



Mackenzie Valley
Environmental Impact
Review Board

Report of Environmental Assessment and
Reasons for Decision on

Tamerlane Ventures Inc.'s
Pine Point Pilot Project
EA0607-002

February 22, 2008

TABLE OF CONTENTS

1 Introduction 1

2 Development Referral..... 2

3 Overview of the Proposed Development..... 3

 3.1 Development Description 3

 3.2 Environmental Setting 7

4 Environmental Assessment Process 12

 4.1 Parties to the Environmental Assessment Process 12

 4.2 Environmental Assessment Approach..... 12

 4.3 Using Traditional Knowledge 17

 4.4 Determinations of Significance 18

5 Scope of the Proceeding 19

 5.1 Scope of the Proposed Development..... 19

 5.2 Scope of the Environmental Assessment 23

6 Water Issues..... 26

 6.1 Introduction 26

 6.2 Water issues resolved during the environmental assessment 27

 6.3 Water Quantity 28

 6.4 Water Quality 37

 6.5 Review Board Analysis and Conclusions on Groundwater 43

7 Air Quality and Fugitive Dust Issues 50

 7.1 Introduction 50

 7.2 General Air Quality Impacts..... 50

 7.3 Fugitive Dust Deposition and Metals Contamination 57

 7.3.3 Review Board Analysis and Conclusions on Fugitive Dust Issues 62

8 Socio-Economic Impacts..... 68

 8.1 Introduction 68

 8.2 Issues Raised 68

 8.3 Access of South Slave Communities to Beneficial Impacts..... 68

 8.4 In-migration Impacts 73

 8.5 Social Impacts on Aboriginal Communities..... 74

 8.6 Sustainable Development: Avoiding “Boom-Bust” Impacts 77

 8.7 Impacts on the Traditional Economy..... 79

 8.8 Overall Analysis and Conclusions on the Human Environment 80

9 Other Issues Requiring Special Consideration 84

 9.1 Introduction 84

 9.2 Wildlife..... 84

9.3 Road Safety and Maintenance 87

10 Cumulative Effects Assessment 88

 10.1 Introduction 88

 10.2 Issues Raised 88

 10.3 Evidence on the Public Registry..... 89

 10.4 Review Board Analysis and Conclusions on Cumulative Effects..... 93

11 Conclusions 99

Appendix A: Summary of Suggestions

Appendix B: List of Developer's Commitments

Appendix C: Public Registry Index

Other Sources Cited in this Report

Acronyms Used in this Report

C1	Commitment 1 (for example) in Appendix B
CO	Carbon monoxide
<i>DAR</i>	<i>Developer's Assessment Report</i>
EC	Environment Canada -
GNWT	Government of the Northwest Territories
INAC	Indian and Northern Affairs Canada
IR	Information request issued by the Review Board, with number attached (e.g. IR55)
km	Kilometre
m	Metre
mg/l	Milligrams per litre
mm	Milimetre
m ³ /hr	Cubic metres per hour (used in measuring volume of movement of water)
Land and Water Board	Mackenzie Valley Land and Water Board (labeled MVLWB in Appendix C)
<i>MVRMA</i>	<i>Mackenzie Valley Resource Management Act</i>
NO ₂	Nitrogen dioxide
NWT	Northwest Territories
PM ¹⁰	Particulate matter less than 10 microns in diameter
PM ^{2.5}	Particulate matter less than 2.5 microns in diameter
PPPP	Pine Point Pilot Project
<i>Report of Environmental Assessment</i>	The Review Board's <i>Report of Environmental Assessment and Reasons for Decision</i>
s.120	Denotes sections of the <i>MVRMA</i> (in this case, section 120)
SARA	The federal <i>Species at Risk Act</i>
SO ₂	Sulfur dioxide

Review Board Decision

To make its decision in this environmental assessment, the Mackenzie Valley Environmental Impact Review Board (Review Board) has considered all the information on the public record.

It is the Review Board's opinion that the proposed development, considered as a whole, would not be likely to cause significant adverse impacts on the environment.

The Review Board has concluded, pursuant to section 128(1)(a) of the *Mackenzie Valley Resource Management Act (MVRMA)*, that the proposed development, as described in this *Report of Environmental Assessment*, is not likely to have any significant adverse impact on the environment or to be a cause of significant public concern, provided the commitments made by the developer during the environmental assessment are implemented. The Review Board has therefore determined that an environmental impact review of this proposed development need not be conducted and this proposed development should proceed to the regulatory phase of approvals.

Gabrielle Mackenzie-Scott

Gabrielle Mackenzie-Scott
Chairperson of the Mackenzie Valley
Environmental Impact Review Board

February 22/08

February 22, 2008

Summary

The Mackenzie Valley Environmental Impact Review Board (Review Board) conducted an environmental assessment on Tamerlane Ventures Inc.'s proposed test mine. The company proposes to build the mine on one of its deposits located approximately 42km east of Hay River, Northwest Territories. This proposed development involves building an underground test mine, extracting one million tonnes of lead/zinc ore, concentrating and separating the lead and zinc ores, and then transporting it using trucks on Highway 5 to a transfer facility south of the built up area of the Town of Hay River where it will be shipped south by train.

During the environmental assessment, the Review Board heard from aboriginal groups, government, and members of the public. Parties in the environmental assessment raised concerns about potential biophysical environmental impacts of the development on local groundwater, air quality, soil quality through dust fall, and wildlife. Throughout the environmental assessment, the Review Board heard aboriginal communities had concerns about new impacts on a land healing from previous impacts of the historic Pine Point Mine.

In addition, parties, in particular aboriginal communities, shared with the Review Board their concerns about the potential socio-economic impacts from the proposed development. The Review Board heard, mainly from Fort Resolution, that communities were concerned about whether they will be able to take full advantage of this proposed development. However, a majority of South Slave parties indicated to the Review Board there was support for this development. The developer gained that support despite widespread perceptions, especially among aboriginal people, that mining activities have historically negatively impacted the area's lands, waters and wildlife. In the Review Board's opinion, the developer has made strong efforts to engage and be responsive to community concerns.

In response to concerns raised during the environmental assessment, the developer made many changes to the development. The most important change from an environmental impact perspective happened when the developer replaced the surface infiltration basin water discharge option with a deep gravity well system. Other changes included adopting line hydro power, moving the proposed transfer facility to an area south of the built up area in the Town of Hay River, including a lined sediment settling pond as backup water storage and treatment facility, and adding a froth flotation circuit to separate lead and zinc ores. The Review Board included these changes in the final scope of development and the Review Board's findings rely both on the developer implementing the proposed changes and on the developer implementing its mitigation commitments.

Based on the evidence on the public record, the Review Board determined that if Tamerlane Venture Inc. implements its commitments listed in Appendix B of this *Report of Environmental Assessment and Reasons for Decision*, the proposed Pine Point Pilot Project test mine is not likely to have any significant adverse impact on the environment or be a cause of significant public concern. This proposed development should therefore proceed to the regulatory phase of approvals.

The Review Board has provided a series of suggestions that would improve the monitoring and management of potential impacts from this development. This includes suggestions that:

- Maximum contaminant concentrations for discharge effluent be set in the water license
- Monitoring of discharge effluent flow direction and speed be included in water license monitoring systems, and the fate of contaminants in the deep groundwater reported
- The developer implement an on-site Air Quality and Emissions Management Plan
- The developer conduct specific monitoring on dust contamination at the R-190 site and ore transfer facility
- Government and the developer establish dustfall and metal content analysis systems along the entire transportation corridor, including assessment of the abandoned Pine Point rail bed, and report results to the public
- The developer publicly report the implementation status of its mitigation commitments on an annual basis

In addition, the Review Board identified the following suggestions to assist environmental impact assessment and environmental management at future developments:

- Federal authorities should investigate other groundwater discharge wells further and provide guidance on best practices, using the Pine Point Pilot Project as an active research site
- Government should finalize enforceable air quality guidelines or standards for industrial development in the Mackenzie Valley
- The Government of the Northwest Territories, in co-operation with affected communities, should undertake a study of the socio-economic impacts of this pilot project
- Health Canada and South Slave aboriginal groups should start a public dialogue about health concerns related to lead-zinc mining and water quality in the Great Slave Lake watershed
- The NWT Cumulative Impacts Monitoring Program should develop a better understanding of cumulative impacts of the historic Pine Point Mine on the lands and waters east of the Buffalo River

1 Introduction

This document is the Mackenzie Valley Environmental Impact Review Board's *Report of Environmental Assessment and Reasons for Decision (Report of Environmental Assessment)* for Tamerlane Ventures Inc.'s Pine Point Pilot Project. It is issued under s.128(2) of the *Mackenzie Valley Resource Management Act (MVRMA)*. This document is organized as follows:

Section 2 provides background information on the Mackenzie Valley Environmental Impact Review Board (Review Board), the referral of this development to the Review Board for an environmental assessment and the requirements for an environmental assessment under the *MVRMA*.

Section 3 briefly describes the proposed development components and activities and this section gives an overview of the environmental setting for the development.

Section 4 walks through the Review Board's environmental assessment process. This section identifies the factors considered in the Review Board's decision that is required under s.128 of the *MVRMA*.

Section 5 outlines the Review Board's decision on the scope of the development and the scope of the environmental assessment. Section 5 also identifies changes to the proposed development made during the course of the environmental assessment, assesses the reasons behind these proposed changes, and provides an initial overview of the Review Board's decisions on the proposed changes' beneficial and adverse impacts.

Sections 6 to 8 summarize the evidence the Review Board considered regarding three issue areas that proved to be of high importance during the environmental assessment and where the Review Board suggested additional mitigation or monitoring. These issue areas are:

1. water quality/quantity (**Section 6**),
2. air quality/fugitive dust (**Section 7**), and
3. socio-economic impacts (**Section 8**) on the people of the South Slave.

Each of these sections includes a summary of the evidence on the public record, the Review Board's conclusions about the impacts of the proposed development, the impact's significance, and any suggested mitigation.

Section 9 identifies some issues of special consideration that were dealt with adequately during the course of the environmental assessment and do not require additional mitigation, if the developer implements the commitments it made during the environmental assessment.

Section 10 focuses on cumulative effects assessment for this environmental assessment, while **Section 11** provides a general conclusion to this *Report of Environmental Assessment*.

There are three appendices:

- **Appendix A** lists all of the Review Board’s suggestions;
- **Appendix B** lists the developer’s commitments during the environmental assessment which the developer confirmed in its response to IR55.
- **Appendix C** lists all of the documents on the public registry for this file.

2 Development Referral

Tamerlane Ventures Inc. (Tamerlane or the developer) applied to the Mackenzie Valley Land and Water Board (Land and Water Board) for a Land Use Permit (MV2006C0014) and Type B Water License (MV2006L2-0003) for its Pine Point Pilot Project (PPPP) on June 1, 2006 (10)¹. The PPPP would involve the construction and operation of an underground mining operation to extract and initially process a 1,000,000 tonne lead/zinc ore deposit at Tamerlane’s R-190 property east of Hay River. The Mackenzie Valley Land and Water Board started a preliminary screening of the proposed development according to s.124 of the *MVRMA*.

Prior to the completion of the preliminary screening, on June 27, 2006, Environment Canada exercised its right under s.126(2)(a) of the *MVRMA* to refer the development to an environmental assessment (2), on the basis that the development “might have significant adverse impacts on the environment”. Environment Canada cited a variety of potential impacts and uncertainties, including

- Use of a frozen perimeter wall, which is a new technology, around the underground works
- Groundwater contamination
- Waste disposal
- Effects on species at risk, as defined under the federal *Species at Risk Act (SARA)*

The Review Board notified Tamerlane Ventures Inc. on June 28, 2006 that the development had been referred to an environmental assessment (1).

2.1 Requirements of the Mackenzie Valley Resource Management Act

The Review Board administers Part 5 of the *MVRMA* and therefore has decision-making responsibilities in relation to the proposed development². The Review Board is responsible for conducting an environmental assessment, which considers the proposed development’s biophysical, social and cultural impacts on the environment in accordance with s.114 and s.115 of the *MVRMA*. The Review Board conducted this environmental assessment based on the Review Board’s *Rules of Procedure* and *Environmental Impact Assessment Guidelines*.

¹ References to documents on the Public Registry will be referenced throughout this document with the registry number of the document, as listed in Appendix C. For example, (10) refers to the developer’s water license and land use permit applications to the Land and Water Board, of June 1, 2006. References to statements from the October 16, 2007, public hearing in Fort Resolution will be referenced throughout this document by the page of the transcript where the statement is recorded (for example, “Hearing Transcript, p12”), and are indicated by italicized text.

² The Minister of the Department of Indian Affairs and Northern Development (INAC) and responsible ministers decide whether to accept the Review Board’s recommendation.

Under s.117(1) of the *MVRMA*, the Review Board must decide the scope of the development. It must also consider the factors set out in s.117(2), which are further described in Section 5.2 of this document. The Review Board must also prepare *Report of Environmental Assessment* under s.128(2), and a decision under s.128(1), with written reasons for the decision. The *Report of Environmental Assessment* must be submitted to the Minister of Indian Affairs and Northern Development (INAC) as required by s.121. Section 128(3) also requires the Review Board to provide a copy of its report to the preliminary screener (the Land and Water Board), the referral agency (Environment Canada), and the developer.

Sections 62 and 130(5) of the *MVRMA* make it clear that once the Review Board's Report of Environmental Assessment has been accepted by the federal and responsible Ministers, the developer, government and regulatory authorities must ensure that any approved measure is carried out. If, as in this case, the Review Board determines the development is not likely to have any significant adverse impact on the environment or be a cause of significant public concern (a s.128(1)(a) decision), the *MVRMA* identifies the following:

- Under s. 129(a), no regulatory authority can issue a license, permit or other authorization before the expiration of ten days after receiving the report of the Review Board; and
- Under s. 130(1)(a), the federal Minister and responsible ministers may agree to order an environmental impact review of the proposal, notwithstanding the Review Board's determination.

3 Overview of the Proposed Development

3.1 Development Description

The Review Board bases its description of the proposed development from the following sources:

- The *Project Description Report* the developer submitted to the Land and Water Board on June 1, 2006 (4)
- The *Developer's Assessment Report* the Review Board accepted on May 2, 2007 (105-107)
- All proposed changes to the development, which the developer committed to after the developer submitted the *Developer's Assessment Report*. These changes include the revised development description the developer provided in the response to IR35 (187)

The developer made many changes to the development description during the environmental assessment. For clarity, this section of the *Report of Environmental Assessment* only describes the current version of the development as the Review Board understands it. This current development description, echoed in Section 5's determination on the scope of the development, is the development description upon which the Review Board has based its s.128 *MVRMA* decision.

Tamerlane Ventures Inc. is a publicly traded Canadian mining company proposing to construct and operate a test lead/zinc mine known as the Pine Point Pilot Project (PPPP), at its R-190 deposit east of Hay River. The development's main purpose is to extract approximately one million tonnes of lead and zinc ore, the entire R-190 mineral deposit, concentrate separate lead and zinc ores, and transport

the material (first by truck west to the Hay River railhead and then south by rail to a smelter) to market. The Pine Point Pilot Project's secondary purpose is to confirm the potential of conducting full-scale underground mining of some or all of the remaining 34 known deposits located in the area and on which Tamerlane has mineral claims.

The PPPP is actually a combination of three linked locations/corridors (see Figure 1):

1. The R-190 mine site and haul road, centred approximately 500 metres north of the kilometer 42 marker of Territorial Highway 5, east of Hay River
2. The territorial highway 5 ore transportation corridor, running 42 kilometers east-west
3. The haul road and ore transfer facility located immediately west of the junction of Highways 2 and Highway 5, south of Hay River

Figure 1: General Location of the Proposed Development



Tamerlane estimates construction and mining of the PPPP will take a total of 24-30 months. The estimated schedule allows 12-15 months for initial construction and an additional 12-15 months for operation. The project will run 365 days a year, with an estimated at 65 workers during construction and 131 mostly highly skilled workers during mining.

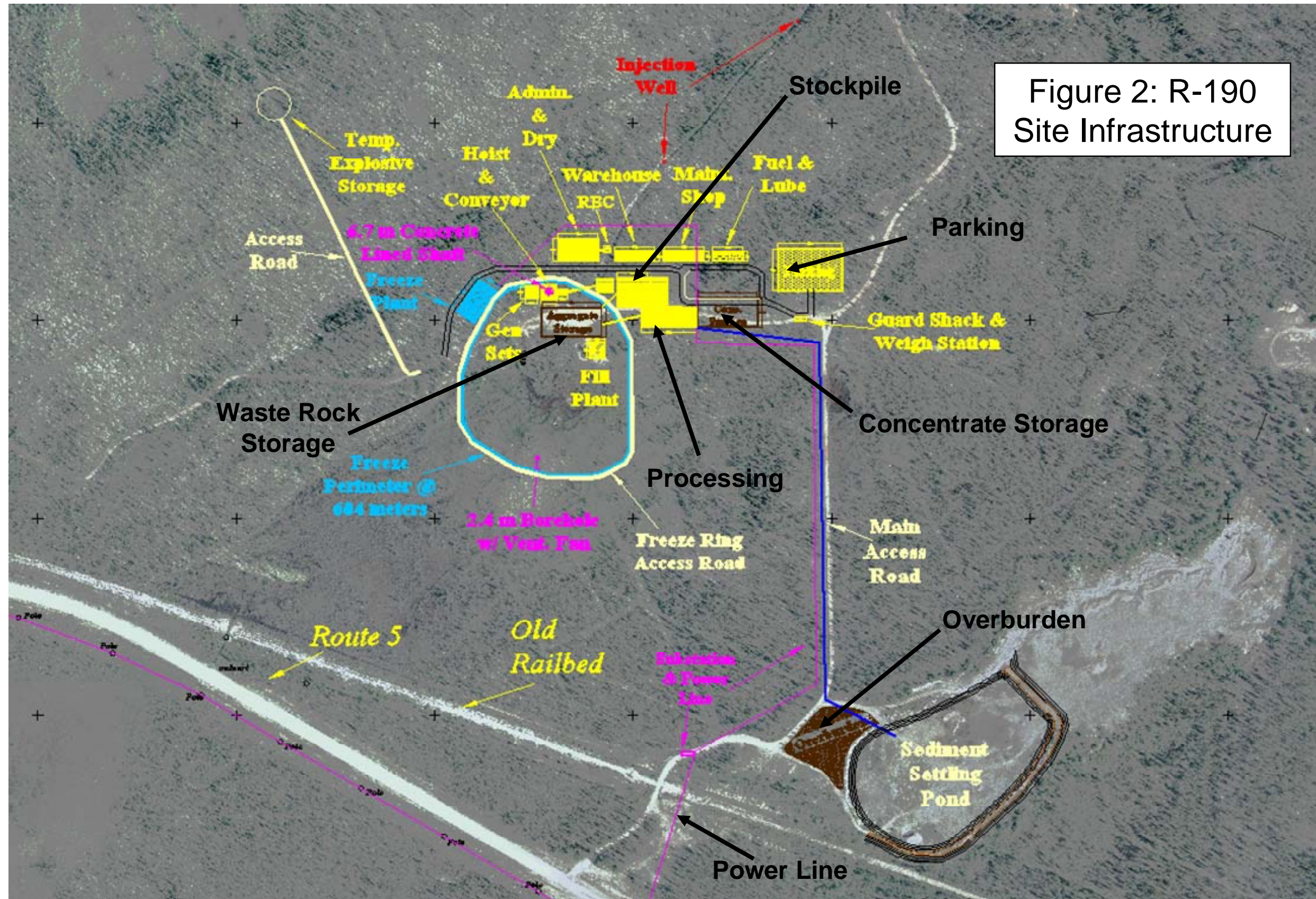
Tamerlane will utilize underground mining methods to extract the ore. Tamerlane will use sublevel stoping methods with internal ramp and drift access to mine the ore. A 185 metre vertical shaft will give access to the mine and it will come complete with a “men and material cage” and a vertical conveyor for continuously hoisting the ore.

The developer will dewater the PPPP using a pumping system at the bottom of the underground works. Tamerlane will construct a frozen earth perimeter barrier (a freezeway) to maintain a ring of ice around the project site. This freezeway will minimize the amount of groundwater that seeps into the mine workings. The ground freezing system is made of 300 freeze pipes and 30 ground temperature monitoring pipes. The frozen barrier will be approximately 185 metres deep and will surround the entire R-190 mineralized zone.

Mined materials will be crushed underground and loaded onto the vertical conveyor. The vertical conveyor will hoist the material to a surface stockpile. The material will be conveyed from the surface stockpile to a secondary crusher. A dense media separation circuit will pre-concentrate the ore at a rate of approximately 2800 metric tonnes per day. After going through this circuit, approximately 42% of the material will be waste that will be stockpiled and returned underground as a cemented paste backfill. The remaining 58% of the mined material will be further ground down to make a fine particle concentrate that will be transferred to a series of froth flotation circuits. The froth flotation circuits will use approximately 30 tonnes per day of combined reagents and inert products (like sand), to separate the lead and zinc ores. No cyanide will be used. The waste made from the froth flotation circuit will be used for underground backfilling. The final concentrate will then be stockpiled in a closed off building to wait for transport to the Hay River railhead.

On-site R-190 surface infrastructure is illustrated in Figure 2. All storage facilities for mined materials will be covered, concrete lined and linked in to a seepage collection system. Tamerlane will use an onsite diesel power plant for the construction phase, and the power plant will provide auxiliary power and emergency backup capacity throughout operations. During operations, an estimated 4.45 megawatts of the required 5.85 megawatts of power will be provided by line power from Taltson Hydro. The water use, management and monitoring system will consist of:

1. An underground pumping system in the mineshaft capable of a minimum of 2273m³/hr
2. Utilization of approximately 173m³/hr of mine water in the process facility
3. Process and storage facility seepage water collection systems and treatment plants
4. A packaged sewage treatment plant capable of handling a 200 person facility
5. Release of combined mine, process and treated sewage water into a gravity well drilled down to the Presquile aquifer approximately 122-158 metres below surface
6. Water quality sampling at the gravity well location(s)
7. One backup gravity well and two dedicated groundwater monitoring wells
8. A sediment settling pond with an impermeable liner east of the site in an abandoned gravel pit, as a startup and contingency water management facility



Tarped trucks will transport the separate lead and zinc concentrates, west down Highway 5 for approximately 42 km, and then across Territorial Highway 2, down an approximately 1km haul road to an ore transfer facility. At this facility, the trucks and train cars will be unloaded and loaded in a fully enclosed, concrete lined, facility with an on-site water treatment system. The developer estimates approximately 50-60 daily truck round trips between the facilities. No camp will be set up and all personnel will commute on a daily basis from South Slave communities. The developer will provide bus transport to employees located in Fort Resolution and Hay River.

If the project does not advance into future full scale mining, the developer will implement a decommissioning and reclamation plan for the PPPP. Reclamation will include removing all surface and underground equipment, sealing off the mine shaft, dismantling all surface structures and removing them from site. Building sites will be re-contoured and reseeded using regulatory agency guidelines. The end use goal is to promote site restoration consistent with uses prior to mining.

3.2 Environmental Setting

This description of the proposed development's environmental setting is based on the broad definition of 'environment' set out in s.2 of the *MVRMA*. This definition encompasses the land, water, air and living organisms, and the way they interact with each other. This section also briefly describes the socio-economic and cultural environmental context – the human environment - of the region. The following brief environmental setting description for this proposed development has been compiled from the developer's application in combination with evidence from the public record.

3.2.1 Biophysical Setting

The proposed location for the PPPP is in the South Slave region of the Northwest Territories (NWT). More specifically it will be located on the eastern flank of the Western Canada Sedimentary Basin near the south shore of Great Slave Lake. This is approximately 110 km west of the community of Fort Resolution and approximately 50km east of the Town of Hay River.

The PPPP development is proposed in the Hay River Lowland ecoregion of the Taiga Plains Ecozone, as defined by Environment Canada (2005). The Hay River Lowland is the broad, level lowland plain drained by the Fort Nelson and Liard rivers in northeastern British Columbia, and the Hay River in northwestern Alberta that ultimately flow into the Mackenzie River in the Northwest Territories. The area is marked by short, warm summers and long, cold winters with mean annual temperatures of approximately -2.9°C. Annual precipitation ranges 300-400 mm and the ecoregion is classified as having a subhumid mid-boreal ecoclimate.

For the purposes of this environmental assessment, the developer focused its analysis of the biophysical environment on a Local Study Area and Regional Study Area surrounding the R-190 site, as indicated in Figure 3.

The Regional Study Area is approximately 10 by 40 km (36,000 hectares). It is separated in the middle by the Buffalo River which feeds into Great Slave Lake. The portion of the Regional Study Area to the east of the Buffalo River is the western portion of an area mined from 1964 to 1987 by

Cominco Ltd as part of its Pine Point Mine. The developer included this previously mined area in the Regional Study Area because the developer has active mineral claims there. The PPPP is proposed for the western part of the Regional Study Area.

Figure 3: Local and Regional Study Areas for the PPPP

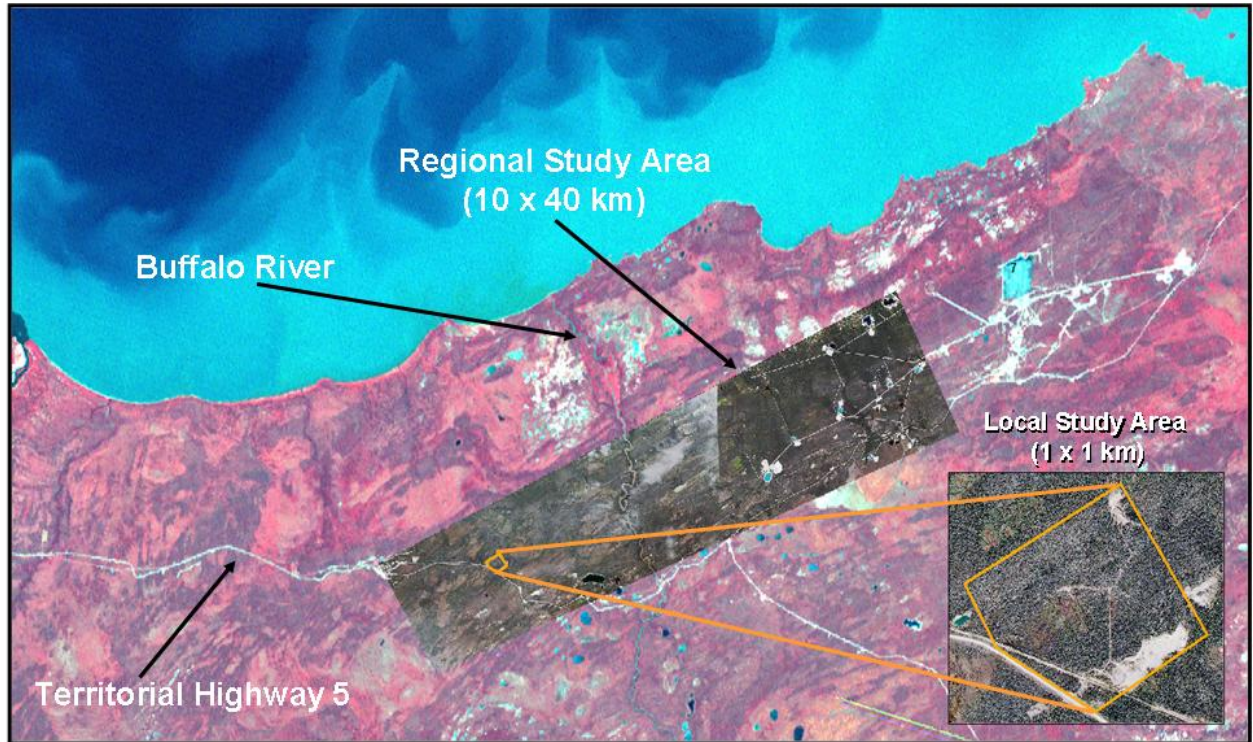


Image courtesy of Tamerlane Ventures Ltd.

Boreal vegetation of medium to tall, closed mixed stands of trembling aspen and jack pine on drier sites characterize the Regional Study Area. Labrador tea-mesic ecosites dominate the smaller Local Study Area, although the area where the mine and freezeway operations are proposed is largely a poorly drained fen. Sporadic discontinuous permafrost occurs in this ecoregion, but not in the Local Study Area.

The Local Study Area is 1km by 1km, approximately 97 hectares, and covers all of the R-190 site and immediate access route. Low-lying and poorly drained lands characterize the area with a gentle northwesterly slope and natural drainage toward Great Slave Lake, which is over 15 km away. Swamp, muskeg, and low gravel ridges are the main topographic features of the area. This is an area of karst geology. Overburden consists largely of clayey glacial till with occasional gravel beds, and can be from 3 to 45 metres in thickness. The glacial till confines a shallow water table separate from the deep groundwater layer. At the R-190 site, this perched water table is approximately 25 metres below surface.

The R-190 ore body is mostly located in the Presquile subunit of the Pine Point geological strata. This limestone and dolomite dominated layer is approximately 122 to 183 metres below surface in the R-190 area, and contains a confined and extremely porous and fractured aquifer that conducts the vast majority of deep groundwater, generally in a slow northeasterly direction.

The two surface drainages nearest to the R-190 site are the Buffalo River, located approximately 10 km to the east, and Twin Creek, located around 7 km to the west. Fish species frequenting the area include inconnu, whitefish, northern pike, pickerel and burbot. There are a couple of small lakes nearby, with Polar Lake to the east being the largest and the only close by lake with known fish. It is a stocked lake used as a campground/sport fishing location, not for traditional harvesting.

Groundwater quality in the area, which consists of both a perched (near surface) and deep groundwater layer, is generally poor in quality and is strongly influenced by the underlying geology. The waters in the region are hard, with high levels of alkalinity, dissolved salts, and conductivity. Traditional knowledge holders identify it as sulfurous and non-drinkable. There is no known human use of local groundwater.

Wildlife species that inhabit the development area or have been known to frequent it include boreal woodland caribou, moose, black bear, wolf, beaver and other furbearers, snowshoe hare and occasionally wood bison. The developer's wildlife historic and baseline studies indicate ungulates are not considered common (187), although some traditional knowledge holders dispute this finding. Scientific and traditional knowledge studies have identified some 40 mammal species known to frequent the area. Bird species known to frequent the area include waterfowl, sandhill crane, ruffed grouse, whooping crane and other birds. The south shore of the Great Slave is an important concentration site for birds during their annual migrations.

Species at risk known to frequent the area and included in this assessment were listed by Environment Canada in their Technical Report (204) and are identified in Table 1.

Species at risk are an important consideration in an environmental assessment, and the Review Board is required by s.79(1) of the *Species at Risk Act*³ to notify Environment Canada when a proposed development might have an impact upon a SARA-listed species or its critical habitat (16).

³ S.C. 2002, c.29.

Table 1: Species at Risk considered during this environmental assessment

SPECIES	COSEWIC ⁴ DESIGNATION	SCHEDULE OF SARA	GOV'T AGENCY RESPONSIBLE
Whooping Crane	Endangered	Schedule 1	EC
Wood Bison	Threatened	Schedule 1; listed as at risk by the GNWT	GNWT
Woodland Caribou (Boreal population)	Threatened	Schedule 1; listed as sensitive by the GNWT	GNWT
Peregrine Falcon (<i>anatum/tundrius</i>)	Special Concern	Pending	GNWT
Yellow Rail	Special Concern	Schedule 1	EC
Northern Leopard Frog	Special Concern	Schedule 1; listed as sensitive by the GNWT	GNWT
Short-eared Owl	Special Concern	Schedule 3	GNWT
Wolverine (Western Population)	Special Concern	Pending	GNWT
Rusty Blackbird	Special Concern	Pending	GNWT
Common Nighthawk	Threatened	Pending	EC

According to the developer, the R-190 property itself encompasses a total area of approximately 14.8 hectares and the development's physical footprint is approximately 8 hectares. There is an existing spur road from Highway 5 to the proposed mine site. To the east of the site there is an open gravel pit under the control of the Department of Transportation for the Government of the Northwest Territories (GNWT). Human activities have previously disturbed about 18.4% of the PPPP. Despite these previous disturbances, the ambient noise levels in the area are typically low (around 35 decibels) and are dominated by the sounds of nature. Ambient air quality is predicted to be relatively free of particulate and gaseous contaminant, given the site's remote nature.

The R-190 property is situated approximately 16 km south of Great Slave Lake and about 500 metres north of the kilometer 42 marker of Territorial Highway 5. This highway links the Town of Hay River to Fort Smith and the Wood Buffalo National Park. It also joins these two communities with Fort Resolution, at the Territorial Highway 6 connector east of the PPPP site. The highway is located just south of, and runs roughly parallel with, the decommissioned railway line that led from the Cominco Ltd. Pine Point Mine to the rail spur in Hay River from the 1960s to the 1980s.

3.1.2 Socio-economic and Cultural Setting

The South Slave region has a recorded history of human use extending back thousands of years. The dominant aboriginal groups are Chipewyan and South Slavey speaking Dene, and Métis groups. The majority of residents of Fort Resolution and the Hay River Reserve (located across the Hay River from the Town of Hay River) are members of the Deninu K'ue First Nation and Katlodeeche First Nation, respectively. Métis residents of the South Slave are represented regionally by the North West Territory Métis Nation, and locally by the Fort Resolution Métis Council and the Hay River Métis Council.

Forestry, oil and gas extraction and exploration, water-oriented recreation, and wildlife trapping, hunting and fishing dominate the South Slave region's land use activities, The region also contains

⁴ COSEWIC is the Committee on the Status of Endangered Wildlife in Canada, an independent advisory organization.

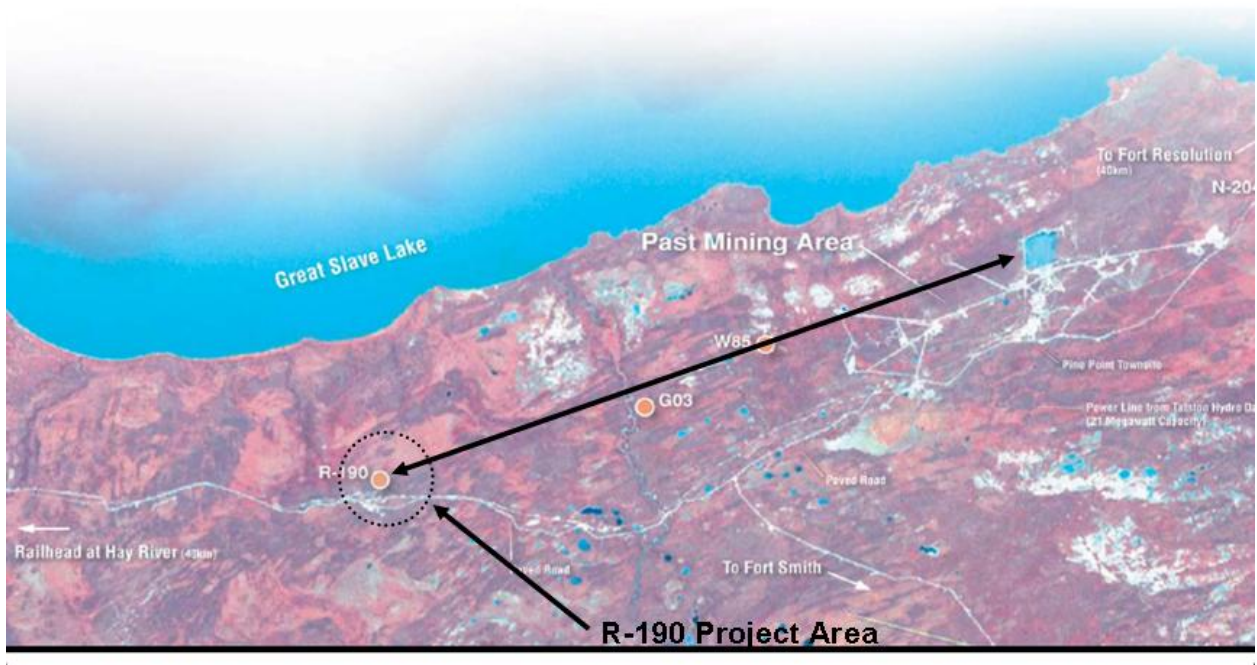
most of Wood Buffalo National Park, the largest park in Canada (44,840 km²). Communities include the Town of Hay River (2005 population of 3,825), the Hay River Reserve, also known as Katlodeeche (population 299), Fort Resolution (population 534), and Fort Smith (population 2385). The Town of Hay River and Fort Smith are economically more robust than the Hay River Reserve or Fort Resolution, which have a younger and higher aboriginal demographic.

The area north of Highway 5 and south of Great Slave Lake between Fort Resolution and the Hay River Reserve is generally referred to as the Pine Point area. The Pine Point geological trend is located within these boundaries. Between 1964 and 1987, Cominco Ltd. ran a world-class lead-zinc mining operation, in the area. The Pine Point town site west of Fort Resolution supported this operation. Lead-zinc concentrate was shipped out on rail using the railway line, which is now abandoned and demolished. The Pine Point community was also dismantled after the mine closed. Previous large scale mining played a major role in the regional economy and also left biophysical impacts on the land in the Pine Point region, in particular that portion east of the Buffalo River.

The aerial photograph in Figure 4 indicates the distance between the proposed PPPP and the main historic mining area. The arrow from R-190 to the past mining area is approximately 45km.

Figure 4:

Pine Point Mining Trend



4 Environmental Assessment Process

4.1 Parties to the Environmental Assessment Process

According to the Review Board's *Rules of Procedure*⁵, the developer is automatically deemed a party to the environmental assessment. The registered first nations and government parties were:

- Katlodeeche First Nation
- Deninu Kue First Nation
- Fort Resolution Métis Council
- Deninoo Community Council
- North West Territory Métis Nation
- Town of Hay River
- Health Canada
- Indian and Northern Affairs Canada (INAC)
- Environment Canada
- Government of the Northwest Territories (GNWT)

In addition, several members of the public identified their concerns about or support for the development during the environmental assessment, and their submissions were included in the public registry. The Review Board distributed Request for Party status forms to all interested groups after the *Developer's Assessment Report* was distributed in May, 2007 (110).

