Shell Proposed Jack Mine Expansion and Pierre River Mine Projects

Environmental Impact Assessment and Application Review

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Contents

Figures

Tables

Appendices

1.0 INTRODUCTION

The following is a technical review of the proposed Shell Canada Limited (Shell) Jackpine Mine Expansion and Pierre River Mine projects. The review was done on behalf of the Fort McKay Industry Relations Corporation (IRC), which represents the Community of Fort McKay including the Fort McKay First Nation and Métis Local 63.

1.1 Review Coordination

The review was coordinated by Marie Lagimodiere (Lagimodiere & Associates Inc.). Specific technical components were reviewed by the following individuals:

- **Air:** David Spink (Pravid Environmental) and Danlin Su
- **Groundwater:** Lew Fahner (Agua Consulting),
- **Surface Water:** Ron Bothe (Bothe & Associates Inc.)
- **Water Quality, Aquatic Resources and Fish:** Brenda Miskimmin and Brent Phillips (Summit Environmental Consultants Ltd.)
- **Wildlife and Wildlife Health:** Lorne Gould (Gould Environmental Inc.)
- **Soil and Terrain:** Mike Janzen and Justin Straker (Stantec)
- **Terrestrial Vegetation, Wetlands, Forest Resources and Biodiversity:** Jeff Anderson and Bob Fuller (Stantec)
- **Mine Plan and C&R Plan:** John Errington (Stantec)
- **Human Health:** John Dennis (SolAero Ltd.)
- **Historical Resources, TLU & TEK:** Ann Garibaldi (Stantec)
- **Resource Use, Visual Aesthetics:** Marie Lagimodiere (Lagimodiere & Associates Inc.)

Our review of the application is based on our understanding of the key concerns of Fort McKay and it is focused on the environmental implications of impacts associated with the project with respect to air, water, land, health and Fort McKay's traditional use of the land. Our approach follows three steps:

- Assess the completeness of the data and the appropriateness of the analysis presented in the application,
- Assess the environmental consequences and possible mitigation,
- Provide recommendations based on our understanding of the key concerns of the community of Fort McKay.

This report is submitted to the Fort McKay IRC for their use in determining any actions required resulting from the project and in negotiations with Shell regarding reasonable mitigation.

To enable easy tracking of issues we have numbered in [square brackets] comments and their associated recommendations to Fort McKay. These recommendations are also presented in summary tables with Fort McKay's key concerns. The category column of the tables indicates the potential path forward to address the issue. Categories are as follows:

- **Agreement** – a suggested activity such as mitigation or monitoring that Fort McKay may want to consider in their agreement negotiations with Shell
- **Regulatory** – a suggestion that Fort McKay may want to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)
- **Response** – a deficiency or question that Fort McKay may want to request a response or additional information from Shell

The following documents were reviewed:

- Jackpine Mine Expansion and Pierre River Mine Project Environmental Impact Assessment (Shell 2007)
- Jackpine Mine Expansion and Pierre River Mine Project Environmental Impact Assessment Update – May 2008 (Shell 2008)
- Pierre River Mine Project Supplemental Information – May 2009 (Shell 2009)

1.2 Review and Validation of Key Issues

The Fort McKay IRC has reviewed and validated the key concerns and recommendations of this review prior to its submission.

1.3 Fort McKay Specific Assessment

Fort McKay, Shell and the Governments of Alberta and Canada agreed to conduct a Fort McKay Specific Assessment, as a pilot project in relation to Shell's proposed Jackpine Mine Expansion and Pierre River Mine Application. The objective of this assessment was to provide, from Fort McKay's perspective, appropriate and sufficient information that:

- Fort McKay can use to more fully understand and assess the effects of the Shell projects and cumulative oil sands developments on environmental, cultural and traditional resources of concern and interest to Fort McKay as well as on Fort McKay's cultural heritage;
- Is specific to Fort McKay and that the regulators must consider when making public-interest decisions regarding the Projects; and

- Provides information and recommendations to assist Alberta, Canada, Shell and Fort McKay develop mitigation and accommodation strategies to address any potential adverse effects; and to inform consultation.

The Fort McKay Specific Assessment is being submitted by Shell as formal supplemental information to its Application and EIA for the Jackpine Mine Expansion and Pierre River Mine Project.

The Fort McKay Specific Assessment is comprised of three main documents:

- An Environmental Assessment (the Environmental Specific Assessment; Fort McKay IRC 2010a)
- A Cultural Heritage Assessment (CHA) Baseline: Pre-development (1964) to Current (2008) - (the Cultural Heritage Assessment Baseline; Fort McKay IRC 2010b)
- An assessment of the effects of the Shell projects on cultural heritage (the Project-Specific Cultural Heritage Assessment), which is presented as an attachment to the CHA Baseline (Fort McKay IRC 2010c)

The results of the Fort McKay Specific Assessment have been used by the Fort McKay Technical Review team to inform this technical review of Shell's projects and the associated key concerns and recommendations.

2.0 PROJECT OVERVIEW

Shell is applying to develop two projects, the Jackpine Mine Expansion and the Pierre River Mine.

Jackpine Mine is located on the east side of the Athabasca River about 15 km northeast of Fort McKay, in the Muskeg River watershed. The Jackpine Mine Expansion is a proposed expansion of the Jackpine Mine Phase 1, which was approved in 2004 for a capacity of 200,000 bbl/cd. Start up of the Jackpine Mine Phase 1 is expected to occur in late 2009 with production ramping up through 2010. The proposed expansion would add another 100,000 bbl/cd and extend the mine life from completion in 2031 to completion in 2049.

The proposed Jackpine Mine expansion would also add 12,719 hectares (ha) to the already permitted 7,836 ha and will ultimately disturb a total of 20,555 ha during its mine life.

The Jackpine Mine Expansion will include (Shell 2007):

- Expansion of the mining area to the east portion of Lease 13 and on to leases to the north
- Ore-handling, conditioning and bitumen extraction facilities and high temperature froth treatment facility
- Adding a cogeneration plant and adding to the utilities systems
- An second external tailings disposal area (North EDTA)

In this same application Shell proposes to also develop the Pierre River Mine, a completely new mine located on the west side of the Athabasca River 35 km north of Fort McKay. The Pierre River Mine will produce up to 200,000 bbl/cd of bitumen and would include a new mining area and associated processing facilities, utilities and infrastructure. Its 22 year operating life will conclude in 2039. The proposed Pierre River Mine would disturb a total of 10,403 ha during its mine life.

The Pierre River Mine would include (Shell 2007):

- a new mine, to be constructed on Lease 9 (with some facilities on other leases)
- access infrastructure including a bridge across the Athabasca River
- ore handling, conditioning and bitumen extraction facilities and a high-temperature froth treatment facility
- a plant site on Lease 9
- a new raw water intake facility
- a new external tailings disposal area (EDTA) at the boundary of Lease 17 and Lease 351

3.0 AIR AND NOISE

3.1 Context

This detailed review of the Shell EIA (Shell 2007) for the Jackpine Mine Expansion (JPME) and Pierre River Mine (PRM) projects was undertaken to identify possible issues and concerns related to:

- Shell's assessment methodology and conclusions,
- Shell's regulatory approval application, and
- Shell's proposed actions to mitigate noise and air impact associated with its proposed projects.

Possible issues that the Community of Fort McKay (Community) might wish to raise with Shell and/or regulators were identified. The review was also informed by, and considered the results from, the Fort McKay Specific Assessment (FMSA) that the Fort McKay IRC (Fort McKay) recently undertook. This FMSA included an air quality review that examined the effects of past, current and planned industrial development, including Shell's proposed projects, on air quality and air-related impacts within the Community and throughout its Traditional Lands. When and as appropriate, the assessments, conclusions and recommendations from the FMSA were included in this review.

3.2 Project Description/Overview

In its EIAs and applications, Shell is seeking approval for two projects:

- **The Jackpine Mine Expansion (JME):** This is an expansion to the previously approved Jackpine Mine – Phase 1 (JPM1) project. This expansion will be located adjacent to the JPM1 development, located 70 km north of Fort McMurray and 15 km northeast of Fort McKay on the east side of the Athabasca River. It will include additional mining areas as well as the associated bitumen processing facilities, utilities, and infrastructure.
- **The Pierre River Mine (PRM):** This is a new oil sands mining project located west of the Athabasca River, about 100 km north of Fort McMurray and 30 km north of Fort McKay. This development will include a new bitumen mining area and the related infrastructure for bitumen processing and supporting facilities.

3.2.1 Jackpine Mine Expansion (JME)

This development involves the expansion of JPM1 from a production capacity of 200,000 barrels per day (bpd) of bitumen to 300,000 bpd of bitumen – an increase of 100,000 bpd. Construction for this project was

initially planned to commence in 2010 with start-up of the new train expected in 2012 but based on the current status of the application review process, construction commencement and start-up will likely be several years later than these dates. With the expansion, bitumen production from the JPM development is expected to last until 2046, as indicated in the May 2008 update submitted by Shell (Shell 2008).

The Jackpine Mine Expansion will occur on the eastern part of Lease 13 and also extend mining activities to additional northern leases. These expansion directions are away from the Community of Fort McKay but the western part of the development is adjacent to Community Treaty Land Entitlement TLE land (I.R.174C).

Construction of a new external tailings disposal area will occur at the southern end of Lease 88. A third process train (in addition to those previously approved for JPM1) will be constructed at the JPM1 site. The ore handling, conditioning, and extraction facilities associated with the additional process train include:

- Mining equipment and ore hauling trucks
- Crushers and conveyors
- Slurry conditioning and ore preparation
- Extraction facilities
- Tailings handling and treatment
- Froth treatment
- Tailings solvent recovery
- Asphaltene recovery
- Associated tank storage and piping and pumping
- Associated boilers, heaters and co-generation facilities including an asphaltene-fired cogeneration unit

Many of these processes and facilities are sources of air emissions and/or noise and the EIA and application provides information and assessments on these issues.

3.2.2 Pierre River Mine (PRM)

This project involves a new oil sands mining development with a proposed production of 200,000 bpd of bitumen. Construction of access facilities is scheduled to commence in 2010 but will likely be later based on the current regulatory review status of the project. Start-up of the two-100,000 bpd process trains are planned for the 2018 and 2021, respectively. Bitumen production from the PRM development is expected to last until 2039.

The project is developing the oil sands resource contained within Lease 9 with some facilities constructed on Lease 17. Shell has also expressed an interest in developing land holdings adjacent to these leases in the future. In addition to the construction of ore handling, conditioning, and extraction facilities, external tailings disposal area, site access infrastructure, include a bridge across the Athabasca River will also be part of the development.

The PRM will consist of two 100,000 bpd process trains with process units including:

- Mining equipment and ore hauling trucks
- Crushers and conveyors
- Slurry conditioning and ore preparation
- Extraction facilities
- Tailings handling and treatment
- Froth treatment
- Solvent recovery
- Asphaltene recovery
- Associated tank storage and piping and pumping
- Associated boilers, heaters and co-generation facilities including an asphaltene-fired cogeneration unit

As with the JPME development, many of these facilities are sources of air emissions and/or noise and the EIA and application provides information and assessments on these issues.

3.3 Issues and Assessment

3.3.1 Regulatory Key Concerns and Recommendations

There are two regulatory approval issues associated with the JPME and PRM projects that the Fort McKay IRC may wish to pursue. These are outlined below.

[1-2] Environmental Protection and Enhancement Act (EPEA) Approval Amendments and Renewals

Shell is proposing that the Jackpine Mine Phase 1 (JPM1) approval be amended and renewed to accommodate the proposed Jackpine Mine Expansion (JPME). The current JPM1 approval was issued in 2004 and must be renewed in 2014. If this approval were amended to include the JPME project, and also renewed (likely to 2020), it would mean that the JPM1 project would essentially be given an additional five years of

operation without having to go through a thorough and meaningful approval renewal assessment. Such an assessment is not possible at this time since the facility is not yet operational (operation is scheduled for 2010).

[1] Recommendation

It is the position of Fort McKay that renewing the approval for JPM1 at this time would be contrary to the intent of the *EPEA* legislation. Fort McKay therefore expects that, should the Jackpine Mine Expansion be approved, only an amendment to the JPM1 approval be provided to allow for advancement of the JPME project and that the 10-year EPEA renewal process be maintained for 2014.

The first production train at the PRM project is not scheduled to start operation until 2018. Fort McKay does not consider it appropriate to issue approvals based on current requirements and knowledge for projects that are scheduled to be constructed and operated well in the future. It is Fort McKay'It is therefore recommended that, as it was done with the Syncrude Aurora South Project, Alberta Environment, if it approves the PRM project, make it a general approval with the following type conditions which are similar to those currently in Syncrude's *EPEA* approval for the Aurora South project:

- The approval holder shall submit an amendment application with design details about the Pierre River Mine Project at least 12 months prior to the planned start of construction, and shall receive an amending approval prior to commencing construction.
- The amendment application referred to in (i) shall include the following information:
    - a description of proposed emissions to air, and associated pollution abatement equipment;
    - a description of water management plans for the project, proposed discharges of water, and associated control facilities;
    - the proposed land conservation and reclamation plans; and
    - any other information requested in writing by the Director.

[2] Recommendation

It is the position of Fort McKay that any JPM Project approval should be general in nature and subject to an approval amendment that would require submitting project design details closer to actual construction commencement date so that these details can be reviewed in the context of the knowledge and possibly new requirements existing at that time.

Table 3-1: Regulatory Recommendations Summary Table

Number	Fort McKay Key Concerns	Recommendation	Category[1]
1	Environmental Protection and Enhancement Act (EPEA) Approval Amendments and Renewals	It is the position of Fort McKay that renewing the approval for JPM1 at this time would be contrary to the intent of the *EPEA* legislation. Fort McKay therefore expects that, should the Jackpine Mine Expansion be approved, that only an amendment to the JPM1 approval be provided to allow for advancement of the JPME project and that the scheduled 2014 approval renewal process be maintained.	Regulatory
2	Environmental Protection and Enhancement Act (EPEA) Approval Amendments and Renewals	It is the position of Fort McKay that any JPM Project approval should be general in nature and subject to an approval amendment that would require submitting project design details closer to actual construction commencement date so that these details can be reviewed in the context of the knowledge and possibly new requirements existing at that time.	Regulatory

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

3.4 Noise Assessment

3.4.1 Summary of Noise Impacts

The locations of the proposed JME and PRM projects are such that they should have no or minimal direct impact on the noise levels observed in the Community. Specific noise receptors that could be impacted by the proposed project are three hunter/trapper cabins that are closer to proposed developments. The location of the receptors that were assessed

for noise impacts from the proposed projects are summarized in Table 3-2.

Shell has identified the following sources of noise associated with the project:

- mine fleet,
- ore crushing facilities,
- extraction plants,
- co-generation facilities,
- tailings management areas (specifically bird deterrent cannons), and
- construction vehicles.

Table 3-2: Receptors Assessed for Possible Noise Impacts from the JPME and PRM Projects

Receptor	Location/Distance from Development
Fort McKay (NR1)	15 km south southwest of JME and 30km south of PRM
Cabin (NR2)	1.5 km east of PRM External Tailings Disposal Area (ETDA)
Cabin (NR3)	0.6 km north of PRM access road
Cabin (NR4)	4.0 km south of PRM
1.5 JME	1.5 km criteria boundary
1.5 PRM	1.5 km criteria boundary

Shell also indicates that noise will result from the traffic to and from the project and also from an airstrip that is adjacent to Jackpine Mine – Phase 1 on the Albian Sands Muskeg River Mine site. Aircraft noise can be disturbing and depending on wind direction there may be some fly-over of Fort McKay. Three flights per day are planned.

Shell has indicated that it will develop and implement a noise management plan to address noise level impacts that are classified as moderate in magnitude, which are only predicted to occur around the 1.5 km perimeter of the PRM project.

3.4.2 Noise Assessment Findings

The noise assessment compared the Base Case (existing and approved projects and their projected impact on noise levels at the receptors) against the Application Case (adding the noise levels from proposed JPME and PRM projects to those from the Baseline Case). The noise assessment for the Application Case evaluated the potential noise levels at maximum

capacity when the mining activities are closest to nearby receivers or criteria boundaries and noise from traffic traveling to and from the project was incorporated into its noise modeling. Existing noise levels were measured at Fort McKay and the three cabins through a 2007 field monitoring program. Table 3-3 below summarizes the noise modeling results for the Baseline and Application case scenarios.

These predictions indicate that the proposed PRM and JME projects will have no or minimal noise impact on the Community or the three identified cabins, though there may be higher than permissible noise levels around the perimeter of the PRM project.

Table 3-3: Comparison of Baseline and Application Case Noise Levels at Sensitive Receptors

Receptors	Measured[1]		Permissible Noise Level (ERCB Directive 038)		Base Case	Application Case	Change from Base Case
	Daytime	Nighttime	Daytime	Nighttime			
Fort McKay (NR1)	46	44	53	43	36	36	None
Cabin (NR2)	44	39	50	40	35	36	Minor
Cabin (NR3)	36	25	50	40	36[2]	38[3]	Minor
Cabin (NR4)	44	38	50	40	37[2]	38[3]	Minor
1.5 JPME	--	--	50	40	38	38[3]	None
1.5 PRM	--	--	50	40	35	47	Significant

[1]An error was made in the original isolation calculations. The values presented here are the corrected isolated data for measured sound levels as present in Table 258-1 in the Pierre River Mine SIR (Shell 2009a).

[2]Base Case noise level of 48 was used for assessment, later revised to be the predicted noise level from the 2007 Fort Hills update, including the ERCB mandated ambient. [Table 257-2 (Shell 2009a)].

[3]Revised Application Case noise prediction as presented in Pierre River Mine SIR (Shell 2009a). Changes are the result of update for PCOSI Fort Hills submitted by Petro-Canada (PCOSI) in July 2007.

In addition to normal operational noise levels, Shell addressed a number of other potential noise related issues. These were:

- **Low frequency noise (LFN)** – Shell indicated that there is potential for LFN at NR3 and NR4 even though the Project contribution to sound in dBA units is lower than the EUB ambient level of 35 dBA. Shell stateS that: "If future monitoring is conducted for NR3 and NR4, LFN and tonal effects will be considered."

- **Project construction**– Shell indicated that construction may generate sound that could be noticed by the sensitive receivers in this assessment, specifically NR2 and NR3 near PRM. Shell states that any noise concerns raised by noise receivers during construction activity will be addressed on a stakeholder basis.
- **Traffic Noise** – Shell indicate that traffic volumes on Hwy 63 will increase as a result of the proposed projects and this could impact traffic noise in Fort McKay. Shell assessed this possibility and concluded that: "…the level of vehicle traffic during construction may result in a traffic noise contribution of 9 dBA at Fort McKay, well below the measured background levels in Fort McKay."
- **Air traffic noise** – Shell assessed the potential impact of air traffic on noise levels in Fort McKay and noted that while airplane sounds will heard in Fort McKay that: "…three additional peaks of 55 dBA is not expected to result in noise level fluctuations of sufficient magnitude to change existing noises experienced or cause sleep disturbance effects."
- **Noise Cannons** - Bird deterrent cannons on tailings ponds will generate intermittent noise but that the cannons are unlikely to be audible at cabin NR2 which is the only noise receptor that could be impacted by this noise source.

These conclusions are considered reasonable based on the assessment conducted.

3.4.3 Noise Assessment Approach

Overall, the noise impact assessment was very thorough. The approach used by Shell for assessing the potential noise impacts as a result of the proposed PRME and PRM Projects is generally consistent with the Energy Resources Conservation Board (ERCB) *Directive 038: Noise Control (2007).* The Alberta Utilities Commission (AUC) has a Draft Rule (012) on Noise Control (2007) that applies to electricity generator facilities and may apply to the co-generation facilities that Shell is proposing as part the JME and PRM projects.

A major concern and issue with the assessment is the approach used to determine permissible sound levels, which is an issue Fort McKay has raised in its review of noise assessment for other projects. As part of this assessment, noise measurements were conducted at selected receiver locations. These found the nighttime integrated average equivalent sound level (L_{eq}) to be 25 dBA (i.e., less than 35 dBA) at receiver NR3 (see Table 3-3). This location does not appear to have been impacted by existing noise from industrial activities and an ambient monitoring adjustment should therefore be considered to yield a nighttime

permissible sound level (PSL) of 30 dBA rather than 40 dBA, which was used in the assessment (Table 3-4).

[3–6] Noise

Regarding the derivation of the Base Case noise level in the Community of Fort McKay (NR1) described on Page 10, Appendix 3-11 (Shell 2007), Fort McKay does not agree that the field measurements should be "adjusted" to exclude local sources. Figure 4 in Appendix 3-10 indicates industrial sources such as bird cannons and Highway 63 traffic are contributors to noise in the community throughout the day. The statement that "local community noise was the dominant source" while perhaps true cannot be used to discount external noise sources that, by their nature, could be consider foreign and intrusive. Fort McKay has previously expressed concerns regarding noise from the existing mining operations. This is reaffirmed by measurement data obtained by Shell as part of this EIA.

In general, the potential for noise impacts from existing and planned developments in the region is a concern of the residents of the Community and Shell's proposed projects will contribute to regional noise levels in areas not currently subject to noise impacts (i.e., the PRM site). Also, since the extensive approved but not yet operating, proposed and planned developments in the region will increase background noise levels, Shell is encouraged to implement all reasonable and cost-effective noise mitigation measures regardless of local and regional noise impacts consistent with the ERCB guidance in that sound level increases should be kept to acceptable minimums and that uncontrolled sound generation should not be allowed.

[3] Recommendation

It is in Fort McKay's position that an ambient monitoring adjustment be required by the ERCB and/or Alberta Utilities Commission (AUC) when developments are proposed on the Community of Fort McKay's Traditional Lands in currently pristine areas.

[4] Recommendation

Fort McKay requests that Shell outline the rationale for using the rural background noise level of 35 dBA to obtain a PSL of 40 dBA without an ambient monitoring adjustment when measurements at cabin NR3 indicated a background nighttime level of 25 dBA.

[5] Recommendation

Fort McKay requests that Shell commit to undertaking noise surveys (measurement and discussion with community/cabin owners) at the Community of Fort McKay and the three receptor cabins identified in this assessment during project construction and project operation to verify the predictions in this assessment and identify and mitigate any noise issues.

[6] Recommendation

Fort McKay requests that Shell provides additional details on its noise mitigation plans for the PRM project and review these plans with Fort McKay.

Table 3-4: Noise Summary Table

Number	Fort McKay Key Concerns	Recommendation	Category
3	Noise	It is in Fort McKay's position that an ambient monitoring adjustment be required by the ERCB and/or AUC when developments are proposed on the Community of Fort McKay's traditional lands in currently pristine areas.	Regulatory
4	Noise	Fort McKay requests that Shell outline the rationale for using the rural background noise level of 35 dBA to obtain a PSL of 40 dBA without an ambient monitoring adjustment when measurement at cabin NR3 indicated a background nighttime level of 25 dBA.	Response
5	Noise	Fort McKay requests that Shell commits to undertaking noise surveys (measurement and discussion with community/cabin owners) at the Community of Fort McKay and the 3 receptor cabins identified in this assessment during project construction and project operation to verify the predictions in this assessment and identify and mitigate any noise issues.	Agreement

Number	Fort McKay Key Concerns	Recommendation	Category
6	Noise	Fort McKay requests that Shell provides additional details on its noise mitigation plans for the PRM project and review these plans with Fort McKay.	Response

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

3.5 Air Quality Assessment

3.5.1 Summary of Air Impacts

The main sources of air emissions from the proposed JME and PRM projects include:

- gas and asphaltene cogeneration units used to generate electricity and produce steam;
- once through and auxiliary steam boilers;
- heaters;
- flares;
- mine fleet exhaust; and
- fugitive emission sources (i.e., mine face, tailings pond and plant and tank fugitives).

The proposed JME includes some requested modifications to the already approved JPM Phase 1 (JPM1) project, e.g., the JPM Phase 1 project had a 160 MW gas-fired co-gen unit which the JME project is proposing to replace with two-85 MW gas-fired co-gen units. This complicates the assessment of project emissions and the relative impact of the proposed project. This issue is discussed further in the detailed assessment review [Recommendation 19].

Shell has identified a number of air emission management and mitigation strategies for its projects. The most significant management and mitigation measures proposed include:

- The cogeneration units to be used for the Project will meet the Emission Guidelines for Oxides of Nitrogen ($NO\chi$) for New Boilers, Heaters and Turbines using Gaseous Fuels Based on a Review of Best

Available Technology Economically Achievable (BATEA) - Interim Guideline (AENV 2007a).

- Advanced emission controls will be employed on the asphaltene-fired cogeneration units e.g., an SO_2 control efficiency of 99%, a $NO\chi$ control efficiency of 75% and a particulate matter (PM) control efficiency of 99.97% with activated carbon control for trace elements.
- Above-ground storage tanks will conform to Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Above-ground Storage Tanks (CCME 1995).
- Plant-wide fugitive emissions identification and control using the protocol recommended by the Canadian Association of Petroleum Producers *Management of Fugitive Emissions at Upstream Oil and Gas Facilities* (CAPP 2007), as well as other relevant guidelines and codes of practice aimed at minimizing fugitive emissions (CCME 1993, 1995).
- Flaring will be minimized at the Projects
- Vehicles in the mine fleet will meet applicable emission standards at the time of purchase.
- Tailings Solvent Recovery Unit (TSRU) tailings deposition will be managed to maintain an annual average rate of 4 volumes of solvent per 1,000 volumes of bitumen produced

These are all positive and are considered close to best management practices except in a couple of areas, which are discussed further in the detailed assessment review in Section 3.5.7.1.

3.5.2 Project Emissions

Process technologies proposed for both the JME and PRM projects are essentially identical with some changes in the size and number of boilers and co-generation units that are part of the JPM1 project. There have also been some re-estimates for mine fleet emissions from JPM1. The boilers, heaters and co-generation facilities (particularly the proposed asphaltene-fired co-generation units), along with the mine fleets and tailings ponds, are the major air emission sources for the proposed JME and PRM projects.

Table 3-5 summarizes the projected air emissions of major air contaminants from the various emission sources associated with each proposed project. Also shown in Table 3-5 are the project's contributions to the total regional emissions (total regional emissions are based on existing project emissions plus projected emissions from approved but not yet operational projects). There are some issues regarding how these emissions are estimated. These are discussed in the detailed assessment review in Section 3.5.6.

These emission levels are not particularly high and do not represent large increases to overall regional emissions. However, they:

- contribute to already deteriorating regional air quality and have an overall small but negative impact on air quality in Fort McKay;
- increase the potential for direct and indirect adverse effects on vegetation due to ambient and deposition levels of nitrogen (further discussed on Page 26 – Recommendation 12);
- have the potential to contribute to ozone formation in Fort McKay and the region (further discussed on Page 39 – Recommendation 25); and
- have the potential to increase nuisance odours in Fort McKay (further discussed on Page 21 – Recommendation 10 and Recommendation 11).

Table 3-5: Projected Emissions from the Proposed JME and PRM Projects (Combined)

Source	Emission Parameter[1]					
	SO_2 (t/cd)	NOχ (t/d)	CO (t/d)	$PM_{2.5}$ (t/d)	VOC (t/d)	TRS (t/d)
Cogeneration Units	8.15	9.13	10.03	0.55	0.40	
Boilers and Heaters	-0.03	-3.68	-3.28	-0.30	-0.22	
Mine Fleet	-0.26	6.73	12.71	0.19	0.76	
Tailing Ponds					14.88	0.07
Mine Face					9.31	0.06
Plant Fugitives					0.26	0.09
Total	**7.86**	**12.18**	**19.46**	**0.44**	**25.39**	**0.22**
Contribution to Total Regional Emissions	3%	2.5%	4.5%	1.5%	3.5%	3%

[1] Figures include adjustments made to the JPM1 emission estimates, which is the reason for the negative numbers for some parameters.

In assessing these potential impacts, the issues considered include:

- are the projected impacts acceptable in terms of environmental and health impacts and risks? and
- are further emission reductions possible?

