



**PEEL WATERSHED**  
PLANNING COMMISSION  
TOGETHER FOR THE PEEL • CHUU TL'TI GEENJIT KHETOK

## **RESOURCE ASSESSMENT REPORT**

September 2008



Produced by:  
**the Peel Watershed Planning Commission**

## **About the Peel Watershed Planning Commission**

The Peel Watershed Planning Commission is responsible for developing and recommending a regional land use plan for the Peel watershed planning region. The Commission is composed of six public members nominated by affected governments. There is one nominee each from the Na-cho Nyak Dun and the Gwich'in Tribal Council, a joint Yukon Government/Vuntut Gwitchin nominee, a joint Yukon Government/Tr'ondëk Hwëch'in nominee and two Yukon Government nominees.

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## **Cover Photo**

Geoff Bradshaw, of the Yukon Geological Survey, overlooking Margaret Lake, Peel Watershed.  
Photo by Brian Johnston, PWPC.

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Coordination of the data collection and production of the Resource Assessment Report was directed by the Peel Watershed Planning Commission Senior Planner, Brian Johnston.

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**In Memory - Geoff Bradshaw**

Geoff Bradshaw of the Yukon Geological Survey provided the Commission with an assessment of the region's mineral potential, which greatly assisted the production of this resource assessment. Geoff died tragically in the summer of 2006 while conducting field work in the Peel watershed. His energy, enthusiasm and dedication will be greatly missed.

## List Of Acronyms

BMPs	Best Management Practices
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
CYFN	Council of Yukon First Nations
DIAND	Department of Indian Affairs and Northern Development
DFO	Department of Fisheries and Oceans
DUC	Ducks Unlimited Canada
EMR	Energy, Mines and Resources (Yukon Government Department)
FN	First Nations
GIS	Geographic Information System
GCLCA	Gwich'in Comprehensive Land Claim Agreement
GILUPB	Gwich'in Interim Land Use Planning Board
GLUPB	Gwich'in Land Use Planning Board
GRRB	Gwich'in Renewable Resources Board
GSCI	Gwich'in Social and Cultural Institute
GTOR	General Terms of Reference
GTC	Gwich'in Tribal Council
Ha	Hectares
IMA	Integrated Management Area
LMU	Land Management Unit
MDBSLUP	Mackenzie Delta Beaufort Sea Land Use Plan
MMbbls	Million barrels (oil)
NND	First Nation of Na-Cho Nyak Dun
NTDB	National Topographic Data Base
NWT	Northwest Territories
NYPC	North Yukon Planning Commission
O & G	Oil and Gas
PCH	Porcupine Caribou Herd
PCMB	Porcupine Caribou Management Board
PWPC	Peel Watershed Planning Commission
PWPR	Peel Watershed Planning Region
RRC	Renewable Resource Council
SARA	Species at Risk Act
SDL	Significant Discovery License
SMA	Special Management Area
Tcf	Trillion cubic feet (natural gas)
TGFN	Teetl'it Gwich'in First Nation
TH	Tr'ondëk Hwëch'in
THFN	Tr'ondëk Hwëch'in First Nation
TWG	Technical Working Group
UFA	Umbrella Final Agreement
VG	Vuntut Gwitchin
VGFN	Vuntut Gwitchin First Nation
WCSC	Wildlife Conservation Society Canada
WKA	Wildlife Key Areas (a database maintained by Yukon Environment)
WTAY	Wilderness Tourism Association of Yukon
YESAA	Yukon Environmental and Socio-Economic Assessment Act
YESAB	Yukon Environmental and Socio-Economic Assessment Board
YG	Yukon Government
YGS	Yukon Geological Survey
YLUPC	Yukon Land Use Planning Council

# Table of Contents

Acknowledgements.....	i
List Of Acronyms .....	viii
Table of Contents .....	ix
Index of Maps.....	xii
Index of Tables.....	xiii
Index of Figures .....	xiii
 1.0 INTRODUCTION.....	 1
2.0 REGIONAL SETTING .....	3
2.1 Legislative Context .....	3
2.2 Physical and Human Geography .....	5
2.3 Land Status.....	5
2.4 Existing Land Dispositions .....	6
2.5 Adjacent Land Status .....	6
2.5.1 Gwich'in Settlement Area.....	7
2.5.2 North Yukon Planning Region.....	7
2.5.3 Tombstone Territorial Park.....	8
3.0 HERITAGE AND CULTURAL RESOURCES .....	9
3.1 Palaeontological Record.....	10
3.2 Archaeological Record .....	10
3.2.2 Contact Sites .....	12
3.2.3 Gold Rush and Trapping Era .....	12
3.3 Culturally Important Elements on the Landscape .....	13
3.4 Outstanding Heritage Information Needs.....	15
4.0 ACCESS & TRANSPORTATION .....	16
4.1 Overview .....	16
4.2 Roads.....	17
4.2.1 Dempster Highway .....	17
4.2.2 Wind River Trail .....	18
4.2.3 Hart River Road .....	18
4.2.4 Road Construction .....	18
4.3 Air Landing Sites .....	19
4.4 Railway Scenario.....	19
4.5 Potential Incentives and Constraints to Development of Access Infrastructure .....	20
4.6 Outstanding Information Needs .....	20
5.0 TOURISM AND RECREATION .....	21
5.1 Road-accessible Tourism and Recreation .....	22
5.2 Remote Wilderness Tourism and Recreation.....	22
5.3 Tourism and Recreation Potential .....	26
5.4 Potential Incentives and Constraints to Tourism and Recreation Opportunities.....	27
5.5 First Nations and Tourism.....	27
5.6 Outstanding Tourism Information Needs.....	27

6.0	BIG GAME OUTFITTING.....	29
6.1	Overview .....	29
6.2	Economic Profile.....	30
6.3	Clientele .....	31
6.4	Incentives or Constraints to Big Game Outfitting in the Peel Watershed.....	33
6.5	Outstanding Big Game Outfitting Information Needs .....	33
7.0	OIL & GAS POTENTIAL AND RESOURCE INTERESTS.....	34
7.1	Overview .....	34
7.2	Summaries by Basin.....	37
7.2.1	Peel Plateau and Plain Basin.....	37
7.2.1.1	Geological Setting .....	38
7.2.1.2	Exploration .....	38
7.2.2	Eagle Plain Basin .....	38
7.2.2.1	Geological Setting .....	39
7.2.2.2	Exploration .....	39
7.2.3	Bonnet Plume Basin.....	40
7.2.3.1	Geological Setting .....	40
7.2.3.2	Exploration .....	40
7.2.4	Kandik Basin.....	40
7.2.4.1	Geological Setting .....	40
7.2.4.2	Exploration .....	41
7.5	Future Exploration and Development Potential .....	41
7.6	Potential Natural Gas Development.....	42
7.7	Potential Oil Exploration and Development .....	43
7.8	Potential Constraints and Incentives for Development .....	44
8.0	MINERAL POTENTIAL AND RESOURCE INTERESTS .....	46
8.1	Overview .....	46
8.2	Mineral Claims.....	47
8.3	Mineral Exploration .....	48
8.4	Mineral Potential .....	50
8.4.1	Crest Iron .....	50
8.4.2	Wernecke Breccias.....	51
8.4.3	Carbonate Hosted Lead-Zinc .....	52
8.4.4	Coal.....	52
8.4.5	Coal-bed Methane.....	53
8.4.6	Aggregate.....	53
8.5	Potential Incentives or Constraints for Development.....	54
8.6	Mineral Information Needs .....	55
9.0	WATER RESOURCES.....	57
9.1	Overview .....	57
9.2	Geography .....	58
9.3	Legislation.....	59
9.4	Water Quality and Quantity .....	60
9.5	Wetlands and Lakes .....	61

9.6	Snow Cover .....	61
9.7	Permafrost .....	61
9.8	Glaciers.....	62
9.9	Water Availability .....	62
9.10	Potential Development of Water Resources.....	63
9.10.1	Hydroelectric Power .....	63
9.10.2	Water Exports .....	63
9.11	Climate Change Impacts .....	64
9.12	Potential Incentives and Constraints to Development of Water Resources .....	64
10.0	FISH, WILDLIFE, HABITAT AND CONSERVATION .....	66
10.1	Overview .....	66
10.2	Process of Resource Valuation and Mapping.....	67
10.3	Biophysical Setting .....	67
10.4	Conservation Indicators.....	68
10.4.1	Ecosystems / Habitats .....	68
10.4.2	Fish.....	69
10.4.3	Caribou.....	70
10.4.4	Moose.....	70
10.4.5	Dall’s Sheep .....	70
10.4.6	Grizzly Bear .....	71
10.4.7	Marten .....	71
10.4.8	Peregrine Falcon .....	72
10.4.9	Waterbirds.....	72
10.4.10	Breeding Birds.....	72
10.4.11	Birds of Conservation Concern .....	73
10.4.12	Rare Plants.....	73
10.4.13	Wilderness .....	74
10.4.14	Subsistence Harvesting.....	74
10.4.15	Special Features.....	75
10.5	Landscape Processes .....	75
10.5.1	Wildland Fire .....	75
10.5.2	Climate Change.....	75
10.6	Areas of Previous Conservation Interest.....	76
10.7	International Significance of the Peel Watershed .....	79
11.0	EXISTING LAND USE .....	83
11.1	Concepts .....	84
11.1.1	Human-caused Surface Disturbance – or “Footprint” .....	84
11.1.2	Linear Features.....	85
11.1.3	Cumulative Effects.....	85
11.2	Status of Land Use Impacts in the Peel Watershed.....	87
11.3	Reclamation, Revegetation, and Restoration .....	87
11.4	Contaminated Sites.....	88
12.0	CONCLUSION .....	92
	APPENDIX 1: Map Series .....	93

## **Index of Maps:**

- Map 1. Regional Overview
- Map 2. Land Status
- Map 3. Subsistence Harvesting
- Map 4. Heritage and Cultural Resources
- Map 5. Access & Transportation
- Map 6. Existing Tourism & Recreation Activities
- Map 7. Trapping & Outfitter Concessions
- Map 8. Oil & Gas Potential and Resource Interests
- Map 9. Simplified Bedrock Geology and Ecodistricts
- Map 10. Simplified Surficial Geology and Ecodistricts
- Map 11. Mineral Potential and Resource Interests
- Map 12. Carbonate Hosted (MVT): Zinc – Lead Potential
- Map 13. Coal Potential
- Map 14. Crest Iron Deposit & Iron Potential
- Map 15. General Mineral Potential
- Map 16. Snow Depth Patterns & 3<sup>rd</sup> Order Sub-watersheds
- Map 17. Areas of Previous Conservation Interest
- Map 18. Existing Land Use Impacts

## Index of Tables

Table 5.1	Wilderness Tourism - Guided Trips & Canoe Rentals: All Peel Watershed: 1999 – 2006* .....	24
Table 5.2	Wilderness Tourism - Guided Trips & Canoe Rentals: Snake River: 1999 – 2006* .....	25
Table 5.3	Wilderness Tourism - Guided Trips & Canoe Rentals: Wind River: 1999 – 2006* .....	25
Table 6.1	Average Annual Harvest by Resident and Non-Resident Hunters in the Peel Watershed Planning Region by Outfitting Area from 2001-2005 .....	30
Table 6.2	Economic Impacts of Outfitter Operations in the Yukon, 2005 .....	31
Table 6.3	Average Financial Profile of Outfitter Operations – 2005 .....	32
Table 7.1	Total Estimated Natural Gas and Oil Resource Potential for the Peel Planning Region .....	36
Table 7.2	Summary of Oil and Gas Exploration History by Basin .....	41
Table 8.1	Summary of Mineral Claims & Coal Licenses in the Peel Watershed Planning Region .....	48
Table 8.2	2007 Mineral and Resource Exploration Projects in the Peel Watershed Planning Region .....	49
Table 11.1	Peel Watershed Planning Region Land Use Feature Types .....	89
Table 11.2	Historical and Current Levels of Land Use Features and Surface Disturbances in the Peel Watershed Planning Region .....	90

## Index of Figures

Figure 5.1	Tourist and Recreational Paddlers on Remote Peel Watershed Rivers, 2007 .....	26
Figure 6.1	Distribution of Facilities Offered by Yukon Outfitters .....	31
Figure 8.1	Mineral and Resource Exploration Expenditures in the Yukon, 1971 To 2007 .....	48
Figure 11.1	Feature Type Examples .....	86







## 1.0 INTRODUCTION

The Resource Assessment Report represents one of the major products of the regional land use planning process, as recognized in the Commission's General Terms of Reference. The chapter themes reflect those that were identified during the Issues and Interests public consultations during the early phase of the planning process.

The intent of the Resource Assessment Report is to present a descriptive profile of the natural, human and economic resources in the Peel Watershed Planning Region (PWPR) (Map 1), and to describe historical, current and potential future land uses and land use patterns in the region. This report does not assess current or potential land use conflicts or offer management strategies; those aspects will be dealt with in the Scenarios and Draft Plan phases of the planning process.

The assessment is based on our current state of knowledge – both scientific and traditional. Although virtually all of the data were already in existence, a significant amount of effort was required by the Commission and the domain experts to analyze and interpret the data in such a way as to ensure its relevance for regional land use planning. The rare occasion in which data were collected specifically for the purposes of the Commission included: traditional knowledge workshops with community members in Dawson and Fort McPherson, and interviews with members of the Na-Cho Nyak Dun First Nation and big game outfitters. These data contributed to a better understanding of areas of cultural significance, key harvesting areas and key wildlife habitat. First Nations participation from Dawson, Mayo and Fort McPherson was also critical for the habitat suitability assessment that represents a

significant component of the Conservation Priorities Assessment Report and the Fish, Wildlife, Habitat & Conservation chapter of this report.

A significant portion of the data gathering, analysis and interpretation portion of this planning process focused on ecological resources in the planning region and is presented in the Conservation Priorities Assessment Report. This was due to a variety of reasons:

- a. it is critical to understand the biological and ecological make-up of the planning region in order to make well informed recommendations on the future behaviour of land use activities and to understand its potential impacts;
- b. conservation priorities and potential protected areas were identified by the public as priorities of the Peel planning process;
- c. much of the data provided to the Commission were in a raw format and widely dispersed, requiring further analysis and interpretation in the context of regional planning, and sometimes requiring modeling exercises in order to assess the habitat potential for species that had limited population and distribution information; and
- d. in contrast, data from the oil and gas, minerals, transportation, tourism and recreation and big game outfitting sectors were very limited or already well documented, requiring minimal analysis and interpretation for regional planning purposes.

The textual content of this report is intentionally brief – providing only the highlights of each theme. Readers are encouraged to refer to the referenced documents for greater detail. In some cases, such as Heritage, Water, and Tourism & Recreation, and Minerals, summary reports were drafted by their respective domain experts, and act as the primary reference source for the chapters. The Fish, Wildlife, Habitat and Conservation chapter is directly extracted from the PWPC's Conservation Priorities Assessment Report.

The maps in this report represent the bulk of the analysis and the spatial compilation of the Commission's best available information. These multiple themed layers will feed into the Commission's analysis as it works towards potential zoning scenarios that best achieve the goals and objectives of the planning process – such as promoting the well being of First Nations; minimizing conflict; promoting cultural values; promoting sustainable development, consideration of integrated management of land, water and resources; and recognizing all economic potential of the planning region.

It is not only important for the Commission to have the best available information to assist it with subsequent phases of the planning process; presenting this information in a public manner will assist the Parties, stakeholders and public in understanding the status of *all* resource values and their distribution throughout the planning region. Regional planning will require consideration of trade-offs and priorities. Hopefully this report will provide all interested parties with a better understanding of what values have to be considered and what is at stake.

## 2.0 REGIONAL SETTING

### Associated Maps

Map 1 Regional Overview

Map 2 Land Status

### *2.1 Legislative Context*

Under the mandate of Chapter 11 of the Umbrella Final Agreement (UFA), the Peel Watershed Planning Commission (PWPC) is responsible for developing and recommending a regional land use plan for the Peel Watershed Planning Region (Map 1). The PWPC is an arms length commission with members that are jointly nominated by the Yukon, Na-Cho Nyak Dun, Tr'ondëk Hwëch'in, Gwich'in and Vuntut Gwitchin governments. Once approved, the regional land use plan will apply to all Settlement and Non-settlement lands in the planning region.

The objectives of Chapter 11 of the Umbrella Final Agreement (DIAND 1993) regarding land use planning are as follows:

- 11.1.1.1 to encourage the development of a common Yukon land use planning process outside community boundaries;
- 11.1.1.2 to minimize actual or potential land use conflicts both within Settlement Land and Non-Settlement Land and between Settlement Land and Non-Settlement Land;
- 11.1.1.3 to recognize and promote the cultural values of Yukon Indian People;
- 11.1.1.4 to utilize the knowledge and experience of Yukon Indian People in order to achieve effective land use planning;
- 11.1.1.5 to recognize Yukon First Nations' responsibilities pursuant to Settlement Agreements for the use and management of Settlement Lands; and
- 11.1.1.6 to ensure that social, cultural, economic and environmental policies are applied to the management, protection and use of land, water and resources in an integrated and coordinated manner so as to ensure Sustainable Development.

The Commission's General Terms of Reference (YLUPC 2004), as agreed to by the Parties, states that:

The Commission will work towards the development of a plan for Settlement Land, Non-Settlement Land, and Tetlit Gwich'in Yukon land that is

consistent with, and achieves the objectives of Chapter 11 of Yukon First Nation Final Agreements, and:

- Promotes the well being of the affected First Nations, other residents of the planning region, the communities and the Yukon as a whole, while having regard to the interest of other Canadians (reference UFA 11.4.5.7)<sup>1</sup>;
- Recommends measures to minimize actual or potential land use conflicts throughout the planning region (reference UFA 11.4.5.4);
- Recognizes and promotes the cultural values of the affected First Nations and other affected Yukon Indian People (reference UFA 11.1.1.3);
- Ensures that social, cultural, economic and environmental policies are applied to the management, protection and use of land, water and resources in an integrated and co-ordinated manner so as to ensure sustainable development (reference UFA 11.1.1.6);
- Promotes sustainable development (reference UFA 11.4.5.9);
- Takes into account that the management of land, water and resources, including fish, wildlife, and their habitats, is to be integrated (reference UFA 11.4.5.8);

The PWPC General Terms of Reference (YLUPC 2004) also states two additional goals that the PWPC shall pursue:

- Recognize all economic potential of the planning region, including, but not limited to sub-surface resources.
- Provides for enhanced opportunities to have ongoing cooperative land use planning activities between the Peel Watershed Planning Commission and the Gwich'in Land Use Planning Board (Appendix C, 7.1.3, GCLCA). Any Regional Land Use Planning Commission, or other planning agency described in Appendix C, 7.1.1, GCLCA, shall consult with the Gwich'in Land Use Planning Board in order to make use of planning that has been done with respect to the Peel River watershed by the Mackenzie Delta Beaufort Sea Land Use Planning Commission, and to discuss ongoing co-operative land use planning activities.

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<sup>1</sup> These goals do not represent direct quotations of the UFA, but are derivations of the referenced clauses, as stated in the Commission's General Terms of Reference. See referenced clauses in the UFA for actual wording.

## **2.2 *Physical and Human Geography***

The Peel Watershed Planning Region (PWPR) is located in north-central Yukon and its boundary, not surprisingly, is defined by the watershed boundaries, with the exceptions of Tombstone Territorial Park which has been extracted from the planning region, and a small portion of Vuntut Gwitchin traditional territory that has been accommodated in the North Yukon Planning Region.

Despite the fact that it encompasses 68,042 km<sup>2</sup>, there are currently no permanent settlements within the planning region. Four First Nations have traditional territory within the PWPR: Na-Cho Nyak Dun, Tr'ondëk Hwëch'in, Teetl'it Gwich'in and Vuntut Gwitchin first nations.

The communities adjacent to the PWPR include Mayo, Dawson, Fort McPherson and Old Crow. While subsistence activities in the PWPR have declined over the past few decades, the fish and wildlife resources that inhabit this region remain an important cultural element of all of the affected First Nations. Activities in the PWPR that have contributed economically to these communities include trapping, big-game guiding, tourism and recreation, mineral and oil & gas exploration, and maintenance of the Dempster Highway.

## **2.3 *Land Status***

Within the planning region, there are five landholders: Na-Cho Nyak Dun, Gwich'in Tribal Council (Teetl'it Gwich'in First Nation), Tr'ondëk Hwëch'in, Vuntut Gwitchin and Yukon Government. (Map 1)

The Na-Cho Nyak Dun hold 25 Site Specific Settlement Lands ("site-specifics") and one rural-block ("R-block") in the southern boundary of the planning region, accounting for 0.38% (256 km<sup>2</sup>) of the PWPR. As Category A lands, the NND have ownership of both surface and subsurface rights. The traditional territory of the Na-Cho Nyak Dun encompasses 91.2% (61,472 km<sup>2</sup>) of the planning region and extends across the entire PWPR, with the exception of the lands west of the Dempster Highway.

The Teetl'it Gwich'in First Nation possess 14 site-specifics and 11 R-blocks, all of which are fee simple land titles – providing surface rights only. The Teetl'it Gwich'in lands represent 2.32% (1,566 km<sup>2</sup>) of the planning region, and are located along the mainstem Peel River in the Peel Plateau. The Teetl'it Gwich'in hold Primary Use and Secondary Use Areas in the planning region. The Primary Use Area, in the northern portion of the planning region – comprising 33% (22,234 km<sup>2</sup>) of the planning region – provides similar land rights to those given to Traditional Territory of other First Nations (DIAND 1992). The Teetl'it Gwich'in Secondary Use Area provides harvesting rights to beneficiaries and is located in the northwestern portion of the PWPR, representing 4.6% (3,082 km<sup>2</sup>) of the planning region.

The Tr'ondëk Hwëch'in have tenure of 8 parcels of Site Specific Settlement Land - mostly in the southwest portion of the planning region.

The Vuntut Gwitchin First Nation have 2 parcels of Site Specific Settlement Land within the planning region – both along the Dempster Highway.

The remaining lands in the PWPR are Yukon public lands administered by Yukon Government, accounting for 97.3% (65,558 km<sup>2</sup>) of the total planning region.

There are no private lands in the region.

There are currently no Special Management Areas or protected areas in the region. The Bonnet Plume River is a recognized Canadian Heritage River. The designation directs the First Nations, Canada and the Yukon Government to manage the watershed with a “higher duty of care”, but currently offers no formal protection.

## ***2.4 Existing Land Dispositions***

- Map 2 shows the current status of land dispositions in the planning region.
- One land parcel in the Peel Plateau & Plain oil and gas basin is currently under an oil and gas exploration permit. The permit holder is AustroCan Petroleum Corp. Expiry of the lease is 2014.
- In the PWPR portion of the Eagle Plain oil and gas basin, Northern Cross is the holder of 2 oil and gas exploration permits, with expiry in 2013. These dispositions represent 0.78% of the PWPR. There are 8 smaller Significant Discovery Licenses in this area, all held by Northern Cross Ltd.
- There are currently 10,631 active mineral claims and 9 coal licenses in the planning region, which represent 5.6% of the planning region.
- There are 19 gravel pits within the PWPR.
- There are two Yukon-managed airstrips in the region – both located along the Dempster Highway – at Chapman Lake and Ogilvie River.
- The Dempster Highway is the only all-season gravel road within the region. The road traverses approximately 130 kms of the western portion of the PWPR, in the Ogilvie Mountains.
- One of six outfitters currently holds leases for his base camps in the planning region. Land tenure policy for all big game outfitters is currently under negotiation with the territorial government.
- In total, the oil and gas dispositions, mineral claims and coal licenses represent approximately 4,608 km<sup>2</sup> or 6.8% of the entire planning region.