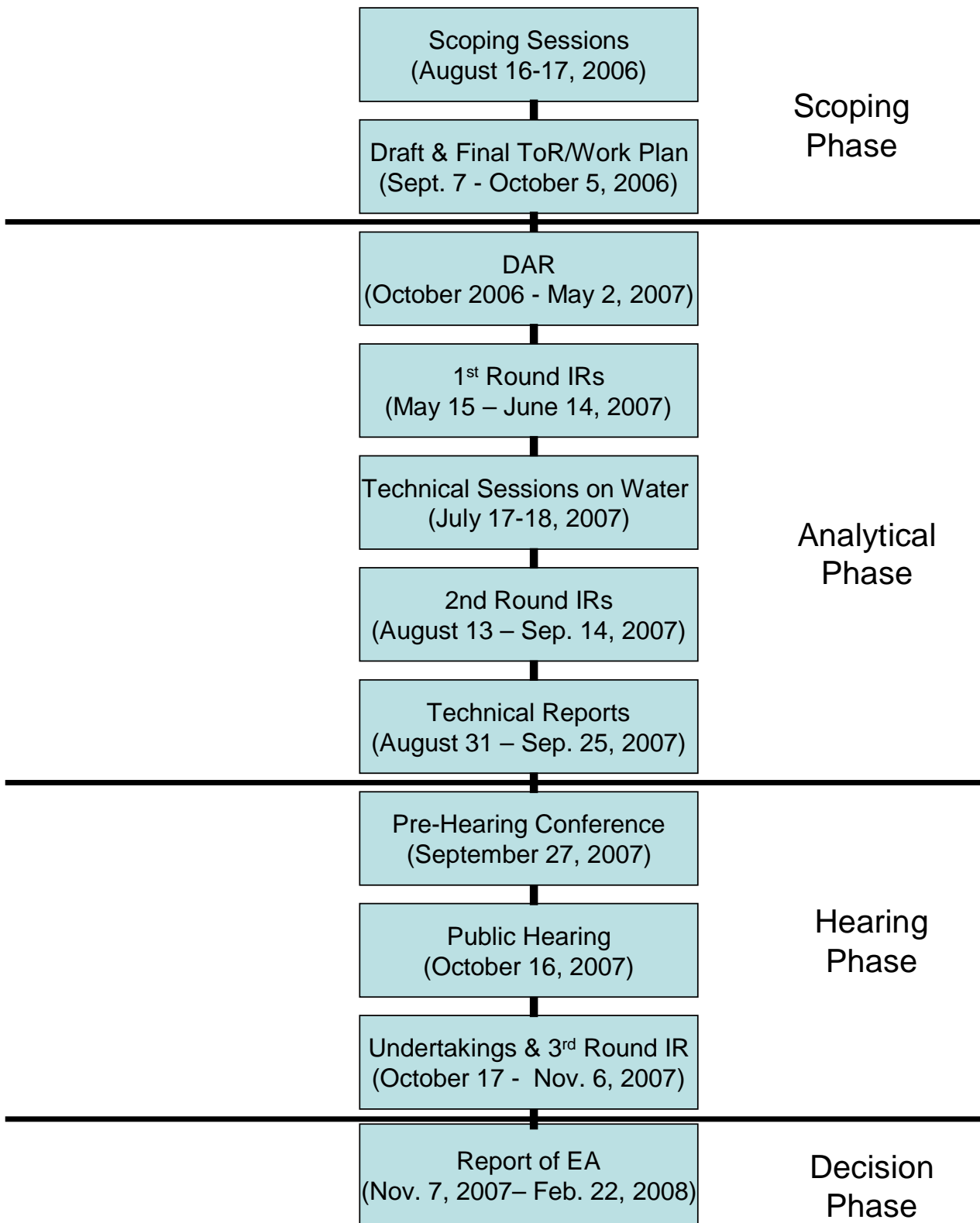
During the environmental assessment process, representatives of government departments had the opportunity to identify their interests and to notify the Review Board of their intent to participate in the proceeding as a responsible minister, as defined in s.111 of the *MVRMA*. The responsible ministers also play a role in the decision-making process, including Environment Canada, INAC and the GNWT (as represented by the Department of Environment and Natural Resources). The Minister of INAC is the federal Minister as defined by the *MVRMA* and plays a central coordinating role in decision-making after the *Report of Environmental Assessment* is released by the Review Board.

4.2 Environmental Assessment Approach

After the referral of June 27, 2006, and initial start up functions such as the development of a distribution list, the Review Board ran this environmental assessment in four phases: a scoping phase, an analytical phase, a hearing phase, and a decision phase. See Figure 5 for tasks associated with each phase of the environmental assessment.

⁵ See the *Rules of Procedure* online at www.mveirb.nt.ca/upload/ref_library/MVEIRB_RulesofProcedure_0505.pdf

Figure 5: EA Process for Tamerlane PPPP



4.2.1 Scoping Phase

The scoping phase focused on determining the scope of the proposed development, the temporal and geographic scope of the assessment, along with all of the issues the Review Board needed to consider when determining this development’s impact on the environment. Information contributed in the scoping phase included:

- Preliminary Screening evidence, including the developer’s *Project Description Report* (4)
- Evidence provided during scoping sessions
- Comments received on the *Draft Terms of Reference and Work Plan*
- Review Board discretion and its environmental assessment experience

Review Board staff-led scoping sessions were held on the Hay River Reserve on August 16, 2006 and in Fort Resolution on August 17, 2006. These sessions were recorded, draft meeting minutes were issued for comment, and then final meeting minutes were issued (44-45).

After the scoping sessions, the Review Board issued a *Draft Terms of Reference and Work Plan* for the environmental assessment on September 7, 2006. The Review Board issued the documents by fax and email to the environmental assessment’s distribution list. Incorporating comments from interested groups, the Review Board issued final *Terms of Reference* and *Work Plan* documents on October 5, 2006. The *Terms of Reference* described the scope of development and scope of assessment and provided direction to the developer on what was required in their *Developer’s Assessment Report*. The *Work Plan* provided direction to the developer and other groups about their roles, responsibilities and deliverables in the environmental assessment process. It established milestones and identified the Review Board’s expected timelines for the environmental assessment.

Site Visits

At the developer’s invitation, the first of three site visits to the R-190 development location coincided with the scoping sessions. Dates and relevant information for each visit are provided here:

Table 2: Site Visits during EA0607-002

DATE	LOCATION(S)	ATTENDEES
August 17, 2006	R-190 site and infiltration basin	Developer, Review Board staff and scoping session attendees
May 23, 2007	R-190 site, infiltration basin and proposed ore transfer facility south of Hay River	Developer, Review Board members staff and members of the Deninu K’ue First Nation
July 17, 2007	R-190 site and infiltration basin	Developer, Review Board staff and technical session attendees

4.2.2 Analytical Phase

Developer’s Assessment Report

It is the developer’s responsibility to issue a *Developer’s Assessment Report* based on the Review Board’s *Terms of Reference*. Tamerlane Ventures first submitted its *Developer’s Assessment Report* on January 4, 2007, and the Review Board began a conformity check. On January 22, 2007, the Review Board issued a deficiency statement that the *Developer’s Assessment Report* was not in

conformity with the *Terms of Reference* (81), largely because Tamerlane did not adequately describe and assess the Pine Point Pilot Project's impacts on the human environment. In late April, 2007, the developer resubmitted the *Developer's Assessment Report*. On May 2, 2007, the Review Board determined the report was in conformity with the *Terms of Reference*. The developer distributed the *Developer's Assessment Report* to all interested organizations.

Information Requests

The Review Board used information requests (IRs) to gather additional information from the developer or other parties. This environmental assessment had three rounds, with 55 information requests, as follows:

- 1st round information requests (IR1 - IR34), identified by the Review Board and issued to the developer and specific parties in May, 2007
- 2nd round information requests (IR35 - IR54), identified by the Review Board and parties and issued to the developer and specific parties in August, 2007
- A 3rd round information request (IR55), identified by the Review Board and issued to the developer on October 31, 2007. This information request asked the developer to comment where necessary to clarify the commitments it made during the course of the environmental assessment.

All of the information requests were responded to, with the exception of IR43 directed to the Katlodeeche First Nation.

Technical Sessions on Water

Technical sessions facilitated informal discussions between parties on technical issues. The sessions were intended to help parties find consensus where possible, to better define and prioritize issues where disagreement remains, and determine what information was needed to resolve issues.

On May 15, 2007, the Review Board asked parties to identify technical session topics (115). The responses to this *Technical Meetings Topic Questionnaire* (received from Environment Canada, INAC and the GNWT) identified water as the dominant issue. Participants at the technical sessions held in Hay River on July 17-18, 2007, discussed the water issues in detail. 35 people attended the technical sessions, including representatives from the Review Board staff and expert advisors⁶, the developer, INAC, the GNWT, Environment Canada, the Deninu K'ue First Nation, the Fort Resolution Métis Council, and the North West Territory Métis Nation. The Review Board placed meeting minutes for the technical sessions on the public registry (199).

Technical Reports

The Review Board also invited parties to submit technical reports critiquing the developer's assessment of impacts. Technical reports provide a structured opportunity for participants to express their ideas, and present their evidence and facts, to the Review Board in writing. The Review Board received technical reports for this environmental assessment from Environment

⁶ The Review Board hired the team of SENES Consultants Limited/SRK Consulting as expert advisors on water issues for this EA. Bruce Halbert of SENES Consultants Limited and Christoph Wels of Robertson Geoconsultants Inc. (sub-contracted by SRK) were the lead expert advisors. See document 111 on the public registry for more details.

Canada and INAC. In addition, the Review Board's expert advisory team submitted technical comments on water issues.

4.2.3 Hearing Phase

Pre-Hearing Conference

On September 27, 2007, a pre-hearing conference was held in Yellowknife by Review Board staff. The Review Board invited parties to the environmental assessment to attend in person or via teleconference. The pre-hearing conference was devoted to discussing the hearing process and procedures, and to setting a draft hearing agenda.

Public Hearing

The Review Board held a public hearing in Fort Resolution on October 16, 2007. The Review Board notified the public in the South Slave via radio and print ads, and posters. The main goal of the public hearing was to allow parties and the public an opportunity to hear and participate in a discussion of issues unresolved during the process leading up to the public hearing. The public hearing also enabled parties and members of the public to speak directly to the Review Board members about issues they considered important. Also, because of the proposed development's relatively recent additions of elements, like the froth flotation circuit and the deep well water discharge system, this was an opportunity for both parties and the public to learn more about the final proposed development and discuss potential impacts and public concerns.

Approximately 65 to 70 people attended the public hearing, including all parties with the exception of Health Canada. The developer and several other parties delivered presentations. Translation was available in Chipewyan and South Slavey, and the Review Board webcast the proceedings on its website. The Review Board filed full transcripts of the proceedings on the public registry (232).

Post-Hearing Undertakings and 3rd Round Information Request

During the public hearing, several parties undertook to provide additional information to the Review Board after the hearing. November 2, 2007 was the deadline for these undertakings. The Review Board received undertaking responses from the developer, INAC, Environment Canada, and the GNWT by this deadline. On October 31, 2007, the Review Board issued IR55 to the developer, consisting of a list of draft commitments the developer had stated during the environmental assessment. The developer was invited to clarify any of their commitments, which it did for 64 of its commitments on November 2, 2007.⁷

4.2.4 Decision Phase

Environmental Assessment Decision

The Review Board closed the public record for this environmental assessment on November 7, 2007. The Review Board then met and deliberated on the evidence on the public record. This *Report of Environmental Assessment* outlines the Review Board's reasons for decision.

⁷ Appendix B lists the 140 final commitments made by the developer that the Review Board has identified are part of the updated development description (see Sections 5 and 11 for more details on the role of these commitments in the Review Board's deliberations and decision).

The Review Board has provided the Minister of INAC with this *Report of Environmental Assessment* as required by s.128(2) of the *MVRMA*. The Minister of INAC is responsible for distributing the report to every responsible minister as per s.128(2)(a) of the *MVRMA*. The developer, referral agency, and the other parties have also been provided copies of the *Report of Environmental Assessment*, and the report is available on the Review Board's website public registry for this environmental assessment at mveirb.nt.ca.

4.3 Using Traditional Knowledge

The Review Board recognizes the important role that aboriginal cultures, values and knowledge play in its decision-making. In accordance with the requirements of s.115(1) of the *MVRMA*, the Review Board considered any traditional knowledge that was made available to it during the environmental assessment.

The Review Board, through its *Terms of Reference*, requested Tamerlane actively engage with traditional knowledge holders and to identify each section of the *Developer's Assessment Report* that included traditional knowledge in its baseline status, analysis or predictions. The developer had a consultant run traditional knowledge studies with aboriginal groups in Fort Resolution (members of the Deninu K'ue First Nation and Fort Resolution Métis Council) and with the Hay River Métis Council. The methods behind these studies, and the findings, were shared with the aboriginal groups, and results of these studies were incorporated into the *Developer's Assessment Report*.

The Katlodeeche First Nation received funding from Tamerlane to run their own traditional knowledge study, which was filed with the Review Board in August 2007 (169). Unfortunately, it was unclear from correspondence from the leadership of the Katlodeeche First Nation attached to the study whether the recommendations therein were still valid. Katlodeeche First Nation did not respond to the Review Board's subsequent information request issued on August 16, 2007 (174). Therefore, the Review Board has exercised caution in its weighing of the information contained in the report.

Some participants at the public hearing in October, 2007 raised concerns about the traditional knowledge studies used in the environmental assessment, particularly whether the Tamerlane-run studies were broad enough to capture the knowledge and concerns of traditional land users. In addition, some concerns were raised that the developer did not thoroughly examine in the *Developer's Assessment Report* some of the socio-economic issues raised by traditional knowledge studies participants.

The Review Board notes that there were several months between the issuance of the *Developer's Assessment Report* in May 2007 and the public hearing in October 2007, during which communities could have made these concerns known. If there are problems with evidence filed by a developer in an environmental assessment the onus is on the other parties including communities and first nations to bring these matters to the Review Board's attention in timely way. If the Review Board had been advised of these concerns earlier, steps could have been taken to address them.

4.4 Determinations of Significance

Section 128 of the *MVRMA* requires the Review Board to decide, based on all the evidence on the public record, whether or not, in its opinion, the proposed development will likely have a significant adverse impact on the environment or be a cause for significant public concern. The Review Board's determinations in this regard are contained in this *Report of Environmental Assessment*.

The Review Board asked the registered parties to assist the Review Board by providing the basis for their conclusions about the significance of potential development impacts, including their predictions of impacts and descriptions of the reasoning behind those predictions. Ultimately, the Review Board is required to make its own determination on the question of impact significance. In so doing, the Review Board considers, among other things, the following characteristics of any environmental impacts identified:

- Magnitude;
- Geographic extent;
- Timing;
- Duration;
- Frequency;
- Nature of the impact;
- Reversibility of the impact;
- Probability of occurrence; and,
- Predictive confidence level.

Significant public concern is also a test under which the Review Board can refer a development to environmental impact review under *MVRMA* s.128(1)(c).

The Review Board's significance determinations may involve comparing quantitative or semi-quantitative predictions to benchmarks. For the impacts that can not be meaningfully described quantitatively, the Review Board must use its own subjective and informed judgment to reach conclusions on the significance of the predicted impact or public concern.

The Review Board's analysis and the reasons for its decisions on the significance of adverse impacts and public concerns that are likely to result from the proposed development are described in detail in sections 6 through 10 of this document.

5 Scope of the Proceeding

Both the scope of the development in question and the scope of assessment changed during the course of this environmental assessment. Most importantly, the scope of development was altered by several changes, as detailed further below.

5.1 Scope of the Proposed Development

The scope of the development describes the elements of the proposed development that were considered in the environmental assessment. The scope of the development takes into account both principal and accessory development activities. The scope of the development is important because it outlines the activities which can be undertaken under any subsequent land use permit, water license or other regulatory instruments. These activities cannot exceed the scope of this environmental assessment without requiring further preliminary screening.

The Review Board initially decided the scope would be the development described in the developer's application to the Land and Water Board for a land use permit and the accompanying *Project Description Report* (4). This was the scope of development included in the Review Board's *Terms of Reference*. This scope of development was subsequently altered on several occasions during the course of the environmental assessment to reflect changes Tamerlane made to the development. Section 5.1.1 describes these changes in detail. The scope of development identified here in Section 5.1.2 includes all relevant changes and in the Review Board's opinion accurately reflects the currently proposed development.

5.1.1 Assessment of Development Description Amendments

A variety of changes occurred during the environmental assessment which materially altered the scope of the development and its potential impacts on the environment. To ensure that all parties to the environmental assessment were up to date on these revisions and the reasons behind them, IR35 was issued on August 16, 2007, asking for a summary of modifications to the development description. These changes to the development description are set out in Table 3, which expands on the developer's response to IR35 (187).

The Review Board has accepted the developer's rationale for these changes and its elimination of other alternative development components for the items listed in Table 3. Therefore, the development's description and the scope of the development the Review Board considered were modified. This *Report of Environmental Assessment* addresses the revised development. The Review Board's conclusions about the impacts of the PPPP development are based on the inclusion of these design changes in the scope of development; this is the scope of the development upon which the Review Board has based its s.128 *MVRMA* decision.

Any development component changes the Review Board has found associated with residual adverse environmental impacts are discussed in more detail in the relevant portions of Sections 6 and 7 of the *Report of Environmental Assessment*.

Table 3: Modifications to the Development Description

Original DAR Component	Alternative Chosen Component	Reasons/Review Board Opinion of Change in Likelihood of Adverse Environmental Impact
Railhead East of Hwy #2 in Town of Hay River	Railhead West of Hwy #2, south of Town of Hay River	<ul style="list-style-type: none"> • Location in Hay River did not meet requirements • Slightly reduced trip length • Reduced highway and in-town exposure increase public safety • Anchor tenant in new CN Rail industrial zone • General reduction in likelihood of adverse environmental impact
Diesel Generation	Majority Line Power with Diesel Generation for startup and backup	<ul style="list-style-type: none"> • Northland Utilities identified that excess power from Taltson Dam is available and reachable from existing line across Highway 5 from PPPP • Reduced emissions due to decreased diesel generation • The addition of power poles creates bird collision risks, but developer's commitments to line placement, height and marking minimize exposure to fen area and risk of collisions • General reduction in likelihood of adverse environmental impact
Dense Media Separation	Dense Media Separation plus froth flotation circuits	<ul style="list-style-type: none"> • Smelter penalties on combined lead-zinc concentrate would have made PPPP uneconomical • Adds about 30 tonnes per day of added chemicals and other reagents • No cyanide compounds used, evidence indicates the bulk of reagents will adhere to product rather than be lost to environment • Decreased particle size to a flour-like consistency through additional grinding required; increased dust creation risk • Decreased number of truck trips per day reduces pollutant emissions • Implementation of reagent worker training program and written contingency plan for handling reagent spills • Neutral to slightly increased likelihood of adverse environmental impact
Infiltration Basin Water Discharge	Deep Gravity Well Discharge and Monitoring System & Contingency Sediment Settling Pond	<ul style="list-style-type: none"> • Recommended by technical experts as a better alternative than the proposed surface infiltration basin release point • Slight reduction in project surface footprint • Less exposure of deep groundwater/process water to near-surface water • Minimized exposure of surface vegetation and wildlife to process water contaminants and poor quality deep groundwater • Discharge water returned to its origin in the high conductivity Presquile aquifer formation which has potential for rapid dilution of contaminants • Greater contingency options in case of high sediment or low water quality • General reduction in likelihood of adverse environmental impact
Treated sewage disposal in infiltration basin	Treated sewage disposal in gravity well system	<ul style="list-style-type: none"> • High quality of effluent does not change; treated sewage massively diluted in Presquile layer and with combination with mine and process water • No drain field required, further minimizing surface footprint of development • Accepted by water experts as the best alternative • Neutral to slightly reduced likelihood of adverse environmental impact

In general, the Review Board finds that the changes in the development description are likely to decrease the environmental impact potential of the proposed development. Through the developer's design changes, the Review Board believes that the environmental assessment process resulted in the consideration and eventual inclusion of alternatives that were more appropriate from an environmental impact standpoint. In the case of the inclusion of a froth flotation system, this appears to be necessary to enhance metal recovery and the economic return from the project. However, this change creates the potential for an adverse environmental impact which the Review Board addresses in Section 6.

Although the Review Board notes the general reduction in environmental effects resulting from the development's proposed changes and applauds the developer's flexibility to adopting such changes, some parties to the environmental assessment expressed concerns about these changes. These concerns appear to be related to uncertainties about the environmental impact of these new development components. This uncertainty appears to the Review Board in some cases to be related to a lack of familiarity with the proposed technology. Community-based concerns related to the changes were largely focused on the introduction of a froth flotation circuit and the use of gravity wells for water discharge.

The Review Board is convinced that it has enough evidence to make a decision on the significance of all the new components of the proposed development. However, the Review Board recognizes that potentially-affected communities and other parties to the environmental assessment still would like more detail on the design, function and potential impacts of these new components. This additional knowledge would contribute to a further reduction in public concerns. The reduction of public concern and environmental risk communication is an important goal of environmental impact assessment and the subsequent regulatory process. The Review Board encourages all potentially-affected communities to engage the developer, responsible authorities and the Land and Water Board during the water licensing stage of approvals, when the development plan will be discussed in further detail.

The Review Board also acknowledges the fact that a number of the proposed development's key aspects have changed since the issuance of the *Developer's Assessment Report*, to the point where certain sections of the *Developer's Assessment Report* are out of date. Specifically, parties to the regulatory process should not rely on the *Developer's Assessment Report* for the examination of water (quality and quantity) or air quality issues, or any discussion of the location and potential impacts of the ore transfer facility. Consideration of these matters requires review of the entire public record from the environmental assessment.

5.1.2 Final Scope of Development

Based on the developer's evidence placed on the public record, the Review Board has determined that the scope of the proposed development includes all physical work and activities related to the construction, operation and closure phases of a test mine on the R-190 property, transportation of concentrate, persons and materials along Territorial Highway 5 to its ore transfer facility south of Hay River, and all activities at that ore-transfer facility. These three locations (R-190, the Highway 5 transport corridor, and the ore transfer facility) comprise the PPPP.

The Review Board defines the scope of development to consist, at minimum, of the following physical works or activities that will occur during the construction, operation and closure phases (*note that changes to the proposed development made by the developer during the course of the environmental assessment are indicated by bold and italicized text*):

Mining Process

- Construction and maintenance of a frozen perimeter around the mine shaft and R-190 orebody, using “freezewayall” technology and an active refrigeration unit;
- Development of underground workings, portals, adits, raises, drifts, stopes and all other mine workings, including a main vertical shaft and a main ventilation shaft;
- Extraction and crushing of ore-bearing rock;
- Management of waste rock and aggregate stockpiles, including associated water treatment and management;
- Management of ore stockpiles, including associated water treatment and management;
- Transport, storage and use of explosives;
- Mine dewatering and the management and treatment of mine water; and
- Mining equipment operation, including the vertical conveyance system.

Milling Process

- Construction and operation of a dense media separation **and froth flotation** circuits;
- Consumption of water extracted from the mine workings by the dense media separation circuit, **froth flotation circuit**, and other on-site activities required for this development;
- Storage, handling, use and disposal of dense media separation **and froth flotation** process additives and chemicals;
- Construction and operation of a **gravity well water discharge system**;
- **Construction and operation of a settlement settling pond**; and
- Transport, recycling and disposal of process water, as well as its treatment and discharge to the receiving environment.

Support/Ancillary Facilities and Activities

- “Direct ship” transport of ore from the R-190 site to the railhead at Hay River, temporary storage, and rail transportation south to a lead-zinc refinery;
- Transportation activities that support the PPPP’s operation, including transportation of goods, contractors and employees from nearby communities;
- Any required structural and/or geometric upgrades to Territorial Highway 5 for the specific purpose of supporting PPPP operations;
- Construction and/or upgrading of spur and connecting roads between project components on the R-190 property, including any potential stream crossings;
- Construction and use of drainage control structures and process/waste water pipelines from the mine to the surface, and from the dense media separation **and froth flotation** circuit to the **settlement settling pond and gravity well discharge system**, including pumping systems;
- Development and use of borrow sources for aggregate production, or contracting out of same;
- Construction and operation of power plant, substation and power transmission

- infrastructure, ***including power lines and other infrastructure required for line power***;
- Construction and operation of the change house, compressor house, refrigeration unit, offices, lunchrooms, warehouses, storage yards, maintenance shops, laboratory and all support buildings;
- Construction and operation of hydrocarbon storage and handling facilities;
- Treatment facilities (and/or transportation to another site for treatment) for wastewater; and
- Solid and hazardous waste management and construction and operation of containment areas.

Closure and Reclamation Activities

- Removal of structures and equipment;
- Reclamation of the ***sediment settling pond area***;
- Reclamation of the road network;
- Reclamation of infrastructure foundations;
- Re-vegetation of areas affected by mining or support activities;
- Reclamation of waste rock and aggregate stockpile locations; and
- Backfilling and capping of the underground works, including backfilling during the operating phase.

5.2 Scope of the Environmental Assessment

5.2.1 Factors Considered

The scope of assessment describes the components of the environment that were evaluated for impacts. In deciding the assessment scope, the Review Board is required to consider the factors listed under s.117(2) of the *MVRMA*. The Review Board also is mindful of the matters identified in the Guiding Principles of Part 5 of the *MVRMA* (s.115) when determining the scope of assessment.

The Review Board retained the right to re-examine the scope of assessment during the environmental assessment, based on new information coming forward. This re-examination took place when the Review Board scoped in any potential impacts created by development description changes during the environmental assessment (for example, when a gravity well was proposed instead of an infiltration basin). The scope of assessment was also altered to reflect changes in the external operating environment, particularly the decision by the Mackenzie Gas Project not to propose a large work camp outside Hay River, which led to the elimination of cumulative impact considerations from that development on in-migration to Hay River.

The Review Board decided on the initial scope of assessment included in its *Terms of Reference* (72) after considering the relevant information available on the public record from the preliminary screening, comments and written material received during scoping sessions, and comments received on the *Draft Terms of Reference*.

5.2.2 Geographic and Temporal Scope

The Review Board determined the geographical scope of this environmental assessment to include Tamerlane's Local Study Area (effectively the R-190 site)⁸ and all of the lands west of the Buffalo River that might be affected in some identifiable way by the development. This includes the Buffalo River downstream of the PPPP and nearshore Great Slave Lake, wherever the development potentially impacts on groundwater or surface runoff flows that enter the river and lake. The Review Board also assessed the ranges of wildlife using the area and the areas potentially-affected by transportation activities. These activities included the Territorial Highway 5 and truck routes to the rail transfer facility south of Hay River, and the ore transfer facility and its immediate surroundings.

The geographical scope for assessing impacts on the human environment included the following South Slave communities: the Town of Hay River, the Hay River Reserve (Katlodeeche), Fort Resolution, Enterprise and Fort Smith. The concerns of aboriginal people in the South Slave who use the land and are potentially affected by the development merited special consideration. No local aboriginal or community government groups from Enterprise or Fort Smith engaged in the process.

Temporal assessment boundaries were set according to potential future effects, rather than just the duration of PPPP operations. Therefore, the Review Board decided the temporal scope includes all phases of the PPPP, from construction to post-closure, until such time that no significant adverse impacts attributable to the development are predicted to occur.

The Review Board laid out in the *Terms of Reference* the scope of issues the developer was required to examine in its *Developer's Assessment Report*. This included examining any interaction between the proposed development and the receiving environment that could somehow alter components of that environment. While greater emphasis was placed on identifying adverse impacts, the developer was encouraged to identify beneficial impacts as well.

Section 117(2)(a) of the *MVRMA* requires the Review Board to consider "*the impacts of the development on the environment, including... any cumulative impact that is likely to result from the development in combination with other developments*" during environmental assessment. The scope of assessment included considering these cumulative impacts, including the potential contributions of past, present and reasonably foreseeable future developments. Of particular importance during this environmental assessment the Review Board considered water quality, wildlife habitat or traditional harvesting impacts of historic mining activities by Cominco Ltd. in the Pine Point area between 1964 and 1987. The Review Board considered these alongside the PPPP's physical works and activities, along with any other current or reasonably foreseeable future developments, for combined total effects.

The *Terms of Reference* identified additional important cumulative effects considerations:

1. Potential local cumulative effects of rapid population growth and increased traffic in the Town of Hay River, especially if the Mackenzie Gas Project goes ahead
2. Potential cumulative effects on the engineering and public safety of Territorial Highway 5

⁸ The Local Study Area is identified in Figure 3 of this *Report of Environmental Assessment*.

3. Potential cumulative local and regional study area impacts on valued wildlife components, especially woodland caribou

Section 10 discusses how cumulative effects were handled during this environmental assessment.

5.2.3 Issues Requiring Special Consideration

The *Terms of Reference* also made it clear that some issues merited greater consideration than others during the environmental assessment, depending on how often they were raised during scoping phase and the potential severity of adverse outcomes. The *Terms of Reference* instructed the developer to give the following items special consideration in the *Developer's Assessment Report*, each of which is also considered in this *Report of Environmental Assessment*:

- All water quality and quantity issues related to the development, particularly in relation to the effluent discharge location (discussed in Section 6);
- Factors affecting the successful establishment and maintenance of the “freezwall curtain” (discussed in Section 6.3);
- Employment, training and business opportunities for local residents and aboriginal groups (discussed in Section 8).
- Impacts on transportation infrastructure and public safety of increasing truck traffic (discussed in Section 9);
- Impacts on *Species at Risk Act (SARA)*-listed species frequenting the area (discussed in Section 9); and

In addition, the potential for fugitive dust emissions contaminating the areas surrounding R-190 site, the Highway 5 corridor, and the ore transfer facility became an important issue during the environmental assessment. The Review Board’s findings on fugitive dust, along with air quality in general, are discussed in Section 7.

6 Water Issues

6.1 Introduction

Water quality and quantity issues dominated this environmental assessment from the outset. Overarching questions throughout focused on:

1. **Water quantity:**

- How much water will enter the mine workings and require pumping out?
- What impacts will the operation of the freeze wall perimeter and mine inflows have on groundwater levels and movement around the mine?
- What environmental impacts might the volume of outflow have at the discharge point?
- How might the developer manage and monitor any impacts associated with water quantity during the lifetime of the project?

2. **Water quality:**

- What will the water quality be when it is discharged?
- How will the contaminants within this discharged water impact on the receiving environment?
- How might the developer manage and monitor any impacts associated with water quality during the lifetime of the project?

6.1.1 Overview of Water Issues Analysis

The assessment of water proceeded in two phases during this environmental assessment. The first phase went from the start of the environmental assessment up until the technical sessions on water. Before then, the developer was unable to provide enough evidence to minimize concerns about both water quantity and quality from the PPPP. The DAR's general assessment of water issues was widely criticized by parties, and first round IR responses failed to shed new light on water issues. This early portion of water analysis was affected by a lack of up-to-date field data and unsubstantiated estimates of water quantity and quality.

The technical sessions started the second phase of water impact assessment. During the technical sessions various experts agreed that while the overall design of the PPPP was environmentally sound, water infiltration at the base of the mine shaft was severely underestimated and the proposed infiltration basin inadequate to dispose of effluent. Adding to concerns, the developer proposed adding new components to the ore processing that rendered previous estimates of water quality outdated. Following the technical sessions the developer provided a revised analysis of the anticipated water quantity and quality, and adopted an appropriate effluent disposal method.

Sections 6.3 (water quantity) and 6.4 (water quality) follow this progression: first the developer's initial analysis, followed by technical sessions critique, re-assessment of water issues by the developer, and finally examination of any remaining concerns or recommendations issued by Parties that were not addressed by the developer prior to the close of the public record. Section 6.3.2 provides the Review Board's analysis and conclusions on water quantity issues, while Section 6.5 provides the Review Board's overall analysis and conclusions on groundwater.

6.2 Water issues resolved during the environmental assessment

Several water issues were dealt with adequately through developer's commitments made during the environmental assessment. These have been largely accepted by experts and are summarized here:

- **On-site storage facility seepage:** The developer initially stated that moisture from stockpiles will be allowed to infiltrate into the ground (*Developer's Assessment Report*, p154). Later commitments (see C36-C41⁹) were made to ensure that all of the on-site materials storage facilities will have concrete pads and footings, and be linked into a moisture collection system and a small water treatment plant or plants. The developer indicated that "capturing minute seepage from the temporary waste rock stockpile is a primary objective of the PPPP water management plan" (C37). The developer also noted its planned rapid redirection of mine waste back underground would also minimize any potential runoff contamination potential.
- **Spill avoidance and management:** The evidence has demonstrated that an accidental release of brine used in the freezeway system would not have a significant impact on the environment because it is simply salty water. There is an adequate contingency plan for spills in place and the developer has committed to appropriate protective measures. These measures include lined ditches and concrete-covered manifold piping to reduce the chance that brine could be lost if a malfunction occurs (C8-C15).
- **Acid rock drainage:** The disposal strategy of converting waste rock into an underground cemented backfill strongly suggests that after the mine is shut down and the underground workings are flooded, no acid formation will significantly occur. The limestone/dolomite host rock is sufficient to neutralize acid production during the time waste rock is stored at surface.

The Review Board has also determined, based on the evidence, that surface water does not need to be assessed in detail, as there are no likely local or regional surface water bodies or surface aquatic life that may be impacted by the PPPP. This has been established by a variety of evidence, such as:

1. The lack of fish-bearing water bodies in the vicinity of the PPPP. The nearest fish bearing rivers are Buffalo River 10 km to the east and Twin Creek 7 km to the west. Great Slave Lake is over 15 km from the R-190 site.
2. Statements from traditional knowledge study participants (105, *Developer's Assessment Report* Appendix A-1) indicate that the lack of water in the project area, the distance of the project from the lake and the use of freezing technology would prevent impacts on traditional fishing activities
3. Evidence indicating that contaminated water from the PPPP will not reach any surface water body except at a distant range and over a long time period
4. The receiving environment, in particular the Presquile aquifer, has enough capacity to likely dilute contaminants of interest long before any surface environment is reached

⁹ Note: Throughout the following sections in the Report of Environmental Assessment and Reasons for Decision, references are made to commitments made by the developer during the course of the environmental assessment. These commitments are often identified by a numerical identifier linked to the comprehensive list of commitments in Appendix B (for example, C1-C4 refers the reader to Commitments 1 to 4 made by the developer on air quality).

5. The federal Department of Fisheries and Oceans did not raise any concerns
6. Previous studies that indicated the much larger and longer lasting Pine Point Mine had no measurable long-term impacts on surface waters¹⁰

Potential cumulative effects on regional water quality and quantity of the PPPP in combination with other development activities are discussed further in Section 10.

6.3 Water Quantity

Environmental impacts of the volume of water flowing both out of the mine and back into the ground at the discharge end of the production system, under a variety of different water inflow scenarios, were considered during this environmental assessment. Early analysis focused on the freezeway perimeter's ability to keep water from flowing into the mine from the sides. The Review Board's focus later shifted to examining the amount of water likely to enter from *below* the mine and whether the shallow infiltration basin in the gravel pit east of R-190 could adequately filter the volume of water discharged from the mine back into the ground.

6.3.1 Evidence on the Public Record

6.3.1.1 The Developer's Assessment Report

The *Developer's Assessment Report* identified water quantity issues as one of the major feasibility issues being tested by this pilot project. The experience of the Cominco Pine Point Mine revealed the great difficulties mining in this region of high groundwater movement. At one point, the Pine Point Mine was pumping in excess of 200 million gallons a day through diversion ditches to access a series of lead-zinc deposits (p181). This caused significant regional drops in groundwater levels during operations, although recharge occurred quickly after pumping stopped (p432).

Influence of Aquifer on Water Quantity

The *Developer's Assessment Report* identified two different types of aquifers at the PPPP site: a shallow "perched" aquifer associated with the overburden and a lower one situated under confined pressure conditions in the bedrock. The lower "Presquile" aquifer is located between 122-183 m below surface.

The developer conducted groundwater modeling to better understand regional groundwater flows. The *Developer's Assessment Report* suggested little likelihood that water from the confined Presquile aquifer would migrate upwards into the perched aquifer as, "groundwater movement is downward from the overburden into the bedrock... The glacial till and shales form a relatively impervious confining layer over the underlying aquifers" (p34). The high permeability Presquile formation is by far the most porous stratigraphic unit. The developer estimated 97% of all groundwater is derived from the Presquile zone (p188). Groundwater movement in the Presquile aquifer was also estimated to be extremely slow, with seepage velocities averaging 0.26 metres per

¹⁰ Both the developer and INAC cited a study (Evans: 1998) where the historic Pine Point Mine (a much larger, surface water release development) was found to have no long-term impacts on water quality in the Great Slave Lake area (130). This study also stated there was no indication of any mechanism by which water flowing through the study region could have been significantly contaminated by that decommissioned mine.

day. The developer used this evidence to argue that groundwater movement was unlikely to be fast enough to impede the development of the freezwall perimeter, the technology chosen to keep the Presquile aquifer from flooding the mine works.

Freezwall Development

The developer noted that the mining and underground construction industry have been using freezwall technology successfully in a variety of different environments for over a 100 years (p132). This technology compared favourably to other water inflow management alternatives:

“While dewatering wells and grouting are executable options, Tamerlane opted to reduce its risk to the environment and installation costs by choosing to freeze the ground around the R-190 deposit. Ground freezing will effectively cut off the groundwater flows into the proposed workings and virtually eliminate dewatering” (p189).

The freezwall system would see the installation of closely grouped pipes (2m spacing – 300 freeze pipes and 30 ground temperature monitoring pipes) around the mine perimeter. These pipes will extend down to the bottom of the mine (185 m) and are filled with brine (salty water) cooled by an on-site refrigeration plant. A cylindrical ring of frozen ground approximately 5-10 m thick would be created around the entire underground mine. The developer argued this technology would have no measurable impacts on groundwater levels and minimal impacts on groundwater flows:

“During the period of time that the freeze curtain is in place and functional, it is anticipated that localized groundwater in the vicinity will be temporarily deflected around the perimeter of the freeze curtain (like water moving around a bridge)” (p273).

Tamerlane estimated that the freezwall had virtual no chance of failure, given that most groundwater is in the Presquile zone well above the proposed shaft bottom elevation. Therefore, little or no frozen barrier erosion is expected. Concentrations of salt in area groundwater, which can inhibit freezing, can be readily addressed by increasing the freezing time or lowering the temperature of the circulating coolant. A computer controlled monitoring system would be able to detect any areas of weaknesses in this frozen perimeter and mitigation (e.g., cooler brine, replacement or closer pipes) implemented.

The developer predicted the freezwall would not have any long-term effects on the environment, especially groundwater flows. The developer stated that “the frozen ground and associated surface water is expected to thaw and return to its normal state within a period of weeks [after refrigeration ceases]” (p267).

Mine Inflows and Discharge

The developer estimated that despite the freezwall, a small amount of water would seep into the mine, especially from underneath. The developer planned for what it called a 40 to 1 safety margin for the estimated 55m³/hr of mine inflows by installing a maximum pumping capacity of 2273m³/hr at the bottom of the mine.

In the *Developer's Assessment Report*, the developer proposed to discharge all mine and process waters to a shallow infiltration basin 400m east of the mine site in a gravel pit leased to the GNWT's Department of Transportation. The *Developer's Assessment Report* stated that there would be no risk of failure of the infiltration basin given that estimated mine water inflows are only one-

third of the percolation capacity of the infiltration basin. Tamerlane predicted the infiltration basin would divert water in an almost vertical pathway deep underground. Therefore, no impacts on vegetation, surface water, or wildlife were predicted by the developer.

6.3.1.2 Evidence Presented at the Technical Sessions

The *Developer's Assessment Report's* assessment of water quantity and water quality (see Section 6.4 for the latter) was widely criticized by parties, and led INAC, Environment Canada and the GNWT to request technical sessions(126, 127, 131).

Revisiting Water Inflow Rates

The technical sessions on water (199)¹¹ established that the freezeway, as predicted by the developer, was likely to function effectively in this environment. On the other hand, experts identified several problems in the developer's other estimates and predictions. The likely water inflows from underneath the mine were the starting point for these concerns. In the *Developer's Assessment Report*, the developer had used the assumption that the base of the mine was almost impermeable to justify inflow estimates of 55m³/hr. The technical experts convincingly argued that predicted inflows are likely at least an order of magnitude higher, and perhaps more. The experts' initial inflow estimates varied from 440m³/hr at the low end to a worst case scenario of over 4000m³/hr if there were large fractures in the underlying rock. Because fracturing is effectively impossible to determine ahead of time because it cannot be comprehensively mapped by exploration drilling, the technical experts requested a complete re-assessment of inflow based on a range of scenarios.

Infiltration Basin Concerns

The experts' concerns regarding environmental impacts from higher than previously estimated water inflows focused on the discharge end of the system. In the *Developer's Assessment Report*, the estimate was that the infiltration basin could discharge (or "percolate") 100m³/hr of water. However, the developer had not done sufficient geotechnical work to support this estimate, relying on only one 25kg soil sample to predict likely percolation rates. In addition, the experts felt it was important that more analysis be done of total suspended solids likely to flow from the mine to the discharge point, because of the ability of suspended solids to clog water discharge systems.

Because of the revised higher inflow estimates, as well as uncertainty around the percolation rates, experts at the technical sessions felt the infiltration basin was unlikely to be able to discharge all the water below surface. This raised the possibility of adverse impacts from standing water in the infiltration basin, as well as from large amounts of water fanning out in the shallow subsurface. The Review Board's experts suggested this could potentially cause adverse impacts on vegetation or the shallow perched aquifer, or cause flooding. One expert estimated that high water inflows could flood the infiltration basin within 17 days of startup.

The GNWT's Department of Transportation was concerned about the potential impacts that flooding and deposition of high metals content sediment could have on their existing and historic gravel bed, especially in terms of long term environmental impacts and liability. At the technical sessions, Department of Transportation representatives expressed doubts over leasing its quarry to Tamerlane for use as the infiltration basin.

¹¹ All references in Section 6.3.1.2 are from *Technical Session Meeting Minutes* (199) unless otherwise noted.

