migratory pathways,

suggest that migration poses formidable hardships to many birds (Skagen, 2006). Contaminant exposure at this stage in annual life history cycle could have heightened impacts on individual fitness.

Effects pathways - When a waterbird lands on an industrial waterbody at a mine site, exposure to contaminants occurs largely via three primary effects pathways: external contact (dermal), ingestion via water and food, and inhalation. The basic effects pathways, possible outcomes, and endpoints (i.e., final disposition of affected bird) resulting from these exposure pathways are shown in **Figure 4-5**. Mechanisms of effect are discussed in detail below in relation to impacts on individual health and fitness (i.e., survival, growth, and reproductive success).

Direct Mortality - Acute lethal effects of contaminant exposure result in the individual not surviving the exposure, with death being relatively rapid. For waterbirds, acute lethal effects of direct exposure to oil typically result from mechanical disruption of the feather structure, which suppresses waterproofing and insulating properties and hinders thermoregulation, buoyancy and flight (Leighton, 1993, Maggini et al., 2017). In the oil sands, this is often the result of external contact with floating bitumen mats. Birds that become heavily oiled may die quickly and sink below the surface rapidly or struggle on the surface until exhaustion or hypothermia causes death or be recovered and euthanized. Mortality from tailing pond landings is reported but has also been recorded at numerous other industrial waterbodies (OMEI, 2015, 2016). Five mass casualty events at oil sands mines in Alberta where large numbers of bird mortalities occurred over a short period, including waterfowl, songbirds, and herons, have been reported since 2008. Ongoing incidental take at mine sites is reported as 150-200 mortalities annually (OMEI, 2016). However, the detection accuracy for oiled and dead birds remains uncertain and reported numbers of deaths are likely underestimated to an unknown degree (OMEI, 2015). Annual mortality has been estimated to range from 458 (Timoney and Ronconi, 2010) to as many as 100,000 birds each year if you extrapolate the estimate of landings at all ponds and assume that 90% of landed birds die (Wells et al., 2008). The large disparity in the size of the mortality estimates indicates that additional effort is needed to more accurately determine actual mortality rates of birds who land on oil sands properties. The populations for some duck species that have landed on the ponds are at or above the long-term average for the population and in that context the mortality is not desirable, but not likely a population level effect. On the other hand, for species designated federally or provincially or populations seeing declines, the mortality may be of greater concern.

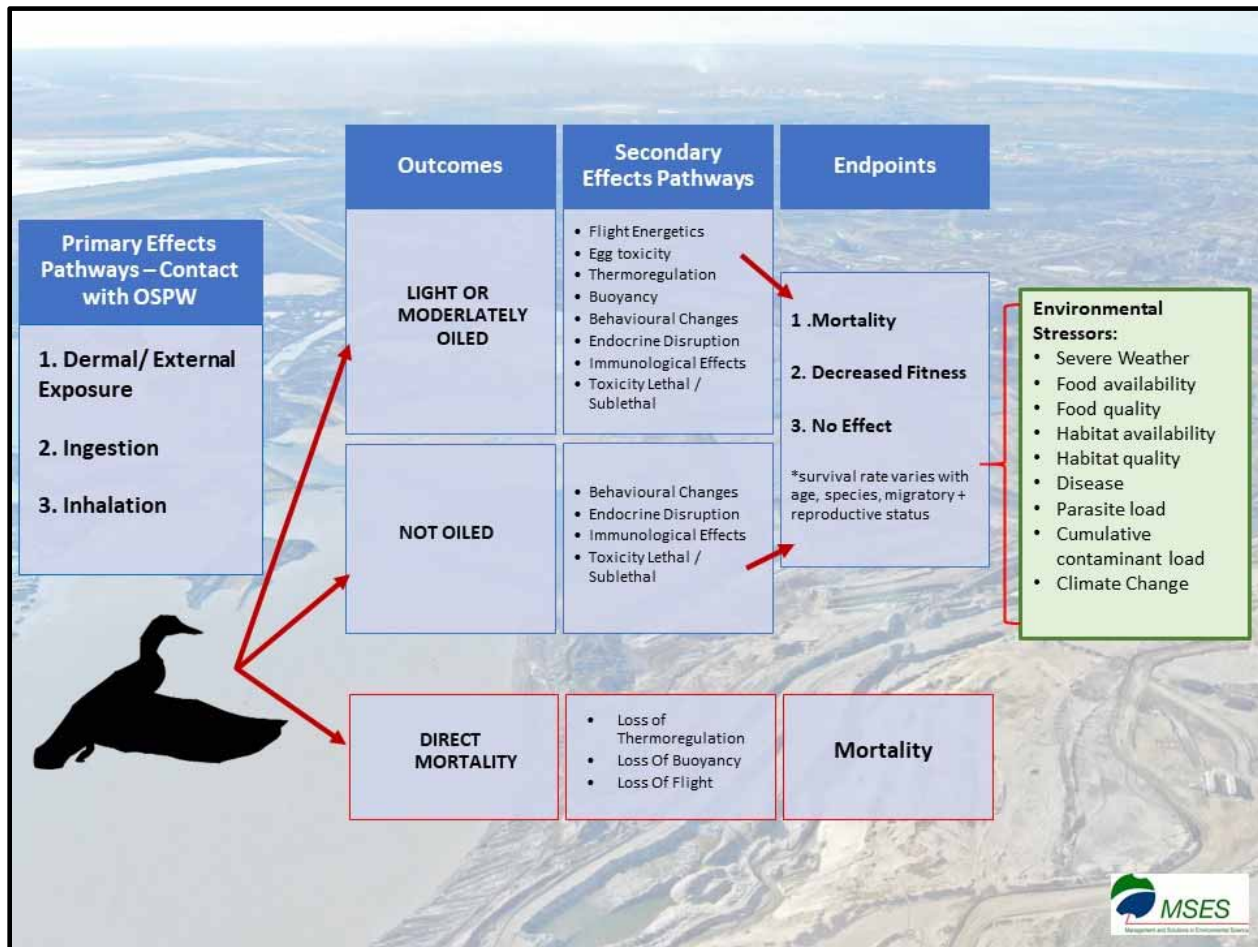


Figure 4-5: Effects Pathways, Outcomes and Endpoints for an Individual Waterbird Exposed to Bitumen, OSPW, or Industrial Wastewater in the MOSR of Alberta

Sub-lethal/Chronic Effects – Sub-lethal effects are defined as effects on individual waterbirds that survive exposure to contaminants but experience adverse effects on fitness after departure from a mine site. These effects can act quickly and severely (acute) or can occur over a long period of time (chronic) at varying degrees of severity. Sub-lethal effects are difficult to measure and often inadequately documented because of the scale of time over which they occur. Evidence suggests that birds may experience either short or long-term effects on health and fitness associated with exposure to contaminants (Beck et al., 2015). Further, hundreds of the migratory waterfowl that are landing in industrial waterbodies in the oil sands are becoming “lightly” or “moderately” oiled and flying away; the fate of these birds is unknown. A range of lethal and sub-lethal effects are reported to result from trace, light and moderate oiling of waterbirds (Leighton, 1993, Maggini et al., 2017).

Most bird mortalities in tailings ponds involve bitumen exposure, and as a result, there is an uncertainty as to whether exposure to OSPW is not toxic to birds unless it contains residual bitumen. However, there are numerous non-bitumen containing industrial waterbodies that pose a risk to migratory waterbirds including: areas of tailings ponds with aged OSPW, recycled water ponds, OSPW seeps from containment ponds into adjacent natural areas, and mature OSPW that has been incorporated into wetlands (Mahaffey and Dube 2016, Beck et al., 2015). To date, there have been no studies investigating the

outcome of the thousands of migratory waterfowl that contact industrial waterbodies but fly away with no visible oil. However, contact with aged or treated OSPW has been shown to have various sub-lethal effects which manifest via diverse pathways, time periods, and locations (see discussion below, Beck et al., 2015); these birds may still become sick and die off site. Sub-lethal effects from exposure to contaminants in oil can adversely affect growth, alter organ function, reduce reproductive success, and increase risk of disease, thereby reducing fitness in individuals which can ultimately affect populations (Leighton, 1993; Cruz- Martinez and Smits, 2012; Beck et al., 2015).

A relatively new contaminant exposure route under investigation for oil sands operations is inhalation of the volatile components of oil and oil processing, which can lead to respiratory irritation and inflammation (e.g. pneumonia), emphysema, suffocation, and degradation of the central nervous system (Sanderfoot and Holloway, 2017). Birds are more sensitive to inhaled contaminants than mammals because of their unique lung structure and physiology (Olsgard et al., 2009). In the oil sands, migratory waterfowl flying through emission plumes or landing on tailings ponds would be exposed to airborne toxicants (including hydrogen sulfide, sulfur dioxide, nitrogen dioxide, ozone and particulate matter) that can compromise the health of wildlife (Cruz-Martinez and Smits, 2012; Cruz-Martinez et al., 2015a, b). To our knowledge, there have been no studies looking at the health of wild waterbirds exposed to airborne pollution from OSPW.

Little is known about the long-term health of the birds that come in contact with OSPW. This uncertainty has not been addressed by regulators or industry and, as a result, reported total mortality inventories from oil sands related industrial activity do not include an estimate of contaminated birds that have flown offsite and later died. This may result in an underestimation of the total mortality rates for migratory waterfowl and of the risk posed by oil sands operations. Contamination of migratory waterfowl is also a concern to Indigenous groups who consume waterfowl and eggs in the region. MCFN hunters and land users have seen oiled, sick, and contaminated birds in the oil sands region and in the PAD (Candler et al., 2015b, MCFN, 2018a). To date, studies related to potential health and fitness effects in birds resulting from oil sands contaminant exposures have all been short-term. To our knowledge, long-term studies of single and/or multiple OSPW-related toxin exposures have not been conducted, but they are urgently needed in order to detect latent, subtle, or cumulative effects of toxin exposure. The only published studies looking at oil sands contaminant exposure over more than 2 years were toxicology studies on gull and tern eggs in the PAD (Hebert et al., 2011, 2013). Mercury contamination in eggs of gulls and terns in the PAD provide evidence of toxicant exposure and accumulation of contaminants in the environment. Regional and downstream toxicology impacts are discussed in Section 4.4.1.2.

4.4.1.4 *Changes in Habitat Availability and Quality at Stopover Sites Along Migration Route*

Beyond risks associated with direct contamination at mine sites, impacts to quality and quantity of available stopover/molting habitat in the MOSR can impact survival, health and breeding success for migratory waterfowl, and may contribute to the overall decline in birds in the PAD and WBNP. The extensive network of wetlands, waterbodies, and watercourses in the MOSR is used by migratory waterfowl, including waterbirds, for breeding, staging and stopover activities. Many of the wetlands heavily utilized by spring- and fall-staging waterfowl are considered critical habitat for migratory waterfowl in the region (Hennan and Munson, 1979; Ronconi, 2006).

In the MOSR, oil and gas exploration and development and forestry practices are the primary causes of industrial disturbances. A comprehensive independent analysis of wetland habitat loss in the MOSR has not been completed to date. However, using satellite change detection analysis Komers and Stanojevic (2013) measured the rate of terrestrial land-cover change in the Alberta boreal forest and found that between 1992 and 2008, 33% of terrestrial forested habitat in the MOSR was disturbed by land clearing (including linear disturbances with zone of influence of 250 m). Although not directly measured, given the abundance of wetland habitats on the landscape in the MOSR, it is likely that a similar proportion of wetland habitat has been impacted and/or lost over the same time period. Effects of fragmentation and habitat loss on migratory land birds in the MOSR, including sensory disturbance, have been studied (Wells et al., 2008), but impacts on migratory waterbirds remain largely unknown. Similarly, the effects of sensory disturbance are not well understood for waterfowl in terms of breeding or stopover use. A JOSM study investigating the potential cause-effect relationship between energy sector activities, especially linear disturbance, and the abundance and productivity of waterfowl has commenced. Some preliminary results are available; however, nothing has been published from the work to date.

The progressive loss of natural wetland habitats in the MOSR is directly linked to increased risks for migratory waterfowl in terms of landing in tailings ponds. During spring and fall migration, storms can force large flocks of birds to seek refuge on tailings pond if no safe landing options are immediately available (Ronconi, 2006). For many years, MCFN and ACFN have been concerned that the continual increase in the number and size of contaminated industrial waterbodies, coupled with cumulative regional loss of wetlands and waterfowl habitat availability will adversely affect migratory waterbirds. Studies confirmed that protecting and maintaining an extensive network of ecologically diverse, natural and undisturbed waterbodies and wetland habitats across the landscape in the MOSR, especially those that are known to be used as migratory stopover sites by waterbirds, are key components for mitigating risks associated with the presence of large tailings ponds along a significant migratory flyway (Ronconi, 2006).

In addition to loss of migratory bird habitat in the MOSR, the existing natural wetlands may be decreasing in quality due to growing oil sands development. For example, Kearn Lake, a regionally important staging area for waterfowl in the MOSR, is now surrounded by oil and gas development and forestry activities. Total PAH concentrations in sediments in Kearn Lake have increased over the long-term, particularly since the 1970s, and a large significant increase in total DBTs (dibenzothiopenes) in sediments was noted (Evans et al., 2016). At nearby McClelland Lake, alkylated-PAH concentrations increased (Evans et al., 2016). Increases in sediment PAH concentrations were even more apparent in lakes closer to development (e.g. Shipyard and Isadore's Lakes) (Evans et al., 2016) suggesting an increasing influence of oil sands mines on sediment PAH concentrations in the region.

4.4.1.5 Changes to Migration Route and Timing for Birds using the PAD

The Athabasca River, south of WBNP, is a significant migratory bird flyway. In the past, vast flocks of geese migrated along traditional northern routes, including the Athabasca River, stopping in the PAD and other locations in WBNP in the spring to eat and rest before continuing to the Arctic to breed and nest. These birds would return to the PAD for a few weeks in the fall before continuing their southward migration (Hennan and Munsen, 1979; Wayland and Arnold, 1993).

Over the past 25 years, Indigenous people have observed dramatic changes to fall and spring flock sizes, migration routes, stopover time and patterns of habitat use by migratory waterfowl, with fewer birds travelling along the Athabasca River corridor, PAD and WBNP (Candler et al., 2015b; MCFN, 2018a; ACFN, 2018b; LRRC, 2018; SLFN, 2018b; DKFN, 2018b; KFN, 2018). Indigenous land users described how in the past you could go to a particular location and wait for waterfowl to fly overhead because it was predictable. Now they need to search for the birds (ACFN, 2018b). They also describe the decrease in number of birds that could be obtained from 100 ducks in 10 days to 7-8 ducks in 4-5 days (ACFN, 2018b).

Several possible explanations for the changes in migration routes have been provided: impacts of the MOSR, lack of habitat and food in the PAD and agricultural fields attracting waterfowl.

Impacts of the MOSR on migration

ACFN and MCFN Traditional Knowledge holders have observed birds getting “re-routed” around oil sands mine areas and indicate that the Athabasca river is “...a corridor of flight for geese, for our birds. They fly up the Athabasca and then into Lake Claire and Lake Mamawi, and further north... it’s sort of like a gate for them when flying north. And when you start putting dust and smoke and smog into the air it affects them” (Candler et al., 2015b, p. 105). MCFN (2018a) members indicate that birds who travel north now “...seem to reflect around industry and bypass us as they go into the artic to have young” and “since the younger ones follow the older ones, over time maybe there will be nothing landing. The oil patch affects the fly over and eventually the young will have a different route”. In the 1970s, the Canadian Wildlife Service stated that tailings ponds could cause changes in migration habits (Schick & Ambrock, 1974). Similarly, researchers with the Northern River Basins Study reported that birds had shifted their migratory patterns westward (Wrona et al., 1996) and ECCC noted potential shifting patterns in migration pathways that could affect the availability of these birds in the PAD, but each recognize that more research is needed (Shell JPM JRP, 2013). Shifting flyways could alter the distribution and abundance of migratory waterfowl that use the PAD, with potential cascading ecosystem effects that threaten the OUV of WBNP (MSES, 2016).

Further, because large predictable annual aggregations of migratory waterfowl in the PAD and across WBNP are a traditional resource, changes to migration routes could impact resource use and available for local Indigenous groups. Areas where the traditional migration route for migratory waterfowl intersect with land user’s ability to access them are where spring and fall bird camps are placed; these camps are of critical importance to Indigenous people for social, economic, cultural, spiritual and other purposes (Candler et al., 2015b). Local indigenous groups have repeatedly expressed their concerns to review Panels about changes to migratory bird routes, reduced population numbers, and altered distributions (Shell JPM JRP, 2013; AERCB, 2011). Although the cause of noted changes remains largely unknown, it is recognized that impacts related to oil sands development such as habitat loss, air pollution, water contamination, tailings ponds increases, and visual and audio disturbances may be contributing factors (Shell JPM JRP, 2013; AERCB, 2011). Changes to habitat in the PAD are discussed in more detail in Section 4.4.1.1.

The suggestion that migratory waterfowl are moving away from the Athabasca River flyway because of industrial development in the MOSR is plausible. Birds use a variety of sensory and environmental cues during migration, although all of the mechanisms are not fully understood (Newton, 2008). The

landscape and sensory cues used by migrating birds within the Athabasca River corridor have changed in a number of ways as a result of the oil sands industry which could alter migratory behaviour:

- 1) **Noise (auditory) stimuli** - oil sands mines actively attempt to deter birds with loud and nearly constant noise; some mines use devices that are capable of projecting auditory stimulus over radii of several kilometres (St Clair, 2014). MCFN (2018a) members have stated that *“the birds come and the plants make noise and the birds go away and around the Park”*. Noise pollution and subsequent collateral environmental damage, including detrimental effects on birds, has been noted in the MOSR (Bayne et al., 2008).
- 2) **Air pollution (olfactory)** - odours and/or visual obstruction from smoke/steam are believed to be a contributing factor to altered migration behaviour for birds (Newton, 2008). Large emission plumes from the mines and refineries and dust are present around the oil sands and MCFN (2018a) members state *“The birds have changed some flight patterns already because they won’t fly through the smoke.”* (pg. 4) as well *“I wonder how the smell affects the birds that fly over. I’m sure those smells must do something.”* (MCFN, 2018a). Also, *“The air is no good for them...”* (Candler et al., 2015b).
- 3) **Habitat change/loss (visual)** – the visual landscape of the Athabasca river corridor has changed dramatically over the past 25 years and the quality and quantity of stopover and breeding habitats for waterbirds has declined. Navigating an altered landscape with fewer natural wetlands for use as stopover sites (rest, food, refugia during storms) could contribute to altered migration routes (Newton, 2008; Pearse et al., 2018).

These altered sensory cues may act cumulatively to alter locations, timing and length of migration routes for birds. Migration places large amounts of stress on the body of a bird; the physiological changes and adaptations to manage the stress associated with normal migration are well understood (Newton, 2008). However, the additional sources of stress experienced by populations of birds migrating through the oil sands could affect their overall fitness (survival, reproductive success) and contribute to the observed migratory bird population declines (Candler et al., 2015b). Climate change may also lead to alterations in location, timing and length of migration routes due to changes in food and habitat abundance (Pearse et al., 2018). The long-term baseline data required to show broad-scale changes to migration routes, staging/stopover sites, and breeding sites are currently lacking. In 2013, the Governments of Canada and Alberta were instructed by the Shell Joint Review Panel to investigate the noted changes to migration routes (Shell JPM JRP, 2013), but to our knowledge this investigation has not yet been completed.

Changes in food and habitat availability in the PAD

In the PAD, the reduction in habitat and food availability as a result of a drying trend has been reported as a potential cause of shifts in migratory patterns (MCFN and ACFN, 2010; Bill et al., 1996; Wrona et al., 1996, MCFN 2018a). An MCFN land user stated that changes to the food and habitat resources have

resulted in birds no longer stopping in the PAD resulting in drastic reduction in numbers “... before there’s millions, now there’s just a few.... ... And the grass are not as good like before for them. Grass don’t grow as good as before. That’s what they eat, those roots, and now everything is all dried up, that’s why they’re flying different places...” (Candler et al., 2015b, pg. 108). The Fort Chipewyan Métis Local 125 also reported changes in habitat as a cause of shifts in migration. Waterfowl “are not stopping anymore, because there is no water and wrong vegetation. If they stop and rest, they leave soon after to Fort Resolution instead of staying. They also do not go inland anymore. Lake Claire used to be good for birds. They used to feed lots of people. Hunters would get hundreds at a time.” (Métis Local 125, 2018b). Changes to habitat in the PAD are discussed in more detail in Section 5.11.

Agricultural fields attracting waterfowl

Indigenous people have also suggested that the agricultural fields may be attracting waterfowl away from flying and stopping over in WBNP. K’atl’odeeche First Nation (KFN) stated “Harvesters have also noticed a decline in geese populations at Ejié Tuvé (Buffalo Lake) in the spring. This indicates that geese are finding other staging areas, which our harvesters attribute to increased farming in northern Alberta (i.e., the geese are now staying in farming fields for longer periods of time, rather than flying north to their traditional staging areas)”. (KFN, 2018)

4.4.2 Status and Trend of Migratory Waterfowl in WBNP

The desired outcomes for migratory waterfowl are:

- 1) Great concentrations of viable, healthy populations of migratory waterfowl species continue to use WBNP seasonally.
- 2) Adequate quantity and quality of habitat, unimpaired by contamination, is available for migratory waterfowl to fulfil all key life cycle stages while present in WBNP.
- 3) Indigenous groups are able to maintain traditional harvest of waterfowl species and practice their way of life with confidence that populations of waterfowl will be healthy, sustainable and accessible.

I would see birds in from the south in spring. Some land, some come down and gradually go up. Now, most won’t stop and will keep on flying. The younger ones follow the older ones and over time maybe there will be nothing landing. The oil patch that affects the fly over and eventually the younger will have a different route. The lower water levels is also a problem though because there is nothing for them to eat. They have to eat to keep going. If there is nothing to eat they will find other routes.

Quote context: Like I said growing up on the land with my late parents, the birds used to land on the Peace River to get gravel. Now the birds don’t even fly to the Peace River because it is so low. They have to find gravel probably somewhere else. And there is less birds landing as the water level is so low.

Source: Gerald Gibot

About Gerald Gibot: I was born in Fort Chip. I was raised up in the trap line with my late mom and dad. I still go on the land. I have two boys 5 and 8. In the summer when there is no school I take my boys out on my boat. My boys enjoy the life that I show them where their grandparents used to be when I grew up. I have seen a lot in my 63 years. At 5 I went to residential school. We get a lot of wisdom from other elders. Also my late father had friends about his age. We would sit down and talk about their lives and I can understand Cree so I can relate to other trappers talk about their lines in other areas.

As described below for each of the above desired outcomes, current information available from both western science and local ITK indicate that over the long-term, all three of the desired outcomes with respect to migratory waterfowl in WBNP are seeing downward trends and unsatisfactory status for areas within the PAD specifically.

- 1) Since 1955, breeding populations and production surveys for waterfowl across North America are conducted annually by the U.S. Fish and Wildlife Service (USFWS)/Canadian Wildlife Service (CWS). Long term trends in abundance of breeding waterfowl are generally difficult to detect against the background of large natural variation in abundance and productivity that is common for waterfowl populations (USFWS, 2017). The USFWS survey data provide minimal information on abundance, diversity or wetland use by birds other than waterfowl (e.g. migrant shorebirds). This data has not been analysed specifically for the PAD to indicate how the number of breeding birds compares to the long term average and in the context of populations at a continental scale.

For fall staging, waterfowl use of the PAD used to regularly exceeds that of other notable waterfowl staging areas in Canada, with averages of 300,000 to 600,000 waterbirds each day during fall migration (Butterworth et al., 2002). In the early 1970s, fall counts of staging ducks, geese and swans totalled 1.5 million birds; in the spring up to 400,000 waterfowl used the PAD per day. No long-term scientific monitoring has been conducted of the use of the PAD by fall staging or spring migrants. However, ITK is very clear that that the number of birds stopping as part of their migration is significantly lower than previously.

As a result, while the status and trend of breeding waterfowl is unknown, the desired outcome is clearly not being met for spring and fall migration and therefore is considered overall not to be met and experiencing a downward trend.

- 2) The availability of adequate quantity and quality habitat, unimpaired by contamination, for migratory waterfowl to fulfil all key life cycle stages while present in WBNP also appears to be decreasing, at least in the PAD. In the 1960s and 1970s, progressive and cumulative water level declines in the PAD resulted in plant succession converting lakes and wetlands into willow thickets and reed grass meadows, and subsequent reduction of use by waterfowl in the spring, summer, and fall (Dirschl, 1972; Nieman and Dirschl 1973). From 1996 to 2008, Parks Canada (2009) reported a general loss of emergent vegetation, encroachment of willows and other vegetation on wetlands, and an increase in invasive plant species in the Peace region of the PAD. Further, Bill et al. (1996) reported reduced use of the PAD by migratory waterfowl compared to previous years for breeding and staging as a result of reduced water levels. The Peace-Athabasca Delta Waterbird Inventory Program noted that over the four-year survey period (1998-2001), five perched basins completely dried out (Butterworth et al., 2002). Notably, in 1996 and 1997 some perched basins in the PAD were briefly flooded for the first time in 25 years and USFWS breeding survey data indicated a mean increase of breeding waterfowl pairs by 43% (compared to 5 years pre-flood) and an increase in total duck production of 89% for 1998 and 1999, followed by a decrease to pre-flood levels in 2000 (Butterworth et al., 2002).

In addition, migratory birds in the PAD may be experiencing cumulative contaminant loading from exposures during migration, on wintering grounds, and at staging/nesting grounds in the PAD. Government of Alberta issued a consumption advisory for these eggs from Lake Athabasca and Mamawi Lake in 2014 (GoA, 2014a).

As a result of the changes to habitat and the contaminant warnings, this desired outcome is considered not to be achieved and experiencing a downward trend.

- 3) Indigenous groups find they cannot maintain traditional harvest of waterfowl species and practice their way of life with confidence in healthy, sustainable and accessible populations of waterfowl. Local traditional land users have noted dramatic changes in the PAD over the past 25 years, including noticeable changes in the diversity of bird species, and declines in the quality and quantity of birds throughout the migratory season. The MCFN and ACFN (2010) reported that since the last major flood in the early 1970s, many of the perched basins, as well as several lakes, disappeared (Egg Lake and Pushup Lake) and that lack of water is impacting plant and animal species in the PAD. They state that *“There is nothing for the birds. Just dry lakes. No water...Once we had birds landing and now it’s full of willows”*. (MCFN 2018a). These changes have impacted traditional bird species population numbers, which has consequences for the availability of these species for annual harvest and egg collection by Indigenous people in traditional locations. Land users report that waterfowl no longer stop on the PAD and Lake Athabasca in the vast numbers that they once did due to loss of critical habitat or food resources (MCFN and ACFN, 2010). They state that

“...in fall time, there will be two weeks straight of snow geese coming over delta. But they aren’t landing any more. The reason why they don’t land in delta is the lack of water and also the lack of vegetation. Goose grass is what is missing in this delta. Goose grass is water dependent. The bison, ducks and geese feed on the seeds in the stems. They come to the perch basins for goose grass... Now they don’t because of the lack of food which is because of lack of water.” (MCFN 2018a).

Land users also state that changes in the PAD appear to be impacting the diversity of species of migratory birds whereby new species are appearing and others have disappeared:

“We are now getting different birds.... hummingbirds, goshawk, and magpies that we never had..... We’ve gone from every kind of a bird and so many, down to literally nothing....They seem to have thinned right out.... areas where there used to be 5-6 different types of seagulls nesting on a rock island. Now they don’t do that...In one area where we used to go for eggs, mud hen eggs, I don’t remember the last time I saw or heard a mud hen. They used to nest in marsh lake area and we’d go egg picking. They are gone.” (MCFN, 2018a) and *“I’ve had a few ducks in my area that I don’t even know the name of because I’ve never seen them before.”* (MCFN, 2018a)

Given the status and trend of the first two desired outcomes and the experiences of Indigenous people, this desired outcome is not being achieved and experiencing a downward trend.

4.5 WOLF-BISON PREDATOR-PREY RELATIONSHIP

The wolf-bison predator-prey relationship in WBNP is recognized as a world heritage value in part because it is “the only place where the predator-prey relationship between wolves and wood bison has continued, unbroken, over time”. Bison and wolves range over much of WBNP (see Figure 4-6). Some bison herds also spend part of their time in WBNP and part of their time outside the boundaries.

While there have always been wolves and bison in WBNP, the relationship had significant interference between the late 1800s and late 1900s. Prior to 1922, hunting by settlers in the region considerably altered the relationship between wolves and bison. Historically the bison population in the region was abundant and the major source of food for local Indigenous communities (Parks Canada, 1984). By the 1850s, the cumulative effects of overhunting and severe winters resulted in a remaining population of approximately 250 wood bison. This severe decline in population prompted the Canadian government to establish the *Buffalo Protection Act* of 1877 to conserve and protect these remaining animals (Ball et al., 2016). The on-going conservation challenges related to bison were acknowledged as problematic in the region, and efforts were needed to protect the bison population as development came closer, as they would be seen as a cheap, easily accessible source of food. As a result, WBNP was established in 1922 and covered 27,200 square kilometres (10,500 square miles). WBNP protected approximately 1500 wood bison living within the original park boundaries (Parks Canada, 1984).



Wolf cub, Sweetgrass, WBNP. Photo: Parks Canada

In 1925, the introduction of disease to the bison altered the relationship with wolves for some time. A decision was made to transfer thousands of plains bison from Wainwright Alberta into WBNP. The plains bison of the Wainwright herd hybridized with the wood bison of WBNP and were a source of diseases for the native bison of WBNP. These diseases include tuberculosis and brucellosis (Parks Canada, 1984).

Between 1935 and the early 1970s, the wolf population in WBNP was controlled to facilitate bison recovery (Bradley and Wilmshurst, 2011). The control of the wolf population resulted in an increase in the bison population, but also an unnatural wolf-bison predator-prey relationship. After wolf control ceased in WBNP in the early 1970s, populations of bison declined. Initially, disease in combination with predation was thought to be a pathway of effect resulting in population level changes in bison. However, more recent study concluded that declines in bison from 1971-1999 would have occurred without disease as a result of predation (Bradley and Wilmshurst, 2011). It is important to note that this conclusion was reached for the bison in WBNP who had been exposed to the diseases since 1925. Herds that are exposed to the disease for the first time may face declines. While wolf control is no longer a pathway of effect, it is not clear whether the wolf-bison populations have again reached an equilibrium.

Bison have a long history as an important component in the ways of life of the Indigenous peoples in and around WBNP. This history of Indigenous bison harvest in and around WBNP is unique as some of the longest continuous harvest relationship with wild bison populations in North America. Bison are important for social, economic, cultural, spiritual and other purposes of Indigenous communities in WBNP. The effects of park management on Indigenous community efforts to maintain their traditional connection to bison is one of the more complicated and divisive elements of the park's history.

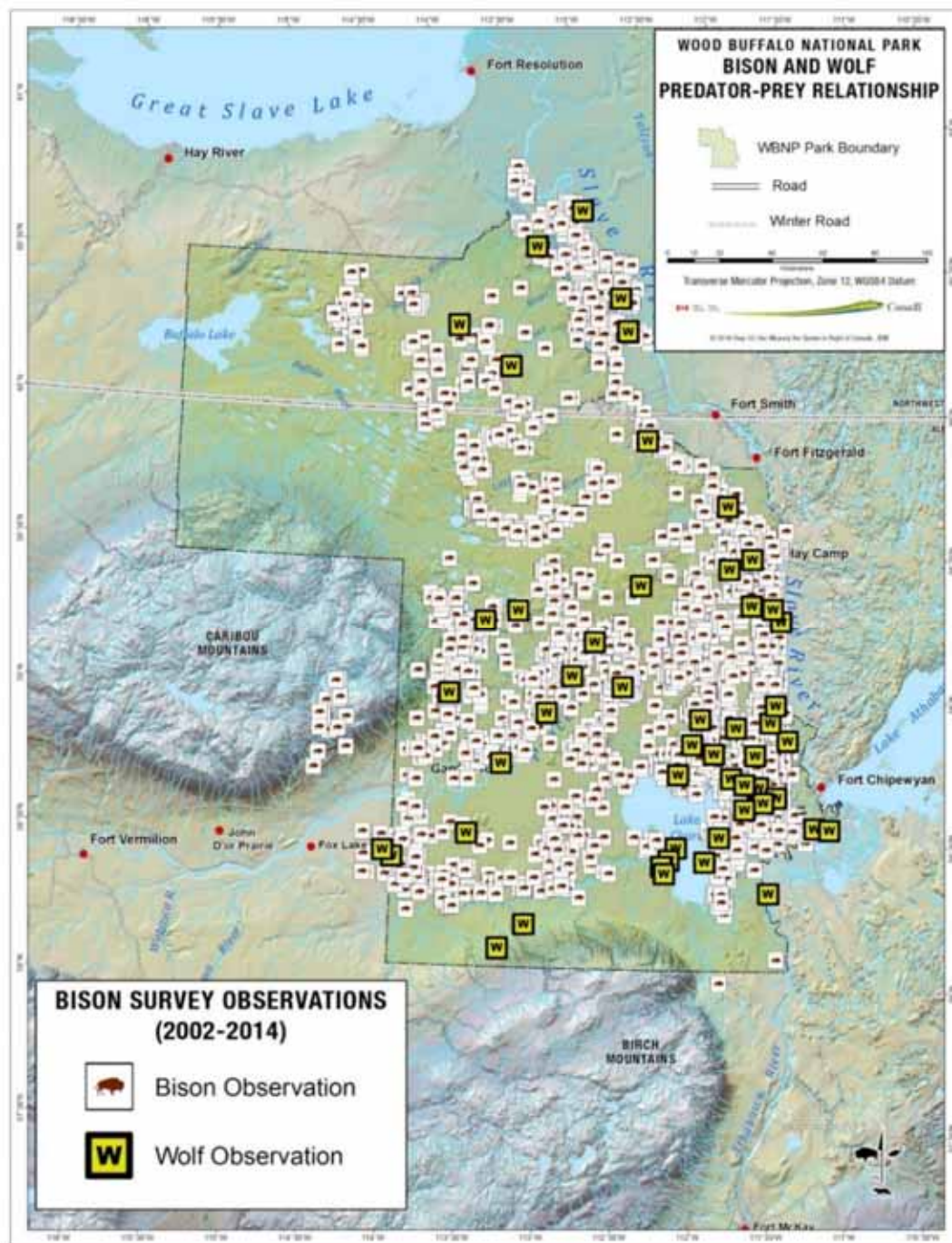


Figure 4-6: Range of Bison and Wolves

4.5.1 Pathways of Effects on Wolf-Bison Predator-Prey Relationship

There are five potential pathways of effects on the wolf-bison predator prey relationship:

- Changes resulting from drying and fewer flooding events
- Changes resulting from increased linear corridor density and habitat changes surrounding WBNP
- Changes resulting from disease management and hunting outside WBNP
- Changes resulting from changes in other prey species populations

Below is a diagram developed by MCFN Traditional Knowledge holders of trends and stressors for the wolf-bison interaction in the areas of the park in and around the PAD, including the effects on Indigenous traditional use and ways of life (Figure 4-7). We have no scientific information on noise disturbance impacts on the bison. Climate change, BC Hydro flow regulation, invasive species and low PAD levels are discussed in Section 4.5.1.1 and 5.13. Fragmentation and disease are discussed in 4.5.1.2 and hunting is discussed in Section 4.5.1.3.

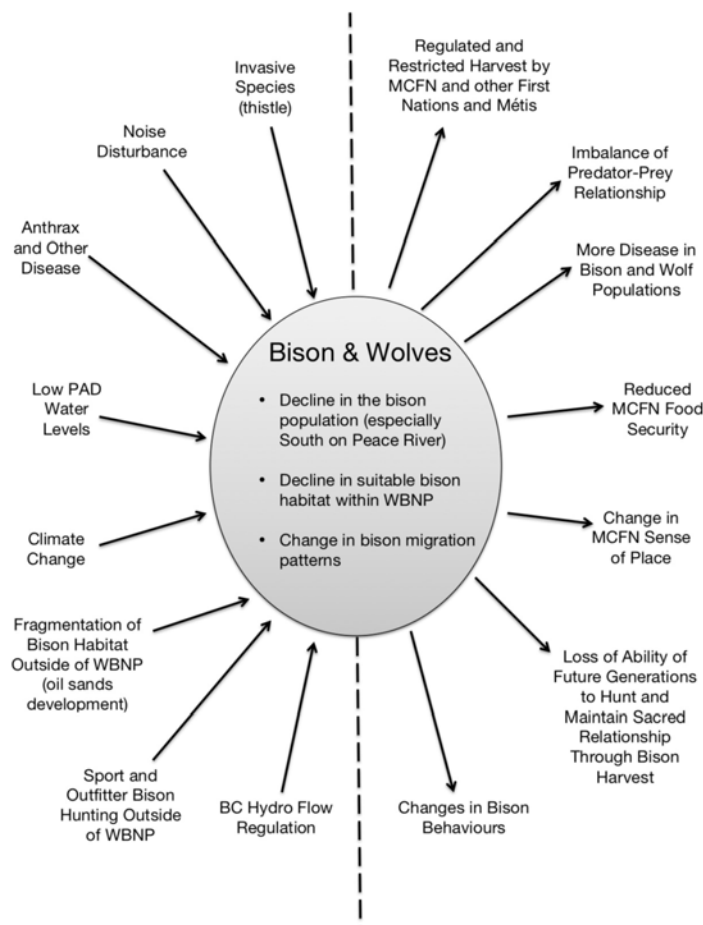


Figure 4-7: Trends and Stressors for the Wolf-Bison Interaction in the Areas of the WBNP in and Around the PAD, Developed by Mikisew Cree First Nation Elders and Land Users (MCFN, 2018a)

4.5.1.1 Risks from Drying and Fewer Flooding Events

The drying of the PAD resulted in an increase of woody vegetation and a decline in the quantity of bison habitat (see Section 4.3.1 and 5.13). Poorer habitat can cause bison to move or affect the overall population. Mikisew members have observed a correlation between PAD drying and a reduction in bison populations in the area of the PAD as bison move to high ground.

Indigenous communities have also observed that the drying of the PAD is enabling the rapid spread of invasive species, particularly Canada thistle, which exacerbates the loss of good bison habitat around the PAD. Bison do not eat Canada thistle and adjust their movement patterns to avoid it, resulting in further changes in migration patterns (see “Risks from alteration or break down of bison habitat connectivity” below). Mikisew knowledge holders agree that flooding is the primary way to combat the spread of Canada thistle. A representative example of ITK regarding the risks from drying is set out below:

Hunted buffalo in my younger days for my dogs and for my kids...buffalos are not around here now. That's because there's no water. They can't eat dried grass. They eat green grass...They are lost in Hay Camp. They won't come back over here, because there's nothing to eat...things growing around Lake Claire, like needles [thistle]...you can't eat those. They were not there before... maybe that's how come they move out of there.... Everything has started drying up around Lake Claire. Maybe that's how come they move out of there...

Since 1974, the water has gone down and down so for the buffalo there isn't the vegetation they live on. The thistle is taking over the whole delta on account of there being no water. Buffalo's main food is goose grass and all the areas that used to have it are all dried up.

Quote context: There is no Goose or Joint grass. That is what the buffalo live on. So it's all dry. If there is no water, then there is no goose grass, no muskrat, and no buffalo. The bottom line is you need water. That is the bottom line to get our vegetation or animals back to what it used to be.

Source: Larry Marten

About Larry Marten: I am 65. I quit school in 1966. That is when I started trapping. Prior to that as a kid was out there every spring with my parents. We lived out there because it's our livelihood. When I quit school, then I was trapping every year, every winter and spring. In summer time I had summer work. I am still a trapper.

In winter, deep snow and resource scarcity may limit bison movement within their home range, whereas in the summer, thawed muskeg, wetlands, lakes and water courses may limit movement (MSES, 2017). As a result of these challenges to movement, bison likely prefer certain habitats for movement which they use to travel between food patches. However, no quantitative analyses exist for the park that identify key habitats for movement and use or how those areas have changed.

Carbyn (1992) believed that the drying of the delta may have “very significant implications for the predator/prey system” by changing the movement and aggregation patterns of bison (p.176). Bradley and Wilmshurst (2011) demonstrated that the change in habitat was not having a population wide effect. However, they also indicated that bison population decline after wolf control stopped was more significant in the PAD. They suggested that this could be because predation was more efficient in the PAD. Whether this higher efficiency is due to drying or just the different habitat in general, is not known. Indigenous knowledge holders noted that with lower water levels bison would sink in the mud, but

wolves would still be able to travel freely (ACFN, 2018b). We have no further scientific or ITK about the different predation rates in the PAD.

Therefore, while the pathway of effect of a drying of the PAD has changed the habitat, it is not clear if that has had a secondary effect on the predator-prey relationship between wolves and bison. The change in movement and use of habitat has resulted in the location of bison and changes in the traditional way of life of Indigenous people.

4.5.1.2 Risks from increased linear corridor density and habitat changes surrounding WBNP

For bison herds that range beyond the park, the potential change in the predator-prey relationship due to increased linear corridor density or habitat changes is highest. Among these, the Ronald Lake Bison Herd is of particular subsistence, cultural, and spiritual importance to regional Indigenous communities. This is the only herd that uses some portion of WBNP, which is known to be disease free. It ranges primarily between the Athabasca River and the Birch Mountains from the northern extent of the oil sands mines to the south-eastern corner of WBNP. (MSES, 2017). This herd has lived in this area for thousands of years and has been hunted and managed by local Indigenous peoples throughout this time. ACFN land users suggest the population could be as low as 75-100 individuals (ACFN, 2018c).



DeMars et al. (2017) have shown that the Ronald Lake Bison Herd avoided cutblocks, with exceptions for male bison in the summer/fall. Female bison avoided disturbed areas during winter and increased avoidance when human activity was present (DeMars et al, 2017). Anthropogenic land-cover changes can also create barriers to bison movement, potentially isolating forage areas from access to bison (MSES, 2017).

Anthropogenic linear features have also been shown to change wolf behaviour and increase their hunting efficiency (Whittington et al., 2005; Dickie et al., 2016). Wolf abundance in the Alberta boreal forest has been found to increase in response to increasing linear feature density in wildlife management units south and south west of the park, while moose abundance decreased (Stewart and Komers, 2017). Wolf abundance also is likely responding to prey abundance (e.g. northward expansion of deer range) and changes in the vegetation from older to a higher predominance of early seral stage vegetation which favour deer. Wolf predation rates have also been shown to increase near human disturbance in the Alberta oils sands region (Neilson & Boutin, 2017). These studies demonstrate the changing relationship between wolves and their prey in ecosystems in the vicinity of the park. Indigenous land users in the Athabasca Delta region outside of the park have reported high numbers of wolves and raised concerns about them (ACFN, 2018a); however, other Indigenous groups have not reported concerns about high

numbers of wolves suggesting this issue may currently be restricted to outside the park, but very much on the border.

4.5.1.3 Risks from Hunting Outside WBNP

Hunting bison outside the park occurs to protect cattle and non-diseased bison, and for sport and for subsistence purposes. In particular, for bison herds that range inside and outside the park, hunting if not managed appropriately could impact bison populations.

The estimated risk of transmission of bovine brucellosis or tuberculosis to the Canadian cattle population is minimal. In a recent analysis, it was determined to a 95% probability that the estimated annual probability of at least one brucellosis infection in cattle was less than 0.0018 (0.2%). This means that with 95% confidence, the risk of introduction of bovine brucellosis into the cattle population from free-ranging bison in WBNP and surrounding area is approximately 1 case within 555 years. The risk of tuberculosis transmission was estimated as 1 case within 107 years (Canadian Food Inspection Agency, 2016).

While the risk of transmission to cattle is low and the diseased condition of bison does not appear to affect the population viability of the diseased herds (Bradley and Wilmshurst, 2011), it is still desirable to avoid the spread of disease to other bison herds. The *Recovery Strategy for the Wood Bison* states a goal of “The long-term population and distribution objective is to ensure the existence of at least five disease-free, genetically diverse, connected, self-sustaining, free-ranging local populations distributed throughout their original Canadian range, with a minimum size for each local population of 1,000 animals.” (ECCC, 2016).

In 1987, the Government of the Northwest Territories implemented a disease containment program to minimize contact between diseased and non-diseased bison. This program resulted in the establishment of the Bison Control Area (BCA), which originally contained lands south of the Mackenzie River, and north of the Mackenzie Highway between Mills Lake and Hay River. The BCA was expanded in 1990 to include all lands north of the provincial-territorial border and south of the Mackenzie River, between Trout River on the West and the Buffalo River and WBNP boundary to the east, encompassing 3,936,339 ha. Bison within the BCA are designated as nuisance and can be shot by an eligible hunter. The purpose of the BCA and other bison control programs are to detect and remove bison in the BCA and prevent the establishment of herds or individuals in this region. In so doing, the risk of transmission between infected and non-infested herds is reduced. Reducing contact also ensures that genetic integrity of certain populations of wood bison is protected from more hybridized or plains dominant herds (Gates & Wierzchowski, 2003).

The Government of Alberta has implemented a similar approach by monitoring a surveillance zone east of Highway 35 to limit the interactions between potentially diseased animals moving west from WBNP towards the disease free herd in the Hay-Zama region in northwestern Alberta. The Wabasca herd closer to the park is presumed to be disease free (ECCC, 2016).

To accommodate their approach, the Government of Alberta, does not consider bison found outside of WBNP, and east of highway 35, as "wildlife", and therefore they are not afforded any protections under the provincial *Wildlife Act* and can be hunted without any limits (AEP, 2017a).

The exception to this is the Ronald Lake Bison Herd, which has been granted protection as a Subject Animal under the Wildlife Regulation, Alberta Regulation 143/97 as of 2016, which closed hunting on this herd in most of its range until further notice except for subsistence purposes by Indigenous people holding constitutional rights to do so. Indigenous knowledge holders confirmed that the Ronald Lake Bison Herd had been experiencing high levels of hunting pressure over the last decade as news of their disease-free, and 'domestic animal' status, led to increases in unregulated hunting. Population declines, likely stemming from increased hunting pressure, were observed by Indigenous land users (MCFN, 2018b). While the Ronald Lake Bison Herd has been provided with this protection for most of its range, the Wabasca herd has not and hunting continues (LRRCN, 2018).

4.5.1.4 Changes from Changes in Populations of Other Species

As described in Section 4.5.1.2, evidence of changes to wolves and moose abundance and predation rates has been observed south of WBNP (Stewart & Komers, 2017; Neilson & Boutin, 2017). Caribou populations are also known to have declined in the region (Environment Canada, 2012). Indigenous knowledge holders have also expressed concerns about declines in the moose population in some places in the park (MCFN, 2018a, Jim Webb Pers. Comm. February 2, 2018).

Given that both these species are also fed on by wolves, there may be effects on these species from changes in the predator-prey dynamics between wolves and bison or changes in these populations may affect the relationship. However, no research has been conducted in this area to determine how these dynamics may be changing.

4.5.2 Status and Trend of Bison-Wolf Predator-Prey Relationship

The desired outcomes are:

- The predator-prey relationship between wolves and wood bison that spend time in the park remains intact and within natural ranges of variation
- Populations of both species remain viable, evolve as naturally as possible and support Indigenous traditional use and ways of life.

The status of the first desired outcome is unknown. Overall, the predator-prey relationship between wolves and bison has improved in the last 15 years in comparison to the previous 100 years as without wolf control it is now a more natural relationship. It is unknown if that trend is continuing to improve, staying the same or worsening at this time. While bison population data exists, unfortunately it has not been analyzed for this purpose taking into consideration the population changes that would occur after wolves populations were allowed to naturally fluctuate. Therefore, the status remains unknown. While there have been declines in the population recently, it is not clear if they are a negative trend in the context of a population in equilibrium. The population of wolves is not known. There is ITK of wolves

that wolves are looking less healthy, as well as, observations of healthy packs (MCFN, 2018a). The overall status and trend for this desired outcome is unknown.

The second desired outcome is not being met because Indigenous traditional use and ways of life are not being met. Hunting of bison within the park has not been permitted for generations and, at times, Indigenous peoples have been prosecuted and expelled from the park for hunting wood bison.

Furthermore, while the diseased condition of bison no longer appears to affect the population viability of the herds that have been exposed since the 1920's directly, it does affect the Indigenous traditional use and ways of life. While bovine tuberculosis does not transfer easily between bison and people, the Canadian Food Inspection Agency recommends taking biosecurity measures in handling the carcass and cooking meat well (Canadian Food Inspection Agency, 2011, 2012, 2013, and 2015). Given this recommendation, some Indigenous people may be hesitant to eat bison.

The drying trend and spread of invasive species are resulting in considerably fewer bison in areas around the PAD, further impacting the prospect of Indigenous communities located in and around the PAD being able to maintain traditional practices relating to bison. Reduced bison populations and/or presence in and around the PAD impact the Indigenous way of life by reducing food security, altering sense of place, and removing the ability of future generations to hunt and maintain sacred relationships through bison harvest.

In summary, Indigenous traditional use and ways of life have been negatively impacted by lack of access to bison, and the movement of bison away from the places they traditionally use. In addition, the quality of bison as a resource has been reduced or compromised by disease.

4.6 WHOOPING CRANE

The Whooping Crane (*Grus americana*) is listed as Endangered under the *Species at Risk Act* (SARA) and is protected under the *Migratory Birds Convention Act* (MBCA). The Recovery Strategy for Whooping Crane in Canada was finalized in 2007 (Environment Canada, 2007). The overall recovery goal is to protect, restore and manage the species to be self-sustaining in the wild. To achieve this goal, the long-term recovery objective is to establish 1000 Whooping Cranes (250 breeding pairs) in the Aransas-Wood Buffalo Population of Whooping Cranes (AWBP) by 2035 (Environment Canada, 2007), if reintroduced populations in the U.S. are not self-sustaining. In winter 2016-17, the AWBP was estimated to contain approximately 431 individuals (95% CI 371-493; Butler and Harrell 2017).

4.6.1 Pathways of Effects on Whooping Crane

There are five potential pathways of effects on Whooping Crane:

- Short-term exposures to contaminants in local migratory habitat



- Changes to habitat and food availability in local migratory habitat
- Possible changes in migration routes
- Exposure to contaminants in water, food and sediments in nesting habitat
- Changes in habitat and food availability in nesting habitat

4.6.1.1 Short-Term Exposures to Contaminants in Local Migratory Habitat

Whooping crane migration areas between their wintering grounds in Aransas National Wildlife Refuge, Texas and their breeding grounds at the north end of Wood Buffalo National Park have been defined and monitored since at least the late 1970s. The most recent description of the migration routes identifies a consistent corridor directly over the MOSR and entering WBNP at its southern boundary (Pearse et al., 2018). Local Indigenous knowledge identifies Whooping Cranes landing in the PAD to rest during fall and spring migrations (MCFN, 2018a).

Ongoing monitoring of Whooping Cranes during migration, conducted via satellite telemetry by the Canadian Wildlife Service, Parks Canada, and their partners, demonstrated that some cranes stop over for 1-2 nights in the MOSR during spring and fall migrations and some of these stopovers occurred on or adjacent to tailings areas at active oil sands mines (Bidwell et al., 2016). Bidwell et al. (2016) states that, on average, 72% of the marked (satellite-tracked) population flew over the MOSR in the spring, and 92% in the fall. Previous to this study, aerial tracking data for Whooping Cranes from 1981-1984 showed the most cranes follow the Athabasca River south from their breeding grounds in WBNP during the fall migration (Kuyt, 1992).

This presents a plausible link between Whooping cranes and known risks to waterbirds associated with industrial waterbodies present on mine sites in terms of direct mortality and/or contamination through contact, ingestion, and inhalation pathways (see Section 4.4). These pathways may be associated with impacts on health, survival, and breeding success of individual birds (i.e., fitness), and thus could have population-level impacts, although these have not yet been demonstrated for Whooping Cranes.

There are no official records of Whooping cranes becoming oiled or contaminated in the oil sands region. Group size during migration in the MOSR is not known with certainty but is assumed to be small (2-4 individuals) so mass mortality events where large numbers of individuals die in tailings ponds are not expected. However, the MOSR is completely contained within Whooping Crane migration corridor (Pearse et al., 2016). Most cranes migrate through the MOSR in spring and fall (Bidwell et al., 2016) and some of these lands and stop overnight near oil sands mine sites (Bidwell et al., 2016). A recent mass oiling and mortality incident of 31 Great Blue Herons (listed as sensitive in Alberta) dying in a sump pond at a Syncrude mine site indicates that all waterbird species, including large diurnal migrants, are at risk of coming into direct contact with tailings ponds and contaminants. Whooping cranes can be present in the MOSR from mid-April through early November, and could thus be present during inclement weather (e.g. late winter storms in spring) which could result in an increased probability of landing during both spring and fall migrations (Bidwell et al., 2016). While stopovers in the MOSR are usually short and far from tailings ponds, there have been some cases where cranes have landed on or adjacent to tailings

ponds or other industrial waterbodies (Bidwell et al., 2016). As discussed in Section 4.4.1, despite the implementation of extensive bird deterrent programs at oil sands mine sites, to date no system exists that can reliably and consistently deter all birds from landing on tailings ponds, especially during extreme weather events (St. Clair, 2011; St. Claire, 2014). Seven years of standardized monitoring as part of the Oil Sands Bird Contact Monitoring Program shows that even with deterrents in place, landings continue to occur by the tens of thousands annually, with mortalities in the hundreds (detected) and likely thousands (estimated). Overall, there is mounting evidence that current mitigation methods to protect migratory birds, including Whooping cranes, in the MOSR are ineffective, and the risks of exposure to contaminants in industrial waterbodies at oil sands mines remains high. Although crane survival appears high during migration through the MOSR (Bidwell et al., 2016), the degree of risk posed to Whooping cranes from contaminant exposures in the MOSR, and the potential for sublethal effects, remain unknown.

4.6.1.2 *Changes to Habitat and Food Availability in Local Migratory Habitat*

During migration, Whooping Cranes use a variety of habitats for roosting and foraging, including wetlands (fen, marsh), open water, rivers and croplands (Pearse et al. 2018, Hall et al. 2012a). Cranes tend to prefer temporary and seasonal wetland mosaics in the spring and more permanent wetlands in the fall (COSEWIC, 2010). The loss and degradation of migratory stopover habitat is a current threat to the recovery of Whooping crane (Environment Canada, 2007) because the suitability of roosting sites and availability of food may influence survival and health during migration and subsequent reproduction in nesting areas (Pearse et al., 2018; Hall et al., 2012). Habitat loss at stopover sites may also interfere with Whooping crane migration patterns in terms of routes or timing. Further, navigating altered landscapes in the MOSR with fewer natural wetlands for use as stopover sites for rest, food, or refugia during storms could increase stress for migratory birds. Whooping cranes appear to use visual cues such as landscape features to locate suitable landing sites during migration, perhaps recognizing features from other previous visits to a particular site (Kuyt, 1992). This is deduced from abrupt changes in flight course shortly before cranes landed, and weather conditions could not account for these changes. Instances have been recorded of cranes locating sites used during previous migrations (Kuyt, 1992), so it is plausible that the removal of wetlands and the placement of large tailings ponds on the landscape in MOSR could interfere with the cues cranes are using to navigate during migration. This could result in accidental landings and subsequent contamination, where previously suitable habitat was present, or shifts in stopover site locations (displacement) during migration through the oil sands region.

Human disturbance and presence in and around Whooping Crane stopover habitat may also pose a threat during migration by reducing stopover habitat quality (Hall et al., 2012). Whooping crane intolerance to human disturbance suggests that stopover habitat in proximity to human activity may be of reduced quality and could create stress for migrating individuals (Hall et al., 2012). Changes in stopover habitat quality could relate to a number of parameters including, but not limited to visual changes, odour, noise, and contamination. Habitat alteration through the addition of infrastructure is also likely to pose a threat to migrating Whooping Cranes stopping in the MOSR. Collisions with powerlines have been identified as a substantial source of injury and mortality during Whooping Crane migration (Environment Canada, 2007; Hall et al., 2012).

During migration in the MOSR, Whooping Cranes tend to use areas containing open water, marsh and fen habitats and avoid those containing upland habitats and anthropogenic disturbance (Bidwell et al., 2016). Sample sizes from ongoing monitoring, however, are too small to make strong inference about patterns of habitat selection (i.e., relative to available habitat) or to determine what constitutes suitable stopover habitat (M. Bidwell, pers. comm.). Whooping Cranes are omnivores but it is not well understood what birds consume at stopover sites in boreal regions of migration route, although some documented foods include frogs, fish, plants, grains, and insects (EC, 2007). These types of information are required in order to understand why cranes may select particular stopover sites and, in turn, develop effective mitigation measures to prevent landings in risky areas, such as the MOSR.

4.6.1.3 Possible Changes in Migration Routes

While local ITK indicates that bird migration routes over WBNP are changing (see Section 4.4.1.5), there is no evidence that this is affecting Whooping Crane specifically. As a result, this pathway of effect is not carried further in the analysis.

4.6.1.4 Exposure to Contaminants in Nesting Habitat

There is limited information available on the potential for Whooping Crane exposure to contaminants within their nesting grounds in WBNP. No environmental sampling for contaminants has been done or is planned within WBNP where nesting sites occur, although a research project has been proposed to sample blood and feathers of juvenile Whooping Cranes for contaminants (M. Bidwell, pers. comm.). At the moment, it is assumed there is no pathway of effect through contaminants in the nesting habitat.

4.6.1.5 Changes in Habitat and Food Availability in Nesting Habitat

Whooping crane nesting habitat at the north end of WBNP is an isolated, unique wetland complex containing marshy areas with numerous shallow potholes (COSEWIC, 2010; Environment Canada, 2007). Whooping cranes appear to use the shallow potholes with soft substrate for feeding, as opposed to deeper water, and require the presence of bulrush for use as nesting material (Novakowski, 1966; Hall et al., 2012). The breeding habitat is relatively undisturbed by humans and it is thought that cranes do not readily adapt to increased disturbance, evidenced by the extirpation of prairie and aspen parkland populations (1800 and 1900s) likely due to human activities such as egg collection, wetland draining, and hunting (COSEWIC, 2010; Environment Canada, 2007; Hall et al., 2012). Whooping cranes may not be breeding in the southern end of WBNP simply due to the loss of isolated wetland habitats (COSEWIC, 2010). While the amount of nesting habitat is not currently considered to be a limiting factor for cranes (Hall et al., 2012), they are identified as being sensitive to changes in nesting habitat quality. A decrease in breeding habitat quality at the north end of WBNP could lead to decreases in fecundity and/or summer growth and condition (Hall et al., 2012).

Altered hydrologic regimes due to anthropogenic change and/or climate change have been identified as threats to Whooping Crane nesting habitat. Environment Canada (2007) identified “*radical or lasting alterations to normal hydrological regimes*” as one example of an activity that is likely to result in the destruction of critical Whooping Crane breeding habitat. This concern is echoed by Hall et al. (2012). Changes to water levels, if occurring within nesting habitat, could also have consequences for Whooping

Crane mortality through increased predation (e.g. wolf, wolverine, fox, black bear), although the overall impact of predation on recruitment is uncertain (Environment Canada, 2007). Whooping crane mortality on breeding grounds (from 1981-1984) often occurred before cranes had fledged and it is suspected that this was largely due to wolf predation. Wolf access to breeding sites may have improved under drought conditions present during that time period (Kuyt, 1992).

During the 2015 breeding season, habitat conditions in the Whooping Crane nesting area were reported as “exceptionally dry”, with water levels in nesting areas and breeding-area ponds being reported as low or dry (Bidwell et al., 2016). These warm and dry conditions can also contribute to increased wildfire risk (Bidwell et al., 2016), possibly reduced chick production and survival (COSEWIC, 2010), and decreases in fecundity and summer condition (Hall et al., 2012). It is possible that changes in hydrology could influence food availability via changes to wetland condition though information on food status and trends on the nesting grounds is inadequate. This topic would benefit from further detailed studies specific to the Whooping Crane breeding grounds.

4.6.2 Status and Trend of Whooping Crane

The desired outcomes for Whooping Crane are:

- Habitat continues to support recovery strategy goals for breeding pairs and demonstrates resilience to climate change impacts.
- Whooping crane population reaches recovery strategy goal.
- Recovery and down listing from endangered status.

The first desired outcome is considered to be achieved because the population continues to increase and there is no evidence of a current pathway of effect impacting the habitat. The last two desired outcomes have not yet been reached, but the trend is positive. The recovery strategy goal is 1000 Whooping Cranes (250 breeding pairs) in the AWBP by 2035 (Environment Canada, 2007). In the winter of 2016-2017, a population of 431 (95% CI 371-493; Butler and Harrell, 2017) Whooping Cranes was estimated with an upward trend (Butler and Harrell, 2017).

4.7 SUMMARY OF EVALUATION OF DESIRED OUTCOMES

Table 4-1: Summary of Evaluation of Desired Outcomes

Desired Outcome	Current Trends And Stressors	Trend Direction
The salt plains remain aesthetically, ecologically and geologically unique in Canada, providing habitat for salt tolerant plants, grazing bison and nesting / staging waterfowl.	Invasive species are known to be on the border of the salt plains, but there is no evidence they have entered the salt plains or that they can ecologically.	➡
Gypsum karst topography in WBNP remains intact and functioning within natural parameters.	No evidence to suggest that karst hydrological processes have changed.	➡
The karst landforms in the park continue to provide some of the finest examples of collapse and pond sinkholes in the world.	No evidence to suggest that karst features have changed.	➡
All species and community representatives of the Great Plains-Boreal grassland are present and functioning.	Declines are being seen in the grassland extent due to changes in water regime. Forest fire regime is within natural parameters. Due to the small extent of changes to vegetation composition, the trend is still overall neutral.	➡
Grasslands continue to provide important grazing and calving areas for Wood Bison	Bison habitat is being negatively impacted by the change in flooding regime facilitating the increase in thistles and change in food.	⬇
Great concentrations of viable, healthy populations of migratory waterfowl species continue to use WBNP seasonally.	Populations of waterfowl using the WBNP during migration are decreasing.	⬇
Adequate quantity and quality habitat, unimpaired by contamination, is available for migratory waterfowl to fulfil all key life cycle stages while present in WBNP.	Habitat for waterfowl is declining in quantity and quality, particularly due to changes in water regime.	⬇
Indigenous groups are able to maintain traditional harvest of waterfowl species and practice their way of life with confidence in healthy, sustainable and accessible populations of waterfowl	The ability of Indigenous groups to practice their traditional way of life with waterfowl is being negatively impacted.	⬇
The predator-prey relationship between wolves and wood bison that spend time in the park remains intact and within natural ranges of variation	While as a whole, the park predator-prey relationship of wolves and bison has improved since wolf control ceased in the 1970s, the current status and trend remain unknown as data has not been analyzed in that context. Bison habitat and movement in the PAD has changed, but it is not clear that there is a population level effect resulting from this. Bison habitat is being impacted by changes in water regime and development around the park. These pressures	?

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Desired Outcome	Current Trends And Stressors	Trend Direction
	on habitat are likely starting to put pressure on the bison-wolf relationship.	
Populations of both species remain viable, evolve as naturally as possible and support Indigenous traditional use and ways of life.	Bison are not supporting Indigenous traditional way of life and there is no change in this.	
Whooping Crane habitat continues to support recovery strategy goals for breeding pairs and demonstrates resilience to climate change impacts.	Habitat continues to support an increasing population.	
Whooping crane population reaches recovery strategy goal.	Population of Whooping Cranes has not met the recovery strategy goal but is increasing.	
Recovery and down listing from endangered status.	Whooping cranes have not yet been down listed, but their population is increasing.	

5.0 CHAPTER 5: CURRENT STATE OF THE PAD SYSTEM – TRENDS AND STRESSORS

In this chapter, the current state of the PAD system is evaluated, including pathways of effects, trends, and stressors in relation to the following desired outcomes:

- 1) Flow regimes and water quality into the PAD maintain the ecological function of the ecosystem.
- 2) Flow regimes and water quality into the PAD sustain vegetation communities and healthy and abundant populations of key ecological and cultural species including waterfowl, muskrat, fish, bison and wolves.
- 3) Indigenous groups have access to the PAD and are confident in the health of the PAD to maintain traditional use and way of life through hunting, fishing, gathering, and cultural activities.

The chapter begins with an introduction to the PAD by those who know it best, followed by an explanation of hydrologic recharge mechanisms in the PAD. Then the trends, causes and effects of hydrologic recharge are examined. Next, the valued components of the hydrologic system, including surface water quality, sedimentation and sediment quality, air quality and groundwater are discussed. Finally, the impacts of these changes on Indigenous way of life, muskrat and beaver, vegetation, migratory waterfowl, bison, moose and fish are evaluated. Finally, a pathways of effects diagram is presented to illustrate the relationships between human activities, environmental pressures, and impacts in the PAD.

5.1 INTRODUCTION

The PAD is one of the world's largest inland deltas and arguably the largest boreal delta in the world. It is formed by a unique hydrological system created by the convergence of the Peace and Athabasca Rivers, along with many smaller rivers and creeks, on the west side of Lake Athabasca. The PAD is made up of three large lakes (Lake Claire, Mamawi Lake, and Baril Lake), as well as more than 1,000 smaller lakes. It is a flood dependent ecosystem that supports rich biodiversity, including wood bison, muskrat and migratory waterfowl. The Delta is understood to include the ecological functions and ecosystems it supports, including vegetation, wildlife and Indigenous communities within the Delta.

The Indigenous peoples of Fort Chipewyan introduce the PAD, or Ayapaskaw in Cree, in a much different way. Their stories about the PAD make it clear that the PAD is their home, their grocery store, their classroom, their church, their highway, their photo album, and the place where their happiest memories live. For many land-user and Elders, how they think and how see the world comes from the PAD.

We were all born in different areas out on the land...[in] the delta, that's why I love the delta so much...this is where you're born and it's such a beautiful feeling when you go out there. It's like going home...[Our house out there] was nothing fancy. But...there was such a tremendous amount of connection with Mother Earth and the people living around there, the people of the land. And culture was there, it was just your way of life...It was sacred...We all lived the same life.

It's a good feeling when you go out there, you feel good. I just put my hand in the water and...you're back home and it's beautiful. It's hard to imagine that you'd have that kind of feeling just by putting your hand in the water and going on a boat, if somebody didn't know, if somebody didn't have that experience. But because we were raised out there, born and raised out there, that's the feeling we have...it's that connectedness with feelings. It's that beautiful feeling that you're home, that you're connected...The closeness is so close to the heart, it's part of you. That's who we are.

First Nations and Métis express a profound gratitude for what Mother Earth and the Creator provided in the PAD. They explain that a healthy PAD is what the animals love — muskrat, beaver, moose, bison, fish, birds, and other living things — and what sustains the connection between all living things. Indigenous peoples utilize the PAD in all seasons, for fishing in summer and winter, hunting moose, bear, caribou and other large game, trapping muskrat, beaver and other fur, harvesting ducks, geese and other birds in spring and fall, collecting eggs in the spring and connecting to the land. The resources in the PAD sustain Indigenous livelihoods, lifestyles, cultures and rights.

Anyone who experiences the PAD with the Indigenous peoples of Fort Chipewyan will be quickly introduced to the Cree phrase *nipî tapîtum* or its English equivalent, “water is boss”. This phrase is a summation of generations of accumulated ITK about how the waters that create the PAD interact to create a vibrant ecosystem. It also describes how important water is to the ways of life of Indigenous communities that depend on the PAD. Clean, abundant water provides for safe drinking and healthy wildlife and vegetation, supports the ecosystem in the PAD, and is what is needed for Indigenous peoples to travel throughout the area. To understand the PAD and what it means to Indigenous ways of life is to understand that “water is boss.”

Indigenous Elders and land-users, the traditional stewards of the PAD, have explained that they have witnessed natural flooding, the lifeblood of the PAD, fade away and the spirit of the water stagnate and suffer. Any depletion and diminishment of quality water flowing into the PAD threatens both the ecosystem and the family, cultural and spiritual connections to the PAD. Below is a diagram developed by MCFN Traditional Knowledge holders of trends and stressors for the state of the PAD, including the effects on Indigenous traditional use and ways of life (Figure 5-1).



Figure 5-1: Peace Athabasca Delta – Key Stressors and Trends (MCFN, 2018a)

5.2 HYDROLOGIC RECHARGE MECHANISMS

The Peace-Athabasca delta (PAD) is comprised of two separate deltas, the Peace delta and the Athabasca delta, each with its own distinct hydrologic regime. The Peace River Delta is primarily fed by flows from the Peace River basin arriving from the west, while the Athabasca delta's main source is Athabasca River flows from the south. The Peace delta is located approximately 40 kms north of the Athabasca delta. The relationship between them is complex - they can function independently of each other or, alternately, work in concert to flood the entire PAD system when the combined flows of both systems collectively inundate large portions of the whole Peace-Athabasca Delta system. In any given year or flood season, depending on the hydrologic conditions on the Peace and Athabasca rivers, each delta experiences separate types of flooding conditions. In general, the main hydrologic mechanism experienced in the Peace delta is ice jam flooding, while the Athabasca delta experiences mainly open water flooding, with occasional ice jam flooding. However, when favourable hydrologic conditions align at the same time in each delta, the two systems function together to flood the entire Peace-Athabasca Delta. The pressures on each of the river systems are also different. Regulation of flows for hydroelectric production and

climate variability influence the Peace River flow regime, while climate variability and removal of water for municipal and industrial purposes influence Athabasca River flows. These pressures have influenced the hydrologic regime of each of the separate delta systems, and subsequently, have also influenced the hydrologic regime of the PAD.

Hydrologic recharge of PAD lakes and basins is caused by a complex process of hydraulic damming, flow reversals, and ice jam flooding in the Peace River. The open-water recharge mechanisms of hydraulic damming and flow reversals occur if and when the Peace River is higher in elevation than the central PAD lakes and Lake Athabasca. If the Peace River is higher in elevation than Lake Athabasca during spring freshet and high summer flows, it prevents outflows from the PAD and 'pushes' water from the Peace River into the PAD.

If major ice jams occur during spring break up, they can flood the high elevation perched basins that the open water mechanism cannot reach directly through the interaction of the two rivers alone. The jams impede the northward movement of the Peace River into the Slave River system, promoting hydraulic damming and flow reversals in the PAD. Major ice jam events produce the over-bank flooding required to recharge the more isolated, higher-level perched basins in the PAD. The ice jam mechanism is, therefore, a lifeline for the perched basins, as they would not receive recharge water otherwise. Figure 5-2 below shows the movement of water within the PAD, where the black arrows indicate the flow direction and the two-headed black arrows indicate the potential for flow reversals.

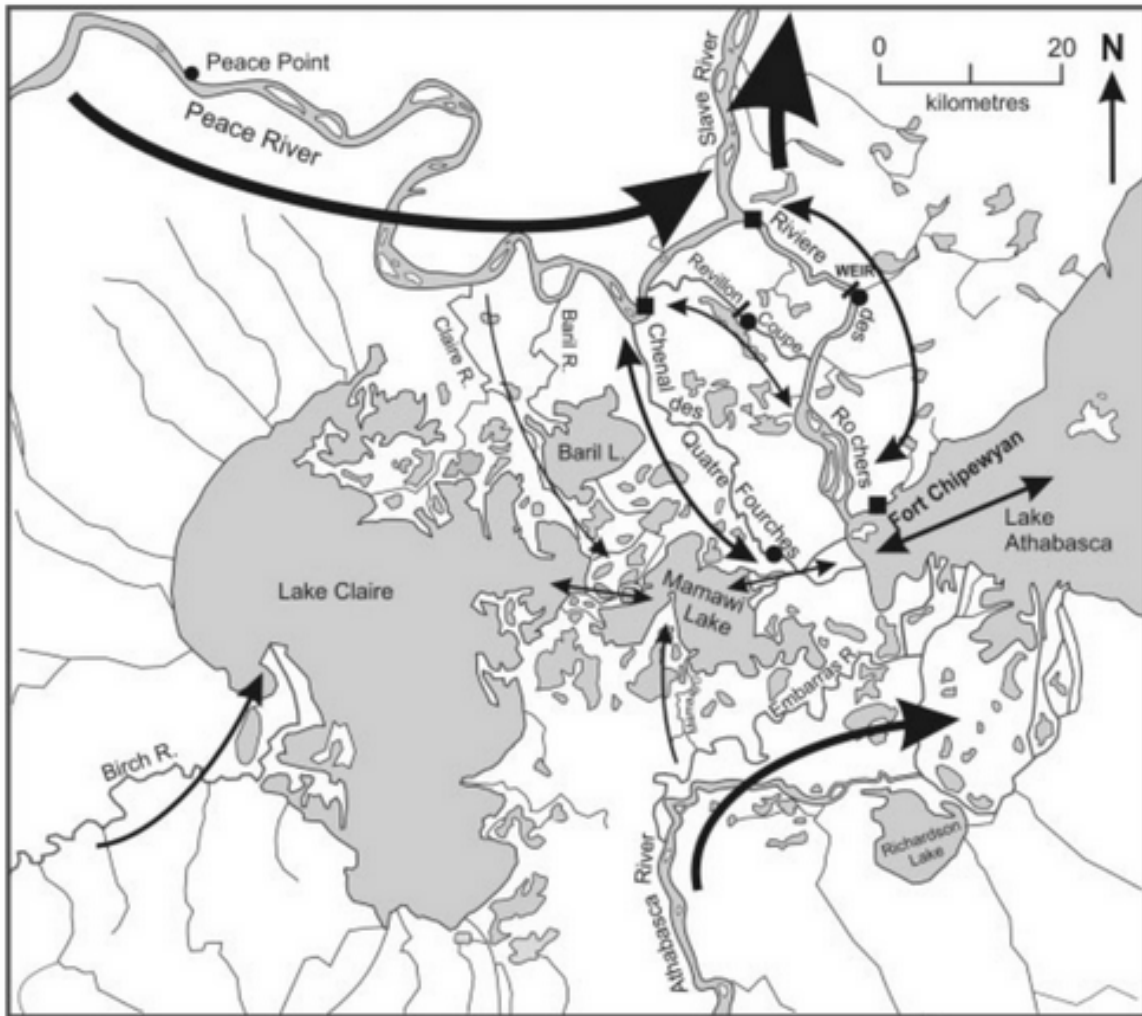


Figure 5-2: Peace Athabasca Delta Flow System (Peters and Buttle, 2010)

5.2.1 Open Water Mechanism

The open water mechanism consists of hydraulic damming and flow reversals. Hydraulic damming can occur during spring ice break up and summer high flows when the water level on the Peace River is higher than the central PAD lakes and Lake Athabasca. If the water levels are higher on the Peace River than in Lake Athabasca, water that would normally flow northward from Lake Athabasca to the Slave River system (via the Chénal du Quatre Fourches and the Rivière des Rochers) is prevented from doing so (aka hydraulic damming), causing reversal flow of water and flooding of the central PAD lakes and adjacent or connected basins. There are two types of open water flood mechanisms: i) flood flow through delta channels that spills over the banks and ii) filling of large central PAD lakes (Lake Claire and Mamawi Lake) that swell beyond the shoreline into PAD floodplains.

5.2.2 Ice Jam Mechanism

Ice jams occur when the lower Peace River is blocked by ice rubble during the mechanical break-up of its ice cover in the Delta reach (the lowest 50 km of the river), typically in late April and early May. At

about the same time, spring runoff generally produces high flow rates and high water levels in the Peace River, and the water levels in Lake Athabasca rise due to runoff received from the Athabasca River and the Fond du Lac Rivers. Further aiding the ice jam process is the spring break up of ice cover on the Athabasca and Slave Rivers, as well as other smaller waterways such as Chenal du Quatre Fourches and the Rivière des Rochers. If the ice cover physically breaks up (rather than melting in place), spring flows can move it downstream to form ice jams where the ice floes pile up against intact ice cover. These jams impede the northward movement of water into the Slave River system, causing water levels to rise in those waterways and further promoting hydraulic damming and flow reversal. Major ice jam events produce the over-bank flooding required to recharge the more isolated, higher-level perched basins in the PAD.

Beltaos (2014) explains how the ice jam process develops along many rivers; in the Peace River, it can recharge the PAD's perched basins. The author notes "ice jams can stay in place for a few minutes or for many days; they can be a few hundred meters or many kilometers long. Owing to characteristically large aggregate thickness and underside roughness, ice jams can cause very high water levels, many meters above the equivalent-discharge, open-water flow stages. When a jam lets go, a large amount of water comes out of storage in short time, producing a 'jave' (short for 'wave generated by the release of an ice jam'). The water level drops precipitously upstream of the jam, but rises rapidly downstream; at the same time, water speeds can increase to extreme values while the wave propagates at even higher rates. Intact ice cover may be broken up and carried by the jave; if it is still very competent, it may stay in place and initiate another jam. In this manner, more and more ice is broken up and carried down the river, until the final jam releases" (p. 3).

More specifically, Beltaos et al. (2006b) notes that three conditions must exist for ice jam flooding in the PAD to occur, including a mechanical ice break-up (as opposed to melting), Peace River flow of at least 4,000 m³/s (at Peace Point), and formation of an ice jam within the last 50 km of the Peace River. Observations indicate that the lodgment point or the "toe" of the jam may be located in the Peace River itself or in the Slave River. Prowse et al. (2006) add that low freeze up elevations and high spring flows help to promote mechanical ice break-up. Indigenous Knowledge holders note a number of conditions that aid in creating a large scale ice jam flood sufficient to flood the PAD, including:

- 1) clear, thick ice,
- 2) consistent temperatures of between -5°C and -10°C, and
- 3) an ice jam duration of at least a week to ten days at critical pinch points such as 30th Baseline,
- 4) a strong 'push' of water from upstream, and
- 5) presence of rubble such as logs and branches (MCFN, 2018b).

5.3 RECHARGE TRENDS AND CAUSES

5.3.1 River Flows

Flows on the Peace and Athabasca Rivers have changed over the past sixty years, with differing causes. As a result of changes in the quantity and timing of flow on these two main rivers, water levels in the PAD are being affected. As the Firelight Group et al. (2018) points out “the timing and magnitude of spring freshet on the Peace River, alongside ice dam formation, are the primary factors that determine spring flooding. Simultaneous high flows on the Peace and Athabasca rivers are what reliably produce hydraulic dam conditions on the PAD, and flow regulation by BC Hydro on the Peace River and upstream withdrawals from the Athabasca River are considered major factors in reducing spring flows. Healthy wetland and muskeg areas adjacent to the Peace and Athabasca rivers are considered essential to maintaining high water through summer and into fall, and MCFN knowledge holders point to the removal of large areas of muskeg as a contributing factor to lower summer and fall flows. Reduced snow and ice melt from mountain areas in summer (due to climate change), combined with the impoundment of headwater areas (for power generation), is also reported to reduce summer and fall flows and result in increasingly frequent low PAD water levels, especially in the late summer and fall periods” (p. 3).

Peace River

The Peace River is the largest river in the PAD system and the water flow conditions on the Peace, to a large extent, dictate the water level conditions for the PAD. The Peace River experienced natural flow conditions until 1968, when construction of the WAC Bennett dam was completed and reservoir filling began. Flow rates on the Peace River have become much less variable since the regulation of natural flow conditions in 1968, resulting in decreased summer flows and increased winter flows (Peters and Buttle, 2010; Peters and Prowse, 2006; Prowse et al., 2006; Prowse and Conly, 2002; Prowse et al., 2002a; Peters and Prowse, 2001). Indigenous Knowledge holders also report the Peace River is the main river that floods the PAD. Since regulation began, flows on the river have increased in the winter and decreased in the summer and, because the water is held back, the river now does not have the power to replenish PAD water bodies, including Lake Claire and smaller associated back channels (MCFN, 2017a, 2018a, 2018b).

All the places we used to go and hunt now in the fall, the water is too shallow to go there. I still take my grandkids for a hunt, but not everything out there anymore. I used to tell them stories of what had happened. I tell them you have to try to carry on the traditional life, making moose hide.

Quote context: A about 5 or 6 fall seasons ago my wife and I went out. The water was low already. Our friends had two small motors and took off. The first time we tried to go out we couldn't. We turned back and tried one more time. The third time I said we might as well turn around but we finally made it. After we got a moose, we loaded and took off. We barely made it to the river. We took off to Lake Mamawi. The mud was flying and we kept on going. Finally after 3 times we made it to the river mouth. The motor was just steaming. I opened the hood and put water on it. The water is very pitiful. It will get worse.

Source: Sloan Whiteknife

About Sloan Whiteknife: I am George Sloan Whiteknife. I was born and raised in the bush. Ever since then I've always been in the bush. I was taught from my dad to trap and to hunting moose, geese etc. I was always with him and he always used to tell me things. I learned quite a bit from my dad in my past life, and my uncles. I went out with all my relations. We need water. When I say something has to be done, I mean we need more water.



Prowse et al. (2002a) conclude “regulation of the Peace River has shifted the pattern of seasonal flows and damped flow extremes creating a less variable annual regime” (p. 429). More specifically, Peters and Prowse (2001) report “post-regulation mean winter flows were 250% higher and annual peaks (1-, 15-, and 30-day highs) were in the order of 35–39% lower than those that would have occurred under a natural regime. Regulation of the Peace headwaters has also reduced the downstream flow variability”

(p. 3193). Further, Peters and Prowse (2006) note “analysis of the Peace River at Peace Point historical record revealed that there is a shift to lower peak discharge and an increased dependence on downstream tributaries for the generation of peak flows after 1968” (p. 4190). More recently, Peters and Buttle (2010) report “storage of spring/summer mountain runoff and subsequent releases over the fall/winter months has increased winter ($>500\text{m}^3/\text{s}$) and decreased summer ($>2000\text{m}^3/\text{s}$) flows compared to those estimated for the Peace and Slave Rivers without flow regulation” (p. 1072).

Other scientists and consultants also conclude that regulation of the Peace River has reduced the variability of flows on the Peace River (Peters, 2016; Eaton & Church, 2015; Dube & Wilson, 2013; Timoney, 2013; Golder Associates, 2012; Teck Resources, 2011c; Candler et al., 2010; Glozier et al., 2009). However, it is important to note these studies, as described below, may have included two different climate periods in their analysis. Therefore, it is more likely these studies illustrate that flow regulation on the Peace River, in conjunction with climate variability, have influenced the variability of flows on the Peace River.

Both the Teck Frontier Oil Sands Mine project (Teck Resources, 2011c) and the Jackpine Mine Expansion project (Golder Associates, 2012) Environmental Impact Statement (EIS) include an analysis of hydrometric data of the mean seasonal flows as measured at the Peace Point station from 1959 to 2010. As shown in Table 5-1, Golder’s analysis illustrates less variable flows on the Peace River between the two time periods, with mean winter flows between January and March increasing by 200% and mean summer flows decreasing between April and June by 31% (Golder Associates, 2012). Mean annual flow has also dropped by 9%.

Table 5-1: Difference in Flow Statistics on Peace River

Parameter (m ³ /s)	Pre-1968 ¹	Post-1971 ²	Change (%)
Mean annual	2,300	2,100	-9
2-year	10,000	5,400	-46
5-year	11,000	7,400	-32
10-year	11,500	8,800	-23
Mean Summer	3,500	2,400	-31
Mean Winter	500	1,500	+200
Note: As measured at Peace Point (Golder, 2012, p. 12), 1: from 1960 to 1967, 2: 1972 to 2010.			

Eaton and Church (2015) also note, after flow regulation was introduced, “mean annual flood (MAF) in the river immediately downstream from the dam was reduced from 5,843 to 1,927 m³/s, a reduction to one-third of its former value. Even at the distal end of the river, more than 1,200 km downstream in the Peace-Athabasca Delta, MAF was reduced to just over half its former value of 9,817 m³/s” (p. 251). Carver (2013) illustrates these changes to the Peace River hydrograph in **Figure 5-3**.

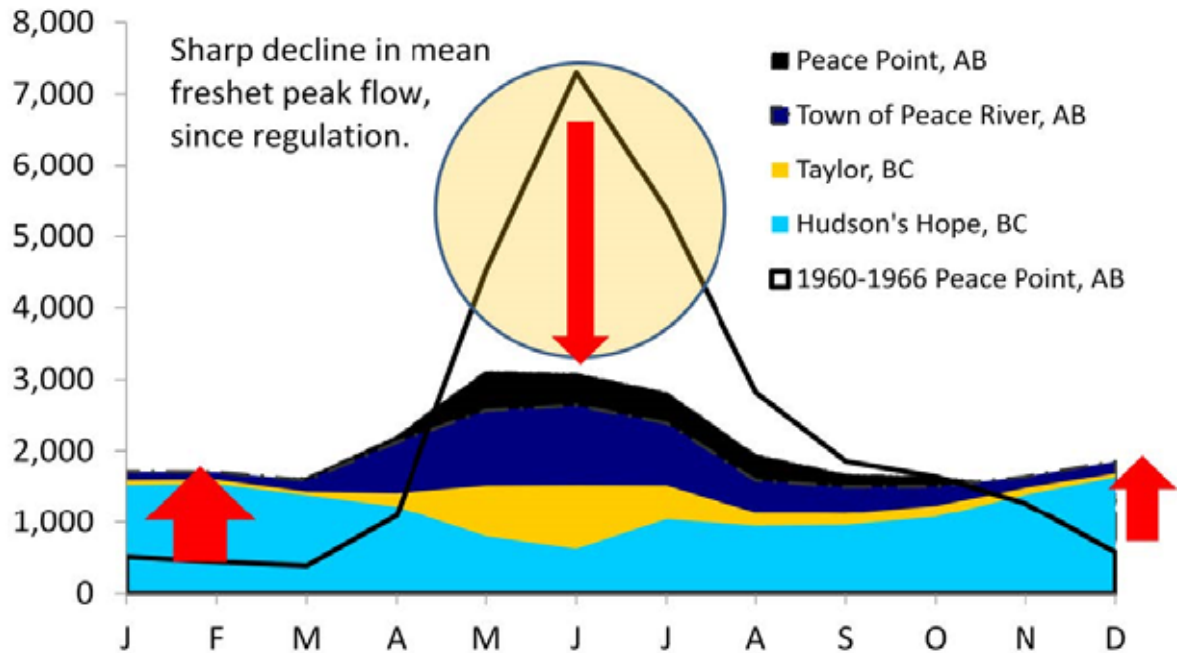


Figure 5-3: Mean Regulated Hydrograph at Hudson's Hope, Taylor, Town of Peace River and Peace Point (1992 – 2012) Contrasted with the Mean Unregulated Hydrograph (1960 – 1966), Highlighting the Seasonal Hydrograph Changes (Carver, 2013, p. 18).

(Note: X-axis tick marks represent the middle of the month)

Slave River

The Slave River originates at the confluence of the Peace and the Rivière des Rochers, where the Peace River contributes approximately 60% of flow volume (Sanderson et al., 2012). Unless the Peace River is high enough to prevent water from entering the Slave River system from Lake Athabasca, the Slave River receives the water from both the Peace and Athabasca systems. This would be typical for most of the year, with the exception of spring runoff conditions, although even during spring runoff, flow rates may not be high enough in the Peace River to prevent Athabasca water from entering the Slave River system.

A number of scientists and consultants report that flow rates on the Slave River have been reduced since regulation of the Peace River began (Dube and Wilson, 2013; Sanderson et al., 2012; Teck Resources, 2011a; Davidson and Hurley, 2007). In their analysis of Slave River hydrometric data from 1930 to 2009 for the Frontier oil sands project EIS, Teck Resources notes higher mean winter flows by around 40% and lower summer flows by about 30% due to the regulation of the Peace River (Teck Resources, 2011a). Sanderson et al. (2012) also report "since regulation... mean winter low flows have increased by 75% and mean spring peak flows have been reduced by 20%" (p. v) and note that while the total amount of water flowing into the Northwest Territories has remained stable, the timing of water arrival has changed. More recently, Dube and Wilson (2013) report "a lower relative contribution of peak flows and potential flood conditions from the Peace to the Slave since the dam was constructed" and note "peak flows (on the Slave River) are significantly lower than they were before oil sands development" (p. 421). However, as noted in the previous paragraph, the studies described above may have included two different climate

periods in their analysis. Therefore, it is more likely these studies illustrate that flow regulation on the Peace River, in conjunction with climate variability, have reduced the variability of flows on the Slave River.

Athabasca River

The Athabasca River flows northeastward through Alberta past Fort McMurray and Fort McKay, draining into Lake Athabasca, and is the second largest river flowing into the PAD system. The Athabasca River and its tributaries contribute the largest amount of water to Lake Athabasca. Teck Resources reports, as part of its Frontier project EIS in 2011, at Fort McMurray, the average streamflow discharge on the Athabasca River during winter, spring, summer, and fall is 180 m³/s, 535 m³/s, 1,225 m³/s, and 567 m³/s, respectively (Teck Resources, 2011b). Mean runoff is 155 mm/year near Fort McMurray (Peters and Prowse, 2006). Alberta Environment and Parks (2017b) reports “actual water withdrawn by oil sands mines in 2016 was less than 1% of the average annual flow - approximately 111.5 million m³, or an average of 3.53 m³/s” (p. 1). Further, as noted by Islam and Leibel (2018), “in 2016, weekly water withdrawal by mineable and in situ oil sands producers from the Athabasca River ranged from 0.63% to 3.18% of the measured flow during the winter period, and from 0.21% to 0.83% of measured flow during the open water period” (p. 15).

Relevant literature reviewed indicates that annual, winter, and summer flow rates on the Athabasca River have declined over the past fifty years (Sauchyn et al., 2015; Gill and Rood, 2009 (in Lebel et al., 2009); Glozier et al., 2009; Davidson and Hurley, 2007; Bruce and Tin, 2006; Schindler and Donahue, 2006). Glozier et al. (2009) report annual average discharge in the Athabasca River below Fort McMurray declined over the 1960 to 2006 monitoring period, with lower flows observed from the 1998 to 2006 period compared to earlier decades. Further, Gill and Rood (2009, in Lebel et al., 2009) note annual, winter, and summer flow declines of 26%, 18%, and 17%, respectively, in the Athabasca River below Fort McMurray from 1958 to 2007 (resulting from declines in mean annual discharge, winter flow, and summer flows of about 0.5%, 0.4%, and 0.4% per year, respectively, over the same time period). Further, Sauchyn et al. (2015) report a reduction in annual flow of 0.56% per year on the Athabasca River at Fort McMurray from 1958 to 2012. Bruce and Tin (2006) further note a 20% reduction in annual flow in the Athabasca River from 1953 to 2003.

With regard to summer flows, Davidson and Hurley (2007) report that “summer (May-Aug) flows in the Athabasca River at Fort McMurray had declined by 29% between 1970 and 2005” and further commented that “flows have been well below average for most years since 1980” (p. 2). Further, Schindler and Donahue (2006) report 19.8% reductions in summer flow (May to August) on the Athabasca River downstream of Fort McMurray from 1958-2003 and a 33.3% reduction since 1970.

The reported causes of the flow rate declines in the Athabasca River are water withdrawals, changes in climate, or a combination of both (Peters, 2016; Bawden et al., 2014; Dube and Wilson, 2013; Timoney, 2013; Candler et al., 2010; Glozier et al., 2009; Lebel et al., 2009; Davidson and Hurley, 2007; Bruce and Tin, 2006; Bill et al., 1996). As part of the Northern River Basins Study TEK report, Bill et al. (1996) report “the change in flow patterns of (the Peace and Athabasca) rivers is attributed to either the damming of the rivers or diversion of waters for industrial or municipal use” (p. 327). Gill and Rood (2009, in Lebel et

al., 2009) note a “decline in river flows upstream from the oil sands withdrawals, but at least part of this reduction could be associated with (climate change)” (p. 30).

More recently, Timoney (2013) reports that the “decline in annual discharge of the Athabasca River is exacerbated by industrial water withdrawals downstream of Fort McMurray” (p. 417)). More recently, Dube and Wilson (2013) determined the peak flows in the Lower Athabasca River (LAR) were “significantly lower...in the post-oil sands period compared to the pre-oil sands period”, but did not attempt to attribute a cause to the change (p. 420). Peters et al. (2013) further report “significant ($p < 0.05$) declines in annual and open-water season median/mean runoff indices over 1958–2009” for the Lower Athabasca River, however the authors note “variation in precipitation explained >67% of the annual median/mean LAR runoff variability since 1958” (p. 1915). The authors also identified “the drainage area between (the Town of) Athabasca and Fort McMurray as a zone that influenced runoff declines observed at the LAR watershed scale since 1958, which warrants further investigation with competent hydrological models” (p. 1915). While the studies indicate some combination of climate change and water withdrawals are causing the declines, they do not provide clarity about the relative contributions.

5.3.2 Ice Jam Flooding

Many scientists, consultants, and Indigenous knowledge keepers have determined that ice jamming and subsequent flood-induced recharge of perched water basins in the PAD has been decreasing since the 1970s (MCFN, 2017a, 2018a, 2018b; Firelight Group, 2018; Beltaos, 2018; Beltaos, 2016; Beltaos, 2014; Candler et al., 2013a; Dube and Wilson, 2013; AECOM, 2010; Peters & Buttle, 2010; Beltaos et al., 2008; Davidson & Hurley, 2007; Beltaos et al., 2006b; Prowse et al., 2006; Prowse & Conly, 2002; Prowse and Conly, 1998; Wrona et al., 1996; Peterson and Courtorielle, 1992; The PAD Project Group, 1972). In order to understand the pathways of effects related to this trend, this section begins with an examination of the role higher winter flows and ice elevations have played in reducing ice jam frequency. It then examines the role of and decreased snowpack runoff from tributaries to the Peace River due to climate change.



Thick ice is 6-10 ft. thick blue or white ice. When that ice broke, my grandpa stayed a week before and there would be a big bang and a few days the ice shoots down the river, the water is high, and everything is clearing the river. When that ice stopped, the ice is thick, big as building, blue, thick, white ice. It would take two days for us to cross the river to go to the store to go shopping there was so much ice! Now when the ice stops, the ice still doesn't hold anything back. Because of the bad quality of ice it melts away faster today.

Quote context: In the past the ice was blue, white, like glass. It really thickened. You know when the ice is solid when you see that blue ice. Now it's a foam ice. There is a lot of air in the ice. Its not good ice like when I was growing up. You cannot really just cross anywhere without double checking ice, especially on the rivers. If you are on the rivers you can go through and get sucked under. In a slue you have a chance as it doesn't flow. On the river you are toast if you go through the ice. That danger is more now, especially in spring. The ice melts quicker because of the pollution from oil and the Peace River and Athabasca Rivers. The ice is thin and the water level is low. In the old days there was water all over, and the ice jammed for a week. We had fresh water every few years. Now it's stale water I can see in summer, and dead plants and dead animals. I can't live from that.