## ***2.5 Adjacent Land Status***

Map 2 depicts the current and proposed land status for areas adjacent to the planning region. The northern and eastern boundary of the PWPR is shared with the Gwich'in Settlement Area.

The northwestern boundary is shared with the North Yukon Planning Region, the southwestern boundary is shared with the Dawson Planning Region, and the southern boundary is shared with the Northern Tutchone Planning Region. Of these regions, the Gwich'in Settlement Area has a regional land use plan and the North Yukon Planning Region has a Recommended Regional Land Use Plan which is currently in the review and approval phase.

### **2.5.1 Gwich'in Settlement Area**

The PWPR's boundary to the north and east, is shared with the Gwich'in Settlement Area in the Northwest Territories. The Gwich'in Land Use Plan has three land use zones that abut the PWPR:

*Conservation Zone:* The James Creek Conservation Zone is adjacent to the northernmost corner of the PWPR, near the Yukon-NWT border. Oil & gas and mineral exploration and development, gravel extraction, and road construction are not permitted in this zone.

*Special Management Zone:* The Porcupine Caribou Special Management Zone is adjacent to the northern boundary of PWPR, and the Arctic Red River Special Management Zone is adjacent along the south east boundary. Gwich'in Special Management Zones permit all land uses as long as the specific conditions applied to each zone are adhered to. Licenses and permits cannot be issued in this zone unless the proposed use is in conformity with the Gwich'in Land Use Plan.

The Porcupine Caribou Special Management Zone restricts activities that might disrupt caribou migration or would alter migration habitat.

Arctic Red River Special Management Zone requires that no new activities can substantially alter water quality, quantity and rate of flow.

*General Use Zone:* All remaining adjacent Gwich'in lands fall under the General Use Zone. Under this zone, all uses are permitted if they meet the standard requirements for regulatory licenses, permits, and authorizations. (GLUPB, 2003)

### **2.5.2 North Yukon Planning Region**

The North Yukon Regional Land Use Plan has not yet been approved by the parties. However, the Recommended North Yukon Regional Land Use Plan identifies two land use zones adjacent to the PWPR, along the northwest boundary. These include

Zone II (low development) in the South Richardson Mountains. This zone indicates "that there are high ecological and heritage/cultural values within a moderately sensitive biophysical setting. Maintaining ecological integrity, protecting heritage and cultural resources, and minimizing land use impacts are the priority." (NYPC, 2008)

Zone IV (highest development) in the Eagle Plains. This zone indicates that there are "lower ecological and heritage/cultural values within a moderately sensitive biophysical setting." (NYPC, 2008)

### **2.5.3 Tombstone Territorial Park**

Tombstone Territorial Park was established through the Tr'ondëk Hwëch'in Final Agreement. The Park sits adjacent to the southwest boundary of the PWPR, encompassing about 2,200 km<sup>2</sup>. Mineral and oil and gas exploration and development are not permitted within the park boundaries.

The northern portion of the Park is part of the Peel watershed, but is not included in the Peel Watershed Planning Region.

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### 3.0 HERITAGE AND CULTURAL RESOURCES

#### Associated Maps

Map 3. Subsistence Harvesting

Map 4. Heritage and Cultural Resources

#### **Introduction**

Although there are currently no human settlements located in the PWPR, the Tr'ondëk Hwëch'in, Na-Cho Nyak Dun, and Vuntut Gwitchin of the Yukon and the Teetl'it Gwich'in of the Northwest Territories have traditionally occupied, travelled or harvested in virtually every corner of the planning region. This presence is reflected in the many trails and named places which provide a window into the culture and history of the region.

Archaeological evidence indicates the region has been occupied for millennia. In traditional patterns of land use, summers were typically spent in family units, at fishing camps; fall was a time for caribou and moose hunting; and winter was an opportunity to congregate, dry meat and hunt caribou. With the advent of the Klondike Gold Rush and the arrival of the Hudson's Bay Company, traditional lifestyle patterns changed in order to take advantage of economic opportunities. Much of the PWPR has yet to be systematically surveyed by archaeologists or palaeontologists, and the First Nations have gathered some but not all traditional knowledge of the region.

The First Nations' heritage is intrinsically tied to the landscape, the environment and the wildlife that inhabit it. For the First Nations, their heritage and culture is represented as much by expansive natural features – such as mountains, mountain ranges, lakes, and rivers and the stories embedded in these places – as it is by archaeological artifacts, fishing camps or tent rings. Presenting the natural and constructed features on maps can be problematic, due to the sensitivity of the information. Heritage managers are concerned that revealing the location of archaeological or palaeontological sites makes these locations vulnerable to looting. The location of traditional resource areas, such as fishing sites, is knowledge that First Nations wish to protect as well. In the case of the natural features, defining their boundaries also presents difficulties for mapping. Fish and wildlife play a critical role in the First Nations culture. In addition to their spiritual role, fish and wildlife had a significant influence on the movement of the people, their social interaction and, obviously, for their diet. Maps 3 and 4 identify some important harvesting areas, travel routes, and culturally significant places. The First Nations' knowledge of important wildlife habitat has been incorporated in the Fish, Wildlife and Conservation chapter.

*Unless otherwise noted, the following information is derived from Preliminary Summary of Heritage Values in the Peel River Watershed Planning Area. (Gotthardt 2007)*

### 3.1 *Palaeontological Record*

- There is a limited understanding of the palaeontological resources of the PWPR. The region has not been systematically surveyed. Significant palaeontological resources are thought to exist in the region, including rare evidence of dinosaurs in the Yukon.
- Evidence of Ice Age animals and environments has been identified in major drainage basins of unglaciated northern Yukon. These are commonly located in the frozen silts that have become exposed along eroded riverbanks.
- Clues to these prehistoric environments are found in the form of pollen, plant macrofossils, microtine fauna (*of the rodent sub-family*) and insect remains.
- Hungry Creek hosts a variety of evidence of palaeoenvironments, fauna, and possibly human presence. The evidence includes wood fragments, plant debris that is reminiscent of open, treeless conditions, insects and Ice Age mammal bones, including mammoth, sheep, bison and Yukon horse.
- Two sites along the Dempster Highway are characterized by plant macrofossil remains that date to 65-70 mya (million years ago). Additional sites of this nature likely exist.
- The remains of a half-grown hadrosaur were unearthed in the “Burning Rock” area in the vicinity of Peel Canyon. The bones date to the late Cretaceous Period, approximately 70 million years ago.
- Bedrock formations in the Snake River area have recently produced the remains of 400 million year old ichthyofaunas (fish-like dinosaurs). Fossil lungfish, dating to 395-345 mya have also been recovered from the Snake River. Lungfish are an evolutionary ancestor to amphibians.<sup>2</sup>

### 3.2 *Archaeological Record*

- Archaeological site density is high in the western Richardson Mountain foothills, where “virtually every exposure that was examined in the area where the Dempster Highway crosses the Rock River had evidence of pre-contact archaeological remains” (Le Blanc in Gotthardt 2007). By contrast, far fewer sites have been identified through surveys on the eastern slopes of the Richardson Mountains. Based on the geographic location or absence of the artifacts, it is hypothesized that this pattern is reflective of the accessibility of caribou and sheep to prehistoric hunters. Traditional knowledge also reinforces the understanding that traditional travel routes crossed the eastern slopes of the Richardson Mountains to get to the more resource rich western portion. However, further surveys in the region will be needed to confirm this hypothesis. There are also many Teetl’it Gwich’in named places and trails in the eastern and southern parts of the Richardson

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<sup>2</sup> Teetl’it Gwich’in and Gwichya Gwich’in stories describe how the Snake River was formed by a giant hairy worm (snake) that came out of the ocean, travelled up the Mackenzie and Peel rivers and then travelled into the mountains by swallowing big boulders as it made its way up the river, thereby creating the Snake River. (Kritsch and Andre 1993:44 – Gwichya Gwich’in Place Names Up the Arctic Red River and South of the Mackenzie River, Gwich’in Settlement Area, N.W.T. Published by GSCI.)

Mountains. indicating knowledge and use of these areas, but because this area appears to have been mainly used in winter when people were following the caribou, sites would be less visible and harder to find and record with the kind of archaeological survey carried out to date. For example, oral history accounts recall large groups of people staying part of the winter in the Caribou River area hunting caribou and moose (around Caribou Mountain) – which in Gwich'in (Edigii) refers to caribou calving here (Robert and Walter Alexie 1998 - Fort McPherson-Mayo ski-doo trip). There is evidence of an adze-cut stump here, so use may be pre-contact. There is also oral history information about a fishhole in the headwaters of the Vittrekwa River where people used to spear fish that spawned here in the fall. (Walter Alexie, TGPN96/97, Tape 15B, June 19, 1996). Trails run up or near the Stony, Vittrekwa, Road, Trail, Caribou rivers for access to hunting and trapping.

- Historic and ethnographic evidence indicates that the Peel River, below the confluence of the Snake River, was an important location for fish camps, and offered a base camp for hunting and trapping in the vicinity. It is presumed that some of these archaeological sites were likely lost through the erosion of the banks.
- There has not been a thorough archaeological survey conducted of the Mackenzie Mountains ecoregion. Six archaeological sites have been identified in the region.
- Our understanding of prehistoric and historic human activities in the Mackenzie Mountains is very limited. According to Teetl'it Gwich'in elders, peoples tended to move into the mountains in the fall to hunt sheep and caribou, and remained there until spring. Then in springtime, they would return to the Peel River to fish for whitefish, grayling, coney, crooked backs, loche, jackfish and herring..
- Archaeological evidence suggests that the upper Ogilvie and Blackstone rivers received fairly intensive human use. Traditionally, this area was used by Tukudh Gwich'in, Teetl'it Gwich'in and Tr'ondëk Hwëch'in cultures.

### 3.2.1 Traditional Sites and Territories

- The traditional territories of the Tukudh (Upper Porcupine) and Teetl'it Gwich'in that were generally in the northern two-thirds of the planning region were shared with the Northern Tutchone Na-Cho Nyak Dun and the Tr'ondëk Hwëch'in Han, who occupied the southern portion of the planning region.
- During the pre-contact period, the Tukudh Gwich'in territories were known to centre around the upper Porcupine drainage, and the upper Ogilvie River drainage. This area was referred to as the Tukudh Homeland in the Gwich'in language. The Tukudh Gwich'in were known to spend their winters in the 19<sup>th</sup> and early 20<sup>th</sup> centuries in the villages of Black City and Calico Town (near the head of the Blackstone River), Whitefish Lake, Whitestone Village and Johnson Creek Village, which was also occupied by Teetl'it Gwich'in and Tr'ondëk Hwëch'in. These villages were used as a base to dry their meat from the fall hunts, and to hunt caribou through the winter.
- The Teetl'it Gwich'in traditional territory encompasses much of the Peel River watershed, reaching into the upper reaches which were shared with the Tukudh Gwich'in. During the

pre-contact period, the Teetl'it Gwich'in hunted caribou in the Richardson, Ogilvie, Wernecke and Mackenzie mountains in winter. Hunting areas were mainly around Vittrekwa River, Stony Creek, Road River, Trail River, Caribou River, Snake River, Bonnet Plume River, Wind River, Hart River, Blackstone River, Ogilvie River, and Hungry Lake. Caribou were traditionally hunted by snare and caribou fences. Springtime offered the opportunity for various family units to gather at Hungry Lake or on the Peel River at the mouth of the Wind or Snake rivers, or most commonly at Burning Rock. Spring break-up would allow families to travel to their fish camps on the Peel River, with the most important being Fish Trap Head (Ok chi; – in the Trail River area). Summers were traditionally spent fishing. The fall was commonly spent hunting migrating caribou in the mountains, and winter usually was a time to follow the caribou herds for further hunting.

- The Teetl'it Gwich'in incorporated spring visits to the HBC post established near Fort McPherson in 1840 into their seasonal round. People and their goods were transported in large moose skin boats constructed at a number of sites below Aberdeen Canyon where there was a good source of tall straight spruce trees: i.e. Doll Creek, Beaver Creek, Hungry Creek, Mountain Creek, Ezhinak'an (a.k.a. Burning Rock), Bonnet Plume River, Aghoo tshik, Snake River.
- Black City and Calico Town are located on the Blackstone River, a few kilometres from each other. Black City was a winter village which served as a base for a number of Teetl'it Gwich'in, Tr'ondëk Hwëch'in and Tukul'dh Gwich'in families that were taking advantage of the economic and trading opportunities that were generated by the Klondike Gold Rush. The site was abandoned in the late 1920s.
- The Na-Cho Nyak Dun traditionally spent most of their time in the Stewart River drainage, south of the Peel watershed. However, the Na-Cho Nyak Dun would often travel in the fall to the Wind River area or near the Arctic Red River to snare sheep. They would also build moose fences and caribou corrals in the Wernecke Mountains in the wintertime.

### 3.2.2 Contact Sites

- There are places in the watershed where Teetl'it Gwich'in place names reveal contact between the Teetl'it Gwich'in and the Siglit. Eneekaii te'echuuch'eü near Road River is one place where there was a battle between the two groups. The name translates as "Eskimos shot their arrows." The Teetl'it Gwich'in name for George Creek (Taa'aih khanjilnaih) translates as "Paddles-broken up." Although this does not appear to be a battle site, it represents an incursion by the Siglit deep into Teetl'it Gwich'in lands (Kritsch et. al. 1998:14). Other places of contact are located further downriver in the NWT portion of the watershed.

### 3.2.3 Gold Rush and Trapping Era

- The fur trade was introduced to the area in the mid-nineteenth century, as the Hudson's Bay Company (HBC) began establishing posts in the 1840s in adjacent regions. HBC

established its first post in the area in 1840, four miles upriver from the present day community of Fort McPherson.

- Some of the Klondike Gold Rush stampeders made their way to Dawson via the Peel River and headed overland southwest. Villages such as Wind City, Hungry Creek, Black City and Calico Town were established to support the increased traffic.
- The trails that had been traditionally used by the Teetl'it Gwich'in between Fort McPherson and Dawson City were later used by the Northwest Mounted Police, trappers, prospectors and outfitters. It was along one of these trails that the four members of the NWMP "Lost Patrol" perished in 1911.
- In the 1930s, trading posts were established at Chappie Lake and at the junction of the Blackstone and Ogilvie rivers.
- The Dempster Highway retraces one of the main trails that the Gwich'in used for hunting and trapping.
- Tr'ondëk Hwëch'in elders once trapped at Hart River, West Hart River, Rae Creek, Worm Lake, and Wind River.
- The Teetl'it Gwich'in trapped throughout the Peel watershed and approximately 60 cabins have been recorded by Gwich'in Social Cultural Institute (GSCI) along the Peel River between Fort McPherson and the Bonnet Plume River.
- Small outpost trading posts were operated by Teetl'it Gwich'in individuals in the Trail and Road river areas in the early 1900s. In the 1930s, Johnny Kaye had a trading post for Northern Traders across from Gwitshii dii'ee located between Trail and Road rivers (Walter Alexie, TGPN 06/07, Tape 15B, June 19, 1996). Chief Julius had a trading post for the HBC on the left bank of the Peel River, in the Trail River area. (Robert Alexie Sr., TGPN96/97, Tape 12A, June 18, 1996).

### ***3.3 Culturally Important Elements on the Landscape***

- Areas and locations with subsistence harvesting or other cultural values were collected at community workshops held in Dawson City, Mayo and Fort McPherson. A more detailed discussion of this process is found in the Conservation Priorities Assessment Report (PWPC 2008). The results of this process are depicted on maps 3 and 4.
- Spring water is an important resource to the Tr'ondëk Hwëch'in, as it is abundant in minerals and is used for healing purposes. Combined with medicinal plants, it is considered especially effective. Spring sources that are particularly important to the Tr'ondëk Hwëch'in include: a stream near Cache Creek, springs in the Hart River territory, and Engineer Creek.
- The Dempster Highway corridor offers access to thousands of different medicinal plants. Some categories of these are: mosses, shrubs, berries and roots. The most notable locations for medicinal plants include: Black City, Chapman Lake, and the West Ogilvie and Churchward Hill area.

- Gravesites are scattered along the Dempster Highway and throughout the Blackstone region. Gravesites have been identified at: Black City, along the Blackstone, Bonnet Plume, Ogilvie, Wind, Trail and Road rivers, as well as Cache Creek. There are possible gravesites across the river from the Blackstone outfitting camp, and near Worm Lake. There are also two monuments along the Peel River commemorating where the four NWMP members of the Lost Patrol died. (Kritsch et al., 1998:16-17).
- Sulphur licks are a medicinal source, usually used in combination with spring water. A few sulphur licks are located in the Ogilvie River area. Sulphur sources have been recorded in the Stony, Caribou and Road river areas (Kritsch et. al. 2000:25, 42, 48, 51).
- There are currently a total of 10 trap lines in the PWPR, of which 6 belong to Tr'ondëk Hwëch'in beneficiaries.
- Marten are the preferred furbearers for trapping, though foxes, wolverines, lynx, beavers and wolves are also trapped.
- Trails and travel routes were important corridors for hunting and trapping, trade and commerce, and social interaction among the First Nations. Most traditional trails have not yet been documented. There are trails between the Ogilvie and Blackstone areas, as well as trails that connect the Blackstone and Hart rivers. The famous Lost Patrol trail was used by the Northwest Mounted Police to transport mail between Dawson City and Fort McPherson. It was also a well used transportation route for the Teetl'it Gwich'in and Tr'ondëk Hwëch'in.
- First Nation camps and cabins – prehistoric, historic and contemporary – are scattered throughout the PWPR. Their locations offer hints to the particular seasonal fish and wildlife resources at a local level.
- The Teetl'it Gwich'in First Nation has identified two sections of the Peel river as deserving recognition as a National Historic Site (Fafard and Kritsch, 2003). The first site is a 10 km wide and 165 km long corridor between the confluence of the Mackenzie and Peel rivers, and the Trail River. The second site is an area further upriver, locally referred to as the Peel Canyon; it is approximately 41 kms in length and 10 kms wide (Map 4 and 17). The two sites are linked by common stories and history. These sites represent very important cultural landscapes – both prehistoric and historic – for the Teetl'it Gwich'in people, reflecting their thriving culture, as well as commemorating their first interaction with European traders. The proposed historic sites encompass trailheads, camp sites, gathering places, burial sites, sacred/legendary places, resource harvesting locations, villages, moose skin boat building and gathering sites, and places where the Teetl'it Gwich'in have interacted with other cultural groups. The sites are also in close proximity to – and provide a physical connection to – numerous other culturally important sites.
- In 1993, the entire Bonnet Plume watershed was nominated to the Canadian Heritage Rivers System by the Government of Yukon, Indian and Northern Affairs Canada, and the Mayo District Renewable Resource Council (MDRRC) in recognition of the extensive First Nations presence in the region, as well as the era of prospecting and trapping, and for the significant natural history of the watershed. The nomination fulfilled an obligation under the First Nation of the Na-Cho Nyak Dun Final Agreement to protect the river's heritage values. The designation provides the cooperative management mechanism to

achieve the “higher duty of care” desired by First Nations, Canada and the Yukon Government. The overall objectives for managing the river from a Heritage River perspective are: 1. to conserve the river’s natural and human heritage values; 2. allow for interpretation of these heritage values; and 3. provide recreational and heritage appreciation opportunities. (Government of Yukon, 1998)

### ***3.4 Outstanding Heritage Information Needs***

- Further gathering of traditional knowledge with respect to all heritage values in the PWPR.
- Further archaeological and palaeontological surveys of the entire PWPR.

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## **4.0 ACCESS & TRANSPORTATION**

### **Associated Maps**

- Map 5: Access & Transportation
- Map 10: Mineral Potential and Resource Interests
- Map 11: Wernecke Breccias: Copper, Gold & Uranium Potential
- Map 12: Carbonate Hosted (MVT): Zinc – Lead Potential
- Map 13: Coal Potential
- Map 14: Crest Iron deposit & Iron Potential
- Map 15: General Mineral Potential
- Map 18: Existing Land Use Impacts

### **Introduction**

Access is often at the crux of all regional land use planning decisions. In the case of the Peel watershed, that certainly holds true. Access, in the context of regional planning, refers to physical access to a particular resource value, as well as the legal rights or policies that permit access to a given area.

Access is critical for any industrial development: access to the resource, and access to bring the resource out to the market. Access can play a significant role with respect to the viability of a development project. In most cases, the more transportation infrastructure available, the more viable an industrial project, such as mining and oil gas, can become.

In contrast, the wilderness tourism industry benefits – and sometimes relies on – the absence of access in order to market its product (with the exception of fly-in landing sites). Increasing access, by constructing a network of roads for example, would eventually diminish the wilderness quality that makes the region unique and marketable to paddlers and other recreational travellers.

Similarly, access infrastructure and associated human traffic can have a detrimental impact on the wilderness character of a region, due to such things as noise disturbance, ecosystem fragmentation, and degradation of the natural environment.

Access, therefore, deserves particular attention in regional land use plan scenario – whether attempting to accommodate or facilitate economic activity in a given area, delineating areas of conservation value and ecological sensitivity, or when attempting to minimize land use conflicts.

### **4.1 Overview**

- Currently, land-based access to the Peel watershed is very limited. The only all-season, maintained highway that transects the PWPR is a 130 km portion of the Dempster Highway that runs north-south through the western portion.



- The Dempster Highway is the only maintained highway in the PWPR, providing an important corridor for the transport of freight, tourists and passenger traffic to and from the Northwest Territories. It provides access to oil and gas exploration, mineral exploration, tourism & recreation and continued subsistence harvesting. It also provides access to aggregate (gravel) reserves, while simultaneously being a major consumer of them.
- Another government-regulated road in the PWPR is the Wind River Trail, which enters the PWPR from the southern boundary via Braine Pass, heading northward following the Wind River, then heading northwest towards the Dempster Highway.
- Air access in the PWPR is most common by float plane to a number of lakes in the region. Land-based airstrips are scattered throughout the PWPR (Map 5). Helicopters can access virtually all portions of the planning region and are a common mode of transportation for mineral and oil & gas exploration.
- Water access is most common along the mainstem of the Peel River, via the Northwest Territories. The Peel River is navigable by motorized vessels as far as Aberdeen Canyon on the Peel River. Paddlers can access the watershed from the Dempster Highway, via the Ogilvie and Blackstone rivers, or from the fly-in launch sites for any of the major tributaries. Water-based access routes can be very unpredictable, due to dramatic fluctuations in water levels. At certain times of the year, these routes may be entirely inaccessible to watercrafts. Portaging is necessarily at Aberdeen Canyon, and often recommended at several other rapids.
- Oil and gas developments typically require all-season access roads along pipeline routes and to well sites. These roads may or may not be publicly accessible. On occasion, the pipeline route may follow the right-of-way along a public road.
- Mineral development projects, in the Yukon, have typically used all-season roads for transportation of the resource to markets. Winter roads and landing strips are the choice of infrastructure for the diamond mines in the Northwest Territories. With some precious and semi-precious minerals, it is possible to conduct the mining operation by air access only.
- The wilderness tourism and big game outfitting industries usually access the PWPR by float plane to specific launch points at lakes near the headwaters of the major tributaries. These are identified as “Put In (air access)” features on Map 6.

## **4.2 Roads**

### **4.2.1 Dempster Highway**

- The Dempster Highway provides a 736 km road link for the Mackenzie Delta communities of Fort McPherson, Tsiigehtchic and Inuvik in the Northwest Territories to the Yukon and southern Canada. A 130 km portion of the highway passes through the PWPR.