While some mine safety and pumping cost implications of high water inflows were identified, it was generally agreed that the mine could technically operate even if there are much larger amounts of water flowing into its base, if adequate pumping capacity is put in place. However, experts asked for a serious reconsideration of the ability of the infiltration basin to discharge this amount of water below surface, rather than having it spill out into the surrounding surface environment.

Secondary Containment Strategy

The experts also criticized the developer's lack of any secondary holding area for water in its plans. This type of containment capacity was something that INAC had identified as essential early in the environmental assessment (65). Given the likelihood of higher than initially predicted inflows and no secondary containment capacity for water, the developer, in a case of water license parameter exceedences, would be faced with two unfavorable options - either discharge the bad water into the infiltration basin or abandon mining until the water problem was dealt with.

Deep Gravity Discharge Well

Since mine inflows could not be accurately predicted ahead of time and could not be controlled by any mitigation at the base of the mine, and also because of the reviewer's lack of confidence in the effectiveness of the infiltration basin, the use of deep gravity discharge well was proposed as an alternative by the assembled experts.

A deep gravity well¹² would consist of a wide diameter (12-24 inches) well drilled down to the Presquile aquifer in an area at least 200 metres outside of the freezeway perimeter. Water discharged from the mine and from processing and sewage treatment facilities would then be discharged into the aquifer via this well. The theory is that the discharge water will join with groundwater in the extremely high conductivity Presquile aquifer 122m below surface.

The assembled experts felt that gravity wells were a better option for this development than an infiltration basin, where water could discharge to surface in undiluted form, creating adverse environmental impacts. One expert noted the use of a gravity well would further enhance an already relatively environmentally-benign mine plan, stating "this excess water is the last problem and just putting it back where it came from is the best solution" (199). Other reasons supporting the use of gravity wells for water quantity management included:

1. Reduction in the development's physical footprint, less surface disturbance and less reclamation work required post-closure¹³.
2. Deep disposal limits contaminant access to valued components (valued components), most of which are at or near the surface. If the expected minimal buildup of water (mounding) around the wellhead occurs, no water is likely to migrate back to the surface, at least for a long distance from the mine. This minimizes the pathways by which any environmental impacts can occur.
3. Greater infiltration capacity, as the potential capacity of a gravity well system is far greater than the most optimistic value for infiltration basin. Historic test work showed the Presquile layer has

¹² Details provided here are from the gravity well system eventually committed to by the developer – see C99-101.

¹³ The developer later concluded that even with the introduction of a sediment settling pond on a portion of the area covered formerly by the infiltration basin the gravity well option reduces the development's direct physical footprint by about 11% - (Hearing Transcript, p24).

- very high conductivity and storage capacities.
4. Downhole monitoring systems will allow for lead time if there is any clogging of the well, so contingencies do not have to be developed at the spur of the moment.

6.3.1.3 Additional Water Quantity Evidence Received after the Technical Sessions

The developer's subsequent re-analysis and expert critiques during technical session undertakings, 2nd Round IRs, technical reports and hearing presentations focused on obtaining more details about the newly proposed water discharge system and estimating a wider range of mine inflow scenarios.

During this period, Tamerlane made several new commitments and changes to its water management plan. This included the formal adoption of a gravity well system for the disposal of process and mine waters as well as treated sanitary waste water (152). Tamerlane committed to the installation of a primary and backup gravity well to allow flexibility in the operation of the discharge system (175 – IR47). The second well also would serve as a down-gradient monitoring well when not in service, to assess effects of the deep discharge of the water on local groundwater quality and flow. The developer also committed to the installation of two additional smaller diameter down-gradient monitoring wells to track water levels and sample water quality in the Presquile formation, and committed to implement a variety of recommendations from the Review Board's advisors on how to structure the gravity wells to avoid plugging and interfering with the perched aquifer (C99-C105, C118). Tamerlane proposed to fully enclose (case) the wells down to the top of the Presquile aquifer so discharge water would not mix with the perched aquifer.

In response to expert concerns about the lack of secondary containment, David Swisher of Tamerlane described at the hearing how Tamerlane would add a lined sediment settling pond to the development plan:

“The infiltration basin originally took up this whole area, but now we've reduced it down to a lined, contained, sediment pond that we would anticipate utilizing for startup. Because during startup we want to make sure that we don't end up flushing any sediments or anything into the injection well, so we'll utilize this for startup and we'll utilize it for any other sediments that we may encounter through the process.” – (Hearing Transcript, p25).

Tamerlane predicted the sediment settling pond capacity as 121,600 cubic metres, or ten days capacity at 500m³/hr inflows (210).

The developer provided a recalculation of estimated mine inflows which identified 941m³/hr as the most likely inflow, with the best case/worst case range of inflows was estimated at 696 m³/hr and 3,120 m³/hr (196). The developer also considered an extremely low flow scenario of 50m³/hr, in which case makeup water from surface well would be required to handle the estimated requirements of 137m³/hr of the processing plant and mine operations.

The developer also provided analysis of the ability of gravity well to handle these different flows at the discharge end of the system, stating that, “the Presquile aquifer has historically produced large yields during long-term pumping tests, and in general we consider it hydraulically as a good candidate for process water injection” (163). Tamerlane predicted that the maximum mounding at

the gravity well would still be below the static level of the perched water table, so no mixing with this very different water or re-surfacing of discharge water was expected. At the hearing, the developer committed to a variety of best practice technologies to minimize well clogging (C103 - C105) and argued that the gravity well system could handle the disposal of all de-watering. The developer believed the gravity well system could be easily monitored, easily maintained, and in combination with the sediment settling pond, was the most effective environmental management plan for water. The developer also committed to conducting pump tests to find out the actual mine inflows once development is started and build these findings into its water management plan, adding pump capacity if necessary.

Tamerlane also argued that, unlike with historic mining, groundwater balance in the local area would be virtually unchanged as a result of this inflow-outflow system:

“When re-injection is underway... a direct recharge path will be established back to the Presquile aquifer. A similar amount of water will be reinjected to the aquifer outside the freezeway as is pumped out from the mine workings inside the freezeway. We expect that a nearly steady state circuit of water flow will be established” (210).

6.3.1.4 Parties’ Alternative Proposed Mitigation and Remaining Concerns

By the closure of the public record, consensus had largely been reached on a number of items including the following:

1. The adequacy of mine inflow scenarios,
2. The best structure for gravity wells and the wells’ ability to discharge expected inflows,
3. The need for and general design of the sediment settling pond, and
4. The lack of adverse impacts associated with water quantity (especially due to the fact that discharge water was unlikely to resurface in the short term).

The GNWT’s Department of Transportation also expressed a willingness to permit the use of its dormant gravel bed for the sediment settling pond.

In spite of this, some concerns remained. During the hearing, the Review Board’s expert advisor Bruce Halbert again highlighted total suspended solids from mine water as a factor that could clog up the gravity wells quicker than expected. The developer argued that with its strategies both for dealing with these solids (through agitation if necessary) and with well maintenance (committed to when well capacity drops by 25%), should not be a big issue. Tamerlane identified the short timeline of this development (given the typical 2-3 year maintenance schedule for gravity wells), the use of flocculants to reduce total suspended solids, and the presence of both a backup gravity well and the settling pond as supporting evidence for well effectiveness.

Community groups identified uncertainty about the gravity well technology. They were especially concerned about the potential for discharge water to resurface. At the hearing, Tom Unka of the Deninu K’ue First Nation questioned how high inflows, combined with potentially high levels of suspended solids that could clog the wells, could both be handled. Deninu K’ue First Nation member Gord Beaulieu asked how, if the groundwater travels only 0.26m/day, the ground could absorb all the water. Scott Schillereff, the developer’s hydrologist, replied (Hearing Transcript, p56):

“The Presquile formation is a highly permeable limestone-type formation or dolomite formation with lots of voids and pore space in the rock. Water is able to move laterally, easily through that rock. And as the water is injected into the rock, there will be a kind of a pressure mound in the area of the well, and over time that pressure mound will bleed off into the formation in a slow manner. But the rate of acceptance or the rate that the water can go into the formation is quite high...It's a thick formation with lots of pore space and it can accept water in a large capacity”

At the hearing, Environment Canada, while noting the overall water management plan was much improved, recommended the developer provide an adaptive management plan detailing contingency responses for water treatment of suspended solids that could foul up the gravity well, methods to be used for well maintenance, as well as seasonal challenges (204).

6.3.2 Review Board's Analysis and Conclusions on Water Quantity

6.3.2.1 Likelihood of Freezeway Success

The most important issue related to water inflows during the early stages of the environmental assessment was whether the freezeway would be effective in keeping water from entering the sides of the mine. Given historic problems with water inflows during Cominco's open pit mining east of the Buffalo River, inflow minimization is a major feasibility issue for the mine. Environment Canada cited uncertainty in freezeway technology success for this type of environment (large amounts of groundwater flow, highly fractured rock systems, high amounts of salt in groundwater) when it chose to refer the PPPP to environmental assessment.

The Review Board has reviewed the evidence and is satisfied that the freezeway technology is an acceptable approach to mine water management in this environment. The developer's experienced freezeway consultants demonstrated that it is not a question of whether the freezeway can work, but what specific combination of pipes, temperature and brine solutions will make it work, as it has worked in numerous other instances and environments. The dedicated monitoring system will identify any short-term problems in maintaining an impermeable frozen perimeter. Because no immediate catastrophic failure is likely to occur once the freezeway is formed, there should be adequate time to fix any problems. Additionally, the developer has shown that local groundwater levels will not be impacted by this perimeter and that once closure occurs, the frozen boundary will naturally thaw with no adverse impacts.

Given this evidence and the developer's commitments on freezeway implementation and monitoring (C13-C19), the Review Board finds that the freezeway technology is a feasible and environmentally preferable option for managing mine water inflows.

6.3.2.2 Calculation of Likely Mine Inflows and Impacts

A greater than expected fracturing and permeability at the base of the mine is more likely than freezeway failure to cause extremely high water inflows in this case. Unfortunately, this is a factor which cannot be determined conclusively ahead of mine construction. The Review Board recognizes that only through pump testing once the shaft has been sunk can inflows be determined. The developer's commitment to conduct pump tests and adjust their contingency plans accordingly is the only effective way to deal with this uncertainty. The Review Board also notes that there is no

mitigation available during operations to minimize basal inflows. This is out of the developer's hands to manage except by pumping. Therefore, the environmental assessment focused on what impacts might occur from a variety of inflow scenarios.

The developer's early estimates of mine water quantity were later established to be very low. It is to the credit of the developer and parties' technical experts that a higher level of certainty around estimates was collectively established. The Review Board accepts the current range of estimates of inflows because they have been confirmed by qualified experts. Several different inflow scenarios have been considered for their implications for water quality and outflow manageability, and appropriate contingency plans committed to by the developer.

Excessive water inflows could cause a mine safety and operability issue, but the developer has stated its preparedness for that possibility. Indeed, testing the operability of underground mining in this environment is one of the main reasons this test mine was proposed. The Review Board finds that the current pumping capacity will handle likely inflows. There is no evidence that water inflows would happen at a catastrophic rate, so mitigation to deal with increased inflows (e.g., the developer has committed to bringing in greater pumping capacity as required) could be set up in time to deal with the issue. No evidence has been provided that worker safety could be compromised by a sudden deluge of water, and appropriate safety precautions seem to be in place¹⁴.

The Review Board finds that historic concerns about dewatering and lowering of groundwater tables like that which occurred during the operations of the Pine Point Mine are not applicable to this development. Water balance should effectively stay the same, with almost all water pumped out of the mine re-entering the same aquifer in the deep gravity well nearby. The Review Board finds that the mine inflows will not likely lead to any noticeable drawdown in the area's deep groundwater table. Even flooding of the mine workings would likely cause only a minor drawdown, if any, in local deep groundwater, and would not likely cause any impacts at the surface, or to the movement of water within the Presquile aquifer. Any unexpected drawdown (which will be effectively monitored) would be unlikely to last beyond the short life of the PPPP, based on evidence of rapid recharge after pumping stopped at the Pine Point Mine.

Given the unlikely case that water inflows cannot be handled at the mine and it floods, the adverse impact would largely be economic (the mine may not be feasible) rather than environmental. The Review Board is satisfied that mine inflows will not likely cause significant adverse impacts on the environment in the immediate area of the mining works.

6.3.2.3 Discharge Capacity and Potential Environmental Impacts

The Review Board finds that potential impacts associated with excess water inflows *could* occur at the discharge end of the system. The worst case scenario here would see both gravity wells clogging much quicker than expected or discharge water mounding much higher than expected, causing discharge water to mix with the perched aquifer or pool on the surface. Another situation that could occur because of lower than expected discharge capacity is settling pond overtopping causing a breach that floods the surrounding area. In either case, the deep mine water and slightly

¹⁴ This should not be read as an endorsement of the developer's mine safety plan. The full assessment of mine safety is outside the Review Board's area of expertise. Other authorities are responsible for assessing the development's overall mine safety under the GNWT's *Mine Health and Safety Act*.

contaminated process water (see Section 6.4 for analysis of water quality) could mingle with the very different near surface perched aquifer, with potential impacts largely on vegetation.

The evidence indicates this is an unlikely outcome on both fronts, and could only occur over a prolonged period of time during which additional mitigation could be put in place to manage against it. The Review Board notes it would likely take a very large amount of water for this scenario to actually happen. In this extremely high inflow scenario, the quality of the discharged water pooling at or near the surface would paradoxically be better than that expected if lower inflows occur. This is because if mine inflows are higher than expected, the dilution of contaminants from the process plant will be greater because it will mix with a higher volume of the less contaminated mine water. This means that in the unlikely event of surface pooling or flooding from the water management system, the concentration of contaminants would be quite low, likely minimizing adverse impacts.

The Review Board concludes the proposed gravity well system will adequately discharge all likely mine and process water back into the deep Presquile aquifer and that discharge water is not likely to resurface anywhere near the R-190 site or anywhere else in the short term. In fact, given that the Presquile aquifer is a confined and deep groundwater body, it is likely to maintain a virtual “closed loop” status. The eventual timing of outflows to or near Great Slave Lake, if they occur, is likely measured in decades if the flow rate predictions of the developer are accurate.

The evidence indicates that any mounding or plugging of the gravity wells can likely be handled under current contingency plans. While it is possible that high levels of total suspended solids in the mine water could clog up a single gravity well, there is a variety of monitoring and management options in place to identify and deal with this possibility. The Review Board is convinced well fouling is not likely a major issue, given the short timelines involved (typically gravity well maintenance is scheduled every 2-3 years, more than the life of the PPP) and the developer’s commitments to maintenance. The Review Board encourages the developer to develop a formal adaptive management plan for the gravity well system such as that described by Environment Canada, but this is an element of good environmental practice rather than a requirement, given the Review Board has found that no likely significant adverse impacts related to the use of this waste disposal method. Given the fact that high concentrations of suspended solids can lead to premature plugging of the gravity wells, the Review Board also encourages the MVLWB to consider including reasonable limits for total suspended solids in discharged mine water among the effluent quality criteria for its Production Water License.

The Review Board is convinced that the primary and contingency plans around deep gravity well release are an important improvement over the previous proposal for a surface infiltration basin. The developer’s willingness to implement best practices in well maintenance reduces concerns, as does the variety of contingency options. It is the Review Board’s opinion that, provided the developer’s commitments are implemented, none of the discharge scenarios will likely cause significant adverse environmental impacts.

6.4 Water Quality

Water quality was a key issue throughout this environmental assessment. The *Terms of Reference* required a comprehensive assessment of the following water quality issues:

1. The background characteristics of the deep groundwater in the Presquile aquifer
2. The type and amounts of chemicals, metals, nutrients and other solids that will be added to the mine and process water before it is released, and the associated discharge water quality
3. Potential impacts this released water might have on the receiving environment
4. How this water will be monitored and, if necessary, treated

6.4.1 Evidence on the Public Record

6.4.1.1 The Developer's Assessment Report

Analysis of water quality in the *Developer's Assessment Report* was largely historic. The developer utilized historic water quality assessment reports from the area heavily, with recent field data limited to surface and near surface (25m) groundwater data collected in 2006. No recent data was collected on the deep Presquile aquifer. The *Developer's Assessment Report* indicated that “the waters tested in the region over the years have been shown to be relatively hard, with high levels of alkalinity and dissolved salts, conductivity and pH, and concentrations of metals that were consistently below existing federal guideline criteria” (p43). The quality of the near surface (“perched”) aquifer is better than that of the deep aquifer, but is still considered undesirable and is not used as a drinking source. Traditional knowledge holders confirmed the area’s ground and surface waters are poor, describing it as alkaline, sulfurous and not drinkable (105, *Developer's Assessment Report* Appendices A-1, A-2)¹⁵.

Dense media separation was the only process identified in the *Developer's Assessment Report* for initial concentration of the lead-zinc ores. The main addition to water used during dense media separation is the relatively inert product ferrosilicon. The developer argued that ferrosilicon will be recycled and reused, and very little will enter the environment, and will not have adverse impacts.

The developer committed to using a highly efficient portable sewage treatment plant to deal with human waste, and co-mingle the high quality treated sewage in with the process and mine water for direct discharge to the infiltration basin discharge point. Data on discharge water quality, monitoring and treatment provided in the *Developer's Assessment Report* are not discussed here because they were all later revised.

6.4.1.2 Evidence Presented at the Technical Sessions¹⁶

At the July 2007 technical sessions, experts identified a variety of problems with the *Developer's Assessment Report's* water quality analysis. Experts expressed no confidence in the *Developer's Assessment Report's* predictions of discharge water quality. For example, tap water rather than site-specific deep groundwater was used in process testing. The assembled experts requested the

¹⁵ Data from Brown, Erdman *et al* (1982), accepted at the technical sessions as a surrogate of current deep groundwater quality at the PPPP, indicated that background water quality far exceeds guidelines for Canadian drinking water for total dissolved solids, sulfates and sulfides (28).

¹⁶ All references in Section 6.4.1.2 are from *Technical Session Meeting Minutes* (199) unless otherwise noted.

developer do additional testing for using representative ground water samples. In addition, the group felt new estimates of higher water inflows at the base of the mine needed to be fully incorporated into discharge water quality estimates, mitigation options and contingency planning. Note that experts did not assume that increased water inflows would have a detrimental effect on discharge water quality concentrations. On the contrary, experts felt contaminants like metals and ammonia were likely to be reduced by the increased ratio of mine water to process water with higher inflows.

The experts expressed concerns about the *Developer's Assessment Report's* analysis of metals in effluent discharge were based on estimates of soluble metals only, which constitute only a small proportion of total metals. While the soluble portion is the most important environmentally (because soluble metals can be readily mobilized in water), experts argued that total metals still need to be measured. If the pH of the discharge water altered in the formation, for example, more metals could become soluble. In addition, the very presence of metals in a surface location could create environmental liabilities. Re-calculation of ammonia concentrations was also considered important, given the *Developer's Assessment Report's* estimates indicated higher levels of ammonia than allowed by typical current water licenses in the NWT.

At the technical sessions, the developer introduced its plan to add froth flotation circuits to the process plant. This system, which would occur after dense media separation, would further concentrate and separate the lead and zinc ores (from +/-40% combined to +/-55% of concentrate shipments). Introduction of froth flotation effectively rendered all water quality estimates included in the *Developer's Assessment Report* irrelevant, because this addition to the process represented the potential to significantly increase contaminant loading in effluent discharge. Re-analysis of discharge water quality was thus considered essential by the assembled experts.

Experts believed that using gravity wells to replace the infiltration basin would likely reduce the potential for effluent to contaminate the environment, because a gravity well system:

1. Eliminates surface contamination by discharge water
2. Eliminates concerns about contamination of a potentially economic resource in the Department of Transportation's gravel pit quarry, as well as linked long-term liability issues
3. Requires no mixing of deep groundwater with the very different perched groundwater layer, as previously proposed with the infiltration basin percolation plan
4. Discharge effluent to the neutral pH Presquile aquifer where none of the metals that might be of concern such as lead, arsenic, and cadmium are soluble and mobile

6.4.1.3 Additional Water Quality Evidence after the Technical Sessions

Subsequent water quality re-analysis by the developer and experts during post-technical session undertakings, 2nd Round IRs, technical reports and hearing presentations focused on the following:

1) Recalculation of Discharge Water Quality

Late in the environmental assessment, the developer provided a more accurate picture of discharge effluent quality for a range of inflows (210) accepted by experts at the hearing. The developer's worst case scenario discharge water quality estimates are compared in Table 4 to parameters of a water license held by Teck Cominco for its Pine Point Mine surface water discharge.

It was noted this was a “worst case” scenario only. It is much more likely that the water inflows into the mine will be higher (estimated at 941 m³/hr). That means dilution will reduce the contaminant levels when process waters and mine waters are mixed prior to being discharged.

Table 4: Tamerlane’s Worst-Case Discharge Effluent Estimates

PARAMETER	PPPP WORST CASE SCENARIO (137 M ³ /HR)	TECK COMINCO WATER LICENSE N1L2-0035 (ALL IN MG/L)
TDS	3340 mg/l	2500/5000 (average/max. grab sample)
Copper	.496 mg/l	.15/.30
Lead	.303 mg/l	.20/.40
Zinc	.202 mg/l	.50/1.0
Ammonia	1.6 mg/l	2.0/.40

The developer estimated that ammonia and nitrates amounts are likely to be lower than the 2:4 mg/l (average:maximum grab sample) standard often used for surface release of water, even in a worst case water quality scenario. The developer made commitments to use emulsion explosives rather than the more soluble ammonium nitrate and fuel oil (also known as ANFO). In addition, Tamerlane committed to using specific emulsion loss management procedures to avoid contaminating the water (C24-C25). The developer also believes that ammonia impacts would be minimized due to the release depth, the large dilution capacity of the aquifer, and the long distance to any key valued components like surface water bodies (163). Experts accepted the revised estimates and agreed that ammonia at the estimated concentrations would not likely impact upon surface waters, vegetation or any other valued components while confined in the deep groundwater zone.

The developer produced evidence that metals concentrations in discharged water are unlikely to exceed parameters set out in the Teck Cominco water license in all but the lowest water inflow scenario. The developer again argued that the confined nature of the discharges to deep groundwater effectively means metals cannot readily reach valued components on the surface of the land. These factors, added to the low mobility of metals in the neutral pH Presquile aquifer (metals will generally not be water soluble), reduced experts’ concerns over metals concentrations.

Community groups and experts had expressed concern about the amount and type of process chemicals added by the froth flotation circuits. The developer’s response to IR49 (175) outlined the variety of chemical and other reagents to be used in froth flotation. The developer predicted the bulk of these reagents and the metals the reagents will release will be adsorbed either onto concentrates or onto the waste rock that will be deposited underground as backfill. The developer also committed to not use cyanide during ore processing. All experts eventually agreed with the developer’s prediction that the vast majority of the reagents would not enter the discharge water system. At the public hearing, Adrian Brown of INAC noted that the +/-30 tonnes a day of chemical and physical reagents added to the system by froth flotation presented no major concerns, predicting that “less than a tonne or a couple of tonnes” will go into discharge effluent (Hearing Transcript, p204).

2) Sewage Disposal Options

The developer felt that treated sewage can be safely mixed with process and mine water and pumped underground through the gravity well, citing the quality of the effluent and the long-term track record of the process. In its response to IR48 (175), the developer provided data from the BIODISK Corporation showing very low contaminant concentrations (total suspended solids around 1 mg/l and total ammonia averaging 0.26 mg/l). INAC initially expressed some concerns with the

direct discharge of treated sewage into the gravity well system, but later accepted it as the best option for the PPPP. The Review Board's expert advisors agreed.

3) Fate Analysis of Discharge Water

It was generally agreed that discharge water was much less likely to resurface from a gravity well system than the previously proposed infiltration system, and that any contaminants were unlikely to impact surface valued components or the perched aquifer in the immediate disposal area. However, questions remained about the longer-term and longer-distance fate of the discharge effluent in the deep groundwater itself.

INAC and the Review Board's expert advisors disagreed with the developer's statement in response to IR47 that no effluent water quality criteria should even be required "as the water to be pumped down-hole will be comparable to the existing groundwater environment and will not contain hazardous materials of any kind" (175). INAC stated in its technical report that metals, sulfate, sulfides, lime, total dissolved solids, and biological oxygen demand are all added during froth flotation and are potentially hazardous or environmentally harmful to aquatic life and drinking water. INAC called for the developer to evaluate the environmental fate and impact of these potentially harmful constituents before the end of the environmental assessment (202).

Echoing these concerns, the Review Board's experts argued that at minimum, simple dilution calculations should be presented by the developer to demonstrate the distance required to reduce metal concentrations to background concentrations in the Presquile aquifer. Such information was in their opinion necessary to alleviate concerns about longer-term down-gradient water quality and to assist in the design of an appropriate groundwater monitoring system (e.g., number and location of monitoring wells, duration of monitoring). In the absence of data from the developer, the Review Board's experts' technical report provided their own dilution analysis, which found:

"The actual amount of dilution depends on the degree of mixing of the process water with the resident groundwater. At one end of the spectrum, the injected discharge water may not mix at all but instead move as "piston flow" into the formation. In this scenario, the aquifer would be "impacted" for a radial distance of 400-500m with contaminant concentrations in the aquifer being very close to those of the "end-of-pipe" [discharge] concentrations. At the other end of the spectrum the injected discharge water may mix completely due to dilution and dispersion along the flow path. Complete mixing is rarely achieved but will be approached over larger transport distances" – (201).

In the Review Board's experts' opinion, realistic dilution potential over 1000m would be two to three times, but that elevated metal concentrations will be present in the local aquifer. Thus, the developer needed to do a proper fate analyses. The Review Board's experts recommended Tamerlane carry out a more in-depth analysis of the environmental impacts of deep well discharge, including estimated concentrations of potential contaminants (including copper, lead, and zinc) for various distances from the discharge well, taking into account dilution and dispersion effects.

The developer's response to these critiques (210) predicted that 100% dilution would occur within 757m of the release point. The developer suggested it would therefore locate one of the monitoring wells 800m east or northeast of the primary gravity well, arguing this should be a suitable distance to gauge the fate and transport of chemicals in the discharged water.

Community members also expressed concerns about the fate of discharged water. At the hearing, Gord Beaulieu of the Deninu K'ue First Nation asked the developer what assurances it had that discharged chemicals would not eventually end up in Great Slave Lake. The developer responded that discharge water would be monitored, but that the speed of flow (estimated at 0.26m/day) meant that it would likely take many years for it to get to Great Slave Lake. The developer's overall opinion was the vast dilution potential of the Presquile aquifer, along with the relatively good discharge water quality, combined with its isolation from surface valued components and slow rate of movement, indicates no potential for significant adverse impacts.

Adrian Brown, INAC's expert, also identified minimal overall environmental impact potential:

"The receiving location will not, in my judgment, create a significant impact to the water quality for two reasons. One, there is already copper, lead, and zinc in that water. Two, the environment is a limestone environment with relatively high pH in the water. And contact of this water with that receiving environment will reduce the concentrations of metals to the lower levels that exist in the receiving water very rapidly. So we don't anticipate a significant impact... ammonium and nitrate concentrations likely, in our opinion, will not be much affected by the receiving water, but in both cases they are sufficiently low it does not appear that any environmental impact will occur as a result of them." – (Hearing Transcript, p202-3).

The Review Board's expert advisor Bruce Halbert added his final opinion on the likelihood of significant adverse impacts (Hearing Transcript, p206):

"What is a potential consequence of that water moving through that aquifer and eventually getting to the surface water environment? That particular question has not really been fully addressed by Tamerlane. The expectation is that it probably would move at least to Great Slave Lake before it did surface and appear back in the lake system... It's very unlikely that the arsenic, lead, and zinc would be transmitted along that flow path and actually reach the lake in any significant concentrations, as a result of dilution effects and absorption onto the rock media through which it's moving."

4) Water Quality Monitoring and Management

The developer made commitments late in the environmental assessment that included contingency plans for water quality management prior to release (see C106-108). Tamerlane's response to IR45 (175) introduced its lined sediment settling pond. Besides removing solids that could interfere with the gravity well system, it would also serve as a containment and treatment area in case water license parameters are exceeded during operations. Solids would be agitated out and put back underground as backfill, with lime treatment to demobilize metals as the primary treatment method.

The developer committed to three monitoring wells – the backup gravity well near the primary, a well between the gravity well and the freezwall (to also provide monitoring of the freezwall), and one approximately 800m from the discharge point to test mixing of discharge water with the Presquile aquifer (210). At the same time that the developer increased its proposed monitoring system parameters, it argued reasonable boundaries need to be set around monitoring requirements:

"The degree of groundwater monitoring should be commensurate with the anticipated risk to users of the groundwater. There is no current or expected groundwater extraction from the Presquile aquifer for human consumption or other use except mine dewatering, and no obvious direct pathways for this

deep aquifer water to ecological receptors at the surface. Therefore there is no anticipated exposure to and or risk posed by re-injecting water ... back into the Presquile aquifer.” - (210)

At the hearing, Adrian Brown of INAC expressed confidence with the proposed water management contingency plan (Hearing Transcript, p217-8):

“The system which we’ve been offered here for water management, including the pond, gives the mine the opportunity to continue operating while discharging water to this relatively large pond while they work out what water quality issues they have that is causing them to fail their standard, if in fact that’s happening. So we believe in reviewing this system that this is what is known in the environmental business as defense in depth. You have the ability to react to an operational problem with respect to water quality in time to do something about it, but not to cause you to have to close the entire mine down or even worse, let it flood, which would be a bad outcome from an environmental point of view and, of course, from an operational point of view”.

INAC stated it had not identified any potential adverse impacts that cannot be mitigated through the water license conditions set by the Land and Water Board (Hearing Transcript, p193).

6.4.1.4 Parties’ Alternative Proposed Mitigation and Remaining Concerns

Most, but not all, water quality issues were dealt with adequately by the close of the public record. The Review Board’s expert advisors still felt the developer had not adequately demonstrated what effect the discharge water contaminants would have on the Presquile aquifer. In addition, no calculations were presented on where and when the effluent will discharge to the surface (Great Slave Lake or somewhere in between).

In the absence of enough information to establish the fate of contaminants being gathered during the environmental assessment, the Review Board’s experts recommended the developer should implement an enhanced groundwater monitoring program during the life of the PPPP (201). The experts recommended two dedicated monitoring wells be set up in the Presquile aquifer on either side of the two gravity wells at distances of approximately 200m and 1,000m (for a total of four wells). They disagreed with the use of the backup disposal well as a monitor. The experts also recommended that groundwater level monitoring occur in monthly intervals and sampling for groundwater quality (complete major ion chemistry and dissolved metals) at quarterly intervals during active mining and for a minimum of two years after cessation of deep well discharge. The Review Board experts believed requirements for longer-term monitoring should be decided after a two year post-closure monitoring term. Environment Canada supported this recommendation (204).

Communities remained concerned both about pollution potentially caused by the PPPP and cumulative effects on water in the Great Slave Lake watershed. The Fort Resolution Métis Council provided a recommendation at the public hearing that a study be done on local groundwater before, during and after the PPPP.

Neither of the above recommendations were adopted by the developer prior to the close of the public record. Developers commitments related to water quality are C98-C122 in Appendix B.

6.5 Review Board Analysis and Conclusions on Groundwater

6.5.1 Overview of Considerations

Regarding the PPPP's groundwater impact potential on groundwater, the Review Board considered:

1. Estimated effluent discharge quality for contaminants of interest under several inflow scenarios
2. The sensitivity of the receiving environment (and valued components) to these contaminants
3. The likelihood that contaminated discharge effluent could find pathways out of the initial receiving environment (to surface valued components, in other words)
4. The adequacy of the developer's commitments on water monitoring (C116-C122) and management (C96-C115)

The Review Board notes there were two key alternative development components proposed during this environmental assessment which had implications for water management. The Review Board finds that the deep gravity well discharge system is superior to the originally proposed surface infiltration basin in terms of both water quality and quantity management. The system maximizes contaminant dilution capacity, it ensures residual contaminants have minimal access to surface valued components, it has a higher capacity for discharge than the surface release, it is a better backup plan, and it has a smaller footprint. The deep gravity well discharge system has been shown to be feasible and preferable from an environmental standpoint.

The introduction of the froth flotation circuit, on the other hand, could increase the potential for significant adverse impacts on the environment, but in the Review Board's view this potential is manageable, provided the developer's commitments are implemented.

6.5.2 Assessment of Contaminants of Interest

The Review Board finds the following about potential water quality contaminants at the PPPP¹⁷:

1. Total dissolved solids and sulfides will be high in the groundwater infiltrating the mine, but since the discharge environment is the same original water body, any (likely minimal) increase in dissolved solids or sulfide concentration during processing will only be of concern if it mixes with shallow groundwater or ponds at surface, which is unlikely to occur.
2. The developer has shown convincingly its ammonia discharge levels will be below standards used in most current surface release water licenses, even in a "worst case" of low mine inflows.
3. Metals levels in the effluent are likely to be lower than the amount typically currently licensed for surface water discharge. The bulk will go out with concentrate or be returned underground into a (non-acid rock drainage creating) cemented backfill.
4. The vast majority of froth flotation and other process reagents will not join discharge water.

The Review Board has heard expert evidence that the developer's estimates of expected discharge effluent quality are reasonable. It notes that even in the worst-case water quality scenario,

¹⁷ High suspended solids levels could create concerns about plugging of the gravity wells, stopping discharge away from the surface. The Review Board finds this is more a discharge capacity operational concern rather than a water quality concern. The significance of total suspended solids for water quantity management is discussed in Section 6.3.2.3.

contaminant levels are estimated to be only be slightly higher (for metals) or still lower (for other contaminants) than that typically allowed for surface water release. On the basis of currently available evidence, the Review Board finds no contaminants of interest in discharge effluent are likely to cause significant adverse impacts on the environment.

6.5.3 Assessment of the Receiving Environment

In addition to the likelihood that discharged effluent will not be highly contaminated, the Review Board also heard evidence, supported by experts, that the discharge system technology and deep groundwater receiving environment will help further minimize the likelihood of significant adverse impacts on the environment. Based on this evidence the Review Board concluded:

1. There are few pathways by which discharge water can migrate to a surface environment (provided the system functions as expected), except at long distances from the development and, given the slow speed of groundwater movement, over a long time span
2. The deep groundwater is likely to be less sensitive to elevated metals, ammonium and process chemicals, being an underground, remote and neutral pH (limiting metals mobility) environment, with no known important valued component's other than the groundwater itself
3. Both traditional and scientific knowledge indicate there are no current or likely users of local deep groundwater. Water in the Presquile aquifer is very hard and not suitable for drinking without treatment. It is not a high valued component from an "end-user" perspective
4. There is strong contaminant dilution potential for discharge water, both above ground, given the expected amount of mine inflows (reducing the likely contaminant loading of discharge water), and below ground. The very active Presquile aquifer has the potential to quickly and over a relatively short distance from the release point effectively dilute contaminants of interest
5. Contingency management plans are generally adequate to deal with problems transporting and keeping discharged effluent deep underground or keeping effluent quality below regulated limits. The lined sediment settling pond and associated treatment strategies have been accepted as a feasible and useful water management tool by all experts.

Taken together, this evidence indicates it is likely all contaminants of interest will be diluted enough to be indistinguishable from background water quality before they resurface. Experts also generally agreed that these factors support the argument that no contaminants of interest are likely to impact upon even local vegetation or wildlife. There is also no evidence to suggest that any past human activities have had significant adverse local impacts on the Presquile aquifer to which impacts from the PPPP would combine. Therefore, the Review Board finds that the PPPP is not likely to cause an immediate significant adverse impact on local groundwater or be a contributor to cumulative significant adverse impacts on local or regional groundwater.

Despite these findings, the Review Board's decision was tempered by the following considerations:

1. The uniqueness and lack of a licensing track record of the proposed discharge technology
2. Uncertainty in predictions of inflow rates and over the fate of effluent in the Presquile aquifer
3. The high likelihood of future development in the same area by the same developer and the corresponding potential for cumulative effects
4. Other parties' recommendations and statements of public concern about water quality, including concerns about water re-surfacing at or near the PPPP or Great Slave Lake

With these considerations in mind, the Review Board provides the following discussion, and suggests precautionary actions by the developer and responsible authorities that may lead to better water management at this and future developments, through the reduction of current uncertainties.

6.5.4 The Need for Site-Specific Effluent Discharge Quality Criteria

The Review Board concludes that current uncertainties can be reduced by implementing the water quality management plan the developer proposed, with slight improvements. Ensuring proper implementation of this plan requires a couple of actions. The first is to set effluent quality criteria for discharge water at the PPPP in the Land and Water Board's Production Water License.

The Review Board notes the switch to a deep gravity well discharge system raised discussion of the possibility of less restrictive water discharge parameters, given the lack of valued components in this remote underground location, and its high storage and dilution capacities. One expert stated at the technical sessions, "It would be very unlikely that there would be any unacceptable concentration" (199). For these reasons, the developer stated on a couple of occasions that it feels there is no level of contamination within the ranges predicted from this development that could harm this receiving environment. When a community member at the technical sessions asked if the water was going to be discharged without treatment simply because it was going into a groundwater receiving environment, the developer argued that "we don't need to treat it because the water quality will be very similar to where it is being injected back to and the water has no ability to do damage in that [deep underground] area" (199, p58). The developer also questioned the need for sites-specific effluent quality criteria for groundwater discharge in its response to IR47 (175).

The Review Board notes also that the PPPP presents a unique situation for regulators, given the release point is direct-to-underground rather than to a surface water body. The Review Board understands that no mine in Canada currently uses a deep groundwater process effluent discharge system. This makes the identification of applicable standards for effluent quality difficult. Environment Canada stated in its response to IR33 that the federal *Metal Mining Effluent Regulations* do not apply to the PPPP. INAC noted at the hearing that there are no current guidelines or standards in Canada for discharge to groundwater. To the Review Board's knowledge, mine effluent discharge to groundwater has never been licensed in the NWT, so the Land and Water Board will be breaking some new ground with its Type A water license.

With no specific guidelines for groundwater discharge water quality to consider, the lack of a permitting track record for this type of discharge, the nature of the receiving environment, and the developer's opinion that effluent quality criteria limits may not be necessary, it is by no means guaranteed that the Land and Water Board will require limits on the amount of metals, ammonia, nitrates, dissolved solids or other contaminants of interest in its Production Water License.

INAC has certainly indicated it feels site-specific effluent discharge criteria must be set; its representatives expressed this perspective at the public hearing. Adrian Brown of INAC noted that

"INAC wants to be clear that we do not necessarily consider that it's okay for this water to be discharged to the injection well... There will be subsequent evaluations to set what the discharge standards will be and these numbers will be compared against that." - (Hearing Transcript, p190).

INAC later re-iterated at the public hearing that its finding of no likely adverse impacts is predicated on the implementation of water license conditions to be set by the Land and Water Board.

The Review Board agrees with INAC that “discharge standards” – (effluent quality criteria, which are maximum concentrations of specified contaminants in discharge water) – should be set for the PPPP. There needs to be assurance that the developer *will* act to mitigate unforeseen poor quality effluent. In order to accomplish this, effluent quality criteria for all major contaminants of interest should be set and monitored¹⁸. Without such criteria, the point at which an impact requires mitigation can be neither determined nor enforced. If, for example, plant upsets or some other unforeseen deviation from expected contaminant levels in discharge effluent were to occur, the absence of set maximums for contaminants of interest would allow the discharge of this effluent without treatment. In the Review Board’s opinion, that would be an unacceptable outcome.

In the absence of regulated criteria for effluent discharge and a monitoring system the developer’s commitment to monitoring would not be enforceable. Without enforceable site-specific maximums and a monitoring program any significant adverse impacts on water quality might not be discovered and if they occur effectively mitigated. Full and effective utilization of the developer’s committed to monitoring system and treatment contingency plans would also not be likely in the absence of set effluent quality criteria.

In the Review Board’s opinion, the setting of reasonable, site-specific effluent quality criteria would be the most effective way to ensure actual water quality outcomes are monitored, compared to predictions, used to refine management strategies, and publicly reported. The Review Board also notes that the findings of this test mine will be valuable in guiding the development of appropriate effluent quality criteria, monitoring systems and adaptive management strategies for possible future mine expansions. The assumption that below ground discharge will have minimal effects is currently untested on site or in examples from other mines. Because prior experience or evidence from case studies was not brought forward during the environmental assessment, it seems appropriate that impact predictions be tested in operations, and the only way to achieve this outcome is through appropriately placed, timed and structured monitoring.