Source: Gerald Gibot

About Gerald Gibot: I was born in Fort Chip. I was raised up in the trap line with my late mom and dad. I still go on the land. I have two boys 5 and 8. In the summer when there is no school I take my boys out on my boat. My boys enjoy the life that I show them where their grandparents used to be when I grew up. I have seen a lot in my 63 years. At 5 I went to residential school. We get a lot of wisdom from other elders. Also my late father had friends about his age. We would sit down and talk about their lives and I can understand Cree so I can relate to other trappers talk about their lines in other areas.

Indigenous knowledge holders have observed poorer quality and thin ice cover, in combination with the lower strength of the Peace River flow in the spring. They see these change as preventing the large ice jams that are needed to flood the PAD in the spring and replace water in lakes and channels in order to keep the PAD healthy. The ice used to be upwards of 18 to 20 feet in height at Rocky Point (and other locations), but now there are no large chunks of ice to build up. There needs to be thick, clear "blue ice" to produce the ice jams to fill the PAD's lakes and creeks, which no longer happens. Indigenous people along the Peace had a history of building platforms, called stages, to a height of 10 feet above the banks of the river to store their important belongings until the ice floods receded. This is no longer necessary (MCFN, 2018a). Firelight Group et al. (2018) also reported ITK indicating alteration of Peace River flows is a primary stressor resulting in reductions in ice jam flooding frequency and duration. The authors note "higher winter flows during ice formation on the lower Peace River results in weaker ice, often with more silt and impurities. Combined with weaker spring flows at breakup, this poor quality ice tends to rot and drift without forming substantial ice dams. While other factors, including climate change and natural annual variation in snow load are recognized, MCFN knowledge holders generally consider flow regulation to be the most significant driver for the negative trend in ice jam frequency" (Firelight Group et al., 2018, p. 2-3).

Scientists have been examining the effects of flows and ice elevation and quality over the past several decades. In 1996, Wrona et al. report "the major effect of regulation on the occurrence of break-up ice jamming near the PAD is...the higher flows and freeze-up elevation of the ice cover throughout the winter period" (p. 11). In 1998, Prowse and Conly report the increased flow on the Peace in the winter due to regulation impairs the flooding and recharge in the PAD because the increased winter base flow means the winter ice sits at a higher elevation and increases the magnitude of the flow required for

mechanical spring ice break-up to create jams capable of flooding perched basins. In other words, “the higher a freeze-up cover is stabilized, the greater the flows it can withstand without breaking” (Prowse and Conly, 1998, p. 1607). In addition, Prowse and Conly (1998) also note, along with declines in spring snowpack, “elevated ice levels and winter flows resulting from regulation have further reduced the potential of tributary runoff to produce severe break-up floods”.

In 2018, Beltaos, as shown in Figure 5-4, used newly developed methodology that examines the slope of the cumulative number of floods in the PAD from 1900 to 2017 reveals an abrupt and sizeable reduction in ice jam flooding frequency after 1968 (Beltaos, 2018). This result is statistically significant and suggests that “regulation has been a contributing factor” to reduced flood frequency. (p. 73).

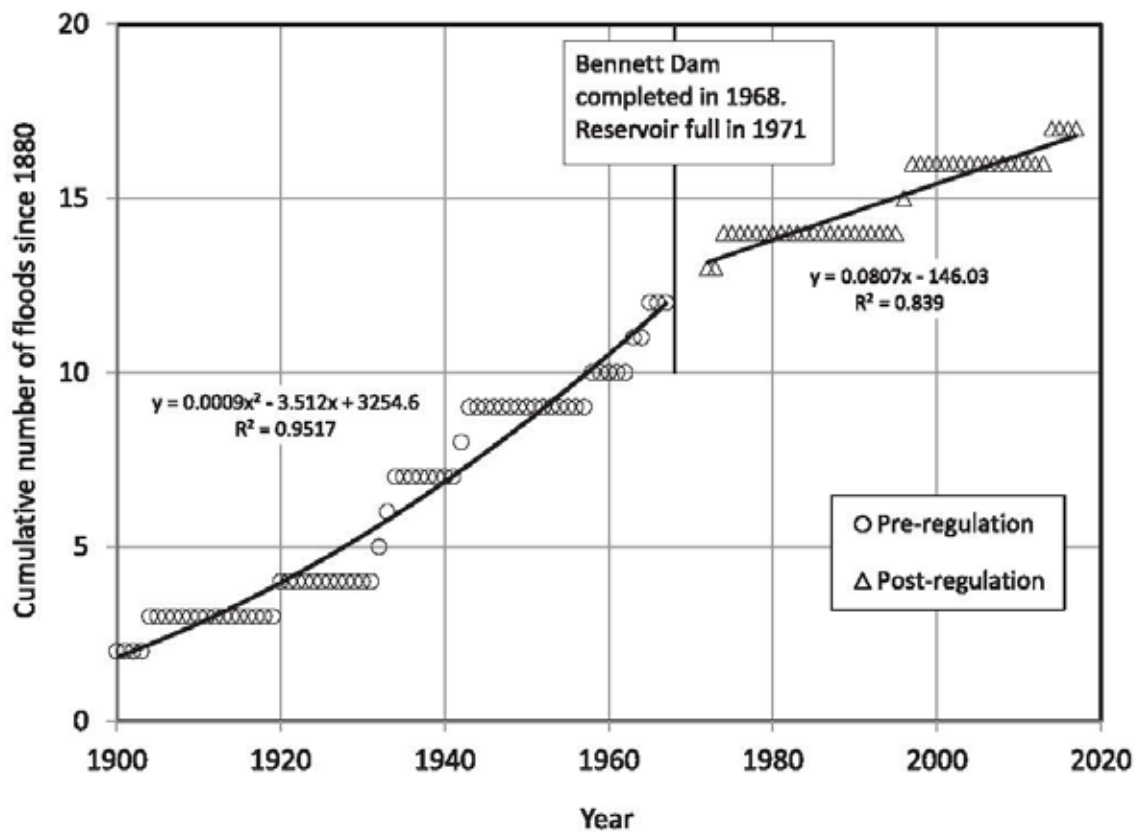


Figure 5-4: Recent History of Large Ice-Jam floods of the PAD, Including the 2014 Event (Beltaos, 2018)

Note: by definition, frequency = slope of cumulative number graph. Flood numbers up to 2008 derive from the comprehensive compilation by Timoney (2009).

Many scientists also report changing climatic conditions contribute to the reduction in frequency of ice jam floods (Beltaos, 2014; Dube and Wilson, 2013; Beltaos et al., 2008; Beltaos et al., 2006a; Prowse et al., 2006; Prowse et al. 2002b; Prowse and Conly, 1998). As early as 1996, Prowse and Conly (1996, 1998) indicated “the absence of a high-order event between 1974 and 1992 seems to be related to a combined effect of flow regulation and the vagaries of climate” (Prowse and Conly, 1998, p. 1589). Later, Beltaos et al. (2008) report “ice jam flooding is shown to depend on freeze-up stage and spring flow. The former has increased as a result of flow regulation; the latter has decreased due to recent climatic trends...contribut(ing) to less frequent ice-jam flooding” (p. 345). More recently, Dube and Wilson (2013) indicate that “before the dam, variability between peak flows and low flows was much higher, with large floods (including ice jam floods) occurring more frequently than post-regulation” and note that “a combination of higher winter flows (from regulation) and reduced spring runoff (effect of climate warming, reducing snowpack depth) have made ice jam floods scarce (only 4 since 1968)” (p. 420). Beltaos (2014) concludes that “regulation accounts for nearly two-thirds of the reduction in ice jam flood frequency”, with the balance as a result of climate change (p. 57).

Other authors further highlight the contributions of climate change to the declining trend in ice jam recharge frequency. Peters and Prowse (2006) indicate the absence of large-scale ice-jam flooding in the Peace Delta is largely due to a decreased magnitude of winter snowpack. Timoney et al. (1997) studied historic PAD records of flood data from 1826 to 1995 and report “climatic change or oscillation likely underlies the drying trend observed in recent decades in the Peace-Athabasca Delta” (p. 463). However, AECOM (2010) studied Timoney et al. (1997) work and determined that “a more recent analysis of these data from 1850 to 2008 indicates that the median time period between large-scale floods (magnitude three) has increased, when comparing pre-dam to post-dam data...confirm(ing) the observations documented by Traditional Knowledge” (AECOM, 2010, p. 18).

Additionally, Wolfe et al. (2006) analyzed lake sediments over the past 180-300 years in two basins located in the northern PAD. Based on this work, they infer “flood frequency has been highly variable over the past 300 years but in decline for many decades beginning as early as the late nineteenth century...” and note “several multi-decadal intervals without a major flood have occurred during the past 300 years” (p. 4131). On the other hand, Beltaos (2016) estimated the occurrence of pristine ice jam floods (the flood regime that would have prevailed had there been no regulation introduced), noting “unregulated flood frequency is at least 55% greater than regulated frequency”, based on a flood once every six years pre-regulation (1923-1967) versus once every nine years post-regulation (1972-2016) (p. 3). Furthermore, based on their own data sources, Beltaos (2016) and AECOM (2010) concluded that regulation has significantly reduced ice jam flooding, which aligns with the extensive body of authoritative physical modelling studies that consistently point to the significant role regulation has played in lowering ice jam flooding frequency since the late 1960s (see Part 4 of Carver, 2016b for a listing of relevant publications) and the accumulated direct experience provided through ITK (reported in Candler et al., 2013a).

5.3.3 Open Water Flooding

Numerous scientists report the open water flooding mechanism has decreased with regulation of the Peace River (Candler, 2013a; Carver, 2013a; Peters and Buttle, 2010; Prowse et al., 2006). Candler et al. (2013a) note “MCFN knowledge holders estimated that the frequency of hydraulic damming on the Peace resulting in reversed flows in the delta prior to the WAC Bennett dam was in the order of one in every four to five years (approximately 20% likelihood). Since WAC Bennett was built, MCFN knowledge holders indicated that Peace River levels have been sufficient to cause reverse flows in only three (1974, 1997, and this spring, 2013) in forty-four years (approximately a 7% likelihood)” (p. 17). In 2006, Prowse et al. concluded “the frequency of (spring) reverse-flow events did decrease after regulation” (p. 191) and Carver (2013a) further report “flow reversals were abundant in the years prior to the closing of the Bennett Dam (an equivalent mean flow throughout the year of 121 m³/s), all but halted during the filling period (3.1 m³/s), and then resumed at a much reduced rate (21 m³/s)...During the regulated period, flow reversals have been 83% below what they had been during the monitored pre-regulated period” (p. 19). ‘Closing’ of the dam in this context means when the control gates were closed in order to fill the reservoir.

There have also reportedly been changes to open water reverse-flow events into Lake Athabasca resulting from regulation of the Peace River. Peters and Buttle (2010) report “during the summer period, (Athabasca) lake level was linked to sustained high flows on the Peace River. The (Peace) River obstructed outflow and contributed reverse flow to the LA-PAD in each year prior to 1968. Following regulation, however, more than half the years did not experience any open-water obstruction and/or reversal, and those that did were characterized by smaller events. The average estimated duration of obstruction was more than two weeks shorter and reverse flow volume was reduced by 90% under a regulated regime compared to a simulated naturalized flow regime” (p. 1065).

One author also reports effects to open water flood recharge efficacy in the PAD due to changes in flow rates on both the Athabasca and Peace Rivers, in combination with climate change. Carver (2013) reports “declining trends in annual peak flows due to climate change and oil sands water withdrawals (on the Athabasca River) interplay with changes occurring in the Peace River due to regulation and climate change. A consequence of this reduced inflow is a general decline in the amount of recharge for a given

In the early 60's, there were floods all the time. Lots of water. My brother Harvey, comes out north of Peace River, we could hardly see the spruce trees with all the ice and sticks. That was clear ice in them days and all that water backed up all the way to Lake Claire. That used to happen every 3-4 years.

Quote context: *It (the water) was way high, that is what I mean. The ice jam would have spruce and timber, ice, logs, everything. Ice then didn't have pollution. Not the brown ice like today. It was blue then and thick. When it jammed it didn't crush, it piled up. When the ice jams it goes into the Pine River and it starts on the Peace. It comes out at Lake Claire. This used to happen every 3 to 4 years. Then there were a lot of rats. Those were the good old days. The Peace River was high in those days.*

Source: Archie Antoine

About Archie Antoine

I am 81. I have been on the land all my life. I started trapping at 15 at Garden River on the Peace River. I have been here 65 years and I am still out on the land. I was born and raised on the land but worked in the summer and trapped in winter. I take out two young boys to teach traditions to, Chance and Robert Jr. They learned fast but I lost one of them not too long ago.

hydraulic damming event by the Peace River. It is important to note, the interactions between the two river systems are complex and additional study is needed to clarify how the Peace and Athabasca Rivers interact in order to generate flooding events in the PAD.

5.3.4 Clarifications on Observations and Causes of PAD Flooding Reductions

Apparent disagreements can be found in the literature from some researchers regarding the pattern and characterization of PAD drying, including variation in ice-jam frequency, in both recent history (two or three centuries before present) and over longer time (going back thousands of years) and the role of regulation in the perceived patterns. In general, it can be said that the perceived differences may be more about time scale and the analytical methods used, rather than about diverging findings. A discussion of some specifics found in the scientific literature is provided below, including clarifications on ice jam flooding and the significance and detectability of comparing the effects of regulation with long-term recharge variability over recent history and longer.



Ice Jam Flooding: Storage Release Hypothesis

Jasek (2016) presented a hypothesis (originally put forth in a conference paper by Ashton) that enhanced storage-release breakup flows resulting from increased freeze up levels and winter releases compensate for the initial negative effect on ice-jam occurrence of the increased freeze up levels associated with regulation. If true, this hypothesis would imply that the widely understood mechanism for regulation to reduce the likelihood of ice jam flooding was incorrect, thereby opening the door to other explanations for the PAD's recent drying trend. However, Beltaos (2016) notes that hydrometric data at Peace Point does not support this hypothesis, further stating "excess storage release will be zero or minimal in cases where the freeze up level is high enough to prevent ice cover dislodgment by the incoming breakup flow, even when the latter is potentially of flood magnitude" (p. 5). Comprehensive technical details of storage-release hydrodynamics and excess release flows can be found in Beltaos (2016).

PAD Long-Term Recharge Variability

Several researchers have placed the reduced recharge experienced by the PAD since regulation within the context of the long-term range of variability for the landscape by extending the timeline of study to several thousand years using paleo-climate techniques. The argument made is that the effects of introducing flow regulation on the Peace River are insignificant because the resulting declines observed in ice jam flooding frequency are within the long-term range of variability looking back over millennia. Although these types of studies shed light on the long-term history of the PAD, they have also

contributed to confusion regarding effects detectability based on the timeframe under consideration and do not consider the undisputed conclusions regarding regulation based on well-established data.

Variability in climate over the past millennia are not relevant to reaching conclusions regarding changes in ice jam flooding frequency over the past century in relation to contemporary stressors. Jasek (2016) reports the “long term average is one flood every 16 years since circa CE 883” and further note “ice jam floods were more frequent during the 20th century than at most other times during the last millennium. One flood every 6 years” (p. 7). However, the lower frequency associated with a climate from a thousand years ago is unrelated to the evaluation of regulation. As noted by Beltaos (2018), if the time period selected for comparison is too long, it may be influenced by climatic regimes of long ago that have little resemblance to that of the period of regulation.

Observations made by application of paleo research techniques can, however, be used to help put the present moisture regime in a long-term context regarding ecological resiliency in response to present-day stressors. For example, the long-term and well-known role of climate variability to hydrology in systems worldwide is emphasized by Wolfe et al. (2012) who document how “climate variability exerts...overwhelming influence on the delivery of water to the PAD” within the context of a 5200-year reconstruction of Lake Athabasca water-level history (p. 191). Wolfe et al. (2012) use their reconstruction to speculate that “the inaccurate perception of normal conditions...have likely contributed to the incorrect paradigm that the delta is drying and dying by unnatural causes. To the contrary, the PAD continues to evolve as a natural floodplain landscape” (p. 208). These comments are similar to those of Timoney (2002) who identifies variations in the natural PAD hydrologic regime as being caused by “climatic variation and change, normal wetland dynamism, stochasticity, flow regulation, weirs, dredging, avulsions and their prevention, influxes of weeds and contaminants, delta evolution, and cultural change” (p. 282).

Ultimately, whereas the partial interpretations from paleo-research provide additional ways to place the drying that has been occurring since regulation in context, peer-reviewed literature on this topic remains unavailable. Thus, it is inappropriate to use the paleo-research to dispute the validity of the 25 years of broad-based peer-reviewed physical modelling work undertaken by a wide range of researchers and supports the observation that the paleo methods are being misapplied to detect effects that they are not suited to detect.

5.4 EFFECTS OF RECHARGE TRENDS ON WATER LEVELS

The net effect of water recharge changes described in Section 5.3 above has resulted in what has become a critical situation for Lake Athabasca and the central PAD lakes. The reductions in ice jam and open water flooding have reduced water levels in the PAD, leading to declines in water depth and resulting in a loss of resilience and function in both ecological and human communities. Water levels on Lake Athabasca and central PAD lakes, and weirs as a mitigation measure, are discussed in the following paragraphs.

Numerous scientists and Indigenous knowledge holders report that changes in the flow regime on the Peace River resulting from regulation, in combination with climate change effects, have caused water levels and spatial extents in the PAD to decrease, resulting in a drying trend over the past fifty years

(MCFN, 2016a; Beltaos, 2014; Schindler and Donahue, 2006; Wiacek and Westworth, 1999). As reported by Candler et al. (2013b) “Traditional Knowledge indicates that the PAD as a whole is drying, and that this drying has coincided with BC Hydro regulation of the Peace” (p. 20). In 1999, Wiacek and Westworth report “regulation of Peace River flows, in conjunction with natural declines in snow pack in tributary headwaters, have contributed to a protracted drying trend in the PAD that began approximately in 1975”. More recently, Schindler and Donahue (2006) report “delta wetlands are already exhibiting negative effects of declining water supply from climate change and the Bennett Dam on the Peace” (p. 7213) and in 2014, Beltaos stated that both regulation and climate change have “resulted in prolonged dry periods and considerable reduction in the area covered by lakes and ponds that provide habitat for aquatic life in the PAD region” (p. 1).

In 2016, MCFN (2016a) report “while Mikisew oral histories recall large scale flooding occurring every few years prior to damming of the Peace River in the late 1960s, the frequency and intensity of spring floods has declined since. When there is not enough water flowing in the Peace River, or when ice dams fail to form, the rivers of the delta do not reverse, the flow of the Athabasca and other tributaries isn’t held back, and the delta continues to empty. Lakes and channels are not recharged and over successive dry years, the ‘sponge’ of the delta becomes empty. Sedges and wetland grasses are replaced by willows and other plants that take over lakeshores and creek beds. The land dries up” (p. 13-14). The MCFN further reports “the Peace River used to be three and a half times the flow of the Athabasca River – now it no longer empties those quantities into Lake Athabasca, which further contributes to decreasing water levels” (MSES, 2010, p. 18-19).

Importantly, hydraulic damming “leads to higher water levels on Lake Athabasca and supports increases in water levels in the central (PAD) lakes area” (Carver, 2013, p. 13). A number of scientists, Indigenous knowledge keepers, and consultants, however, report specific decreases in Lake Athabasca water levels due to the regulation of flows on the Peace River (Teck Resources, 2011a; Parks Canada, 2009; Peterson and Courtorielle, 1992). In their analysis of Lake Athabasca water levels from 1930 to 1991, Peterson and Courtorielle (1992) report a 0.5 m decrease in the mean high water level in the lake after flow regulation started on the Peace River. Similarly, Teck Resources note “a noticeable decrease in the average seasonal water levels during the July-September period because of the effects of the regulation of the Peace River from the dam” in their analysis of hydrometric data of Lake Athabasca for the Frontier oil sands project (Teck Resources, 2011a, p. 7A-9). Similarly, Parks Canada (2009) report “water levels in Lake Athabasca have fluctuated across a range of about 3.4 metres between 1940 to the present...and since 2000, summer lake levels have been five to 95 centimetres below the long term average” (p. 18).

Carver and Maclean (2016) review the compounding effects of deltaic processes in their examination of PAD water depths. They note “Delta progradation (forward movement of the leading edge of deltaic sedimentation) is generally accompanied by aggradation as sedimentation proceeds. All other things being equal, the excess of sediment supply above and beyond what gets removed shapes the pace and magnitude of aggradation” (p. 47). Whereas PAD recharge is known to have declined, subsequent interpretation of changes in water depth require additional consideration of these deltaic processes. According to Carver and Maclean (2016), the onset of the increased rate of aggradation in the three PAD locations reviewed in Timoney (2016) coincides with the beginning of Peace River regulation. They explain “regulation has resulted in diminished hydrologic recharge to the PAD and thus a potentially

reduced likelihood that sediment inputs will be removed or reorganized locally, leading to accelerated aggradation” (p. 47). In other words, examples of deltaic sedimentation reviewed by Timoney (2016) appear to support the view that regulation has not only diminished water levels directly due to a loss in recharge but is also associated with an increase in sedimentation that can exacerbate declines in water depth due to declining recharge.

5.4.1 Weir Effects

In response to declining water levels in the PAD, a temporary dam was installed in the Quatre Fourches river in the fall of 1971 to immediately raise water levels while more permanent solutions were being investigated (PADIC, 1987). The temporary dam was damaged in 1974 flood and removed in 1975, following completion of the Rivière des Rochers weir.

The two permanent submerged outflow weirs were constructed in two smaller tributary rivers, which are widely regarded as an important intervention to at least partially restore water levels in the PAD. The submerged rock fill notched weirs were constructed on the Rivière des Rochers (aka ‘Little Rapids’) and the Revillon Coupé River in 1975 and 1976 as a joint effort by the Federal, Alberta, and Saskatchewan governments (PADIC, 1987). The locations of the two existing weirs are shown by thick red arrows in Figure 5-5.

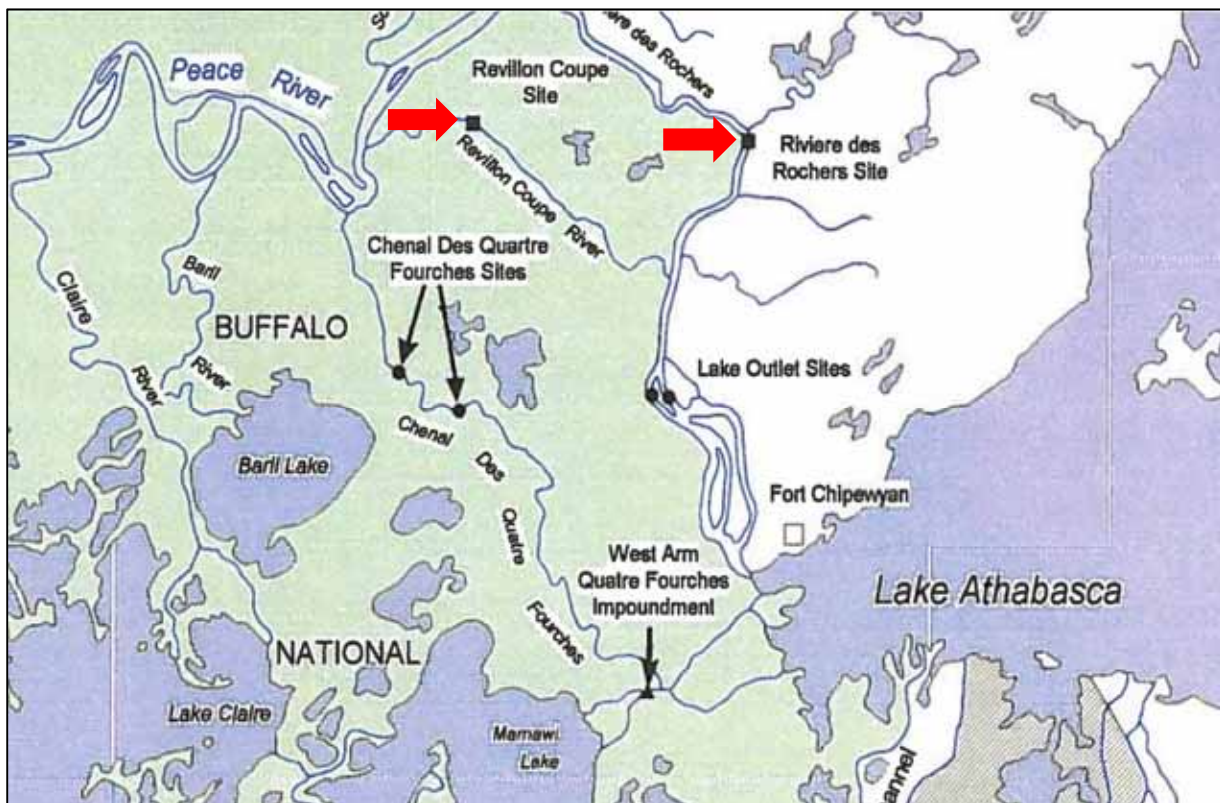


Figure 5-5: Location of Remedial Works That Were Investigated and Implemented (DeBoer, 1996)

The two existing weirs have apparently been partially successful in restoring water levels in Lake Athabasca and the central PAD lakes, such as Lake Claire and Mamawi Lake. As noted by Prowse and Conly (1996), “the effect of regulation and the restoration effect of the weirs are evident for all lakes and most pronounced for Lake Athabasca” (p. 57). With the weirs in place, as shown in Figure 5-6, the water levels in Lake Athabasca have increased by 0.50 m in summer and 0.56 m in winter, as compared to dam-regulated levels (resulting from upstream hydroelectric development) (DeBoer, 1996).

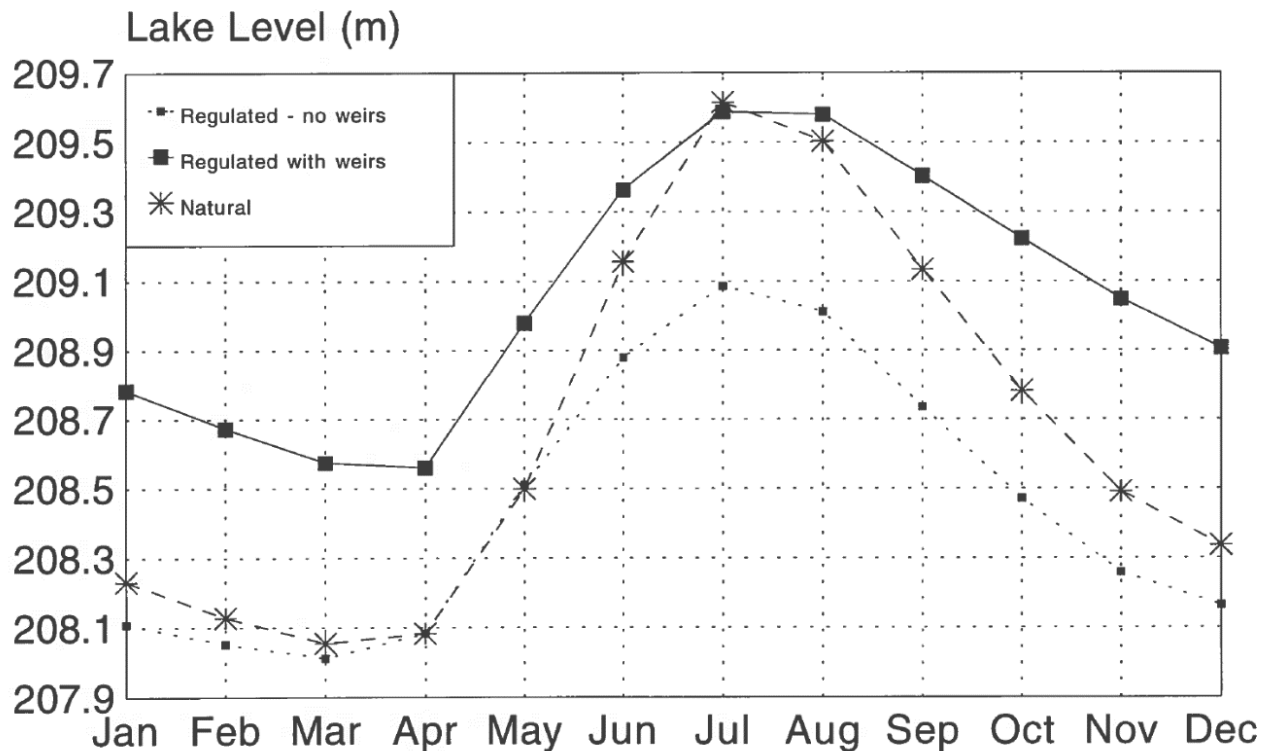


Figure 5-6: Lake Athabasca at Crackingstone Point, Mean Monthly Lake Level Estimates (1960 to 1984) (DeBoer, 1996)

As illustrated in **Figure 5-6**, a number of researchers confirm the weirs increase both mean summer and winter water levels in Lake Athabasca (as compared to dam-regulated levels). Aitken and Sapach (1994) report “the weirs have restored the peak annual water levels on the large delta lakes to what they were prior to the Dam being built, but in so doing have also raised the mean and minimum water levels above what they would have been under natural conditions” (p. ii). In 1996, DeBoer reports “although the weirs have closely restored the peak summer levels in the Delta, winter levels have (also) been increased” (p. 9). Importantly, as a result, “the weirs have eliminated critical, seasonal drawdowns in water levels that produce unique near-shore vegetation/habitat and waterfowl staging zones” (Prowse and Conly, 1996, p. 57).

The introduction of flow regulation by both dams (from upstream hydroelectric development) and weirs also produces a less variable water level regime in Lake Athabasca. As illustrated in Figure 5-6, the amplitude in Lake Athabasca water levels is about 0.5 m lower for regulated conditions, as compared to natural conditions (for the dam alone, as well as weirs and dam). Interestingly, the difference in

amplitude between dam regulation with weirs and dam regulation without weirs is approximately 6.2 cm, indicating the weirs have had minimal influence on water level amplitude in Lake Athabasca (DeBoer, 1996). As noted by DeBoer (1996), “the amplitude between the summer peaks and the winter lows is lower for both the (dam) regulated and regulated with weirs scenario”.

Interestingly, several groups report that the weirs have not fully restored water levels in Lake Athabasca and the central PAD lakes, such as Lake Claire and Mamawi Lake (MCFN, 2018a; Parks Canada, 2009; Indian Claims Commission, 1998; Farley and Cheng, 1986). Perhaps most importantly, as Farley and Cheng (1986) note, water is not being replenished as often in the perched basins, even with the weirs in place. The Indian Claims Commission (1998) reports “the weirs were not successful in restoring peak summer levels to pre-dam conditions in Lake Athabasca” (p. 45) and further notes “the summer peak levels...are 0.5 metres below average” (p. 49). For Lake Claire, Parks Canada (2009) reports “although rock weirs on the Rochers and Revillon Coupé rivers have maintained elevated lake levels, they do not allow for extreme seasonal rise and fall of the natural regime. Currently water levels are higher in winter (September to May) and lower in summer as compared to an unregulated regime” (p. 18). Farley and Cheng (1986) also note “the weirs have been effective in maintaining mean natural levels on Lake Athabasca and the delta lakes. However, simulated peak and observed peak levels for lakes Claire, Mamawi, and Baril for the weirs in place and Bennett Dam regulation are about 0.3 m lower than the simulated and observed natural levels” (p. 26). Similar to Farley and Cheng’s (1986) conclusion, the Indian Claims Commission (1998) report the weirs have been “unsuccessful in restoring water levels in the delta to pre-dam conditions. Most significantly, they did not have the desired effect of recharging the elevated lakes or perched basins” (p. 97).

Figure 5-6 also illustrates that flow regulation in the Peace River (without weirs) appears to have lowered both summer and winter water levels in Lake Athabasca, although winter levels have not been reduced as much (a reduction of 0.04 m in March and a reduction of 0.53 m in July). As noted by DeBoer (1996), “the results show that Bennett Dam regulation, without the existing weirs, would result in significantly lower peak levels in the summer than would occur under the natural regime, while lake levels experienced in the late winter are approximately the same”.

The long term effect of the weirs, in conjunction with flow regulation, has been to increase summer levels on Lake Athabasca by about 0.5 m, thus closely restoring natural mean summer water levels, but also increasing winter levels by about 0.5 m, as compared to natural levels (without flow regulation or weirs in place). It is important to note this is for average conditions, rather than dry or wet years. Prowse and Conly (1996) further note the weirs have their greatest effect on winter and spring water levels, particularly immediately upstream. These results indicate the weirs have produced higher winter water levels in Lake Athabasca, which may be exacerbating the problem of increased winter flows from the Peace River increasing winter freeze up levels and reducing ice jam flooding frequency in the PAD.

5.5 SURFACE WATER QUALITY

Long term water quality monitoring has been conducted by Parks Canada and Environment Canada at three locations on the Athabasca, Peace, and Slave Rivers in WBNP since 1989, 1960, and 1967, respectively (Glozier et al., 2009), as shown in Figure 5-7.

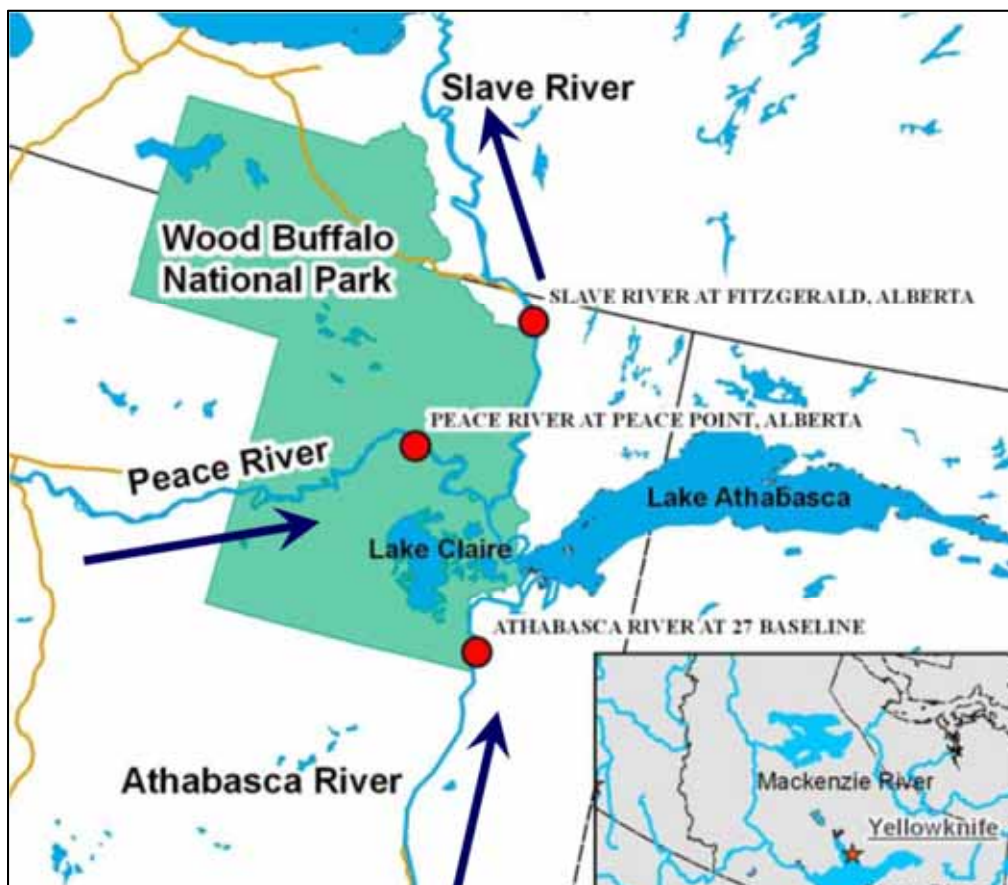


Figure 5-7: Long Term Water Quality Monitoring Locations Since 1989 (Glozier et al., 2009)

In 2011, the Governments of Canada and Alberta established JOSM in response to concerns regarding the effect of oil sands development in the Athabasca River basin. The JOSM focused on “monitoring of water quality in the main stem of the lower Athabasca River (LAR), its tributaries, and the deltaic and wetland ecosystems at the mouth of the river from April 2012 to March 2015” (Glozier et al., 2018, p. ii). Parameters measured included major ions, nutrients, mercury, metals, and PACs. The sampling sites established in the Lower Athabasca River and the PAD are shown in Figure 5-8 and Figure 5-9, respectively.

Surface water quality changes in PAD lakes and rivers have been reported by many scientists, consultants, and Indigenous knowledge holders, mainly attributed to oil sands, pulp and paper, agricultural (pesticides), and municipal effluents, as well as changes to flow rates in the PAD rivers. As expressed by Baird et al. (2016), “when combined with drivers from other developments (e.g. hydrology

shifts caused by hydro development on the Peace River), a potential for cumulative effects from multiple stressors (e.g. oil sands mining) exists” (p. 3).

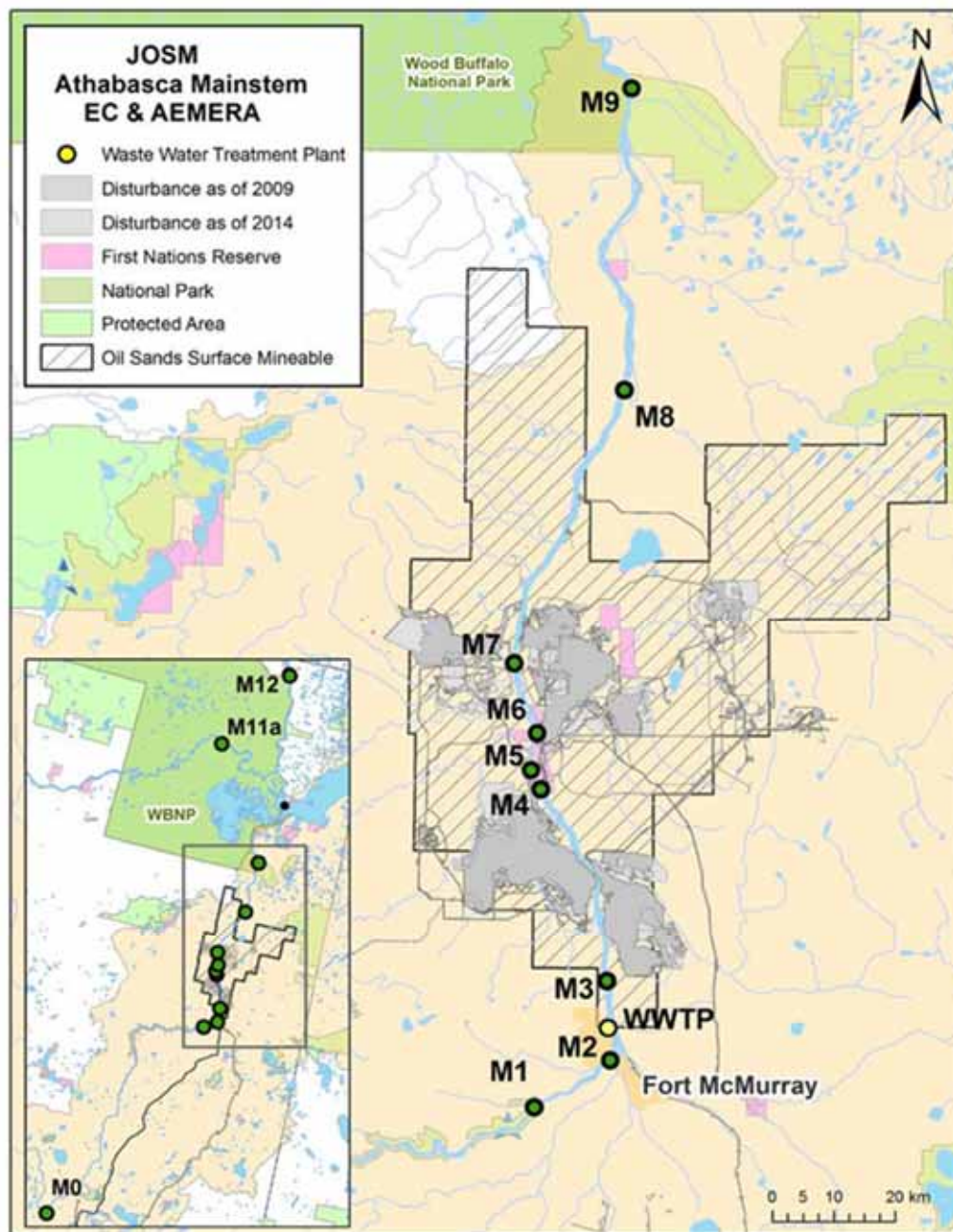


Figure 5-8: Water Quality Monitoring Sites in the Lower Athabasca River (LAR) (Glozier et al., 2018)

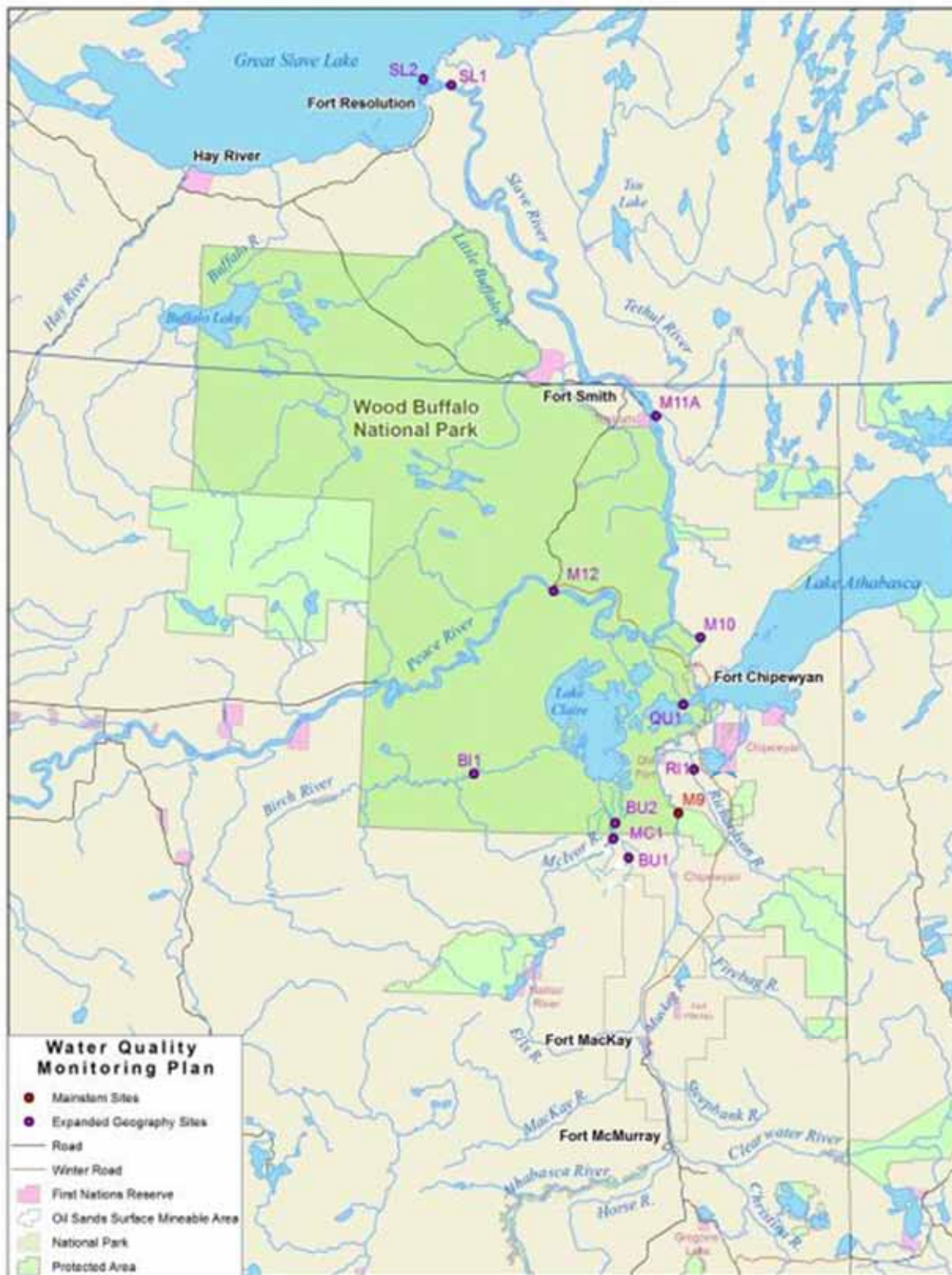


Figure 5-9: Water Quality Monitoring Sites in the Tributaries of the PAD (Glozier et al., 2018)

5.5.1 Monitoring Issues

Numerous academics and researchers report water quality effects in the PAD are difficult to quantify for a number of reasons including:

- 1) shifting dissolved and total parameter concentrations with changing flow rates and sediment loading in the PAD rivers (Peace, Athabasca and Slave rivers);
- 2) changes in PAD river flow rates over time;
- 3) a lack of information about water quality prior to development; and
- 4) difficulties in consistent monitoring (in terms of geographic location and the use of a common set of parameters).

Each of these is discussed in the following paragraphs. The first monitoring issue is that the total nutrient and metal concentrations varies with flow, making guidelines problematic to apply. Total nutrient and metals concentrations increase in PAD rivers during high flow volumes in relation to high suspended sediment loading (Glozier et al., 2009). Glozier et al. (2018) report “particulate associated parameters (such as metals) generally had higher concentrations during high flow spring/summer periods when suspended sediment loads were high” (p. iv). The variation in total nutrient and metals concentrations, in particular, may present problems in referencing provincial and federal guideline concentration limits, which may not be appropriate during high sediment loading periods (AECOM, 2010; Parks Canada, 2009) and AECOM (2010) concluded “the status of nutrient concentrations in the PAD cannot be assessed because appropriate guidelines for the highly sediment-laden Athabasca and Peace Rivers are not available at this point” (p. 22).

The second monitoring issue involves the challenge of determining water quality trends given the changes resulting from alterations in PAD river flow rates over time. As part of the JOSM program, Glozier et al. (2009) studied the water quality on the Athabasca, Peace, and Slave rivers at the boundaries of Wood Buffalo National Park between 1989 and 2006. They report changes in the seasonal patterns of dissolved parameters (metals, major ions, and nutrients) in both the Peace and Slave rivers due to the changes in river discharge patterns related to regulation of the Peace River. Further, the authors report increasing nutrient levels, especially phosphorus (total phosphorus or TP), in the Athabasca and Slave rivers from 1989 to 2006 with decreasing river discharge. Similarly, Parks Canada (2009) also found “the seasonal patterns of dissolved metals and ions in the Peace and Slave Rivers have been substantially changed from natural patterns in unregulated rivers. Normally, peak concentrations would occur in winter when a river is ice covered and flow rate is at its lowest. Currently, peak concentrations are occurring in the open water period (spring to fall), with minimum concentrations in winter” (p. 30). More recently, Glozier et al. (2018) note the potential linkage between lack of trends in concentrations of dissolved iron, most major ions, several nutrients, total suspended solids (TSS), and turbidity in relation to “changes in flow due to water withdrawal” (p. iv).

The third issue with monitoring, is the problem of determining water quality objectives and changes in the PAD without water quality data from the ‘pre-development’ era on the Athabasca and Peace Rivers. This includes regulation of the Peace River, as well as water withdrawals from and effluents discharged

into the Athabasca River from the oil sands, agriculture, municipalities, and pulp and paper mills. Dube and Wilson (2013) report that, while “lower Peace River had adequate long-term discharge data, it completely lacked in pre-regulation water quality monitoring data (federal or provincial)” (p. 420) and Timoney (2013) notes “there are, in fact, virtually no pre-development environmental baseline data, which makes it difficult to assess change” in the PAD (p. 432). Although there is limited data from the Slave River pre-1967 (Glozier et al., 2018), many water quality programs undergo periodic review and, as a consequence, data gaps or changes to frequency are not uncommon.

The final issue regarding water quality monitoring is that there have reportedly been gaps in terms of using a comprehensive set of water quality parameters and a lack of sufficient monitoring in the PAD. Glozier et al. (2009) note that, in part, because the water monitoring program had a focus on nutrient enrichment identified during earlier studies (Northern River Basins Study, NRBS, 1996), the water quality monitoring program for Wood Buffalo National Park did not include dioxins, furans, and sulphur compounds from pulp and paper effluents, as well as PAHs, naphthenic acids, and chlorinated phenols from oil and gas activities. In their State of the Park report, Parks Canada (2009) also report “these existing data do not provide the opportunity to describe the occurrence and abundance of a broad suite of petroleum and oil-based contaminants” (p. 30). In response to concerns regarding inadequate water quality parameters and sampling locations, the recently expanded JOSM monitoring program sampled for a broader range of contaminants of concern and added sampling locations in the Athabasca River and PAD connecting channels (Glozier et al., 2018; Baird et al., 2016).

5.5.2 Trends in the PAD

The Community Based Monitoring (CBM) program established by the MCFN and ACFN in 2011 has monitored surface water quality at 26 sites within the PAD from 2011 to 2016, utilizing the Canada Council of Ministers of the Environment (CCME) Water Quality Index (WQI) Calculator to assess water quality (e.g. for the protection of aquatic life) (MCFN and ACFN, 2017a). In the absence of parameter specific guidelines for PAHs, the WQI allows users at a community level to reliably, rapidly, and cost-efficiently screen water bodies that could be causing adverse effects to humans, animals and plants. The WQI used by the CBM program in the PAD incorporates 60 parameters, including nutrients, physical parameters, major ions, organics (VOCs, PAHs) and metals, in its calculations. Coupled with a robust community-based water monitoring program, the WQI Calculator is an excellent tool to simplify complex data to a format that is easily understood by the wider community.

From 2011 to 2016, an average CCME Water Quality Index (WQI) of Fair (74.4) was reported for all sites monitored in the PAD over the six year study period, where “water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels” (MCFN and ACFN, 2017a, p. 12). The authors identified a number of parameters as substantial contributors to poor water quality in the PAD, including iron, phosphorus, manganese, nitrite, lead, aluminum, copper, and methylmercury over the monitoring period (MCFN and ACFN, 2017a). The CBM program in the PAD reports the following results:

- On average since 2011, study sites in the Peace-Athabasca Delta had “Fair” overall water quality, as compared to “Good” overall water quality at the reference sites.

- Iron, manganese and phosphorous are the compounds that most often exceeded water quality guidelines; 2013, a consistent rise in aluminum and turbidity was detected at the study sites.
- Some sites did poorly, or marginally poor in terms of water quality, but these poor readings were only over a single year and were not consistent through the years.

The authors did not perform a trend analysis of the results over the six year monitoring period.

Effects to local Indigenous people's health and welfare resulting from water quality changes in the PAD are also being seen. Indigenous Knowledge holders describe the quality of the water in the PAD as so poor the people cannot drink it (MCFN, 2018a, 2018b). They must now carry drinking water with them when they go out on the land. This means they only have the capacity to go out on the land for as long as the water lasts. In addition, they have to transport the water, which adds weight to the boats. If the boat sits lower in the water, it is even more difficult to access channels and lakes in the PAD. The water is undrinkable from the lakes because spring water is not coming through to flush the water, and it has a stagnant, foul smell, along with scums, foams, films and algae. There is concern about the contamination that may be coming down the rivers from municipal, agricultural and industrial development. In the winter, people will no longer melt snow for water because it has a sheen to it when melted and does not taste good. People have also noticed skims of yellow between layers of snow in Lake Claire. Contaminants in the water are causing deformed fish, which the people will not eat when they catch them, and mercury has also been found in high levels in fish and bird eggs, so consumption limits were set by the government, further limiting people's access to food sources and further eroding confidence in local foods.

The MCFN further note "without flooding, water that remains in rivers, wetlands, and muskegs is often 'dead' or dirty. There is often oil sheen visible on the surface and strange deposits left on boats. The water from many areas is no longer considered safe to drink" (MCFN, 2016a, p. 22). Timoney (2007) also reports "the people and biota of the Athabasca River Delta and western Lake Athabasca are exposed to higher levels of metals than those upstream", with arsenic being of particular concern (p. 68). More recently, the Firelight Group et al. (2018) report "MCFN land users have observed an increase in scums and films in the PAD (noticeable on boats and in drinking water), decreased quality and taste or texture of fish, changes in taste and smell of water, changes in fish and animal health, including deformities, and changes in aquatic invertebrate presence. Taken together, these changes have led to an overall perception of risk and loss of confidence in the use of water and wildlife in many areas of the PAD, resulting in serious impact to MCFN way of life for many MCFN families" (p. 4).

The identification of the overall water quality trend for the PAD requires consideration of both scientific research and ITK. The CBM monitoring information has not been presented in terms of trends, rather the results indicate a consistent "fair" water quality index (WQI) and a number of CCME exceedances over a relatively short monitoring period (MCFN and ACFN, 2017a). ITK indicates an observed negative trend in water quality in the PAD over the past several decades. Since the CBM information is limited in regard to its ability to identify trends over a long monitoring period, it is possible there is consistency between the ITK and the CBM findings. The ITK trend does align with the declining trend observed in

Athabasca water quality detailed in the following paragraphs and further highlights the need for improved scientific information regarding water quality in the PAD in the future.

Numerous scientists and researchers also report spatial and temporal water quality changes in the Peace, Athabasca, and Slave Rivers, compiled below in Table 5-2 (Glozier et al., 2018; Jautzy et al., 2015a; Timoney and Lee, 2011; Sanderson et al., 2012; Candler et al., 2010; Kelly et al., 2009; Squires et al., 2010; Glozier et al., 2009). The trends discussed in the following paragraphs refer mainly to the JOSM program results from Glozier et al. (2009) and Glozier et al. (2018).

Table 5-2: Spatial and Temporal Trends for Typical Water Quality Parameters in PAD Rivers

Parameter	Peace River	Athabasca River	Slave River
Total P	→ 1a,1b	↑ 1a,1a*,2,4a → 1b,4b,4b*,12	↑ 1a → 1b
Dissolved P	→ 1a,1b	↑ 1a,3 → 1a*,1b,4a ↓ 2,4b,4b*	↑ 1a,3 → 1b
Dissolved N	→ 1a,1b	→ 1a,1a*,1b,4a,4b,4b*	↓ 1a,1b
Dissolved NH ₃	→ 1a,1b	↑ 1a → 1a*,4a ↓ 1b,4b,4b*	→ 1a,1b
SO ₃	↑ 1a → 1b	↑ 1a,2,4a → 1a*,1b,4b,4b*	↑ 1a,3 → 1b
Mg	→ 1a,1b	↑ 4b* → 1a,1b,4a,4b ↓ 1a*	→ 1a,1b
Cl	↓ 1a,1b	↑ 2 → 1a, 1b, 4a,4b* ↓ 1a*,4b	↓ 1a,1b
Na	↓ 1a,1b	↑ 2,4b* → 1a,1b, 1a*,4a, 4b	→ 1a,1b ↑ 3
TDS	→ 1a,1b	→ 1a,1a*,1b,4a,4b,4b*	→ 1a ↓ 1b,3
Dissolved As		↑ 4b,4b* → 1a,1a*	
Dissolved Cu	→ 1b	→ 1b,1b*,4b,4b*	
Dissolved Fe	→ 1b	→ 1b,1b*,4b ↑ 4b*	
Dissolved Al		↑ 4b,4b*	

Parameter	Peace River	Athabasca River	Slave River
Dissolved Se, V		→ ^{4b,4b*}	
Total Cu, Fe, Ni	→ ^{1a}	→ ^{1a*,4b,4b*} ↓ ^{1a}	
Total Pb	↓ ^{1a}	↓ ^{1a,1a*} → ^{4b,4b*}	
Total Zn	→ ^{1a}	→ ^{1a*} ↓ ^{1a,4b,4b*}	
Total Se		↑ ^{4b,4b*}	
Total Al		→ ^{4b,4b*}	↓ ³
Total V	→ ^{1a}	→ ^{1a,1a*,4b,4b*}	
Other		Measurable PACs ⁴ ↑ PACs ⁶ ↑ PAHs ^{5,7}	↓ Mb, Cr ³
Notes: 1a: Glozier et al. (2009) from 1989 to 2006, 1a*: Glozier et al. (2009) from 1989 to 2006 flow adjusted values; 1b: Glozier et al. (2009) from 1997 to 2006, 2: Squires et al. (2010); 3: Sanderson et al. (2012) from 1972 to 2010, 4: Glozier et al. (2018), 4a: Glozier et al. (2018) from 1989 to 2014, 4a*: Glozier et al. (2009) from 1989 to 2014 flow adjusted values, 4b: Glozier et al. (2018) from 2000 to 2014, 4b*: Glozier et al. (2009) from 2000 to 2014 flow adjusted values, 5: Timoney and Lee (2011), 6: Kelly et al. (2009); 7: Jautzy et al. (2015a) Abbreviations - Al: Aluminum, As: Arsenic, Cl: Chloride, Cr: Chromium, Cu: Copper, Fe: Iron, Pb: Lead, Mg: Magnesium, Mn: Manganese, Mb: Molybdenum, Ni: Nickel, N: Nitrogen, NH₃: Ammonia, P: Phosphorus, PAH: Poly Aromatic hydrocarbons, PACs: Polycyclic Aromatic Compounds, Na: Sodium, Se: Selenium, SO₃: Sulfate, TDS: Total Dissolved Solids, V: Vanadium, Zn: Zinc			

5.5.3 Trends in the Peace River

As illustrated in Table 5-2, the JOSM results indicate the concentrations of all relevant parameters of interest in the Peace River reportedly exhibited either stable or decreasing trends with time. From 1989 to 2006, concentrations of total phosphorus, dissolved phosphorus, dissolved nitrogen, magnesium, ammonia, and total dissolved solids (TDS), as well as total copper, iron, nickel, zinc, and vanadium reportedly showed a stable trend in the Peace River (Fe from 1993 to 2006) (Glozier et al., 2009). In addition, dissolved copper and iron have shown stable concentrations from 1999 to 2006. Sulfate has reportedly increased over the 1989 to 2006 period, but showed a stable trend from 1997 to 2006 (Glozier et al., 2009). Parameters such as chloride, sodium, and total lead showed a decreasing trend from 1989 to 2006 (Glozier et al., 2009).

5.5.4 Trends in the Athabasca River

As illustrated in Table 5-2, the JOSM results indicate concentrations of most relevant nutrients in the Athabasca River reportedly exhibited stable to decreasing trends. Parameters showing an increasing trend with time in the Athabasca River included magnesium, sodium, dissolved aluminum, total selenium, dissolved iron, and dissolved arsenic. From 1989 to 2014, concentrations of magnesium, once adjusted for flow, showed a decreasing trend from 1989 to 2006, but an increasing trend from

2000 to 2014 (Glozier et al., 2018; Glozier et al., 2009). Concentrations of sodium exhibited a stable trend from 1989 to 2014, but showed an increasing trend from 2000 to 2014 when adjusted for flow (Glozier et al., 2018; Glozier et al., 2009). Dissolved aluminum and total selenium showed an increasing trend from 2000 to 2014 and, adjusting for flow, dissolved iron showed an increasing trend for the same time period (Glozier et al., 2018; Glozier et al., 2009). Dissolved arsenic, while stable from 1989 to 2002, showed an increasing trend from 2000 to 2014 (Glozier et al., 2018; Glozier et al., 2009).

Nutrients such as total phosphorous exhibited an increasing trend from 1989 to 2014, with stable trends from 1997 to 2006 and 2000 to 2014 (Glozier et al., 2018; Glozier et al., 2009). Dissolved phosphorus exhibited a stable trend from 1989 to 2014 (adjusted for flow from 1989 to 2006), with a decreasing trend from 2000 to 2014 (Glozier et al., 2018; Glozier et al., 2009). Concentrations of dissolved ammonia showed stable trend from 1989 to 2014 (adjusted for flow from 1989 to 2006), with a decreasing trend from 1997 to 2014 (Glozier et al., 2018; Glozier et al., 2009). Concentrations of dissolved nitrogen and total dissolved solids showed a stable trend from 1989 to 2014 (Glozier et al., 2018; Glozier et al., 2009). Sulfate exhibited an increasing trend from 1989 to 2014, but a stable trend once adjusted for flow for the same time period (Glozier et al., 2018; Glozier et al., 2009). Chloride exhibited a stable trend from 1989 to 2014, but showed a decreasing trend once adjusted for flow from 1989 to 2006 and from 2000 to 2014 (Glozier et al., 2018; Glozier et al., 2009). Further, Squires et al. (2010) report “dissolved Na, sulfate, chloride, and total P concentrations (from 1996 to 2006) were greater than, and in some cases double, the 90th percentiles (from 1966 to 1976) in the lower part of the (Athabasca) river” (p. 119).

Metals such as dissolved copper and dissolved iron reportedly exhibited a stable trend from 1999 to 2006 and 2000 to 2014, while dissolved selenium, dissolved vanadium, and total aluminum showed a stable trend from 2000 to 2014 (Glozier et al., 2018; Glozier et al., 2009). Concentrations of total copper, iron and nickel showed a decreasing trend from 1989 to 2006, however adjusting for flow from 1989 to 2006 and from 2000 to 2014, a stable trend was seen (Glozier et al., 2018; Glozier et al., 2009). Total zinc showed a stable trend from 1989 to 2006 (once adjusted for flow) and a decreasing trend from 2000 to 2014 (Glozier et al., 2018; Glozier et al., 2009). Concentrations of total lead showed a decreasing trend from 1989 to 2006 and a stable trend from 2000 to 2014, while total vanadium showed a stable trend from 1989 to 2006 and 2000 to 2014 (Glozier et al., 2018; Glozier et al., 2009).

With respect to federal and provincial guideline value exceedances, the key findings from the long-term water monitoring up to 2006 for the Athabasca, Peace, and Slave Rivers, as identified by Glozier et al. (2009), found exceedances of CCME guideline values (for aquatic life) for total metal concentration related to flow rate changes. The authors also note total phosphorus and nitrogen showed exceedances to Alberta guideline values in the Athabasca River, however site-specific objectives for three parameters (dissolved oxygen, sulphate, total dissolved solids) developed under the Northern River Systems Initiative (NREI) were met within the expected frequency. Later, Glozier et al. (2018) report, in PAD tributaries from 2011 to 2014, “evaluation of the data against 39 water quality guidelines revealed that nineteen of the parameters showed no values above guidelines (i.e., no exceedances). Some metals (namely iron and aluminum) commonly (>75%) showed values higher than the guideline, particularly during periods of high suspended sediment concentrations. Total mercury samples showed occasional (<6%) exceedances but, similar to total metals, these values were associated with high suspended sediment values” (p. iv). The authors further stated “site specific guidelines may be more appropriate

and provide a better warning of changes to water quality, particularly for parameters which are associated with the commonly occurring high suspended sediments” (Glozier et al., 2018, p. iv).

PAHs and PACs in the Athabasca River and the PAD

PAHs (a subclass of PACs) are released from a variety of sources in the Lower Athabasca river basin, including natural releases from oil sands deposits and extraction and upgrading of oil sands, as well as forest fires, urban runoff, and deposition from long-range, atmospheric transport from urban and industrial activities (Ohiozebau et al., 2016). As Dolgova et al. (2018) note “the Athabasca River is a significant source of water and sediment to the PAD, and therefore, is important in terms of regulating possible riverine transport of contaminants to the delta” (p. 15). Several researchers specifically attribute increases in PACs and PAHs in the Athabasca River to oil sands and other industrial and municipal development in the region. Kelly et al. (2009) found “dissolved PAC concentrations in tributaries to the Athabasca (River) increased from 0.009 µg/L upstream of oil sands development to 0.023 µg/L in winter and to 0.202 µg/L in summer downstream. In the Athabasca (River), (total) dissolved PAC concentrations were mostly <0.025 µg/L in winter and 0.030 µg/L in summer, except near oil sands upgrading facilities and tailings ponds in winter (0.031–0.083 µg/L) and downstream of new development in summer (0.063–0.135 µg/L)” (p. 22346). Similarly, Kurek et al. (2013) studied six lakes in the Athabasca oil sands region, reporting “PAHs within lake sediments, particularly C1–C4–alkylated PAHs, increased significantly after development of the bitumen resource began, followed by significant increases in dibenzothiophenes” and “PAH ratios indicate temporal shifts from primarily wood combustion to petrogenic sources that coincide with greater oil sands development” (p. 1).

In addition to monitoring surface water quality in tributaries that drain into the PAD, the Mikisew Cree First Nation’s Community Based Monitoring Program characterizes PAHs at various surface water locations in the PAD (MCFN, 2015). The report characterizes both alkylated petroleum derived PAHs (indicative of bitumen upgrading and oil sands sources) and parent, non-alkylated PAHs associated with wood combustion (most likely a reflection of forest fire activity and/or residential wood burning). The author reports “sites in the Athabasca River, at the mouth of the Athabasca River, and the Quatres Fourches sites are influenced by petroleum derived PAHs” and added “PAHs were found far downstream the Athabasca River at two sites inside the Peace-Athabasca Delta and Wood Buffalo National Park” (p. 5). The report notes, however “levels of PAHs in the PAD are lower than those found throughout the Athabasca River (with the exception at the mouth of the Athabasca River site)”. MCFN (2015) further notes the “Quatres Fourches and the Athabasca River mouth were the only two sites in the PAD where this (petroleum-derived) fingerprint was detected. At these two sites, PAHs reflect an oil sands influence. However, at every other site in the PAD, detected PAHs are suggesting a wood and coal combustion input. These patterns are in accordance with forest fire activity in the region, the use of wood for residential heating, and the fact that the Quatres Fourches and the Athabasca River mouth sites were more closely connected to the Athabasca River, so subject to the influence of any PAHs from the oil sands flowing down river” (p. 23). Continued monitoring of PAHs at Quatres Fourches and mouth of the Athabasca reveals slight elevations (non-significant) in PAH concentrations (MCFN and ACFN, 2017b). Jautzy et al. (2015a) also report an increase in (specifically oil sands derived) PAH concentrations in a lake from the Athabasca sector of the PAD situated ~150 km downstream of mining operations. More recently, and as shown in Figure 5-10. Glozier et al. (2018) found measurable concentrations of PACs

(specifically C4-Phenanthrenes/Anthracenes) in the Athabasca River at the southeast tip of the WBNP (M9) that retained the oil sands chemical fingerprint. Also, the authors also found EGA (expanded geographical area) “tributaries within the PAD (Richardson, Quatre Fourches, and Birch rivers) also contained measurable concentrations of PACs” (p. 37), although PACs were non-detectable in two PAD wetland sites. It is interesting to note, however, what appear to be ‘background’ levels of PACs in areas where oil sands mining is not taking place. As shown in Figure 5-10, the Peace River station (M12) and a station on the Athabasca River far upstream of Fort McMurray (M0) also show detectable concentrations of PACs, which could likely be considered background or control locations for future comparison of monitoring results.

In summary, the Athabasca River and certain sections of the PAD have experienced an increasing trend in concentrations of magnesium, sodium, dissolved aluminum, total selenium, dissolved iron, and dissolved arsenic, as well as PAHs and PACs (Glozier et al., 2018). Elevated PAC concentrations retaining an oil sands chemical signature were found in the lower reaches of the Athabasca River near the southeastern tip of the WBNP and the Richardson, Quatre Fourches, and Birch Rivers (tributary EMP sites) also showed slightly elevated PAC levels in comparison to background values (Glozier et al., 2018). Elevated PAH levels were also found in at least one PAD lake (Jautzy et al., 2015a). As a result, the overall trend of the Athabasca water quality is decreasing.

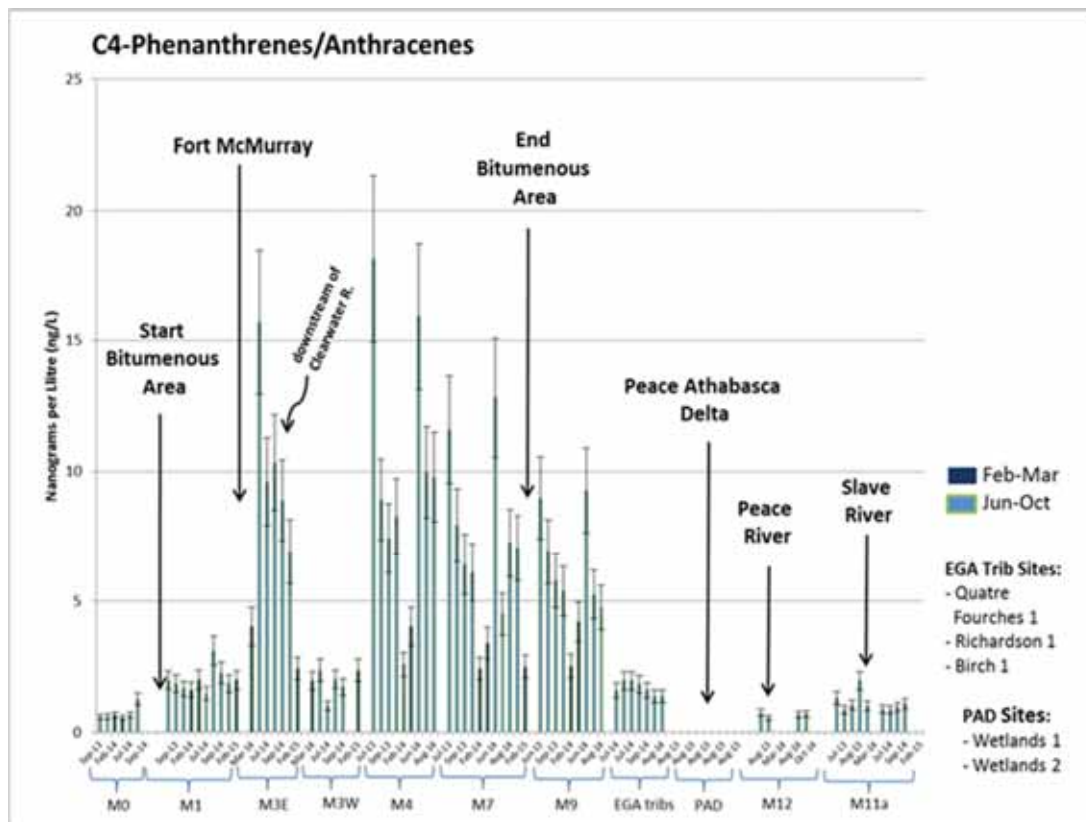


Figure 5-10: Concentration of C4-Phenanthrenes/Anthracenes (ng/L) From 2013 to 2015 at Eight Main Stem Sites, M0 Through M11A, Tributaries and Wetlands in the Peace-Athabasca Delta (PAD) (Glozier et al., 2018)

Notes: EGA: Expanded Geographical Area.

5.5.5 Stressors in the Athabasca River

While changes to water quality have been seen in the Athabasca River over time, it appears researchers cannot clearly attribute those changes to specific types of development. For example, Davidson and Hurley (2007) note it was unclear if the water quality decreased in the Athabasca River are due to oil sands mining activity. Hebben (2009) indicated the upward nutrient and metal trends in the Athabasca River may be linked to lower flow rates, which would increase the concentrations from point source pollutants (such as municipal wastewater treatments plants and pulp mills). Additionally, the authors note that the trend “may be linked to basin development and anthropogenic disturbance. Agriculture, forestry and resource extraction activities, for example, could contribute to higher levels of nutrients and metals in non-point source runoff” (Hebben, 2009, p. 15). Timoney (2013) also reports the primary source of increases in nutrients in the Athabasca River are “probably pulp mills, municipal discharges, and the bitumen industry” (p. 431). Further, Glozier et al. (2009) attribute increases in TP in the PAD to “many cumulative inputs, including 10 pulp mills which have been discharging effluent into these rivers since 1957, a large growth in municipal population, particularly in Grande Prairie and Fort McMurray, as well as the activities surrounding the oil sands which can also contribute to nutrient loadings in the Athabasca River” (p. 68).

Other researchers report water quality changes associated with specific types of development on the Athabasca River, including the oil sands and agriculture. Kelly et al. (2010) report water quality effects resulting from oil sands development in the PAD, reporting “at sites downstream of development and within the Athabasca Delta, concentrations of 11 (metals, including antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, thallium, and zinc...were) greater than upstream of development” and indicated that “Canada’s or Alberta’s guidelines for the protection of aquatic life were exceeded for seven metals, including cadmium, copper, lead, mercury, nickel, silver, and zinc in melted snow and/or water collected near or downstream of development” (p. 16178). The same authors note “concentrations of some metals at one location in Lake Athabasca near Fort Chipewyan were also greater than concentrations in the Athabasca River upstream of development” (Kelly et al., 2010, p. 16178).

More recently, Culp (2016) notes municipal effluents, urban runoff, camp effluent, and land clearing for oil sands operations have contributed to increased nutrients (N and P) in the lower Athabasca River. The author also reports that pre-mining land clearing and oil sands operations have contributed to increased PACs and metals in the lower Athabasca River (Culp, 2016). In addition, Shotyk et al. (2017) report “vanadium, nickel, molybdenum, and rhenium concentrations were all significantly ($p < 0.05$) greater downstream of industry” (p. 660) in the Athabasca River. Further, Alexander and Chambers (2016) compiled a 38-year dataset (1972 to 2010) to evaluate changes in water chemistry over time due to oil sands mining activities. They demonstrated that concentrations of the three focal elements (dissolved selenium, dissolved arsenic, total vanadium) and 17 other variables either associated with bitumen or consider priority pollutants were significantly greater post oil sands development compared to reference values, and were typically greatest during the early exploration and land clearing stage of mine development. These changes could not be attributed to bitumen-bearing geologic formation or natural background. The authors concluded that erosion and subsequent runoff associated with land clearing, construction, and early operational activities have affected water quality in the oil sands region.

Glozier et al. (2018), however, state “for several major ions and dissolved metals which displayed increasing trends at M9 (the southeast tip of the WBNP), results were similar when we examined trends at other sites in northern areas of Canada not directly downstream of the OSMA (oil sands mineable area). As such, the increasing trends reported may have a broader regional pattern and are thus not likely directly related to upstream oil sands activities” (p. iv). The same authors also note all major ions, nutrients, mercury, and metals, except Se, had consistent concentrations along the Athabasca River from upstream of major oil sands developments to the southeast tip of the WBNP (Glozier et al., 2018). The authors concluded “spatial patterns (other than for dissolved selenium) that were observed were attributed to changes in non-oil sands related inputs, such as municipal or other industrial inputs, or differences in geological sources” (Glozier et al., 2018, p. ii). Further, Kirk et al. (2014) also report “in the Peace Athabasca Delta, both (mercury and methyl mercury) were near background levels” in snowpack (p. 7) and Shotyk et al. (2017) note “concentrations of silver, cadmium, lead, antimony, and thallium were extremely low, not significantly more abundant downstream of industry and probably reflect ‘background’ values” in the Athabasca River (p. 660).

5.5.6 Trends in Lake Athabasca

The Eastern Athabasca Regional Monitoring Program (EARMP) monitored long-term changes in the aquatic environment far downstream of uranium mining and milling operations in the Eastern Athabasca region of northern Saskatchewan from 2011 to 2015. CanNorth reports “water chemistry, sediment chemistry, benthic invertebrate community, and fish tissue chemistry endpoints were assessed against the baseline monitoring period data, available guidelines, and the reference range to establish if endpoints are currently within expected background levels of the region” (p. vii). The author notes “with few exceptions, endpoints were found to be similar to baseline, below guidelines, and/or within the reference range” (CanNorth, 2016, p. vii).

Smithson (1993) studied radionuclide concentrations (lead-210, polonium-210, radium-226, and thorium isotopes) in northern pike, lake whitefish, white suckers, and longnose suckers in western Lake Athabasca as part of the northern river basins study (NRBS). Radioisotope levels were very low and consumption of these fish were determined to pose no health risk.

5.5.7 Trends in the Slave River

As illustrated in Table 5-2, the JOSM results indicate concentrations of most relevant parameters of interest in the Slave River are reportedly exhibiting either stable or decreasing trends. Concentrations of dissolved phosphorus, total phosphorus, and sulfate reportedly showed an increasing trend from 1989 to 2010, but showed a stable trend from 1997 to 2006 (Glozier et al., 2018; Glozier et al., 2009). Parameters such as dissolved nitrogen and chloride showed a decreasing trend from 1989 to 2006, while magnesium, sodium, and ammonia showed a stable trend over the same time period (Glozier et al., 2018; Glozier et al., 2009). Concentrations of total dissolved solids showed a stable trend from 1989 to 2006 and decreased over the 1997 to 2006 time period (Glozier et al., 2018; Glozier et al., 2009). From 1990 to 2010, dissolved phosphorus, sulfate, and dissolved sodium concentrations reportedly increased, while total dissolved solids, total aluminum, molybdenum, and chromium concentrations decreased (Sanderson et al., 2013).

For the Slave River, polychlorinated biphenyls (PCBs), PAHs, and others were either not found or found at levels below the below CCME guidelines for the protection of aquatic life (measured at Fort Smith, NWT) (Sanderson et al., 2012). Glozier et al. (2018) found detectable concentrations of PACs in the Slave River (as shown in Figure 5-10); however, the levels appear similar to background.

5.6 SEDIMENTATION AND SEDIMENT QUALITY

A number of researchers have reported changes to the fluvial geomorphology and sediment transport regime in the PAD resulting from flow rate changes on the Peace River due to regulation (Culp, 2016; Eaton and Church, 2015; Carver, 2013; Prowse and Conly, 1996; Wrona et al., 1996). In 1996, Wrona et al. report that due to regulation on the Peace, “the physical structure of the delta and mainstem has been changed by the formation of new sand bars and related habitat” (p. 39). More specifically, they note “the erosional force of the Peace River...has been reduced as a result of changes in flow regime...(causing) increased sediment deposition, channel narrowing, abandonment of secondary channels, and in-channel shoaling. Sand and silt deposit along channel edges and former back-channels now provide new habitat for semi- aquatic shoreline and riparian vegetation” (Wrona et al., 1996, p. 10). Prowse and Conly (1996) also report “the sediment load at Fitzgerald (Slave River) has decreased by almost one-half after regulation (of the Peace River) for the open-water period, with the most pronounced changes being during the main flow months of June and July...due to the reduction in peak flows during this period” (p. 98).

More recently, Carver (2013) further reports that regulation causes “reduced capacity of the river to transport the sediment load delivered to it by the tributaries and the valley sidewalls. This diminished competence is expected to aggrade the channel and limit its ability to transport its bed material. Over long periods, Peace River is developing a new morphology...making the ice jam mechanism less likely through time” (p. 27). In 2013, Candler et al. note “the blue, clear ice that used to form on the Peace is (now) thinner and full of sediment, making the ice weaker and melt faster which prevents the ice jams from forming” (2013a, p. 8). More recently, the Firelight Group et al. (2018) report both flow regulation and weirs are impacting sedimentation levels in the PAD. They note “in particular, MCFN members have observed the build-up of sediment from weirs and increased sediment in the Peace River during winter freeze up. Secondary effects include negative changes to fish spawning, as well as sediment-loaded ice, which is lower quality and faster melting” (p. 4-5).

Several scientists also report high levels of contaminants in sediments in PAD water bodies from a number of sources (Evans et al., 2016; Kelly et al., 2009; Timoney, 2007; Wrona et al., 1996). Wrona et al. (1996) report “higher levels of PCBs, CL-RAs (chlorinated resin acids) and PAHs were found in (the sediments of) the Peace River upstream of the confluence of the Smoky River” (p. 16). Timoney (2007) further reports “constituents of concern (in PAD sediments) include arsenic, cadmium, a variety of PAHs, and resin acids” (p. 69) and notes that “the majority of the Athabasca River Delta, one-half of the Athabasca River, and one-third of its western tributaries were characterized by high metal concentrations (and) high PAH concentrations showing little variability” (p. 70). The same author reports “metal levels tend to increase downstream from the Athabasca River mainstem to its delta then to Lake Athabasca as finer-textured suspended sediments carry the metals to areas of deposition” and he further notes that “mercury, cadmium, and arsenic concentrations of all sediment samples exceeded potential effect levels of the Canadian Sediment Guidelines for the Protection of Aquatic Life” in the Slave River

delta (Timoney, 2007, p. 68). Kelly et al. (2009) further note “PAC-contaminated sediments in the Athabasca Delta and Lake Athabasca are consistent with long-range atmospheric and fluvial transport of particulate” from oil sands development (p. 22350). More recently, Evans et al. (2016) report that total PAH and DBT concentrations in surface sediments were generally low and have declined over time in the lower Athabasca River, but have increased over time in the Athabasca River Delta portion of the PAD.

On the other hand, several researchers have found PAD sediments are not affected by contaminants from the oil sands. Hall et al. (2012b) report “the Athabasca Delta has been a natural repository of PACs carried by the Athabasca River for at least the past two centuries. We detect no measurable increase in the concentration and proportion of river-transported bitumen-associated indicator PACs in sediments deposited in a flood-prone lake since onset of oil sands development” (p. 1). Evans et al. (2002) also note “there is little or no evidence of temporal trends of increasing PAH concentrations in sediment cores collected in Lake Athabasca and the Athabasca Delta lakes, suggesting no or minimal effect from the oil sands operations. Some PAHs exceed interim sediment quality guidelines and some bioassay studies have shown evidence of toxicity, particularly in the Athabasca Delta. However, there is no evidence that this is associated with the oil sands industry”, possibly reflecting the natural erosion of bitumen deposits by the Athabasca River and its many tributaries (p. 365). In addition, Wiklund et al. (2014) report “little to no evidence of pollution by the oil sands development in downstream surficial bottom sediments of the Athabasca River” at sites located 200 km downstream of oil sands facilities (p. 4).

As described in the above paragraphs, the current trend for sedimentation in the Peace River is downward (i.e. sedimentation in the Peace River is increasing due to the reduced erosional force of the river resulting from changes in flow regime). However, given the differences regarding the current state of sediment quality in the PAD, the trend for sediment quality is considered unknown.

5.7 AIR QUALITY

An AEP air quality station in Fort Chipewyan, located on the shore of Lake Athabasca, measures sulfur dioxide (SO₂), oxides of nitrogen (NO_x), nitrogen dioxide (NO₂), ozone (O₃), and fine particulate matter (PM_{2.5}) (WBEA, 2018). Together, they comprise the Air Quality Health Index (AQHI). As noted by Parks Canada (2009), “an index of zero to 25 indicates good air quality, 26 to 50 is fair, 51 to 100 is poor, and more than 100 is very poor” and “between November 2000 and August 2008, air quality was reported as good 75 to 90% of the time” (p. 25). Parks Canada also report “there was an obvious seasonal trend where air quality was good over the winter, good or fair in early summer and improved again in fall. The air quality index was poor less than 0.2 per cent of the time (<20 hours a year). Brief periods of poor air quality index occurred in June and July. At this time of year, higher levels of particles and ozone are associated with poor index ratings. Likely sources of these pollutants include industrial activity and forest fires” (p. 25). In addition, air quality monitoring data for the Fort Chipewyan station showed no exceedances to Alberta Ambient Air Quality Objectives (AAAQO) for nitrogen dioxide (NO₂) and sulphur dioxide (SO₂) from 2012 to 2015 (Adams and Wentworth, 2015).

Indigenous Knowledge holders also report impacts to air quality as a result of industrial impacts surrounding WBNP. Local Indigenous people who live in Fort Chipewyan and in the southern PAD report experiencing ongoing air quality impacts and in particular, the “oil sands smell” is especially noticeable when southern winds blow up the Athabasca River valley (MCFN, 2018a). Candler et al. (2015b) also report “poor air quality, smoke, and industrial smells from industry perceived as far as Fort Chipewyan when wind is from the south” (p. 44). The authors also note “Mikisew members with cabins near Fort Chipewyan and on Lake Claire indicate that existing levels of oil sand development are already visible at night as a result of a low glow of industrial light visible in the south, and unpleasant smells associated with oil sand production carried on the wind” (Candler et al. 2015b, p. 53).

In summary, both science and ITK have indicated a downward air quality trend resulting from poorer air quality at certain times of the year. This reduced air quality could result in deposition to snow and water within the PAD, as discussed below.

When there is a south wind from industry. We used to smell in March two plants. Now there are more plants so as soon as you get a south wind you can smell a different odor in the air. We see skins of yellow in between snow levels on Lake Claire and a film in between layers of snow.

Quote context: In March when it starts warming up you get a south wind and then you know spring is coming. That is when we get Sulphur and other odors in the air from the tar sands. Now there is more oil plants coming up, and more frequently. Now all through summer we get that smell every time there is a south wind. At night it seems to be mixed with Sulphur, it's the smell of burnt eggs. Whatever is in air falls in the snow, and in water, and accumulates over time. Any odor that is brought in has to have some effects over time on animals, water, snow, and the people that depend and eat animals and drink that water.

Source: Ron Campbell

About Ron Campbell: I was born in Fort Chip. I have and still do spend a lot of time in the delta. I've been trapping muskrats since I was a kid. And I do spring hunts and moose hunting etc. Everything I got was once natural and country food. We spent a lot of time in the bush, and learned about life from the traditional users.

5.7.1 Air Deposition of Contaminants

As noted by Kirk et al. (2014) “chemicals in snowpacks enter terrestrial and aquatic ecosystems at spring snowmelt, where they may impact biological communities in the Athabasca River basin” (p. 7381). The authors report low levels of spring-time snowpack THg (total mercury) concentrations at nine sites in the PAD, ranging from 0.95 to 1.43 ng/L, with an average of 1.19 ng/L, and note “the guideline for AI was exceeded at 8 of the 9 distal sites in the PAD” (p. 7381). The authors also found MeHg (methylmercury) “results just above the method detection limit of 0.015 ng/L in the PAD and at several distal sites (average = 0.016 ± 0.002 ng/L in the PAD)” (Kirk et al., 2014, p.7378).

Due to the potential for long-range atmospheric transport of contaminants, such as PAHs, from the oil sands region to the PAD, several studies researching the geographical extent of air deposition of contaminants from the oil sands region were examined. Manzano et al. (2017) studied air, snow, and lake sediment deposition of PAHs in the oil sands development region. They report while “heterocyclic aromatics diminished with distance, some were detected at large distances (>100 km) in snow and surface lake sediments, suggesting that the impact of industry can extend >50 km” (p. 5445). The northernmost site in the study was near Fort McKay, located less than 125 km from the southeast extent of the WBNP and 150 km from the PAD. Kirk et al. (2014) add “given that snowpacks provide a direct measure of atmospheric deposition, these results suggest that oil sands developments are a source of airborne THg and MeHg emissions to local landscapes and water bodies” (p. 7378). The authors did note, however “further work linking snowpack loadings to hydrology is needed to determine the relative importance of atmospheric deposition in driving observed trends in river water contaminant concentrations” (Kirk et al., 2014, p. 7382).

Kirk et al. (2014) and a growing number of other recent peer reviewed studies (Willis et al. 2018, Cooke et al. 2017, Landis et al. 2017, Manzano et al. 2016, Landis et al. 2012) demonstrate that the numerous toxic metals and PACs are currently deposited within 50-75 km of the major oil sands developments and that these contaminants originate from bitumen upgrading facilities and fugitive dusts originating from a number of sources, including open pit mines, tailings ponds, and haul roads. Currently, the authors suggest that metals and PACs deposition in the PAD are near background levels. However, these studies strongly imply that new oil sands developments, including upgrading facilities, open pit mines, new roads, and tailings ponds will generate metals and PACs emissions that will only be deposited to the landscape within 50-75 km of these new developments.

Other air quality studies indicate impacts from oil sands development resulting from acidic deposition, such as potential critical load exceedances. ECCC’s air quality prediction model was used to predict ecosystem impacts in northern Alberta and Saskatchewan, including parts of the WBNP region (Makar et al., 2018). Model runs for August 2013 through July 2014 predicted the exceedances of critical loads for sulphur, and for sulphur plus nitrogen, for a variety of ecosystems (forest, terrestrial, and aquatic ecosystems) in different parts of Alberta, Saskatchewan and the southern Northwest Territories. The model predictions showed how emissions of sulphur and nitrogen-containing compounds can be carried far downwind from the sources, chemically transformed en-route, and deposited, causing potential ecosystem damage. These model simulations also predicted critical load exceedances within the WBNP for: (a) terrestrial ecosystems, along the south-western border, (b) aquatic ecosystems with respect to sulphur deposition, in the park’s south and south-western portions, and (c) aquatic ecosystems in

throughout much of the park. Further, satellite measurements were used to gather information about air pollutants, which indicated background levels for NO₂ in WBNP, except for the south-eastern boundary region.

On the other hand, Cooke et al. (2017) report “no evidence that oil sands emissions have resulted in trace element deposition beyond 50 km, and Hg deposition appears to be reflective of global-scale patterns in atmospheric Hg emissions” (p. 8). Similarly, Wiklund et al. (2012) note “although Pb and Hg currently remain above background levels, decreasing trends during the period of increasing oil sands production similarly imply that this industry is not a major far-field source of airborne Pb and Hg” (p. 381). The same authors also point out “no measurable evidence of related far-field airborne metal contamination in the Peace–Athabasca Delta, located ~200 km to the north (of industry)” and add “current industrial emissions from the Alberta oil sands are not measurably increasing airborne Sb and As to the delta” (Wiklund et al., 2012, p. 381). More recently, Parrott et al. (2018) report “aerial deposition of fugitive dust particles and aerosols from oil sands mines, coke piles, and stacks can result in snowmelt that is toxic to larval fish”, however they add “the dilution of the contaminants in snow as it melts in the spring and mixes with river water is currently sufficient to confer a protective effect for larval fish in local rivers” (p. 272-273).

5.8 GROUNDWATER IN THE LOWER ATHABASCA RIVER BASIN

The municipal, agricultural, and industrial use of groundwater in the province of Alberta is governed by the provincial *Water Act* (through the issuance of water allocation licenses) and industrial activities that may impact groundwater are assessed as part of Alberta’s *Environmental Protection and Enhancement Act* (Government of Alberta, 2012). In 2012, the Government of Alberta established a groundwater management framework for both the Northern Athabasca Oil Sands area (NAOS - north of Fort McMurray) and Southern Athabasca Oil Sands area (SAOS - south of Fort McMurray) as part of the Lower Athabasca Regional Plan (LARP) (Government of Alberta, 2012). The PAD is located approximately 100 km north of the northernmost boundary of the NAOS area. No groundwater quantity or quality information could be found for the PAD itself.

Groundwater conditions have been monitored in the lower Athabasca region for the last 20 to 30 years, including monitoring at individual oil sands facilities and as part of the Groundwater Observation Well Network (GOWN) (Government of Alberta, 2012). For the NAOS, the Groundwater Management Framework report “no significant trends in key indicators have been recorded since initial sampling in 1975”, noting “there is poor to fair knowledge of groundwater quality in the surficial sands and buried channels within the NAOS area as well as the Basal McMurray area” (Government of Alberta, 2012, p. 20). For the SAOS, it was determined “groundwater quality conditions in the various key aquifers beneath the SAOS area is limited both from a temporal and spatial perspective” (Government of Alberta, 2012, p. 21).

The Groundwater Management Framework outlined a number of challenges to groundwater management in both the NAOS and SAOS areas from oil sands mining, as well as other activities, such as municipal development, agriculture, forestry, aggregate mining, and natural phenomenon. Activities that may negatively affect groundwater in the region include the following (from Government of Alberta, 2012):

- Physical disturbance of the landscape and alteration to natural drainage and recharge patterns from conventional oil sand mining activities.
- Drawdown effects from dewatering of overburden aquifers and bedrock formations to facilitate safe, conventional oil sands mine development.
- Potential seepage of contaminants from conventional oil sands process waste containment structures (tailings ponds, tailings impoundments).
- Leaching of contaminants from conventional oil sands mining overburden waste dumps and material stockpiles.
- Pressure effects and contaminant migration following deep well injection of oil sands depressurization water and process wastewater.
- Spills and leaks of chemicals and hydrocarbons at processing facilities and active conventional oil sands mining areas.
- Disruption and creation of pathways to groundwater from in-situ oil sands extraction activities;
- Release of production fluids from casing failures or annual leakage from in-situ oil sands extraction activities.
- Spills, leaks, and uncontrolled releases of chemicals and hydrocarbons from in-situ oil sands extraction activities.
- Natural discharge of saline waters from bedrock formations into local water bodies and aquifers.
- Leaching of hydrocarbons, salts, and trace elements from exposed bedrock formations and muskeg deposits into local water bodies.
- Leaching of hydrocarbons, salts, and trace elements to the local groundwater from segments of oil sands deposited within the overburden deposits, and from buried channels eroding into underlying oil sands deposits.
- Leaching of pesticide and fertilizer residues into shallow aquifers.
- Upstream oil and gas activity (effects of gas production on the Cretaceous bedrock aquifer water levels).
- Effects of natural disturbance such as forest fires and climate variability on regional groundwater levels and quality.
- Natural climate cycles affecting basin hydrology and groundwater levels.

5.8.1 Groundwater Quality

As noted by Droppo et al. (2011), “the most significant groundwater quality issue associated with oil sands development relates to the seepage of OSPW (oil sands process-affected water) from the tailings ponds that are distributed throughout the region” (p. 40). The authors further report “the main stem of the Athabasca seems to have relatively small groundwater inputs...however, tributaries such as the Clearwater, Steepbank and Firebag Rivers appear to have intermediate to high groundwater inputs, suggesting that they may be more vulnerable to groundwater changes associated with oil sands developments (e.g. seepage from tailings facilities) than the main stem” (Droppo et al., 2011, p. 39).

Frank et al. (2014) sampled groundwater near several tailings ponds in the Athabasca oil sands region, suggesting “oil sands process-affected groundwater (OSPW) is reaching the Athabasca River system” (p. 2660). Oiffer et al. (2009) examined a tailings pond groundwater plume in a shallow sand aquifer, reporting elevated levels of HCO_3 , SO_4 , Na, and Cl, as well as NA (naphthenic acid) persistence. Ferguson et al. (2009) also studied a large tailings impoundment (pond) in the Athabasca oil sands. The authors report tailings ponds are intrinsically permeable structures with the potential to contaminate surface and groundwater. However, they note the hydraulic barrier formed by the thick layer of fine sediment tailings at the base of the pond restricted seepage into the foundation of the pond, which, in combination with a collection and recirculation system for seepage water from the dykes (pond walls), significantly reduced the potential for process-affected water to enter the river system (Ferguson et al., 2009). The authors further concluded “the potential for flow of tailings process water into the foundation and river initially appeared to be high; however, more detailed analysis revealed that hydraulic barriers to process water flow existed within the system” (p. 1458). Ferguson et al. (2009) did note, however, “although this helped reduce the fluxes observed through the foundation and into the drains, it has resulted in a long-term environmental concern, as this water and fine tailings will have to be managed and eventually reclaimed” (p. 1459, Ferguson et al., 2009).

5.8.2 Groundwater Quantity

As part of the LARP groundwater management framework developed by the Government of Alberta in 2012, the available drawdown estimated in the various aquifers in the lower Athabasca region was assessed as substantial (Government of Alberta, 2013). Further, for the NAOS “initial high-level estimates of groundwater volumes and recharge in the Lower Athabasca Region suggest a significant and sufficient volume to accommodate the current level of development and water use. However, additional data is required from future monitoring and assessment initiatives to refine these estimates and help facilitate future determination of sustainable yields for the regional aquifers in the NAOS area” (Government of Alberta, 2012, p. 20).