In general the answer to the first question is "no" and the answer to the second question is "yes", which dictates that additional air pollution control measures to those proposed should be required.

3.5.3 Ambient Air Quality

The predicted impact of the proposed Shell JME and PRM Projects and other existing, approved, and planned projects in the region on air quality in Fort McKay are summarized in Table 3-6. Also shown in the table are the predicted increases in air contaminant concentrations and the project-only impact as a result of the proposed project.

Table 3-6: Predicted Impact of the Proposed JPM Expansion and PRM Projects and Other Existing, Approved and Planned Projects in the Region on Air Quality in Fort McKay

Parameter and Averaging Period	Predicted Ambient Level of Contaminant (µg/m³)			
	Baseline Case[1]	Application Case[2]	Planned Development Case[3]	Increase Due To Project
SO_2 (Sulphur Dioxide)				
1-Hr Peak	162.8	162.8	170.8	0
24-Hr Peak	24.3	24.3	31.8	0
Annual Average	4.19	4.23	5.43	0.04
NO_2 (Nitrogen Dioxide)				
1-Hr Peak	129.7	130.1	132.1	0.4
24-Hr Peak	88.7	88.9	96.6	0.2
Annual Average	27.94	28.08	31.25	0.14
$PM_{2.5}$ (Particulate Matter less than 2.5 microns)				
24-Hr 98^{th} Percentile	25.5	25.4	28.2	-0.1
TRS (Total Reduced Sulphur)				
1-Hr Peak	18.195	18.196	23.45	0.001
24-Hr Peak	4.46	4.46	5.35	0.0004
Annual Average	1.06	1.07	1.16	0.02

[1]This case includes all existing and approved cases

[2]This case includes the baseline case emissions plus the proposed project emissions

[3]This case includes the application case emissions plus projected emissions from announced projects

Projected impacts from the proposed Shell projects are small but represent another incremental deterioration in the Community's air quality. There are also some concerns that the modeling approach used to estimate the future impact of industrial emissions on regional air quality may be underestimating impacts at least on a local level. This issue is discussed on Page 37 – Recommendation 24.

3.5.4 Environmental Impact Assessment Approach

[7-8] Relevant Objectives and Criteria

As with other EIAs completed for oil sands development in the Fort McMurray region, Shell primarily assessed criteria air compounds (SO_2, NO_2, CO, O_3, and $PM_{2.5}$) against the Alberta Ambient Air Quality Objectives (AAAQOs), Canada-Wide Standards (CWS), and Federal Air Quality Objectives (FAQOs). Trace air compounds (TRS, VOCs, PAHs, and airborne metals) were compared against the AAAQOs and Texas Commission on Environmental Quality (TCEQ) Effects Screening Levels (ESLs). Fort McKay has expressed concerns in its previous reviews of EIAs for other proposed oil sands developments that the AAAQOs or FAQOs are not acceptable comparison criteria for protection of human health and their use as a benchmark to assess the acceptability of air quality changes is inappropriate. Air quality consistently at or near the AAAQOs would represent extremely poor air quality by any relative or absolute measure. For instance, the annual NO_2 and SO_2 AAAQOs are equivalent to the levels of these parameters in Mexico City in 1997. As for the FAQOs, which were established in 1981, they are dated and should not be referenced or used as a comparison against current ambient air quality. As regulatory air quality guidelines are frequently, in part, based on achievability, they are therefore somewhat reflective of pollution control technologies available at the time of establishment. In this regard, the significant advances in pollution control technologies over the last 27 years, as well as advances in understanding regarding the health and environmental impacts of air pollutants, combine to dictate a more current and relevant alternative for the selection of air quality criteria.

As Fort McKay has suggested in previous EIA reviews, the World Health Organization (WHO) Air Quality Guidelines for Europe (2000) would be a more appropriate, relevant and useful comparative reference to include in this air quality assessment. In 2005, the WHO updated its air quality guidelines for PM, Ozone, NO_2, and SO_2 (WHO 2005). These updates should also be included as part of future assessments. The WHO limits are current and strictly health-based, and therefore their inclusion in EIA assessments is necessary for Fort McKay to evaluate the potential impact of development projects on the health of their residents. In its draft Healing the Earth Strategy (HTES), Fort McKay has developed health-based air quality criteria that includes; WHO guidelines, the use of Health

Canada's Air Quality Health Index (AQHI), odour-based criteria and Keeping Clean Areas Clean criteria (Fort McKay IRC 2009).

The selection and use of relevant air quality criteria is an issue that has been discussed with Shell and is addressed in detail as part of the Fort McKay Specific Assessment.

[7] Recommendation

It recommended Fort McKay's health and odour-based air quality criteria as well as the Keeping Clean Areas Clean criteria be adopted and considered in future oil sands project EIAs for the assessment of air quality impacts on the Community of Fort McKay.

[8] Recommendation

Fort McKay requests that Shell be required to participate in and support the development of specific procedures for assessing, measuring and tracking air quality changes in the region and in Fort McKay. This would include a process for formally reviewing air quality changes above certain levels to ensure that significant deterioration of air quality in the region and in the Community of Fort McKay does not occur.

[9] Impact Criteria and Classification

Fort McKay strongly disagrees with Shell's magnitude of impact classification system for residual effects in air quality brought about by the project emissions. According to Volume 3, Page 3-43 of the EIA (Shell 2007), the system defines a "negligible" change as an increase of <1% of the relevant criteria, whereas a "low" magnitude of change applies to a predicted increase to a level below the Alberta Ambient Quality Objectives (AAAQOs). "Moderate" and "High" levels are both based on the Federal Air Quality Objectives (FAQOs).

The scale used in this impact classification is not practical for assessing the magnitude of change in air quality as a result of the Jackpine Mine Expansion and Pierre Rive Mine projects or any other oil sands development projects in the region. First, the scale is not meaningful, in that a "high" impact (peak or maximum greater than the FAQOs) would (or should) NEVER occur. Consequently the inclusion of this category is essentially meaningless. Secondly, as discussed on Page 19 – Recommendation 7 and Recommendation 8, the AAAQOs and FAQOs are not strictly health based limits. Thirdly, this system of classification evaluates project-specific impacts without giving consideration to the cumulative impact that the oil sands industry collectively has on air quality in the region.

Individual project impacts are, and will continue to be, disguised behind the big picture as regional emissions continue to increase because single-

project impacts appear, relatively speaking, miniscule in the big picture. While one of Fort McKay's primary concerns is the impact of air quality deterioration on its residents, the impact classification system used in this EIA is not one that is practical for discussions on this issue. Fort McKay's opinion of a reasonable impact classification system is one that takes into consideration the background air quality. Magnitude of change due to the projects should be assessed relative to pre-development and current air quality as well as regulatory limits. Increments of change or significance should be selected such that they are practical, and would lead to meaningful interpretation of the impact of projects. The qualitative impact classification system should be quantitatively defined and consistently applied to all project EIAs in the region in order for these magnitude of impacts be comparable from project to project.

This is an issue that has been discussed with Shell and is addressed in detail as part of the Fort McKay Specific Assessment. The Fort McKay IRC developed green, yellow and red significance criteria and applied these to the actual and/or predicted impact of the Base, Application and Planned Development cases.

[9] Recommendation

Fort McKay suggests that a standardized impact classification system that is specifically applicable to Fort McKay's Traditional Lands and the Regional Municipality of Wood Buffalo be established, in consultation with Fort McKay, since impact criteria can vary significantly between EIAs.

3.5.5 Effects Criteria and Assessment

[10] Odour Thresholds and Impacts

Alberta has established odour-based ambient air quality criteria for some substances as has the WHO (AENV 2008; WHO 2000). These criteria, along with the odour threshold criteria used for these substances by Shell in its assessment [(Shell 2007) Vol. 3 Tables 3.4-26 & 27, Page 3-97] are summarized in Table 3-7.

The WHO odour levels tend to be lower than Alberta Ambient Air Quality Objectives (AAAQOs) based on either the actual numerical value and/or the shorter averaging period, i.e., 30-minutes with the WHO values rather than one hour as used for the AAAQOs. Generally speaking, a 30-minute average of 1 $\mu g/m^3$ is equivalent to a 1-hour average of approximately 0.8 $\mu g/m^3$ under average atmospheric stability (Ontario 2004). The WHO levels are also much lower than the threshold odour levels used in the Shell EIA (Shell 2007).

Table 3-7: Odour Threshold and Ambient Air Quality Criteria Comparison

Parameter	Averaging Period	Ambient Air Quality Criteria or Odour Threshold for Odourous Substances (µg/m³)		
		Alberta AAQO	WHO	EIA Odour Threshold
Ammonia (NH_3)	1-Hr	1,400	NA	NA
Carbon Disulphide (CS_2)	30-Min	N/A	20	NA
	1-Hr	30	NA	749
Hydrogen Sulphide (H_2S)	30-Min	NA	7	NA
	1-Hr	14	NA	14.1
	24-Hr	4	NA	NA
Formaldehyde (CH_2O)	30-Min	NA	100	NA
	1-Hr	65	NA	18725
Nitrogen Dioxide (NO_2)	1-Hr	400	200	NA
	24-Hr	NA	NA	
	Annual	NA	40	
Styrene[1]	30-Min	NA	70	NA
	1-Hr	215	NA	4147
Tetrachloro-ethylene (C_2Cl_4)	30-Min	NA	8000	NA
Toluene[1] **($C_6H_5CH_3$)**	30-Min	NA	1000	NA
	1-Hr	1880	NA	4583
	24-Hr	400	NA	NA

[1]Note: These may be health-based limits in terms of Alberta objectives.

[10] Recommendation

Fort McKay requests that the criteria and basis for selection of the odour thresholds used in the EIA be provided by Shell.

The assessment by Shell and the assessments in previous oil sands project EIAs regarding odours are not consistent with the actual experience of Fort McKay, which clearly indicates that ambient air quality levels of certain odourous substances in the Community are frequently above their respective threshold odour levels and are on occasion at nuisance odour

levels. The EIA (Shell 2007) would also indicate that a significant increase in the number of hours (7 to 460 hours– see Table 3-8 (Shell 2007, 2009b)) of odourous substances being above their respective odour threshold levels will likely occur in the Community and on the Community's Traditional Lands in the northeast to northwest areas north of Fort McKay.

Table 3-8: Comparison of Base and Application Case 1-Hour, Peak and 3-Minute Peak Odour Threshold Exceedence Predictions at Key Fort McKay Traditional Land Receptors

Receptor/ Impact Location	Annual Sum of Hours with Odour Levels Above Threshold					
	Base Case			Application Case		
	Hourly Average	Peak Concentration[1]	3-Minute[2]	Hourly Average	Peak Concentration[1]	3-Minute[2]
Fort McKay	20	336	576	22	363	587
Cabin A	0	7	16	0	363	149
Cabin B	0	23	16	0	26	24
Cabin C	0	13	19	0	16	24
Cabin D	0	20	34	0	27	75
Cabin E	0	29	47	0	36	64
Cabin F	0	27	53	0	37	81
Cabin G	303	768	398	307	783	422
Cabin H	8	198	211	11	240	293
Cabin I	0	135	221	0	144	242
Cabin J	108	545	646	120	573	681
Cabin K	96	545	685	107	582	725
Cabin L	0	73	161	0	278	447

[1]Based on multiplying hourly concentration by a factor of 2 or 10 depending on the distance of the receptor to the odour source

[2]Based on multiplying the hourly concentration by a factor of 2.314 to convert an hourly concentration into a 3 minute concentration

Fort McKay's assessment conclusions (Fort McKay Specific Assessment; Fort McKay IRC 2010b) are:

- odours are currently a significant issue in the Community of Fort McKay. Shell's Base Case prediction that indicates odour threshold levels in the Community are only exceeded 22 hours per year is **very significantly** under-predicting the odour impacts that oil sands developments have on the Community;

- odour thresholds used by Shell appear to be high, at least for some substances, relative to those adopted by the WHO. This perhaps may be one reason for the significant under-prediction of odour impacts;
- a doubling of hours of ambient air quality exceeding odour thresholds is very significant, especially considering the current frequency of odour episodes in the Community;
- the Community is concerned about the significant increases in the hours of ambient air quality predicted to be above odour thresholds at some cabins on moderate to high use areas of the Community's Traditional Land; and
- the odour assessment in the Total Upgrader Project EIA (2007) indicates that the unpleasantness of a mixture of odourants was typically greater than that of its individual constituents. (Note: The lack of consideration given to the effects of mixtures of the odourous emissions would be a further explanation for the current under-prediction of odour impacts.)

The odour impacts of existing, approved, Shell's proposed projects and planned projects are therefore considered very significant, although there is uncertainty around the exact sources and nature of regional odours. This is an issue that needs to be addressed through the development of an odour management strategy before any more projects are to be approved. The Fort McKay Specific Assessment discusses the issues of odours in detail.

[11] Recommendations

Fort McKay recommends that a regional odour management strategy be developed, in consultation with Fort McKay, prior to the approval of any more projects.

Fort McKay recommends that this strategy consist of:

Odourous Emissions Characterization

To better characterize and quantify odourous emissions, which has not been done on a focused basis in the region to date, that companies be required to:

i. undertake a detailed and ongoing emission characterization and quantification monitoring program from the tailings ponds and that these characterization programs be reviewed and/or developed in conjunction with Fort McKay with the results of the monitoring reported to the Fort McKay IRC at regular intervals;

ii. develop a comprehensive plant site fugitive emissions detection, monitoring and characterization program and associated repair and reduction program that includes periodic DIAL (**Di**fferential **A**bsorption **L**idar) or equivalent monitoring and that this program be developed in conjunction with the Fort McKay IRC with the results of the monitoring reported to the Fort McKay IRC at regular intervals; and

iii. To improve the availability of information and related understanding on odour sources that, the Regulators, in co-operation with industry, collect, collate and publish all the hydrocarbon and reduced sulphur monitoring data that has been generated to date related to mine faces, tailings pond and fugitive bitumen processing and upgrading facility emissions.

Odour Modeling and Characterization Studies

To better understand and relate odourous emissions to actual odour responses and to improve odour modeling and predictions it is recommended that companies be required to:

i. participate (through funding and oversight) in the development and implementation of a regional odour study that would include:

ii. real time, high volume and low detection limit monitoring of the hydrocarbons and reduced sulphur compounds in the vicinity of existing oil sands operations, at key areas within Fort McKay's Traditional Lands (to be identified by Fort McKay), and within the Community of Fort McKay, and

iii. using odour panels to relate the data collected in i) above to the human characterization and response to air quality at the time of sampling, and

iv. be required to participate (through funding and oversight) in the development and testing of odour modeling and/or other predictive tools that can be used to assess the potential odour impacts of future oil sands projects.

Odour Management in the Community of Fort McKay

To address odour issues within the Community of Fort McKay it is recommended that:

i. companies and the Regulators continue to work with Fort McKay on addressing odour issues in the Community and support the notification protocol that Fort McKay is developing with industry to address episodic air quality issues including odours, and

ii. companies and the Regulators support (through funding and oversight) the development of an ongoing Community odour monitoring program including human response-based odour monitoring and recording and also a supporting, within Community, odour-based air sampling program.

[12] Impacts of Emissions to Vegetation

Direct effects on vegetation from industrial emissions could significantly impact the nature, use and enjoyment by Fort McKay of its Traditional Lands. A comparison of the available evaluation criteria for critical effect air quality levels, nitrogen deposition and PAI critical loads and those adopted by Shell and Fort McKay is presented in Table 3-9.

There currently almost no ambient air quality criteria specifically developed for Alberta and none have been specifically developed for boreal ecosystems like those in the Regional Municipality of Wood Buffalo (RMWB) that are directed at vegetation management. Therefore the assessments of impacts to vegetation as a result of regional industrial activities rely heavily on criteria from other jurisdictions or Alberta criteria that are perhaps not appropriate. This leads to assessment conclusions that range from no effects to significant effects simply based on the use of different assessment criteria (a specific example of this concerning NO_2 is discussed on Page 30 – Recommendation 13). As with other air quality parameters, Fort McKay selected criteria for the evaluation of nitrogen deposition effects based on current science and direct applicability of the criteria to the types of vegetation and ecosystems on Fort McKay's traditional lands. Fort McKay therefore considers its assessment criteria to represent a reasonable and responsible approach for assessing the potential impacts of regional air emissions on vegetation and for guiding the management of these impacts.

[12] Recommendation

It is recommended that air quality criteria for assessing vegetation impacts in Fort McKay's Traditional Lands the RMWB region be established and standardized, in consultation with Fort McKay. Consistency in the application of assessment criteria would allow Fort McKay to evaluate and compare results from different project EIAs to better understand the true impacts that projects in the region are expected to have on vegetation on the Fort McKay's Treaty Land Entitlement land and on its Traditional Lands.

Table 3-9: Comparison of Available Air Quality Critical Levels, Nitrogen Deposition and PAI Critical Loads and those Adopted by Shell and Fort McKay

Parameter	Source for Criteria/Objectives/Guidelines			Criteria Used in Assessment By		Comments
	(AENV 2008)[a]	(WHO 2000)	Other	Fort McKay	(Shell 2007)	
SO_2	30 µg/m³ annual average	• 10 µg/m³ annual average (for lichens) • 15 µg/m³ annual and winter average (for forests and natural vegetation)	-	• 10 µg/m³ annual average (for lichens) • 20 µg/m³ annual and winter average (for forests and natural vegetation)	• 10 µg/m³ annual average (for lichens) • 20 µg/m³ annual and winter average (for forests and natural vegetation)	Both the same; Based on WHO (2000) and (CLRTAP 2004))
NO_2	60 µg/m³	• 75 µg/m³ 24-Hr average (as NOχ i.e., NO + NO_2) • 30 µg/m³ annual average (as NOχ)	-	• 75 µg/m³ 24-Hr average (as NOχ i.e., NO + NO_2) • 30 µg/m³ annual average (as NOχ)	• 60 µg/m³ annual average as NO_2 and 200 µg/m³ for a 24-Hr average	Fort McKay's assessment criteria is based on (WHO 2000) and (CLRTAP 2004) which is considered more relevant to vegetation protection than the (AENV 2008) annual average and 24-Hr limits of 60 µg/m³ and 200 µg/m³, respectively

Parameter	Source for Criteria/Objectives/Guidelines			Criteria Used in Assessment By		Comments
	(AENV 2008)[a]	(WHO 2000)	Other	Fort McKay	(Shell 2007)	
NH_3	-	• 270 µg/m³ 24-Hr average • 8 µg/m³ annual average	• 1 µg/m³ annual (lichens and bryophytes) • 3 µg/m³ annual (forest ground flora) Recommendations from ECE (2007a)	• 1 µg/m³ annual (lichens and bryophytes) • 3 µg/m³ annual (forest ground flora)	Not assessed	Recommendations from ECE (2007a)
O_3	-	• 10 ppm-h AOT 40[b] (6 months – daylight hours)	SUM60[c] values of: • 0 to 2000 ppb hrs over a 3 month period (Baseline) • 2000 to 4400 ppb hrs over a 3 month period (Surveillance) • 4400 to 6600 ppb hrs over a 3 month period (Management) • > 6600 ppb hrs over a 3 month period (Exceedance) From CEMA (2007)	SUM60[c] values of: • 0 to 2000 ppb hrs over a 3 month period (Baseline) • 2000 to 4400 ppb hrs over a 3 month period (Surveillance) • 4400 to 6600 ppb hrs over a 3 month period (Management) • > 6600 ppb hrs over a 3 month period (Exceedance)	No criteria used in assessment	From CEMA (2007)

Parameter	Source for Criteria/Objectives/Guidelines			Criteria Used in Assessment By		Comments
	(AENV 2008)[a]	(WHO 2000)	Other	Fort McKay	(Shell 2007)	
Nitrogen Deposition	-	• 5-10 kg N/ha/yr ombrotrophic bog • 10-15 kg N/ha/yr coniferous trees	• < 8 kg N/ha/yr for bogs • 5-10 kg N/ha/yr boreal forests Recommendations from ECE (2007b)	• 8 kg N/ha/yr	• 0.25 keq N/ha/yr • (3.5 kg N/ha/yr) as a possible effect level (increased growth of moss in bogs) • 2.0 keq N/ha/yr • (28 kg N/ha/yr) as an adverse effect level in bogs	Based on Recommendations from ECE (2007b), discussion at a CEMA/NSMWG Dec. 2008 Nitrogen Critical Workshop in Calgary and the conclusion that significant impacts would be expected at Shell's criteria based on (ECE 2007b) and (CLRTAP 2004)
PAI	Not considered	Not considered in this assessment	CEMA (2004)	CEMA (2004) + CEMA (2006) criteria	CEMA (2004) + CEMA (2006) criteria (with a slight variation}	Fort McKay was heavily involved in the development of CEMA's Acid Deposition Management Framework and supports its implementation and use in assessing PAI impacts

[a] Note: it is not clear to Fort McKay how the SO_2 and NO_2 annual average ambient air quality objectives relate to vegetation protection

[b] AOT 40 – Accumulated exposure to ozone Over a Threshold of 40 ppb

[c] SUM 60 - SUM60 is the sum of all hourly ozone readings at or above 60 ppb between 8:00am and 8:00pm over any consecutive 3-month period in the period May 1 to September 30

[13] NO_2 Impact on Vegetation

In its EIA (2007), Shell used Alberta Environment's annual Ambient Air quality Objective (AAAQO) of 60 µg/m^3 for NO_2 as a vegetation effect level and predicted an area of 539 hectares (ha) of vegetation potentially affected by NO_2. The potential vegetation effect areas calculated by Golder (2009) using an annual NO_2 effect level of 15 µg/m^3 for NO_2 (which was provided by Fort McKay to Shell and Golder) is much larger, i.e., 100,000+ hectares. This much higher area of potential impact is generally in agreement with the modeled effects area presented by Imperial (2005) in its Kearl Project EIA, which indicates that a very large area within the Community's Traditional Lands (i.e., possibly in the hundreds of thousands of hectares), is either at risk or already being impacted. Shell's project could add approximately 20,000 hectares to the regional area with annual average ambient levels above 15 µg/m^3 of NO_2.

This large difference in impact predictions is based on Shell's use of a vegetation effect level for NO_2 of 60 µg/m^3 instead of the above-noted 15 µg/m^3. This also highlights the significance of assessment criteria selection on impact estimations. Fort McKay uses a 75 µg/m^3 24-hour average as NOχ (i.e., NO + NO_2) and a 30 µg/m^3 annual average (as NOχ; or 15 µg/m^3 annual average as NO_2) based on WHO (2000) as an effect level. This is an issue that is addressed in detail as part of the Fort McKay Specific Assessment (Fort McKay IRC 2010b).

Shell (2007) concludes that all the possible vegetation related impacts associated with their proposed projects were negligible (Vol. 3, Section 5.5.5.3, Table 5-237, Page 5-237). Fort McKay disagrees with this assessment, which it considers is based on the use of inappropriate impact assessment criteria. Also the assessment does not include all nitrogen species that could be environmentally significant nor does it consider data from the WBEA TEEM monitoring program that shows higher ambient air levels of certain nitrogen species than previously assumed. Finally, ozone modeling by Environment Canada would indicate the potential for ozone related impacts. The Fort McKay Specific Assessment discusses these in detail (Fort McKay IRC 2010b).

[13] Recommendation

It is the position of Fort McKay that the possible vegetation related impacts associated with the proposed JME and PRM projects cannot be considered negligible and that Shell should basing its assessment on the appropriate impact criteria and consider the 2005/2006 ozone monitoring work conducted by Environment Canada (2007), all regional monitoring data as well as all key nitrogen species when assessing nitrogen deposition related impacts.

3.5.6 Air Emission Estimates

[14-16] Regional Emission Estimates

Basic assumptions upon which emission estimations were based are presented in Section 2 in Appendix 3-8 (Shell 2007). There has been considerable variation in the Base and Planned Development Case (PDC) emission estimates presented in recent EIAs. For example, the variations in PDC emission estimates for SO_2 and $PM_{2.5}$ are presented in Table 3-10 and Table 3-11, respectively. Such inconsistencies present challenges when comparing EIA predictions and results. While Fort McKay acknowledges the challenge in estimating certain emissions, the range of variation in air emissions estimates highlights the need for standardized approaches in estimating air emissions combined with an ongoing process for verification as well as periodic updating and revision of these approaches.

Table 3-10: Estimated Planned Development Case SO_2 Emissions from Various Project EIAs

Project	Year of EIA	Emission Estimate for SO_2 (Planned Development Case; Tonnes/day)
Shell Jackpine Mine	2002	447[1]
Imperial Kearl	2005	298
Suncor Voyageur South	2007	315
DCEL North Mine	2006	244
Petro-Canada MRE	2005	279
Synenco Northern Lights	2007	401
Shell Jackpine Mine Expansion	2008	323
Shell Pierre River Mine	2008	

[1]Does not reflect SO_2 emission reductions associated with Syncrude's flue gas desulphurization program.

Similar emission estimate issues apply to NOχ emissions, particularly from mine fleets, and volatile organic compounds (VOCs) emissions from tailings ponds.

[14] Recommendation

Fort McKay recommends that the Government lead and Shell participate in the development of standardized approaches for estimating air emissions that would be refined through an ongoing verification process with periodic updating and revision of these approaches. This process should be done in consultation with Fort McKay.

Table 3-11: Estimated Planned Development Case $PM_{2.5}$ Emissions from Various Project EIAs

Project	Year of EIA	Emission Estimate for $PM_{2.5}$ (Planned Development Case; Tonnes/day)
Imperial Kearl	2005	34
DCEL North Mine	2006	31.5
Petro-Canada MRE	2005	35
Synenco Northern Lights	2007	44
Shell Jackpine Mine Expansion	2008	39.4
Shell Pierre River Mine	2008	

[15] Recommendation

Fort McKay recommends that, should an approval be issued for these projects, that it requires a specific evaluation of predicted versus in operation measured VOC emissions from tailing ponds (quantity and quality).

[16] Recommendation

Fort McKay recommends that Shell be required to conduct or participate in actual emission testing on representative mine fleet units during typical use conditions to confirm actual mine fleet emissions, which is a major area of uncertainty in terms of regional emission estimates.

[17] Asphaltene-Fired Cogeneration

Shell is proposing the use of asphaltene as a fuel source to support cogeneration operations. Since for the proposed projects asphaltene-fired cogeneration is the primary emission source for SO_2, $PM_{2.5}$ and a significant emission source for NOχ, a good understanding of the composition and fuel quality of the asphaltene is critical in the prediction of project emissions. Fort McKay has questions regarding the approach used in this EIA (and elaborated upon in the May 2009 PRM project supplemental information) (Shell 2009) for estimation of emissions from the asphaltene-fired cogeneration units. Shell indicates design pollution control efficiencies were used in the estimation of sulphur, NOχ, and PM emissions, while PAH and metals emissions were estimated based on flue gas desulphurization stack monitoring data from the combustion of coke. Overall, the EIA provided a limited amount of design information on the system, and a detailed characterization of the asphaltene feedstock (e.g., S,

N, Hg, As, V, Ni, Cr, etc., and heating value) is requested. Overall, Fort McKay considers that the emission controls proposed for these units represent "best practices" but wants to be certain that the proposed emission reductions are realistic and achievable.

[17] Recommendation

Fort McKay requests that the characteristics of the asphaltene in terms of quality and energy content be provided by Shell. Shell should also provide additional details on the design specifications/basis for the emission control systems for the asphaltene-fired co-gen units and outline the basis for using 0.256 kmoles of flue gas per kg of fuel estimate as specified in the JPM 2009 supplemental information submission from Shell (Shell 2009).