The Review Board finds it unnecessary to suggest specific maximum concentrations for any water quality parameters because it is confident the Land and Water Board’s Type A water license process is the most appropriate forum for setting specific criteria limits for effluent quality. The Review Board suggests that the effluent quality criteria limits for the PPPP should be developed in reflection of the remote and confined nature of the receiving environment. A review of licensing experiences in other jurisdictions may be of assistance in setting realistic effluent quality criteria limits for deep groundwater discharge.

¹⁸ The Review Board notes that greater than expected mine inflows are another uncertainty that should require action by the developer (e.g., installation of additional pumps, more frequent gravity well maintenance). However, unlike water quantity mitigation, which is required to ensure that the mine can feasibly operate, water quality problems, if not regulated, would not affect mine feasibility.

In order to proactively deal with uncertainty related to the lack of experience with licensing this type of discharge system, and to protect the receiving environment in a precautionary manner, the Review Board provides the following suggestion:

Suggestion #1:

The Mackenzie Valley Land and Water Board should establish effluent quality criteria in its Pine Point Pilot Project Production Water License to address the potential for discharge water contributing to groundwater quality deterioration and possible impacts on the surface environment.

The Review Board also concludes that additional guidance will be necessary for any future developments proposing to use a similar groundwater discharge system. The Review Board notes the developer has stated it is likely that future development will occur if the PPP is a success. The developer has also suggested it would like to use as much of the same infrastructure as possible for local mine expansion, which may include the groundwater discharge system. If this system proves successful for this development, it may also create demand for similar discharge systems at other unrelated developments. The Review Board is also aware that industry and the Northwest Territories Water Board are investigating the use of deep groundwater discharge in the Inuvialuit Settlement Region for oil and gas applications.

Despite this likely increase in the use of deep groundwater discharge systems, there is a current lack of territorial or even national guidance on acceptable discharge quality and operational requirements for this technology and type of receiving environment. Therefore, the Review Board feels that government needs to start researching and providing guidance on groundwater discharge systems. This will make future impact assessment and licensing of this type of discharge system easier and more effective in avoiding potential adverse impacts on local and regional groundwater.

Suggestion #2:

Federal authorities responsible for water should investigate best practices in deep groundwater discharge wells systems. The goal is to give additional guidance in advance of future uses of this technology in the Mackenzie Valley. These authorities should consider working with Tamerlane Ventures Inc. to use the Pine Point Pilot Project as an active research site for assessing potential deep well disposal impacts in the Pine Point region.

6.5.5 Water Quality Monitoring Needs

A second element useful to reduce uncertainty around groundwater impacts is the implementation of an effective and responsive monitoring and adaptive management system; one that can find and deal with unforeseen significant adverse impacts if they do arise and avoid them entirely where possible.

The water management plan for this mine has changed significantly during the course of the environmental assessment, in the Review Board's opinion for the better. Assuming the developer's commitments to water monitoring and management systems are put in place, the Review Board finds that the overall plan for management of discharge water from the PPP is sound and should, once firmed up by the Land and Water Board's water licensing process, minimize potential impacts on the environment. The Review Board finds the currently proposed local groundwater monitoring system, if implemented, is adequate to fulfill most of the following necessary functions:

1. ensure compliance with groundwater quality objectives set by the Land and Water Board;
2. establish a current baseline for deep groundwater quality and quantity in the area, given that no data has been collected from some 20 years;
3. track changes in water quality and quantity over time due to changes in land and water use;
4. determining whether treatment is necessary, and if so, whether it is effective in lowering the contaminants of interest over time;
5. determining the direction (horizontally and vertically) that effluent flows in the deep groundwater, how quickly, and whether contamination is adequately diluted over time and space.

The currently proposed monitoring system, if implemented, includes the ability to track and deal with any freeze wall malfunctions, to monitor the discharge system for mounding and clogging which will help prevent re-surfacing of discharge water in the immediate R-190 area, and to monitor discharge water quality before its release¹⁹. The Review Board is also confident that the developer's commitments covering water management contingency plans, once put into action, will be adequate to minimize impacts if the monitoring system does identify them.

The exception to the Review Board's general confidence in the developer's currently proposed monitoring system is in its ability to adequately gauge the fate and transport of contaminants such as metals, ammonia and process chemicals in the Presquile aquifer. There is still uncertainty about how discharged water will interact with the receiving environment because of lack of experience with this type of discharge. Given this uncertainty, the lack of a track record for this type of effluent discharge in the NWT, and the fact that local communities remain concerned about potential impacts on the environment, the Review Board concludes the monitoring system needs to be comprehensive. Potential adverse impacts can only be avoided if the developer and regulatory agencies can effectively track the contaminants that may cause them.

The Review Board suggests the groundwater monitoring system for the Production Water License should be designed in part to test the following predictions made about the PPPP, that:

1. Contaminants of interest will be quickly diluted (in terms of time and distance from the release point) by the large body of water that is the Presquile aquifer
2. No contaminant plume will occur and no cumulative loading of contaminants will occur in the local deep groundwater below and surrounding the R-190 site
3. Discharge water will not resurface until a long time and distance from the R-190 site

Unless appropriate monitoring is put in place, uncertainty will remain about how process and mine water will mix with the deep groundwater - what kind of chemical and biological interactions will occur below surface. There is also uncertainty about the flow (direction and speed) of the groundwater. And there is uncertainty about when and where (and with what levels of residual contamination) discharge water will resurface. These uncertainties about how discharged water will interact with the receiving environment are caused by a lack of historic and current data and lack of

¹⁹ Although the Review Board has noted above that this commitment to monitor discharge water quality before release should be linked to specified effluent quality criteria limits for it to have any effective water management function.

experience with this discharge technology. The Review Board questions the ability of the currently proposed monitoring program to accurately gauge fate and ground water transport of contaminants.

To determine the accuracy of the predicted impacts, upon which the Review Board's significance determination rests, an enhanced dedicated down-gradient monitoring system should be in place. The Review Board understands that the Land and Water Board will decide the actual location and number of monitoring stations during water licensing. The Review Board is confident in that process's ability to determine appropriate specific monitoring mechanisms. The Review Board anticipates the Land and Water Board will consider these concerns during the regulatory process and the Review Board encourages a review of the public record for this environmental assessment by the Land and Water Board as it addresses these issues. In particular, the Land and Water Board is encouraged to consider the Review Board's expert advisors' alternative monitoring and reporting recommendations as listed in Section 6.4.1.4 in combination with the suggestion provided below.

The Review Board concludes that comprehensive monitoring of, and reporting on, the concentration and movement of contaminants of interest through the Presquile aquifer should occur during the lifetime of the PPPP and for an appropriate time after closure. This will ensure the impact predictions are accurate and that management plans are effective in protecting the environment from any potential significant adverse impacts on groundwater. This monitoring and associated adaptive management program would also have the benefit of minimizing public concern through a transparent flow of monitoring results to the public.

In the face of uncertainty in predictions, the unique proposed discharge method, and in the interest of good environmental management, the Review Board suggests the Land and Water Board consider the following when developing its Production Water License for the PPPP. The Review Board concludes that if the following monitoring is implemented alongside the commitments made by the developer (in particular C116-C122), the likelihood of significant adverse impacts on local groundwater will be reduced. These improvements to monitoring will also mean that if significant adverse impacts on groundwater do occur, they can be identified early and effectively mitigated.

Suggestion #3:

The Mackenzie Valley Land and Water Board should give consideration to the following when developing its monitoring requirements for the PPPP Production Water License:

- **A requirement for monitoring of discharge water flow directions and speed from appropriately located downgradient monitoring wells to establish accurately the flow path of the effluent discharge**
- **A requirement for downgradient monitoring and reporting of deep groundwater quality, including a dilution and fate analysis for metals species, ammonia and any chemical reagents that can feasibly be tested, to determine how quickly and at what linear distance contaminants are diluted in this groundwater system**

Tamerlane Ventures Inc. should be required to include these elements in its PPPP groundwater monitoring program, develop an adaptive management plan for water quality concerns, and report results of both to the Mackenzie Valley Land and Water Board, and make those reports publicly available on an annual basis over the life of the PPPP.

7 Air Quality and Fugitive Dust Issues

7.1 Introduction

Air quality and dust deposition are concerns in most mining developments. These can impact soil, vegetation, wildlife, water and human health. Two important factors in this case are:

1. High intensity fossil fuel use and associated gaseous emissions. Diesel and gasoline are used to power machinery and motorized vehicles, and for electrical generation. Emissions emanate from fuel combustion, vehicle exhausts and other sources. Gaseous emissions are often considered in relation to overall contributions of human activities to climate change, but can have significant localized effects in high concentrations. Contaminants of interest include nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and carbon monoxide (CO).
2. Dust and other particulate matter created by the use of explosives and construction activities, vehicular transport along dirt roads, and crushing rock down to very small sizes. After processing, this finished product (lead and zinc concentrates) is stored in large piles and transported off-site by truck, and might release dust to the surrounding environment. Particulate emissions are of potential local concern at the mine site, along the transportation route and at the facility where ore is transferred onto railcars. Particulate matter is measured as dust (also called Total Suspended Particulates), PM₁₀, and the smaller PM_{2.5}, typically from combustion.

Gaseous emissions from PPPP activities and the potential for dust creation and lead/zinc contamination from both historic mining and the PPPP were identified early in the environmental assessment as issues to consider. This section examines the evidence on the public record in relation to gaseous and particulate air quality and fugitive dust creation and deposition and their potential impacts on the environment at all the sites/corridors of the PPPP. General air quality and fugitive dust deposition are related issues but will be examined separately here. The former relates largely to site-specific impacts at R-190, while the latter encompasses the entire PPPP.

7.2 General Air Quality Impacts

7.2.1 Issues Raised

R-190 site-specific air quality impacts (both particulate matter and gaseous emissions) were more a focus in the environmental assessment than dust deposition. Air quality in general was identified at the scoping sessions by several parties. Section 1-6 of the *Terms of Reference* directed Tamerlane to assess the potential impacts of the PPPP on local and regional air quality and greenhouse gas emissions, and to identify mitigation to deal with any found or suspected impacts related to air quality, either gaseous or particulate.

This focus on air quality became more acute during the latter part of the environmental assessment, as Environment Canada and the GNWT critiqued the appropriateness of the *Developer's Assessment Report's* assessment of likely air quality impacts and mitigation. The territorial *Environmental Protection Act* provides the GNWT with the authority to protect air quality from adverse impacts,

The GNWT has set *Guidelines for Ambient Air Quality Standards* (GNWT: 2002), although the guidelines are not currently enforced except on GNWT controlled Commissioner's Lands. For the assessment of air quality impacts on Crown lands, which constitute the bulk of the Mackenzie Valley and the R190 site and associated transportation infrastructure, the GNWT works in combination with Environment Canada, the federal regulatory authority agency responsible for air quality (SENES Consultants Limited: 2005).

7.2.2 Evidence on the Public Record

7.2.2.1 The Developer's Assessment Report

Section 2.3.3 of the *Developer's Assessment Report* gave broad estimates of baseline air quality at the PPPP. The remote location and lack of additive emissions from other sources makes the expected baseline air quality at the PPPP very good. External sources (e.g., GNWT: 2005) support the developer estimate that pollutant readings at the PPPP are likely in the very low, or pristine, realm. NWT air pollutant levels in general are very low.

Section 7.7 of the *Developer's Assessment Report* focused on PPPP impacts on air quality. The air quality assessment used in the environmental assessment for the De Beers Snap Lake diamond mine (Snap Lake) was used as a surrogate on the rationale that the projects were similar in scale (2800 tonnes per day vs. 3000 at the Snap Lake mine), both are underground and both employ dense media separation circuits. The main stationary source of emissions at the time the *Developer's Assessment Report* was issued was expected to be the diesel-fired power plant. Later in the environmental assessment the reliance on this power source was substantially reduced with the introduction of line power.

Particulate and gaseous emissions from the PPPP were estimated to be smaller than those of Snap Lake. Snap Lake emissions were all below applicable standards, according to the developer. This indicated the PPPP would not contribute significantly to air quality impacts in the local or regional context. In terms of transit operations, the developer argued that the relatively low level of truck and other related vehicle emissions of the Tamerlane PPPP are not expected to have a measurable effect on the existing air quality of the Highway 5 transportation corridor, or the general Pine Point region.

Initial estimates of greenhouse gas emissions indicated the PPPP would create a 5.1% increase over the estimated 2005 "business as usual" NWT greenhouse gas emissions. The developer's overall opinion from the *Developer's Assessment Report* is that no measurable impacts on vegetation or wildlife would occur because of air quality changes in the PPPP development area, especially due to the PPPP's relatively small size and location in an area with pristine air quality.

7.2.2.2 Additional Evidence

Despite the developer's predictions, Environment Canada wanted analysis of air quality discussed in further detail (126). Its concerns, shared by the GNWT, included the *Developer's Assessment Report's* lack of an independent emissions inventory and dispersion modeling of sources. Environment Canada questioned the developer's reliance on the Snap Lake study when there are differences in the environmental settings of the two developments. Environment Canada also cited the minimal developer mitigation measures for air quality concerns, and the lack of discussion by

the developer of what monitoring would be appropriate. Environment Canada's stance was that early work assessing and monitoring localized air quality impacts was justified because this development is the likely precursor to additional mining in the area.

Environment Canada and the GNWT were particularly concerned that the developer did not compile Section I-6 of the *Terms of Reference*.

'a project specific air quality assessment which includes on site air dispersion modeling is essential to assess potential impacts from mine emissions to vegetation and human health and to assure that ambient air quality guidelines are achieved' (171).

The developer was reluctant to conduct such a test. Tamerlane's opinion was the adoption of line power, mitigation strategies, and the underground and minimal footprint nature of the development meant that they were unlikely to contribute a large amount of air quality impacts. When parties could not agree on how to proceed, Environment Canada and GNWT jointly proposed a second round information request requiring a site specific air quality assessment, issued as IR54 (174).

To answer this information request, the proponent commissioned a site specific air quality assessment for R-190. RWDI Air Inc. (219) conducted the study which found the gaseous air emissions associated with the R-190 mine, especially since the developer switched its plans in July, 2007 (149) to mostly rely on line power, will likely be much lower than at other mines currently operating in the NWT. For example, greenhouse gas numbers were reduced from a 5.1% increase to only a 0.34% increase compared to NWT's total reported greenhouse gas emissions in 2005. Tamerlane estimated that PPPP's per-day greenhouse gas emissions would be 17 times lower by volume than that of Snap Lake.

On the other hand, modeling did predict localized exceedences of relevant air quality parameters at the R-190 site. RWDI found that "haul road particulate and mobile emissions have a localized measurable effect on ambient levels of Total Suspended Particulates, NO₂ and CO adjacent to the roads" (219). RWDI did note that ambient air quality impacts are all within a short range of the project facilities, largely within 1 km. As a result of its findings, RWDI recommended:

"Monitoring of dust, PM₁₀, PM_{2.5}, NO₂ and CO is recommended as dispersion modeling predicted concentrations of particulate matter, NO₂, and CO to be above the most stringent ambient air quality criteria" (219).

7.2.2.3 Developer's Mitigation

Despite their estimation that air quality impacts are likely negligible, the developer committed to the following mitigation and monitoring related to air quality (C1-C4):

1. The use of hydro-electric line power for approximately 75% of power needs during operations
2. The use of low sulphur diesel and regular equipment and engine maintenance
3. Conformance with the GNWT's *Guidelines for Ambient Air Quality Standards in the NWT*

On October 22, 2007, the developer committed to only a portion of RWDI's recommendations, as indicated in its response to an air quality undertaking from the public hearing:

For air quality monitoring, Passive Integrated Samplers will be employed. They will provide monthly averages for parameters such as NO₂, SO₂ and VOC's [Volatile Organic Compounds]. For particulate matter sampling, an integrated sampler such as an Airmetrics "MiniVol" sampler will be employed to sample PM₁₀. The developer's commitment meets the recommendations from RWDI with the exception of CO. Based on EBA and Tamerlane's opinion, atmospheric testing of CO is negligible for this project, however, Tamerlane will be monitoring CO levels underground daily" – (231).

7.2.2.4 Alternative Proposed Mitigation

On Nov 2, 2007, GNWT provided response to the RWDI Air study and the developer's commitments in regard to air quality monitoring (243). The GNWT stated that its focus is on best available technologies and best management practices when reviewing proposed projects, and projects are expected to meet *NWT Ambient Air Quality Standards*. The GNWT's expectation is "that projects will make every reasonable effort to minimize emissions and not simply meet the 'standards' – i.e., 'polluting up to a limit' should not be the goal" (243).

The GNWT considered the RWDI report's methods and findings acceptable stating that "it is apparent that exceedences of particulate and gaseous pollutant criteria are predicted to occur up to a kilometer away from the emission sources". However, the GNWT did note exceedences are localized and there are a number of uncertainties associated with the modeling that make additional mitigation measures unnecessary at this time.

What GNWT proposed instead was an ambient air quality monitoring program as suggested by RWDI. Monitoring results could determine whether there are exceedences and the developer could then implement additional mitigation as necessary. The GNWT was critical of the developer's commitment of October 22. The GNWT's critique focused on the argument that:

1. Passive Integrated Samplers typically measure a 1-month exposure period, when the focus of the monitoring should be one hour and 24-hour averaging
2. The developer did not committed to monitoring the full slate of recommended pollutants
3. CO, rather than NO₂ (which may not be monitorable) and VOCs (which were not identified as a pollutant of concern), should be monitored
4. The use of battery-powered particulate samplers ("MiniVol's"), as well as assessment of the pollutant NO₂, may not be feasible due to cold temperatures

The GNWT stated the developer's commitment falls short of the requirements either recommended by RWDI or what the GNWT feels is required given the potential for exceedences of gaseous and particulate emissions on site and along the R-190 spur road. Overall, the GNWT predicted the technology currently proposed for monitoring by the developer will be inadequate.

The GNWT recommended instead that the developer create an Air Quality and Emissions Management Plan to be approved by the appropriate regulatory authority prior to project construction that includes (243):

1. A summary of pollution prevention and emission mitigation strategies, best available technologies and best management practices employed at the PPPP;
2. A summary of contingency mitigation plans in case monitoring identifies need;
3. A plan of the project facilities showing emission sources and monitoring locations and

- delineation of property boundaries;
4. An emissions tracking program including annual estimates of common air contaminants – Total Suspended Particulates, PM₁₀, PM_{2.5}, CO, NO_x, and SO₂, as well as GHGs – CO₂, CH₄ and N₂O (reported as CO₂E);
 5. An ambient air quality program determined prior to project construction, but including dustfall monitoring and metal content analysis; and
 6. Annual reporting of results

This recommendation was not adopted by the developer prior to the closure of the public record.

7.2.3 Review Board Analysis and Conclusions on General Air Quality

7.2.3.1 Air Quality Monitoring and Emissions Management

General air quality issues centre on the potential for industrial activity to pollute at the R-190 site. The Review Board saw no evidence to suggest there will be exceedences in ambient air quality standards along Territorial Highway 5, partly because of the remote location and low existing traffic levels. As for the ore transfer facility, the Review Board finds that some localized heightening of gaseous emissions may occur due to the enclosed nature of the facility. However, the Review Board is confident that standard workplace mitigations set through *GNWT Safety Regulations* (GNWT: 1990) and the use of CN Rail's environmental policy, as stated by the developer (C83), will mitigate against potential impacts at that site.

While the modeling performed by RWDI identified some small, local exceedences of the most stringent air quality standards, the evidence shows that this project is not likely to have a significant, long-lasting adverse impact on either local or regional air quality. Emissions of particulate matter, greenhouse gases and other emissions are considerably lower than for other larger mines in the NWT. Exceedences are limited to the minesite itself and the dirt haul road. This mine is located over 40 km from the nearest community, and will not have a noticeable effect on any community's air quality. There is very little other industry nearby to contribute to regional cumulative effects. Therefore, the potential for cumulative local impact loading is very slight.

The area in question (the localized area with 1 km of the R-190 site where higher emissions are expected) is already extensively disturbed, with low habitat values for wildlife. The developer made specific commitments to reduce gaseous and particulate emissions that are likely to be effective if correctly implemented. The shift from hydro line power rather than diesel generation and the minimization of surface infrastructure also provides potential reductions in emissions. Finally, the life of the project is only about 3 years.

Despite these findings, some issues remain outstanding. There remain differences of opinion on the need to monitor exceedences for different pollutants, the appropriate technology to use, and the need to develop an adaptive air quality management plan.

The *Terms of Reference* (Section I-6-7) asked specifically for a conceptual outline of the developer's air quality adaptive management plan, including specifics about monitoring programs, as well as how monitoring results will be reported to regulators and impacted communities. No

dedicated effort was made by the developer to comply with this requirement. The Air Quality and Emissions Management Plan identified by the GNWT is, in the Review Board's opinion, an adaptive management plan that would fill this planning gap.

In the *Developer's Assessment Report*, the developer committed to conform with the *Guidelines for Ambient Air Quality Standards in the NWT*. An Air Quality and Emissions Management Plan would make this commitment easier to meet and results more transparent. Currently, with all of the mitigation the developer proposed, localized exceedences of those standards are still predicted. Therefore, the Review Board questions how this compliance can occur in the absence of effective monitoring (to determine whether standards are being met) and adaptive management (to reduce emissions when standards are not met). The developer's commitment is not feasible without some form of adaptive management plan.

The Review Board recognizes a desire for the implementation of best practices for air quality management in the GNWT's criticism of the developer's monitoring program for gaseous emissions. For example, the GNWT felt that the developer did not accept all of their own consultant's advice on monitoring, not measuring for PM_{2.5} or CO. In addition, the GNWT feels the developer's chosen technology for monitoring will likely not accomplish their stated intentions.

The Review Board notes that the GNWT and Environment Canada have expressed interest in working with the developer on air quality. At the public hearing, Joel Holder of the Environment and Natural Resources of the GNWT stated that "[the GNWT] is looking for a commitment from Tamerlane to sit down with Environment Canada and Environment and Natural Resources and collaboratively work to resolve" their differing opinions of what is an appropriate air quality monitoring program (Hearing Transcript, p265). The Review Board encourages further dialogue toward this end goal.

The Review Board is confident that the critique the GNWT provided is accurate, and finds that the developer has not identified an appropriate air quality monitoring system. It would appear that the developer's proposed monitoring system was chosen for ease of implementation rather than to deal with the likely pollutants of concern at the PPP. The Review Board suggests the developer reconsider its proposed monitoring system based on the GNWT's recommendations.

The developer should also consider carefully the GNWT's statement that "the proponent should be aware that if the project progresses beyond the proposed 'pilot' scenario, an additional air quality assessment would be required unless it can be demonstrated that the emissions regime is unchanged" (243, p6). In the Review Board's opinion, it is in the interest of the developer to put an emissions tracking and ambient air quality monitoring program in place for three reasons:

1. To confirm ambient air quality predictions, which may lead to less onerous future environmental impact assessment
2. To incorporate best available technologies and best management practices in the name of good environmental practice
3. To determine the effectiveness of different mitigation measures and develop appropriate adaptive management strategies that can be "time tested" prior to any future development

Given the developer's stated intentions to mine other ore bodies in the Pine Point area, it should start conducting air quality monitoring as soon as possible. Doing so is necessary for effective environmental management. Given its prediction of minimal emissions, it is in the developer's own best interests to have a clear record of monitoring results in advance of any further development using the R-190 infrastructure.

The Review Board finds that the PPPP is not likely to cause a significant adverse impact on local air quality around the R-190 location, but that overall management of site-specific air quality will be improved by implementing the following suggestion.

Suggestion #4:

Tamerlane Ventures Inc. should implement the recommendations made by the Government of the Northwest Territories in their submission to the Review Board of November 2, 2007, to develop an appropriate air quality monitoring program at the R-190 site. Tamerlane Ventures Inc. should link this monitoring to an overall Air Quality and Emissions Management Plan, and should work with the Government of the Northwest Territories and Environment Canada to develop its on-site emissions monitoring program and plan.

7.2.3.2 Air Quality Standards

Another issue of continuing concern goes beyond the boundaries of this one development. It is noted by the Review Board that the Northwest Territories is one of the few jurisdictions in Canada with no enforceable regulatory regime for air quality. As the NWT becomes more industrialized, developing requirements on a case-by-case basis in environmental assessment processes is an inefficient way to deal with these entirely relevant long-term air quality concerns. This issue has been brought up during many environmental assessments, in both the mining and oil and gas industries.

The 2005 NWT Environmental Audit (SENES Consultants Limited: 2005) identified the lack of enforceable air quality standards as a major gap in the regulatory system:

“Neither Canada nor the Government of the Northwest Territories has accepted responsibility for the protection of air quality throughout the whole of the NWT. As a consequence, air quality impacts associated with activities in the NWT remain largely unregulated”.

These gaps have not been filled in the interim. When questioned on progress toward enforceable air quality standards at the public hearing, Environment Canada representative Jesse Jasper stated

“There are standards in the works, but there hasn't been, to my knowledge, a designated agency in the north responsible for implementing the standards once promulgated. So it's in the works but it's not official at this point.” – (Hearing Transcript, p261)

A big problem with this gap is there are very few existing regulatory instrument conditions that deal with air quality mitigation, and none being used for mining developments. Thus, if mitigation is necessary, government is currently relying on the environmental assessment as the only time to deal with it. When asked by the Review Board to address this issue, the GNWT and Environment Canada stated that the Land and Water Board lacks “regulatory hooks” at present for setting air quality conditions in its instruments.

The Review Board appreciates the diligence of the GNWT and Environment Canada in raising air quality concerns during various environmental assessments, including this one. However, the Review Board wants to emphasize that enforceable guidelines, not ad hoc measures, are required if management of air quality impacts is actually going to be accomplished. The environmental assessment process is of limited reach. It can only address significant adverse air quality impacts when the evidence in a proceeding supports such a finding. In the Review Board's opinion, this can be solved by finalizing the development of enforceable air quality guidelines governing industrial activities in the NWT. Having enforceable air quality regulations would put the setting of terms and conditions for air quality on a site-by-site basis in the hands of the regulators. It could also more effectively protect the environment of the NWT, and create a level playing field and a degree of certainty for prospective developers. Creating this context is the responsibility of the GNWT and Environment Canada, not Tamerlane Ventures. Considering this, the Review Board makes the following suggestion:²⁰

Suggestion #5:

The Government of the Northwest Territories and Environment Canada, working with industry and affected communities, should address the need for enforceable air quality guidelines or standards for industrial developments operating in the Mackenzie Valley.

7.3 Fugitive Dust Deposition and Metals Contamination

7.3.1 Issues Raised

South Slave aboriginal residents raised concerns over onsite dust creation and fugitive dust losses, along with potential cumulative effects associated with metals deposition on the historic rail bed from Cominco Ltd's Pine Point Mine. At the scoping session in Hay River (45), one participant stated concerns about the potential for mined material to be spilled or dispersed while in transport. Another participant cited potential contamination of the rail bed as a concern alongside PPPP hauling operations. Work done by Crosscurrent Associates Ltd. on behalf of the Deninu K'ue First Nation (42) during scoping, found historic documents that identified concerns associated with previous mining at Pine Point about contaminants concentrated in plant roots²¹, and the need for further studies on soils²².

The *Terms of Reference* asked for information from the developer on dust creation, dust control on site and in transit, predictions of contaminant loading and dispersion, and potential impacts on vegetation, wildlife habitat and air quality. Section I-1-6 of the *Terms of Reference* asked for

²⁰ This was recommended previously by the Review Board in a required measure in the Report of Environmental Assessment of December 7, 1999, for the Ranger-Chevron environmental assessment (Recommendation 7). It was later re-iterated in Recommendation 7 of its June 1, 2004 *Report of Environmental Assessment and Reasons for Decision* for environmental assessment 03-005, the Paramount Cameron Hills Extension Project. Although these were accepted as binding measures, they have not yet been implemented.

²¹ NWT Water Board (1984). *Assessment of the Possible Environmental Impacts from Pine Point Mines Limited Dewatering*. Report of the Technical Advisory Committee Working Group.

²² Stevenson International Groundwater Consultants Ltd. 1983. *Hydrology of R190 Mineralized Region, Great Slave Reef Project*, prepared for Westmin Resources Ltd.

identification of any other potential sources of surface or groundwater contamination that will add to effects from the PPPP, and gave highways and rail bed contamination as examples.

Pollution from fugitive dust deposition and contamination only received substantial focus late in the environmental assessment. In its technical report of September 25, 2007, Environment Canada first raised its concerns about fugitive dust contamination (204), linked to reports on the Red Dog lead-zinc mine in Alaska that found “significant concentrations of lead, zinc, and cadmium in snow and vegetation along the transportation system” (217, 220-222).

7.3.2 Evidence on the Public Record

7.3.2.1 Developer’s Assessment Report

The *Developer’s Assessment Report* included a general assessment of dust impacts on vegetation, surface waters, human health and animals. The R-190 site was the main focus. The developer did not provide any quantitative predictions of the amount of dust that would be lost along the Highway 5 corridor or near the ore transfer facility. The developer argued that the relatively small amounts of dust predicted, coupled with mitigation measures, indicate no likelihood of significant adverse impacts. The developer felt covered trucks and moist product were the main reason why dust will not be released during transit. It was also argued that moisture content will minimize particulate emissions from underground.

The *Developer’s Assessment Report* estimated that the power plant, waste oil and mine heaters, mobile equipment, underground and above ground crushing, among other activities, would emit approximately half a tonne each day of Total Suspended Particulate, and a combined quarter of a tonne of the smaller PM₁₀ and PM_{2.5} particles. This was compared to the operating diamond mines and Snap Lake. The open pit mines at Diavik and Ekati have much higher levels of particulate matter creation, but estimates showed the PPPP having slightly less particulate matter than that of Snap Lake. The developer pointed out that the time period for the PPPP is much shorter than for any of these mines.

The developer predicted about 50 to 65 return trips a day with 20 to 30 tonne loads of concentrate.

7.3.2.2 Additional Evidence

During the technical sessions on water, the developer introduced the possibility, later confirmed, that a froth flotation circuit would be added to the process plant. This would require crushing of the rock down to a size where 80% would pass through a 105 micron filter (for comparison purposes, human hair averages about 100 microns in diameter). The ball mill crushes the rock into a fine dust before entering the froth flotation system and be separated into lead and zinc ores. The reduced particle size of the concentrate product heightened the need assess fugitive dust creation and potential losses, as it seems likely that smaller particles can be more easily blown around than larger ones. The addition of a froth flotation circuit will also increase the lead or zinc content of concentrate from +/-40% to +/-55%.

David Swisher of Tamerlane stated at the public hearing that the additional crushing associated with the froth flotation system will not create any additional dust because it will be running through a “wet circuit” (Hearing Transcript, p91).

RWDI’s study of air quality (219) included particulate emissions and incorporated the new froth flotation system in its calculations. RWDI estimated that the background particulate matter levels at the R-190 site would be very low. The study also points out that the amount of total particulate matter released from PPPP operations per day will be somewhere between 1/5th and 1/6th that of Snap Lake, and even a smaller percentage of that of open pit mines such as Ekati or Diavik. Both these modeling estimates confirmed and in fact enhanced the developer’s previous predictions.

The developer later stated at the public hearing that RWDI’s modeling was done without the mitigation measure of watering down the dirt haul road, making the exceedences seem larger than they are likely to be. This does not appear to be an accurate assertion. The RWDI study stated that “the haul road is the single largest source [of Total Suspended Particulates emission], even when a dust suppression efficiency of 80% has been incorporated into the estimations (219, p16). In addition, RWDI found that, despite being lower than the other mines, the PPPP would likely cause some local particulate emissions above the most stringent standards, mostly along the dirt haul road.

No other parties presented evidence of onsite impacts. However, Environment Canada provided the Review Board case study material from the Red Dog Mine in Alaska showing that significant amounts of lead and zinc contamination have occurred at the Red Dog mine site, on its transportation corridor, and at the ore transfer facility (220-222). The general findings of these studies were that there were elevated levels of lead, zinc and other metals along the transportation corridor. One stated that the highest levels near the Red Dog haul road equaled or exceeded maximum reported samples from severely polluted regions in Central European countries (221). The same study found that vegetation along side of roads has very high levels of heavy metals, containing four to seven times as much lead, zinc and cadmium as heavily dust-laden samples from another area in Alaska.

One study noted that where trucks pick up and drop off the ore is where the highest dustfall occurs. Another noted that “in the past, concentrate spillage and escapement from trucks was likely a significant factor; however, new trucks with hydraulically closed steel covers that seal tightly may have minimized or possibly eliminated this source” (222).

The studies cited indicate that risk assessments are ongoing, and that impacts on the environment have not been fully determined. Impacts on vegetation, soil, fish, wildlife and humans are all being considered. There are some concerns that local subsistence users of fish, game, plants and berries may be exposed through consumption of food items (221).

When questioned about how the information from the Red Dog Mine should be considered in this case, Jesse Jasper of Environment Canada stated it was raised as a general issue to show that dust can spread considerable distances (Hearing Transcript, p257). In answer to a follow-up question about whether Environment Canada had any specific recommendations or knowledge of any studies relating to cumulative contamination from the old Pine Point Mine, Jesse Jasper stated “*I’m not*

aware of any monitoring being done on the rail line or other transportation corridors associated with previous mining” (Hearing Transcript, p258).

No evidence was presented during the environmental assessment that any studies have been conducted to determine the background or baseline concentration of metals along the Highway 5 corridor running parallel to the old rail bed.

7.3.2.3 Developer’s Mitigation

The developer argued that the very nature of the product assists in two ways to minimize the potential for dust formation:

1. The lead and zinc ores are quite heavy and therefore dense, and a full truck load will stay well below the freeboard of the trucks.
2. The product will be in a moist condition both coming out of the mine and after going through the “wet” (water-fed) process plant. The developer estimates 5-8% moisture content by the time it enters the concentrate storage facility on site.

The developer’s combined mitigation proposed in the *Developer’s Assessment Report*, IR responses, and other submissions have identified a variety of dust control mechanisms. They are included in the dust control (C5-C7) and transportation (C83, C85, C88-C89) sections of Appendix B. The developer’s general conclusion was that dust release from the concentrate will be prevented through the following mitigation:

1. Use of misting systems and water trucks for dust minimization
2. Covered concentrate storage facilities
3. Maintenance of a moist product (5-8% moisture content) to minimize dust creation, and ensuring quick turnaround of product (no long stockpiling leading to moisture loss)
4. Washing down of trucks prior to start of each trip, at both facilities
5. Completely covered concentrate transfer facilities at both ends of the line, allowing trucks (and trains) to load and offload inside a building
6. Tarping of loads
7. Visual inspections of every load, focusing on size, load balance and tarp coverage

The first round of information requests focused on how the developer will implement its mitigation. The developer’s response to IR8 identified isolated storage in the bed of the truck as the sole method of keeping the product moist (120). IR29 asked on the developer to provide information on what level of particulate in the air is the threshold for using misting systems, and how this would be measured. The developer responded that it does not believe it necessary to measure particulate levels because it “intends to judiciously employ dust suppression through watering”. The need for 1m³/hr of water for dust minimization was estimated (120).

The developer’s response to IR55 (242) provided the following final statement on dust mitigation:

“Tamerlane will use water for dust suppression on site, on the haul road from the site to the highway, and at the ore transfer facility outside Hay River. Spray bars will be installed at the feed end of the

crusher to mist the area if dust is encountered. During winter months, a mixture of glycol and water may be necessary to prevent freezing”.

7.3.2.4 Remaining Concerns and Alternative Mitigation Proposals

At the public hearing, it emerged that fugitive dust and the potential for cumulative effects from lead-zinc deposition were still a concern for communities. Tom Unka of the Deninu K’ue First Nation stated (Hearing Transcript, p100):

The residual effects of lead and zinc along the transportation corridor should the ore not be adequately contained... during the transportation, should this product not be adequately covered, it's gonna start falling on the roadway and it's gonna get into the environment”.

Kara King of the Fort Resolution Métis Council identified that more information was required on the residual effects of lead and zinc, and Amos Cardinal of the Katlodeeche First Nation highlighted longstanding concerns about the potential for cumulative effects from historic mining, noting “there's been a concern with some type of chemicals on the rail beds over the years with this mine been hauling material” (Hearing Transcript, p163).

Despite these stated concerns, and perhaps because this issue was not raised until late in the environmental assessment, there were few mitigation proposals forthcoming. GNWT suggested RWDI’s modeling highlights the need for diligent application of the proposed mitigation strategies at the R-190 site, such as dust suppression, enclosed crushing operations and good site management.

Jesse Jasper of Environment Canada stated at the hearing, with specific focus on the R-190 site, that

“It appears that ambient monitoring to measure dust and particulate particulates will be needed, and this involves total suspended particulates, PM₁₀ and PM_{2.5}. The summary did not discuss deposition, so we don't know if dust fall will be a problem. For this reason, monitoring for dust fall is recommended, subject to the results of the air quality assessment and other work. Metal analyses should be done on the dust fall samples” – (Hearing Transcript, p242).

In its response to IR55, the developer clarified its air quality monitoring commitment to conduct “periodic metal content and dustfall analysis during the life of the project for use in future baseline applications”. How frequently this will occur was not established. No such mitigation was proposed for Highway 5 or the ore transfer facility.

One way to minimize dust losses en route would be speed reductions in trucks. In its response to IR5 from the Review Board (120), the developer did not commit to any reduced speeds for trucks, stating that all trucks would operate within the posted limits.

While Environment Canada raised the issue of fugitive dust along the transportation corridor, it declined to make any recommendations other than that the developer should check their trucks for gaps (already committed to), and perhaps consider locking steel doors like those used in Alaska now (not a firm recommendation). Upon direct questioning, Environment Canada declined to recommend any baseline analysis of existing lead-zinc levels along the transport corridor.

Environment Canada stated it did not have any specific monitoring recommendations, only that they wanted to raise fugitive dust concerns.

A traditional knowledge study conducted by the Katlodeeche First Nation (169) recommended that a study be conducted on the old railroad bed to determine if it is contaminated in any way, and to assist in determining what long term impacts of fine dust might be on the transportation corridor. A study on finding ways to reduce the dust from the ore coming off the trucks was also recommended. The developer did not adopt these recommendations before the public record closed.

7.3.3 Review Board Analysis and Conclusions on Fugitive Dust Issues

The Review Board finds the following in relation to dust deposition and contamination. Existing concentrations of lead-zinc particulate matter in the operations area are likely to be low given it is a forested area with no other current industrial activity and no historic full scale mining. Also, the Review Board finds that the underground mining operations, the moisture levels in the product, the relatively small development footprint and short timeline, and the developer's committed to mitigation strategies all reduce dust creation potential during operations. As well, the bulk of the transportation route is a paved road less likely to create dust than a dirt road. Impacts on human health are unlikely from this short-term operation. The nearest human habitations are 45km away from the work site. The developer's mitigations for employee health and safety are adequate and controlled by other regulatory authorities. The developer identified that personal protective equipment would be worn by all employees. The Review Board notes that no evidence of safety concerns to workers from lead-zinc particulate exposure was identified during the course of the environmental assessment.

Dust is largely a cumulative impact concern at this time. Fugitive dust contamination is the particulate matter issue the Review Board is most concerned about from this proposed development. The focus on dust impacts from the PPPP is twofold. One is with on-site dust, estimated to be highest along the dirt haul road to Highway 5. Much of this dust will be from disturbance of the dirt on the roads, and from underground blasting. The evidence on the public record indicates that while some exceedences of the most stringent air quality standards are predicted, the PPPP will have significantly lower particulate emissions than comparable mines in the NWT. However, because the dust will include some amount of lead, zinc and other metals, mitigation that merely deposits the dust on the ground might not be adequate to dealing with the dust's impacts on the environment.

The second issue is fugitive dust from the movement of product creating contamination along the transportation corridor. In this case, the Review Board is concerned about any pollution from dust deposition away from the R-190 site, including on Territorial Highway 5 and near the ore transfer facility south of Hay River. The Review Board shares concerns initially raised by Environment Canada that lead and zinc rich dust may escape and potentially pollute the transport corridor. These concerns surrounded the possibility of the mining product blowing away in the air at higher speeds on the highway. The mining product size became more of a concern with additional crushing required by the introduction of a froth flotation circuit, because the smallest pieces became even finer and more likely to be picked up in the wind.