In 2007, Davidson and Hurley report “only three of the major oil sands projects were operating in 2005, including Suncor, Syncrude and Albion Sands. These three projects are allowed to withdraw up to 191,375 dam³ from the Athabasca River, 9,015 dam³ from tributaries, 8,932 dam³ from groundwater, and 20,124 dam³ from surface water run-off” (p. 3). In 2011, eight industrial bodies held groundwater withdrawal licenses of greater than 1,000 dam³/year in the Fort McMurray and Fort McKay regions (Hatfield, 2011). However, it is unclear what the allocation of groundwater resources are in the oil sands currently and what proportion of the total water allocation for oil sands activities may be.

Given the limited knowledge regarding the current state of groundwater quantity and quality in the PAD, the trend is considered unknown.

5.9 IMPACTS ON INDIGENOUS WAYS OF LIFE

Indigenous Knowledge holders emphatically assert that to the people who were born there and live on the land, the PAD is not simply a place, it is who they are (MCFN, 2018a). The local Indigenous people are intricately tied to the land and they remember how the PAD used to be. They have seen dramatic drops in water levels in the PAD over the past forty plus years. As the water levels go down and the PAD becomes drier, both the natural environment and their Indigenous way of life are being impacted, as they are inseparable. Everything is connected: water, vegetation, insects, frogs, fish, birds, beavers, muskrats, bison, wolf, moose and the Indigenous way of life. The people identify themselves as part of the land. They are connected to it physically and spiritually.

A large body of relevant literature reviewed indicates that the decreasing trends in water levels and water quality in the PAD are negatively affecting muskrat populations, vegetation, fish communities, water birds, and ultimately, local Indigenous communities. In 1972, the PAD Project Group predicted that the continued regulation of the Peace River would result in effects involving a redistribution of the PAD's plant communities, as well as a decrease in muskrat populations and waterfowl production, thereby affecting the Indigenous peoples who hunt and fish in the PAD, as well as present and future generations of the Canadian public (The PAD Project Group, 1972).

This prediction is supported by more recent research that reports "drying of the delta results in shifting vegetation with less grass and more willow, increased sand bars and islands in the Peace River, and drying of wetlands and muskegs well back from the main course of the river, especially those that depend on seasonal flooding for renewal. Drying results in less habitat for muskrat, waterfowl, and other species, reduced ability to travel or hunt in the delta, and changes in other resources and parameters critical to MCFN use" (Candler, 2013b, p. 20). Wiacek and Westworth (1999) also note "drying of perched basins has negatively affected populations of waterfowl, muskrats, and other wetland wildlife on the delta" (p. 1). More recently, the Firelight Group et al. (2018) report "MCFN members have observed a number of secondary effects related to declining water levels and changes in the pattern of flows, including expansion of invasive species, expansion of willows and trees into former flood maintained grasslands, loss of biodiversity, loss of perched basins, reduced water quality, decline in migratory bird presence, decline in muskrat populations, decreased quality of semi-aquatic mammal fur, disruption of bison-wolf relationships, loss of access, and overall impairment of MCFN way of life" (p. 4). Further, Indigenous Knowledge holders emphasize they no longer hear or see insects, frogs, or song birds (MCFN, 2018a).

5.9.1 Sufficient Water for Indigenous People to Navigate Safely in the Exercise of Their Treaty and Aboriginal Rights

As noted by Carver and Maclean (2016), “the waterbodies within the PAD provide critical access to Indigenous territory for the ACFN and MCFN” (p. 16) and boat access is the preferred means by which MCFN members choose to exercise rights such as hunting, trapping, and fishing, mainly due to MCFN member’s familiarity with water navigation for subsistence and their water-based knowledge (Candler et al., 2010). Frequent transportation routes, as used by ACFN and MCFN members, are shown in Figure 5-11.

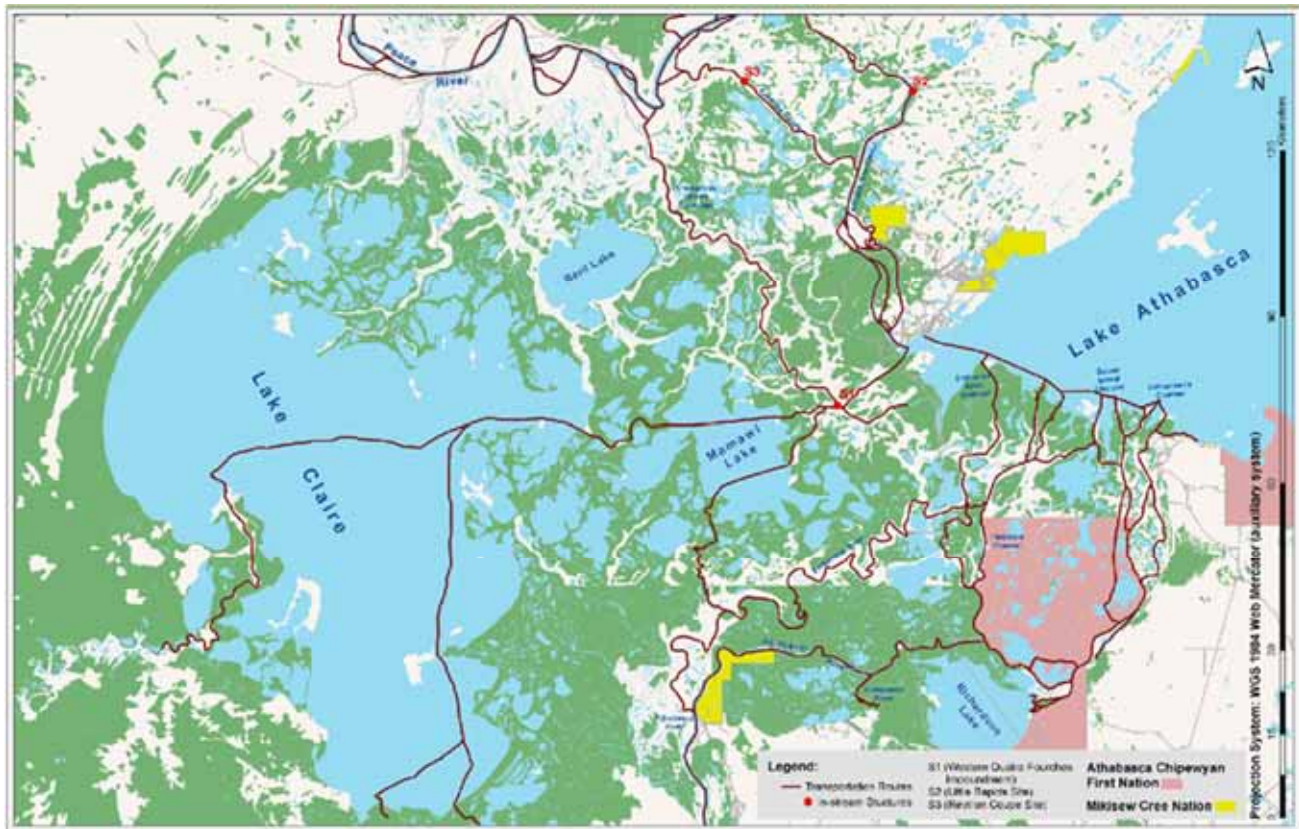


Figure 5-11: Frequent Transportation Routes, as Used by ACFN and MCFN, and Structures Constructed Within Selected Reversing Channels (Carver and Maclean, 2016)

Notes: Red dots S2 and S3 show weir locations, S1 no longer exists.

Local Indigenous people report serious difficulties in accessing traditional lands resulting from lower water levels in the PAD, and Indigenous Knowledge holders report it is now impossible to reach some areas of the PAD by boat (MCFN, 2018a, 2018b; ACFN, 2018a). The best hunting locations tend to be those accessible by boat alongside channels, tributaries, and on the far side of islands away from the main channel because large game like to be near lakes and creeks, but tend to avoid the main channels of large rivers. However, “these smaller channels and tributaries are especially vulnerable to loss of access due to low water levels” (Candler et al., 2010, p. 14). As a result, lower water levels in Lake Athabasca and other PAD lakes have led to “lost access to traditional Use Areas for hunting, fishing, collecting, spiritual use” in the PAD (Maclean, 2016, p. 3).

The MCFN report “low water levels have depleted local waterways to the point that they are no longer traversable. Few waterways can be traveled; those that are still useable for transportation are so low that community members frequently encounter travel delays as a result of impediments such as sandbars” (MSES, 2010, p. 17). The MCFN also note “it’s difficult to fish, trap, hunt, pick berries, enjoy the land, and visit spiritually important places because lower water levels often make it impossible to travel” (MCFN, 2016a, p. 22). Further, Candler et al. (2010) report low water levels on Richardson River, Jackfish Creek, Richardson Lake, Lake Mamawi, and Lake Claire, are creating access issues, thereby preventing local Indigenous people from practicing their trapping, hunting, fishing and cultural rights. Figure 5-12 below shows the areas of the PAD that have become inaccessible to boats during low water levels.

If the water levels in Lake Mamawi go as low as a foot of water or lower, we can’t access our territory because people in Fort Chip have outboard motors with props, so need at least 2 ft. of water to get across Mamawi to Claire Lake. So low water really limits travel to access our traditional territory. In the summer months, Lake Mamawi is a gateway those rivers. If it’s low, the gate is closed for us to pick eggs, fish, hunt, and teach our youth. Sometimes water levels are so low the ice freezes right to the bottom at Lake Mamawi that the fish run out of oxygen and there are fish kills.

Quote Context: *It seems like all our concerns, and everyone’s concerns are all intertwined. There are less frequent floods. The ice is different, it’s not as thick. We used to get flooding every 3 to 6 years before the Bennet Dam and now its way far in between. Its 20 years in between floods now. Lake Mamawi is an example. When we go to hunt or trap our traditional food, it’s like a gateway to the delta where you have to pass in summer months by outboard motor. If it doesn’t flood we get really drying trends and can’t even access our traditional area as water is so low. There are years where my uncle and I had to literally jump in water and push our boat for 3km to get to Lake Mamawi. And you try to go out for weekend, loaded with gas, drinking water, and you have to get in water and push boat 3 kms. That wastes one day right there. Those kinds of things affect our way of life and impact our social and mental well-being! We can’t access our traditional food, our healthy food. The biggest thing to rectify the problem or save part of the delta in PAD area, we have to get our water back!*

Source: Ron Campbell

About Ron Campbell: *I was born in Fort Chip. I have and still do spend a lot of time in the delta. I’ve been trapping muskrats since I was a kid. And I do spring hunts and moose hunting etc. Everything I got was once natural and country food. We spent a lot of time in the bush, and learned about life from the traditional users.*

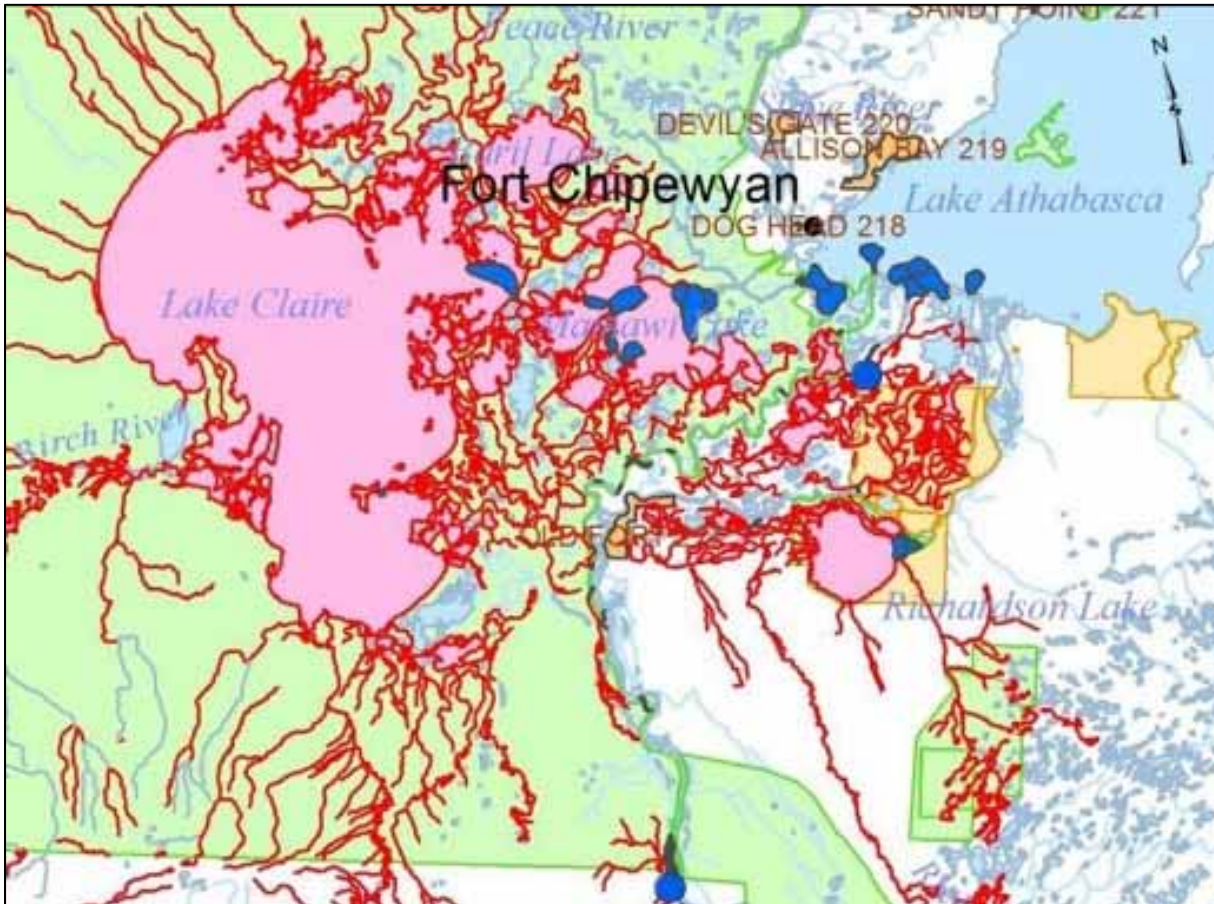


Figure 5-12: PAD Areas with no Boat Access at Extreme Low Water Levels (from Candler et al., 2010)

(Notes: Red represents areas with no access at flows <400 m³/s in to the PAD)

Indigenous Knowledge holders indicate when water levels are too low, the PAD lakes and channels become inaccessible and the people cannot reach their traditional lands to hunt, fish, trap, and collect eggs and plants because their boats get stuck in the shallow water and mud (MCFN, 2018a, 2018b). This forces them to find other ways to get to their lands, such as walking, buying expensive equipment for their boats, or taking much longer routes to get to their land (if they can find another access route), which requires more money, time, and effort. When a strong wind blows from the East, the water level in Prairie River (the main access point to Lake Claire) decreases even further and the boats get stuck.

Indigenous Knowledge holders also report if they cannot access their lands at all, they are forced to concentrate their activities and to hunt and trap on other's land (MCFN, 2018a, 2018b; ACFN, 2018a). Traditional family lands have been handed down from generation to generation and they are integral to the identity of those families. Having to ask to hunt and trap on someone else's land can be humiliating and demoralizing. Some people are too proud to ask to hunt on someone else's land, while others have had to abandon the cabins in their traditional territory and build cabins in other areas that are accessible. If the people do end up hunting and trapping on someone else's land, they don't know the land like they know their own and it's harder to be successful. It can also be more dangerous and stressful.

Indigenous Knowledge holders also note if the people cannot access their land, they cannot exercise their treaty rights (MCFN, 2018a). If they catch a moose when they are out on the land, they cannot easily transport it back home because it weighs down the boat and they have even more trouble traversing the low waters of the PAD. The meat could go bad in the process of trying to get boats unstuck, which is stressful to hunters. The outboard motors on their boats need at least two feet of water to operate properly and often there is not enough water to run the motor. Many expensive motors are destroyed trying to get through waterways filled with mud and weeds and sometimes people are stuck for hours before they free themselves.

Perhaps most importantly, Indigenous Knowledge holders report a loss of culture and transfer of knowledge resulting from reduced access to traditional lands in the PAD (MCFN, 2018a). The Cree language is connected to the land itself and it is place-based. When on traditional lands, stories and legends are told to children in the native language to teach them lessons and explain culture and history. The local people connect the language to the place and the activities they are doing. The place-based stories and knowledge are lost if the people cannot access their traditional lands because there are different stories told in different areas of the PAD.

Access Issues Related to Weirs

Carver and Maclean (2016) note two weirs installed in the 1970s on the Rivière des Rochers and Revillon Coupé are also creating access and navigation issues for the local Indigenous people (shown as S2 and S3, respectively, in and MCFN members, are shown in 11). In particular, Carver and Maclean (2016) note the channel at the north end of the Rivière des Rochers weir is “too shallow at many times of the year to provide safe passage” and the Revillon Coupé weir “remains a serious barrier to navigation at low-to-medium flows and expert knowledge of the river is needed to safely pass through the weir” (p. 17).

Access Issues Specifically Related to the Athabasca River

Dredging occurred on the Athabasca River between 1945 and 1996 to facilitate commercial barge traffic. Dredging in summer until September or water levels fell, they created a channel 60 m wide and 1.2 m deep. Dredging occurred for different periods of time on Big Point Channel, Fisherman’s Channel, Goose Island Channel and the Athabasca River between the delta and Fort McMurray (Timoney, 2013).

More recently, since dredging ceased, changes to flow rates in the Athabasca River are preventing Indigenous people from accessing their traditional lands in and around the PAD (Carver and Maclean, 2016; Candler et al., 2010). Candler et al. (2010) report several local Indigenous groups (including the ACFN and MCFN) either had difficulty accessing or could not access their traditional lands because the low water levels on the Athabasca River created sand bars and log jams and exposed rocks and other hazards for boats. This results in increased travel time and expense, damaged boats, engines and equipment, and reduced ability for local Indigenous people to live, hunt and fish on traditional lands, thus preventing them from exercising their Treaty rights by water. Carver and Maclean (2016) monitored water flow and depth in the PAD from 2011 to 2015, reporting “extensive losses of traditional use during the five-year monitoring period” due to declining water depths throughout the PAD (p. 8). The authors attribute this decline mainly to lowered incoming flows from the Athabasca River, especially in the southern PAD and, to a lesser extent, Lake Mamawi, which is particularly evident during fall hunting

season, when “a general average flow decline of 100-200 m³/s is evident” in the Athabasca River (Carver and Maclean, 2016, p. 19).

Candler et al. (2010) defines Aboriginal Base Flow (ABF) as a minimum flow rate that “reflects a level on the Athabasca River and adjacent streams where MCFN members are able to practice their rights, and access their territories fully”, while Aboriginal Extreme Flow (AXF) “reflects a level at which widespread and extreme disruption of Treaty and Indigenous rights occurs along the Athabasca river, delta, and tributaries due to a loss of access related to low waters” (Candler et al., 2010, p. 24). As shown in Figure 5-13, weekly average flow rates on the Athabasca River are consistently below the ABF. Flow rates are also below the AXF in spring and approaching the AXF in fall. Additionally, instantaneous flows can occur that are much lower than the weekly average flows. As noted by Carver and Maclean (2016), this presents substantial difficulties for Indigenous people in accessing traditional lands during early spring (generally weeks 16 to 20) and fall hunting season (generally weeks 39 to 43).

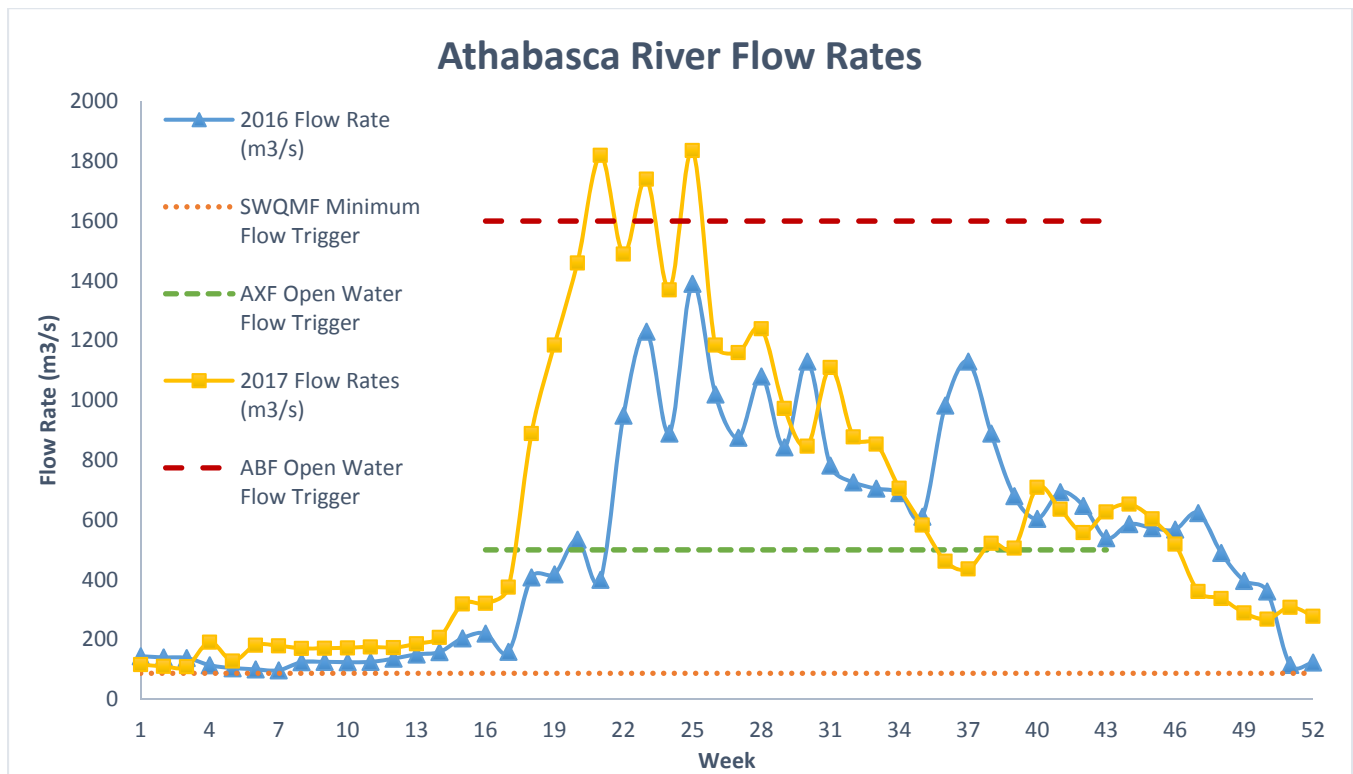


Figure 5-13: Weekly Athabasca River Flow Rates for 2016 and 2017¹

¹ (2017, flow rates and SWQMF trigger from <http://www.environment.alberta.ca/apps/OSEM/ATHMCM.aspx>; ABF and AXF open water flow discharge thresholds from Carver and Maclean, 2016) (Notes: winter weeks 44 to 15, spring weeks 16 to 23, summer weeks 24 to 38, fall weeks 39 to 43, open water season from weeks 16 to 43)

Access Issues Related to Winter Water Levels

Indigenous Knowledge holders also describe considerable difficulties in accessing traditional lands due to higher winter flows on the Peace River (MCFN, 2018a, 2018b; ACFN, 2018). The winter water releases degrade the ramps from the river onto the winter road, which is both a lifeline to other communities in the north, as well as a key way the local people access the land. The overflow affects snowmobile and vehicle access to the road for several weeks to a month. The winter releases decrease the quality and thickness of ice on the river by adding dirty water (with sediment) on top of ice that has already formed. The ice is no longer pure. The darker color of the sediment in the new ice layer promotes melting from the sun. This melting ice sinks into the ice layer below and creates holes in the ice (“candle ice”), as well as poor quality, slushy ice. People can get trapped in this ice and they cannot access their traditional lands because the ice will not support the weight of the snowmobiles. There are also open water areas on the Athabasca River during the winter due to water discharges from industry, which are thought to result from increased temperatures and/or contaminants in the discharge water, further reducing access to back channels on the river (ACFN, 2018).

Increased winter water levels and changes to the ice composition and quality have also made winter travel increasingly unpredictable for MCFN members, impairing their ability to access their traditional lands and to pass on ITK to the younger generation. Candler et al. (2013a) report “the high waters from the springtime flood are critical in order to create the ice jams and damming in the winter. Since the Bennett dam, ice quality and quantity has significantly decreased and made access and travel to lands difficult and increasingly dangerous” (p. 8). Candler et al. (2013b) further note “overflow in the winter on the Peace and adjacent creeks makes it impossible to use snowmobiles at key places, such as creek crossings, and dangerous or impossible to travel on the Peace River ice in particular locations, including near Rocky Point and Peace Point rapids, due to weak ice and persistent open water” (p. 5). More recently, the Firelight Group et al. (2018) reported “effects observed by MCFN members related to declining ice jam frequency include unpredictable flooding and ice melt in winter, low quality candle ice, silty or dirty ice, rapid melting in spring, and absence of jamming at key locations including the 30th Baseline and at Rocky Point. These changes have created unpredictable flooding and ice melts which results in loss of reliable access for MCFN members and land users, as well as inability to teach youth on the land and pass on MCFN knowledge to younger generations” (p. 3).

Métis Local 125 (2018b) based in Fort Chipewyan also reported challenges with winter access noting: “the increasing difficulty of travel in the PAD in winter and ... specifically on the thin and changing ice, from too many contaminants in the water, and the different pressure, which is why it drops so easy. The shore ice is gone, so you have to get to the center ice channels. It is tough to cross Mamawi and get around Lake Claire.”

The difficulties in accessing traditional lands and preferred harvest areas during the winter also has social and economic impacts on local Indigenous people. Candler et al. (2013b) note “changes in ice quality, including increasing sediment in Peace River ice, and winter releases of water (especially in November)...reduce the chance of ice damming and create dangerous conditions for travel by MCFN members that restricts access to traplines, sometimes destroys traps where these are set on the Peace River or nearby creeks or rivers, and kills or disturbs animal dens, especially muskrat and beaver” (p. 22). Further, Candler et al. (2013b) also report “we have records where we have had to close the road

because the water came up. As Indigenous people, we never saw water come up in the winter. That's human caused[d], that's man cause[d], to get their power, so we have to close our road. It's just a headache in itself [for] getting groceries and living our lifestyle and getting parts for our snowmobiles and for our traps, it gives us a headache...Not only is it just the delta, it affects us socially as well." (p. 6).

5.10 MUSKRAT AND BEAVER

As noted by Candler et al. (2015b), "trapping (of muskrat) is important for social, economic, spiritual and other purposes. MCFN members rely on family trapping areas as a refuge for a wide range of cultural activities" (p. 114). Muskrat habitat preferences are mainly based on water depth and "high spring and summer water levels are important for maintaining adequate habitat for breeding and overwinter survival" (Hood et al., 2009, p. 27). The habitat provided by perched basins in the PAD is also of great importance to muskrats, as Hood et al. (2009) pointed out "of 9,071 ha classified and mapped on 24 study basins within Wood Buffalo National Park (1978 to 1979), perched basins accounted for 27.3% of the area, but contained 64.2% of the muskrat houses" (p. 26).

Indigenous Knowledge holders describe drastic reductions in muskrat populations in the PAD due to the lack of flooding and encroachment of invasive plant species (MCFN, 2018b; ACFN, 2018a). A favourite food source for muskrat (and other animals and birds in the PAD) is "goose grass", however it requires 2 to 5 feet of water to grow in. As the water levels go down and dryness is sustained, the goose grass, also known as joint grass, water horsetail, or river horsetail (*Equisetum fluviatile*), is replaced by thistle, willow, and poplar. This is disrupting the food chain because goose grass is a favourite food source for muskrat, bison, and migratory waterfowl. If the goose grass is gone, the animals either starve or go somewhere else.

In 1996, Bill et al. report "reduced flow patterns of the rivers forming the Peace-Athabasca Delta are attributed as the cause for significant reductions in muskrat populations over the past twenty years, but most noticeably in the last ten years" (p. 332). More recently, Straka et al. (2018) report "Elders and Indigenous land-users in the PAD have observed a dramatic decline in relative abundance of muskrat in recent decades (~1935-2014)...(due to) reduction in suitable habitat as a result of decades without ice jam flooding on the Peace River" (p. 3). The same authors also note "delta lakes formerly supporting high densities of wildlife, including muskrat, are now dry (p. 39) and the Indian Claims Commission (1998) indicated "muskrat have declined substantially since the operation of the Bennett dam" (p. 49).

My father said it used to flood every 3 or 4 years. Old water would get washed out and always fresh water from the Peace River, muskrats lots! A chain reaction: muskrats, otter, to wolves and buffalo. Now less animals because the rats are gone so that chain reaction is broken! Water is not as good as back then. Something has to be done.

Quote context: All the lakes that would get replenished every few years, that hasn't been going on now. Now water is stale. The muskrats are not there anymore. Where there were once lakes is dried up. There are no more muskrats. Without water you have no muskrats. You need water for all animals from the mice up to the buffalo! It's a chain reaction! In the old days 300k muskrats were trapped in the delta and PAD. That is in the written history. Today not even a 100. Usually I get a few, this year I got nothing. It's the same with beavers. There is one lake where I always found a few beaver, that lake is now dried up and the beaver left. What needs to be done, first of all water is #1.

Source: Gerald Gibot

McLachlan (2016) further report there were “muskrats, years ago, in the 70s. Even early 70s and 60s. There were lots of muskrat around this area. People used to kill 3000 or 4000 rats in a trapping season. I guess the reason there was lots of rats in those days was there was lots of water. Water was high. Always water out in the lakes and ponds and that. Lots of muskrats all over. Once the water started going down, once the water dropped. Every year after the Bennett Dam, the water is worse than ever. Now there’s no muskrats anymore. They’re gone” (p. 31). Finally, the MCFN (2016b) report “we have no muskrats, they just disappear. Nowhere to live, no water, and no feed. You’ve got to have water in order for the proper grass to grow for the muskrats to survive with in the lakes, ponds, lakes or where, and sloughs. But now...after the Bennett Dam, the delta is dried up where there used to be 3-4 feet of water” (p. 32).



Swimming muskrat. Photo: Tom Koemer, US Fish and Wildlife Service

Indigenous knowledge holders indicate winter releases of water on the Peace River raise winter ice levels in the PAD, drowning muskrat and beavers where they have made their homes (MCFN, 2018a, 2018b). UNESCO (2017) also reports wildlife effects from increased winter flows resulting from regulation of the Peace River, noting “beavers build a house when (the) river is low in October. Now Bennett releases water in November, around November 20. That water flows over the beaver lodges and they’re forced out in search of warmth and food. They usually starve and freeze” (p. 74). In addition, the MCFN (2016b) report “because of hydro dams, more water is released in the winter, and less in the spring, causing problems with ice formation, making the rivers dangerous for humans, and causing animals to freeze or drown, including beavers and muskrats” (p. 22).

5.11 VEGETATION AND INVASIVE SPECIES

Lower water levels in the PAD are reportedly causing increases in vegetation cover and invasive species over time, along with a decrease in the availability of traditional plants and berries. Parks Canada (2009) report a “loss of flooded vegetation, in-growth of willows, and an increase in invasive plant species, primarily in the Peace sector of the delta” (p. 22) from 1996 to 2008, however they also note a great deal

Since 1974, the water has gone down and down so for the buffalo there isn’t the vegetation they live on. The thistle is taking over the whole delta on account of there being no water.

Quote context: From 1974 the water dropped. There are trees now growing in the lakes. If there is water the thistle doesn’t grow. Where it doesn’t flood there is thistle. Lower in the bay there is nothing. Thistle doesn’t grow in wet ground, only where it is dry. Thistle came in 96-97. That is when it really picked up. There was a bit starting before that but not as bad. Now it’s really dry! It’s hard to walk around.

Source: Larry Marten

About Larry Marten: I am 65. I quit school in 1966. That is when I started trapping. Prior to that as a kid was out there every spring with my parents. We lived out there because it’s our livelihood. When I quit school, then I was trapping every year, every winter and spring. In summer time I had summer work. I am still a trapper.

of variability within vegetative communities across the PAD. Indigenous Knowledge holders emphatically stress water levels in the PAD are lower than they should be (MCFN, 2017a, 2018a, 2018b; ACFN, 2018a; Métis Local 125, 2018 a,c). As a result, the water levels in the lakes and channels are too low and more land around the edges is exposed or completely dried out. In addition, the low water levels in the lakes and channels are also causing invasive plant species to replace traditional plants and medicines that are harvested by the people. The plants are becoming harder to find and the Traditional Knowledge of how to harvest and use the plants is being lost.



In 1996, Bill et al. reported “stabilization of the flows of these major rivers (Athabasca and Peace) is considered by those having Traditional Knowledge of the region as contributing to a reduction in the productivity of the lands that were historically flooded and marked encroachment of plant species that are not tolerant to flooding” (p. 327). The ACFN and MCFN (2010) also report, since the last major flood in 1974, “many perched basins are disappearing and two (Egg Lake and Pushup Lake) have disappeared. Willows and other vegetation are encroaching on wetlands. These changes have an effect on the number of species and the population of species (plant and animal) that ACFN members harvest” (p. 27). More recently, the MCFN report “Mikisew members have observed an increase in thistle populations when flooding events are infrequent” (MCFN, 2016b, p. 33) and UNESCO reports “willows are invading because the water is too low”, “...there are too many willows”, and “all the healthy vegetation is gone” (p. 73). Similarly Fort Chipewyan Métis Council 125 reported (Métis Local 125, 2018b) “The plains are described as filling up with willow and poplar because there is no water. Willow is filling in dried areas which when grow tall obscure landmarks for land users. Thistle chokes out feed for bison and keeps them north because they cannot get past it. It is a natural barrier.”

The ACFN and the MCFN (2010) also report that “changing moisture regimes and flooding cycles alter plant communities in traditional plant collection areas” due to declining water levels in the Athabasca River and Lake Athabasca (p.23). In the PAD itself, the MCFN (2016b) note “our berries and medicines are absent or poor quality in places where they were previously abundant (especially wetland areas)” (p. 22) and Candler et al. (2015b) report “reduced water levels in the PAD and along the Athabasca River are report to have resulted in berry patches ‘drying out’ with smaller and less abundant fruit” (p. 112). Further, the Indian Claims Commission (1998) report “changes in vegetation as a result of the drying out of the Athabasca Delta has led to reduced availability of some medicinal and food plants for the Chipewyan people, as well as reductions in the availability of productive wetland and meadow habitats and ecosystem integrity” (p. 50). Candler et al. (2015b) note “drying of muskegs and the Athabasca River mean that muskrat and many important species of plants are now often rare or hard to find” (p. 87).

5.12 MIGRATORY WATERFOWL

Migratory waterfowl are also discussed in Section 4.4. Impacts to migratory waterfowl creates challenges for Indigenous communities. As noted by Candler et al. (2015b) “migratory birds, especially ducks and

geese, use the Athabasca River, wider PAD, and inland lakes as staging areas in the spring and fall as they move between more southern ranges and the Athabasca Delta or other nesting and summering areas further to the north” (p. 104). This movement of migratory waterfowl along the Athabasca River and through the PAD “supports spring and fall bird hunts of critical importance to MCFN for social, economic, cultural, spiritual and other purposes” (Candler et al., 2015b, p. 104). However, “in recent years (since about 2000), MCFN knowledge holders have observed changes in the patterns of migratory birds, including ducks and geese, with fewer birds travelling the Athabasca River corridor, and more travelling east and west around Oil Sand mine areas. Fewer birds are flying along migration routes near the Athabasca River and more are bypassing the Peace-Athabasca Delta, possibly to avoid impacts from oil sands development, including pollution and bird deterrent systems, and because of reducing feeding habitat due to low water levels in the PAD” (Candler et al., 2015b, p. 105).

Indigenous Knowledge holders note less water in the PAD means fewer birds (MCFN, 2018a, 2018b; ACFN, 2018a). There are far fewer owls, yellow rails, blackbirds, seagulls, American coots (mud hens), whiskey jacks, ducks, and geese than there used to be. The birds also land in places where they did not before. Migratory waterfowl that used to land and feed in the PAD by the thousands are not coming anymore. Instead of stopping in the PAD, they are either flying right over it or going around it to other areas to rest and feed.

The Firelight Group et al. (2018) note reductions in the quantity of migratory waterfowl utilizing WBNP and the availability of quality migratory habitat. The authors further report “observed trends include the declining number of eggs per nest and declining condition of migratory birds during harvest. The absence of migratory bird and the decline of preferred bird species impacts the important spring and fall harvest periods, as well as MCFN member’s sense of place and their ability to teach younger generations on the land” (Firelight Group et al., 2018, p. 6-7). Indigenous Knowledge holders have heard geese and ducks flying overhead during the spring and fall migrations, but they no longer stop in the PAD in the same numbers as they used to. Instead, the birds stay for a shorter period of time or fly around the PAD all together (MCFN, 2018b; ACFN, 2018a). Since there are fewer birds in the PAD to hunt, local Indigenous people are no longer able to provide as much food for their families. Where hunters used to get 60 birds in a few hours, now they get only around 10 birds and it takes all day to get them. ECCC, as part of the Joint Review Panel for Shell’s Jackpine Mine project, note the shifting patterns in waterfowl migration pathways and comment “the migration routes of birds may be changing and this change could affect the availability of these birds in the PAD” (AER and CEAA, 2013, p. 161). However, ECCC also note that the cause of the changes in migration routes were not clear and more study is required (AER and CEAA, 2013).

With regard to reductions in water bird populations due to reduced water levels in the PAD, Bill et al. (1996) report “migratory bird use of the PAD is also considered to be much reduced for both breeding and staging during the spring and fall migrations...the reduction in use of this area is believed to be caused by reduced water levels” (p. 333). MCFN (2016b) also report “now you don’t even see half the waterfowl you used to see years ago. There’s places where they used to do their nesting laying eggs, they don’t do that, they can’t, there’s nothing there it’s all dry...The migratory birds for one thing there’s nowhere near what used to fly over here. In the fall, like come September, October, well into September I guess the birds going south, you don’t even know when they go by, there gone in a day. Years ago we

used to hunt migratory birds in the spring and in the fall to stock up for the winter like you know bird hunting, now we don't do that because the birds are not there anymore" (p. 34). The MCFN (2016b) also report "the birds, the birds have pretty much changed their fly-way because different vegetation...it's what we see, it's what we know. The ducks have left because there's no water, there's nothing" (p. 33, 34).

With regard to loss of the quantity and quality of natural habitat, Wrona et al. (1996) report "birds have shifted their migratory patterns westward perhaps in response to improved feeding opportunities in the agricultural areas, but also because of the significant reduction in breeding and staging habitat in the delta" (p. 39). The Indian Claims Commission (1998) note "numbers of waterfowl throughout the Athabasca and Peace deltas are believed to have declined as a result of reduced nesting and brood rearing habitat, and the loss of large areas of suitable fall staging habitat" (p. 49). The MCFN and ACFN also report "waterfowl no longer stop on the PAD and Lake Athabasca in the vast numbers that they once did. The decline in waterfowl is, in part, related to reduction in habitat quality incurred as a result of decreasing water flows in the PAD" (MCFN and ACFN, 2010, p. 19).

Bird Eggs

Indigenous Knowledge holders indicate the number, i.e. clutch size (total number of eggs laid per nest by a single female), and quality of bird eggs is also changing (MCFN, 2018a). Where up to 15 eggs were collected from a nest, now there are only about 6 to 8. In addition, up to 1/3 of coot eggs harvested now have two yolks in them, the yolks are darker in colour and they have visible veins on them. Researchers have also investigated mercury levels in bird eggs in the PAD/Lake Athabasca. Hebert et al. (2011) report that mercury levels in gull eggs from Egg Island, Lake Athabasca increased 40% from 1977 to 2009, however the authors note "more research is required to evaluate temporal trends in levels of environmental contaminants and to identify sources" (Hebert et al. 2011, p. 1178).

In 2013, Hebert et al. report that mercury concentrations in gull eggs collected from the PAD and Lake Athabasca in 2012 were statistically greater than levels in eggs collected from earlier years. As part of the ongoing oil sands monitoring program, ECCC and partners continue to study contaminant levels in bird eggs from the PAD (and several other sites). Eggs have been collected annually from 2009-2017 (with the exception of 2010). Through this work, temporal trends in egg mercury levels are becoming clearer. For example, inter-year differences in egg mercury levels are apparent, but there are no clear temporal trends in egg mercury levels. However, recent research (Hebert, 2018, pers.comm.) indicates that annual egg mercury levels are affected by inter-year differences in the flow of the Athabasca River. Hebert et al. (2011, 2013) note that eggs collected from sites in closer proximity to the Athabasca River had greater levels of some contaminants and further commented that "changes in oil sands-related sources of Hg could be responsible for the egg Hg trends described here" (Hebert et al. 2013, p. 11791), but indicated the need for further corroboration of evidence. More recently, Dolgova et al. (2018) compared mercury levels in gull eggs from 12 sites in Alberta, Saskatchewan, and Northwest Territories spanning 14 degrees of latitude. They note that "egg Hg levels were greatest at sites in receiving waters of the Athabasca River", such as Mamawi Lake and Lake Athabasca (Dolgova et al. 2018, abstract), compared to more northerly or southerly sites. All of these egg results taken together provide evidence to support the hypothesis that the Athabasca River is an important source of contaminants, especially mercury, to downstream ecosystems (e.g. the PAD).

In response to the results from the JOSM monitoring program indicating relatively high mercury levels in gull and tern eggs, the Alberta Government issued egg consumption advisories for Lake Athabasca and Mamawi Lake. Alberta's Chief Medical Officer highlighted the fact that "if fish are regularly consumed from these lakes or from lakes where there is a fish consumption advisory in effect, no eggs should be consumed by children or adults" (Government of Alberta, 2014). This essentially precludes egg consumption by consumers of traditional foods because it is highly likely that anyone contemplating the consumption of eggs would also be eating fish.

5.13 BISON AND MOOSE

In brief, a number of researchers and Indigenous groups report the lower bison numbers stem from low water flows and a drying PAD (MCFN, 2017a, 2018a, 2018b; MCFN, 2016b; Candler et al., 2015a; Bill et al., 1996; Wrona et al., 1996). In 1996, Wrona et al. noted "the observed decline of wood bison in the PAD is implicated by the Indigenous people as being a result of drying in the delta" (p. 39). In the same year, Bill et al. (1996) also reported "low water flows are thought to have caused the decline in bison (buffalo) on the Peace-Athabasca Delta" (p. 333). The MCFN (2016b) report "bison are moving away from the Delta because habitat is drying out and being replaced with thistle" (p. 16) and "...buffalos are not around here now. That's because there's no water. They can't eat dried grass. They eat green grass..." (p. 33). Later, Candler et al. (2015a) report "key changes to bison habitat and bison populations in southern WBNP over time. Several MCFN participants indicated that the main herds of bison in the park are moving north. Knowledge holders connected this to a decrease in suitability of habitat south of Lake Claire because of invasive 'cactus like' thistles caused by lower water levels and the lack of seasonal flooding in the Athabasca Delta and especially around the south end of Lake Claire" (p. 32).



More recently, the Firelight Group et al. (2018) report "based on Indigenous knowledge and observation, MCFN members report that key stressors include invasive species (most importantly thistles) colonizing former bison habitat within WBNP, unregulated hunting by sport hunters and outfitters outside WBNP,

Its moose that I am trying to save! A moose has a better chance of surviving over a wolf when there is deep snow as the wolves can't catch up to them. What I am trying to say today, or bring back. Aside to the water, all these other animals. We are losing them.

Quote context: You know, that is true that even the moose are less now. And when we go hunting at Birch River I found out that moose are going away because they have less feed. It's very hard for animals. And the moose are getting skinnier. And the buffalo are going away. If there is no water then there is no grass. If we have no water everything will be gone. If there is no water then there is nothing else. Animals are smart too. Wolves, if they try to jump on them on non-frozen snow they won't reach the moose. If they jump on packed snow, then it's like a spring on hard snow.

Source: Sloan Whiteknife

No water then no willows. Moose won't eat dry willow! It has to be nice AND green. The moose eats another grass in fall where hardly no water. I don't know what it is called hey like it in fall. It's a grinder for the stomach after eating willows. There is no more of that now! All kinds of ways animals know!

Quote context: Like I told you before, the moose won't eat dry willows. Another thing that moose eat in fall, its white stuff like can see it in grass. The moose eats that. In the prairie there is nothing of that so that is why moose left places here. They go further inland as in that muskeg they can eat that and the grass that buffalo like too. I'm pretty sure that is why the buffalo is gone to and moose are starting to leave the area around Birch River as there is better feed in the muskeg.

Quote source: Sloan Whiteknife

About Sloan Whiteknife: I am George Sloan Whiteknife. I was born and raised in the bush. Ever since then I've always been in the bush. I was taught from my dad to trap and to hunting moose, geese etc. I was always with him and he always used to tell me things. I learned quite a bit from my dad in my past life, and my uncles. I went out with all my relations. We need water. When I say something has to be done, I mean we need more water.

as well as anthrax disease, noise disturbance, and climate change. BC Hydro regulation of river flows and low PAD water levels are considered to be primary factors resulting in alteration of bison habitats and decreased habitat suitability. MCFN members note secondary effects of bison decline, including the regulation and restriction of bison harvest by MCFN members and other First Nation and Métis communities, and imbalance of the predator-prey relationship between bison and wolves resulting in more disease within the bison and wolf populations. Reduced bison populations impact the MCFN way of life by reducing food security, altering sense of place, and removing the ability of future generations to hunt and maintain scared relationships through bison harvest" (p. 5-6).

Indigenous Knowledge holders describe a substantial decline in bison numbers in the PAD (MCFN, 2018a, 2018b; ACFN, 2018). The low water levels allow for encroachment of willows and thistle, forcing the bison to leave the PAD. This causes wolves to begin hunting other types of large game, such as moose, which is causing a dramatic reduction in moose numbers in the PAD and in a few other areas of the park (MCFN, 2018b; LRRCN, 2018). Moose inhabit the inland PAD lakes, back channels, and wetland areas in order to find young willows for food and to avoid being hunted by wolves. Due to low water levels, the moose are forced out of these areas and exposed to increased predation by packs of wolves, which are becoming dominant. Several participants also added when they attempt to call moose, they will not come into the area because they can hear the wolves (ACFN, 2018b, MCFN, 2018b). Since moose are a preferred food source for local Indigenous people, the decline of moose is of great concern.

5.14 FISH

As part of the Northern River Basins Study, Wrona et al. (1996) stated “traditional users report a decline in the quantity and quality of fish from the lower Peace and Athabasca Rivers, and from the PAD” attributed to contaminant exposure, a reduction in the availability of critical spawning and rearing habitat (resulting from changes in flow regime and flooding frequency), and/or over-fishing (p. 45). Specific to the Athabasca River, Candler et al. (2010) note that the local Indigenous community has seen a decrease in the Athabasca River water quality with time, including taste, smell, presence of foams and films on the water, and the absence of insects. Later, Candler et al. (2015b) further report Indigenous people’s use of aquatic resources, including fishing, has been impacted along the Athabasca River and into the Athabasca portion of the PAD, including “contaminants, fish deformities, and changes in fish quality and taste” (p. 109). Further, the authors note “current (wildlife) harvest levels have been impacted by industrial change and contaminant concerns, and that existing levels of harvest reflect an unacceptable level of impact on the ability of Mikisew families to rely on lands and waters for subsistence and cultural use. Knowledge holders also indicated concern that, with existing levels of industrial impact and concern, many Mikisew families and young Mikisew members are not able to learn the knowledge and skills necessary to carry on harvesting into the future” (Candler et al., 2015b, p. 95).

Candler et al. (2015b) report “fishing for species including goldeye, jackfish, whitefish, pickerel, suckers, and mariah remains important to many Mikisew members for social, economic, cultural, spiritual and other purposes. When conditions are appropriate, fishing provides a critical and reliable source of protein, especially in the winter and early spring when it’s most needed...(and) in the past, fish were a critical source of food when other kinds of food (e.g. moose, bison, caribou) were scarce” (p. 108). Fish populations and ecology in the PAD, however, are reportedly being affected from low water levels and lack of recharge, and Indigenous Knowledge holders describe numerous instances of recent fish kills in the PAD caused by stagnant water, a lack of oxygen in the water, and lakes freezing right to the bottom (MCFN, 2018b; Métis Local 125, 2017a).

Now we see changed vegetation and oily sheen on lakes on a calm day. When you slide out your fishing nets, there is a different smell from net, deformed fish, spotted fish, heads huge but body is skinny, a lot of deformed fish.

Quote Context: The biggest change I have seen in vegetation is the Canada thistle and sow thistle. Because the delta is so low and dry, this invasive species of grass came in and took over natural native species of grass. No animals feed on it. And the bison, muskrat, moose depend on the vegetation and water. It is changing their routes and migration. In the past the delta and the food was healthy. The fish was healthy. They used to commercial fishing in lake Athabasca, Lake Claire, and the PAD in the 50’s. So there were healthy fish and the market for it was there. Whitefish and Pickerel were fished in Lake Athabasca and Lake Claire. They shut that down. There is no more commercial fishing so that tells me something is happening as well too. The change in fish health as well there, as people are turned away from eating fish from there.

Source: Ron Campbell

About Ron Campbell: I was born in Fort Chip. I have and still do spend a lot of time in the delta. I’ve been trapping muskrats since I was a kid. And I do spring hunts and moose hunting etc. Everything I got was once natural and country food. We spent a lot of time in the bush, and learned about life from the traditional users.

Wrona et al. (1996) report “the drying up of the channels, perched lakes and marshes has directly affected fish ecology: both wintering and spawning habitat have been altered or lost” (p. 39). Loo (2007) also report “fewer channels for Walleye to reach their spawning grounds and for juvenile fish to reach important nursery areas. If they got there, there was often less food available for them, further compromising their survival” (p. 904, citing Green, no date). The MCFN (2016b) also report “the fish, the numbers of fish and that in our areas have dwindled. One of our Elders still has a net out in the traditional land, depends on that, and yet he’s having a hard time getting enough for himself” (p. 33). With regard to siltation and sedimentation effects, the MCFN report “the substantially lowered waters of the Athabasca River results in the build-up of silt that prevents fish from entering Lake Claire and Jackfish Lake to spawn” (MSES, 2010, p. 19). More recently, the MCFN (2016b) also note “some elders have observed that silt is not washed into or through the lakes the same way as pre-regulation which has spillover effects on ice jamming, fish spawning and habitat availability. Some fish (Goldeye) are not able to spawn the same way because channels and lakes have silted in. Lake Mamawi began to silt in, which in turn, impacts the spawning of fish, such as Jackfish, as there are fewer shallows for them to spawn in” (p. 30).

Contaminant and Nutrient Levels

Candler et al. (2015b) report “fish are considered an especially sensitive indicator of the health of an area” (p. 108) and note “Mikisew members have widespread concerns regarding the health of fish, and the safety of eating them. These widespread concerns have resulted in most Mikisew members now limiting or avoiding harvest or consumption of fish from the Athabasca River and many becoming distrustful of fish caught in the wider PAD” (p. 109). However, there is currently no long-term contaminant monitoring program for fish in western Lake Athabasca, Mamawi Lake, or Lake Claire, despite the fact that fish are important in local diets and there has been an intermittent commercial fishery.

A number of researchers also report an increased prevalence of malformations and deformations in fish resulting from water quality changes in the Athabasca River and the PAD (McLachlan, 2016; Maclean, 2016; Timoney, 2013; Candler et al., 2010; Bill et al., 1996). In 1996, Bill et al. reported “in recent years, the jackfish in the Pine Creek area have begun to exhibit wart-like growths and their blood vessels appear more blue (in) colour. Fish livers and intestines historically were eaten regularly by the Indigenous people in the Delta area. However, in recent years, the livers of fish have had spots, growths, and inconsistent colour and the intestines have a very yellow liquid in them. As a result, these parts of the fish are now only rarely eaten by the people in the area” (p. 335-336). More recently, Candler et al. (2010) further observe that the decrease in Athabasca River water quality has resulted in physical abnormalities in hunted game and fish, which has caused loss of subsistence use of the Athabasca River for Indigenous people and Timoney (2013) also reports “increased rates of fish abnormalities have been observed by local fishermen” (p. 432). Maclean (2016) reports “increase(s) in observations of deformed fish” (p. 3) in the PAD. McLachlan (2016) also compiled comments from Traditional Knowledge holders in the PAD, including “I have quit eating fish, I will not eat fish from Lake Athabasca” (p. 32) and note that many Indigenous people in the PAD are worried about environmental contaminants in the traditional foods that they consume.

More recently, as part of the ongoing JOSM program, ECCC (2018) studied contaminant levels in fish in the PAD from 2012 to 2018. Of the 23 fish collected, “55% of them had visible skin and/or liver lesions as well as other physical signs of impaired health” and “pickerel often had the greatest number of malformations and skin lesions, perhaps a reflection of their diet as top carnivores” (p. 2). However, it is unclear if this result is statistically significant due to the small sample size. The Firelight Group et al. (2018) also report a negative trend in quality and quantity of fish in the PAD “related to the decline of water quality and quantity within the PAD resulting from BC Hydro regulation of flow and contamination from upstream development, as well as potential sediment build up around weirs. MCFN members have observed changes in the taste and color of fish, deformities, the inability of fish to access spawning sites due to siltation and low water, and low water level induced fish kills. In addition to deformities and poor taste or texture, there are also concerns for high levels of mercury and other PAD contaminants within fish resulting in avoidance by many MCFN members due to potential contamination and health concerns” (p. 6).

A number of scientists also report increasing contaminant and nutrient levels in fish in the lower Athabasca River and the PAD, such as nitrogen, phosphorus, mercury, PCBs, and PAHs (Dolgova et al., 2018; Baird et al., 2016; Culp, 2016; Ohiozebau et al., 2016; Timoney, 2007; Scheider et al., 1998; Wrona et al., 1996; Suns et al., 1993). Wrona et al. report, from 1977 to 1992, mean total mercury levels in walleye were high in the lower end of the Athabasca River. Timoney (2007) also notes “mercury levels in fish used for human consumption present a serious concern. If US EPA standards are applied, all walleye (pickerel), all female whitefish, and ~90 % of male whitefish exceed subsistence fisher guidelines for mercury consumption” in the lower Athabasca River (p. 4).

Small fish or minnows are good indicators of local contaminant sources (Suns et al., 1993; Scheider et al., 1998). A joint ECCC and Mikisew Cree CBM study of minnows in the Athabasca River (both up and downstream of oil sands surface mines), the PAD, and Lake Athabasca found that mercury levels were highest in fish collected in the Athabasca River immediately downstream of Fort McMurray and oil sands operations, remained somewhat elevated in Mamawi Lake fish, and were lower in Lake Claire and western Lake Athabasca. However, minnows from all of these locations had higher mercury levels than fish from a reference location upstream of Fort McMurray (near Athabasca, AB) on the Athabasca River (Dolgova et al., 2018). The authors note “elevated levels in fish from Mamawi Lake may have reflected that site’s closer connection with the Athabasca River or other processes regulating the bioavailability of mercury at that site, e.g. Hg methylation” (Dolgova et al. 2018, p. 16). In response to increasing mercury levels in fish, the Alberta Government set fish consumption limits for a number of lakes and rivers in Alberta, including the Athabasca River (downstream of Fort McMurray), Lake Athabasca, and Richardson Lake (2018, from <https://mywildalberta.ca/fishing/advisories-closures/documents/FishConsumptionLimitsAlberta-Feb24-2016.pdf>).

In 1996, Wrona et al. reported “anomalously high levels of PCBs were observed in burbot collected...in the Athabasca River downstream of Hinton...and in the Peace River above the confluence of the Smoky” (p.36). More recently, Culp (2016) notes municipal effluents, urban runoff, camp effluent, and land clearing for oil sands operations have contributed to increased nutrients (N and P) in the lower Athabasca River, which have led to increased fish size and body mass index changes in fish. Similarly, Baird et al. (2016) report an increase in condition factor (fish weight), liver size, and PAC levels in fish in the

Athabasca River downstream of oil sands development that may be related to nutrient enrichment and contaminants. Gewurtz et al. (2011) also report Canadian Federal Environmental Quality Guideline exceedances for polybrominated diphenyl ethers (PBDEs) in lake trout from Lake Athabasca, however they note similar exceedances were found in lakes across Canada. More recently, ECCC (2018) report “fish mercury levels were slightly higher in the PAD (at 0.26 ppm on average), but not significantly different than fish collected further south in Lac La Biche, Alberta” (p. 2). In addition, ECCC notes in “2013 minnow samples, mercury levels were higher in fish collected in the surface mineable area of the oil sands in the Athabasca River...(and) levels measured in Mamawi Lake were intermediate” (p. 5).

A number of researchers have found increased PAC and PAH levels in a variety of fish species in the Athabasca River and the PAD. Culp (2016) reports that pre-mining land clearing and oil sands operations have contributed to increased PACs and Ethoxyresorufin-O-deethylase (EROD) activity, a well-established biomarker of fish exposure to certain classes of PAH compounds, in fish in the lower Athabasca River. Ohiozebau et al. (2016, 2017) studied PAH concentrations in Goldeneye, Whitefish, Northern Pike and Burbot species in the Athabasca and Slave Rivers from the summer of 2011 to the spring of 2012, including Fort McMurray, Fort McKay, Fort Chipewyan, Fort Smith, and Fort Resolution. They found measurable concentrations of PAHs (both spatially and temporally) in all of the fish species studied and note “fishes from upstream reaches of the Athabasca River, close to oil sands extraction and upgrading activities, contained greater concentrations of individual PAHs than concentrations in muscle of fishes from further downstream in the Slave River” (2017, p. 1). Ohiozebau et al. (2016) further note “facilities where oil sands are processed are located just upstream from Fort McKay, which could explain why Fort McKay and Fort Chipewyan had greater concentrations of the sum of PBPAHs (products of biotransformation of PAHs) that were studied” (p. 586). However, the authors note, in addition to aerial deposition of PAHs from processing of oil sands, the source of PBPAHs in the study area might also be from municipal runoff effluents, from incomplete combustion of organic matter and fossil fuel, or forest fires (Ohiozebau et al., 2016) and Ohiozebau et al. (2017) further report PAH concentrations in fish in the Athabasca and Slave Rivers are “likely not a health risk to human consumers in the area” (2017, p. 17).

On the other hand, a number of scientists report no evidence that increasing oil sands activity has influenced a detectable increase in PAH and metal concentrations in the PAD and western Lake Athabasca (Hall et al. 2012b, Wiklund et al. 2012, Jautzy et al. 2015b, Evans et al. 2016). In addition, Evans (no date) reports mercury trends in fish in western Lake Athabasca, including in walleye, lake trout, northern pike and burbot, were below commercial sale guidelines and the author further notes “there was no evidence of increasing Hg concentrations with the expansion of the oil sands industry” (p. 1). Further, Evans and Talbot (2012) conducted a review of all available data for mercury in fish from the Athabasca River north of Fort McMurray to the PAD, as well as western Lake Athabasca, concluding there was no evidence that oil sands activities were resulting in increased mercury concentrations in fish. The authors note “while mercury emissions rates have increased with oil sands development and the landscape become more disturbed, mercury concentrations remained low in water and sediments in the Athabasca River and its tributaries and similar to concentrations observed outside the development areas and in earlier decades”, although the authors note future monitoring programs should be more rigorous in their design (Evans and Talbot, 2012, p. 1989).

5.15 CONCLUSIONS

5.15.1 Stressors and Trends

The proceeding sections describe the current state of the PAD system as a result of trends and stressors observed over the past sixty years on various valued components in the PAD, as reported by researchers, scientists, and Indigenous knowledge holders. These results are summarized and presented below in Table 5-3.

Table 5-3: Current Stressors and Trends in the PAD

Valued Component	Current Trends and Stressors in the PAD	Trend Direction
Peace River Seasonal Flows	Seasonal flow rates in the Peace have become much less variable due to flow regulation on the river and (past) climate change, resulting in decreased summer flows and increased winter flows.	
Peace River Sedimentation	Sedimentation in the Peace River is increasing due to the reduced erosional force of the river resulting from changes in flow regime.	
Ice Jam Recharge	Increased winter flows on the Peace River have increased freeze up elevations, resulting in decreased ice jamming flooding frequency, and reduced recharge of perched water basins. Winter releases of water have resulted in poorer quality ice.	
Open Water Recharge	Reduced summer flows in the Peace River and reduced flows in the Athabasca, in combination with (past) climate change, have decreased open water recharge.	
Lake Athabasca Water Levels	Reduced summer flows on the Peace and reduced seasonal flows on the Athabasca have decreased water levels in Lake Athabasca. Weir operation has increased winter water levels and produced a less variable water regime.	
Central PAD Lake Water Levels	Reduced summer flows on the Peace and reduced seasonal flows on the Athabasca, in conjunction with (past) climate change, have decreased water levels and extents.	
Athabasca River Annual & Seasonal Flows	Annual and seasonal flows have declined over the past fifty years due to a combination of water withdrawals and (past) climate change.	
PAD Water Quality	ITK indicates decreased water quality over the long term, while the WQI indicates a consistent 'Fair' trend over the last 6 years.	
Athabasca River Water Quality	Increasing concentrations of magnesium, sodium, dissolved aluminum, total selenium, dissolved iron, dissolved arsenic, and PAHs and PACs have reduced water quality.	
Groundwater Quality & Quantity	Information is limited. It is unclear if groundwater quality and quantity are issues.	?
Air Quality	ITK and science indicate contaminants from industrial sources and forest fires have reduced air quality at certain times of the year.	

Valued Component	Current Trends and Stressors in the PAD	Trend Direction
Sufficient Water for Indigenous People to Navigate Safely in the Exercise of their Treaty & Aboriginal Rights	Winter water releases on the Peace River have resulted in reduced quality and quantity of ice, reducing or eliminating access to areas of the PAD in winter. Lower water levels have reduced or eliminated access to the inland PAD lakes and back channels. Flow rates on the Athabasca River are consistently below the ABF, below the AXF in early spring, and approaching the AXF in fall, preventing and/or limiting access to traditional lands during early spring and fall hunting season.	
Indigenous Access and Enjoyment of the PAD	Decreased quality and quantity of fish, increased exposure to toxins and pathogens, films, and foams on water. Inability to transfer knowledge and skills between generations	
Wildlife Quantity and Habitat	Reduced water levels have caused drastic declines in muskrat populations. Reduced water levels and increased invasive species have caused declines in bison populations. Increased winter water releases have caused decreases in beaver and muskrat populations.	
Migratory Bird Quantity, Quality and Habitat	Lowered water levels have reduced water bird habitat, causing water birds to shift their migratory patterns. Increased mercury levels have been found in bird eggs, resulting in consumption advisories.	
Vegetation Quantity and Quality	Lowered water levels have increased vegetation cover and invasive species, such as thistle and willows. Lowered water levels have reduced availability of medicinal and food plants.	
Fish Quantity, Quality and Habitat	Lowered water levels have reduced fish populations and habitat. Water quality changes have produced malformations and abnormalities and increased contaminant levels in fish. Increased mercury levels have been found in fish, resulting in consumption advisories. Siltation of PAD lakes has affected fish spawning.	

5.15.2 Pathway of Effects

As shown in Table 3-2, the three desired outcomes for the PAD are as follows:

- Flow regimes and water quality into the PAD maintain the ecological function of the ecosystem.
- Flow regimes and water quality into the PAD sustain vegetation communities and healthy and abundant populations of key ecological and cultural species including waterfowl, muskrat, fish, bison and wolves.

- Indigenous groups have access to the PAD and are confident enough in the health of the PAD to maintain traditional use and way of life through hunting, fishing, gathering, and cultural activities.

Based the current trends in the PAD as outlined in Table 5-3, none of the three desired outcomes are currently being achieved and the trend direction is negative. With regard to the desired outcome that flow regimes and water quality into the PAD maintain the ecological function of the ecosystem, the trend direction was based on the valued components of:

- 1) Peace River seasonal flows;
- 2) Peace River sedimentation;
- 3) Ice jam recharge;
- 4) Open water recharge;
- 5) Athabasca River annual and seasonal flows.

The trend direction for all of these valued components is negative, thus the desired outcome is not currently being achieved and the trend direction for the desired outcome is negative.

With regard to the desired outcome that flow regimes and water quality into the PAD sustain vegetation communities and healthy and abundant populations of key ecological and cultural species including waterfowl, muskrat, fish, bison and wolves, the trend direction was based on the valued components of:

- 1) Lake Athabasca water levels;
- 2) Central PAD lake water levels;
- 3) PAD water quality;
- 4) Athabasca River water quality;
- 5) Wildlife quantity and habitat;
- 6) Migratory bird quantity, quality and habitat;
- 7) Vegetation quantity and quality; and
- 8) Fish quantity, quality and habitat.

The trend direction for all, except one mixed trend, of these is negative; thus the desired outcome is not currently being achieved and the trend direction for the desired outcome is negative.

Finally, with regard to the desired outcome that Indigenous groups have access to the PAD and are confident enough in the health of the PAD to maintain traditional use and way of life through hunting, fishing, gathering, and cultural activities, the trend direction was based on the valued components of:

- 1) Sufficient water for Indigenous people to navigate safely in the exercise of their Treaty and Aboriginal rights; and
- 2) The implications of the above desired outcomes not being met result in inadequate resource quantity and quality needed for traditional way of life and Indigenous access and enjoyment of the PAD.

The trend direction for these valued components is negative, thus the desired outcome is not currently being achieved and the trend direction for the desired outcome is negative.

From a holistic systems perspective, the activities and pressures that influence the PAD valued components, along with the resulting effects, are illustrated below in **Figure 5-14**. The overall effect of human activity, such as Peace River regulation, Athabasca River withdrawals, and climate change, influences valued components of the PAD, including Peace River flows, ice jam and open water recharge, and Athabasca River flows and water quality. These changes then affect other PAD valued components, including water levels and extents, sedimentation and sediment quality, and vegetation and habitat, as well as fish, wildlife, and migratory bird populations, all of which impact local Indigenous people's health and welfare and access to traditional lands, and ultimately the world heritage value of the PAD.

Indigenous Knowledge holders underscore the importance of the PAD to their culture and way of life (MCFN, 2018a, 2018b). The people were born on the land and they want to continue to live on the land. Indigenous people are proud of the traditions and culture they have lived for thousands of years. ITK has been passed down from generation to generation, and it is now being lost because the PAD is drying. If people cannot access their traditional lands to hunt, fish, trap, and collect plants, berries, and eggs, they lose their connection to the land and to their culture. For Indigenous people, the land is their school and the Elders are the teachers. They bring their children and grandchildren to their land to teach them the ways of their people. If they cannot access the lands they know intimately and have lived on for many past generations, they cannot pass on important traditions and stories to future generations.

Indigenous Knowledge holders also emphatically stress the PAD needs more water to support life (ACFN, 2018a; MCFN, 2017a, 2018a, 2018b; Métis Local 125, 2017a). The local Indigenous people want a more natural water cycle restored, with more water coming into PAD in the spring and summer and less in the winter, like the natural cycle has always been. If the water comes back, the local people hope the animals, plants, birds, and fish will return and the natural balance of the system will be restored. Then they can continue to live on the land where they are happy, healthy, and proud, and where they can pass their ITK, culture, and identity on to future generations and preserve their homelands and their way of life for the future.

The PAD depends on recharge of its lakes and basins in order to retain its world heritage value as an internationally significant rare and superlative natural phenomenon. Currently, hydrologic recharge in the PAD is decreasing. Without immediate intervention, this trend will likely continue, and the world heritage values of the PAD will be lost.

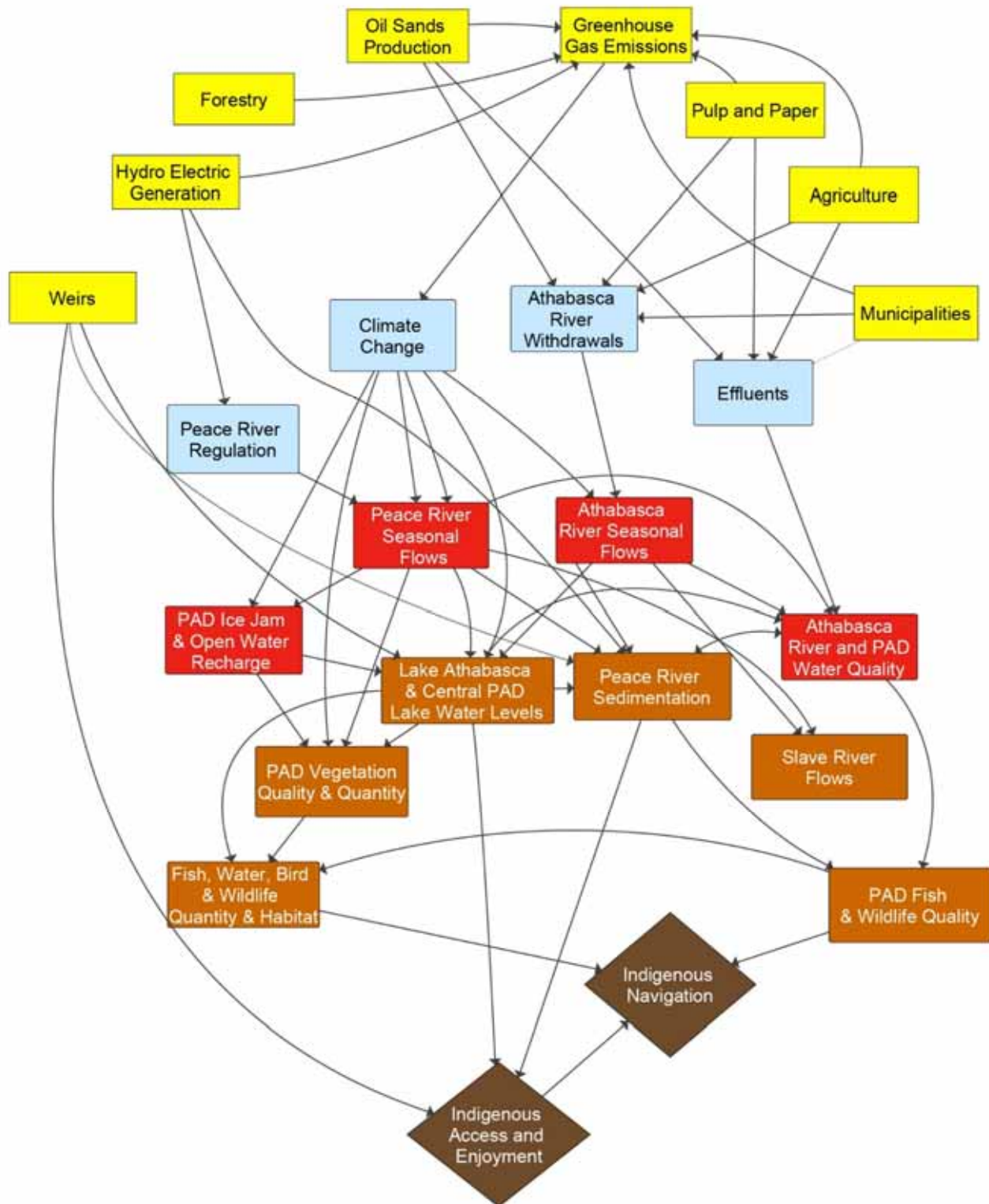


Figure 5-14: Pathways of Effects System Diagram

6.0 CHAPTER 6: CUMULATIVE EFFECTS ASSESSMENT ON THE WORLD HERITAGE VALUES OF THE WBNP

6.1 INTRODUCTION

This chapter considers the future challenges to the world heritage values that industrial development and climate change around WBNP could generate. This chapter begins with identifying existing, proposed and reasonably foreseeable activities that could impact world heritage values. The second section examines predicted impacts of climate change specifically on the PAD. The chapter concludes with a high-level projection of cumulative effects trends that combines both foreseeable industrial development and climate change, in the context of understanding some of the tools intended to manage cumulative effects on the World Heritage Values.

6.2 EXISTING, PROPOSED, AND REASONABLY FORESEEABLE ACTIVITIES WITH THE POTENTIAL TO AFFECT THE WORLD HERITAGE VALUES OF WBNP

In order to assess the effects stemming from future development on the world heritage values of WBNP, the existing, proposed, and reasonably foreseeable future developments in the WBNP area with the potential to affect the world heritage values of the WBNP were identified. As outlined in the SEA scope of work request, relevant development in the region with the potential to impact WBNP includes hydroelectric development and oil sands development, as well as pulp and paper facilities, industrial mines, forestry activities, and municipal development. Relevant information for these projects was then reviewed and compiled, as detailed below.

6.2.1 Hydropower Projects on the Peace River

6.2.1.1 Existing Projects

The WAC Bennett Dam is a 2,730 Megawatt (MW) capacity earth fill dam operating on the Peace River since 1968 and the Peace Canyon Hydroelectric Dam is a 694 MW capacity concrete dam operating since 1980 (2017, from <https://www.bchydro.com/energy-in-bc/operations/our-facilities/peace.html>). The Bennett and Peace Canyon dams are located on the Peace River in northeastern British Columbia, west of Hudson's Hope. The Peace Canyon dam is located 23 km downstream of the Bennett dam on the Peace River. The two hydroelectric facilities have a total capacity of about 3,424 MW and the combined power from the Peace region facilities averages about 17,500 GWh/year (38% of BC Hydro's total 46,000 GWh) (BC Hydro, 2018). The Bennett Dam is one of the world's biggest earth fill dams, standing 183 m (660 ft) high, 800 m wide, and 2 km long (Mackenzie and District Museum, 2016). The spillway capacity of the dam is 9,205 m³/s. The Williston reservoir covers a total area of 1,761 km² (251 km long and 155 km at its widest point), making it the largest lake in British Columbia and the seventh largest reservoir (by volume) in the world. Filling of the reservoir from 1968 to 1971 flooded the Parsnip, Finlay, and Peace River valleys upstream of the dam.

6.2.1.2 Approved Projects

Site C (BC Hydro) is a 1,100 MW capacity earth fill hydroelectric dam currently under construction in British Columbia. As shown by a red arrow in Figure 6-1, it is located 85 km downstream from the Peace

Canyon Dam and approximately 115 km downstream from the W.A.C. Bennett Dam. Site C will be the third dam and generating station on the Peace River in northeast BC and will provide 5,100 GWh of energy each year. Site C “will gain significant efficiencies by taking advantage of water already stored in the Williston Reservoir. This means that Site C will generate approximately 35 per cent of the energy produced at W.A.C. Bennett Dam, with only five per cent of the reservoir area” (Site C Clean Energy Project, 2017).

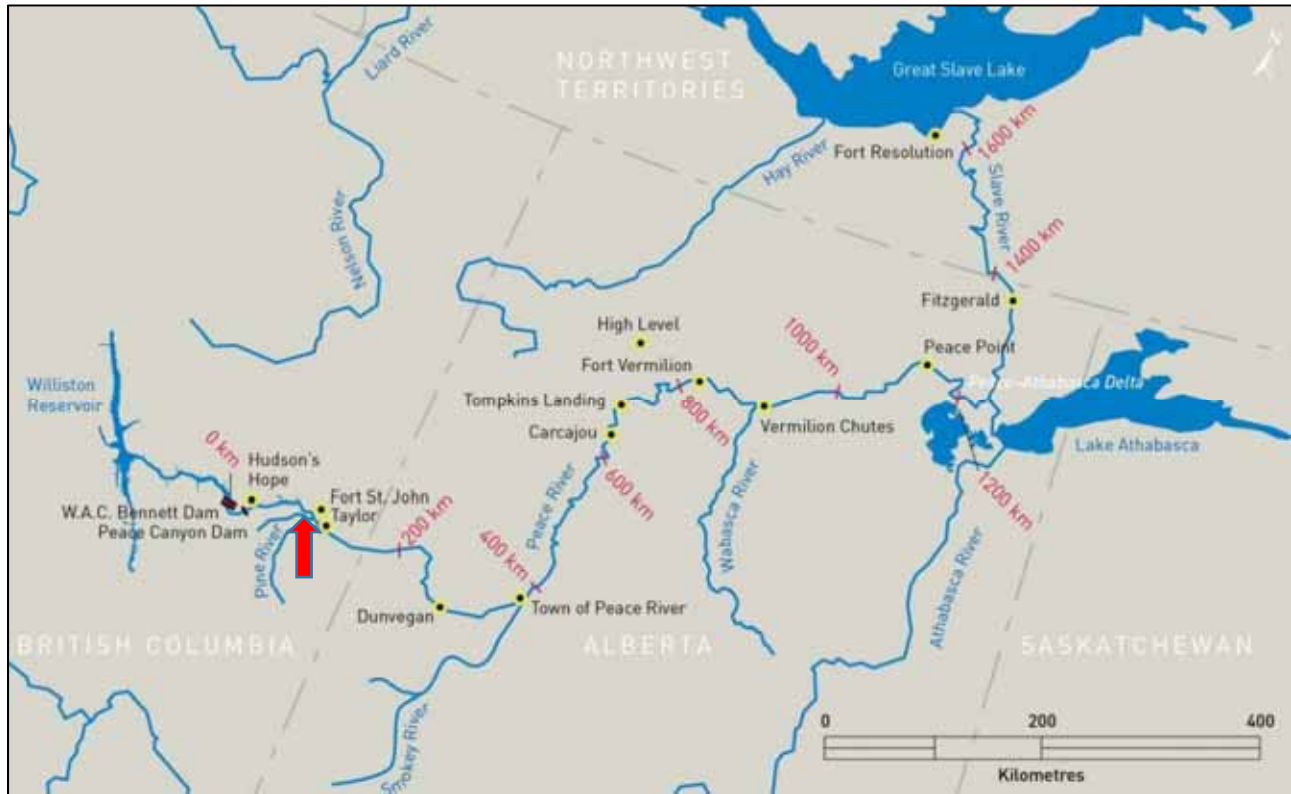


Figure 6-1: Map of the Peace River (BC Hydro, 2016).

Note: The red arrow shows the location of the Site C dam, currently under construction

The Dunvegan Hydroelectric Project (Glacier Power) is a 100 MW capacity run-of-river (ROR) project located near Dunvegan, AB (shown in Figure 6-1). It was approved through the Federal Environmental Assessment process in 2008, but will likely not be constructed due to geotechnical issues with the proposed site location. The proposed project is a low-head, run-of-river hydroelectric development, including a powerhouse, a seven bay control weir, two rock-fill ramp fishways, seven fish sluiceways, and a navigation lock (Northwest Hydraulic Consultants, 2018).

6.2.1.3 Reasonably Foreseeable Projects

The Amisk Hydroelectric Project (Concord Green Energy) is a 370 MW capacity run-of-river project near Dunvegan, AB. The Federal government has referred the proposed project to an independent review panel and an Environmental Impact Statement is not expected until 2020. The consideration of the potential effects of the project on the world heritage of the park, including the PAD, will be considered

in the assessment. The Amisk facility is proposing to operate with a limited extent of active storage (i.e., less than 48 hours retention time in the reservoir, which is a slower and deeper upstream section of water created by the presence of the hydroelectric facility). The head pond would extend roughly 77 km upstream. The water level at the dam would be raised approximately 24 m by the structure and river flows would pass through powerhouses equipped with turbine units to generate electricity, or released through a spillway during times of high water flow (Amisk Hydroelectric Project, 2015).

6.2.2 Hydropower Projects on the Athabasca River

6.2.2.1 Existing Projects

No hydroelectric projects currently exist on the Athabasca River.

6.2.2.2 Proposed Projects

Proposed hydroelectric projects in the area include **Innergex's Sundog and Pelican** projects located on the Athabasca River upstream of Fort McMurray. Alberta Environment and Parks has determined that, in compliance with the Alberta *Environmental Protection and Enhancement Act*, an Environmental Impact Assessment (EIA) is required (NRCB, 2017). The proposed projects were also recently determined to be designated projects by the federal Minister of Environment and are subject to review under the Environmental Assessment process of the *Canadian Environmental Assessment Act, 2012*. On January 19, 2018, the Canadian Environmental Assessment Agency (the Agency) received correspondence from (Innergex) that they “do not intend to carry out either the Sundog or Pelican Renewable Generation Station (RGS) Projects and requested that the Agency end the federal environmental assessment process” (Teague, 2018).

6.2.3 Oil Sands Projects in the Athabasca River Basin

The Regional Aquatics Monitoring Program described the geology of the oil sands region as follows (RAMP, n.d.): “The Athabasca oil sands deposit is the largest Cretaceous oil sands deposit in Alberta, covering an area of about 46,000 km² (Conly et al., 2002). Most of the bitumen deposits are found in the McMurray Formation, a layer of shale, sandstone, and oil-impregnated sands formed during the Cretaceous period by river and ocean processes. The McMurray Formation, up to 150 m thick, lies over a layer of shale and limestone (the Devonian Waterways Formation) and beneath the Clearwater Formation, a layer of marine shale and sandstone. The McMurray Formation overlies a landscape of valleys and ridges. The Formation is almost absent where the Devonian layer rises in a ridge, cutting through the McMurray Formation. North of Fort McMurray the Formation can be found within 75 m of the surface and is exposed at the surface where the Athabasca River and its tributaries have incised into the landscape. The McMurray Formation is first exposed in the Athabasca riverbed at Boiler Rapids, 50 km upstream of Fort McMurray, and again near the MacKay River (Conly et al., 2002). Oil sands exposed at the earth's surface are a widespread natural source of hydrocarbons entering the aquatic ecosystems of the area.”

There are currently 37 oil sands facilities operating in the Athabasca River Basin (ARB), with an additional 47 projects proposed, in construction, under regulatory review, or recently announced (Alberta Energy,

2017). There are 3 operating upgraders in the ARB, with an additional facility approved and 2 at the application stage. All of these projects are located in the Athabasca River drainage basin, which flows directly in to the southeast corner of the PAD in the WBNP.

6.2.3.1 Existing Projects

Existing oil sands projects and upgraders located within the ARB are presented below in Figure 6-2 and Table 6-1 and Table 6-2. The numbers for individual projects shown in Figure 6-3 correspond to the project details given in Table 6-1 and Table 6-2. As of September 2017, there are currently 38 oil sands facilities producing bitumen and/or oil sands product as of the last period (Alberta Energy, 2017). Approximately half of the existing oil sands projects are thermal in-situ projects. Three operating oil sands upgraders also exist in the Athabasca River basin (2017, from (http://www.energy.alberta.ca/LandAccess/pdfs/OilSands_Projects.pdf)).

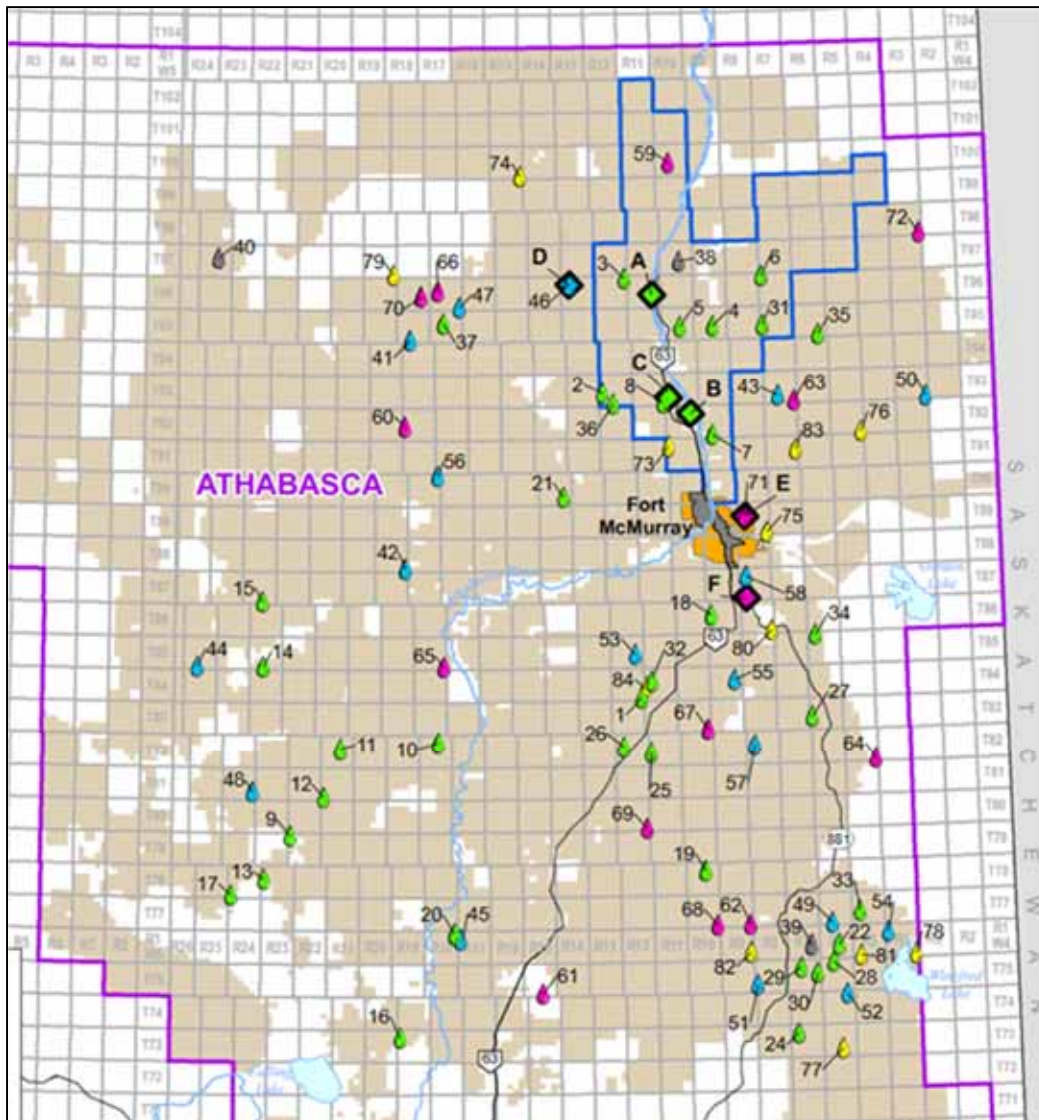


Figure 6-2: Alberta's Oil Sands Projects and Upgraders in The Athabasca River Basin Area (as of Sept. 2017, Alberta Energy).

Notes: Blue Outline: Surface Mineable Oil Sands Area, Diamonds (upgraders), Oil Drops (oil sands projects), Green (operating), Blue (approved), Grey (under construction), Pink (application stage), Yellow (announced).

Table 6-1: List of Operating Athabasca Oil Sands Projects (as of Sept. 2017, Alberta Energy)

Facility	Owner	Facility Name	Facility Type	Status
1	N-Solv Corporation	Suncor Dover Lease Pilot	Experimental	Operating
2	Suncor	Dover Demonstration	Experimental	Operating
3	CNRL	Horizon	Mining	Operating
4	CNRL	Jackpine Mine	Mining	Operating
5	CNRL	Muskeg River Mine	Mining	Operating
6	Imperial Oil	Kearl	Mining	Operating
7	Suncor	Suncor Oil Sands	Mining	Operating
8	Syncrude	Syncrude Mine	Mining	Operating
9	Bronco Energy	Brintnell 9774	Primary	Operating
10	CNRL	Pelican Lake III	Primary	Operating
11	CNRL	Brintnell	Primary	Operating
12	CNRL	South Brintnell	Primary	Operating
13	CNRL	South Wabasca	Primary	Operating
14	CNRL	Wabasca North	Primary	Operating
15	CNRL	Woodenhouse	Primary	Operating
16	Husky	Amadou	Primary	Operating
17	Husky	McMullen Primary Heavy Oil	Primary	Operating
18	Athabasca Oil Sands	Hangingstone	Thermal	Operating
19	Athabasca Oil Sands	Leismer Demonstration Project	Thermal	Operating
20	Black Pearl Resources	Blackrod SAGD Pilot	Thermal	Operating
21	Brion Energy	MacKay River Commercial Project	Thermal	Operating
22	Cenovus	Christina Lake Thermal	Thermal	Operating
23	Cenovus	Foster Creek	Thermal	Operating
24	CNRL	Kirby South	Thermal	Operating
25	Connacher	Algar	Thermal	Operating
26	Connacher	Great Divide	Thermal	Operating
27	Conoco Phillips	Surmont	Thermal	Operating
28	Devon	Jackfish SAGD Thermal Project	Thermal	Operating
29	Devon	Jackfish 2 SAGD Thermal Project	Thermal	Operating
30	Devon	Jackfish 3 SAGD Project	Thermal	Operating
31	Husky	Sunrise Thermal	Thermal	Operating
32	JACOS	Hangingstone Expansion Project	Thermal	Operating
33	MEG Energy	Christina Lake Regional	Thermal	Operating
34	Nexen	Long Lake	Thermal	Operating
35	Suncor	Firebag	Thermal	Operating
36	Suncor	MacKay River	Thermal	Operating
37	Sunshine Oilsands	West Ells	Thermal	Operating
38	Suncor	Fort Hills Oil Sands Project	Mining	Start-up

Table 6-2: List of Operating and Approved Athabasca Upgraders (as of Sept. 2017, from Alberta Energy)

Facility	Owner	Facility Name	Facility Type	Status
A	CNRL	Horizon	Upgrader	Operating
B	Suncor	Base and Millennium	Upgrader	Operating
C	Syncrude	Mildred Lake	Upgrader	Operating
D	BP P.L.C.	Terre de Grace Pilot	Upgrader	Approved
E	Value Creation	Advanced Tri-Star	Upgrader	Application
F	Value Creation	Demonstration of Excellence (DOEx)	Upgrader	Application

Oil Sands Production

Bitumen from the oil sands in Alberta is produced mainly through conventional open pit surface mining and thermal in-situ techniques. In conventional surface mining, large trucks and shovels are used to extract a mixture of bitumen, sand, and clays, while in-situ techniques inject steam into the reservoir to heat the bitumen so it can be pumped to the surface (Suncor, 2018). Only 20% of all oil sands are close enough to the surface to be mined and thermal in-situ bitumen production is expected to surpass production from surface mining in the next few years (Oil Sands Magazine, 2018a).

There are two common thermal in-situ techniques employed in the oil sands, including Cyclic Steam Stimulation (CSS) and Steam-Assisted Gravity Drainage (SAGD) (Oil Sands Magazine 2018a). Both CSS and SAGD have identical central processing facilities, however they have different positioning and number of wellheads. In-situ facilities consist of the following basic unit operations, as follows (Oil Sands Magazine, 2018a):

- A series of well pads scattered throughout the oil sands deposit;
- A steam and power generation plant which provides power for the facility and high-pressure steam for injection into the wellheads;
- A central processing plant where the oil and water emulsion produced at the injection wells is separated;
- A water treatment plant where the recovered water is cleaned and recycled back into the process; and
- A product storage facility where the bitumen is diluted with condensate for storage and transportation via pipeline.

An in-situ processing plant is generally much smaller and simpler than an oil sands mining facility. However, bitumen can only be extracted in-situ if the oil sands deposit is deep below the surface. Most in-situ deposits lie at least 200 meters below grade.

Primary production of bitumen is a method most similar to conventional oil wells and requires no steam. Primary oil recovery is the first phase, which happens once a well has been drilled from the surface to an underground reserve. Gravity, along with the pressure inside the reservoir, forces the oil into the wellbore. From the wellbore, the oil is brought to the surface through mechanical means, such as a pump jack. The primary phase of oil recovery continues until the pressure inside the well is no longer enough to produce oil in quantities that make it financially worthwhile. Primary production facilities are small scale projects (K. Zariffa, pers. comm., 2018).

Oil Sands Water Use and Waste Production

Conventional mining operations use warm water and alkali to separate the bitumen from the sand and clay, while in-situ drilling operations use water to generate steam to heat the bitumen reservoir to enable it to flow to production wells. On average, in-situ operations require 0.4 barrels of fresh water for every barrel of bitumen produced, while conventional mining requires, on average, 3.1 barrels of fresh water for every barrel of bitumen produced (CAPP, 2018). Oil sands mining operations in northern Alberta recycle over 80 to 95% of the water they use. The Athabasca River is the primary source of fresh water for the oil sands, however in order to further decrease fresh water consumption, some producers use brackish or saline groundwater as an alternative to fresh water. In some in-situ projects, fresh water is entirely replaced with non-fresh water (CAPP, 2018).

Conventional oil sand mining activities result in the accumulation of large amounts of residual waste known as tailings, which contain a mixture of water, clay, unrecovered bitumen and solvent, and dissolved chemicals, including some organic compounds that are toxic to the environment (NRCAN, 2016). These tailings are stored in large ponds, where the solids settle to the bottom and remain as mud in the ponds almost indefinitely. The water released from the ponds can be recycled and reused in oil sands processing. As shown in Figure 6-3, all tailings ponds have groundwater monitoring facilities that are designed to capture and recycle material that may seep from the ponds and producers are also required to take steps to prevent waterfowl from landing in the tailings ponds (Government of Canada,

2015). In-situ oil sands operations do not produce tailings and do not require large waste storage facilities such as tailings ponds (Government of Canada, 2015).

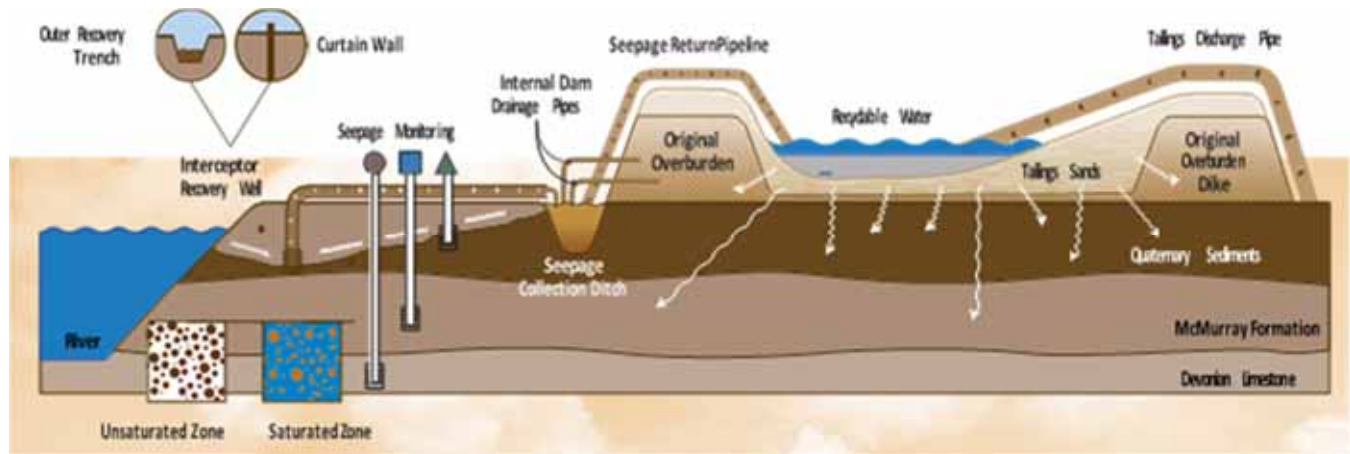


Figure 6-3: Cross-Section View of Tailings Seepage Recapture and Monitoring Systems (Government of Canada, 2015)

Since bitumen extracted from the oil sands can contain as much as 2% water and solids, as well as heavy metals and sulfur, it is upgraded into light oil through a process of distillation/fractionation and chemical (hydrocracking) treatment (Oilsands Magazine, 2018b). About 40% of Alberta's oil sands bitumen is upgraded into light/sweet synthetic crude before being sold to downstream refineries. Upgraders also use water, in the form of steam, to heat the bitumen and the oil products for processing and to generate electricity as a by-product (CAPP 2018).