- The Dempster Highway was built between 1960 and 1978 at a total cost of approximately \$100M. The average cost of construction per kilometre ranged from \$13,000 (in 1960-62 Canadian dollars) to \$315,000 (in 1978 Canadian dollars).
- During the period 1993 – 2003, an average of 40 vehicles per day travelled the Dempster Highway. During summer, peak traffic levels of 150 – 200 vehicles per day occur occasionally.
- The Dempster Highway is managed under a special regime. The *Dempster Highway Development Area Regulations*, which fall under the *Area Development Act*, apply within 8 km on each side of the road centre line, for a total corridor width of 16 km (Map 5). The regulations are intended to provide for a higher level of environmental assessment and regulation of activities for new road access originating off of the highway within the 16 km corridor.

#### **4.2.2 Wind River Trail**

- The Wind River Trail is a 175 km long trail that enters the PWPR through Braine Pass.
- The original purpose of the trail was to supply oil drilling operations taking place on Eagle Plains and as far north as the Bell River. The original road was built by White Pass as a winter road as part of their contract to supply the drilling operations. They also ran freight trucks on the road after its construction.
- The Trail has supported mineral exploration over many years since its construction. However, the Trail has experienced very sporadic use in recent years.
- In the winter of 2007, Cash Minerals Ltd was granted permission to construct and use a portion of the Trail for mineral exploration purposes during winter months only.

#### **4.2.3 Hart River Road**

- The Hart River Road was built prior to 1971 for access into the Silver Hart Mines.
- Yukon residents currently use the road for hunting and recreation access.

#### **4.2.4 Road Construction**

- A rough cost estimate for the upgrading of an existing “resource type” access road in the PWPR is approximately \$250,000 per kilometre. If constructing a similar road in a completely new location (requiring additional route location work, soil testing, clearing and grubbing), a rough cost estimate would be \$300,000 to \$350,000 per kilometre. Maintenance costs, though weather dependent from year to year, would cost approximately \$7,500 per kilometre. [W. Hidingier 2008, pers. comm., 1 Apr. The Yukon Government produced a “Roads to Resources” map product which outlines potential routes for road scenarios (Map 5). The “desktop” exercise considered the most viable routes, based on topography. In total, 11 out of 47 roads pass through the PWPR, representing 1,170 km of potential roads.

- Winter roads, constructed of snow and ice, are a common means of temporarily accessing remote locations in the PWPR, primarily for oil & gas and mineral exploration purposes. Map 5 identifies the winter roads in the planning region.

#### **4.3 *Air Landing Sites***

- There are 35 of air landing strips in the PWPR. Of these air strips, only two airstrips, both located along the Dempster Highway, fall within the jurisdiction of Yukon Government: Chapman Lake and Ogilvie River.
- Construction of new air strips require land use permits and review by the YESAB.
- Fixed wing and helicopter are the most common means of accessing the Peel watershed for mineral and oil & gas exploration.
- Float plane is the most common method of accessing the major tributaries for guided and self-guided paddlers. Put-in locations include Bonnet Plume Lake, Duo Lake, Elliott Lake, Fairchild Lake, Goz Lake, Hart Lake, and Worm Lake. Take-out points by float plane include Canyon Creek, and Taco Bar. (Map 6)
- Big game outfitters commonly access their base camps by float plane or terrestrial-based fixed wing.

#### **4.4 *Railway Scenario***

- Railway construction was indicated as the most practical mode of transporting iron ore from the Crest Iron deposit to market. (Gartner Lee, 2006)
- In 2005, the Yukon Government and State of Alaska launched a feasibility study of a rail link that would connect Yukon and Alaska with the North American railroad system. Phase I Feasibility Study was completed in 2006. The study considered a variety of railway scenarios – some of which included a rail link between the Crest Iron deposit and Carmacks for the purposes of transporting iron ore to processing plants and markets.
- The estimated cost of constructing a railway line from the Carmacks to the Crest Iron deposit is approximately \$4.7 billion dollars (U.S.), or a cost of \$6.8 million dollars per kilometre. The estimate does not include maintenance of the rail link. (Banjar Management et al., 2006)
- The Feasibility Study includes an iron ore scenario with a pellet plant in Carmacks, whereby the source of the iron ore is the Crest Iron deposit. The estimated revenue from the iron ore pellets is \$22 billion dollars (ALCAN RaiLink Inc. 2007, p. 15). However, the cost of getting the iron ore from the Crest deposit to Carmacks – either by railway or slurry – is not accounted in the study, as that was considered to be part of a separate mine development plan and estimate.

#### **4.5 *Potential Incentives and Constraints to Development of Access Infrastructure***

- *Development prospects.* An investment in access infrastructure is not likely unless there is a viable resource to exploit for revenue. The remote nature of the PWPR would result in substantial costs for road or railway infrastructure.
- A significant revenue generator (or network of generators) could warrant the development of access infrastructure. Once infrastructure is in place, it becomes easier for smaller or less viable development projects to get established.
- *Terrain.* The soil conditions, topography and accessibility to aggregate (gravel) will contribute to access decisions regarding routing and the costs of road construction.

#### **4.6 *Outstanding Information Needs***

- Comprehensive survey data of available aggregate deposits in the PWPR. Knowledge of these deposits would facilitate the planning, construction and maintenance of roads.

#### **References:**

ALCAN RaiLink Inc. 2007. Rails to Resources to Ports: The Alaska Canada Rail Link Project Phase 1 Feasibility Study, Executive Report. Prepared for The Yukon Government and The State of Alaska. Whitehorse, Canada. 76pp.

Banjar Management and CH2M Hill Canada Ltd. 2006. Alaska-Canada Rail Link Study: Phased Multimodal Integration Work Package (B3b) Life Cycle Capital Cost Estimation. Prepared for Alaska Canada Rail Link Project: Feasibility Study ALCAN RaiLink and Yukon Engineering Services. 52pp.

Gartner Lee Limited. 2006. Strategic Overview of Possible Mineral Development Scenarios – Phase 1 Peel River Watershed Planning Region. Prepared for Economic Development, Government of Yukon. September 2006. 34pp.

## **5.0 TOURISM AND RECREATION**

### **Associated Maps**

Map 5: Access & Transportation

Map 6: Existing Tourism & Recreation Activities

### **Introduction**

Tourism and recreation activities in the Peel region are similar and are usually based on the same natural, historic and built resources. In this report, tourists are non-Yukon resident visitors and recreation refers to Yukon resident activities. This report does not include guided hunting. Traditional and subsistence activities carried out by First Nations people are not considered as recreation.

Tourism has been a consistent foundation to Yukon's economy for many decades and remains so today. The Peel watershed, in particular, has been a draw for river paddlers – both Yukoners and foreign visitors – since the 1960s. The PWPR has experienced a growth in visitations during the past five years – particularly among self-guided paddlers. The expansive wilderness in the Territory supports tourism products that attract visitors from around the world, and recreation opportunities for Yukon residents.

From a tourism and recreation perspective, the Peel watershed can be divided into two areas: a) two road-accessible watersheds traversed by the Dempster Highway in the west and b) four remote, and essentially unroaded, watersheds in the east. The Peel watershed supports very high quality tourism products and experiences for highway travelers on the Dempster Highway and for wilderness travelers seeking remote canoeing and hiking experiences. Just as highway tourism relies on roads, high quality backcountry tourism relies on their absence. Touring is the main activity along the Dempster Highway corridor, and often includes wildlife viewing, day hiking, camping and sightseeing. Remote watersheds to the east attract paddlers and hikers interested in multi-day, physically challenging river trips that include a variety of activities such as hiking, wildlife viewing and photography. These activities occur along the Snake, Wind, Bonnet Plume, Ogilvie, Blackstone and Hart river corridors. Highway touring and remote river travel have both grown over the past decade, with remote wilderness tourism showing the greatest potential for growth in the region. However, future growth will have to be managed to remain within a carrying capacity, or threshold, based on ecological, cultural, sociological and tourism sector factors.

The Peel watershed is a valued destination among Yukon residents seeking a high quality wilderness paddling experience. There is limited data regarding recreation (self-guided) visitation by residents and non-residents to the Peel watershed.

To date, the First Nations have had a limited presence in the tourism sector in the PWPR. It is up to the First Nations to direct and manage their future role in tourism in the Peel watershed. Potential involvement in the sector could include business development, joint ventures, employment, and training.

*Unless otherwise noted, the following information is derived from “Peel Watershed Tourism and Recreation Report”, Earle (2008). (See reference below).*

### **5.1 Road-accessible Tourism and Recreation**

- The Dempster Highway represents a unique and renowned tour route in North America and is recognized as one of the last wilderness highways in North America. The highway is the only public route in Canada to cross the Arctic Circle, passes through three Yukon planning regions, and provides access to scenic sub-arctic landscapes. The highway attracts thousands of visitors each year, offering many opportunities for hiking, nature walks, photography, birdwatching, camping, mountain biking and wildlife viewing. The Dempster’s scenic viewsapes are especially important to highway travelers.
- Tourists have ventured up the Dempster Highway since it was completed in 1978. In more recent years, highway travel north of Tombstone Park has increased steadily – from 4,455 in 1994 to over 8,000 in 2004. Most travel in private vehicles, however about 10 mostly Yukon-based operators currently offer van and camping tours as well as summer and winter wilderness trips along the highway.
- The Dempster Highway is a popular travel route and destination for Yukon residents, due to its access to rivers, hiking, wildlife viewing and birdwatching.
- There is very little data regarding self-guided tourism activities along the Dempster Highway.

### **5.2 Remote Wilderness Tourism and Recreation**

- The PWPR is the Yukon’s largest intact remote wilderness area, and the watershed is recognized as a world-class wilderness canoeing and ridge hiking destination.
- The PWPR possesses a unique set of attributes that contribute to its wilderness tourism value: a) multiple, challenging and attractive canoeing rivers with easy access to overland hiking; b) large, healthy, intact and roadless wilderness; c) visually dramatic and varied landscapes; and d) abundant wildlife. These features support very high quality wilderness tourism products and valued recreation experiences.
- In 2008, a study prepared for Yukon Parks concluded that: a) diversity of recreational activities is highest in the Snake, Bonnet Plume, and Wind basins; b) the most extensive hiking area is in the Hart River basin, but the highest quality hiking is found in the upper Wind and Snake river basins; and c) very high recreation potential is identified along and between the upper Snake and Bonnet Plume rivers, and along a 70 km section of the Peel River (likely upstream of the Snake River) (Green et. al. 2008). *See section 10.7 for further details.*
- In 1988, the Department of Renewable Resources (Environment) completed a *Recreation Features Inventory for Northern Yukon*. In the PWPR, the Mackenzie Mountain ecoregion, in the southern half of the planning region, and the Richardson Mountains in

the northwest portion, ranked as “high” recreation significance. These features are consistent with those areas of recreational importance that have been identified by wilderness tourism operators, hunting outfitters, First Nations, ecologists, conservation organizations and others.

- The “Importance of Nature to Canadians” (2000, cited in Earle, 2008) indicated that Yukon residents spent \$1,298 on outdoor activities in natural areas, almost twice the national average (\$704).
- Yukoners represent a significant portion of visitors to the PWPR. Yukon residents accounted for 30% of all paddlers on Peel rivers in 2007. (*See Figure 5.0*)
- The PWPR offers a range of key recreation values of interest for residents seeking recreational opportunities that incorporate challenge, adventure and the importance of self-reliance in a remote setting.
- The PWPR is comprised of six mountain tributaries that feed into the Peel River: the Snake, Bonnet Plume, Wind, Hart, Ogilvie and Blackstone rivers. These rivers offer canoeable routes of varying degrees of duration, character and difficulty (grade II or III). Paddlers also take advantage of the high-quality alpine hiking opportunities during their excursions.
- The PWPR has attracted river paddlers since the 1960s and by the early 1970s half a dozen Yukon-based operators were running trips on remote rivers. In 2006, 10 mostly Yukon operators guided canoe trips in the watershed, and several additional companies rented canoes and equipment to self-guided tourists. The Wind and the Snake rivers are the most popular rivers for tourists, and several operators guide trips on the Bonnet Plume and Hart rivers.
- Peel Watershed rivers support tours that generate very high revenues per client. Peel trips cost approximately \$5000 or more per person, while trips of comparable length on road accessible rivers in the Territory cost about \$2000. Most operators use regional air charter companies and accommodations.
- In 2006, 84 guided tourists spent 1,131 user days in the region; 73 self-guided tourists spent 1,228 user days on remote river trips. (Wilderness Tourism Licensing Act Trip and Rental Report data, cited in Yukon Department of Tourism and Culture and Department of Environment Parks Branch) In 2007, about 70 recreational paddlers (mostly Yukoners) accessed remote Peel Watershed rivers. (*See Tables 5.1, 5.2, 5.3 and Figure 5.0*)
- Very high value hiking areas are most numerous in the Snake, Bonnet Plume, Wind and Hart river basins. Most of the very high recreational potential has been identified along the headwaters of the Snake and Bonnet Plume rivers, midway along the divide between the Snake and Bonnet Plume valleys and along a 70km section of the Peel River (Green et al. 2008).
- In 1993, the entire Bonnet Plume watershed was nominated to the Canadian Heritage Rivers System by the Government of Yukon, Indian and Northern Affairs Canada, and the Mayo District Renewable Resource Council (MDRRC) in recognition of the extensive First Nations presence in the region, as well as the era of prospecting and trapping, and for the significant natural history of the watershed. The nomination fulfilled an obligation

under the First Nation of the Na-Cho Nyak Dun Final Agreement to recognize the river's heritage values. The designation provides the cooperative management mechanism to achieve the "higher duty of care" desired by First Nations, Canada and the Yukon Government, but provides no legislated or regulated protection to the watershed. The overall objectives for managing the river from a Heritage River perspective are: 1. to conserve the river's natural and human heritage values; 2. allow for interpretation of these heritage values; and 3. provide recreational and heritage appreciation opportunities (Government of Yukon, 1998).

- River travel is the most popular wilderness tourism activity in the region. However, other activities include: hiking, horseback riding, wildlife viewing, birdwatching, fishing, and photography.
- Anyone who takes clients into the Yukon wilderness in return for any kind of fee or reward needs to have a Wilderness Tourism License. The purpose of this *Act (WTLA)* is primarily to provide a minimum standard of client and staff safety and to help sustain the wilderness quality of Yukon lands and waters, and by so doing, enhance the quality of the wilderness tourism sector.

**Table 5.1 Wilderness Tourism - Guided Trips & Canoe Rentals:  
All Peel Watershed: 1999 – 2006\***

	Guided Trips**			Canoe Rental Clients**	
	Operators	Clients	User Days	Clients	User Days
1999	6	49	540	20	340
2000	4	27	344	36	616
2001	6	60	719	37	639
2002	10	98	1,434	26	486
2003	11	157	1,949	54	1,216
2004	7	124	1,792	20	316
2005	8	129	1,697	83	1,062
2006	10	84	1,131	73	1,228



**Table 5.2 Wilderness Tourism - Guided Trips & Canoe Rentals:  
Snake River: 1999 – 2006\***

	Guided Trips**			Canoe Rental Clients**		
	Operators	Clients	User Days	Canoe Rental Operators	Canoe Rental Clients	User Days
1999	NA	NA	NA	NA	NA	NA
2000	3	19	259	3	26	424
2001	4	31	394	3	28	470
2002	4	30	438	3	6	124
2003	5	63	709	3	24	618
2004	4	30	384	NA	NA	NA
2005	4	35	525	3	39	528
2006	3	20	274	3	29	389

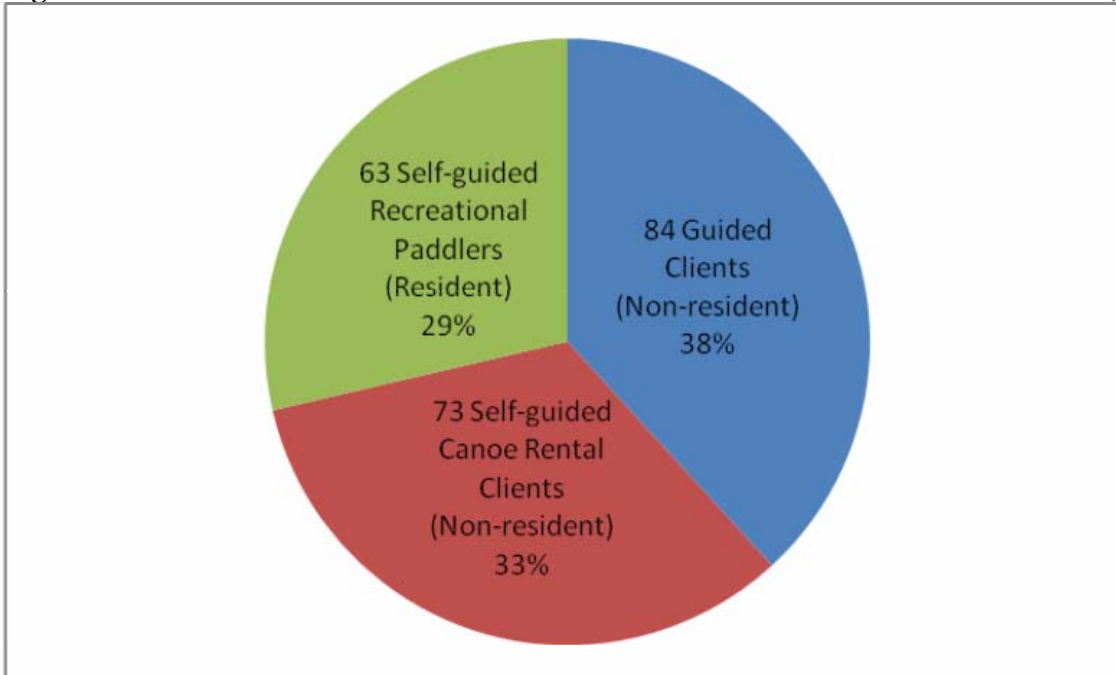
**Table 5.3 Wilderness Tourism - Guided Trips & Canoe Rentals:  
Wind River: 1999 – 2006\***

	Guided Trips**			Canoe Rental Clients**		
	Operators	Clients	User Days	Canoe Rental Operators	Canoe Rental Clients	User Days
1999	4	22	266	NA	NA	NA
2000	NA	NA	NA	4	8	156
2001	3	14	168	NA	NA	NA
2002	6	53	718	3	10	152
2003	3	23	399	3	18	304
2004	4	47	585	NA	NA	NA
2005	3	15	188	3	33	426
2006	7	34	377	6	73	828

\* Source: Wilderness Tourism Licensing Act Trip and Rental Reports

\*\* Almost all clients are non-Yukon residents.

**Figure 5.1 Tourist and Recreational Paddlers on Remote Peel Watershed Rivers, 2007**



### ***5.3 Tourism and Recreation Potential***

- Recent tourism research shows continued demand in Yukon’s primary tourism markets for high quality wilderness tourism products.
- There is room for the growth of existing remote tourism products in the Peel watershed, within carrying capacity, and opportunities for road accessible tourism. This growth can come from increasing the number of trips and clients on more popular rivers within carrying capacity limits (e.g. Wind, Snake), delivering more commercial products on lesser-travelled rivers (e.g. Hart, Bonnet Plume, Blackstone) and diversifying and attracting more niche river products (e.g. extended educational expeditions, themed river trips).
- Some products that have been identified as having development potential in the Peel watershed include: lodge-based tourism, destination alpine hiking, winter tourism, or niche products such as educational and cultural tourism, birdwatching, and photography.
- The development of basic infrastructure to support multi-day hiking and winter activities could enhance recreational opportunities.
- There has been significant growth in recreational paddling in the PWPR in the past 5 years and there is an opportunity for increased canoeing on remote and road accessible rivers, within carrying capacity limits.

#### **5.4 *Potential Incentives and Constraints to Tourism and Recreation Opportunities***

- *High quality wilderness.* Large, healthy, intact and mostly roadless ecosystems in the PWPR support very attractive and high quality tourism products and recreation opportunities. Increased development in the region has the potential to diminish these wilderness values and negatively impact trip quality and wilderness experience, and reduce the appeal of the watershed as a tourism and recreation destination.
- *Unique products and experiences.* While the natural and historic resources of the watershed are important, it is the aggregation of special features in one destination that make the PWPR unique and attractive compared to other international wilderness tourism destinations. Similar landscapes are becoming rare, increasing the value of the Peel in international tourism markets. Reducing intact wilderness in the Peel may diminish the unique quality of the region, and therefore potentially reduce its attractiveness as a wilderness destination.
- *Carrying capacity.* Increased tourism and recreational traffic can impact environmental and trip quality in two ways. Currently, the “packing up” of parties, typically at put-in sites, is a common trip quality impact, and is usually caused by several parties departing at the same place and time. Secondly, impacts could be caused by the sheer number of visitors to an area. This carrying capacity is difficult to assess, but may not yet be a current issue on most Peel tributaries. The Wilderness Tourism Licensing Act can manage commercial use; however, recreational use currently has no triggers for regulation.
- *Fuel prices.* Rising fuel prices affect the cost of getting to the Yukon and the cost of remote trips. This can impact Yukon’s ability to compete with other tourism destinations, and the affordability of remote destinations to Yukoners.
- *Local involvement.* Participation of the adjacent communities could enhance the tourism products and potentially expand the targeted market. The primary benefits of more local involvement are enhanced tourism products and increased local economic and social benefits from tourism.

#### **5.5 *First Nations and Tourism***

- The First Nations have had a limited role in the tourism sector in the Peel watershed thus far. However, there are opportunities for the First Nations to direct, manage, participate in, and benefit from existing or new tourism products in the region.

In 2006, the Tr’ondëk Hwëch’in signed a venture agreement with Yukon Government and Holland America to participate in bus tours to Tombstone Territorial Park, adjacent to the PWPR.

#### **5.6 *Outstanding Tourism Information Needs***

- Collection of data regarding recreational traffic in the Peel watershed.

- Identification of First Nations and community interests, issues, roles and responsibilities with respect to tourism in the Peel watershed.

## **References:**

Government of Yukon. 1998. Bonnet Plume Canadian Heritage River Management Plan. Government of Yukon. 55pp.

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## 6.0 BIG GAME OUTFITTING

### **Associated Maps**

Map 5: Access & Transportation

Map 7: Trapping & Outfitter Concessions

### **Introduction**

Big game outfitting has been an economic generator in the Peel watershed for decades. In order to be economically viable and ecologically sustainable, the industry requires large intact wilderness and healthy wildlife populations. The Peel watershed represents some of North America's highest quality big game hunting opportunities. There are six outfitting concessions in the PWPR. Sport hunting products focus primarily on hunting of Dall sheep, grizzly bear, caribou, and moose. Other products offered by guide outfitters include: horseback riding, birdwatching, and wildlife viewing. Most excursions are accessed by float plane, with overland transportation by horseback or by foot. Big game outfitting activities, and their associated concessions, generally occur in the southern half of the PWPR.

There are very little big game outfitting data specific to the PWPR. Most data are Yukon-wide, which makes it difficult to determine PWPR-specific averages, such as the number of clients, revenue, and full-priced vs. add-on priced tags.

### ***6.1 Overview***

- There are 6 outfitting concessions and businesses that partially fall within the Peel watershed. They include:
  - Blackstone Outfitters
  - Bonnet Plume Outfitters
  - Midnight Sun Outfitting
  - Pete Jensen
  - Reynolds Outfitting
  - Widrig Outfitters
- Guide outfitting (sport hunting) relies on large, healthy, intact wilderness and healthy wildlife populations.
- Guide outfitting in the Peel watershed is usually accessed by fixed-wing (float or wheels). Travel within the concessions is normally by horseback and by foot.
- Guide outfitting infrastructure includes permanent base camps – cabins, docks, corrals, boats, and a cooking facility. Spike camps are scattered throughout the concessions but normally consist of tent poles or frames only.
- Outfitting activity usually occurs from approximately June 15 to October 1. The peak of outfitting operations occurs during the months of August and September.