The Review Board's concern about dust generation from this development is focused more on the contaminants in the dust than its predicted volume. In other words, it is not just the amount of dust it

is what is in it that is important. Given the size of the particles generated by the PPPP (most will be larger than PM₁₀), the most likely scenario is not human respiration, but the creation of wind blown dust and settling of lead and zinc rich dust on the ground. Potential environmental impacts would be through terrestrial or freshwater receptors. Berries and plants can take up the metals in soils and the aquatic food chain can take up the metals in freshwater. These contaminants bio-accumulate and can reach animals that are harvested as traditional foods.

The Review Board finds that dust should be a concern at all three sections of the PPPP: the R-190 mine site, in transit along Territorial Highway 5, and at the ore transfer facility south of Hay River. Analysis here will focus on two dust deposition and potential contamination issues in turn, and the reasons behind the Review Board's opinion that corridor and on-site monitoring (at R-190 and the ore transfer facility) are appropriate precautionary actions in the face of uncertainty.

7.3.3.1 Cumulative Lead-Zinc Contamination along the Transport Corridor

The biggest uncertainty about contamination at the present time is along the transportation corridor along Highway 5. Environment Canada raised concerns about potential fugitive dust losses by identifying corridor contamination issues at Alaska's Red Dog lead/zinc mine, but did not identify the likelihood that similar issues would occur from the PPPP. Neither did Environment Canada recommend any corridor monitoring. No other party to the environmental assessment provided any estimation of the likely amounts of, or recommended strategies for dealing with, fugitive dust. The GNWT identified the need only for on-site monitoring and adaptive management for particulate matter, not on the transportation corridor.

What is known is that any dust generated by the concentrate will include lead, zinc, and to a lesser degree, other metals. Approximately 50-55% of any given load will be lead or zinc particulate. This equals about 800 tonnes of lead and zinc in transit each day.

There are dual uncertainties in this case. First of all, there is uncertainty that the developer's mitigation to avoid fugitive dust losses during transit will be effective. The developer has stated that the lead and zinc concentrates will stay "moist" (5-8% moisture content) from the time it comes out of the froth flotation circuit until the time it leaves on the train south. This requires a very short turn around time on concentrate transfer, a factor the developer promises but provides no details on how it will be accomplished. The Review Board finds the commitment that all product hauled will be in a moist condition, which relies on a certain speed of delivery from the process plant to the railhead and a distribution system that is effective at all times, may not be enforceable. And the developer does not commit to any adaptive management steps in case it is not. No evidence has been presented indicating what level of moisture is required before dust is generated with a product this size, how the developer will assure the tight transport scheduling needed to keep the product in a moist condition, and no commitment by the developer that moisture levels will be tested for adequacy prior to transport and what surety there is that mitigation will be applied if the content "dries up".

Neither does the Review Board have full confidence that tarping of haul trucks will be adequate to keep dust from circulating and leaving the haul trucks, especially given product size. The lack of a commitment to reducing truck speeds below the marked highway limit of 90km/h is a contributing factor. If the concentrate dries out, and if the tarping is not effective, dust laden with small particles

that are predominantly lead or zinc will escape as fugitive dust along the side of Highway 5 or at (or near) the ore transfer facility. In the Review Board's opinion, this is a realistic scenario.

This uncertainty can be dealt with quickly and effectively through the implementation of a dustfall/metal content monitoring system along Highway 5. If, several months after operations have started, there is no indication that dust is escaping the trucks this monitoring system will have proven the effectiveness of the proposed mitigation. If dust is accumulating, this monitoring system will have identified an issue that needs to be dealt with through adaptive management.

Uncertainty about the likely amounts of project-specific fugitive dust needs to be combined with uncertainty about the levels of lead and zinc contamination along the nearby rail bed corridor utilized by the historic Cominco Pine Point mine. This rail bed corridor runs roughly parallel to Highway 5, in places less than 50 metres north of it. Concerns about rail bed contamination were raised by communities during the scoping sessions, and the *Terms of Reference* (Section I-1-6), required information on how much lead and zinc were deposited during historic mining at Pine Point. Despite these concerns, no party produced any evidence of testing for rail bed contamination.

The Review Board has no evidence that any party knows how much, if any, lead and zinc (or any other form of) contamination occurred along the historic Pine Point rail corridor. There seem to have been no tests done on this rail bed. Statements heard at the scoping sessions indicate that contamination of the rail bed has long been suspected by local residents, but no evidence has been provided on this issue. This uncertainty needs to be dealt with through soil sampling of the area around the historic rail bed.

The Review Board finds that both baseline lead and zinc contamination levels from previous activities and the contribution of the PPPP are uncertain. This makes it impossible to determine the potential for cumulative loading of lead and zinc concentrations in transportation corridor soil at the current time. This in turn makes corridor soil quality baseline and continuous monitoring necessary.

The Review Board also shares Environment Canada's concerns, expressed at the public hearing, that "*while the Pine Point project will be occurring on a small scale, we note the potential for future ore extraction, which may extend the duration and volume of trucking*" (Hearing Transcript, p244). Given that the developer is likely to propose further development proposed if PPPP is a success, further baseline work on the transportation corridor (virtually none was completed for this environmental assessment) should be encouraged. This is the only feasible transportation corridor for future mines. Now is the time to determine what past contaminant loading has been, and what this type of operation adds to lead and zinc concentrations, in order that any longer term developments with higher potential impacts can be planned for in advance.

While the Red Dog Mine in Alaska may not be comparable in size or the type of main haul road (dirt there vs. blacktop in this case), it is evident from the evidence Environment Canada introduced, that trucks along the Alaskan road, even though they are now not allowing large amounts of lead-zinc dust to escape, continue to 'kick up' dust that escaped over time. For this reason, it is necessary to immediately find out whether additional mitigation to stop dust from escaping is necessary. This should not wait until later when the product has already entered the surrounding environment. It is

in the interest of the developer, government authorities and the people of the South Slave to understand just how effective the proposed transportation method is in minimizing fugitive dust.

The Review Board is not suggesting a significant adverse impact is likely at this point. It is also not suggesting a full scale risk assessment is required. The Review Board finds that it is *possible* that there are already elevated levels of metals in the transportation corridor and that fugitive dust losses from haul trucks may occur. The Review Board therefore finds the appropriate way to deal with this uncertainty is for the responsible authorities to implement pre-development and during-development soil sample collection and dustfall analysis for metal content. This would make it possible to establish the presence or absence of either cumulative or development-specific risks, or both.

This does not have to be an onerous program. If no elevated levels of lead and zinc are found in the existing rail bed, and no or very small amounts of lead and zinc are found in dustfall collection, it is unlikely that any further work will be required at any time, without evidence of a substantial change in risk factors. If elevated levels are found, then perhaps later studies on lead-zinc distribution, animal and plant tissue analyses will be necessary. But that scenario is entirely hypothetical; the first steps are to conduct a simple background sampling and front-end monitoring program. Effective corridor contamination analysis requires three things:

1. data on the natural (background) amount of lead and zinc in the soil and overburden in the area
2. data on how much lead and zinc particulate has been transported into the area by historic mining and is currently in the ecosystem (baseline)
3. monitoring of dustfall and metal content of dust from PPPP operations and transportation

It is the Review Board's opinion that the responsibility for determining historic deposition of lead and zinc should not be placed on Tamerlane, as it had nothing to do with any historic contamination. The Review Board suggests it is the responsibility of Environment Canada and the GNWT to implement this corridor dustfall and metal content analysis system. They are the government authorities responsible for environmental protection and the health of the people of the South Slave. It is in the interests of these authorities to get a better idea of whether this long-standing issue, which local people have cited for many years, is actually related to significant adverse environmental impacts, before additional large scale and long term development ensues.

In looking for an effective dust monitoring system, the Review Board suggests the responsible authorities examine the work done previously in Alaska around the Red Dog Mine.

The Government of the Northwest Territories and Environment Canada should work with the developer, if corridor contamination is found to be occurring or if there are already elevated lead or zinc particulate in the area around the transportation corridor, to identify and implement adaptive management strategies that can reduce additional fugitive dust losses to the environment. For example, adaptive management may consider locking metal doors on trucks, speed restrictions for trucks, and moisture levels monitoring and minimum moisture content standards for transported concentrate, among other mitigation strategies.

The Review Board would further suggest that, given community concerns, baseline testing of the historic Pine Point railroad corridor should be part of the baseline assessment of metals in the

environment. Any existing accumulations of lead and zinc should be considered as part of any cumulative effects assessment on the transportation corridor.

Suggestion 6:

Before the Pine Point Pilot Project's operating phase starts, the Government of the Northwest Territories and Environment Canada should establish a dustfall monitoring and metal content analysis system along Territorial Highway 5, from the point where Territorial Highway 5 meets the Pine Point Pilot Project access road, to the junction of Highway 5 and Highway 2. This system should also include baseline metal content analysis of soil in the vicinity of Highway 5 and the historic Pine Point Mine rail bed, and public reporting of all results.

7.3.3.2 Onsite Monitoring Systems

The Review Board is aware the RWDI modeling study predicted (for the R-190 site) Total Suspended Particulates maximum concentrations about 3 times, PM₁₀ maximum concentrations to be about five times, and PM_{2.5} maximum concentration to be twice that of the most stringent air quality standards. These exceedences are predicted in close proximity to the operations only. While the exceedences are high enough that RWDI recommended monitoring for dustfall, PM₁₀ and PM_{2.5}, particularly along the access road, the Review Board has found that particulate will not create a significant adverse impact on the environment. What is unknown is whether metals will accumulate in dust on the ground and vegetation over time, an issue of higher environmental concern.

The developer has mitigation in place for on-site dust control (such as water trucks or misting systems). Quickly putting dust to ground is a good strategy from an immediate human health perspective; so that irritation and respiration of fine particulate is avoided. However, this strategy does not deal with the issue of how much metal is in the particulate. In the long term, this product could be just as harmful to the environment on the ground as in the air.

RWDI estimated that Total Suspended Particulates would account for the bulk of dust around R-190. Emission sources were estimated to break down to about 53% caused by haul road activity, and 34% from underground sources. This indicates that much of the Total Suspended Particulates are going to be road dust. What is not known yet is how much of that road dust will be high in lead and zinc, and whether lead and zinc will accumulate over time near the site.

Also unknown is the extent to which underground dust will migrate through and beyond R-190. Dust created by underground activities, including blasting, will certainly contain lead and zinc particulate. The combined grade of lead and zinc in the R-190 deposit is estimated by the developer at 18.4%. The Review Board finds it reasonable to believe that similar lead-zinc concentrations, although perhaps slightly smaller given the heavier weight of the metallic particles, would be in the dust coming out of the mine and drifting to ground on site and in the near vicinity.

Once the product is through the processing plant, it has over 50% metals content in separate lead and zinc concentrates. While the developer maintains that this product will stay "moist" and not create dust on site, the Review Board has found that a variety of factors could lead to dust being created before the product is moved or during the initial stages of transportation. The mitigation the developer has committed to does not adequately address this potential adverse impact. The Review

Board finds that the collection over time of significant amounts of contaminated dust in the vicinity of R-190 is a realistic scenario even with currently proposed commitments in place.

Therefore, consistent monitoring in the form of regular and reported metal content analysis of collected dustfall, is required to fill the knowledge gap at R-190. The developer's commitment lacks detail. It is currently unclear how often the developer will conduct metal content and dustfall analysis and what reporting procedures will be utilized. Periodic metal content and dustfall analysis does not set up a consistent monitoring system for the relevant issue of potential health and ecosystem effects of metals laden dust.

The Review Board also notes that no metal content analysis of dustfall has been adopted at the ore transport facility. The Review Board considers this lack of monitoring a problem. The Review Board notes that the studies of the Red Dog Mine in Alaska found the highest levels of metals deposition at the beginning and end of the transportation system. Given that trucks will have to stop at the intersection of Highway 5 and Highway 2, and then proceed down a 600-800 metre haul road west of Highway 2, the Review Board feels that a similar dustfall and metal content analysis in this area and at the ore transfer facility would be prudent.

The Review Board is of the opinion that responsible government authorities and the developer share responsibility for controlling contaminants by mitigating and monitoring fugitive dust. The onus is on the developer to minimize the amount of fugitive dust occurring from their operations, and to monitor dustfall and metal content at R-190 and at and near the ore transfer facility. The developer's commitment to analyzing the metal content of dustfall was unclear and should be refined. It should be extended to the ore transfer facility and its immediate surroundings. Results of corridor dustfall and soil sampling studies by the responsible authorities should be integrated with the dual site monitoring to be conducted by the developer. This is important to achieve reliable adaptive management of ore transport.

The exact location of the sampling points should be determined with the assistance of the Government of the Northwest Territories and Environment Canada. Results of this testing should be reported to the Government of the Northwest Territories, Environment Canada, and concerned South Slave communities on a bi-annual basis. These programs should be compatible with a larger air quality and dustfall and metal content monitoring and management system, in concert with the Government of the Northwest Territories and Environment Canada that covers the entire production and transportation system of the PPPP up to the railhead.

Suggestion #7:

Tamerlane Ventures Inc. should have independent metal content analysis done on dustfall samples collected at appropriate time intervals, and publicly report the results, for the following locations:

- **The R-190 site;**
- **Along the R-190 haul road;**
- **Near the intersection of Territorial Highways 2 and 5; and**
- **The ore transfer facility south of Hay River and its road approach.**

8 Socio-Economic Impacts

8.1 Introduction

The Review Board felt the assessment of the human environment and the identification of impacts that influence social, economic and cultural well being to be important during environmental assessment. Section 115(b) of the *MVRMA* requires the Review Board to consider the social and cultural well-being of the residents and communities of the Mackenzie Valley. The Review Board does this for both the project-specific and the larger cumulative contexts. The Review Board also recognizes increasing demand from communities that their social, economic and cultural well-being is taken into full consideration during environmental assessment. In s.111 of the *MVRMA*, “impact on the environment” is specified to include “any effect on the social and cultural environment or on heritage resources”. Since it is often economic impacts, both beneficial and adverse, that influence social change, these must be considered as well. These analyses together are often referred to as socio-economic impact assessment, which examines social, economic and cultural impacts.

8.2 Issues Raised

A wide range of social, economic and cultural impact concerns were raised during scoping. Aboriginal groups from Fort Resolution and the Hay River area were particularly vocal, although the Town of Hay River also raised concerns. The *Terms of Reference* required a comprehensive assessment of the PPPP’s potential adverse and beneficial impacts on the South Slave people, with emphasis on Fort Resolution, the Hay River Reserve, and the Town of Hay River.

The Review Board determined based on the evidence on the public record that five socio-economic impact considerations raised during the environmental assessment merited specific attention:

1. The ability of residents of the South Slave to take economic advantage of the PPPP;
2. The likely amount of in-migration to the Town of Hay River and associated social impacts;
3. The social impacts of the PPPP on aboriginal communities in the South Slave;
4. The contribution of the PPPP to “boom-bust” economic fluctuations in the South Slave; and
5. Impacts on the traditional economy of aboriginal people.

This section examines evidence and provides the Review Board’s conclusions for each of these issues. Consideration of cumulative effects on the traditional economy is included in Section 10.

8.3 Access of South Slave Communities to Beneficial Impacts

8.3.1 Evidence on the Public Record

The big issues raised in relation to access to beneficial impacts (jobs, wages, economic spinoffs, business opportunities) from the PPPP were:

- The small available labour and business pool in the South Slave region
- Barriers to South Slave residents (especially those outside the Town of Hay River, and especially among aboriginal people) accessing PPPP employment and business opportunities

- The adequacy of training programs to provide skills training (especially apprenticeships and transferable certifications) to residents of the South Slave

The developer estimates the PPPP will provide a variety of beneficial economic impacts. The development is estimated to cost about \$100 million to build and about \$30 million to operate over its 2-3 year lifespan. The developer estimates there will be about 65 people employed during the construction phase, and about 131 people working full time at the mine during operations.

Tamerlane estimated the PPPP would provide relatively short-term direct and indirect employment, training, apprenticeships and business opportunities “consistent with the scale and duration of the relatively short-term initial project” (*Developer’s Assessment Report*, p340). In the *Developer’s Assessment Report* (Appendix AA) the developer estimated the PPPP will:

- Lead to a rise of \$89 million in NWT Gross Domestic Product (62% vs. 38% for the rest of Canada) and contribute \$35 million in tax revenues over 3 years²³
- Create a total of 1021 person years total work through direct, indirect and induced effects
- Provide 197 person years of employment for South Slave residents, and 281 person years for the NWT in total
- Lead to a 2.5% increase in employment rate in the South Slave for two years

To understand the ability of the South Slave and individual communities to take advantage of these opportunities requires an understanding of the existing socio-economic environment. The developer provided an overview in the *Developer’s Assessment Report*:

- Hay River and Fort Smith are larger, market-based communities with approximately a 50% higher per capita income than Fort Resolution. This gap has been shrinking in the past decade, however. Income data was not provided for the Hay River Reserve.
- Fort Resolution and the Hay River Reserve have significantly lower participation rates and employment rates than Hay River or Fort Smith.
- Unemployment rates in Fort Resolution are twice as high as either Fort Smith or Hay River, while on the Hay River Reserve they are triple those of the market-based communities.

The developer noted there is very limited excess labour and business capacity in the north in general. The *Developer’s Assessment Report* notes the NWT in total has only about 1300 unemployed people; only about 400 of them in the South Slave. The *Developer’s Assessment Report* estimated the number of estimated available workers in each community as 42 in Fort Resolution, 206 in Hay River, 38 on the Hay River Reserve. Even though unemployment rates on the Hay River Reserve and Fort Resolution are highest, these two small communities only account for just over 1/5th of total available labour pool in the South Slave.

²³ In their hearing presentation, the Fort Resolution Metis Council estimated project costs of \$130 million, gross revenue of \$530 million and net profit of approximately \$53 million for the PPPP, presumably cited from the developer’s feasibility study (Barnard and Sandefur: 2007), which provides similar estimates.

In the *Developer's Assessment Report*, Tamerlane anticipated a “considerable proportion” of the workforce would be residents of the South Slave region. Its actual economic analysis somewhat dampened this anticipation. While noting in the *Developer's Assessment Report* that previous mining projects (the diamond mines) established employment targets for northerners of about 40% for initial construction and 60% for operations, the developer found these commitments unrealistic for the PPPP. It was pointed out that the available labour force is now smaller (many people are already working at mines) and remaining people tend to have minimal training or lower education levels. The *Developer's Assessment Report* (p381) states “it needs to be emphasized that particularly for the more skilled positions to be offered by the PPPP, completion of Grade 12 will typically be a minimum requirement”. The developer estimates that about 80-85% of the available positions for this high technology operation are considered “skilled; this is a major hurdle to engaging people from the smaller communities, which have lower high school graduation rates.

The *Developer's Assessment Report* (p351) therefore predicted a very small available local labour pool with the requisite skills for this type of development, and that only about 19% of direct employees for construction phase will be northerners. However, it did predict that “based on expected results of the employment strategy (involvement in training programs, etc.) proposed by Tamerlane, the direct employment for operations is expected to rise to 47%. Over the life of the PPPP, 37% of workers expected from the NWT”. These numbers may yet prove optimistic. Mayor John Pollard of the Town of Hay River stated at the hearing, “*I hope they haven't overestimated how many people they're going to get out of this region, because you know, there's a lot of people working now*” (Hearing Transcript, p134).

There are a couple of factors that create potential barriers to maximizing employment of South Slave residents at the PPPP. One factor is the lack of a large excess labour pool to choose from. This is a consequence of a strong economy, and the developer can do little except make the development attractive to skilled workers already working elsewhere. The PPPP does provide some incentives in this regard, including paying for daily commuting from Fort Resolution and Hay River rather than a camp rotation, and a work schedule that sees approximately 15 days off a month for workers.

A second factor is the lack of available workers with both the skills and the high school completion required by most of the available jobs at the PPPP. Many if not most of the South Slave residents in the “excess labour pool” may not have these minimum requirements. The developer has committed in several ways to overcome this barrier, with a focus on aboriginal people (C68-C69, C73-C76):

- Consideration of experience as equivalent to education on a case-by-case basis
- Working with the Mines Training Society to develop and run some training programs to “skill up” South Slave aboriginal people, in particular (see below)
- Requiring that contractors adhere to the goal of maximizing Northern and aboriginal workers, and directly recruit from South Slave communities and hire trainees

The developer stated that training will include site-based on-the-job training and the support of a number of apprenticeships. Most notably, Tamerlane committed to working with the NWT Mines Training Society to begin an underground mine training program that will include people from the

communities of Fort Resolution and Hay River. Tamerlane committed to sponsor 24 people (six from each area aboriginal group) and hire them upon completion of this program.

At the public hearing, the GNWT identified concerns that the developer's training programs need to focus specifically on certification and apprenticeships - "*To guarantee longer-term benefit from this project, the project will have to create opportunity for Northerners aimed at enhancing skill capacities and developing transferable skills*" (Hearing Transcript, p268). The GNWT recommended that Tamerlane's commitment to training and support for apprenticeships (the developer did not identify how many) be organized and implemented so that employees completing the training will be able to use the skills acquired and time spent as credit toward certification or status recognized in the NWT under the *Apprenticeship, Trade and Occupations Certification Act*. The GNWT's obvious interest is to see this development create transferable skills so that previously unskilled labour can engage in future developments.

The people of Fort Resolution raised concerns about who "wins" and who "loses" *within* the South Slave as well, noting their concern that Hay River receives the bulk of benefits from developments like the PPPP. The developer recognized these concerns. While noting that logistically Hay River makes sense because it is closer to the PPPP and is the region's major centre, the developer at the hearing restated commitments to provide as many job opportunities for Fort Resolution as possible.

The developer also identified commitments to giving aboriginal and other South Slave businesses a reasonable advantage (C77-C79) over southern competitors and identified a number of specific projects (e.g., heavy equipment tasks, infrastructure) local businesses may have the capacity to be take on. Within a certain reasonable percentage, local northern contractors would be preferred.

8.3.2 Review Board Analysis and Conclusions

The Review Board finds that the development as proposed will have a short-term but strong beneficial effect on regional employment, income and business activity. While the development is regionally significant in scale (it is likely to be the largest capital investment project in the South Slave in 2008-9), the Review Board notes the PPPP's short 2-3 year life span in finding it is unlikely to have long-term effects on employment and business opportunities to any South Slave community. The Review Board agrees with the developer that many of the beneficial economic impacts, especially during construction but also during operations, will accrue to southern provinces, due to the NWT's small economy, underdeveloped industrial base, and limited available skilled labour force. The Review Board notes these factors are beyond the developer's control.

The Review Board finds that the developer's estimate that 37% of the workers at the PPPPP will be South Slave residents is likely optimistic. The PPPP is not alone in its likely difficulty recruiting northern and aboriginal workers. For example, the Snap Lake diamond mine reported that in 2006 it was only able to employ 27% northern workers as construction moved toward operations (Hay River Hub: January 17, 2007). The *Developer's Assessment Report* (Appendix AA) notes that less than 25 people from the South Slave are employed at Snap Lake, a much larger development. The reality is that many of the required skilled trades in high demand for mining development are currently unavailable in the NWT. The Review Board agrees most PPPP workers will have to come from outside the region. PPPP employment possibilities for South Slave residents are limited by:

- The region's small labour market to start with and current low unemployment rates, especially among skilled workers
- The high skills and education requirements demanded by 80-85% of the direct jobs required at the PPPP is not a good fit with the South Slave's currently available labour pool
- The potential lack of interest of South Slave skilled workers currently working at other operations to move to a short-term development

The Review Board notes there are significant barriers to aboriginal people taking advantage of this type of development. Those include low access to education and training, low graduation rates, and less mining experience, among other factors. The PPPP's short life span also means that it will be difficult for people with minimal training in the skills required for underground mining and minerals processing from the South Slave to "train up" in time to take advantage of employment or business opportunities from this development.

In the face of these challenges, the developer has shown a willingness to provide employment, business opportunities and training to anyone from the South Slave that can take advantage. A variety of strategies are enumerated by the developer to try and let northern, especially South Slave and aboriginal, businesses get contracts. The South Slave is clearly the area the developer would prefer to source labour and business from.

Within the South Slave, it is likely that the Town of Hay River, and to a lesser degree the Hay River Reserve, will benefit more from increased economic activity associated with the PPPP. Both communities are closer than Fort Resolution to the PPPP, and have a combined 6:1 advantage in available labour. Hay River's status as the largest community and economic and service centre means that business opportunities preferentially flow there. Despite these obvious advantages, the developer has committed to engaging Fort Resolution as much as possible.

The Review Board finds overall that the developer's commitments to maximizing inter- and intra-regional employment and business opportunities are adequate. Therefore, impact equity (who "wins" and who "loses" from the PPPP) is not in the Board's view likely to constitute a significant adverse impact or to generate significant public concern.

The Review Board finds that the developer's proposed training programs are numerically appropriate for a project of this size and timeline. However, the Review Board shares the GNWT's concern the developer has not provided a great deal of information on the number of apprenticeships it will be offering or how the training will result in transferable certifications for workers.

The Review Board recognizes that many of the reasons behind lack of aboriginal engagement in mining are beyond the responsibility of the developer, and beyond the immediate capacity of the communities and the GNWT to mitigate. However, the Review Board also notes the problem of a regional "unskilled labour pool" that cannot access job opportunities will remain for future developments if actions to deal with underlying problems are not implemented. This requires:

- Maximizing training opportunities for even short-term developments like the PPPP

- The developer focusing on, and the GNWT keeping track of, the levels of transferable certifications and apprenticeships actually achieved by trainees
- Identifying what potential barriers remain at the regional and local levels, especially among aboriginal people, to recruitment and retention at mines

If the Pine Point area is to become a viable mining location for a decade or more hence, a regional strategy for maximizing business and employment is required as soon as possible.

8.4 In-migration Impacts

8.4.1 Evidence on the Public Record

Because the need for skilled workers at the PPPP cannot likely be filled by South Slave residents at this time, the *Developer's Assessment Report* estimated that the PPPP will require in-migration, from southern provinces in particular. The *Developer's Assessment Report's* estimates of 19% direct local labour during construction equates to over 50 of the 65 direct workers during construction being from outside the South Slave. In addition, approximately 70 of 131 direct workers during operations will likely be from outside the South Slave, again according to the developer's own estimates. The developer predicted the PPPP will lead to a population rise of 219 workers and family members over two years, but that all in-migrants will leave after the project is over.

The developer estimated this in-migration will have only beneficial impacts on the Town of Hay River, where the developer predicts virtually in-migrants will likely choose to live because of its proximity to the mine site and its higher service levels. The *Developer's Assessment Report* (p373) predicts no workers are likely to move to Fort Resolution or the Hay River Reserve, so "there should be no new significant incremental population growth or pressure on infrastructure capacity in these two communities". The PPPP would cause population growth of about 5% in the Town of Hay River over two years. Despite this, the developer predicted that in-migration, along with increased overall economic activity associated with the PPPP, will not have any adverse impact on community infrastructure or social service demands, nor will it have a measurable impact on inflation.

Despite initially stating concerns about potential pressures on existing services (88), the Town of Hay River provided strong support for the PPPP in later submissions and expressed no concerns about any social issues or service demand concerns related to in-migration. The *Developer's Assessment Report* (p369) also noted that "communications between Tamerlane and the Town of Hay River... indicate that sufficient housing exists to accommodate southern employees and contractors", and argues that sufficient excess rental and other short-term accommodation will be available in Hay River to cover the 112 or so required residences.

Results from traditional knowledge surveys did find six of 12 Hay River Métis Council members interviewed had concerns that more money and outside influence may result in more drugs, alcohol and crime in the Town of Hay River. Some members of the Hay River Métis Council also identified concerns about population growth-related effects on cost of living and access to services.

8.4.2 Review Board Analysis and Conclusions

The Review Board noted concerns about adverse social and economic impacts of in-migration and population increase in general were minimal during this environmental assessment. No other party raised the issue as a concern except the Town of Hay River, which later showed steadfast support for the PPPP, based largely on a desire to take advantage of the beneficial socio-economic effects. The GNWT did not raise concerns about increasing demand on services as a result of in-migration.

The Review Board notes that in-migration effects in the Town of Hay River are expected to be substantial over two years, approximately 5% growth over the community's current population of approximately 4000. No other large developments are expected to impact on the population of the Town of Hay River over that time. The Town of Hay River has stated there is enough housing available to accommodate all of the expected in-migrants. The Review Board finds the developer's predictions that in-migration will not cause adverse impacts accurate, whether on housing (availability or cost), cost of living, access to services, or other social impacts. The short life span of the PPPP is a major factor in this finding.

The Review Board notes that any increases in adverse social impacts can be tracked over the life of the PPPP by the existing social service authorities in Hay River and utilized in any future environmental impact assessment to help assess the accuracy of the developer's predictions of negligible adverse impacts and potential need for future mitigation.

8.5 Social Impacts on Aboriginal Communities

8.5.1 Evidence on the Public Record

While in-migration was the major issue of interest in terms of socio-economic impacts on the Town of Hay River, aboriginal groups in Fort Resolution and on the Hay River Reserve focused more on potential social impacts. Some traditional knowledge study participants gave the impression they do not want to see a "repeat" of the impacts of the Pine Point Mine in terms of drugs, alcohol and negative outside influences on the community's young people. Additional potential adverse impacts noted by aboriginal group members included increases in housing costs and general cost of living, and concern that family well-being may be impacted.

The developer predicted in the *Developer's Assessment Report* that no adverse impacts of high magnitude were likely to occur as a result of the PPPP, based on the following:

1. The relatively small size and short term nature of the project
2. The majority of impacts are beneficial, including employment, training, and business opportunities, and likely to provide overall beneficial impacts on South Slave society as well
3. Government social services agencies, the developer's Human Resources Management Plan, and aboriginal communities together can be used to manage any adverse impacts that do occur
4. The smaller communities more vulnerable to change were estimated to not see any in-migration that could cause adverse social impacts.

The developer has made some specific commitments that may assist in the reduction of social impacts, especially in Fort Resolution. These commitments relate to commuting:

- A commitment not to use a camp facility at any time during the PPPP (C67), thereby allowing workers to be home at the end of every shift
- Daily bused transport for each shift from Fort Resolution and Hay River, which reduces individual commuting and may reduce worker fatigue (C87)
- A shift schedule which has flexibility so that each worker has about 15-16 scheduled days a month, leaving plenty of time to engage with families and in traditional activities

Residents of Fort Resolution, in particular, did not feel the developer provided enough detail on how it would reduce social impacts in the communities. The Fort Resolution Métis Council stated in their analysis of the *Developer's Assessment Report* (146) that “we feel that there has not been anything done to address socio-economic issues”. The Fort Resolution Métis Council also expressed concerns that the *Developer's Assessment Report's* social impact mitigation relied too heavily on territorial and local government authorities' capacities, given these services are already under extreme pressure. The Fort Resolution Métis Council and Deninu K'ue First Nation reiterated their concerns about potential impacts on the human environment in their public hearing submissions, as did the Deninoo Community Council. Concerns included losses of harvesting area and income, loss of language, and increase of drugs and alcohol in communities with no increase in wellness and addiction programs to combat them.

A specific social impact that also relates to the “access to jobs” issue is the lack of day care spaces available in the community of Fort Resolution. Local aboriginal groups argued this was another hurdle to community members engaging with the PPPP, as well as a social problem for those families that do choose to have parents work at the mine. At the hearing, the Deninu K'ue First Nation re-iterated its concerns that the increased workforce does not meet increased requirements for child care services in Fort Resolution and asked what government and Tamerlane planned to do to fill this gap. The GNWT's response noted Fort Resolution currently has one licensed program for part time nursery school childcare. The GNWT is looking to expand that to a full-time facility (243). The GNWT did not estimate the adequacy of current programs in light of potential increased employment opportunities from the PPPP. However, the GNWT did note Tamerlane's statements from the *Developer's Assessment Report* that child care-related concerns for specific employees can be addressed with company support. Tamerlane did not identify the exact nature of that support.

The public hearing from Fort Resolution gave the Review Board the impression the community felt a “huge impact” would ensue economically from the PPPP, and that the community needed help to prepare for the adverse social outcomes that can come alongside economic growth in small communities. At the hearing, the Fort Resolution Métis Council opposed the PPPP, recommending the developer do a socio-economic impact study done with the community of Fort Resolution.

8.5.2 Review Board Analysis and Conclusions

Social impact concerns were stated most prominently during the environmental assessment by residents of Fort Resolution. Many of these concerns were linked to historical experiences from mining at the Pine Point Mine. While the people of Fort Resolution are optimistic about the prospects of employment and income from the PPPP, they are in equal measure concerned about the

future of their community and what impacts more jobs, more traffic, more money and more time away from home can have on their well-being and way of life.

The Review Board recognizes and considered these concerns. However, the Review Board finds statements about “huge” impacts on Fort Resolution from this development are not realistic given:

- The number of workers recruited from Fort Resolution is likely to be minimal - according to the developer’s own estimates and comparison of the skill requirements of the PPPP versus the regional labour pool
- The fact that very few or no outsiders will be moving to Fort Resolution as a result of this development - because of Fort Resolution’s distance from the mine site and lack of services compared to Hay River.

Consider the developer’s estimates of the number of local people likely to be employed. The developer has estimated that on average, 37% of PPPP workers are likely to be South Slave residents. Given Fort Resolution’s proportion of the available regional labour pool (only about 1/7th, and this does not count Fort Smith), only at most 20% will come from Fort Resolution. If that is the case, only about 10 of the estimated 131 mine employees will be from Fort Resolution. Even if the developer’s training programs are effective and these already optimistic numbers double or more over the project’s life, the adverse social impact outcomes the people of Fort Resolution raised are not likely to be locally significant even with an optimistic 20 people employed directly by the PPPP, even during its short life span.

The Review Board also finds that the daily commute option the developer has chosen is a better alternative from a social perspective than the camp option. A daily commute may help minimize the social impacts on families and communities sometimes caused by camp operations, where parents and spouses are separated for long time periods. The developer’s commitment to busing Fort Resolution employees is also noted as a positive element of the mine plan from a public safety and economic perspective, because it will cut down on individuals choosing to drive to work.

The Review Board finds the PPPP by itself is unlikely to cause significant adverse social impacts on any of the aboriginal communities of the South Slave. In coming to this determination, the Review Board also noted the level of support received from most aboriginal communities, despite their residual concerns. The only aboriginal organization to oppose the PPPP at this time is the Fort Resolution Metis Council, which called for additional socio-economic impact study to be conducted. While the Review Board concludes that additional study should occur during the life of the PPPP (and provides a suggestion to that effect in Section 8.8.2), the Review Board finds that further impact assessment studies prior to the development are not required.

However, in terms of the developer’s specific mitigation for social impacts, the Review Board notes the lack of detail the developer provided other than the use of blanket statements. The Review Board also notes the reliance of the developer on two items in assessing social impacts:

1. *Results from quantitative studies of NWT diamond mines as a proxy for assessing changes that might occur as a result of mining at the PPPP.* The Review Board finds that these studies (the

Communities and Diamonds reports published annually by the GNWT²⁴) are useful to a degree, but that it would be better in the future to provide details about social impacts from this test mine, specifically, including qualitative case study material, rather than rely on these largely quantitative reports of a very different type of mining (fly-in, fly-out camp operations).

2. *Reliance on territorial and local government services to manage any unforeseen social impacts.* The Review Board agrees with communities that these services are already stretched pretty tight. Child care access in Fort Resolution is one example. In fact, it would be useful for the GNWT to provide, prior to any further expansion of mining in the South Slave region, an assessment of how this short-term development actually impacts upon local services.

See Section 8.8.2 for the Review Board's suggestion to deal with these outstanding concerns.

8.6 Sustainable Development: Avoiding "Boom-Bust" Impacts

8.6.1 Evidence on the Public Record

Another socio-economic impact concern parties expressed was PPPP's contribution to regional sustainable development. Much of this concern was linked to the short lifespan of the proposed development, as well as the abruptness with which Pine Point Mine was closed. The major economic setback this caused also led to social impacts. The Review Board expressed concerns about whether the PPPP could contribute to such a bust in its *Terms of Reference*, which asked in several places for the developer to consider the scenario where the mine is closed without further activity in 2-3 years. Concerns were especially focused on worker transition.

The developer did not feel boom and bust patterns would be generated by the PPPP. It argued that the PPPP is large enough to be a beneficial economic force in the South Slave, but small enough that closure will not cause severe economic damage to the region like that which occurred when the Pine Point Mine closed. The developer predicted the PPPP will contribute to a sustainable economy through training initiatives and work experience and will help diversify the South Slave economy. At the same time, the developer cautioned that this "pilot project" itself is short-lived and may end all activities within three years. The developer also felt the project is small enough it will not have the type of regional economic impact the Pine Point Mine closure had.

The *Developer's Assessment Report* treated concerns over boom and bust patterns in a generic way. No lessons learned from prior short-term, relatively high employing developments were discussed. In its response to IR39, the developer found no literature related to short-lived, relatively high employing developments such as the PPPP. It did note a lesson learned from analysis of boom and bust cycles in other Canadian jurisdictions is that continuous dialogue between communities, government, and developers in advance of closure is a key to effective transitions.

Overall, the developer stated it could not commit to long-term employee transition initiatives and support for a short-term project. However, the developer did state its goal is to prove the economic feasibility of underground freezeway mining of lead-zinc deposits in this region through the PPPP,

²⁴ For copies of these and other community wellness reports compiled by the GNWT, go to www.iti.gov.nt.ca/industrial_benefit/reports.htm.

and to continue to mine in the region in the near future if this is successful. This would extend the benefits and expand the training initiatives of the developer into the future.

The only submissions from other parties related to the avoidance of boom-bust cycles and sustainable development was the previously mentioned GNWT concern, raised in IR44 and again at the hearing, that the PPPP needs to provide transferable training certifications and apprenticeships, in case the current mine does not lead to future mines. The degree to which the developer's training initiatives will be transferable to other jobs was not answered by the closure of the public record.

8.6.2 Review Board Analysis and Conclusions

The Review Board notes the following about potential boom-bust impacts from the PPPP:

- The PPPP will be regionally economically important, but is unlikely to have a large impact on regional employment levels in the South Slave
- The likely inability of the PPPP to attract labour from the South Slave is a sign the economy is strong and this development will not cause a significant impact even if it abruptly closes
- There are other reasonably foreseeable future developments that may absorb excess regional labour if the PPPP closes after 2-3 years (e.g., the Mackenzie Gas Project, the Taltson Hydroelectric Expansion, De Beers' Gahcho Kue diamond mine)
- The developer has shown there is a high likelihood of future mine expansion after the PPPP, which would negate the "bust" element of boom-bust impacts in the short term
- The developer has been up front with communities about the possibility this development may not lead to future mining, and has not purposely caused overheated expectations of employment and business opportunities, which should assist in preparing communities for closure in advance

Initial efforts in the *Developer's Assessment Report* to show how the PPPP might contribute to either sustainable development or the creation of boom-bust effects were hampered by a lack of detail. No NWT context or case studies, or even a definition of sustainable development, was offered. However, the Review Board finds that the treatment of sustainable development by the developer during subsequent portions of this environmental assessment is adequate for a project of this size and duration. One exception is the developer did not provide enough detail to show whether the training it is providing will lead to transferable certification of employees, a key requirement of any short-term development's contribution to sustainability. The Review Board finds the success of training programs need to be tracked and provides a suggestion in Section 8.8.2.

The developer's assertion that case studies of short-term, relatively high employing developments' contributions to sustainable development (and its converse, a boom and bust cycle) is unavailable leads the Review Board to two observations:

1. The accuracy of the developer's assertion that no information on this type of economic cycle from short-term resource development is questionable. Further literature review would be useful to identify relevant case studies prior to future environmental impact assessment
2. If these studies are not available, the PPPP is a good opportunity to fill this important knowledge gap - to study closer how sustainable development can be contributed to, and boom and bust cycles avoided, by short-term natural resource development projects

The Review Board finds no significant adverse impacts are likely to occur as a result of a boom-bust economic cycle associated with the PPPP, either at the South Slave regional level or in any of the local communities. However, the Review Board suggests the GNWT, the developer and the potentially-affected communities should work together during the life of the PPPP to study its actual contribution to sustainable development (see Suggestion 8). The Review Board also notes that additional expectations of “boom”-side impacts may be necessary in any future environmental impact assessment if future Pine Point mine expansions propose larger facilities requiring more employees or other large developments are likely to proceed at the same time in the region, or both.