Oil sands processing and upgrading produces greenhouse gas (GHG) and other air emissions. In 2014, the oil sands contributed about 9.3% of Canada's total GHG emissions (NRCAN, 2016). In 2009, oil sands production constituted approximately 4% of national sulphur oxides (SOx) emissions, 1% of national nitrogen oxides (NOx) emissions, 2% of national volatile organic compounds (VOC) emissions, and 3% of Canada's greenhouse gas (GHG) emissions (NRCAN, 2013). Poly Aromatic Hydrocarbons (PAHs) and other Polycyclic Aromatic Compounds (PACs) are VOCs, in addition to light hydrocarbons from diluent and bitumen and reduced sulfur compounds (RSC).

6.2.3.2 Approved Projects

Approved oil sands projects and upgraders located within the ARB are also presented in Figure 6-2, Table 6-2, and Table 6-3 (below). As of September 2017, 19 projects have received regulatory approvals required to operate and two projects have commenced on-site construction (Alberta Energy, 2017). A majority of these are thermal in-situ projects. One additional upgrader has received regulatory approval.

Table 6-3: List of Approved and Under Construction Athabasca Oil Sands Projects (as of Sept. 2017, Alberta Energy)

Facility	Owner	Facility Name	Facility Type	Status
39	Harvest Operations	BlackGold	Thermal	Construction
40	Sunshine Oilsands	Harper	Thermal	Construction
41	Athabasca Oil Sands	Dover West Carbonates (Leduc)	Experimental	Approved
42	Husky	Saleski Carbonate Pilot	Experimental	Approved
43	Oak Point Energy	Lewis SAGD Pilot	Experimental	Approved
44	Renergy Petroleum	Muskwa Pilot	Experimental	Approved
45	Black Pearl Resources	Blackrod Commercial	Thermal	Approved
46	BP P.L.C.	Terre de Grace	Thermal	Approved
47	Brion Energy	Dover Commercial Project	Thermal	Approved
48	Cavalier Energy Inc	Hoole	Thermal	Approved
49	Cenovus	Narrows Lake	Thermal	Approved
50	Cenovus	Telephone Lake Borealis	Thermal	Approved
51	CNRL	Kirby Expansion (North)	Thermal	Approved
52	Devon	Pike	Thermal	Approved
53	Grizzly Oil Sands	May River	Thermal	Approved
54	MEG Energy	Christina Lake Regional Project Phase 3 SE	Thermal	Approved
55	Suncor	Meadow Creek East	Thermal	Approved
56	Sunshine Oilsands	Thickwood	Thermal	Approved
57	Surmont Energy	Wildwood	Thermal	Approved
58	Value Creation	Demonstration of Excellence (DOEx)	Thermal	Approved
NA	CNRL	Jackpine Mine Expansion	Mining	Approved

Shell's Jackpine Mine Expansion project (#4 in Table 6-2 and Figure 6-3), would increase the capacity of its existing oil sands mine by 100,000 barrels per day (15,900 m³/d), bringing the total bitumen production capacity of the mining facility to 300,000 barrels per day (CEAA, 2017).

6.2.3.3 Reasonably Foreseeable Projects

Reasonably foreseeable oil sands projects located within the ARB are also presented in Figure 6-2 and below in Table 6-4. As of September 2017, 14 project applications are currently being reviewed by the Alberta Energy Regulator and/or Alberta Environment and Parks, in addition to 10 projects where the operator has disclosed intent to construct (Alberta Energy, 2017). A majority of these are thermal in-situ projects.

Table 6-4: List of Applied for and Announced Athabasca Oil Sands Projects (as of Sept. 2017, Alberta Energy)

Facility	Owner	Facility Name	Facility Type	Status
59	Teck Resources	Frontier	Mining	Application
60	Athabasca Oil Sands	Dover West Sands & Clastics	Thermal	Application
61	CNRL	Grouse	Thermal	Application
62	Grizzly Oil Sands	May River	Thermal	Application
63	Imperial Oil	Aspen	Thermal	Application
64	MEG Energy	Surmont	Thermal	Application
65	OSUM	Sepiko Kesik	Thermal	Application
66	Prosper Petroleum Ltd.	Rigel	Thermal	Application
67	PTT Exploration and Production	Mariana-Hangingstone	Thermal	Application
68	PTT Exploration and Production	Mariana-South Leismer	Thermal	Application
69	PTT Exploration and Production	Mariana-Thornbury	Thermal	Application
70	Sunshine Oilsands	Legend Lake	Thermal	Application
71	Value Creation	Advanced TriStar	Thermal	Application
72	Value Creation	Audet Pilot	Thermal	Application
73	Suncor	Voyageur South	Mining	Suspended
74	Athabasca Oil Sands	Birch	Thermal	Announced
75	Cenovus	East McMurray	Thermal	Announced
76	Cenovus	Steepbank	Thermal	Announced
77	Cenovus	West Kirby	Thermal	Announced
78	Cenovus	Winefred Lake	Thermal	Announced
79	CNRL	Birch Mountain	Thermal	Cancelled
80	CNRL	Gregoire Lake	Thermal	Cancelled
81	Devon	Jackfish East	Thermal	Announced
82	MEG Energy	May River	Thermal	Announced
83	Suncor	Lewis	Thermal	Announced
84	Suncor	Meadow Creek West	Thermal	Announced

The Frontier Oil Sands Mine project (#59 in Figure 6-2 and Table 6-4) is a proposed 292 km² (29,217 ha) conventional ‘truck-and-shovel’ surface oil sands mine located approximately 30 km from the south boundary of the WBNP. It would consist of surface mining operations, an ore preparation plant, a bitumen processing plant, tailings preparation & management facilities, cogeneration facilities, water management facilities, disposal and storage areas, river water intake, a fish habitat compensation lake, access roads and 7 watercourse crossings, including an Athabasca River bridge crossing, roads, airfield and camp facilities. Water withdrawals from the Athabasca River are estimated at 98 million cubic meters per year for an eight-year period during start up, then 60 million cubic meters per year for the remaining 49 year period for mining operations (Teck, 2015). Frontier is expected to produce 3 billion

barrels of bitumen over the life of the mine, with 260,000 barrels per day at full production to be transported via pipeline (Teck, 2015). External tailings areas (ETA) are expected to have a peak fine fluid tailings (FFT) inventory of approximately 242 Mm³ in Year 12 (Teck, 2015).

6.2.4 Oil Sands Projects in the Peace River Basin

As shown in Table 6-5 and Figure 6-4, there are currently 25 oil sands projects operating in the Peace River basin. The closest project is located 250 km southwest of the WBNP boundary and is an approved thermal project. The remaining 25 operating projects are located more than 300 km from the WBNP boundary, comprising 19 conventional projects, 5 thermal projects, and one experimental project.

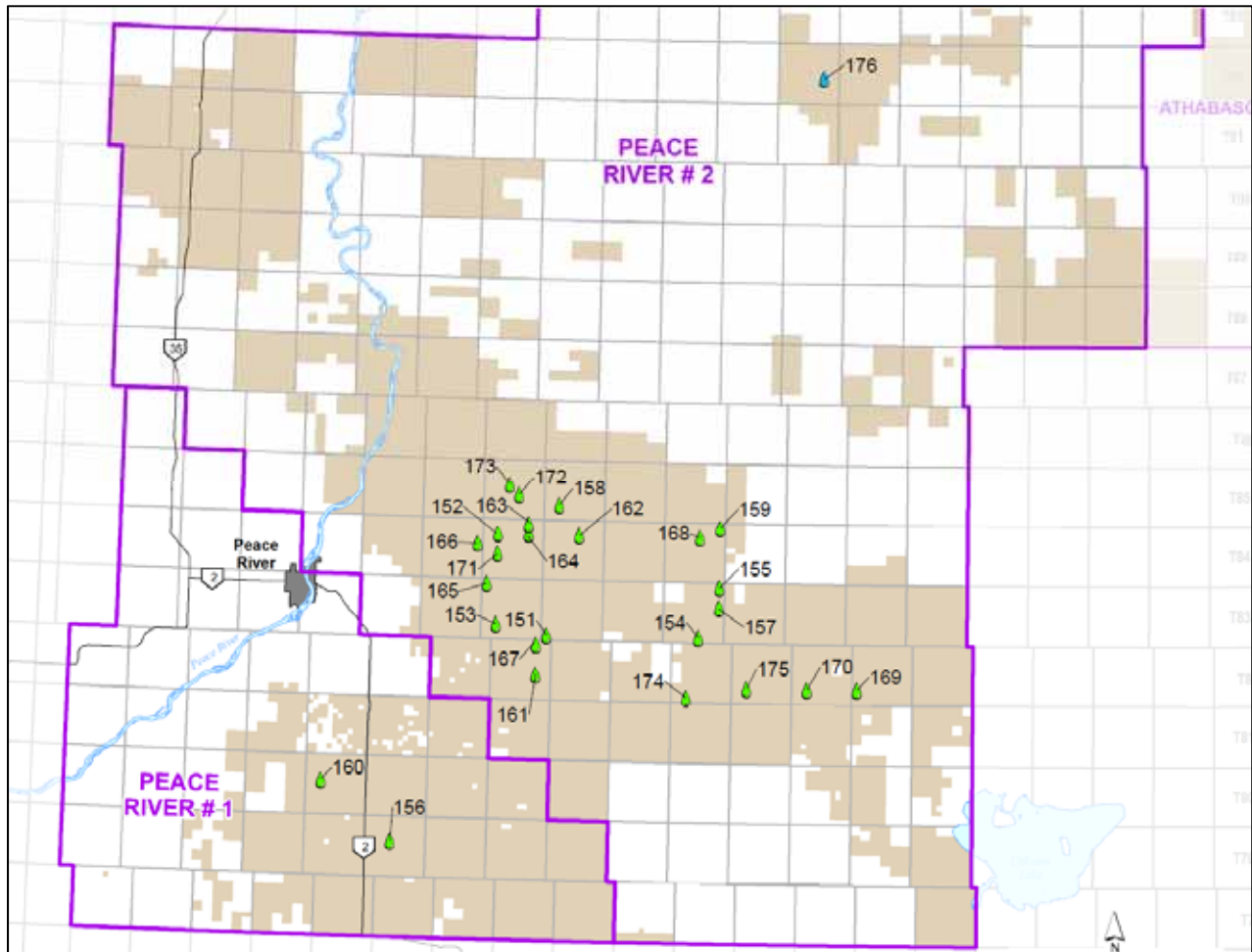


Figure 6-4: Alberta's Oil Sands Projects and Upgraders in the Peace River Basin Area (as of Sept. 2017, Alberta Energy).

Notes: Oil Drops (oil sands projects), Green (operating), Blue (approved)

Table 6-5: List of Operating and Approved Peace River Oil Sands Projects (as of Sept. 2017, Alberta Energy)

Facility	Owner	Facility Name	Facility Type	Status
151	Obsidian Energy	Seal Harmon Valley South Thermal Pilot	Primary	Operating
152	Baytex	Cadotte Heavy Oil	Primary	Operating
153	Baytex	Harmon Valley Bluesky	Primary	Operating
154	Baytex	Murphy Seal	Primary	Operating
155	Baytex	Peace River	Primary	Operating
156	Baytex	Reno	Primary	Operating
157	Baytex	Seal I	Primary	Operating
158	Baytex	Seal Cadotte	Primary	Operating
159	Baytex	Seal – Northern Cadotte Block	Primary	Operating
160	Baytex	Tangent 11437	Primary	Operating
161	Baytex	Walrus	Primary	Operating
162	CNRL	Cliffdale	Primary	Operating
163	CNRL	Galloway	Primary	Operating
164	Murphy Oil	Murphy Cliffdale	Primary	Operating
165	Obsidian Energy	Harmon Valley	Primary	Operating
166	Obsidian Energy	Seal Cadotte	Primary	Operating
167	Obsidian Energy	Seal Harmon Valley South	Primary	Operating
168	Obsidian Energy	Seal North	Primary	Operating
169	Prosper Petroleum Ltd.	Chipmunk	Primary	Operating
170	Prosper Petroleum Ltd.	Chipmunk II	Primary	Operating
171	Baytex	Harmon Valley – Pilot	Thermal	Operating
172	CNRL	Peace River Bluesky	Thermal	Operating
173	CNRL	Peace River	Thermal	Operating
174	Obsidian Energy	Dawson Seal	Thermal	Operating
175	Obsidian Energy	Seal Main East	Thermal	Operating
176	Northern Alberta Oil	Swan Lake	Thermal	Approved

6.2.5 Pulp and Paper/Forestry Projects

6.2.5.1 Existing Projects

Eleven pulp and paper mills are located in the Peace and Athabasca River basins, with five in the Athabasca basin and six in the Peace River basin, as outlined in Table 6-6. Three bleach kraft pulp mills currently operate on the Peace River, along with two CTMP (chemical thermo-mechanical pulping) mills and one mechanical pulp newsprint facility (Glozier et al., 2009). In the Athabasca River basin, two bleach kraft pulp mills currently operate, along with three CTMP mills. The main contaminants discharged to rivers from these facilities include total phosphorus (TP) and ammonia (NH₃) and, in 2006, loadings from these facilities ranged from 1 to 148 tonnes of NH₃ and 0.2 to 45 tonnes of TP (Glozier et al., 2009).

Table 6-6: List of Pulp and Paper Mills within the Peace and Athabasca River Basins (Glozier et al., 2009)

Company Name/ Pulp Mill	Details					
	Receiving Water	Location	Start Up	Product	2006 Loadings (Tonnes)	
					TP	NH ₃
Athabasca River Watershed						
West Fraser Mills, Ltd/Hinton Pulp	Athabasca River	Hinton, AB	1957	Bleached Kraft pulp	45	140
Alberta Newsprint Co. Ltd.	Athabasca River	Whitecourt, AB	1990	Thermomechanical pulp, de-inked paper	4	0.5
Millar Western Industries Ltd.	Athabasca River	Whitecourt, AB	1988	Bleached chemi-thermomechanical pulp	NA	1.0
Slave Lake Pulp Corporation	Lesser Slave River	Slave Lake, AB	1991	Bleached chemi-thermomechanical pulp	14	2.0
Alberta Pacific Forest Industries Inc.	Athabasca River	Near Grassland, AB	1993		41	148
Peace River Watershed						
Pope and Talbot Ltd. /Mackenzie Pulp	Williston Lake	Mackenzie, BC	1972	Bleached Kraft Pulp	31	19.5
Abitibi Bowater Inc /Mackenzie Paper	Williston Lake	Mackenzie, BC	1969	Mechanical Pulp, newsprint	0.2	10
Louisiana-Pacific	NA	Chetwynd, BC	1991	Bleached chemi-thermomechanical pulp	--	--
Canfor Forest Products Ltd. / Taylor Pulp	Peace River	Taylor, BC	1988	Bleached chemi-thermomechanical pulp	27	NA
Weyerhaeuser Canada / Grande Prairie Operations	Wapiti River	Grande Prairie, AB	1973	Bleached Kraft Pulp	24	48
Daishowa-Marubeni	Peace River	Peace River, AB	1990	Bleached Kraft Pulp	NA	19.1

6.2.5.2 Proposed/Reasonably Foreseeable Projects

There are no new pulp and paper projects being proposed or planned at the current time.

6.2.6 Mineral Mine Projects

6.2.6.1 Existing Projects

As shown in Figure 6-5, there are four industrial mineral mines located near the WBNP and the PAD. Three limestone mines are located 105 km from the southeast boundary of the WBNP, while one silica sand mine is located approximately 300 km from the southwest corner of the WBNP (2018, Alberta Energy Regulator Interactive Minerals Map, from <http://ags-aer.maps.arcgis.com/apps/webappviewer/index.html?id=cfb4ed4a8d7d43a9a5ff766fb8d0aee5>).

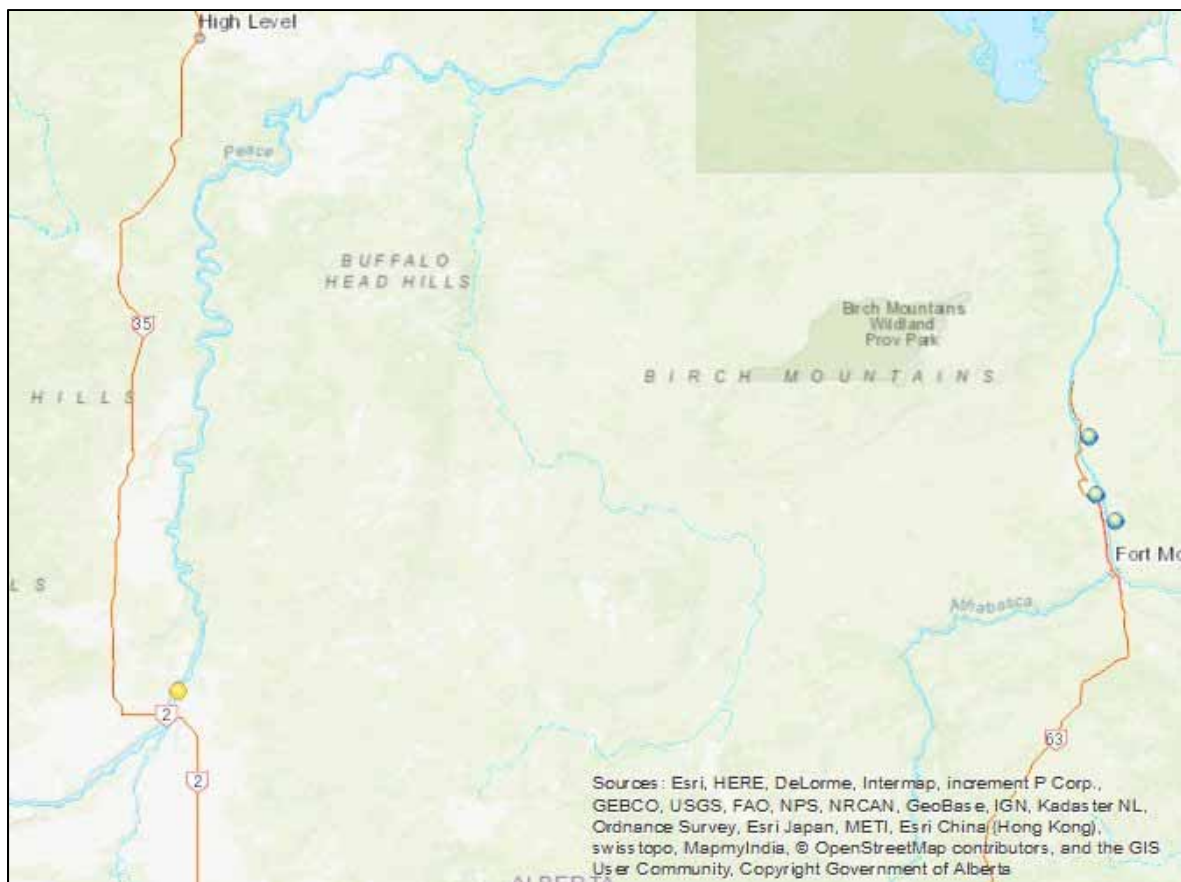


Figure 6-5: Locations of Minerals Mines Near Wood Buffalo National Park

(from <http://ags-aer.maps.arcgis.com/apps/webappviewer/index.html?id=cfb4ed4a8d7d43a9a5ff766fb8d0aee5>; Notes: Yellow: Silica sand mine, Grey: Limestone mine)

There are four decommissioned uranium mines around Lake Athabasca in Saskatchewan: Beaver Lodge, Lorado, Gunnar and Areva (Canadian Nuclear Safety Commission, 2018).

6.2.6.2 Proposed Projects

The former Pine Point lead-zinc mine located on the south shore of the Great Slave Lake is not currently in operation. A preliminary economic assessment has been conducted to reopen the mine, however no applications have been submitted (Pine Point Mining Limited, 2018). Similarly, mineral exploration is occurring around Lake Athabasca in Saskatchewan and in Alberta just south of WBNP, but no projects have been applied for. As a result, there are no new industrial mineral mine projects being proposed or planned at the current time.

6.2.7 Forestry Projects

Current forest management areas in the Northern Alberta region are provided below in Figure 6-6, along with the annual allowable cuts for each of the management areas in Table 6-7.

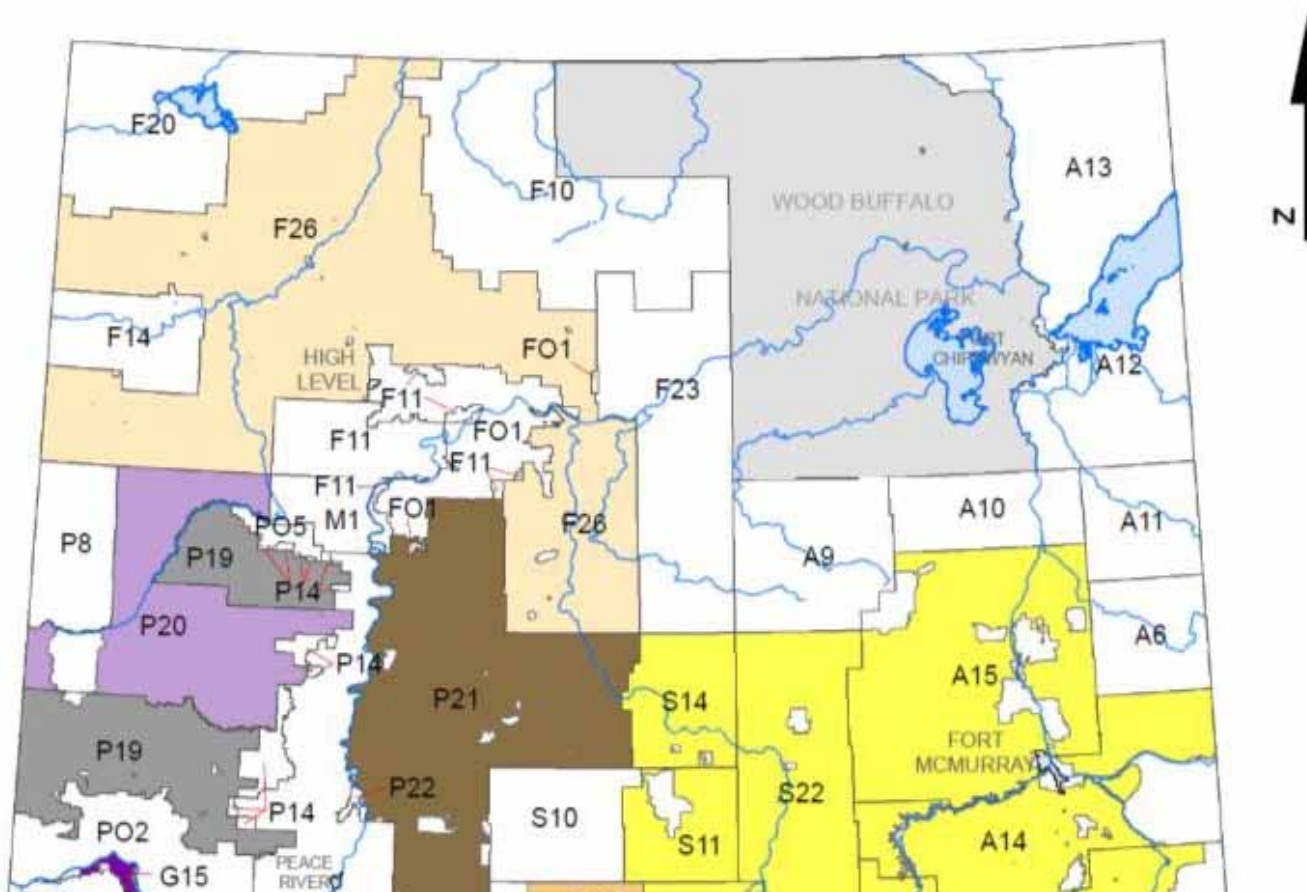


Figure 6-6: Forest Management Agreements in Northern Alberta (Government of Alberta, 2014a)

Table 6-7: Annual Allowable Cuts for Management Areas in Northern Alberta

Forest Management Unit	Annual Allowable Cut	Company
F10	No harvest	
F23	550,100 m ³	Askee Development Corp (Little Red River Cree First Nation)
A9	31,912 m ³	Netaskinan Development (GP) Ltd.
A10	6,900 m ³	Northland Forest Products Ltd.
A11	No harvest	
A12	No harvest	
A13	No harvest	

Current timber harvest planning areas in the Northwest Territories are provided below in Figure 6-7. A forest agreement for Timberworks, owned by the Deninu Kue First Nation and Fort Resolution Métis Council, in an area located adjacent to the park. Harvesting has yet to begin in this area.

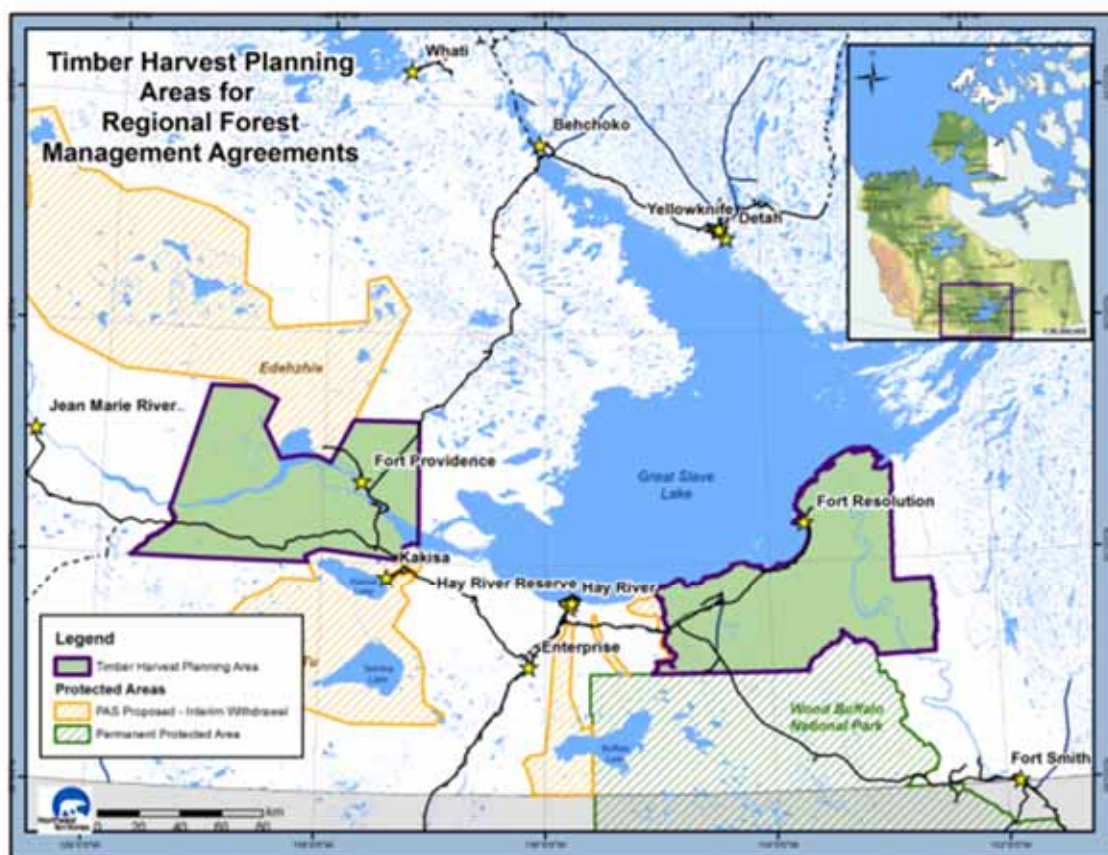


Figure 6-7: Timber Harvest Planning Areas for NWT Regional Forest Management Agreements (Government of the Northwest Territories, n.d.)

6.2.8 Conservation Areas

A number of provincial parks, conservation areas or public land-use zones exist or have been proposed around the park. Caribou Mountains Wildland Provincial Park, Richardson River Dunes Wildland Provincial Park and La Butte Creek Wetland Provincial Park are existing provincial parks that border WBNP. Additional areas proposed for protection include Kazan Wildland Park and Richardson Wildland Park on the eastern border of WBNP. In addition, there is a proposal for a Birch River Conservation Area on the southern border of WBNP (Government of Alberta, 2012).

6.3 POTENTIAL CUMULATIVE EFFECTS ON THE PAD FROM FUTURE CLIMATE CHANGE

6.3.1 Climate Change Projections Relating to the PAD

Climate change projections from available literature were compiled in order to gain an understanding of the magnitude of potential cumulative risk to the desired outcomes for the PAD from future climate change in the region over the next thirty years. The potential cumulative effects were assessed in relation to the flow regime desired outcome for the PAD, including river flow rates, lake water levels, and ice jam flooding frequency.

Available literature relevant to climate change influences on the PAD over the next 30+ years (within the context of existing levels of development) generally falls within one of three categories, as follows:

- Examining the exacerbating effects that future climate change may have on the PAD in conjunction with current levels of project development (e.g. Davidson and Hurley, 2007).
- Modelling potential climate induced change to ice-jam flooding frequency and other hydrologic processes in the PAD in the future (e.g. Eum et al., 2017).
- Discussing historical changes in the PAD and providing hypotheses regarding likely effects from future climate change, recognizing that projections using past trends over less than 100 years is somewhat unreliable (e.g. Timoney, 2013)

Numerous researchers report the potential for significant climate-related changes to ice-jam flooding frequency, river flows, and water levels in the Peace and Athabasca River basins in the future (Eum et al., 2017; Shrethsa et al., 2017; Peters, 2016; Carver, 2013; Timoney, 2013; Teck Resources, 2011c; Timoney, 2009; Andrishak and Hicks, 2008; Beltaos et al., 2008; Davidson and Hurley, 2007; Beltaos et al., 2006; Beltaos et al., 2006a; Pietroniro et al., 2006; Toth et al., 2006; Prowse et al., 2006). Table 6-8 presents a summary of available literature, which will be discussed in the following sections.

Table 6-8: Climate Change Projections for the PAD

Area of Interest	Decreases	Increases	Other
Peace Athabasca Basin (and PAD)	↓ Snowpack ^{1,3,8,11,12,15} ↓ Glacier meltwater ¹¹ ↓ Tributary snowmelt ¹⁹ ↓ Spring peak water levels by 1.0 m ⁽³⁾ ↓ Avg annual peak levels by 0.1-0.6 m ⁽³⁾ ↓ Summer levels by 0.5 m (PR) ³	↑ Temperature ^{3,8,16} ↑ Winter levels ³ ↑ Winter & Spring melt ³ ↑ Snowmelt (PR) ¹ ↑ Winter flows (PR) ⁷	Midwinter thaws/melt ^{1,8,15} Earlier spring peak water levels by 20-30 days ³ Earlier melt (PR) ⁷ Wide variations in wetness ⁸
PAD Lakes	↓ Spring water levels by 0.15-0.4 m (LA) ³ ↓ Lake levels by 2 to 3 m (LA) ²²	↑ Pre-melt spring levels ³ ↑ Shallowing of lakes ⁸ ↑ Spring water levels by 0.1-0.25 m (LA) ³	Earlier peak water levels by 40-50 days (LA, Mamawi and Claire) ³
PAD Ice Jams & Flooding	↓ Ice season by 2-4 weeks ^{2,8,10,15} ↓ Ice cover thickness by up to 20% (Peace Pt) ¹⁰ ↓ Max extent of ice cover ¹⁴ ↓ Duration of ice cover by 28 days or 31% ¹⁴ ↓ Ice-jam flooding frequency ^{2,6,10,12,13,15} ↓ Perched basin recharge ² ↓ Flow reversals ⁶	↑ Dry period between floods ⁸ ↑ Thermal ice breakups ⁶ ↑ Dry periods between floods ⁸	Ice cover slightly thinner ¹⁵
Athabasca River Basin	↓ Summer flows ^{2,21} ↓ Summer flows by up to 21% ⁴ ↓ Summer flows by 14.3% ¹⁷ ↓ Summer levels by 0.2 m ⁽³⁾ ↓ Summer flows by 16% ²³ ↓ Runoff by 30% ¹⁸ ↓ Low winter flows by 7-10% ¹⁸ ↓ Winter flows by 58.6% ¹⁷ ↓ Winter flows by 6% ²³	↑ Precipitation ^{4,5} ↑ Precipitation by 1% per decade ²³ ↑ Winter precipitation ²⁰ ↑ Evapotranspiration ^{4,5,9} ↑ Winter flows ^{2,4,7,20,21} ↑ Spring flows ^{2,4,20} ↑ Peak flow by 30% ²⁰ ↑ Flow by 16-54% ⁹ ↑ Annual melt volumes ³ ↑ Frequency of summer low flows ²¹	Warmer by 2-5.4 ⁰⁽⁹⁾ Warmer by 0.4°C per decade ²³ Wetter by 21-34% ⁹ Wetter in lower elevations ³ Earlier onset spring freshet ³ Extended spring freshet ⁴ Earlier snowmelt ⁷
Notes : LA : Lake Athabasca ; PR : Peace River ; 1: Beltaos et al. (2006b); 2: Peters (2016); 3: Pietroniro et al. (2006); 4: Eum et al. (2017); 5: Davidson and Hurley (2007); 6: Carver (2013); 7: Toth et al. (2006); 8: Timoney (2009); 9: Shrethsa et al. (2017); 10: Beltaos et al. (2006a); 11: Timoney (2013); 12: Prowse et al. (2006); 13: Teck Resources (2011c); 14: Andrishak and Hicks (2008); 15: Beltaos et al. (2008); 16: BC Hydro (2011); 17: Burn (2009, in Lebel et al., 2009); 18: Bruce and Tin (2006); 19: Prowse and Conly (1998); 20: Alberta WaterSMART (2017); 21: Leong and Donner (2015); 22: Rasouli et al. (2013); 23: Lebel et al. (2009)			

6.3.2 Potential Climate Change Effects on the PAD

As shown in Table 6-8, the majority of relevant literature indicated future climate changes in the PAD over the next thirty (plus) years will likely cause less surface water to be available and what is available will reach PAD water bodies earlier in the spring. This reportedly stems from a number of factors. Increases in temperature will potentially produce thinner snowpack in the headwater and tributary areas of the PAD, which in turn will produce less snowmelt. As a result, average annual peak, spring peak, and summer flows will all likely be reduced in the future. Anticipated increases in air temperature also may produce mid-winter thaws, causing the snowpack that is available to melt sooner in the year, resulting in earlier delivery of meltwater to the PAD. This may cause winter flows and winter water/ice levels to further increase from current levels. In addition, the decrease in the volume of water delivered to the Peace River will likely cause less water to be delivered to PAD lakes and it will arrive earlier in the spring. The literature is unclear whether overall water levels in the lakes will be lower or higher as a result of this.

A number of authors project increased air temperatures, a thinner snowpack, mid-winter thaws, and less glacier meltwater in the Peace Athabasca basin as a result of climate change. BC Hydro (2011) report “air temperatures in the Peace region have increased approximately 1.2°C over the past century, and are projected to increase 1.9°C to 2.5°C by the 2050s and 2.5°C to 3.9°C by the 2080s. The increase in mean air temperatures has been, and is expected to be, mostly due to warmer temperatures in winter” (p. 11-118).

Pietroniro et al. (2006) report increased temperature would result in increased winter melt events, which, in turn, would reduce the snow pack and accelerate spring melt. Beltaos et al. (2006a) also report “a large part of the Peace River basin is expected to experience frequent and sustained mid-winter thaws, leading to significant melt and depleted snowpacks in the spring” into the 2080s (p. 4031). Wolfe et al. (2008) studied the climatic driven shifts in the PAD over the past 1,000 years, indicating “Recent climate-driven hydrological change appears to be on a trajectory to even lower levels as high-elevation snow and glacier meltwater contributions both continue to decline.” (p. 1). More recently, Timoney (2013) also reports that the PAD will be warmer and drier in future decades with depleted snowpacks and mid-winter thaws. Beltaos et al. (2006a) also projected a decrease in spring snowpack in the 2080s due to extensive mid-winter melt. Finally, Timoney (2009) also note “portions of the Delta will flood periodically, but the dry period between floods may become more prolonged and intense” (p. 511).

One set of researchers also report that climate change will likely cause water levels in PAD rivers and lakes to peak earlier and be lower overall. Pietroniro et al. (2006) indicated spring peak water levels in the PAD rivers could be lowered by up to 1.0 m and occur 20 to 30 days earlier and average annual peak elevations for PAD rivers could be lowered by 0.1 to 0.6 m. The same authors also projected summer water levels in the Peace River would be lowered by 0.5 m (on average) and water levels in Lakes Athabasca, Claire and Mamawi could peak 40 to 50 days earlier than at present. More recently, Timoney (2013) also notes that there is the potential for shallowing of lakes in the PAD due to a warming climate. Several groups of researchers also indicated a strong likelihood of “higher winter levels in the PAD system, which cause elevated pre-melt spring levels in the lakes of the PAD” (Pietroniro et al., 2006, p. 4237). Toth et al. (2006) echoed this projection, noting a “significant shift towards an earlier melt season

as well as elevated winter flows for both (Peace and Athabasca) river systems” (p. 4197). Further, Rasouli et al. (2013) report the level of Lake Athabasca “may drop 2 to 3 m by 2100” (p. 1681).

Changes experienced by the PAD in the future will depend on the severity and speed of changes in the climate within these watershed basins. Leconte et al. (2006) modelled four climate scenarios (mild to severe winters) with varying flow conditions (low, average and high hydraulic regimes) in the PAD and found a reduction in winter severity caused lowered lake levels and river flows and, as a result, the flow reversal effect was diminished. More specifically, they found “extending the ice-cover season (severe winter) by 14 days resulted in an increase of up to 5 cm in water level of large lakes in the PAD, while reducing it by 28 days (mild winter) lowered the levels by almost 10 cm” (p. 4215).

One group of researchers also projected the effect climate change would have on the filling of the W.A.C. Bennett Dam reservoir at Williston Lake. Pietroniro et al. (2006) note “The inflows to the Williston Reservoir will also be subjected to an increase in winter flows and a shift in seasonality, but the spring freshet and subsequent summer flow input will be reduced under climate change. This may have a significant effect in the early autumn months as the Peace struggles to refill the reservoir before the higher winter flows accumulate the necessary recharge volume” (p. 4236).

6.3.3 Potential Climate Change Effects on Athabasca River

The potential effects of climate change upon the Athabasca River basin appear varied. Climate projections depend on the relative strength of the temperature and precipitation trends, the seasonal distribution of these trends across the seasons (i.e. how much of the warming occurs in winter versus summer), and how the hydrologic cycle would respond (e.g. evaporation, precipitation as snow versus rain, etc.) (Lebel et al., 2009). Some researchers have projected a warmer and wetter basin, producing increased winter melt and winter flows, along with greater spring and annual flow volumes. However, other researchers project lower summer flows and levels, along with decreasing low winter flows.

Several researchers project an increase in air temperatures, precipitation, and annual flow volumes in the Athabasca River basin as a result of climate change. Davidson and Hurley (2007) note Fort Chipewyan air temperature has increased by more than 3°C and “is projected to undergo a further 4.8°C increase, with coincidental increases in precipitation of 32 mm. However, potential evapotranspiration is projected to be substantially higher than any projected increases in precipitation, as a result of warmer temperatures and longer summers” (p. 8). Shrestha et al. (2017) report the Athabasca River Basin will be warmer by 2–5.4°C and wetter by 21–34% in the future, thus producing increases in annual average water flow in the Athabasca River basin by 16–54% (p. 425). Pietroniro et al. (2006) also project increased annual melt volumes in the Athabasca River basin and specifically note “the wetland and lower elevations of the Athabasca basin will be significantly wetter” (p. 4236). Pietroniro et al. (2006) also found, depending on the model, spring water levels in Lake Athabasca could vary from an increase of between 0.1 m and 0.25 m to a decrease of between 0.15 to 0.4 m. Numerous scientists report that the increased volumes experienced in the basin would involve earlier melts and elevated winter and spring flows. Toth et al. (2006) note a “significant shift towards an earlier melt season as well as elevated winter flows” (p. 4197) and Pietroniro et al. (2006) also projected earlier onset spring freshet and increased winter and spring flow for the Athabasca River.

More recently, Eum et al. (2017) projected “spring and winter flows within the Athabasca River basin will increase, resulting in an extended period of spring freshet, with a higher rate of increase at the upper reach of the river due to the combined effects of increased precipitation and earlier snowmelt resulting from a warming climate” (p. 327). Alberta WaterSMART (2017) modelled streamflow for the Athabasca River from Athabasca to Fort McMurray and the Embarrass River for a 30-year period under two scenarios, one based on future precipitation and air temperature under projected climate change conditions, and the other under drought conditions. Under the climate change scenario, large increases in peak flow (~30%), higher winter flows, and increased spring flows are projected, with no change to the timing of spring freshet. The author also notes “increased winter precipitation led to a large increase in snowpack, which melted rapidly during the long late-spring days” (p. 90). Under the drought scenario, peak flow was reduced by approximately 20% on average throughout the summer and winter months.

In contrast to the above, several researchers project a decrease in runoff and winter flows in the Athabasca River basin. Based on a 20% reduction in Athabasca River flows from 1953 to 2003 and a 1.5 to 1.8°C increase in temperatures from 1961 to 2000, Bruce and Tin (2006) projects “minimum flows in the Athabasca River are likely to diminish by 7 to 10%” into 2060 (p. 2). Davidson and Hurley (2007) project a “decrease in runoff from the Athabasca River basin below Fort McMurray of about 30% by the mid-21st century” (p. 6), as shown in Figure 6-8. It is important to note that Davidson and Hurley (2007) used a relatively short record (less than 100 years) and may reflect a period when the flow rates are decreasing due to factors other than climate change.

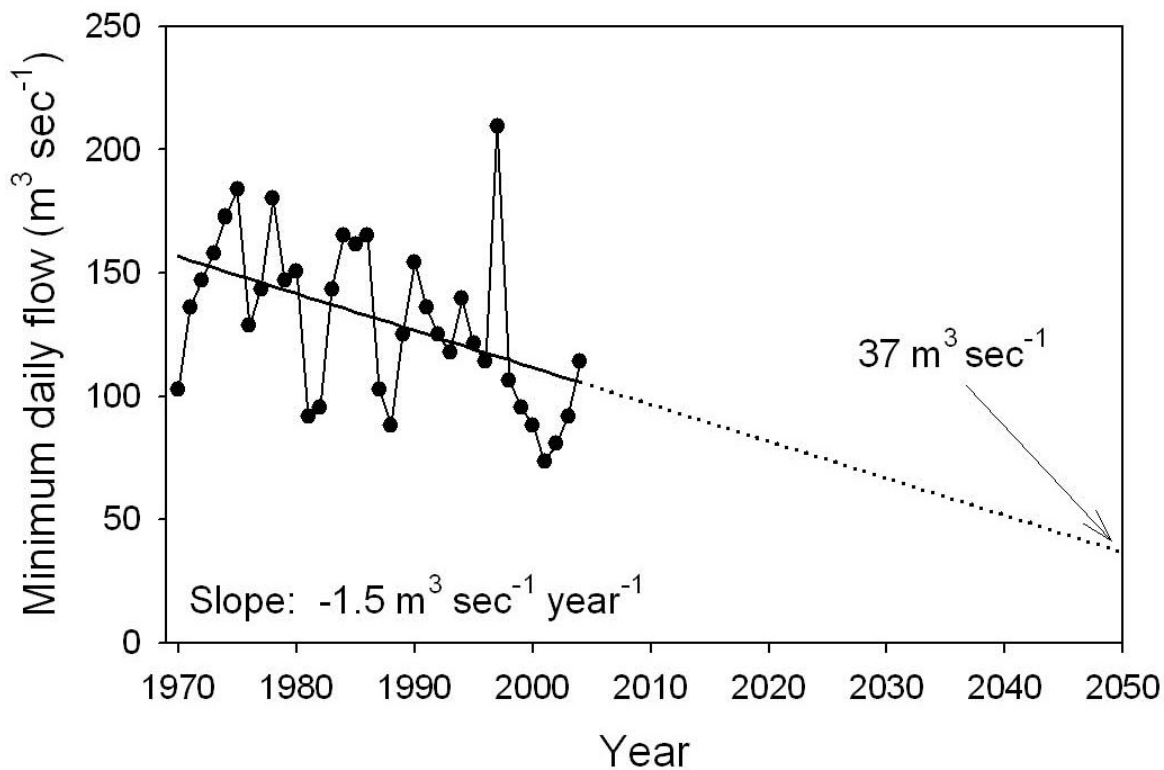


Figure 6-8: Trend Over Time in Lowest Winter Flows in the Athabasca River (Davidson and Hurley, 2007).

Lebel et al. (2009) use four major climate change models to develop flow projections for the Athabasca River for 2010 to 2039 (based on flows during the period 1957-2007) to project a mean decrease in minimum winter flows of 5.8% and mean summer flows of 16.3%. Burn (2009, in Lebel et al., 2009) reports the “projected reduction in future streamflow values, as estimated by extrapolating the trend slopes, ranges from 14.3% of the long term median streamflow for summer for the year 2022 to 58.6% for winter streamflow for the year 2037” for the Athabasca River below McMurray (p. 46). Pietroniro et al. (2006) also project lower summer levels in the Athabasca River, on average by 0.2 m (p. 4244). Kerkhoven and Gan (2011) note “the shortened snowfall season and increased sublimation together lead to a decline in the spring snowpack, and mean annual flows are expected to decline with the runoff coefficient dropping by about 8% per °C rise in temperature” in the ARB (p. 583). More recently, Eum et al. (2017) report “summer flows in the Athabasca River basin are projected to decrease by up to 21% because of earlier snowmelt, increased evapotranspiration, and no significant increase in summer precipitation” (p. 327).

In addition, Leong and Donner (2015) examine the response of streamflow in the ARB to climate change this century, the impacts of which are “projected to be the primary driver of future low flow occurrences” (p. 651). The authors indicate “future climate change is projected to increase winter flows and decrease summer flows, with the frequency of summer low flows projected to rise by up to 85% in the highest future emissions scenario by the end of the century” (p. 651), which they note “could interrupt oil sands water withdrawals and subsequent daily bitumen production for an additional 2–3 months each year by mid-century” (p. 651).

6.3.4 Potential Climate Change Effects on Ice Jam Frequency in the PAD

Several researchers have projected significant changes to ice-jam flooding frequency in the PAD as a result of climate change in the future. Overall, as temperatures increase and snowmelt contributions to the PAD decrease, a shorter ice season, less ice cover, and increased thermal ice break-ups are likely to result. They report that, as a result of climate change, the ice season duration in the PAD is likely to be reduced by 2 to 4 weeks (Peters, 2016; Timoney, 2013; Andrishak and Hicks, 2008; Beltaos et al., 2008; Beltaos et al., 2006) and the maximum extent of ice cover on the Peace River will also likely be reduced (Andrishak and Hicks, 2008). Ice cover is also projected to be thinner than current levels (Beltaos et al., 2008; Beltaos et al., 2006a). Based on future climate modelling of future (2070-99) versus recent (1961-90) climate, Beltaos et al. (2006a) estimated the ice cover thickness at Peace Point would be reduced by up to 20%.

As mentioned earlier, “a large part of the Peace River basin is expected to experience frequent and sustained mid-winter thaws” (Beltaos et al., 2008, p. 345). In combination with reductions in ice season duration and ice cover thickness, this will cause “significant melt and depleted snowpack in the spring, leading to severe reduction in the frequency of ice-jam flooding” (p. 345). Prowse et al. (2006) also projected the frequency of ice jams in the PAD would be further reduced because of reduced snowpack. The projected reduction in ice-jam flooding frequency in the PAD will likely produce “significant declines in the effectiveness and frequency of the ice-jam mechanism in causing flooding in the perched basins of the PAD and similar declines in flow reversals due to the demise of the hydraulic damming effect of the Peace River” (Carver, 2013, p.31), which will severely limit the replenishment of highly elevated perched basins in PAD. This reduction in flow reversals and perched basin recharge, in turn, will likely

“accelerate the loss of aquatic habitat in the PAD region” (Beltaos et al., 2006a, p. 4031). Prowse and Conly (1998) also note, in the future, climate factors could “favour the development of thermal over dynamic break-ups, and hence reduce the probability of severe ice-induced flooding” (p. 1606).

6.4 PROJECTED FUTURE TRENDS FOR THE DESIRED OUTCOMES

The assessment of cumulative effects on the desired outcomes for the WBNP includes past activities (and past climate change), in conjunction with other reasonably foreseeable future activities and future climate change. As illustrated in Figure 6-9, the methodological approach to assess the cumulative impact to the desired outcomes for the WBNP consists of the following steps:

- Document the pathways of effects and trends currently being experienced on desired outcomes for the WBNP resulting from existing levels of development (see Chapters 4 and 5 and summarized in Table 6-9);
- Identify the reasonably foreseeable future projects that may contribute to pathways of effects; (see Section 6.2)
- Determine the potential effects on PAD valued components from future climate change (see Section 6.3); and
- For each primary pathway of effect and desired outcome for WBNP, project the likely future trends resulting from future climate change and reasonably foreseeable development.

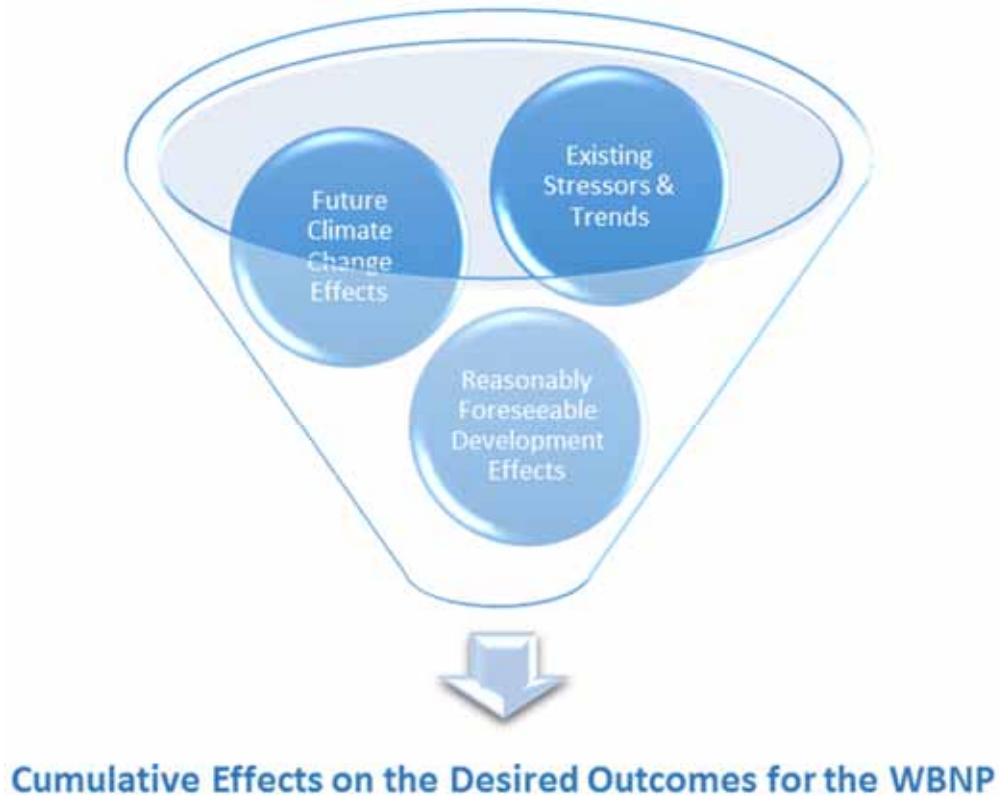


Figure 6-9: Contributory Factors in Creating Cumulative Impact to the World Heritage Values of the WBNP.

The potential cumulative effects are managed using a suite of tools with the objective of keeping the impacts within levels deemed acceptable. For example, in the Northwest Territories, a framework illustrated in Figure 6-10 was used to demonstrate the suite of tools that were used to manage cumulative effects (Indian and Northern Affairs Canada, 2007). While a full explanation of the existing and proposed tools being used to manage cumulative effects is beyond the scope of this assessment, some explanation of the cumulative effects management tools is helpful context. It is important to note that the tools are developed and applied by the various responsible jurisdictions.



Figure 6-10: Environmental Stewardship Framework Used in the Northwest Territories (Indian and Northern Affairs Canada 2007)

Table 6-9: Pathways of Effects Identified in Chapter 4 and 5

Primary Pathway of Effect	Secondary Pathway of Effect	Receptor
Peace River Seasonal Flows	- Invasive species - Changes in habitat and food availability for migratory waterfowl - Changes in bison habitat from drying and fewer flooding events - Ice jam and open water recharge - PAD Water Quality	Great Plains Boreal Grasslands Migratory waterfowl Wolf-Bison Relationship Indigenous people
Athabasca River Annual & Seasonal Flows		
Groundwater Quality & Quantity in Athabasca Basin		
Groundwater Quality & Quantity in Athabasca Basin		
Air Quality	- PAD Water Quality - Exposure to contaminants in water, food and sediments in the PAD of migratory waterfowl	Migratory waterfowl Indigenous people
Athabasca River Water Quality		
Fire suppression		
Increased linear corridor density and habitat changes surrounding WBNP		Great Plains Boreal Grasslands Wolf-Bison Relationship
Disease management and hunting outside WBNP	Changes resulting from changes in other prey species populations	Wolf-Bison Relationship
Hydrological changes in karst/Whooping Crane nesting area	Changes in habitat and food availability in nesting habitat for Whooping Crane	Karst Whooping Crane
Short-term exposures to contaminants in local migratory habitat		Migratory waterfowl Whooping Crane
Changes to habitat and food availability in local migratory habitat		Migratory waterfowl Whooping Crane
Invasive species		Great Plains Boreal Grasslands Salt plains
Changes in local migration routes		Migratory waterfowl

6.4.1 Peace River Seasonal Flows

Potential Future Impacts from Development and Climate Change

The reasonably foreseeable projects on the Peace River, as described in Section 6.2, include one proposed oil sands project in the Peace River Basin, as well as the Site C project (currently under construction) and the proposed Amisk hydroelectric project.

The Site C EIS did not assess the cumulative effects of existing hydroelectric development on the hydrologic flow regime in the Peace River. In its review of the Site C project, the Joint Review Panel (the Panel) report the cumulative effects assessment by BC Hydro “did not provide the Panel with a full understanding of past activities that cumulatively interact with present and future ones” (Government of Canada, 2014, p. 259). The Panel notes that existing hydroelectric developments, particularly the Bennett Dam, had a large impact during initial construction and operation and that some of those effects are ongoing and would act cumulatively with the Site C project. The Panel also determined that the assessment should have considered effects using a pre-industrial baseline starting around 1950, before the construction of the Bennett Dam, and notes “an assessment based on existing environmental conditions does not accurately reflect incremental effects on VCs” (Government of Canada, 2014, p. 259). Further, the Panel notes that the assessment should have included the Bennett and Peace Canyon Dams in order to take into account the “effects that occurred in the past that may not be reflected in the current baseline (e.g. loss of riparian habitat)” (p. 259). Finally, the Panel concludes that, considering the information available on the Bennett and Peace Canyon Dams (including first-hand and second-hand Traditional Knowledge, anthropological studies, air photos, environmental impact studies, research from various provincial and independent bodies, and historic maps of changing land tenure), “BC Hydro could have done more to provide the ‘qualitative analysis and conclusions’ that are missing in the assessment” (Government of Canada, 2014, p. 259).

As noted in Chapter 5 of this report, seasonal flow rates on the Peace River have become much less variable due to flow regulation on the river and (past) climate change, resulting in decreased summer flows and increased winter flows (Peters, 2016; Dube and Wilson, 2013; Carver, 2016; Carver, 2013; Timoney, 2013; Golder Associates, 2012; Teck Resources, 2011c; Candler et al., 2010; Glozier et al., 2009; Prowse et al., 2006; Schindler and Donahue, 2006; Prowse and Conly, 2002; Prowse et al., 2002a, Peters and Prowse, 2001). The changes to the winter flow regime in the Peace River and (past) climate change have decreased ice jam flooding frequency (Beltaos, 2018; Beltaos, 2016; Carver, 2016; Beltaos, 2014; Carver, 2013; Dube and Wilson, 2013; AECOM, 2010; Peters and Buttle, 2010; Beltaos et al., 2008; Davidson and Hurley, 2007; Beltaos et al., 2006; Peters and Prowse, 2006; Prowse et al., 2006; Prowse and Conly, 2002; Prowse and Conly, 1998; Wrona et al., 1996; Peterson and Courtorielle, 1992), resulting in higher freeze up elevations, decreased ice jam flooding frequency, and reduced flooding of perched water basins in the PAD.

As noted in Section 6.3.2, relevant literature indicates future climate changes will likely cause less water to be available in the PAD due to reduced average annual peak, spring peak, and summer flows on the Peace River. In addition, mid-winter thaws and earlier delivery of meltwater to the PAD may cause winter flows and winter water/ice levels to further increase from current levels. In addition, several researchers have predicted major changes to ice-jam flooding frequency in the PAD as a result of climate change in

the future. Predictions include a shorter ice season, less extensive ice cover, thinner ice cover, and increased thermal ice break-ups. This may result in the reduced hydraulic damming effect of the Peace River, which could further reduce the frequency of ice-jam flooding, and perched basin recharge in the PAD. These effects may accelerate the loss of aquatic habitat in the PAD region, presenting a potential risk to the normal ecological function of the PAD in the future.

The documented changes to the flow regime in the Peace River to date, in conjunction with the potential changes from reasonably foreseeable hydroelectric development and future climate change, could further affect seasonal flow rates on the Peace River, ice jam flooding frequency, and perched basin recharge in the PAD. Thus, the projected trend for the desired outcome of both 1) flow regimes and water quality into the PAD maintain the ecological function of the ecosystem and 2) flow regimes into the PAD sustain vegetation communities and healthy and abundant populations of key ecological and cultural species including waterfowl, muskrat, fish, bison and wolves are negative.

Currently, some of the management tools in place include: the Mackenzie River Basin Transboundary Waters Master Agreement, monitoring and reporting of surface water flow rates on the Peace River, groundwater and surface water allocations, water licences and environmental approvals for individual projects. In addition, two management tools focused more on cumulative effects have been proposed to manage flows on the Peace River. The Lower Peace Region Regional Plan and the associated surface water quantity framework is proposed to manage surface water flows within Alberta. A British Columbia – Alberta Bilateral Water Management Agreement could be used to manage the cumulative flows from British Columbia.

6.4.2 Athabasca River Seasonal Flows

Future Development Water Use Predictions

In 2011, the estimated net use of surface water in the Athabasca River basin was 143,483,558 m³/year, or 4.6 m³/s (Government of Alberta, 2015a). The majority of surface water used was 3.3 m³/s (102,686,300 m³/year) used by the oil sands and 1.3 m³/s (10,197,258 m³/year) used for other purposes (Government of Alberta, 2015a). The actual surface water withdrawn by conventional oil sands mines in 2016 from the mainstem Athabasca River was approximately 111.5 million m³/year, or an average of 3.53 m³/s (AEP, 2017b and Islam and Leibel, 2018). It is projected that by 2030, the oil sands will have an average demand of 16 m³/s (505 million m³/year), with an associated peak demand rate of 29 m³/s in the summer and fall seasons (Ohlson et al., 2010).

It is unclear whether surface water withdrawal rates listed above for oil sands facilities are only for the Athabasca River mainstem and, as a result, may not include tributaries such as Firebag, Muskeg, and Ells Rivers, which are not captured by the hydrologic station at Fort McMurray. Thus, actual withdrawal rates affecting the Athabasca River system may be greater. In addition, rain water and water from muskeg and peat lands is also being collected and stored for use by oil sands facilities, which may be lowering surface water runoff volumes into the Athabasca River system. As discussed by Gibson et al. (2016), surface water runoff into the Athabasca River from drainage from peat lands is widely important and dominant in three tributaries, including the Clearwater River, Mackay River, and Ells River, accounting for 45–81% of annual streamflow. Additional information regarding current surface

water withdrawal rates from Athabasca tributary rivers, as well as surface water diversion volumes, is needed to further assess the effect on surface water quantities in the Athabasca River system from existing facilities.

Projections of Climate Change and Development Impacts to Ecological PAD Values

Currently, some of the management tools in place include: the Mackenzie River Basin Transboundary Waters Master Agreement, monitoring and reporting of surface water flow rates on the Athabasca River, groundwater and surface water allocations, water licences and environmental approvals for individual projects.

In 2015, the Government of Alberta introduced the Lower Athabasca Region Surface Water Quantity Framework for the Lower Athabasca River (SWQMF) (Government of Alberta, 2015a). The SWQMF's objective is to "manage cumulative water withdrawals to support both human and ecosystem needs, while balancing social, environmental and economic interests" (Government of Alberta, 2015a). Weekly flows of the Athabasca River measured at the McMurray station (Water Survey of Canada gauge 07DA001) are compared to the management triggers to determine the applicable limits on how much water is available for cumulative mineable oil sands water withdrawal for each week of the year. The weekly management triggers and water withdrawal limits are divided into five seasons: Mid Winter, Early Spring, Late Spring, Summer/Fall, and Early Winter. Each of these seasons has distinct weekly flow triggers and corresponding cumulative water withdrawal limits (AEP, 2017b).

Based on projections of future water withdrawals, the SWQMF puts in place weekly cumulative water withdrawal restrictions for the Athabasca River, where peak withdrawals of 29 m³/s would be allowed only in summer and fall when weekly flow rates in the river are greater than 111.6 m³/s (AEP, 2017b). AEP further notes "cumulatively, licensed pumping capacity for mineable oil sands projects may eventually exceed this (peak 29 m³/s) limit. Water sharing agreements will identify how water management decisions will help ensure maintenance of the limit" (AEP, 2017b). It is also important to note the following:

- 1) Some existing conventional oil sands projects will likely be decommissioned before new projects begin production;
- 2) All but three of the reasonably foreseeable projects are thermal, in-situ projects with limited surface water requirements;
- 3) New processing technologies will likely be developed to decrease water demands for the three proposed conventional mining projects, however there are significant start up water volume requirements for these projects;
- 4) The thermal projects will likely draw groundwater, rather than surface water from the Athabasca River; and
- 5) Some oil sands facilities store water during high flow periods for use during low flow periods

In the SQWMF, cumulative water withdrawal limits are based from weekly flow rates in the Athabasca

River and when flow rates fall below trigger values during low flow periods, total water withdrawals are reduced, potentially requiring some operators to ‘pro-rate’ their withdrawals based on the flow rate in the Athabasca River (Government of Alberta, 2015a). Surface water withdrawals during low flow periods are also of concern in relation to future projects on the Athabasca River, particularly in relation to fall and winter periods. If weekly winter flow rates in the Athabasca River fall below 87 m³/s (shown in Figure 6-11, as per the SWQMF minimum flow trigger), the cumulative water withdrawals from the river are limited to 4.4 m³/s (AEP, 2017b). From 1965 to 2010, the lowest winter flows in the Athabasca River ranged from 90 to 250 m³/s and the lowest weekly flow experienced since monitoring began was 88 m³/s (Government of Alberta, 2012a). This represents, as Carver (2013) reports in several low flow months from 2005 to 2008, withdrawals ranging from 4 to 6% of monthly Lower Athabasca River flows.

As described in Section 6.3.3, future climate change may cause increased winter melt and winter flows, greater spring and annual flow volumes, lower summer flows and levels, and/or decreasing low winter flows in the Athabasca River. While the cumulative water withdrawal limits set for oil sands projects would likely not have an effect on the Athabasca River during increased spring and winter flows, they could have a substantial effect during periods of decreased winter, spring, summer, and fall flows. As shown in Figure 6-11 (based on Figure 5-13), summer flows in the Athabasca River could decrease by up to 21% in the future due to climate change, as projected by Eum et al. (2017).

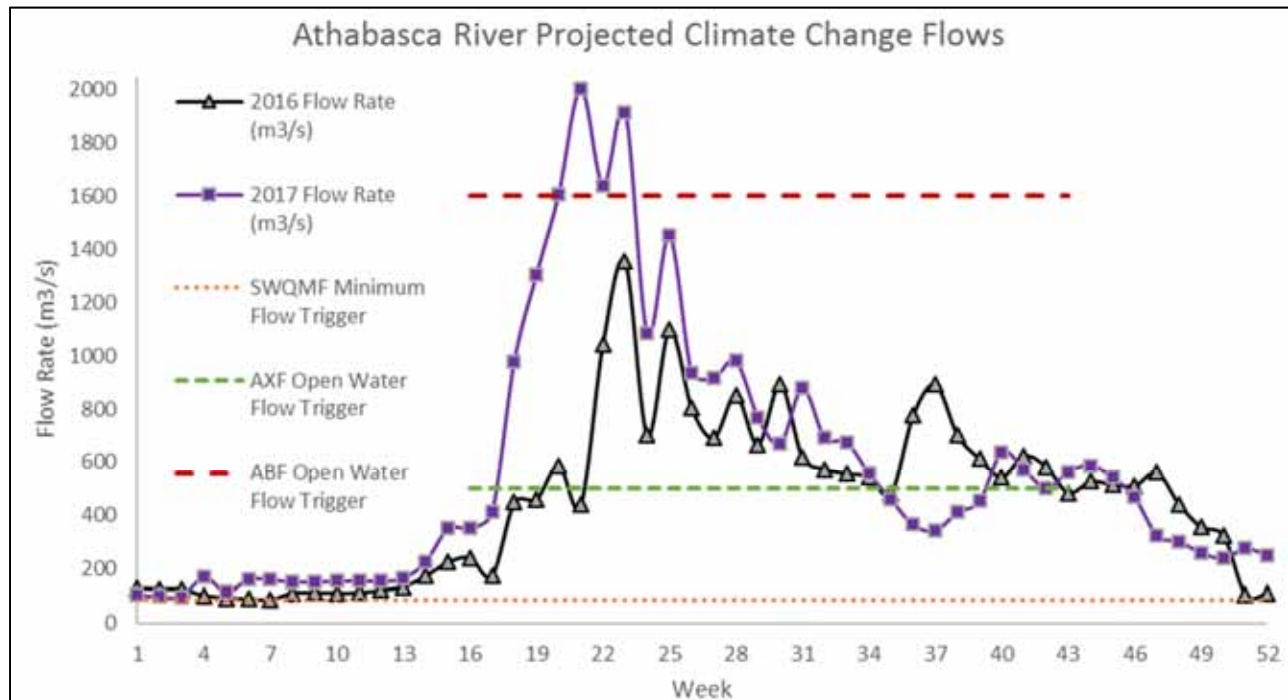


Figure 6-11: Weekly Athabasca River Flow Rates for 2016 and 2017 Under a Climate Change Modified Flow Regime*

(Notes: 21% reduced summer flows as per Eum et al., 2017; 10% reduced winter flows as per Bruce, 2006; earlier spring freshet by 2 weeks as per Pietroniro et al., 2006, 10% reduced fall flows (estimate), 10% increased spring flows as per Eum et al., 2017 and Pietroniro et al., 2006; winter weeks 44 to 13, spring weeks 14 to 23, summer weeks 24 to 38, fall weeks 39 to 43, open water season from 16 to 43; *not considered year over year reductions/additions in flow)

In addition, an extended spring freshet could begin two weeks earlier and could increase spring flows in the Athabasca by up to 10% in the future due to climate change, as projected by Eum et al. (2017) and Pietroniro et al. (2006). Finally, winter flows could decline by up to 10%, as estimated by Bruce and Tin (2006). In this case, flow rates could reach or fall below the weekly winter flow rate trigger of 87 m³/s, when water withdrawals from the river are allowed, up to a total limit of 4.4 m³/s. Further, as shown in Figure 6-8, the low flows in the Athabasca River could potentially be as low as 37 m³/s by 2050 (Bruce, 2006). If future cumulative water withdrawal limits are kept at current levels of 4.4 m³/s, this is equivalent to almost 12% of weekly flow (and rising as flow declines), which will likely have downstream effects on the PAD. If withdrawal limits are set at 5% of low flow, the cumulative water withdrawal limits during low flow periods in the future will be approximately 1.9 m³/s. It is unlikely this is a practical or achievable rate for future oil sands demands, considering a projected four-fold increase in average water demand from future oil sands development by 2030 alone.

Thus, the potential additional withdrawals of water from reasonably foreseeable oil sands projects, in conjunction with projected climate change, could further negatively impact the water flows in the Athabasca River and the PAD. Thus, the projected future trend for the desired outcome of both 1) flow regimes and water quality into the PAD maintain the ecological function of the ecosystem and 2) flow regimes into the PAD sustain vegetation communities and healthy and abundant populations of key ecological and cultural species including waterfowl, muskrat, fish, bison and wolves is negative.

The withdrawal limits discussed above from the SWQMF (Government of Alberta, 2015a) provide mitigation for the world heritage values, but the limits were set with limited knowledge about the implications for the world heritage values. The SWQMF acknowledges gaps in ecological knowledge about: winter habitat in the delta (though said to later have been addressed), riparian vegetation and aquatic mammals in the delta, access to tributaries, Richardson Lake connectivity (in the Athabasca Delta), Big Egg Lake connectivity (perched basins), and dissolved oxygen in some parts of the Athabasca River. Thus, not only are there concerns about the future achievability of the current limits, but it is unknown if the current limits adequately protect the ecological world heritage values in the PAD right now.

Projections of Climate Change and Development Impacts to Access by Indigenous People

As shown in Figure 6-11, summer flows in the Athabasca River could decrease by up to 21% in the future due to climate change. In this case, flow rates below the Aboriginal Extreme Flow (AXF), set at 500 m³/s, could be seen in some late summer weeks. In addition, if fall flows decline by up to 10%, flow rates could reach or fall below the AXF in the fall. In addition, given winter low flow withdrawal restrictions, some operators store river water in surface reservoirs during higher flow periods for use during low flow periods (Imperial Oil, 2017). However, this restriction may prompt additional removal of surface water from the Athabasca River during the fall season, which could impact the AXF during the critical fall hunting period, as shown in Figure 6-11 (See Section 0 for explanation of AXF) (Carver and Maclean, 2016).

The SWQMF considers access by Indigenous people through the Aboriginal Navigation Index (ANI). While the general limits in SWQMF mitigate effects to Indigenous access, the ANI application in the SWQMF does not mitigate impacts on access by Indigenous people. There are two problems.

1) Not Mitigating

The ANI is calculated after the fall season is over as a mean fall-season value based on an average of weekly flows throughout the fall. Given that the calculation occurs after the impacts have occurred, it is not possible to mitigate them. In addition, even if the ANI threshold was crossed, the resulting management action is investigation, not mitigation.

2) Not Addressing Cumulative Effects and Incremental Impacts

The ANI is based on the contribution of the oil sands water withdrawals. As long as their contribution to lower water levels remains small, the ANI threshold is not crossed. Most cumulative effects occur as a result of many small contributions, often from different sources. As a result, to mitigate the effects, even small contributions may need to be mitigated so that the overall result of all those small mitigations adds up to sufficient mitigation. Even small withdrawals of water may need to apply mitigations so that overall impacts are reduced.

The second issue with this approach is that it assumes that a small increase in an already large problem is insignificant. Under this assumption, if water levels are already very low due to a dry season, any small addition to this problem as a result of water withdrawals is considered to be insignificant in comparison to the already great impact of the low water that year. However, this assumption does not reflect the significance of actual impacts from changes in navigation, for example, relating to Indigenous access to harvesting areas in the fall. Access in the fall is of critical importance to Indigenous peoples because it is a key time for harvesting. If they can't travel the Athabasca River and access harvesting areas in the PAD, they can't harvest wildlife and then their freezers are emptier all winter long and costs of store bought food are large. Small changes in water levels (e.g. that last cm of water that allows clearance of a motor) can shift navigation from being possible to impossible, and prevent that extra week of harvesting. A one week difference may seem small, but if it was a key week for waterfowl harvest, for example, it could be very costly socially, culturally and economically.

In summary, while the general limits in SWQMF mitigate effects to Indigenous access, there is no assessment and mitigation to ensure the mitigation is adequate for Indigenous access in the PAD.

6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin

It is important to note existing conventional mining and thermal in-situ oil sands facilities utilize groundwater for production and there appears to be no available data on the actual volumes of groundwater being withdrawn, along with the impact this may be having on the recharge of the Athabasca River system. It is unclear what effect additional conventional mining and in-situ projects may have on groundwater resources in the Athabasca River basin. Although unlikely, significant use of groundwater resources by in-situ oil sands facilities may have an effect on the recharge of the Athabasca River. Gibson et al. (2016), who investigated the partitioning of streamflow sources in the Athabasca River and its tributaries, note groundwater accounts for 39 to 50% of the annual streamflow in the Steepbank River, Muskeg River, and Firebag River. As such, additional developments utilizing groundwater on these tributary rivers may have an impact on the surface water flows of the Athabasca

River in the future. Additional information regarding current and potential groundwater withdrawals by oil sands facilities in the Athabasca River basin is needed in the future to further assess the potential effect from additional in-situ oil sands facilities.

With regard to groundwater quality, the Government of Alberta reports “no significant trends in key indicators have been recorded since initial sampling in 1975” for the Northern Alberta Oil Sands area (NAOS), however they note “there is poor to fair knowledge of groundwater quality in the surficial sands and buried channels within the NAOS area, as well as the basal McMurray Formation” (Government of Alberta, 2012b, p. 20). For the SAOS, knowledge of “groundwater quality conditions in the various key aquifers beneath the SAOS area is limited both from a temporal and spatial perspective” (Government of Alberta, 2012b, p. 21). From this assessment, it is clear that much more information is required in order to obtain an accurate picture of groundwater quality conditions in the NAOS and SAOS. More targeted and localized scientific studies may be required in the future in order to obtain additional information on groundwater quality to assess impacts from point sources. In summary, given the limited information about the current status, the future withdrawals from reasonably foreseeable development, and the impacts of climate change, the future trend is considered unknown.

The municipal, agricultural, and industrial use of groundwater in the province of Alberta is mainly governed by the provincial *Water Act* (through the issuance of water allocation licenses) and industrial activities that may impact groundwater are assessed as part of Alberta’s *Environmental Protection and Enhancement Act* (Government of Alberta, 2012b). As part of any industrial approval application, key policies and legislation reviewed include the Alberta Tier 1 and Tier 2 Soil and Groundwater Remediation Guidelines (AEP, 2016; AESRD, 2014), the Water Conservation and Allocation Guideline for Oilfield Injection (AENV, 2006), and the Alberta Environment Guide to Groundwater Authorization (AENV, 2011).

Historically, groundwater conditions have been monitored in the lower Athabasca region for the last 20 to 30 years through site-specific monitoring programs at oil sands facilities (Government of Alberta, 2012b). The Alberta government’s Groundwater Observation Well Network (GOWN) monitored regional groundwater conditions from the 1970s to the 1990s, however the program was put on hiatus until 2009, when the Groundwater Management Framework was established. In 2012, the Government of Alberta issued their Groundwater Management Framework for the Northern Athabasca Oil Sands area (NAOS - north of Fort McMurray) and began the development process for the Southern Athabasca Oil Sands area (SAOS - south of Fort McMurray) as part of the Lower Athabasca Regional Plan (LARP) (Government of Alberta, 2012b). The NAOS encompasses 18,000 km² north of Fort McMurray and the SAOS area encompasses 35,215 km² south of Fort McMurray, as shown below in Figure 6-12. With the exception of 2015, since 2012 groundwater monitoring has been conducted each year in the NAOS and SAOS.

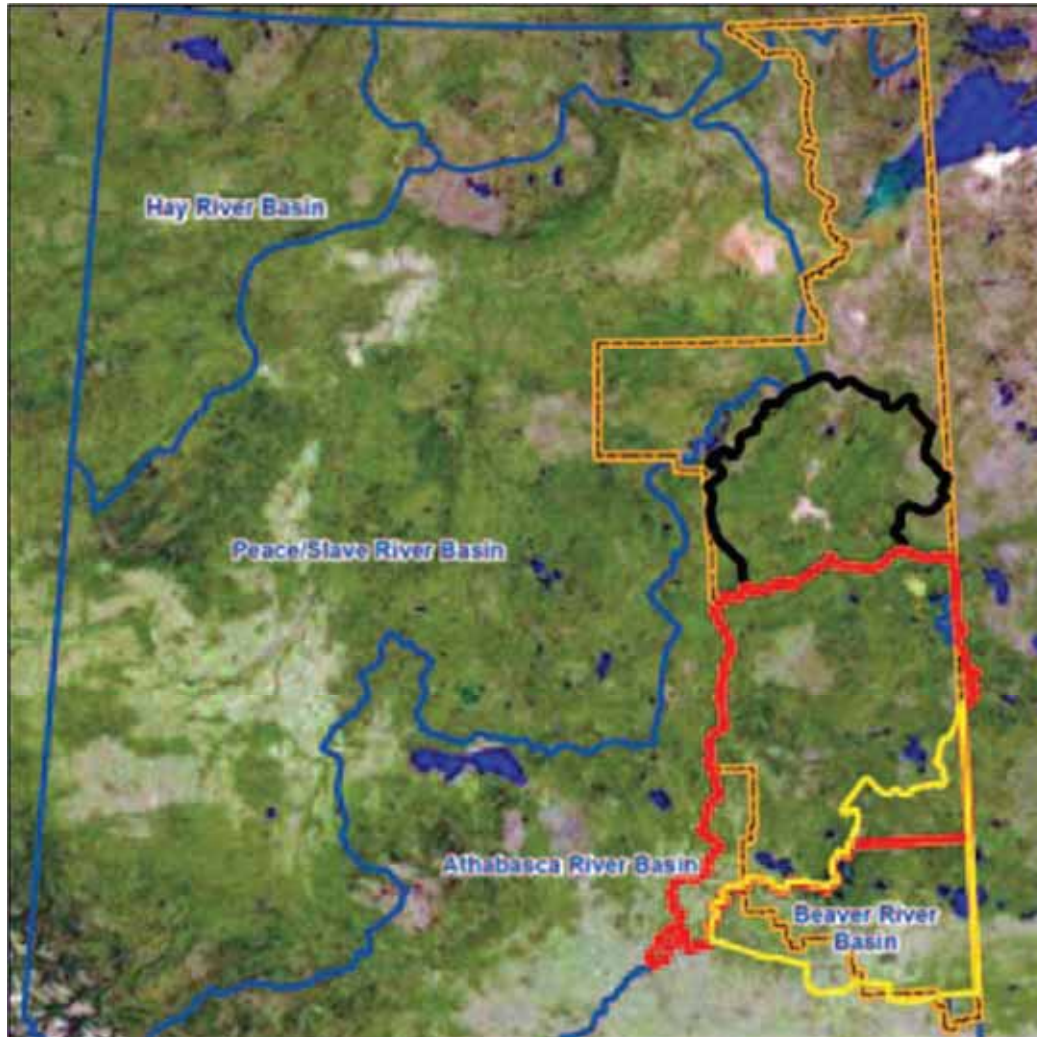


Figure 6-12: Map of the Groundwater Management Areas (Notes: NAOS shown in black and SAOS shown in red) (from Government of Alberta, 2012b)

As part of the Groundwater Management Framework, the Government of Alberta developed interim groundwater quality triggers in the NAOS and the SAOS. As they note “knowledge of the region’s groundwater resources is incomplete and continues to develop...The interim regional triggers will be compared to measurements taken at monitoring wells identified as representative of regional quality (i.e., not to compliance wells on industrial sites)” (Government of Alberta, 2012b, p. 26).

With regard to groundwater quantity, the available drawdown estimated in the various aquifers in the lower Athabasca region was assessed as substantial (Government of Alberta, 2012b). Further, for the NAOS “initial high-level estimates of groundwater volumes and recharge in the Lower Athabasca Region suggest a significant and sufficient volume to accommodate the current level of development and water use. However, additional data is required from future monitoring and assessment initiatives to refine these estimates and help facilitate future determination of sustainable yields for the regional aquifers in the NAOS area” (Government of Alberta, 2012b, p. 20). In addition, the Government of Alberta notes “at the current time, there are no interim regional (groundwater) quantity triggers. In their absence, a

guideline [described below] exists for the in-situ industry with respect to the amount of water that can be safely used in support of bitumen recovery or injection for enhanced oil recovery” (Government of Alberta, 2012b, p. 26).

The Water Conservation and Allocation Guideline for Oilfield Injection (AENV, 2006), mentioned in the quote above, states “an applicant that proposes to use non-saline groundwater for underground (oilfield) injection will be restricted to a maximum of one-half of the long-term yield of a given aquifer in the immediate vicinity of the water source well. This will be accomplished by limiting drawdown in the production aquifer, as measured in the observation well at a distance of 150 m from the production well, to 35% during the first year of operation and no more than 50% over the life of the project” (p. 27). However, as described above, the cumulative effects of following this guideline are unknown.

6.4.4 Air Quality

As noted in Section 5.7, both science and ITK have indicated a downward air quality trend resulting from poorer air quality at certain times in the year. Further, Section 5.7.1 outlines the potential for long-range atmospheric transport of contaminants, such as metals and PAHs, from the oil sands region to the PAD, ranging anywhere from 50 km to 100 km from the source (Willis et al., 2018; Cooke et al., 2017; Landis et al., 2017; Manzano et al., 2017; Manzano et al. 2016; Kirk et al., 2014; Landis et al. 2012). Further, ECCC’s air quality model for air deposition impacts resulting from oil sands development (August 2013 through July 2014 model simulations) predicted critical load exceedances within the WBNP for: (a) terrestrial ecosystems, along the south-western border, (b) aquatic ecosystems with respect to sulphur deposition, in the park’s south and south-western portions, and (c) aquatic ecosystems in throughout much of the park (Makar et al., 2018).

Given these findings, the fact the proposed Teck Frontier project is located within 30 km of the south border of the WBNP indicates a potential increased risk to the air quality of WBNP. However, the current downward air quality trend is relatively weak and the Teck Frontier project is currently being reviewed through the environmental assessment process and mitigation measures are not known for this project. Thus, the future status of the air quality trend for the WBNP world heritage values is unknown.

Currently, some of the management tools in place include: JOSM monitoring, environmental approvals for individual projects, and a number of federal and provincial frameworks described below. Federally, air quality targets are set and managed through the *Canadian Environmental Protection Act* and work of the Canadian Council of Ministers of the Environment (2014a), among other tools. The federal, provincial, and territorial governments are working collaboratively to improve air quality through the implementation of the Air Quality Management System (AQMS). Under the AQMS, each province and territory is delineated into one or more air zones. These air zones provide focal points for stakeholders and governments to work together in order to improve air quality and maintain air pollutant concentrations below established Canadian Ambient Air Quality Standards (CAAQS).

Air zones provide guidance for assigning priority to those areas where air quality is approaching or exceeding the CAAQS or where populations and the environment are most at risk. As a result, the Alberta government published the Lower Athabasca Region Air Zone Canadian Ambient Air Quality Standards Response Government of Alberta Action Plan (September 2017).

(<http://aep.alberta.ca/air/management-frameworks/canadian-ambient-air-quality-standards/documents/LowerAthabascaCAAQS-ActionPlan-Sep2017.pdf>).

In Alberta, the Air Quality Management Framework for the Lower Peace Region has not been completed. An Air Quality Management framework is available for the Lower Athabasca Region. This Framework includes the area immediately outside WBNP (i.e. Fort Chipewyan), but not WBNP World Heritage Site (Government of Alberta, 2012c). It is unknown if mitigation for Fort Chipewyan would be adequate for WBNP World Heritage Site.

Air quality in the Lower Athabasca Region is monitored by the Wood Buffalo Environmental Association (WBEA) through contracts with the Environmental Monitoring and Science Division (EMSD) of the Government of Alberta. The 23 WBEA air monitoring stations include continuous and intermittent monitoring at facility fence line, community, and background locations for the following contaminants, which may be naturally present and/or associated with regional developments, include carbon monoxide (CO), hydrogen sulphide (H₂S), total reduced sulfur (TRS), ammonia (NH₃), nitric oxide (NO), nitrogen dioxide (NO₂), nitrogen oxides (NO_x), ozone (O₃), particulate matter (PM_{2.5}), sulfur dioxide (SO₂), total hydrocarbons (THC), and methane/non-methane hydrocarbons (CH₄/NMHC). However, it is important to note the Lower Athabasca Region Air Quality Management Framework assesses regional ambient quality using only Sulfur Dioxide (SO₂) and Oxides of Nitrogen (NO_x) and there is only a single monitoring station within the PAD region at Fort Chipewyan. The air quality rating is calculated as the Air Quality Health Index (AQHI). Lower Athabasca Region's Air Quality Management Framework does not include important elements, such as odours, flaring, CO₂ and particulate matter that can degrade the world heritage values of the park.

Environment and Climate Change Canada began monitoring air quality in WBNP in 2014 through its Canadian Air and Precipitation Monitoring Network (CAPMoN). The Canadian Air and Precipitation Monitoring Network (CAPMoN) is designed to study the regional patterns and trends of atmospheric pollutants such as acid rain, smog, particulate matter and mercury, in both air and precipitation. The WBNP CAPMoN site was installed in collaboration with Parks Canada to address data gaps in air quality and atmospheric deposition in Western Canada. It is located in an area of WBNP free from local pollution sources and monitors ozone, air and precipitation chemistry in real time. Data from the CAPMoN site will be used to evaluate and validate air quality modelling outputs and satellite measurements. Further, the site will provide a baseline for air quality and atmospheric deposition in the WBNP region and for assessment of individual and cumulative impacts on the WBNP.

6.4.5 Athabasca River Water Quality

As outlined in Chapter 5 of this report, the Athabasca River has experienced an increasing trend in concentrations of magnesium, sodium, dissolved aluminum, total selenium, dissolved iron, and dissolved arsenic, as well as PAHs and PACs (Glozier et al., 2018). Elevated PAC concentrations retaining an oil sands chemical signature were found in the lower reaches of the Athabasca River near the southeastern tip of the WBNP and the Richardson, Quatre Fourches, and Birch Rivers (tributary EMP sites) also showed slightly elevated PAC levels in comparison to background values (Glozier et al., 2018). The documented increase in contaminant levels in the Athabasca River, in conjunction with the potential for increased

contaminant levels from reasonably foreseeable oil sands facilities, could affect water quality in the Athabasca River and the PAD in the future.

Further, as noted in Section 5.5.1, dissolved nutrient and metals concentrations increase in the PAD rivers as flow volumes decrease, including phosphorus (TP), dissolved iron, major ions, nutrients, TSS, and turbidity. Presumably, as flow volumes in the Athabasca River are further reduced due to climate change and increased withdrawals from reasonably foreseeable oil sands facilities, concentrations of nutrients and metals concentrations will increase. Thus, based on the potential for increased concentrations of metals, nutrients, and PAHs and PACs in the Athabasca River from reasonably foreseeable projects, combined with the potential for increases in nutrients and metals due to decreasing water flows on the Athabasca River due to climate change, the projected future trend for the desired outcome for water quality in the PAD is negative.

Currently, some of the management tools in place include: JOSM/RAMP monitoring, water licences and environmental approvals for individual projects and the LAR Surface Water Quality Management Framework.

The Regional Aquatics Monitoring Program (RAMP), initiated in 1997, reports on surface water quality in the upstream river basin systems within the Lower Athabasca Region. Notably, there are minimal sampling locations within the PAD beyond Fort Chipewyan.

In addition, the LAR Surface Water Quality Management Framework for the Athabasca River is in effect. Spatially, the framework excludes WBNP World Heritage Site and PAD within it and therefore while mitigating effects on the PAD, it is not designed to ensure that effects are fully mitigated in the context of the cumulative effects being experienced by the PAD. It also excludes certain oil sands-related contaminants (naphthenic acids and polycyclic aromatic hydrocarbons and compounds) and does not require biological measurements such as fish counts, health assessments and bioaccumulation of toxic substances in key species for WBNP.

The lack of monitoring within the PAD and WBNP has led independent researchers and First Nations to undertake community-based monitoring and research programs in an attempt to understand current ambient conditions in surface water quality (see Chapter 5). There is no indication that regulators or companies are using community-based monitoring information to inform decision-making.

6.4.6 Fire suppression

Increases to temperature and decreases in precipitation predicted for the region (see Section 6.3.2) could result in increased fire risk. The management response to this increased risk is important for WBNP's future landscape. The *Parks Canada Wildland Fire Management Directive* (Parks Canada, 2017a) provides fire management guidance, which:

- ensures public and staff safety and the protection of natural and cultural resources by reducing wildfire risk and maintaining an effective fire management capacity;
- maintains and restores EI of park/site ecosystems;

- contributes to the restoration of cultural landscapes and integrates Indigenous Knowledge (IK), including cultural practices in the management of fire;
- demonstrates a commitment to the “PARKS” principles outlined in *Promising Pathways Guide*;
- facilitates unique visitor experiences and learning opportunities

Park fire management plans are used to clarify how these goals are met in an individual park. WBNP does not have an approved fire management plan. Therefore, while fire in WBNP is currently managed such that the long term ecological process is maintained, the park wild fire plan should be finalized to ensure this direction continues. In the absence of a final plan, the trend is assumed to be worsening due to climate change.

6.4.7 Increased Linear Corridor Density and Habitat Changes Surrounding the WBNP

Low impact seismic practices, restoration and land use planning are all mechanisms used to decrease the impact of linear corridor density and habitat loss around WBNP. However even with this mitigation, the reasonably foreseeable developments identified in Section 6.2 are expected to further contribute to this pathway of effect. It is not known if climate change will be a significant contributor to this pathway of effect. The future trend is therefore predicted to be worsening.

As mentioned, a variety of management tools are already in place to manage this effect, including: project assessments, low seismic practices and restoration. In addition, a variety of tools focused on the cumulative nature of effects could be used to manage this pathway of effect, including forest management agreements, species specific plans, and land use plans and associated frameworks.

The Lower Peace Regional Plan has not been completed. There is also no land use plan in this area of the Northwest Territories. As a result, there is an opportunity to address linear corridor density and habitat loss in the development of any future plans.

The Lower Athabasca Regional Plan has been completed and indicates that a biodiversity management framework will be developed including biodiversity indicators and addressing caribou habitat. Alberta has also indicated that a landscape management plan will be developed to manage linear footprint and land disturbance (Alberta Government, 2014).

The Ronald Lake Bison Herd is particularly important, given it is the only disease-free herd to include range in the park. Existing development in their range is already extensive and the proposed Teck Frontier project plans to add to the disturbance, risks are higher for this herd than the others.

6.4.8 Disease Management and Hunting Outside WBNP

The reasonably foreseeable development identified in Section 6.2 could facilitate access for hunting (legal or illegal), for example for the Ronald Lake Bison Herd. However, this contribution to the pathway of effect is likely small. It is unknown if climate change will significantly contribute to this pathway of effect. Likely the more significant impacts on this pathway of effect are not climate change and development, but rather government decisions with respect to disease management. As the current status of bison is unknown and the contributions of proposed development and climate change are small or unknown, the future trend is considered unknown.

Wood Bison are protected under the *Species at Risk Act*. The *Recovery Strategy for the Wood Bison* (ECCC, 2016) has not been finalized. Alberta and Northwest Territories Regulations are intended to protect the healthy herds and the risk of disease transmission to cattle, but there is currently no protection for the Wabasca herd which is presumed disease free and protection for the Ronald Lake Bison Herd does not cover the full herd range.

6.4.9 Hydrological Changes in Karst/Whooping Crane Nesting Area

Changes in hydrology could affect both the karst and the Whooping Crane nesting area. Forestry is the only reasonably foreseeable project that could contribute to this pathway of effect, in combination with climate change effects on hydrology. The hydrology of this habitat is not understood sufficiently to make a prediction about the impacts of climate change and these proposed developments. As a result, the future trend for the related desired outcomes is considered unknown.

Whooping cranes are protected under the *Species at Risk Act*. Critical habitat for the Whooping Crane has been identified in WBNP and protected through identification in the Canada Gazette. The *Whooping Crane Recovery Strategy* indicated that further studies were needed to identify critical habitat beyond WBNP and they would be completed by 2013 (Environment Canada, 2007). Critical habitat has not yet been identified and protected outside of WBNP. Project environmental assessments and forest management agreements are other tools that may be important to manage hydrological changes in the future.

6.4.10 Short-Term Exposures to Contaminants in Local Migratory Habitat

Two proposed developments identified in Section 6.2 will add further tailings ponds area. However, closure and capping of tailings ponds is expected to occur as will over the next 30 years. The trend will depend on the relative speeds of restoration versus expansion, which is unknown at this time.

There is no coordinated approach to mitigating the contamination of migratory waterfowl to oil sands development. However, there is a coordinated Oil Sands Bird Monitoring Plan (St. Clair et al., 2014) for monitoring and project level assessments are used to identify mitigations and an Oil Sands Bird Technical Team whose work includes research on acute and chronic effects on birds that have come into contact with process affected waters.

6.4.11 Changes to Habitat and Food Availability in Local Migratory Habitat

While many of the proposed projects in Section 6.2 are smaller, the reasonably foreseeable developments are expected to continue to impact habitat for migratory waterfowl. Furthermore, the potential success of the restoration of wetland habitat has currently not been demonstrated (Gosselin et al., 2010). The effects of climate change on this pathway of effect are not known. As a result of the reasonably foreseeable developments expected, this pathway of effect is predicted to continue to worsen.

As discussed in Section 6.4.7, a variety of cumulative effects management tools could be used to manage this pathway of effect, including forest management agreements, species specific plans, and land use plans and associated frameworks.

6.4.12 Invasive Species

As a primary pathway of effect, the mechanism for introducing invasive species is not understood. Given that it is not clear to what degree invasive species can enter the salt plains, the future trend remains unknown. For the Great Plains Boreal Grasslands, invasive species would be a negative trend, although the extent of the effect is unknown.

6.4.13 Changes in Local Migration Routes

Not enough is known about what is causing the changes in local migration routes to know whether proposed future development or climate change will contribute to the effect. However, given the already substantial effect, the trend is assumed to continue to worsen in the future without further understanding and intervention.

6.5 SUMMARY

After identifying the reasonably foreseeable development and the projected climate change for the next 30 years, each primary pathway of effect identified in Chapter 4 and 5 was evaluated to predict the future trend. These trends in combination with their current status were then used in Table 6-9 to predict the future trend for each desired outcome. For context to this analysis, the cumulative effects tools being used to manage the pathways of effects were described. The existence of such a broad suite of cumulative effects and other environmental effects management tools is evidence of the evolving sophistication of management of cumulative effects. Only a decade ago, this breadth of tools was not available.