[18] Fuel Source

Much of the fuel currently used in oil sands projects is in the form of natural gas, which has negligible sulphur content. Regional sulphur dioxide emissions associated with the burning of coke have decreased and will decrease further through the additional flue gas desulphurization emission controls currently being installed by Syncrude. Predictions for future regional SO_2 emissions are generally calculated based on the use of natural gas as an energy source and past and planned SO_2 controls on existing sources. If there were a significant shift away from natural gas as a regional fuel source to fuels that contain high levels of sulphur, such as asphaltenes, coke, bitumen, produced gas, refinery fuel gas etc. as Shell is proposing in this project, then regional sulphur emissions could start to increase. The potential scale and air emissions significance of this type of fuel use/ switching is of concern to Fort McKay and needs to be considered in developing regional emission control strategies.

[18] Recommendation

Fort McKay requests that the Regulators consider the potential of a shift to the use of alternative fuel sources in place of natural gas by oil sands projects in establishing source control limits and regional emission management strategies.

[19] Jackpine Mine Phase 1 Emission Estimate Adjustment

Shell is proposing that the Jackpine Mine Phase 1(JPM1) approval be amended and renewed to reflect revised emission estimate calculations as well as actual proposed facility changes. It is also proposing an amendment to include the JPME facilities. Adjustments made to emission estimates from the JPM1 EIA were incorporated into calculations of emissions from the JME project presented in this EIA. While Fort McKay appreciates Shell's effort in updating emissions figures as well as air

quality predictions to reflect project JPM1 changes, this approach has the effect of masking the true impact of the proposed JME project.

Updated emission estimates from JPM1 related to revised emission estimating and emissions from the proposed JPME represent two distinct changes to the requested amendment. In order for Fort McKay and other stakeholders to better understand the impact of the proposed expansion, the two issues and their respective impact to air quality predictions should each be considered and discussed independently – i.e., emission reductions for JPM1 related to revised calculation methods should be applied to create a new baseline case and then the JME and PRM impacts (the Application Cases) be assessed against this new baseline.

[19] Recommendation

It is recommended that Shell present the adjusted emission estimates from JPM1 and emission estimates from JME independently - i.e., emission reductions for JPM1 related to revised calculation methods should be applied to create a new baseline case and then the JPME and PRM impacts (the Application Cases) be assessed against this new baseline.

[20-21] Nitrogen Deposition

Nitrogen deposition occurs from wet and dry deposition of reactive nitrogen species and this deposition has the potential to affect vegetation through fertilization effects. Dry nitrogen deposition is very difficult to measure directly and is generally determined using inferential deposition models.

A number of studies and monitoring programs are currently directed at improving regional information and understanding related to nitrogen deposition. Estimates of current general regional nitrogen deposition based on monitoring appear to range from 3 to 4 kg N/ha/yr to 5 to 10 kg N/ha/yr, with the uncertainty around possible ammonia deposition being the major contributor to this large range in current nitrogen deposition estimates. According to a report prepared on behalf of the NOχ SO_2 Management Working Group (TEEM 2005), between 20,000 (at a critical load of 5 kg N/ha/yr) and 3,000 hectares (at a critical load of 10 kg N/ha/yr) of sensitive ecosystem/vegetation types (i.e., bogs, black spruce and coniferous) on Fort McKay Traditional Lands could be already have been affected by nitrogen deposition. While the model predictions are likely high (NSMWG 2005), they do not include all nitrogen species (e.g., HONO, NH_3 and NH_4^+) and might therefore be under-estimates of the total nitrogen deposition. Based on the current information available related to nitrogen deposition in the region, it appears that the levels on Fort McKay's Traditional Lands in the vicinity of current mining developments may be at effect levels and therefore regional nitrogen

deposition is a current concern to Fort McKay (a yellow situation as defined in the Fort McKay Specific Assessment).

Table 3-12 summarizes the extent of areas predicted to exceed a regional critical loading of 8 kg N/ha/yr under the different assessment scenarios. In the absence of more details on the individual planned development projects it is not possible to assess whether or not all or some of these planned projects would exceed Fort McKay an area impact criteria of 5% of the total project development area (the criteria used in the Fort McKay Specific Assessment). Based on the current Application Case predictions and a subsequent extrapolated prediction of 9750 ha in exceedence area for the Planned Development Case, Fort McKay considers the potential nitrogen deposition impact on the Community to be significant.

Table 3-12: Areas Exceeding a Regional Critical loading of 8 kg N/ha/yr under the Base, Application and Planned Development Case Scenarios

Scenario	Area Exceeding Regional Critical Load (ha)	Area Outside Project Development Area that Exceeds Regional Critical Load (ha)	Area Impacted by Proposed Project as % of Total Project Development Area
Base Case	55,000	5,500	--
Application Case	60,000	7,500	9.4%
Planned Development Case	Not Assessed[1]	9750[1]	--
Total Proposed Project Development Area (ha)			**21,339**

[1]Planned Development Case nitrogen deposition was not assessed by Shell. Area exceeding regional critical load of 8 kg N/ha/yr would be 9,750 ha if estimated based on 28% increase in regional NOX emissions from various planned projects in the region.

[20] Recommendation

Fort McKay recommends that the regulators require, and Shell commit to, more stringent NOχ emission control measures to minimize project emissions that would contribute to nitrogen deposition in the region.

[21] Recommendation

Fort McKay requests that actions be taken by the Regulators and Shell as well as other companies to continue to support WBEA and CEMA in activities related to monitoring and management of potential impacts of air emissions on vegetation. Fort McKay would expect such actions to include support of recommendations and work plan work as outlined in CEMA's *Interim Nitrogen (Eutrophication) Management Recommendations*

and Work Plan, which includes developing nitrogen critical loads for sensitive regional ecosystems. Fort McKay would also expect participation in the development of ambient air quality critical levels for NO, NO_2 and NH_3 based on potential impacts on vegetation relevant to the RMWB.

[22-23] Ammonia Emissions

The potential impact of industrial ammonia emissions is also an issue of concern to Fort McKay. Shell provided an assessment of total nitrogen deposition in its EIA, the assessment, however, did not include an evaluation on the potential impacts of ammonia on vegetation in the region. Ammonia emissions are not well quantified in the region. In a *Summary of State of the Issues Sheets for Trace Metals and Air Contaminants Priority Pollutants* report (AENV 2005), regional ammonia emissions were estimated at 1,097 tonnes/annum in 2003 - all from stack sources.

Syncrude has subsequently added a flue gas desulphurization system that uses ammonia so there are some ammonia emissions from this source. Some fugitive ammonia releases from oil sands processing operations, tailings ponds and mine faces would also be expected. Recent regional passive monitoring for ammonia shows reasonably high ambient ammonia levels at certain times and in certain areas of the region (Table 3-13) an annular denuder intermittent sampler located in Fort McKay in 2003 that measured ammonia concentrations found the average ammonia concentration in Fort McKay to be 0.78 $\mu g/m^3$. Both the passive and denuder ammonia monitoring would indicate that ammonia values may currently be at levels that could adversely affect sensitive vegetation receptors such as lichens, and therefore regional ammonia levels are a concern to Fort McKay. Identification and quantification of regional ammonia emissions are therefore areas that require further work.

[22] Recommendation

In order to gain better understanding in the sources and possible environmental effects of regional ammonia releases, Fort McKay requests that Shell be required to participate, through both funding and oversight, in the development and implementation of a regional ammonia monitoring study. Scope of the study would include monitoring both point and area emission sources in the region for ammonia using low detection ammonia monitors.

[23] Recommendation

Fort McKay also requests that Shell be required to undertake studies to determine if there is the potential for ammonia releases from its proposed projects and, if so, indicate how these can be minimized.

Table 3-13: Summary of Ambient Ammonia (NH_3) Levels from WBEA's Passive Ammonia and Nitric/Nitrous Acid Monitoring Network

Month	Ammonia Levels by Month (µg/m³)					
	2005	2006	2007	2008	Average (µg/m³)	Average (ppb)
January	0	0.95	1.31	1.08	1.11	1.59
February	0	1.09	1.79	0.76	1.18	1.69
March	0	0.80	1.79	0.76	1.08	1.55
April	0	1.68	1.47	0.76	1.29	1.86
May	1.49	1.72	1.50	1.30	1.50	2.16
June	1.23	2.35	1.90	0	1.94	2.79
July	3.22	2.34	2.35	0	2.63	3.78
September	1.40	0.86	1.71	0	1.32	1.90
October	1.43	1.65	1.43	0	1.50	2.15
November	1.24	1.01	0.98	0	1.08	1.55
December	0.73	1.06	1.08	0	0.96	1.37

Note: 24 Sites covering the May 2005 to May 2008 period inclusive – not all sites were sampled for this entire period.

3.5.7 Air Quality Modeling and Predictions

[24] Air Quality Modeling Performance

Like many other oil sands project EIAs, Shell used the CALMET/ CALPUFF models to predict the changes in air quality as a result of pollutant dispersion for the different emission scenarios. Despite the same models being utilized by the various project EIAs that have been conducted in the region, the resulting air quality predictions from these EIAs differ significantly even for the same emissions scenarios. Table 3-14 provides a summary of air quality predictions for the Planned Development Case, which demonstrates the variance in modeled air quality predictions amongst these projects.

A factor that impacts model performance is the uncertainties in regional air emissions, which are discussed on Page 31 – Recommendations 14 to 16. Another factor that influences model performance appears to be the distance of the modeled receptor from emission sources. It is apparent that the models have difficulty in predicting air quality accurately near emission sources. These models also have somewhat limited capability in terms of predicting atmospheric reactions and do not include all possible pollutants of interest in terms of ambient concentrations and or

Table 3-14: Comparison of Predicted Air Quality Levels in the Various Recent EIAs for the Planned Development Case

Proponent		Suncor	Synenco	DCEL	DCEL	Imperial	Petro-Canada	
Year		2007	2007	2005	2006	2005	2005	
Project EIA		Voyageur South[1]	Northern Lights	Phase IIIA	North Mine	Kearl	MacKay River Expansion	
Parameter	Averaging Period	Modeled Air Quality in Fort McKay under the Planned Development Case ($\mu g/m^3$)						Range ($\mu g/m^3$)
SO_2	1-Hour	N/A[2]	78.	96	47	78	50	47 - 96
	24-Hour	N/A[2]	26	24	25	23	26	23 - 26
	Annual	N/A[2]	6	7	4	5	5	4 - 7
NO_2	1-Hour	127	199	177	131	107	329	107 - 329
	24-Hour	97	182	124	71	90	240	71 - 240
	Annual	31	60	81	24	28	57	24 - 81
CO	1-Hour	N/A[2]	1540	1300	1180	1020	1500	1020 - 1540
	8 hr	N/A[2]	1470	1220	810	560	1480	563 - 1480
$PM_{2.5}$	98^{th} %ile 24-Hour	25	49	43	25	26	48	25 - 49

[1] Peak 1-Hour, 24-Hour and annual average values.

[2] SO_2 and CO modeling for PDC was not conducted. Since they were both considered to have a "negligible impact" in the Application Case, an assessment for PDC was deemed not necessary.

deposition. This can lead to under-prediction of parameters like nitrogen deposition and $PM_{2.5}$ formation. Some inputs to the models, such as leaf area index (LAI), which is important in deposition estimates, have not been accurately measured and current values may be resulting in over-predictions (Golder 2009). Fort McKay compared model predictions from different EIAs in its Fort McKay Specific Assessment and generally used the highest prediction when assessing potential impacts.

[24] Recommendation

In order to gain more accurate predictions of NO_2, NO, $PM_{2.5}$, and SO_2 concentrations and depositions in the Community and on Fort McKay's Traditional Lands, it is recommended regional models be validated and updated to improve model predictions of the impacts of future NOχ emissions. We recommend that Shell participate in this process.

[25] Ambient Ozone Predictions

Fort McKay's assessment of possible ozone related impacts associated with Shell's proposed projects was limited because the issue was not assessed quantitatively by Shell and has not been assessed quantitatively in any recent EIAs. Therefore, no numeric Application Cases predictions are available for ozone. In terms of the Application Case Shell (2007) notes that:

> *"The Project (Jackpine Mine Expansion and Pierre River Mine) is predicted to increase ozone precursor emissions by less than 5% in the Oil Sands Region and modeling domain (Volume 3, Section 3.2.3.5), which is not expected to result in a measurable change in ground-level ozone concentrations. Under these conditions, the effect of ozone on terrestrial vegetation and wetlands is predicted to be negligible." (Vol. 3, Section 5.5.5.3, Page 5-233).*

Increased regional emissions of NOχ and VOCs, resulting from proposed projects like Shell's have been modeled in terms of future ozone levels and significant increases and potential impacts were identified. Environment Canada's (2007) future emission scenario modeling run for ozone can be considered to represent a Planned Development Case scenario. This modeling indicated the potential for the area of the region where SUM 60 levels were above 2000 ppb-hrs to substantial increase and for some areas to have SUM 60 values above 4400 ppb-hrs (the recommended "management" level) and some areas to have SUM 60 values above 6600 ppb-hrs (the recommended "exceedence" level; CEMA 2007). Future levels of ozone may therefore have an adverse impact on regional vegetation. It is Fort McKay's assessment that the potential impact of Shell's proposed projects on future regional ozone levels and vegetation impacts cannot be considered as negligible and needs to be considered when establishing emission limits for the project.

This is an issue that is addressed in detail as part of the Fort McKay Specific Assessment (Fort McKay IRC 2010).

[25] Recommendation

It is recommended that the potential impact of Shell's proposed projects on future regional ozone levels and vegetation impacts should not be considered as negligible and needs to be considered by the Regulators when establishing emission limits for the project for NOχ and VOCs – the two precursors for ground-level ozone formation.

3.5.7.1 Emissions Management

[26] Steam and Power Generation Facilities Integration

The proposed integration of steam and power facilities for the JPM1 and JME projects and the proposed use of asphaltenes as fuel source for the JME steam co-generation results in an increase in the per barrel emissions for the expanded JPM project. This is illustrated in Table 3-15.

Table 3-15: Emission Intensities from the Jackpine Mine Phase 1 and Jackpine Mine Expansion

Project	Emissions of noted parameter in tonnes per day per 100,000 of Bitumen Production (t/d/100,000 bbl)					
	SO_2	NOχ	CO	$PM_{2.5}$	VOC	TRS
Jackpine Mine Phase 1 (200,000 bbl/d)	~0	5.81	5.35	0.25	8.68	0.07
Expanded Jackpine Mine (Phase 1 + Proposed Expansion) (300,000 bbl/d)	1.36	6.02	6.15	0.27	8.72	0.07
Jackpine Mine Expansion (100,000 bbl/d)	4.08	6.45	7.75	0.31	8.79	0.07

The fact that an application is being made that, will in effect, increase emissions on a per-unit of production basis for both an existing and proposed project is of significant concern to Fort McKay. Fort McKay therefore requests that additional emission controls be required on the gas turbines to reduce the NOχ emission intensities to partially offset the significant increase in SO_2 emission intensities. (Note: The issue is further discussed on Page 41 – Recommendation 27 and Page 41 – Recommendation 28.)

[26] Recommendation

Fort McKay requests that additional emission controls be required by the Regulators on Shell's gas-fired co-generation units to reduce the NOχ emission intensities and to partially offset the significant increase in SO_2 emission intensities.

[27] Cogeneration Emission Control Technology

Shell provides, in this EIA, the specifications for heater, auxiliary boiler and natural gas-fired turbine and HRSG. This information includes NOχ emission factors and emission rates. Fort McKay is concerned that the general approachs taken with respect to specification and performance are inconsistent with current emission criteria and expectations. For example, for the auxiliary power boiler the new Alberta Environment Interim Guidelines specify a compliance limit of 26 µg/GJ, not 40 µg/GJ, as was used in the application. In terms of unit specifications the Interim Guidelines clearly indicate that**: "The design, selection and operation of equipment are to be based on meeting the performance target"**. Therefore the specifications should reflect these performance target based criteria with a reference note that these are the limits that units will be designed to achieve but that the allowed compliance limits are higher.

In terms of mitigation measures, no details are provided on the control technologies and strategies that will be used to meet the above noted performance targets. As noted previously, the technologies proposed to control emissions from the asphaltene co-generation units are considered to represent best available control technologies and as such Fort McKay does not object to the units even though the overall emissions are higher than those that would result from the use of equivalent sized natural gas-fired units. As noted above, Fort McKay is requesting that additional emission controls be required on the gas-fired co-generation units to reduce the NOχ emission intensities to partially offset the significant increase in SO_2 emission intensities associated with the proposed asphaltene-fired boilers.

[27] Recommendation

Fort McKay has a number of issues with the proposed NOχ emission rates from the proposed projects and requests additional details on emission controls from the gas-fired co-generation units and boilers so it can fully assess and comment on the air emission rates and controls.

[28] Emissions Reduction and Management Strategies

Shell has identified a number of operational actions that it will undertake to mitigate impact of the proposed projects on regional air quality. For the most part these are considered to represent best practices but the EIA did not include all options available for emissions reduction. The areas for possible additional emission reductions are:

- Early adoption of Tier 4 mine fleet vehicles if units are available (it is unclear in the EIA what percentage of mine fleet will be Tier 2, Tier 3, or Tier 4 vehicles, and when Tier 2 and Tier 3 vehicles will be replaced),
- Possible application of retrofit emission controls on mine fleet units and existing point sources,
- Improved diluent loss reduction targets e.g., less than 3 bbl per 1000 bbl of bitumen, and
- Improved Oχ removal efficiency from gas boilers and co-generation units (see Section 3.4.2).

With respect to greenhouse gas (GHG) emissions, Shell acknowledges in Volume 3, Section 3.4.8.4, that the implementation of asphaltene energy recovery (AER) is more GHG intensive relative to gas-fired cogeneration. GHG management strategies specifically applicable to the AER include designing facilities to be CO_2 capture ready and using advanced combustion process.

[28] ***Recommendations***

Fort McKay expects best practices to be adopted in all aspects of production and processing and requests that Shell assess possible options for additional reductions.

Fort McKay expects the following additional emission control measures:

i. To reduce the regional precursor concentrations of ozone forming compounds that Shell be required to reduce solvent losses to its Jackpine Mine expansion and Pierre River Mine tailings pond to less than 3 bbl per 1000 bbl of bitumen within five years of commencing bitumen production at these mines;

ii. To reduce the regional precursor concentrations of ozone forming compounds that Shell be required to reduce the NOχ emissions from all gas-fired boilers, heaters and gas turbines that emit more than 100t/yr of NOχ and that these reductions be based on the use of post combustion selective catalytic reduction technology, or equivalent, which Shell is proposing for its asphaltene-fired co-generation units.

iii. To minimize regional $PM_{2.5}$ emissions through continuous improvement measures, that Shell implement mine fleet $PM_{2.5}$ emission control retrofit devices that become commercially available;

iv. To better manage NOχ emissions from one of the major regional NOχ emission source types, i.e., heavy haulers, that Low NOχ emission heavy hauler vehicles with NOχ emissions similar to the USEPA Tier 4 limits for non-road vehicles in the 600-750 hp size range be developed and mandated; and

v. To minimize regional NOχ emissions through continuous improvement measures, that Shell implement mine fleet NOχ emission control retrofit devices that become commercially available.

[29] Collaborative Initiatives in Emissions and Air Quality Monitoring

Shell has noted its commitment to regional collaborative initiatives such as CEMA, WBEA and RAMP as well as CONRAD. Fort McKay acknowledges and commends Shell for its strong support for, and participation in, these associations and related committees and work groups. Fort McKay is very concerned, however, that the Oil Sands Developers Group (formerly RIWG) has been taking a larger role in the review and approval/allocation of the budgets for regional multi-stakeholder programs. The Oil Sands Developers Group (OSDG) is not a regional multi-stakeholder group and has no status or standing in CEMA, WBEA and RAMP.

[29] Recommendation

Companies and the Regulators ensure that regional multi-stakeholder committees are open and transparent and not run indirectly by industry groups through budget controls.

Fort McKay considers regional environmental effects monitoring as one component of industry's environmental impact mitigation measures. Such monitoring is the only direct way to ultimately determine whether or not industrial emissions are adversely impacting the environment. Fort McKay therefore expects that the planning, implementation and funding for such monitoring will be a government and company priority comparable to the priority given to ensuring environmental controls are operating properly and environmental performance limits in approvals are met.

[30] Recommendations

To better understand current and potential future regional air-related environmental effects and impacts, and the factors contributing to these effects, it is recommended that Shell, other companies and the Regulators fully support WBEA and CEMA in activities related to monitoring and managing the potential impacts of air emissions on vegetation.

The regional monitoring and air emissions effects management activities that should be part of Shell's proposed projects should, at a minimum, include:

i. Implementation of the recommendations and work plan work as outlined in CEMA's Interim Nitrogen (Eutrophication) Management Recommendations and Work Plan which includes the development of nitrogen critical loads for sensitive regional ecosystems,

ii. Implementation of CEMA's Acid Deposition Management Framework including full development and deployment of the time-to-effect dynamic acidification model for the entire region,

iii. Implementation of CEMA's Ozone Management Framework and using the results of Framework ozone model predictions in emissions management planning,

iv. Sensitive and spatially representative vegetation effects and exposure monitoring programs be developed that can be used to accurately determine if, when and where adverse air-related vegetation effects are occurring and to validate and/or calibrate model predictions, and

v. Development of ambient air quality critical levels for NO, NO_2 and NH_3 based on potential impacts on vegetation relevant to Fort McKay and its Traditional Lands.

Ambient air quality monitoring is an important way of assessing the impact of industrial emissions on regional air quality and for assessing trends in regional air quality. The PRM project will be the only industrial development due north of the Community and Fort McKay would like to be able to assess the impact of this development on the Community's air quality.

[31] Recommendation

To determine the frequency and magnitude of the impact of the proposed Pierre River Mine project on air quality in Fort McKay it is recommended that Shell be required to provide an "attribution" continuous air quality monitoring station between the Community and the proposed Pierre River mine that would monitor for NOX, TRS, SO_2, $PM_{2.5}$ and PM_{10}, O_3, THC, VOCs and basic meteorological parameters, and that this station be incorporated into the WBEA ambient monitoring network.

Table 3-16: Air Summary Table

Number	Fort McKay Key Concerns	Recommendation	Category[1]
7	Relevant Objectives and Criteria	It recommended Fort McKay's health and odour-based air quality criteria as well as the Keeping Clean Areas Clean criteria be adopted and considered in future oil sands project EIAs for the assessment of air quality impacts on the Community of Fort McKay.	Agreement Regulatory
8	Relevant Objectives and Criteria	Fort McKay requests that Shell be required to participate in and support regional initiatives to develop specific procedures for assessing, measuring and tracking air quality changes in the region and in Fort McKay. This would include a process for formally reviewing air quality changes above certain levels to ensure that significant deterioration of air quality in the region and in the Community of Fort McKay does not occur.	Agreement Regulatory

Number	Fort McKay Key Concerns	Recommendation	Category[1]
9	Impact Criteria and Classification	Fort McKay suggests that a standardized impact classification system that is specifically applicable to Fort McKay's Traditional Lands and the Regional Municipality of Wood Buffalo be established through joint efforts of the regulators, companies and regional communities since impact criteria can vary significantly between EIAs.	Agreement Regulatory
10	Odour Thresholds and Impacts	Fort McKay requests that the criteria and basis for selection of the odour thresholds used in the EIA be provided by Shell.	Response
11	Odour Thresholds and Impacts	Fort McKay recommends that a regional odour management strategy be developed prior to the approval of any more projects.	Agreement Regulatory
12	Impacts of Emissions to Vegetation	It is recommended that air quality criteria for assessing vegetation impacts in Fort McKay's Traditional Lands and RMWB region be established and standardized through collaboration between the Regulators and industries with input from stakeholders such as Fort McKay. Consistency in the application of assessment criteria would allow Fort McKay to evaluate and compare results from different project EIAs to better understand the true impacts that projects in the region are expected to have on vegetation on the Band's reserve land and on its traditional lands.	Agreement Regulatory
13	NO_2 Impact on Vegetation	It is the position of Fort McKay that the possible vegetation related impacts associated with the proposed JPME and PRM projects cannot be considered negligible without basing the assessment on the appropriate impact criteria and without considering the 2005/2006 ozone monitoring work conducted by Environment Canada, all regional monitoring data as well as all key nitrogen species when assessing nitrogen deposition related impacts.	Regulatory Response

Number	Fort McKay Key Concerns	Recommendation	Category[1]
14	Regional Emission Estimates	Fort McKay recommends that the government lead and Shell participate in the development of standardized approaches for estimating air emissions which would be refined through an ongoing verification process with periodic updating and revision of these approaches.	Regulatory Response Agreement
15	Regional Emission Estimates	Fort McKay recommends that the approval require a specific evaluation of predicted versus in operation measured VOC emissions from tailing ponds (quantity and quality).	Regulatory
16	Regional Emission Estimates	Fort McKay recommends that Shell be required to conduct or participate in actual emission testing on representative mine fleet units during typical use conditions to confirm actual mine fleet emissions which is a major area of uncertainty in terms of regional emission estimates.	Agreement Regulatory
17	Asphaltene-Fired Cogeneration	Fort McKay requests that the characteristics of the asphaltene in terms of quality and energy content be provided by Shell. Shell should also provide additional details on the design specifications/basis for the emission control systems for the asphaltene-fired co-gen units and outline the basis for using 0.256 kmoles of flue gas per kg of fuel estimate as specified in the JPM 2009 supplemental information submission from Shell.	Regulatory Response
18	Fuel Source	Fort McKay requests that the potential of a shift to the use of alternative fuel source in place of natural gas by oil sands projects in the region be considered by the Regulators in establishing source control limits and regional emission management strategies.	Regulatory
19	Jackpine Mine Phase 1 Emission Estimate Adjustment	It is recommended that Shell present the adjusted emission estimates from JPM1 and emission estimates from JPME independently.- i.e., emission reductions for JPM1 related to revised calculation methods should be applied to create a new baseline case and then the JPME and PRM impacts (the application cases) be assessed against this new baseline.	Regulatory Response

Number	Fort McKay Key Concerns	Recommendation	Category[1]
20	Nitrogen Deposition	Fort McKay recommends that the regulators require, and Shell commit to, more stringent NOχ emission control measures to minimize project emissions that would contribute to nitrogen deposition in the region.	Regulatory Agreement
21	Nitrogen Deposition	Fort McKay requests that actions be taken by the Regulators and Shell as well as other companies to continue to support WBEA and CEMA in activities related to monitoring and management of potential impacts of air emissions on vegetation. Fort McKay would expect such actions to include support of recommendations and work plan work as outlined in CEMA's Interim Nitrogen (Eutrophication) Management Recommendations and Work Plan which includes developing nitrogen critical loads for sensitive regional ecosystems. Fort McKay would also expect participation in the development of ambient air quality critical levels for NO, NO_2 and NH_3 based on potential impacts on vegetation relevant to the RMWB.	Agreement Regulatory
22	Ammonia Emissions	In order to gain better understanding in the sources and possible environmental effects of regional ammonia releases, Fort McKay requests that Shell be required to participate, through both funding and oversight, in the development and implementation of a regional ammonia monitoring study through WBEA. Scope of the study would include monitoring both point and area emission sources in the region for ammonia using low detection ammonia monitors.	Agreement Regulatory
23	Ammonia Emissions	Fort McKay also requests that Shell be required to undertake studies to determine if there is the potential for ammonia releases from its proposed projects and, if so, indicate how these can be minimized.	Agreement Regulatory

Number	Fort McKay Key Concerns	Recommendation	Category[1]
24	Air Quality Modeling Performance	In order to gain more accurate predictions of NO_2, NO, $PM_{2.5}$, and SO_2 concentrations and depositions in the Community and on Fort McKay's traditional lands, it is recommended that regional model validation and continual improvement program to improve model predictions of the impacts of future NOχ emissions be developed and that Shell participate in this program.	Agreement Regulatory
25	Ambient Ozone Predictions	It is recommended that the potential impact of Shell's proposed projects on future regional ozone levels and vegetation impacts should not be considered as negligible and need to be considered when establishing emission limits for the project for NOχ and VOCs – the two precursors for ground-level ozone formation.	Regulatory Response
26	Steam and Power Generation Facilities Integration	Fort McKay requests that additional emission controls be required on the gas-fired co-generation units to reduce the NOχ emission intensities to partially offset the significant increase in SO_2 emission intensities.	Agreement Regulatory
27	Cogeneration Emission Control Technology	Fort McKay has a number of issues with the proposed NOχ emission rates from the proposed projects and requests additional details on emission controls from the gas-fired co-generation units and boilers so it can fully assess and comment on the air emission rates and controls.	Regulatory Response
28	Emissions Reduction and Management Strategies	Fort McKay expects best practices to be adopted in all aspects of production and processing and possible options for additional reductions should be assessed as part of the EIA. (See detailed list within the text of Recommendation 28)	Agreement Response
29	Collaborative Initiatives in Emissions and Air Quality Monitoring	Companies and the Regulators ensure that regional multi-stakeholder committees are open and transparent and not run indirectly by industry groups through budget controls.	Agreement Regulatory

Number	Fort McKay Key Concerns	Recommendation	Category[1]
30	Collaborative Initiatives in Emissions and Air Quality Monitoring	To better understand current and potential future regional air-related environmental effects and impacts, and the factors contributing to these effects, it is recommended that Shell, other companies and the Regulators fully support WBEA and CEMA in activities related to monitoring and managing the potential impacts of air emissions on vegetation (see detailed list within the text of Recommendation 30).	Agreement Regulatory
31	Collaborative Initiatives in Emissions and Air Quality Monitoring	To determine the frequency and magnitude of the impact of the proposed Pierre River Mine project on air quality in Fort McKay it is recommended that Shell be required to provide an "attribution" continuous air quality monitoring station between the Community and the proposed Pierre River mine that would monitor for NOχ, TRS, SO_2, $PM_{2.5}$ and PM_{10}, O_3, THC, VOCs and basic meteorological parameters, and that this station be incorporated into the WBEA ambient monitoring network.	Agreement; Regulatory

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

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4.0 GROUNDWATER

4.1 Groundwater Impacts

Several of the activities associated with the proposed Shell Jackpine Mine Expansion and the Shell Pierre River Mine Project will impact the groundwater resources in the two project areas. These impacts may result in changes to groundwater levels, changes in groundwater flows and flow directions and changes in the groundwater quantity. These changes can impact the aquatic resources including surface water flows, surface water quality and wetlands in the Local Study Area (LSA) and the Regional Study Area (RSA). Wetland vegetation can also be impacted where the vegetation is dependent on groundwater for survival (i.e. fens, which are ground water fed).