8.7 Impacts on the Traditional Economy

8.7.1 Evidence on the Public Record

Aboriginal communities raised a variety of concerns about impacts on the traditional economy in relation to the PPPP. These included:

- The ability for people formerly dependent on trapping to transition into other livelihoods
- Cultural loss associated with declining practice of the traditional economy
- Access to land, land degradation because of industrial activity, and lower harvesting success
- Direct losses from damage done to the land or trapping equipment by the developer

Members of all four aboriginal groups reported using the area for traditional harvesting. During scoping, four trappers from the Deninu K’ue First Nation were identified as using the area near R-190 (42). Estimates of the total number of area land users were not identified by the other aboriginal groups. Traditional knowledge studies identified concerns that physical access to the project area may be restricted, impacting traditional harvesting. Aboriginal groups also raised the possibility of contaminated waters and vegetation affecting the health of key animal species, and concerns that contaminants may be bio-accumulating among harvesters and other consumers of country food.

The developer felt that the PPPP’s small physical footprint, its minimal sensory disturbance zone (estimated at only about a 1km radius), and the previously disturbed nature of the R-190 location all minimize its potential to impact on either wildlife prevalence or traditional harvesting. The developer predicted the greatest threat to animal populations is likely from increased hunting, and noted the PPPP provides no new access. In the *Developer’s Assessment Report* (p409), Tamerlane stated “the relatively small size and short-term nature of the PPPP and the mitigation measures to be employed will not have any measurable effect on overall harvesting success, the quality of harvested materials or use of the general area for potential leisure activities”. The *Developer’s Assessment Report* also notes the draft *Dehcho Land Use Plan* designated the Local Study Area and the area at least 3km around it as Special Management Zones where mining would be permitted.

The developer agreed that some direct damage to trap lines has occurred as a result of Tamerlane’s activities in the past. Evidence was submitted that the developer has compensated some area trappers in the past, and has committed to working with aboriginal leadership in the future on these issues. When asked directly at the public hearing what it wanted the Review Board to do about

concerns over traditional harvesting impacts and requests for compensation, Deninu K'ue First Nation representative Rosy Bjornson stated (Hearing Transcript, p123): "*As for respected compensation, we just want it known for the public registry that that is our intent to support our land users and our membership, with respect to their traditional land use and loss of livelihood*".

No request was made by any party for the Review Board to make a determination on this issue.

8.7.2 Review Board Analysis and Conclusions

Potential losses of traditional harvesting livelihoods were a concern raised largely by the people of Fort Resolution. The Review Board notes that many of these concerns link back to land degradation and loss of access for traditional harvesters caused by the much larger Pine Point Mine between 1964-1987, and cumulative effects on the lands and waters that have remained in the interim (See Section 10). Aboriginal groups consider the R-190 site a part of a larger healing land, where in many places animals are only just now regaining their pre-Pine Point Mine numbers.

Traditional harvesters clearly use the Pine Point region west of the Buffalo River, although the extent to which the relatively small and previously disturbed area that PPPP will impact is used for harvesting was not clearly established during this environmental assessment. No maps of traditional land use were provided. . The Review Board also notes that wildlife prevalence in the immediate R-190 area was subject to differing interpretations by community members in both traditional knowledge studies and at the public hearing. Some stated key harvesting species were relatively abundant; others estimated them relatively rare.

No party asked the Review Board to provide a measure on harvester compensation of any type during the environmental assessment. Given the small number of harvesters likely using the relatively small impacted area, the Review Board finds that bilateral negotiations between the individual and the developer are likely adequate to deal with harvester compensation issues. The Review Board notes this finding relies on the developer living up to its commitment to "actively work with communities' chiefs and councils to ensure that traditional land users who currently frequent the proposed project area will be accommodated during the life of the PPPP" (C81).

The Review Board finds that the PPPP does not have a large enough footprint (such as noise, ground disturbance, water, air, soil or vegetation contamination or any other sensory disturbance) to impact even short-term harvesting in a significant fashion.

8.8 Overall Analysis and Conclusions on the Human Environment

8.8.1 General Socio-economic Considerations and Findings

The Review Board would characterize the developer's efforts to economically engage South Slave communities as adequate or better. The prospect of economic benefit has generated a fair amount of support from some communities. The Town of Hay River has been particularly supportive, at one point stating "frankly, we need the economy" (88). The developer has made efforts to consult with and engage all of the aboriginal communities. Exploration agreements have been tabled with all four local aboriginal groups, three of which were parties to this environmental assessment. Only the Fort

Resolution Métis Council had not signed an exploration agreement with the developer by the close of the public record. The Katlodeeche First Nation, Hay River Métis Council, and the Town of Hay River all put their support for the development in writing, while the Deninu K'ue First Nation gave a cautious show of support for this type of “responsible development”, and signed an Exploration Agreement with the developer.

The Review Board considers the PPPP a relatively large development, and a regionally economically important one, over its short life span. The Review Board finds the PPPP will largely have beneficial socio-economic effects in the short term on all the communities of the South Slave. These beneficial impacts will likely outweigh any adverse social impacts the communities are concerned about in this instance. While the Review Board has some concerns about the mitigation proposed by the developer if adverse social impacts do occur (given their lack of detail and over-reliance on existing social services agencies and communities to handle additional impact loading), these concerns are outweighed by the evidence pointing out the low likelihood of any adverse social impacts occurring at a large scale.

The Town of Hay River and the Hay River Reserve will likely accrue the most benefits, because of transportation routing, proximity to the development site, the attractiveness for in-migrants (which, according to the developer, will make up the bulk of the workforce), and the current business and skilled labour capacity of Hay River. Nonetheless, the developer has provided credible evidence it will make strong efforts to engage the people of Fort Resolution too. The Review Board finds there is no real “impact equity” concern related to this development, because no group in the South Slave is likely to economically or socially “lose” as a result of the PPPP.

8.8.2 The Need for Socio-economic Monitoring

The Review Board finds the PPPP is not likely to have significant adverse impacts on the human environment of the South Slave. It has done so based on the length of time the PPPP will be in place and the small local workforce, combined with the fact most of the impacts will be beneficial.

However, the Review Board also noted that the concerns of the aboriginal people of the South Slave have not been fully addressed by the socio-economic impact assessment for this development. The people of Fort Resolution, in particular, expressed ongoing public concern about this type of development. They have been adversely impacted by the previous Pine Point Mine without, in their opinion, a great deal of benefit to show for it. They also expressed concerns that what benefits they did have were lost, seemingly overnight, when the mine closed down. They want to avoid that situation occurring again. This community has consistently raised its concerns about maintaining its largely aboriginal cultures while still taking advantage of industrial development opportunities.

The Review Board finds these are reasonable concerns. The developer has not been able to show any lessons learned from previous similar short-term developments. The education levels, distance from the job site and training programs, and lack of support services in Fort Resolution lead the Review Board to find that the people of Fort Resolution in particular, without a dedicated effort by the developer and responsible government authorities, will not be able to take full advantage of either the PPPP or likely future mine expansions. With the exception of their closer proximity to the mine, aboriginal people of the Hay River area face similar barriers.

Social impacts also merit more examination during the development. The developer did provide some blanket assurances that Tamerlane's corporate policy, family member support and community social networks will deal with social issues, especially for vulnerable populations. In the Review Board's opinion this is not sufficient mitigation, because few plan details were brought forward or suitable case studies compared against the PPPP. In addition, communities provided the impression they were concerned about potential social impacts, and they did not feel that current social services were adequate at present, let alone to handle any increasing social impacts.

Good socio-economic impact assessment needs to consider the ability of families and communities to maintain resiliency in the face of change. The developer did not closely consider the stress load from this type of work environment and change in families, as well as the ability for this stress to be distributed and dealt with by individuals, families and social support networks. The time is now to do some deeper analysis of this resiliency, in advance of any larger developments with longer-term consequences.

A recurring theme throughout the environmental assessment was that this development is a test mine or pilot project. The Review Board also believes it is also an opportune test to see how such a development can balance society, economy and the environment in the South Slave to maximum benefit. The PPPP provides an ideal testing ground for more effective analysis of communities facing change. This development offers an opportunity to monitor the effects of a short-term operation that is likely to be similar in scope to future operations occurring over a longer time scale; a unique opportunity to identify issues that may occur on a more expansive scale in the future, and set up adaptive management programs and protocols in advance. The Review Board also notes that the developer states that "assuming success of the initial PPPP and longer-term, larger-scale development in the future, Tamerlane's ongoing commitments and programs will be expanded as appropriate" (*Developer's Assessment Report*, p386). If that is the case, the success of its human resource management and social impact management programs, not just the mine, merit testing.

The Review Board suggests additional monitoring work focusing on the aboriginal communities of Fort Resolution and the Hay River Reserve be conducted, for the following reasons:

1. Public concerns, and the lack of incorporation of these concerns into the PPPP development plan
2. The lack of case studies on relevant issues like boom-bust impacts of short-term, regionally large-scale developments, daily long-distance commuting effects, aboriginal training, recruitment and retention at mining developments, and the transition of traditional harvesters into other occupations
3. The likelihood of larger, longer lasting future developments after the PPPP by the same developer with the same potentially affected communities
4. Evidence that current GNWT studies on socio-economic impacts from mining tend to be quantitatively focused. There is room for qualitative additions to assess not only what is happening to aboriginal communities affected by mining, but why.

The Review Board's opinion is that additional research studies should be set up by the GNWT, which is responsible for the health and well-being of the people of the NWT. In addition, the developer, the communities of Fort Resolution and the Hay River Reserve should contribute to these studies. The focus should be on determining both hurdles to aboriginal people engaging in mining

(using the PPPP as an example) and what social impacts (beneficial and adverse) are occurring on families in these communities through engagement in the mining economy.

The exact nature of these studies should be determined cooperatively by parties involved. However, appropriate themes based on issues identified during this environmental assessment include:

- The success of the Tamerlane-sponsored, Mines Training Society-run underground mining training program, especially its ability to generate transferable certifications and apprenticeships
- Self-reported socio-economic impacts of mine work on aboriginal workers and their families
- Access to business opportunities for aboriginal businesses
- The effectiveness of existing social services programs in the face of change
- Access to livelihood transition services for traditional harvesters

The Review Board is also aware that aboriginal groups have perceived some previous efforts to assess the human environment by governments and developers as ineffective. Concerns are often linked to inappropriate methods and indicators and a lack of community involvement from the outset. In addition to using standard quantitative techniques to generate information, the use of more qualitative studies is encouraged to put context behind the data. This might include case studies of individual families engaged in work at the PPPP, open-ended aboriginal community member surveys, and annual surveys and exit interviews for all mine workers to assess their perspectives on social and economic change.

The Government of the Northwest Territories should incorporate the findings into appropriate strategies so that South Slave communities can take full advantage of any future mining development in the region. Results of this research should be reported back to communities and the developer and included in future socio-economic impact assessment.

Suggestion #8:

The Government of the Northwest Territories, with the developer and affected communities, should use the opportunity created by this test mine to study the following:

1. **The existence and relative effectiveness of transition programs and success of transition for displaced traditional harvesters, as well as consideration of what additional programs may be necessary to assist displaced harvesters;**
2. **The existence and relative effectiveness of “boom and bust” transition programs for mining-dependent communities;**
3. **More effective, timely and attractive “job ready” training programs to bolster the number of aboriginal people ready to engage in the mining economy;**
4. **Barriers to engagement/recruitment of people from the South Slave to the PPPP; and**
5. **Pressures on families and individuals that lead to employee retention issues and social impacts in the home community of miners.**

9 Other Issues Requiring Special Consideration

9.1 Introduction

The Review Board appreciated the developer's willingness during the environmental assessment to identify ways the development proposal could be improved through changes to the development components, proactive mitigation and the acceptance of the recommendations of other parties to the environmental assessment. For example, the developer committed, largely during the latter part of the environmental assessment, to a wide variety of mitigation and monitoring measures, as well as detailed contingency plans, related to the issues listed below. All of these commitments are reported in Appendix B, and were confirmed by the developer in IR55. The Review Board finds that the identified commitments are adequate, providing they are implemented, for dealing with the following issues that came up during the course of the environmental assessment:

- Wildlife monitoring and management strategies, especially for *SARA*-listed species (see below)
- Hazardous material management and contingency planning (C20-C35)
- Closure and reclamation planning (C44-C56)
- Public and workplace safety, particularly concerns with increased truck traffic and road maintenance costs, especially along Territorial Highway 5 (see below)²⁵
- Waste management (C93-C95)
- Heritage resources (C81-C82)

9.2 Wildlife

Concerns about impacts of the PPPP on wildlife were expressed by aboriginal parties and responsible government authorities during the course of this environmental assessment. In particular, species at risk were of the highest concern, although impacts on moose and fur-bearing mammals were also important. Section 79(2) of the federal *Species At Risk Act* states that organizations responsible for environmental assessment of a development must identify any adverse effects on *SARA*-listed species or their critical habitat. If likely impacts are identified, that organization must, regardless of the significance of the impacts, ensure that measures are taken to avoid or lessen those effects and to monitor them.

Environment Canada identified ten species at risk whose ranges overlap with the PPPP (listed in Section 3.2.1). Traditional knowledge indicated the presence of a variety of animal species in the Regional Study Area, and noted that traditional harvesting activities are conducted there. Aboriginal parties criticized the developer's short baseline data collection period for wildlife information, requesting all season information. The evidence on the public record indicates that previous development activities have likely contributed to impacts on animals over a relatively long period of time across the Regional Study Area. This includes reports of decline in large mammals from the

²⁵ The assessment of workplace health and safety adequacy is beyond the expertise of the Review Board. The commitments made by the developer related to workplace safety as listed in Appendix B (C57-C66) do not replace the developer's responsibility to live up the specific workplace safety requirements as enforced by the Worker's Compensation Board or other responsible authorities.

area, and traditional knowledge indicates similar declines in upland furbearers. Traditional knowledge holders also talked about there being some recovery of animals in the region after mining activities ceased; the area as a whole is considered to be a healing land.

In the *Developer's Assessment Report* (p298), the developer identified that the PPPP could cause impacts during all phases of the development, "through physical or behavioral disturbance, including displacement and habituation. Potential effects on wildlife may also result from the loss or degradation of habitat". Specific examples identified during the environmental assessment of possible impacts, all of which apply to the SARA-listed species along with other animals include:

- Attraction of predators to site infrastructure, habituation risks and associated increased predation and collisions
- Air emissions, odours, noise and dust generation
- Airborne collisions associated with new power lines
- Loss of habitat through increased industrial use of the R-190 area

The developer has committed to a slate of mitigation measures to minimize or avoid impacts on wildlife. The developer has agreed to comply with all but one of the recommendations provided by government authorities on wildlife management (see C123 -C140 for details). One important commitment made by the developer to minimize potential collisions between the endangered whooping crane, known to travel through the area, with the proposed power lines. Mitigation in this case consists of keeping the line along the haul road rather than crossing the open fen area, keeping the line below the tree line where possible, and marking the line when it is not. Environment Canada accepted this proposed mitigation as adequate to protect whooping crane.

The Review Board notes that this development is occurring largely in an area that has been previously disturbed. The developer has stated that 52% of PPPP buildings and the associated infrastructure footprint will be in previously disturbed areas. New disturbance to wildlife habitat in the project footprint area will be limited to about 4.3 hectares, according to the *Developer's Assessment Report*²⁶. The R-190 site is also within 500 metres of Highway 5, meaning existing noise issues may have already made this area less attractive to wildlife.

The GNWT recommended the developer stop work if woodland caribou are within 500 metres of the development area. However the developer did not commit to this. The Review Board accepts the developer's rationale that stopping the entire mining operation is not feasible for safety and economic reasons. The developer's commitments to not interact with woodland caribou and to report any sightings of to the GNWT will assist in mitigating impacts on woodland caribou.

The Review Board also notes that the R-190 location and the Regional Study Area in general are not generally considered areas of high woodland caribou concentration. This finding was partially

²⁶ The Review Board notes that the actual sensory disturbance footprint of the PPPP is likely to be much larger than either the "new disturbance" area identified by the developer or the total physical footprint of less than 8 hectares identified by the developer. That said, even if the sensory disturbance zone at R-190 extended to the entire Local Study Area (a 97 hectare area), this would still represent a relatively small sensory disturbance footprint in comparison with other types of development and even other mines.

supported by evidence the developer and traditional knowledge holders presented. At the public hearing, while community members identified woodland caribou do frequent the general Pine Point region, both their local (R-190) and regional concentration was not clearly defined. Some people felt that there were more woodland caribou in recent years. Others felt that the numbers were declining. Similar differences in predictions of woodland caribou prevalence in the area were identified in the studies conducted by the developer with local traditional knowledge holders (105).

Woodland caribou, as a species at risk and an important biophysical and socio-economic valued component, merit special consideration. Aboriginal parties shared particular concern for woodland caribou. The Fort Resolution Métis Council recommended that a woodland caribou study take place in the area prior to the finalization of the environmental assessment, and the Deninu K'ue First Nation asked whether other mitigation such as fencing could be used in place of a 500 meter buffer zone.

The Review Board finds no likely significant adverse impact on woodland caribou will occur as a result of the PPPP. The Local Study Area and Regional Study Area do not appear to be valuable or highly utilized habitat for this species. Given the importance and vulnerability of this species and the concerns and recommendations raised by the GNWT and aboriginal parties, the Review Board does encourage continued dialogue between the GNWT, the developer and other parties toward an acceptable compromise on woodland caribou mitigation at the PPPP. It may also be important for the GNWT and Environment Canada to determine what areas *are* critical habitat for boreal woodland caribou and other SARA-listed species. The GNWT has not presented any information defining critical habitat for woodland caribou in this environmental assessment. The Review Board understands from statements made by the GNWT at the public hearing that regional level woodland caribou studies are at the early stages, and encourages that those studies focus attention on the Pine Point area, a likely centre of future industrial development interest if the PPPP is successful.

The PPPP is located in a previously disturbed area that has not been shown to be high utility habitat for any species at risk. Indeed, the Local Study Area does not appear to be frequented by a large number of animals in general. The area has not been designated critical habitat for any SARA-listed species. The development itself has a relatively small footprint, near the existing transportation infrastructure. The development plan maximizes work inside buildings and underground. Any impacts that do occur on SARA-listed species will likely be localized and short-term in nature. The management and monitoring proposed by the responsible government authorities has been fully adopted by the developer, with the one above-noted exception. No responsible government authority predicted significant adverse impacts on any SARA-listed species.

Consequently, the Review Board finds that a significant adverse impact on Species at Risk or any animal species is not likely from the proposed development by itself, as long as all commitments are implemented. Notwithstanding this finding, there may be impacts on species at risk, so by law (*SARA*) monitoring is required. The Review Board finds that the developer's commitments for wildlife management and monitoring, many adopted from Environment Canada and the GNWT, are acceptable and upon implementation will fulfill the requirements of s79(2) of *SARA* without further recommendations from the Review Board.

The Review Board does recognize and share the concerns raised by some Parties about the status of cumulative wildlife assessments at the local and regional level. Suggested future cumulative effects work to bolster knowledge of animal distribution and health in the Pine Point region is provided in Section 10.

9.3 Road Safety and Maintenance

Road safety and maintenance was raised during scoping as a major issue. In the *Terms of Reference*, the Review Board labeled road safety and engineering/maintenance as issues requiring special consideration. During the environmental assessment, potential impacts were identified in relation to the following:

- Increases in vehicle traffic, especially heavy truck traffic along Highway 5 from the Highway 2 junction to km 42 and in the Town of Hay River, and associated public safety
- Increased highway maintenance costs from damage inflicted by heavy truck traffic

Evidence in the *Developer's Assessment Report* indicated that there are no load restrictions on Highway 5. Predicted truck traffic is 50 to 65 round trips per day with bus traffic and individual worker traffic limited to an additional 20 to 30 round trips per day. The Review Board finds that even if these are conservative estimates and traffic doubles due to the PPPP, the vehicle traffic between Hay River and the PPPP site would still be low, in the order of one vehicle every four minutes on average.

At the public hearing, the GNWT identified that estimated increases in traffic volume from the PPPP raise no significant safety concerns. Increased traffic volumes were also predicted by the GNWT to have a negligible impact on road surface and maintenance routines.

The Review Board finds that the PPPP is not likely to cause significant adverse impacts on public safety or transportation infrastructure, in particular along Territorial Highway 5. This route is not considered a busy corridor and is load rated for the proposed haul truck traffic. The Department of Transportation of the GNWT has stated there are no likely adverse impacts either on road structures or public safety from the predicted traffic increase.

The developer's commitments to minimize impacts on both public safety and road maintenance are generally adequate (C86-C87, C89-C92). The Review Board does encourage the Department of Transportation of the GNWT and the developer to have discussions prior to the start of the PPPP about improvements to signage and other road safety considerations, specifically at the relatively busy intersection of Highway 5 and Highway 2 south of Hay River.

10 Cumulative Effects Assessment

10.1 Introduction

This section examines the cumulative effects assessment that occurred during this environmental assessment and the Review Board's conclusions on the PPPP's likely contribution to any significant cumulative adverse environmental impacts. The Review Board considers cumulative effects assessment to be an important aspect of any environmental assessment. Section 117(2)(a) of the *MVRMA* specifies that every environmental assessment "shall include a consideration of... any cumulative impact that is likely to result from the development in combination with other developments". Cumulative effects refer to impacts that result from the proposed development in combination with all other past, present and reasonably foreseeable future developments. Assessment of cumulative effects provides a more complete understanding of what might happen to valued components beyond a single development's influence.

10.2 Issues Raised

This environmental assessment considered cumulative effects related to:

- Woodland caribou and other terrestrial wildlife
- Aquatic resources, especially fish, in the Great Slave Lake watershed
- Lead-zinc contamination along the transportation corridor from the Pine Point Mine to Hay River (discussed in depth in Section 7 of this *Report of Environmental Assessment*)
- Human health impacts from the above three factors
- Local and regional groundwater levels from mine dewatering
- Increased industrial activity and traffic and in-migration in the Town of Hay River

South Slave aboriginal community members raised almost all the cumulative effects concerns brought up during this environmental assessment. The people of Fort Resolution were especially vocal. During scoping, an overall lack of effective cumulative impact assessment in the Pine Point Region was raised as a concern. In particular, aboriginal groups have concerns about the lack of closure to outstanding concerns with the historic Pine Point Mine east of the Buffalo River, which shut down in 1987. Both the former operator (Cominco Ltd., now Teck Cominco) and INAC were criticized for the lack of resolution to community concerns about long-term impacts on lands, waters and wildlife. Community members also raised concerns that the PPPP is located in a larger land healing from previous Pine Point operations and exploration activities and that the entire area remains fragile.

The *Terms of Reference* required the developer to focus in particular on two major cumulative effects considerations:

1. Potential local cumulative effects of rapid population growth and increased traffic in the Town of Hay River and on Territorial Highway 5, in combination with the Mackenzie Gas Project; and
2. Cumulative biophysical effects from historic and current industrial development on the Pine Point area on both sides of the Buffalo River. The historic mining at Pine Point east of the

Buffalo River from 1964-1987, on water quality and quantity, wildlife habitat and numbers, and traditional land use, were singled out as focal points.

The *Terms of Reference* required that the proposed Mackenzie Gas Project, past mining at Cominco's Pine Point Mine, and likely future mining expansion by Tamerlane in the Pine Point area all be developments considered alongside the PPPP during cumulative effects assessment.

10.3 Evidence on the Public Registry

10.3.1 Evidence from the Developer and Government Authorities

Submissions from the developer and government sources focused on identifying potential past, present and future contributors to cumulative effects on water, lands, wildlife and people.

Past Developments

The developer's and government authorities' concerns about cumulative effects from past developments solely focused on the impacts of the historic Pine Point Mine. IR32 asked INAC to update the current status of the historic Pine Point mining lands, as well as to provide any information INAC had on potential cumulative effects previous mining has had on local or regional water quality. INAC's response (130) indicated the federal government controls most of the area, with the town and mill site transferred to the GNWT, and the airfield Transport Canada controlled. Teck Cominco still has management of the tailings pond under a water license. Two regional environmental impact studies were completed as evaluations on past mining activities in the 1990s – one by INAC's Water Resources Division in 1992-3, and one by the National Hydrology Research Institute (Evans *et al.*, 1998). INAC stated that "the conclusions from both reports essentially find no measurable impacts from the impact of mining operations on the water, sediment, or fish in Great Slave Lake". Evans *et al.*'s study (quoted in the *Developer's Assessment Report*, p434) found

"there was no evidence that water in the study area (Great Slave Lake) was being contaminated by the decommissioned mine... no indication of any mechanism by which water flowing through the study region could be significantly contaminated by the decommissioned mine... there was no evidence of contaminated sediments offshore of the decommissioned mine site".

Drops in regional groundwater levels due to mine dewatering were a major concern during operations at the Pine Point Mine. Concerns were that dewatering caused widespread die-off of vegetation, and affected ground water levels to the south toward Wood Buffalo National Park. Studies by Hocking (1975 - 154) and Weyer (1983 - 153) introduced by government departments to the public record both theorized that the vegetation in and around the Pine Point Mine had been impacted by groundwater levels falling or from other dewatering impacts. Hocking (1975, p27) found "circumstantial evidence suggests a major contribution to forest injury by the pit dewatering and resulting drawdown of the ground water table". However, the *Developer's Assessment Report* (p432) notes rapid groundwater recharge in the Pine Point area occurred immediately after pumping stopped at the Pine Point Mine in the 1980s, and predicted that groundwater levels are likely back at or near pre-mining levels. The developer thus predicted no cumulative effect on groundwater levels from the Pine Point Mine.

Present Developments

Present day developments assessed for their contribution to cumulative effects included the Pine Point Mine and the PPPP itself. The *Developer's Assessment Report* (p430) stated that Teck Cominco water license reporting from 2001-2005 indicates "that the total metals in the water of the receiving environment [Buffalo River] remain stable at low and environmentally acceptable levels". The developer used this finding and those of Evans *et al* (1998) as a rationale for not developing a plan for the monitoring of cumulative effects from the PPPP on surface waters. The developer also predicted there is no viable mechanism by which the PPPP can influence any regional water bodies given its deep groundwater discharge and distance from area surface water bodies.

The *Developer's Assessment Report* predicted the PPPP itself would not contribute to any significant adverse cumulative effects on the area for other reasons as well, including:

1. *The "limited scope and scale" of the PPPP, including a small footprint and short two to three year timeframe.* The developer noted that the PPPP's direct physical footprint was just under 8 hectares, while that of the Pine Point Mine was estimated at 39,000 hectares
2. *The fact the area being utilized was already extensively impacted by human activities and the developer's plan to maximize the placement of activities on previously disturbed terrain (e.g., the developer estimated that 52% of the buildings at the PPPP would be on disturbed lands)*
3. *The minimal intervention mine plan (underground, freezeway to minimize groundwater inflow, the relatively remote location, no large waste rock piles)*

Impacts from the PPPP were predicted to be intermittent, short-term, highly localized and rapidly reversible. The developer also noted that hunting is likely the number one impact on wildlife in the area, and the PPPP creates no new access routes for harvesters. The developer used a rationale that first, there are few if any other current contributory developments in the Pine Point region, and second, the PPPP is too small to have major individual adverse impacts on the environment, as reasons for conducting only a minimal cumulative effects assessment during this environmental assessment.

Reasonably Foreseeable Future Developments

The developer was instructed in the *Terms of Reference* to consider, at minimum, the Mackenzie Gas Project's localized socio-economic effects on Hay River as well as future expansion in Tamerlane's mineral claims in the Pine Point region as reasonably foreseeable future developments.

In its socio-economic impact assessment, the developer rejected consideration of the Mackenzie Gas Project on the grounds that project faced regulatory delays that would push its timeline back far enough that the PPPP was unlikely to overlap with that large development (*Developer's Assessment Report*, Appendix AA).

While noting the overall goal of the PPPP being to determine the feasibility of mining additional prospects in the area, in the *Developer's Assessment Report* (p426) the developer stated: "In terms of future expansion, this assessment includes only those additional potential deposits that can be reached underground from the PPPP site". The developer provided no evidence for or against potential future cumulative effects contributions of these expansions, which are known to include up to five prospects to the west of the Buffalo River. Tamerlane also stated in the *Developer's*

Assessment Report it was not aware of any other reasonably foreseeable land uses that may occur in the Pine Point region over the next 10 years. Therefore, no likely future contributory developments to cumulative effects were identified.

The developer did conduct limited wildlife, water and vegetation analysis throughout the Regional Study Area, which includes portions of the historic Pine Point Mine and the locations of all of the reasonably foreseeable future ore bodies, in 2006-7, and included information from these field studies in its overall cumulative effects assessment. The *Developer's Assessment Report* found no likely significant adverse cumulative effects of the PPPP in combination with any other developments for any valued component studied.

10.3.2 Community Concerns and Recommended Further Studies

Criticism of the developer's cumulative effects assessment focused on the short length of baseline studies, the lack of incorporation of traditional knowledge, and lack of data to support the developer's predictions of cumulative effects from other developments. During scoping, aboriginal groups had concerns with the developer's preliminary cumulative effects assessment. The Deninu K'ue First Nation stated in its *Post Scoping Session Comments*: "This is a sensitive land in the process of healing, why is [the developer's biophysical assessment consultant] saying there will be no cumulative impacts in this area?" (50). It also challenged assertions the developer made that the Pine Point Mine operated from 1964 to 1987 without significant environmental impact (42).

The developer's final cumulative effects assessment was similarly criticized at the public hearing (Hearing Transcript, p77-8), by Steve Ellis of the Treaty 8 Tribal Corporation. He stated:

"My assessment of your cumulative effects assessment is that I don't think that Tamerlane has done an adequate job. There's a very clear past cumulative effect here, which is at it's time the -- the largest open pit mine in the world, which is the old Pine Point Mine. I don't see any consideration of the proposed pilot project in combination with the effects of the old Pine Point Mine. And very clearly, that this Pilot Project is being developed in anticipation of potential other new resources being exploited. I don't see any consideration of the potential effects of those resources as well."

Aboriginal communities felt that negative experiences with the Pine Point Mine, both biophysically and socio-economically, meant this new development had to be held to a higher standard of cumulative effects assessment. They felt the entire Pine Point region is a healing land that needs to be carefully studied and treated with extra caution. The Katlodeeche First Nation traditional knowledge study (169) stated "We have already experience a mine operating on Katlodeeche First Nation Traditional lands and [are] aware of the negative impacts that are still very visible and still impacting the wildlife".

At the public hearing, Fort Resolution residents identified concerns with the historic operations at Pine Point Mine, and identified concerns that residual cumulative effects may still be impacting the people of Fort Resolution today. Elder Marcel Norn of the Deninu K'ue First Nation spoke about the environmental damage from the previous Pine Point Mine, culminating with the statement: "*the mine that was there previous... has caused more problems than anything else*" (Hearing Transcript, p109). Trapper Eddie Lafferty of the Deninu K'ue First Nation focused on the loss of historic trapping east of the Buffalo River due to the Pine Point Mine, combined with damage to his

livelihood west of the Buffalo River by Tamerlane's activities. Tom Unka from the Deninu K'ue First Nation stated

"We are living with the cumulative effects from a mine that operated in our back-yard and further, we are still restricted from freely utilizing that area for subsistence harvesting because of the questionable nature of the environment and the physical blockage on the haul roads... DKFN wants assurance that history will not repeat itself" - (Hearing Transcript, p105-6).

Community members raised human health impact concerns at the public hearing. The Fort Resolution Métis Council cited concerns about contamination of animals in and around the R-190 site and the potential bio-accumulation of lead and zinc in traditional harvesters. Members of the Deninu K'ue First Nation spoke of concerns about cancer rates, asthma and increased metals in drinking water, fish and fish habitat and asked how these issues were being addressed. Carol Chapman of the Deninoo Community Council (Fort Resolution) stated:

"The impact out of previous activities in Pine Point is still present and felt by our community. Restoration in some areas were not properly done or dealt with. Poor health issues during that era were very evident amongst those that lived in Pine Point, more specifically cancer. We cannot afford to live through the same thing again." - (Hearing Transcript, p159).

Tom Unka of the Deninu K'ue First Nation noted both public concern and lack of information about impact sources:

"It's pretty evident that [health concerns] it is probably caused from some of the development that occurred within our area, such as Pine Point mines or the tar sand development to the south of us. It's all affecting our waters and our land. And we're not really saying that this one company is responsible for the high cancer rates or the prevailing asthma or the metals in our water. It's there already and we can't really say for sure where it all came from, though we'd like to maybe think that it came from somewhere." - (Hearing Transcript, p126).

Community groups recommended a variety of additional cumulative effects and monitoring studies to establish current valued components of health, assess the impacts of the PPPP, and avoid future impacts. The Fort Resolution Métis Council identified three key further studies it thought should be initiated before development begins:

1. A study on woodland caribou throughout the entire Pine Point region (172)
2. A new water study on Great Slave Lake near the proposed project to identify levels of concentrated metals and trace elements in the water and in the aquatic life before, during and after the PPPP, citing outdated water quality studies as a primary reason for additional studies, and requested the involvement of Tamerlane and the federal or territorial governments (172)
3. Studies on the amount of lead/zinc in traditional harvester's diets before, during and after the PPPP (Hearing Transcript, p152)

The Katlodeeche First Nation traditional knowledge study (169) recommended a wildlife study be conducted on the area north of the Pine Point Mine to determine the impacts of the past mining operation, including contamination levels and the return of wildlife once the mine closed.

Neither the developer nor any government authorities adopted any of these recommendations prior to the close of the public record. Representatives of Environment Canada and the GNWT both stated at the public hearing they were involved with some regional monitoring for Species at Risk, but provided little detail. Government noted its reliance on developers for site-specific monitoring.

10.4 Review Board Analysis and Conclusions on Cumulative Effects

The mining history of the Pine Point area has caused public concern about wildlife and water contamination, the loss of land useful for traditional activities, and a perceived lack of economic benefit for many aboriginal people. This historic backdrop colours the perceived impacts of new developments, as well as elevating community expectations of what comprises an adequate effort in a developer's assessment of cumulative effects. The community of Fort Resolution, in particular, has consistently raised concerns about how the Pine Point Mine impacted water, sediments, fish, soils, vegetation, wildlife, and country food harvesters and consumers. The people of the Hay River Reserve and Fort Resolution both identify the entire Pine Point region as a healing land.

The Review Board has to balance these concerns against the lack of up-to-date information about the Pine Point Mine currently available for cumulative effects assessment. On the basis of the evidence available on the public record, the Review Board finds the individual contribution of the PPPP to cumulative effects in the Pine Point region is likely to be small, given its size, location, development plan, and duration. Keeping these competing factors of high public concern from the Pine Point Mine and the low likely relative impact of the PPPP in mind, the Review Board has made determinations of significance on four specific cumulative effects themes – socio-economic, human health, the terrestrial environment, and water and aquatic ecosystems.

10.4.1 Socio-economic Cumulative Effects

The *Terms of Reference* required serious analysis of how the Mackenzie Gas Project might impact on the Town of Hay River, especially in terms of increased traffic and in-migration. This requirement was effectively dropped when the proponents of the Mackenzie Gas Project decided, on May 15, 2007, to withdraw their proposed 425 person construction camp on Vale Island in the Town of Hay River (Imperial Oil Resources Ventures Limited: 2007). This was the only component of the Mackenzie Gas Project likely to have a large influence on in-migration in Hay River in combination with PPPP in-migration. The developer provided a rationale that additional delays to the timeline of the Mackenzie Gas Project eliminate its potential cumulative contributions to socio-economic impacts, either beneficial or adverse. The Review Board accepts this rationale.

While population increases of about 5% will occur quickly in Hay River if the development proceeds, there are currently no other developments that will compound potential adverse social, economic or public safety issues. The Town of Hay River has identified full support for the PPPP, and has not identified any adverse likely cumulative effects related to socio-economic growth caused by increased development. The Review Board also heard testimony from the Department of Transportation of the GNWT that there are minimal traffic concerns to do with the proposed development (see Section 9.3), and ample capacity for the road to take additional wear and tear. Current Territorial Highway 2 and 5 usages are both manageable and not likely to grow

significantly during the life of the PPPP. The Review Board finds no likely significant cumulative effects related to increased traffic or in-migration on the Town of Hay River.

Communities also raised concerns about cumulative effects on the lands of the Pine Point region causing economic hardship for traditional harvesters. The Review Board notes some traditional knowledge was brought forth indicating some animal species were not present in historic concentrations during mining at Pine Point Mine, and there were a variety of factors reducing traditional harvesters' access and success. More recent information on the post-mining era is not conclusive, with some traditional harvesters citing increasing numbers of fur-bearing mammals, and others noting continued decline. The PPPP itself has a small footprint that limits its potential disturbance area for wildlife. The Review Board finds that there is no current evidence that significant cumulative adverse impacts on wildlife harvesting that PPPP will contribute to.

10.4.2 Cumulative Effects on Human Health

The Review Board heard concerns from aboriginal users of the Pine Point region, particularly those from Fort Resolution, about health impacts of changing water quality on the waters, fish and other aquatic resources in Great Slave Lake and its watershed. Communities were also concerned about potential bio-accumulation of metals up the food chain and associated health impacts. No NWT-based studies on human health effects of either concern were brought forward during the course of this environmental assessment.

However, it is known that there are no current or likely users of area groundwater for drinking in the PPPP area, and there has been and is likely to remain little contamination of surface waters by the Pine Point Mine activities. The few studies that have been done there have shown no known human health impacts. The Review Board finds the PPPP itself will not likely contribute greatly to any health issues communities are concerned about, provided the developer's commitments are implemented. The implementation of the Review Board's suggestions on groundwater and dustfall monitoring would also be beneficial. These monitoring programs will identify the PPPP's potential contributions to cumulative impacts, while also providing a better understanding of historic impacts and natural concentrations of contaminants of concerns.

The Review Board notes that communities' human health impact concerns are likely linked to lack of information. Dialogue with Health Canada can partially fill this knowledge gap. The Review Board notes that Health Canada was a party to this environmental assessment, but did not attend the public hearing because human health issues directly linked to this development were not at the forefront of topics identified during the pre-hearing conference (208). However, the Deninu K'ue First Nation representatives did identify some concerns that members of the public might like to discuss with Health Canada. For example, Deninu K'ue First Nation representatives noted public concerns are often raised in the community about the overall impacts of mines and water quality changes on human health. The Deninu K'ue First Nation representatives at the pre-hearing conference were interested to start a dialogue with Health Canada on these issues.

The Review Board has heard a variety of human health concerns expressed during this environmental assessment, but very few answers and almost no data on the issues the communities raised. The type of dialogue proposed between Health Canada and the Deninu K'ue First Nation needs to be encouraged on a more frequent basis. This type of dialogue may assist South Slave

communities in getting their concerns about Great Slave Lake waters raised with a wider audience. In the interest of reducing public concern, the Review Board provides the following suggestion:

Suggestion #9:

Health Canada, the Deninu K'ue First Nation and any other South Slave aboriginal groups or communities concerned about cumulative health related impacts of lead-zinc mining and the health impacts of any perceived reductions in the water quality and aquatic resources contamination of the Great Slave Lake watershed, should initiate a dialogue about these issues as soon as possible.

10.4.3 Terrestrial Biophysical Cumulative Effects

Prior activity has extensively impacted the area in which the PPPP is proposed. At the local level, road, cut lines, mineral exploration drilling and gravel extraction, along with the transportation corridor have impacted upon the biophysical environment. There is also no defined critical habitat for any wildlife species in the PPPP's Local Study Area or Regional Study Area.