- Non-resident aliens must be outfitted by a registered Yukon outfitter.
- One of six outfitters currently holds a lease for his base camps in the planning region.
- Land tenure policy for all big game outfitters was recently developed.

## 6.2 Economic Profile

- In 2006, the Yukon Outfitters Association released a study entitled, “The Yukon Outfitting Industry: an Economic Analysis of 2005”. The study outlined revenue and investments in the industry throughout the Yukon, covering 19 outfitters in the territory. Some of the report’s findings included:
  - The total revenues earned directly by Outfitters is estimated at \$8.1 million in 2005, of which \$7.7 million was for providing hunting services, another \$0.19 million for other client-based wilderness tourism activities, and a remaining \$0.22 million due to non-tourism revenues.
  - The number of employees employed in the Outfitting Industry reached 240 in 2005, or 58.7 Person-Years (PYs) or full-time equivalents (FTEs).
- Average outfitting prices in the Peel watershed for 2008 (US Dollars):
  - Caribou: \$9,750
  - Moose: \$13,180
  - Grizzly: \$9,433 (spring hunt); \$6,500 (fall hunt)
  - Sheep: \$15,817

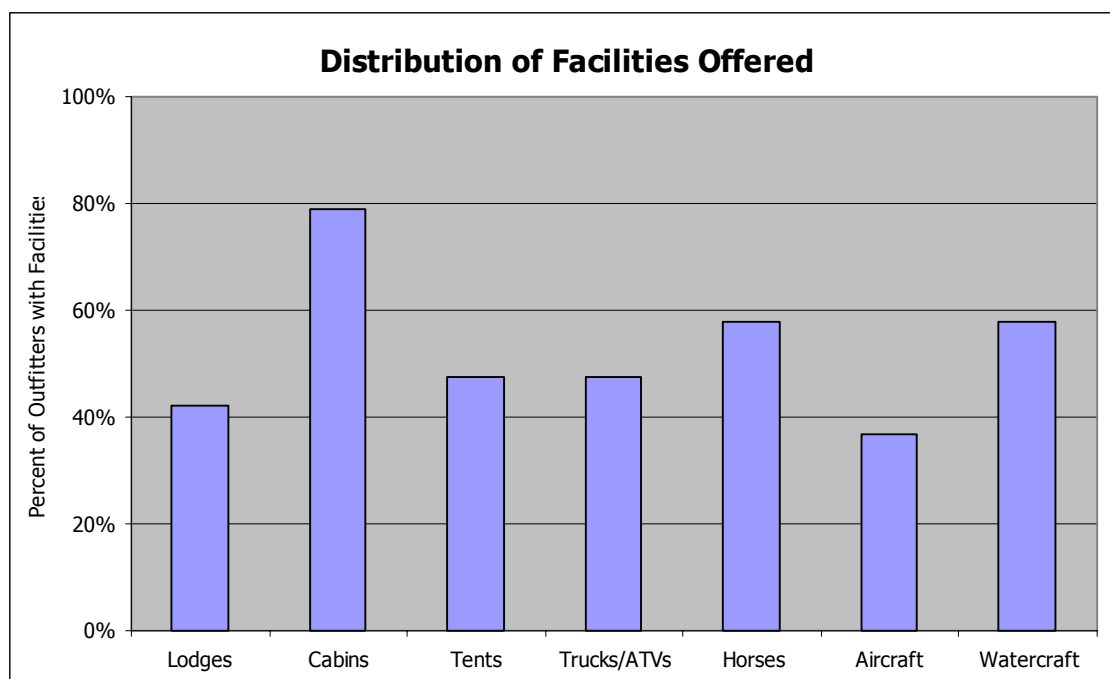
**Table 6.1 Average Annual Harvest by Resident\* and Non-Resident\*\* Hunters in the Peel Watershed Planning Region by Outfitting Area from 2001-2005**

Outfitter Area	Caribou		Moose		Grizzly		Sheep	
	Res	NR	Res	NR	Res	NR	Res	NR
1	0.2	0.4	0	1.6	0	1.4	0	4.8
2	117	25.6	0.8	12.6	0	3.4	0.8	17.8
3	167	8	2.2	4.2	0	0.8	1.4	1.8
4	0.4	6	0.8	9.8	0.4	2.6	0.6	6
5	0	10	0.2	13.6	0	5	0.6	19.6
6	0	12.6	0	13	0	4.6	0	10.2
No OA	2	0	0.2	0	0	0	0.8	0
<b>Total</b>	<b>286.6</b>	<b>62.6</b>	<b>4.2</b>	<b>54.8</b>	<b>0.4</b>	<b>17.8</b>	<b>4.2</b>	<b>60.2</b>

\* Does not include subsistence harvest.

\*\* All non-resident hunts in the Peel watershed are presumed to be guided sport hunts.

Source: Department of Environment, Yukon Government

**Figure 6.1 Distribution of Facilities Offered by Yukon Outfitters**

Source: Pacific Analytics, 2006.

**Table 6.2 Economic Impacts of Outfitter Operations in the Yukon, 2005**

	Direct Impacts	Indirect Impacts	Induced Impacts	Total Impacts
<b>Client Spending</b>	\$8,426,378			
<b>Output</b>	\$8,144,478	\$2,500,939	\$2,031,261	<b>\$12,676,677</b>
<b>GDP (Value Added)</b>	\$4,454,092	\$1,028,036	\$1,349,516	<b>\$6,831,644</b>
<b>Labour Income</b>	\$2,661,702	\$685,682	\$812,501	<b>\$4,159,885</b>
<b>Employment (PYs)</b>	58.7	18.3	18.1	<b>95.1</b>
<b>Total Taxes and Levies*</b>	\$1,062,137	\$128,344	\$215,062	<b>\$1,405,543</b>

\* Total Taxes and Levies include all client taxes including GST, as well as taxes and fees paid by the operators and corporate and personal income taxes. Appendix A gives an explanation of how all these impacts are determined.

Source: Pacific Analytics, 2006.

### 6.3 Clientele

- 587 clients took part in hunting in 2005 for a total of 5,558 hunting days or an average of 9.5 days per hunting client. The number of non-hunting clients reached 81 for a total of 694 days or the equivalent of 8.6 days per non-hunting client.

- Since 1995 there has been an almost continuous erosion of the “Other” market (especially Europe) and an upward trend in the US market. Several reasons may explain the upward trend in the US market, including the relatively strong performance of the US economy, particularly between 1998 and 2001, and, as well, the depreciation of the Canadian dollar during the 1990s and very early 2000s which made hunts relatively cheap.
- The “Other” category (effectively Europe) has witnessed a steady decline over the whole of the 1990s and early 2000s. While the Canadian dollar depreciated against the US dollar during the 1990s and early 2000s, it actually appreciated against the major European currencies and the Euro until just the last few years. This, together with the relatively poorly performing European economy, and the continuing impacts of 9/11 may explain this trend. The European market experienced a slight turn-around in 2005, likely a reflection of the appreciation of the Euro against the Canadian dollar during the past few years.

**Table 6.3 Average Financial Profile of Outfitter Operations – 2005\***

	<b>Total Industry</b>	<b>Average per Operation</b>	<b>Average per Hunter</b>
<b>Number of Operations - 2005</b>	19	1	0.032
<b>Revenues</b>	\$8,117,713	\$427,248	\$13,143
Hunting (incl Licenses & Fees)	\$7,714,663	\$427,248	\$13,829
Other Sports and Recreation	\$186,041	\$9,792	\$317
Other	\$217,008	\$11,421	\$370
<b>Employment</b>			
Headcount	<b>240</b>	<b>12.6</b>	<b>0.41</b>
F.T.E.s	<b>58.7</b>	<b>3.1</b>	<b>0.10</b>
<b>Clients</b>	<b>668</b>	<b>35</b>	<b>1.1</b>
Hunting Clients	<b>587</b>	<b>31</b>	<b>1.00</b>
Non-hunting Clients	<b>81</b>	<b>4</b>	<b>0.14</b>
<b>Revenue Distribution</b>			
Wages, Salaries & Benefits	\$2,569,868	\$135,256	\$4,378
Purchase of Goods & Services	\$4,017,497	\$211,447	\$6,844
Taxes and Levies (excl. corp taxes)	\$357,025	\$18,791	\$608
Depreciation	\$630,182	\$33,167	\$1,074
Interest Payments	\$52,034	\$2,739	\$89
Earnings Before Taxes	\$491,106	\$25,848	\$837
Corporate Taxes	\$89,663	\$4,719	\$153
<b>Investment in Capital Assets</b>	<b>\$724,757</b>	<b>\$38,145</b>	<b>\$1,235</b>

\* Average is based on all 19 outfitters in the Yukon.  
Source: Pacific Analytics, 2006.



- The average outfitter operation in the Yukon earned \$427,248 in total revenues in 2005, of which \$406,035 came from providing guided hunting. The average earnings before corporate taxes per operation are estimated at \$25,848 or after-tax retained earnings at \$21,129. This doesn't quite offset the average investment in fixed capital assets (estimated at \$38,145 in 2005). While it is possible that a few outfitter operations are losing money, on average the Outfitting Industry is doing reasonably well financially, although its activities are just economically viable.

#### **6.4 *Incentives or Constraints to Big Game Outfitting in the Peel Watershed***

- *Maintenance of large, intact wilderness.* Big game outfitting requires large, healthy, intact ecosystems that are largely roadless. When other land uses are introduced in the region, there is the potential that the marketability of the product diminishes as the unique and high wilderness quality diminishes.
- *Maintenance of wilderness quality experience.* Sport hunting clientele have high expectations of a quality experience. The quality of the experience can be negatively affected by the introduction of other land uses, or by excessive traffic by tourism and recreational users. Carrying capacity, therefore, is a management concern.
- *Fuel prices.* Rising fuel prices could affect the clientele's ability or willingness to travel to remote areas. It can also result in an added overhead expense for the outfitter, in terms of transportation of the clientele or their supplies to their concession.
- *Tapping into competitive or new markets.* Given that the Peel watershed is in a remote location, it makes it more challenging to attract visitors. Duplication of similar products that are already available in more accessible locales would not make a Peel product very marketable. The outstanding and unique wilderness qualities that currently exist in the PWPR provide a marketing advantage in the competitive industry.

#### **6.5 *Outstanding Big Game Outfitting Information Needs***

- Economic data for Peel watershed-specific concessions, as a whole.
- Land use patterns of outfitters in all concessions, including, but not limited to, the locations of camps and trails.

#### **References:**

Pacific Analytics Inc. 2006. *The Yukon Outfitting Industry: An Economic Analysis of 2005*. Unpublished report prepared for Yukon Outfitters Association. 31pp.

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## 7.0 OIL & GAS POTENTIAL AND RESOURCE INTERESTS

### Associated Maps

Map 5: Access and Transportation

Map 8: Oil & Gas Potential and Resource Interests

### **Introduction**

Oil and gas exploration has had a presence in the Peel watershed since the early 1960s, at which time there was a surge in seismic exploration. Exploration activity in the PWPR has been low for the past forty years.

Four petroleum basins occur in the region: Peel Plateau and Plain, Bonnet Plume and Eagle Plain, and an insignificant portion of the Kandik. Only a small portion of the Eagle Plain basin – approximately 6.5% – occurs within the PWPR.

Exploration and development activity in the PWPR has been low for several decades. During previous periods of exploration, there were 23 wells drilled in the Yukon portion of the Peel watershed, 19 within the Peel Plateau basin. One suspended well in the Eagle Plain basin yielded some gas, and the remaining wells were dry and abandoned. Of all the basins in the PWPR, the Peel Plateau & Plain basin possesses the greatest potential for a discovery. Should viable natural gas resources be discovered in the PWPR, the prospect and timing of development is dependent on the existence of the proposed Mackenzie Valley pipeline and the Dempster lateral pipeline from Eagle Plain to the Mackenzie Delta. Therefore, the earliest likely date for natural gas production in the Peel Plateau would be 2036.

Oil and gas production requires significant infrastructure to explore, test, extract and ship the resource to market. Likewise, using current technology, the oil and gas sector is one of the more intensive activities with respect to linear features (all-season roads, seismic lines, and pipelines) and footprint (linear features and well pads). However, using best management practices and the latest technological advances for seismic exploration, the linear density and footprints can be greatly reduced from the practices that had been used in the North in the 1960s and 1970s.

*Unless otherwise noted, the following content is derived from Natural Resource Canada's Petroleum Resource Assessment Reports for the Eagle Plain Basin (Osadetz et al., 2005a) and the Peel Plateau and Plain Basin (Osadetz et al., 2005b).*

### **7.1 Overview**

- The Peel Watershed planning region contains portions of four of the Yukon's eight sedimentary oil and gas basins - Peel Plateau and Plain, Bonnet Plume, Eagle Plain, and Kandik.

- The oil and gas basins partly or completely within the planning region contain approximately 61% of the Yukon's natural gas potential, and 70% of the Yukon's oil potential. The caveat, however, is that the only basins entirely within the region are the Bonnet Plume and the Peel Plateau and Plain. A small portion of the Eagle Plain and Kandik basins fall within the planning region boundaries.
- Based on the current understanding of geology in the region, the hydrocarbon of interest in the Peel watershed focuses on natural gas, rather than oil. The area of highest prospect in the planning region is located in the Peel Plateau and Plain and Eagle Plain, in the northeast and northwest, respectively, of the planning region.
- Oil and gas exploration and development activities in the region are currently low. Two additional locations in the Peel region were requested in Spring 2008, however, there were no bids on those blocks. For the Fall 2008 Request for Postings, no requests were received in the Yukon, so there will be no disposition process for fall/winter 2008/2009.
- There is one exploratory Oil and Gas Permit in the Peel Plateau and Plain basin, issued to AustroCan Petroleum Corp. in January 2008. Three permits and eight significant discovery licenses (SDLs) have been issued Northern Cross (Yukon) Ltd in the PWPR portion of the Eagle Plain basin.
- During previous periods of exploration, there were 23 wells drilled in the Yukon portion of the Peel watershed, 19 within the Peel Plateau and Plain basin. One suspended well in the Eagle Plain basin yielded some gas, and the remaining wells were dry and abandoned.
- In recent years, Yukon Geological Survey geologists discovered three areas with oil stained rocks, and two with gas seeps in Peel Plateau and Plain basin.
- The prospects for, and timing of, development of the natural gas resources in the Peel watershed are largely dependent on the development of the Mackenzie Valley Pipeline. It is also assumed that the Eagle Plain natural gas play would precede the development of the Peel Plateau and Plain basin, thereby providing a pipeline link along the Dempster Highway for the Peel Plateau and Plain basin resources.
- Three major conditions must be met prior to a significant natural gas development at Eagle Plain: a) a major pipeline must be built along Mackenzie Valley or Alaska Highway, b) capacity must exist in that pipeline to accept Eagle Plain natural gas, and c) Eagle Plain natural gas must be accepted for delivery into that pipeline at reasonable toll rates.
- The drilling for natural gas in the Peel Plateau and Plain has been modeled to begin in 2020 with an effective halt in 2053 (Corbet, 2007). This is an arbitrary choice but is based on the implicit assumptions of a Mackenzie pipeline and Eagle Plain development timing. A total of 192 exploratory wells were assumed for the Yukon portion of the basin.
- The Kandik and Bonnet Plume basins are of less interest in the near future due to limited exploration history and their remoteness.

**Table 7.1 Total Estimated Natural Gas and Oil Resource Potential for the Peel Planning Region**

<b>Basin</b>	<b>Hydro-carbon</b>	<b>Plays</b>	<b>Pools (mean)</b>	<b>Resource (mean)</b>	<b>Notes</b>
<b>Peel Plateau &amp; Plain</b>	Gas	10	88	2,916 Bcf	The Peel Plateau and Plain basin currently has no reserves.
<b>Eagle Plain</b>	Gas	9 (Total Basin)	114 (Total Basin)	6,054 Bcf (Total Basin)	Only 4.6% of Eagle Plain basin extends within the Peel planning region. The Eagle Plain basin would likely be the first of the Yukon basins to be developed, should necessary infrastructure be in place.  Note: the PWPR portion of the basin cannot be isolated from these figures
	Oil	6 (Total Basin)	32 (Total Basin)	437 MMbbbls (Total Basin)	
<b>Bonnet Plume</b>	Gas	3 (conceptual) 3 (speculative)		800 Bcf	The Bonnet Plume basin is considered as the least viable and lowest priority in the Peel watershed.
<b>Kandik</b>	Gas	3	48	649 Bcf (Total Basin)	Only 19% of the Kandik basin is located within the PWPR.  Note: the PWPR portion of the basin cannot be isolated from these figures
	Oil	2	33	99 Mmbbls (Total Basin)	

Sources: Osadetz et al. (2005a) and Osadetz et al. (2005b).

**Oil and Gas Quick Facts:**

- 1 cubic ft (1 ft<sup>3</sup>) = 1 basketball
- 1 barrel (bbl) = 1 fuel drum (42 U.S. gallons, or 158.99 litres) or 1 bathtub
- Oil and gas companies are generally interested in a frontier area (i.e. no infrastructure) if they contain >1000 Bcf (1 Tcf) natural gas. In Yukon, it would require discovering approximately this much gas to make development economically feasible.
- 1 Bcf natural gas contains enough energy to heat 8,600 Canadian homes for one year
- The Mackenzie Delta/Beaufort Sea has an estimated discovered resource of 13 Tcf natural gas in four major plays and an overall estimated resource potential of 46-52 Tcf natural gas-in-place
- Prudhoe Bay, Alaska has an estimated oil resource of 22,000 MMbbls. Prudhoe Bay has been in production since 1977 and currently produces approximately 900 MMbbls of oil per day
- The Alaska North Slope holds a total estimated potential of 100-126 Tcf natural gas-in-place, none of which has been produced due to a lack of required pipeline infrastructure to transport it to a market.

**Oil and Gas Definitions:**

Pool: a natural gas or oil pool consists of an accumulation (or reservoir) of gas or oil that occurs in a single rock layer in a single trap.

Play: all pools that occur or are inferred to occur in a similar rock type with a similar history of origin. A play in a region may be proven (i.e. a well has actually intersected a pool) or conceptual (i.e. inferred to exist based on knowledge of geology in a region).

Resource: all oil and gas pools that are known or inferred to exist

Reserves: the portion of a resource that has been discovered and is therefore known to exist

Potential: the portion of a resource that is inferred to exist but has not yet been discovered

## ***7.2 Summaries by Basin***

### **7.2.1 Peel Plateau and Plain Basin**

- The basin straddles the Yukon/NWT border. The Yukon portion of the basin lies entirely within the PWPR.
- The basin has the potential to be an economically viable region for natural gas development.
- Nineteen exploratory wells have been drilled in the Yukon portion of the basin, resulting in some petroleum shows but no economic reserves or production. All nineteen wells in the region are currently dry and abandoned.

- The mean gas play potential in the basin is 2,916 Bcf, representing 17% of the Yukon's total natural gas volumes.
- The basin extends over 20% of the planning region. There is one Oil and Gas Permit in the Peel Plateau and Plain basin, issued to AustroCan Petroleum Corp. in January 2008.
- 2,283 line-kilometres of seismic surveys were completed in the 1960s and 1970s.
- In recent years, Yukon Geological Survey geologists have discovered three areas in the basin with oil stained rocks, and two areas with gas seeps. The oil stained rocks may indicate some previously undescribed oil potential.
- The portion of the basin east of the Trevor fault is thought to have the greater potential.

#### **7.2.1.1 Geological Setting**

- The Peel Plain is east of the Peel Plateau and corresponds to all the undisturbed, relatively flat-lying sedimentary rocks east of the Cordilleran Orogen deformation front. The basin is located in the Northern Interior Platform north of the Mackenzie Mountains and east of the Richardson Mountains. It contains a Lower Cambrian to Upper Cretaceous stratigraphic succession with a maximum thickness of approximately 4.5 km. Geologically it is similar in setting to the Western Canada Sedimentary Basin. The basin extends over 20% of the PWPR.

#### **7.2.1.2 Exploration**

- Most exploration in the basin occurred between 1964 and 1977. During those 33 years, 19 wells were drilled in the Yukon portion of the basin (20 additional wells on the NWT side), of which none of the wells resulted in a significant discovery.
- To date, the Peel basin has experienced a total of 2,283 kms of seismic surveys.
- There is one Oil and Gas Permit in the Peel Plateau and Plain basin, issued to AustroCan Petroleum Corp in January 2008.

### **7.2.2 Eagle Plain Basin**

- The Eagle Plain basin possesses the most significant portion of petroleum resources in the Yukon.
- The Eagle Plain basin is estimated to hold 57% of the Yukon's oil resources.
- The portion of the Eagle Plain basin that falls within the planning region represents 4.6% of the entire basin, and 1.4% of the PWPR.
- There are 9 plays and 114 pools in the entire basin.
- There have been a total of 33 exploratory and outpost wells drilled in the Eagle Plain basin between 1957 and 2004. There are 4 exploratory wells that were drilled in the PWPR portion of the basin, one yielded some gas, and was suspended.
- The mean gas play potential of 6,054 Bcf, representing 35% of the Yukon's total gas volumes.

- Three permits and eight significant discovery licenses (SDLs) have been issued Northern Cross (Yukon) Ltd in the PWPR portion of the Eagle Plain basin. Two additional locations in the Peel region were requested in early 2008.
- There are 9,952 line-kilometres of seismic surveys in the basin.

#### **7.2.2.1 Geological Setting**

- The majority of the Eagle Plain basin is located in the North Yukon Planning Region, while a small portion – approximately 4.6% –extends southeasterly into the western portion of the Peel watershed. Eagle Plain basin is bounded to the east by the Richardson Mountains, to the south by the Ogilvie Mountains and to the west by the Nahoni and Keele ranges. The Eagle Plain basin accounts for 1.4% of the planning region.

#### **7.2.2.2 Exploration**

- Following the Mackenzie Valley Pipeline hearings and the Berger Inquiry (Berger 1977) of the 1970s, exploration interest in the region (and in northern Canada generally) decreased dramatically. After the decision was made to not proceed with the Mackenzie Valley Pipeline, only three wells were drilled in Eagle Plain during the period 1978-85. In the winter of 2005, an exploration well was drilled at Eagle Plain following a 20-year period of inactivity. During the period of relative inactivity, responsibility for the management of onshore oil and gas resources was transferred to the Yukon Government; this occurred in 1998. The *Yukon Oil and Gas Act* provides for integration with the Yukon First Nation Final Agreements and reflects the federal transfer of broader resource rights and responsibilities to Yukon Government through the 2003 devolution agreement.
- Eagle Plain basin has received the most exploration attention in the region. During the period 1957–2004, thirty-five exploration wells were drilled in proximity to the basin and approximately 10,000 km of seismic surveys were conducted. Most wells were drilled in the mid-1960s and early 1970s. The most recent exploration well (K-58) was drilled in 2005. Few seismic surveys were conducted in Eagle Plain basin after 1975.
- Of the 35 wells drilled in the Eagle Plain basin from 1957-2004, ten wells flowed gas to surface, and numerous others had gas and oil shows. Discovered resources contain 83.7 Bcf gas and 11.1 MMbbls oil. All of the currently discovered petroleum resources are found in the South Eagle sub-basin.
- Northern Cross (Yukon) Ltd. holds Oil and Gas Permit #1 in the Eagle Plains region. Recently, Devon Canada Ltd. surrendered two of their previous exploration permits in Eagle Plain, and reduced the size of Permit #1 before transferring ownership to Northern Cross (Yukon) Ltd. Permit #1 has an expiry date of November 30, 2008. Northern Cross (Yukon) Ltd. is scheduled to conduct test drilling in the Peel watershed portion of the basin in 2008.