Activities that are common to Jackpine Mine Expansion and Pierre River Mine Project and which can result in changes to the groundwater resources are:

- Dewatering and removal of the overburden
- Basal Aquifer depressurization
- External tailings disposal
- Overburden disposal
- Plant-site (Note: Jackpine Mine Expansion will use the existing Jackpine Phase l plant-site)
- Mine pit backfill
- Reclamation and the mine closure landscape

4.1.1 Dewatering and Removal of the Overburden

Discontinuous minor thicknesses of muskeg occur throughout the project area and may need to be removed. Where there are underlying surficial aquifers, dewatering will occur before the muskeg will be removed. Muskeg removal will usually be done in the winter to help minimize surface runoff. Any water from dewatering of the muskeg will be directed to sedimentation ponds and will be released to the environment, if the water quality is satisfactory.

The overburden will be dewatered to allow its removal prior to mining of the underlying bitumen. The groundwater will be removed using ditches and shallow de-watering wells. Water from dewatering of the overburden will be directed to sedimentation ponds and will be released to the environment, if the water quality is satisfactory. The dewatering will have an effect on groundwater levels, flows and flow patterns in the LSA.

The dewatering will result in the lowering of the groundwater levels within the dewatering area to, or below, the level of the mining surface. The dewatering and the development of the pit will result in the incidental or passive dewatering of

the geological materials surrounding the mining pit. The lower water level associated with the pit, the bottom of which will be many metres (m) below the water table in the surrounding undisturbed materials, will cause the groundwater in the surrounding materials to flow towards the pit walls where some will discharge into the pit as groundwater seeps and some will be lost as evaporation. Some of the groundwater entering the mining pit through the pit walls will be collected for use around the mine as it may be affected by mining activities. The amount of lowering of the water level in the area surrounding the pit will gradually decrease from a maximum equal to the depth of the mining pit at the pit walls, to zero at a distance predicted to be 3,500 m from the pit wall for Jackpine Mine Expansion and to zero at a distance predicted to range from 1,000 to 3,000 m west from the mining area and up to 5,000 m north and south from the mining area for Pierre River Mine Project. Overburden dewatering may affect wetlands as well as terrestrial ecosystems and in the case of Pierre River Mine Project may induce seepages from the Athabasca River, although this seems unlikely based on current geological data.

The Jackpine Mine Expansion overburden and Pleistocene Channel Aquifer dewatering will impact the Muskeg River and its tributaries as the amount of groundwater normally discharged to these features decreases. These magnitudes of the impacts are uncertain, but are predicted to be “small” when compared to the mean annual flow of the river. The drawdown in the overburden and the Pleistocene Channel Aquifer is expected to reach the southern edge of the patterned fen northeast of Jackpine Mine Expansion and south-east of McClelland Lake, but is predicted to have little impact on the fen itself as the reduction in the amount of groundwater being discharged to the fen is predicted to be negligible.

The Pierre River Mine Project overburden dewatering will impact the Pierre River as the amount of groundwater normally discharged to this feature decreases. Overburden dewatering and other mining activities will also reduce the amount of groundwater discharging to the Athabasca River. Impacts from overburden dewatering are predicted to be small due to low-permeable materials that occur below the overburden and above the river elevation. The magnitudes of the other mining impacts on the Athabasca River are uncertain, but are predicted to be “small” when compared to the mean annual flow of the river.

For both Jackpine Mine Expansion and Pierre River Mine Project the dewatering and removal of the overburden, including the Pleistocene Channel Aquifer for Jackpine Mine Expansion, will also result in a reduction in the amount of groundwater recharge to the overburden that occurs over the area of the mine excavation as precipitation will be intercepted in the working pit drainage system to keep the working area dry. This recharge would normally be destined for the groundwater flow system that existed in the mining area prior to any mining activity. The reduction in the amount of recharge is predicted be small, due to the low permeability of the underlying bedrock which naturally limits downward movement of groundwater except in the case of the Pleistocene Channel Aquifer which is a preferential route for groundwater flow.

For both Jackpine Mine Expansion and Pierre River Mine Project the dewatering will result in an increase in the amount of groundwater recharge that occurs in the area of passive water level decline surrounding the mining pit in response to the increased hydraulic gradient. The amount of the increase is predicted to be small.

Mitigative measures to counter the effects of dewatering and removal of the overburden (including the Pleistocene Channel Aquifer in the case of Jackpine Mine Expansion) and the resulting reduction in discharge of groundwater to surface water features and are likely to be effective as the groundwater will be released to the environment if the water quality is satisfactory. No appreciable reduced flows in surface water bodies, as the results of the dewatering and removal of the overburden, should be evident from the start of the dewatering and removal of the overburden. According to the proponent, the proposed mitigation has been successfully used at similar mining projects.

4.1.2 Basal Aquifer Depressurization

The Basal Aquifer is a geological unit occurring below the zone to be mined for both Jackpine Mine Expansion and Pierre River Mine Project. The Basal Aquifer is more extensive on the eastern side of the mining area near the plant site location for Pierre River Mine Project. For both Jackpine Mine Expansion and Pierre River Mine Project, the elevation of the water level associated with the Basal Aquifer is above the elevation of the mining pit floor so it will be necessary to lower the water level by depressurization prior to the mining of the bitumen, for safety reasons.

The Basal Aquifer water level will be lowered in the mine area by pumping groundwater from the Basal Aquifer using depressurizing, water wells which will have an effect on groundwater levels, flows and flow pattern. Depressurization will cause the groundwater from the Basal Aquifer in the area surrounding the mine to flow towards the mine. As pumping proceeds, the maximum water level decline associated with the Basal Aquifer will occur in the immediate vicinity of the pumping wells and will gradually decrease with increasing distance from the wells. For Jackpine Mine Expansion, the decline is predicted to extend a maximum of three kilometres beyond mining pit walls. For Pierre River Mine Project, the decline is predicted to be limited to the mine area and immediate vicinity.

Basal Aquifer depressurization will also have an impact on shallow groundwater in the area surrounding the mining pits, by increasing the rate at which the groundwater moves downward through the overlying material in response to the increased hydraulic gradient. However, it is predicted that the low permeable geological materials between the surface and the Basal Aquifer will result in the amount of groundwater moving downward being minimal.

Use of groundwater from the depressurization of the Basal Aquifer in the mining operation via an expanded closed-circuit system collecting process-affected

water should be effective in mitigating/offsetting the losses of Basal Aquifer discharge to surface water bodies by reducing the amount of make-up water that has to be diverted from the Athabasca River. The losses to surface water bodies are predicted to be relatively minor and are unlikely to be related to an outcome. The mitigation has been used by the proponent at other similar mining operations.

4.1.3 Jackpine Mine Expansion Project Tailings Disposal

Tailings are produced during the bitumen separation process and will need to be stored. An External Tailings Disposal Area (ETDA) will be used for disposal of the tailings until there is sufficient space in the mine pits to accommodate in-pit disposal. The Jackpine Mine Expansion ETDA will be a topographic high, about 60 m higher than the original ground surface elevation, and will become a groundwater recharge feature. Construction and operation of the Jackpine Mine Expansion ETDA will result in changes to the local topography and groundwater levels, flows and quality.

Process-affected seepage from the ETDA can be expected to enter the shallow surficial deposits (Quaternary) and possibly the Basal Aquifer beneath the ETDA. Once the process-affected groundwater reaches the surficial deposits and the Basal Aquifer it will enter the local or regional groundwater flow system. The Pleistocene Channel Aquifer beneath the ETDA will become a preferential flow path for process-affected groundwater that may flow towards Kearl Lake or the Fish Habitat Compensation Lake.

During operations, seepage of process-affected groundwater from the ETDA is to be intercepted by the use of toe ditches, seepage collection wells and collection sumps. A pumping system will recycle the collected water back to the external tailings area pond for use in processing. This can help prevent process-affected groundwater from entering the groundwater flow system and impacting the quality of the groundwater in the aquifer.

4.1.4 Pierre River Mine Project Tailings Disposal

The Pierre River Mine Project ETDA is to be located away from the mining area and as such will be surrounded by undisturbed land. During operations seepage from the ETDA to the Quaternary deposits (surface deposits) will be intercepted using perimeter ditches and wells if necessary, and returned to the tailings facility as part of the tailings management. Construction and operation of the Pierre River Mine Project ETDA will result in changes to the local topography and groundwater levels and quality. The ETDA will be about 50 m higher than the surrounding ground levels. Process-affected seepage can be expected from the ETDA as groundwater and will enter the shallow surficial deposits (Quaternary). Process-affected seepage may enter the Basal Aquifer beneath the ETDA, although the intervening geological materials are of low hydraulic conductivity. Once the process-affected groundwater reaches the surficial deposits, and possibly the Basal Aquifer, it will enter the local or regional groundwater flow

system. Seepages through the shallow groundwater flow system from the ETDA will reduce the quality of the groundwater discharging to Big Creek and the Athabasca River valley.

During operations, seepage of process-affected groundwater from the ETDA is to be mitigated by the use of toe ditches, seepage collection wells and collection sumps to intercept process-affected groundwater. A pumping system will recycle the collected water back to the external tailings area pond for use in processing. This can help prevent process-affected groundwater from entering the groundwater flow system and impacting the quality of the groundwater in the aquifer. It can also reduce the amount of surface water that needs to be diverted for make-up from the Athabasca River. It is predicted that an outcome should be process-affected free groundwater in the surficial deposits around the ETDA. Mitigation may be effective, and has reportedly been used successfully by the proponent at similar mining projects in the area.

The quality of process-affected groundwater will gradually improve as recharge flushes the tailings and natural degradation takes place for both the Jackpine Mine Expansion and Pierre River Mine Project ETDAs. The improvement in groundwater quality will be very slow.

4.1.5 Pierre River Mine Project Overburden Disposal Area[1]

Overburden will be stored in the north overburden disposal area, west of the plant site for Pierre River Mine Project. Perimeter ditches will collect runoff from the overburden area and direct it towards sedimentation ponds. The overburden disposal area will result in the reduction of some surface runoff that would normally occur if there was no disposal area.

The runoff from the overburden disposal area collected in the sedimentation pond will be released to the surface environment if the water quality is suitable. This will offset some of the groundwater baseflow loss to surface water bodies in the area as a result of the overburden disposal area construction and operation. If the water quality is unsuitable for surface release, it will be directed to the in-pit water system for use in processing thereby reducing the amount of water that would need to be diverted from the Athabasca River.

4.1.6 Pierre River Mine Plant Site[2]

Various chemicals and materials are stored at the plant site. Storage and handling of these chemicals and materials can result in spills which have the potential to affect the groundwater quality below the spill.

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[1] Jackpine Mine Expansion will use existing overburden disposal areas.

[2] Jackpine Mine Expansion will use existing plant site.

Although the storage and handling of chemicals and materials at the plant site has the potential to affect the underlying groundwater quality the engineering mitigation procedures , the groundwater monitoring program to be developed and the response plans the plant site facilities should minimize the potential to affect the groundwater quality. This procedure has been effectively used by the proponent at similar mining projects in the area.

4.1.7 Mine Pit Backfill

Tailings will be stored in the Jackpine Mine Expansion and Pierre River Mine Project mining pits as soon as there is sufficient space available to accommodate in-pit disposal. Process-affected seepages from these deposits will begin and continue through operation of the mine and closure, once the backfilling commences. Seepage from the backfill material has the potential to change groundwater levels, flows, flow patterns and quality in the areas around the backfill locations, although is predicted to be limited to the mine footprint. The shallow groundwater seepage from the mine backfill materials will be controlled by the closed-circuit drainage system during operations.

Mitigating the flow of process-affected water from the pit backfilled areas through cell construction techniques should be effective with the outcome being minimal seepage from the cells being observable from the time backfilling of the mine pits commences. This mitigative procedure had been used by the proponent at similar mining projects in the area.

4.1.8 Reclamation and the Mine Closure Landscape Common to Jackpine Mine Expansion and Pierre River Mine Project

Mining results in the removal of materials with a low hydraulic conductivity from the pit areas, and replaces them with materials, such as tailings, which have a higher hydraulic conductivity. After closure and reclamation at the end of the mining process, the water levels in the area surrounding the mine will recover with the final recovery level being controlled by the water table elevation in the reclaimed ground surface in the mine area. Where the water table levels recover to pre-mining elevations, the re-established groundwater flow systems will restore flow to drainage channels, terrestrial plant areas and wetlands. Where water table elevations do not recover to pre-mining elevations, either higher or lower, groundwater flows will remain permanently altered.

Precipitation which would normally recharge the area where the ETDA is located will recharge to the groundwater flow system through a topographic high, the reclaimed ETDA, which contains process-affected porewater. The recharging groundwater will flush out some process-affected porewater as it moves downward through the tailings in the ETDA. Some of the process-affected groundwater will discharge as springs along the edge of the ETDA and some will flow towards the reclaimed mine areas to the west and the northwest, and to wetlands and the pit lake. Some of the process-affected groundwater could be

discharged to surface water features in the area surrounding the ETDA and have an impact on the water quality.

The groundwater flow system which will re-establish after the reclamation and mine closure landscape has been completed will largely be controlled by the infiltration rates that develop for the reclamation topography. The main components of the mining project that can have a lasting impact on the groundwater resources of the area are seepages of process-affected groundwater from the tailings within the ETDA and backfilled mine pits.

It is planned that shallow seepages from the ETDA will be prevented from entering the groundwater flow system in the area around the ETDA by being intercepted and directed towards the pit lake through wetland areas. The magnitude of the seepage is difficult to predict due to hydrostratigraphic uncertainty and computer model predictions were based on conservative hydrogeological parameters to reduce some of the uncertainty. The magnitude of the seepage from the process-affected tailings in the backfilled mine pits are more controllable as pathways can be controlled by selective placement of materials with low hydraulic conductivity. Seepages will be directed towards the pit lake through wetland areas.

Mitigative measures to prevent/minimize seepages of process-affected groundwater into the environment surrounding the ETDA and backfilled mine pits can be effective and are linked to outcomes such as the absence of, or minimal presence of, process-affected contaminants in groundwater or in surface water bodies that receive groundwater as baseflow. Confirmation that end-pit lakes are capable of improving water quality would be an important step in verifying that this mitigative measure actually works. Existing projects are not sufficiently advanced to have long-term experience with some planned mitigative measures and the proposed outcomes.

4.1.9 Jackpine Mine Expansion-Specific Reclamation and the Mine Closure Landscape

The Jackpine Mine Expansion ETDA will be a topography high, about 60 m higher than the original ground surface elevation, and will become a groundwater recharge feature. Once mining is completed in the area, the Jackpine Mine Expansion ETDA will be largely surrounded by backfilled mined-out areas minimizing direct seepage into undisturbed geological materials. A plume of process-affected groundwater can be expected to follow the Pleistocene Channel Aquifer beneath the ETDA, moving towards Kearl Lake. There is some seepage rate uncertainty due to uncertainty of some hydrogeological parameters in the ETDA materials. The ETDA is predicted to be filled by 2024 although reclamation is not planned until 2065 when the ETDA will be capped and reclaimed.

Seepages from backfilled areas within the mine are more certain as pathways can be avoided by man-made control of the landscape and the resulting hydrostratigraphy. However, a plume of process-affected groundwater is

expected to follow the Pleistocene Channel Aquifer east towards Kearl Lake and the Basal Aquifer to the west of the reclaimed mine area.

4.1.10 Pierre River Mine Project-Specific Reclamation and the Mine Closure Landscape

The Pierre River Mine Project ETDA will be an isolated topography high, about 50 m higher than the original ground surface elevation, and will become a groundwater recharge feature. The reclaimed ETDA contains process-affected porewater. Some of the process-affected groundwater will discharge as springs along the edge of the ETDA and some will enter the shallow surficial deposits (Quaternary) and possibly the Basal Aquifer beneath the ETDA. Once the process-affected groundwater reaches the surficial deposits and the Basal Aquifer it will enter the local or regional groundwater flow system. Seepages from the ETDA will reduce the quality of the groundwater seepages to Big Creek and the Athabasca River valley. There is some seepage rate uncertainty due to uncertainty of some hydrogeological parameters in the ETDA materials.

Seepages from backfilled areas within the mine are more certain as pathways can be avoided or at least minimized, by man-made control of the landscape and the resulting hydrostratigraphy and will be controlled within the closed-circuit drainage system.

4.2 Groundwater Assessment

Overall the groundwater resource impact assessment has been reasonably well done and with the exception of the impact uncertainty noted below. The impacts that the operating and approved developments (the Base Case), the proposed Jackpine Mine Expansion and Pierre River Mine Project as well as the potential development case will have on groundwater resources have been considered. There is a degree of uncertainty in the validity of the impacts predicted for changes in groundwater discharge from the surficial (part of the overburden) deposits. Uncertainties include the conceptual model, the hydrogeological properties and the boundary conditions selected. The proponent indicates "The predictions and conclusions present in this EIA are therefore not considered sensitive to the degree of hydrogeological prediction uncertainty associated with changes in groundwater discharge from Quaternary deposits to surface water" (Volume 4A, Section 6.3.2.11, Page 6-63).

Several computer model simulations have been used to predict changes and impacts of the proposed development on the groundwater resources of the Jackpine Mine Expansion and Pierre River Mine Project areas. The various parameters used in the models are within acceptable limits and the proponent has often used "worst case conditions" to provide conservative predictions. The understanding of the hydrogeological characteristics of the general area east of the Athabasca River has greatly improved as a result of previous EIA investigations. However, the Pierre River Mine Project is located on the west side of the Athabasca River and further north than most previous mining projects and

as a result there is less experience with the hydrogeological characteristics of the area. Computer modelling predictions are always subject to possible errors as a result of the hydrogeological uncertainties in a complex environment, and hence the potential impacts could be under or over estimated. Ongoing groundwater level and groundwater chemistry monitoring is necessary to ensure computer-predicted results are valid.

4.3 Groundwater Key Concerns and Recommendations

[32] Loss of Groundwater Resources for Traditional Use

Fort McKay will not have access to any part of the Traditional Lands which are located within the active mining area for the proposed Jackpine Mine Expansion and Pierre River Mine projects. Fort McKay may wish to seek some form of offset for the loss of access to the groundwater resource-dependent traditional activities on traditional lands on which the active mining will take place.

[32] Recommendation

Offsets be developed to mitigate the loss of existing and potential future groundwater-sources and ground-water resource dependant traditional activities (e.g. loss of fens), in consultation with Fort McKay.

[33-34] Plant Harvesting and Groundwater Sources

The Jackpine Mine Expansion and Pierre River Mine projects may affect the ability of Fort McKay to harvest traditionally-used plants, which are dependent on groundwater flow for survival, on Traditional Lands located around the active mining area.

Traditionally used plants which are found in non-wetland areas may also be lost if they are dependent on groundwater for survival. Such losses would be permanent, unless reclamation provides suitable areas where the plants could re-establish. Wetlands that develop after reclamation may have the potential to be adversely affected by process-affected groundwater from areas where tailings have been stored and may be less desirable areas for the collection of plants.

Similarly, any groundwater sources located in the areas surrounding the mine may be permanently or temporarily impacted through drawdown or seepage and may or may not be unsuitable for further use after closure and reclamation.

[33] Recommendations

Shell consult with Fort McKay (potentially through the Shell Elders Advisory Group) regarding locations of traditionally-used plants and groundwater sources that may be in the areas adjacent to the Jackpine Mine Expansion and Pierre River Mine Project mining projects (e.g. within potential drawdown or seepage areas) to:

i. confirm that the proponent is aware of where they exist; and

ii. plan mitigative measures to protect the groundwater sources and the growing environments

[34] Recommendation

Shell be required, at its expense, to collect and test for potability ground water, from any source on traditional lands at the request of Fort McKay, prior to its use.

[35] Incidents

Fort McKay may want to be advised of any groundwater incidents reported to the authorities and to be provided with the outcome of any investigations for both the Jackpine Mine Expansion and Pierre River Mine projects.

[35] Recommendations

Shell should advise the Community of any groundwater incidents reported to the authorities and meet with the community to discuss the incident, the subsequent investigation, any follow-up action to be taken and the results of the follow-up actions.

[36] Seepage and Natural Treatment System Monitoring

Fort McKay is concerned about the potential for process-affected water from the ETDA and the EPL to affect groundwater, surface water and vegetation and needs assurance that the seepage and 'natural treatment systems' are monitored appropriately during operation and after reclamation and closure.

[36] Recommendations

The following be developed in consultation with Fort McKay:

i. a groundwater-monitoring program designed to detect process-affected seepage that bypasses the interception and/or containment system for external and internal tailings disposal areas.

ii. development and implementation of a ground water monitoring program to detect process-affected seepage that bypasses the collection system, after closure and reclamation.

iii. Monitoring to confirm that natural treatment systems, through which process-affected groundwater is directed, work effectively and if they do not, implement changes or mitigation measures to address the problems.

[37] Verification of Impact Predictions

Computer-predicted impacts, or lack of impacts, are subject to some uncertainty.

Groundwater monitoring must demonstrate that project activities are preceding without unreasonable impacts on the groundwater resources in the area. Fort McKay may want to have copies of the proposed groundwater monitoring programs for both the Jackpine Mine Expansion and Pierre River Mine projects made available to, and discussed with, the community. Any discussions should focus on how the proposed groundwater monitoring will confirm that professional judgments and computer-predicted impacts are valid and accurate.

[37] Recommendations

We recommend the development of a groundwater-monitoring program to determine the validity of computer and professional-judgement predictions that have the potential to impact ground water resources and the ability of the Community to utilize their Traditional Lands. Shell should be required to:

i. prepare a table summarizing computer-predicted and professional judgment impacts;

ii. outline the groundwater level and/or quality monitoring to be undertaken to verify the predictions;

iii. the table should be designed to simplify the comparison of previous and new data, so changes are easily detected;

iv. monitoring data should be added to the table as it becomes available and the updated table provided to Fort McKay;

v. deviations from the predicted impacts which indicate that impacts have been underestimated shall result in a reassessment of impacts, updating of the table and reassessment of mitigation measures; and

vi. the measurement of impacts shall be provided to Fort McKay with the results of any reassessment of impacts and mitigation measures developed in consultation with Fort McKay

[38] Verification of Impact Predictions

Fort McKay needs to be assured that the groundwater impacts from Shell's proposed projects as well as existing, approved and planned developments are monitored in a consistent way, that facilitates a regional understanding of groundwater changes, and managed so that impacts on groundwater systems within Fort McKay's Traditional Lands are minimized and mitigated.''

[38] Recommendation

We recommend that a regional groundwater management framework be developed, in consultation with Fort McKay.

Table 4-1: Groundwater Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
32	Fort McKay will not have access to any part of the traditional lands which are located within the active mining area for the proposed Jackpine Mine Expansion and Pierre River Mine projects.	Offsets be developed to mitigate the loss of existing and potential future groundwater-sources and ground-water resource dependant traditional activities (e.g., loss of fens), in consultation with Fort McKay.	Agreement Regulatory
33	The Jackpine Mine Expansion and Pierre River Mine projects may affect the ability of the Fort McKay to use groundwater sources and to harvest traditionally-used plants on traditional lands located around the active mining area, which are dependent on groundwater flow for survival.	Shell consult with Fort McKay (potentially through the Shell Elders Advisory Group) regarding locations of groundwater sources and traditionally-used plants and groundwater sources that may be in the areas adjacent to the Jackpine Mine Expansion and Pierre River Mine Project mining projects (e.g. within potential drawdown or seepage areas) to • confirm that the proponent is aware of where they exist; and • plan mitigative measures to protect the groundwater sources and the growing environments	Agreement
34	The Jackpine Mine Expansion and Pierre River Mine projects may affect the ability of the Fort McKay to access traditionally used groundwater sources.	Shell be required, at its expense, to collect and test for potability ground water, from any source on traditional lands at the request of Fort McKay, prior to its use.	Agreement Regulatory
35	Groundwater incidents (unexpected groundwater quantity and/or quality changes) are reported to the authorities.	It is recommended that the Fort McKay require the proponent to advise the community of any groundwater incidents reported to the authorities and to meet with the community to discuss the incident, the subsequent investigation, any follow-up action to be taken and the results of the follow-up actions.	Agreement Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
36	Seepage and 'natural' treatment system monitoring	The following be developed in consultation with Fort McKay: • a groundwater-monitoring program designed to detect process-affected seepage that bypasses the interception and/or containment system for external and internal tailings disposal areas. • development and implementation of a ground water monitoring program to detect process-affected seepage that bypasses the collection system, after closure and reclamation. • Monitoring to confirm that natural treatment systems, through which process-affected groundwater is directed, work effectively and if they do not, implement changes or mitigation measures to address the problems.	Agreement Regulatory
37	Computer-predicted impacts, or lack of impacts, are subject to some uncertainty.	We recommend the development of a groundwater-monitoring program to determine the validity of computer and professional-judgement predictions that have the potential to impact ground water resources and the ability of the Community to utilize their Traditional Lands. Shell should be required to: • prepare a table summarizing computer-predicted and professional judgment impacts; • outline the groundwater level and/or quality monitoring to be undertaken to verify the predictions; • the table should be designed to simplify the comparison of previous and new data, so changes are easily detected; • monitoring data should be added to the table as it becomes available; • and the updated table provided to Fort McKay;	Agreement Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
37	(cont'd) Computer-predicted impacts, or lack of impacts, are subject to some uncertainty.	• deviations from the predicted impacts which indicate that impacts have been underestimated shall result in a reassessment of impacts, updating of the table and reassessment of mitigation measures; and • the measurement of impacts shall be provided to Fort McKay with the results of any reassessment of impacts and mitigation measures developed in consultation with Fort McKay	Agreement Regulatory
38	Regional groundwater management	We recommend that a regional groundwater management framework be developed, in consultation with Fort McKay.	Regulatory

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

5.0 SURFACE WATER

5.1 Surface Water Impacts

The Jackpine Mine Expansion will continue to add development impacts to the Muskeg River watershed. The Jackpine Mine Expansion will increase the disturbed area in the Muskeg River watershed to 44.6% (Fort McKay Specific Assessment; Fort McKay IRC 2010a). The lack of a long-term water management plan for the Muskeg River basin that directs development and ensures the long-term viability of the watershed continues to be a major concern. Shell's proposal calls for a number of major river diversions, the most significant being the central portion of the Muskeg River. This portion of the Muskeg River, along with the outflow of Kearl Lake would be confined to a pipeline for many years. Shell's Jackpine Mine Expansion proposal represents a major departure from other mines in the watershed, which maintain the integrity of the main channel of the Muskeg River.