The short lifespan, relative compact footprint, minimal intervention mine plan, and minimal pathways of contaminants to many valued components are among several factors that indicate the PPPP itself has low potential to provide a significant contribution to cumulative effects on the land. Possible and currently unknowable exceptions to these low cumulative effects potentials are impacts on local groundwater quality which could impact on vegetation and wildlife (Section 6), and impacts of metals accumulation in soil on ecosystem health onsite and along the transportation corridor (Section 7). The Review Board has made suggestions to fill these key cumulative effects information gaps during the lifetime of the PPPP. The Review Board also notes the current lack of other industrial activity in the local area, in finding that local cumulative effects on the terrestrial environment are unlikely, if the developer's commitments and the Review Board's recommendations are implemented.

Regardless of the PPPP's individual local contribution, the Review Board has heard a variety of concerns about cumulative effects on the lands, vegetation and wildlife of the overall Pine Point region from aboriginal communities. Many of these focus on uncertainty and a lack of "closure" and follow-up studies of the historic Pine Point mining area. Traditional knowledge and scientific studies indicated that key wildlife species might have avoided much of the area during active mining. Historical research also indicates the Pine Point Mine caused at least some short-term terrestrial biophysical impacts. Because the studies put on the public record for this environmental assessment were from 25-35 years old, they do not provide useful up-to-date information on the health of the Pine Point region. Since Pine Point region is in a cold northern climate with relatively slow regeneration patterns, impacts on lands and resources sustained decades ago may still be, as the communities state, healing. Current government monitoring programs for woodland caribou, for example, were not adequately detailed during this environmental assessment, and should be utilized more heavily in future cumulative effects assessment.

The Review Board recognizes both public concern and the lack of current information on the health of the terrestrial environment in the entire Pine Point Region, and concludes that additional work should be done to update this knowledge in order for more effective cumulative effects assessment to contribute to environmental impact assessment of likely future mining developments that will

encroach more on the Buffalo River from the west. The Review Board provides a suggestion to this effect in Section 10.4.5.

10.4.4 Cumulative Effects on Water and Aquatic Ecosystems

Given that the PPPP will not have any surface discharge and no likely resurfacing of discharge except over a long distance and timeline, no surface water quality impacts are likely even at the local scale. The Review Board finds that the PPPP is not likely to impact on surface water quality and therefore cannot be a contributor to any cumulative effects on surface waters. The Review Board notes that the evidence provided during this environmental assessment, while sparse and dated, indicates that the historic Pine Point Mine is unlikely to have contributed significant adverse impacts to water quality and aquatic resources in the Great Slave Lake watershed.

In terms of groundwater, the PPPP itself will be discharging water back into the same aquifer as it is drawn out of, less than 1km away. The Review Board has accepted the developer's rationale that this will effectively create a "closed loop" system where groundwater levels will not change. In addition, the developer provided evidence in the *Developer's Assessment Report* that when the old Pine Point Mine shut down its pumps, the significant groundwater drawdown was reversed very quickly. This signals that even if more of a drawdown in groundwater from the PPPP or reasonably foreseeable future developments that expected occurs, the groundwater system has the capacity to quickly replenish. There is also no evidence for any other development activities having adverse impacts on groundwater quality in the Pine Point region.

10.4.5 The Need for More Effective Cumulative Effects Assessment

The PPPP itself has been shown to be unlikely to contribute significantly to cumulative effects and there is evidence to suggest the same about the Pine Point Mine. Nonetheless, environmental impact assessments of reasonably foreseeable future development will likely require a more valued component-focused approach. For instance, there is no question that the water quality and aquatic resources of the Great Slave Lake and its watershed are very important to all parties, but especially to the people who live around and use these waters. The Review Board notes that public concerns about this water quality were prevalent even for this environmental assessment, which has only a small possibility of impacting on Great Slave Lake. The Review Board also notes that the industrial activities causing contamination in Great Slave Lake are likely to include upstream as well as NWT sources. These upstream sources were not scoped into this environmental assessment, but given the consistency of public concern and increasing evidence of change²⁷, they may be considered in future environmental impact assessment and regional cumulative effects efforts, given rising concerns about the valued component itself, water quality in Great Slave Lake.

The Review Board has noted public concerns about lack of information on the key valued components of water and wildlife throughout the environmental assessment. It is evident that not enough scientific or traditional knowledge information has been gathered to make a fully educated determination of impacts on either valued component. While the evidence on the public record for this environmental assessment does not indicate significant adverse cumulative impacts from

²⁷ The National Water Research Institute (www.nwri.ca) has reported heightened persistent organic pollutants (POPs) originating from human activities in sediment and biological samples in the Western Basin of Great Slave Lake in recent years, "pointing to the Slave River as a significant source of contaminant loading to the lake floor." (NWRI: 2003).

mining at Pine Point, public concerns remain and studies are dated and few in number. This environmental assessment uncovered no work done on cumulative effects of the large Pine Point operations for the past decade. The most recent studies of aquatic effects submitted for the public record were over a decade old (Evans *et al*: 1998), and the Review Board received no evidence of focused cumulative effects studies on the lands around Pine Point in the interim.

Given the remaining levels of public concern and the lack of up-to-date information, the Review Board concludes that environmental impact assessment of future larger and longer-term mining developments will require updated cumulative effects data on the ecosystem health of the nearshore Great Slave Lake in the Pine Point region and on the lands in the historic mining area as well. If, as seems likely, the Pine Point mineral trend again becomes a viable longer-term (10 or more years) mining area, the developer and the responsible government authorities should be conducting cumulative effects assessments prior to further mine expansions. Cumulative effects assessments should be started as soon as possible in the historic Pine Point mining area, with the developer (which is already conducting biophysical baseline work east of the Buffalo River), impacted communities and government agencies involved.

The Review Board suggests that the NWT's Cumulative Impacts Monitoring Program, with the assistance of responsible government authorities and the potentially affected communities of the South Slave, should carry out a cumulative effects assessment of the historic Pine Point Mine area east of the Buffalo River. The Cumulative Impacts Monitoring Program is the ideal vehicle for this necessary work because it is the body mandated to conduct of cumulative effects assessment at the regional level in the NWT, whose stated responsibilities correspond well to the principles needed for effective cumulative effects assessment on the Pine Point Mining region. They are to (Cumulative Impact Monitoring Program: 2007):

- encourage community-based monitoring and community capacity-building;
- provide resources to fill the gaps in current monitoring activities;
- report on the health of the environment, which includes biophysical, social and economic components;
- help with better decision-making to protect the environment;
- include both scientific and traditional knowledge; and
- help coordinate monitoring and reporting in the NWT (www.nwtcimp.ca).

It is envisioned that the cumulative effects assessment of the historic Pine Point Mine area east of the Buffalo River would incorporate the related work of Tamerlane Ventures Inc.

The Review Board concludes that INAC should also play a key role in any cumulative effects assessment of the Pine Point Mine because of the agency's role as primary landholder and its ability to access additional historic data about the biophysical environmental impacts of the Pine Point Mine.

Updated cumulative effects assessment at the historic Pine Point Mine is necessary prior to any future mine expansions for the following reasons:

1. There are still strongly held community concerns about historic and cumulative effects on the land and water at and around the Pine Point Mine
2. Available evidence (at least that provided for the public record) on environmental impacts of the Pine Point Mine is dated
3. Little information on key valued components like woodland caribou, moose and aquatic furbearers, both east and west of the Buffalo River, was available to this environmental assessment
4. Increasing and potentially long-term mining activity encroaching on the Buffalo River from the west. The Review Board also notes that the developer has indicated its desire to explore and potentially mine from claims it holds east of the Buffalo River as well, and that all but one of Tamerlane's potential ore deposits trend to the east from the PPPP, toward and eventually across the Buffalo River

This cumulative effects assessment need not be an onerous one. The main priority is to determine, with a variety of interested parties, what information is already available about cumulative effects in the Pine Point region. If gaps are identified, further research may then be required.

To minimize public concern, to help bring closure to the historic Pine Point Mine, and to contribute to more effective cumulative effects assessment during likely subsequent environmental impact assessment of mines in the Pine Point region, the Review Board provides the following suggestion:

Suggestion #10:

The NWT Cumulative Impacts Monitoring Program, with the assistance of Indian and Northern Affairs Canada and other government authorities, should initiate a comprehensive review of existing research findings that can contribute to a greater understanding of how the historic mine workings at Pine Point east of the Buffalo River has impacted the surrounding region. The goal is to have a consolidation of existing research completed within the next three years. This should include a full literature review of all environmental baseline and impact assessment studies on the Pine Point Mine, including current regional monitoring programs, and the identification of gaps in the research, with the assistance of South Slave communities, other responsible government authorities and Tamerlane Ventures Inc.

11 Conclusions

11.1 Implementation of the Developer's Commitments

Tamerlane Ventures has shown a willingness to proactively minimize potential impacts on the environment through 140 mitigation commitments. The Review Board's analysis of the public record enumerated these commitments and the developer confirmed them in its response to IR55 (242). The resulting list of confirmed commitments is included as Appendix B. These commitments have been fundamental in shaping the Review Board's determinations of significance. The developer is to be commended for its willingness to adjust development components and monitoring and management plans as impacts and uncertainties about potential impacts have been identified.

The Review Board's decision has been made on the assumption that the developer will fulfill all its commitments. The failure to implement these commitments would alter the Review Board's determinations of significance. In the absence of these commitments, there would likely be significant adverse impacts on the environment from the PPPP. In the Review Board's opinion, it is therefore important that the developer and responsible authorities ensure that all the commitments listed in Appendix B are fulfilled. The public reporting of the implementation of commitments, combined with the results of monitoring which the developer has committed to or the Review Board has suggested, will also contribute to public certainty about the impacts of the PPPP. The Review Board notes that for a test mine like the PPPP, this information is especially valuable and can lead to adaptive management and efficient future environmental impact assessment. As a precautionary step, the Review Board suggests the developer do the following to ensure that impact mitigation takes place and to help create this system of accountability.

Suggestion #11:

Tamerlane Ventures Inc. should prepare a plain language report within 12 months and thereafter, annually, until the Pine Point Pilot Project is abandoned and restored, for public distribution. The report should outline the implementation status of each commitment made during the course of this environmental assessment, as set out in Appendix B.

Appendix A: Summary of Suggestions

Suggestion #1:

The Mackenzie Valley Land and Water Board should establish effluent quality criteria in its Pine Point Pilot Project Production Water License to address the potential for discharge water contributing to groundwater quality deterioration and possible impacts on the surface environment.

Suggestion #2:

Federal authorities responsible for water should investigate best practices in deep groundwater discharge wells systems. The goal is to give additional guidance in advance of future uses of this technology in the Mackenzie Valley. These authorities should consider working with Tamerlane Ventures Inc. to use the Pine Point Pilot Project as an active research site for assessing potential deep well disposal impacts in the Pine Point region.

Suggestion #3:

The Mackenzie Valley Land and Water Board should give consideration to the following when developing its monitoring requirements for the PPPP Production Water License:

- **A requirement for monitoring of discharge water flow directions and speed from appropriately located downgradient monitoring wells to establish accurately the flow path of the effluent discharge**
- **A requirement for downgradient monitoring and reporting of deep groundwater quality, including a dilution and fate analysis for metals species, ammonia and any chemical reagents that can feasibly be tested, to determine how quickly and at what linear distance contaminants are diluted in this groundwater system**

Tamerlane Ventures Inc. should be required to include these elements in its PPPP groundwater monitoring program, develop an adaptive management plan for water quality concerns, and report results of both to the Mackenzie Valley Land and Water Board, and make those reports publicly available on an annual basis over the life of the PPPP.

Suggestion #4:

Tamerlane Ventures Inc. should implement the recommendations made by the Government of the Northwest Territories in their submission to the Review Board of November 2, 2007, to develop an appropriate air quality monitoring program at the R-190 site. Tamerlane Ventures Inc. should link this monitoring to an overall Air Quality and Emissions Management Plan, and should work with the Government of the Northwest Territories and Environment Canada to develop its on-site emissions monitoring program and plan.

Suggestion #5:

The Government of the Northwest Territories and Environment Canada, working with industry and affected communities, should address the need for enforceable air quality guidelines or standards for industrial developments operating in the Mackenzie Valley.

Suggestion 6:

Before the Pine Point Pilot Project's operating phase starts, the Government of the Northwest Territories and Environment Canada should establish a dustfall monitoring and metal content analysis system along Territorial Highway 5, from the point where Territorial Highway 5 meets the Pine Point Pilot Project access road, to the junction of Highway 5 and Highway 2. This system should also include baseline metal content analysis of soil in the vicinity of Highway 5 and the historic Pine Point Mine rail bed, and public reporting of all results.

Suggestion #7:

Tamerlane Ventures Inc. should have independent metal content analysis done on dustfall samples collected at appropriate time intervals, and publicly report the results, for the following locations:

- **The R-190 site;**
- **Along the R-190 haul road;**
- **Near the intersection of Territorial Highways 2 and 5; and**
- **The ore transfer facility south of Hay River and its road approach.**

Suggestion #8:

The Government of the Northwest Territories, with the developer and affected communities, should use the opportunity created by this test mine to study the following:

- **The existence and relative effectiveness of transition programs and success of transition for displaced traditional harvesters, as well as consideration of what additional programs may be necessary to assist displaced harvesters;**
- **The existence and relative effectiveness of "boom and bust" transition programs for mining-dependent communities;**
- **More effective, timely and attractive "job ready" training programs to bolster the number of aboriginal people ready to engage in the mining economy;**
- **Barriers to engagement/recruitment of people from the South Slave to the PPPP; and**
- **Pressures on families and individuals that lead to employee retention issues and social impacts in the home community of miners.**

Suggestion #9:

Health Canada, the Deninu K'ue First Nation and any other South Slave aboriginal groups or communities concerned about cumulative health related impacts of lead-zinc mining and the health impacts of any perceived reductions in the water quality and aquatic resources contamination of the Great Slave Lake watershed, should initiate a dialogue about these issues as soon as possible.

Suggestion #10:

The NWT Cumulative Impacts Monitoring Program, with the assistance of Indian and Northern Affairs Canada and other government authorities, should initiate a comprehensive review of existing research findings that can contribute to a greater understanding of how the historic mine workings at Pine Point east of the Buffalo River has impacted the surrounding region. The goal is to have a consolidation of existing research completed within the next three years. This should include a full literature review of all environmental baseline and impact assessment studies on the Pine Point Mine, including current regional monitoring programs, and the identification of gaps in the research, with the assistance of South Slave communities, other responsible government authorities and Tamerlane Ventures Inc.

Suggestion #11:

Tamerlane Ventures Inc. should prepare a plain language report within 12 months and thereafter, annually, until the Pine Point Pilot Project is abandoned and restored, for public distribution. The report should outline the implementation status of each commitment made during the course of this environmental assessment, as set out in Appendix B.

Appendix B: List of Developer's Commitments

The table below summarizes the specific commitments made by Tamerlane Ventures Inc. throughout the environmental assessment process. Note that the document number in the second column is the number on the public registry, as listed in Appendix C.

C#	Document# & page#	Commitment
		Air Quality
C-1	106, p150 and p330	The PPPP will conform with GNWT and WCB standards for mine air quality. A designated employee will monitor the air quality at each underground working location, during each shift, on a daily basis (including CO) and maintain records of the air quality monitoring information.
C-2	106, p330	Tamerlane commits to use low sulphur diesel and to regular equipment and engine maintenance
C-3	106, p330	Tamerlane will conform with the Guidelines for Ambient Air Quality Standards in the NWT
C-4	231; 242, #5	For air quality monitoring, Passive Integrated Samplers will be employed. They will provide monthly averages for parameters such as NO ₂ , SO ₂ and VOC's. For particulate matter sampling, an integrated sampler such as an Airmetrics "MiniVol" sampler will be employed to sample PM ₁₀ . Tamerlane will also be employing periodic metal content and dustfall analysis during the life of the project for use in future baseline applications.
		Dust Control
C-5	106, p154; 242, #9	Tamerlane will use water for dust suppression on site, on the haul road from the site to the highway, and at the ore transfer facility outside Hay River. Spray bars will be installed at the feed end of the crusher to mist the area if dust is encountered. During winter months, a mixture of glycol and water may be necessary to prevent freezing.
C-6	106, p323	To prevent dust from the concentrate from being released during transportation, the concentrate will be maintained in a "moist" condition and the truck boxes and product will be covered.
C-7	209	Tamerlane will adhere to the GNWT's <i>Guideline for Dust Suppression</i> .
		Freezewall
C-8	210, B-1; 159	Tamerlane will utilize isolation valves on each of the freeze pipes in the freeze perimeter, to minimize brine intrusion in the case of breakage/leakage. The brine tanks will be equipped with low level sensors and valving that will detect a lower than normal level and automatically shut off the outgoing valve. Built within the manifold system is a series of electronically controlled valves that will close based on a change in brine level or pressure, and pumps will be shut off to reduce pressure and flow from the rupture. An on site repair package will be provided as well as reserve storage capacity.
C-9	210, B-3	Tamerlane will place berms around the freeze plant to contain and prevent the spreading of brine in the event of a tank rupture. If precipitation builds up in the lined brine distribution trench, Tamerlane will clear ice to ensure proper volume (in the trench) to capture all potential brine leakage in case pipes rupture.
C-10	210, B-5	In the event of an uncontrolled brine spillage, Tamerlane will follow a 10 to 1 dilution ratio (water to brine) as part of its cleanup plan and this is included in its spills contingency planning.
C-11	199, p56; 159	The developer will line the area where the bulk of construction will occur with concrete, and elsewhere ditch and bury the distribution pipes to protect them, especially during construction. Traffic control around the manifold will be implemented.
C-12	199, p13	A contingency plan and environmental impact worst case assessment of a massive loss of brine from the manifold will be developed
C-13	32, p2	The developer will use blasting techniques that minimize fracturing, using narrow stable stopes, and monitoring of rock mechanics by visual inspections of loose ground along with periodic deflection measurements to determine areas of potential movement.

C#	Document# & page#	Commitment
C-14	26, #3; 106, p133	The network of surface lines connecting vertical freeze pipes and freeze plants will be placed in concrete or HDPE trenches. The installation of each individual freeze pipe will be pressure tested. The pressure test will be conducted by filling each pipe with water and applying 200 psi of air pressure while assuring that the pipe holds this pressure for at least one hour.
C-15	106, pp133-4, p333	The development will have an instrumentation system integrated between the freeze pipes, distribution manifold and refrigeration plant. The system will measure, record and reduce the data for the following components: ground temperatures measured at 30 different temperature pipes equally located throughout the site; coolant return temperatures measured at each freeze pipe at the connection to the return manifold; groundwater levels continuously measured using transducers installed in each of the piezometers or monitoring wells installed during the initial engineering; coolant flow and pressure constantly monitored and connected to an alarm system., refrigeration plant data built within the compressor system. These data will be incorporated into the central monitoring system. Engineers will establish a monitoring program including appropriate alarms and response actions. An HSE [Health, Safety and Environment] plan will be provided along with on-site management and inspection during operations.
C-16	199, p20	The developer will monitor the creation of the freezwall through an advanced downhole monitoring system linked to a central computer and alarm system. Temperature parameters are set ahead of time, and no lateral work on mining stopes and other infrastructure will occur until the freeze ring is fully established. Gyroscopic surveys will confirm all holes are vertical within a tolerance of a 2 metre cylinder for each freeze pipe. Where more than this deflection occurs, additional infill drilling will be conducted to assure the freeze pipes are close enough to create an impermeable barrier.
C-17	199, p12	Adaptive mitigations that will be used to ensure proper development of the freezwall include: 1. adjusting the spacing of the pipes (the closer they are together, the greater the strength of the barrier); 2. adjusting the temperature of the brine (the colder, the stronger the barrier); 3. Constant monitoring of pipe, brine and ground temperatures to look for anomalies; and 4. If problems are found, grouting and/or additional pipes will be utilized. Brine will be the freezing agent; liquid nitrogen will not be used.
C-18	199, p21	Thermal erosion potential will be remodeled based on pump test data gathered after freeze curtain establishment. Once basal hydraulic-conductivity values are determined, thermal erosion rates can be estimated and any required changes built into freezwall adaptive management.
C-19	144, p4; 242	Tamerlane will develop an environmental monitoring plan that documents the rate and changes associated with the melting of the freeze curtain. Sensors used to track the freeze-in will be used to monitor the thaw rate. This is expected to take about 3 months. Tamerlane's monitoring plan will provide real-time data that will enable a predictable model for the thawing process, once the freeze system is shutdown. After removal of the freeze system, manual monitoring of flow regimes in the wells will confirm the modelling predictions for future operations.
Hazardous Materials		
C-20	175, IR50.1	Underground fuel will be transported in a buried Schedule 40 pipe from the tank farm on the surface directly to the mine shaft. The piping will be attached to the shaft wall and run to an underground holding facility with polypropolene storage tanks sized to supply 1-2 days of fuel. Tanks will be contained in a lined catchment sized to 110% capacity. Tamerlane's Hazardous Spills Contingency Plan applies underground as it does above.
C-21	32, p3	Tamerlane will contain all stored fuels and lubricants in separate designed catchments, pipe fuel underground for short term use rather than batch re-supply, and have weekly re-supply to minimize on site quantities.
C-22	24, R-12, 242	The temporary construction magazine will house approximately 25,000 kg of explosives (the exact amount is dependent on delivery and weather restrictions) and be located a minimum of 330 meters from the nearest building of the Pine Point Pilot Project. The magazine will be bermed and follow the regulated minimum distance from operations of 235 metres.

C#	Document# & page#	Commitment
C-23	26, R-11	The temporary construction explosives storage facility will be designed, located and operated in accordance with NWT Mine Health and Safety Act and Regulations. Tamerlane will obtain an Explosives Magazine Permit for its temporary construction explosives storage facility.
C-24	161	Tamerlane has committed to primarily use emulsion explosives for mining the R-190 underground deposit, although operational variance may require different explosive products depending on ground conditions encountered, for isolated, short term events.
C-25	161; 199, p26	Best Management Practices adopted by Tamerlane's to minimize lossess of ammonia and nitrate at the PPPP include: All blast holes will be primed according to the explosive manufacturers specifications and any specific Tamerlane operating procedures; proper supervision of loading, emphasis on correct loading procedures and proper training updates of blasting personnel; the time that explosives sit in the ground in wet areas prior to detonation will be minimized, and down hole loading will be used.. These initiatives will be passed on through training of Tamerlane's employees and Contractors.
C-26	106, p453	Explosives ingredients (e.g., Ammonium Nitrate, diesel) will be transported to the site from local distributors in accordance with federal <i>Transportation of Dangerous Goods, Workplace Hazardous Materials Information System, and Explosives Act</i> requirements.
C-27	106, p147-8, 242	Both [underground explosives] storage drifts will be gated and locked with access keys given only to designated responsible employees. The two drifts will be separated by at least 4.5 metres (15 feet) of consolidated rock. One drift will be used for the safe storage of ANFO and Emulsion and the second drift will be utilized for all Detonators. Only properly trained and certified employees or contractors will be permitted to handle explosives.
C-28	106, p164-5	Explosives and detonators will be stored separately at the temporary surface explosives magazines. A primary lock will secure the magazines while a secondary loack will be used for a chain link fence to be installed at the magazine access.
C-29	4, Sections 2.10.3; 5.2	All fuel and lubrication tanks (welded in place) will be placed in an engineered and lined enclosure capable of holding 110% of the largest tank's capacity. Appropriate spill response equipment will be stored at the tank facility. Any fuel leaks and/or equipment spills will be reported to the On-Site Coordinator, who will record and report the spills and direct cleanup activities in accordance with the procedures described in Tamerlane's Hazardous Materials Spill Contingency Plan. A spill kit will be located at the surface fuel storage facility. The Environmental Advisor (EBA Engineering) will be involved in any spill response.
C-30	106, p453	Fuel and other hydrocarbons will be stored in accordance with the existing CCME environmental code of practice for storage of these products ²⁸ . Any spills will be immediately reported to the 24-hour Spill Report Line. Spill containment and cleanup will be in accordance with Tamerlane's Hazardous Materials Spill Contingency Plan.
C-31	105, Appendix F, p9	The On-Site Coordinator will conduct training for all surface personnel working in the techniques and materials required to manage hazardous spill responses. Training will include the following: initial spill response procedures; location and use of emergency spill response equipment; safe operation of equipment and tools to minimize spill potential; procedures to limit the potential and impact of spills; monthly safety discussions to address work hazards.
C-32	106, p170; 242, #37	Contractors involved in trucking will be qualified in transportation of dangerous goods and the trucks appropriately placarded in compliance with Transport of Dangerous Goods legislation.
C-33	106, p453	As regulated by the <i>NWT Mine Health and Safety Act</i> and regulations, Tamerlane will be developing an emergency response plan prior to mine operations. Response preparedness will be maintained for incidents involving medical, fire, underground flooding, fuel, refridgerant or concentrate spills or other environmental related incidents (e.g., wildlife collisions).
C-34	210, E-1	No cyanide compounds will be used in the flotation process or at all at the PPPP.
C-35	133	Any hazardous materials will be shipped to the hazardous waste facility in Hay River.

²⁸ Canadian Council of Minister's of the Environment document available at www.ccme.ca/assets/pdf/pn_1326_eng.pdf.

C#	Document# & page#	Commitment
Materials Management		
C-36	120, IR8	All product leaching will be captured and recycled through the process facility. In the unplanned event that a spill happens to the environment in the process plant, it will be treated like any other spill outlined in Tamerlane's Hazardous Materials Spill contingency plan.
C-37	4, Sections 2.5, 2.81, 2.8.2, 2.9.1	Monitoring of waste rock storage seepage will be included in design and operation of the waste rock storage location. The stockpile area will be covered and concrete lined or bermed. The monitoring of this facility will encompass visual inspections and periodic water quality tests to develop background baseline data for future operations. Capturing minute seepage from the temporary waste rock stockpile is a primary objective of the PPPP water management plan.
C-38	106, p154	Run-of-mine ore will be temporarily stockpiled in a enclosed heated structure with concrete pad
C-39	187, page iii	The floor of the process plant will be concrete lined and sloped to a central drainage sump.
C-40	145	Tamerlane commits to using an appropriate water treatment plan for sump cleanup in both the processing facility and the concentrate facility.
C-41	144, p4	There will be separate lead and zinc areas in the covered, heated storage building, each made with concrete floors and contained. If any seepage is collected, it will be sent to the processing circuit or the water treatment system.
C-42	106, p293; 199, p45	The mined out area will be backfilled with a waste rock/concrete mixture. By filtering off 40% more coarse mined material [in the expanded process plant] and using it as backfill, the project will not need any additional backfill sources.
C-43	187, IR35.2	Tamerlane will employ hydroelectric line power for the bulk of its power needs. A diesel generation plant will be used for some ancillary activities and primary safety and environmental back-up in the event of power failures or scheduled maintenance on the Taltson Dam.
Reclamation		
C-44	106, p290	To the extent possible, organic and mineral top soils will be salvaged and stored for future re-application during reclamation of the site
C-45	106, p290; 187, page X	Following removal of PPPP surface facilities, the remaining fill embankments, borrow pits, access roads and development footprint will be re-contoured and scarified to ensure surface stability and to facilitate the re-establishment of native vegetations. Re-seeding of disturbed areas with appropriate and approved native seed mixes will occur.
C-46	106, p417; 198, C-1; 242, #61	During closure, freeze plants will be turned off and brine completely removed from the system. Inner freeze pipes from surface down 185 meters will be reclaimed and reused. The external freeze pipes will be capped below surface and left in place. These wells will not be plugged, as they can provide a means for future water surveys. All infrastructure related to the freeze ring will be shipped off site. Temporary foundations and leakage barriers will be removed and hauled off site. The abandoned area where the freeze infrastructure once lay will be leveled and reclaimed in a manner consistent with INAC and Land Use Permit conditions.
C-47	199, p55	At closure, all freeze pipe brine will be removed from the system and possibly sold to another group. If they don't sell it, the developer will return it to the supplier for reuse or storage.
C-48	106, p418; 175, IR51.2; 198, C-3	Tamerlane will reclaim all externally exposed piping on or near the surface during closure. Water discharge lines will be reclaimed & shipped off site. Fuel and lube tanks & piping will be drained, washed, cleaned and then dismantled. Fuel and lube tanks, if not sold or reused, will be washed and the wash water captured and the tanks hauled off site to an appropriate disposal facility either in Hay River or Edmonton. All infrastructure will be removed from site. Catchment containment berms will be breached or re-contoured to encourage natural drainage.
C-49	106, p418	Waste oils will be shipped off site or consumed in used oil heaters. Unused explosives will be shipped off site or burned/destroyed on site. Standard practice is to consume unused or spilled explosives in the next blast initiated. In the event a bad batch of explosives is delivered, they will be picked up by the vendor and replaced. Unused chemicals and any other hazardous wastes will be treated on site or shipped off-site for disposal. All non-combustible, non-hazardous waste will be disposed of in the non-hazardous solid waste disposal facility located in Hay River. Peripheral equipment like lighting and signposting will be removed.

C#	Document# & page#	Commitment
C-50	106, p140-1 and p143	Reclamation [of the shaft] will consist of removing all pipes & support sets from the shaft. The head-frame will be removed & the concrete pad lifted if necessary. Once the shaft is cleared, a concrete plug will be installed on the ground that will extend several feet into the shaft. Reclamation [of the vertical conveyor] will consist of removing all surface and underground conveyor components and belting. Surface structures will be dismantled & removed from site.
C-51	106, p151 and p417	Temporary [surface] structures will be removed at the completion of the program unless future full-scale mining is deemed viable. All temporary buildings will be stripped down and prepared for off-site transport. Any remaining foundations will be removed or buried.
C-52	120, p74; 175, IR45.2	Tamerlane accepts all responsibility for proper cleanup of the used portion of the former gravel pit which will house the sediment settling pond. Reclamation of the settling pond will entail final agitation and removal of all sediments for mixture into the backfill for return underground. The liner will be removed and the area contoured as necessary to resemble its former state.
C-53	175, IR51.5	Post-closure monitoring for re-vegetation success is envisioned at 1 & 5 year post closure.
C-54	199, p53	If R190 is successful the shaft would be reused, the existing freezeway kept in place, and other freezeways set up as necessary to reach other ore bodies.
C-55	144, pp4-5; 242, #75	The Closure and Reclamation Plan will be updated if: the PPPP leads to expansion not contemplated in the existing Plan; there is a change (or proposed change) in reclamation procedures; there are unforeseen or significant hazards as well as operational changes identified. Should changes occur, Tamerlane will update community groups and regulators.
C-56	209	Tamerlane will follow reclamation guidelines set forth in section 15 of the Mackenzie Valley Land use Regulations and the 2007 INAC Mine Site Reclamation Guidelines as applicable.
Safety and Health		
C-57	175, IR40.1	All contractors or subcontractors will be required to sign and adhere to Tamerlane's policies and procedures when working on site. Any contractor or subcontractor found to not be in compliance will be escorted from the site and the validity of their main contract discussed.
C-58	232, p166	Tamerlane will conduct annual health and safety checkups for its employees.
C-59	120 IR12	Tamerlane has committed to using health and safety training as well as zero tolerance drug policy to promote a healthy employee population.
C-60	26, R-20	Tamerlane's Emergency Response Plan (ERP) will include: an emergency response coordinator, a site hazard assessment, an ERP committee, site personnel accountability method, posted and designated escape routes and assembly points, reporting procedures, alarm system notification, procedures for key employees required to remain to operate critical equipment, identity of medically trained employees, posting of emergency numbers and contacts throughout facility, emergency drills, annual employee reviews.
C-61	4, Section 2.11.4	The PPPP will employ a full-time training coordinator to implement and deliver specific training sessions. Safety related training will be given high priority and be a requirement for all employees and subcontractors. Required training will include: site orientation, mine site general safety rules, personal protective equipment use, hazardous materials spill contingency training, basic first aid training, and other (job specific) training.
C-62	4, Section 2.11.5	Tamerlane will comply with all Emergency Medical Response criteria associated with the <i>Mine Health and Safety Act</i> . An Emergency Response Plan will be distributed to all employees and posted for easy access in the event of an emergency. Selected employees will be trained in First Aid, and mine rescue crews will be on-site. A dedicated first aid facility will be located on-site. There will be a dedicated ground vehicle for evacuation to Hay River.
C-63	4, Section 5.1	All machinery will be equipped with standard noise suppression equipment. The company will construct earth berms as needed. Employee Personal Protective Equipment guidelines will also be outlined in all contractor and company operation procedures.
C-64	106, p150	All [underground] escape routes will be inspected on a regular interval and maintained in a safe, travelable condition. Both the primary & secondary escape-ways will be marked with conspicuous & easily read direction signs that clearly indicate escape routes. Prior to entering the mine, all personnel will be trained & oriented to proper methods of escape from the mine.

C#	Document# & page#	Commitment
C-65	10, Section 8. Roads; 120, p34	A manned gate will be installed at the guard shack on site to provide security for plant equipment and materials. It will also serve as a safety precaution and prevent the public from coming into contact with plant equipment and explosives. The guard shack will be positioned such that no walking or driving access will be possible w/o checking into the guard shack first. In the event that unauthorized human access is attempted the individual's personal information will be gathered and they will be turned around at the guard shack.
C-66	120, p34	Appropriate signage is to be posted along all visible points surrounding the project site, including indications of a no shooting zone between the highway and project site. Tamerlane will consult on a consistent basis with the local Aboriginal groups to ensure that traditional land users are aware of the project and its boundaries.
Socio-economic		
C-67	187, page i	No camp facilities will be used during the life of the PPPP.
C-68	44; 106, p381; 175, IR41.3	Tamerlane will employ as many persons as it can from the limited local labour pool. Criteria for employee selection will recognize the value of years of experience in the work world, work ethic and quality of the worker as equivalent to education on a case-by-case basis.
C-69	175, IR40; 242, #105	Tamerlane is incorporating its policy to maximize Northern and Aboriginal employment into its final contractual agreements with key specialized contractors. Contractors are required to hire as many skilled & non-skilled employees from the local communities as possible and provide on-the-job training to those employees.
C-70	175, IR41.1	Tamerlane will conduct pre-employment screening, including criminal background checks on all finalists. In considering whether to hire a finalist who has been convicted of a criminal offense, several factors will be considered, including: the relevance of the criminal conviction to job duties, the date of the most recent offense and employment history since the commission of the crime, the nature of the offense, the accuracy of the information the finalist provided on the employment application, [and whether the offense was committed as a minor].
C-71	175, IR41.2	Tamerlane will have zero tolerance for possession &/or use of drugs or alcohol at any Tamerlane work site, and will conduct drug screens for "reasonable cause" & "post-accidents".
C-72	120, IR17	Medical/dental benefits will be available to employees and their immediate families.
C-73	175, IR44.1	Tamerlane is working with the Mine Training Society to begin an underground mine training program that will provide training for the communities of Fort Resolution and Hay River. The classes will be in sizes of 12 students per community depending on the demand. Additional instructors or classes may need to be added if demand is high. Tamerlane has committed to hiring 6 people each from the KFN and the DKFN, as well as 6 people from each of the HRMC and the FRMC. Tamerlane's HR Superintendent will liase with the community points of contact and the Mine Training Society to advertise, screen and select candidates.
C-74	175, IR44.2	Tamerlane will continue upon request to provide content expertise to the Mine Training Society in development of curriculum for college certificate level training in mining at Aurora College.
C-75	45, p8; 187, pp iv, ix	The Tamerlane [training] program will initially be designed to fill apprenticeship and technological occupations. The apprenticeship program will allow non-skilled employees the opportunity to garner skills for advancement opportunities within the company. Infrastructure contractors will be required to hire trainees & adhere to developer's training guidelines.
C-76	106, p340 and p357; 120, p58	Tamerlane's commitment to training will include site-based on the job training and support of a number of apprenticeships. Training opportunities include pre-employment, on the job, health and safety, environmental protection and archaeological resource protection. Tamerlane will consult and collaborate with local Aboriginal interests & communities to encourage effective development and delivery of training programs.

C#	Document# & page#	Commitment
C-77	106, pp359-360	In considering contract bids, Tamerlane will prioritize Aboriginal and northern (South Slave) businesses through a number of measures to maximize project-related business opportunities. This will include preparing annual business opportunities forecast to identify foreseeable procurement requirements for mining equipment, operations & maintenance support services; technical support & assistance in accessing sources of commercial capital; working closely with local First Nations interests and communities; identifying project components at all stages of development and operations that should be targets for a northern business development strategy; facilitating subcontracting opportunities for northern businesses; & identifying opportunities for joint ventures with Aboriginal and northern businesses.
C-78	45, p8	Within a certain reasonable percentage, local northern contracts will be preferred.
C-79	120, p48	Tamerlane has already and will continue to seek out bid packages from all local communities and aboriginal groups for the non-specialized services required for the project. Tamerlane will work first with the aboriginal groups to determine and demonstrate capacity, competitiveness, regulatory requirement compliance and Tamerlane's operational requirement. If this cannot be done the developer will encourage joint venturing w/local business to meet these requirements.
C-80	120, p41	Tamerlane is actively working with communities, chiefs and councils to ensure traditional land users who currently frequent the project area will be accommodated during the life of PPPP.
C-81	120, IR18	During early stages of construction orientation sessions will be held w/personnel to address the issues including: site safety, heritage/archaeological protection, environmental protection. The Heritage resource component includes information on legal, reporting and mitigation requirements related to protection of Archaeological/Heritage Resources if any are found.
C-82	242, #49	If unexpected archeological materials are encountered during any phase of the development, all activity in the area will cease and the PWNHC and any affected First Nations will be contacted.
Transportation and Operations at the Ore Transfer Facility		
C-83	120, p27; 187, IR35.2; 232, p85	At the ore transfer facility, concentrate will be handled in a fully enclosed shelter, the facility size will be large enough to ensure rail loaders and haul truck traffic in and out, the facility will be constructed with a concrete floor, the facility will contain, treat and recycle all wash water on site, the facility will be supported by CN's environmental policy and standards. Tamerlane will follow its cleanup procedures as outlined in its Hazardous Materials Spill contingency plan if there is a spill at the transfer facility. Any spillage of concentrate will be picked up and the remaining residue on concrete floors will be washed into the wash sump and treated. Concrete barriers will separate the zinc from the lead. All material will be contained inside the building. Before trucks depart the building, an automated wash will clean undercarriages. The wash water will be collected in a sump and routed through a small water treatment plant. The resulting clean water will be reused. Any solids buildup over time will be added to the concentrate bins for loading into railcars. Railcar loading activities will also take place inside the building to eliminate outside exposure. The railcar will be covered and sealed before it leaves the building.
C-84	195	Tamerlane's proposed rail loadout facility will have a concrete foundation and walls will be constructed ~1.0 m above the Designated Flood Level set by the Town of Hay River.
C-85	106, p164; 232, p164	Before the concentrate leaves the minesite storage facility, it will go over an undercarriage truck wash that will clean the underside of the undercarriage of the truck. All haul trucks will be covered and undergo an external inspection to ensure everything is clean, covered and enclosed properly. Trucks will be sent for clean up, if necessary, before departing from the PPPP site. If the security guard deems a truck to be overloaded, the truck will be returned to the concentrate loadout area to have its load adjusted.
C-86	106, p170	Tamerlane will conduct construction, repair and maintenance of the access roads from Highway #5 to the PPPP site year round to ensure safe access for the PPPP & local land users.
C-87	106, p197	Tamerlane will provide daily transportation via bus/van to and from site to workers from Hay River and Fort Resolution, funded by Tamerlane, from designated parking areas.
C-88	106, p454	Concentrate product will be transported from the PPPP site to the Hay River railhead in designated trucks equipped with covers.