### **7.2.3 Bonnet Plume Basin**

- Of the three main basins in the planning region, the Bonnet Plume basin is lowest priority for exploitation, due to its projected diminutive size of reservoir.
- The mean gas play potential in the basin is 800 Bcf, representing 4.7% of the Yukon's total gas volumes.
- No seismic surveys have been conducted, and no wells have been drilled in the basin.
- Geochemical evidence indicates that there is not much oil potential in the basin.
- The basin contains some of the thickest and most extensive coal deposits in the Yukon. Drilling by Pan Ocean Oil of 37 shallow holes in 1978-1980 delineated a proven reserve in one deposit of 121 million tonnes. Coal within the basin is considered to have extensive gas from coal potential.

#### **7.2.3.1 Geological Setting**

- The Bonnet Plume basin is located in central Peel watershed, along and between the lower low gradient portions of the Wind and Bonnet Plume rivers, and includes Chappie Lake and most of Iltyd Creek. The basin is an intermontane, fault-bounded basin within the Northern Yukon Fold Complex located at the intersection of the north-trending Richardson fault array with the Mackenzie fold front. The basin developed as a depositional site in early Late Cretaceous in response to strike- and dip-slip faulting. It contains extensive non-marine late Cretaceous to Tertiary sandstone, shale, conglomerate and coal which constitute the Bonnet Plume Formation.

#### **7.2.3.2 Exploration**

- No seismic exploration or test drilling has taken place in the Bonnet Plume basin.

### **7.2.4 Kandik Basin**

- The mean gas play potential in the basin is 649 Bcf, representing 3.8% of the Yukon's total gas volumes.
- Only 19% of the Kandik Basin falls within the PWPR, representing 1.6% of the planning region.
- There are approximately 85 kms of seismic in the PWPR portion of the basin, and no test wells.
- No petroleum exploration activities are currently taking place in the Kandik basin.

#### **7.2.4.1 Geological Setting**

- Kandik Basin consists of three separate areas with preserved Mesozoic sedimentary rocks that are surrounded by exposed Precambrian-Paleozoic outcrops. The southern portion of the basin is bounded by the Tintina Fault with some 420 km of lateral strike-slip displacement. The area remained unglaciated during the Pleistocene time; alluvial sediments occur along river valleys.



#### 7.2.4.2 Exploration

- During the period 1970-1972, three exploration wells were drilled in the Yukon portion of the basin and approximately 180 km of seismic surveys were conducted (Hannigan et al. 2000). Table 4.1.2.3(b) summarizes the historical wells (Map 8). In 1970, the INC Husky Amoco Black-fly YT M-55 well was drilled near the eastern margin of the basin.
- In the winter of 1971, Inexco conducted approximately 180 km of seismic surveys in three areas along the eastern margin of the basin. In December 1971, Inexco Husky et al. drilled Porcupine YT G-31 well on the northeast margin of the basin. The most recent exploration well (Inexco et al. Mallard YT O-18) was drilled in 1972. None of these wells encountered natural gas or oil.

**Table 7.2 Summary of Oil and Gas Exploration History by Basin**

<b>Basin</b>	<b># of Wells in Entire Basin</b>	<b># of Wells Within PWPR</b>	<b>Kilometres of Seismic Lines in Entire Basin</b>	<b>Kilometres of Seismic Within PWPR*</b>
<b>Peel Plateau &amp; Plain</b>	19 (Yukon)	19	1,711* (reported >3,000**)	1,711
<b>Eagle Plain</b>	33	4	3,751* (reported 9,952**)	353
<b>Bonnet Plume</b>	0	0	0***	0
<b>Kandik</b>	3 (Yukon)	0	160* (reported 180*)	85

\* Based on incomplete seismic data (1961-84) for Yukon only.

\*\* Based on figures from Yukon Oil and Gas Management Branch (2007)

### 7.5 Future Exploration and Development Potential

- Predicting future natural gas and oil activity in the region is a difficult and uncertain exercise.
- If Peel Plateau and Plain natural gas is eventually developed, the Fort McPherson Plain, to the east of the Peel River, is anticipated to be the principal exploration and development area of interest.
- Future natural gas and oil activity is anticipated to be initially focused on the Eagle Plain basin – primarily in the portion that falls within the North Yukon Planning Region. A small portion of the activity is anticipated within the PWPR.
- Three major conditions must be met prior to natural gas development at Eagle Plain: a) a major pipeline must be built along Mackenzie Valley or Alaska Highway, b) capacity must exist in that pipeline to accept Eagle Plain natural gas, and c) Eagle Plain natural gas must be accepted for delivery into that pipeline at reasonable toll rates.
- A likely route to transport Eagle Plain natural gas would be via pipeline constructed along the Dempster Highway to the Mackenzie Valley pipeline near Inuvik.

- Assuming the Mackenzie pipeline is operational by 2014 and has capacity to transport Yukon natural gas, Eagle Plain gas production could begin between 2020-2025, preceded by 10-15 years of exploration, infrastructure development, and pipeline planning and construction (Fekete and Associates Inc. 2006).
- Assuming that the Mackenzie pipeline is constructed, and Eagle Plain infrastructure is built along the Dempster to the Mackenzie Delta, the Peel Plateau and Plain basin could see some natural gas extraction.
- The Bonnet Plume basin is not expected to receive significant levels of oil and gas exploration interest in the foreseeable future.

### **7.6 Potential Natural Gas Development**

- Predicting the specific location, pace and scale of future natural gas and oil activities in the region is a difficult and uncertain exercise. Future energy sector activity and timing will depend on a number of factors including the size of the current and future economically-recoverable resource, access to the resource, technological advances, operating costs, pipeline infrastructure, geopolitical factors and global commodity prices. However, it is possible to examine development scenarios that are more plausible than others, based on the best available information regarding natural gas and oil resource potential and industry trends.
- The development of the Peel Plateau and Plain basin would require a longer pipeline than that of the Eagle Plain basin, in order to connect to the presumed Dempster pipeline. This pipeline would have to traverse difficult terrain with no existing infrastructure. For this reason, Fekete (2006) estimated that the Peel Plateau and Plain natural gas wells would not enter production until 20 years after production of Eagle Plain natural gas begins. Given an estimated initial Eagle Plain production date of approximately 2025, the Peel Plateau and Plain basin production may occur around 2040 – 2050. Exploration and construction of necessary infrastructure would occur well before this initial tie-in date.
- Corbet (2007) developed a Petroleum exploration and development model, based on the Petroleum Resource Assessment of the Peel Plateau and Plain (Osadetz et al. 2005b). The model is based on two assumptions:
  - A Mackenzie Valley Gas Pipeline is approved and constructed with initial operation by 2018.
  - A Dempster Highway lateral is constructed to connect potential Eagle Plain production to the Mackenzie Valley line by approximately 2025. This is expected to be the connection for an eventual Peel production. While it may be possible to connect potential discoveries directly to a Mackenzie Valley line, the most economic route will likely tie into a Dempster Highway line.
- Corbet's model reached the following conclusions – *please note, these are estimates and projections*:
  - Exploration would begin to pick up momentum in 2016.

- Construction of exploration well pads would begin in 2020 and end in 2053.
- Construction of all-season roads would begin in 2028.
- Construction of production pads would begin in 2036.
- Construction of infrastructure would cease in 2057.
- There would be an estimated total of 192 exploration wells drilled; if successful, the exploratory well pad would be the site of further development drilling to a maximum of 4 development wells per pad. The expected number of production pads – new production well pads plus exploratory pads with development wells added later – would be 40. The number of development wells would be 124 plus an expected 32 exploration wells that found something, for a total of 156 producing wells. Note: these well estimates are all mean values – the true numbers could be higher or lower.
- There would be an estimated 600 kilometres of all-season roads.
- Flowlines and small to medium pipelines should be expected to follow the road rights of way; therefore they would not produce any additional linear features or footprint.
- Cumulative linear features – such as seismic lines, trails, and roads – would peak at approximately 1449 kilometres in 2024.
- Cumulative physical disturbance (or “footprint”) – such as seismic lines, trails, roads, and well pads – would peak at approximately 1200 hectares in 2054.
- Given that both Fekete (2006) and Corbet (2007) have respectively built their Eagle Plain and Peel Plateau and Plain development scenarios around the premise of an anticipated Mackenzie Valley pipeline that is still very uncertain, these projections are still rather speculative. If the Mackenzie Valley pipeline or the Alaska Highway Pipeline do not proceed, then there is very little likelihood that these basins would see large scale production of any kind.

## ***7.7 Potential Oil Exploration and Development***

- Currently, it is not anticipated that oil development would occur in the Peel planning region, given the current understanding of the hydrocarbon basins. However, oil yielding wells in the Eagle Plain basin within 20 km of the planning region may be indications of oil potential.
- The current estimated Eagle Plain basin oil resource is not considered sufficient to construct an oil pipeline from Eagle Plain to southern Yukon or NWT (Fekete 2006). Therefore, future potential oil development is anticipated to be of a smaller scale and may proceed separately from, and possibly in advance of, the natural gas scenario described above.
- Given this situation, the oil scenario currently anticipated for Eagle Plain does not require the construction of a pipeline. One operator, Northern Cross (Yukon) Ltd., has proposed to begin producing three oil wells on the Chance Significant Discovery License (SDL-022) in Eagle Plain. Crude oil would initially be trucked to southern refineries until such

time as the well productivity is established and justifies construction of a small on-site refinery at or near Eagle Plain. This refinery would be capable of processing 2,500 bbls/day, sufficient to meet current demand within the Yukon for refined petroleum products.

- Northern Cross (Yukon) Ltd. anticipates acquiring the necessary licenses and permits to carry out flow tests at Eagle Plain in the next 1-2 years. The construction timing of required access roads and production wells would be determined based on project economics and results of the flow tests. Possible construction of the Mackenzie Valley Gas Project is anticipated to play an important role in determining project economics, as the proposed oil production may have the ability to supply a large proportion of diesel fuel required during construction of the MVP.

### **7.8 *Potential Constraints and Incentives for Development***

- *Market price.* The price of the commodity on the market remains the strongest driver for project viability. If the market price is sufficient to overcome the investment costs, then it can become more attractive to develop the resource.
- *Market demand.* The demand for the commodity on the continental or global market can strongly affect the market price.
- *Supply.* The supply usually reflects the demand which, in turn, influences the market price. If the commodity is readily available elsewhere, or more accessible for the major markets, then there is less demand for less accessible sources. By directing a commodity to a more local market, it is sometimes possible to compete with global markets on occasions when supply is high and demand is low.
- *Reserve size.* Future oil and gas reserves, if found in the PWPR, will require a minimum volume in order to make them economically viable.
- *Infrastructure.* Oil and gas development requires significant infrastructure for exploration, extraction and shipping, such as test wells, well pads, all-season roads, production wells and pipelines.
- *Access to market.* For the foreseeable future, any potential natural gas reserves in the PWPR are likely dependent on the existence of the Mackenzie Valley Pipeline to get the resource to market. If the pipeline is built, the issues of pipeline capacity and access issuance would also have to be addressed

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## **8.0 MINERAL POTENTIAL AND RESOURCE INTERESTS**

### **Associated Maps**

- Map 5: Access & Transportation
- Map 9: Simplified Bedrock Geology and Ecodistricts
- Map 10: Simplified Surficial Geology and Ecodistricts
- Map 11: Wernecke Breccias: Copper, Gold & Uranium Potential
- Map 12: Carbonate Hosted (MVT): Zinc – Lead Potential
- Map 13: Coal Potential
- Map 14: Crest Iron deposit & Iron Potential
- Map 15: General Mineral Potential

### **Introduction**

Mineral development – historically a significant economic contributor in the Yukon – has not had a presence in the PWPR to date. However, the region has been drawing interest from mineral prospectors during the past few years. Much of the PWPR still remains unexplored. There are currently 219 known mineral occurrences and 13 known deposits in the Peel watershed. There are two mineral deposit-types of significant volume: the Crest iron deposit and the Bonnet Plume coal deposits.

The remote location, rugged geography, and lack of infrastructure have been limiting factors for exploration to date, and will continue to constrain mineral development in the region. Projecting the most likely mineral development scenario and its location and timing are extremely difficult, due to a number of factors such as the difficulty in predicting mineral potential and the need for favourable conditions like commodity prices and market demand, which tend to be rather volatile.

A mineral development scenario in the PWPR would face many challenges: lack of infrastructure, costly infrastructure, remote location, rugged terrain, and lack of water. The economic viability of a development scenario will ultimately be driven by the market price for the targeted commodity, and that too is difficult to predict.

### **8.1 Overview**

- Mineral resources are difficult to locate because they are small, rare and generally buried.
- The demand and price for mineral resources are very dynamic and trends are difficult to predict.
- There are 219 known mineral occurrences and 13 known deposits in the Peel watershed.
- The Peel watershed possesses two mineral deposit-types of significant volume: the Crest iron deposit and Bonnet Plume coal deposits.
- There currently is no mineral extraction occurring in the Peel watershed.

- No infrastructure for mineral development currently exists in the Peel watershed.
- In 2007, the Yukon ranked 8<sup>th</sup> out of 12 provinces and territories with respect to mineral exploration and deposit appraisal expenditures, representing 5.5% of Canada's expenditures. Projections for 2008 suggest that the Yukon will rank 6<sup>th</sup> among Canadian provinces and territories for exploration and deposit appraisal expenditures, and account for 4.8% of Canada's expenditures (Natural Resources Canada, 2008).
- Spending on exploration in the Peel watershed was approximately \$1.8M in 2005, approximately \$8M in 2006 and just under \$20M in 2007 (M. Burke 2008, pers. comm., 21 Feb.).
- On average it requires approximately ten years and \$50-75 million exploration expenditures to locate and define an economic mineral deposit (Yukon Chamber of Mines, 2006).

## **8.2 Mineral Claims**

- The number of mineral claims (as of April 2005) that intersected the PWPR:
  - Active: 2261
- The number of mineral claims (as of Feb. 8, 2008) that intersect the PWPR:
  - Active claims: 10,631
  - Active claims account for 2318 km<sup>2</sup> or 3.4% of the PWPR.
- The number of mineral claims, by type:
  - Active, Iron Mica: 525
  - Active Iron Mica claims account for 278 km<sup>2</sup> or 0.4% of the PWPR.
  - Active, Quartz: 10,106
  - Active Quartz claims account for 2040 km<sup>2</sup> or 3.0% of the PWPR.
- The number of coal licenses that intersect the Peel planning region (coal licenses permit coal exploration):
  - Active: 9
  - Active Coal Licenses account for 1461 km<sup>2</sup> or 2.2% of the PWPR.
- The combined area for all active mineral claims and coal licenses is 3779 km<sup>2</sup> or 5.6% of the PWPR, but, due to overlap, the actual area is 3455 km<sup>2</sup> or 5.1% of the PWPR.
- There are currently no coal leases that intersect the PWPR. Coal leases permit coal mining.
- There are currently no placer claims in the PWPR.

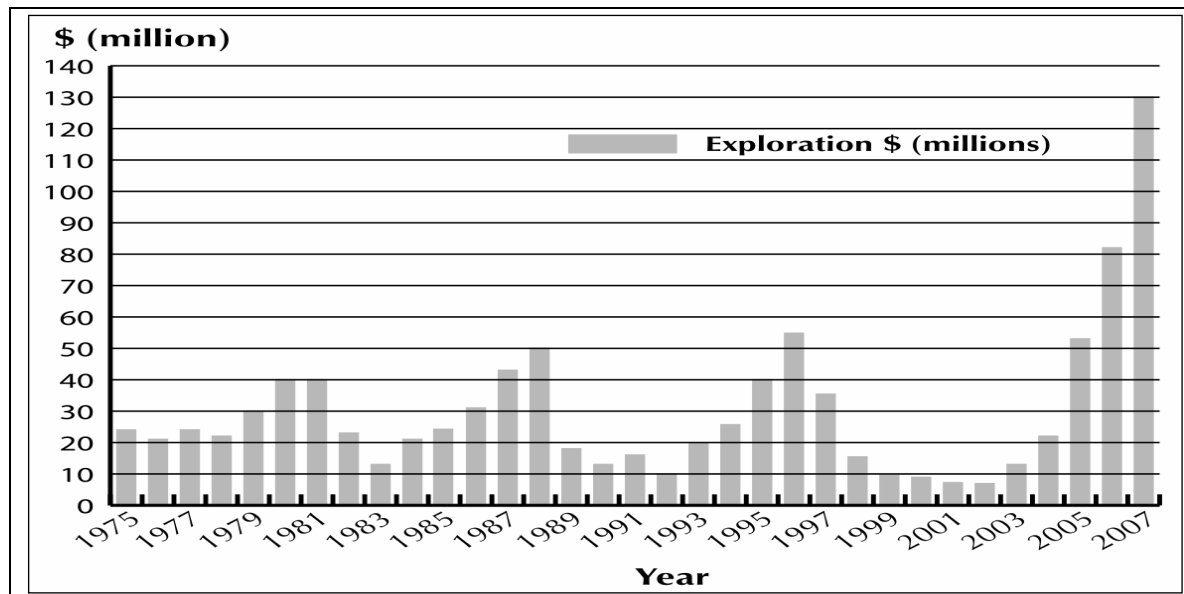
**Table 8.1 Summary of Mineral Claims & Coal Licenses in the Peel Watershed Planning Region\***

CLAIMS OR LICENSES	# OF CLAIMS	TOTAL AREA (km <sup>2</sup> )	% OF PLANNING REGION
Iron Mica	525	278	0.4
Quartz	10,106	2040	3.0
Coal	9	1461	2.2
<b>TOTAL</b>	<b>10,631 claims and 9 coal licenses</b>	<b>3779</b>	<b>5.6</b>

\* As of February 8<sup>th</sup>, 2008

### 8.3 Mineral Exploration

- Five companies conducted mineral exploration projects in the PWPR in 2007:
  - Cash Minerals / Mega Uranium
  - Fronteer Development Group and Rimfire Minerals
  - International KRL Resources
  - Southampton Venture / Strategic Metals
  - Tarsis Capital Corp.
- It is anticipated that all of these companies will be conducting further exploration work in the summer of 2008 in the Peel watershed.

**Figure 8.1 Mineral and Resource Exploration Expenditures in the Yukon, 1971 To 2007\***

\* Source: Burke et al. 2007.



**Table 8.2 2007 Mineral and Resource Exploration Projects in the Peel Watershed Planning Region\***

OWNER	PROJECT NAME	WORK TYPE	PRIMARY COMMODITY	DEPOSIT	# DRILL HOLES	# OF METRES
<b>Cash Minerals / Mega Uranium</b>	Odie	Diamond Drilling	Copper	Wernecke Breccia	6	3050
	Igor	Diamond Drilling	Copper	Wernecke Breccia	31	9043
	Lumina	Prospecting, Geology, Geochemistry,	Uranium	Vein / Breccia	25	4367
	Angel	Diamond Drilling	Uranium	Wernecke Breccia	5	1478
	Vic	Diamond Drilling	Uranium	Wernecke Breccia	10	3012
	Bonnie	Diamond Drilling	Uranium	Wernecke Breccia	2	1000
<b>Fronteer Development Group / Rimfire Minerals</b>	Fireweed	Diamond Drilling	Uranium	Wernecke Breccia	5	1028
	Slats	Diamond Drilling	Uranium	Wernecke Breccia	6	886
	TVA	Diamond Drilling	Uranium	Wernecke Breccia	5	855
	Pagisteel Fault	Diamond Drilling	Copper	Wernecke Breccia	1	300
	DR	Diamond Drilling	Copper	Wernecke Breccia	2	350
	Hoover	Diamond Drilling	Copper	Wernecke Breccia	10	3150
<b>Southampton Venture / Strategic Metals</b>	El	Prospecting, Geology,	Nickel, Platinum Group Elements	Sediment Associated	19	2840
	Rich	Airborne Geophysics, Diamond Drilling	Nickel, Platinum Group Elements	Sediment Associated	25	2486
<b>Zincorp Resources Inc. / Strategic Metals</b>	Michelle	Diamond Drilling	Zinc-Lead	Mississippi Valley Type	7	850

cont'd

Table 8.2 cont'd

OWNER	PROJECT NAME	WORK TYPE	PRIMARY COMMODITY	DEPOSIT	# DRILL HOLES	# OF METRES
International KRL Resources	Nor	Prospecting, Geology, Airborne Geophysics, Geochemistry, Diamond Drilling	Copper	Wernecke Breccia	7	1040
Tarsis Capital Corp.	Goz Creek	Prospecting, Geochemistry	Zinc-Lead	Mississippi Valley Type	0	0
TOTAL					166	35735

\* Source: Burke et al. 2007..

## 8.4 Mineral Potential

*Unless otherwise noted, the following information regarding the Crest Iron, Wernecke Breccias, Carbonate-hosted lead-zinc, and Coal are derived from Gartner Lee's report of 2006. See reference below.*

### 8.4.1 Crest Iron

- The Crest iron deposit is located in the eastern portion of the Peel planning region by the NWT-Yukon border, near Iron Creek, a tributary of the Snake River.
- The Crest deposit is a flat lying sedimentary deposit and represents the largest of its type in North America.
- It contains an estimated 2.6 million tonnes of iron in a drill-indicated historical estimate of 6.0 billion tonnes (24.8% silica and 0.35% phosphorus). The margins of the mineralization have not been defined by drilling, thus estimates may be conservative.
- The estimated mine life is 110 years, based on a 6 billion tonne reserve.
- The estimated workforce for a potential mine would be 400 to 500 people full-time.
- The Crest deposit would likely represent the high extreme for onsite mine and mill costs, compared with other mine sites around the world, with respect to dollars per ore milled.
- The likely method of extraction would be an open pit system.
- Likely milling method would be conventional flotation.
- Assumed infrastructure options would include:
  - Power options:
    - on-site natural gas, or

- on-site coal-fired power plant, or
- off-site coal-fired power plant.
- Transportation options:
  - Railway from Crest to proposed Alaska-Canada rail link (e.g. Carmacks), or
  - Railway from Crest to an Alaskan port, or
  - Railway from Crest to a port on the arctic coast, or
  - Slurry pipeline to central Yukon (with pelletization and loading product to proposed Alaska-Canada rail link), or
  - Slurry pipeline to Alaskan port, or
  - Slurry pipeline to port on arctic coast.
- Railway construction was indicated as the most practical mode of transporting iron ore from the Crest Iron deposit to market, via Carmacks.
- The estimated cost of constructing a railway line from the Carmacks to the Crest Iron deposit is \$4.7 billion dollars (U.S.), or a cost of \$6.8 million dollars per kilometre. [Banjar Management et al. 2006]

#### **8.4.2 Wernecke Breccias**

- The Wernecke Breccias are located in the southeast of the Peel watershed.
- The Wernecke Breccias host potential iron-oxide copper gold deposits (IOCG). Such a deposit would likely yield gold, copper, or uranium.
- There have been no IOCG deposits identified in the Yukon. However, there is high potential for discovery – especially in the central Wernecke Mountains, in a group of old rocks known as the Wernecke Supergroup.
- Given the remote nature of this portion of the planning region, an IOCG development would likely need to be a larger size (e.g. upper 10%) deposit. Once that primary deposit was developed, it would be reasonable to assume one or two of the “median size” deposits would be developed subsequently.
- Likely milling method would be conventional flotation
- The estimated mine life of a hypothetical “large” mine scenario (40 million tonnes) is 16 years. The estimated mine life for a hypothetical “median size” mine is 9 years.
- The estimated workforce for a hypothetical “large” mine would be 200 people full-time. The estimated workforce for a hypothetical “median size” mine would be 100 people full-time.
- Assumed infrastructure options would include:
  - Power options:
    - On-site diesel generator (moderate to small mine scenario), or

- Coal-fired power plant, if the coal is readily accessible (larger mine scenario).
- Transportation options:
  - Overland truck haulage and all-season road, or
  - Overland truck haulage by winter road only, or
  - Railway, if built for the Crest deposit.