Shell plans to meet Jackpine Mine Expansion and Pierre River Mine Project water needs from the Athabasca River. This would bring the total water allocation from the Athabasca River to about 701,000,000 m^3, or a little over 4% of the annual flow in the river. This represents an average annual water withdrawal of 22.2 m^3/s. The maximum instantaneous peak withdraw is 29.3 m^3/s. For very low flow conditions on the Athabasca River (such as the 7Q10 flow of 100 m^3/s), this represents about 30% of the water in the river. Fortunately, the Phase 1 Athabasca River Water Management Plan currently restricts total industry water use during such a time to a maximum of 8 m^3/s. This means industry has to store water to meet their needs during such a low flow period. This highlights the importance of completing Phase 2 of this plan so impact limits on the Athabasca River can be set and future development can be directed. As with other oil sands projects, Shell is waiting for the outcome of Phase 2 to optimize their water intake and water storage requirements.

[39] Recommendation

That the regulators ensure that the Phase 2 Athabasca River Water Management Plan is completed on an expedited basis and that this plan includes water withdrawal and impact limits.

5.2 Surface Water Assessment

The assessment presented by Shell covers the key surface water areas. As with many other analyses in tributary streams, the predicted changes to stream flow are highly dependent on the accuracy of the Hydrologic Simulation Program – Fortran (HSPF). This modeling continues to suffer from limited data as a basis for calibrations. While the model can average conditions and some extreme statistics, it performs poorly on individual events.

5.3 Surface Water Key Concerns and Recommendations

[40-45] Water Act Licences

Shell proposes to use the existing river intake and pumping system for the Muskeg River Mine and Expansion for Jackpine Mine Expansion.

[40] Recommendation

Shell should comment on the degree that existing raw water storage meets Jackpine Mine Expansion needs and what options are being considered if more water storage is needed to meet the Phase 2 Water Management Framework.

We recommend that Shell either provide three to four months of water storage to ensure continued operations during periods of water withdrawal limitations or present contingency plans for there operations that show how they would meet limits on water withdrawals.

Shell states that their existing Water Act license for Athabasca River water withdrawals of 63.5 Mm^3 for Stage 1 and 35.3 Mm^3 for Stage 2 for the Jackpine Mine - Phase 1 will not meet the water supply needs for Jackpine Mine Expansion during Stage 2. Shell is therefore requesting an additional allocation of 18 Mm^3 of Athabasca River water.

[41] Recommendation

Shell should provide an annual breakdown of their existing Athabasca River Water Act license showing what water would be destined for use in Jackpine Mine – Phase 1, what would be available for JMEP, and what additional water is needed from the Athabasca River for Jackpine Mine Expansion.

[42] Recommendation

Shell should indicate what other contingencies, if any, are provided for in their request for an additional 18 Mm^3 of water.

Shell indicates that the Jackpine Mine Expansion Athabasca River water requirement for 2039 is 74.27 Mm^3. The amounts for 2038 and 2040 are 59.36 Mm^3 and 45.19 Mm^3, respectively. Water requirements in 2039 represent a 25% increase over 2038 and a 49% increase of 2040. The cause is attributed to changes in in-pit pore water storage. Levelling out this storage would dramatically reduce Athabasca River water demand in 2039.

[43] Recommendation

Shell should comment on the reason for the large change in in-pit pore water storage between 2038 and 2040 and suggest ways of reducing this variation.

Shell indicates that the maximum annual make-up water for the Pierre River Mine Project is 55.1 Mm^3. They propose to obtain this water from the Athabasca

River using a new river intake and pumping system. This number is consistent in their Water Act application and Figure 10-4 – Estimated Water Withdrawal from the Athabasca River. However the detailed annual water balance for Pierre River Mine Project provided in Table 10-2 shows that both 2026 and particularly 2028 exceed this amount. Athabasca River water requirements are shown to be 55.24 Mm^3 in 2026 and 63.28 Mm^3 in 2028. The latter amount is 15% greater than Shell's Water Act application. The large increase in 2028 is attributed to a significant change in free water storage in ETDA.

[44] Recommendation

Shell should comment on the inconsistencies in the Pierre River Mine Project annual water need and their Water Act application.

[45] Recommendation

Shell should comment on the reason for the large change in free water storage at ETDA between 2027 and 2028 and suggest ways of reducing this variation.

[46-48] Water Management

Shell proposes to mine through the portion of the Muskeg River that falls within the Jackpine Mine Expansion lease. The river will be conveyed through a pipeline and returned to the Muskeg River downstream of the mine area.

[46] Recommendation

Shell should comment on why they cannot maintain the Muskeg River channel in its natural state as was done just upstream in the Imperial Oil Kearl Project, rather than piping the water through a 11.3 km pipeline and mining through the river.

The size of Jackpine Mine Expansion pit lakes is inordinately large relative to another other proposed pit lakes in the watershed. Muskeg River lake area in the Pre-Development Case was 7.4 km^2. In the Base Case, this lake area increases to 89.3 km^2. Shell proposes to add an additional 29.4 km^2 of lake area to the watershed. Mining through the Muskeg River plays a part in this total.

[47] Recommendation

Shell should discuss any changes that could be made to the configuration of their end-pits to reduce the size of the lakes.

Shell indicates that they have met with Syncrude and Imperial Oil to coordinate mining activities in the Muskeg River watershed. Given a different timing for mine development in the watershed, the overall range in flow changes can shift.

[48] Recommendation

Given the slowdown in the oil sands development, Shell should comment on the representativeness of their Application Case flow predictions for the Muskeg River.

Table 5-1: Surface Water Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
39	Water management	That the regulators ensure that the Phase 2 Athabasca River Water Management Plan is completed on an expedited basis and that this plan includes water withdrawal and impact limits.	Regulatory
40	Water use by industry	Shell should comment on the degree that existing raw water storage meets Jackpine Mine Expansion needs and what options are being considered if more water storage is needed to meet the Phase 2 Water Management Framework. We recommend that Shell provide three to four months of water storage to ensure continued operations during periods of water withdrawal restrictions or present contingency plans for their operations to show how they would meet limits on water withdrawals	Response Agreement Regulatory
41	Water use by industry	Shell should provide an annual breakdown of their existing Athabasca River Water Act license showing what water would be destined for use in Jackpine Mine – Phase 1, what would be available for JMEP, and what additional water is needed from the Athabasca River for Jackpine Mine Expansion.	Response
42	Water use by industry	Shell should indicate what other contingencies, if any, are provided for in their request for an additional 18 Mm^3 of water.	Response
43	Water use by industry	Shell should comment on the large change in in-pit porewater storage between 2027 and 2028 and suggest ways of reducing this variation	Response
44	Water use by industry	Shell should comment on the inconsistencies in the Pierre River Mine Project annual water need and their Water Act application.	Response

Number	Fort McKay Key Concern	Recommendation	Category
45	Water use by industry	Shell should comment on the reason for the large change in free water storage at ETDA between 2027 and 2028 and suggest ways of reducing this variation.	Response
46	The Muskeg River watershed is protected	Shell should comment on why they cannot maintain the Muskeg River channel in its natural state as was done just upstream in the Imperial Oil Kearl Project, rather than piping the water through an 11.3 km pipeline and mining through the river.	Response
47	The Muskeg River watershed is protected	Shell should discuss any changes that could be made to the configuration of these end-pits to reduce the size of the lakes.	Response
48	The Muskeg River watershed is protected	Given the slowdown in the oil sands development, Shell should comment on the representativeness of their current flow predictions for the Muskeg River.	Response

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

6.0 WATER QUALITY AND AQUATIC HEALTH

This water quality and aquatic health review is organized by project. The Jackpine Mine Expansion (JME) project is first and the water quality and aquatic health issues that are specific to that project and the Muskeg River watershed are discussed. As well, issues that are common to both projects are discussed in this section (and identified with an asterisk *). Following the Jackpine Mine Expansion review, the water quality and aquatic health aspects of the Pierre River Mine (JME) project are reviewed.

6.1 JME Water Quality and Aquatic Health Impacts

The JME project is the second phase of the Jackpine Mine oil sands mine to be developed by Shell. The expansion is one of a number of oil sands mines being developed in the Muskeg River watershed and affects many tributaries of the Muskeg River as well as Kearl Lake. The EIA (Shell 2007) and the Update document (Shell 2008) consider the pre-development conditions compared to Base Case (all existing and approved projects), as well as the Application Case (Base Case plus Shell's proposed project) during the life of the project through construction, operation, closure and far future scenarios.

The JME is a proposal to develop further upstream on the Muskeg River than the first phase of the Jackpine project. Unlike the first phase, Shell now plans to mine directly through the Muskeg River mainstem. It also plans to mine through several tributaries, including Wapasu Creek upstream of the confluence of the Muskeg River and Stanley Creek. Water quality may be negatively affected and aquatic habitat lost in relation to:

- Release of muskeg drainage and overburden dewatering flows;
- Closed-circuiting of large areas of the Muskeg River watershed that will withhold water from local water courses including the Athabasca River;
- Seepage or runoff of process-affected waters from tailings reservoirs or pit lakes;
- Diversion of 22 km of the Muskeg River mainstem;
- Diversion of the headwaters of Pemmican, Green Stockings, Blackfly, Wesukemina and Iyinimin Creeks to Kearl Lake (requiring a dyke to contain the higher water levels);
- Removal of the natural outflow of Kearl Lake (Muskeg Creek) and replacement with two constructed outlets; and
- Potential catastrophic failure of tailings holding areas or pit lakes.

Shell proposed the following as their main mitigation to reduce impacts to water quality and aquatic health:

- Use of sedimentation ponds to settle solids associated with muskeg drainage and overburden dewatering;
- Closed-circuiting process-affected, runoff or seepage waters, with re-use of water where possible;
- Perimeter ditches around low-permeability dykes that contain contaminated water;
- Use of wetlands, pit lakes and treatment lakes to promote decontamination of reclamation waters prior to release outside the project area; and
- Best management practices to manage accidental spills and prevent failure of retention structures.

6.2 JME Water Quality and Aquatic Health Assessment

Shell makes general statements that some water quality variables will increase in the Muskeg River during some time snapshots compared to the pre-development condition. They define a negligible effect on water quality as an increase of less than 10% above pre-development or Base Case. Shell provides great detail on the quality control, robustness of their data, and uncertainty analysis of their predictions. The significance analysis is referred to other sections of the report (e.g., fish) and requires examining the specific time snapshot water quality results in Appendix 4-7.

For the aquatic health assessment, Shell used the less conservative approach of considering chronic effects benchmarks (CEBs taken from single lab tests) rather than CCME guidelines. In this way, far fewer effects were predicted to aquatic biota. This is a weak approach because laboratory tests with effects of single contaminants are not comparable with the additional stresses that may occur in diverse natural systems with mixtures of contaminants.

Shell expects that pit lake water quality will be acceptable for discharge to the Muskeg River in the future. They anticipate that pit lakes will provide treatment of runoff from reclaimed landscapes, seepage and tailings flux waters and become biologically productive systems. While water concentrations of some contaminants may be reduced through dilution, degradation and sedimentation over time, the sediments at the bottom of most pit lakes as well as any biota that reside in them, will remain contaminated with metals and organic contaminants (e.g., PAHs) for a very long time.

6.3 JME Key Concerns and Recommendations

Following are comments and recommendations concerning the water quality and aquatic health findings in the EIA (Shell 2007), some of which are in common with the Pierre River Mine Project (as indicated by an asterisk *):

*[49] Aquatic Health Criteria**

Shell elected to develop Chronic Effects Benchmarks (CEBs) for a select set of substances, including for those substances where water quality guidelines exist. With the exception of four substances where a valid method was used to derive the benchmark[3], the development of the CEBs differs from guidelines in that a single laboratory toxicity result is used without the application of a safety factor (CCME used 10X). As such, CEBs derived in this way are much less conservative than guidelines that consider uncertainties including differences that may occur in field circumstances compared to the lab. There is also no consideration for the potential toxicity of mixtures of many contaminants as may occur in industrial areas.

[49] Recommendations

i. For future assessment rather than using SSD-derived benchmarks that have not been critically reviewed, use CCME or AENV guidelines where they exist (i.e. arsenic, boron and copper) and/or consider utilizing aquatic toxicity reference values (TRVs) that are used by USEPA for ecological risk assessments; and

ii. provide a discussion of the potential additive impact of mixtures of contaminants on aquatic health.

*[50] Contaminant Uptake Model**

Shell calculates the uptake of metals to fish using bioaccumulation factors (BAFs) that consider the uptake of contaminants from the water (i.e. through gills) but not through the food web (i.e., diet). As such, the predicted concentration for some substances known to accumulate mainly from food (e.g., organometallics) fall short of the tissue concentration that is likely to occur. A case in point that serves as quality control for this argument is the substance that is currently measured by RAMP in fish tissue: methylmercury.

[50] Recommendations

i. Explain how it is likely for future scenarios to result in lower mercury concentrations in fish than have occurred for the past few decades in the region (including the Athabasca River) given environmental concentrations are not likely to decrease in disturbed systems; and

ii. Apply a more realistic model that considers bioconcentration factors (BCFs; diet uptake) and/or re-calculate methylmercury (for JME and PRM) and other organometallic concentrations in fish tissue.

[3] SSD (species sensitivity distribution) is a currently accepted approach for deriving guidelines, and Shell should be commended for the effort required to derive benchmarks using the SSD method for arsenic, boron, manganese and molybdenum.

*[51] Increases in Several Contaminants Predicted**

Even given the above shortcoming about CEBs, Fort McKay is concerned that several metals and organic contaminants are predicted to increase substantially in future scenarios (Fort McKay Specific Assessment; Fort McKay IRC 2010). For example, strontium and chromium are expected to be very high in 2065 and far future at the mouth of the Muskeg River because of the outflow from pit lakes combined with low flows. Even though vanadium will exceed toxic benchmarks in all pit lakes, the risk is assessed as negligible by Shell (p. 6-518, Shell 2007). Furthermore, mixtures of these contaminants could be more toxic than single substances in isolation. Guideline exceedances are expected for these and other substances concurrently, with naphthenic acids, PAHs, tainting potential, chronic toxicity and molybdenum increasing in excess of 500 times by 2065. These substantial increases are assessed as causing negligible impacts to aquatic health in the EIA.

[51] Recommendations

i. Explain the assessed impact of negligible for aquatic biota in view of the increases of some substances beyond guidelines or even the less conservative CEBs;

ii. Fort McKay must be involved in developing the sediment and water quality monitoring program for this project to ensure that the frequency, timing and types of analyses will capture all runoff events and scenarios of concern to Fort McKay.

*[52] Wetland Natural Water Treatment Lost**

Shell plans to replace many natural wetlands and muskeg areas with pipelines and drainage ditches. While this proposal has the effect of sometimes controlling hydrologic changes downstream, the natural decontamination that is a benefit of wetlands will be lost in pipelines and ditches. The Muskeg River is high in muskeg-source organic carbon (DOC, brown water); dewatering will result in the export of PAHs and metals bound to DOC. The polishing ponds, pipelines and ditches will not remove DOC-bound contaminants.

[52] Recommendations

i. Explain and/or map where constructed wetlands will be used to replace natural wetlands related to drainage from and around project areas, and provide the location in the EIA or Supplemental Information where the design of the wetlands is described

ii. Provide measurements of the dissolved forms of metals and organic contaminants (including DOC-bound, not particulate) rather than just totals (does not separate dissolved and particulate-bound forms).

[53] Kearl Lake Issues

Water levels in Kearl Lake are projected to increase in future because of the diversion to the lake of several streams that currently flow elsewhere. The increased flows will cause aluminum, cadmium and strontium to exceed effects benchmarks. Increasing water levels in Kearl Lake goes against a recommendation in Muskeg River Watershed Framework for Water Quantity and Quality[4]. Also, flooding vegetation in Kearl Lake will increase Hg methylation; the berm will remove habitat for and access to traditional plants around the shoreline.

[53] Recommendations

i. Describe the higher diverted flows' effect on augmenting the deposition of particulates and associated contaminants in Kearl Lake; and

ii. Provide information about how the berm around the lake may be adjusted to expose more natural shoreline and permit traditional uses to continue.

*[54-55] Pit Lakes Issues**

It is a widely anticipated predicted outcome by industry that end pit lakes will function as treatment systems. A "viable aquatic ecosystem" for pit lakes is currently defined as a system in which aquatic biota can survive. Though biota may be able to survive, pit lakes will always have some level of contaminated sediments, as acknowledged with the statement "Sediment PAH concentrations in the south, south central, north central and north (upstream cell) pit lakes that will receive MFT may be higher than guideline values" (p. 6-431, Shell 2007). The concentration of many of these contaminants is likely to increase with increasing levels of the food chain. More than just water quality needs to be monitored prior to it leaving these potentially contaminated systems.

[54] Recommendation

Describe plans to monitor aquatic biota in pit lakes for metals and other contaminants, and plans to prevent biota from escaping from the lakes if they remain contaminated.

[55] Recommendation

The acceptance and reliance on end pit lakes for treatment of MFT and process affected waters be stopped until such time as this method of treatment is proven to be viable in a scientifically defensible (peer reviewed) manner.

*[56] Catastrophic Failure**

While it is considered of low probability, considering the long life of the project, it is prudent to plan for natural or unnatural events that could result in the

catastrophic failure of reservoir structures containing contaminated fluids and sediments.

[56] Recommendation

Describe plans for the prevention of, detection of, and response to the potential catastrophic failure of any of the reservoirs of contaminated fluids and sediments.

[57] Muskeg River Watershed Management Plan

Removal of 21 km of the mainstem Muskeg River is contrary to both a recommendation in the draft Muskeg River Watershed Framework as well as the expressed concern of many residents of Fort McKay. This river is relatively near Fort McKay and is one of the most important watercourses to the Community, having been used by them for generations (FMFN 1994).

[57] Recommendation

Fort McKay recommends finalizing the watershed management planning for the Muskeg River watershed prior to final decisions about the mainstem and expects to be involved in the development and finalization of any such plan.

Table 6-1: JME Water Quality and Aquatic Health Summary Table

Number	Fort McKay Key Concern	Recommendation	Category[2]
49	Use of Chronic Effects Benchmarks (CEBs) for those substances where water quality guidelines exist.[1]	i) For future assessments rather than using SSD-derived benchmarks that have not been critically reviewed, use CCME or AENV guidelines where they exist (i.e. arsenic, boron and copper) and/or consider utilizing aquatic toxicity reference values (TRVs) that are used by USEPA for ecological risk assessments; and ii) provide a discussion of the potential additive impact of mixtures of contaminants on aquatic health.	Response

Number	Fort McKay Key Concern	Recommendation	Category[2]
50	Use of bioaccumulation factors (BAFs) that consider the uptake of contaminants to fish from the water (i.e., through gills) but not through the food web (i.e., diet)[1]	i) Explain how it is likely for future scenarios to result in lower mercury concentrations in fish than have occurred for the past few decades in the region (including the Athabasca River) given environmental concentrations are not likely to decrease in disturbed systems; and ii) Apply a more realistic model that considers bioconcentration factors (BCFs; diet uptake) and/or re-calculate methylmercury (for JME and PRM) and other organometallic concentrations in fish tissue.	Response Agreement
51	Water quality guideline exceedances are expected for many substances concurrently[1]	i) Explain the assessed impact of negligible for aquatic biota in view of the increases of some substances beyond guidelines or even the less conservative CEBs; ii) Fort McKay must be involved in developing the sediment and water quality monitoring program for this project to ensure that the frequency, timing and types of analyses will capture all runoff events and scenarios of concern to Fort McKay.	Response Agreement
52	Shell plans to replace many natural wetlands and muskeg areas with pipelines and drainage ditches that will not remove DOC-bound contaminants.[1]	i) Explain and/or map where constructed wetlands will be used to replace natural wetlands related to drainage from and around project areas, and provide the location in the report where the design of the wetlands is described; Fort McKay requests the opportunity to review the new information; and ii) Provide measurements of the dissolved forms of metals and organic contaminants (including DOC-bound, not particulate) rather than just totals (does not separate dissolved and particulate-bound forms).	Response or Agreement

Number	Fort McKay Key Concern	Recommendation	Category[2]
53	Increased water levels in Kearl Lake	i) Describe the higher diverted flows' effect on augmenting the deposition of particulates and associated contaminants in Kearl Lake; and ii) Provide information about how the berm around the lake may be adjusted to expose more natural shoreline and permit traditional uses to continue.	Response or Agreement
54	Pit lakes may not function as anticipated, and will support contaminated biota.[1]	Describe plans to monitor aquatic biota in pit lakes for metals and other contaminants, and plans to prevent biota from escaping from the lakes if they remain contaminated.	Response Agreement
55	Pit lakes may not function as anticipated, and will support contaminated biota.[1]	We recommend that the acceptance and reliance on end pit lakes for storage of MFT and treatment of process waters be stopped until such time as this method of treatement is proven to be viable in a scientifically defensible (peer reviewed) manner.	Regulatory
56	Potential catastrophic failure of tailings holding areas.[1]	Describe plans for the prevention of, detection of, and response to the potential catastrophic failure of any of the reservoirs of contaminated fluids and sediments.	Response
57	Lack of watershed management plan for the Muskeg River watershed.	Fort McKay recommends finalizing the watershed management planning for the Muskeg River watershed prior to final decisions about the mainstem and expects to be involved in the development and finalization of any such plan.	Regulatory

[1]Key Concerns and Recommendations that apply to both Jackpine Mine Expansion and Pierre River Mine

[2]***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

6.4 PRM Water Quality and Aquatic Health Impacts

The Pierre River Mine Project (PRM) project is the first oil sands project in the local area west of the Athabasca River between Pierre River and north to Redclay Creek. The EIA (2007) and the Update document (2008) consider the various development scenarios during the life of the project through construction, operation, closure and far future.

The key concerns considered in common with the Jackpine Mine Expansion are discussed in Section 6.3 (Recommendations 49-52, 54-56) and are not repeated here.

The main tributaries of the Athabasca River that will be affected by PRM have sizeable watersheds ranging in size from 134 km^2 for Pierre River to 311 km^2 for Eymundson Creek. Big Creek's watershed is nearly as large as Eymundson's at 276 km^2.

The upper reaches of Pierre River, Big Creek, Eymundson Creek, Asphalt Creek, and several unnamed creeks are made up of an extensive network of smaller streams that will not be directly impacted by the PRM. The lower reaches of these watercourses will ultimately be extensively diverted (some to the Athabasca River), closed-circuited or partially used for filling two pit lakes, the raw water storage lake and Redclay Compensation Lake.

Water quality and aquatic habitat may become impacted in relation to:

- Release of muskeg drainage and overburden dewatering flows into Eymundson Creek and the Athabasca River;
- Closed-circuiting of large areas of watersheds that will withhold water, nutrients and invertebrate drift from local water courses including the Athabasca River;
- Seepage or runoff of process-affected waters from tailings disposal areas or pit lakes;
- Diversion of the headwaters of Pierre River, Asphalt, Eymundson, Big and Redclay creeks within the project area;
- Construction of a bridge and pipeline crossing of the Athabasca River;
- Removal of the environmentally significant Eymundson Sinkhole lakes; and
- Potential catastrophic failure of tailings holding areas or pit lakes.

Mitigation is stated by Shell to be the same as for the Jackpine Mine Expansion except for additional perimeter wells around the External Tailings Disposal Area.

6.5 PRM Water Quality and Aquatic Health Assessment

Shell's data and predictions indicate that impacts to water quality and aquatic health will be less for the PRM project area than for the Jackpine Mine Expansion. This is because the PRM is currently the only oil sands mine currently planned for

the area, whereas many projects are proposed for the Muskeg River system. Nevertheless, some contaminants are likely to increase substantially as a result of this project. The prediction of decreases in fish tissue mercury in several systems including the Athabasca River indicates a problem with the predictive model.

6.6 PRM Water Quality and Aquatic Health Key Concerns and Recommendations

Following are key concerns specific to the water quality and aquatic health findings for the Pierre River Mine Project.

[58] Sinkhole Lakes Environmentally Significant Area (ESA)

The groundwater-fed Eymundson Sinkhole lakes are designated provincially as an environmentally significant area (ESA). They were described in the groundwater environmental setting report (Volume 4B) but not carried forward to the water quality section. They are discussed by Shell in the Resource Use section (Shell 2007, Section 8, Volume 5). It is Fort McKay's view that they should have been in the category of "local waterbodies" indicated in Key Questions 6.5.6.3 (p. 6-434) and 6.6.5.3. (p. 6-525) of the EIA or at the very a cross-linkage to the Resource Use section provided.

In a discussion paper (**Fort McMurray Mineable Oil Sands Integrated Resource Management Plan**, 2005) prepared by Sustainable Resource Development (SRD), Eymundson Sinkholes were ranked such that it was recommended that mine operations not encroach on **"the hydrologic element or the width of the buffer, whichever is greater"**. The Integrated Resource Plan Guidelines (ASRD 2002) indicate that the Applicable Guideline for these lakes is as follows **"Development proposals will mitigate adverse impacts on nationally or provincially significant natural features including the Athabasca River – Tar Sands Reach and Eymundson Sinkholes on Pierre River. The level of protection for each site will be determined through interagency review"**

According to Shell two of the three Eymundson Sinkhole lakes are within the proposed mine footprint and would be lost to development as well as the entire Eymundson Sinkhole ESA (766 ha; Table 8.4-12, Volume 5, Shell 2007). Sinkhole lakes can not be recreated with reclamation. While Shell admits that this is a high magnitude local impact, they dismiss it as not of regional concern since there are other sinkhole lakes in the area.

[58] Recommendations

i. Shell should comment on why it did not offer any mitigation options for loss the Eymundson Sinkhole ESA and what some mitigation options might be (e.g. offsets)

ii. Shell should describe potential impacts to other local waterbodies, notably those that support fish, and provide a brief characterization of the 21.6 ha of waterbodies that will be lost in the Eymundson watershed (including sinkholes).

iii. The government should clarify how an interagency review will take place and what approval process that would be required for this particular ESA. Fort McKay expects to be consulted on this issue

[59] Undetectable Concentrations

Some of the metal concentrations in water used for fish tissue predictions were based on non-detectable analytical results. This leaves doubt about the accuracy of any predictions regardless of whether "half of the detection limit" was used in the calculations. For example, nickel was predicted to exceed chronic effect benchmarks (CEBs) based on an unknown nickel concentration that was assumed to be half of the detection limit. Also, peak concentrations of aluminum, chromium and iron exceeded CEBs at various time snapshots in Big Creek, but Shell rescinded their predicted negative outcome stating they may have "over estimated" the impact. Confusingly, Shell states they are conservative in their calculations; but if the result is a prediction of possible toxicity, they dismiss the outcome as a probable error.

[59] Recommendations

i. Will Shell commit to using an analytical laboratory that is able to detect substances at least to guideline levels for metals and organic contaminants, and for substances where calculations predict that a chronic effect benchmark is exceeded for fish or other biota?

ii. Tabulate each instance where a guideline or CEB is exceeded (in relation to the inputs to the fish tissue predictions) so that Fort McKay may readily evaluate the significance.