Key observations from the analysis in this chapter are as follows:

- With the PAD and migratory waterfowl desired outcomes already not being met and predicted negative trends, the predicted trends of these desired outcomes are negative.
- With the exception of Whooping Crane, future trends for other desired outcomes were not possible to predict.
- Many tools with the potential to effectively manage cumulative effects have not been completed or were developed without analysis to ensure they were protective of the WBNP world heritage values. While all tools that are in place contribute to the protection of WBNP, if they were not developed with consideration of the world heritage values, it is unknown whether they will adequately protect the world heritage values in the context of the cumulative effects on the world heritage values.

Chapter 7 identifies recommendations to address these issues.

Table 6-9: Projected Cumulative Effects Trends on Desired Outcomes for the WBNP

Desired Outcomes	Does weight of evidence indicate outcome is currently being achieved? ²	What does the weight of evidence indicate with respect valid linkage or pathway of effect between the desired outcome and key stressors? What is the likely current direction of the trend from each stressor? ³				What is the likely future trend direction resulting from all stressors?
		Climate Change (e.g. low rain or snowfall)	Change in Surface Water Quantity (e.g. dams, water removal)	Change in GW and Surface Water Quality (e.g. metals or HC pollution)	Other Impacts	
1. Great concentrations of viable, healthy populations of migratory waterfowl species continue to use WBNP seasonally.	NO	YES ↘	YES ↘	YES ↘	Local Migratory Habitat ↘	↘
2. Adequate quantity and quality habitat, unimpaired by contamination, is available for migratory waterfowl to fulfil all key life cycle stages while present in WBNP.	NO	YES ↘	YES ↘	YES ↘		↘
3. Indigenous groups are able to maintain traditional harvest of waterfowl species and practice their way of life with confidence in healthy, sustainable and accessible populations of waterfowl	NO	YES ↘	YES ↘	YES ↘		↘
4. Flow regimes and water quality into the PAD maintain the ecological function of the ecosystem	NO	YES ↘	YES ↘	Unknown YES↘	Air Quality ↘	↘

² Determined based on chapters 4 & 5 and described in narrative rationale in chapter 6 prior to this table

³ ↗= positive or improving effect on desired outcomes, →= neutral effect ..., ↘= declining or negative effect..., assumes overall anticipated trend from present (2017) to 2050 unless otherwise stated.

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Desired Outcomes	Does weight of evidence indicate outcome is currently being achieved? ²	What does the weight of evidence indicate with respect valid linkage or pathway of effect between the desired outcome and key stressors? What is the likely current direction of the trend from each stressor? ³				What is the likely future trend direction resulting from all stressors?
		Climate Change (e.g. low rain or snowfall)	Change in Surface Water Quantity (e.g. dams, water removal)	Change in GW and Surface Water Quality (e.g. metals or HC pollution)	Other Impacts	
5. Flow regimes and water quality in the PAD sustains vegetation communities and healthy and abundant populations of key ecological and cultural species including waterfowl, muskrat, fish, bison and wolves.	NO	YES ↘	Unknown	YES ↘		↘
6. Indigenous groups have access to the PAD and are confident enough in the health of the PAD to maintain traditional use and way of life through hunting, fishing, gathering, and cultural activities.	NO	Unknown	YES ↘	YES ↘	Air Quality ↘	↘
7. The salt plains remain aesthetically, ecologically and geologically unique in Canada, providing habitat for salt tolerant plants, grazing bison and nesting / staging waterfowl.	YES	Unknown	Unknown	Unknown		Unknown
8. Gypsum karst topography in WBNP remains intact and functioning within natural parameters.	YES	YES	YES	Unknown		Unknown
9. The karst landforms in the park continue to provide some of the finest examples of collapse and pond sinkholes in the world.	YES	YES	YES	Unknown		Unknown

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Desired Outcomes	Does weight of evidence indicate outcome is currently being achieved? ²	What does the weight of evidence indicate with respect valid linkage or pathway of effect between the desired outcome and key stressors? What is the likely current direction of the trend from each stressor? ³				What is the likely future trend direction resulting from all stressors?
		Climate Change (e.g. low rain or snowfall)	Change in Surface Water Quantity (e.g. dams, water removal)	Change in GW and Surface Water Quality (e.g. metals or HC pollution)	Other Impacts	
10. All species and community representatives of the Great Plains-Boreal grassland are present and functioning.	YES	YES ↘	YES - locally ↘	NO	Fire Suppression ↘ Invasive Species ↘	↘
11. These grasslands continue to provide important grazing and calving areas for wood bison.	NO	YES ↗	YES ↘	NO	Invasive Species ↘	Unknown
12. The predator-prey relationship between wolves and wood bison that spend time in the park remains intact and within natural ranges of variation	Unknown	Unknown	YES locally ↘	NO	External development ↘ Disease management ↘	Unknown
13. Populations of bison and wolves remain viable, evolve as naturally as possible and support Indigenous traditional use and ways of life.	NO	Unknown	YES - locally ↘	NO		Unknown
14. Habitat continues to support recovery strategy goals for Whooping Crane breeding pairs and demonstrates resilience to climate change impacts.	YES	NO	YES	NO		Unknown

FINAL REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

Desired Outcomes	Does weight of evidence indicate outcome is currently being achieved? ²	What does the weight of evidence indicate with respect valid linkage or pathway of effect between the desired outcome and key stressors? What is the likely current direction of the trend from each stressor? ³				What is the likely future trend direction resulting from all stressors?
		Climate Change (e.g. low rain or snowfall)	Change in Surface Water Quantity (e.g. dams, water removal)	Change in GW and Surface Water Quality (e.g. metals or HC pollution)	Other Impacts	
15. Whooping crane population reaches recovery strategy goal.	NO	NO	NO	NO	Local Migratory Habitat ↘	↗
16. Recovery and down listing from endangered status.	NO	NO	NO	NO		↗

7.0 CHAPTER 7: RECOMMENDATIONS

Chapters 4 and 5 discussed the pathways of effects (stories of change), current status and trends of aspects of the world heritage values of WBNP. Chapter 6 first described reasonably foreseeable developments in the WBNP region and projected climate change impacts. Based on this, Chapter 6 then projected likely future cumulative effects trends. This final chapter of the SEA makes recommendations in response to the findings about pathways of effects and desired outcomes.

7.1 INTRODUCTION

In order to understand and implement the recommendations in this chapter, the precautionary principle, adaptive management, partnership with Indigenous peoples and robust collaboration are essential and introduced briefly.

7.1.1 Precautionary Approach

The precautionary approach recognizes “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.” (ECCC, 2017). The precautionary approach is applied when there is 1) a lack of full scientific certainty and 2) a risk of serious or irreversible harm.

***“If we don’t save what we have, pretty soon we won’t have anything.”
(NWT Métis, 2018)***

Lack of full certainty

Lack of full certainty is often evident when baseline information is lacking and there are gaps in understanding. The RMM recommendations recognized the need for baseline information. For example, recommendations 3, 7, 6, 8, 9, 10, 16, 17 all focus on gathering more information or undertaking analysis. Similarly, in this chapter there are a number of gaps identified in information. The PAD is a very complex ecosystem. The hydrological ecosystem processes alone are multi-dimensional and in addition to these, fire, predation and other processes are at work. The complexity of developments around the park also adds to the uncertainty. Chapters 4 and 5 demonstrate that there are some emerging lines of consensus and clarity about some impact pathways; however, given the level of complexity in this system there will continue to be some level of uncertainty in determining cause and effect contributions from various activities in the region and their consequent impacts on ecosystem receptors in the receiving WBNP environment.

Risk of serious or irreversible harm

Chapters 4 and 5 document important changes that have been observed within WBNP, and in the PAD in particular. Chapter 6 identifies that at least some of these changes will continue to increase without changes to the management of cumulative effects on the world heritage values of WBNP. Ecologists and Indigenous knowledge holders have already implied that some impacts may already be irreversible given the large amount of change they have seen. For example, Remmer et al. (2018) found that a single ice-

jam flooding event in 2014 was insufficient to mitigate the ongoing declining water availability for more than a season. While the ecological changes may still be reversible, the scale of intervention needed to reverse them may increase the more time passes.

When determining the seriousness of the risk, one must consider the ecological impacts, as well as the context of those impacts and the values associated with them. In other words, the consequences of effects cannot be reversed are higher or lower depending on the values associated with them. In the case of this SEA for WBNP, the risk must be examined in the context of value of the place to Indigenous people, international designations, and the national park designation.

For the Indigenous people of the WBNP region, particularly those using the main water ways and the PAD as well as downstream areas, there are many risks to their current health, culture and ways of life. Furthermore, those who can no longer travel to their traditional areas can no longer pass on their ways of life and stories to future generations. The risk increases that this loss will be irreversible as those who used these areas when they were accessible and healthier grow older.

As a world heritage site, Wood Buffalo National Park is recognized for its outstanding universal value. Furthermore, the designation of two Ramsar wetlands within the park's boundaries also encourage the maintenance and restoration of wetlands where possible. If serious and/or irreversible harm occurred to components of such international designations, the world would face an impoverishment of this international heritage treasure.

Canadian national parks, like Wood Buffalo National Park, are dedicated to the "people of Canada for their benefit, education and enjoyment, ...and the parks shall be maintained and made use of so as to leave them unimpaired for the enjoyment of future generations" (*Canada National Parks Act* s.4(1)). Therefore, if serious and/or irreversible harm was caused to the ecological integrity of Wood Buffalo, Indigenous peoples of the area, and all Canadians, including future generations, will be impacted.

Conclusion

Given the high risk to the health, culture, way of life of Indigenous peoples, the world heritage values, and the ecological integrity of the national park, as well as the possibility of irreversible impacts, the governments at all levels, Indigenous communities and industry should apply the precautionary principle.

You can tell kids, but it's so much better to show them where we pick because they will remember then. If it's too shallow, you can't go out with family and friends.

Quote context: *This is very true! That is why a lot of times we say in meetings that when we tell you stuff some don't really believe it as you don't actually see it (while in a meeting room). I tell my grandkids a lot of stuff when we go camping. "That is good papa." My grandson said "I want to try to be like you, you showed me all that I want to be like you." I. If you want to learn I will open the book (on the land).*

Source: Sloan Whiteknife

About Sloan Whiteknife: *I am George Sloan Whiteknife. I was born and raised in the bush. Ever since then I've always been in the bush. I was taught from my dad to trap and to hunting moose, geese etc. I was always with him and he always used to tell me things. I learned quite a bit from my dad in my past life, and my uncles. I went out with all my relations. We need water. When I say something has to be done, I mean we need more water.*

7.1.2 Adaptive Management Approach

An adaptive management approach is imperative given that there is a considerable need to act in WBNP, even without full understanding and information. The process of adaptive management is “seen as an evolving process that includes learning (the accumulation of understanding over time) and adaptation (the adjustment of management over time)” (Williams & Brown, 2014).

Adaptive management is most effectively applied in ecosystems:

- that are dynamic and have been influenced by changing environmental variables and management actions;
- where environmental change is only partially predictable and often appears as random;
- where management intervention influence the system’s behaviour, directly or indirectly; and
- where traditional management processes are limited by uncertainty in the system behaviour and the lack of knowledge over how management will influence the system.

These characteristics are all present within the PAD.

Adaptive management (Figure 7-1) works to implement and monitor management approaches with the intention of reducing uncertainty over time, and to enable changes in management to be made in based on new information and teachings (Williams & Brown, 2014). Adaptive management is often illustrated by a loop where the formulation of a problem flows “through decision-making, implementation, evaluation, and feedback into problem formulation” (Williams & Brown, 2014).

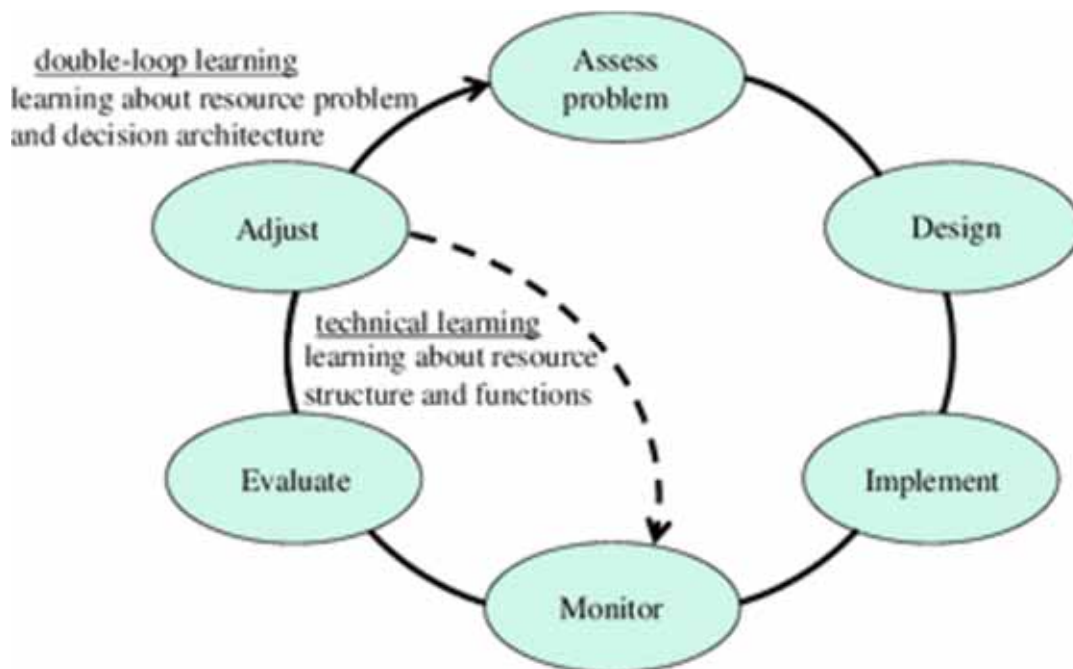


Figure 7-1: Adaptive Management Cycle (Source: Williams & Brown, 2014)

It will be important to apply the adaptive management approach along with the precautionary approach described above as they work in tandem.

7.1.3 Partnership with Indigenous peoples

As the ones whose grocery store, kitchen, school, photo album and culture are most affected by the recommendations of this SEA, Indigenous peoples need to be full partners in the identification, implementation and adaptive management of future management approaches within WBNP. Indigenous peoples experience impacts most directly due to their intrinsic connection to the land. As such, ITK is critical to the advancement of adaptive management solutions. This SEA has attempted to illustrate the complementarity, importance and necessity of inclusion of ITK alongside western science in analysis and decision making.

RMM Recommendations 1, 13, and 14 have recognized the importance of partnerships with Indigenous people. In addition, the mandate letter for the Minister responsible for Parks Canada and Environment and Climate Change Canada calls for a “renewed, nation-to-nation relationship with Indigenous Peoples, based on recognition of rights, respect, co-operation, and partnership”.

7.1.4 Robust collaboration

This SEA does not include a comprehensive analysis of the legal, policy, administrative and governance framework that is in place to protect the world heritage values of WBNP. However, two observations can be made as a result of the SEA process.

First, the existence of already observed effects on the world heritage values described in Chapter 5 means to some degree that the past and present framework for anticipating cumulative effects has not succeeded. While some of the effects observed are more recent, and perhaps one could argue that a response is in progress, other effects have clearly occurred over a longer time scale. Whatever the situation, the fact that effects have been observed indicates additional mitigation is required.

Second, the SEA found that there are multiple legal, policy, administrative and governance components involved in the framework. In the development of the SEA, discussions were held with and/or comments were received from more than 11 Indigenous groups, two provinces, a territory, federal government departments and stakeholder groups. This represents the breadth of groups with a role in protecting the world heritage values of WBNP. In addition, all these groups referred to numerous legal, policy, administrative and governance tools that were relevant to the protection of the world heritage values of WBNP. The extent of the groups and tools considered indicates that collaboration will be foundational to the implementation of recommendations from the SEA to protect the world heritage values of WBNP.

Third, many of the pathways of effects cross jurisdictional boundaries. For example, water flows into the park, wildlife move in and out of the park, migratory waterfowl fly through the park etc. The nature of jurisdictional responsibilities is that a jurisdiction focuses on fulfilling their responsibilities. Yet in order to protect the world heritage values of WBNP it will be necessary for all to look beyond their jurisdictional responsibilities.

While it is true that collaboration has the power to bring positive and improved results, there are also risks that collaborative processes lead to inaction and the lowest common denominator, among other problems. In order for collaboration to result in restoration of and reduced risk to the world heritage values of WBNP, robust collaboration will require careful design and commitment to results by all those involved.

7.2 URGENCY

Since the world heritage designation in 1983, there have been improvements to the Great Plains Boreal Grasslands as fire has been restored to more natural levels on the landscape, to bison as wolf control effects are reduced, and to Whooping Crane populations. However, the status of some of the desired outcomes demonstrates that restoration has not occurred for all desired outcomes and the trends for many are negative. As a result, further action and restoration is urgently needed.

The call for action and action now, was repeated throughout the course of the development of this SEA. Ecological monitoring and ITK have shown that with improved flooding, for example, ecosystems will rebound. However, if the current direction continues, other undesirable permanent shifts are possible. The urgency for Indigenous people to maintain their culture and ways of life cannot be understated. One way Indigenous people transfer knowledge and skills to the next generation is on the land, in the context of carrying out traditional activities. When Indigenous people cannot do this, they risk losing their culture and connections to the land. The longer the time that traditional way of life cannot be carried out due to lack of access, limited resources and/or diminished quality of resources, the higher the risk that the chain of transmission will be permanently broken.

We are here to show/tell you we need action. We are the reasons why. That is why we have our stories.

Quote context: *We are telling you are stories good heartedly. I know the land. The elders know the land all their lives. That is why we call them our scientists. My quote is to explain why they are here. The years' experience they have. This is their true experiences and what they go through. It is the truth today and what they want for the future generations.*

Source: Terri Marten

About Terri Marten: *I was born and raised out in the PAD. I was out there until I was 7 or 8. Then I was in the convent until 16. Then my parents took me out for a year in the bush at 16 or 17. Then I stayed around town with families here. I have always stayed in Chip, in and out from different areas of the PAD.*

7.3 SEA RECOMMENDATIONS

The SEA recommendations were developed to address the findings for desired outcomes, pathways of effects and the SEA in general. Where desired outcomes were not being met, in some cases there is a need for more information to understand the causes for the effects being observed. In other cases, the causes are understood well enough and restoration is needed. Similarly, there is not enough information about some pathways of effects and recommendations are made to investigate. In other cases, there is need to address the cumulative effect tool to adequately mitigate the pathway of effect. Finally, some recommendations were developed as a result of the general learning from the development of the SEA.

The future risk to the desired outcomes identified in Table 6-9 will be significantly reduced with the implementation of these recommendations and the recommendations of the RMM. Given that specific

RMM recommendations are intended to protect and restore the world heritage values, it is appropriate to consider the recommendations of the SEA in this context. Recommendations from the SEA, which are more detailed than the RMM recommendations, were therefore grouped under the same headings as the RMM recommendations. Each of these headings identify lead jurisdiction(s) responsible for developing and implementing the Action Plan. The intent is to provide SEA recommendations to these jurisdictional leads for consideration in the development and implementation of the Action Plan. In recognition of the constraints to this SEA (see Section 1.5.1), it is expected that additional analysis will be needed during the Action Plan development and implementation to confirm the appropriateness of these recommendations and, where appropriate, further develop them.

It should be noted that some of these recommendations have been made before, committed to and are even embodied in legal requirements. Yet, they have not been acted upon or completed. Understanding the urgency of the situation must motivate all those involved to act now.

RMM Recommendations 1, 13 and 14 represent a foundational approach to implementation and, therefore, are not repeated here. RMM Recommendation 2 and 12 relate to capacity required to implement all other recommendations. Completion of this SEA fulfills RMM Recommendation 8 and the 2015 World Heritage Centre decision. The other RMM recommendations are listed below followed by additional recommendations arising from the SEA.

7.3.1 Environmental Flows / Hydrology

Chapter 4 and 5 describe how the desired outcomes related to the PAD and the consequential impacts on migratory waterfowl, Great Plains Boreal Grasslands, and wolf-bison relationship are not being achieved. As a result, action/restoration is required to achieve the desired outcomes (Recommendations 1, 2 and 4). Pathways of effects related to the flows on the Peace River and Athabasca River were found to have expected declining trends in the future due to climate change and reasonably foreseeable development and therefore these pathways of effects need additional information gathering (Recommendations 3, 5 and 6). The following recommendations are made for consideration by the Environmental Flows/Hydrology Working Group.

- 1) Implement cross-jurisdictional cooperation (including Indigenous governments) in order to achieve the world heritage desired outcomes for the PAD and the national park by:
 - Recognizing the fact that water releases are complex hydrological events with potential negative consequences, consult with communities upstream and downstream of the PAD to ensure intervention risks are understood and acceptable.
 - Providing major water releases from the Bennett Dam at appropriate opportunities during the early freshet to encourage ice-jam events capable of flooding the PAD's perched basins
 - Investigating and implementing strategies to promote favourable flooding conditions on the Peace River, involving reducing water flow in late fall to promote lower and thicker ice cover freeze up, as well as increasing water flow during spring freshet and summer open water season.
 - Reviewing the relative success of past attempts to restore flood conditions in the PAD, including the following releases of water from the Bennett dam to inform above work:

- In the spring of 1996, approximately 500 m³/s was released for approximately a week to augment hydrometeorological conditions favourable to ice jam formation (a large spring snowpack, high ice cover strength, and intense spring snowmelt). The augmented release increased the ice-jam flooding near the PAD and increased flood elevations in the PAD by 20 cm (Maclean, 2018).
 - In July of 1996, approximately 5,000 m³/s was released for approximately seven weeks due to of a structural fault (sinkhole) in the dam, resulting in an emergency spill to draw down the reservoir by 3 metres while repairs took place. The spill resulted in the contribution of additional water to the delta through an extended period of flow reversals on delta channels (Maclean, 2018). However, following this spill, water levels were again reduced on the Peace River and water flowing from Lake Athabasca toward the Slave River resulted in the degradation of the winter road and open water on the Rivière des Rochers, causing vehicle damage and loss of life.
- 2) Consider options for strategically placed water management/control structures within the PAD, recognizing flow regulation, water withdrawals, and projected climate change impacts on available water resources and implement using an adaptive management approach, including:
- Reviewing past attempts to control outflow on the PAD, conducting modelling analyses of interventions in Recommendation 1 and climate change, identifying appropriate feasible objectives and evaluating implications of any options for the downstream.
 - Developing options for constructing ice dams, improvement to or additional rockfill weirs, inflatable/gated weirs, and/or retentive/flexible flow barriers at strategic points within the PAD to restore water levels in the PAD in the short term and long term.
 - As noted by MCFN (2007), a control dam on the Quatre Fourches River at Dog Camp would immediately raise water levels in the Delta, and greatly improve water levels in both Lake Claire and Lake Mamawi.
 - Establishing a monitoring system in the PAD to measure ice conditions (thickness and quality), water levels, advise on water release measures, and to verify the effectiveness of physical interventions measures (flow releases and flow barriers) on an ongoing basis.
 - Developing a PAD water management group to monitor the success of implementing water release/control measures.
- 3) Work with Alberta's Climate Change office and federal climate change specialists to determine more precise climate change model projections for the Athabasca and Peace River basins
- 4) Update the water flow framework for the Athabasca River (the Surface Water Quantity Management Framework or SWQMF) to incorporate all three world heritage desired outcomes for the PAD, including:
- Completing the work required to address gaps in knowledge related to impacts to the PAD identified in SQWMF.
 - Including a mechanism that provides mitigation for navigation and access by Indigenous people.

- 5) Install additional monitoring capability at the hydrological stations on the Athabasca River below the Fort McMurray oil sands area, including:
 - Investigating options for the Embarras, Old Fort and/or 27th Baseline stations
 - Investigating the ability to measure water depths to provide data for navigational studies on the Athabasca River.
 - Assessing water quality in terms of flow rates (AECOM, 2010)
 - Estimating sediment and nutrient loads to the PAD
- 6) Install a hydrometric monitoring station on the Peace River at the 5th meridian.
- 7) Develop a hydrologic and hydraulic model of the watershed for the Peace, Athabasca, Lake Athabasca and PAD system that could be used to understand the cumulative impacts of upstream developments and activities and assess restoration options.
- 8) Conduct a water balance of the entire lower Athabasca River basin or, alternately, Fort McMurray downstream to the PAD, and Peace River basin considering:
 - Weekly surface water demand (m^3/s) for oil sands facilities from the mainstem Athabasca River
 - Weekly surface water withdrawals from tributary rivers of the Athabasca River (i.e., not the main stem as measured at the Fort McMurray station)
 - Municipal and other non-industrial water withdrawals
 - Projected weekly start up surface water demand for the three new conventional mine projects coming on line (mainstem AR and tributary)
 - Weekly groundwater demand for in-situ oil sands facilities
 - Projected groundwater demand for reasonably foreseeable in-situ projects coming on line
 - Annual volume of surface water being diverted by conventional and in-situ oil sands facilities from rain/snow and muskeg/peat water
 - Weekly peak demand for surface water for the oil sands (mainstem and tributary)
 - Weekly low flow surface water demand during the winter (if any)
 - Annual volume of in-situ process water being injected into deep formations (and the depth of injection)
 - Groundwater discharge rate into the Athabasca River downstream of the oil sands
 - Water volumes entering the PAD from the Athabasca River
 - Annual estimate of total volume of surface water being removed by conventional oil sands facilities
 - Annual estimate of total volume of groundwater being removed by in-situ oil sands facilities
- 9) In order to determine the difference between climate variability and anthropogenic effects on the Athabasca River over the past fifty years, investigate the naturalized flows (flow conditions that would have existed without the effect of industrial, agricultural, and municipal water withdrawals) below the Fort McMurray hydrometric station.

7.3.2 Environmental Assessment

One objective of this SEA was to inform project environmental assessments. Project environmental assessments are forward looking with an opportunity to prevent future impacts rather than fix them afterwards. The following recommendations support the fulfillment of this objective.

- 10) Submit this SEA to the Joint Review Panel for the Teck Frontier Oil Sands Mine Project for consideration.
- 11) Revise the *Guidelines for the Preparation of an Environmental Impact Statement* for the Amisk Hydroelectric Project to include a requirement to evaluate the effects on the Outstanding Universal Values of WBNP and the effects the project would have on the ability to restore the PAD.
- 12) Refer projects under the *Canadian Environmental Assessment Act, 2012* (or subsequent legislation) and *Mackenzie Valley Resource Management Act* for environmental assessment when they might have significant adverse environmental effects on the World Heritage Values of WBNP world heritage site and evaluate those potential impacts as part of the assessment.
- 13) Include an analysis of the impacts of projects within WBNP on the World Heritage Values of WBNP proportionate to the risk of the project to the World Heritage Values.
- 14) Build on the experience of this SEA by including ITK related to WBNP in project assessments.

7.3.3 Tailings Ponds Risk Assessment

RMM recommendation 6 requested a systematic risk assessment of the tailings ponds of the Alberta Oil Sands region with a focus on risks to the PAD. Chapter 4 and 5 describe how the desired outcomes related to the PAD are not being achieved. The pathway of effect related to the water quality on the Athabasca River was found to have a declining trend and a declining/stable trend in the PAD. As a result, additional work is recommended to reduce the unknowns and understand if the tailings ponds are contributing to the trends in water quality from the Athabasca River. Recommendations related to the tailings pond risk assessment below are for consideration by Alberta in leading this aspect of the Action Plan.

- 15) The evaluation of the risk of the tailings ponds on the PAD and OUV objectives (as described in Chapter 5) should include an evaluation of the probability and consequence of catastrophic failure as well as risks from seepage, VOCs, GHG emissions and bird impacts.
- 16) Ensure active involvement of relevant Indigenous groups in the risk assessment process so that Indigenous views and perspectives are represented and taken into account to support trust in the restoration of resource quality.
- 17) Ensure that the risk assessment captures the cumulative impact of both existing and future tailings ponds facilities within the Athabasca River basin.

- 18) Establish a governance structure and terms of reference for this assessment to be conducted at arm's length from government and industry. The model, terms of reference and findings from the review of the Mount Polley tailings breach in British Columbia may be a helpful guide in this regard.

7.3.4 Conservation Area Connectivity

There are a mix of desired outcomes for wolf-bison predator prey relationship, karst, Whooping Crane and PAD water quality being achieved and not being achieved. However, each includes pathways of effects that are on the border of WBNP. The increased linear corridor density and habitat changes and surface water quality pathways of effects were both found to be expecting additional pressures from climate change and reasonably foreseeable development. The karst hydrology and Whooping Crane changes in nesting habitat and food availability pathways were both found to lack information required to project future impacts. RMM recommendations 10 and 11 relate to creating a buffer around WBNP. More important than a buffer around WBNP, is the ability to situate WBNP as a protected area in an ecologically connected landscape. A suite of different tools could be used achieve this goal, but in order to select the right tools for the right location to achieve the desired outcomes, a systematic analysis must be conducted as outlined in RMM recommendation 11. By systematically evaluating the relevant desired outcomes and pathways of effects for specific locations, the appropriate tools can be selected. Forest management agreements are highlighted as one of those potential tools needing examination. Recommendations below are for consideration by Alberta and Northwest Territories in leading this aspect of the Action Plan.

- 19) When conducting the systematic assessment of options required by RMM recommendation 11, consider:
- Protection of Whooping Crane habitat and supporting hydrology beyond the WBNP boundary
 - Protection of hydrology supporting karst within WBNP
 - Habitat protection for bison herds ranging beyond the WBNP boundary
 - Implications for changes to other species that may affect the wolf-bison relationship such as deer, moose and caribou
 - Opportunities to reduce the risk to water quality
- 20) A number of the forest management agreements bordering WBNP are held by Indigenous groups. These agreements present opportunities for management to address the issues identified in SEA recommendation 18 either through long term conservation forest management agreements, protected areas that permit timber harvesting (permitted in some IUCN category VI parks), Indigenous protected and conserved areas or other effective area-based conservation measures.

7.3.5 Wildlife and Habitat Conservation

There are a mix of desired outcomes for wolf-bison predator prey relationship and Whooping Crane that are being achieved and not being achieved. The following recommendations support the desired outcomes for Whooping Crane and the wolf- bison relationship, respond to the information gaps identified and address pathways of effect related to habitat and hunting/disease management. Note that additional recommendations related to bison and Whooping Crane can be found in Section 7.3.4. Recommendations below are for consideration by multiple jurisdictions in leading this aspect of the Action Plan.

- 21) Analyze bison population data in light of the end of wolf control to better understand the population's natural range of variability.
- 22) Complete the identification and protection of Whooping Crane critical habitat to meet desired outcomes.
- 23) Implement additional measures to protect the Wabasca Bison herd and the entire Ronald Lake Bison Herd range from non-Indigenous hunting.
- 24) While maintaining or restoring the ecological integrity of WBNP, minimize the risk of disease and parasite transmission to or from cattle. Proactively consider implementing management actions that support the wood bison recovery goal of the local population levels being sufficient "to sustain traditional Aboriginal harvesting activities, consistent with existing Aboriginal and Treaty rights of Aboriginal peoples of Canada"

7.3.6 Water Quality

The RMM recommendations did not explicitly include actions related to water quality. Yet, this SEA has shown that there are increasing risks to water quality and the desired outcome is already not being achieved. Identification of actions to mitigate impacts on water quality is particularly difficult as a result of the gaps in understanding, whether because no data have been collected or because monitoring does not show there are concerns, yet issues continue to be identified in the PAD. Following the precautionary approach, action should be taken before water quality effects in the PAD become too difficult or impossible to reverse.

- 25) Consider implementing a water quality improvement plan for each watershed draining into the PAD using inspiration from similar plans from other places with sensitive receiving waters from multiple drainages.

7.3.7 Monitoring and Science

Recommendations below are for consideration by Environment Canada and Parks Canada in leading this aspect of the Action Plan in collaboration with others.

While the lack of understanding of the karst and salt plains is likely not an issue given the current threats, monitoring programs can be designed for these values with limited additional effort. For example,

satellite monitoring could include measurements of the extent of the salt plains. If the Pine Point Mine moves to production, additional research into the hydrology of the region would help to ensure that the information is available during the environmental assessment to ensure desired outcomes for the karst and salt plains are achieved.

26) Opportunistically include monitoring and research on karst and salt plains in other research and monitoring programs.

27) If Pine Point Mine becomes closer to an application for full mine operation, conduct research on hydrological connectivity between the mine site and the karst and Whooping Crane habitat.

Lack of analysis and information are obstacles to achieving the desired outcomes for migratory waterfowl. As a result, recommendations related to these outcomes focus on understanding the situation better.

28) Analyze breeding waterfowl data for the PAD to better define the quantitative objectives breeding bird populations in the PAD and to better understand the relationship between breeding waterfowl population trends in the PAD and elsewhere in North America.

29) Develop a multi-partner project to understand changes in waterfowl migration around WBNP. A key element of this project should be a more detailed exploration of ITK about changes in waterfowl migration. During the SEA discussions, Indigenous land users discussed in much greater detail the changes they had seen by species and differences in spring and fall migration patterns etc. It wasn't possible to explore all this detail in the SEA, but it would be helpful in the context of this project.

30) Establish an approach to monitoring and understanding waterfowl migration numbers and routes.

Chapter 6 predicted that climate change may contribute to the pathway of effect related to fire in the Great Plains Boreal Grasslands in the future. Although the desired outcome is currently being achieved, the WBNP fire management plan is a key tool to maintain habitat across the park in the context of a changing climate.

31) Complete the WBNP fire management plan including consideration of climate change.

ITK was integral to the completion of this SEA and will be important to achieve the desired outcomes and implement the Action Plan, yet multiple Indigenous groups indicated they may have to systematically gather Action Plan related ITK.

32) Support ITK studies that can feed into the Action Plan implementation. A robust monitoring program will be essential as the Action Plan is implemented.

Based on the experience of this SEA, the following recommendations would support all monitoring for all desired outcomes.

- 33) Implement approaches to monitoring for all monitoring recommendations that integrate ITK and science and engage local land users, including Community Based Monitoring programs. The Peace-Athabasca Delta Ecological Monitoring Program provides an example of the approach that could be used.
- 34) Ensure monitoring information and hydrological data is provided by regulatory and industry bodies in a transparent and easily accessible format.
- 35) Ensure data collected by researchers on world heritage values is shared in a manner that it can benefit broader ongoing work.
- 36) Use integrated monitoring approaches, particularly in the PAD, to support understanding in this very complex ecosystem. For example, monitor sediment, ground water, fish, water, snow, wildlife and air in an interconnected manner. This approach can help with understanding the linkages between biota and the dynamic abiotic processes that are characteristic of the PAD.
- 37) Develop and implement objectives to maintain/restore traditional resources (such as bison, muskrat, moose, migratory waterfowl, fish and traditional plants) and biodiversity in the PAD.

Invasive species were found to be a pathway of effect on the desired outcomes for the wolf-bison relationship and Great Plains boreal-grasslands. However, there is still not a lot known about the pathway of effect. As a result, the recommendation focuses on restoration and action, while learning to address gaps.

- 38) Develop and implement adaptive management approaches for managing invasive species (such as thistle) using science and ITK.

The SEA has shown there are increasing risks to water quality and the desired outcome is already not being achieved. There are also gaps in information related to water quality and air quality which these recommendations are aimed at addressing.

- 39) Develop and implement site specific guidelines for water and sediment quality in the Athabasca and Peace Rivers and Athabasca River estuary in Lake Athabasca, including:
 - Referring to CCME 2003 for published approaches;
 - Providing a better information about water quality concerns, particularly for parameters which are associated with the commonly occurring highly suspended sediments, such as total metals, total petroleum hydrocarbons (TPH) including F1-F2 fractions and nutrients.
- 40) Implement a large-scale monitoring program for PACs and PAHs in the PAD, including:
 - Expanding the scope of the current JOSM PAH water monitoring program to snow sampling, spring runoff sampling, and an expanded water sampling within PAD water bodies and tributary rivers;
 - Implement an air quality monitoring program for PAHs and RCSs in Fort Chipewyan;

- Distinguishing between petrogenic vs. pyrogenic PAHs in PAD.
- 41) Update and expand the Surface Water Quality Management Framework for the Lower Athabasca Region to include monitoring stations in the Peace Athabasca Delta, a more comprehensive selection of oil sands related contaminants and guidelines or thresholds relevant to the desired outcomes for the PAD.
 - 42) Implement a fish monitoring program for western Lake Athabasca and the PAD.
 - 43) Develop life-cycle assessment (LCA) for major pollutants such as Hg including global sources when applicable.
 - 44) Initiate a study of natural sources of pollutants originating from bitumen deposits through which the Athabasca River and its tributaries are incised, or other sources responsible for loading of PAD sediments
 - a) Propose measures how to manage natural pollution from bitumen and groundwater in order to manage cumulative effects on the PAD.
 - b) Quantify contribution of tributaries to the mass balance of contaminants of potential concern (COPC'-s) that influence water quality in PAD.
 - c) Assess Birch Mountain contribution to PAD pollution from its natural Black Shale deposits and propose measures to control it.

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VOLUME 2: MILESTONE 3 - FINAL SEA REPORT APPENDICES

Strategic Environmental Assessment of Wood Buffalo National Park
World Heritage Site



Independent Environmental Consultants (IEC)
70 Valleywood Drive, Suite 200, L3R 4T5



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A.1 – AUGUST 2017 DRAFT SCOPING REPORT



DRAFT SCOPING REPORT

Strategic Environmental Assessment of Wood Buffalo National Park

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

This report outlines the key issues to be addressed in the Strategic Environmental Assessment (SEA) and the approach that will be used to undertake the assessment.

1.2 OVERVIEW OF WOOD BUFFALO NATIONAL PARK ECOLOGICAL INTEGRITY AND OUTSTANDING UNIVERSAL VALUES

Wood Buffalo National Park of Canada (WBNP) spans the Alberta/Northwest Territories boundary and at 44,807 square kilometres, it is the largest national park in North America. The land that Wood Buffalo National Park occupies has been inhabited for approximately 2500 years. The park is within Treaty 8 territory. Treaty 8 was signed on July 13, 1899, on the northwest shore of Lake Athabasca in Fort Chipewyan. Treaty 8 guarantees the hunting, fishing and trapping rights of indigenous peoples in order to support and maintain traditional livelihoods.

The Cree and Dene people have depended upon WBNP ecosystems as an integral part of their identity, culture and well-being for millennia. Within the park, maintaining a functional ecosystem is critical for the cultural, spiritual and physical health of these communities.¹ In particular, this review will focus upon the health of bison, the Peace Athabasca delta, including water quantity and quality, air quality, cumulative effects of industrial development and the long term holistic health of the ecosystem as integral components to review. This scoping report acknowledges that these

ecosystem components are critical to supporting and maintaining traditional livelihoods.

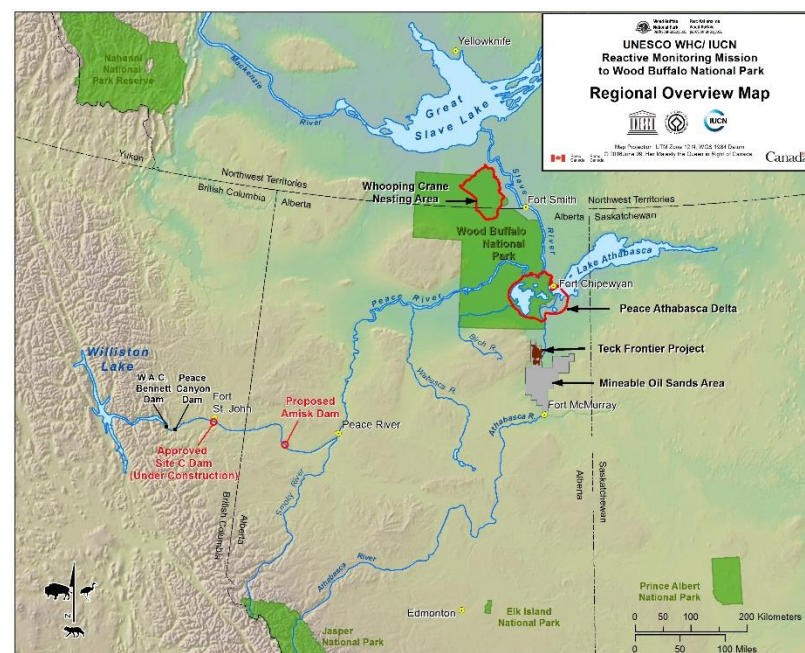


**Figure 1 – Wood Buffalo National Park location map
(from Parks Canada, 2016)**

The park was created in 1922 to protect the last free roaming herds of bison in northern Canada, in part to ensure continued access to bison by indigenous peoples.² Today it protects the herds of bison and more, including the last remaining natural nesting area for the endangered whooping crane; the Peace-Athabasca Delta (PAD), one of the largest inland freshwater deltas in the world; some of the finest examples of gypsum karst landforms in North America; unique salt plains and vast undisturbed expanses of boreal wilderness. Because

of these resources WBNP was designated a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site in 1983. The PAD Delta and the whooping crane nesting area were also designated as Ramsar sites, a designation by the Ramsar Convention which focuses on identification and protection of important habitat for migratory birds.

World Heritage Sites are designated based on several criteria which express the Outstanding Universal Value (OUV) the site represents. OUV is the basis for a site's inscription on the World Heritage List and is defined by UNESCO as "*natural significance, which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole*". WBNP meets three of the criteria:

- **Criterion vii: to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;**

The great concentrations of migratory wildlife are of world importance and the rare and superlative natural phenomena include a large inland delta, salt plains and gypsum karst that are equally internationally significant.

- **Criterion (ix): to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water,**

coastal and marine ecosystems and communities of plants and animals;

Wood Buffalo National Park is the most ecologically complete and largest example of the entire Great Plains-Boreal grassland ecosystem of North America, the only place where the predator-prey relationship between wolves and wood bison has continued, unbroken, over time.

- **Criterion (x): to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.**

Wood Buffalo National Park contains the only breeding habitat in the world for the whooping crane, an endangered species brought back from the brink of extinction through careful management of the small number of breeding pairs in the park. The park's size (4.5 million ha), complete ecosystems and protection are essential for in-situ conservation of the whooping crane.

Other conservation values of particular note beyond the OUVs include:

- The world's largest Dark Sky Preserve since 2013
- Some of the largest relatively undisturbed and least fragmented forest, grassland and wetland ecosystems in North America;

- Two Wetlands of International Importance have been recognized within WBNP under the Ramsar Convention, the “Whooping Crane Summer Range” and the PAD
- Increasingly rare ongoing large-scale ecosystem processes with limited human interference, including the comparatively natural fire regime;
- Extensive salt plains and gypsum karst with associated extraordinary plant communities;
- Significant populations of migrating, nesting, breeding and moulting waterfowl at an intersection of four major bird migration flyways - among many other significant wildlife populations.

In addition to these listings of ecological values, Parks Canada has in place an Ecological Integrity Monitoring System. The Canada National Parks Act (CNPA or the Parks Act) defines Ecological Integrity as a “first priority” which is notable both as a conceptual framework and as a legal obligation. The CNPA defines Ecological Integrity as;

“a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes”.

Parks Canada monitors Ecological Integrity and reports findings in the State of the Park Reports. A summary of relevant information from the most recent 2009 State of the Park Report for WBNP is provided in Section 2.1.

1.3 OVERVIEW OF MATERIAL REVIEWED TO DATE

Scientific reports, academic articles, project level environmental assessments, park documents, and traditional knowledge documents were reviewed to inform this scoping document. The OUVs were the primary focus of our research. The size of the park and the scale of industrial development in the region resulted in methodological challenges for comprehensive analysis. However, by focusing on the OUVs as the foundation of the SEA, the valued ecosystem components (VCs) upon which the assessment would focus, were more readily identifiable. These VCs are examined in terms of their historic and current baseline conditions, stressors and trends.

The data gathered to date provides a good understanding of the ecosystem complexity present in WBNP. There are many ecosystem elements and complex systems interacting within WBNP however the focus of this Scoping Document is the critical elements for the protection of the OUV.

Additionally, there are knowledge gaps within the literature, particularly surrounding baselines or optimal ecosystem functionality that have been identified by this analysis. These gaps represent opportunities for further analysis and study following the completion of the SEA.

2.0 REVIEW OF CURRENT CONSERVATION STATUS OF PARK

2.1 PARKS CANADA STATE OF THE PARK REPORTS

The State of the Park Report (2009) was reviewed and a summary of the information is provided below as it relates to the OUV of WBNP. There are a number of ecological integrity indicators that relate to the OUV for WBNP and they include those measures related to the delta, grasslands, wetlands and streams and rivers.

The State of the Park report summarized the key opportunities and concerns for WBNP. For the purposes of this report, the key findings were the declining health of the PAD, disease management challenges for local bison and the lack of an Aboriginal Governance structure. Each of these concerns is part of a larger socio-ecological system without clear solutions.

On the PAD, the report states, *“Peace River flow regulation is impacting delta hydrology and ecology and declining Athabasca River flows and increasing trends in nutrient levels are a concern. Ecological changes in turn impact the delta’s cultural landscape and cultural heritage.”*

As noted in the State of the Park Report and other information reviewed, the key stressors on the park ecosystem are climate change, water withdrawals, dams, and pollution. It is clear that anything that affects the complex hydrology of the PAD creates cumulative effects to the park resources and the ecology of the delta.

2.2 REACTIVE MONITORING MISSION (RMM) REPORT SUMMARY

Reactive Monitoring is defined in Paragraph 169 of the *Operational Guidelines for the Implementation of the World Heritage Convention* as being *“the reporting by the World Heritage Centre, other sectors of UNESCO and the Advisory Bodies to the World Heritage Committee on the state of conservation of specific World Heritage properties that are under threat”*.

The Mikisew Cree First Nation submitted a petition to the World Heritage Committee in late 2014, which was accepted in a World Heritage Committee Decision (39 COM 7B.18, Bonn, 2015) requesting the State Party of Canada to invite a joint World Heritage Centre/IUCN reactive monitoring mission to assess the state of conservation of the property and potential threats to its OUV. The scope of the mission was to assess:

- Current effects of flow regulation on the Peace River;
- Potential (cumulative) impacts of the planned Site C Hydroelectric Dam on the PAD;
- Effects of existing and proposed oil sands projects in the Alberta Oil Sands region, including as the various projects related to Aboriginal Peoples; and
- Any other relevant issues that may negatively impact the OUV of the property [which included other stressors such as forestry]

More specifically, the mission scope required the mission to review and assess the following:

- *“The current effects of Peace River flow regulation activities associated with operation of the W.A.C. Bennett Dam and Peace Canyon Dam, on the OUV of the property;*
- *The potential (cumulative) impacts of the planned Site C Hydroelectric Dam on the hydrological regime of the PAD that could impact the OUV of the property, and the ecological processes as they relate to the OUV of the property, also taking into account the effects of climate change*
- *The impacts of existing and planned oil sands projects in the Athabasca Oil Sands Region, as well as their associated tailings ponds, on the OUV of the property, including the impact on movement of migratory birds, and discuss the development and implementation of monitoring programs with the relevant authorities and stakeholders;*
- *The above-mentioned developments on the ecosystems that support some of the traditional ways of life of indigenous communities.”*

The mission was further tasked and mandated to *“review any other relevant issues that may negatively impact the OUV of the property, including its conditions of integrity and protection and management”*. The mission met with a wide range of federal and provincial government officials, First Nations and Metis leaders, advisors and community members, university researchers and NGOs.

2.2.1 Issues

The RMM Report (2017) identifies 7 categories of issues affecting WBNP:

1) Governmental relationships with First Nations and Métis

- On-going tensions and conflicts with First Nations and Métis communities in relation to WBNP, related to access restrictions despite permissive hunting access, limited (past) consultation and lack of involvement in decision-making directly or indirectly affecting First Nations and Métis; and,
- Aboriginal representatives acknowledged important and credible efforts to improve relationships on the part of PCA, including the Aboriginal Committee for the Cooperative Management of WBNP.

2) Governance of impact assessment and environmental monitoring

- Concerns about both regulatory failure and regulatory capture were consistently brought forward during the mission;
- Concerns about impact assessments, including limited mandates of panels set up to review proposals of very large and complex projects and absence of adequate assessment and management of cumulative effects;
- Limitations in coherent, adequate and independent monitoring under the Joint (Alberta – Federal) Oil Sands Monitoring System (JOSM) including gaps in the ability to

differentiate natural sources of contaminants from impacts caused by bitumen mining and upgrading; and, a lack of transparency and involvement of Aboriginal communities in monitoring; and,

- Deficiencies in functional mechanisms to manage water across jurisdictional boundaries despite longstanding efforts and a wealth of existing information, including specific recommendations for enhancing governance, for example under the Mackenzie River Transboundary Water Master Agreement (MRTWMA).

3) Changes in capacity and focus of Parks Canada Agency

- Lack of scientific capacity within PCA (to implement and monitor the implementation EI framework adequately); and,
- An excessive focus on tourism promotion.

4) Overarching concerns about climate change

- As part of a high latitude wetland-dominated landscape, WBNP and the PAD are highly vulnerable to the effects of climate change.

5) Pressures and risks from industrial development - hydropower development and industrial resource extraction (Alberta oil sands region, forestry and pulp and paper)

Hydropower

- A series of existing and proposed dams on the Peace River have impacted and create potential for further impacts on the PAD;
- The Mission cites compelling evidence of dam impacts along the Peace River, most notably the changes in both the timing and magnitude of seasonal flows measured at Peace Point;
- The RFF notes that planners for the Site C and the proposed Amisk Projects concluded that Peace Point, upstream of the PAD, was the furthest reach of any potential impact of these projects – the RFF finds this scientifically indefensible given that existing large hydropower projects along the upper Peace River appear to have had effects on the PAD and given the high likelihood of cumulative impacts of additional flow regulation; and
- The mission endorsed the technical points and recommendations made in PCA's submission to the JRP established for Site C (Parks Canada Agency).

Oil Sands

- The report summarizes major impact types citing Kelly et al. (2010), Timoney (2013) and Schindler (2015). As adapted to the main current Teck Frontier project EA proposal, these are:
 - Tailings water ponds and contaminants causing risks of direct exposure to fish and wildlife, that can be transported downstream towards the PAD;

- Water withdrawals by oil sands operators from the Athabasca River that may be affecting in-stream flows towards the PAD;
 - Atmospheric deposition of particles containing contaminants such as polycyclic aromatic hydrocarbons (PAHs), nitrous oxides, and sulphate;
 - Avoidance of this highly industrialized region by migratory birds en route to WBNP or on their way south, including the endangered Whooping Crane; and
 - Encroachment into the documented habitat of the Ronald Lake Bison Herd of Wood bison placing the actively mined oil sands region ever closer to the southern boundary of WBNP.
- The proposed Teck Frontier project would clear about 30,000 ha south of WBNP and diminish the existing de facto “buffer zone” between the Alberta Oil Sands region and WBNP to less than 80 km.

Forestry and Pulp and Paper

- Forestry is a major land use in the region
- Noting the absence of a formal buffer zone the mission considered forestry to be one of several industries potentially conflicting with conservation values of WBNP

6) Cumulative Effects

- Mineral exploration and extraction potentially adds individual and cumulative impacts to an already complex

setting, including past uranium mining near the shores of Lake Athabasca

- Outside the PAD, the report summarizes Timoney (2013) which documented potential sources of agricultural, industrial, and municipal sources of contaminants to the Peace and Athabasca Rivers that may be affecting the health of the PAD
- Inside the PAD, land-use and management decisions have had varying degrees of impact on the system
- The report identifies the need for a systematic analysis of a pre-regulation condition (historic or reference condition), an existing base condition (with current projects and operations), a future without projects, and a future with project conditions to build an understanding of cumulative impacts.
- Assessment of impacts on PAD needs the incorporation of other competing water uses and impacts within the basin as well as climatic drivers and climate change that may affect the net availability of water and the timing of that water in the basin.

7) Boundary Configuration, Neighbouring Areas and Land Use Planning

- There is no buffer zone around the park boundary. In the wording of the Operational Guidelines (OG) guiding the implementation of the World Heritage Convention (UNESCO / Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage, 2015), “a buffer zone is

an area surrounding the nominated property which has complementary legal and/or customary restrictions placed on its use and development to give an added layer of protection to the property” (paragraph 104);

- The report identifies the potential for de facto “adaptation” of WBNP boundaries by harmonization of WBNP management with existing or planned contiguous provincial and/or territorial protected areas;
- There is a need for management of the buffer zone particularly at the southern boundary with the potential of the Teck Frontier oil sands project; and
- The report identifies the importance of land use planning and in particular the critical nature of Alberta Lower Athabasca Land Use Plan for effective management of WBNP; it raises a number of the well-known short-comings of LARP including the identification of potential protected areas within LARP being seen as a by-product rather than the result of systematic conservation assessment and planning.

2.2.2 Stressors

The mission concluded that significant past, ongoing and potential new stressors on the PAD ecosystem exist from development around and upstream of the park (including oil sands development, hydroelectric projects, commercial logging, pulp and paper industry, past uranium mining, expanding agricultural region, and intense resource development in the Peace River watershed. The report highlights concerns about cumulative effects of several current proposals on top of existing pressures.

The RMM finds that the multiple stressors stemming from industrial development are of exceptional scale, pace and complexity. While located outside of WBNP’s boundaries, in some cases at large distance, the report states that it is undeniable that industrial development has changed the quality, quantity and flow of water of the two major rivers feeding the PAD, with additional concerns about air quality. New threats stem from recent approval and multiple proposals for additional and major projects joining an ever more intense and quickly advancing development frontier, including the proposed Site C hydroelectric dam and Teck Frontier mine projects.

2.3 PEACE ATHABASCA DELTA ECOLOGICAL MONITORING PROGRAM

Peace Athabasca Delta Ecological Monitoring Program (PADEMP) has been monitoring and reporting on the changes in state of the PAD ecosystem since 2008. They have been monitoring: muskrat abundance, water extent, contaminants in bird eggs, mercury in frogs, waterfowl populations, and traditional water and lands in the PAD; water quality on the Peace and Athabasca rivers, sediment loads in the Athabasca river, and water quality in delta lakes; and wood bison populations and aquatic and terrestrial biodiversity of species within the WBNP. They have determined that there are several important ecosystem components currently at risk in the PAD, including water quality, water quantity, sediment, aquatic life (benthic invertebrates and fish), vegetation, wildlife, and air quality. A number of contributing stressors, both past and present, are affecting those ecosystem components. They are described as follows:

- Climate change from burning fossil fuels, deforestation, agricultural and industrial practices, and vehicle emissions;
- Industrial and municipal discharge (into the river system or other parts of the watershed) from pulp mills, oil sands operations, municipal development, and natural gas (fracking);
- Water withdrawals and retention (from rivers upstream of the delta) from pulp mills, oil sands operations, municipal development, hydroelectric development, and natural gas (fracking);
- Flow regulation (dams) from hydroelectric development;
- Landscape alteration from agriculture, forestry and oil sands operations; and
- Invasive species from soil disturbance, land cover conversion, roadways, and seismic exploration.

PADEMP has identified water quality and water quantity as the ecosystem components most vulnerable to environmental stressors resulting from flow regulation, industrial and municipal discharges, and climate change.

3.0 ASSESSMENT APPROACH

With respect to WBNP, the overall objective of this SEA is to inform the preparation of an environmental management framework(s) and tools for a region. In this regard, this SEA is intended to accomplish the following objectives:

- improve the management of cumulative environmental effects;
- increase the effectiveness of Parks Canada's review of project-level environmental assessments; and
- identify strategies and priorities for the future management and protection of the ecosystem integrity and OUV of WBNP and its designation as a World Heritage Site.

Cumulative effects analysis, as with predictive analysis in all kinds of EA, is an exercise of applied systems analysis (see Munn, 1979; Holling, 1978; Ward, 1978; Beanlands and Duinker, 1983). The goal is to understand the mechanisms by which multiple stressors, both natural and anthropogenic, affect a VC and/or our ability to achieve the desired outcomes. This understanding would then be used to adjust the stressors through mitigation/collaborative management etc. so that the sustainability and integrity of the VC is not compromised by human action (Duinker and Greig, 2006). This is the primary focus of the proposed approach to undertaking the SEA for WBNP.

The assessment approach proposed to complete this SEA for the WBNP is as follows (and an overview provided in the paragraphs below):

- Identify past, present and reasonably foreseeable future projects and activities with the potential to affect the OUV for WBNP;
- Identify the geographic and temporal boundaries for the assessment;
- Determine the relevant OUVs and VCs for the Park; our focus is on the impact of surrounding development on the WBNP;
- Describe the existing baseline, stressors and trends for each VC;
- Set desired objectives and outcomes for each VC to protect OUVs of the Park; and
- Assess potential cumulative impacts on the VCs from existing and planned projects;

3.1 PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE PROJECTS AND ACTIVITIES WITH POTENTIAL TO AFFECT WBNP

Based on the review of reports to date, the following major existing and proposed projects and activities have been identified and will be assessed as part of the cumulative effects assessment.

Hydropower – Peace River

- Site C hydroelectric project - approved
- Glacier Power (Dunvegan) – not constructed
- Amisk hydroelectric project – under EA review
- W.A.C. Bennett Dam – operating since 1960's

Oil Sands

- Teck Frontier oil sands mine – under EA review
- Joslyn North oil sands mine – approved, on hold
- Jackpine Mine Expansion Project – approved, construction not started

Forestry and Pulp and Paper

- Five mills are operating on each river upstream of the PAD and WBNP (Glozier et al. 2009).
- Past forestry activities in and around WBNP
- Current and planned forestry activities around WBNP

Overriding all past, present and reasonably foreseeable future projects and activities are the changes being brought about as a result of climate change. Information reviewed suggests that climatic changes have already affected the complex ecology and hydrology of

WBNP particularly as it relates to the PAD. Climate change is an overriding issue that must be addressed in the SEA/CEA. It will be addressed by looking at how climatic change may have contributed to past baseline conditions, how it may be contributing currently, and future climate change scenarios will be overlaid with the future development scenarios.

3.2 IDENTIFY GEOGRAPHIC AND TEMPORAL BOUNDARIES FOR THE SEA

The identification of geographic and temporal boundaries for the SEA poses a number of challenges given the history of WBNP, the change in land use surrounding the park and influencing the OUVs and the diverse issues to be addressed for each VC. It is further complicated by the need to overlay the effects of climate change on the assessment. Based on the review of information to date the following geographic and temporal boundaries (Table 1) are proposed for each VC.

3.3 OUTSTANDING UNIVERSAL VALUES AND VALUED ECOSYSTEM COMPONENTS

From the review of relevant information for the WBNP, VCs were identified that correlate to the OUV of the park. The identification of VCs was guided by the following principles:

- Workable – pragmatic and realistic
- Relevance to OUVs
- Feasible with respect to availability of data
- Cognizant of public concern
- Potential to address gaps in knowledge or data
- Amenable to collaborative management procedures

Thus, the VCs for the WBNP SEA, as they relate to protecting the OUV of the Park, were determined to be the PAD, the he Wood Bison, and the Whooping Crane. Each of these VCs is described below with respect to its importance, historic and current baseline conditions, stressors and relevant trends. This information will be the focus of the SEA/CEA.

Table 1 – Geographic and Temporal Boundaries

VC	Geographic Boundary	Temporal Boundary
PAD	The geographic boundaries of the PAD are well defined. The PAD is fed by both the Peace and Athabasca rivers which lay largely outside WBNP boundary. For this assessment, the PAD itself and these two rivers systems are included as part of the PAD system.	Traditional Ecological Knowledge (TEK) reported in project level assessments and academic literature indicate the important temporal boundary to be pre-1962, before operation of the Bennett dam. Relevant hydrological monitoring records for the Athabasca River are from the 1950s onward. Commercial oil sands mining started in the Fort McMurray region in the 1960s. Therefore, the temporal boundary is proposed to start in 1950 and extend 30 years into the future (2050) to reflect realistic bounds of climate projections that science can reasonably predict.
Wood Bison	The geographic boundaries of assessment include WBNP, the Bison Control Area (BCA) and the range areas of the herds within and in the vicinity of WBNP including the following herds: Wentzel Lake, Mackenzie, Hay Zuma, Harper Creek and Ronald Lake.	The temporal boundary for the assessment will begin in the 1920's when the park was created and extend 30 years into the future (2050) to reflect realistic bounds of climate projections that science can reasonably predict.
Whooping Crane	WBNP in particular the gypsum karst nesting ground is considered the primary geographic boundary and the migratory route to Texas (e.g. the Aransas National Wildlife Refuge) is the secondary geographic boundary.	The temporal boundary is proposed to start in 1967 when they were put on the endangered species list and extend 30 years into the future (2050) to reflect the realistic bounds of climate projections that science can reasonably predict.

3.3.1 The Peace Athabasca Delta – Baseline, Trends and Stressors

The PAD is the site where two of Alberta's largest rivers, the Peace and the Athabasca, meet. The Athabasca River has mean annual flow of 650 cubic metres per second and flows into the delta from the south. The Peace River carries a mean annual flow of 2,100 cubic metres per second from the north. Overall, the Peace River has a much larger influence on the PAD's flood regime than the Athabasca.³

Maintaining the PAD's flood regime is essential for healthy ecosystem function. The delta is flat, meaning that changes to water depth will impact the wetted coverage area. Delta water levels are impacted by climatic factors, such as precipitation and evaporation, and flow contributions from river systems, particularly the Peace River. On average, evaporation exceeds precipitation in the region. Flow rates are comparatively more variable and have been impacted by regulation (see section 3.4.1). Flow rates, in particular, contribute to the frequency and intensity river flood events on the PAD.^{3–8}

Floods in the PAD are the product of:

- ice jams, where the Peace River freezes, thaws and break ups in the spring. The ice is pushed across the delta, including up onto higher elevation on the plateau, which results in flooding; or
- peak summer flows with melt from the mountain snow packs and regional rain fall which increase peak flow on the rivers.

Perched basins are slightly elevated portions of the delta landscape. Peak summer flows in channels, lakes and adjacent wetlands are

unable to reach perched basins. In order for these perched basin areas to be recharged, over bank flows from ice jam events are required. Ice jams are essential for maintaining water cover in the higher elevations of the delta.^{3–5,7,9,10}

The PAD is a unique delta ecosystem that has supported indigenous communities for thousands of years. Indigenous peoples particularly value the PAD as it is the habitat for diverse species harvested in hunting, trapping, gathering and fishing; its waterways are crucial means of transportation; and as a place of spiritual and cultural significance.¹ The PAD contains 219 species of birds, 300 species of invertebrates, 22 species of fish and 43 species of mammals. Due to this diversity and complexity, the delta has been designated a Ramsar site and contributes to UNESCO's World Heritage Site status as part of the WBNP (80% of the PAD is within the park).

The unique ecology of the delta relates to the complex hydrological cycle in the delta as discussed above. Over the past 100 years, the Delta has entered a drying cycle. The Peace River has been regulated since 1968 when the W.A.C. Bennett Dam in British Columbia was constructed. The Athabasca River is unregulated, but impacted by water withdrawal from industry upstream. Climatic change has also contributed to drying conditions.

In 1945, marsh cover reached its peak and since has varied significantly. Additionally, over the past 75 years, forest cover has increased slightly (Timoney, 2006). There is some debate among scholars as to what range of drying exists within a healthy and dynamic delta. However, the majority of scholars believe that anthropogenic factors, including regulation on the Peace River,

withdrawal from the Athabasca for oil sand production, and climate change, all play roles in the drying of the region. In particular, the construction of the Bennett dam in 1968 on the Peace River drastically changed flow regimes on the river and the frequency and intensity of ice jams. Beltaos (2014) estimates that Peace River regulation accounts for nearly two thirds of the reduction in ice jams. (2014). At Peace Point, the Bennett Dam has decreased summer flows by 31% and increased winter flows by 200%. Peace Point is a relevant flow measure point for the PAD because this is the location on the Peace River where ice jams form. Ice jams are crucial to the hydrological cycle. Drastic changes to flow rates can alter ice formation.¹⁵

While river regulation on the Peace has changed flow rates, regional climatic change has increased evaporation. With climatic change, increased evaporation is expected, but warmer and drier conditions also decrease runoff required to stimulate spring and summer flooding. Subsequent regulation and development, when combined with climatic change, have been linked to further drying in the PAD.^{3,6-8,15} The general consensus from literature reviewed is that the PAD has been drying over the past 50 years. Generally speaking, the lower lake and wetland water levels have resulted from decreased river flow into the system and fewer flooding events. The stressors on the PAD are flow regulation on the Peace River and water withdrawals on the Athabasca River from oil sands developments, as well as climate change. In addition, air and water pollution from oil sands developments, agricultural operations, pulp and paper mills, and municipal sewage from nearby communities are also stressors to the PAD system.

Flow regulation on the Peace River has increased fall and winter flows and decreased spring and summer flows. The increased winter flows have contributed to fewer ice jam flooding events in the PAD, which contributes to less recharge of perched water tables in the PAD. The lower spring and summer flows have generally contributed to lower water levels (water extent, water coverage) in lakes and wetlands of the PAD. From the literature reviewed, it appears that there is no real consensus on whether the water extent in the PAD is actually stable or declining (Parks Canada, 2016; AECOM, 2010; Parks Canada, 2009), however there is general agreement that both river flow into the PAD and flooding frequency in the PAD have been decreasing since the 1960s. River flow into the PAD from the Athabasca River has also been declining since the 1960s and nutrient loads in the river have been increasing in that time. Also, invasive plant species numbers have been increasing in the PAD over time.

Interventions to the flow regime have been attempted, including the construction of outflow weirs on two channels to maintain lake levels, but prevent winter drawdown. Artificial ice jams were constructed in the mid-1990s. In 1996, BC hydro increased the Bennett Dam release that supplemented flooding in the PAD.

Migratory wildlife emerging from the PAD and other areas within WBNP are given explicit mention in the relevant OUVs. There are risks to migratory wildlife from industrial development around the park and also on their migratory route. For example, the Athabasca oil sands' estimates annual bird tailings pond mortality derived from mortality surveys at 863 to 5,029 birds and landing-oiling rates at 458 to 1,630 birds.

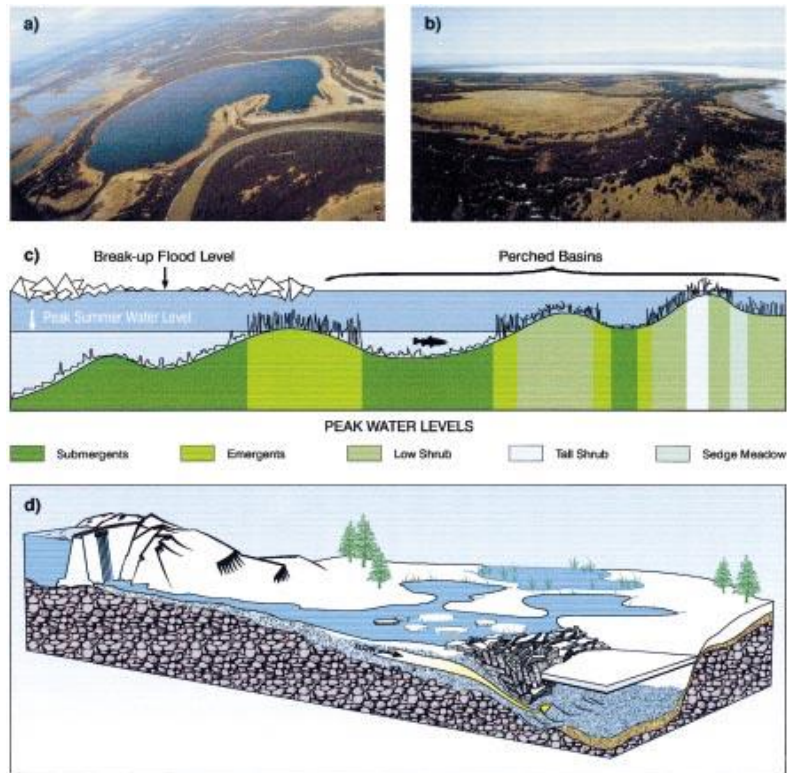


Figure 3. Typical flooded perched basin (A); dried perched basin with encroaching terrestrial vegetation (B); vegetation composition of perched basins with water levels from open-water and ice-jam extreme events; note only the latter is capable of flooding high-elevation zones (C); and schematic illustrating effect of additional flow releases from hydro-electric reservoir (some 1200 km upstream of delta) assisting downstream ice-jam flooding of delta wetlands (D).

Figure 2 – Typical Flooded Perched Basin (Timoney, 2006)

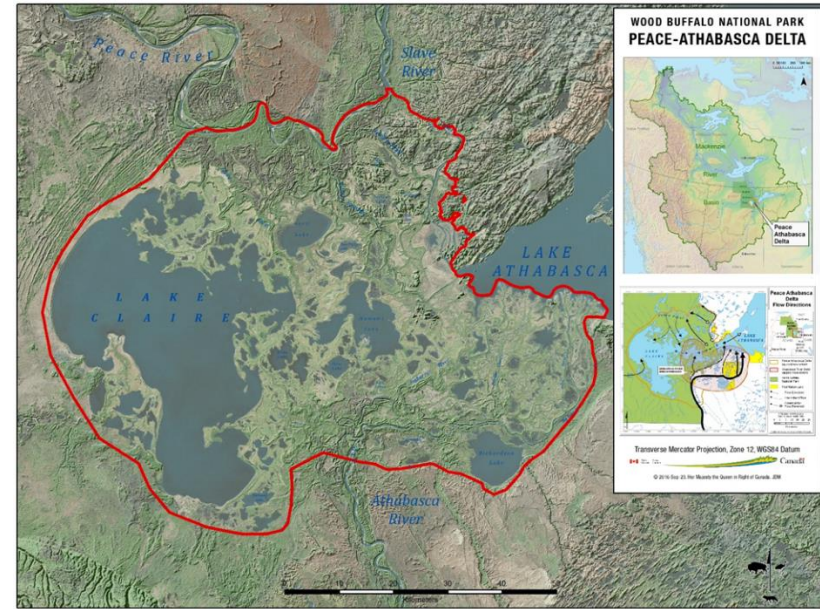


Figure 3 – Peace Athabasca Delta

3.3.2 Wood Bison – Baseline, Trends and Stressors

The land that Wood Buffalo National Park occupies has been inhabited for approximately 2500 years. Human populations in the region rose with the rise of the fur trade in the late 1700s. The WBNP area was rich in resources and benefited from easy water access via rivers and lakes for traders in the region. The influx of Colonial settlers, traders and explorers began to put a major strain on the buffalo population in the region, the major source of food for local indigenous communities.² By the 1850s, the cumulative effects of overhunting, loss of habitat, and severe winters resulted in a population of approximately 250 wood bison. This severe decline in population prompted the Canadian government to establish the Buffalo Protection Act of 1877 to conserve and protect these remaining animals.¹² The on-going conservation challenges related to bison were acknowledged as problematic in the region, but the major impetus for the development of WBNP in the early 1920s was the discovery of oil sands in the region. Oil development in the region meant that there would be an increased pressure on the bison population due to another massive influx of people to work in the new industry. Efforts were needed to protect the population because bison were seen as a cheap, easily accessible source of food. As a result, WBNP was established in 1922 and covered 10 500 square miles. The park protected approximately 1500 wood bison living within the original park boundaries.

In 1925, park management agreed to a controversial decision to transfer thousands of plains bison from Wainwright Alberta into the park. The Wainwright herd was considered overcrowded. By 1928, 6673 plains bison were transferred to the park's Hay River area. The

transferred bison did not stay in this area and moved Southward across the Peace River into the PAD. Due to this movement, 7000 additional square miles, encompassing the PAD, were added to the existing park. However, the introduction of these bison introduced diseases to the native bison.

Maintaining the size of the herd was an early focus of the conservation effort, but in the late 20th century, genetic diversity and disease management became additional focus for management. The introduction of these plains bison resulted in hybridization. Diseases afflicting the bison include tuberculosis, brucellosis, anthrax, erysipelas and black leg.² The issue was reviewed by multiple government task forces in the late 1980s and early 1990s. In 1987, the Government of the Northwest Territories implemented a disease containment program to minimize contact between diseased and non-diseased bison. This program resulted in the establishment of the Bison Control Area (BCA), which originally contained lands south of the Mackenzie River, and north of the Mackenzie Highway between Mills Lake and Hay River. The BCA was expanded in 1990 to include all lands north of the provincial-territorial border and south of the Mackenzie River, between Trout River on the West and the Buffalo River and WBNP boundary to the east, encompassing 3,936,339 ha. Bison within the BCA are designated as nuisance and can be shot by an eligible hunter. The purpose of the BCA and other bison control programs are to detect and remove bison in the BCA and prevent the establishment of herds or individuals in this region. In so doing, the risk of transmission between infected and non-infested herds is reduced. Reducing contact also ensures that genetic integrity of certain populations of wood bison is protected from more hybridized or plains dominant herds.¹⁶ A primary transboundary

consideration is to ensure that the Bison Control Area instituted by the Federal and Provincial government as a means of preventing disease and ensuring genetic differentiation between herds.

Bison within the WBNP have been managed in some form for 140 years. The population, genetic diversity and vectors for disease have been influenced directly and indirectly by humans in the region. The wood bison populations within WBNP are endangered and are a species explicitly listed within the OUVs. Managing bison populations is complex and requires consideration of population levels, maintaining genetic differentiation and containing disease.^{3,11–13} Currently, approximately 40% of the wood bison within the park are diseased with bovine tuberculosis (bTB; caused by *Mycobacterium bovis*) and brucellosis (caused by *Brucella abortus*).¹² Herds outside of the park have been segregated from WBNP and managed since the early 1990s. Wood Bison herd numbers in the Park have generally been increasing since around 1988 and calf survival rates are stable.

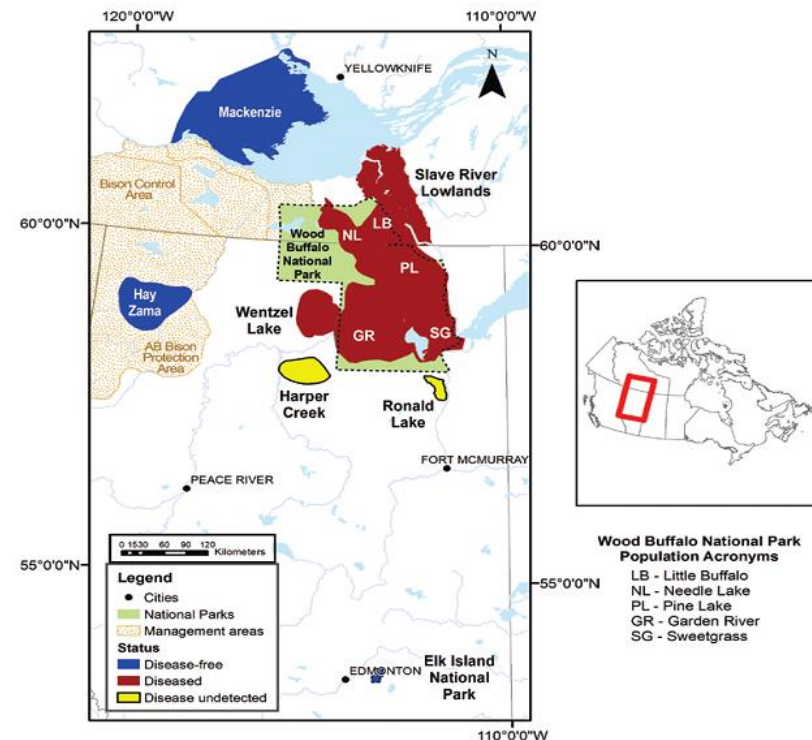


Figure 4 – Approximate Location of Wild Bison
(Map Source: Ball et al, 2016)

3.3.3 Whooping Crane – Baseline, Trends and Stressors

Whooping Cranes historically nested across North America, with a peak pre-1870 population of 1300 to 1400 birds. Their range extended from the Arctic Coast south to central Mexico, west to Utah and east to New Jersey and South Carolina. Whooping Cranes are an endangered species, requiring large, undisturbed areas of poorly drained wetland for habitat. Industrial development on these habitats drove the species to near extinction. Due to industrial development, there has been a significant loss of suitable wetland habitat south of WBNP since the early 1900's. In 1941, the world population of the whooping cranes was 21 individuals. The surviving Whooping Cranes were members of the Wood Buffalo-Aransas flock (meaning that they migrated between WBNP and the Aransas National Wildlife Refuge in Texas). This flock became the focus of major cross-border conservation efforts to protect habitat and encourage breeding.

The population rose due to concerted effort by conservationists. The global population rose to 57 by 1970. By 1999, the total population of wild Whooping Cranes was 260 individuals. Of that 260 cranes, 183 of which were members of the Wood Buffalo /Aransas flock. In 2005, there were 214 cranes and this flock had increased by more than 35 % over a ten year period. In total, whooping cranes have had recent population growth of 3.7% per year. Despite the establishment of other flocks in Florida, sixty-four percent of the total wild population (215 of 338 individuals) had summered in Canada (Whooping Crane Recovery Plan, 2005).

Protecting Whooping Crane habitat is crucial to protecting the species and the whooping crane is as an endangered species explicitly listed within the OUVs. In WBNP, cranes nest in the northeastern section of the park, in gypsum karst wetlands. WBNP provides suitable protected nesting habitats that have supported population recovery from 3 or 4 adult pairs in 1941 to 73 adult pairs in 2005. The vast majority (60-80%) of mortality rates occur during their migration. These cranes migrate southeasterly through Alberta, Saskatchewan, and eastern Manitoba. The cranes stop in southern Saskatchewan for several weeks in fall migration before continuing migration through the Great Plains states of eastern Montana, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. In spring, their migration is more rapid and they reverse the fall route (Whooping Crane Recovery Plan, 2005). During this migration, Whooping Cranes roost and feed in a variety of wetlands and croplands. 85% of Whooping Crane staging sites used during migration are on private land, illustrating the importance of fostering cooperation with private landowners and authorities in protecting feeding and staging sites for migrating cranes. Some major wetlands along the Whooping Crane's migration corridor are also protected, such as Last Mountain Lake National Wildlife Area (also a Ramsar site) and Luck Lake Heritage Marsh, both of which lie within fall staging areas in Saskatchewan (COSEWIC, 2005).

The stopover habitat currently available is sufficient to maintain the population in the near future, with the winter habitat in Aransas able to support 500 individuals (Whooping Crane Recovery Plan, 2005). Within WBNP, the Whooping Cranes only utilize 14% of their available range of habitat (Timoney, 1999). Experts do not believe

that breeding habitat will not be a limiting factor. Additionally, sufficient migratory stopover habitat is available to support the present population and numbers likely to be attained in the near future. However, uncertainty remains given the pressures on land from industrial development (Whooping Crane Recovery Plan, 2005).

Whooping crane numbers are still low due to migration losses outside of the Park. However, our review indicates that the population and breeding pairs are increasing in the nesting area of the Park. Additionally, the nesting area hydrology in the northern portion of the Park is in stable condition. Stressors to the whooping crane population are generally outside of the Park. Future stressors such as climate change impacts could cause drier or drought conditions and lower water tables, as well as cold weather or precipitation after hatching, which would negatively affect the population.

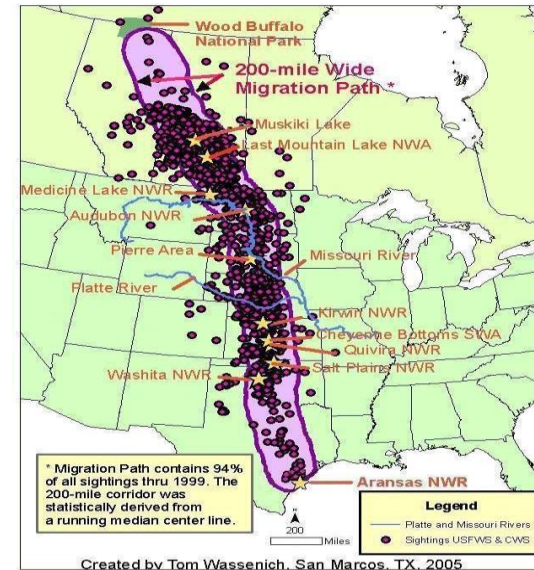


Figure 5 – Breeding and Winter Areas, Primary Migration Pathway and Nesting Clusters

3.4 IDENTIFICATION OF OBJECTIVES, INDICATORS AND DESIRED OUTCOMES

To determine the current and potential cumulative impacts on the VCs, we have identified objectives, indicators and desired outcomes. Parks Canada is obligated to protect the OUV that resulted in WBNP's designation as a World Heritage Site. Objectives have been articulated that define the measurable conditions that must exist to protect the OUV and VCs. Desired outcomes are the thresholds that should be met to achieve these objectives. The indicators are the measurable conditions that can be monitored and assessed for trends to measure achievement of objectives and desired outcomes.

Table 3.1 illustrates a number of indicators for each of the VCs, along with their current status and trends. The indicators were determined by information gleaned from three comprehensive monitoring reports compiled in recent years (Parks Canada 2016, AECOM 2010, Parks Canada 2009). Further discussions with Parks Canada are necessary to determine which ecological integrity monitoring indicators and thresholds are most appropriate for use in this study particularly with respect to information availability.

The preliminary set of objectives and desired outcomes and proposed thresholds have been defined in Appendix A. This information will be used in the assessment of cumulative effects to determine if desired outcomes are likely to be compromised under various development and climate change scenarios.

Table 2 –VC Objectives and Desired Outcomes

OUV	VC	Objective	Desired Outcome
vii	Peace Athabasca Delta	- Protection of flow regime and water levels in the PAD - Accommodation of First Nations traditional land uses (hunting, fishing, etc.) - Provision of appropriate habitat for wildlife, birds, and vegetation in the PAD - Resilience to climate change impacts	- Protect ecological features and functions within the PAD by maintaining flow regimes into and within the PAD within threshold/optimal values - Ensure cycle of ice jams and flooding is appropriate to flood perched areas and ensure appropriate seasonal variation of water levels to maintain ecological function
vii, ix, x	Wood Buffalo	- Protection and separation of Wood Buffalo herds to maintain herd health through the provision of sufficient range area and prevention of herd mingling - Maintain integrity of their range from encroachment or decrease - Resilience to climate change impacts	Prevent undue pressure on range areas of herds to minimize potential for mingling of herds
vii, ix, x	Whooping Cranes	- Provision of appropriate habitat for nesting - Resilience to climate change impacts	Increase in population and breeding pairs in the nesting grounds

Table 3 – VCs Potential Indicators

OUV	VCs	Potential Indicators
vii	Peace Athabasca Delta (PAD)	Lake Hydrology Historic Flood Frequency Plant Community Fish Community Herbivore Community Air Quality Water Quality
x	Whooping Crane	Breeding and Habitat Migratory Patterns Population
vii, ix	Wood Bison	Bison Migratory Patterns Wood Bison Population Wood Bison Health

3.5 IDENTIFICATION OF SCENARIOS FOR THE ASSESSMENT OF CUMULATIVE EFFECTS

Consistent with the recommendations of the RMM Report, in order to undertake a systematic assessment of cumulative effects the following scenarios will be analyzed:

- Pre-regulation condition (historic or reference condition),
- Existing base condition (with current projects and operations),
- Future without projects only climate change, and
- Future with project conditions and likely climate change scenario.

The pre-regulation condition will reflect the state of the park and its environs around about 1950. This will capture the stressors on WBNP prior to oil sands development and the development of the Bennett Dam. The discussion of the baseline and stressors at this time will be structured around appropriate indicators.

The existing base condition includes all of the past and existing projects and will reflect today's baseline condition. Much of the information that portrays this condition is already represented in the RMM report and this information will be synthesized with information available from Traditional Ecological Knowledge, academic literature, and other sources.

The future scenarios both with and without likely projects will try to characterize the likely affects associated with climate change and those effects associated with likely projects.

3.6 CUMULATIVE EFFECTS ASSESSMENT METHODOLOGY

Determinations regarding cumulative effects will use a "Weight of Evidence" approach, meaning that a combination of information from several different sources (if available) will be used to give sufficient evidence to fulfil an information requirement. This approach is beneficial in a cumulative effects assessment when,

- i. the information from a single piece of evidence alone is not sufficient to draw a conclusion. This could be, for example, due to clear deficiencies in one of the existing studies.
- ii. individual studies provide different or conflicting conclusions.

The weight given to the available evidence depends on factors such as the quality of the data or studies undertaken, the consistency of results or conclusions drawn, nature of effects, and the relevance of the information. Although the weight of evidence approach will require using the Team's professional judgment and relying on the professional judgement of others; as a general principle, the more information available, the stronger the weight of evidence is.

Where possible, information will be presented in a structured and organized way, outlining information gaps and uncertainties, to support and/or qualified a conclusion. Where available, TEK will be part of the information reviewed for each VC.

As part of the Weight of Evidence approach, it is proposed that the cumulative effects analysis be undertaken using several tools:

- Information provided through discussions with First Nation, Parks Canada representatives and others will be used to collect information about past, present, or planned development projects, current status and trends in VCs and

opinions about where, why, and how cumulative effects may occur.

- Matrices will be used to present and organize information on the cumulative effects of a project and other physical activities on VCs. They will be used to identify the likelihood of cumulative effects on one or more VCs.
- Network and systems analysis would be used to identify the pathway of cumulative effects using a series of links between past, existing and future projects, and a VC. Network diagrams would be "high-level" and would not necessarily represent a specific scientific hypotheses, but rather would be used to illustrate linkages between a source of effect and the VC.

It is anticipated that the SEA will provide the substantive basis for Parks Canada to develop tools and management strategies in cooperation with other agencies and jurisdictions including First Nations. These tools and management strategies may be used by Parks Canada to inform comments on project specific approvals and to work collaboratively with other stakeholders to better manage the VCs and protect the OUVs given the stressors and potential effects identified.²⁰

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APPENDIX A



Table 4 OUV Objectives, Desired Outcomes, and Proposed Thresholds for Achieving the OUV Objectives

OUV	VC	Objective	Desired Outcome	Proposed Thresholds
vii	Peace Athabasca Delta	Protection of flow regime and water levels in the PAD Accommodation of First Nations traditional land uses (hunting, fishing, etc) Provision of appropriate habitat for wildlife, birds, and vegetation in the PAD Resilience to climate change impacts	Protect ecological features and functions within the PAD by maintaining flow regimes and water levels into and within the PAD within threshold/optimal values to ensure appropriate flooding of PAD and flows into perched water basins	- Maintain optimal river and lake ice levels at key locations - Maintain optimal water extent in the PAD (between 43.5 and 63.8%)¹ - Maintain optimal river flow into the PAD (no numbers given)⁴ - Maintain optimum flow in the Peace River (daily flow between 1510-2501 m³/s, avg 30 d flow between 375-1387 m³/s, freeze up levels between 932-1854 m³/s, break up levels between 1839-3536 m³/s)¹ - Maintain optimum flow in the Slave River (daily flow between 2720-4313 m³/s, avg 30 d flow between 767-2296 m³/s, freeze up levels between 1791-2885 m³/s, break up levels between 2597-4522 m³/s)¹ - Maintain optimum flow in the Athabasca River (daily flow between 451 -769 m³/s, avg 30 d flow between 106-187 m³/s, freeze up between 181-349 m³/s, break up between 450-1092 m³/s)¹ - Maintain optimal river water quality for rivers feeding into the PAD (Water Quality Index >79)¹, (CCME WQI >80)³ - Maintain optimal muskrat population numbers (between 84 and 200+)^{1,3} - Maintain optimal lake ice phenology (within 1 Std Dev, TBD)¹ - Maintain optimal flooding frequency (between 9 and 11*extrapolated)³
vii, ix, x	Wood Buffalo	Protection and separation of Wood Buffalo herds to maintain herd health through the provision of sufficient range area and prevention of herd mingling Resilience to climate change impacts	Prevent exertion of undue pressure on BCA and herds outside WBNP to minimize potential for mingling of herds	- Maintain optimal range - Maintain optimal bison control area (BCA) (39,000 km² set out by Parks and Govt NWT in 1987) - Maintain optimal bison abundance in PAD (1.5 std dev from 1,197 animals)³ - Maintain optimal bison abundance in PAD (between 3,554 and 6,139 animals)¹ - Maintain optimal bison abundance in Park (more than 1,000 animals)³
vii, ix, x	Whooping Cranes	Provision of appropriate habitat for nesting Resilience to climate change impacts	Increase in population and breeding pairs in the nesting grounds	- Increase population and breeding pairs in the nesting grounds to optimal numbers (>1000 animals)³ - Maintain optimal hydrology in crane nesting habitat in the northern area of the Park (stable water levels in creeks, ponds, wetlands, bogs)³

Superscripts ¹: From WBMP EIM Program Review Report, Parks Canada, 2016; ²: From "As Long As the River Flows", Candler, 2010; ³: From the State of the Park Report, Parks Canada, 2009); ⁴: From Synthesis of Ecological Information Related to the Peace Athabasca Delta (AECOM, 2010)

Table 5 VC Indicator Status, Trends and Impacts from Project Development

VC (& OUV)	Current Status of VC Indicator	Indicator Trends	Past & Current Impacts: Bennett Dam, Pulp and Paper Mills, Oil Sands, Agriculture, Municipal Sewage, Climate Change	Potential Future Impacts : Site C, JackPine, Joslyn, Teck Frontier, Dunvegan, Amisk, Climate Change
Peace Athabasca Delta (vii)	- River & lake ice levels at Peace Pt = TBD¹ - Water extent in the PAD = Good¹, Fair^{3,4} - River flow into the PAD = Fair⁴ - Water flow dynamics in the Peace River = Good¹, Poor³ - Flow in the Slave River = Good¹, Poor³ - Flow in the Athabasca River = Good^{1,3} - Flow in Athabasca River = NA² - Water discharge rates for rivers feeding into the PAD = Good¹ - River water quality for rivers feeding into the PAD = Fair^{1,3} - Athabasca river nutrient loads = NA⁴ - River oxygen levels = Good⁴ - Muskrat population numbers = Good¹, NA^{3,4} - Waterbird & amphibian abundance & occupancy rate = Poor¹ - Migratory bird & waterfowl = Good⁴ - Macroinvertebrate population numbers = Good¹ - Mercury levels in waterbird eggs = Good¹ - Invasive plant species = Fair^{1,4}, Good³ - Air quality = Good 75-90% of the time³ - Air quality = Good⁴ - Lake ice phenology = TBD¹ - Lake hydrology = Fair¹ - Flooding frequency = Fair³, NA⁴ - Lake fish community = Good^{3,4} - Moose numbers in PAD = Fair³	- River & lake ice levels at Peace Pt = NA¹ - Water extent in the PAD = Stable¹, Declining³, Stable⁴ - River flow into the PAD = Decreasing⁴ - Flow in the Peace River = Stable¹, Stable³ - Flow in the Slave River = Stable¹, Stable³ - Flow in the Athabasca River = Decreasing^{1,3} - Flow in Athabasca River = NA² - Discharge rates for rivers feeding into the PAD = Stable¹ - River water quality for rivers feeding into the PAD = Stable¹, Declining³ - Athabasca river nutrient loads = Declining⁴ (i.e. increasing loads) - River oxygen levels = Increasing⁴ - Muskrat population numbers = NA¹, Stable^{3,4} - Waterbird & amphibian abundance & occupancy rate = NA¹ - Migratory birds & waterfowl in PAD = Stable⁴ - Macroinvertebrate population numbers = NA¹ - Mercury levels in waterbird eggs = Stable¹ - Invasive plant species = Down¹, Declining^{3,4} (i.e. increasing numbers & species) - Air quality = Stable^{3,4} - Lake ice phenology = NA¹ - Lake hydrology = Stable³ - Flooding frequency = Declining^{3,4} - Lake fish community = Stable^{3,4} - Moose numbers in PAD = NA³	30% decrease in mean summer flow and 200% increase in mean winter flow on Peace River - Increased freeze up and reduced break up flows on Peace River - Fewer ice jam floods on Peace River, reduced reversal of flows into perched basins of PAD (since 70s) [large scale flooding of the delta has happened only three times between 1968 and 2009 (years 1974, 1996 and 1997). - Lower water levels in PAD - Decreased snowpack depth, decreased runoff, decreased flow rates on Athabasca River - Decreased water quality (TP, Na, Cl, TOC, Turbidity) in AR - Decreased sediment quality in Athabasca River	- Site C: No impacts on PAD (from EIS) - JackPine: No impact to air quality & metal deposition in PAD, frequency & depth of flooding in PAD, flow rates & water levels in the PAD, water quality & thermal regime in Athabasca River, DO & sediment quality in the PAD (from EIS) - Teck Frontier: No impacts to air quality, groundwater quality & quantity, flow rates & water quality on Athabasca River, frequency of flooding & water quality in PAD (from EIS) - Dunvegan: unknown, no PAD assessment - Amisk: unknown, no PAD assessment - Joslyn: No impact to water quality & hydrology on Athabasca R (from EIS) - Climate change: Lower flows on Athabasca R and Peace R, delayed ice formation and thinner ice on Peace R, earlier spring break ups & fewer ice jams on Peace R, lower water levels & less flow reversal in PAD - Other water takings
Wood Buffalo (vii, ix, x)	- Range/control area = ?? - Bison Control Area = NA - Buffer zone = ?? - Bison abundance in PAD = Fair³ - Bison abundance in PAD = Poor¹ - Bison abundance in Park = Good³	- Range/control area = ?? - Bison Control Area = NA - Buffer zone = ?? - Bison abundance in PAD = Increasing³ - Bison abundance in PAD = Down¹ - Bison abundance in Park = Increasing³	- Limited impact from oil sands development - Low risk of habitat fragmentation impacts from other developments outside the Park	- Teck Frontier: No impacts to wildlife populations (from EIS) - None other documented - Climate change: Increased risk of fire, insect outbreaks from warming climate that may be new stressors

DRAFT SCOPING REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

VC (& OUV)	Current Status of VC Indicator	Indicator Trends	Past & Current Impacts: Bennett Dam, Pulp and Paper Mills, Oil Sands, Agriculture, Municipal Sewage, Climate Change	Potential Future Impacts : Site C, JackPine, Joslyn, Teck Frontier, Dunvegan, Amisk, Climate Change
	• Bison abundance in PAD = Fair⁴ • Calf survival rates = Good¹ • bTB rates = ??	• Bison abundance in PAD = Increasing⁴ • Calf survival rates = Stable¹ • bTB rates = ??		
Whooping Crane (vii, ix, x)	• Population and breeding pairs in nesting grounds = Poor³ • Crane nesting hydrology = Good³	• Population and breeding pairs in nesting grounds = Increasing³ • Crane nesting hydrology = Stable³	• 1941- 21 birds • 1970- 57 birds • 1999- 260 (183 of which were members of the Wood Buffalo /Aransas flock). • 2005- 214 2005 (flock had increased by more than 35 % over the last ten years). • In total, whooping cranes have population growth of 3.7% per year. • 64% of the total February, 2006 wild population (215 of 338 individuals) had summered in Canada (Whooping Crane Recovery Plan, 2005).	• None documented • Climate change: Drier or drought conditions and lower water tables, as well as cold weather or precipitation after hatching would negatively affect the population • Potential/ unknown migratory Pattern concerns
Forests (ix, x)	• Index of primary productivity = Good³ • Plant productivity and growing season = Good¹ • Normalized vegetation difference index (NDVI) = Good¹ • Fire frequency = Good¹ • Forest insects and disease levels = Fair¹ • Snowshoe hare populations = Good¹ • Forest composition = TBD • Annual area burned = Good³ • Moose community = Fair³	• Index of primary productivity = Stable³ • Plant productivity and growing season = Stable¹ • Normalized vegetation difference index (NDVI) = Stable¹ • Fire frequency = Stable¹ • Forest insects and disease levels = NA¹ • Snowshoe hare populations = NA¹ • Forest composition = NA¹ • Annual area burned = Stable³ • Moose community = NA³	• None documented	• None documented • Climate change: Increased risk of fire, insect outbreaks from warming climate

Superscripts 1: From WBMP EIM Program Review Report, Parks Canada, 2016; 2: From "As Long As the River Flows", Candler, 2010; 3: From the State of the Park Report, Parks Canada, 2009); 4: From Synthesis of Ecological Information Related to the Peace Athabasca Delta (AECOM, 2010)

A.2 – DECEMBER 2017 DRAFT SCOPING REPORT – ADDENDUM



ADDENDUM TO THE AUGUST 2017 DRAFT SCOPING REPORT

Strategic Environmental Assessment of Potential Threats to the World Heritage Values of Wood Buffalo National Park World Heritage Site

December 2017

Strategic Environmental Assessment of Potential Threats to the World Heritage Values of Wood Buffalo National Park World Heritage Site

Addendum to the August 2017 Draft Scoping Report

1. Purpose of Addendum

This addendum prepared by Independent Environmental Consultants (IEC) presents a summary of the comments Parks Canada received in September 2017 on the Draft Scoping Report for the Strategic Environmental Assessment (SEA) of potential threats to the world heritage values of Wood Buffalo National Park (WBNP) World Heritage Site. The addendum also presents how these comments have refined both the approach to, and content of, the SEA. It was determined that an addendum document would be a more effective and efficient response to the comments than a revised Scoping Report. The addendum is also an opportunity to identify the other mechanisms available to address some of the comments that have been raised.