#### **8.4.3 Carbonate Hosted Lead-Zinc**

- Several lead-zinc deposits and a very high number of lead-zinc occurrences are present in the carbonate rocks (e.g. limestone dolomite) of the Peel River watershed.
- These deposits, although small, are attractive because they are found in limestone or similar rocks with little or no pyrite. This means that they would not have significant acid-rock drainage problems such as found at Faro or other Sedex style lead-zinc deposits.
- The Goz deposit is the only defined carbonate hosted deposit in the Peel watershed. It consists of an estimated 2.5 million tonnes at 11% zinc. The Blende deposit, immediately adjacent to the planning region, contains 19.6 million tonnes averaging 3.04% zinc and 2.8% lead.
- The average deposit size of a similar type to the Goz deposit is 1 to 10 million tonnes with a typical median size around 3 million tonnes (Bradshaw 2006, cited in Gartner Lee, 2006).
- The most likely development scenario would be to mine several deposits in a common district, with milling at a central mill. Individual mines could be mined by open pit or underground methods.
- The estimated mine life of a hypothetical “large” mine scenario (12 million tonnes) is 12 years. The estimated mine life of a hypothetical “median size” mine is 9 years.
- The estimated workforce for a hypothetical mine would be 100 to 200 people full-time.
- Assumed infrastructure options would include:
  - Power options:
    - On-site diesel generators
  - Transportation options:
    - Overland truck haulage and road.
    - Railway or road connection to a railway, if it is built for the Crest deposit

#### **8.4.4 Coal**

- The Bonnet Plume Basin contains the majority of the Yukon’s coal reserves. It is located in the central portion of the Peel watershed.

- There are 16 known coal occurrences in the planning region, 7 of which are defined as deposits.
- The currently known coal reserves in the Bonnet Plume are 670 million tonnes.
- The coal is thermal grade, suitable for power and heat production. Most of the coal mines in British Columbia are metallurgical grade coal. Metallurgical grade coal commands a significantly higher price per tonne than thermal coals.
- Significant transportation challenges face any future plans to export these coals from the Yukon. Coal would also have to compete with other energy sources, such as hydro-electric for future domestic power generation.
- The most likely development scenario of the Bonnet Plume coal deposits would be to provide power for the Crest Iron mine. Two scenarios can be envisioned:
  - The coal would feed a power plant at the coal mine site, whose energy would then be conveyed by electrical lines to the Crest mine site.
  - The coal is mined and transported to the Crest mine site, where it would feed an on-site power generator.
- The estimated mine life of a hypothetical surface or underground coal mine is 20 years.
- The estimated workforce for a hypothetical surface coal mine is 100 to 150 full-time people. The estimated workforce for a hypothetical underground coal mine is 150 to 200 people.
- Assumed infrastructure options would include:
- Power options:
  - Coal-fired plant, on-site.
- Transportation options:
  - It is unlikely that the coal would be exported from the Bonnet Plume area.
  - Coal would most likely be transported for power/heat generation at the Crest or a nearby Wernecke Breccia mine site. Coal transport would be by truck or rail.

#### **8.4.5 Coal-bed Methane**

- Coal deposits in the Bonnet Plume have not been explored for their coal bed methane potential.
- Coal licenses and permits do not give access rights to the coal bed methane.

#### **8.4.6 Aggregate**

- Aggregate is a very important construction material for roads, well pads and other facilities.

- Aggregate is most common in glaciated regions. In the Peel watershed, the unglaciated portions of the Peel watershed mostly pertain to the eastern portion of the planning region. (see in *Conservation Priorities Assessment Report, Map 4: Glaciation Extents and Ecoregions*)
- Very little surficial geology data has been collected for much of the Peel watershed. Our understanding of available aggregate resources is mostly limited to the Dempster Highway, where there has been a demand for it since the construction of the highway in the 1970s.

### **8.5 *Potential Incentives or Constraints for Development***

- *Metal prices.* World metal prices must be sufficient enough that the value of the ore mined covers the cost of the mine development, operation, closure/reclamation and a reasonable expectation of profit. Metal prices can fluctuate, depending largely on the market demand for that metal.
- *Market demand.* The market demand for a metal is reflected in the metal price. The surging economies of such nations as China and India will likely increase the demand for a variety of metals. Like metal prices, the market demand can be volatile. The demand is also affected by the availability of that metal on the market. There can be a strong demand for a commodity but if production increases and more of that commodity is available on the market, then the price can decline. Conversely, if the supply of the commodity is rather limited in comparison to the demand, then the price can rise.
- *Supply.* The supply usually reflects the demand which, in turn, influences the market price. If the commodity is readily available elsewhere, or more accessible to the major markets, then there is less demand for less accessible sources. By directing a commodity to a more local market, it is sometimes possible to compete with global markets on occasions when supply is high and demand is low.
- *Global competition.* The economic viability of a mineral development scenario in the Peel watershed has to be weighed in comparison to similar deposits elsewhere in the world. The remote nature of the Peel watershed and the lack of development infrastructure can be a disadvantage for mineral development in the region. A similar ore body elsewhere in the world that is more accessible and has the necessary infrastructure already in place would likely make it more desirable to exploit.
- *Infrastructure.* Refers to the means of transporting the resources to the mine site and the transportation of the mine's commodity to market. The infrastructure required for this transportation must exist or be developed such that the transporting the resource is cost effective in the context of the mine development. With the exception of the Dempster Highway and the Wind River Trail, there is no significant infrastructure in the planning region to support mineral development.
- *Access.* The more accessible a commodity is to its market, the more viable it becomes to develop. With the exception of the Dempster Highway, there is no all-season road in the planning region.

- *Type of Commodity.* The type of metal being extracted plays a large role in determining the complexity of the development scenario. For example, precious minerals such as gold could potentially be shipped from the mine site to the market by air, whereas an iron ore development would likely require shipping of large volumes of ore to another location for processing, which would rule out air transport as a viable option.
- *Power.* All development projects require energy for extracting, processing and transporting the metal to the market. There currently is no power-generating or transmission infrastructure in the planning region.
- *Water.* All mining operations require water, of varying amounts, for mineral extraction, processing, on-site services, and winter & ice road construction. Access and consumption could be a significant constraint for development in the Peel watershed, which generally has low water flows – particularly in the winter periods.
- *Technology.* Mining technology improves over time, driving the cost of mine development lower (including costs associated with increasing environmental responsibility). This allows for the development of deposits that were historically sub-economic.
- *Ore quality.* The quality of the ore will be a factor in the economic viability of the project, since poorer grades of ore will likely require more processing, or simply result in a lower price for the commodity on the market.
- *Workforce.* Having access to skilled and unskilled workers is vital for any development project. In recent years, the Yukon has been competing for crew with Alberta's tar sands developers. If the Mackenzie pipeline proceeds and coincides with mineral development in the region, then further competition will arise. However, securing sufficient labour may not be a problem if the timing of mineral development is staggered or there is a lull in other industrial projects.
- *Regulations, Policy and Legislation.* A jurisdiction's regulations, policies and legislation pertaining to mineral exploration and development can deter or entice mineral activity in a region.

## **8.6 Mineral Information Needs**

- Completion of detailed surficial geology mapping for the remainder of the planning region.

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## 9.0 WATER RESOURCES

### Associated Maps

Map 16. Snow Depth Patterns & 3<sup>rd</sup> Order Sub-watersheds

### **Introduction**

The fact that the planning region is defined by its watershed highlights the critical role of water in the land use plan – ecologically, socially, culturally and economically. The waters sustain the full spectrum of plant and animal life across many ecosystems, provide an important source of food for the First Nations, offer a means of access to renewable and non-renewable resources, are required for a number of industrial activities, and are critical to the health of the downstream communities of Fort McPherson and Aklavik.

The headwaters of the six tributaries flow northward through the planning region, converging with the Peel River, which then flows west and north before crossing into the Northwest Territories and passing by the communities of Fort McPherson and Aklavik. What happens upstream – from the headwaters to the mainstem – has a significant impact on the wildlife of the planning region, as well as the people of the Mackenzie Delta.

The water resources of a region can be described via many attributes, such as snow cover, permafrost, glaciers, water availability, and water properties such as chemistry and water quantity/quality. Water resources can also be described by its anthropogenic uses such as industrial needs and availability and how it responds to climate change.

*Unless otherwise noted, the following information is derived from Kenyon and Whitley (2008). See reference below.*

### **9.1 Overview**

- Water use (and deposit of waste into water) is regulated by the *Waters Act* (Yukon).
- Water rights, usage and management, according to the UFA and GCLCA, are subject to Laws of General Application.
- Regulatory decisions will consider water/aquatic ecosystem objectives as identified in the transboundary water management agreements.
- Several ecological indicators were suggested for monitoring hydrological changes in the Peel, as part of transboundary water management discussions (MacDonald Environmental Sciences 1995).
- Several wetlands have been identified for their importance to waterbirds including Chappie Lake, Turner Lakes, Tabor Lake, and Jackfish Creek.
- Major rivers within the watershed include the Peel, Bonnet Plume, Snake, Wind, Ogilvie, Blackstone, and Hart.

- Despite some human impacts such as the Dempster Highway, water quantity and quality are believed to remain virtually unchanged from natural conditions.
- Benchmark water quality is naturally poor, due to high mineralization and sediment from natural sources and causes.
- Surface water availability is particularly limited in winter, and very little is known about the subsurface hydrology.
- Industrial requirements may be more than the potential supply of available water.
- Data – especially long-term trends – related to water quality, flow and hydrology are very sparse for surface and subsurface water in the PWPR.

## **9.2 Geography**

- The Peel Watershed Planning Region encompasses the Yukon Portion of the Peel River watershed.
- The Peel River watershed is bounded in the west by the Richardson Mountains and Nahoni Range, the Selwyn and Wernecke Mountains in the south, the Ogilvie Mountains in the southwest, and the Mackenzie Mountains in the east. The Ogilvie River drains the Nahoni Range and the western portion of the Ogilvie Mountains. The Ogilvie Mountains are also drained by the Blackstone River. The Wernecke Mountains are drained by both the Hart River in the west and the Wind River. The Bonnet Plume River drains the Selwyn Mountains west of the Bonnet Plume Range while portions of the Mackenzie Mountains are drained by the Snake River. The Richardson Mountains are drained by a series of small rivers including the Caribou, Trail, Road, and Vittrekwa Rivers flowing directly into the Peel River (Map 16).
- The Peel River watershed is comprised of five major river drainages: the upper Peel, Hart, Bonnet Plume, Snake, and Wind rivers. Additionally, the Blackstone, and Ogilvie rivers are large tributaries in the upper reaches of the Peel.
- Other important lakes and wetlands include Chappie Lake, Turner Lakes, Tabor Lake, Vittrekwa River, and Jackfish Creek.
- The basin is covered with continuous permafrost, and groundwater may be limited or nonexistent.
- Due to the dynamic nature of the basin, waters of the basin are commonly turbid with high sediment loads. Water quality has been this way since before humans arrived in the region.
- The rivers, streams and lakes are ice covered from freeze-up to break-up, approximately September to late-May or early-June. Water quality in winter is good, as it reflects the quality of the soils and gravels of the shallow aquifers. Some localized areas are persistently without ice cover, due to relatively warm groundwater discharge, extreme turbulence, or other factors; these areas are often important habitat for fish and migrating birds.

- Since storage of water in lakes and shallow aquifers is limited due to permafrost, flowing water in winter may only be found in localized reaches and in the large rivers such as the Peel River. Limited water supply and cold water temperature are limitations on water use; however, water quality would be expected to be suitable for industrial use.
- The Peel River is notable for the high sediment concentrations which can occur during open water (summer) and the resulting poor water quality. Surface water may not be suitable for industrial or municipal uses without treatment.

### **9.3 Legislation**

- In the UFA and GCLCA, the water rights are subject to laws of general application.
- The Final Agreements state that “Government may identify on maps described in 5.3.1 no more than 10 sites for a hydro-electric or water storage project in the Yukon.”(UFA 7.8.1) While each Final Agreement makes Specific Provisions for the identification of potential hydro-electric or water storage projects, no rivers in the PWPR are identified.
- Water use (and deposit of waste into water) is regulated by the *Waters Act* (Yukon).
- The Mackenzie River Basin Transboundary Waters Master Agreement is an agreement between the Government of Canada and the Alberta, British Columbia, Northwest Territories, Saskatchewan, and Yukon governments.
- There are five guiding principles of the Mackenzie River Basin Transboundary Waters Master Agreement: equitable use, prior consultation, use of resources in a sustainable manner, maintenance of ecological integrity, and harmony and cooperation in resolving issues.
- The Yukon-Northwest Territories Transboundary Water Management Agreement falls under the Master Agreement. Its purpose is to “cooperatively manage, protect, and conserve the ecological integrity of the aquatic ecosystem”. This agreement will lead to the development of ecological indicators that assess environmental stress, meet water quality objectives consistent with the Canadian Environmental Quality Guidelines (Canadian Council of Ministers of the Environment 1999, cited in Kenyon and Whitley 2008), and have the interim water quantity objective of “no significant change in flow regime resulting from new human activity that could affect the aquatic ecosystem.” Ecological indicators will be developed at a later date with the agreement being amended accordingly. Some ecological indicators have already been suggested (MacDonald Environmental Sciences 1995).
- Yukon First Nations have water rights under Chapter 14 of the Umbrella Final Agreement (Minister of Indian Affairs and Northern Development 1993). Traditional uses are guaranteed although no changes in water quality, quantity, or rate of flow are allowed.

## 9.4 *Water Quality and Quantity*

- Knowledge of water quantity and quality come from many sources including a 1965 report on hydroelectric potential, Water Survey of Canada hydrometric surveys, Mackenzie River Basin Study reports from 1981 and 2003, and a wide variety of scientific reports conducted since the early 1980's. Generally, water quality is naturally poor within the Peel River watershed.
- From a technical perspective, water quality is naturally poor but is safe for drinking (after boiling for 5 minutes as per Health Canada) and aquatic life.
- There is no licensed water use or deposit of waste in the Yukon portion of the basin.
- The basin is subjected to atmospheric deposition of long range transport of pollutants (such as persistent organic pollutants) which remain at low levels.
- In the open water season, the Peel River and lower tributaries often contain high sediment levels due to erosion.
- Water quality in the Peel River watershed is different in winter and summer. In winter, the ice cover separates the river from surface disturbance so generally suspended sediments and metals are low and dissolved substances are at a seasonal high (Hem 1985, Mackenzie River Basin Board 2003, EMAN-North 2005, cited in Kenyon and Whitley 2008). In summer, water quality is dominated by erosion (bank erosion and channel scour). The associated parameters are colour, turbidity and total suspended solids (TSS) (Hem 1985, EMAN-North 2005, cited in Kenyon and Whitley 2008). Suspended sediments can be very high following heavy summer rains.
- Engineer Creek is a significant source of metals, acid rock drainage and related water quality variables to the Ogilvie River (Kwong et al. 2008, cited in Kenyon and Whitley 2008). Trace metal amounts, including zinc, peak during high flow periods of summer and when suspended sediment loads in the river are also high (Mackenzie River Basin Board 2003, cited in Kenyon and Whitley 2008).
- Most water flow data is historical data from five stations throughout the Peel River watershed although two stations have been reactivated: one along the Peel River above Canyon Creek and the other on the Blackstone River near Chapman Lake.
- Water flow is controlled by the mountainous terrain and permafrost (Energy, Mines and Resources Canada, Surveys and Mapping Branch 1985, cited in Kenyon and Whitley 2008) with peak flows occurring after snow melt in late May/early June (Smith et al. 2004, cited in Kenyon and Whitley 2008).
- Annual precipitation is about 300 mm throughout the watershed with mountainous regions receiving slightly higher levels (Smith et al. 2004, cited in Kenyon and Whitley 2008).
- Numerous ecological indicators of water quantity and quality were considered by their hydrological, biological, and social relevance, and by their sensitivity, measurability, timeliness, appropriateness of scale, availability of historic data, nondestructiveness, lack of redundancy, and cost-effectiveness. The suggested suite of indicators include: aquatic plants, Broad Whitefish, Northern Pike, Lesser Canada Goose, waterfowl of ponds and wetlands, and muskrat and/or beaver (MacDonald Environmental Sciences 1995).

### **9.5 *Wetlands and Lakes***

- Wetlands are important for maintaining the hydrology of a watershed through the ability to mitigate effects of flooding, filtering sediment, preventing erosion, and storage and supply of surface water.
- In addition to lakes, all five wetland classes have been identified within the watershed. These classes include: bogs, fens, swamps, marshes, and shallow open water. (Rosie 2005, cited in Kenyon and Whitley 2008)
- Wetlands are very common in the Fort McPherson Plain and Peel Plateau ecoregions but less so in the Eagle Plains and British-Richardson Mountains ecoregions.
- Four wetland complexes have been identified by the Yukon Wetlands Technical Committee as important wetland sites: Chappie Lake, Jackfish Creek, Tabor Lakes, and Turner Lakes. All four wetland complexes were chosen due to their use by waterbirds, songbirds, gulls, and birds of prey. Chappie Lake is located between the Bonnet Plume and Wind rivers, Jackfish Creek is located along the Yukon-Northwest Territories border in the eastern portion of the Peel River watershed. Tabor Lakes is located along the Yukon-Northwest Territories border just east of the Peel River. Turner Lakes is located just west of the Peel River north of the confluence of the Peel and Snake Rivers. The use of these areas by waterbirds, particularly during the moulting period and migration, is due to its natural connection as a flight path for birds travelling to and from Alaska and the Mackenzie Valley.

### **9.6 *Snow Cover***

- Snow depths vary by basin within the Peel River watershed (Map 16).
- The Ogilvie, Hart, and Snake River drainages usually have less snow than the Peel River or forested areas of the Wernecke Mountains, but alpine areas have similar snow level (Russell et al 1993, cited in Kenyon and Whitley 2008).
- The headwaters of the Hart, Wind, Bonnet Plume and Snake rivers receive more snow than their lower reaches (Map 16).
- Environment Yukon (2007) (cited in Kenyon and Whitley 2008) prepares a snow survey three times annually after March 1, April 1 and May 1. It summarizes annual winter and meteorological conditions for Yukon.

### **9.7 *Permafrost***

- Permafrost is critical to the cyclical nature of bog-fen complexes commonly observed on the Fort McPherson Plain and Peel Plateau.
- Most wetlands have no permafrost under them with the exception of bogs and some swamps. The Peel Basin is in a region of continuous permafrost. Continuous permafrost

(defined as more than 90% coverage) prevents surface water from penetrating the surface to become groundwater.

- Annual peak flow increases significantly with latitude as a result of the increasing dominance of the underlying permafrost which reduces the pathways to the stream channel. Conversely, annual minimum flows decrease with latitude due to lesser groundwater contributions to winter stream flow. Many smaller streams within the continuous permafrost zone are completely dominated by the underlying permafrost and have no observed flow during the latter part of the winter.

## **9.8    *Glaciers***

- Western sections of the region were not glaciated but the Peel Plateau, Fort McPherson Plain and lower elevations within the Richardson Mountains were covered by the Laurentide ice sheet (Reid and Skinner 2008, cited in Kenyon and Whitley 2008).
- The Mackenzie Mountains were heavily impacted by glaciation and have a few alpine cirques remaining (Reid and Skinner 2008, cited in Kenyon and Whitley 2008).
- There presently are glaciers in the headwater regions of the Peel (Bonnet Plume), but streamflow response due to glacier melt would be restricted to headwater regions only.

## **9.9    *Water Availability***

- Water is available for industrial-level use mainly during the summer months.
- Flow rate of rivers declines to near zero during winter with large increases during summer months when it peaks shortly after ice melt.
- Other sources of water, other than river water, are limited as most lakes are shallow and ground water is scarce.
- Traditional water users take the natural variation in water quality and quantity into account in their seasonal use patterns. The traditional fishery is adapted to the natural water quality even though fish life may be limited by it.
- Past and present water consumption has been limited to tourists/recreationists, and mining and oil/gas exploration teams who take water for drilling and camp use.
- Future industrial camp users would likely face significant challenges when searching for a winter water supply and when treating the more abundant summer water, due to its variable quality.
- Developers looking for an industrial water supply may find that water supply is limiting. Storage and recycling may be required to maintain operations year round.
- Lack of information on the fisheries resources – particularly over-wintering fish populations – will make water extraction a critical issue for development planning.

## ***9.10 Potential Development of Water Resources***

### **9.10.1 Hydroelectric Power**

- A study was conducted in 1965 by the Department of Northern Affairs and National Resources, Water Resources Branch, to examine the feasibility of hydroelectric projects on northern Yukon rivers, including the Peel River (Department of Northern Affairs and National Resources 1965, cited in Kenyon and Whitley 2008).
- Diversion and non-diversion plans were discussed in the report. The diversion plan dammed the Porcupine River to provide flow for power plants on the Rat River through the Bell-Rat Pass. The final stage of development would include the flow of the Peel River by damming at Aberdeen Canyon and diverting to the Porcupine River through Eagle Pass. This five stage project would produce 10 billion kWh of firm power annually.
- Additional hydrologic data and studies would be required to define the hydroelectric potential of the basin and engineering feasibility using recent experience with northern systems.
- The study discussed the lack of markets for the size of the power projects examined and mentioned the iron ore deposits as a potential future customer. The need for large reservoirs to compensate for the long winter low flow season and the need for bedrock dam foundation in permafrost shaped the design of the power projects.
- There are currently no plans for hydroelectric development within the Peel watershed.

### **9.10.2 Water Exports**

- “Bulk removal” is usually used to describe the removal of significant quantities of water through tanker ships, pipelines or inter-basin diversion projects. Such removals have the potential, directly or cumulatively, to harm the health of the watershed.
- In 1999, the federal government announced a strategy to prohibit bulk water removal out of all Canadian water basins, thereby ensuring the long-term security of Canada’s freshwater resources. Since that time, the federal government and virtually all the provinces have taken steps to ban bulk water removal.
- The Yukon Government adopted the Department of Indian and Northern Affairs’ Policy Statement respecting the Prohibition of Bulk Removal from the Northwest Territories and Nunavut in December, 2003. This policy defines bulk water as any water transferred out of a river basin in any individual container greater than 40 litres, or removal by any means that involves permanent out-of-basin transfer, whether by diversion, tanker or other mechanism.

### ***9.11 Climate Change Impacts***

- Impacts of climate change are difficult to predict as the complexity of hydrologic changes make different responses possible (Price and Waddington 2000, cited in Kenyon and Whitley 2008).
- Climate change could result in flow and quality changes which would not be observed in a monitoring record because it takes some years of data to demonstrate change and monitoring is limited.
- Increases in mean air temperature may cause an increase in melting of permafrost resulting in the extensive peat plateau bogs to transform into fens (Rosie 2005, cited in Kenyon and Whitley 2008).
- Jorgenson and Ostercamp (2005) (cited in Kenyon and Whitley 2008) suggest melting surface permafrost may lead to low lying areas with fine grained soils forming lakes and a transition of forested areas to bogs and fens, or in some cases becoming better drained.
- Warmer temperatures may lead to an increase in winter flow in streams causing a reduction in the magnitude of spring peak water flow.
- Glaciers within the Peel River watershed are within a transitional zone where advancement or retreat is possible depending upon a number of factors including elevation and proximity to an ocean (Brugman et al. 1997, cited by Kenyon and Whitley 2008).