Table 6-2: PRM Water Quality Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
58	Impacts to environmentally significant waterbodies: Eymundson Sinkhole lakes	i) Shell should comment on why it did not offer any mitigation options for loss the Eymundson Sinkhole ESA and what some mitigation options might be (e.g., offsets) ii) Shell should describe potential impacts to other local waterbodies, notably those that support fish, and provide a brief characterization of the 21.6 ha of waterbodies that will be lost in the Eymundson watershed (including sinkholes). iii) The government should clarify how an interagency review will take place and what approval process that would be required for this particular ESA. Fort McKay expects to be consulted on this issue.	Response Regulatory
59	Inaccuracies of toxicity predictions due to lack of detection	i) Will Shell commit to using an analytical laboratory that is able to detect substances at least to guideline levels for metals and organic contaminants, and for substances where calculations predict that a chronic effect benchmark is exceeded for fish or other biota? ii) Tabulate each instance where a guideline or CEB is exceeded (in relation to the fish tissue prediction input information) so that Fort McKay may readily evaluate the significance.	Response

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

7.0 FISH AND FISH HABITAT

7.1 JME Fish and Fish Habitat Impacts

Impacts to fish and fish habitat are expected as a result of large-scale changes in the Muskeg River watershed that will be in addition to changes that will occur with existing and approved projects. The specific activities that will cause loss of fish and aquatic habitat were detailed in the water quality and aquatic health section (Section 6.0) above.

Following are comments and recommendations concerning the fish and fish habitat in the Muskeg River watershed, some of which are in common with the Pierre River Mine Project (as indicated by an asterisk *):

7.2 JME Fish and Fish Habitat Assessment

Shell indicated that there would be no residual impacts to fish habitat and fish abundance following implementation of the compensation plan, and that there would be no impacts to fish in the Athabasca River. Impacts to fish and fish habitat in the Muskeg River watershed will certainly increase over time as projects continue to expand. There will be much reliance on the proposed compensation habitat to replace lost fish habitat.

7.3 JME Fisheries Key Concerns and Recommendations

[60] Kearl Lake Compromised Connectivity to the Muskeg River

Kearl Lake has provided important fish rearing habitat for small fish and is known to support northern pike at times. The report describes the loss of the natural connection between Muskeg River and Kearl Lake (Muskeg Creek), and the construction of a 9.3 km drainage outlet that will allow connectivity but may be virtually devoid of fish habitat along its length until closure in 2065. While there may be a water connection, it isn't clear if this long stretch will provide any functional or fish-attracting habitat.

[60] Recommendations

i. Fort McKay requests that an effort be made to provide appropriate protective and functional fish habitat in the 9.3 km connector channel between the Muskeg River and Kearl Lake; and

ii. Clarify whether the loss of Muskeg Creek was a component of compensation calculations.

*[61] Substances of Potential Concern**

A large number of substances were suggested to be substances of potential concern (SOPCs) for fish health, and all of these were eliminated based on Shell's predictions. No discussion was provided about the potential toxicity of mixtures

of contaminants, other than a vague description of whole effluent toxicity tests completed by others. It is well known that the only substance that is monitored in fish tissue, methylmercury, is a substance of concern for local residents that consume fish. Furthermore, the predictions of routine fish tissue mercury concentrations in excess of 0.5 mg/kg is unfortunate but not surprising given the widespread disturbances that are planned for the watersheds.

[61] Recommendations

i. Fort McKay requests that since Shell is basing its toxicological benchmarks on predicted tissue concentrations in fish, the company should validate their models by measuring these SOPCs in fish tissue; and

ii. Fort McKay requests that methylmercury be treated as a substance of concern because of its historical importance in the region.

*[62] Sub-lethal Impacts to Fish in Pit Lakes**

Given that end pit lakes will be contaminated systems for at least some period of time (naphthenic acids, PAHs, metals), it is possible that fish may suffer chronic (sublethal) impacts because of transfer of contaminants from sediments through the food web.

[62] Recommendations

i. Address the potential contamination and sublethal effects to fish exposed to contaminated sediments and food web diet sources;

ii. Given the stated paucity of chronic toxicity data for oil sands-source naphthenic acids, will Shell commit to funding the necessary research to fill these data gaps?

*[63] Lost Fishing Opportunities for Fort McKay**

Fish that lose physical habitat due to JMR and PRM may survive in the compensation lake but the fish from the lake may not be safe for human consumers of fish. Large fish high on the food chain (northern pike, walleye, burbot) will likely be contaminated with methylmercury for at least a couple of decades.

[63] Recommendation

Mitigation and accommodation measures should be developed in consultation with Fort McKay with respect to lost fishing opportunities caused by the JME and PRM including but not limited to the development of a Fishing Opportunities Management Plan. This could include a number of potential strategies (e.g., offsets, additional access/opportunities for fishing).

Fort McKay recommends that Shell participate in the development of this plan. Fort McKay may want to work with Shell to identify fishing opportunities that could be located near to the Community and/or accessible from the Community.

Note that the Department of Fisheries and Oceans authorized habitat compensation is not compensation or mitigation from the perspective of Fort McKay's lost fishing and other traditional use opportunities due to unknowns about contamination of fish remaining in the system, concerns regarding potential mercury levels in fish in the compensation habitat, the loss of culturally-significant areas and the conversion of river habitat to artificial lakes.

*[64] Compensation Plans and Threatened Species**

A significant loss of fish and fish habitat is predicted and compensation plans are the subject of discussions between Shell, regulators and various stakeholders. Among the fish species to be potentially impacted is Arctic grayling, now designated as a Species of Special Concern in Alberta (Fish and Wildlife Division 2008).

[64] Recommendations

i. Fort McKay must be included in all discussions and reviews concerning fish and fish habitat compensation, including habitat design, review of mitigation and monitoring plans, *Fisheries Act* Authorization, and other approvals emanating from the compensation plans; and

ii. Fort McKay requests that Provincial regulators become involved in consultations about the expanding threat to Arctic grayling due to incremental habitat losses and increased fishing pressure.

*[64] Setbacks**

Appropriate mitigation measures need to be in place to protect the remaining fish habitats that are not directly affected by Shell's proposed projects.

[65] Recommendations

Fort McKay recommends that a minimum setback be established and mandated:

i. 100 m from all fish bearing watercourses including the Muskeg River, Jackpine Creek, Muskeg Creek, and other fish bearing watercourse within the Muskeg River and Pierre River watersheds as well as from all diversion channels that drain into fish bearing waters.

ii. 250 m from the Pierre River Mine project to the Athabasca River

Table 7-1: JME Fisheries Summary Table

Number	Fort McKay Key Concern	Recommendation	Category[2]
60	Lost realistic connectivity for fish of Kearl Lake to the Muskeg River	i) Fort McKay requests that an effort be made to provide appropriate protective and functional fish habitat in the 9.3 km connector channel between the Muskeg River and Kearl Lake; and ii) clarify whether the loss of Muskeg Creek was a component of compensation calculations	Agreement
61	Toxicity of mixtures of contaminants[1]	i) Fort McKay requests that since Shell is basing its toxicological benchmarks on predicted tissue concentrations in fish, the company should validate their models by measuring these SOPCs in fish tissue; and ii) Fort McKay requests that methylmercury be treated as a substance of concern because of its historical importance in the region.	Response/ Agreement
62	Sub-lethal impacts to aquatic biota from contaminated pit lake sediments[1]	i) Address the potential contamination and sublethal effects to fish exposed to contaminated sediments and food web diet sources; ii) Given the stated paucity of chronic toxicity data for oilsands-source naphthenic acids, will Shell commit to funding the necessary research to fill these data gaps?	Response
63	Lost fishing opportunities and mercury-contaminated fish in the compensation lake[1]	A mitigation and compensation plan with respect to lost fishing opportunities needs to be developed, including but not limited to a **Fishing Opportunities Management Plan.** Fort McKay recommends that Shell participate in the development of a Fishing Opportunities Management Plan for the Community. This may include identifying or creating fishing opportunities near the Community.	Agreement Regulatory

Number	Fort McKay Key Concern	Recommendation	Category[2]
64	Loss of habitat for the **Species of Special concern,** Arctic grayling[1]	i) Fort McKay must be included in all discussions and reviews concerning fish and fish habitat compensation, including habitat design, review of mitigation and monitoring plans, Fisheries Act Authorization, and other approvals emanating from the compensation plans; and ii) Fort McKay requests that provincial regulators become involved in consultations about the expanding threat to Arctic grayling due to incremental habitat losses and increased fishing pressure.	Agreement Regulatory
65	Setbacks from fish bearing watercourses	Fort McKay recommends that a minimum setback be established and mandated: i) 100 m from all fish bearing watercourses including the Muskeg River, Jackpine Creek, Muskeg Creek, and other fish bearing watercourse within the Muskeg River and Pierre River watersheds as well as from all diversion channels that drain into fish bearing waters. ii) 250 m from the Pierre River Mine project to the Athabasca River	Agreement Regulatory

[1]Key Concerns and Recommendations that apply to the Jackpine Mine Expansion and Pierre River Mine Project

[2]***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

7.4 PRM Fisheries Impacts

The tributaries of the Athabasca River in the PRM area have diverse fish communities that include many large and smaller fish species. Pierre River supports Arctic grayling, burbot, northern pike, longnose suckers, white suckers, plus seven smaller species; Eymundson also supports Arctic grayling, while Redclay Creek has burbot, northern pike, walleye, and others. Fish habitat lost in these watersheds will be replaced through the proposed fish habitat compensation plan (Redclay Lake). The design of the lake is the subject of

ongoing planning sessions among the company, DFO, and various stakeholders, including Fort McKay.

Since there are no industrial developments in the current project area, the Base Case and Pre-development Case for fish were considered the same, and the Project impacts were assessed as the only potential impacts to the watersheds (Application Case). Water quantity changes related to closed-circuiting and diversion will occur, and water quality may be impacted due to the activities described in the water quality assessment above.

The key concerns regarding fish and fish habitat considered in common with the Jackpine Mine Expansion are discussed in Section 7.4 (Recommendations 61 to 65) and are not repeated here.

7.5 PRM Fisheries Assessment

A total of 188 ha of natural surface water fish habitat will be lost due to the project operations, including 104 ha of unnamed lakes and ponds, and 84 ha of streams. An additional 45 ha of surface water habitat will be lost at closure as a result of "repositioning diversions". The fish compensation plan is expected to offset all of the fish habitat losses so there is No Net Loss in the productive capacity of fish in the region.

The replacement of flowing streams with lake habitat is likely to result in an overall decrease in habitat diversity, and habitat that some fish species may be unsuited to. The residual impact to fish following compensation was assessed by Shell as negligible.

7.6 PRM Fisheries Key Concerns and Recommendations

[66] Significance of Benthic Invertebrate losses

The significance to fish in the Athabasca River of the loss of benthic invertebrate drift for the many streams that will be removed for the PRM and all other projects was assessed by Shell as negligible. Shell did not study the importance of the current benthic invertebrate drift to fish in the Athabasca River, so it is not apparent how they could conclude that the loss of this fish food resource would be negligible. The streams that contribute localized drift would certainly augment the diversity of any in situ Athabasca River drift. Potential impacts to invertebrate-consuming fish in the Athabasca River were not accounted for in the compensation plan.

[66] Recommendations

i. Re-evaluate the assessment of negligible impact for benthic invertebrate drift from tributaries to the Athabasca River, because streams that are diverted or interrupted from direct flow to the river will not produce benthic drift in the same way as they currently do; and

ii. Describe potential impacts to local invertebrate-consuming fish from lost benthic drift at the outflow of streams flowing to the Athabasca River in compensation calculations.

Table 7-2: PRM Fisheries and Aquatics Summary Table

Number	Fort McKay Key Concern	Recommendation	Category*
66	Loss of benthic invertebrate drift to local fish in the Athabasca River	i) Re-evaluate the assessment of negligible impact for benthic invertebrate drift from tributaries to the Athabasca River, because streams that are diverted or interrupted from direct flow to the river will not produce benthic drift in the same way as they currently do; and ii) describe potential impacts to local invertebrate-consuming fish from lost benthic drift at the outflow of streams flowing to the Athabasca River in compensation calculations.	Response/ Agreement

Note: See also recommendations 2, 3, 4, 5, which apply to both JME and PRM

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

7.7 References

Alberta Sustainable Resource Development. 2002. Fort McMurray – Athabasca Oil Sands Subregional Integrated Resource Plan. Approved by Cabinet on May 7, 2006. Ammended June, 2002. Publication No. I/358. Alberta Sustainable Resource Development. Edmonton, AB.

Fish and Wildlife Division. 2008. Alberta species at Risk Program and Projects 2004-2008. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 120, Edmonton, AB. 66 pp.

Fort McKay Industry Relations Corporation. 2010. Fort McKay Specific Assessment.

8.0 SOILS AND TERRAIN

This soil and terrain review examined the relevant soil and terrain and reclamation (Conservation and Reclamation Plan) information presented in the Environmental Impact Assessment (EIA) for the Jackpine Mine Expansion (JME) & Pierre River Mine (PRM) Projects (the Projects; Shell 2007), including updates completed in March 2008 (Shell 2008) and May 2009 (Shell 2009).

The initial development of the Jackpine Mine Phase I involved the disturbance of 7,836 ha for bitumen production until final closure in 2031. Shell proposes to increase the mine development area resulting in the extension of mine closure to 2049 to achieve additional bitumen production. This is accomplished through the disturbance of an additional 12,719 ha in the JME area (total of 20,555 ha for the JME) and an additional 10,403 ha in the PRM. It is noted that there are minor discrepancies in the reported disturbance areas throughout the EIA due to rounding of calculations.

8.1 Soil Disturbance, Reclamation and Equivalent Capability

Development of the Shell JME and PRM will result in the additional disturbance of approximately 23,000 ha of soils. This amounts to approximately 35% of the disturbance to mineral soils and 65% to organic soils for the JME and approximately 60% to mineral soils and 40% to organic soils for the PRM. The project will result in the permanent loss of almost 6,000 ha of terrestrial ecosystems and soils, due to the creation of end pit lakes in the closure landscape. Reclamation will result in the shift to a drier landscape (higher proportion of upland to wetland areas) than pre-disturbance (additional detail can be found in the Vegetation & Biodiversity review, Section 9).

The EIA outlines the permanent loss of wetlands and peatlands within the development area. Wetlands, including peatlands, account for 38% of the pre-disturbance local study area and comprise less than 10% of the post-disturbance/ closure environment in the JME and PRM. While there is mention that surface water area is expected to increase, less attention is given to how the loss of these areas affects the landscape's ability to produce equivalent ecosystem functions.

One of the underlying goals of the CC&R Plan is to achieve equivalent landscape capability as the Base Case following reclamation. The classification of reclamation quality focuses on forest productivity and the establishment of upland environments. Shell's analysis predicts the equivalent land capability for forestry to be equivalent or better than pre-disturbance levels following reclamation (areas of Forest Capability Classes 1-4 are expected to increase in the post-closure environment, with a corresponding decrease in Forest Capability Class 5 area). No mention of equivalent land capability for other ecosystem types was noted.

Key Indicators of assessing the impact on overall soil quality include soil goals and management indicators, which were outlined in the EIA as follows:

- sustain natural soil capability and productivity through the assessment of total soil disturbance and the duration of non-vegetated soils; and
- sustain diversity of soil types through the evaluation of the capability, number, and distribution of soil types.

8.2 Key Concerns and Recommendations

It has been noted that Project disturbances to soils will largely be mitigated by reclamation. Planned reclamation activities are focused on the establishment of mineral and peat-mineral mix soils for the development of upland environments. These soil handling and reclamation plans do not adequately mitigate against the loss of organic soils and the wetlands they support within the proposed project areas. While organic soils may be classified as less productive from the perspective of forest soils, they play an integral part in boreal forest ecosystem function, including the production of aquatic vegetation, provision of wildlife habitat, regulation of water and carbon balances, and biological processes affecting water quality. Thus, these organic soil-based wetland ecosystems play a critical role in Fort McKay's traditional land use - without restoration of peatlands it is difficult to see how many of the traditional land uses can be restored to equivalent capability.

[67] Peatland Reclamation

[67] Recommendation

Fort McKay may wish to consider requesting Shell to commit to research towards the reclamation of organic soils and the establishment of peat-accumulating wetlands, to help sustain the capability, diversity, and distribution of soil types. This research should include ways of creating more gently sloping topography and the hydrological conditions suited to peatland formation, as well as specialized soil salvage and revegetation techniques for peatland reclamation.

[68] Tailings Management

[68] Recommendation

There is additional potential that the permanent loss of soils to pit lakes can be minimized by alternative strategies in tailings management. Fort McKay requests to review Shell's revised tailings strategies which will undoubtedly be required as a result of the ERCB Tailings Directive 074.

[69] Soil Salvage and the Pace of Reclamation

The existing approved Shell mines (Muskeg River and Jackpine Phase I) and the proposed large-scale mine developments will ultimately occupy a total of

44,000 ha of land. The proposed JME will cover 20,555 hectares and the proposed PRM a further 10,403 ha (see EIA Update, May 2008). The JME will not be fully reclaimed until 2060 (see Figure 12-1 in the C&R review). The PRM as proposed will not be fully reclaimed until 2050.

The proposed pace of reclamation is different between the JME and PRM. At PRM, land is disturbed during the first 30 years of mining (approximately one half of the area is disturbed within the first 10 years) but very little reclamation (less than 10%) is completed during mining (Figure 12-2 in the C&R review). Reclamation is primarily undertaken during the 10 year period after mining is completed in 2040. In contrast, at the proposed Jackpine Mine Expansion, the disturbance occurs over a longer time frame, approximately 40 years, and during that time period approximately 25% of the area is reclaimed. The remaining 75% of the area is then reclaimed over the next 20 year period after new mine disturbance has ceased (Figure 12-1 in the C&R review). While this later scenario reclaims a higher percentage of land earlier in the mining process than the PRM scenario, reclamation at both of these projects occurs at a much slower pace than at the Muskeg River Mine where, after 2017, land reclaimed in each year keeps pace with new land disturbance (Figure 12-3 in the C&R review). When the disturbance and reclamation from all three mines are considered together, it will take 45 years of mine operation before 50 % of the disturbed land will be reclaimed, and the final 50% will be reclaimed during the last 15 years (Figure 12-4 in the C&R review).

The pace of reclamation is a concern from Fort McKay's perspective for reasons of access to traditional land (see Sections 12 and 13 of this review), but this pace also has direct impacts on soils handling for reclamation. Direct placement offers opportunities to replace biotic diversity during reclamation, by salvaging living vegetation propagules and other soil biota from surface soils, and placing these materials directly in conditions that ensure their survival and propagation, and their contribution to achievement of reclamation objectives. In contrast, stockpiling these materials results in substantial mortality and loss of propagule viability, to the extent that after long stockpiling periods, these materials will contribute little to regeneration of vegetation communities. Unfortunately, mine plans that incorporate long lag periods between disturbance and reclamation – such as the JME and PRM – offer limited opportunity for direct placement.

[69] Recommendation

Fort McKay recommends that Shell increase the pace of reclamation on all of their mines, in order to realize opportunities for direct placement of surface soil materials.

Table 8-1: Soil and Terrain Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
67	Peatland Reclamation	We recommend that Shell to commit to research towards the reclamation of organic soils and the establishment of peat-accumulating wetlands, to help sustain the capability, diversity, and distribution of soil types.	Agreement
68	Tailings Management	Fort McKay would like to review revised tailings strategies which will undoubtedly be required as a result of the ERCB Tailings Directive 074.	Agreement
69	Pace of Reclamation	Fort McKay recommends that Shell increase the pace of reclamation on all their mines, in order to realize opportunities for direct placement of surface soil materials.	Agreement

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

9.0 TERRESTRIAL VEGETATION, WETLANDS & FOREST RESOURCES ASSESSMENT

This review of terrestrial vegetation, wetlands, forest resources and biodiversity focused on the information provided in Shell's EIA (Shell 2007, Volume 5, Section 7) and in the EIA Update (Shell 2008, Appendix IV).

9.1 Setting

The proposed development is comprised of two new mine components; the Jackpine Expansion Mine Area (JMA), an expansion of the Jackpine Mine – Phase 1 (JMP1) operation on the east side of the Athabasca river, and the Pierre River Mine Area (PRM), a new mine on the west side of the Athabasca. The total local study area (LSA), which includes the JMA, PRM and JMP1 as well as an additional 500-m buffer, is 50,640 ha in size or 39,484 ha excluding the approved JMP1 area. For the purpose of this review, the project is addressed in the same way it is in the main body of the environmental assessment, which is the JMA, PRM and JMP1 treated as a single Project. The regional study area (RSA), which is used by Shell to assess the effects of the Project in a broad regional area, is 2,277,376 ha.

9.1.1 Jackpine Expansion Mine Area

The proposed JMA component is located 70 km north of Fort McMurray, and 15 km east of Fort McKay, and is contained within Townships 95, 96 and 97, and Ranges 9 and 8 W4M. The project development area of the JMA is 10,936 ha. The terrestrial resources local study area (LSA) includes the Jackpine Mine – Phase 1 and is a total of 29,503 ha in size; this area was defined by placing a 500 m buffer around most of the mining areas. The Jackpine Mine – Phase 1 makes up 11,156 ha of the 29,503 ha LSA.

The proposed project schedule is as follows:

- Start of site preparation/construction: 2012
- Start of operations: 2015
- Start of site decommissioning: 2052
- Start of site closure: 2065

9.1.2 Pierre River Mine

The proposed PRM component is located 100 km north of Fort McMurray, and 35 km north of Fort McKay, and is contained within Townships 97, 98 and 99, and Ranges 10 and 11 W4M. The project development area of the PRM is 10,403 ha. The terrestrial resources local study area (LSA) is 21,136 ha in size; this area was defined by placing a 500 m buffer around most of the mining areas.

The proposed project schedule is as follows:

- Start of site preparation/construction: 2010
- Start of operations: 2018
- Start of site decommissioning: 2039
- Start of site closure: 2049

9.2 Application Case

The application case considered what impact the Projects, made up of the JMA, PRMA and JMP1 developments, will have on the terrestrial vegetation, wetland and forest resources within the LSA and RSA. The effects for the LSA exclude the Fort McKay Reserve Land (1,538 ha) that was originally included in the assessment of the Jackpine Mine Expansion LSA (Shell 2008). RSA numbers reflect those provided in the original EIA (Shell 2007).

9.2.1 Direct Impacts

9.2.1.1 Changes to Vegetation Types

The full development, including JMP1, will disturb 30,957 ha or about 61% of the total local study area. Of this, JMP1 accounts for 11,156 ha, and the new mine areas, JMA and PRMA account for 9,399 ha and 10,403 ha, respectively. Project activities will result in the loss of 11,212 ha (22% of the LSA) of terrestrial vegetation types, 13,814 ha of wetland types (27% of the LSA), 3,230 ha of miscellaneous vegetation types, 1,173 ha of existing disturbances (i.e., cutblock and other disturbed land; 2% of the LSA) and 1,526 ha (3%) of non-vegetated types which include lakes. Only one, wooded bog with raised islands of forested peat plateau (BTNR), of the ecological land classification units (i.e., ecosites phases or wetland types) found within the local study area will not be impacted by the proposed development.

Following mining and reclamation there will be a net increase in upland ecosite area and a significant loss of wetland area within the LSA (Table 9-1; Figure 9-1). The total area of wetlands will decrease by 13,814 ha to about 5,653 ha (or 71% less than baseline conditions) while the area of terrestrial uplands will increase by 10,032 ha. Following closure, terrestrial uplands will occupy 31,056 ha, or about 61% of the reclaimed area. There will be a substantial change in the distribution of wetland types following reclamation; the areas covered by peat forming wetlands will decrease from 15,157 ha to 4,319 ha following closure. The area covered by non-peat forming wetlands will also decrease from 4,299 ha at baseline to about 1,335 ha after reclamation. Open water and littoral areas will increase by 5,421 ha (210%) over baseline conditions.

Table 9-1: Change in Distribution of Vegetation Categories within the LSA (excluding the Fort McKay Reserve Land)

Map Code	Description	Baseline (LSA)		Closure (Post Reclamation) [(a)]			
		Area [ha]	% of LSAs	Area [ha]	Change [ha]	% of LSAs	% change
Central Mixedwood Natural Subregion Ecosite Phases							
a1	lichen jack pine	267	1	1,156	889	2	333
b1	blueberry jack pine-aspen	1,058	2	625	-433	1	-41
b2	blueberry aspen (white birch)	562	1	102	-460	<1	-82
b3	blueberry aspen-white spruce	393	1	161	-232	<1	-59
b4	blueberry white spruce-jack pine	264	1	423	159	1	60
c1	Labrador tea-mesic jack pine-black spruce	139	<1	2,671	2,532	5	1,822
d1	low-bush cranberry aspen	1,744	3	2,292	548	5	31
d2	low-bush cranberry aspen-white spruce	2,668	5	1,893	-775	4	-29
d3	low-bush cranberry white spruce	795	2	250	-545	<1	-69
e1	dogwood balsam poplar-aspen	287	1	22	-265	<1	-92
e2	dogwood balsam poplar-white spruce	188	<1	112	-76	<1	-40
e3	dogwood white spruce	53	<1	20	-33	<1	-62
f1	horsetail balsam poplar-aspen	4	<1	0	-4	<1	-100
f2	horsetail balsam poplar-white spruce	72	<1	503	431	1	599
f3	horsetail white spruce	267	1	558	291	1	109
g1	Labrador tea-subhygric black spruce-jack pine	202	<1	5,601	5,399	11	2,673
h1	Labrador tea/horsetail white spruce-black spruce	351	1	226	-125	<1	-35
PJ-Lt	jack pine-tamarack complex	14	<1	0	-14	<1	-100
central mixedwood ecosite phase subtotal		9,327	18	16,616	7,289	33	78

Map Code	Description	Baseline (LSA)		Closure (Post Reclamation) [(a)]			
		Area [ha]	% of LSAs	Area [ha]	Change [ha]	% of LSAs	% change
Athabasca Plain Natural Subregion Ecosite Phases							
a1	bearberry jack pine	2,740	5	2,301	-439	5	-16
b1	Canada buffalo-berry-green alder jack pine aspen-white birch	2,922	6	2,025	-897	4	-31
b2	Canada buffalo-berry-green alder aspen	2,151	4	2,213	62	4	3
b3	Canada buffalo-berry-green alder aspen-white spruce-black spruce	1,728	3	1,172	-556	2	-32
b4	Canada buffalo-berry-green alder white spruce/black spruce-jack pine	927	2	515	-412	1	-44
c1	Labrador tea-mesic jack pine-black spruce	60	<1	1,858	1,798	4	2,997
d1	Labrador tea-subhygric black spruce-jack pine	130	<1	3,043	2,913	6	2,241
e1	willow/horsetail aspen-white birch-balsam poplar	325	1	293	-32	1	-10
e2	willow/horsetail aspen-white spruce-black spruce	404	1	293	-111	1	-27
e3	willow/horsetail white spruce-black spruce	307	1	726	419	1	137
PJ-Lt	jack pine-tamarack complex	3	<1	0	-3	<1	-100
Athabasca plain ecosite phase subtotal		11,697	23	14,440	2,743	29	23
Terrestrial uplands subtotal		21,024	42	31,056	10,032	61	48
Wetlands							
BFNN	forested bog	73	<1	28	-45	<1	-61
BONN	open bog	61	<1	9	-52	<1	-86
BONS	shrubby bog	1	<1	0	-1	<1	-100
BTNI	wooded bog with internal lawns	714	1	224	-490	<1	-69
BTNN	wooded bog	1,976	4	644	-1,332	1	-67

Map Code	Description	Baseline (LSA)		Closure (Post Reclamation) [(a)]			
		Area [ha]	% of LSAs	Area [ha]	Change [ha]	% of LSAs	% change
BTNR	wooded bog with raised islands of forested peat plateau	17	<1	17	<1	<1	2
BTXC	wooded bog with collapsed scars	89	<1	77	-12	<1	-13
FFNN	forested fen	2	<1	0	-2	<1	-100
FONG	graminoid fen	1,688	3	291	-1,397	1	-83
FONS	shrubby fen	3,627	7	1,058	-2,569	2	-71
FOPN	open patterned fen	861	2	691	-170	1	-20
FTNI	wooded fen with internal lawns	409	1	3	-406	<1	-99
FTNN	wooded fen	5,224	10	1,091	-4,133	2	-79
FTPN	wooded patterned fen	415	1	186	-229	<1	-55
MONG	Marsh	671	1	50	-621	<1	-93
SONS	shrubby swamp	2,424	5	768	-1,656	2	-68
STNN	wooded swamp	1,123	2	496	-627	1	-56
WONN	shallow open water	81	<1	21	-60	<1	-74
wetlands subtotal		19,456	38	5,653	-13,803	11	-71
Miscellaneous Vegetation Types							
BUu	burn upland	1,126	2	135	-991	<1	-88
BUw	burn wetlands(a)	1,903	4	24	-1,879	<1	-99
Me	Meadow	8	<1	7	-1	<1	-9
Sh	Shrubland	451	1	91	-360	<1	-80
Sh2	shrubland type 2	0	0	387	387	1	100
Sh2	shrubland type 3	0	0	2,371	2,371	5	100
miscellaneous vegetation types subtotal		3,488	7	3,015	-473	6	-14

Map Code	Description	Baseline (LSA)		Closure (Post Reclamation) [(a)]			
		Area [ha]	% of LSAs	Area [ha]	Change [ha]	% of LSAs	% change
Non-Vegetation Types							
Lake	Lake	2,298	5	6,517	4,219	13	184
River	River	282	1	252	-30	<1	-10
Littoral	Littoral zone	0	0	1,232	1,232	2	100
Sand	Sand	41	<1	36	-5	<1	-12
non-vegetation types subtotal		2,621	5	8,037	5,416	16	207
Disturbances							
CC	Cutblock	655	1	143	-512	<1	-78
DIS	Disturbance	3,397	7	2,735	-662	5	-19
disturbances subtotal		4,052	8	2,878	-1,174	6	-29
Total		50,640	100	50,640	0	100	0
Jackpine Mine – Phase 1[(b)]		11,156	22	11,156	0	22	0
Application Area		39,484	78	39,484	0	78	0

(a) Closure scenario includes reclamation of the Project development areas.