This addendum presents a summary of the comments received on the Draft Scoping Report and outlines how relevant comments have informed the approach of the SEA going forward.

2. Overview of Comments Received

A large number of detailed submissions were received in response to the comment period on the Draft Scoping Report. The submissions offered comments on the scoping document, but also a wide variety of other issues which ultimately may or may not be best addressed within the SEA. Parks Canada and IEC have followed-up with many of the partners and stakeholders through meetings and/or teleconferences to discuss their comments and the scope of the SEA.

Comments were received from a wide spectrum of reviewers including federal government departments and agencies, provincial and territorial governments, Indigenous communities, industry and industrial associations and environmental non-governmental organizations (ENGOS). Based on the submissions received, it is apparent there is a keen interest in the SEA and the issues it is addressing, along with other issues concerning the adequacy of scientific information, governance, consultation and engagement.

It should be noted that some of the comments were contrary to other comments received (for example, there are those who maintain that the causes of change are from human activity and those that maintain that change is occurring naturally), or not within the direct decision-making and control of Parks Canada to address requiring collaboration with other jurisdictions (for example, the adequacy of the federal environmental assessment process, the best approaches forward for Crown-Indigenous relationships, etc.). It should also be noted that through the Action Plan that will follow the completion of the SEA, decision makers and affected parties will continue to work together on addressing potential threats to WBNP's world heritage values.

The comments can be grouped into 5 categories: 1) Data Sources, 2) Indigenous Knowledge (IK), 3) Assessment Approach, 4) Governance Framework, and 5) Consultation.

The following paragraphs provide a general overview of who submitted comments, a summary table of some of the comments received, and a brief description of the nature of the comments by category. Note that the overview is general, and that certain issues could be captured under multiple categories (e.g. comments from Indigenous groups on data sources are included under Indigenous knowledge). Section 4 describes how these comments have influenced the SEA. Tables listing all the comments received, and SEA team's responses will be appended to the SEA final report. The Appendix will list comments in a manner where specific comments are not attributable to individual reviewers.

1) Data Sources:

Commenting Group	Summary of Comments
Indigenous Communities	Additional literature to be examined and potentially incorporated provided to Parks Canada. (See summary below related to IK)
ENGOS	Ensure that the limitations of the Environmental Impact Statements for individual projects are taken into consideration.
	The temporal boundary should extend much farther into the past than 1950 to capture the natural variability of the system and the system under natural conditions.
	The sources of information and science that the SEA proposes to study should have been provided.
Industry	A robust list of the information sources that will be used in completing the SEA should be provided.
	Industry has identified information sources which are important for consideration in the SEA. A number of peer reviewed studies, monitoring reports, and government documents were suggested.
	Relied too heavily on the Reactive Monitoring Mission report as a data source to the exclusion of other perspectives
	The temporal boundary of 1950 to 2050 excludes a body of scientific research that provides paleo-limnology data for the PAD that covers a much broader timeframe
	Not all literature is in agreement on some matters and this is not mentioned.
Government	Recognize the ongoing Oil Sands Monitoring Program in the Extended Geographic Area that has been focused on the PAD connected waterways and deltaic wetland/lakes
	Information used in Table 1 is unclear.
	Hydrology impacts from upstream development need to include risks from chemical contaminants that may be associated with oil sands developments, pulp and paper, and/or hydroelectric projects
	The temporal boundary should extend much farther into the past than 1950 to capture the natural variability of the system and the system under natural conditions.
	There is more recent and additional scientific information on the air quality impacts of the oil sands industry on the surrounding region available.
	Support for using "several different sources" of information for a weight of evidence approach

As outlined in the table above, comments referenced scientific studies which indicated differing effects of various projects and natural changes to the health of the Peace Athabasca Delta (PAD) and the park's world heritage values (referred to as Outstanding Universal Value or OUV by the

World Heritage Committee).¹ The world heritage values of WBNP are the international criteria that are critical to the park's designation as a World Heritage Site. There is some disagreement as to what is causing the changes within WBNP, specifically the PAD, however, there is general agreement on the importance of maintaining and protecting the world heritage values, the ecological integrity of the park, and the ability of the land to support Indigenous ways of life. In addition, given the amount of information available for review there was commentary on the information sources used to develop the Scoping Report. For example, some comments indicated that not enough weight was given to IK while others commented on the lack of focus on published research by certain researchers. Others noted the lack of monitoring data from industry, and others thought too much weight was given to the information presented to the 2016 World Heritage Reactive Monitoring Mission (RMM) and reflected in the March 2017 RMM report.

2) Indigenous Knowledge:

Commenting Group	Summary of Comments
Indigenous Communities	Lack of consideration of IK. Greater coordination and commitment is required to ensure that our IK is appropriately incorporated
	Lack of support and involvement of Indigenous peoples and their community. Indigenous experts should contribute to the SEA.
	Would benefit from additional context relating to Indigenous people.
	Does not provide clarity on how, when and where IK and perspectives will be involved in the assessment approach for the SEA
ENGOS	Support for inclusion of IK in SEA.
	Encouragement to work with Elders to understand PAD maximum height of ice and water based on clues in the landscape
Government	When scoping OUV elements it is unclear how IK has been taken into account
	What's missing is a discussion on muskrat: their historical importance to local trappers as a source of income, their importance as traditional food, their abundance and historical population levels, and their recent declines due to changes in water quantity and quality
	According to IK, wet meadows are declining and being invaded by invasive thistles in some areas.
	The condition of the grasslands may be declining.

As noted in the table above, Indigenous communities, ENGOS and government all commented on the need to consider IK. Indigenous communities requested the more comprehensive and explicit use of Indigenous (Traditional) Knowledge (IK) in the SEA. In addition, greater clarity on when and how Indigenous perspectives would be utilized in the SEA was also requested.

¹ The term OUV is utilized by the International Union for the Conservation of Nature (IUCN) and United Nations Educational, Scientific and Cultural Organization (UNESCO) to mean "parts of the cultural and natural heritage are of outstanding interest and therefore need to be preserved as part of the world heritage of mankind as a whole."

3) Assessment Approach:

Commenting Group	Summary of Comments
Indigenous Communities	We are concerned that the purpose and scope of the SEA may not match the request of the RMM
	Impacts to local wildlife, wood bison and migratory birds, need to be included in the SEA.
	The PAD includes aspects outside of WBNP and includes the watersheds that flow into Lake Claire. This is not reflected in the geographic boundary of the PAD in the Draft Scoping Report.
	Stressors relating to water quality in the SEA are not included. Consult with us before finalizing the new list of stressors
	Additional scenarios should be added to take into account the volatile nature of local development trends and uncertainties inherent in modeling future conditions.
	Please provide a description of, and justification for, the extent that the SEA will assess the Athabasca River and impacts to the river from existing and proposed oil sands operations.
	Please include the Whooping Crane in the scope of the SEA and assess the impacts from existing and proposed oil sands development to the Whooping Crane as they occur along the migratory corridor and in the PAD
	Please assess the need for a formal buffer zone around WBNP, particularly at the southern boundary, and provide recommendations regarding the nature and extent of this buffer.
ENGOS	Should more clearly identify whether current information gaps are responsible for omitting certain stressors and indicators,
	Uncertain closure approach for large impounded oil sands tailings ponds should be identified as a future stressor. There is no proven process yet to reclaim tailings ponds and safely release process-affected water into the Athabasca River.
	Maintain optimal fish populations in the PAD should be added as an important indicator.
	Consider water quality stressors
Industry	Missing from the assessment methods is the description of how the SEA will identify and assess the residual effects of the past, present and future projects which (according to typical methodologies for project-specific EAs) should form the basis of the cumulative effects assessment
	Selection methods for valued components (VCs) do not follow typical EA selection methods. Please clarify.
	How is Table 1 relevant to the assessment? How are these selected values going to be used in the assessment?
	How will the SEA assess climate change? Climate change is discussed mostly related to projects) but it is occurring independently of existing and proposed projects.
	The various weirs (e.g. on the Rochers and Revillon Coupe Rivers) that have been constructed in the PAD with the purpose of altering water flows should be included as projects in the cumulative effects assessment.
Government	By excluding a world heritage value that is currently considered to have a good or very good status eliminates the possibility to determine if and how stressors will influence that value's status in the future.
	Please ensure that climate is appropriately considered while scoping world heritage value elements. Given the intent of the SEA, it is recommended that elements that are anticipated to be influenced by climate change should be scoped in.
	A large number of migratory birds land on tailings ponds every year with unknown health effects. The SEA should consider migratory bird populations as the element for analysis.
	It is not clear what contaminants will be considered in the SEA. Metals and PACs (PAHs and related compounds) have been flagged by multiple groups as areas of concern. Also acid deposition is not mentioned, but warrants consideration.
	Bison (in particular the Ronald Lake Wood Bison herd) should be considered a separate OUV element for evaluation
	Consider disease as a stressor including disease associated with climate change

	Consider increased geographic distribution of white-tailed deer associated with road development and oil sands activity as a potential risk factor to wildlife in WBNP
	Suggest that the proposed approach also include strategies, priorities and recommendations for future management and protection of ecosystem integrity.
	Why is the Slave River excluded from this SEA?

As detailed above, a considerable number of comments were received about the assessment approaches and methodology. In general, concerns were raised about time and geographic boundaries proposed for the assessment, the lack of independent oversight, lack of clarity of data sources, how some components of world heritage values were screened out from consideration in the SEA, and the need for a clearer description of how data and information will be used in the SEA. In addition, comments were raised about the scenarios to be used for the cumulative effects assessment, the scope of projects being included and how climate change would be addressed. Many commenters also suggested additional data sources and approaches to be used.

4) Governance Framework:

Commenting Group	Summary of Comments
Indigenous Communities	Support for RMM recommendations
	Suggestion for an oversight body for the SEA
ENGOS	Support for RMM recommendations
	Many publications that the SEA will use were generated within, or were limited by, a regulatory system that has had inadequate monitoring and has not assessed or managed cumulative effects
	Does not adequately reflect the guidance provided by the Cabinet directive that an SEA must include: (a) Follow up. There is a need for measures to monitor the environmental effects of the policy and (b) Public and stakeholder concerns. The SEA must identify concerns among those most likely to be affected by impacts on the world heritage values of WBNP.
	The scoping report does not adequately reflect IUCN's guidance that: (a) "EAs must ensure that impacts on the world heritage values of the site are fully considered in land use planning decisions with the objective of preserving these sites for future generations" (b) "Experts with world heritage, protected area, and biodiversity knowledge should be involved early on"
	We are concerned that the Mackenzie River Basin Trans Boundary Waters Master Agreement does not recognize the waters of the Peace River within WBNP as Federal waters and Alberta becomes the de facto negotiator with BC for a flow regime which will protect the Delta.
	Given the ongoing relationship between buffalo and wolves such depopulation will wreak havoc within the park as wolves turn to other prey or other vulnerable species at risk such as caribou within and outside the park.
	Does not indicate that the SEA will consider the management regime of Parks Canada with respect to the world heritage values of the Park.
	The SEA should identify all projects that will likely have irreversible adverse environmental effects on the world heritage values of the Park.
	The Government of Canada is in the process of amending its regulatory processes (<i>Canadian Environmental Assessment Act</i> , <i>National Energy Board</i> , <i>Navigation Protection Act</i> and <i>Fisheries Act</i>) in part to ensure stakeholders are adequately engaged as early as possible within decision-making processes
Industry	Note that, during its 10-day visit, the RMM spent approximately 8 days with the MCFN and representatives. Meetings with industry representatives were confined to a half day.

Government	Regional and strategic assessments should be prepared in consultation with the provinces and other land managers.
	Discussion is focused solely on the potential use of the SEA by Parks Canada. The SEA should be driven by and informed by broader interests than just that of a single federal agency.
	The matter of a buffer around the WBNP is certainly a concern and some on the west of the Park continually ask for the depopulation of the entire buffalo herd given their infection with brucellosis.
	The SEA should identify all projects that will likely have irreversible adverse environmental effects on the world heritage values of the Park.

The table above notes that some comments questioned the ability of the SEA to provide recommendations and strategies for management and protection of the world heritage values into the future. In addition, some questioned whether the SEA would meet relevant Canadian government guidance for SEA, and International Union for the Conservation of Nature (IUCN) guidance for EA. Others questioned the ability of Parks Canada to comment on and influence resource management decision-making responsibilities which sit with the Provincial governments (for example, water flow regulation on rivers).

5) Consultation:

Commenting Group	Summary of Comments
Indigenous Communities	Lack of involvement of Indigenous communities in SEA
ENGOS	Ensure SEA is presented in a way that it is understandable to lay people
Government	Metis peoples should also be consulted as part of the cumulative effects analysis.

A few commenters observed a lack of early consultation consistent with best practices, nation-to-nation relationships, reconciliation, and ongoing reviews of regulatory frameworks (including legislation related to environmental assessment). Questions were also raised about on-going consultation mechanisms and what will be done with comments. Indigenous communities raised concerns about the lack of appropriate consultation.

3. Mechanisms to Address Comments

Given the breadth and complexities of the comments received, they will be addressed using one of the mechanisms detailed below:

Refinements to the data and approach used for the SEA:

Comments received have influenced the approach taken to completing the SEA and the data used to support it. This is detailed in Section 4 below. As noted above, some of the comments were contrary to others; as such, the SEA report will endeavour to reflect opposing points of view where possible. Not all comments will be addressed in the SEA as some are better responded to by mechanisms beyond the SEA (i.e., addressed directly by government rather than within the SEA by an independent contractor).

Inform the Action Plan being coordinated by Parks Canada:

Many comments will be addressed by the Action Plan for WBNP that Parks Canada is creating for December 1st, 2018, as per the World Heritage Committee request. The Action Plan will constitute a funded and coherent work plan that will be implemented over time to ensure the world heritage values of the WBNP World Heritage Site are maintained for generations to come.

The plan will be informed by the findings of the SEA, and its development will require the involvement of Indigenous communities, other levels of government, industry and ENGOs. To date, Parks Canada has been reaching out to these groups to seek their involvement, and together a more formal working relationship will be developed to complete the Action Plan. Information about the Action Plan will be posted on the Parks Canada website as it becomes available.

Shared with Other Decision-Makers:

Other comments received which relate to the relationship between the Government of Canada and Indigenous Peoples, the adequacy of the existing federal EA process, resource availability for science and consultation, etc. will be shared with the Government of Canada and respective jurisdictional authorities for consideration in existing or new programs and initiatives.

4. [Key Influence of Comments on Scope of SEA](#)

The following sections describe how the comments summarized in Section 2 are influencing the preparation of the SEA report.

Data Sources:

Since its creation in 1922 WBNP has been studied extensively by researchers in numerous fields. Additionally, there exists a body of IK created over many generations about the lands and resources in the park. Both sources of knowledge will be used in the SEA. The SEA will present a detailed analysis of the state of the park including how it has changed over time, and the challenges and opportunities that exist for the future. The SEA will be a desktop study of relevant available literature (peer-reviewed papers, non-peer reviewed documents, reports, and presentations), supplemented by emails as well as in-person and phone interviews. The SEA approach is directed by several imperatives, including to:

- Follow the stated goal for the SEA by the World Heritage Committee to determine the cumulative impact of development on the world heritage values of WBNP as a World Heritage Site;
- Incorporate the views of different parties involved;
- Meet the data requirements and information needs for the SEA;
- Where possible provide decision makers with a shared repository of current information to inform and guide their future decision making;
- Do the best job possible given the time constraints for the SEA (with submission of a final report in the spring of 2018); and

- Utilize as much as possible the breadth and depth of knowledge about the park generated over the past 50 plus years.

Extensive review and dialogue within the scoping exercise clarified the focus of the SEA. The analysis of potential threats to world heritage values is focused on the PAD, not to the exclusion of other world heritage values, but because preliminary research and consultation identified the PAD as the most affected component of the world heritage values and the health of the PAD links to most other components of the world heritage values. In the scoping analysis, the values that lie north of the Peace River (i.e., gypsum karst, whooping crane breeding habitat, salt plains) were found to be situated in areas more isolated from industrial development. However, there have been changes noted broadly in WBNP by IK holders, including waterfowl, bison, muskrat, fish and moose population changes (not all of which fall within the scope of the world heritage values). The status of all components of the world heritage values will be assessed in the SEA but in less detail than the analysis of the PAD.

The SEA will focus on the cumulative change observed on important environmental aspects of the PAD. The challenge in assessing cumulative effects in the PAD is that there are numerous influences that interact over time to shift the health and function of an extremely complex ecosystem. Therefore, it can be extremely difficult to attribute changes to specific causes. As a result, the SEA will critically examine a wide range of perspectives and conclusions related to the extent and nature of change in the PAD.

Indigenous Knowledge:

Indigenous peoples have inhabited the area of WBNP and the surrounding regions for thousands of years. The SEA approach acknowledges that the impacts discussed within this report not only affect the world heritage values of the park as a World Heritage Site, but also the ecological integrity of the park and the way of life of Indigenous peoples. Therefore both IK and scientific knowledge will be considered within the SEA. The draft and final SEA reports will be reviewed by Indigenous communities prior to final distribution, all IK will be properly credited, and this research acknowledges the crucial role that Indigenous communities have in this assessment. WBNP is their home and they have been instrumental in the initiation and development of this assessment process. Parks Canada and IEC are working to keep Indigenous communities involved in the assessment, including further trips to WBNP to engage with elders, land users and leadership on the development of the SEA. Ongoing engagement with interested communities will support an iterative approach to developing the SEA and allow community representatives to validate how IK is shared, used and presented in the report.

Assessment Approach:

The SEA is being developed using an approach that respects change and the unknown. As commented upon by several reviewers, the principles of the approach were not made explicit in the Draft Scoping Report. These principles will be clarified in the SEA report and will aid the reader in understanding the overall direction of the SEA. These concepts include:

- a) a commitment to a precautionary approach;

- b) a commitment to integrating IK throughout the SEA; and
- c) a commitment to recommending adaptive management principles in the development of recommendations.

These concepts guide the SEA research approach and provide the foundation for its interpretation.

Based on the comments received, the broadened scope of this SEA has also resulted in an expansion of the assessment approach. Going beyond what was presented in the Draft Scoping Report, methodologies referred to as "pathways of effects" and "systems based modelling" are now being added to demonstrate the relationships between important ecological components within the PAD. Pathways of effects, described as "stories of change" in meetings with land users from the Mikisew Cree First Nation (MCFN), can be used to communicate potential effects of development and climate change. Additionally, systems based diagrams will be used to show the integration of these pathways across time, space and scale by generating a web where all the pathways are connected. These models will help identify opportunities and challenges for future management.

The SEA will include a cumulative effects analysis of different important environmental aspects of the PAD² and scenarios involving a high level strategic analysis of effects to the PAD, including industrial growth projections around WBNP and climate change. A set of recommendations for achieving both short-term and long-term ecosystem health of WBNP will also be generated, including identifying gaps in knowledge and areas for future research and attention. The recommendations will focus on actions that may be considered in the subsequent WBNP Action Plan.

Governance Framework:

This SEA recognizes that changes in the PAD are multi-faceted and all parties, including Federal, provincial and territorial governments, Indigenous communities, industry, ENGOs and researchers have crucial roles to play in ensuring the PAD's sustainability in the future. As Melody Lepine, of the MCFN Government and Industry Relations (GIR) said, "Solutions must be cumulative as well."

This SEA is not a stand-alone process and product, but part of a complex governance structure emerging to support WBNP in maintaining the integrity of the natural features that resulted in its designation as a world heritage site. The SEA results will inform the development of the Action Plan and may provide recommendations regarding research, monitoring, management and governance.

² Cumulative effects analysis includes analysis of factors such as Peace River Flow Effects, PAD Drying and Water Level Effects, Athabasca River Flow and Water Level Effects, Lake Athabasca Water Level Effects, Slave River Flow and Water Level Effects, Weir Effects on River and Lake Levels, Cumulative Effects of Sedimentation in the PAD (sediment transport and quality), Cumulative Effects on Ice Jamming and Flood Events in the PAD considering river regulation, climate change, and timescale, Cumulative Effects on Water Quality in the PAD and Cumulative Impacts on Aboriginal Peoples, Fish, Wildlife, and Vegetation

Consultation:

The world heritage values of WBNP and the methods to measure them have been modified and expanded to reflect the feedback received from Indigenous groups and other parties.

In response to the comments received, the breadth and depth of the SEA has been expanded from that outlined in the Draft Scoping Report. IEC and Parks Canada have committed to greater engagement with Indigenous communities. The intention is to ensure better integration of IK into the report, as well as to increase communication with other parties such as provinces, territories, industry and researchers. This commitment to greater engagement will require several consultant visits to Fort Chipewyan and Fort Smith to learn about ecosystem change from IK holders. Additionally, email and phone engagement with other groups has been expanded to generate a final SEA report that is iterative, balanced and reflective of all sources of knowledge.

5. Concluding Statement

Parks Canada and IEC would like to thank all stakeholders and Indigenous representatives who provided comments on the Draft Scoping Report and shared their perspective on the SEA project. All of the comments received have been reviewed and considered and will continue to inform the SEA as it progresses.

A draft of the SEA will be made available for review and comment in February 2018. Discussions will continue with interested parties, and particularly with Indigenous communities. A list of next steps and anticipated dates is provided below:

Month	SEA Phase/Objective	SEA Tasks – IEC and PCA	Engagement Activities
November	Respond to Scoping Report	Refinement of SEA approach Balancing and incorporation of feedback	Follow-up calls and meetings where needed
	SEA writing and integration with Action Plan	Prepare addendum describing how input received is being used	Follow-up with Indigenous communities regarding interest and capacity
December	SEA writing	IEC commence writing of SEA report Complete and share Addendum	Publish 2 nd newsletter and website update
January	Draft SEA report	Verify approach for inclusion of Indigenous Knowledge Continue writing of SEA report chapters	Meetings in WBNP
February	Comment Period on draft SEA begins	Draft SEA report released for comment Parks Canada WBNP Website update Comment period for all interested parties	
March	Assess comments received	Analyze comments Prepare summary of comments Refine SEA report	Submission of SEA review Specific clarifications as necessary Develop and share tracking tables

April	Finalize SEA	End of SEA contract Parks summary and response	Possible submissions in response to final SEA
	Continue with Action Plan	Share SEA results with Action Plan delegates	Separate engagement processes going forward related to Action Plan

A.3 – COMMENT RESPONSE FORM TO SCOPING REPORT

FINAL REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
1	Indigenous	Indigenous Consultation	Overall	There is a lack of involvement of indigenous people in the SEA process - Canada has not fully and effectively involved indigenous groups in the SEA process	Addressed in SEA
2	Indigenous	Indigenous Knowledge	Overall	Lack of treatment and consideration of indigenous knowledge. Greater coordination, clarity and commitment is required at the outset of the Wood Buffalo SEA to ensure that our indigenous knowledge is appropriately incorporated	Addressed in SEA
3	Indigenous	Indigenous Consultation	Overall	Lack of Support and involvement of indigenous people and their community. We are still working with Parks Canada to determine whether Indigenous communities will be able to have its experts contribute to the SEA, many of whom have decades more background with the issues being considered in the SEA than the consultants hired for this project	Addressed in SEA
4	Indigenous	RMM	General	World Heritage Centre and IUCN input is needed to confirm the scope of the Wood Buffalo SEA is responsive to 41 COM 7B.2 and the recommendation of the 2016 Reactive Monitoring Mission. The report of the 2016 WHC/IUCN reactive monitoring mission to Wood Buffalo National Park made it clear that the Wood Buffalo SEA should not be constrained to flow regulation and oil sands development	Not addressed in SEA
5	Indigenous	SEA Approach	General	Oversight mechanism is needed for Wood Buffalo SEA. Independent oversight of strategic environmental assessments is a helpful way to ensure rigour, transparency and accountability	Not addressed in SEA

FINAL REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
6	Indigenous	SEA Purpose / Objectives	General	Confirmation of the purpose of the Wood Buffalo SEA is needed. We are concerned that the purpose and scope of the Wood Buffalo SEA, as defined in section 1:1 of the Draft Scoping Report, may not match the request of the Reactive Monitoring Mission	Addressed in SEA
7	Indigenous	Indigenous Consultation	Overall	Greater inclusion of Indigenous people and Indigenous knowledge is needed. Two comments are made about the treatment of Indigenous people and Indigenous knowledge. 1) The Draft Scoping Report would have benefited from additional context relating to indigenous people. 2) The Draft Scoping Report does not provide clarity on how, when and where Indigenous knowledge and perspectives will be involved in the "assessment approach for Wood Buffalo SEA	Addressed in SEA
8	Indigenous	Identified Projects	Overall	Projects with potential impacts to wildlife and the landscape are missing. Many projects (past, present and foreseeable) with the potential to impact wood bison, migratory birds and the Peace Athabasca Delta are missing	Addressed in SEA
9	Indigenous	OUV's and VC's	Overall	Impacts to local wildlife need to be included in the SEA. Wood Bison and migratory birds should either be included in the SEA or, If budgetary limitations make that impossible, the scoping report should be revised to confirm that these elements of the Park's OUV have been excluded because of budget limitations	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
10	Indigenous	SEA Approach	Table A1	Lack of clarity, errors and omissions in Table A1. It is unclear to us how the SEA consultants selected the data sources for this table, what it is meant to accomplish, how it fits into the Draft Scoping Report at large, and what its role will be in the next phase of the Wood Buffalo SEA. Update Table 1a to address the omissions and inaccuracies, the exclusion of indigenous knowledge and the lack of clarity regarding its purpose or remove it in its entirety so that these problems are not carried over to the Wood Buffalo SEA report.	Addressed in SEA
11	Indigenous	SEA Approach	Overall	Geographical boundaries need to be established. The geographic boundaries of the Wood Buffalo SEA are not clearly defined in the Draft Scoping Report and, if taken literally, would suggest that all oil sands projects are excluded. From an Indigenous perspective, the PAD includes aspects outside of WBNP and includes the watersheds that flow into Lake Claire. This is not reflected in the geographic boundary of the PAD in the Draft Scoping Report.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
12	Indigenous	OUV's and VC's	Overall	All potential OUV stressors should be included in the SEA. The Draft Scoping Report does not include stressors relating to water quality in the Wood Buffalo SEA. Expand the Draft Scoping Report to clearly include all possible stressors to the Peace Athabasca Delta (including the vegetation, wildlife and indigenous peoples that are part of the PAD ecosystem) so that these can be considered in the Wood Buffalo SEA. Consult with Mikisew before finalizing the new list of stressors	Addressed in SEA
13	Indigenous	SEA Purpose / Objectives	Table 2	Objectives, indicators and desired outcomes need refinement. Table 2 in the Draft Scoping Report identifies a number of indicators relating to surface water quantity and quality. These potential indicators may lack the specificity to identify upstream causes on impacts to OUV in the Peace Athabasca Delta. The relationship between OUV and VC is unclear in the Draft Scoping Report, and the selection of a single VC is likely to create methodological and assessment difficulties.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
14	Indigenous	SEA Approach	Overall	Further refinement of scenarios is necessary. The separation of scenarios in the Draft Scoping Report may make sense in regions with less development, but it may be too coarse for the area surrounding Wood Buffalo National Park. Additional scenarios should be added alongside the four basic scenarios laid out for the assessment of cumulative effects to take into account the volatile nature of local development trends and uncertainties inherent in modeling future conditions.	Addressed in SEA
15	Indigenous	SEA Approach	Overall	Assessment approaches & methodology are unclear. The Draft Scoping Report refers to cumulative effects assessment, cumulative effects analysis and SEA interchangeably. As these are distinct yet linked practices with unique and defined outcomes and objectives, it is not clear to us what implications there may be from the Draft Scoping Report including terminology from all three. Commit to engage in a more detailed discussion with us regarding methodological choices and options for the assessment prior to finalizing the Draft Scoping Report. Provide an explanation for why quantitative methods are not considered.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
16	Indigenous	OUV's and VC's	Overall	Indigenous group agrees with inclusion of the PAD as a VC because of its importance however, after reviewing Industry EIA and supplemental material, government reports and available scientific material, we disagree with the conclusion that the wolf/bison ecosystem and whooping crane are potentially not threatened by outside influences.	Addressed in SEA
17	Indigenous	SEA Approach	Overall	Indigenous Traditional Territory extends north of Fort McMurray and includes a portion of WBNP and the Peace Athabasca Delta (PAD) and current and future effects on these areas is of great concern to our community. As a result of oil sands development, the ability to continue our traditional and cultural practices requires community members to travel further to the edges of our territory. Community members have expressed concern for they have been witness to the declining availability of berries, medicines and wildlife close to the community's reserve lands.	Not addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
18	Indigenous	SEA Approach	Overall	However, when discussing the cumulative effects of the Athabasca oil sands only three planned projects were identified; Teck Frontier, Joslyn Mine, and the Jackpine Mine Expansion projects. The Scoping Report does clearly include the present operating mines in the cumulative effects assessment. Mines that should be included are Aurora North and South (Suncrude), Base Operations (Suncor), Horizon (Canadian Natural), Kearl (Imperial), Mildred Lake (Suncrude), Muskeg River (Canadian Natural), and Jackpine (Canadian Natural). Fort Hills (Suncor) is also scheduled to start operations by the end of 2017. Neither does the Scoping Report include other future projects such as Suncor Lewis or Voyageur South. These operations use large quantities of water from the Athabasca River, release air and water emissions, have tailings ponds, and vast infrastructure (e.g., electrical transmission lines and buildings).	Addressed in SEA
19	Indigenous	OUV's and VC's	Overall	The Scoping Report states that whooping cranes were not included in SEA because there is little evidence that breeding habitat condition and its use is declining. The Scoping Report makes this conclusion without presenting sufficient data to support exclusion of this OUV.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
20	Indigenous	Other	Overall	The Scoping Report concludes that the WBNP predator-prey relationship between bison and wolves is intact and in good condition, and stressors do not appear to be related to activities outside of the WBNP. This conclusion is made based on stable bison population observations. The data on bison population was not presented in the Scoping Report and it is unclear how the conclusion about the intact predator-prey relationship was made and; therefore, it should be included in the SEA.	Addressed in SEA
21	Indigenous	SEA Approach	Overall	Concerns about the air quality predictions reported in oil sands EISs (EIAs) and as a result has felt the need to conduct independent air and odor monitoring. Air quality predictions from EIAs should not be assumed correct and the SEA should include an independent assessment of air quality predictions in WBNP.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
22	Indigenous	Traditional Knowledge	Overall	Impacts to whooping cranes, wolves, and bison are not included in the SEA because the Scoping Report concluded that whooping crane breeding habit is in good condition and the wolf/bison predator prey relation is unaffected by influences outside WBNP. However, traditional environmental knowledge provided by Indigenous groups and others indicates that the Athabasca oil sands is a danger to whooping cranes and that the bison/wolf predator-prey relation is unbalanced. The Scoping Report conclusions have disregarded the environmental knowledge provided by Aboriginal communities without proper justification (e.g., presentation of data). Based on the provided environmental knowledge by traditional land users, the SEA should include impact to whooping cranes, bison, and wolves.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
23	Indigenous	OUV's and VC's	Overall	The Scoping Report needs to include all past, present, and planned development in the Athabasca oil sands region and not be limited to the assessment of three planned Athabasca oil sands developments. For an appropriate assessment of influences on WBNP OUVs, water quantity and quality, air quality, and the wildlife community for the entire Athabasca oil sands area should be included within the scope of the Report. Factors that should be considered but not limited to are: the water management framework and the biodiversity management framework in the oil sands region, wolf and deer expansion to the north, population and movement of the RLBH, Industries proposed mitigation for wildlife, the mitigation and monitoring of tailings ponds, and existing and planned migratory bird hazards	Not addressed in SEA
24	Indigenous	SEA Approach	Section 3	The Scoping Report indicates that the geographic boundary of the SEA is comprised of the "PAD system", defined as "the PAD itself and these two river systems [the Peace River and the Athabasca River]". It is unclear from this description how far down these rivers the SEA will consider. Please provide a description of, and justification for, the extent that the SEA will assess the Athabasca River and impacts to the river from existing and proposed oil sands operations.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
25	Indigenous	SEA Approach	Table 1	In Table 1, the “interpreted meaning” of the “Individual OUV Elements” for Criterion (vii) is defined as the “[p]ortion of the Peace-Athabasca Delta within WBNP”. This appears to suggest that the SEA will not consider the entirety of the PAD, ignoring the 20% of the PAD that lies outside of the WBNP. This definition also appears to be contrary to the stated geographic boundary of the SEA: “the PAD system”. Please amend the Scoping Report to reflect the inclusion of the entire PAD system in the SEA.	Addressed in SEA
26	Indigenous	SEA Approach	Section 3	The temporal boundary of the SEA is proposed to start in 1950 and extend to 2050. While this future limit reflects the realistic bounds of climate predictions, it does not capture the full lifespan of the Teck Frontier Project, which will conclude its mining operations in 2066 and finish reclamation in 2081. Please extend the temporal boundary of the SEA to include the full lifecycle of the Teck Frontier Project	Addressed in SEA
27	Indigenous	OUV's and VC's	Overall	Although the Whooping Crane is considered an OUV element, the Scoping Report does not include it within the SEA on the grounds that the primary threats to the Whooping Crane exist during migration or within their wintering ground. Please include the Whooping Crane in the scope of the SEA and assess the impacts from existing and proposed oil sands development to the Whooping Crane as they occur along the migratory corridor and in the PAD	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
28	Indigenous	SEA Approach	Overall	The Ronald Lake Bison Herd (RLBH) has not been included in the scope of the SEA. Indigenous groups submit that the RLBH should be included in the SEA because the herd is an element of the OUV of WBNP. Please include the Ronald Lake Bison Herd in the scope of the SEA.	Addressed in SEA
29	Indigenous	SEA Approach	Overall	While the Scoping Report acknowledges the lack of a buffer zone around WBNP and the particular need for management of the buffer zone at the southern boundary of the Park, it does not properly address the issue. Indigenous groups submit that the SEA represents a timely opportunity to assess the need for a buffer zone around WBNP to protect the OUV. Please assess the need for a formal buffer zone around WBNP, particularly at the southern boundary, and provide recommendations regarding the nature and extent of this buffer.	Not addressed in SEA
30	Indigenous	Baseline Studies	Overall	Additional literature to be examined and potentially incorporated. Refer to Microsoft Word Document	Addressed in SEA
31	Government	OUV's and VC's	Overall	Criteria for scoping OUV. By excluding an OUV that is currently considered to have a good or very good status eliminates the possibility to determine if and how stressors will influence an OUV's status in the future. Excluding OUV's bases on their current status would also fail to assess these OUV's throughout the entire temporal frame outline in this study – starting in 1950 and extending 30 years into the future (2050)	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
32	Government	OUV's and VC's	Overall	Climate must be properly incorporated into the SEA as the impacts of climate change on the PAD and its OUV's is an area of focus. Please ensure that climate is appropriately considered while scoping OUV elements. Given the intent of the SEA, it is recommended that OUV elements that are anticipated to be influence by climate change should be scoped in. Eliminating these elements would limit the value of the SEA results by diminishing the understanding of the impacts of climate change.	Addressed in SEA
33	Government	Indigenous Knowledge	Overall	Input of traditional Indigenous knowledge when scoping OUV elements. The report states that "[w]here available, [Traditional Ecological Knowledge] will be part of the information reviewed for each [Valued Component]." However, when scoping OUV elements it is unclear how Traditional Ecological Knowledge has been taken into account	Addressed in SEA
34	Government	Identified Projects	Table A1	Ensure that the limitations of the EIS are taken into consideration when assessing the impact of the Teck Frontier oil sands project. In Table 1A, the Teck Frontiers Environmental Impact Statement (EIS) is referenced in several locations. During the environmental assessment process for the Teck Frontier project a number of information requests that identify limitations of the EIS have been submitted to the joint review panel.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
35	Government	SEA Approach	Overall	Missing index. The report should provide an index or section summarizing what issues will be assessed in the SEA report. Referencing location by subject matter (e.g. hydrology, water quality, species at risk, air quality, navigability, CEs, etc.)	Addressed in SEA
36	Government	OUV's and VC's	Overall	The Draft Scoping Report does not adequately capture the dynamics of the PAD hydrology. Draft Scoping Reports capture the major potential natural and anthropogenic impacts/effects on the hydrology of the PAD; namely climate change, flow regulation and development	Addressed in SEA
37	Government	Other	Table 1	Information used to assign "condition and "condition trend" in Table 1 are unclear. Another point to highlight is that the source(s) of information used to assign "condition and "condition trend" in Table 1 are unclear	Addressed in SEA
38	Government	Other	Table A1	Provide listings for sources of information in Table A1 that came from other reports. Sources of information used to assign "Good", "Fair" and "Poor" designations in Table A1 are mostly other reports. It would have been helpful to provide listing of the original studies these statements were based upon	Addressed in SEA
39	Government	SEA Approach	Overall	Recognition of ongoing Oil Sands Monitoring Program. The Draft Scoping Report does not explicitly recognize the ongoing Oil Sands Monitoring Program in the Extended Geographic Area that has been focused on the PAD connected waterways and deltaic wetland/lakes	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
40	Government	Other	Section 1.2	2009 or 2010 State of the Park Report? Page 8 and Page 10 have two different dates for the State of the Park Report for WBNP. Confirm the date and be consistent	Addressed in SEA
41	Government	Other	Figure 2	Does Figure 2 list all of the Indigenous Communities? Is this list comprehensive / complete with all Indigenous communities?	Addressed in SEA
42	Government	Other	Figure 2	Spelling errors for #1 and #5 - and Groups 3, 5 and 6 should be excluded. If all these groups need to remain in this figure, perhaps the legend should be revised to include "surrounding communities inside X km"	Addressed in SEA
43	Government	Indigenous Consultation	Section 1.3	Are we properly consulting with all Indigenous groups? Why is ACFN not being consulted? Why not consult with all Indigenous groups inside the PAD?	Addressed in SEA
44	Government	SEA Approach	Section 1.4	Methodological challenges need to be further explained. What were these challenges?	Addressed in SEA
45	Government	OUV's and VC's	Section 1.4	Provide more detail regarding OUV and VC. It might be helpful to provide more detail regarding how OUV and VC are different	Addressed in SEA
46	Government	OUV's and VC's	Section 1.4	Properly defining the focus of the scoping document. This should be revised for clarity... logic behind the statements? Why is the protection of VCs also not a focus of this scoping document? Clearly defining VCs and OUVs and how they are linked would help with the messaging.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
47	Government	Baseline Studies	Section 2.2.1	Forest and Pulp and Paper. ECCC's Environmental Effects Monitoring (EEM) program has many reports on Pulp and Paper available. Maybe more information is required	Addressed in SEA
48	Government	Other	Section 2.3	Relevant Monitoring Programs. What does this encompass? Not mentioned again in the document. It should encompass contaminants in a broader wildlife health monitoring program. If written as "Contaminants in wildlife" would encompass this. Finally, need to add "water level" to list of parameters monitored in the PAD	Addressed in SEA
49	Government	Other	Section 3.1	Hydropower - Peace River. Need to clarify status of EA (EIS Guidelines issued but waiting for EIS 2019?)	Addressed in SEA
50	Government	SEA Approach	Section 3.1	More information is needed on the selection process of the mine's involved. It is not clear why only these mines were selected (in addition to Frontier). There are other mines (operating or under construction) that are closer to WBNP than the approved Joslyn North and Jackpine Mine Expansion mines. These include CNRL's Horizon mine, Suncor's Fort Hills mine, and Syncrude's Aurora North mine. The SAE should consider including all projects within the mineable oil sands area as all projects have the potential to affect migratory birds that utilize the PAD. Pierre River? Insitu impacts should be considered as well.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
51	Government	SEA Approach	Section 3.2	Expressing Criteria Properly. Criteria do not accurately reflect what the data may be indicating. An alternative way to express them could be: Re-characterize rating categories: Very good - Acceptable, Good - Some Concern, Poor - Concern, Very Poor - Significant Concern. Trends should be described as: improving, stable, declining	Addressed in SEA
52	Government	SEA Approach	Section 3.1	Addressing and looking at climate change. ECCC likely has expertise in this area	Addressed in SEA
53	Government	OUV's and VC's	Section 3.2	SEA criteria needs further consideration. OUVs characterized as being of "Some Concern" (currently rated as "Good") should be included in the SEA	Addressed in SEA
54	Government	OUV's and VC's	Section 3.2	Criteria for deteriorating elements. What about elements that are in good condition now, but might deteriorate in the future as a result of additional cumulative developments?	Addressed in SEA
55	Government	OUV's and VC's	Section 3.2	Criteria. Would climate change effects have to be first applied as a filter to see if could subsequently be linked / vulnerable?	Addressed in SEA
56	Government	OUV's and VC's	Section 3.2	The OUVs proposed for omission from the SEA are linked to aspects which the SEA is tasked to address, e.g. climate change. Additional justification is required	Addressed in SEA
57	Government	SEA Approach	Section 3.2	Geographic Boundaries of PAD. See comments in table. There are important elements that occur outside the PAD.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
58	Government	Other	Section 3.2	Hydrology impacts from upstream development. This needs to include risk from chemical contaminants that may be associated with oil sands developments, pulp and paper, and/or hydroelectric projects, i.e. dams/flooding/Hg	Addressed in SEA
59	Government	Other	Section 3.3	Hydrology impacts - how far upstream are we considering? These are extremely long river systems.... How far upstream is being considered. Furthermore, need to add that the PAD is located at western end of Lake Athabasca, which in addition to the Peace and Athabasca River, has significant influence on water levels of large interior lakes and connected waterways	Addressed in SEA
60	Government	Other	Section 3.3	The temporary boundary should extend much farther into the past than 1950 to capture the natural variability of the system and the system under natural conditions. For instance, there is near century long flow data on stations upstream of Ft McMurray and Peace Point and Lake Athabasca that would provide relevant information.	Addressed in SEA
61	Government	Other	Section 3.3	Temporal Boundaries. For examining ice-jam flood frequency and how it may have changed after construction of the Bennett Dam, we need to go farther into the past so that pre-and post-regulation periods are, at least, equal.	Addressed in SEA
62	Government	Other	Section 3.3.1	1.5 million migratory birds - Is this estimate current given TK holders observations of declines in bird abundance? Pg. 16	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
63	Government	Other	Section 3.3.1	Historical importance of muskrats. What's missing here is a discussion on muskrat: their historical importance to local trappers as a source of income, their importance as traditional food, their abundance and historical population levels, and their recent declines due to changes in water quantity and quality	Addressed in SEA
64	Government	Other	Section 3.3.1	Floods in the PAD. There is a need to qualify the statement that "Peak summer flows are unable to reach perched basins". This statement generally applies to Peace River Delta but not to Athabasca River Delta and areas contiguous to large central lakes.	Addressed in SEA
65	Government	SEA Purpose / Objectives	Table 1	SEA scope and supporting rationale. Primary focus of PAD - what about the potential effects of oil sands tailings ponds on migrating birds that use the PAD? A large number of migratory birds land on tailings ponds every year with unknown health effects. The SEA should consider migratory bird populations as the element for analysis.	Addressed in SEA
66	Government	SEA Approach	Table 1	Potential key factors affecting the current conditions and trends. Contaminants - It is not clear what contaminants will be considered in the SEA. Metals and PACs (PAHs and related compounds) have been flagged by multiple groups as areas of concern. Also acid deposition is not mentioned anywhere in this report, but warrants consideration.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
67	Government	Other	Table 1	Trend - "Stable", but may not be - Great Plains. According to Indigenous knowledge, wet meadows are declining and being invaded by invasive thistles in some areas. The condition of the grasslands may be declining.	Addressed in SEA
68	Government	SEA Purpose / Objectives	Table 1	SEA scope and supporting rationale - Great Plains. This does not consider that the grasslands extend beyond the PAD and support bison elsewhere in the park (e.g., Ronald Lake range). The Ronald Lake herd is a component of the boreal-grassland community, and it may be adversely affected by the Teck Frontier Project. The Frontier project may also affect predator-prey relationships within and adjacent to the park. Bison (in particular the Ronald Lake Wood Bison herd) should be considered a separate OUV element for evaluation	Addressed in SEA
69	Government	Other	Table 1	Predator and Prey Relationships. The Ronald Lake herd is disease-free and its range extends into the park. It could also be considered a WBNP herd.	Addressed in SEA
70	Government	Other	Table 1	Predator and Prey Relationships. The relationship for the Ronald Lake herd may be adversely affected by the Teck Frontier Project.	Addressed in SEA
71	Government	Other	Table 1	Predator and Prey Relationships. Should look at herds separately, especially diseased vs non-diseased herds. It is possible that the Ronald Lake herd has declined recently.	Addressed in SEA
72	Government	Other	Table 1	Predator and Prey Relationships. The Teck Frontier project may affect the occurrence and distribution of predators, which may affect the Ronald Lake bison herd	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
73	Government	Other	Table 1	Predator and Prey Relationships. Bison (in particular the Ronald Lake bison herd) should be considered a separate element for analysis.	Addressed in SEA
74	Government	Other	Table 1	The cranes themselves should be considered part of the OUV element, not just the habitat. Although the population is increasing slowly, it is at risk when migrating over the oil sands area, where it may come in contact with tailings ponds and other infrastructure. The number and area of ponds have been increasing.	Addressed in SEA
75	Government	OUV's and VC's	Section 3.3.1	Bison occur outside of the PAD. The SEA should consider bison as a separate OUV element.	Addressed in SEA
76	Government	Other	Section 3.3.1	Including the Teck Frontier project which will affect the Ronald Lake wood bison herd (outside the PAD).	Addressed in SEA
77	Government	Baseline Studies	Section 3.3.1	stressors - peace river regulations. One could mention here that a similar finding has been reported for regulation in China (Chang et al. 2016; see full citation and other relevant publications below).	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
78	Government	Baseline Studies	Section 3.3.1	stressors - peace river regulations. It would be helpful to cite the source(s) of these figures and to specify what is meant by “winter” and “summer”. Depending on context, these terms may involve different calendar dates and months. Also, it may be appropriate to mention the physically-based and data-supported link between increased winter flows and reduced frequency of ice-jam floods, as has been described in Beltaos et al 2006b (higher winter flows cause higher freezeup water levels, which in turn inhibit occurrence of dynamic ice breakup events that can lead to major jams and floods).	Addressed in SEA
79	Government	Baseline Studies	Section 3.3.1	Recent Work with respect to Ice dynamics - Stressors. Beltaos, S. 2017. Self-sustaining waves resulting from dynamic storage release in ice-covered channels. CGU HS Committee on River Ice Processes and the Environment 19 th Workshop on the Hydraulics of Ice Covered Rivers, <i>Whitehorse, Yukon, Canada, July 9-12, 2017</i> .	Addressed in SEA
80	Government	Baseline Studies	Section 3.3.1	Recent Work with respect to Ice dynamics - Stressors. Beltaos, S. 2017. Hydrodynamics of storage release during river ice breakup. <i>Cold Regions Science and Technology</i> , 139: 36-50.	Addressed in SEA
81	Government	Baseline Studies	Section 3.3.1	Recent Work with respect to Ice dynamics - Stressors. Chang, J., Wang, X., Li, Y., and Wang, Y., 2016. Ice regime variation impacted by reservoir operation in the Ning-Meng reach of the Yellow River. <i>Nat Hazards</i> , 80:1015–1030.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
82	Government	Baseline Studies	Section 3.3.1	Recent Work with respect to Ice dynamics - Stressors. Huokuna, M., Morris, M., Beltaos, S., and Burrell, B. 2017. Ice in Regulated Rivers and Reservoirs. CGU HS Committee on River Ice Processes and the Environment 19 th Workshop on the Hydraulics of Ice Covered Rivers, <i>Whitehorse, Yukon, Canada, July 9-12, 2017</i>	Addressed in SEA
83	Government	Other	Table 2	Title - What about waterflow?	Addressed in SEA
84	Government	Other	Table 2	Potential Indicators. How is optimal determined / defined?	Addressed in SEA
85	Government	Other	Section 3.5 - Table A1	The results in Table A1 are not easy to understand nor is it obvious how cumulative effects are being evaluated.	Addressed in SEA
86	Government	SEA Approach	Section 3.6	Methodology. Is this referencing to an odds ratio approach? More details on the methods would be useful	Addressed in SEA
87	Government	SEA Approach	Section 3.6	Methodology. "Territories" should be added to list of collaborators as need to include Lake Athabasca influence/inflow	Addressed in SEA
88	Government	Other	Table A1	As mentioned above for Table 1, re-definition of categories should be considered. The same evaluation scheme should be applied here as in Table 1. Here, it is: Poor, Fair, Good. In Table 1 it is: Very Good, Good, Poor, and Very Poor. We suggest that neither of these schemes adequately captures what the data may be indicating. Please consider the following alternative rating scheme: Acceptable, Some Concern, Concern, Significant Concern. These ratings could be applied in both Tables 1 and A1	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
89	Government	Other	Table A1	Use consistent trend ratings throughout Tables 1 and A1, here both decreasing and declining are used. Use improving, stable, declining.	Addressed in SEA
90	Government	Other	Table A1	Are these statements of “no impact” from the project EISs? Caution advised in taking them at face value – particularly Teck Frontier which has yet to go to hearing.	Addressed in SEA
91	Government	Baseline Studies	Table A1	Muskrats - I would argue the numbers are poor, and declining. There are a number of studies showing this that have not been considered for this scoping report – see work by Glynnis Hood - UofA	Addressed in SEA
92	Government	Other	Table A1	This should be re-evaluated as “Concern”. I’m sure others will also comment on this as TK holders have commented extensively at PADEMP forum on the degree to which muskrat populations have declined, primarily as a result of water level issues.	Addressed in SEA
93	Government	Other	Table A1	“Some Concern” might be more appropriate given TK concerns.	Addressed in SEA
94	Government	Other	Table A1	Use consistent ratings throughout Tables 1 and A1	Addressed in SEA
95	Government	Other	Table A1	This indicator should be re-defined as “Mercury toxicity to waterbirds” and it can be given an “Acceptable” rating.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
96	Government	Other	Table A1	This new indicator would capture issues associated with the human consumption of waterbird eggs. Its rating as “Concern” is based upon Alberta Health’s existing consumption advisory for waterbird eggs based upon egg mercury levels (see: https://mywildalberta.ca/hunting/safety-procedures/gull-and-tern-egg-consumption-advisory.aspx .)	Addressed in SEA
97	Government	Other	Table A1	This new indicator would capture issues associated with the human consumption of waterbird eggs. Its rating as “Concern” is based upon Alberta Health’s existing consumption advisory for waterbird eggs based upon egg mercury levels (see: https://mywildalberta.ca/hunting/safety-procedures/gull-and-tern-egg-consumption-advisory.aspx .)	Addressed in SEA
98	Government	Other	Table A1	Both of the waterbird indicators address habitat quality, i.e. do chemical contaminants in the environment pose a risk to: 1) wildlife health and 2) human health	Addressed in SEA
99	Government	Baseline Studies	Table A1	Justification for air quality as being “stable” is based on references that are 6 and 7 years old respectively. The body of scientific information on the impacts of the oil sands industry on the surrounding region has expanded greatly since these reports were written.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
100	Government	Other	Table A1	The safety of consuming traditional foods from the listed species is of concern to TK holders. We are showing higher levels of some contaminants (compared to the province and on a national scale) in these animal species that warrant further investigations. This is actually now being funded by the Canadian Institute for Health Research, and was also part of the First Nation Food and Nutrition Environmental Study (FNFNES).	Addressed in SEA
101	Government	Other	Overall	Overall comment - A good copy edit for proper use of commas, parentheses, verb agreement, word usage in some cases (e.g., effects vs affects), consistent citations, formatting (e.g., pages 17/22; pages 24/26) etc. would be valuable for the final product.	Addressed in SEA
102	Government	Baseline Studies	Overall	Overall comment - Consideration of downstream effects on the water quantity and quality of the Slave River should be more prominent. While the PAD has certainly experienced changes, the Slave River also has experienced environmental changes.	Addressed in SEA
103	Government	Indigenous Consultation	Section 1.3	Please clarify how the list of indigenous peoples has been assessed because there are a number of groups with overlapping asserted territories in the area of the PAD and WBNP.	Addressed in SEA
104	Government	Other	Overall	Consistent capitalization of "indigenous"	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
105	Government	Other	Section 2	Consider disease as a stressor (e.g., anthrax, winter tick, <i>Brucella</i> and bovine tuberculosis). There could be other diseases that could be major stressors even if they are not currently playing a role in the ecosystem (e.g., avian cholera in waterfowl, highly pathogenic avian influenza in geese, swans, and raptors, Newcastle disease in cormorants, West Nile virus can cause mortality in pelicans)	Addressed in SEA
106	Government	Other	Section 2.2.1	Consider emerging infectious diseases as concerns associated with climate change (e.g., arthropod-borne diseases and expansion in distribution of southern species such as white-tailed deer that can carry pathogens that are relevant to moose)	Addressed in SEA
107	Government	Other	Section 2.2.1	Consider increased geographic distribution of white-tailed deer associated with road development and oil sands activity as a potential risk factor to wildlife in Wood Buffalo	Addressed in SEA
108	Government	Other	Section 2.2.1	Consider potential agricultural development associated with other industrial practices as a potential threat to wildlife in the park in terms of potential for conflicts (e.g., predation of livestock and transfer of pathogens to and from livestock) and encourage maintenance of a buffer zone.	Addressed in SEA
109	Government	Other	Section 2.2.1	Industrial resource extraction should include unconventional oil and gas such as hydraulic fracturing	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
110	Government	Other	Section 2.2.2	Development could be better defined and should include unconventional shale gas and associated hydraulic fracturing. Add some clarification here with more detail.	Addressed in SEA
111	Government	OUV's and VC's	Section 3	The proposed assessment approach does not include climate change - e.g., "assess potential cumulative impacts on the VCs from existing and planned projects"...what about from climate change as well? On the subsequent page (14) climate change is discussed as an overriding issue. Suggest that it also be incorporated into the bulleted list on page 13.	Addressed in SEA
112	Government	SEA Approach	Section 3	Suggest that the proposed approach also include strategies and priorities (and recommendations) for future management and protection of ecosystem integrity.	Addressed in SEA
113	Government	Other	Section 3.3	the temporal boundary is proposed to start in 1950 and extend 30 years <i>from 2020</i> into the future (2050)	Addressed in SEA
114	Government	Other	Table A1	Please provide more information such that the NWT can assess statements regarding limited impact from oil sands development.	Addressed in SEA
115	Industry	RMM	Overall	Mission report was not critically assessed. The scoping document and the proposed methods for a Strategic Environmental Assessment (SEA) is ultimately flawed because the consultants assume that the conclusions from the 10 day Mission were accurate, and do not critically evaluate those conclusions.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
116	Industry	Other	Section 3.3.1	Scoping document - pre-emptive conclusions. At various times throughout the document, the authors go beyond summarizing information reviewed and begin to draw pre-emptive conclusions. These conclusions are made without the assessment or reference and therefore come across as biased and without scientific basis. This is particularly true in the existing condition section (3.3.1).	Addressed in SEA
117	Industry	RMM / OUV's and VC's	Overall and Section 3.5	Methodology - Authors use as the basis of their assessment the identified issues affecting the outstanding universal value (OUV) from the Mission Report. No additional information appears to have been reviewed or considered (see literature gaps below). The key concern with this is the Mission Report is based on a 10 day Mission to assess the state of conservation of the Wood Buffalo National Park (WBNP) ¹ . The Mission Report is not (nor does it claim to be) representative of the existing base condition of Park. Further, the Mission report is not (nor does it claim to be) an environmental effects assessment. The scoping document describes under section 3.5, using the information from the Mission Report to largely characterize the existing base condition for the cumulative effects assessment. This was not the intent of the Mission Report. Also, the SEA uses the identified issues affecting the OUV of WBNP from the Mission Report as the basis for the SEA assessment without critical assessment of those conclusions	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
118	Industry	SEA Approach	Overall	Methodology - Missing from the assessment methods is the description of how the consultant proposes to identify and assess the residual effects of the past, present and future projects. Those residual effects should form the basis of the cumulative effects assessment	Addressed in SEA
119	Industry	OUV's and VC's	Overall	Methodology - VC selection methods do not follow typical EA selection methods. What standard methods were followed? No candidate VCs were provided, and no rationale was provided for the selection of the PAD as the only VC for the assessment. The scoping document says that only one VC is selected, the PAD. Appendix 1 has a table that lists four VCs? Also, this appendix specifically says wood buffalo is a VC where the scoping document says wood buffalo are not considered. Please clarify	Addressed in SEA
120	Industry	OUV's and VC's	Overall	Methodology - How is the screening table for the OUV relevant to the assessment? How are these selected OUVs going to be used in the assessment – how do they relate to the VC (the PAD)? The description provided is not really clear	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
121	Industry	Other	Table A1 - Appendix 1	Methodology Appendix 1 – where did the info in this table come from? The table is confusing and not well organized. The table also provide lots of results including climate change results – where did all these come from? Again, methods for determining the effects of the existing and future projects were not discussed in the report – yet this table provides a list of effects. How were these determined? How were the effects of climate determined (see climate change section below)?	Addressed in SEA
122	Industry	Other	Section 1.4	Literature Gaps. The scoping report does not include a summary of the literature reviewed. Section 1.4, Overview of the Materials Reviewed to Date does not describe the information reviewed, but rather how it was reviewed. This section reads more like a methods section.	Addressed in SEA
123	Industry	OUV's and VC's	Overall	How will the consultant assess climate change? Climate change is discussed only within other sections of this Scoping Report (mostly related to projects) and not addressed on its own, even though climate change is identified as a key issue affecting the OUV of the PAD in the WBNP.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
124	Industry	Other	Section 3	Temporal Boundaries - The Consultant chose to select the temporal boundary of 1950 to 2050. Baseline condition ('pre- development) for the Cumulative effects assessment is focused on 1950. There is a body of scientific research that provides paleo- limnology data for the PAD that covers a much broader timeframe (100s of years of years prior to the construction of Bennett Dam. This data is particularly important when examining the effects of climate change on the PAD. Can the authors explain why this peer-reviewed scientific data should not be considered in the analysis?	Addressed in SEA
125	Industry	RMM	Section 2.2	page nine of the Scoping Report cites the RMM report where it suggests "water withdrawals by oil sands operators from the Athabasca River may be affecting in-stream flows towards the [Peace-Athabasca Delta] PAD". The Scoping Report should take into account that on March 13, 2015, the Government of Alberta released an update to the 2007 Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River called the Surface Water Quantity Management Framework for the Lower Athabasca River (SWQMF).	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
126	Industry	SEA Approach	Section 1.3	On page six, the Scoping Report states that “[s]cientific reports, academic articles, project level environmental assessments, park documents, and traditional knowledge documents were reviewed to inform this scoping document.” There is no mention of either routine data collected by industry and submitted to various levels of government as a condition of operating approvals or the independent monitoring data collected jointly by the governments of Canada and Alberta under the Oil Sands Monitoring Program (JOSM); both of which are critical in reviewing any impact the oil sands industry has had in the region.	Addressed in SEA
127	Industry	Baseline Studies	Appendices A&B	In Appendices A & B, we have provided information sources that should be considered in addition to those identified in the Scoping Report to have a balanced perspective. The Scoping Report should identify how this information will be used to assess the RMM report recommendations and the validity of those recommendations against the existing data	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
128	Industry	Other	General	The Government of Canada is in the process of amending its regulatory processes with regard to the Canadian Environmental Assessment Act, National Energy Board, Navigation Protection Act and Fisheries Act in part to ensure stakeholders are adequately engaged as early as possible within the process. We believe this should also occur with the creation of this Scoping Report and subsequent SEA, but that has not occurred to date. Further, in order to be effective, regional and strategic assessments should be prepared in consultation with the provinces and other land managers. SEAs should inform project assessments, but not stall or delay them.	Addressed in SEA
129	Industry	Baseline Studies	Overall	Data Sources. A robust list of the information sources that will be used in completing the SEA is not provided in the draft Scoping Report. Industry has identified a number of information sources which are important for consideration in the SEA	Addressed in SEA
130	Industry	Other	Figure 1	Clarification Figure 1: The Teck Frontier Oil Sands Mine Project disturbance area (PDA) shown in the figure is from the Frontier Oil Sands Mine Project Integrated Application in 2011. It has since been updated in the 2015 Project Update.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
131	Industry	Other	Table A1	Clarification Appendix A, Table A1: The results summary presented in Table A1 regarding Teck Frontier should align with the assessment findings in the 2015 Project update and acknowledge the proposed Project is currently undergoing a joint federal-provincial regulatory review.	Addressed in SEA
132	Industry	SEA Purpose / Objectives	Section 1.1	Introduction - Purpose of the scouting report. There is some very loose paraphrasing of the WHC decision. The decision is very brief and very specific. If it is going to be referenced, it should be done with verbatim quotes (not paraphrased). Further, the part of the decision that was paraphrased related to the RMM--not the SEA. I have included both (although I'm not sure what the reference to the RMM adds at this point)	Addressed in SEA
133	Industry	Other	Section 1.2	The introduction of the sentence ascribes reasons for the 1983 designation decision. There is no reference given, and I'm not sure all of the above were referenced in the 1983 decision. The remainder of sentence is factual.	Addressed in SEA
134	Industry	OUV's and VC's	Section 1.2	Introduces a new term "world heritage value" which is undefined. Is this meant to be something different from OUV	Addressed in SEA
135	Industry	Other	Section 1.1	Terminology - petitions to the WHC are not "accepted" (or "rejected") at this stage. The WHC responded (as per the decision cited)	Addressed in SEA
136	Industry	Other	Section 1.1	Improper designation - The response to the WHC request comes from Canada, not Parks Canada.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
137	Industry	Other	Section 1.1	Clarification to a sentence -The role of the SEA or the role of this Scoping Document?	Addressed in SEA
138	Industry	Other	Section 1.1	"natural significance.....all humanity". What is the reference for the quote?	Addressed in SEA
139	Industry	Other	Section 1.2	Unclear quotations - Pg. 3 - "defines ecological.....a legal obligation". Is this material (following each criterion) a quote from some UNESCO document, or is it commentary from the authors of the Scoping Document? Unclear.	Addressed in SEA
140	Industry	Other	Section 1.2	Inaccurate paraphrasing - Pg. 3 - "(m)aintenance or.....management of parks". The paraphrase of the Act is inaccurate, and blends in commentary on the Act.	Addressed in SEA
141	Industry	Other	Section 1.2	Incomplete quoted definition - Pg.3 - "with respect to a park" - the definition quoted was incomplete	Addressed in SEA
142	Industry	Other	Section 1.3	I would suggest using only "Fort Chipewyan Métis" to reference the broader community. Recently, the Alberta Court of Queen's Bench concluded that Local 125 "cannot claim to be representative of the entire Aboriginal community for the purpose of asserting Aboriginal rights and seeking consultation." See Fort Chipewyan Métis Nation of Alberta Local #125 v Alberta, 2016 ABQB 713 at para. 411.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
143	Industry	Other	Section 1.3	Source of information - "in situ conservation of the Whooping Crane". Is this from UNESCO (and, if so, where)? Alternatively, is this commentary from the authors of this Scoping Document? If it is the later, such commentary seems to go beyond the bounds of a scoping document.	Addressed in SEA
144	Industry	Other	Section 1.3	"Treaty 8". There were also subsequent adhesions in 1900 for the groups in the NWT	Addressed in SEA
145	Industry	Other	Section 1.3	Loose paraphrasing - pg.7 - "provides that....or other purposes" . This is a very loose paraphrase of the treaty language (and builds in an interpretation of that language). The proposed text is a quote from the text of the treaty.	Addressed in SEA
146	Industry	Other	Section 1.3	Pg.7 - "This report" unclear which report referring to - Changes should be made to the three times "this report" is used in this section	Addressed in SEA
147	Industry	Other	Section 1.3	Pg. 7 Final paragraph - Query whether it is the proper role of a "scoping" document to make the acknowledgements in the preceding paragraphs	Addressed in SEA
148	Industry	Other	Section 1.4	Vague/improper title. Despite the title, the section does not give any insight into what material was (or was not) reviewed. Propose listing the material reviewed to date in an appendix.	Addressed in SEA
149	Industry	Other	Section 1.4	Literature review or methodology? This is more of a methods section on how you conducted your lit review rather than an overview of the literature considered	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
150	Industry	Baseline Studies	Section 1.4	Literature review - There is a wealth of scientific literature. Not all of it is in agreement. This generic list does not provide any insight into what was (or was not) reviewed.	Addressed in SEA
151	Industry	Baseline Studies	Section 1.4	Literature review - Where the all of the presentations and materials provided to the mission reviewed as well?	Addressed in SEA
152	Industry	Baseline Studies	Section 1.4	Literature review - Is there a lit review available? Where more documents reviewed that what is listed in the reference folder? Given this is a scoping document I think more content needs to be added to this section to say what was reviewed and included or not included and why.	Addressed in SEA
153	Industry	Baseline Studies	Section 1.4	Literature review - Given that not all literature is in agreement on some matters and this is not even mentioned in this section makes me concerned that there are gaps in the literature reviewed. The reference section is an indication that my concerns may be valid	Addressed in SEA
154	Industry	Baseline Studies	Section 1.4	Literature review - Again, there is no way of knowing (from this document) what data has (or has not) been gathered and reviewed. This makes it impossible to identify and/or remedy any data gaps.	Addressed in SEA
155	Industry	Other	Section 2.1 and Section 1.2	Referencing - Section 1.2 refers to a 2009 document and in section 2.1, they refer to the same document as a 2010 document - which year is it? Be consistent	Addressed in SEA
156	Industry	Baseline Studies	Section 2.1	WBNP State of the Park Report - were the materials and presentations provided to the mission also reviewed?	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
157	Industry	Other	Section 2.2	Terminology - petitions to the WHC are not "accepted" (or "rejected") at this stage.	Addressed in SEA
158	Industry	Other	Section 2.1	Disputed conclusions - "Peace river flow regulation.....and ecology" - this is a disputed conclusion. There is a significant amount of scientific literature that challenges this view. Was any of it reviewed? There is nothing in the scoping document that indicates that any of it was reviewed/considered.	Addressed in SEA
159	Industry	Baseline Studies	Section 2.1	To continue from comment above - "other information reviewed as key stressor in the park ecosystem" - What "other information" was reviewed? Further to the comment above, was there any review of the scientific literature that challenges the view that dams/flow regulation are impacting the PAD?	Addressed in SEA
160	Industry	Other	Section 2.2	"as appropriate" - Paraphrase replaced with quote from decision	Addressed in SEA
161	Industry	Other	Section 2.2	There is no source given for this "scope of the mission" statement. Is this a quote from something? Or is it a paraphrase of	Addressed in SEA
162				the (quoted) material in the next paragraph? Either way, it seems duplicative of the next paragraph	
163	Industry	SEA Approach	Section 2.2.1	"The RMM report (2017) identifies 7 categories..." - Of concern is that the consultant accept all issues and rationale/justification by RMM as givens - this gives a sense of lack of impartiality and lack critical scientific approach	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
164	Industry	Other	Section 2.2.1	"The rmm report (2017) ..." - It is unclear whether the following list is a quote or a paraphrase of the RMM report. No citations/references to the report to enable cross - checking. In many places, the following goes far beyond a "summary" of the RMM report. Instead it engages in interpretation and comment on the RMM report	Addressed in SEA
165	Industry	Other	Section 2.2	"traditional ways of life....." - this is in quotes, but there is no source identified	Addressed in SEA
166	Industry	Other	Section 2.2	"The mission met with a wide range..." - They also met with industry	Addressed in SEA
167	Industry	Other	Section 2,2	"The mission met with a wide range..." - It should be noted that, during its 10-day visit, the Mission spent approximately 8 days with the MCFN and representatives. Meetings with industry representatives was confined to a half day (on the final day). See itinerary of RMM	Addressed in SEA
168	Industry	Other	Section 2.2.1	"The RMM finds this scientifically indefensible..." - the RMM did not reference/discuss the scientific evidence (that was presented to the RMM) explained the Site C JRP's conclusions	Addressed in SEA
169	Industry	Other	Section 2.2.1	"The mission cites compelling evidence..." - Recommend the removal of this adjective "compelling" as it shows bias towards the information presented below rather than objectivity	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
170	Industry	Other	Section 2.2.1	Above comment continued - In comments like this, the consultant clearly departs from any effort at objectivity and accepts (and enhances) conclusions of the RMM. As indicated in BC's previous response to the RMM Report, there was a significant volume of scientific evidence presented to the RMM team; however, it was not cited or discussed in the RMM report. It is not a proper departure point for the SEA consultant to uncritically accept each and every RMM statement/conclusion without even examining contrary evidence.	Addressed in SEA
171	Industry	Other	Section 2.2.1	Above comment continued - "changes" are not necessarily impacts	Addressed in SEA
172	Industry	Other	Section 2.2.1	Cumulative effects - "A future without projects" - Not sure what is implied by: a future without projects. The industry hydro projects have a very long service life 100 years+.	Addressed in SEA
173	Industry	Other	Section 2.2.1	Terminology - Site "C" is not a proposed project, it is under construction. Also, the Government of Canada rejected the RMM's recommendation in respect of Site C	Addressed in SEA
174	Industry	Other	Section 2.2.2	"is undeniable that industrial...." - Again, this reflects an uncritical acceptance of RMM report statements. The RMM report did not address (or even discuss) the contrary scientific evidence that was presented to them.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
175	Industry	SEA Approach	Section 3.0	"with the potential to affect the OUV...". How is the "potential to affect" going to be assessed? As noted above, the Scoping Document appears to accept uncritically some of the sweeping conclusions/statement of the RMM Report	Addressed in SEA
176	Industry	Other	Section 3.0	First paragraph - typo errors - Sentences do not make sense - also, is it the SEA scoping document or SEA report? I thought this report was the scoping document and not the SEA itself. Please check entire document for this error, it has come up several times.	Addressed in SEA
177	Industry	OUV's and VC's	Section 3.0	"Determine the relevant OUV's and VC's for the Park..." - There is a difference between OUV and VC; however, this proposed approach appears to treat them as interchangeable. There is no discussion of how FC's may be related to OUV.	Addressed in SEA
178	Industry	Other	Section 3.0	First paragraph - "to accomplish the following objectives" - Is this statement of "objectives" drawn from some other source/document? Or is it proposed for the first time in this scoping document?	Addressed in SEA
179	Industry	Other	Section 3.0	"on the impact of surrounding developing on the VC's" - What about the effects of climate change?	Addressed in SEA
180	Industry	Other	Section 3.0	"improve the management of cumulative environmental effects" - Not sure how the SEA will do this. Just by identifying the cumulative effects or are you also going to provide recommendations on how Canada manages those identified cumulative effects? It's not clear here.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
181	Industry	Other	Section 3.1	"based on the review of reports..." - What reports? Literature? Or just the RMM Report? Be specific	Addressed in SEA
182	Industry	Other	Section 3.0	"compromised of x human action" - What does this mean?	Addressed in SEA
183	Industry	Other	Section 3.1	Oil sands in proximity to WBNP - this is not consistent with the other titles - how is "in proximity" defined? How is it defined in relation to the distance of the hydroelectric projects listed?	Addressed in SEA
184	Industry	Other	Section 3.1	"criteria for WBNP listed in the statement..." - Reference/citation?	Addressed in SEA
185	Industry	Baseline Studies	Section 3.1	"jackpine mine expansion project" - What about the existing Jackpine project? Why only reference the expansion project? Are there no existing projects in proximity of WBNP that may potentially draw water from the Peace or the Athabasca or pollute the WBNP?	Addressed in SEA
186	Industry	Other	Section 3.2	"The content in this table..." - What table? Table 1? - Surely part of the "benchmarking" to 1983 should involve consideration of which activities pre-date 1983. These were known facts at the time of inscription.	Addressed in SEA
187	Industry	Other	Section 3.1	Pulp and paper - "current and planned forestry activities around WBNP" - Why is this list not as exact as the ones above? Perhaps this list will be fleshed out in the final?	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
188	Industry	Other	Section 3.1	"Climate change is an overriding issue...." - Clearly. However, there is no discussion of how to identify and distinguish between the potential impacts of projects/activities and the impacts of climate change.	Addressed in SEA
189	Industry	Other	Section 3.1	To continue from comment above - I recommend this climate change section be pulled out of the Past Present and reasonably foreseeable future projects section and place into its own section. Climate change is not related to projects, it is occurring independently of the existing and proposed projects. The effects of Climate change projections on the OUV of the WBNP should be considered independently and in relation to the cumulative effects assessment.	Addressed in SEA
190	Industry	Other	Section 3.3	Geographic boundaries section - Aren't geographic boundaries for effects assessments and cumulative effects assessment comprised of a local study area and regional study area. Local study area is the area where direct effects of an activity on the VC are observed and the regional study area defines the assessment bounds for where cumulative effects may be observed....at a minimum I would assume this area encompasses the projects listed earlier.	Addressed in SEA
191	Industry	Other	Section 3.2	"from the review of relevant information..." - How was the information defined as relevant. This has not yet be described in this report (not mentioned in Section 1.4)	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
192	Industry	OUV's and VC's	Section 3.2	"from the review of relevant information..." - do you mean key indicators? VC's do no measure change, they are selected based on environmental, social, cultural and aboriginal importance.	Addressed in SEA
193	Industry	OUV's and VC's	Section 3.2	Amenable to collaborative management procedures" - What methods of VC selection are you following here? Not sure VCs are selected to address gaps in any assessment methods I am aware of.	Addressed in SEA
194	Industry	Other	Section 3.3	Temporal Boundaries - Climate change models typically provide climate projections and not predictions due to the many limitations of current climate models	Addressed in SEA
195	Industry	OUV's and VC's	Section 3.2	"...were determined to be the PAD. The VC...." - So the PAD is the only VC identified?	Addressed in SEA
196	Industry	Other	Section 3.3.1	"Overall, the Peace river has a much larger..." - What is this based on? Was a hydrology assessment done by PC? The Athabasca river flows directly into the PAD while the Peace River flows past the PAD. There certainly a hydraulic relationship between the Peace River and the PAD but it is more difficult to define than the clear hydraulic relationship between the Athabasca River and the PAD.	Addressed in SEA
197	Industry	Other	Section 3.3.1	"precipitation and evaporation, and flow contributions...." - What about sedimentation?	Addressed in SEA
198	Industry	Other	Section 3.3.1	"Flow rates are comparatively more variable..." - Yet there is no established link (and the SEA can't assume such a link) between flow regulation and the frequency of flood events.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
199	Industry	Other	Section 3.3.1	"peak summer flows..." - Unsupported and inconsistent with the paragraph below. "Peak summer flows ...are unable to reach perched basins. In order for these perched basin areas to be recharged, over bank flows from ice jam events are required"	Addressed in SEA
200	Industry	Other	Table 1	Title - Screening of the element of the OUV - [A91]: It's not clear how and by whom the conditions and trends were determined. Need citations otherwise would appear subjective and/or selective.	Addressed in SEA
201	Industry	Other	Table 1	"flow regulation and climate change contribute...." - there is no established link between flow regulation and flood frequency. The SEA cannot assume such a link in the absence of evidence	Addressed in SEA
202	Industry	Other	Table 1	"primary focus will be the impact of river regulation" - The SEA is assuming a link to flow regulation. See comment above	Addressed in SEA
203	Industry	Other	Table 1	"substantial evidence" - there is equally substantial contrary evidence	Addressed in SEA
204	Industry	Other	Table 1	"Declining frequency of large flood...." - Again, can't assume declining flood frequency. The long-term evidence does not support this.	Addressed in SEA
205	Industry	Other	Table 1	"flow regulation is likely affecting portions of the PAD" - Need to consider the entire body of literature, not just those parts that support an assumed conclusion.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
206	Industry	Other	Table 1	"flow regulation and climate change for both condition and trend" - there is a significant body of science that refutes the connection between flow regulation and flood frequency/ None of this is referenced in the Scoping document.	Addressed in SEA
207	Industry	Other	Table 1	"in fewer floods over time..." - unsubstantiated. Cannot be assumed.	Addressed in SEA
208	Industry	Other	Section 3.3	"stressors" - How are these stressors identified? Are these simply from the RMM report?	Addressed in SEA
209	Industry	Other	Section 3.3	"the stressors on the PAD are flow regulation...." - In a scoping document, this is already assuming a conclusion (before any assessment has been undertaken)	Addressed in SEA
210	Industry	Other	Section 3.3	"these stressors change the ecological functions..." - This is again a conclusion - where did it come from? No assessment has been completed (this is a scoping document) so I am not sure how this conclusion can be drawn?	Addressed in SEA
211	Industry	Other	Section 3.3	"however, the majority of scholars believe..." - Science is not a poll of a majority. This statement equates the views of certain lay observers with the (contrary) view PhD scientist conducting a multi-year paleo limnology study.	Addressed in SEA
212	Industry	Other	Section 3.3	"general agreement that both river flow into the PAD...." - There is no consensus on the cause	Addressed in SEA
213	Industry	Other	Section 3.3	Artificial Ice jams? Correct terminology?	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
214	Industry	Other	Section 3.3	Interventions to the flow regime paragraph - Should also mention here the Athabasca River Evulsion prevention as an "intervention" that changes the course of the PAD hydrology (See Dr. Timoney's Mission presentation)	Addressed in SEA
215	Industry	Other	Section 3.3	"the increased winter flows have...." -What is the reference for this? This is incorrect. Spring flows during the ice jam formation period have on average increased since regulation.	Addressed in SEA
216	Industry	Other	Section 3.3	"the lower spring and summer flows..." - statement not supported by evidence - again incorrect	Addressed in SEA
217	Industry	Other	Table 2	"Indicators in title" - How are threshold/optimal values, adequate flow rates/level and "optimal" determined and by whom?	Addressed in SEA
218	Industry	Other	Table 2	"maintain optimal flooding frequency" - There is no consensus (and no supporting evidence) to link flow regulation and flood frequency. There is consensus that climate change has been a significant driver of change in the delta. Further, the "indicator" begs the question - what is "optimal"?	Addressed in SEA
219	Industry	Other	Section 3.5	"pre-regulation condition" - best evidence available is the paleo limnology work led by Dr. Smol. Not referenced in scoping document	Addressed in SEA
220	Industry	Other	Section 3.5	"with current projections and operations" - How do you know how industry operates its facilities? This info has not been requested from us to date?	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
221	Industry	Other	Section 3.5	"future without projects only climate change: and" - : Do you mean future without proposed projects? Otherwise, not sure what future without existing projects looks like? How would you be able to scientifically assess this? Also it is not a realistic scenario so I am not sure the point in assessing it.	Addressed in SEA
222	Industry	Other	Section 3.5	"future with project conditions..." - What project conditions? Conditions on existing projects or future projects? This is not clear. How would you come up with the conditions? How would the conditions be implemented from a regulatory perspective? If for an existing project, what are the costs involved with implementing conditions to the owner and to the Province or to Canada?	Addressed in SEA
223	Industry	Other	Section 3.5	"again, the description and assessment will be qualitative in nature..." - Concern that the study will compare a series of qualitative assessments - it will be challenging to draw	Addressed in SEA
224	Industry	Other	Section 3.5	"The future scenario both with and without likely project..." Which projects? How do you define likely?	Addressed in SEA
225	Industry	Other	Section 3.6	"parks, Canada representative and others..." - No other federal departments/agencies? And, with respect to "others", the only catch-all for (a) the provincial governments with constitutional authority over resource development and; (b) the owner and operator of the impugned hydro-electric facilities?	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
226	Industry	Other	Section 3.6	"network and system analysis would...." We require more detail on the analytical approach. This is required in a scoping document	Addressed in SEA
227	Industry	Other	Section 3.6	Final Paragraph - "parks canada" : This discussion is focused solely on the potential use of the SEA by Parks Canada. The SEA should be driven by an informed by broader interests than just that of a single federal agency.	Addressed in SEA
228	Industry	References	References	The report does not reference any of the information provided by Industry to the Mission. Why is this? Was this not provided to the consultant for review? Industry is happy to provide a package of information to the consultant, so they may consider all available information on the topic. This reference list appears to be quite biased I am wondering how information was provided to the independent consultant? I would expect that at a minimum they would have reviewed and considered all information submitted to the mission. Also to ignore Dr. Smol's peer reviewed materials is a significant gap.	Addressed in SEA
229	Industry	Other	Section 3.0	"This SEA is intended to accomplish the following objectives" - Is this statement of "objectives" drawn from some other source/document? Or is it proposed for the first time in this Scoping Document?	Addressed in SEA
230	Industry	Other	Section 3.0	"describe the existing baseline, stressors and trends for each VC" - Are you going to identify any key indicators or intermediate VCs? What about pathway components?	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
231	Industry	Other	Section 3.0	"Parks Canada review of project-level EA" - Parks Canada is not responsible for conducting environmental assessments. It is one participant among many.	Addressed in SEA
232	Industry	Other	Section 3.0	"Parks Canada review of project-level EA" - How? Will this SEA model be used for all projects in the vicinity of all National Parks? Is this statement really accurate?	Addressed in SEA
233	Industry	Other	Section 3.0	"Set desired objectives and outcomes for each VC....." - When does the effects assessment happen? To conduct a cumulative effects assessment, one needs to assess and identify the residual effects.....this step is missing in this process.	Addressed in SEA
234	Industry	Other	Section 3.1	"based on the review of reports to date....." - What reports? Literature? Or just the RRM report? Be specific.	Addressed in SEA
235	Industry	Other	Section 3.1	"....projects and activities have been identified and their residual effects..." - This is a Scoping Document. On what basis were the following projects/activities "identified"? - Projects are not in and of themselves 'effects'. So how will you assess a project in a cumulative effects assessment? Do you mean you will assess and identify project residual effects and conduct a cumulative effects assessment?	Addressed in SEA
236	Industry	Other	Section 3.1	Hydropower - Peace River - What about the various weirs (e.g. on the Rochers and Revillon Coupe Rivers) that have been constructed in the PAD with the express purpose of altering water flows?	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
237	Industry	Other	Section 3.1	Hydropower - Peace River - Under construction. Again, the Government of Canada rejected the RMM's recommendation in respect of Site C.	Addressed in SEA
238	Industry	Other	Section 3.2	...potential impacts from upstream developments...." - Again, the scoping document appears to assume (without critical consideration) that there is an impact from upstream development. There is significant scientific material that disputes this conclusion. (The RMM report did not address this material—although it was presented to the RMM team.)	Addressed in SEA
239	Industry	Other	Section 3.3	Geographic Boundaries - The “geographic boundaries of the PAD are well defined” but you do not appear to limit the geographic boundary to these “well-defined” boundaries when you also include the “two river systems”. Does the boundary include the entirety of the two rivers? The entire watershed of the two rivers? Other?	Addressed in SEA
240	Industry	Other	Section 3.3	Geographic Boundaries - Do you mean key indicators? VC's do not measure change, they are selected based on environmental, social, cultural, aboriginal importance.	Addressed in SEA
241	Industry	Other	Section 3.3	Temporal Boundaries - "project level assessments" - Which projects? Do you mean the development projects that have been approved, or those under approval or are you referring to the SEA assessment as a project? Please clarify.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
242	Industry	Other	Section 3.2	"The identification of VC's was guided by the following principles..." - What methods of VC selection are you following here? Not sure VCs are selected to address gaps in any assessment methods I am aware of.	Addressed in SEA
243	Industry	Other	Section 3.3	Temporal Boundaries - "Start in 1950...." - There is significant scientific data and analysis from Dr. Smol (Queen's University) that sheds light on the conditions in the PAD over many 100s of years. This information is highly relevant in consideration of potential long-term changes in the PAD.	Addressed in SEA
244	Industry	Other	Section 3.2	"Thus, the VCs for the WBNP SEA, as they relate....." - Not sure the above provides a rational for why only the PAD was identified as the one VC for the assessment. Please provide a more detailed rational for this selection	Addressed in SEA
245	Industry	Other	Section 3.3	Temporal Boundaries - "To reflect realistic bounds of climate projections that science can reasonably predict..." - Who will model your climate projections?	Addressed in SEA
246	Industry	Other	Section 3.3	Temporal Boundaries - "...climate projections that science can reasonably predict..." - Climate change models typically provide climate projections not predictions due to the many limitations of current the climate models.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
247	Industry	Other	Section 3.3	Stressors - "Beltaos (2014) estimates that Peace River regulation accounts for nearly two thirds..." - Beltaos (2014) also acknowledged that it is "difficult to discern a regulation-caused increase or decrease in breakup flows of the lower Peace River." Further, the results of the Beltaos (2014) paper need some careful attention as outlined below:	Addressed in SEA
248	Industry	Other	Section 3.3	Stressors - "Interventions to the flow regime have been attempted...." - Should also mention here the Athabasca River Evulsion prevention as an "intervention" that changed the course of the PAD hydrology. (see Dr. Timoney's Mission presentation)	Addressed in SEA
249	Industry	Other	Section 3.3	Stressors - "subsequent regulation and development, when combined with climatic change, ..." - None of the contrary evidence (assembled by world class scientists) is cited.	Addressed in SEA
250	Industry	Other	Section 3.5	"future with project conditions..." - What project conditions? Conditions on existing projects or future projects? This is not clear. How would you come up with the conditions? How would the conditions be implemented from a regulatory perspective? If for an existing project, what are the costs involved with implementing conditions to the owner and to the Province or to Canada?	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
251	Industry	Other	Section 3.5	"The pre-regulation condition will reflect the state of the park and its environs around about 1950." - This was a relatively wet period – see Dr. Smol's academic literature and presentation to the Mission. Dr. Smol provides paleo limnology records for the PAD that span a much larger timeframe and should be examined in this assessment – particularly in relation to climate change and the effect on the PAD.	Addressed in SEA
252	Industry	Other	Section 3.5	"The pre-regulation condition will reflect the state of the park and its environs around about 1950" - The Delta is a dynamic place, and no single snapshot can or should be frozen in time. "Although it is understandable to view the delta at the time scale of our human experiences, those time scales limit our ability to understand such a dynamic system...." Timoney, K. P. (2013). The Peace-Athabasca Delta: Portrait of a Dynamic Ecosystem, page 442.	Addressed in SEA
253	Industry	Other	Section 3.5	"...relying on the professional judgement of others;" - It would be helpful to know who will also be providing professional judgement and hopefully the consultant will also rely on professional judgement of BC government experts.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
254	Industry	Other	Section 3.5	"...portrays this condition is already represented in the RMM report..." - the RMM did not consider all key scientific and factual information leading to findings and conclusions. The consultant must be open to considering additional information not included in the RMM report. The conclusions of the RMM (based on a 10-day visit) cannot be used to override the views of those who have dedicated large portions of their professional lives to the study of the PAD.	Addressed in SEA
255	Industry	Other	Section 3.5	"...portrays this condition is already represented in the RMM report..." - The RMM report did not conduct a baseline assessment nor did the Mission claim to have done so in the report. I am concerned about using only or mostly this report as the existing condition 'baseline'. I do not think this is a scientifically sound approach.	Addressed in SEA
256	ENGO	Other	Overall	As stated in reports, oil sands withdrawals "may be affecting in-stream flows towards the PAD". Any withdrawal in a system has impacts at the end of the system. I think it prudent to look at the growing demand for water across the Athabasca Basin. I also think it is important to realize the difference in flow with and without withdrawals from the river, as climate change and natural variability of the climate have more of an influence on Athabasca flows than water use.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
257	ENGO	Other	Overall	As part of the SEA, natural variability (historic and future), not just future changes in climate, of the Peace and Athabasca Rivers should be considered. There is pre-historical data (tree rings) that show that natural variability in these watersheds has occurred for hundreds of years. These changes in climate (precipitation and temperature) are the drivers behind streamflow volumes, and through modelling work indicate that changes in climate produce significant impacts in flow	Addressed in SEA
258	ENGO	Other	Overall	The report states “A series of existing and proposed dams on the Peace River have impacted and create potential for further impacts on the PAD”. This statement is correct, but would suggest that new structures on the river (i.e., Site C) have potential to create opportunity to re-establish a natural flow regime that was changed by upstream operations starting in the late 1960s. New dams can be developed with operations that can help re-naturalize flows.	Addressed in SEA
259	ENGO	Other	Overall	Pg. 14 last word under “temporal boundary” paragraph- consider changing “predict” to “estimate” or “forecast”. Predicting of future climates is not possible	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
260	ENGO	Other	Overall	We are heartened by the emphasis on the constraints that hydroelectric generation in British Columbia and perhaps in the future in Alberta place on the flow regime of the lower Peace within the Park in the scoping report. We are aware of other possible locations besides those detailed in your report	Addressed in SEA
261	ENGO	Other	Overall	We are concerned that the Mackenzie River Basin Trans Boundary Waters Master Agreement does not recognize the waters of the Peace River within Wood Buffalo National Park as Federal waters and Alberta becomes the de facto negotiator with BC for a flow regime which will protect the Delta. Alberta Trans Boundary Secretariat regularly report to the Gov't organizations but have never detailed any linkage with Parks Canada officials.	Addressed in SEA
262	ENGO	Other	Overall	The matter of a buffer around the Park is certainly a concern and some on the west of the Park continually ask for the depopulation of the entire buffalo herd given their infection with brucellosis. Given the ongoing relationship between buffalo and wolves such depopulation will wreak havoc within the park as wolves turn to other prey or other vulnerable species at risk such as caribou within and outside the park. We would hold that those who've established livestock operations in the County of Mackenzie after the identification of brucellosis in the park, did so at their own peril, not at the taxpayers or that of the buffalo and wolves	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
263	ENGO	Other	Overall	While Parks Canada has successfully communicated to a wide audience the dramatic fluctuations in visible open water in the Delta environment it has not demonstrated with LIDAR the accompanying wetted area and its declining extent as drought periods continue. Similarly the hydrological barriers to overland flooding or capacity of tributaries to accommodate reverse flow when ice jams occur hasn't been communicated.	Addressed in SEA
264	ENGO	Other	Overall	Add Water Quality Stressors including Flow Water Quality and Tailings Pond Contacts	Addressed in SEA
265	ENGO	Other	Overall	Add Fish Population Indicator. Gov't requests that "Maintain optimal fish populations in the PAD" be added as a Valued Component (VC) Indicator. A fish indicator is important to support two proposed VC Objectives: "Maintenance of traditional land uses (hunting, fishing, etc.,)" and "Provision of appropriate habitat for wildlife, birds and vegetation in the PAD" (Table 2, p. 22).	Addressed in SEA
266	ENGO	Other	Overall	Cumulative Effects assessment gaps using existing studies The stated cumulative impacts goal of SEA, which AWA supports, is clear: "to assess the cumulative impacts of all developments (including hydroelectric dams, oil sands development, and mining) on the [Outstanding Universal Values] OUV of WBNP. The resultant information with inform the preparation of an environmental management framework(s) and as the Action Plan for a region." (s. 3.0, 1st paragraph).	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
267	ENGO	Other	Overall	Include earlier references to pre-regulation baseline condition. The Assessment Approach section should refer to a pre-regulation 1950 baseline, instead of only itemizing the existing baseline: “Describe the existing baseline, stressors and trends for each VC” (s. 3.0, 3rd last point, p. 12, 2nd column). Section 3.2 should also be clearer that a 1983 benchmark is not sufficient to assess cumulative impacts to the Outstanding Universal Values (OUV) of WBNP. “The content in this table is benchmarked against the 1983 inscription date of WBNP World Heritage Site.” (s 3.2, end of 1st paragraph, p. 13, column 2) It is only in Section 3.3 that the temporal boundary of 1950 is made clear, and section 3.5 further details a process to identify ‘pre-regulation baseline’ circa 1950, and ‘a future without projects’ for key water, land, air and biodiversity values, in keeping with what RMM identified as robust cumulative effects assessment. Consistent (and earlier) reference to this pre-regulation baseline is requested.	Addressed in SEA
268	ENGO	Other	Overall	Potential Future Impact – Teck Frontier Mine Table A1 references findings from the environmental impact study of mine proponent Teck Resources. The study has been generated within a system that is still focused on incremental project impacts, and these statements have not been scrutinized in a hearing process. The Table should note that this is prior to a hearing review process.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
269	ENGO	Other	Overall	Potential Future Impact - Uncertain Closure Approach for Impounded Oil Sands Tailings. Gov't requests that another foreseeable future stressor be identified: uncertain closure approach for large impounded oil sands tailings ponds. There is no proven process yet to reclaim tailings ponds and safely release process-affected water into the Athabasca River. Tailing ponds were 234 km ² in area and 1.1 trillion liters' volume at the end of 2014, and keep growing. Only five percent of the funds estimated to reclaim current disturbed oil sands mine sites and tailings are now held by the Alberta government (Alberta Energy Regulator, 2017), leaving a significant unfunded reclamation liability risk.	Addressed in SEA
270	ENGO	Other	Overall	Potential Future Impact – Other flow structures We request the final item in Table A1's 'Potential Future Impacts' state 'Other water takings and flow structures' rather than just 'Other water takings.' There is potential for Athabasca River on-stream dam/reservoir impoundments (for example, Alberta Utilities Commission, 2010).	Addressed in SEA
271	ENGO	Other	Section 1	In Section 1.0 (Introduction), the scoping report states:	Addressed in SEA
272				"The role of the SEA is to define on a preliminary basis the results of investigations to date with respect to understanding key impact pathways that may impact elements of Wood Buffalo National Park (WBNP) Outstanding Universal Values (OUV)."	