### ***9.12 Potential Incentives and Constraints to Development of Water Resources***

- *Availability of water.* Seasonal fluctuations and low flow rates in winter could make it difficult to exploit the water resources – depending on the scale of the development and its associated water needs.
- *Proximity of water.* The location of economically viable mineral resources in the PWPR is currently undetermined. They may or may not be found within proximity to a viable water source.
- *Bedrock conditions and topography.* Large-scale diversions for hydroelectric developments would require reservoirs and dams which, in turn, require the appropriate bedrock conditions and valley walls for containment.
- *Market.* With respect to hydroelectric energy, an attractive market would need to be identified and committed for consumption.



**References:**

Kenyon, J. and G. Whitley. 2008. Water Resources Assessment of the Peel Watershed. Prepared for the Peel Watershed Planning Commission. Whitehorse, Canada. 15 pp.

MacDonald Environmental Sciences Ltd. 1995. Expert's Workshop on the Development of Ecosystem Maintenance Indicators for the Transboundary River Systems within the Mackenzie River Basin. Prepared for the Water Resources Division, INAC. Ladysmith, Canada. 49 pp.

## **10.0 FISH, WILDLIFE, HABITAT AND CONSERVATION**

### **Associated Maps**

Map 2: Land Status

Map 17: Areas of Previous Conservation Interest

Please see the Conservation Priorities Assessment Report (PWPC 2008) for maps of conservation indicators and ecology.

### **Introduction**

Fish and wildlife populations, their habitats, and the full suite of biodiversity, are key resource issues for the PWPC for various reasons. First Nations members and other Yukoners rely on them for subsistence harvest and cultural identity. Collectively they are one of the key attractions behind recreation, tourism, and sport hunting activities in the PWPR. A number of species are rare globally and nationally, and many are unique to the Yukon. The ecosystems created by these species and their associated interactions perform services, such as provision of oxygen and sequestration of atmospheric carbon. Each species has intrinsic value in the ongoing sustenance and evolution of life in the PWPC. In sum, adequate assessment of conservation priorities for wild species in fully functioning ecosystems is key to a successful land use plan.

Conservation, in this context, refers to the desire to ensure a sustained future for healthy and robust populations of all naturally-occurring organisms that occupy and have evolved in the PWPC, as well as fully functioning ecosystems derived from the interactions of these organisms and their environments. This definition includes the sustainable harvest of wild animals and plants by First Nations peoples, Yukoners, and commercial enterprises.

The PWPC Conservation Criteria and Indicators Report (PWPC 2007) and Conservation Priorities Assessment Report (PWPC 2008) provide substantial detail regarding the fish, wildlife and habitat values, the specific indicators chosen to represent those values spatially, and the technical analyses and resultant maps for each of the indicators. In this Report we provide quick synopses of those two Reports, including the process for data gathering and analysis, and the principal results for each indicator. However, we do not provide maps for each indicator, but refer the reader to the Conservation Priorities Assessment Report (PWPC 2008) for more detail and copies of the maps.

### ***10.1 Overview***

- There are no lands currently designated and managed for fish and wildlife conservation (e.g., Parks and protected areas) within the PWPR.
- The Canadian Heritage River status for the Bonnet Plume watershed offers moral direction for heightened care of its wilderness status, but no legislated or regulated protection.

- The PWPR has very little human footprint, and therefore encompasses diverse and widespread wilderness areas and wildlife habitats. It is one of the few remaining areas in North America with such intact ecosystems.
- There is substantial interest in the potential of the PWPR to satisfy territorial and global needs for conservation.

### ***10.2 Process of Resource Valuation and Mapping***

- A major goal of the Conservation Priorities Assessment is to map the distribution of key fish, wildlife and habitat values so that areas of greatest concentration of these values, and locations of unique or irreplaceable values, can be selected for potential conservation protection.
- The key values were identified in the Issues and Interests Report (PWPC 2005), and indicators were chosen to represent those values (PWPC 2007).
- Biologists, First Nations members, and guide-outfitters are the most knowledgeable sources of information on distribution of fish, wildlife and habitat values, and so are the expert sources of information for our analyses.
- Government databases on the distribution of indicators (e.g., the Wildlife Key Areas (WKA) database) are rarely complete for the entire PWPR, so we employed a habitat suitability approach. This approach allowed us to model and map the likely distribution of indicators over the entire planning region. Suitability maps generally included four quality classes: 0=Nil, 1=Low, 2=Medium, 3=High.
- Various experts provided data and assessments through a series of meetings and workshops, and worked with planning staff to refine the resulting maps.

### ***10.3 Biophysical Setting***

- PWPR encompasses diverse mountain ranges of the Taiga Cordillera ecozone, and extensive forested plateaus of the Taiga Plains ecozone. The Taiga Cordillera ecozone includes portions of the following ecoregions: British–Richardson Mountains, North Ogilvie Mountains, Eagle Plains, and Mackenzie Mountains. The Taiga Plains ecozone includes portions of the Peel River Plateau and Fort McPherson Plains ecoregions.
- The mountainous ecozone ranges from about 650 to 2740 m in elevation, and includes ranges with diverse sedimentary, metamorphic and igneous origins. Exposed bedrock and barrens are extensive, as are alpine tundra and shrub vegetation. Spruce and pine forests are limited to valley floors and lower slopes.
- The lowland plateaus are covered in spruce forests, with extensive wetlands and lakes, including bogs, fens and shrub lands.
- The western half of the PWPR was not glaciated in the Pleistocene, and therefore supports endemic and nationally unique biota typical of the Beringian refugium.

- Climate is northern continental, with long cold winters and short summer when most precipitation falls.
- Permafrost under lays all areas with any soil development.
- The eastern mountain rivers have steep, high energy headwater tributaries which drop to wide braided river beds in their glaciated valleys. These include the Snake, Bonnet Plume and Wind Rivers.
- The western mountain rivers, such as Ogilvie, Blackstone and Hart, have more gradual gradient and join to form the upper Peel River, which passes through Aberdeen Canyon, an impassable barrier to fish.
- Downstream of the Aberdeen Canyon, the Peel River is a relatively slow river with heavy silt load from its various tributaries and its erosion of the deep glacial deposits of the Peel Plateau.
- The dominant processes currently shaping the physiography are water erosion, freeze-thaw cycles, mass wasting, and permafrost slumping.
- Dominant processes and factors that have shaped and continue to shape the pattern and distribution of vegetation are the history of glaciation, elevation, aspect, and wildland fire.
- Biotic diversity in the PWPR is relatively high for this latitude because of the overlap of Beringian and non-Beringian species, the diverse sets of habitats in mountain areas, and the changing drainage patterns from the late Pleistocene (when most of the area drained into the Yukon River system) to present (draining into the Mackenzie River system).
- Humans have been part of the ecology of the Peel watershed for thousands of years, and continue to take a generally sustainable harvest of various species.

#### ***10.4 Conservation Indicators***

This section provides an overview of the derivation and results of mapping each conservation indicator. The experts who provided and interpreted the data, and in some cases who compiled the maps, are listed in the Acknowledgements section of this Report.

##### **10.4.1 Ecosystems / Habitats**

- Ecosystems are mapped (i) to quantify their spatial extent and representation by ecoregion, and (ii) as a habitat template for mapping suitability of habitats for focal species.
- A comparison of the distribution of ecosystems and ecoregions with a map showing the limits of Pleistocene glaciation, gives an estimation of ecoregions with the highest concentrations of Beringian biota today. These are principally Eagle Plains and the North Ogilvie Mountains, with significant portions of the west side of the British Richardson Mountains, and the northern edge of the Mackenzie Mountains ecoregion also not experiencing Pleistocene glaciation. The Peel Plateau and Fort McPherson Plains were covered by continental glaciers.

- The ecosystems map is derived from satellite imagery, a digital elevation model, and various masks to delimit alpine and riparian zones. It includes 31 unique ecosystems which are assessed for relative rarity by ecoregion, and which are also used as habitats for the habitat suitability assessments.
- 3 alpine ecosystems (e.g., high elevation bryoid community) are rare (i.e. constitute <1% of an ecoregion) in more lowland ecoregions, and their rarity is mostly an artifact of boundary delineation.
- 12 water accumulating, wetland, and riparian ecosystems are consistently rare (<1% of the area) or uncommon (<3% of the area) through most ecoregions. These are low-mid elevation moist herb, low-mid elevation moist coniferous forest, gravel-sand bars, riparian herb marsh, riparian shrub, riparian mixedwood forest, riparian spruce forest, wetland herb, wetland shrub, wetland forest, open water, and flowing water. This emphasizes the additional conservation attention these aquatic and riparian ecosystems require.

#### 10.4.2 Fish

- Fish resources are particularly valuable as foods for First Nations communities.
- Fish species in the Peel River drainage are particularly diverse because some species have multiple genetic lineages, including both Pleistocene Yukon River drainage origins, and post-Pleistocene Mackenzie River drainage origins. Also, a number of Mackenzie River drainage species are not found in the Yukon River drainage.
- Fish distribution is mapped as (i) known locations of spawning, occupancy and traditional use, (ii) likely maximum extent of any fish species, and (iii) features likely to have high local value for fish.
- Known locations of spawning, occupancy and traditional use are incompletely inventoried, but the Peel River main stem, downstream of Aberdeen Canyon, is highly valuable. It includes spawning habitat for various whitefish species (coregonids) with high subsistence food value, and is also highly valuable as wintering habitat for numerous species which cannot winter in tributary rivers with very low winter flow regimes. The Peel River upstream of Aberdeen Canyon is also highly valuable winter habitat, because various species occupy this section of the drainage and evidently do not move through the Canyon annually.
- Maximum likely extent of fish occupancy is mapped in a GIS, based primarily on stream gradient. This represents summer distribution, when water flow regimes allow fish to move furthest upstream, and Dolly Varden char are probably the species with most extensive occupancy. All major tributaries to the Peel River (e.g., Snake, Hart and Ogilvie) provide suitable summer habitat, including many of their tributary streams.
- Features likely to be of high value to anadromous coregonids and salmonids include the Peel main stem, in which spawning locations are incompletely inventoried, and some headwater spawning habitats for Dolly Varden char. Winter habitats for potadromous species may be associated with major confluences, especially along the Peel, and with aufeis formation.

#### **10.4.3 Caribou**

- Caribou are primary subsistence food for First Nations communities, and are particularly susceptible to human development pressures.
- The barren-ground Porcupine caribou herd (PCH), one boreal woodland caribou herd (BCH), three northern mountain caribou herds (Bonnet Plume – BPCH; Hart River – HRCH; Redstone – RCH), occupy portions of the PWPR, sometimes with overlapping ranges.
- Winter is considered the critical season for caribou. The PCH winters primarily in the Eagle Plains and southern Richardson Mountains, but the majority of its annual range is to the north and west of the PWPR. The range of the BCH lies primarily in the Northwest Territories, to the northeast of the PWPR, but some members of the herd move into the Fort McPherson Plains portion of the planning region in winter. The range of the BPCH is almost entirely within the PWPR, and the HRCH spends most of its annual cycle, including winter, in the PWPR. The RCH range only includes a small portion of the upper Bonnet Plume and Snake drainages, and its habitat relationships are considered similar to the BPCH.
- Known areas of high use by caribou, based on telemetry data, satellite collar data or aerial surveys, provide maps of distribution of high quality areas.
- Biologists and knowledgeable community members provided winter habitat suitability ratings, on a four-class scale, for each herd which were then translated into habitat suitability maps.

#### **10.4.4 Moose**

- Moose are an important subsistence food species, and an indicator of riparian habitats.
- The population structure of moose in the PWPR is poorly understood, so habitat suitability ratings provided by biologists and community members were applied to three subregions for which the community members had most direct experience. WKA data helped refine the ratings, including some specific areas in the North Ogilvie Mountains.
- Late winter is deemed the critical season for moose, and suitability was rated on a four class scale.
- Forested ecoregions, such as the Peel River Plateau and the Fort McPherson Plains, support the most extensive higher quality winter habitats. However, high quality late winter habitat is extensive in ribbons following riparian areas in all mountainous areas, and extends through wetland and subalpine shrub lands throughout.

#### **10.4.5 Dall's Sheep**

- Dall's sheep are indicators of alpine ecosystems, and are critical to the commercial viability of the guide-outfitting industry in the PWPR.

- Sheep are widespread in the mountain areas of the region, and winter is thought to be the critical season. High quality winter range is influenced not only by vegetation, but also by aspect and slope steepness (escape terrain).
- Biologists and community members provided winter suitability ratings for mapped habitat types, and planning staff developed a model combining aspect, slope steepness, and habitat type. The model was refined using WKA data on known distributions, and an adjustment for higher snow depths in the southern portion of the planning region.
- High quality winter sheep habitat is very extensive through the Mackenzie Mountains, North Ogilvie Mountains, and Richardson Mountains ecoregions, but very limited to non-existent in the Peel Plateau and Fort McPherson Plains ecoregions.

#### **10.4.6 Grizzly Bear**

- Grizzly bears are susceptible to human disturbance, and represent widespread intact wild ecosystems because of their large area requirements.
- Most of our knowledge of grizzly bear ecology in the PWPR is based on a few focused studies of habitat use in the Mackenzie Mountains ecoregion, and inference from other studies in Yukon.
- Biologists agreed that no one season is particularly critical to bears, but that three feeding seasons (spring, summer and fall) should be mapped based on the availability of high quality plant foods, and the use of certain habitats by females with young needing security cover from adult males. There is insufficient knowledge about denning habitats, and the availability of animal foods across habitats, to rate habitats for these features.
- A composite, four-class, suitability map is based on the highest habitat rating each habitat received out of all three seasons, with suitabilities being rated lower in the flatter ecodistricts of the Taiga Plains ecozone where black bears are more common.
- High quality grizzly bear habitats are strongly associated with riparian areas, and the rich growth of horsetail, forbs, graminoids and berries these habitats can provide. In the mountainous regions, these habitats are highly concentrated in valley floors, but they are more extensive on the boreal forest plateaus.

#### **10.4.7 Marten**

- Marten are one of the most valuable furbearing species for local trappers, and an indicator of mature forest growth.
- Knowledge of marten distribution is patchy, and the best source of information is local community members who have trapped. Winter is considered the critical season.
- Workshops in Dawson City and Fort McPherson provided winter habitat suitability ratings on a four-class scale. The highest rating from either workshop for each habitat was mapped.

- Marten habitat is extensive in the Taiga Plains ecozone, and the Eagle Plains ecoregion. In the mountainous ecoregions it is much more restricted to forested valley floors.

#### **10.4.8 Peregrine Falcon**

- The Peregrine Falcon is a threatened species, and an indicator of the health of wetland ecosystems with its principal prey – shorebirds.
- There is substantial inventory information on the distribution of Peregrine Falcon nests, enough to build a model to map likely high quality nesting habitat, based on nesting cliffs adjacent or close to wetland foraging habitats, through the PWPR.
- The map of nesting and likely foraging habitat (2-class scale) indicates that peregrine falcons are heavily associated with the Peel River mainstem, and downstream sections of its major tributaries, such as the Wind and Bonnet Plume. Therefore, the Peel River Plateau ecoregion, and portions of the Eagle Plains ecoregion, support the Peregrine Falcon population of the PWPR.

#### **10.4.9 Waterbirds**

- Waterbirds (notably waterfowl and shorebirds) are indicators of wetland ecosystems, the most productive ecosystems in the region.
- Inventory of waterbirds is incomplete in the PWPR, and a habitat suitability approach is the best way to depict likely distributions. Nesting and brood rearing seasons are deemed critical, but water bodies also provide substantial migratory staging sites.
- For standing water, two suitability classes were used. High suitability includes all open water mapped in the National Topographic Database (NTDB), plus a buffer of 250 m. Low suitability includes a further buffer of 250 m. The total 500 m buffer represents the areas within which 95% of waterfowl nests are likely to occur. Low suitability habitats also include all NTDB wetlands without open water.
- For flowing water, one suitability class was mapped (high) which includes the water body itself and the riparian zone mapped on the ecosystems map, all unbuffered.
- Waterbird nesting habitat is widespread and much higher overall quality through the Peel River Plateau and Fort McPherson Plains ecoregions. In the more mountainous areas, it is clearly associated with valley bottoms, along river courses and around the few lakes.

#### **10.4.10 Breeding Birds**

- The richness (number of bird species) by habitat type is considered one indicator of the general distribution of biodiversity across the PWPR.
- Nesting season is deemed the critical time of year for most birds in the PWPR.
- Biologists compiled a list of bird species that have been observed in the PWPR. They excluded those species that only migrate through the region or that are vagrants. Of the



remaining species likely to nest, they excluded those already mapped through other indicators (i.e. waterbirds and Peregrine Falcons). For the 86 species remaining, they classified the likely use of each habitat by the species in the breeding season. Habitats were then placed in one of four classes based on the number of species likely to nest in each of them. Numbers of nesting species by habitat ranged from 0 (snow/ice) to 50, with a median value of 17.

- The four-class map of species richness indicates that habitats with the highest species counts were in wetlands, riparian forests, or shrubby areas at all elevations. Rugged mountainous areas (e.g. Selwyn Mountains) had extensive areas with few species, while more subdued and extensively vegetated mountains (e.g. Richardsons) had higher species richness.
- The map of species richness is difficult to interpret because it is not based on direct inventory data within the mapped habitats, but more on inferred habitat associations. The particular mix of species in any one habitat may or may not include species from other habitats, so there is no way to infer replaceability. Conservation zoning should recognize that the full range of habitats is the best way to conserve biological diversity, rather than a focus on high species richness alone.

#### **10.4.11 Birds of Conservation Concern**

- Species that are at risk of extinction, or are in significant population decline, deserve particular attention, and are listed as being of conservation concern by various management authorities (e.g., Committee on the Status of Endangered Species in Canada).
- 12 such species are thought to nest in the PWPR, but two are considered as part of other indicators (i.e. Peregrine Falcon and Harlequin Duck).
- Each habitat was assessed as to whether or not each of the 10 remaining species of conservation concern would nest in it. For each habitat the total number of possible species was summed, and habitats were placed in one of four classes: Nil (0 of 10 species); Low (1 of 10 species); Moderate (2 of 10 species); High (3 to 5 of 10 species).
- Habitats hosting 3 to 5 species were wetlands, wet meadows, and vegetated alpine areas.
- Mountainous areas had strong contrasts between habitats with high value for these rare species, and habitats with low or no value. The more subdued, well vegetated ranges (e.g., Richardsons) had the highest values overall. Other areas within the PWPR with high values for rare species included the wetlands on the Peel River Plateau, Edigii Hill and the Ogilvie pediments.

#### **10.4.12 Rare Plants**

- The PWPR includes the known or suspected ranges of numerous rare and endemic plant species requiring focused conservation attention, but inventory data are incomplete.

- Rare species in boreal taiga and montane environments are generally associated more often with certain broad habitat types, such as exposed bedrock or substrates, and wetlands.
- Endemic species in Yukon generally evolved in the Beringian glacial refugium, and the likelihood of their occurrence at an ecodistrict scale, can be inferred from knowledge of the extent of glaciation.
- Although the categories “rare” and “endemic” often overlap, biologists assessed them separately. Each habitat type was given a rarity rank (4 class scale), independent of location in the planning region. Each ecodistrict was given an endemism rank (3 class scale), varying with extent of Pleistocene glaciation. The products of the two ratings were re-classified in a four-class scheme for a Unique Plant Likelihood map.
- The North Ogilvie Mountains and Richardson Mountains have the highest likelihood of occurrence of rare and endemic plant species.

#### **10.4.13 Wilderness**

- Maintaining the integrity of wilderness in the PWPR is a stated goal of the planning process, and a key desire of most people who visit the region.
- Most of the PWPR is currently wilderness, by most peoples’ definition, and this status is very attractive to recreationists and tourists.
- Wilderness was mapped by removing certain areas where human footprint or ongoing human activity has created non-wilderness conditions. These include: (i) long term human footprint – the regularly used motorized corridor of the Dempster Highway with 5 km buffer on each side; (ii) short-term human footprint – intermittently used motorized corridor such as the Wind River trail and airstrips, plus fixed infrastructure such as camps, with 2 km buffer, or, if rarely used, such as seismic lines, with 0.5 km buffer; (iii) disturbance without footprint – repeated seasonal or annual use but no infrastructure such as float plane landing lakes, with 2 km buffer.
- Wilderness is very extensive throughout the planning region, and the buffered non-wilderness areas are more extensive than the very limited human footprint. The Hart River drainage stands out as the major drainage with the least human footprint, and least exclusion of areas from wilderness status.

#### **10.4.14 Subsistence Harvesting**

- First Nations have used, and continue to use, portions of the PWPR for subsistence harvesting of fish, wildlife and plants.
- These areas were mapped by community members at workshops held in Dawson City, Mayo and Fort McPherson. Staff from the respective First Nation governments collated and finalized the mapping and provided it to the PWPC staff. (Map 3)

- Maps of culturally important areas created during the Mackenzie Delta/Beaufort Sea land use planning process were provided to the PWPC staff for use alongside or complementary to the workshop derived mapping.
- The map of subsistence harvesting areas includes numerous large polygons and numerous localized sites. There is heavy use of the Dempster Highway corridor, and of the Peel River main stem. Use appears to be more restricted in the Wind, Bonnet Plume and Snake drainages.
- Maps of subsistence use and of other cultural values are not complete; areas on the map without any feature(s) do not necessarily indicate lack of use or value.

#### **10.4.15 Special Features**

- Certain local landscape or habitat features which are crucial for wildlife survival are not represented in habitat suitability maps, or maps of wildlife distribution. They need particular mapping and attention in land use planning.

### ***10.5 Landscape Processes***

Two processes have such a widespread impact on the distribution of habitats and organisms in this region that they deserve special focus in a conservation context. They are wildland fire, and climate change.

#### **10.5.1 Wildland Fire**

- Wildland fire is the dominant stand replacing disturbance in the boreal forest, and changes the entire species composition of the plant communities for extended periods of time. Consequently habitat suitabilities change for wildlife species, and the distributions of these species can be radically affected.
- Wildland fires are highly variable in size ranging from a few to many thousands or tens of thousands of hectares, but burn less than 1% (c. 0.15 – 0.8%) of the landscape per year. Forests take many decades, and often well over a century, to return to pre-fire structure and species composition. Fire size and spread is much less in mountain areas.
- Conservation zones need to be large enough to accommodate extensive burns, through a normal fire return interval of ~250 to 1000 years, and maintain the full suite of age classes of forest available as habitats for wildlife during that time.
- This goal is impossible to plan for in an exact way, because of the somewhat stochastic nature of fire incidence and spread. Large tracts of contiguous forest are required.

#### **10.5.2 Climate Change**

- Ongoing climate change is forcing most species to re-distribute themselves as growing conditions, and habitat conditions, change.

- Conservation planning needs to facilitate the natural tendency of organisms to compensate for such changes by re-distributing themselves. Plants that are not wind-dispersed are the group that will have the most difficulty changing.
- We are unable at present to model the future distribution of climate regimes and changing permafrost conditions, in a predictive way, so as to show where organisms are most likely to survive in the future.
- Our best approach at present is to focus on certain general adaptive strategies designed to minimize the risk of species loss.
- The key adaptive strategies include:
  - Conserve watersheds and sub-regions which are likely to be most resilient to projected climate change because they are not experiencing extreme conditions at present. This includes monitoring key species and processes to see how they are responding to change.
  - Enhance the ability of organisms, particularly plants, to move by natural dispersal, focusing on downslope to upslope connectivity, south to north connectivity, and connectivity within types of bedrock, soils and moisture regimes.
  - Minimize the negative effects of other limiting factors on population health and distribution, because these will have stronger effects on a population under stress from climate change. This includes more control on harvesting levels, thresholds on the intensity of human footprint and development, and minimizing linear corridors.