(b) The Jackpine Mine – Phase 1 area has been previously approved. It has been presented as the total LSA area to show the changes brought about by the integration of the Jackpine Mine – Phase 1 and Jackpine Mine Expansion Closure Plans.

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

Adapted from Table 2.7-4 of the EIA Update (2008)

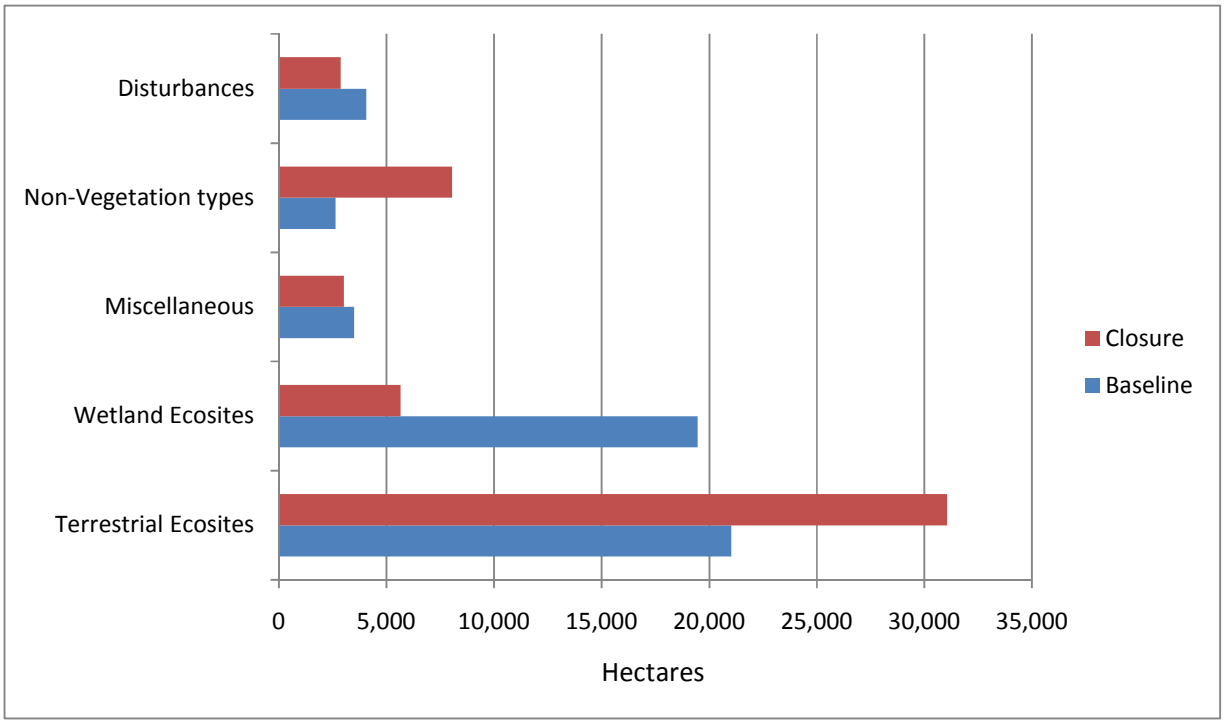

Figure 9-1: Distribution of Vegetation Cover Class at Baseline and Closure

Project disturbance will lead to the complete reduction of five vegetation types within the LSA; shrubby bogs [BONS], wooded permafrost bogs with collapse scars [BTXC], forest fens [FFNN], patterned fens [FTPN] and jack pine-tamarack complexes. These sites will be removed and not reclaimed. Two new shrubland classes will be created at closure; shrubland type 2, shrubland type 3.

The changes to distribution of vegetation classes, due to the JMA, PRM and JPM1 projects, will result in a less than 1% increase in the cover of terrestrial vegetation and a less than 1% decrease in the amount of wetlands at the RSA level. The LSA (50,640 ha) only represents about 2.22% of the entire RSA while the disturbance footprint (32,495 ha) is about 1.42% of the RSA. Therefore, changes greater than 1% of the RSA are not likely at this scale for these broad land cover classes. However, greater than 1% changes occur for some of the individual land cover classes.

9.2.1.2 Landscape Heterogeneity

An in-depth quantitative analysis of the combined effects of the Jackpine Mine Expansion and Pierre River Mine on landscape heterogeneity was not included in the assessment since the projects are not adjacent to each other. However, the assessment does address some predicted effects. The EIA Update indicates that patch richness will decrease by one patch type at closure, However, Table 2.7-4 shows that four units will be lost including the h1 (horsetail balsam poplar-aspen), jack pine-tamarack complex, shrubby bog (BONS) and forested fen

(FFNN), while two terrestrial shrubland types will be created. This should result in a net loss of two patch types. However, four natural patch types will be lost in the LSA as a result of the Projects.

Overall, the Projects will result in a 66% decrease in the wetland cover category while the terrestrial class will increase by 58% within the LSA. In general, the median patch size of wetlands will decrease at closure for both mining areas (although patch size will increase for some units in the JPME LSA). The median patch size of terrestrial ecosites will vary from Baseline conditions following closure. At the JPME, the median patch size will decrease for most of the ecoistes and increase significantly for two ecosites (c1, f3). Median patch size at the Pierre River mine following closure will increase for five ecosites and increase for seven; substantial increases will occur for the c1 and 1 ecosite phases. The area covered by the water class will increase by 172%. The EIA predicts that the loss of wetland area, corresponding increase in terrestrial and open water area together with decreased patch richness will lead to a more homogenous landscape at closure.

9.2.1.3 Landscape Fragmentation

As per heterogeneity, fragmentation analyses where completed separately for the Jackpine Mine Expansion and Pierre River Mine. Analyses of natural versus human disturbed areas; forested versus non-forested areas; riparian areas; and old growth were completed. Following closure, the area occupied by the natural class will increase, while the number of natural patches and total edge will decrease on both mines. These changes generally occur because existing disturbances will be reclaimed and larger contiguous areas of reclaimed land will be created. Median patch size of natural patches is predicted to decrease at the Jackpine Mine and increase at Pierre River.

Changes to forested and non-forested patches are not similar between the two mines. Forested areas included all ecosites and wetland types with trees while the non-forested category includes natural occurring non-forested wetlands, water and burns. The area of the forested land will increase while non-forested land will decrease in the Jackpine Mine Expansion LSA. Median patch size will decrease for both categories at closure; however the decrease is very substantial for the non-forested category. These changes occur because large amounts of land within the JPME will be converted from wetland to upland terrestrial at closure. The opposite effect is predicted at the Pierre River Mine at closure. The area of forested land is predicted to decrease slightly as compared to baseline conditions while the amount of land occupied by the non-forested category is predicted to increase. These changes occur because of the large amounts of land that will be converted to shrubland types and pit lakes in the Pierre River landscape following reclamation and closure. The median patch size for both categories is expected to increase at closure.

The area of the old growth class will decrease in the LSA for both mines following closure. The median patch size will decrease in the JPME LSA and increase for

the Pierre River LSA. The patches of old growth will be further at closure for both mines.

9.2.1.4 Riparian Areas

Riparian communities are found adjacent to rivers, streams, lakes and ponds. These communities occupy about 4,859 ha of land in the baseline condition in the LSA. About 3,305 ha (68%) of the existing riparian communities will be destroyed or altered during mining. Following closure, the area occupied by riparian areas is planned to decrease by 272 ha to 4,587 ha. Most of the riparian reclamation will occur in the "riparian shrubland 2" and "riparian shrubland 3" classes; these two units, which do not exist in the natural landscape at baseline, will be created as a result of reclamation. These two reclaimed classes will account for 2,758 ha (57%) of the closure riparian area. There will be a significant loss, 3,049 ha (72%), of riparian areas associated with wetland classes in the closure landscape.

No estimate of the impact of the project to riparian communities was undertaken for the RSA.

9.2.1.5 Old Growth Forest

Old growth forests, as defined for the study, occupy about 3,068 ha (6%) of the LSA. There will be a direct loss of 1,162 ha (38% of the existing resource) of old growth forest in the LSA as a result of project activities. Old growth forests are not considered reclaimable within the closure time period; "Old growth forest lost during construction and operation of the project will not return within the 80-year closure time frame because development of old growth requires 100 years or more." (Volume 5, Section 7.5.2.2)

The assessment also modeled the effects of the proposed project on old growth within the RSA (2,277,376 ha). The 1,223 ha of old growth forest which will be impacted represent less than 1% of the resource at the RSA level.

9.2.1.6 Forest Capability Class Changes

An assessment of potential changes to land capability for forestry is included in the Soil and Terrain Assessment (Volume 4, Section 7.5) and in the EIA Update (Section 2.7.2).

9.2.1.7 Economic Forests

The assessment did attempt to predict the potential changes to timber productivity within the LSA. In the baseline case, about 23,944 ha and 26,696 ha of the LSA are included in the productive forest and unproductive land base categories, respectively. Unproductive forests include those ecosites having black spruce or tamarack as a leading species or non-forested vegetation types. Following closure the area included in the productive forest category increases by 31% to 31,404 ha while the area occupied by the unproductive classes falls by

28% to 19,235 ha. This increase in land that supports productive timber categories is also predicted to result in an increase in the Long Run Sustained Yield Average (LRSYA) for the LSA. This increase in the sustained yield is predicted to be a 25% increase in merchantable timber, comprised of; increases of 25% in merchantable conifer and 3% in deciduous, as well as a 5% decrease in mixedwood. The increase in total merchantable LRSYA is not totally unexpected given that a larger portion of the land base will be occupied by terrestrial uplands while the area of wetlands, which are generally classed as unproductive, will decrease following closure.

The assessment of economic forests was completed by grouping vegetation types into productivity classes (i.e., good, moderate, fair and unproductive). Within the productive forest group, the area occupied by the good group is predicted to increase by about 22% at closure while the moderate class decreases by 46%. The biggest change is predicted for the fair class, increasing from 684 ha to 10,030 ha, which h represents an increase of 1,466%. In the assessment the Central Mixedwood Natural Subregion "a", "b", "d" and "e" ecosites, and the Athabasca Plains Natural Subregion "a" and "b" are rated as good productivity. The black spruce stands and non-forested wetlands are in the unproductive class. Rationale for the groupings was not found in the document.

9.2.1.8 Peatlands (Fens and Bogs)

A total of 10,838 ha of peat forming wetlands, or 72% of the 15,157 ha of peatlands found at baseline, will be altered or destroyed by project activities (excluding the Fort McKay lease). These peatlands which occupied 30% of LSA at baseline will only cover 9% of the LSA following closure. Destruction of these wetlands is considered as a permanent loss since techniques to recreate peat forming wetlands in the oil sands region are unproven; "Due to soil disturbance in the LSAs and RSA, the loss of peatland wetlands (i.e., fens and bogs) are considered to be permanent because the processes that build peatlands occur gradually over long time periods." (Volume 5, Section 7.5.6.4). A total of 399 ha, or 31% of patterned fens in the LSA will be lost as result of the disturbance.

9.2.1.9 Rare and Special Plant Communities

No rare plant communities were identified within the LSA. However, three special plant communities (lenticular patterned fen, river alder/ostrich fern, and sparsely vegetated slope) were identified in the LSA. The term "special" as used in the report captures unranked communities that may be unique or rare but have not been listed by the Alberta Natural Heritage Information Centre (ANHIC). Project development is expected to directly disturb 37 ha (6%) of the lenticular patterned fen, and indirectly disturb a further 97 ha (15%) through drawdown. The other two special plant communities are outside of the development area, and will not be directly disturbed.

No regional information is provided about these special communities and their distribution through the RSA.

9.2.1.10 Rare Plants

A total of 469 occurrences of rare plants were identified within the project LSA. This list of occurrences includes species that are listed by the ANHIC as well as other species, unranked by ANHIC, due to lack of information. The list of rare plants included 14 vascular, 13 bryophyte and 44 lichen species; or 71 species in total. The project will impact 366 (78%) of the known rare plant occurrences in the LSA.

Each of the vegetation communities (ecosite phases and wetland types) was ranked for it potential to contain rare plants. The project will result in the loss of 8,899 ha of land classified as having high rare plant potential. At baseline, areas with high rare plant potential occupied 31% of the LSA but will decrease to 14% following closure. The area ranked as having moderate potential to contain rare plants will increase by 8,359 ha (from 44 to 60% of the LSA) while the area with low rare plant potential will increase by 540 ha (from 25% to 26% of the LSA). Although it is not stated in the assessment document, this loss of area with high rare plant potential is correlated to the direct loss of wetlands. Almost all (with the exception of the shrubland vegetation type) of the vegetation types in the high rank class are wetlands, especially fens (*Terrestrial Vegetation, Wetlands and Forest Resources Environmental Setting*, Shell Canada Limited 2007).

The impacts to rare plant potential, on the regional scale appear to be low. The area of land ranked as having high rare plant potential will decrease by 9,839 ha (<1%) following closure while the area of land with moderate and low rare plant potential will increase by 6,411 ha (<1%) and 3,248 ha (<1%) respectively. However, as is the case with other regional calculations, this is an incremental measurement of the impacts of the project and net changes of 1% or greater are not likely since the entire development area itself represents only 1.5% of the RSA.

9.2.1.11 Traditional Plants

At the baseline case, the areas considered to have high (34%), moderate (25%) and low (42%) traditional plant potential are fairly evenly balanced within the LSA. The project will disturb 9,574 ha of lands with high traditional plant potential, 9,976 ha of lands with moderate traditional plant potential and 11,408 ha of lands with low traditional plant potential. Following closure (and assuming successful reclamation), the area occupied by the lands with high traditional plant potential is predicted to decrease slightly (292 ha) to 33% of the LSA. The area occupied by the moderate traditional plant potential class will increase by 7,058 ha (to 39% of the LSA) while the low class will decrease to 6,767 ha (to 28% of the LSA).

The traditional plant list used for the assessment contains 63 known vascular plants (by common name), seven fungi (by common name), as well as a moss group that contains eight common genera/species. The system developed to separate the vegetation types into the classes with very common, common,

occasional, rare traditional plant potential is somewhat subjective. The methods described in the *Terrestrial Vegetation, Wetlands and Forest Resources Environmental Setting*, (Shell Canada Limited 2007) state that "Species that commonly occurred within a vegetation type with relatively high percentage cover were given a high abundance score while other species that were rarely present and exhibited low cover were given a low abundance score." However, those species that are in the rare, occasional or common frequency class and have very low covers (1 to 2%) and/or the rare frequency class with low cover (>2 to 10%) were not assigned an abundance score (i.e., where scored as "0") and therefore do not influence any of the traditional plant abundance scores for the vegetation types. As a result, any species that does not commonly appear above low cover in any ecotype is counted as zero in this system, and subsequently has no value in this system. These uncommon, low cover plants may still be of high traditional value, which are not represented in this assessment.

An assessment of berry producing capability is not included the Terrestrial Vegetation, Wetlands and Forest Resources Assessment. There is a brief assessment in the Human Environment section (Volume 5, Section 8), which is specific to particular land-users. It is stated "Impacts to berry picking areas will be mitigated through reclamation. Berry picking habitat is expected to improve following reclamation, resulting in positive long-term change." (Volume 5, Section 8.4.2.7). The reclamation practices which will be used to reclaim berry-picking habitat aren't discussed in this section.

9.2.1.12 Biodiversity Potential

The assessment of biodiversity groups the different vegetation types into three rankings of biodiversity potential; high, moderate and low. In the (LSA), the area ranked as having a high biodiversity potential will decrease by 7,217 ha (72%) from the base case to closure. The areas ranked as low and moderate will increase by 843 ha (8%) and 6,372 (22%), respectively. The reason for the large loss of high biodiversity area after closure is because the vegetation types which are listed as having a high biodiversity potential are all wetland classes, which are very difficult, or not currently possible (i.e. peatlands), to reclaim. This is particularly true for the JME area, as there is high cover of high biodiversity potential area within the JME LSA.

At the regional level, there is a projected disturbance of 9,839 ha of high biodiversity potential area; this represents a 2% decrease of high biodiversity potential area in the RSA. Moderate and low ranked lands will increase by 725 and 9,115 ha, respectively.

9.2.1.13 Non-native Plants and Weeds

Three species, classified as noxious weed under the Alberta *Weed Control Act,* were observed in the LSA (Shell 2007). An additional seven species that are considered as nuisance weed were also identified. Six other native species found on the LSA were classed as non-native or native invasive species. These species

were found in open natural habitats, closed forests and disturbances such at clearings and cutblocks. The assessment does not make any conclusions about the possible effects of invasive plants or weeds during operations or after closure. The assessment does state as a mitigating measure "expanding and implementing the existing weed control system for the Project area." (Volume 5, Section 7.1.3)

9.2.2 Indirect Impacts

9.2.2.1 Changes in Hydrogeology and Hydrology

The assessment recognized that drawdown of the surficial aquifer as a result of mining activities could have the potential to affect wetlands, especially fens, outside of the development area. The proponent indicates that modeling of the possible drawdown effect will primarily only effect areas within the LSA, with two exceptions; to the west of the JMA LSA boundary, where drawdown will affect an area extending 3.5 km beyond than the LSA, and the area south and west of lease 9 in the PRM development area where drawdown will affect an area extending 4.5 km beyond the LSA

The approach determined that another 1,883 ha of peatlands are within the "potential drawdown zone". This is on top of the 10,838 ha of peat forming wetlands which will be directly impacted by the project, bringing the total "potential loss" of peat forming wetlands in the RSA to 12,721 ha. These combined effects have the potential to affect 92% of the total peatland area (13,891 ha) found in the LSA at Baseline.

The assessment indicates that: "The potential effects due to drawdown on wetlands include reductions in water levels and moisture regimes that may lead towards a shift in species composition and eventually a shift towards a terrestrial vegetation community. A second potential effect is a change in the nutrient levels within fens."

9.2.2.2 Dust

Dust associated with mining operations has the potential to affect adjacent vegetation that has not been directly altered by clearing. The assessment indicates that 5,769 ha of adjacent lands may be exposed to dust in the baseline case while a total of 8,849 ha of land may be exposed to dust during the application case (i.e., during construction and operation).

9.2.2.3 NOχ and SO_2 Emissions and Nitrogen Depositions

Project emissions may have a direct or indirect effect on vegetation resources in the regional area. These issues are discussed in Volume 3 Section 3 (Air Quality) and Volume 3, Section 5 (Environmental Health).

9.2.3 Residual Impact Classification

Shell's assessment found that the project would have negative residual effects on the several of the criteria/indicators used to assess vegetation resources in the LSA. The environmental consequences to these indicators are summarized below. The effects are considered irreversible, except for the traditional use plants, dust and non-forested areas indicators.

Table 9-2: Residual Impact Classification

Criteria/Indicator	Environmental Consequence
Old growth forest	Low
Wetlands (including peatlands)	High
Rare and special plant communities and rare plants (high potential class)	High
Traditional use plants (high potential class)	Negligible
Changes in hydrogeology and hydrology on wetlands	Low
Dust	Negligible
Non-forested areas	Negligible
Biodiversity (vegetation and wildlife grouped, from Volume 5, Section 7.5.6)	High

Shell's assessment indicates that a shift in vegetation community structure will occur in the LSA as a result of the project. It notes that the reclaimed landscape will be dominated by terrestrial upland ecosite types, riparian shrublands (a reclaimed class) and open water. Within the LSA at closure, terrestrial vegetation will have increased by 48%; the area covered by lakes will have increased by 184%, while the area covered by wetlands will have decreased by 71%. Wetlands occupy about 38% of the landscape in the baseline case while at closure they are predicted to cover about 11% of the area. There will be a substantial decrease in the area covered by peatlands.

Biodiversity is not addressed for vegetation alone, but it is addressed together with wildlife in Volume 5, Section 7.5.6 (Shell 2007). It assesses the change in biodiversity potential by categorizing each ecotype as high, moderate or low biodiversity potential. The assessment predicts a 7,852 ha (76%) reduction in high biodiversity potential areas, and a 614 ha (6%) and 6,981 ha (24%) increases in areas rated moderate and low, respectively. This change is likely due to a decrease in area of wetland ecotypes, many of which are ranked as high biodiversity potential, and a corresponding increase in area of upland ecosites, many of which are ranked as low biodiversity potential. At the RSA level, a 9,839 ha (2%) decrease in high biodiversity potential area is predicted.

The assessment concluded the environmental consequences of the project are negligible for the key indicators for the RSA (see comments in Section 9.4).

9.2.3.1 Climate Change and Effects on Project Closure

The assessment acknowledges that climate change could affect vegetation plans, and that species and community composition could change as a result. It also notes that climate change could increase fire activity in the region, and that increased timber harvesting could possibly offset this.

9.3 Planned Development Case

The planned development case (PDC) is designed to consider the effects this project and other approved and planned projects will have on the terrestrial vegetation, wetlands and forest resources in the region.

Three key indicators were analyzed for the PDC since the environmental consequence of the proposed project was rated as moderate to high for the indicators for the application case (i.e., within the LSA). These indicators include wetlands, old growth forests and rare and special plant communities/rare plants (high potential class).

The RSA for the assessment is 2,277,376 ha in size. The assessment lists total area to be lost or altered by planned developments in the region is given as 161,270 ha. This figure equals the sum of the known planned developments of 128,776 ha (Terrestrial, Vegetation, Wetlands, and Forest Resources, Wildlife and Biodiversity) and 32,495 ha for the JMA, PRM and JMP1 projects.

9.3.1.1 Wetlands

A total of 161,270 ha (7%) of land within the RSA is predicted to be disturbed based on the planned developments and this project. Of this total, 52,625 ha (33%) of the disturbed area is occupied by terrestrial vegetation while 55,021 ha (34%) are wetlands; about 9,411 ha (6%) fall in the other category (i.e. burns or water) and 44,213 ha (27 %) are classified as previously disturbed.

The predicted net loss, based on the planned developments, of the treed bog/poor fen class is about 21,651 ha (-4% of the resource found in the RSA). The predicted loss of treed fens is about 18,175 ha (-6% of the total resource). Following closure, there is a predicted net increase of 36,220 ha (+16% of the baseline resource) in the area covered by non-forested wetlands. This category captures all of the wetlands to be created by reclamation on oil sands operations (i.e., marshes, shrub swamps, riparian swamps wooded swamps and graminoid fens). It may also improperly place some other non-wetland units, such as riparian shrublands, in the wetland category. The ability to reclaim graminoid fens is doubtful since fens have peat soils. A more conservative approach to estimated wetland loss would exclude graminoid fens, and “shrubland” from the non-forested wetland class. These shrublands are not considered as wetlands in the analysis of effects completed for the LSA.

The total net loss of all wetland types, predicted by this assessment, is 3,606 ha (or <-1% of the total wetland area at baseline). As discussed above, this is due to the predicted increase in the area occupied by non-treed wetlands through

reclamation. The assessment states (Section 7.6.2, p. 7-140) that about 67% of wetlands mapped in the RSA are peatlands and that the net loss to peatlands after reclamation should be 2,416 ha. However, Table 7.6-4 estimates that a total of 39,609 ha of wetlands will be lost in the PDC as compared to the Base Case. Therefore regional peatland losses should be much greater (about 26,538 ha) given the assumption and previous statements that acknowledge that peatlands cannot be reclaimed. This method of assessing the predicted net change in peatlands ignores the standard reclamation practice of replacing peat forming wetlands with non-peat forming wetlands. This taken into account, the regional, irreversible loss of peatlands will be much higher.

In the end, Shell's assessment indicates a negative, low rated environmental consequence for wetlands (including peatlands) in the RSA under the planned development case. These impacts are stated as long-term and irreversible.

9.3.1.2 Old Growth Forest

The PDC will affect about 17,906 ha, which represents 1% of the RSA or 5% of the old growth in the RSA. This prediction is based on a timber harvest plans for up to the year 2011; The assessment acknowledges that under a longer-term harvesting plan, the impact to old growth forests will be greater than the predicted 17,906 ha.

The assessment predicts a low overall environmental consequence based on information on harvesting plans to 2011. The impacts are stated to be long-term but are listed as irreversible/reversible. No prediction as to the environmental consequences to old growth forest under a long-term harvesting scenario in combination with planned developments is provided.

9.3.1.3 Rare Plants

The PDC assessment predicts that a net increase of 18,045 ha (1% of the RSA) of ecological communities with high rare plant potential will occur within the RSA. This finding is based on the assumption that the wetlands created through reclamation as well as natural regeneration of wetlands on linear disturbances will be as successful in supporting rare plants as those found in the natural landscape. This methodology is questionable for a number of reasons. Firstly, the high rated category includes a broad suite of wetland types, including many peat forming wetlands that are known to have high rare plant potential. However, peat forming wetlands are expected to decline in area in the PDC. The project will result in the loss of 8,899 ha of land classified as having high rare plant potential. At baseline, areas with high rare plant potential occupied 31% of the LSA but will decrease to 14% following closure. In addition, Shell's assessment found that the JMA, PRM and JMP1 projects would decrease the area of high rare plant potential in the LSA from 31% at baseline to 14% at closure. This represented a decrease of 56% of the high rare plant potential lands following closure. The decrease measured at the LSA scale is largely due to the loss of wetlands such as fens and bogs. Fort McKay suggests that similar declines would

be measured at the regional scale if a comparable classification system was available for use. The coarse nature (i.e., broad ecological land classes as well as scale) of the information used to calculate impacts for this indicator at the RSA may be masking effects.

Shell's assessment predicted a net increase in areas with high rare plant potential following reclamation. Thus a positive environmental consequence for areas of high rare plant potential is predicted for the PDC. The effects have been considered as long-term in nature.