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
273	ENGO	Other	Section 1	The scoping report states (Section 1.0):	Addressed in SEA
274				“The Canada National Parks Act (CNPA or the Parks Act) defines Ecological Integrity as “a first priority” which is notable both as a conceptual framework and as a legal obligation.”	
275	ENGO	Other	General	The sources of information and science that the SEA proposes to study should have been provided in the Scoping Report.	Addressed in SEA
276	ENGO	Other	General	Effects of climate change are not adequately reflected in the scoping document, as the timeline only dates back to 1950. The SEA should examine at a longer time frame to adequately assess the cumulative effects of climate change and projects impacting the OUVs of WBNP.	Addressed in SEA
277	ENGO	Other	General	The scoping document does not adequately reflect the guidance provided by the Cabinet directive that a SEA must include:	Addressed in SEA
278				(a) Follow up. There is a need for measures to monitor the environmental effects of the policy.	
279				(b) Public and stakeholder concerns. The SEA must identify concerns among those most likely to be affected by impacts on the OUVs of WBNP.	
280	ENGO	Other	General	The scoping report does not adequately reflect IUCN’s guidance that:	Addressed in SEA
281				(a) “EAs must ensure that impacts on the OUVs of the site are fully considered in land use planning decisions with the objective of preserving these sites for future generations”	

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
282				(b) "Experts with world heritage, protected area, and biodiversity knowledge should be involved early on"	
283	ENGO	Other	General	The scoping document does not indicate that the SEA will consider the management regime of Parks Canada with respect to the OUVs of the Park. This must be a consideration	Addressed in SEA
284	ENGO	Other	Section 3	The Reactive Monitoring Mission ("RMM") recommended that the SEA be expanded to adequately reflect the scale, pace, and complexity of industrial development, land use changes, and river flow manipulations. This scoping report only examines the impacts of a few discrete projects and does not adequately address the scale and pace the RMM was referring to. In addition to the objectives enumerated, the SEA should identify all projects that will likely have irreversible adverse environmental effects on the OUVs of the Park.	Addressed in SEA
285	ENGO	Other	Section 3	It is important that impacts on flow regime are assessed, but pollution from upstream oil and gas activities should also be considered	Addressed in SEA
286	ENGO	Other	Section 3	Recommendation 15 of the RMM recommends an analysis of the Ronald Lake bison herd, including threats posed by proposed development, within the context of a broader Species Recovery Strategy. For the SEA to truly assess cumulative effects, it should consider the impacts of climate change and flow regime changes on bison habitat outside of the park that is used by the Ronald Lake bison herd.	Addressed in SEA

Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
287	ENGO	Other	Section 3	The historical context of flooding and drying must be understood in order to truly assess the cumulative impacts of climate change and projects on the OUVs of WBNP. 1950 is not an adequate place to begin assessing changes in water flow regime in the PAD. The flow regime should be studied within the context of the last century or two centuries at least in order to get a better understanding of historic drying and flooding periods, and how the PAD has been impacted over time. This is especially important since it is understood that over the past 100 years the PAD has been in a drying cycle.	Addressed in SEA
288	ENGO	Other	Section 3	The RMM recommended looking at the Peace, Athabasca, AND Slave Rivers and the impact of damming and activity on all three with relation to the PAD. Why is the Slave River excluded from this SEA?	Addressed in SEA
289	ENGO	Other	Section 3.5	The historic or reference condition must be earlier than 1950	Addressed in SEA
290	ENGO	Other	Section 3.5	To be a cumulative effects assessment, an “over time” scenario should be considered wherein the indicators are assessed after each new project/impact is added to the system.	Addressed in SEA
291	ENGO	Other	Section 3.5	We support using “several different sources” of information for a weight of evidence approach	Addressed in SEA
292	ENGO	Other	Section 3.5	Metis peoples should also be consulted as part of the cumulative effects analysis.	Addressed in SEA

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Comment Response Form to Scoping Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
293	ENGO	SEA Approach	Overall	The scope of the Strategic Environmental Assessment is appropriate but we hope that action will come out the process. We have already identified the need for greater recharge of the delta if existing values are to be maintained but we have also examined many other values on the Peace River including upstream risks (eg., flooding in the Town of Peace River) that could be associated with changes to flow regime designed to create flooding in the Lower Peace.	Addressed in SEA
294	ENGO	Other	Overall	The examination of satellite imagery archives for a time series that might illustrate ice jamming on the Peace within the Park	Addressed in SEA
295	ENGO	Other	Overall	working with local elders to determine the maximum height of water and ice in recent history using clues on the landscape	Addressed in SEA
296	ENGO	Other	Overall	determination of the minimum elevation on the Peace at which flow begins to reverse	Addressed in SEA
297	ENGO	Other	Overall	creating a Lidar based map to indicate the tributaries where reversals and/or overland flooding will occur	Addressed in SEA
298	ENGO	Other	Overall	applying the specific hydraulic capacity to project where and when overland flooding occurs	Addressed in SEA
299	ENGO	Other	Overall	the packaging of this information in a format accessible to lay people, which would include visual representations.	Addressed in SEA

A.4 – COMMENT RESPONSE FORM TO DRAFT SEA REPORT

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
1	ENGO	Oil Sands	Ch.6 Figure 6-2	Edits suggested that Alberta's oil sands project (Figure 6-2) also includes some site in the Peace River Basin.	Comment considered in final SEA
2	ENGO	Jurisdictional Authority	Ch.7; Sec7.3.1 Environmental Flow/Hydrology	Comments & concerns were raised to include recommendation in regard to various jurisdictional authorities to enter a bilateral agreement for the "Transboundary Water Master Agreement".	Forward to Action Planning process for consideration
3	ENGO	Jurisdictional Authority	Ch.7; Sec7.3.1 Environmental Flow/Hydrology	Concerns were raised to include that communication regarding "the Environmental Flow/Hydrology" is extended to all in the affected area.	Forward to Action Planning process for consideration
4	ENGO	Ice Jam	Ch.7; Sec7.3.1 Environmental Flow/Hydrology	Edits suggested to clarify and ensure the information presented on ice jam formation was accurate.	Comment considered in final SEA
5	ENGO	Ice Monitoring	Ch.7; Sec7.3.1 Environmental Flow/Hydrology	Suggestions were made to address the potential for existing monitoring system to include ice monitoring.	Comment considered in final SEA
6	ENGO	Water Quantity	Ch.7; Sec7.3.1 Environmental Flow/Hydrology	Suggestions were made to include an "Aboriginal Base Flow for the Peace River".	Comment considered in final SEA
7	ENGO	Watershed Management	Ch.7; Sec7.3.6 & 7.37	Suggestions were made to discuss a more detailed "Integrated Watershed Management Plan" "for the Alberta portion of the Peace and Slave Watersheds", and to recommend water quality monitoring for evaluating management objectives.	Forward to Action Planning process for consideration

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
8	ENGO	Cumulative Effects	Throughout	Concerns were raised on the SEA being focused on existing documentation which resulted in minimizing the information presented on cumulative impact in regards to developments in WBNP.	Comment considered in final SEA
9	ENGO	Cumulative Effects	Throughout	Comments & concerns were raised to clarify any contradicting information presented and to include more detailed assessment of cumulative effects of impacts on the OUVs of the PAD.	Comment considered in final SEA
10	ENGO	OUVs	Throughout	Comments & concerns were raised to discuss further the risks and effects of development on PAD. Recommendations to clearly state that "the OUVs of the PAD are suffering from adverse effects of development and have significantly declined below an acceptable level" & to strengthen the Executive summary conclusion in this regard.	Comment considered in final SEA
11	ENGO	Oil Sands	Throughout	Comments were made to include the risk of "inadequately reclaimed oil sands tailings" for better risk assessment recommendations.	Comment considered in final SEA
12	ENGO	Oil Sands	Ch.7; Sec.7.3.3 Tailing Pond Risk Assessment	Suggestions were made by providing additional reference material to support the discussion on tailings reclamation risks to be included in the section.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
13	ENGO	Oil Sands	Ch.7; Sec.7.3.3 Tailing Pond Risk Assessment	Comments were made that the SEA address the financial risk associated with tailings reclamation to be included in the section. Additional reference material was provided to support the discussion.	Outside of Action Plan and SEA scope
14	Indigenous Community	Bison	Executive Summary	Questions & concerns were raised on hunting permit & type of bison being discussed.	Comment considered in final SEA
15	Indigenous Community	Indigenous Issues	Executive Summary	Comments were made to clarify the names of Indigenous groups.	Comment considered in final SEA
16	Indigenous Community	OUVs	Executive Summary	Suggestions were made to include examples of management tools for WHC values.	Comment considered in final SEA
17	Indigenous Community	Indigenous Issues	Ch.1; Sec. 1.2.2 Cumulative Impacts to Indigenous Ways of Life	Comments were made to clarify the discussion on Indigenous people.	Comment considered in final SEA
18	Indigenous Community	References	Ch. 1; Sec- 1.4.3 Indigenous Rights and Ways of Life	Comments were made in regard to proper citation.	Comment considered in final SEA
19	Indigenous Community	Indigenous Issues	Ch.2; Sec. 2.3.3 Negative Histories Between Parks Canada and Indigenous Peoples	Comments were made to include ACFN hunting activity treaty rights.	Comment considered in final SEA
20	Indigenous Community	Other	Ch.4; Sec. 4.4.1.2 Exposure to contaminants in water, food and sediments in PAD	Edits were suggested in regard to proper usage of acronyms	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
21	Indigenous Community	Migratory Birds	Ch.4; Sec. 4.4.1.3 Sublethal/Chronic Effects	Edits suggested to clarify the information presented on migratory birds on OSPW.	Comment considered in final SEA
22	Indigenous Community	Oil Sands	Ch.4; Sec. 4.4.1.5 Changes to migration route and timing for birds using the PAD	Questions & comments were made on the accuracy of the data presented on OSW.	Comment considered in final SEA
23	Indigenous Community	Bison	Ch.4; Sec. 4.5.1.2 Risks from increased linear corridor density and other human driven changes surrounding the Park	Comments were made in regard to consistent usage of acronyms & terms.	Comment considered in final SEA
24	Indigenous Community	Bison	Ch.4; Sec. 4.5.1.2 Risks from increased linear corridor density and other human driven changes surrounding the Park	Edits suggested to include information on wood bison habitat and Indigenous people's hunting activities, for better clarity.	Comment considered in final SEA
25	Indigenous Community	Bison	Ch.4; Sec. 4.5.1.2 Risks from increased linear corridor density and other human driven changes surrounding the Park	Edits suggested to include information on RHBL habitat change due to development activities, for better clarity.	Comment considered in final SEA
26	Indigenous Community	Bison	Ch.4; Sec. 4.5.1.3 Risks from Hunting Outside WBNP	Comments were made to include information on Wood Bison Recovery Strategy	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
27	Indigenous Community	Indigenous Issues	Ch.4; Sec. 4.5.1.3 Risks from Hunting Outside WBNP	Comments were made to include information on Bison population	Comment considered in final SEA
28	Indigenous Community	Bison	Ch.4; Sec. 4.5.2 Status and Trend of Bison-Wolf Predator-Prey Relationship	Questions & concerns were raised on the consistency of information presented in regard to bison mortality due to disease.	Comment considered in final SEA
29	Indigenous Community	Bison	Ch.4; Sec. 4.5.2 Status and Trend of Bison-Wolf Predator-Prey Relationship	Edits were suggested to include information on Bison population	Comment considered in final SEA
30	Indigenous Community	Indigenous Issues	Ch.4; Sec. 4.5.2 Status and Trend of Bison-Wolf Predator-Prey Relationship	Edits suggested to more accurately portray the information presented on Indigenous culture.	Comment considered in final SEA
31	Indigenous Community	Whooping Crane	Ch.4; Sec. 4.6 Whooping Crane	Concerns were raised on the consistency of terminologies used	Comment considered in final SEA
32	Indigenous Community	Whooping Crane	Ch.4; Sec. 4.6.1.2 Changes to Stopover Habitat	Concerns were raised to clarify the information presented on mortality from power lines.	Comment considered in final SEA
33	Indigenous Community	Indigenous Issues	Ch.5; Sec 5.1 Introduction	Comments were made to include citations for quoted information presented.	Comment considered in final SEA
34	Indigenous Community	Ice Jam	Ch.5; Sec 5.2.2 Ice Jam Mechanism	Questions & concerns were raised to clarify the presented information on ice jam release	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
35	Indigenous Community	Water Quantity	Ch.5; Sec 5.9.1 Access Issues Specifically Related to the Athabasca River	Edits suggested to clarify information presented on AXF values & better reflect the references & to add references and information to clarify discussion.	Comment considered in final SEA
36	Indigenous Community	Pathways of Effects	Ch.5; Figure 5 16: Pathways of Effects System Diagram	Comments were made on the Pathways of effects system diagram to include more data in regard to agriculture & municipalities	Comment considered in final SEA
37	Indigenous Community	Identified Projects	Ch.6; Sec. 6.2.3.2 Approved Projects	Questions & concerns were raised to ensure information presented is under appropriate sections for accuracy & to include additional information on the impacts from industrial developments such as Teck.	Comment considered in final SEA
38	Indigenous Community	Identified Projects	Ch.6; Sec. 6.2.3.2 Approved Projects	Edits suggested to include an introductory information on Teck project for better clarity of the discussion.	Comment considered in final SEA
39	Indigenous Community	Identified Projects	Ch.6; Sec. 6.2.5.2 Proposed/Reasonably Foreseeable Projects	Questions & concerns were raised on including a summary in regard to cumulative effects of industrial projects.	Comment considered in final SEA
40	Indigenous Community	Water Quantity	Ch.6; Sec. 6.4.1 Surface Water Flow in the Peace River	Questions & concerns were raised to reflect the correct document reference in regard to land-use plan / Regional Plan	Comment considered in final SEA
41	Indigenous Community	Water Withdrawal	Ch.6; Sec. 6.4.1 Surface Water Flow in the Athabasca River	Comments were made to ensure that presented data reflects information in regard to water withdrawal activates & exceptions to SWQMF restrictions.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
42	Indigenous Community	Water Withdrawal	Ch.6; Sec. 6.4.1 Surface Water Flow in the Athabasca River	Questions & concerns were raised in regard to water withdrawals during low flow seasons.	Comment considered in final SEA
43	Indigenous Community	Water Withdrawal	Ch.6; Sec. 6.4.1 Surface Water Flow in the Athabasca River	Suggestions & concerns were raised in regard to fall season water withdrawal impacting AXF & to include any additional studies to better support the discussion.	Comment considered in final SEA
44	Indigenous Community	Water Withdrawal	Ch.6; Sec. 6.4.1 Surface Water Flow in the Athabasca River	Questions & concerns were raised in regard to including an assessment on the adequacy of SWQMF low flow triggers.	Forward to Action Planning process for consideration
45	Indigenous Community	Water Withdrawal	Ch.6; Sec. 6.4.1 Surface Water Flow in the Athabasca River	Questions & concerns were raised in using appropriate AXF data (proposed /current) to highlight inadequacy of SWQMF.	Comment considered in final SEA
46	Indigenous Community	Water Withdrawal	Ch.6; Sec. 6.4.1 Surface Water Flow in the Athabasca River	Suggestions & concerns were raised to include discussion on problems caused due to water withdrawal due to inadequacies of the other seasonal low flow rate triggers.	Comment considered in final SEA
47	Indigenous Community	Watershed Management	Ch.6; Sec. 6.4.1 Surface Water Flow in the Athabasca River	Concerns were raised to clarify the information presented and reflect the appropriate reference, in regard to SWQMF's zero navigability index.	Comment considered in final SEA
48	Indigenous Community	Air Quality	Ch.6; Sec. 6.4.4 Air Quality	Concerns were raised to clarify the information presented on air quality management.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
49	Indigenous Community	Indigenous Issues	Ch.6; Sec. 6.4.7 Increased linear corridor density surrounding the WBNP	Comments & concerns were raised to include further discussion on how LARP currently does not support Aboriginal & Treaty rights & OUVs of WBNP.	Outside of Action Plan and SEA scope
50	Indigenous Community	Oil Sands	Ch.6; Sec. 6.4.7 Increased linear corridor density surrounding the WBNP	Edits suggested to clarify discussion	Comment considered in final SEA
51	Indigenous Community	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Comments were made to clarify & ensure that there was no duplication of presented information.	Comment considered in final SEA
52	Indigenous Community	Other	Ch.7; Sec. 7.3.7 Monitoring and Science	Edits suggested to reflect appropriate term usage.	Comment considered in final SEA
53	Indigenous Community	References	Ch.2; Sec. 2-1 Wood Buffalo National Park	Comments were made in regard to proper citation in text and reference of RAMSAR in Sec. 8	Comment considered in final SEA
54	Indigenous Community	Other	Throughout Chapter 3	Comments were made in regard to proper usage of acronyms "NWTMN" & "EC" & to add them in the Abbreviation Sec.	Comment considered in final SEA
55	Indigenous Community	References	Throughout Chapter 4	Comments were made in regard to proper citation in text and reference of these citations Sec. 8	Comment considered in final SEA
56	Indigenous Community	Indigenous Issues	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Comments were made to clarify discussion on Indigenous groups harvesting activities.	Comment considered in final SEA
57	Indigenous Community	Bison	Ch. 4; Sec. 4.5.1.3 Risks from Hunting Outside WBNP	Comment were made to that the SEA identifies "bovine brucellosis" crossover as a more random event occurrence than a periodic regularity.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
58	Indigenous Community	Indigenous Issues	Ch. 4; Sec. 4.5.1.4 Changes from Changes in Populations of Other Species	Suggestions were made to clarify the nature of concerns being discussed.	Comment considered in final SEA
59	Indigenous Community	Other	Ch. 4; Sec-4.7 Summary of Evaluation of Desired Outcomes	Comments were made to clarify color coding of tables and to include "Whooping Crane" for better clarity.	Comment considered in final SEA
60	Indigenous Community	Water Quantity	Ch.5; Table 5-1 Difference in Flow Statistics on Peace River	Edits suggested to accurately reflect the presented data in table 5-1.	Comment considered in final SEA
61	Indigenous Community	References	Throughout Chapter 5	Comments were made in regard to proper citation in text and reference of these citations Sec. 8	Comment considered in final SEA
62	Indigenous Community	Reference	Throughout Chapter 5	Comments were made in regard to accurate referencing of Figures & tables in texts.	Comment considered in final SEA
63	Indigenous Community	Other	Throughout Chapter 5	Comments were made in regard to proper usage of acronyms & to add them in the Abbreviation Sec.	Comment considered in final SEA
64	Indigenous Community	Groundwater	Ch5; Sec. 5.8 Groundwater in the Lower Athabasca River Basin	Edits suggested to clarify the information presented on effects on groundwater.	Comment considered in final SEA
65	Indigenous Community	Groundwater	Ch5; Sec. 5.8.2 Groundwater quantity	Suggestions were made to present data in consistent units.	Comment considered in final SEA
66	Indigenous Community	Water Quantity	Ch. 5; Sec. 5.9.1 Access Issues Specifically Related to the Athabasca River	Suggestions were made to include text for clarification of ABF & AXF terms.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
67	Indigenous Community	Other	Ch.5; Figure 5-16: Pathways of Effects System Diagram	Recommendations were made to reference and incorporate valued components & information in table 5.3 into Pathway Effects System Diagram for better clarity of the report.	Comment considered in final SEA
68	Indigenous Community	Identified Projects	Ch.6; Sec. 6.1.2.2 The Dunvegan Hydroelectric Project	Suggestions were made to better support the presented information	Comment considered in final SEA
69	Indigenous Community	References	Throughout Chapter 6	Comments were made in regard to proper citation in text and reference of these citations Sec. 8	Comment considered in final SEA
70	Indigenous Community	Reference	Throughout Chapter 6	Comments were made in regard to accurate referencing of Figures & tables in texts.	Comment considered in final SEA
71	Indigenous Community	Other	Throughout Chapter 6	Comments were made in regard to proper usage of acronyms & to add them in the Abbreviation Sec.	Comment considered in final SEA
72	Indigenous Community	Oil Sands	Ch.6; Figure 6-2 & 6-4	questions and comments raised seeking clarification of the "brown area" in figures 6-2 & 6-4.	Comment considered in final SEA
73	Indigenous Community	Identified Projects	Ch.6; Sec. 6.2.6.2 Proposed projects	Comments were made to include a more current explanation on proposed projects.	Comment considered in final SEA
74	Indigenous Community	Identified Projects	Ch.6; Sec. 6.2.7 Forestry Projects	Edits were suggested to improve accuracy of information and clarify potential impacts.	Comment considered in final SEA
75	Indigenous Community	Pathways of Effects	Ch.6; Table 6-9 & Fig 6-13	Suggestions were made to tie in section on "pathway of effects" with table 6-9 & figure 6-13 & 5-16 for clarity of the report.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
76	Indigenous Community	OUVs	Ch.6; Sec. 6.4.1 Surface Water Flow in the Peace River	Comments were made to ensure the SEA recognized the Shortcomings of the Amisk EIS guidelines.	Comment considered in final SEA
77	Indigenous Community	OUVs	Ch.6; Sec. 6.4.1 Surface Water Flow in the Peace River	Comments were made to ensure the SEA recognized the Shortcomings of limited access and traditional use of the PAD by Indigenous people.	Comment considered in final SEA
78	Indigenous Community	Groundwater	Ch.6; Sec. 6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin	Questions and concerns were raised on the cumulative effects of multiple applicants in regard to effects on groundwater.	Comment considered in final SEA
79	Indigenous Community	Air Quality	Ch.6; Sec. 6.4.4 Air Quality	Edits suggested to cite references for the information presented.	Comment considered in final SEA
80	Indigenous Community	Watershed Management	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River Basin	Comments were made to ensure the SEA recognized the Shortcomings of SWQMF.	Comment considered in final SEA
81	Indigenous Community	References	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River Basin	Edits suggested to clarify information presented in reference to EIA.	Comment considered in final SEA
82	Indigenous Community	Jurisdictional Authority	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River Basin	Edits suggested to clarify information presented in regard to parties conducting monitoring in the PAD area.	Comment considered in final SEA
83	Indigenous Community	Water Quality	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River Basin	Comments were made to ensure SEA recommendations addresses the lack of "community-based monitoring" information.	Comment considered in final SEA
84	Indigenous Community	Fire Management	Ch.6; Sec. 6.4.6 Fire suppression	Questions were raised requiring clarification of "PARKS principles outlined in Promising Pathways Guide".	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
85	Indigenous Community	Other	Ch.6; Sec. 6.4.6 Fire suppression	Questions were raised to clarify information presented & to maintain consistency in the report.	Comment considered in final SEA
86	Indigenous Community	Bison	Ch.6; Sec. 6.4.7 Increased linear corridor density surrounding the WBNP (bison)	Comments were made to include text for better clarity on this section.	Comment considered in final SEA
87	Indigenous Community	OUVs	Ch.6; Sec. 6.4.7 Increased linear corridor density surrounding the WBNP (bison)	Recommendations were made to highlight issues mentioned in WHC decision.	Comment considered in final SEA
88	Indigenous Community	Forest Management Agreements	Ch.6; Sec. 6.4.7 Increased linear corridor density surrounding the WBNP (bison)	Questions and concerns were raised to clarify the importance of forest management agreements.	Comment considered in final SEA
89	Indigenous Community	Bison	Ch.6; Sec. 6.4.8 Disease management and hunting outside WBNP	Edits suggested to cite references for the information presented.	Comment considered in final SEA
90	Indigenous Community	Migratory Birds	Ch.6; Sec. 6.4.9 Changes in habitat and food availability in nesting habitat	Suggested edits to support the presented information on critical habitat protection.	Comment considered in final SEA
91	Indigenous Community	OUVs	Ch.6; Sec. 6.4.11 Hydrology	Suggested edits to support accuracy of presented information in regard to potential impacts on the OUV of WBNP.	Comment considered in final SEA
92	Indigenous Community	OUVs	Ch.6; Sec. 6.5 Summary	Clarification of the terms world heritage values versus OUVs were raised.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
93	Indigenous Community	OUVs	Ch.6; Table 6-10 Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Comments were made to ensure proper identification of the trend in table 6-10	Comment considered in final SEA
94	Indigenous Community	References	Ch.7; Sec. 7.1.1 Risk of serious or irreversible harm	Comments were made to incorporate citation in Section 8.	Comment considered in final SEA
95	Indigenous Community	PAD	Ch.7; Sec. 7.1.1 Risk of serious or irreversible harm	Edits suggested to clarify information presented.	Comment considered in final SEA
96	Indigenous Community	Other	Ch.7; Sec. 7.1.1 Risk of serious or irreversible harm	Comments were made to include acronyms into Abbreviation section.	Comment considered in final SEA
97	Indigenous Community	OUVs	Throughout	Concerns for consistency & clarification of terms world heritage values versus OUVs were raised.	Comment considered in final SEA
98	Indigenous Community	Jurisdictional Authority	Ch.7; Sec. 7.1.4 Robust collaboration	Comments were made to ensure SEA recognized the issue with "multiple jurisdictions & responsibilities" & to address it in recommendations.	Comment considered in final SEA
99	Indigenous Community	OUVs	Ch.7; Sec. 7.2 Urgency	Concerns & comments were made to alter text to accurately report presented data in relation to OUVs being met.	Comment considered in final SEA
100	Indigenous Community	Indigenous Issues	Ch.7; Sec. 7.2 Urgency	Questions & concerns were raised to clarify the discussion on "improved flooding" and to incorporate edits for better clarity.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
101	Indigenous Community	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Comments were made to address specific aspects of the WHC decision in this section & to ensure that recommendations are action oriented.	Comment considered in final SEA
102	Indigenous Community	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Edits suggested to prevent duplication of information.	Comment considered in final SEA
103	Indigenous Community	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Edits suggested to incorporate detail on the RMM recommendations.	Comment considered in final SEA
104	Indigenous Community	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Comments were made to incorporate specific edits in regard to "WHC decision".	Comment considered in final SEA
105	Indigenous Community	OUVs	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Questions and concerns were raised in relation to each OUVs being addressed in this section and to ensure recommendations and action plans are driven by them. Also, comments were made to reference appropriate tables in various sections for better clarity.	Comment considered in final SEA
106	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Edits suggested to reflect more action-oriented recommendations.	Comment considered in final SEA
107	Indigenous Community	Flood	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Edits suggested to clarify the flood condition in PAD. Also, Edits suggested to better reflect the presented information.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
108	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.1 & 7.3.4	Comments were made to clarify text and suggestions to structure and number the recommendations for better clarity.	Comment considered in final SEA
109	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Edits and addition were suggested to better reflect implementations measures & further work.	Comment considered in final SEA
110	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.2 Environmental Assessment	Clarification was sought in regard to "an analysis of the impacts" in relation to OUVs.	Comment considered in final SEA
111	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.3 Tailings Ponds Risk Assessment	Comment were made to clarify text to evaluate the risk on tailing ponds	Comment considered in final SEA
112	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.3; 7.3.4 & 7.3.5	Comments were made to tie reference of Sec. 7.3.3; 7.3.4 & 7.3.5 to Sec. 6.2 & table 6-10.	Comment considered in final SEA
113	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.3 Tailings Ponds Risk Assessment	comment for clarity was made in regard to "involvement of relevant Indigenous groups"	Comment considered in final SEA
114	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.3 Tailings Ponds Risk Assessment	Comments were made to include recommendation for risk assessment from future actions.	Comment considered in final SEA
115	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.4 Conservation Area Connectivity	Comments were made to clarify information presented on FMA & borders on WBNP	Comment considered in final SEA
116	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.4 Conservation Area Connectivity	Questions & concerns were raised to confirm & clarify current timber harvesting.	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
117	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.4 Conservation Area Connectivity	Comments were made to include recommendation on consideration of impacts on OUVs in relation to land use permits.	Comment considered in final SEA
118	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.5 Wildlife and Habitat Conservation	Comments were made to include the increase in OUV objective trend an action plan in table 6-10	Comment considered in final SEA
119	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.5 Wildlife and Habitat Conservation	Suggestion to make recommendations more action oriented.	Comment considered in final SEA
120	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.5 Wildlife and Habitat Conservation	Questions and clarification were made on aboriginal harvesting activities and to cite references.	Comment considered in final SEA
121	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.6 & 7.3.7	Comments were made to edit section, to better clarify the information presented.	Comment considered in final SEA
122	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.6 Water quality	Edits suggested to include recommendation on adaptive management approach.	Comment considered in final SEA
123	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Comments were made to ensure accountability of Pine Point mine on OUV impacts.	Comment considered in final SEA
124	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Edits were suggested to include data usage to positively impact OUV objective trends.	Comment considered in final SEA
125	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Edits suggested to include information on FMP habitat maintenance.	Comment considered in final SEA
126	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Edits were suggested to include "establishment of data bank as data repository/ library."	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
127	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Questions & concerns were raised in regard to the specifics of threshold discussed in the sec.	Comment considered in final SEA
128	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Comments suggested that the discussion on "invasive species" to be part of the recommendation	Comment considered in final SEA
129	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Questions & concerns were raised as to the reference of "experimental approach" versus. "Adaptive Management Approach" in the Sec.	Comment considered in final SEA
130	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Suggestion were made to clarify & address separate idea-based recommendations on separate points.	Comment considered in final SEA
131	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.7 Monitoring & science	Comments were made to include recommendation for air quality monitoring in Fort Chipewyan.	Comment considered in final SEA
132	Indigenous Community	Indigenous Issues	Ch 4. WBNP World Heritage Elements Excluding the PAD	Concerns were raised to consider the Indigenous Knowledge based information to be concrete evidence rather than a supportive evidence to western science, and to include more eyewitness accounted information to support the SEA's findings.	Comment considered in final SEA
133	Indigenous Community	Migratory Birds	Ch.4; Sec. 4.4 Migratory Waterfowl	Comments were made in agreement towards the migratory pathways of Waterfowl and suggestion were made to include additional studies in regard to observation of geese & duck interbreeding in the region.	Outside of Action Plan and SEA scope

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
134	Indigenous Community	Bison	Ch.4; Sec.4.5 Wolf-Bison Predator-Prey Relationship	Comments were made to clarify the information regarding the wolf-bison relationship, the Indigenous people, state that wolves are not the major unbalancing factor in bison population, but rather the disease may be the major cause.	Comment considered in final SEA
135	Indigenous Community	Indigenous Issues	Ch.5; Sec. 5.9 Impacts on Indigenous Ways of Life	Comments were made to clarify that components & resources that sustain the Indigenous ways of living are part of the " Pre-existing Aboriginal Rights" as per Section 35 of the Constitution Act. Plans & activities causing a negative impact on these components & resources are considered as a direct adverse impact on Aboriginal Legal Rights.	Outside of Action Plan and SEA scope
136	Indigenous Community	Water Quality	Ch.5 Current State of the PAD system – Trends and Stressors	Comments were made to include observations in regard to thinning of ice and lack of snow bugs due to water quality.	Comment considered in final SEA
137	Indigenous Community	Bison	Ch.5 Current State of the PAD system – Trends and Stressors	Comments were made to provide information on the natural barrier for bison in the Park.	Forward to Action Planning process for consideration
138	Indigenous Community	Oil Sands	Ch. 6 Cumulative Effects Assessment on the World Heritage Values of the WBNP	Questions & concerns were raised in regard to the water quality & quantity that could be impacted by existing and proposed projects. Also, questions were raised to clarify the growth of GHGs after 2014.	Outside of Action Plan and SEA scope

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
139	Indigenous Community	Cumulative Effects	Ch. 6 Cumulative Effects Assessment on the World Heritage Values of the WBNP	Comments & concerns were raised in regard to the SEA lacking to "clearly and adequately" express the severity of the adverse impact on environmental and world heritage values towards biodiversity and the Indigenous cultural due to development.	Comment considered in final SEA
140	Indigenous Community	Cumulative Effects	Ch. 6 Cumulative Effects Assessment on the World Heritage Values of the WBNP	Questions & concerns were raised to consider not furthering development in the WBNP with proposed projects, due to the current negative outcome of existing projects. Also, to consider including discussion on the ethical point of view in regard to biodiversity and Rights of Indigenous people being adversely affected by current & proposed projects.	Outside of Action Plan and SEA scope
141	Indigenous Community	Jurisdictional Authority	Ch. 6 Cumulative Effects Assessment on the World Heritage Values of the WBNP	Questions & concerns were raised on the validity of laws and legal obligations if they forfeit to uphold its core values of "people and biodiversity relationship" in this regard. Also, suggestions were made to include discussion on the lack of consideration towards "Rights of Indigenous People" and the inadequacy of including "Indigenous indicators & thresholds" for "cultural sustainability" as part of the LARP.	Outside of Action Plan and SEA scope

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
142	Indigenous Community	Recommendation	Ch.7 Recommendations	Comments suggest that the SEA values and considers the Indigenous Knowledge based observations to "help fulfill the RMM recommendations that identified a need for baseline information for analysis" so as to prompt a more compiling action plan to protect the world heritage values of the WBNP.	Comment considered in final SEA
143	Indigenous Community	Recommendation	Ch.7 Recommendations	Comments suggest that the precautionary approach must be broadened to include additional available information and respond with higher urgency for action. To also, ensure a more robust collaborative approach is taken towards restoring the world heritage values in the WBNP through prioritizing legal obligations.	Comment considered in final SEA
144	Indigenous Community	Recommendation	Ch.7 Recommendations	Concerns were raised to ensure jurisdictional challenges are strongly addressed in this section to "prioritize Indigenous rights and livelihoods".	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
145	Indigenous Community	Recommendation	Ch.7 Recommendations	Questions and concerns were raised in regard to the establishment of the baseline & thresholds values that will prompt timely action to still be able to protect the Park from further sustainable decline. Also, comments suggested that assertive action-oriented approach be taken towards addressing the requirement for jurisdictions to "prioritize their Constitutional obligations and change their inadequate policies and legislated Frameworks" to conserve the ecological health & Indigenous livelihood within the PAD.	Comment considered in final SEA
146	Indigenous Community	Recommendation	Ch.7 Recommendations	Comments were made to ensure there is "urgent Crown environmental priorities" placed on the need for more water to support life in the PAD during spring & summer, and to reduce water withdrawal amounts.	Comment considered in final SEA
147	Indigenous Community	Oil Sands	Ch.3; Sec. 3.3 Industry and Industrial Associations	Comments suggested to differentiate and clarify "regional data" collection versus. "compliance monitoring" in regard to Oil Sands Monitoring.	Comment considered in final SEA
148	Indigenous Community	OUVs	Ch.3; Table 3-3 –Elements of the OUV	Comments were made to clarify the information presented in table 3-3, to recognize indicators versus methods to measure the indicators.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
149	Indigenous Community	Cumulative Effects	Ch.6; Sec. 6.4 Assessment of Potential for and Management of Cumulative Effects on the World Heritage Values	Edits were suggested to clarify and better describe the information presented in regard to EIAs	Comment considered in final SEA
150	Indigenous Community	Air Quality	Ch.6; Table 6-9: Major Primary Pathways of Effects and Associated Cumulative Effects Management Tools	Comments were made to include the "Canada-Alberta oil sands environmental monitoring program" as a management tool as "AQMF only addresses SO2 and NOx "	Comment considered in final SEA
151	Indigenous Community	Bison	Ch.6; Table 6-9: Major Primary Pathways of Effects and Associated Cumulative Effects Management Tools	Comments suggest that a sub-regional plan under LARP may be required to support the linear corridor surrounding the WBNP.	Forward to Action Planning process for consideration
152	Indigenous Community	Oil Sands	Ch.6; Table 6-9: Major Primary Pathways of Effects and Associated Cumulative Effects Management Tools	Comments suggested to include the "Canada-Alberta oil sands environmental monitoring program" and potentially a sub-regional plan	Comment considered in final SEA
153	Indigenous Community	Migratory Birds	Ch.6; Table 6-9: Major Primary Pathways of Effects and Associated Cumulative Effects Management Tools	Edits suggested to include the "Canada-Alberta oil sands environmental monitoring program"	Comment considered in final SEA
154	Indigenous Community	Cumulative Effects	Ch.6; Sec. 6.4.1 Surface Water Flow in the Peace River	Edits suggested to include information in regard to LARP development to better support the presented information on cumulative effects of development	Comment considered in final SEA

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155	Indigenous Community	Water Quality	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River	Edits were suggested to clarify the that RAMP has been assumed by GoA since 2012.	Comment considered in final SEA
156	Indigenous Community	Cumulative Effects	Ch.6; Sec. 6.5 Summary	Edits suggested to include the limitations of LARP	Comment considered in final SEA
157	Indigenous Community	Recommendations	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Edits were suggested to clarify and better support the objectives to be achieved with the "cross-jurisdictional water management strategy".	Comment considered in final SEA
158	Indigenous Community	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Edits suggested to include working with Indigenous communities under various groups of the RMM recommendations.	Forward to Action Planning process for consideration
159	Indigenous Community	Recommendations	Ch.7; Sec.3.5 Wildlife and Habitat Conservation	Edits suggested to include options to eliminate diseases in wildlife.	Forward to Action Planning process for consideration
160	Indigenous Community	Recommendations	Ch.7; Sec.7.3.7 Monitoring and Science	Edits suggested to include recommendation to study the sediment chemistry & dissolved oxygen levels.	Comment considered in final SEA
161	Indigenous Community	Recommendations	Ch.7; Sec.7.3.7 Monitoring and Science	Edits suggested to include recommendation to "Develop an Indigenous Community Ranger program for the park"	Forward to Action Planning process for consideration and park management planning processes

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
162	Indigenous Community	SEA Approach	Throughout	Questions & concerns were raised on the approach of the SEA to make a difference in enforcing & ensuring the recommendations are implemented in contrast to past efforts of such similar recommendations.	Comment considered in final SEA
163	Indigenous Community	Recommendation	Ch.7 Recommendations	Questions & concerns were raised on recommendations geared towards further monitoring, as to how, within what time frame, by who and what quality control measures will be associated with these recommendations.	Comment considered in final SEA
164	Indigenous Community	Flood	Throughout	Suggestions were made to inquire in regard to the impact risks of artificial flooding to the FMFN468.	Comment considered in final SEA
165	Indigenous Community	Migratory Birds	Throughout	Concerns were raised in regard to the fate of contaminated waterfowl and in-turn their health effects on Indigenous groups.	Forward to Action Planning process for consideration
166	Indigenous Community	Water Quality	Ch. 7 Recommendations	Suggestions were made in regard to combining traditional knowledge with western environmental monitoring to support informed policy.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
167	Indigenous Community	Recommendation	Ch. 7 Recommendations	Comments were made indicating that the "Muskeg Health Initiative" will complement the SEA in regard to water quality & water levels. Also, that FMFN wishes to include Indigenous perspectives for reviewing circulated regional engagement packages.	Forward to Action Planning process for consideration
168	Indigenous Community	SEA Approach	Ch 1; Sec. 1.5.1 Study Limitations	Comments were made in regard to the limitation of the SEA, in relation to the short time-frame to complete the report representing a complex ecosystem & the approach that the SEA is steered based on past findings.	Comment considered in final SEA
169	Indigenous Community	Indigenous Issues	Ch.2; Sec. 2.3.3 Negative Histories Between Parks Canada and Indigenous Peoples	Comments were made that this section is beyond the scope of the SEA.	Comment considered in final SEA
170	Indigenous Community	OUVs	Ch.2; Sec. 2.2 World Heritage Values	Comments were made in regard to the lack of Indigenous involvement in developing the criteria and the lack of "holistic Indigenous perspective" of the World heritage values.	Comment considered in final SEA
171	Indigenous Community	Bison	Overall	Comments suggested to incorporate interpretations from "the available knowledge" in regard to bison-wolf relationship.	Comment considered in final SEA
172	Indigenous Community	Whooping Cranes	Overall	Concerns were raised on the validity of the information presented in regard to the benefit of climate change towards Whooping Cranes.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
173	Indigenous Community	Air Quality	Overall	Concerns were raised on the validity of the information presented in regard to the air quality in Fort Chipewyan as there are contradicting scientific & Indigenous information available in this regard.	Comment considered in final SEA
174	Indigenous Community	Air Quality	Overall	Comments were made to suggest including information from additional studies to provide a more current and accurate information relating to air quality in the Fort McKay region.	Comment considered in final SEA
175	Indigenous Community	Indigenous Issues	Ch 4, 5 & 6	The SEA conclusion is getting close to what people are seeing on the land, but we need to confirm with our Knowledge Holders that the conclusions match.	Comment considered in final SEA
176	Indigenous Community	Indigenous Issues	Throughout	Indigenous Knowledge is misunderstood and/or misrepresented.	Comment considered in final SEA
177	Indigenous Community	Indigenous Issues	Throughout	Community voices are missing and it is critical to find a stronger way to include community within the report.	Comment considered in final SEA
178	Indigenous Community	Other	Throughout	There is a need for a plain language version of the report for community members to access and understand.	This is being done
179	Indigenous Community	Cumulative Effects	Ch 4, 5 & 6	Comments stated that the section on cumulative effects needs to be strengthened.	Comment considered in final SEA
180	Indigenous Community	Recommendations	Ch 7 Recommendation	Quite a bit of the wording in the recommendations section also needs to be strengthened.	Comment considered in final SEA

FINAL REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
181	Government	Climate Change	Throughout	Suggestions were made for the SEA to include a discussion on the impact of development towards permafrost thawing within the WBNP.	Outside of Action Plan and SEA scope
182	Government	Indigenous Issues	Ch.7 Recommendations	Suggestions were made to elaborate the recommendation on Parks Canada engaging Aboriginal people towards a bilateral relation approach in regard to the WBNP, and to add reference and data to support the discussion.	Forward to Action Planning process for consideration
183	Government	Other	Throughout	Comments suggested to verify for consistency & accuracy of edits & formatting issues throughout the document	Comment considered in final SEA
184	Government	OUVs	Ch.1; Sec 1.1.4 Request for Action Plan	Comments suggested to clarify the roles of other jurisdictions discussed in the section.	Comment considered in final SEA
185	Government	Identified Projects	Ch.1; Sec 1.4 Guiding Principles	Suggestions were made for the SEA to include "the socioeconomic benefits of development in the region" to provide a more thorough discussion.	Forward to Action Planning process for consideration
186	Government	Indigenous Issues	Ch.1; Figure 1-3 Connections between Indigenous Ways of Life and Access to Resources	Comments were made to clarify Figure 1-3 with a written discussion.	Comment considered in final SEA
187	Government	Indigenous Issues	Ch.2; Sec 2.3.3 Negative Histories Between Parks Canada and Indigenous Peoples	Concerns were raised for the SEA to provide a recommendation towards the engagement challenges of the Indigenous groups with Parks Canada.	Forward to Action Planning process for consideration

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188	Government	OUVs	Ch.3; Table 3-1 Elements of the OUV	Comments were made to clarify & ensure the presented information in regard to the interpretation of the Criteria/OUV statements in Table 3-1 is current & accurate.	Comment considered in final SEA
189	Government	SEA Approach	Ch.3; Sec 3.3.1 Geographic and Temporal Boundaries	Comments were made to clarify the physical boundaries of the SEA, so as to include "the area of influence of all values" being discussed.	Comment considered in final SEA
190	Government	SEA Approach	Ch.1; Sec. 3.3.2 Literature Review and Engagement	Concerns were raised in regard to lacking more engagement earlier in the SEA process.	Comment considered in final SEA
191	Government	Bison	Ch.3; Table 3-3 –Elements of the OUV	Comments suggested to consider including "the issue of disease in bison in WBNP" area, and to ensure that the information presented regarding the wolf-bison relationships are more thorough and accurate.	Comment considered in final SEA
192	Government	Boreal Grasslands	Ch.4; Sec. 4.3.1 Pathways of Effects on the Great Plains Boreal Grassland	Comments were made to clarify contradictory information in regard to "Fire Suppression and Changes to Water Regime". Also, to clarify "sedge meadows" as wetlands and wood-bison population impact on grazing.	Comment considered in final SEA
193	Government	Migratory Birds	Ch.4; Sec. 4.4.1 Pathways Effects on Migratory Birds	Suggestions were made, that the SEA recognize the fluctuation in water levels "help maintain interspersed vegetation and open water areas" & increases habitat complexity.	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
194	Government	Bison	Ch.4; Sec. 4.5 Wolf-Bison Predator-Prey Relationship	Comments suggested to ensure the information presented on predator-prey is accurate and clear. Discussions regarding settlers; loss of bison population prior to 1850s; legal protection; jurisdictional authorities; transmission of TB; wolf densities inside & outside WBNP; and Indigenous culture need to be verified for accuracy and present references to support the discussion.	Comment considered in final SEA
195	Government	Indigenous Issues	Ch.5; Sec. 5.1 Introduction	Edits suggested to clarify information presented.	Comment considered in final SEA
196	Government	References	Ch.1; Sec 5.2 Hydrologic Recharge Mechanisms	Comments suggested to verify references made within Chapter 5 were accurately presented in Section 8 with appropriate formatting standards.	Comment considered in final SEA
197	Government	Water Quantity	Ch.5; Table 5-1 Difference in Flow Statistics on Peace River	Edits suggested to verify the data presented in table 5-1 to reflect accurate information and to add reference to Section 8.	Comment considered in final SEA
198	Government	References	Ch.5; Sec 5.3.1 Slave River	Comments suggested to verify data from additional references and to ensure the references were accurately presented in Section 8 with appropriate formatting standards.	Comment considered in final SEA
199	Government	Flood	Ch.5; Sec 5.3.1 Slave River	Suggestions were made to include text to clarify the discussion on recharge to Slave River.	Comment considered in final SEA

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200	Government	Other	Ch.5; Sec 5.3.1 Athabasca River	Comments suggested to better define the different seasons referenced in this section and to maintain consistency in terminologies for clarity.	Comment considered in final SEA
201	Government	Ice Jam	Ch.5; Sec 5.3.2 Ice Jam Flooding	Edits were suggested to clarify the discussion on ice jam flooding	Comment considered in final SEA
202	Government	Water Quality	Ch.5; Sec. 5.5 Surface Water Quality	Comments suggested to ensure the accuracy of the water quality monitoring time periods presented in this Section and to include the reference in Section 8.	Comment considered in final SEA
203	Government	Jurisdictional Authority	Ch.5; Sec. 5.5.2 Trends in the PAD	Concerns were raised on the variation in water quality assessment from different jurisdictional and suggested a resolution to the issue prior to additional assessments.	Forward to Action Planning process for consideration
204	Government	Water Quality	Ch.5; Sec. 5.5.7 Trends in the Slave River	Concerns were raised to verify the location of the reference study discussed in this section in regard to assessment of water quality.	Forward to Action Planning process for consideration
205	Government	Water Quality	Ch.5; Sec. 5.6 Sedimentation and Sediment Quality	Suggestions were made to include data from study related to "suspended sediment quality"	Forward to Action Planning process for consideration
206	Government	Identified Projects	Ch.6; Sec. 6.2.5 Pulp and Paper/Forestry Projects	Questions & concerns were raised to clarify the number of "pulp and paper mills in the Peace River Watershed".	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
207	Government	Climate Change	Ch.6; Sec. 6.3 Potential Cumulative Effects on the PAD from Future Climate Change	Suggestions were made that SEA includes discussion on permafrost.	Outside of Action Plan and SEA scope
208	Government	Climate Change	Ch.6; Table 6-8: Climate Change Projections for the PAD	Recommendation were made to edit table 6-8 to clarify & accurately present the data.	Comment considered in final SEA
209	Government	Groundwater	Ch.6; Sec. 6.3.2 Potential Climate Change Effects on the PAD	Questions & concerns were raised to clarify the interpretation in table 6-8 in regard to groundwater flow & water table levels. Suggested referring to BC Hydro reports for more data.	Comment considered in final SEA
210	Government	Climate Change	Ch.6; Sec. 6.3.3 Potential Climate Change Effects on Athabasca River Flow Rates	Suggestions were made to alter section title & to incorporate information on "Groundwater and permafrost" for a thorough representation of this section.	Comment considered in final SEA
211	Government	Identified Projects	Ch.5; Sec. 6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin	Questions & concerns were raised to clarify the terminology "in-situ" in relation to thermal facilities discussed in this section.	Comment considered in final SEA
212	Government	Water Quality	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River	Questions were raised in regard to the lack of usage of data/ information generated by JOSM by LAR SWQMF.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
213	Government	Bison	Ch.6; Sec. 6.4.7 Increased linear corridor density surrounding the WBNP (bison)	Comments were made in regard to the need of data supporting linear corridor density to detrimental to bison population. Also, to ensure recommendations are highlighted in the SEA to help future planning process.	Forward to Action Planning process for consideration
214	Government	OUVs	Ch.7; Sec. 7.3.2 Environmental Assessment	Questions & concerns were raised to clarify and better define the basis of "significant adverse environmental effect" on WHC values and areas of influence.	Comment considered in final SEA
215	Government	Recommendation	Ch.7; Sec. 7.3.4 Conservation Area Connectivity	Question & concerns were raised to clarify the term "systematic assessment" described in section and to clarify the role of IPCAs & OECMs in regard to forest management agreements.	Comment considered in final SEA
216	Government	Water Quality	Ch.7; Sec. 7.36 Water Quality	Suggestions were made to recommend including the NWT/AB transboundary areas for water quality improvement plans.	Comment considered in final SEA
217	Government	Water Quality	Ch.7; Sec. 7.3.7 Monitoring and Science	Concerns were raised to clarify the goals in relation to effects/change. Recommendation were made to set guidelines to detect early changes so as to prevent effects.	Comment considered in final SEA
218	Government	SEA Approach	Throughout	Disapprove publication of the Draft SEA Report at this time, based on insufficient data collection; lack of scientific evidence, and as the SEA does not take into account the conclusion of "The [Site C] Project".	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
219	Government	SEA Approach	Throughout	Comments were made to suggest that the SEA “does not provide a constructive basis” for the “development of the Action Plan as contemplated” by WHC.	Comment considered in final SEA
220	Government	SEA Approach	Throughout	Comments suggested that the Draft SEA failed to address the issues identified by BC during the initial "Scoping Report"	Comment considered in final SEA
221	Government	SEA Approach	Ch 4, 5 & 6	Comments suggested that the Draft SEA did not accomplish the intended detail in examination & conclusion in addressing "what is causing the changes within WBNP", an observation made in the Addendum to the Draft Scoping Report.	Comment considered in final SEA
222	Government	SEA Approach	Ch 5 & 6	Comments suggest that the SEA is flawed as it uses and assumes data accuracy from a study that lasted only 10-days. Also, the SEA assumes an insignificant link between Bennett Dam & drying of the PAD.	Comment considered in final SEA
223	Government	SEA Approach	Throughout	Comments suggest that the process of obtaining primary reviews from "certain participants" has influenced the Draft SEA Report towards a non-critical view of particular perspective.	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
224	Government	SEA Approach	Ch 4, 5 & 6	Concerns were raised on the reliability of the information presented in the SEA, as some major groups of researchers were omitted while collaborating to collect reliable long-term data/ information for the SEA.	Comment considered in final SEA
225	Government	SEA Approach	Ch 4, 5 & 6	Comments suggest that the SEA is deficient in providing a balanced "discussion of expert evidence and opinion" in regard to opposing viewpoints. As selected few studies/expert opinions have been referenced significantly more number of times than other studies/expert opinions.	Comment considered in final SEA
226	Government	SEA Approach	Ch.5; Sec. 5.3.2 & 5.3.3	Comments suggest that the SEA focuses on the "old paradigm" and only reflects researchers that support this view, making this a very limited assessment of the issues related to this section.	Comment considered in final SEA
227	Government	References	Ch.5; Sec. 5.3.4 Ice Jam Flooding	Comments suggested to provide a more detailed discussion of "Jasek's work" and to present a balanced representation of competing hypotheses & contradicting studies in regard to this section.	Comment considered in final SEA
228	Government	References	Ch.5; Sec.5.3.4 PAD Long-Term Recharge Variability	Comments suggested this section of the SEA lacks to represent studies from varied views points and omits studies with extensive field work that would be substantial for this section.	Comment considered in final SEA

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229	Government	Identified Projects	Ch.6; Sec.6.2 Approved Projects	Comments suggest to describe the Site C project in more details and to include the conclusions from "The 2014 Site JRP Report " in regard to the environmental and social impact assessment of the Site C project.	Comment considered in final SEA
230	Government	Indigenous Issues	Acknowledgment	Comments were made to clarify the listing of Indigenous groups.	Comment considered in final SEA
231	Government	Oil Sands	Executive Summary	Comments were made to differentiate oil sands from industrial mines.	Comment considered in final SEA
232	Government	SEA Approach	Executive Summary	Questions were raised to clarify how outcomes are being addressed.	Comment considered in final SEA
233	Government	SEA Approach	Executive Summary	Suggestions were made to edit and clarify the presented information.	Comment considered in final SEA
234	Government	Climate Change	Executive Summary	Suggestions were made to include historically recorded data.	Comment considered in final SEA
235	Government	Water Withdrawal	Executive Summary	Questions were raised to clarify the withdrawal activities and to include supportive data.	Comment considered in final SEA
236	Government	Water Quantity	Executive Summary	Questions were raised in regard to quantifying water levels.	Comment considered in final SEA
237	Government	Climate Change	Executive Summary	Questions were raised in regard to contamination guidelines and to better clarify the discussion.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
238	Government	SEA Approach	Executive Summary	Comments were made to clarify contradicting statements in regard to desired outcomes	Comment considered in final SEA
239	Government	Indigenous Issues	Ch.1 Sec. 1.5 Approach to SEA	Suggestions were made to include recommendations in regard to constitutional obligation of Indigenous People	Comment considered in final SEA
240	Government	Climate Change	Ch. 3; Sec. 3.3.1 Temporal Boundary	Questions & concerns were raised to clarify the information presented in regard to climate change and to supplement with supportive study	Comment considered in final SEA
241	Government	References	Ch. 3 Sec. 3.3.2.1 Literature Review	Suggestions were made to include the original manuscript source rather than numerous secondary sources.	Comment considered in final SEA
242	Government	Indigenous Issues	Ch. 3 Sec. 3.3.2.1 Literature Review	Comments suggested to adopt "a systematic review framework " for better clarity and readability. Additional references were suggested to support the discussion in this section.	Comment considered in final SEA
243	Government	Migratory Birds	Ch. 3; Step 3 predict future trends	Questions were raised to clarify the aspect of wildlife & water birds being discussed in this section.	Comment considered in final SEA
244	Government	References	Ch. 4; Sec.4.4.1.2 Exposure to contaminants in water, food and sediments in PAD	Comments were made with respect to references used and to include data from other sources	Comment considered in final SEA
245	Government	References	Ch. 4; Sec.4.4.1.2 Exposure to contaminants in water, food and sediments in PAD	Comments were raised with respect to the references used and suggestions were made to include data from other sources	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
246	Government	References	Ch. 4; Sec.4.4.1.2 Exposure to contaminants in water, food and sediments in PAD	Comments suggested to verify the presented information and to include additional study in regard to migratory birds.	Comment considered in final SEA
247	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Edits suggested to clarify information presented and better reflect the references and to add references and data to clarify discussion in regard to migratory birds	Comment considered in final SEA
248	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Edits suggested to clarify information presented in regard to bird landings and to better reflect the references. Also, to add references and data to clarify discussion.	Comment considered in final SEA
249	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Edits suggested to verify the information presented and to add references and data to clarify discussion.	Comment considered in final SEA
250	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments were made to provide references for presented information.	Comment considered in final SEA
251	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Suggestions were made to provide further detail and the extent of toxic effect discussed in this section	Comment considered in final SEA
252	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments suggested to clarify the basis of toxicity in birds from OSPW to be associated with bitumen.	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
253	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Sublethal/Chronic Effects	Suggestions were made to expand on the discussion of bird contamination and include the related study as recommendation for Action Plan	Forward to Action Planning process for consideration
254	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Sublethal/Chronic Effects	Comments suggested that preliminary studies in regard to long-term health of birds has begun.	Comment considered in final SEA
255	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.3 Sublethal/Chronic Effects	Comments suggested to include new approaches such as "genetic/biochemical-based "arrays" that evaluate toxicity through responses in cells" over traditional methods.	Forward to Action Planning process for consideration
256	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.4 Changes in habitat availability and quality at stopover sites along migration route	questions and comments were raised seeking clarification of the information being presented. Suggestions were made to indicate if "the lost habitats were associated to Hennan and Munson (1979) survey."	Comment considered in final SEA
257	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.4 Changes in habitat availability and quality at stopover sites along migration route	questions and comments were raised seeking clarification in on the status of the JOSM study and to include any available preliminary data.	Comment considered in final SEA
258	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.4 Changes in habitat availability and quality at stopover sites along migration route	questions and comments raised to include information related to the PAH & DBT concentrations in sediments.	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
259	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.5 Changes to migration route and timing for birds using the PAD	suggestions were made to include the "potential shifting pattern of migration pathways" to be part of the action plan in the SEA.	Comment considered in final SEA
260	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.5 Changes to migration route and timing for birds using the PAD	Comments were made to recognize and discuss the unaccounted number of birds that fly overhead at night indicating more than ~200,000 birds migrating.	Comment considered in final SEA
261	Government	Migratory Birds	Ch. 4; Sec. 4.4.1.5 Changes to migration route and timing for birds using the PAD	Comments were made to clarify and differentiate between low & high-flying birds passing over oil sand mines.	Comment considered in final SEA
262	Government	Migratory Birds	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Comments recommend use of additional data from USFWS\CWS studies to supplement the discussion.	Comment considered in final SEA
263	Government	Migratory Birds	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Comments recommend include potholes in to quantifying wetlands.	Forward to Action Planning process for consideration
264	Government	Migratory Birds	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Suggestions were made to include data for long-term "waterfowl breeding population" and to reflect the reference	Comment considered in final SEA
265	Government	Bison	Ch. 4; Sec. 4.5.1.2 Risks from increased linear corridor density and other human driven changes surrounding the Park	Suggestions were made in regard to the changing predator-prey relationship in areas adjacent to development. Additional resources were provided to support this discussion.	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
266	Government	Bison	Ch. 4; Sec. 4.5.1.2 Risks from increased linear corridor density and other human driven changes surrounding the Park	Comments were made to verify the information presented in regard to natural obstructions. Suggestions were made to include additional analyses in this regard.	Forward to Action Planning process for consideration
267	Government	Whooping Crane	Ch.4; Sec. 4.6 Whooping Crane	Comments were made to clarify the discussion on loss of wetlands and to reflect the related reference.	Comment considered in final SEA
268	Government	Whooping Crane	Ch.4; Sec. 4.6 Whooping Crane	Comments were made to clarify the areas where there has been wetland loss due to development.	Comment considered in final SEA
269	Government	Whooping Crane	Ch.4; Sec. 4.6 Whooping Crane	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
270	Government	Bison	Throughout	Suggestions were made to maintain consistency of terminologies used.	Comment considered in final SEA
271	Government	Whooping Crane	Throughout	Comments were made to ensure figures properly portray the intended information.	Comment considered in final SEA
272	Government	Migratory Birds	Ch.4; Sec. 4.6.1.1 Short-Term Exposures to Contaminants in Migratory Habitat	Recommendations were made to include a figure showing WBNP, ANWR, MOSR and the migration corridor.	Comment considered in final SEA
273	Government	Migratory Birds	Ch.4; Sec. 4.6.1.1 Short-Term Exposures to Contaminants in Migratory Habitat	Suggestions were made to not list specific mines as bird landings occur on numerous sites	Comment considered in final SEA

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274	Government		Ch.4; Sec. 4.6.1.1 Short-Term Exposures to Contaminants in Migratory Habitat	Suggestions were made to be specific when discussing "weather events".	Comment considered in final SEA
275	Government	References	Ch.4; Sec. 4.6.1.2 Changes to Stopover Habitat	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
276	Government	References	Ch.4; Sec. 4.6.1.2 Changes to Stopover Habitat	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
277	Government	Whooping Crane	Ch.4; Sec. 4.6.1.2 Changes to Stopover Habitat	Comments suggested to edit the discussion on Whooping Crane mortality to avoid duplication of presented information.	Comment considered in final SEA
278	Government	Migratory Birds	Ch.4; Sec. 4.6.1.2 Changes to Stopover Habitat	Edits were suggested to clarify and better present the discussion on habitat for migratory birds.	Comment considered in final SEA
279	Government	Migratory Birds	Ch.4; Sec. 4.6.1.3 Possible Changes in Migration Routes	Comments suggested to clarify the discussion on migration routes and to present more relevant information in this regard.	Comment considered in final SEA
280	Government	References	Ch.4; Sec. 4.6.1.3 Possible Changes in Migration Routes	Suggestions were made to incorporate a figure in this section from a supportive study.	Comment considered in final SEA
281	Government	Migratory Birds	Ch.4; Sec. 4.6.1.3 Possible Changes in Migration Routes	Comments suggested to edit the discussion to avoid duplication of presented information.	Comment considered in final SEA

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282	Government	Migratory Birds	Ch.4; Sec. 4.6.1.3 Possible Changes in Migration Routes	Comments were made to reorganize the information presented for better clarity and to include additional data from supportive references	Comment considered in final SEA
283	Government	Oil Sands	Ch.4; Sec. 4.6.1.4 Exposure to Contaminants in Nesting Habitat	Comments suggested to clarify the information presented and to incorporate any supportive data available for contamination from oil sands to nesting sites.	Comment considered in final SEA
284	Government	References	Ch.4; Sec. 4.6.1.4 Exposure to Contaminants in Nesting Habitat	Comments were made to verify the references used and to present additional more relevant references in regard to contamination in nesting sites	Comment considered in final SEA
285	Government	References	Ch.4; Sec. 4.6.1.4 Exposure to Contaminants in Nesting Habitat	Concerns were raised to ensure a standard format was presented throughout the SEA.	Comment considered in final SEA
286	Government	References	Ch.4; Sec. 4.6.1.5 Changes in Habitat and Food Availability in Nesting Habitat	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
287	Government	References	Ch.4; Sec. 4.6.1.5 Changes in Habitat and Food Availability in Nesting Habitat	Suggestions were made to reference original source than secondary for presented information.	Comment considered in final SEA
288	Government	Climate Change	Ch.4; Sec. 4.6.2 Status and trend of whooping crane	Suggestions were made to recognize the uncertainty of the "impact of climate change on wetlands in the WHCR nesting area" and to reflect this uncertainty in the text / table.	Comment considered in final SEA

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289	Government	Whooping Crane	Ch.4; Sec. 4.6.2 Status and trend of whooping crane	Comments were made to reference to a study related to bird population.	Comment considered in final SEA
290	Government	Whooping Crane	Ch.4; Sec. 4.6.2 Status and trend of whooping crane	Recommendations were made to include a new survey on Whooping Crane for 2016-2017	Comment considered in final SEA
291	Government	Waterfowl	Ch.4; Sec. 4.7 Summary of Evaluation of Desired Outcomes	Comments were made to clarify the information presented on Waterfowl population decrease.	Comment considered in final SEA
292	Government	Indigenous Issues	Ch.5 Current State of the PAD System - Trends and Stressors	Recommendations were made to consider discussing the impacts of contamination through water, air and wildlife as a stand-alone section for better impact on this matter.	Comment considered in final SEA
293	Government	Water Quantity	Ch.5; Sec. 5.2 Hydrologic Recharge Mechanisms	Comments were made in regard to clarifying the information presented on flooding mechanism in PAD and to reflect the reference source.	Comment considered in final SEA
294	Government	Water Quantity	Ch.5; Sec. 5.2 Hydrologic Recharge Mechanisms	Comments were made to better describe hydraulic damming.	Comment considered in final SEA
295	Government	Ice Jam	Ch.5; Sec. 5.2 Hydrologic Recharge Mechanisms	Questions & concerns were raised to clarify the discussion on how "ice jams enhance open water flooding?"	Comment considered in final SEA
296	Government	Other	Ch.5; Sec. 5.2 Hydrologic Recharge Mechanisms	Comments were made to ensure figures labels properly describe the interpretation to the figure	Comment considered in final SEA
297	Government	Flood	Ch.5; Sec. 5.2.1 Open Water Mechanisms	Comments were made to clarify and to discuss the two types of open-water mechanisms.	Comment considered in final SEA

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298	Government	References	Ch.5; Sec. 5.2.1 Open Water Mechanisms	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
299	Government	Water Quantity	Ch.5; Sec. 5.2.1 Open Water Mechanisms	Suggestions were made to include information from studies in regard to peak summer flow	Comment considered in final SEA
300	Government	References	Ch.5; Sec. 5.2.1 Open Water Mechanisms	Comments were made to ensure the discussion does not contradict the cited literature.	Comment considered in final SEA
301	Government	Flood	Ch.5; Sec. 5.2.1 Open Water Mechanisms	Questions & Comments were raised to clarify the statement on ice versus open water mechanism and the area that are flooded.	Comment considered in final SEA
302	Government	Water Quantity	Ch.5; Sec. 5.2.1 Open Water Mechanisms	Questions & concerns were raised in regard to the lake in discussion of raising water levels.	Comment considered in final SEA
303	Government	Flood	Ch.5; Sec. 5.2.1 Open Water Mechanisms	Questions were raised to clarify & provide additional information on large flood in discussion.	Comment considered in final SEA
304	Government	Water Quantity	Ch.5; Sec. 5.2.1 Open Water Mechanisms	Questions were raised in regard to the source of the presented data.	Comment considered in final SEA
305	Government	Water Quantity	Ch.5; Sec. 5.2.2 Ice Jam Mechanisms	Suggestions were made to include information from two other related studies to support the discussion on obstructed outflow & reverse flow events.	Comment considered in final SEA
306	Government	Water Quantity	Ch.5; Sec. 5.2.2 Ice Jam Mechanisms	Comments suggested to verify the time period for high water levels in Late Athabasca.	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
307	Government	Ice Jam	Ch.5; Sec. 5.2.2 Ice Jam Mechanisms	Comments suggested to clarify statements on ice jam to and reflect accurate information.	Comment considered in final SEA
308	Government	References	Ch.5; Sec. 5.2.2 Ice Jam Mechanisms	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
309	Government	Water Quantity	Ch.5; Sec. 5.2.2 Ice Jam Mechanisms	Questions were raised in regard to the location of the river flow in discussion	Comment considered in final SEA
310	Government	References	Ch.5; Sec. 5.2.2 Ice Jam Mechanisms	Comments were made to avoid duplication of information	Comment considered in final SEA
311	Government	References	Ch.5; Sec. 5.3. Recharge Trends and Causes	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
312	Government	Water Quantity	Ch.5; Sec. 5.3. Recharge Trends and Causes	Comments were made to verify and clarify the information presented on hydraulic dam effect.	Comment considered in final SEA
313	Government	Water Withdrawal	Ch.5; Sec. 5.3. Recharge Trends and Causes	Questions were raised to clarify the information on withdrawal activities.	Comment considered in final SEA
314	Government	Water Quantity	Ch.5; Sec. 5.3. Recharge Trends and Causes	Suggested to include additional studies to support the information on reservoir operations	Outside of Action Plan and SEA scope
315	Government	References	Ch.5; Sec. 5.3. Recharge Trends and Causes	Comments were made to cite the original study.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
316	Government	Water Quantity	Ch.5; Sec. 5.3. Recharge Trends and Causes	Comments suggested to include data from an additional study to support the data presented on reservoir operation.	Outside of Action Plan and SEA scope
317	Government	Water Quantity	Ch.5; Sec. 5.3. Recharge Trends and Causes	Edits suggested to verify the data presented in table 5-1	Comment considered in final SEA
318	Government	Water Quantity	Ch.5; Sec. 5.3. Recharge Trends and Causes	Comments were made to the description of Figure 5-3	Comment considered in final SEA
319	Government	Water Quantity	Ch.5; Sec. 5.3. Recharge Trends and Causes	Questions were raised to clarify the statement presented on Slave River flow in regard to pre or post regulation values.	Comment considered in final SEA
320	Government	Water Quantity	Ch.5; Sec. 5.3. Recharge Trends and Causes	Comments were made to clarify the discussion on decline in flow over past 50 years in regard to climate period.	Comment considered in final SEA
321	Government	References	Ch.5; Sec. 5.3. Recharge Trends and Causes	Comments suggested to reference and cite more current and relevant published studies.	Comment considered in final SEA
322	Government	Water Withdrawal	Ch.5; Sec. 5.3. Recharge Trends and Causes	Questions were raised to quantify the water withdrawal amounts and to include a description of the statistical test used for it and reflect the reference.	Comment considered in final SEA
323	Government	References	Ch.5; Sec. 5.3.3 Open Water Flooding	Comments were made to include specific references to the information presented in this section.	Comment considered in final SEA
324	Government	Water Quantity	Ch.5 ; Sec. 5.4 Effects of Recharge Trends on Water Levels	Suggestions were made to include information on sustained high flows.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
325	Government	Weirs	Ch.5; Sec. 5.4.1 Weir Effects	Comments were made to ensure figure descriptions correlate to the figure.	Comment considered in final SEA
326	Government	Water Quantity	Ch.5; Sec. 5.4.1 Weir Effects	Questions & concerns were raised in regard to the accuracy of water level measures presented and to include the source of this information.	Comment considered in final SEA
327	Government	Weirs	Ch.5; Sec. 5.4.1 Weir Effects	Questions & concerns were raised to clarify the discussion on dam regulation and to include the source of this information.	Comment considered in final SEA
328	Government	Reference	Ch.5; Sec. 5.4.1 Weir Effects	Comments were made to verify the validity of the information on flow regulation	Comment considered in final SEA
329	Government	Reference	Ch.5; Sec. 5.5 Surface Water Quality	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
330	Government	Water Quality	Ch.5; Sec. 5.5.1 Monitoring Issues	Comments to edit the discussion on monitoring issues and dissolved nutrients for better clarity.	Comment considered in final SEA
331	Government	Water Quality	Ch.5; Sec. 5.5.1 Monitoring Issues	Comments were made to include information on predevelopment data in relation to water quality prior to 1967.	Outside of Action Plan and SEA scope
332	Government	Water Quality	Ch.5; Sec. 5.5.1 Monitoring Issues	Comments suggested the need for clarification in terms of monitoring requirements as part of the Action Plan.	Forward to Action Planning process for consideration

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
333	Government	Water Quality	Ch.5; Sec. 5.5.2 Trends in PAD	Questions were raised on the availability of data to support the various activities discussed to result in stronger recommendations of the SEA.	Comment considered in final SEA
334	Government	Water Quality	Ch.5; Sec. 5.5.2 Trends in PAD	Comments suggested the need to include description and comparison to references sites for water quality and objectives selected for water quality index calculations.	Forward to Action Planning process for consideration
335	Government	Water Quality	Ch.5; Sec. 5.5.4 Trends in Athabasca River	Questions & concerns were raised on the validity of the information presented in regard to water quality values. Suggestions were made to verify the data and source references.	Forward to Action Planning process for consideration
336	Government	Water Quality	Ch.5; Sec. 5.5.4 Trends in Athabasca River	Comments suggested to include suspended sediment concentration as a parameter in table 5-2	Comment considered in final SEA
337	Government	Oil Sands	Ch.5; Sec. 5.5.4 Trends in Athabasca River	Comments suggested to verify and clarify the information presented on APAHs associated with forest fires.	Comment considered in final SEA
338	Government	Reference	Ch.5; Sec. 5.5.5 Stressors in the Athabasca River	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
339	Government	Water Quality	Ch.5; Sec. 5.5.5 Stressors in the Athabasca River	Edits were suggested to clarify and better present the discussion on dissolved metal concentrations in Athabasca River.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
340	Government	Water Quality	Ch.5; Sec. 5.5.5 Stressors in the Athabasca River	Comments were made to ensure that to include that the studies related to mercury & methylmercury deposition only evaluated snowpack and not river/lake water.	Comment considered in final SEA
341	Government	References	Ch.5; Sec. 5.5.5 Stressors in the Athabasca River	Comments suggested to reference and cite more current and relevant published studies.	Comment considered in final SEA
342	Government	Water Quality	Ch.5; Sec. 5.5.5 Stressors in the Athabasca River	Comments suggested to include pertinent material to discuss western Lake Athabasca as well in this section.	Comment considered in final SEA
343	Government	Water Quality	Ch.5; Sec. 5.5.6 Trends in Lake Athabasca	Suggestions were made to define the period of CanNorth monitoring	Comment considered in final SEA
344	Government	Reference	Ch.5; Sec. 5.5.7 Trends in the Slave River	Comments suggested to include the "exceptions" from "CanNorth report.	Comment considered in final SEA
345	Government	Flood	Ch.5; Sec. 5.6 Sedimentation and Sediment Quality	Concerns were raised to clarify the discussion on "Flood evidence" and to reflect any relevance to other studies	Comment considered in final SEA
346	Government	Water Quality	Ch.5; Sec. 5.6 Sedimentation and Sediment Quality	Comments suggested to clarify the discussion of PAHs present in Athabasca River due to "natural erosion of bitumen deposits"	Comment considered in final SEA
347	Government	References	Ch.5; Sec. 5.6 Sedimentation and Sediment Quality	Suggestions were made to include a new study in regard to suspended sediments and poly aromatic compounds in the Athabasca region	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
348	Government	Air Quality	Ch.5; Sec 5.7 Air Deposition of Contaminants	Comments suggested to clarify and verify the discussion on airborne contaminants.	Comment considered in final SEA
349	Government	Air Quality	Ch.5; Sec 5.7 Air Deposition of Contaminants	Edits suggested to include information from studies in regard to air quality impacts from oil sands development.	Comment considered in final SEA
350	Government	References	Ch.5; Sec 5.7 Air Deposition of Contaminants	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
351	Government	Groundwater	Ch.5; Sec.5.8. Groundwater in lower Athabasca River Basin	Comments suggested to expand the groundwater section of the report to include discussion of the PAD on the whole in regard to impact of groundwater from oil sands development.	Comment considered in final SEA
352	Government	Groundwater	Ch.5; Sec.5.8.1 Groundwater Quality	Comments suggest to include studies related to the impact of tailings pond on groundwater quality.	Comment considered in final SEA
353	Government	References	Ch.5; Sec.5.8.1 Groundwater Quality	Suggestions were made to include only published or at least peer reviewed studies.	Comment considered in final SEA
354	Government	Groundwater	Ch.5; Sec.5.8.1 Groundwater Quality	Concerns were raised on the clarity and validity of the information presented in regard to OSPW affected groundwater	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
355	Government	Oil Sands	Ch.5; Sec.5.8.1 Groundwater Quality	Concerns were raised on the interpretation and representation of finding from a study related to tailings process water flow into river. Edits were suggested to better clarify and reflect the information.	Comment considered in final SEA
356	Government	Groundwater	Ch.5; Sec.5.8.1 Groundwater Quality	Concerns were raised on the interpretation and representation of finding from a study related to saline groundwater fluxes. Edits were suggested to better clarify and reflect the information.	Comment considered in final SEA
357	Government	Muskrat	Ch.5; Sec.5.10 Muskrat and Beavers	Comments suggested to include results from a study related to "changes in muskrat population in the PAD" to better support the discussion.	Comment considered in final SEA
358	Government	Migratory Birds	Ch.5; Sec.5.10 Muskrat and Beavers	Comments suggested to include the species being discussed in this section.	Comment considered in final SEA
359	Government	Migratory Birds	Ch.5; Sec.5.10 Muskrat and Beavers	Edits suggested to include information in regard to ECCC's study on contamination in bird eggs to better support the discussion in this section.	Comment considered in final SEA
360	Government	References	Ch.5; Sec.5.14 Fish	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
361	Government	Water Quality	Ch.5; Sec.5.14 Fish	Comments were made to clarify PAD contaminant being discussed in this section	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
362	Government	Water Quality	Ch.5; Sec.5.14 Fish	Edits suggested to include discussion on small fish as an "indicators of local contaminant sources" to better support the discussion	Comment considered in final SEA
363	Government	Oil Sands	Ch.5; Sec.5.14 Fish	Comments were made to verify the sources of the 2018 oil sands monitoring as presented in this section.	Comment considered in final SEA
364	Government	Water Quality	Ch.5; Sec.5.14 Fish	Comments were made to clarify the information presented in regard to contamination and effects from industry input.	Comment considered in final SEA
365	Government	Water Quantity	Ch.5; Table 5-3 Current Stressors and Trends in the PAD	Comments suggested to verify the time period of spring flow discussed in this section.	Comment considered in final SEA
366	Government	Ice Jam	Ch.5; Table 5-3 Current Stressors and Trends in the PAD	Comments suggested to verify the validity of the information presented in regard to winter flows.	Comment considered in final SEA
367	Government	Water Quality	Ch.5; Table 5-3 Current Stressors and Trends in the PAD	Comments were made to clarify the that "the exceedances are in reference to water quality guidelines"	Comment considered in final SEA
368	Government	Water Quality	Ch.5; Table 5-3 Current Stressors and Trends in the PAD	Comments suggested to include more description on" parameters, objectives and location of reference sites"	Forward to Action Planning process for consideration
369	Government	Water Quality	Ch.5; Table 5-3 Current Stressors and Trends in the PAD	Suggestions were made to include information in regard to CABIN as water quality indicator, and to include related study.	Forward to Action Planning process for consideration

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
370	Government	Ice Jam	Ch.5; Sec.5.15.2 Pathway of Effects	Comments were made to clarify the information presented in regard to flow rates and ice jams, and to include relevant studies for better clarity.	Comment considered in final SEA
371	Government	Water Quantity	Ch.5; Figure 5-16 Pathways of Effects System Diagram	Suggested to include agriculture as an industry related to water withdrawal activities.	Comment considered in final SEA
372	Government	Other	Ch.6; Figure 6-5	Suggested to clarify the location of the limestone mine depicted in fig 6-5	Comment considered in final SEA
373	Government	Climate Change	Ch.6; Sec. 6.3.1 Climate Change Projections Relating to the PAD	Suggested to include specific studies in regard to projected estimate of climate change rather than a cumulative literature review as a study.	Comment considered in final SEA
374	Government	Identified Projects	Ch.6; Sec. 6.3.1 Climate Change Projections Relating to the PAD	Comments suggested to verify the time-line of the project in discussion.	Comment considered in final SEA
375	Government	Climate Change	Ch.6; Sec. 6.3.1 Climate Change Projections Relating to the PAD	Suggested to clarify and better discuss the future climate change as a not a simple and direct extrapolation of past climate changes.	Comment considered in final SEA
376	Government	Climate Change	Ch.6; Sec. 6.3.1 Climate Change Projections Relating to the PAD	Comments suggested to clarify and better describe the link between table 6-8 to available literature by discussing "the future time period and methods/data used to project future trends in the various studies."	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
377	Government	Water Quantity	Ch.6; Sec. 6.3.2 Potential Climate Change Effects on the PAD	Suggestions were made to clarify the discussion on changes to seasonal flow.	Comment considered in final SEA
378	Government	Climate Change	Ch.6; Sec. 6.3.2 Potential Climate Change Effects on the PAD	Suggestions were made to include a section on projected climate change in the region " as a precursor to understanding the impacts, which are detailed in this section."	Comment considered in final SEA
379	Government	References	Ch.6; Sec. 6.3.3 Potential Climate Change Effects on Athabasca River Flow Rates	Suggested to eliminate the assessment starting form 1970 discussed in this section as it does not add significant value and would be incorrect to extrapolate the values form the study.	Comment considered in final SEA
380	Government	Climate Change	Ch.6; Sec. 6.3.3 Potential Climate Change Effects on Athabasca River Flow Rates	Comments suggested that the projected climate changes be more climate scenario based rather than extrapolation of historical trends and to include the references in section 8.	Comment considered in final SEA
381	Government	Water Quantity	Ch.6; Sec. 6.4.1 Surface Water Flow in the Peace River	Comments suggested to include an "estimate of overall reduction in water flow"" due to hydro projects" and to "attempt to assess the carrying capacity of PAD."	Comment considered in final SEA
382	Government	Water Quantity	Ch.6; Sec. 6.4.1 Surface Water Flow in the Peace River	Comments suggested to further describe "how open water flooding" links to "winter flow regime and ice jam flooding"	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
383	Government	Water Withdrawal	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	Comments suggested to verify the information presented in regard to "withdrawal rates affecting Athabasca River" and to include the reference source.	Comment considered in final SEA
384	Government	Water Withdrawal	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	Suggestions were made to include an estimate in regard to cumulative water withdrawal "effects during decreased flow seasons.	Comment considered in final SEA
385	Government	Water Quantity	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	Comments were made to clarify the discussion on flow rates below in relation to spring and fall seasons	Comment considered in final SEA
386	Government	Water Quantity	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	Comments suggested to verify if the estimates of flow rates could be linked to existing and proposed hydro projects.	Forward to Action Planning process for consideration
387	Government	References	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	Suggestions were made to include a more current peer reviewed study	Comment considered in final SEA
388	Government	References	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
389	Government	Groundwater	Ch.6.; Sec. 6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin	Comments suggested to verify the accuracy of interpretation and representation of information for the "Jasechko" study.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
390	Government	Groundwater	Ch.6.; Sec. 6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin	Comments were suggested to consider the benefits of "extensive monitoring in the form of an expansion in the provincial groundwater monitoring network" versus "targeted and localized scientific studies" also include references to related studies.	Forward to Action Planning process for consideration
391	Government	Groundwater	Ch.6.; Sec. 6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin	Comments were made to clarify the estimate being discussed here is in terms of numerical /percentage.	Comment considered in final SEA
392	Government	Air Quality	Ch.6; Sec6.4.4. Air Quality	Comments suggested to further elaborate this section on air quality to better understand "the potential future impacts to air quality." Also, to include the collaborative work of various jurisdictions toward improving air quality through AQMS.	Comment considered in final SEA
393	Government	Air Quality	Ch.6; Sec6.4.4. Air Quality	Comments suggested to include available monitoring information from Oil Sands and relevant studies, in regard to PAC, metal and acid deposition.	Forward to Action Planning process for consideration
394	Government	Air Quality	Ch.6; Sec6.4.4. Air Quality	Comments were made to incorporate data from more than one monitoring station for more reliable and accurate data analysis.	Forward to Action Planning process for consideration
395	Government	Air Quality	Ch.6; Sec6.4.4. Air Quality	Edits suggested to induced information in regard to ECCC air quality monitoring to better support the discussion in this section.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
396	Government	Water Quality	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River	Comments were made to ensure the references and discussions from this section are well linked to the rest of the SEA.	Comment considered in final SEA
397	Government	Water Quality	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River	Comments were made to include further detail in regard to RAMP.	Comment considered in final SEA
398	Government	References	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
399	Government	Bison	Ch.6; Sec. 6.4.8 Disease management and hunting outside WBNP	Edits suggested to include the organization associated with development in the RLBH range.	Comment considered in final SEA
400	Government	Recommendations	Ch.6; Sec 6.4.10 Local migratory route contamination and mortality	Suggested to list the challenges identified in Sec 6.4 in this section.	Comment considered in final SEA
401	Government	Cumulative Effects	Ch.6; Sec 6.5 Summary	Comments suggested to recognize the lack of available data as a limitation of this SEA to assess cumulative effects "on the world heritage values from every single stressor."	Comment considered in final SEA
402	Government	OUVs	Ch.6; Sec 6.5 Summary	Suggested to clarify the information and reflect the current state of affair in regard to impacts to the WBNP	Comment considered in final SEA
403	Government	Other	Ch.6; Sec 6.5 Summary	Suggested to edit information presented to avoid duplication.	Comment considered in final SEA
404	Government	Recommendations	Ch.6; Sec 6.5 Summary	Suggested to state in this sec. that the issues identified will be addressed as recommendations in Ch.7	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
405	Government	Cumulative Effects	Ch.6; Table 6-10 Trends and Potential Cumulative effects on OUV Objectives for the WBNP	Suggestions were made to "include analysis of impacts from each stressor for each OUV"	Comment considered in final SEA
406	Government	Water Quality	Ch.6; Table 6-10 Trends and Potential Cumulative effects on OUV Objectives for the WBNP	Comments suggested to verify the information presented in table 6-10 in regard to assessment of objective 6 & 7.	Comment considered in final SEA
407	Government	Recommendations	Ch.7; Sec. 7.1 Introduction	Suggestions were made to clarify the discussion on irreversible changes to state it as potential irreversible harm	Comment considered in final SEA
408	Government	Recommendations	Ch.7; Sec. 7.1 Introduction	Comments were made to clarify this section and to include the decision in sec. "7.1.1 after presenting the precautionary principle."	Comment considered in final SEA
409	Government	Recommendations	Ch.7; Sec. 7.1.2 Adaptive Management Approach	Comments were made in regard to the critical aspect of the timeliness of adoptive management cycle.	Comment considered in final SEA
410	Government	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Comments were made to ensure the shortcomings identified in Chapter 6 are proposed as recommendations in this chapter.	Comment considered in final SEA
411	Government	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Suggested to prioritize the recommendations.	Comment considered in final SEA
412	Government	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	Suggestions were made to describe risks as more definitive	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
413	Government	Jurisdictional Authority	Ch.7; Sec. 7.3.1 Environmental Flow / Hydrology	Comments suggested to include the cross-jurisdictional benefit of developing a "hydrodynamic modelling capability for the entire regulated reach of Peace River"	Comment considered in final SEA
414	Government	Water Quantity	Ch.7; Sec. 7.3.1 Environmental Flow / Hydrology	Comments suggested to recognize and clarify the complexity of information presented in regard to ice cover breaks in relation to fall flow.	Comment considered in final SEA
415	Government	Ice Jam	Ch.7; Sec. 7.3.1 Environmental Flow / Hydrology	Suggested to incorporate the discussion on ice jam in relation to hydroelectric dam to the appropriate section of the SEA.	Comment considered in final SEA
416	Government	Water Quantity	Ch.7; Sec. 7.3.1 Environmental Flow / Hydrology	Comments were made to clarify and accurately portray the information presented on "released flow" and to include information from relevant studies.	Comment considered in final SEA
417	Government	Water Quantity	Ch.7; Sec. 7.3.1 Environmental Flow / Hydrology	Comments suggested to verify the cited AXF values.	Comment considered in final SEA
418	Government	References	Ch.7; Sec. 7.3.1 Environmental Flow / Hydrology	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
419	Government	Water Quantity	Ch.7; Sec. 7.3.1 Environmental Flow / Hydrology	Comments suggested to clarify the statement on winter flow demand in regard to oil sands/ecological flow.	Comment considered in final SEA
420	Government	Recommendations	Ch.7; Sec. 7.3.2 Environmental Assessment	Suggestions were made to clarify the recommendation in regard to the need or not of an EA to resolve the impacts on the PAD.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
421	Government	Oil Sands	Ch.7; Sec. 7.3.3 Tailings Ponds Risk Assessment	Suggestions were made to include and expand recommendations pertaining to management of tailings ponds.	Comment considered in final SEA
422	Government	Oil Sands	Ch.7; Sec. 7.3.3 Tailings Ponds Risk Assessment	Comments suggested to verify the source of PACs in relation to tailings ponds and to include relative studies.	Comment considered in final SEA
423	Government	Water Quality	Ch.7; Sec. 7.3.7 Monitoring and Science	Comments suggested to include other aspects other than better monitoring standards.	Comment considered in final SEA
424	Government	References	Ch.7; Sec. 7.3.7 Monitoring and Science	Suggestions were made to include the source for the data presented in this section.	Comment considered in final SEA
425	Government	Migratory Birds	Ch.7; Sec. 7.3.7 Monitoring and Science	Comment suggested to further emphasize the health issues of water birds in relation to migration.	Comment considered in final SEA
426	Government	Oil Sands	Ch.7; Sec. 7.3.7 Monitoring and Science	Comments suggested to better discuss the link "between biota and the dynamic abiotic processes that are characteristic of the PAD" to better understand the impact of development on biological communities downstream.	Comment considered in final SEA
427	Government	Monitoring	Ch.7; Sec. 7.3.7 Monitoring and Science	Comments suggested to clarify if the SEA considers " Fort Chipewyan is a good location for PAH monitoring"	Comment considered in final SEA
428	Government	References	Ch. 8 References	Comments suggested to verify references for accuracy and consistency of formatting	Comment considered in final SEA
429	Government	References	Ch. 8 References	Comments suggested to include number of additional references to better support the SEA.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
430	Government	References	Ch. 8 References	Questions were raised to verify the listed reference in this section to the appropriate source.	Comment considered in final SEA
431	Government	References	Ch. 8 References	Edits suggested to include additional reference to better support the SEA	Comment considered in final SEA
432	Government	References	Ch. 8 References	Comments suggested to verify references for accuracy and consistency of formatting	Comment considered in final SEA
433	Government	SEA Approach	Executive Summary	The intent of the SEA is to inform??	Comment considered in final SEA
434	Government	Desired Outcomes	Executive Summary	Would suggest that improving the management of CE is desired outcome subsequent to the SEA (which has is assessing/recognizing/identifying impacts)	Comment considered in final SEA
435	Government	SEA Approach	Executive Summary & Ch. 1; Sec.1.3 Purpose of the SEA	Suggested edit the SEA objectives to be more in line with the scope.	Comment considered in final SEA
436	Government	Desired Outcomes	Executive Summary	These are not outlined until way later in the report. Recommend that this a quick reference to be included for context	Comment considered in final SEA
437	Government	SEA Approach	Executive Summary	Is this in scope of the SEA or an additional piece of work that was conducted?	Comment considered in final SEA
438	Government	SEA Approach	Executive Summary	Comments suggested to clarify the core objective of the SEA and to accordingly alter chapter 7 as conclusions and key findings.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
439	Government	Desired Outcomes	Executive Summary	Comment suggested to state the desired outcome with regard to Indigenous way of life.	Comment considered in final SEA
440	Government	OUV	Executive Summary	Comments states that, "Federal and provincial governments do not make policy/project decisions based on international values developed outside the context of the region/country."	Comment considered in final SEA
441	Government	SEA Approach	Executive Summary	Comments suggest that the conclusion should be focused on key findings rather than recommendation for action.	Comment considered in final SEA
442	Government	SEA Approach	Executive Summary	Comments suggested that conclusions need to be in line with core SEA objectives.	Comment considered in final SEA
443	Government	Other	Ch. 1; Sec. 1.2 Introduction to Strategic Environmental Assessment	Not sure that this section adds to the report. Should cite the CCME definition from the glossary	Comment considered in final SEA
444	Government	OUV	Ch. 1; Sec. 1.2 Introduction to Strategic Environmental Assessment	Preferred state = achievement of stated outcomes for OUVs of the park?	Comment considered in final SEA
445	Government	SEA Approach	Ch. 1; Sec. 1.2 Introduction to Strategic Environmental Assessment & Sec. 1.4 Guiding Principles	Comments addressed the limitation of SEA with regard to social & political consideration.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
446	Government	Other	Ch. 1; Sec. 1.2 Introduction to Strategic Environmental Assessment	Edits suggested to omit the last paragraph for better clarity.	Comment considered in final SEA
447	Government	Cumulative Effects	Ch. 1; Sec.1.2.1 Cumulative Effects and SEA	Suggestions were made to refer to the CCME definition to support the discussion on Cumulative Effects or to refer to the definition section of the Alberta's Land Use Framework.	Comment considered in final SEA
448	Government	Jurisdictional Authority	Ch. 1; Sec.1.2.1; Ch. 2; Sec. 2.1 & Ch. 3; Sec. 3.3.2.2	Comments suggested to include a section discussing jurisdictional authorities of the region.	Comment considered in final SEA
449	Government	Desired Outcomes	Ch. 1; Sec.1.2.1 Cumulative Effects and SEA	Note that SEA asks the 'what if' questions – that will inform the decisions on the 'desired future'.	Comment considered in final SEA
450	Government	Other	Ch. 1; Sec.1.2.2 Cumulative Impacts to Indigenous Ways of Life	Comment made to clarify "alternative framework of hypothesis" discussed in the section.	Comment considered in final SEA
451	Government	Other	Ch. 1; Sec.1.2.2 Cumulative Impacts to Indigenous Ways of Life	Edits were suggested for better clarity.	Comment considered in final SEA
452	Government	SEA Approach	Ch. 1; Sec.1.2.3 Benefits of SEA & Sec. 1.3 Purpose of the SEA	Comments stated, " This report is not meant to provide "better management of cumulative effects"; only a baseline of current conditions/cumulative effects."	Comment considered in final SEA
453	Government	SEA Approach	Ch. 1; Sec.1.2.3 Purpose of the SEA	Who are the affected parties?	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
454	Government	Identified Projects	Ch. 1; Sec. 1.5.3 Structure of the SEA	How were “foreseeable developments” identified?	Comment considered in final SEA
455	Government	SEA Approach	Ch 1, 3, 6, & 7	Comments suggested to represent information in line with the scope of the SEA.	Comment considered in final SEA
456	Government	SEA Approach	Ch. 2; Sec. 2.3 Indigenous Perspectives on the SEA	Comments questioned, “Have government or industry and/or other stakeholder perspectives been included in the report as well?”	Comment considered in final SEA
457	Government	SEA Approach	Ch. 3; Sec. 3.1 Methodology Used in the SEA	Comments suggested that Ch 6 & 7 be in line with the scope of the original mandate of the SEA.	Comment considered in final SEA
458	Government	Desired Outcomes	Ch. 3; Sec. 3.5 Step 4 – Develop Recommendation	These are based on desired outcomes determined by an international agency. No consideration was given to jurisdiction, existing climate change efforts, or economic considerations.	Comment considered in final SEA
459	Government	Desired Outcomes	Ch.3; Table 3-3 –Elements of the OUV	Comments suggested to clearly define desired outcomes. How do we know desired outcomes are being met?	Comment considered in final SEA
460	Government	OUV	Ch.3; Table 3-3 –Elements of the OUV	Comments suggested to verify the potential indicator column to reflect indicators rather than techniques.	Comment considered in final SEA
461	Government	Water Quantity	Ch.3; Table 3-3 –Elements of the OUV	Comments suggested to separate water quality and water quantity.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
462	Government	Water Quantity	Ch.3; Table 3-3 –Elements of the OUV	Comments suggested to include other measures for water quantity	Forward to Action Planning process for consideration
463	Government	Bison	Ch.3; Table 3-3 –Elements of the OUV	Comments suggested to clarify the Potential Indicators section of the table with regard to bison and wolf population.	Comment considered in final SEA
464	Government	Hydrology	Ch.4; Sec.4.4.1.1 Changes in Habitat and Food Availability in PAD	Recommendations were made to separate the effects on hydrologic regimes caused by natural variation and dams, and oil sands withdrawals.	Comment considered in final SEA
465	Government	Migratory Birds	Ch.4; Sec. 4.4.1.2 Exposure to contaminants in water, food and sediments in PAD	Comments stated, "Note, we do not have access to this report." with regard to ECCC 2018 study on accumulation of PACs in birds.	Outside of Action Plan and SEA scope
466	Government	References	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments were made to ensure source references are properly reflected in text and listed in Section 8.	Comment considered in final SEA
467	Government	Oil Sands	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments suggested to verify and clarify the discussion on tailings pond size.	Comment considered in final SEA
468	Government	Oil Sands	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Questions were raised to clarify the change of fluid tailings over time.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
469	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments suggested to include additional study reference to support the discussion on migratory bird population.	Comment considered in final SEA
470	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments suggested to verify the information presented from reference study to be relevant to the discussion.	Comment considered in final SEA
471	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments provided additional information in regard to migratory birds that come in contact with bitumen.	Comment considered in final SEA
472	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Suggested to include more detailed information on impacts to focal species/species groups would be helpful.	Comment considered in final SEA
473	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments stated the information presented is a "Preliminary detection estimates."	Comment considered in final SEA
474	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Suggested to include studies to support the estimates provided with regard to migratory bird landings.	Comment considered in final SEA
475	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments suggested to verify the information presented with regard to Beck's study.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
476	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	This is not a common belief. The effects to these birds are unknown at this time. This is conjecture.	Comment considered in final SEA
477	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments suggested to provide more details on exposure periods.	Comment considered in final SEA
478	Government	Migratory Birds	Ch.4; Sec. 4.4.1.3 Short-Term Exposures to Contaminants in Local Migratory Habitat	Comments suggested to provide more information to clarify the discussion on migratory birds flying through emission plumes.	Comment considered in final SEA
479	Government	References	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Suggested to verify the information presented and to add reference of USFWS 2017 study with regard to decline in migratory birds.	Comment considered in final SEA
480	Government	References	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Suggested to include data pertinent to regional population.	Comment considered in final SEA
481	Government	Migratory Birds	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Suggested to clarify the information presented on fall count of migrating birds.	Comment considered in final SEA
482	Government	Migratory Birds	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Comments suggested to validate the information presented in regard to repeated exposure of migratory birds to contaminants.	Comment considered in final SEA
483	Government	Water Quality	Ch.4; Sec. 4.4.2 Status and Trend of Migratory Birds in WBNP	Comments suggested to be more specific with regard to water quality impacts on migratory bird contamination.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
484	Government	Bison	Ch.4; Sec. 4.5.1.1 Risks from Drying and Fewer Flooding Events	Edits suggested to clarify the section on bison movement and habitat.	Comment considered in final SEA
485	Government	Wolf	Ch.4; Sec. 4.5.1.2 Risks from increased linear corridor density and other human driven changes surrounding the Park	Comments suggested to verify and clarify the information presented with regard to increase in wolf population.	Comment considered in final SEA
486	Government	Bison	Ch.4; Sec. 4.5.1.2 Risks from increased linear corridor density and other human driven changes surrounding the Park	Comments suggested to verify and clarify the information presented on bison movement.	Comment considered in final SEA
487	Government	Indigenous Issues	Ch.4; Sec. 4.5.1.3 Risks from Hunting Outside WBNP	Comments suggested to clarify and present additional information with regard to hunting outside the park.	Comment considered in final SEA
488	Government	Bison	Ch.4; Sec. 4.5.2 Status and Trend of Bison-Wolf Predator-Prey Relationship	Suggestion to present 2013 COSEWIC assessment and status report on bison.	Comment considered in final SEA
489	Government	Wolf	Ch.4; Sec. 4.5.2 Status and Trend of Bison-Wolf Predator-Prey Relationship	Comment suggest to clarify the statement on wolf predation.	Comment considered in final SEA
490	Government	Bison	Ch.4; Sec. 4.5.2 Status and Trend of Bison-Wolf Predator-Prey Relationship	Comment to verify and clarify the information presented with regard to wolf-bison population and predation rate.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
491	Government	Whooping Cranes	Ch.4; Sec. 4.6.1.1 Short-Term Exposures to Contaminants in Migratory Habitat	Suggested to include information on any noticeable health effect of Whooping Cranes from the monitoring study referenced here.	Comment considered in final SEA
492	Government	Whooping Cranes	Ch.4; Sec. 4.6.1.1 Short-Term Exposures to Contaminants in Migratory Habitat	GBH and Whooping cranes may use different habitats during migration and may not be exposed to the same risks.	Comment considered in final SEA
493	Government	Migratory Birds	Ch.4; Sec. 4.6.1.3 Possible Changes in Migration Routes	How many animals were tracked? Is this thought to be representative of the population?	Comment considered in final SEA
494	Government	Indigenous Issues	Ch.4; Sec. 4.6.1.3 Possible Changes in Migration Routes	Are Indigenous Knowledge holders speaking to cranes? Or focused on harvested species?	Comment considered in final SEA
495	Government	Migratory Birds	Ch.4; Sec. 4.6.1.5 Changes in Habitat and Food Availability in Nesting Habitat	Is this in reference to changes in hydrological conditions evidenced in the PAD?	Comment considered in final SEA
496	Government	Migratory Birds	Ch.4; Sec. 4.7 Summary of Evaluation of Desired Outcomes	Suggested to verify and provide data to support the information presented on contamination	Comment considered in final SEA
497	Government	Withdrawal Activities	Ch.5; Sec. 5.3.1 River Flows	Edits were suggested to clarify the information presented on the influence of water withdrawal activities towards reduced spring flow.	Comment considered in final SEA
498	Government	Flood	Ch.5; Table 5-1: Difference in Flow Statistics on Peace River	Suggested to verify the data presented in table 5-1 with regard to 2 yr. flood event and mean winter values.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
499	Government	Water Quantity	Ch.5; Sec. 5.3.1 River Flows	Clarify statements with regard to decrease in Athabasca River flow.	Comment considered in final SEA
500	Government	Withdrawal Activities	Ch.5; Sec. 5.3.1 River Flows	Suggested this section needs to describe and distinguish between the overall trends in flow for the Athabasca River and water withdrawals in the basin.	Comment considered in final SEA
501	Government	References	Ch.5; Sec. 5.3.1 River Flows	Suggested to verify and clarify the information presented from various studies with regard to water levels in Athabasca River.	Comment considered in final SEA
502	Government	Withdrawal Activities	Ch.5; Sec. 5.3.1 River Flows	Suggested to separate the two time periods (low & high rate) of withdrawal activities to better evaluate the declining flow rates.	Comment considered in final SEA
503	Government	Identified Projects	Ch.5; Sec.5.3.2 Ice Jam Flooding	Questions were raised with regard to Site C project.	Comment considered in final SEA
504	Government	Flow	Ch.5; Sec. 5.3.3 Open Water Flooding	More discussion of simulating (i.e. modelling) natural flows would be helpful.	Comment considered in final SEA
505	Government	Withdrawal Activities	Ch.5; Sec. 5.3.3 Open Water Flooding	Suggested changes to accurately present information with regard to peak withdrawals.	Comment considered in final SEA
506	Government	Water Quantity	Ch.5; Sec. 5.3.3 Open Water Flooding	Could Athabasca flows versus naturalized be drawn out from this work, or identified as a potential action for investigation?	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
507	Government	Reference	Ch.5; Sec. 5.3.4 Clarifications on Observations and Causes of PAD Flooding Reductions	Did Beltaos indicate what is an adequate time period?	Comment considered in final SEA
508	Government	Weirs	Ch.5; Sec. 5.4.1 Weir Effects	Suggested to provide context with regard to weirs effects on water levels.	Comment considered in final SEA
509	Government	Reference	Ch.5; Sec. 5.4.1 Weir Effects	Does “Prowse and Conly (1996)” literature provide any indication of how the weirs impact water levels during the fall or other key hunting/navigation season?	Comment considered in final SEA
510	Government	Other	Ch.5; Sec. 5.5.1 Monitoring Issues	Suggested to clarify “PAD Rivers” to better understand if the mainstream of Peace and Athabasca Rivers are included.	Comment considered in final SEA
511	Government	Water Quality	Ch.5; Sec. 5.5.1 Monitoring Issues	Comment stated that the discussion of studies with regard to water quality during winter and summer flows have been overly simplified.	Comment considered in final SEA
512	Government	Monitoring	Ch.5; Sec. 5.5.1 Monitoring Issues	Suggested to clarify the source of water quality data (federal versus provincial) and to include the limitations of characterizing water quality in large rivers.	Comment considered in final SEA
513	Government	Water Quality	Ch.5; Sec. 5.5.1 Monitoring Issues	Suggested to specify the waterbody being discussed and to include more specific characteristics information of Peace and Athabasca Rivers.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
514	Government	Flow	Ch.5; Table 5-2: Spatial and Temporal Trends for Typical Water Quality Parameters in PAD Rivers	Questions and concerns were raised with regard to the validity of the dataset used for the statistical analysis presented in table 5-2.	Comment considered in final SEA
515	Government	References	Ch.5; Sec. 5.5.4 Trends in Athabasca River	Questions were raised to verify the information presented with regard to a 2009 report being discussed in this section and to ensure the reference is properly listed in Section 8.	Comment considered in final SEA
516	Government	Flood	Ch.5; Sec. 5.6 Sedimentation and Sediment Quality	Comment stated that flood remnants likely don't offer the best signal to noise ratio when looking for evidence of anthropogenic pollution.	Comment considered in final SEA
517	Government	Air Quality	Ch.5; Sec 5.7 Air Quality	Suggestions were made to support the information presented with regard to Fort Chipewyan station.	Comment considered in final SEA
518	Government	Reference	Ch.5; Sec 5.7 Air Quality	AQHI is now measured in the number 1-10 http://aep.alberta.ca/air/air-quality-health-index/about-AQHI.aspx	Comment considered in final SEA
519	Government	Reference	Ch.5; Sec 5.7 Air Quality	Suggested to include additional current data with regard to air quality monitoring.	Forward to Action Planning process for consideration
520	Government	Indigenous Issues	Ch.5; Sec 5.7 Air Quality	Comments stated that the Indigenous experience shared with regard to air quality in the region are not directly comparable with the referenced data and must be reflected as a concern in its own right.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
521	Government	Contamination	Ch.5; Sec 5.7.1 Air Deposition of Contaminants	Questions were raised to validate and clarify the actual source of the atmospheric deposition and to discuss data from areas not affected by oil sands emissions.	Comment considered in final SEA
522	Government	Oil Sands	Ch.5; Sec.5.8.1 Groundwater Quality	Note OSPW was observed to reach the river at two sampling sites located immediately adjacent to Suncor's Pond 1 (built on an island of the AR). All other tailings ponds are located farther from the river.	Comment considered in final SEA
523	Government	Groundwater	Ch.5; Sec.5.8.1 Groundwater Quality	Edits suggested to clarify that Jasechko et al. does attempt to determine where the largest groundwater discharge occurs.	Comment considered in final SEA
524	Government	Other	Ch.5; Figure 5-14	Suggested to clarify what "extreme low water levels" means in figure 5-14 for better interpretation of the figure.	Comment considered in final SEA
525	Government	Watershed Management	Ch.5; Sec. 5.9.1 Access to Traditional Lands	Concerns were raised to recognize the complexity of the PAD water levels and to identify this as a gap for further investigations.	Comment considered in final SEA
526	Government	Withdrawal Activities	Ch.5; Sec. 5.9.1 Access to Traditional Lands	Need to provide context. Peak withdrawals of the order of 5 m3/s	Comment considered in final SEA
527	Government	Water Quantity	Ch.5; Sec. 5.9.1 Access to Traditional Lands	What does 'general' refer to? Can more detail/context be added here?	Comment considered in final SEA
528	Government	Withdrawal Activities	Ch.5; Sec. 5.9.1 Access to Traditional Lands	For context, this figure (figure 5-15) should include actual water withdrawals	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
529	Government	Recommendations	Ch.5; Sec. 5.9.1 Access to Traditional Lands	Suggested to include recommendation toward further understanding of the naturalized flow trend of the Athabasca River through simulated modeling	Comment considered in final SEA
530	Government	Water Quantity	Ch.5; Figure 5-15	The minimum flow trigger is included here without explanation of what it triggers.	Comment considered in final SEA
531	Government	Bison	Ch.5; Sec. 5.10 Muskrat and Beaver	Comments suggested to move the discussion on bison to a more suitable section than this section	Comment considered in final SEA
532	Government	Migratory Birds	Ch.5; Sec. 5.12 Migratory Birds	Suggested to provide available data with respect to regional population of key species to understand if the populations are actually declining or if there appears to be a significant shift in use of the PAD.	Comment considered in final SEA
533	Government	Contamination	Ch.5; Sec. 5.12 Migratory Birds	Suggested to state the comparative sites and quantitative information of contamination in eggs.	Comment considered in final SEA
534	Government	Reference	Ch.5; Sec. 5.13 Bison and Moose	Suggested to include available scientific data with regard to population in the PAD area and population change over time.	Comment considered in final SEA
535	Government	Bison	Ch.5; Sec. 5.13 Bison and Moose	Suggested to differentiate between a local decline (PAD area) in bison population versus a population –level decline.	Comment considered in final SEA
536	Government	References	Ch.5; Sec. 5.14 Fish	Is there any AEP or JOSM data on fish populations in the PAD or Athabasca River?	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
537	Government	Indigenous Issues	Ch.5; Sec. 5.14 Fish	Does this mean that Mikisew families are not harvesting wildlife because of concerns? i.e. a negative impact on harvest levels?	Comment considered in final SEA
538	Government	Water Quality	Ch.5; Sec. 5.14 Fish	Can this be more specific? With regard to water quality from Candler et al. (2010)	Comment considered in final SEA
539	Government	Water Quality	Ch.5; Sec. 5.14 Fish	Suggested to include available information on the types and causes of the abnormalities and the time period of the study referred here. Also, to include additional reference with this regard.	Comment considered in final SEA
540	Government	Water Quality	Ch.5; Sec. 5.14 Fish	Suggested to refer to the data from the RAMP program for mercury levels in fish tissue.	Comment considered in final SEA
541	Government	Reference	Ch.5; Sec. 5.14 Fish	Comment suggested to include rate of increase for each contaminant and nutrient level listed.	Comment considered in final SEA
542	Government	Contamination	Ch.5; Sec. 5.14 Fish	Suggested to provide available information on the specific source of the identified mercury levels and to provide background mercury levels in non-disturbed land within LAR.	Forward to Action Planning process for consideration
543	Government	Contamination	Ch.5; Sec. 5.14 Fish	Suggested to clarify the discussion presented. "It starts with a statement on PCBs and then moves into the nutrients nitrogen and phosphorus. The correlations provided are not necessarily causation."	Comment considered in final SEA