## ***10.6 Areas of Previous Conservation Interest***

Over the past several decades, areas of conservation interest have been identified through a variety of exercises, using a variety of criteria and methodology (Map 17). None of the previous exercises were as comprehensive as the Commission's Conservation Priorities Assessment, nor were the criteria, methods or rationales as well documented; however, these other exercises demonstrate the historical interest in identifying conservation priorities in the PWPR and, in many cases, confirm the values identified in the PWPC assessment process.

- There are very few currently recognized conservation areas in and around the PWPR. Within the PWPR, the Bonnet Plume River is a recognized Canadian Heritage River (see section 2.5, Map 2). At the northernmost corner of the PWPR, the Gwich'in Land Use Plan established the James Creek Conservation Zone (see section 2.5.1), while the Tr'ondëk Hwëch'in Final Agreement established Tombstone Territorial Park along the southwest boundary of the PWPR (see section 2.5.3).
- The Peel River Preserve was established by the Government of Canada in 1924. While this preserve guaranteed the hunting rights of the Gwich'in within its boundaries, it did not provide any protection to other ecological or cultural values.
- Starting in the 1960s, several processes have proposed protected areas or identified conservation areas of interest within the Peel Watershed Planning Region.

- Differing in their goals, objectives, selection criteria, and overall extent, these processes have often reached different conclusions.
- Several previous processes repeatedly identified the Richardson Mountains, Edgii Hill, Turner Lakes, and the upper Peel River Plateau (Map 17), however this pattern may be due, in part, to some processes focusing on the northern portion of the PWPR.
  - Several previous processes were led by largely aboriginal entities with the goal of suggesting discreet protected areas. These areas (and the amount of their overlap represented by progressively darker shading) are depicted in Map 17; the processes are briefly described below:
  - In 2003, the Gwich'in Social and Cultural Institute (on behalf of the Teetl'it Gwich'in First Nation) applied for two blocks of land along the Peel River to be designated as a National Historic Site. Traditional trails, camps, gathering places and resource areas, as well as burial sites, sacred/legendary places, and historical locations lie within these blocks (GSCI 2003).
  - In 2001, the Gwich'in Interim Land Use Planning Board described a number of locations, both in NWT and Yukon, which had important wildlife habitat, traditional use areas, and/or cultural sites. Workshops held at four communities used previous recommendations (including MDBSLUP, and PRWAC) as general guides to identifying areas needing protection. Two designations were suggested for these locations: conditional, and protected. Within the PWPR, four large discreet blocks of land were suggested to be protected (GILUPB 2001).
  - In 1994, two adjacent land claim agreements (GCLCA and NND Final Agreement) led to the creation of the Peel River Watershed Advisory Committee (PRWAC). In 1996, the PRWAC recommended the protection of ecosystems, heritage values, and recreational opportunities in the Peel River Watershed through the use of Special Management Areas, Protected Areas, and other tools. It also identified 19 general locations as candidate areas for conservation. Many of these locations overlap with one another; however their exact extents were not mapped at the time. Finally, it suggested the conservation of less readily identifiable locations including: critical caribou habitat, traditional campsites, landslide areas of the Bonnet Plume Watershed, trails within the Snake, Bonnet Plume and Wind watersheds, and winter open water areas (PRWAC 1996).
  - In 1991, the Mackenzie Delta–Beaufort Sea Land Use Plan was released following a four year study of land interests and concerns in that region. This process involved all eight communities in that region, including the Gwich'in, the Inuvialuit, and the federal and territorial governments. Along with guiding principals and other suggestions, this plan recommended the zonation of the land into five categories of varying conservation value (cultural and/or renewable resource). Category C and D lands, the categories of land with particular significance and sensitivity, are depicted in Map 17. No category E lands (extreme significance – typically applied to small localized sites) were designated in the PWPR. Nonetheless, this plan suggested protected area status for the Peel River watershed north of the Mackenzie Mountains (MDBSLU Planning Commission 1991).

- Several other processes, with varying degrees of First Nation involvement, described areas of ecological or cultural values within the PWPR. Some processes went as far as suggesting that protected areas be established, while others expressed general concern or interest in various blocks of land.
- The Yellowstone to Yukon Conservation Initiative, together with CPAWS, identified the southern Peel watershed as its northernmost “priority area” in its network of proposed conservation areas between Wyoming, USA, and Yukon (YYCI 2008).
- The Canadian Parks and Wilderness Society (CPAWS), Yukon Chapter, recommended in 2006 that the Snake River watershed be protected as a territorial park, that the Bonnet Plume and Wind Rivers also be include in a core protected area, and that special conservation zones be established to help protect the Turner Lake wetland complex, sensitive river corridors, and a portion of the southern Richardson Mountains. CPAWS also urges that the entire Peel River watershed be nominated to become a cooperatively managed UNESCO Biospere Reserve. (Pojar 2006).
- The Mayo District Renewable Resources Council identified three discussion areas in the late 1990's within the PWPR: Peel River around Aberdeen Canyon, Wernecke Mountains, Nash Creek Area (CPAWS 2004).
- The Yukon Protected Areas Strategy (2002) identified core areas representative of Yukon's ecoregions, one of which overlapped with the PWPR around Eagle Plains (YPAS 2002).
- The Yukon Parks System Plan (1993) identified a small number of areas of interest for their ecological values and minimal resource conflicts (J.S. Peepre and Associates 1993). In addition to one proposed landscape-representative park along the Peel River valley from the Bonnet Plume to the Snake River, the report proposed an historic park at Wind City, and several potential ecoregion-representative protected areas (Canyon Creek, Aberdeen Canyon, Caribou River/Peel Plateau, Hart River/Peel River/Hungry Lake area).
- The Canadian Wildlife Service identified two blocks of land needing protection for their valuable waterfowl breeding and staging habitat: Chappie Lake area, and Turner Lakes/Caribou River area (Dennington 1985).
- Several critical wildlife areas were identified by the Yukon Game Branch and the CWS in the 1970's (McPherson et. al. 1987), and overlap (both geographically and in goal) with the current WKA database of Yukon Environment.
- The International Biological Program identified, in the early 1970's, two blocks of land for research purposes (Beckel 1975): one, adjacent to the Crest iron deposit, for research on the effects of mining on wildlife populations; and the other west of Nash Creek for researching the ecology of a montane arctic environment. A third block, straddling the PWPR boundary and representing unique flora and a range of geological features, was partially protected by Tombstone Territorial Park.

### ***10.7 International Significance of the Peel Watershed***

The report prepared for Yukon Parks, entitled “Peel Watershed, Yukon: International Significance from the Perspective of Parks, Recreation and Conservation” (Green et al. 2008) examines the extent and quality of the wilderness, and ecological and recreational values of the Peel Watershed in comparison to the Arctic as a whole. It also compares these values among the subregions of the PWPR. The section below provides an overview of the results of this report that are not adequately treated elsewhere in the Conservation Priorities Assessment Report.

- Global arctic “wilderness” (defined as habitat not fragmented by any substantial infrastructure):
  - The PWPR straddles two of the 25 largest remaining uninterrupted Arctic wildernesses in the world.
  - The majority of the Peel Watershed lies within the second largest remaining uninterrupted Arctic wildernesses. The largest uninterrupted Arctic wilderness is found in northern Siberia.
- Global ecological representation:
  - 26% of the PWPR lies within one of the 195 terrestrial “Global 200 Ecoregions” - units of land considered, at a global scale, to be a priority for conservation. These units are part of a global system of ecological description, and are defined at a more coarse scale than the “ecoregions” of the national/territorial system used elsewhere in this resource assessment.
  - The PWPR represents only 1% of this “Global 200 Ecoregion” which corresponds to the Taiga Plain portion of the PWPR.
- The PWPR was subdivided into seven sub-regions that corresponded to the six southern large tributaries to the Peel (Snake, Bonnet Plume, Wind, Hart, Blackstone, and Ogilvie) and the combination of the northern smaller tributaries (e.g. Trail and Caribou Rivers) called “Northern Peel”.
  - “Wilderness quality” for each sub-region was assessed by a panel of experts not familiar with the watershed using ten criteria: untrammelled, size, evidence of permanent roads, evidence of human occupancy, evidence of human modification, naturalness, natural processes, lack of accessibility for recreation, and lack of recreational facilities. The maximum score was 190. This definition of wilderness quality does not take into account biodiversity or conservation indicators.
    - Hart: 140 (74%)
    - Bonnet Plume: 134 (71%)
    - Wind: 120 (63%)
    - Snake: 113 (59%)
    - Northern Peel: 96 (51%)
    - Blackstone: 94 (49%)
    - Ogilvie: 89 (47%)
  - Diversity of recreational activities is highest in the Snake, Bonnet Plume, and Wind

basins.

- The most extensive hiking area is in the Hart River basin, but the highest quality hiking is found in the Upper Wind and Snake river basins.
- Very high recreation potential was identified along and between the upper Snake and Bonnet Plume rivers, and along a 70 km section of the Peel River (likely upstream of the Snake).
- The “core wilderness” of the Peel watershed consists of the Hart drainage and adjacent unfragmented areas. However, there are several key areas with high values beyond this core area.
- Recommendations of the report:
  - The PWPC should give serious consideration to effectively protect the wilderness and biodiversity values of the Peel watershed in perpetuity through formal designations and other mechanisms.
  - Several issues should be examined in greater detail. A number of these issues have been addressed within this and other publications of the PWPC. Some exceptions are:
    - Quality of wilderness should be re-evaluated using the methods of above, but based on the opinions of local stakeholders familiar with the PWPR.
    - An assessment of the ecological importance and representation of the overlapping “Global 200 Ecoregion” within the PWPR.
    - An assessment of the ecological services provide by the PWPR (e.g. Biological, cultural, protection of water, and provision of sinks for carbon).
    - An assessment of the PWPR in the context of national wilderness policies and strategies. Also, areas should be assessed for inscription on the World Heritage List.

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## 11.0 EXISTING LAND USE

### Associated Maps

Map 18. Existing Land Use Impacts

### **Introduction**

An important contribution of regional land use planning is that it can help to monitor and mitigate cumulative effects of multiple land uses in a given area. From the perspective of cumulative effects, it is important to assess the historical and current human-caused impacts and disturbances in the planning region. These impacts – often referred to as footprints – can arise from a variety of physical changes to the landscape, such as road construction, gravel pits, air strips, seismic cut lines, well sites, camps, trails, etc.

Relative to southern regions of the Yukon or Canada, the PWPR has not experienced significant impacts. The dominant features in the PWPR include the Dempster Highway in the western portion, and the cut lines from oil and gas seismic exploration in the 1960s and 1970s in the Peel Plateau. The Dempster Highway represents a feature that is essentially permanent, whereas seismic lines or winter roads and trails are presumed to be temporary. There is not enough data to assess the extent to which historical footprints have naturally recovered. Yukon Government has initiated some field research that will help provide a reasonable estimate. In lieu of conclusive research data, the Commission has estimated that 20% of the seismic lines have naturally regenerated. Using contemporary best management practices in the oil and gas industry, it is anticipated that the footprints of future seismic lines will be substantially reduced from those that were created 40 years ago.

Some human activities, such as small mine sites and camps, may not possess extensive footprints on their own (presuming that they would not inflict significant downstream or downwind impacts), but the associated access roads to these sites would have an additional impact. Linear features such as roads and trails can cause fragmentation of ecosystems and disrupt natural processes such as predator-prey relationships. A healthy body of scientific research (see below) has confirmed that the greater the density of linear features, the greater the ecological impact. Further, all human footprints, to varying degrees, have the potential to affect other human land uses.

Small site-specific activities may not, individually, produce a significant footprint, but the presence of multiple small-scale activities can result in more significant negative impacts. Consideration of existing land use impacts therefore can help mitigate cumulative impacts when presenting future scenarios for zoning and management strategies for various activities on the land and water.

## 11.1 Concepts

### 11.1.1 Human-caused Surface Disturbance – or “Footprint”

- Human-caused surface disturbance is a general term used to describe the physical disruption of soil or hydrology, or the clearing of trees and woody vegetation. The amount of surface disturbance provides a measure of direct human ‘footprint’ on a landscape. The amount of human-caused surface disturbance can be measured as a discrete area (e.g. ha or km<sup>2</sup>), or as a proportion of a defined unit of analysis (e.g. % of an ecodistrict or other land management unit).
- A growing body of research suggests that the total amount of human-caused surface disturbance and density of linear features is related to overall ecological integrity of natural systems (Duinker, 2000; Dyer et al., 2001; Environment Directorate, Northern Affairs Program, 2002; Cameron et al., 2005). As the total amount of surface disturbance and linear feature density increases, so do the risks to wildlife and fish populations, and overall ecological integrity.
- Surface disturbances may impact the local ecology several ways: forage and cover for wildlife may be degraded or eliminated within the disturbance; surface erosion, run-off and sediment input into streams may increase; permafrost may melt, causing changes to local hydrology; hunters (both animals and human) can use linear features for access, and thus impact prey species more efficiently.
- Human 'footprints' may affect other land uses. For example, obvious human-caused disturbances would likely reduce the value of an area for wilderness tourism, yet some disturbances (e.g. roads) could facilitate resource extraction, from various nearby locations, not only the terminus.
- Land use activities have resulted in the creation of surface and vegetation disturbances ranging from small features that regenerate quickly to relatively permanent features such as the Dempster Highway. Most areas contain very few documented human-caused surface disturbances.
- New human development footprints will be cumulative with any remaining historic footprints.
- Some land use footprints are relatively permanent, such as highways or municipal infrastructure. Other land use footprints are temporary in nature, and may exist on the landscape for short periods of time. Examples of non-permanent footprints may include low impact seismic lines or winter trails. (*See Figure 11.1*)
- Not all human-caused surface disturbances or land use activities incrementally add to the ecologically-relevant human footprint. Examples of activities that do not contribute to this footprint can include: helicopter-supported mineral exploration; no-trace wilderness camping; snowmobile travel across frozen ground; seismic lines and trails in forested areas less than 1.5 m in width; winter land use activities that occur on frozen waterbodies or in non-forested landscapes; and winter activities that utilize existing un-reclaimed

human-caused disturbances. Note that these activities may disturb wildlife while they occur.

### 11.1.2 Linear Features

- Linear features represent a particular type of footprint. Linear features can include roads, trails, seismic lines, and power transmission lines.
- The amount of linear features can be measured as a discrete length (e.g. km of features), or expressed as a total length of all linear features per unit of analysis (e.g. km of features per km<sup>2</sup> of land area). The latter method, known as linear density, is the most relevant measure for land and resource management as it describes both the amount and spatial distribution of linear features within a given area.
- Linear density provides a measure of landscape fragmentation, and may therefore also be used as an index of core habitat area or “wilderness”. Landscape fragmentation is the disruption of large contiguous areas of habitat into smaller, less contiguous areas of habitat.

### 11.1.3 Cumulative Effects

- Cumulative effects are changes to the environment and/or society that result from a land use activity in combination with other past, present and future activities, and may be positive or negative. Negative cumulative effects are referred here as cumulative impacts. One activity may have only a small impact, the combined effect of a number of activities may have a significant impact. There may be thresholds whereby the economic or ecological effects of the same development/disturbance may vary considerably depending on what effects have already been experienced.
- Cumulative effects can also be positive in nature. An example of *positive* cumulative effects would be the socio-economic benefits of direct and spin-off business development, which generate employment and income as more enterprises are introduced to a community.
- Managing cumulative impacts is best accomplished by applying a suite of integrated and coordinated actions to land management. Assessment, mitigation, government policy, legislation and planning all play a role.
- In the Yukon, no single agency or group is responsible for cumulative effects management. Adherence to the regional land use plan on its own is not sufficient to manage cumulative effects. However, the tools and approaches in the plan will provide responsible agencies and land users with a framework for cumulative impacts management.
- Among the key issues related to managing cumulative impacts:
  - Assessment and mitigation of land use activities on a project-by-project basis do not provide a sufficient strategy for managing cumulative effects.

- Cumulative impacts management must consider both direct and indirect impacts to valued resources.
- Monitoring the impacts of multiple land use activities is necessary to assess and evaluate potential cumulative effects.

**Figure 11.1 Feature Type Examples**



Photos: a) C. Roots, YGS; b) S. Francis, NYPC; c) J. Hawkins, CWS; d, f) M. Waterreus, YG - Environment; e) J. Meikle, YG – Environment

### ***11.2 Status of Land Use Impacts in the Peel Watershed***

- Map 18 shows the distribution of documented human-caused surface disturbances in the PWPR.
- The status of human-caused surface disturbance and linear density indicators should currently be viewed as estimates that represent the ‘best available data’.
- In comparison to southern Canadian conditions, the PWPR currently has very little human-caused surface disturbances.
- The total estimated footprint in the PWPR for linear and non-linear features is 7,122 ha, or 0.1% of the entire planning region (*See Table 11.2, below*). Non-permanent historical and current linear features (seismic, trails, tote roads, etc) account for the majority of surface disturbance impacts.
- An estimated 20% of historical non-permanent linear features are in a state that can be considered reclaimed, a conservative regional average that varies by landscape type and fire history. [*see 11.3 for PWPC’s definition of “reclaimed”*]
- To date, the Peel Plateau and Dempster Highway have been the most intensely used areas in the PWPR, due to oil and gas exploration and transportation/access, respectively. (Map 18)

### ***11.3 Reclamation, Revegetation, and Restoration***

- Reclamation is the process of applying focused or deliberate actions to restore a disturbed area to an undisturbed or desired condition, or to a former productive capacity. Reclamation activities generally attempt to restore disturbed lands resulting from localized human land use impacts, including gravel pits, mine sites, roads or contaminated sites.
- Revegetation is the process where natural plant succession restores a disturbed site without human intervention. Linear features such as seismic lines, which may be many kilometres in length and occur in remote areas, can return to an undisturbed condition through the process of revegetation.
- A definition for restoration should consider the major impacts caused by the human-caused disturbance, and the management goals for the area. The Peel Watershed Planning Commission is considering adopting the following definition of “restored”, whether resulting from reclamation or revegetation, that is similar to that of the North Yukon Planning Commission: A linear feature or other human-caused surface disturbance is considered restored when it does not facilitate increased motorized access or travel, and incremental run-off and sediment loading associated with the disturbance is no longer significant. The PWPC suggests more direct indicators of restoration:
  1. For forested and shrubby terrain: a feature can be considered “restored” when it is at least 25% covered by woody vegetation (trees and shrubs) of at least 1.5m in height.

2. For terrain predominately vegetated with low growing vegetation (i.e. <1.5m): a feature may be considered “restored” if it is vegetated with native species of approximately equal height to the surrounding dominant vegetation, and the percent cover of this vegetation is at least 50% that of surrounding undisturbed terrain.
- A key consideration for the former definition is related to access and ungulate management. In some studies, human-caused footprints, especially linear features, facilitate increased access (hunting) and predator movement/success (mortality). Both factors can contribute to increased mortality of caribou and moose, two of the focal species for the region.
  - The rate and process of reclamation / revegetation is variable and may be influenced by a number of factors including intensity of the surface disturbance, size of the feature, intensity of feature use (including access legacy), landscape type and natural disturbance history. Different types of surface disturbances may have characteristic rates and processes of reclamation / regeneration on different landscape types.
  - Without further research to better understand the rates of revegetation in the PWPR, the Commission has chosen to estimate that, on average, a minimum of 20% of the historical non-permanent linear features represented in existing databases are in a state that can be considered reclaimed (based on a definition of 1.5m shrub growth in forested landscape types). This is also consistent with the estimate used by North Yukon Planning Commission.

#### ***11.4 Contaminated Sites***

- Fourteen contaminated sites are identified in the DIAND database (Map 18) requiring clean-up. Two of the sites – both at the Hart River Mine Site – have been earmarked as being a high priority for remediation. One of the sites at the Crest site is identified as a moderate priority for remediation. The data was last updated in 2004; the Commission has no further knowledge regarding the condition of the sites or the status of remediation.



**Table 11.1 Peel Watershed Planning Region Land Use Feature Types**

<b>Feature Type</b>	<b>Width (m)*</b>	<b>Description</b>
<b>Linear Features</b>		
Major Road	60	Dempster Highway
Access Road	10	All-season gravel access roads (e.g. Initial portion of the Hart River Road)
Winter Road	10	Wind River Trail
Seismic Line	8	Features classified as seismic lines in the Yukon Government Oil and Gas Management Branch Seismic Line database. Prior to 1990, historical seismic lines were on average 8m in width. Future seismic lines are anticipated to be 5m or less in width.
Trail	8	Unclassified linear features as recorded in the transportation layer of 1:50,000 scale National Topographic Database. Most “trails” are considered to be historical seismic lines and associated winter tote roads.
Traditional Camp	50 x 50	First Nation traditional camps and cabins
Outfitting Base Camp	50 x 50	Big game outfitting base camps
Airstrip	60 x 1000	Rough airstrips, used primarily for resource exploration or tourism purposes
Well site	100 x 100	Oil and gas well sites/pads. All well sites in the region are currently abandoned and in various stages of revegetation.
Gravel Pit**	Estimated and Actual	Gravel extraction locations where active quarrying is or has occurred. The total gravel lease area is not included in the definition of gravel pit.

\* Width (m). Average linear feature width, in metres. Linear feature widths have been averaged based on consultation with sector experts. For other features, ‘actual’ refers to the mapped extent of the feature

\*\* Gravel Pit. Half of the total area of gravel quarry leases is estimated to be active gravel pits.

**Table 11.2 Historical and Current Levels of Land Use Features and Surface Disturbances in the Peel Watershed Planning Region\***

FEATURE TYPE	HISTORICAL		CURRENT		
	AREA (ha)	LENGTH* (km)	AREA (ha)	LENGTH* (km)	% of PWPR
<b>Linear Features</b>					
Major Road (Dempster Highway)	796	133	796	133	0.0117
Access Road	1,064	1,079	1,064	1,079	0.0156
Winter Road	550	550	550	550	0.0081
Trail (unclassified linear features recorded in 1:50K NTDB)	2,425	3,045	2425	3,045	0.0356
Seismic Line (features recorded in YG seismic line database)	2,043	2,617	1,634	2,093	0.0240
<b>Linear Feature Totals</b>	6,878	7,424	6,469	6,900	0.0951
<b>Other Features</b>		<b>Feature Count</b>			
Airstrip	204	35	204	-	0.0030
Gravel Pit	165	19	165	-	0.0024
Well Site	23	25	23	-	0.0003
Traditional Use and Outfitter Camps	13	29	13	-	0.0002
Communications	248	8	248	-	0.0036
<b>Other Feature Totals</b>	653	101	653	-	0.0095
<b>Planning Region Total</b>	<b>7,531</b>	<b>-</b>	<b>7,122</b>	<b>-</b>	<b>0.1046</b>

\* Total Area of the Peel Watershed Planning Region is 68,042.32 km<sup>2</sup>

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## **12.0 CONCLUSION**

The extensive traditional and scientific data contained in this report not only provides a status report and profile of the resource values in the Peel watershed, but this information will also be incorporated into the recommended zoning and management strategies that guide land use activities in the planning region. The spatial data, in particular, with its numerous layers of resource values, will be analyzed during the Scenarios planning phase to find scenarios that meet the goals and objectives of the plan. A periodic review and update of this information can also assist in the monitoring of the implementation of the land use plan, and monitoring the land use patterns in the planning region.

## **APPENDIX 1: Map Series**