C#	Document# & page#	Commitment
C-89	232, p278; 242, #118	If highway maintenance [in the area travelled by PPPP-related activities] is in excess of the funds made available, Tamerlane will work with the GNWT DoT to help maintain that section of the road. For example, if the 1 kilometre of the chip seal road becomes a major maintenance issue, the developer would work with the DoT to mitigate that, including potentially paving the road back to the site to ensure proper and safe operating parameters.
C-90	106, p96 and p380; 120, p15	Tamerlane initially plans to haul during the day shift to use the daylight hours and coincide with the rail loading operations conducted by CN. But, as necessary, Tamerlane is willing to stagger haul schedules, or run graveyard shift hauling. The haul trucks to follow all operating regulations in the NWT and operate within the posted speed limits. Tamerlane will require its employees, contractors or subcontractors to comply with government and company transportation policies and regulations during any PPPP-related transportation. Tamerlane will reinforce this expectation with all employees & contractors.
C-91	120, p15	If a truck accident occurs, Tamerlane will first assist local authorities secure the safety of the truck driver and other vehicle traffic. Then, Tamerlane will scoop up the concentrate and load it into another truck. The truck will haul the concentrate to either the rail loadout site or back the facility for re-processing
C-92	232, p277	Tamerlane will post proper signage to make sure people are aware of main intersections used by Tamerlane traffic.
		Waste Management
C-93	160	Used oils will be burned in an approved used oil heater (i.e., an incinerator approved by the Canadian Standards Association of the Underwriters' Laboratories of Canada for incineration of used oil and waste fuel). The developer will adhere to ENR's <i>Used Oil and Waste Fuel Management Regulations</i> , including providing a burning plan for the site.
C-94	187, page iv; 242, #124	All solid non-combustible and non-hazardous waste will be collected and consolidated as frequently as necessary and disposed of in the Hay River landfill.
C-95	160	The Town of Hay River accepts waste originating outside of the municipal boundary including hazardous wastes such as propane tanks, batteries, paints, solvents, glycol, petroleum products, pesticides and corrosive substances and is agreeable to enter into an agreement with Tamerlane to accept waste generated from the proposed PPPP.
		Water Management
C-96	175, IR48.2	The BIODISK treatment system will be used for treating sewage, and the treated sewage [and greywater] will be co-mingled with process and minewater and directed to the gravity well
C-97	209	The sewage treatment plant will meet the Camp Sanitation Regulations, RR.NWT. 1990 c P12 and Public Health Act, RS.NWT. 1998, c P12.
C-98	106, p263	There will be no direct discharge of any DMS circuit or mine-related water discharges to any surface water such as area streams or lakes.
C-99	198, Appendix A	Each discharge well will be cased to the top of the Presquile aquifer strata. The bottom of the well will be an open hole drilled through the entire thickness of the Presquile Dolomite, to take advantage of all available capacity. The open hole section will be lined with a perforated well liner. Discharge water will be fall through a drop pipe that extends below the static water level.
C-100	175, IR45.1 and IR47.5; 210, I-5	A secondary discharge well will be drilled next to the primary well to serve as a back-up to the primary disposal well for maintenance activities and to function in the unlikely event problems occur with the primary well. The backup well will be identical to the primary well, but located approximately 100-200 metres away from and down-gradient of the primary well. The secondary well will be plumbed in from project outset. Discharge water can be rerouted through valves and pipes to this secondary well if routine maintenance or unexpected fouling of the primary well occurs.
C-101	199, p61	The developer will locate the discharge wells in an area of high aquifer activity (a "hinge line").

C#	Document# & page#	Commitment
C-102	232, p27	Pump tests will be undertaken on the two discharge wells to provide more information about the aquifer and its capacity to take the outflows from the operation - permeability and K-values will be recalculated and the water management system altered accordingly.
C-103	242, #132	Tamerlane will be adhering to best practice standards for gravity well maintenance. Gravity well maintenance methods will vary based on the type of fouling occurring, but will occur when the specific capacity of a well drops 25%.
C-104	232, p161	During well maintenance, the discharge water will be diverted to the backup well. And the primary well will be cleaned mechanically with a brush arrangement and/or cleaned hydraulically with surging water. If there's a buildup of calcium carbonate deposits or other minerals some chemical additives will be added to the well temporarily to break those up.
C-105	232, p209	Prior to discharge of the water into the well, a mechanical filter will filter out a certain fraction of the particulates which might be in the water, also a degassing element so any evolved gas can be taken off. The developer will measure the levels of suspended solids or particulate matter prior to release into the wells and document that it is as low as possible.
C-106	198, S-1; S-2	The sediment settling pond will utilize materials excavated during the shaft sinking operations. A high density polyethylene (HDPE) liner will be utilized, with a thin layer of gravel or waste rock under it to act as protection against puncture. The settling pond will be approximately 121,680 cubic metres capacity. An HDPE discharge line from the process facility will be buried along the access road and discharge into the pond. A sump with an agitator will provide agitation of any suspended sediments that will be pumped back to the process facility through a second HDPE buried line, and used in the underground backfilling process.
C-107	210, M-3; S-4	The settling pond will be used not only as a temporary storage for process water in the event of high suspended solids but also as an initial usage during start-up of operations to test all facilities and processes before discharging into the primary discharge well. In addition, the settling pond can be used when maintenance is occurring on the discharge well system.
C-108	120, p64; 198, S-3; 232, p161	If unexpected exceedences occurred, or a power outage or something that may cause a surge of sediments through the system, contaminated process water would be aerated and agitated with lime slurry or another appropriate material in the settling pond, prior to being sent to the discharge well. Hydroxides would be settled/thickened and then mixed with DMS "float" reject plus cement for final deposition as backfill in the mined out underground areas. Proactive measures would include pH monitoring of the discharge water.
C-109	198	If the settling pond breaches, Tamerlane will take immediate steps to first stop any further introduction into the sediment pond and then transfer all clean water to the gravity well, and if necessary, agitate and transfer solids to the backfilling system. Tamerlane will then clean up all material and repair the area back to design specifications.
C-110	199, p24; 232, p207; 242, #153	Once the development starts, representative water samples will be taken from depth and the findings built into water management systems. The developer will be contracting out a third party to do additional test work to provide additional information on suspended solids in the mine water. The end of flotation circuit will have a conventional thickener to which flocculants will be added to keep the suspended solids to a number under 50. In the unlikely event that additional flocculants to the discharge thickener don't produce the desired water quality, overflow water could be pumped to the lined settling pond for additional settling time.
C-111	198, O-2	Flotation system operators will be trained in a thorough personnel training program to prevent excess quantities of all reagents entering the process. The operator training will include their purpose, addition point to the flotation circuit and the proper handling, measuring and mixing. Signs will identify the reagents. MSDS classifications will be distributed to all operators and copies will be located in the operator control rooms and in the reagent mixing/storage area. A written contingency plan for the handling of reagent spills will be prepared before the commissioning of the DMS and flotation plants.

C#	Document# & page#	Commitment
C-112	210, M-3; E-2	Tamerlane will be putting in place a pumping system with a maximum capacity of 2,273 m3/hr. In the event that higher inflows of water than the pumping system is designed for are encountered early on during development and operations, Tamerlane will install additional pump capacity.
C-113	26, R-23; 133; 242, #142	All mine inflows will be shipped through plastic piping methods, except in the shaft and process facility, where structural considerations require steel piping. Tamerlane will heat tape and bury the near surface water distribution lines to prevent exposure.
C-114	210, E-1; 242, #136	If inflows to the mine are too low to run the process plant, the developer will acquire makeup water from surface wells in the area, established during the construction phase of development.
C-115	106, p278; 232, p34; 242, #145	Implementation of erosion control measures will be implemented as warranted and may include, but are not limited to, ditching and sloping as necessary. During construction, Tamerlane will install silt barriers to make sure no sediments get into the marsh area.
Water Monitoring		
C-116	4, p3; 242, #143	Tamerlane commits to water quality sampling for a minimum of six months after completion of the PPPP. The specific post-operative sampling timeline will be re-evaluated based on the results of the water quality test work to ensure compliance with water license criteria.
C-117	120, p79	Persons responsible for conducting water quality monitoring program as well as any other environmental management responsibilities are expected to include locally-based personnel to participate in reporting results of testing and other environmental data gathering to the local communities. This includes dedicated environmental monitors from each community, trained by Tamerlane in monitoring techniques for educational purposes.
C-118	175, IR47.1; 198; 242, #134	The following parameters will be measured and monitored at the discharge well(s): flow rate, pressure at discharge well head, pumping water level, discharge water chemistry, air venting, and sediment filtering. Well head systems, controls & monitoring will be in an enclosed, secure & weather-proof control house. Data from the control house will be logged and interfaced into a site specific monitoring program. There will be safety sensors and alarms to indicate unacceptable variances with the well operation. Monitoring will continue after shutting down of the gravity well system, to document the recovery of groundwater to a natural static water level. In addition, groundwater sampling for chemical analysis in accordance with the mine closure plan will occur at these sites.
C-119	232, p82	There will be a minimum of three separate monitoring points dedicated to the gravity well system. In addition, the primary discharge well will be monitored for buildup of head [mounding] in the casing. The 2 nd backup well, when not in use, will be used to monitor for changes in the water level in that well and also for samples of ground water to measure what the quality of water is as it flows to that 2 nd well. There will be two smaller diameter monitoring wells, one at about 300 metres from the primary well and one about 800 metres away from the primary well. These 2 monitoring wells will measure both the buildup of water level and be able to be sampled for water quality.
C-120	175, IR47.4; IR49.4	When not in use, the backup gravity well will be accessible for a submersible groundwater sampling pump. This configuration could be temporary (installed only at the prescribed sampling intervals) or semi-permanent as a dedicated sampling pump (to be removed only when the backup well was needed for discharge purposes). Water quality at the gravity well itself will be monitored for key indicator parameters as required. Water samples will be taken according to a prescribed schedule and submitted to a chemical laboratory. An automatic sampler will be placed in each well to take a sample before water enters the gravity well pump.
C-121	198	Tamerlane will employ an Environmental Health and Safety coordinator responsible for monitoring on the condition of the sediment settling pond.
C-122	133	Tamerlane will regularly monitoring effluent prior to its leaving the process circuit.

C#	Document# & page#	Commitment
Wildlife		
C-123	160	GNWT's <i>Food and Waste Management Guidelines</i> will be implemented to ensure carnivores do not become habituated and eventually require relocation and destruction.
C-124	106, pp309; 312	All waste foods and human garbage will be stored in wildlife proof containers prior to offsite disposal in an approved manner. No landfilling of such wastes will be conducted on site.
C-125	233, p1	Tamerlane will have sealed solid and liquid waste containers, most of them located indoors.
C-126	233, p1	Tamerlane will incorporate new hire orientation to include awareness of best practices pertaining to waste management and wildlife avoidance.
C-127	160	As required by the <i>NWT Mine Health and Safety Regulations</i> (s.15.05), all field personnel will undertake bear-safety training. In the event that a bear is disturbed and/or encountered during project operations, information on the sighting will be forwarded to the local Renewable Resource Officer at the earliest opportunity. If a bear is encountered, response should be in accordance with ENR's <i>Bear Response Guidelines</i> (by extension, all employees must be familiar with these guidelines; it will be included in employee training). Any defense of life and property kills must be reported. Tamerlane will develop a project bear response plan.
C-128	35, R-7	If a grizzly bear is disturbed and/or encountered during project operations, information on the sighting will be forwarded to the local Wildlife officer at the earliest opportunity.
C-129	35, R-7	If a mineral lick is found in the project area, the proponent will maintain a 300 m buffer zone between any development activities and the lick.
C-130	35, R-7	If an active wolf or fox den is observed in the project area a buffer of 800m for wolf and 150 m for fox will be maintained between the den and any development activity between May 1st and July 15th. Further, these sites will not be approached on foot by project personal.
C-131	35, R-7	If a nest site of a peregrine falcon or short-eared owl is identified in the project area, a buffer of 1.5 km will be maintained between development activities and the nest site from April 15 th to September 15 th .
C-132	242, #86	If woodland caribou or any other wildlife is encountered during the development they will be left alone, and as necessary, local wildlife officials will be consulted.
C-133	106, p334	Tamerlane will conduct limited wildlife monitoring in the immediate vicinity of the PPPP development area. Tamerlane will record all significant wildlife observations made by PPPP personnel while in the project area, and report any wood bison sightings to GNWT's ENR.
C-134	232, p236	The primary mitigation measure for any species at risk will be avoidance. If species at risk are encountered the proponent will avoid contact with or disturbance to the species, its habitat, or its residence. Monitoring will be done to determine the effectiveness of mitigation or to determine if further mitigation is required. At minimum, the proponent will record and provide to the relevant authorities all observations of any species at risk, including information on location sighted, number and reaction of the wildlife to project activities, and in some cases further monitoring may be required for particular species. Mitigation and monitoring will be consistent with recovery strategies and action or management plans for the particular species.
C-135	232, p237	The proponent will undertake monitoring for whooping crane near the project site. Wetlands near the project site including the area identified as shrubby fen in the local study area will be visually checked every two weeks from May to September to see if any cranes are present. If a whooping crane is observed, the wetland area will be visually checked on a weekly basis for cranes and measures undertaken to avoid disturbance to the bird. As well, Environment Canada will be contacted to determine whether any further mitigation measures are required.
C-136	232, p238	The proponent will conduct a survey for Yellow Rails near the project area. The survey will include the area identified as "shrubby fen" in the local study area and any other wetland areas near the project site. The survey will be done in June 2008 or in June the year before project activities begin. If rails are observed or heard, measures will be undertaken to avoid disturbance to the birds, the area will be re-surveyed in subsequent years, and Environment Canada contacted to determine if any further mitigation might be required.

Tamerlane Pine Point Pilot Project Report of Environmental Assessment and Reasons for Decision
Mackenzie Valley Environmental Impact Review Board

C#	Document# & page#	Commitment
C-137	232, p255	The developer will provide employee education on SARA-listed species, so workers know what they are looking at and know what to identify when they see it, as well as make a policy that sightings are reported immediately to the Environmental Health and Safety Manager.
C-138	144, pp2-3	Infrastructure design, to the extent reasonable, will implement to following to minimize predator attraction: wedges of greater than 45 degrees to deter ravens from nesting; enclosure of all areas (large and small) with horizontal surface that can be enclosed; horizontal supports of the minimum possible width; heat exhaust from incineration or activity being recycled to heat other buildings will be transported using glycol in insulated pipes; anti-nest spikes or angled surfaces will be used near heat sources at greater than 45 degrees; infrastructure surface complexity will be reduced to avoid small nooks and crannies; all buildings and stairs will be skirted down to the ground; waste management will be consolidated in one secure, well-monitored location; domestic waste will not be exposed to the environment; all infrastructure will be continuously monitored for points of compromise; monitoring of wildlife use of decommissioned sites will continue post-closure; and a knowledgeable wildlife specialist will be contracted to evaluate building plans and operations to identify points of likely exploitation.
C-139	187, IR35.2	Power pole locations are being designed alongside the existing access road to minimize exposure to nearby fen areas. Marking material will be added to enhance visibility of the power lines between the poles.
C-140	187, page vii	Tamerlane will implement a no hunting policy for all employees and contractors working on or off-site for Tamerlane. In addition, the company will require all project-related transportation activities to give the right-of-way to any wildlife that such activities may encounter.

Appendix C: Public Registry Index

Registry Item #	Document Name	Date Filed	Originator
1	Tamerlane Pine Point - Developer Notification (28-June-06)	28-Jun-06	MVEIRB
2	Pine Point letter of referral from EC (27-June-06)	28-Jun-06	Environment Canada
3	Public notice of referral - Tamerlane PPPP	29-Jun-06	MVEIRB
4	Initial development application to Land and Water Board	30-Jun-06	Tamerlane Ventures
5	PS file -Tamerlane to Land and Water Board re. DMS info.	30-Jun-06	Tamerlane Ventures
6	PS file – INAC Water Comments	30-Jun-06	INAC Waters
7	PS file – INAC comments (27-June-06)	30-Jun-06	INAC
8	PS file - Land and Water Board to Stanton Health Authority	30-Jun-06	MVLWB
9	PS file – NTMN concerns (June-06)	30-Jun-06	NWTMN
10	Water license and land use permit applications	30-Jun-06	Tamerlane Ventures
11	PS file - Land and Water Board distribution list for PPPP	30-Jun-06	MVLWB
12	PS file - DMS note from Malcolm Robb	30-Jun-06	MVLWB
13	Water license and land use permit applications	04-Jul-06	Tamerlane Ventures
14	Tamerlane MDAG presentation (30-May-06)	05-Jul-06	Tamerlane Ventures
15	Map from INAC to Land and Water Board (22-June-06)	06-Jul-06	INAC
16	MVEIRB letter to EC re. SARA notification (7-July-06)	07-Jul-06	MVEIRB
17	Distribution list as of July 13, 2006	13-Jul-06	MVEIRB
18	Preliminary screening comments from GNWT (27-June-06)	11-Jul-06	GNWT
19	NRCAN explosives questionnaire for Tamerlane	11-Jul-06	NRCAN
20	Summary of preliminary screening comments	13-Jul-06	MVEIRB
21	HRMC letter to Tamerlane (14-July-06)	19-Jul-06	HRMC
22	Tamerlane to MVEIRB re. DMS circuit (18-July-06)	19-Jul-06	Tamerlane Ventures
23	Tamerlane presentation to INAC and EC (12-July-06)	20-Jul-06	Tamerlane Ventures
24	Tamerlane response to NRCAN explosives questions	20-Jul-06	Tamerlane Ventures
25	MVEIRB notice to distribution list re. scoping sessions	21-Jul-06	MVEIRB
26	Letter from Tamerlane to NWTMN re. concerns	21-Jul-06	Tamerlane Ventures
27	Hydrology test of R190 for Westmin Resources Ltd. (1983)	21-Jul-06	Tamerlane Ventures
28	Hydrology test of R190 by Brown Erdman (4-April-1982)	21-Jul-06	Tamerlane Ventures
29	Article: <i>Open-Pit Dewatering at Pine Point Mines</i>	21-Jul-06	Tamerlane Ventures
30	Article: <i>Aspects of Open-Pit Dewatering at Pine Point</i>	21-Jul-06	Tamerlane Ventures
31	Invitation to visit Tamerlane site on Aug. 17, 2006	24-Jul-06	Tamerlane Ventures
32	Minutes from Tamerlane/regulator meeting of 12-July-06	25-Jul-06	Environment Canada
33	MVEIRB letter to distribution list re. scoping sessions	02-Aug-06	MVEIRB
34	Tamerlane response to INAC re. preliminary screening	03-Aug-06	Tamerlane Ventures
35	Tamerlane response to GNWT re. preliminary screening	03-Aug-06	Tamerlane Ventures
36	Maps to get to Fort Resolution scoping sessions	03-Aug-06	MVEIRB
37	Tamerlane public registry update (3-Aug-06)	03-Aug-06	MVEIRB
38	Environment Canada SARA notification letter response	14-Aug-06	Environment Canada
39	Invitation to provide supplementary scoping comments	21-Aug-06	MVEIRB

Tamerlane Pine Point Pilot Project Report of Environmental Assessment and Reasons for Decision
Mackenzie Valley Environmental Impact Review Board

Registry Item #	Document Name	Date Filed	Originator
40	Tamerlane presentation for technical scoping sessions	21-Aug-06	Tamerlane Ventures
41	Tamerlane presentation for community scoping sessions	21-Aug-06	Tamerlane Ventures
42	DKFN scoping session submission (17-Aug-06)	21-Aug-06	DKFN
43	MVEIRB presentation at Tamerlane scoping sessions	21-Aug-06	MVEIRB
44	Fort Resolution scoping session meeting report (17-Aug-06)	23-Aug-06	MVEIRB
45	Hay River scoping session meeting report (16-Aug-06)	23-Aug-06	MVEIRB
46	Hay River scoping session sign-in sheet	06-Sep-06	MVEIRB
47	Fort Resolution scoping session sign-in sheet	06-Sep-06	MVEIRB
48	Draft <i>Terms of Reference</i> and workplan release (6-Sept-06)	06-Sep-06	MVEIRB
49	PPPP public registry update (6-Sept-06)	06-Sep-06	MVEIRB
50	Deninu Kue post scoping comments (24-Aug-06)	06-Sep-06	DKFN
51	Tamerlane community engagement log to (23-Aug-06)	06-Sep-06	Tamerlane Ventures
52	BEAK preliminary environmental evaluation	06-Sep-06	Tamerlane Ventures
53	Hydrogeologic evaluation for Environment Canada (1983)	06-Sep-06	Tamerlane Ventures
54	Kara King post-scoping sessions questions and comments	06-Sep-06	Kara King, DKFN
55	List of historical files at CS Lord Geoscience Center	06-Sep-06	Tamerlane Ventures
56	NWTMN post-scoping sessions comments (28-Aug-06)	06-Sep-06	NWTMN
57	Tamerlane PPPP Draft <i>Terms of Reference</i> (7-Sept-06)	07-Sep-06	MVEIRB
58	INAC post-scoping comments (6-Sept-06)	07-Sep-06	INAC
59	Tamerlane response to draft <i>Terms of Reference</i>	13-Sep-06	Tamerlane Ventures
60	Email - INAC to MVEIRB re. request for draft <i>Terms of Reference</i> comment	13-Sep-06	INAC
61	NRCAN Explosives Questionnaire for Pine Point	13-Sep-06	MVEIRB
62	NTMN comments on draft <i>Terms of Reference</i>	14-Sep-06	NWTMN
63	Cover letter for Environment Canada's draft <i>Terms of Reference</i> comments	15-Sep-06	Environment Canada
64	Environment Canada comments on Tamerlane draft <i>Terms of Reference</i>	15-Sep-06	Environment Canada
65	INAC comments on Tamerlane draft <i>Terms of Reference</i>	21-Sep-06	INAC
66	MVEIRB response to NTMN request for comment extension	22-Sep-06	MVEIRB
67	NTMN request for extension to comment period for <i>Terms of Reference</i>	22-Sep-06	NWTMN
68	Comments from GNWT-ENR on draft <i>Terms of Reference</i> for PPPP	22-Sep-06	GNWT - ENR
69	Notification re: submission of comments on draft <i>Terms of Reference</i>	22-Sep-06	MVEIRB
70	DKFN comments on draft <i>Terms of Reference</i> for Tamerlane PPPP	25-Sep-06	DKFN
72	Final <i>Terms of Reference</i> and Work Plan	02-Oct-06	MVEIRB
73	Notification concerning Final <i>Terms of Reference</i>	03-Oct-06	MVEIRB
74	Final Work Plan	05-Oct-06	MVEIRB
75	TK study agreement between Tamerlane and DKFN	07-Nov-06	DKFN
76	Tamerlane article from StockHouse (30-Oct-06)	07-Nov-06	StockHouse
77	Town of Hay River comments on draft <i>Terms of Reference</i> (25-Sept-06)	03-Jan-07	Town of Hay River

Tamerlane Pine Point Pilot Project Report of Environmental Assessment and Reasons for Decision
Mackenzie Valley Environmental Impact Review Board

Registry Item #	Document Name	Date Filed	Originator
79	Hay River Hub article re. info session (10-Jan-07)	12-Jan-07	Hay River Hub
80	Notice re. receipt of <i>Developer's Assessment Report</i>	22-Jan-07	MVEIRB
81	<i>Developer's Assessment Report</i> Deficiency Statement for Pine Point Project	22-Jan-07	MVEIRB
82	Notice of <i>Developer's Assessment Report</i> Deficiency Statement for Pine Point Project	22-Jan-07	MVEIRB
83	CBC article on Hay River meeting (17-Jan-07)	22-Jan-07	CBC News
84	Northern News Services article (22-Jan-07)	25-Jan-07	Tamerlane Ventures
85	Hay River Hub article (24-Jan-07)	25-Jan-07	Hay River Hub
86	Instructions re. treatment of news items on public registry	25-Jan-07	MVEIRB
87	1998 Evans <i>et al</i> study of Pine Point Mine effects on water	07-Feb-07	Tamerlane Ventures
88	Letter from Town of Hay River (12-Feb-07)	12-Feb-07	Town of Hay River
89	Report on Great Slave Reef lead-zinc deposits (2001)	12-Feb-07	Tamerlane Ventures
90	Mine site reclamation guidelines for the NWT (2006)	13-Feb-07	INAC
91	Tamerlane public registry update (13-Feb-07)	13-Feb-07	MVEIRB
92	MVEIRB letter to Town of Hay River (16-Feb-07)	19-Feb-07	MVEIRB
93	CBC news item on MLA's Pine Point concerns (19-Feb-07)	19-Feb-07	CBC
94	Comments on PPPP from Greg McMeekin of Hay River	22-Feb-07	Greg McMeekin
95	<i>Error on the public registry, copy of Item 94</i>	<i>n/a</i>	<i>n/a</i>
96	Minerals of Pine Point webpage	22-Feb-07	Greg McMeekin
97	R. Swanson letter of support for Tamerlane PPPP	24-Feb-07	R. Swanson
98	Tamerlane public registry update (7-Mar-07)	07-Mar-07	MVEIRB
99	DKFN press release (6-Mar-07)	07-Mar-07	DKFN
100	Greg McMeekin email (25-Feb-07)	07-Mar-07	Greg McMeekin
101	News North Tamerlane article (5-Mar-07)	08-Mar-07	News North
102	KFN letter of support (20-April-07)	19-Apr-07	KFN
103	Tamerlane response to <i>DAR</i> deficiencies with Appendix	19-Apr-07	Tamerlane Ventures
104	Tamerlane public registry update (19-Apr-07)	19-Apr-07	MVEIRB
105	Tamerlane <i>Developer's Assessment Report</i> Appendices	02-May-07	Tamerlane Ventures
106	Tamerlane <i>DAR</i> Master Final Report	02-May-07	Tamerlane Ventures
107	Tamerlane <i>DAR</i> Plain Language Summaries (April 2007)	02-May-07	Tamerlane Ventures
108	Notice of Tamerlane site visit (23-May-07)	03-May-07	MVEIRB
109	Notification of receipt of <i>DAR</i> to distribution list (3-May-07)	03-May-07	MVEIRB
110	Request for Party Status form	09-May-07	MVEIRB
111	Notice to distribution list re. background of expert advisors	09-May-07	MVEIRB
112	Fax cover on first round IRs	15-May-07	MVEIRB
113	Fax cover on technical meeting topics questionnaire	15-May-07	MVEIRB
114	Notice to distribution list that first round IRs are on website	15-May-07	MVEIRB
115	Technical meetings topics questionnaire	15-May-07	MVEIRB
116	First round of information requests for PPPP (15-May-07)	15-May-07	MVEIRB
117	EC response to first round of IRs (18-May-07)	18-May-07	Environment Canada
118	Greg McMeekin email & MVEIRB response (17-May-07)	18-May-07	Greg McMeekin
119	PPPP site visit report (4-Jun-07)	01-Jun-07	Pat Duxbury

Tamerlane Pine Point Pilot Project Report of Environmental Assessment and Reasons for Decision
Mackenzie Valley Environmental Impact Review Board

Registry Item #	Document Name	Date Filed	Originator
120	Tamerlane response to Round 1 IRs	04-Jun-07	Tamerlane Ventures
121	Tamerlane support letter from MLA Hay River South	04-Jun-07	Jane Groenewegen
122	Tamerlane public registry update (4-Jun-07)	04-Jun-07	MVEIRB
123	Fax cover on project update (4-Jun-07)	04-Jun-07	MVEIRB
124	Hay River Métis Council letter of support (5-Jun-07)	08-Jun-07	Hay River Métis
125	Hay Rive North MLA letter of support	08-Jun-07	Paul Delorey
126	Tamerlane technical meetings - EC comments	14-Jun-07	Environment Canada
127	Tamerlane technical meetings - GNWT comments	14-Jun-07	GNWT
128	GNWT response to IR #34 (11-Jun-07)	14-Jun-07	GNWT
129	Letter of support from DKFN for PPPP	14-Jun-07	DKFN
130	INAC response to IR # 32 (13-Jun-07)	14-Jun-07	INAC
131	Tamerlane technical meetings – INAC comments	14-Jun-07	INAC
132	Tamerlane additional material for IR # 19	14-Jun-07	Tamerlane Ventures
133	Tamerlane response to proposed technical meeting topics	19-Jun-07	Tamerlane Ventures
134	Notification of party status	20-Jun-07	MVEIRB
135	Notice of technical sessions in Hay River (9-May-07)	20-Jun-07	MVEIRB
136	Tamerlane public registry update (22-Jun-07)	22-Jun-07	MVEIRB
137	MVEIRB questions for the PPPP technical meeting	25-Jun-07	MVEIRB
138	Agenda for technical sessions	26-Jun-07	MVEIRB
139	Meeting notes from pre-technical session meeting	28-Jun-07	MVEIRB
140	Final agenda for technical sessions	05-Jul-07	MVEIRB
141	INAC proposed technical sessions questions	05-Jul-07	INAC
142	INAC - Fort Resolution fish study	05-Jul-07	INAC
143	NWT Mine site reclamation guidelines (2007version)	06-Jul-07	INAC
144	Notes from Tamerlane July 5 conference with regulators	06-Jul-07	Environment Canada
145	Water treatment plant specifications	06-Jul-07	Tamerlane Ventures
146	Fort Resolution Métis concerns from analysis of <i>DAR</i>	06-Jul-07	FRMC
147	Additional Topic 1 questions for technical sessions	06-Jul-07	MVEIRB
148	Water related documents for technical sessions	09-Jul-07	MVEIRB
149	Tamerlane update on power usage and dialogue with EC.	12-Jul-07	Tamerlane Ventures
150	Tamerlane presentation at technical sessions	19-Jul-07	Tamerlane Ventures
151	Appendix 3 from Brown Erdman (water quality results 1981)	19-Jul-07	Tamerlane Ventures
152	Tamerlane commitment to using gravity wells	20-Jul-07	Tamerlane Ventures
153	Placeholder for Weyer study on Pine Point groundwater	15-Aug-07	MVEIRB
154	EC letter for Weyer & Hocking reports, & Hocking report	15-Aug-07	Environment Canada
155	Email from Tamerlane- lock cycle test water info (25-Jul-07)	15-Aug-07	Tamerlane Ventures
156	Drill logs from Tamerlane R-190	15-Aug-07	Tamerlane Ventures
157	Tamerlane email re. freezwall schedule (24-July-07)	15-Aug-07	Tamerlane Ventures
158	Ortho-photo of surface topography around R190	15-Aug-07	Tamerlane Ventures
159	Info. re freezwall undertakings from Layne Christensen	15-Aug-07	Tamerlane Ventures
160	ENR questions for developer and responses (27-July-07)	16-Aug-07	Tamerlane Ventures
161	EBA to Tamerlane re. ammonia undertaking (27-July-07)	16-Aug-07	Tamerlane Ventures

Tamerlane Pine Point Pilot Project Report of Environmental Assessment and Reasons for Decision
Mackenzie Valley Environmental Impact Review Board

Registry Item #	Document Name	Date Filed	Originator
162	Fax from the Deh Cho First Nations (30-July-07)	07-Aug-07	Deh Cho FN
163	EBA to Tamerlane re. deep disposal (30-July-07)	16-Aug-07	Tamerlane Ventures
164	MVEIRB request for public hearing comments (30-July-07)	16-Aug-07	MVEIRB
165	IR Round 2 – Environment Canada concerns re. air quality	07-Aug-07	Environment Canada
166	INAC comments on holding public hearing (7-Aug-07)	08-Aug-07	INAC
167	INAC proposed 2nd round IRs (7-Aug-07)	08-Aug-07	INAC
168	GNWT proposed 2nd round IRs (8-Aug-07)	08-Aug-07	GNWT
169	KFN traditional knowledge study (8-Aug-07)	08-Aug-07	KFN
170	KFN - INAC correspondence (9-Aug-07)	09-Aug-07	INAC and KFN
171	EC proposal for IR on air quality (9-Aug-07)	09-Aug-07	Environment Canada
172	FRMC proposed 2nd round IRs (10-Aug-07)	10-Aug-07	FRMC
173	DKFN comments on holding public hearing (9-Aug-07)	10-Aug-07	DKFN
174	Second round of IRs (final copy) (14-Aug-07)	16-Aug-07	MVEIRB
175	Tamerlane responses to second round of IRs (15-Aug-07)	16-Aug-07	Tamerlane Ventures
176	Report - <i>From restless communities to resilient places</i>	16-Aug-07	Tamerlane Ventures
177	Workshop report <i>Northern communities – Boom, bust</i>	16-Aug-07	Tamerlane Ventures
178	INFC paper <i>Planning for a soft landing</i> (Nov-05)	16-Aug-07	Tamerlane Ventures
179	<i>The Resilient City</i> Vancouver Working Group (June 2006)	16-Aug-07	Tamerlane Ventures
180	Draft list of undertakings for comments from tech. sessions	17-Aug-07	MVEIRB
181	KFN request for party status (20-Aug-07)	20-Aug-07	KFN
182	Surface drainage images from Beak Consultants (1980)	20-Aug-07	MVEIRB
183	DKFN proposed IRs (24-Aug-07)	24-Aug-07	DKFN
184	MVEIRB announcement of public hearing (24-Aug-07)	24-Aug-07	MVEIRB
185	KFN party status announcement	24-Aug-07	MVEIRB
186	Adrian Brown submission re. Diavik ammonia work	31-Aug-07	Adrian Brown
187	Tamerlane responses to IR # 35 and 38	31-Aug-07	Tamerlane Ventures
188	Information package from MVEIRB re. Tech reports/hearing	31-Aug-07	MVEIRB
191	Letter to go along with technical session CDs	13-Sep-07	MVEIRB
192	Tamerlane submission of MSDS sheets for all reagents	13-Sep-07	Tamerlane Ventures
193	INAC 2nd Round IR responses	13-Sep-07	INAC
194	Tamerlane image and usage info on gravity wells	13-Sep-07	Tamerlane Ventures
195	Tamerlane info. on flood risk at ore off-loading site	13-Sep-07	Tamerlane Ventures
196	Basal Inflow Evaluation Pine Point Pilot Project NWT	13-Sep-07	Tamerlane Ventures
197	Notice to fax recipients of all 2nd round IR responses	14-Sep-07	MVEIRB
198	Tamerlane report of Q&A with GNWT DOT re. settling pond	17-Sep-07	Tamerlane Ventures
199	Technical session meeting minutes (19-Sept-07)	19-Sep-07	MVEIRB
200	Notice of Deninoo Community Council party status	19-Sep-07	MVEIRB
201	MVEIRB expert advisors technical comments - water issues	24-Sep-07	MVEIRB
202	INAC technical comments (David Livingstone)	24-Sep-07	INAC
203	Jesse Jasper (EC) re. historic Pine Point dewatering issues	25-Sep-07	Environment Canada
204	EC technical report	25-Sep-07	Environment Canada
205	Environment Canada presentation	04-Oct-07	Environment Canada

Tamerlane Pine Point Pilot Project Report of Environmental Assessment and Reasons for Decision
Mackenzie Valley Environmental Impact Review Board

Registry Item #	Document Name	Date Filed	Originator
206	Town of Hay River speaking notes	05-Oct-07	Town of Hay River
207	Notice of attendance of Bruce Halbert at public hearing	05-Oct-07	MVEIRB
208	Proposed agenda and pre-hearing conference notes	05-Oct-07	MVEIRB
209	Developer's presentation for public hearing (16-Oct-07)	05-Oct-07	Tamerlane Ventures
210	Tamerlane responses to technical reports (5-Oct-07)	05-Oct-07	Tamerlane Ventures
211	Tamerlane public registry fax update (5-Oct-07)	05-Oct-07	MVEIRB
212	Developers hearing presentation summary	09-Oct-07	Tamerlane Ventures
213	Fort Resolution Métis Council public hearing presentation	09-Oct-07	FRMC
214	Deninu Kue First Nation public hearing presentation	09-Oct-07	DKFN
215	INAC hearing presentation	10-Oct-07	INAC
216	Adrian Brown's (water consultant for INAC) resume	11-Oct-07	INAC
217	Final Environment Canada presentation with notes	11-Oct-07	Environment Canada
218	KFN hearing summary	12-Oct-07	KFN
219	Pine Point Pilot Project air quality assessment RWDI	12-Oct-07	Tamerlane Ventures
220	Article reference – cadmium and lead deposition	15-Oct-07	Environment Canada
221	Article reference – heavy metals in mosses and soils	15-Oct-07	Environment Canada
222	Article reference – fugitive dust	15-Oct-07	Environment Canada
223	INAC public hearing presentation – Fort Resolution	15-Oct-07	INAC
224	GNWT public hearing presentation – Fort Resolution	17-Oct-07	GNWT
225	Final revised DKFN public hearing presentation	17-Oct-07	DKFN
226	Fort Resolution Métis Council public hearing presentation	17-Oct-07	FRMCI
227	Deninoo Community Council public hearing speaking notes	17-Oct-07	DCC
228	Public hearing sign-in sheet – Fort Resolution (16-Oct-07)	17-Oct-07	MVEIRB
229	INAC mine site reclamation policy for the NWT	17-Oct-07	INAC
230	Notice of Public Hearing undertakings and PR closure date	23-Oct-07	MVEIRB
231	Tamerlane Air Quality Monitoring Undertaking	23-Oct-07	Tamerlane Ventures
232	Official hearing transcript – Fort Resolution	24-Oct-07	MVEIRB
233	Tamerlane commitments on wildlife (24-Oct-07)	24-Oct-07	Tamerlane Ventures
234	DKFN final analysis	29-Oct-07	DKFN
235	CD Audio Recording of Public Hearing - October 16, 2007	29-Oct-07	MVEIRB
236	Tamerlane response to DKFN final recommendations	29-Oct-07	Tamerlane Ventures
237	Draft commitments table for IR # 55	31-Oct-07	MVEIRB
238	MVEIRB IR # 55 (third round) (31-Oct-07)	31-Oct-07	MVEIRB
239	Tamerlane public registry update (31-Oct-07)	31-Oct-07	MVEIRB
240	EC response to undertaking #3	02-Nov-07	Environment Canada
241	INAC response to undertaking #1	02-Nov-07	INAC
242	Developer response to IR # 55	02-Nov-07	Tamerlane Ventures
243	GNWT response to undertakings (2-Nov-07)	02-Nov-07	GNWT
244	Final Tamerlane PR update prior to close of PR (2-Nov-07)	02-Nov-07	MVEIRB
245	Final comments from FRMC	06-Nov-07	FRMC

Other Sources Cited in this Report

Barnard, F. & R.L. Sandefur (2007). *NI 43-101 Technical Report: Pine Point Project, Northwest Territories, Canada*. Prepared by Chlumsky, Armbrust & Meyer LLC for Tamerlane Ventures Inc., August 15, 2007. Available at www.sedar.com.

Cumulative Impacts Monitoring Program (2007). NWT Cumulative Impacts Monitoring Program: Home Page. <http://www.nwtcimp.ca/index.asp>. Last viewed on February 12, 2008.

Environment Canada (2005). *Narrative Descriptions of Terrestrial Ecozones and Ecoregions of Canada*. http://www.ec.gc.ca/soer-ree/English/Framework/Nardesc/taipln_e.cfm Last updated April 11, 2005.

Evans, M.S., Lockhart, L. and J. Klaverkamp (1998). *Metal Studies of Water, Sediments and Fish from the Resolution Bay area of Great Slave Lake: Studies Related to the Decommissioned Pine Point Mine*. Hydrology Research Institute, Contribution Series No. 98-87, July 15, 1998, 209 p.

Government of the Northwest Territories. 1990. *Safety Act: General Safety Regulations*. Available at http://www.justice.gov.nt.ca/PDF/REGS/SAFETY/General_Safety.pdf.

Government of the Northwest Territories. 2002. *Guidelines for Ambient Air Quality Standards in the Northwest Territories*. December 2002. http://www.enr.gov.nt.ca/eps/pdf/ambient_airquality.pdf

Government of the Northwest Territories. 2005. *Air Quality in the NWT*. <http://lisin.rwed-hq.gov.nt.ca/NWTAQ/nwtairquality.aspx>.

Hay River Hub (2007). *Mine struggles to meet NWT employment targets*. January 17, 2007.

Imperial Oil Resources Ventures Limited (2007). *Supplementary Information: Project Update 2007*. Submission to the Joint Review Panel for the Mackenzie Gas Project, May 15, 2007. Calgary: Imperial Oil Resources Ventures Limited. http://www.ngps.nt.ca/Upload/Proponent/Imperial%20Oil%20Resources%20Ventures%20Limited/Project_Update_May2007/project_update_May2007.html

National Water Resources Institute (2003). *Protecting a Northern Great Lake*. Ottawa: Environment Canada. Available at http://www.nwri.ca/sande/jan_feb_2002-e.html. Last updated Feb 24, 2003.

SENES Consultants Limited (2005). *Northwest Territories Environmental Audit 2005: Main Report*. Available at http://nwt-tno.inac-ainc.gc.ca/nwt-a_e.htm. Last viewed on February 12, 2008.