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544	Government	Water Quality	Ch.5; Sec. 5.14 Fish	Suggested to better describe the correlation of forest fires with " water levels, water quality, fish abundance and fish quality."	Comment considered in final SEA
545	Government	Water Quality	Ch.5; Sec. 5.14 Fish	Where is the location of the lowered waters in the Athabasca River?	Comment considered in final SEA
546	Government	Fish	Ch.5; Sec. 5.14 Fish	Suggested to elaborate upon available information with regard to change in spawning due to change in channel positions and to verify if fish are moving to other suitable locations due to any other factors.	Forward to Action Planning process for consideration
547	Government	Water Quantity	Ch.5; Table 5-3: Current Stressors and Trends in the PAD	Where authors have used naturalized flow regimes, the results can more clearly contribute to understanding the effects of regulation alone.	Comment considered in final SEA
548	Government	Withdrawal Activities	Ch.5; Table 5-3: Current Stressors and Trends in the PAD	Evidence is needed of reduced flows in Athabasca and where they are reduced. Use of naturalized flows can more clearly contribute to understanding the effects of withdrawals	Comment considered in final SEA
549	Government	Climate Change	Ch.5; Table 5-3: Current Stressors and Trends in the PAD	Is this directly attributable to climate change and withdrawals? There seems to be some argument over the driving forces involved.	Comment considered in final SEA
550	Government	Wolf	Ch.5; Table 5-3: Current Stressors and Trends in the PAD	Has this relationship been determined? With regard to wolf-moose relationship.	Comment considered in final SEA

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ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
551	Government	Withdrawal Activities	Ch.5; Sec.5.15.2 Pathway of Effects	Suggested to elaborate on factors other than Peace River as a reason for diminishing hydrologic recharge of the PAD.	Comment considered in final SEA
552	Government	Dams	Ch.5; Sec.5.15.2 Pathway of Effects	The 'source or sub-activity' of hydroelectric generation is storage of water behind the large dam. Water is then released whenever electricity is produced.	Comment considered in final SEA
553	Government	Dams	Ch.6; Sec. 6.2.1.1 Existing Projects	Questions were raised with regard to spill way capacity and suggested to include "Dinosaur Reservoir" capacity.	Comment considered in final SEA
554	Government	Dams	Ch.6; Sec. 6.2.1.2 Approved Projects	Suggested to elaborate on how reservoir is filled each spring and how water is released from storage through the turbines when power is produced.	Comment considered in final SEA
555	Government	Dams	Ch.6; Sec. 6.2.1.2 Approved Projects	Note the small water volume capacity for storage of water, similar to the Peace Canyon Dam/Dinosaur Reservoir	Comment considered in final SEA
556	Government	Other	Ch.6; Table 6-1: List of Operating Athabasca Oil Sands Projects	Please indicate surface water requirements e.g. limited surface water requirements in table 6-1.	Comment considered in final SEA
557	Government	Withdrawal Activities	Ch.6; Table 6-1: List of Applied for and Announced Athabasca Oil Sands Projects	What is the peak withdrawal discharge? Do they have to report weekly withdrawals?	Comment considered in final SEA
558	Government	Climate Change	Ch.6; Sec. 6.3.2 Potential Climate Change Effects on the PAD	Suggested to discuss climate change affects BC Hydro operations for hydropower.	Outside of Action Plan and SEA scope

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
559	Government	Reference	Ch.6; Sec. 6.3.3 Potential Climate Change Effects on Athabasca River Flow Rates	Suggest removing this sentence and diagram on Davidson and Hurley, 2007, as this does not include available longer-term data.	Comment considered in final SEA
560	Government	Climate Change	Ch.6; Sec. 6.3.3 Potential Climate Change Effects on Athabasca River Flow Rates	Note that current regulations may constrain the oil sands and hydro operators more under climate change scenario.	Comment considered in final SEA
561	Government	Other	Ch.6; Sec. 6..4 Assessment of Potential for and Management of Cumulative Effects on the World Heritage Values	Recommendations were made to omit the discussion on Canada's federal environmental assessment, as it is beyond the scope of the SEA and as the assessment is undergoing changes.	Comment considered in final SEA
562	Government	Cumulative Effects	Ch.6; Sec. 6..4 Assessment of Potential for and Management of Cumulative Effects on the World Heritage Values	Comments suggested to evaluate the section for unnecessary information	Comment considered in final SEA
563	Government	Cumulative Effects	Ch.6; Sec. 6..4 Assessment of Potential for and Management of Cumulative Effects on the World Heritage Values	Comments suggested to omit the discussion on "cumulative impacts from reasonably foreseeable development" for better clarity.	Comment considered in final SEA
564	Government	Climate Change	Ch.6; Table 6-9: Major Primary Pathways of Effects and Associated Cumulative Effects Management Tools	Edits suggested to properly and consistently identify order of government and to include other frameworks that impact climate change.	Comment considered in final SEA

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565	Government	Climate Change	Ch.6; Sec. 6..4 Assessment of Potential for and Management of Cumulative Effects on the World Heritage Values	The table 6-9 did not include the provincial or pan-Canadian climate change policies. This question is unfair in this context.	Comment considered in final SEA
566	Government	Jurisdictional Authority	Ch.6; Sec. 6..4 Assessment of Potential for and Management of Cumulative Effects on the World Heritage Values	From an intergovernmental perspective, why would the GoA mitigation programs take into consideration international values that were not developed in the context of the region.	Comment considered in final SEA
567	Government	Cumulative Effects	Ch.6; Sec. 6.4.1 Surface Water Flow in the Peace River	Suggested to omit text pertaining to cumulative effects from this section and including it at a more appropriate section.	Comment considered in final SEA
568	Government	OUV	Ch.6; Sec. 6.4.1 Surface Water Flow in the Peace River	Not sure why a project assessment would take into consideration world heritage values?	Comment considered in final SEA
569	Government	Climate Change	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	Suggested to include information on seasonal impacts on rivers due to withdrawal activities and various scenarios with and without withdrawal for better clarity of the section.	Comment considered in final SEA
570	Government	Withdrawal Activities	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	For context, please include the actual reported withdrawals.	Comment considered in final SEA
571	Government	Watershed Management	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	This does not reflect the management approach under the Surface Water Quantity Management Framework.	Comment considered in final SEA

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572	Government	Hydrology	Ch.6; Sec. 6.4.2 Surface Water Flows in the Athabasca River	Considering the complexity of the flows and hydraulics in the PAD, as discussed extensively earlier in the report, this is the only statement needed in this section.	Comment considered in final SEA
573	Government	Groundwater	Ch.6; Sec6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin	Comments suggested to verify and clarify the information presented on groundwater discharge and water withdrawals discussed in this section.	Comment considered in final SEA
574	Government	References	Ch.6; Sec6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin	Comment stated to note that the results have not been publicly reported. With regard to Government of Alberta, 2012.	Comment considered in final SEA
575	Government	Cumulative Effects	Ch.6; Sec6.4.3 Groundwater Quality and Quantity in the Athabasca River Basin	Comments suggested to verify and include additional reference on assessment of cumulative effects.	Comment considered in final SEA
576	Government	Air Quality	Ch.6; Sec6.4.4 Air Quality	Comment suggested to recognize and include other air quality management methods that would help maintain the World Heritage Values.	Comment considered in final SEA
577	Government	Air Quality	Ch.6; Sec6.4.4 Air Quality	Note, the Lower Athabasca Region Air Quality Management framework considers all the air monitoring stations including Fort Chipewyan.	Comment considered in final SEA
578	Government	Air Quality	Ch.6; Sec6.4.4 Air Quality	Comment provided additional information to support the discussion on the Lower Athabasca Region Air Quality Management framework and to provide more current information.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
579	Government	Air Quality	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River	Suggested to incorporate additional information to reflect more current and accurate information with regard to air quality.	Comment considered in final SEA
580	Government	Other	Ch.6; Sec. 6.4.5 & Table 6-10	Comments suggested to clarify the information presented with regard to environmental impacts.	Comment considered in final SEA
581	Government	Climate Change	Ch.6; Sec. 6.4.5 Surface Water Quality in the Athabasca River	Suggested additional reference to support the information presented on the Regional Aquatics Monitoring Program (RAMP).	Comment considered in final SEA
582	Government	Land use	Ch.6; Sec.6.4.7 Increased linear corridor density surrounding the WBNP	Provide more accurate and current information with regard to The Lower Athabasca Regional Plan, in relation to prioritize bitumen development.	Comment considered in final SEA
583	Government	Bison	Ch.6; Sec.6.4.7 Increased linear corridor density surrounding the WBNP	Edits were suggested to clarify the information on biodiversity management with regard to bison and its habitat.	Comment considered in final SEA
584	Government	Bison	Ch.6; Sec.6.4.8 Disease management and hunting outside WBNP	There is a technical committee for Ronald Lake Bison and a group working on a cooperative management approach for the herd. How is this reflected in the report?	Comment considered in final SEA
585	Government	Climate Change	Ch.6; Sec.6.4.8 Disease management and hunting outside WBNP	There should be some understanding of climate change impacts on disease to make an educated suggestion of impact.	Comment considered in final SEA
586	Government	Bison	Ch.6; Sec.6.4.8 Disease management and hunting outside WBNP	Suggested to elaborate on future plans toward wood bison recovery.	Comment considered in final SEA

FINAL REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
587	Government	Migratory Birds	Ch.6; Sec.6.4.10 Local migratory route contamination and mortality	Suggested to clarify what is the local migratory route contamination for migratory birds.	Comment considered in final SEA
588	Government	Migratory Birds	Ch.6; Sec.6.4.10 Local migratory route contamination and mortality	Comment provided additional reference for the study of acute and chronic effects of birds that have contact with process affected waters.	Comment considered in final SEA
589	Government	Other	Ch.6; Sec.6.4.12 Grazing/changes in other prey species	Clarify what issues are being referred here with regard to the Lower Peace Regional Plan.	Comment considered in final SEA
590	Government	Other	Ch.6; Sec.6.4.12 Grazing/changes in other prey species	What about Alberta's Draft Caribou Range Plan and the ongoing process of range-specific planning?	Comment considered in final SEA
591	Government	OUV	Ch.6; Sec.6.5 Summary	Comment stated that world heritage values can be protected even without direct consideration of the values.	Comment considered in final SEA
592	Government	Desired Outcomes	Ch.6; Sec.6.5 Summary	Please reference the desired outcomes, in this section.	Comment considered in final SEA
593	Government	Other	Ch.6; Table 6-10: Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Table 6-10 should be the focus of the conclusion of this report	Comment considered in final SEA
594	Government	OUV	Ch.6; Table 6-10: Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Suggested to state throughout the report that the OUV objectives are focused exclusively on the PAD area.	Comment considered in final SEA

FINAL REPORT: Strategic Environmental Assessment of Wood Buffalo National Park

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
595	Government	Other	Ch.6; Table 6-10: Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Suggested to indicate unknown for air quality under point 4 of table 6-10 based on the information presented in the SEA.	Comment considered in final SEA
596	Government	Other	Ch.6; Table 6-10: Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Suggested to indicate "No" when there is no adequate weight of evidence to support point 5 of table 6-10.	Comment considered in final SEA
597	Government	Other	Ch.6; Table 6-10: Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Please indicate impact for point 14 of table 6-10.	Comment considered in final SEA
598	Government	Whooping Cranes	Ch.6; Table 6-10: Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Suggested to indicate 'YES' for point 16 of table 6-10. As, there is ongoing increase in this population and it could certainly be on track to reach the population goal by 2035.	Comment considered in final SEA
599	Government	Whooping Cranes	Ch.6; Table 6-10: Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Please clarify other impacts and is this really considered significant if population is still increasing? With regard to point 16 of table 6-10.	Comment considered in final SEA
600	Government	Other	Ch.6; Table 6-10: Trends and Potential Cumulative Effects on OUV Objectives for the WBNP	Suggested to change the current response as it would be an inaccurate response, for point 17 of table 6-10.	Comment considered in final SEA
601	Government	SEA Approach	Ch.7; Recommendations	Questions and concerns were raised with regard to scope and overall goal of Ch.7 and the SEA report. The SEA is meant to assess the cumulative effects, the current and predict potential future state; and inform decisions for desired outcomes.	Comment considered in final SEA

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Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
602	Government	Other	Ch.7; Sec. 7.1.2 Adaptive Management Approach	Edits suggested to clarify the discussion.	Comment considered in final SEA
603	Government	SEA Approach	Ch.7; Sec. 7.1.4 Robust collaboration	Concerns were raised with regard to a framework for environmental and cumulative effects assessment pre-Bennett Dam.	Comment considered in final SEA
604	Government	Other	Ch.7; Sec. 7.1.4 Robust collaboration	Suggested to omit discussion on policies and governance mechanisms.	Comment considered in final SEA
605	Government	Indigenous Issues	Ch.7; Sec. 7.1.4 Robust collaboration	Comment suggested to clarify about the 11 Indigenous groups being discussed in this section.	Comment considered in final SEA
606	Government	Jurisdictional Authority	Ch.7; Sec. 7.1.4 Robust collaboration	Suggested to clarify contradicting information with regard to government collaboration.	Comment considered in final SEA
607	Government	Recommendations	Ch.7; Sec. 7.3 SEA Recommendations	If the SEA recommendations are the same as the RMM recommendations, then what value do they provide?	Comment considered in final SEA
608	Government	Other	Ch.7; Sec. 7.3 SEA Recommendations	What is the legislation being discussed here?	Comment considered in final SEA
609	Government	Recommendations	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Do these recommendations take into consideration jurisdiction?	Comment considered in final SEA
610	Government	Watershed Management	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Clarify what is meant by intervention risks discussed in this section.	Comment considered in final SEA
611	Government	Withdrawal Activities	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	This seems unlikely to be completely possible, with regard to reducing or water withdrawals from oil sands.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
612	Government	Withdrawal Activities	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Suggested to clarify and provide information with regard to withdrawal activities and PAD access.	Comment considered in final SEA
613	Government	Water Quantity	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Edits suggested to clarify and provide accurate information with regard to monitoring stations.	Comment considered in final SEA
614	Government	Water Quantity	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Redundant, with Athabasca at Embarras Airport station	Comment considered in final SEA
615	Government	Water Quantity	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Suggested to clarify if it is water quality or quantity being related to flow rates.	Comment considered in final SEA
616	Government	Recommendations	Ch.7; Sec. 7.3.1 Environmental Flows / Hydrology	Suggested recommending a detailed assessment of the Peace River and PAD in addition to the Athabasca River. With regard to full assessment of flow regulation impacts and full modelling of PAD dynamics including ice.	Comment considered in final SEA
617	Government	Recommendations	Ch.7; Sec. 7.3.4 Conservation Area Connectivity	Suggested to clarify how recommendation on conservation are connectivity links to desired outcomes for predator prey relationship & whooping cranes.	Comment considered in final SEA
618	Government	Recommendations	Ch.7; Sec. 7.3.7 Monitoring and Science	Clarify as to who would benefit from this recommendation with regard to site specific guidelines.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
619	Industry	SEA Approach	Ch.1; Sec. 1.5 Approach to SEA	Comments & suggestions were made to present a more consistent & balanced scientific & ITK representation of available information, research & monitoring on oil sands region. Also, concerns were raised that the SEA alone would not be sufficient to base future actions of the Government towards protecting the WBNP as the SEA overlooks significant & credible scientific information in understanding of the system.	Comment considered in final SEA
620	Industry	PAD	Ch.2; Site Context	Recommendations were made to include discussion on "regional geology" and "identify existence and extent of protected areas that buffer the park" to help support the context of the addressed OUVs. Also, to include information regarding the legal obligations & protective measures that are in place to mitigate the impacts of development.	Comment considered in final SEA
621	Industry	SEA Approach	Ch.1; Sec.1.3 & 1.4	Comments were made to clarify the scope and purpose of the SEA in regard to "maintaining or restoring Indigenous ways of life" in par with the original & addendum "Scoping Report".	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
622	Industry	Indigenous Issues	Overall	Comments & suggestions were made in regard to the SEA incorporating available information from broader range of Indigenous groups rather than focusing on a few groups, and/or to discuss the reliance and prioritization criteria for the few groups.	Comment considered in final SEA
623	Industry	SEA Approach	Ch.3; Sec. 3.3.2 Literature Review and Engagement	Comments & concerns were raised in regard to using the "snowball" method & to recognize the limitations of this method. In addition, comments were made to suggest that additional broader set of relevant literature sources be included in the SEA.	Comment considered in final SEA
624	Industry	References	Overall	Comments were made to verify & correct any discrepancies or errors in relation to references cited throughout the report	Comment considered in final SEA
625	Industry	Water Quality	Overall	Comments were made to verify the accuracy & to clarify the information presented in regard to the EIAs; and water withdrawals in the PAD. Also, suggestions were made to include information regarding past dredging activities of the region.	Comment considered in final SEA

Comment Response Form to Draft SEA Report					
ID	Stakeholder Type	General Topic	Report Section	Summary of Comment	Response
626	Industry	Migratory Birds	Overall	Comments suggested that the section on Migratory Birds include discussion on impact on these birds in "over-wintering areas". Also, additional references were suggested in relation to increasing in bird species and harvesting of birds in PAD.	Comment considered in final SEA
627	Industry	Migratory Birds	Overall	Question & concerns were raised to clarify the discussion of risk to migratory birds in regard to OUVs, and comments were made on the lack of sufficient data and credibility of the presented information in regard to mortality of Whooping Cranes due to loss of 10% of wetlands.	Comment considered in final SEA
628	Industry	Bison	Overall	Recommendations were made for the SEA to include additional relevant, current & publicly available studies for a balance and thorough representation of the information presented in relation to RLBH & trans-boundary herds.	Comment considered in final SEA

A.5 – COMMENTS RECEIVED FROM INDIGENOUS COMMUNITIES AND NOT ADDRESSED OR NOT FULLY ADDRESSED IN SEA

A.5 – COMMENTS RECEIVED FROM INDIGENOUS COMMUNITIES AND NOT ADDRESSED OR NOT FULLY ADDRESSED IN SEA

Governance

- Some community members totally against this process and how one community tried to control all the groups – also criticized some communities for the excessive trapping in the PAD and considered everything was a waste of time
- Monitoring of trans boundary agreements
- We want to be part of the road maintenance for the park – I don't know why you don't maintain the Hay Camp Road – why don't you build a road there? – we need to do that – we can do something together"
- You can see oil bubbling up to the surface in some parts of the park
- Recommendations 1, 12, 13 and 14 all point to building better relationships with the nations to co-mange the park. Recommendation 12 is an ideal opportunity for Parks Canada to really show good faith in this process and to gain support among the local people. As we agreed today, Parks Canada will only achieve success if it is supported by the nations.
- Employment with Parks Canada or more specific meaningful employment of local First Nations peoples within WBNP is a frequent topic among leadership. Employment of local First Nations peoples is at an all time low. So without hesitation, I strongly encourage implementing recommendation # 12.
- Alberta traditional land use framework is based on 3 legged stool: economic, environmental, social. We want to have treaty rights recognised as 4th leg.
- LARP Process – Gov't needed to develop traditional use framework; include ability to exercise treaty rights; created protected areas which disrupted quiet enjoyment of FN.
- PCA needs to set up how it can participate in regional planning processes and issues with Indigenous Communities.
- Wonder whether all input is being included, such us the potential role of BC's water licence for the Bennett Dam, and its lack of attention to downstream impacts. Low water levels are generally recognised as a priority issue. Flow regulation will reduce the potential for more dams on the Peace River - the big challenge of managing the PAD is increasing the downstream flow to flood the Delta on a more regular basis - until someone gets the water operating licence for the Bennett Dam modified it won't be possible to affect the ecology of the PAD.
- Suggestion that to deliver on Ecological Integrity for the park, Parks Canada needs a greater role in decision making for regional water management, such as the Mackenzie River Basin Board.
- Need to build on the work of PADEMP and the SEA. Need to bring focus to Indigenous ways of life downstream of the dams. Need to consider all tools: water licence, Canada Water Act, navigable waters.

Environmental Components

- Air quality predictions from EIAs should not be assumed correct and the SEA should include an independent assessment of air quality predictions in WBNP.
- For an appropriate assessment of influences on WBNP OUVs, water quantity and quality, air quality, and the wildlife community for the entire Athabasca oil sands area should be included within the scope of the Report. Factors that should be considered but not limited to are: the water management framework and the biodiversity management framework in the oil sands region, wolf and deer expansion to the north, population and movement of the RLBH, Industries proposed mitigation for wildlife, the mitigation and monitoring of tailings ponds, and existing and planned migratory bird hazards
- Frogs are disappearing
- Sink and sponge effect of the Slave River Delta
- Create a caribou map inside/outside park using PCA data.
- The economics of water withdrawal and how much industry pays for what it uses
- Question of the potential impact of industry at Pine Point on the underground aquifer system which he said could have a negative impact on the surrounding water table.
- Would like to see a water audit on what we get as regards potable water
- Lower water Big Buffalo River, Big Buffalo Lake – reverse because of wind
- Concerns about caribou
- Concerns about moose populations were raised repeatedly and the importance of moose
- Concerns about changing bird species
- Concerns about contaminants absorbed by waterfowl in agriculture fields
- Concerns about agricultural lands attracting waterfowl away from WBNP
- There is concern about water quality, quantity, and flow from the Caribou Mountains to Ejié Túé (Buffalo Lake), and a lack of information as there is no active monitoring or management of this watershed.
- There are concerns about the health of muskrat and inconnu populations in Area 1211 of the Park.
- There are concerns about the potential future impacts of invasive species on the forest ecosystem of the Park (e.g., whitetail deer).
- The potential cumulative impacts of climate change, harvesting, and potential development north and northwest of the Park, including a proposed expansion of the Northwest Territories hydro grid, could negatively impact moose and caribou populations.
- A north-western buffer zone for the Park should be considered as part of management planning for moose and caribou populations.

Indigenous Rights and Land Uses

- Community members have expressed concern for they have been witness to the declining availability of berries, medicines and wildlife close to the community's reserve lands.

- All sorts of changes are occurring – these need to be acknowledged and documented

Other Project Issues

- Fracking in the Peace River region has led to earthquakes
- Run off from farming and chemicals and medical waste on the Peace and Athabasca Rivers

A.6 – EXTENDED CONTEXT FOR INDIGENOUS LAND USER QUOTES

A.6 – EXTENDED CONTEXT FOR INDIGENOUS LAND USER QUOTES

A.6.1. Chapter 3: Methodology - 3.3.2.2 Engagement

Quote:

We are the scientists. We are the specialists. We know what it was and we are the ones who have seen the changes.

Quote context:

Exactly. I am speaking for the group now. The land users and trappers and traditional users on the land, we see the changes. We are out there every day. Growing up as young people, it was our store, fresh drinking water, fresh food. We start seeing changes animals, finding dead rats, fish kills. That tells us something is wrong. We see changes first-hand like sea gulls, in certain animals. It tells us the delta, there is something wrong. Something happens there. And the western science now is backing up what we are saying. We all agree something is happening and something needs to be done to save some of it!

Source: Ron Campbell

About Ron Campbell

I was born in Fort Chip. I spent a lot of time in the delta. I've been trapping muskrats since I was a kid. And spring hunts, moose hunting. Everything I got was natural and country food. We spent a lot of time in the bush. I went to school in Fort Chip. When I was old enough to go on my own, the first place I went was straight out into bush that I love and people I knew and respected and learned about life was in the bush, the traditional users. I still go out in bush. It makes me wonder though now with the changes, if I made the right decision. But if something is broken and weak, I want to fix the problem. I want to help fix this delta for future generations. Maybe by putting in weirs and moving water. We have to get the govts, BC, BC Hydro, AB, industry, all these players at the table and come up with all agree to work together in a positive manner to help the delta for future generations. It affects everybody. We all need clean air and water to drink. It's the largest fresh water delta in the world. We have to save it. Down the road we may need this fresh water to sustain ourselves in the future as humans. We need to be looking at this long term. I am doing my part to rectify the problem.

A.6.2. Chapter 3: Methodology - 3.3.2.2 Engagement

Quote:

"The Mikisew Cree First Nation (MCFN) Elders and Land Users were brought to the table to participate and tell their stories regarding their Traditional Territory/Homeland within the Wood Buffalo National Park. We were invited to share this information to help with the Strategic Environmental Assessment (SEA) of Wood Buffalo National Park, led by Parks Canada, as directed by UNESCO.

As noted, story-telling is the oral tradition and holds a different perspective/method from society's way of documentation, which leads to a final technical report.

With the wealth of knowledge within the group of Elders and Land Users, I decided to offer my experience to help facilitate the work in understanding two different perspectives in a way that does not diminish either, and that honours both.

Drafts of the SEA were provided to the Elders and the MCFN Technical team to review as the work progressed. We then realized the drafts were not capturing the true reflection of our stories and words.

It was not until March that the real work began to facilitate a process to capture the true perspective of MCFN Elders and Land user's words and stories.

Parks then made the attempt to include the voices by identifying quotes by the Elders. Through the help of the MCFN Technical team, we went to work to ensure the quotes had a name attached, as a way of showing respect along with the context of the quote to tie the quote to the section of the report. The Elder's short profile was included to validate his/her experience as an expert on the subject."

Source: Alice Martin

About Alice Martin

Alice was born on the land within MCFN Traditional Territory, which is within Wood Buffalo National Park. Alice has strong ties to her homeland, and made it her practice to visit annually with her two sons and family.

Alice's experience on the land and her passion for her 'Way of Knowing' is the premise of her work today. Alice is still an active land user and goes out on the land for fall hunting trips, moose camps with her boat. She also goes on the land with snowmobile with family when trips are organized. Passing on the Cree Way of Knowing through on the land experience with her sons and grandchildren is very important and ties in with this work with the SEA which will then go on to the Action Plan to help bring water back to the Peace Athabasca Delta. Without the water, this on the land teachings may die and the MCFN families will not have the opportunities to teach through their way of knowing.

Alice's experience with her connection to the land and her education provides her with a different role that enables her to help facilitate a process through which society can engage the Elders and Land Users in a meaningful engagement process to respect both perspectives. Alice now resides in Fort Chipewyan.

**A.6.3. Chapter: Chapter 4: WBNP World Heritage Elements Excluding the Pad - Section: 4.3.1
Pathways of Effects on the Great Plains Boreal Grassland**

Quote:

It's willowed in all over, shrunk and there is thistle on one side. The few buffalo that come in eat have to around the thistle and then they are gone again. Buffalo may eat willow for a few years when the willows are small. But when the willows get bigger, the buffalo don't bother.

Quote context:

Willow, even what they do now is not normal. Buffalo don't bother with willow. The last 5 or 6 years that is when they are getting into the willow, and in an area willows weren't before. Some sand bars on the Peace River became willow islands. As the sandbars form, the low water. For a few years a sand bar, then you start to see a few willows growing. It becomes even part of the shoreline. Sandbar, buffalos go out and feed on that, end up by the willows. They eat until they are big enough and they go away from them. A lot of the places where they used to eat the grass is covered in thistle. All getting smaller. One time a lake, then a prairie. Then we don't know what to call it as its grass, willow, thistle, just an opening. This is not just by my place but all over, Peace River. A lake 30 kms downriver was a good lake for next, eggs, birds in the fall. From 50 to 60 years back, now all that is just prairie used to be full of rats. Last time we took rats out of there was 30 years ago. There was still a few rats there. In the spring we found rat houses. Usually their feed and water is there and that is where they come and eat. We were finding there was nothing in the bottom, the house hung. They couldn't come up to feed as water went right down. After a few years nothing, just plain old prairie, willows. The same thing that happened in all the other places. I haven't been there for years so don't know if the thistle, if all that area the buffalo for some reason left. They used to migrate from Hay Camp, all the way to my area in fall. hey totally left that now, nothing migrates there in the fall, I'll see a few that hang on what is left of the grass, keep moving on, same thing with moose, they kind of hang around, sometimes you catch a moose in the midst of all these buffalo, they are gone too, for me buffalo eats the grass, but I used to watch them from my kitchen table started to eat the willows, now not their either as the willows are 10-15 feet, a lot of area where we went on the tour last year we didn't get to go, are areas that I hoped we could have gone, wanted to show and see more, different terrain, with us high banks, that is all different, 40-50 years, people don't hunt or trap but it's still was a good area lots of rats, even for hunting, now people all come down, I even hunt with people from Fort Smith they end up hunting in the river for moose, for birds I have nowhere to go in fall, spring, summer for eggs, now I don't have anywhere to go for that kind of stuff, ducks, was a place in the river, now they are gone, there are places you cannot travel at all. Like Mud Lake we used to go in, that I could show. It's just a blank and it's all solid and you can't get in. It's the same up the river. We call it twin islands. There was a back channel we used to be able to get in. Now at the top end there is a big sand bar right across. In other areas we can't get in as at the mouth a sand bar forms. In the prime of hunting season you can't get in. There are few places I could have shown last summer but we couldn't get in. Some places you'd have to do by air now. It has affected rabbits too. We used to get rabbits too, we all used to go. Now you just have to stay in the river, and even there now you have to be careful and worry about sandbars or rocks.

It's all over. We used to make loop Moose Island to Hay Camp road, a loop. One of those roads gone now. At Moose Island there was a lot of water off the road, ponds, slews, beaver dams. We'd hunt there when the river was iced, and travel to Piece Point. Now there is nothing, even the beavers left it! I remembered 40 years back a big beaver lodge was there and used over and over. The lodge is still there but it has weeds growing on top and the beavers are gone. They finally left. For the buffalo it's the same thing. A lot of places just off the road you used to go shoot ducks, now nothing. Areas like Jacksons to Vermilions, there used to be, and you can still see old stages for hanging rats. There used to be so many rats. They all used to come from Piece Point or Jacksons to trap rats and there was enough rats for everybody. You can still see some old sticks. It's the same the other way to Murdoch. Robert Grandjambe has a cabin there. Where he has his cabin you can see all kinds of signs of spring hunts for rats. The Prairies by there were all full of rats, now it's just prairies. We talk about how we will bring back, with the delta we have half a chance with dams or weirs. But with the Peace River and area on other side, how we will ever do that?! It's just out; it's been so long since the Dam was built. The last time we had a lot of water 96-97, a few lakes were replenished and good for 6 years, and we still had rats. Then since then we never got that. In 2014 we got close but the water didn't stay long enough. I sat on the top of my roof for 10 days to watch the ice. It stayed maybe 2 weeks. In 96-97 the water stayed in there and held a bit. But in 2014 it came up and went down, the water. By July all the little lakes were dry again (2014). If they put in Site C we are dead in the water, really dead in the prairie! And we are whipped on the other side by Teck, the Athabasca River. How are we doing to do it if industry is still getting permits to withdraw? The level of the water wasn't a comfortable number either, but the First Nation was involved in the level of the water they need. Now we are stuck with it. However they did those #'s (didn't listen to the First Nations), they would have got something that even 40 years ago where the water was and we could have gotten to all the areas. That would be a better # than what it is now. What they did now is already below what we could access even with that number. They use 4ft to lift a loaded boat on step, but won't find that depth even in Lake Mamwai. I have a depth measure in my boat. One year the water level was really low. I check Piece Point. The deepest I got in middle of main channel was only 4 ft. of water in the Peace River. We will never get those channels flowing again. One year it was only 2 ft. wide, then it just stopped. We went from my cabin to Scow channel with quads! Right on the channel with quads! A short cut in the fall! That is another main hunting area all the time. No one will walk nowadays. Years ago we'd walk a long way to hunt but now no one does that. If they can't drive they don't go. For young people it's hard. We still try to go to the slews. Some still have water. Thank god for the beaver dams holding the water. They can only do it for so long as water is stale. Without fresh water, they and the moose leave it. In some places you can smell the stale water. We still try to go to those places, hoping there is water. We keep an eye on them and check them out. Nothing now. We get little pitiful rats now, it's all we have left. They are hardly even edible, and not spring fat. We quit bothering with rats we got years ago. They are probably ok to eat but different than a long time ago.

Source: Matthew Lepine

About Matthew Lepine:



I've been on the land most of my 69 years. I was born in Fort McMurray. I lived in the bush until it got to a point. Even when I went to work I still kept up. I used to come from McMurray on the weekend to cut grass. I always kept up with everything. Even when I lived in McMurray 25 years, I still trapped, hunted in the same areas for most of my 69 years. As I was growing up, by the time I realized trapping wouldn't make me money. In the back of my mind I thought ok I'll go to work. And eventually I'll come back to go back and live in the bush. And then came when I could like holidays and hunting season to the cabin. I built my cabin 30 years ago and still live in it. When I left and then came back to live more out there, it's totally different. Its not what I expected to see when I came back. Man what a shock when I came back. Simple stuff like drinking water from the river I couldn't do that when I came back. The changes that have happened over 60 years, a lot. I am living on the land still. I'm going back tomorrow morning. I won't be back until after open water. I get out, got a road, lucky, and weather permitting I can get out. All that is getting kind of less and less. One day I won't be able to do things as I get older. It can be disrespectful for others to do things for us, it's not my way. I have to travel 20 kms extra when the water is so. When water is high in spring until July I can use the Coupé if I'm lucky. To get through there you have to be careful. I have to come around Quatre Fourches most of the summer. One trip just to get water. To come to town I have to get 10-15 jugs of water, then gas, compared to years ago.

A.6.4. Chapter: Chapter 4: WBNP World Heritage Elements Excluding the Pad - Section: 4.4.1.1 Changes in Habitat and Food Availability in PAD

Quote:

All the water that shows up on these maps, half the water isn't in there now. Some of these lakes are all willows, poplars. Once we had birds landing and now it's full of willows. Where are they going to land? Mikisew Elder (MCFN 2018a)

Quote Context

I can't go into Gull River now because its grown in because of low water. Ever year there is less water. That is what is happening. Sometimes water is higher like last summer. Years before that there is a difference. The water is low; the water doesn't move fast, the water. All that muddy water and silt settles down to the bottom. That is what brings up the ground from the bottom, the water. That is why it is getting shallower than it should be normally. If the water goes out, the lake or creek is dried up, the water comes back, it fills up again. That is how much pressure the water has. But now it doesn't have that because of low water. There is no pressure behind it, and all that stuff and mud under the river, the water, it all settles to the bottom of the lake or river or creek. When there is the high water it goes up and down and washes off the mighty water. It may settle a little bit, but now it is going so fast. It's about 2.5, 2 ft. mud, underneath, not the bottom of the lake; it builds up from the bottom. From both ways the water is losing its pressure. The water meets the delta, that is what brings up the water. So that is what is happening nowadays with the water. It's not only muskrats that we are trying to get the water for, it's our transportation, it's our accessible way of getting to the river where we hunt and trap and have our cabins out there. But now the water is too shallow sometimes you can't even go to Hay River. You can't go to Lake Mamwai, unless you push your boat up. That is what is happening.

For birds, what I mean the bottom is growing up from the water, vegetation, instead of that the willows grow on top now, instead of the grass it used to have, the willows are taking over, replacing the grassy area. The lake that used to be a #1 hunting area, now there is different grass, hay. The birds eat gravel after they eat grass. The geese, they go somewhere there is gravel for their digestive system. Now they can't do that as the mud is so high. They have to go to the bottom to get the gravel. That is part of the reason they don't stop, that is their main thing to digest their food. They use the gravel, sand. The chain reaction of no water, no birds, no food, invasion of willow, the chain reaction Gerald said.

Source: George Martin

I'm 76. I started trapping at 12 by myself. At 11 years old I got out of the mission, 1953 when I started that. I've been here all my life. This is my area. I came here 1942 when I first arrived here, ever since then I've been here. I killed my first caribou at 8 years old; we had to learn in the bush.

A.6.5. Chapter 4: WBNP World Heritage Elements Excluding the Pad - Section: 4.4.1.2 Exposure to contaminants in water, food and sediments in PAD

Quote:

There are less nesting areas in the Delta than there used to be. I go out in May to get eggs, May 15 to end of May, and now I find more of two yolks in the one egg. It can be as many as one in three will have two yolks. That is different to me in past couple of years. Also nests used to have 12-15 eggs but now I'm lucky to get 6. The nests are not as full.

Quote context:

Maybe it's the feed, what is in the water. Maybe there is not enough of their food they normally get on the delta, the bugs and vegetation. Now it's just a lot of algae. Oh my god more algae than anything else! Come see in June July, August. The three lakes called Frog Lakes where we used to spend summer. It is full of algae, starting in the early 90's. That was one of the main nesting areas for ducks and chug-eggs (American coot or mud-hens), and fish. You can't even go there now these years with a boat. You can't run a motor in there. Sometimes it's deep enough but with the algae and weeds and stuff you can't run the motor or go anywhere. That was always a main part, where the birds would even land in the spring time like the Wavies. Nothing since the 90's. That is our main spring camp for muskrat, beaver, everything else. We used to go paddling around those lakes. You just go. Maybe the first lake would be 4 miles around, and same thing with the second and third. You wouldn't even go half ways; say 10 gallon pale or 5 gallon pale. You'll fill it up in 15, 20 mins of going out to paddle on the side. The nest would be just full. You'd go back a few days later and they'd have laid eggs again. The nests were full again. It was the chug-eggs (or American coot or mud-hen). There is not enough food, not enough bugs. Even the bugs have disappeared in the past few years. The bugs that look like big daddy long legs on the water top, they disappeared for a while. They just started maybe coming back last year. But they are still not like it used to be. That is one of the bird's foods. Also the little black things that look like beetles but are just black and tiny on top the water. Those have disappeared for a long time.

People may have saw some last year, but not as many. It's because of the algae. What is causing this is low water and the chemicals in the water. The water doesn't move, and yeah stuff in the water. Motors just seize up. It's probably in the air too. In winter it's stuck, it comes down with snow. It's in the air also. Some of it is inland lakes that you can't go in there. Like we used to canoe. It's just full of algae, and the wind carrying it too. And the eggs have two yolks. I collected eggs since I could remember. It used to be that it was kind of like I got happy when see two yolks long ago. Now it's kind of how come there is two yolks in one egg all the time? It's just about every second egg is two yolks. This must be again from what the birds are eating. Like we have found rabbits that have two private parts. CBM has been collecting them, that even the female has two parts. Maybe that is happening with the birds too. We haven't tested the birds and ducks. It's scary. I wonder if I should eat the eggs. And even just to go show you or anyone how to pick eggs, its hard if there is nothing out there. It's a loss of way of life, we can't pass it on. Frog Lake was where we had our spring camps. That is one of the places my grandpa Saul grew up. His father had a two story house. He built it himself. We all grew up there. He had a potato garden. It was like his community there: his life, his yard, your house. He lived there. GM I think was born there maybe or somewhere here. Yeah you can't go there. It's impossible. That creek at his cabin is dried out. In the early 70's you could paddle in both creeks. One creek where he had his 2 story cabin that he built, it dried up around the Bennet Dam around the 60s. In the late 80's the second creek dried up. While I was out there my grandparents used to go paddle and set muskrat traps and get ducks. Float planes used to land in that lake in late 70's, early 80's. For spring, visitors like Terry or Stella coming to visit family. They'd come and visit and we'd be happy showing them everything. That is why I cried the other day in the meeting.

Source: Jocelyn Marten

About Jocelyn Marten:

I have been on the land probably since I was born, 1970. I grew up with my grandparents and two uncles GM and Sammy. We lived in Doghead, in a shack, a house. Then I remember living on the Athabasca River. That is where I spent my winters, trapping with buying fur, with my whole family. I called it Embarras house, they called it Snowbird's. I saw ice break ups, jams. It was a small community like 10 families there. There was a store across the river; it was passed on to other owners. In spring time we'd move to Frog Creek, say beginning of April as there was so much snow and water a lot of overflow. And all we had was dog teams to move with. We'd be lucky if have a skidoo. We would move there with 4 kids, a bunch of kids. I had my own team of dogs, 5-6 dogs. People used to come down from McMurray on the skidoo in the winter to come to visit. Alice used to trace me against the wall on a big paper. Again there at Easter or Christmas time there would be float plans coming in, and Lorne Yanik (Elsie Yanik's husband), brother Rod, and family coming to visit. I am out there. I don't trap anymore I still do everything else but, that I haven't had a lot of time sometimes with work. I am out on the land and I take my family. I help with GM's cabin. So any time you want to volunteer, you and Justin, and Carl and Mark just let me know. GIR has to come spend a week out there. If we did spend spring on the Athabasca River, I always went in back beaver and muskrat hunting with my grandpa. We'd canoe and there were 4 portages. It was ten days out shooting beaver and hauling everything back again. It was

the most wonderful experience I ever had in my life. It's not experience, it was my way of life and how I was brought up. I loved it and enjoyed it. I wouldn't mind doing the same thing with my grandson. Or, anyone who wants to go out and has the time to spend out there and really take in the way of life out on the land. People just have to take that time. And yes they have to give us back the water.

**A.6.6. Chapter: Chapter 4: WBNP World Heritage Elements Excluding the PAD - Section: 4.4.1.5
Changes to migration route and timing for birds using the PAD**

Quote:

30 years ago, 40 years ago, there were only a couple of oil plants. Now have ten plants and more every year. Over the last 20 years or so, the birds are changing and using different route when they fly away. We are not having nothing nowhere for birds. There are oil plants in the flyway causing them to move away. Plus we have no water anyway in our Delta.

Quote context:

They tour around the delta on account of the oil plants. Just a few come in. Even if we have the water we will never have the birds as we used to as the oil plants won't move. Migratory birds are using different routes because of the plants and no water yeah. Where we used to hunt birds at the lakes and Lousy Creek and back, used skidoo or dog teams. I used to drive my dogs or use a snow machine after. Now there is nothing! No trees. You can't see Beaver Ass Lake, even Hilda Lake. It's all grown in! When we do the video we have to go in winter. All those little creeks, Lloyd's cabin at Prairie River. He used to drive in right there to Hilda Lake. Now it's all full of grass. There is no water there. That is how low it is. It would be good to go in with a snow machine. 50 years ago I'd go but not now, maybe with an Argo you could get in there. Birds are pretty well finished. About 30 years ago when it was really that the birds left. Same thing in the fall. They used to come by going back south. They don't anymore. That is how long ago they quit coming. With all the vegetation the willows and poplar. All those lakes had Joint grass good for muskrats, buffalo, around Prairie River. They used to have that, not any more.

Source: Larry Marten

**A.6.7. Chapter: Chapter 4: WBNP World Heritage Elements Excluding the Pad - Section: 4.4.1.5
Changes to migration route and timing for birds using the PAD**

Quote:

I would see birds in from the south in spring. Some land, some come down and gradually go up. Now, most won't stop and will keep on flying. The younger ones follow the older ones and over time maybe there will be nothing landing. The oil patch that affects the fly over and eventually the younger will have a different route. The lower water levels is also a problem though because there is nothing for them to eat. They have to eat to keep going. If there is nothing to eat they will find other routes.

Quote context:

Like I said growing up on the land with my late parents, birds used to land on the Peace River to get gravel. At Lake Claire they go to eat grass and bugs that live on the water. Now they go in the morning to the Peace River to get gravel, it goes to their gizzard. That is how they crunch their food, they munch it up. That is why they fly back and forth. Now the birds don't even fly to the Peace River because it is so low that they find gravel probably somewhere else. And there is less birds landing as the water level is so low. Some will come in the spring from the south. From a distance I used to see a whole flock going towards the delta, Lake Claire, where I hunted. Some will land and some will lift up again and keep going. As time goes on, the younger ones learn from their elders like we do. I would imagine that less and less birds will land. They eat out in prairies where farmers are. It's in their mind and system that they always land on the delta. As time goes on and their migration route changes, their instinct says land on this lake but as time goes on nothing will like snow geese, galoots, speckle bellies. The ducks will keep landing, others will keep going.

Source: Gerald Gibot

A.6.8. Chapter: Chapter 4: WBNP World Heritage Elements Excluding the Pad - Section: 4.5.1.1 Risks from Drying and Fewer Flooding Events

Quote:

Since 1974, the water has gone down and down so for the buffalo there isn't the vegetation they live on. The thistle is taking over the whole delta on account of there being no water. Buffalo's main food is goose grass and all the areas that used to have it are all dried up. Mikisew Elder (MCFN 2018a)

Quote context:

Flooding, there is no risk, it is drying. There are no more floods. It floods a bit every spring but it is not what it used to be. The Athabasca has given all the water it can give. It looks after Lake Athabasca. People don't understand the Peace River before the Bennett Dam to cover it, Athabasca also. These rivers both worked together to keep the delta the way it used to be. As soon as the Bennet Dam the water is 50% cut off. But the Athabasca can't cover the whole delta and the lake if Peace River can't do its job. There is no Goose or Joint grass. That is what the buffalo live on. If it takes the buffalo to get the water lets have it. Muskrat is the #1 food to the goose grass. When its dry nothing, nothing now. There is no goose grass anywhere. So it's all dry. No water, then no goose grass, no muskrat, no buffalo. If there is thistle, there is no food for buffalo. If there is no thistle then there is the goose grass food for buffalo. IF WE HAVE WATER. If there is no water there will be goose grass. If there is water thistle won't grow, for the buffalo to eat. Bottom line is you need water. That is the bottom line to get our vegetation or animals back what it used to be.

Source: Larry Marten

A.6.9. Chapter 5: Current State of the PAD System – Trends and Stressors - Section: 5.3.1 River Flows

Quote:

All the places we used to go and hunt now in the fall, the water is too shallow to go there. I still take my grandkids for a hunt, but not everything out there anymore. I used to tell them stories of what had happened. I tell them you have to try to carry on the traditional life, making moose hide.

Quote context:

A about 5 or 6 falls ago me and my wife went out. The water was low already. We were going to go hunt at Birch River. My buddy Larry was ahead of me with George Lepine. They had two small motors and took off. I saw them idling slow. The first time we tried to go out we couldn't. We turned back and tried one more time. The third time I said we might as well turn around but finally made it. We idled at Lake Mamwai and finally my buddy took off where there was usually more water. We took off and got to Hay River. While they were eating we joined them I was in a hurry, saying we gotta come out. Even if it's kind of shallow going in as I knew where to go. The water was low, so we were looking. I kill and skin a moose and make a supper. Towards evening I said I'd call a moose again. Sure enough at 10 pm at night a moose was coming across from river. I had forgotten to set up the spot light. I shot him and didn't hit him right so I went to check. There was another bull moose and I shot him right. On purpose it happened as it would have been too much meet if I killed all moose. We loaded and took off. We barely made it to the river. We stopped for lunch at Jody's old cabin. W said what if we get stuck in the middle? We had to put some meat in water and mark it. I am going to run my motor all the way. We took off to Lake Mamwai. The mud was flying and we kept on going. Finally after 3 times we made it to the river mouth. The motor was just steaming. I opened the hood and put water on it. Took off to Quatre Fourches. In the future 2 or 3 years from now it's going to be worse. If they make Site C that is when it is going to have to use quads to go to Birch River. The water is very pitiful. It will get worse. The water will go down in the ground. We will have some water from mountains. We've gotta have lots of water to flood all the basins that are dried up. Hopefully we have that water, the dam to help us.

Source: Sloan Whiteknife

A.6.10. Chapter: Chapter 5: Current State of the PAD System – Trends and Stressors - Section: 5.3.2 Ice Jam Flooding

Quote:

Thick ice is 6-10 ft. thick blue or white ice. When that ice broke, my grandpa stayed a week before and there would be a big bang and a few days the ice shoots down the river, the water is high, and everything is clearing the river. When that ice stopped, the ice is thick, big as building, blue, thick, white ice. It would take two days for us to cross the river to go to the store to go shopping

there was so much ice! Now when the ice stops, the ice still doesn't hold anything back. Because of the bad quality of ice it melts away faster today.

Quote context:

In the past the ice was blue ice, white, like glass. It really thickened. You know when the ice is solid when you see that blue ice. Now it's a foam ice, there is a lot of air in the ice. Its not good ice like when I was growing up. You cannot really just cross anywhere without double checking ice, especially on the rivers. If you are on the rivers you can go through and get sucked under. In a slue you have a chance as it doesn't flow. On the river you are toast if you go through the ice. That danger is more now, especially in spring. The ice melts quicker because of the pollution from oil and the Peace River and Athabasca River. The ice don't last long. Also the Bennett Dam releases water in fall and that disturbed sediments underneath the Peace River so it flows on top the ice. So the ice is not as thick and blue as years ago. Its slush. It's dangerous. The changes that I've seen out on the land and with the ice. In the past as we all know was less pollution. As time went on there is more activity on the river right from the BC Mountains. All the water and glacier ice comes down. There are a lot of plants along the way like pulp mills, factories, oil, industrial. The quality of ice has started to diminish. It's not blue ice. Its shell ice. Its like a slush in a gas station, the ice is similar to that. I worked on the ice for 17 years on the ice roads going to FM. I finally became a foreman, so I have a lot of experience on ice. I know ice, how much weight it can take, how long it will take to melt. If its solid blue ice it takes longer for solid blue ice to melt. Slush ice is mixed with everything like sand. It's not blue ice, its slush. As soon as it warms up the sun, that is from the top. From the bottom 24/7 that current is really fast so the main channel on every river it is dangerous to get on the ice. So Larry M and I worked on winter road down south. This time of year we don't want to bother the ice as you go through. There are two different kinds of ice. Snow melts faster in the sun as it is mixed with sediments. If you get blue ice after all melts away the main ice will be that blue solid ice like an ice berg. That is a good example, the ocean salt water but still it is solid. About the last sentence in the quote: In winter time now it gets thicker and thicker without anyone disturbance it gets natural freezing, it gets ticker and thicker. In the old days when I grew up it was 40, 60 below, that was the temperature. Nowadays it is so fast. It freezes really fast so that has a lot to do with ice too. The ice is freezing then all of a sudden it warms up doesn't freeze then. Or if there is lots of snow it doesn't freeze as the snow is like a blanket. The ice used to be 6-8 ft. thick. My father said when the Catholic fathers fished for us in the school, there was no augers to fish for us. They punched a hole from the ice so thick that you had to go down to put net underneath. The ice is thin and the water level is low. In the old days there was water all over, the ice jammed for a week. We had fresh water every few years. Now it's stale water I can see in summer, and dead plants, dead animals, I can't live from that. Matthew seen it firsthand right on the river where he lives. The ice jams up and doesn't hold long, a few days. In the old days it was a week of water breaking up.

Source: Gerald Gibot

About Gerald Gibot:

I was born in Fort Chip. I was raised up in the trap line with my late mom and dad until I was 5 years old. Within those few years, I remember prior to going to residential school at 5. I remember on the land with my father. He had dogs. I'd go with him to check the water, muskrat. I didn't know as I was young. As I grew up then I look at the surrounding of where I was trapping, I realized it's a lot of water. When I would go out toward the prairie I could see the other side of the prairie, beautiful, and now its willows in between. As I got older the water level was going down because of the Bennett Dam. The water was going down and down. As years went by there is less flooding, and the prairie turned into meadows with grass growing. Then the muskrats were starting to fade away. Same with the rest of the animals that depend on the muskrat. And us, we eat the muskrat and trap them to buy groceries, support our families. I still go on the land. I have two boys 5 and 8. They are in school so I don't have much time for the bush. So when I get a babysitter on the weekend I will go in the bush when I can for a couple days. In the summer when no school I take my boys out on my boat. I extended my cabin 14 ft. and I have a shed ad a lot of stuff. My boys enjoy the life that I show them where their grandparents used to be when I grew up. I have seen a lot in my 63 years. When I was a 5 year old I was with my late father in the bush. At 5 I went to residential school. We get a lot of wisdom from other elders. Also my late father had friends about his age. We would sit down and talk about their lives and I can understand Cree so I can relate to other trappers talk about their lines in other areas. On the Birch River, it's all similar, everybody traps and everybody depends on the water. With my experience on the land I can see the visible difference on the land. I also said teachings from the elders. This knowledge comes from teachings of elders and also through my experience on the land, and now I'm taking my sons out to see for themselves.

A.6.11.Chapter: Chapter 5: Current State of the PAD System – Trends and Stressors - Section:
5.3.3 Open Water Flooding

Quote:

In the early 60's, there were floods all the time. Lots of water. My brother Harvey, comes out north of Peace River, we could hardly see the spruce trees with all the ice and sticks. That was clear ice in them days and all that water backed up all the way to Lake Claire. That used to happen every 3-4years.

Quote context:

It was way high. That is what I mean. The ice jam with spruce and timber, ice, logs, everything. Ice didn't have pollution. Not the brown like today. It was blue, thick. When it jammed it didn't crush, it piled up. From sweet grass landing there is a creek there, Pine River. We worked there on a fire crew. When the ice jams it goes into the Pine River and it starts on the Peace. It comes out at Lake Claire. This used to happen every ¾ years. A lot of rats, those were the good old days. The Peace River was high in those days. We used to have big boats to go to saw mills. The barges would pick up the lumber. In the late 50's, we worked in Sweet grass. You'd never be able to do this now. All the water is gone. It's hard to believe now, but we are not making it up. We saw this all our lives. People come here. They should have ½ guys from BC hydro so we can take them out in summer time so they understand. Ronnie went to lake Claire, went down river, he stopped

here and there now. He told these guys what happened them days, told them where the water was. I would be happy if we could do that again. We didn't go to Peace River that time as I had motor troubles. I want to take them to Peace River where the water was. If they can help us. If they want to help us then take them to little Rapids, Coupé River. People need to see it on the land to understand. Talking about birds, long ago when the river was high, they used to go Lake Claire for gravel back and forth for gravel. They did that early in the morning. They'd come for sand. A lot of fun them days, not far. On the Peace River from Lake Claire.

Source: Archie Antoine

I am 81. I have been on the land all my life. I started trapping at 15 at Garden River on the Peace River. 65 years and still out on the land. Born and raised on the land but worked in the summer, trapped in winter. When I was 18 years old I came down here as no jobs there. The saw mills were here. I left there to work at 18 with my brothers here. I have been here for 60 years. I take out two young boys to teach traditions to, Chance and Robert Jr. They learned fast but I lost one of them not too long ago.

A.6.12. Chapter 5: Current State of the PAD System – Trends and Stressors - Section: 5.7 Air Quality

Quote:

When there is a south wind from industry. We used to smell in March two plants. Now there are more plants so as soon as you get a south wind you can smell a different odor in the air. We see skins of yellow in between snow levels on Lake Claire and a film in between layers of snow.

Quote context:

Finding out now we are getting so used to the smell from industry. There are so many plants in the tar sands area. And before, I'll go back when I was a kid. Every day I'd walk from school to my house which is a mile. In March when it starts warming up you get a south wind and then you know spring is coming. That is when get Sulphur and other odors in the air from the tar sands. Now there is more oil plants coming up, and more frequently. Now all through summer we get that smell every time there is a south wind. At night it seems to be mixed with Sulphur, its burnt eggs. That goes in the air, from 100 kms to the north smelling it so that must have some effect to cumulative effects over time. Whatever is in air falls in the snow, and in water, and accumulates over time. And that is what I'm noticing, the air quality is getting worse. That means the health for sure is affected. Any time you get a different odor that is not natural. The delta is (was) so pristine. Any odor that is brought in has to have some effects over time on animals, water, snow, and the people that depend and eat animals and drink that water. A big drastic change I've seen in my time living in Fort Chip and the delta!

Source: Ron Campbell

**A.6.13.Chapter: Chapter 5: Current State of the PAD System – Trends and Stressors - Section:
5.9.1 Access to Traditional Lands**

Quote:

If the water levels in Lake Mamawi go as low as a foot of water or lower, we can't access our territory because people in Fort Chip have outboard motors with props, so need at least 2 ft. of water to get across Mamawi to Claire Lake. So low water really limits travel to access our traditional territory. In the summer months, Lake Mamawi is a gateway those rivers. If it's low, the gate is closed for us to pick eggs, fish, hunt, teach our youth. Sometimes water levels are so low the ice freezes right to the bottom at Lake Mamawi that the fish run out of oxygen and there are fish kills.

Quote Context:

The current state of the PAD in general: It seems like all our concerns, everyone's concerns are all intertwined. Or we almost see the same things, water, snow, air, animals. We are noticing the PAD, the whole system or ecosystem is changing. Where I mentioned fishing, deformed fish, fish with different colors, red dots, open sores, scales falling off. We are noticing the changes over time in the whole ecosystem. The die-off of gulls, fish kills. It's all something that is alarming for all who live and depend on this delta. We notice drastic changes over time with this ecosystem. There are less frequent floods. The ice is different, it's not as thick. There is more sediment mixed with ice. Especially on the Peace River when they start generating power and releasing water from the Bennet Dam. There is more turbulence and sediment mixed with the water. That freezes in the ice and it becomes a different color ice. Its darker ice and not as strong. When the sun comes it goes to the dark spots on ice. It eats away at ice and disrupts the whole frequent flooding. We used to get flooding every 3 to 6 years before the Bennet Dam and now its way far in between. Its 20 years in between floods now. We need that frequent flooding to bring the PAD back to its natural state.

We are noticing less frequent flooding. The Perch River basin, all the rivers, creeks have less water. Lake Mamawi is an example. When we go to hunt or trap our traditional food, it's like a gateway to the delta where you have to pass in summer months by outboard motor. If it doesn't flood we get really drying trends and can't even access our traditional area as water is so low. There are years where my uncle and I had to literally jump in water and push our boat for 3km to get to Lake Mamawi. And you try to go out for weekend, loaded with gas, drinking water, and you have to get in water and push boat 3 kms. That wastes one day right there. Then it's time to come back another day walking. So it's not worth it to go for a weekend. If you go for longer than a weekend then you need more water and have to load your boat more, and your boat is then not floating as much. Those kinds of things affect our way of life and impact our social and mental well-being! We can't access our traditional food, our healthy food. It's supposed to be healthy, but you wonder with all the high level of contaminants in the water. Is that duck, moose, fish, as healthy as they used to be? As well, human beings and those living Fort Chip. When we go in the delta it used to be like going to the grocery store. It used to have fresh meat, fish, berries. All this healthy food sustained us for generations. For a lot of years it was keeping MCFN people healthy

and you change and alter it. And changes in the delta, you get a funny feeling when you check the net, are they good for eating fish? Some are deformed and have sores on them. You don't have an appetite to eat them. It's kind of a little frustrating too, to see all that! All these things that are affecting the PAD, it's all man-induced, man-made construction, man's work! It throws the whole ecosystem out of whack.

If they had left nature alone it can take care of itself for centuries. The proof is in the pudding, cumulative effects, water withdrawals, water holding back. It breaks the whole food chain. It affects everything, all animals or their food. The biggest thing to rectify the problem or save part of the delta in PAD area, we have to get our water back! You hear the elders and land users say that, if we get or manage the water the delta may manage itself and come back some. If we do our best with today's technology with weirs. Or do a pilot with water up in one area and do a study if more fish, ducks, moose, wildlife. And we could do some of those studies to try to fix the problem long term. If nothing is done more time it's wasting. This delta needs something to help it move forward! The state it's in right now, we get fire, the vegetation is changing. Some of these lakes, like Hilda Lake, twice now I fought fires on that lake because of the drying process. So vegetation, willows take over and different species of grass and fires burned. That tells you, when a lake is burning, we are losing a lot of lakes in the delta. Something is happening, the drying trend. Everything is changing to the worse. Because of what I have been seeing in the past, especially in the past 30 years. Everything just changed all at once, animals, water, people health really changed in the last 30 years!

Source: Ron Campbell

A.6.14.Chapter: Chapter 5: Current State of the PAD System – Trends and Stressors - Section: 5.10 Muskrat and Beaver

Quote:

My father said it used to flood every 3 or 4 years. Old water would get washed out and always fresh water from the Peace River, muskrats lots! A chain reaction: muskrats, otter, to wolves and buffalo. Now less animals because the rats are gone so that chain reaction is broken! Water is not as good as back then. Something has to be done.

Quote context:

When I was growing up, my late father had his trap line at Sweet Grass creek. Every few years then there would be an ice jam when I grew up. That is the reason the people living along the Peace River, had a fair size raft (15X18), in case of a big flood. That is how it was when I grew up. We'd put the dogs on the raft, and our personal stuff we need, and then when the water goes down life continues. I would say 10 miles from the Peace River is where WBNP has their corral. The water goes over and towards Lake Claire, goes up. There are other trappers along the Peace River maybe 4-5 miles, some have passed on. It floods in the spring time. You would have to live on the raft. People further away from the Peace River don't get flooded out as much as those living closer. The last major flood was 1974. I was out on the land at the time with Marten, his

son Baby Joe is still around. We moved onto the raft, we put the dogs on it. The helicopter came by a week later and brought us to Ft Chip. That was the last major flood. Today there are no floods. All the lakes that would get replenished every few years, that hasn't been going on now. Now water is stale. The muskrats are not there no more. Where there was lakes is dried up. No more muskrats. Today right from last year today I didn't kill one muskrat. There is nothing to trap, it's gone. Without water you ain't got not muskrats. You need water for all animals from the mice up to the buffalo! It's a chain reaction! If muskrats are gone then others who depend on them will be gone.

Like I was saying above, that is true what I and my late father seen. Not only me and my dad but the rest of the trappers out there. We used to get fresh water. Today there is stale lakes and nothing lives in them hardly. In the old days it was all flushed out and you'd get fresh grass, goose grass. And the muskrats were in harmony with environment and survive. And beavers were all over doing their work with dams to hold water. After the flood goes away the beavers hold water. Every 2-3 years, the same process. In the old days 300k muskrats were trapped in the delta, PAD. That is in the written history. Today not even a 100. Usually I get a few, this year I got nothing. It's the same with beavers. I went there this winter. There is one lake where I always found a few beaver, that lake is now dried up and the beaver left. The flooding every 2-3 years stopped in 1974. Something needs to be done! In order to correct what was done, the major factor here is water. Without water there no flooding every 2-3 years. What needs to be done, what I meant is first of all water is #1. What needs to be done is like Ron C says is that Little rapids, fix that up. That is the only think holding a lot of lake Athabasca water. Without that the water would be a lot lower. Let's see what can be done. If time goes on and we build a controlled gate. Rome wasn't built in one day, we got to test out. They should continue what they done in the past. Realized that dam is helping so let's get that bridge for AB to help with that to be built. And Parks put one at Quatre Fourches right at the island there. They brought rocks. They need a controlled gate so they can open gate if water get to high like Bennett dam. That helps quite a bit over here. Things need to be done! Siting and talking about it for next 100 years and the mean time the land is dying. The people and animals and their knowledge die with them. The younger don't know how to trap. Things will all die. If they do something like get that dam fixed with control, and younger can learn from the elders.

Source: Gerald Gibot

**A.6.15.Chapter: Chapter 5: WBNP World Heritage Elements Excluding the Pad - Section: 5.11
Vegetation and Invasive Species**

Quote:

Since 1974, the water has gone down and down so for the buffalo there isn't the vegetation they live on. The thistle is taking over the whole delta on account of there being no water.

Quote context:

The river froze good then: blue ice, not shitty, no pollution. Years ago we had solid ice. Now its overflow ice, mixed with sand. When it warms up and it melts so fast! From 74 the water went down. All the vegetation and everything. There was no water. No water at Perch Basin lakes where we did trapping and stuff like that. They are all dried up. Parks always says buffalo. Buffalo was never our sources of livelihood. If it takes the buffalo to bring back the water lets have the buffalo! Parks Canada it's all about the buffalo. The Parks wardens are always watching us steady. Buffalo we didn't care if they are there or not. They are in the way a lot of times. They were in the way of dogs in old days. Our main food source was muskrat. From 74 the water dropped. After the last major flood. It came back 96-97 a bit. Already all our deltas are all grown in most of them. I'd say 50% by 96-97 were gone. For a few years after they finished the Bennett Dam. When they fixed it, since then the water dropped. No floods in the little lakes there. There are trees now growing in the lakes, no water since. Even last flood 2014, the cabin there of mine. I said it won't flood. Lake Claire didn't get no water. All those lakes nothing. The 74 was a real flood the whole country, all the creeks and rivers. The only place that didn't flood was Lousy Creek as it's the highest. In 96-97 they released water but, 96-97 they had the weirs there by that time. If we had that dam we'd still have been ok maybe. If there is water the thistle don't grow. Where it doesn't flood is thistle. Lower in bay is nothing. It doesn't grow in wet ground, only where it is dry. Thistle came in 96-97 that is when it really picked up. There was a bit starting before that but not as bad. Now it's really dry! Its hard to walk around. You can't get around even to get raspberries.

Source: Larry Marten

About Larry Marten:

How old am I 65? I quit school 1966. That is when I started trapping. Prior to that as a kid was out there every spring with my parents. After I got out of convent for a few years. I'd go out. When I was a kid I'd spend spring in the bush. Those days the family, everybody moved out. Yesterday someone said people used to go cause they just like to be out there to listen to birds. That wasn't it. We lived out there because it's their (our) livelihood. We were all out there doing trapping and making money. In those days not all had full time job. I worked in summer after trapping. We didn't go out there to enjoy, it's our livelihood. I went in with my parents. When I quit school, then I was trapping every year, every winter and spring. In summer time I had summer work. I am still a trapper. Hay River, my area, my Grandpa John Marten, and Isadore Marten, the traditional area. I've trapped around that area since I started. The main source was muskrats, until we lost water. The area dried, so we had to move. Used to trap towards French Lake, Birch River area. Used to trap muskrats one month before Christmas, then to French lake for fine fir, Muskrats in March. We had no water so had to do something. Then went to French Lake and Birch River. Had to move in order to follow the animals and support my family. Now I'm back around Prairie River. I still trap every year. I get a few, but no muskrats. This year is the first year I only got 5 muskrats. The last few years 100-200. This year went right down. At the little lakes by the cabin nothing this year. In the old days money wasn't high for muskrats but if you got a lot. And if you got 500 rats you could make \$1500 and butter was then under a dollar. Muskrat prices varied. Some years 7 or 8 dollars. They would go up and down. Now its \$3 and there is way

less of them. The land is drying up. There is no rat root, it is a simple thing. It grew just about any place, a lot. Around the delta where we used to go there is nothing now as it's all dried up? There used to be a lot in Birch River. It has to be wet for rat root. Sloan talks about medicine

A.6.16.Chapter: Chapter 5: Current State of the PAD System – Trends and Stressors - Section: 5.13 Bison and Moose

Quote:

Its moose that I am trying to save! A moose has a better chance of surviving over a wolf when there is deep snow as the wolves can't catch up to them. What I am trying to say today, or bring back. Aside to the water, all these other animals. We are losing them.

Quote context:

You know, that is true that even the moose are less now. And when we go hunting at Birch River I found out that moose are going away because they have less feed. Even in willows they are drying up. There are no more new willows growing. It's very hard for animals. Even young ones after they feed from mom. The moose teach them how to eat. There are no small willows so it's hard for them. The moose get hungry and skinny and calves are not full grown. The wolf has a better chance to kill them and others, and last year's calf. One time I went hunting in fall and was calling moose 4 years ago, that is really important to me, and I found something. Usually the moose is always calling when he comes. But this time he wasn't, just came sneaking up to us, me and my brother. Good thing there was grass there. I pushed my brother and said it was coming. We killed him. After that I went for kill alone. The moose come sneaking up again so I killed him. I thought it was strange though so I called relations in different places. I made a phone call 3 other places and they said the same thing, the moose are acting funny. It was the first time they ever saw that. The older guy I called was over 70 and the first time that ever happened. Yeah I said something was wrong. My dad really thought lots. I watched everything he used to tell me so even that is changing. And the moose are getting skinnier. And the buffalo are going away. If no water then no grass. If we have no water everything will be gone. If no water then nothing else.

A wolf will catch up to a moose any way unless there is deep snow, and then moose will have a better chance. If the moose's belly is touching the snow that is when moose have better chance. Other than that I don't think so. Wolves can run so far but the moose will take off from them. Unless you really play them out or there is not much snow, or if they get the moose in leg and let them go. The leg will swell up. The wolves go sneaking by the moose then sitting down 2-3 feet away. The wolves dig and harden the snow so the wolf goes back now. Where they hardened the snow they go back early in morning as soon as the moose gets up and jump them. Then they have a better chance to get them. Animals are smart too. Wolves that is the only way they can do it. If they try to jump on them on non-frozen snow they won't reach the moose. If they jump on packed snow, it's like in spring on hard snow. Another story my old man said: people long ago would say they had a lot of snow that winter. And the moose belly was touching snow in so the old timers made snow shows 8 ft. long to stay on top the snow. The moose takes off, goes far.

They'd see them going. A guy walks fast. Even the speed of walking a person, to a moose in too deep snow. So the moose has no advantage to the guy. They kill the moose. They were happy with a lot of snow as they can go in the bush and fresh tracks. They walk fast and there is a moose trying to run. Its pitiful. So you better become a bush woman, so you don't have to learn from all these stories.

Source: Sloan Whiteknife

A.6.17. Chapter: Chapter 5: Current State of the PAD System – Trends and Stressors – Section 5.13 Bison And Moose

Quote:

No water then no willows. Moose won't eat dry willow! It has to be nice AND green. The moose eats another grass in fall where hardly no water. I don't know what it is called hey like it in fall. It's a grinder for the stomach after eating willows. There is no more of that now! All kinds of ways animals know!

Quote context:

Like I told you before, the moose won't eat dry willows. Another thing that moose eat in fall, its white stuff like can see it in grass. The moose eats that. That is the grinder for their food and everything. My old man used to tell me watch in fall the moose eat that. It has lots of vitamins. It won't take long to get fat if eats that. In the muskeg lots of time I seen when trapping, a special kind of moose food. They dig it. Even moose and buffalo eat it only with grass. Its muskeg moss. I forget what it's called. Moose eat that too in the muskeg. In the prairie there is nothing of that so that is why moose left that parks here. They go further inland as in that muskeg they can eat that and the grass that buffalo like too. I'm pretty sure that is why the buffalo is gone to and moose are starting to leave area around Birch River as there is better feed in the muskeg. There is underground water and all that grows. The moss and white stuff that moose eat in the fall. Yeah the moose and buffalo are leaving as the area dries. Not too many people know that as a lot don't go trapping. I see it and my old man told me. A lot of what he told me it sticks. I had a good scientists as teachers him, and my uncles. Our family were very spiritual. My dad always talked to me about different things. He talked more than a lot of people. His teachings are very important.

Quote source: Sloan Whiteknife

About Sloan Whiteknife

I am George Sloan Whiteknife. I was born and raised in the bush. Ever since then I've always been in the bush. I was taught from my dad to trap and hunting moose, geese. I was always with him and he always used to tell me stuff. Like what kind of water it's going to be. He knew by signs of the wind and how the moon looked. I learned quite a bit from my dad in my past life, and my uncles. I went out with all my relations. Talking about the birds, I noticed about ten years ago it is slowing down. Birds are starting to go different route and still flying. In the last 5 years its very

serious no birds are coming through here. I used to see lots downtown, even 3 or 4 a week. Nothing now. Animals are smart. They know by how they get up and travel. Animals are same thing. They know by the water. That is now we know right way something is wrong in oil sands and smoke. Its why they took a different road. Later on there will be no birds, seagulls, animals. We will have a big problem later on, later on our generation. Its pitiful if they don't do something. We need more water. You have to be careful with weather. Like water it is almost like another boss. If it is windy you can't go anywhere. You have to wait for the weather to be just right before you are able to go anywhere. Especially over the water and out on the land with wind and rain. Especially in the olden days. We had small motors. And you are out on a big lake. If they are out there they might the wind may come up and have all kinds of problems. We need water. When I say something has to be done, I mean we need more water.

A.6.18. Chapter 5: Current State of the PAD System – Trends and Stressors - Section: 5.14 Fish

Quote:

Now we see changed vegetation and oily sheen on lakes on a calm day. When you slide out your fishing nets, there is a different smell from net, deformed fish, spotted fish, heads huge but body is skinny, a lot of deformed fish.

Quote Context:

I mentioned in the past section, the biggest change I seen in vegetation is the Canada thistle and south thistle. Because the delta is so low and dry, this invasive species of grass came in and took over natural native species of grass. No animals feed on it. The bison don't, muskrat don't. That really took over in the past 20/25 years and this seems to be spreading re lack of flooding that drowns it. The only thing thistle doesn't like is water. It comes from higher elevations. It's not water-dependent like goose grass or sedge meadows that the bison feed on. They are getting taken over by thistle because of the drying change. And the bison, muskrat, moose that depends on the vegetation and water. It is changing their routes and migration. Maybe they are not coming into the delta as much. I know they aren't as I am out there almost every weekend. The bison and muskrat numbers are really down because of the lack of water, and the lack of goose grass that Muskrat most depend on. So they are getting, the poor animals, less water, and have no food. They can't survive too long or they can't have high numbers of young when food isn't there. Any animal is food dependent. There will be a small litter if the body is sick and weak. They are having a rough time surviving in the delta. The fish you look at when do health study. The fish are supposed to be one of most healthy foods on the food chain. It was like that in delta in the past. The food was healthy as fish was healthy. They used to commercial fishing in lake Athabasca and Lake Claire, and the PAD in the 50's. So healthy fish and the market for it was there, whitefish and pickerel in Lake Athabasca and Lake Claire. They shut that down. There is no more commercial fishing so that tells me something is happening as well too. The change in fish health as well there, as people are turned away from eating fish from there.

Source: Ron Campbell

A.6.19. Chapter 7: Recommendations - Section: 7.2 Urgency

Quote:

You can tell kids, but it's so much better to show them where we pick because they will remember then. If it's too shallow, you can't go out with family and friends.

Quote context:

This is very true! That is why a lot of times we say in meetings. When we go in meeting with you guys we tell you stuff but some don't really believe as you don't actually see it. Last fall you saw. We got you out. It's better to take you out even for 1 or 2 days or camp one night. We showed you lots. It's the same thing with kids. I tell my grandkids a lot of stuff when we go camping. "That is good papa." My grandson said "I want to try to be like you, you showed me all that I want to be like you." I said "thank you my boy." I tell him lots. He says "papa some teach us in school but we don't understand as its just talking, but you papa show me here and that is good." Anything I can do until I'm too old I'll show you everything. If you want to learn I will open the book. It is very nice of him telling me that. He was only 8 years old. I always tease him, ha ha. So yeah it's better to teach people on the land.

Source: Sloan Whiteknife

A.6.20. Chapter 7: Recommendations - Section: 7.2 URGENCY

Quote:

We are here to show/tell you we need action. We are the reasons why. That is why we have our stories. Mikisew Elder

Quote context:

We are telling you are stories good heartedly. I know the land. They know the land all their lives. That is why we call them our scientists. My quote is to explain why they are here. The years' experience they have. When we go through the quotes and add up the years we will see how many years' experience and that is only these elders here. We have other elders and younger people. This is their true experiences and what they go through. The truth today and what they want for the future generations. I really appreciate the elders telling their first hand experiences. Hopefully we give them the video that we will make, so that every one of them gets one for their families. They do a lot of hard work to have to remember and tell us, but they enjoy it.

Source: Terri Marten

About Terri Marten:

I was born and raised out in the PAD. I was out there until I was 7 or 8, then the convent until 16. Then my parents took me out for a year in the bush at 16 or 17. Then I stayed around town with families here. I have always stayed in Chip, in and out from different areas of the PAD.

About David Campbell

I grew up mostly in Fort Chip. I was out on the land for my younger years. I spent summers out on the land in Quatre Fourches. In the winter we came to school at Bishop Fisher, to grade 12. Then I went to Fort Smith for renewable resources training for 2 years. Then I worked for Water services in Fort Simpson. I went back to Ft Chip 87-96 to work with Alberta environment. In 1998 I went to work for WBNP. I have been with them since then as resource management officer. I go on the land every chance I have, like weekends. My parents both trapped. Dad had a trap line since 1949 at Quatre Fourches area. That is where we were raised, in an area designated for registered trap lines. Over half a century and the land is still in the family. I and my brother have cabins there.

A.7 – RECOMMENDATIONS FROM THE REACTIVE MONITORING REPORT

A.7 – RECOMMENDATIONS FROM THE REACTIVE MONITORING REPORT

Recommendation 1: Adopt a clear and coherent policy and guidance to enable the transition to a genuine partnership with First Nations and Métis communities in the governance and management of the property.

Recommendation 2: Considering the increasing pressures on the property at this time, prioritise conservation and ensure that the State Party's science capacity enables Parks Canada's legal obligation to maintain and restore the Ecological Integrity of the property.

Recommendation 3: To enable informed decision-making, conduct environmental flows assessments to the highest international standards for the Peace, Athabasca and Slave Rivers as they pertain to the health of the Peace-Athabasca Delta (PAD), in order to identify water flows needed to sustain the ecological functioning of the PAD under the circumstances of existing and planned future dams and water withdrawals. These assessments should incorporate projections of climate change and should determine the cumulative effects on the PAD and the property of flow regulation of all existing and proposed dams on all three rivers.

Recommendation 4: Conduct, in line with the IUCN World Heritage Advice Note on Environmental Assessment, an environmental and social impact assessment of the Site C project and, if moved forward, any other hydropower projects potentially affecting the Outstanding Universal Value of the property.

Recommendation 5: Conduct an environmental and social impact assessment of the proposed Teck Frontier oil sands mine project in line with the IUCN World Heritage Advice Note on Environmental Assessment, fully taking into account the Outstanding Universal Value of the property, including the Peace-Athabasca Delta.

Recommendation 6: Conduct a systematic risk assessment of the tailings ponds of the Alberta Oil Sands region with a focus on risks to the Peace-Athabasca Delta, and submit the report of this assessment to the World Heritage Centre, for review by IUCN, in accordance with Paragraph 172 of the Operational Guidelines.

Recommendation 7: Establish adequate baseline hydrological information of the Peace and Athabasca River Basins to enhance the reference for monitoring and assessing current and future hydrological conditions.

Recommendation 8: Expand the scope of the Strategic Environmental Assessment (SEA), which was requested by the Committee in its Decision 39 COM 7B.18, so that it adequately reflects the scale, pace and complexity of industrial development, land use changes and river flow manipulations in the Peace and Athabasca River watersheds, both in terms of individual and cumulative impacts.

Recommendation 9: Expand the scope of monitoring and project assessments to encompass possible individual and cumulative impacts on the Outstanding Universal Value of the property and in particular the PAD.

Recommendation 10: Conduct a comprehensive assessment of options, in order to underpin decision-making to put in place an effective buffer zone, as defined in the Operational Guidelines. The Birch River deserves particular attention as the only relatively intact major watershed of the PAD.

Recommendation 11: Conduct a systematic assessment of options to better realize synergies between the property and land use planning in its immediate vicinity, including the existing and planned provincial protected areas.

Recommendation 12: Consolidate the management resources and capacity to a standard commensurate with World Heritage status and adequately respond to the challenges facing the property by:

- Reinstating a year-round status and staffing of WBNP;
- Recruiting a full-time Superintendent exclusively in charge of WBNP;
- Ensuring an adequate Parks Canada presence in Fort Chipewyan, part of the critical Peace-Athabasca Delta area and a major ecological region of WBNP.

Recommendation 13: Further develop the existing Cooperative Management Committee established by the State Party, and consolidate a functional and effective mechanism to involve Aboriginal Peoples in the management of the property.

Recommendation 14: Ensure that the preparation and skills of involved governmental staff correspond to the requirements inherent in the evolving relationship with First Nations and Métis communities.

Recommendation 15: Further harmonize and adopt the Species Recovery Strategy for Wood Bison throughout its range, including but not limited to the Greater WBNP Ecosystem, and specifically:

- Urgently invest in comprehensive and independent analysis of the conservation importance and status of the Ronald Lake Bison Herd, including threats to it posed by proposed development, within a broader Species Recovery Strategy;
- Dedicate, in full cooperation with Aboriginal Peoples, adequate attention and funding to the management of Wood Bison, including as regards the development of disease management options other than culling.

As noted in Chapter 5, wood bison populations are decreasing. The development of a recovery strategy for the wood bison population in the PAD is recommended, including a further evaluation of the Ronald Lake Bison herd.

As noted in Chapter 6, the construction of the Teck Frontier mine could push the Ronald Lake herd into the PAD. This could have significant implications for both the Aboriginal people who hunt the Ronald Lake herd, both in terms of the herd losing its disease-free status, as well as the availability of the herd for hunting once they are in the WBNP boundaries. An assessment of impacts from the Teck Frontier mine on the Ronald Lake herd and the PAD is recommended.

Recommendation 16: Continue to closely monitor the entire used and potential nesting area of the Whooping Crane within the Greater WBNP Ecosystem so as to be able to respond to possibly changing management requirements.

Recommendation 17: Incorporate invasive alien species (IAS) into the overall monitoring of the property and the PAD based on science and local and indigenous knowledge, and based on monitoring results, develop an appropriate management response to control the spread of IAS.

A.8 – BIBLIOGRAPHY BY SUBJECT MATTER

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