9.4 General Comments Concerning the Terrestrial Vegetation, Wetlands and Forest Resources Assessment

Shell's Baseline and Application Case components are detailed in nature. The tabulation of the areas to be disturbed by the project in the LSA is very useful in providing context to the assessment.

However, the use of different types of mapping for the LSA and RSA make comparisons between the local and regional effects difficult. In many cases, the negative effects predicted at the LSA (i.e., rare plants, loss of rare and/or special plant communities, wetlands) are not observed at the regional scale, in part, because of the difference in the land classification systems. The ecosite and wetland classes used in the LSA are not carried through to the RSA. At the RSA level vegetation is lumped into broader ecological land cover categories. The correlation between these different types of units are shown in Table 3.3-2 in *Terrestrial vegetation, wetlands and forest resources environmental setting for the Jackpine Mine Expansion and Pierre River Mine project (Golder 2007).*

9.5 Vegetation Key Concerns and Recommendations

[70] Wetlands

There will be substantial and irreversible changes in the distribution and abundance of wetlands within the project area. Wetlands are a key component of the existing landscape. The reclamation plans do not propose to re-establish any peat accumulating wetlands.

[70] Recommendation

Shell should continue its involvement with CEMA's Reclamation Working Group (Wetlands and Aquatics Subgroup) and facilitate wetland reclamation technology. Shell should commit to research for on-site peatland reclamation (fens and/or bogs) on the JMA, PRM, and JPM1 project sites.

Fort McKay may wish to ask Shell to dedicate land to a long-term pilot wetland research project.

[71] Economic Forests

It is unclear how ecosite phases and wetland types were separated into the four productivity classes.

[71] Recommendation

Fort McKay may wish to ask for clarification on the methods used to determine forest productivity classes.

[72] Rare Plants

A large number of rare plants species have been found within the project area. Most of the documented occurrences within the LSA will be impacted. Ecosites have also been classified with respect to their potential to contain rare plant species. Wetland ecosites generally have higher potential to contain rare species.

[72] Recommendation

We recommend that Shell develop and implement a program to salvage and relocate known occurrence of rare (vascular) species, where possible, to areas located outside the project footprint before development occurs. This program should also evaluate the potential to reintroduce rare species into reclaimed areas.

[73] Traditional Plants

Land classification units were ranked based on their potential to contain traditional use species. Results indicate that the post reclamation landscape, in general, will have a greater area of the high ranked lands that support traditional use plants.

Shell's assessment rated areas based on abundance (i.e., frequency of occurrence and percentage cover). However, no value was assigned to species in the less abundant categories. It may be possible that this ranking system places too much weight on the value of the most abundant species. There may be value in assessing the unique and uncommon traditional use species separately or adding to the analysis. Separation based on uniqueness would determine if any species (such as rat root) associated with a particular ecosite and/or wetland would be lost completely or significantly impacted by the Project.

The report indicates that native species will be used in reclamation. It would be useful to list the TU species that are presently available commercially and can be used successfully in reclamation. This information could be used to generate a post closure assessment scenario that reflects the ability of reclamation to re-introduce traditional use plants into the landscape.

[73] Recommendations

We recommend that Shell develop and implement reclamation practices that utilize a broad range of traditional plant species in reclamation across a range of upland and wetland ecosystems. Fort McKay may wish to request that Shell develop a list of traditional use plants, in consultation with Fort McKay, that can currently be used in reclamation programs.

[74] Hydrologic Changes

Changes to surface and subsurface water flows are predicted to occur off the project area. These changes have the potential to affect off-site wetlands; potential impacts include drying of wetlands (draw down of the water table), changes to species abundance and distribution and changes to wetland type.

[74] Recommendations

i. We recommend that Shell design and implement a program to monitor the potential effects of surface water disturbance, including changes to water quantity and quality, on off-site wetlands.

ii. We recommend that Shell implement a program to mitigate for potential effects to wetlands caused by changes to hydrologic conditions.

[75] Introduction of Invasive or Weedy Species

This project has the potential to introduce invasive plant species during both operation and reclamation stages. These species could impact the success of the reclamation program.

[75] Recommendation

Fort McKay may wish to request that Shell monitor encroachment of non-native plant species as part of its normal environmental activities, ensure that it does not introduce these species as part of the reclamation activities and, if necessary, take steps to eradicate introduced species.

[76] NOχ and SO_2 Emissions and Nitrogen Depositions

Project emissions may have a direct or indirect effect on vegetation resources in the regional area (see Air Quality review).

[76] Recommendation

Fort McKay may wish to request that Shell continue to support and participate in regional monitoring (i.e. Terrestrial Environment Effects Monitoring Program and biodiversity monitoring) to monitor potential effects of air emissions on vegetation resources.

[77] Loss of Biodiversity

Biodiversity, at both a species and landscape level contributes to a stable, functioning ecology, and facilitates traditional activities. There will be a significant negative and irreversible consequence to specific biodiversity indicators resulting from this project. Most of the area in the LSA rated as high biodiversity potential will be disturbed and replaced with units of lower biodiversity potential area. Landscape heterogeneity will be negatively impacted due to a reduction in patch richness.

[77] Recommendation

We recommend that Shell develop a biodiversity monitoring program in order to measure and evaluate the success of on-site reclamation in creating terrestrial and wetland habitats that demonstrate biodiversity values equivalent to pre-disturbance conditions.

[78] Integration of Post-closure Plans

In order to ensure that the post-closure landscape in the region is contiguous, stakeholders must have access to regional closure maps. In order to be useful, it must have the closure plans of all developments in the region, with common mapping features. This is not possible in the current framework, in which proponents dictate the format in which closure plans are submitted. This makes it difficult for stakeholders to track and assess the composition and condition of the post-closure landscape.

[78] Recommendations

Fort McKay may want to ask the regulator to establish a standard format in which closure maps are submitted including the following criteria:

i. Submitted digitally, in a common GIS format
ii. Submitted geo-referenced
iii. Submitted on a common scale
iv. Submitted with a common legend for all features and ecosites (to be developed and provided by the regulator)
v. To be updated and resubmitted with any changes as they occur

[79] Establishment of meaningful thresholds

It is difficult to assess the long-term effects that disturbances to ecosystems and landscapes could have on traditional Fort McKay lands. Regional thresholds have not been established that would assist in the assessing cumulative environmental effects to vegetation resources or biodiversity.

[79] Recommendation

Fort McKay may want to ask the regulators to develop meaningful criteria to assess disturbance of ecosystems and landscapes and establish thresholds for disturbance that consider long term effects on biodiversity, traditional land use, economic forests, rare plants and rare plant communities and wetland destruction/ degradation in the Fort McKay Traditional Lands, in consultation with Fort McKay.

Table 9-3: Vegetation Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
70	Irreversible Wetland Impacts	Fort McKay may wish to request that Shell continue its involvement with CEMA's Reclamation Working Group (Wetlands and Aquatics Subgroup) and facilitate the development wetland reclamation technology. Fort McKay may wish to ask that Shell develop on-site plans for experimental peatland reclamation and the possible creation of fens and/or bogs during reclamation. Fort McKay may wish to ask Shell to dedicate land to a long-term wetland research project.	Agreement/ Regulatory
71	Economic Forests	Fort McKay may wish to ask for clarification on the methods used to determine forest productivity categories.	Clarification
72	Rare plants	Fort McKay may wish to request that Shell develop and implement a program to salvage and relocate known occurrence of rare species to areas located outside the project footprint before development occurs. This program should also evaluate the potential to reintroduce rare species into reclaimed areas.	Agreement
73	Traditional Plant Potential	Fort McKay may wish to ask Shell to develop reclamation practices that utilize a broad range of traditional use plants in their reclamation programs and to develop a list of which TU plants are available for reclamation, in consultation with Fort McKay.	Regulatory/ Agreement/ Clarification

Number	Fort McKay Key Concern	Recommendation	Category
74	Hydrological Changes	Fort McKay may wish to request that Shell develop measures to monitor and mitigate the potential effects of surface water disturbance, including changes to water quantity and quality, on off-site wetlands.	Regulatory/ Agreement
75	Introduction of Invasive Species	Fort McKay may wish to request that Shell monitor encroachment of non-native plant species as part of their normal environmental activities, ensure that they do not introduce these species as part of the reclamation activities and, if necessary, take steps to eradicate invasive and weedy species.	Regulatory
76	Air Emissions	Fort McKay may wish to request that Shell continue to support and participate in regional monitoring (i.e., Terrestrial Environment Effects Monitoring Program and biodiversity monitoring) to monitor potential effects of air emissions on vegetation resources.	Regulatory/ Agreement
77	Biodiversity	Fort McKay may wish to request that Shell develop a biodiversity monitoring program in order to measure and evaluate the success of on-site reclamation in both terrestrial and wetland habitats.	Regulatory/ Agreement
78	Integration of post closure plans	Fort McKay may want to ask the regulator to establish a standard format in which closure maps are submitted including the following criteria: • Submitted digitally, in a common GIS format • Submitted geo-referenced • Submitted on a common scale • Submitted with a common legend for all features and ecosites (to be developed and provided by the regulator) • To be updated and resubmitted with any changes as they occur	Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
79	Establishment of meaningful thresholds	Fort McKay may want to ask the regulators to develop meaningful criteria to assess disturbance of ecosystems and landscapes and establish thresholds for disturbance that consider long term effects on biodiversity, traditional land use, economic forests, rare plants and rare plant communities and wetland destruction / degradation in the Fort McKay Traditional Lands, in consultation with Fort McKay.	Regulatory

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

10.0 WILDLIFE

10.1 Introduction

Shell Canada prepared an environmental impact assessment to assess the impacts of the Jackpine Mine Expansion and Pierre River Mine projects on wildlife (Shell 2007). The projects are located within Fort McKay's Traditional Lands.

Documents containing information on wildlife that were included in this review are listed below:

- Shell Canada 2007. Application for Approval of the Jackpine Mine Expansion and Pierre River Mine Project. Environmental Impact Assessment (Shell 2007a). The main sections reviewed were:
- Shell Canada 2007. Application for Approval of the Jackpine Mine Expansion and Pierre River Mine Project. Environmental Setting Reports (Shell 2007b). The main section reviewed was:
- Shell Canada 2008. Application for Approval of the Jackpine Mine Expansion and Pierre River Mine Project. Environmental Impact Assessment Update (Shell 2008).
- Shell Canada 2009. Application for Approval of the Pierre River Mine Project. Supplemental Information (Shell 2009).

The main reports reviewed were:

- the Wildlife and Wildlife Habitat Assessment (hereafter referred to as the Wildlife Assessment) (Shell 2007, Section 7.0, Volume 5);
- the Wildlife Environmental Setting Report (hereafter referred to as the Wildlife ESR (Shell 2007b); and
- and the Wildlife Health Risk Assessment (hereafter referred to as the Wildlife Health Assessment) (Shell 2007a, Volume 3, Section 5.4)

10.2 Shell's Approach

Shell developed three Key Questions to address to assess impacts on wildlife from the Jackpine Mine Expansion and Pierre River Mine projects on wildlife abundance, movement and health. The Key Questions are presented below:

- **Key Question TR-3:** What Effects Will the Project and the Existing and Approved Developments Have on Wildlife Abundance?
- **Key Question TR-4:** What Effects Will the Project and the Existing and Approved Developments Have on Wildlife Movement?
- **Key Question WH-1:** What are the Risks of Adverse Wildlife Effects from Exposure to Air Emissions and Water Releases from the Project and Existing and Approved Developments?

To answer the Key Questions, Shell considered several factors that could lead to reductions in wildlife abundance, movement, and health. These factors are listed below:

- interactions with infrastructure
- site clearing
- removal of nuisance wildlife
- increase vehicle-wildlife collisions
- sensory disturbance
- air and water contaminants

10.2.1 Wildlife Assessment

Questions TR3 and TR4 were addressed through the analysis of several Key Indicator Resources (KIRs). The KIRs included moose and beaver, which are cultural keystone species for Fort McKay (Garibaldi 2006).

- Moose
- Canada Lynx
- Black Bear
- Fisher
- Beaver
- Barred Owl
- Yellow Rail
- Black-throated Green Warbler
- Canadian Toad

To obtain site specific information on the KIRs, Shell completed the following wildlife surveys between 2005 and 2007:

- Remote photographic bait stations and corridor monitoring
- Winter track counts
- Amphibian surveys
- Marsh bird surveys
- Breeding bird surveys
- Bat surveys
- Waterfowl and beaver/muskrat surveys
- Owl surveys

Shell relied on computer models to predict wildlife habitat loss and population trends. They used Resource Selection Function (RSF) and Habitat Suitability Index (HSI) computer models to assess impacts to wildlife habitat and Population Viability Analysis (PVA) computer models to predict populations of moose and black bear within the regional study area.

10.2.2 Wildlife Health Assessment

The Wildlife Health Assessment (EIA Volume 3; Section 5.4, Shell 2007) examined short and long term health risks from the projects to wildlife. Predicted exposure limits of various air and water emissions to wildlife were compared to toxicity reference values (TRVs). TRVs were intended to be protective of wildlife health and populations.

The Wildlife Health Assessment was completed several wildlife species. The wildlife species selected for assessment by Shell were the following:

- Beaver
- Black bear
- Canada lynx
- Fisher
- Masked shrew
- Meadow vole
- Moose
- Snowshoe hare
- Barred owl
- Great blue heron
- Mallard
- Ruffed grouse
- Spotted sandpiper

Contaminant uptake models were used to assess the impacts of chemical in the environment on wildlife health.

10.3 Shell Results and Conclusions

Shell has indicated that the environmental consequence of the projects will be high for 25 to 50 years. However, Shell claims that reclamation will reduce the environmental consequences of the projects to low or negligible. They state **"Land will be returned to equivalent land capability including traditional land uses, wildlife habitat and forest productivity"**. They predict an increase in available habitat for moose, Canada lynx, fisher/marten, black bear, beaver, black-throated

green warbler, and Canadian toad. The exception is that there will be a high magnitude loss for yellow rails even after reclamation. Shell predicts that impacts will be negligible at a regional scale (Shell 2007a, Volume 5,).

Residual impacts from activities associated with direct mortality due to site clearing, removal of nuisance wildlife and highway mortality were predicted to have a negligible to low environmental consequence for all selected KIRs. Residual effects due to stress from sensory disturbances are difficult to predict. Shell anticipates that most KIRs affected by sensory disturbance will habituate to disturbance effects of the Project to some degree; therefore the magnitude for all KIRs was predicted to be negligible to low.

Contaminant uptake models were used to assess the impacts of chemical in the environment on wildlife health. Several "chemicals of concern" were identified. They included nitrogen oxide, aluminum, methyl mercury, antinomy, manganese, and vanadium. Overall, Shell predicted that impacts to wildlife health would be low or negligible. The residual impacts are summarized in Table 10-1 below.

Table 10-1: Residual Impacts – Contaminant Uptake Models

Parameter	Wildlife at Risk	Magnitude of Effects
Nitrogen Dioxide	Mammals	Low
Aluminum	Beaver, Canada lynx, fisher, masked shrew, meadow vole, spotted sandpiper,	Low
Methyl mercury	Great blue heron	Low
Antinomy	Masked shrew	Low
Manganese	Meadow vole	Low
Vanadium	Spotted sandpiper	Low
Other Chemicals of Concern	None	Negligible

10.4 Fort McKay Specific Assessment

Concurrent to this technical review, Fort McKay's completed the Fort McKay Specific Assessment (FMSA; Fort McKay IRC 2010). The FMSA included an assessment of impacts to moose, beaver, Canada lynx and fisher and marten habitat. Analysis was also included on moose populations within Fort McKay's Traditional Lands. A further description of the Traditional Lands and usage is provided in the FMSA.

The conclusions of the FMSA are that there have been significant impacts (>20% habitat loss) to moose, beaver, Canada lynx, and fisher and marten habitat in the most important areas that are used by Fort McKay. Additionally, the FMSA presents data that suggests that there may be a decline in moose populations in

Fort McKay's Traditional Lands. The FMSA contains recommendations to help mitigate impacts to wildlife.

10.5 Key Concerns and Recommendations

10.5.1 Traditional Environmental Knowledge

Shell is required to provide a strategy and mitigation plan to minimize impacts on habitat and wildlife populations through the life of the Project and to return productive wildlife habitat to the area considering the potential impacts on traditionally used wildlife. Shell indicates that this has been completed in Section 7.3.4. (Shell 2007a)

Shell states that traditional knowledge was integrated into various components of the EIA and used to select wildlife KIRs. After interviews with the RFMA holders, interview reports were sent to each component leads. Component leads reviewed the reports and where the traditional knowledge has been relevant, have incorporated it into the assessment for their component.

For example, a Registered Fur Management Area (RFMA) holder reported that moose numbers have declined in the area. This observation is supported by recent moose surveys (WMU 531) that were partially funded by Shell in 2009. Shell completed a PVA model predicting an increasing moose population.

[80] Incorporation of Traditional Knowledge

[80] Recommendation

A RFMA holder reported that there was a decline in moose abundance. Shell predicts moose populations will increase. Fort McKay is concerned that the observations of traditional land users were not used appropriately. How specifically was traditional knowledge incorporated into the Wildlife Assessment (e.g., ESR surveys)?

10.5.2 Wildlife Interactions with Infrastructure

A major issue of infrastructure impacting wildlife are water birds coming into contact with tailings ponds. This is a concern of the Community because water birds (e.g., ducks and their eggs) are a traditional resource. Further, this issue has attracted global attention to the oil sands region. For example, the recent report by the Natural Resources Defence Council, estimated an annual mortality of 8,000 to 100,000 birds due to direct bird contact with tailings ponds (Wells *et al.* 2008). If this report is correct, tailings ponds in the oil sands may already be having a significant effect on water bird populations.

Syncrude is fighting legal charges for killing approximately 1,600 water birds in 2008. Syncrude's actions will draw additional scrutiny to the oil sands region. Some companies continue to use an antiquated effigy and propane cannon

systems (the "industry standard") and have not upgraded to radar activated systems that have been implemented by Shell.

In the Wildlife Assessment, Shell reports that 68 bird fatalities at the Muskeg River Mine were observed. Shell does not provide an estimate of the number of birds that land on the tailings pond then leave or die and sink (not recovered). Shell does indicate that the manufacturer of their bird deterrent system estimates that from 96.9% to 99% of birds are deterred from the pond (Shell 2009). Shell then makes the conclusion that there are low-magnitude effects to all KIRs.

[81-85] Water Bird Deterrent System

[81] Recommendations

Fort McKay believes that Shell has implemented the best water bird deterrent system in the oil sands region.

i. Shell's water bird deterrent should be considered the industry standard.

ii. Shell should share their experiences through participation of a bird/wildlife protection committee for the oil sands region.

iii. Fort McKay wants to be a member of any regional bird/wildlife protection committee formed in the oil sands region. Fort McKay would like Shell's support for in this endeavour.

[82] Recommendation

The collection of 68 dead birds is not a measure of impact and the manufacturer's bird deterrent performance claims are inappropriate for an EIA. Therefore, Fort McKay believes that the conclusion of low magnitude impact is invalid. Until shown otherwise, a local negative impact should be assumed. Shell needs to determine the site-specific effectiveness of their bird deterrent system.

Shell states that ponds that are less than 400 m across only need propane-fired cannons and human effigies. However, it has been shown that cannons and effigies only are not as effective as radar activated systems, in particular for shorebirds.

[83] Recommendation

Shorebirds may not be effectively deterred from ponds less than 400 m across. Will Shell use additional methods (e.g., pond construction) to prevent shorebirds from landing on ponds?

[84] Recommendation

The regulators should require a regional scale cumulative impact assessment, which would include participation by all mine operators.

[85] Recommendation

A regional monitoring program to assess tailings pond impacts on water birds needs to be designed and implemented by impartial scientists. A regional scale cumulative impact assessment and monitoring should be a joint effort funded by all oil sands operators.

10.5.3 Site Clearing

Large quantities of moose, beaver, Canada lynx, and fisher and marten habitat has been lost in the Traditional Lands of Fort McKay. Fort McKay is concerned about how the loss of habitat will impact wildlife populations and contribute to a loss of traditional knowledge. A potential impact of habitat loss was observed in recent moose surveys completed in Wildlife Management Unit (WMU) 531. During these surveys the moose populations observed were statistically significantly smaller than previously observed populations (see FMSA, Section 6 - Wildlife for details). WMU 531 overlies the northwest area of Fort McKay's Traditional Lands. Long term moose population and density data is also presented in the FMSA.

Shell predicts negligible to low magnitude after mitigation measures have been implemented. Shell predicts that reclamation will take 25 to 50 years after mining is complete.

[86-88] Moose and Wildlife Populations

[86] Recommendations

Moose populations may be declining in parts of the oil sands region. Surveys to determine moose and wildlife populations are required throughout the oil sands region. We recommend that:

i. ASRD immediately reduce harvest levels for moose in the regiona, until additional population information is available

ii. ASRD conduct moose surveys for all oil sands region Wildlife Management Units within the next two years;

iii. Shell contribute to these surveys; and

iv. Once moose surveys are completed that ASRD takes appropriate management action, in consultation with Fort McKay

[87] Recommendation

We recommend that ASRD determine the remaining population of Canada Lynx, Marten, Fisher, Beaver and other wildlife populations. The population levels for these species are currently poorly understood. Once populations are determined, ASRD should develop management methods in consultation with Fort McKay.

From Fort McKay's perspective it is unreasonable to consider the removal of wildlife habitat for between 25 to 50 years as "negligible". Remove of wildlife life habitat for more that one generation of Fort McKay community members is a significant adverse effect (See FMSA Section 9 – Disturbance and Access, Section 6 – Wildlife) in terms of access to traditional resources. As well, Fort McKay has substantial concerns about reclamation (See FMSA Section 10 – Reclamation) and, while reclamation is important and necessary, does not agree that reclamation mitigates loss of wildlife habitat or loss of traditional use.mbers ability to harvest wildlife species.

[88] Recommendations

i. Conservation offsets including protected areas are established, in consultation with Fort McKay, to preserve wildlife habitat, wildlife populations and provide opportunities for traditional land use in proximity to the Community of Fort McKay

ii. Reclamation of disturbed areas in the mineable oil sands area be accelerated; that additional new development approval be based upon reclamation performance and re-establishment of effective wildlife habitat. For example, approval of further development be contingent on the amount of moose habitat re-established in reclaimed areas or wildlife habitat protected with conservation offsets

iii. Shell support a conservation offsets plan

[89] Reclamation Certification

[89] Recommendation

Shell has indicated that impacts to wildlife are "*negligible or low*" because of the reclamation of habitat. Therefore, Shell's Approval should state that reclamation certification is based on habitat suitability for wildlife, rather than forest capability.

10.5.4 Removal of Nuisance Wildlife and Black Bears

The number of black bears removed from oil sands work sites ranged between five and 15 black bears per year prior to 2000. In 2005, 51 black bears were removed. In 2006, the berry crop was abundant and one black bear was destroyed and another relocated. It appears that there is much stronger correlation of black bear removal and berry abundance than other factors. However, Shell concludes "as nuisance bear incidents are generally low and effective mitigation is planned, magnitude is predicted to be low." It is unclear how Shell knows that mitigation is effective based on the sparse data presented in the Wildlife Assessment.

[90] Impacts to Black Bears

Black bear populations are unknown in the region. However, Shell (and others) has shown that black bears can be attracted to bait stations and photographed. These bait stations can likely be modified to collect DNA samples to provide additional population information (i.e., identification of individuals for mark recapture analysis).

[90] Recommendation

Shell has not provided enough data to make conclusions about removal of nuisance black bears on their populations. Additional data are required to assess impacts on black bears. Regionally, population data are needed on black bears to assess the impacts to this wildlife species (e.g. % lost or removed within a year). We recommend that a monitoring program to determine black bear populations is developed and that Shell contribute to this monitoring program.

10.5.5 Increased Vehicle-Wildlife Collisions

Shell predicts that there will be a doubling of vehicle traffic between 2007 and 2012 with traffic decreasing after 2012. They conclude that magnitude is low, frequency and duration low and long term.

[91] Vehicle/Wildlife Collisions

[91] Recommendation

Shell has not provided enough data to make conclusions about vehicle-wildlife collisions impacts on wildlife populations. Additional data are required to assess impacts on wildlife.

10.5.6 Sensory Disturbance

Shell states that their assessment on sensory disturbance " is primarily an assessment of short-term sensory disturbance effects because the less apparent long-term effects to wildlife physiology and reproduction are difficult to observe and predict." (EIA Volume 5, Shell 2007). Yet Shell feels confident enough to conclude "that the expected mortality loss resulting from sensory disturbance associated with the Project is predicted to be low for black bears, yellow rails, and black-throated green warblers and negligible for all other KIRs"

It is not surprising that there is a negligible or low mortality from sound and light. However, the effects on long-term reproduction and population impacts are a more important question to answer. Shell indicates that this is difficult. Habib *et al.* (2007) was able to show negative impacts to passerine reproduction due to industrial activity. Shell has been operating facilities in the oil sands region for years and has had ample opportunity to study the effects of sensory disturbance on wildlife.

[92-93] Sensory Disturbances

[92] Recommendation

Shell has not provided enough data to make conclusions about sensory disturbances on wildlife populations. Additional data are required to assess impacts on wildlife. Shell should be required to monitor effects of sensory disturbance on their existing facilities to determine the effects of noise and light.

Shell states "Sensory disturbance as a result of noise will not affect Canadian toads or beavers because these species have been found to habituate to sound generated from the same location" (EIA Volume 5, Shell 2007). This statement is not supported with data or referenced.

[93] Recommendation

Shell appears to have based their conclusions on anecdotal information. This is inappropriate for an environmental impact assessment. Shell should provide the source for their conclusions.

10.6 Computer Modelling

10.6.1 Resource Selection Function

Shell used Resource Selection Function (RSF) habitat modelling to quantify wildlife habitat quality and availability. These models are an improvement over the expert opinion models because the model accuracy can be verified using Spearman-rank correlations (Boyce *et.al.* 2002). However, the RSF models used for the Wildlife Assessment did not perform well, according to Shell. This likely indicates that additional data is required to strengthen the model results. The modelling result must be interpreted cautiously and predictions tested with monitoring data.

[94] Model Verification and Conclusions

[94] Recommendation

The model verification results (i.e., Spearman-rank correlations) are not sufficiently strong to allow the wildlife assessment conclusions (i.e., negligible or low impacts). Wildlife abundance needs to be determined and monitored on a regional scale to assess cumulative effects from all oil sands operations.

10.6.2 Population Viability Assessment

Shell completed a population viability analysis (PVA) on moose in the Wildlife Assessment. Shell predicts that despite all the development in the region, moose populations will increase. Fort McKay is sceptical of this prediction. Some issues with the PVA model predictions are as follows:

- Shell indicates that the PVA model was sensitive to fecundity and survival but demographic data is lacking. Yet, Shell reports that their confidence in the model is moderate.
- Alberta Environment has questioned the results of this model as well. In Question 450 (PRM SIRs) it states – Shell's impact predictions and KIR modelling do not seem to reflect the results of the recent CEMA SEWG modelling. It is expected that there should be similarities between the two sets of results, despite the difference in areal boundaries. The CEMA SEWG modelling suggests many of the KIRs will decline over the time period during which Shell will be operating in the region
- Based on recent moose surveys (early 2009) in WMU 531 there appears to be declining moose populations.

Shell predicts that moose will move from mined areas to adjacent habitat. They suggest that this is possible because moose populations are not at carrying capacity. Shell states:

> *"The winter moose density in the Jackpine Mine Expansion LSA was 0.22/km^2. Most will be displaced by habitat loss. Assuming that the moose density in the surrounding area is similar, when these moose are displaced to adjacent land of equivalent size, the moose density in the surrounding areas would double to 0.44 moose/km^2. This density is slightly greater than the highest reported density in the oil sands region, but only 22% of the carrying capacity put forward by Crete (1987) and Messier (1994).*

In Messier (1994), it states that the carrying capacity of moose would be 2.0 moose per km^2 in the absence of predators. Messier indicated that under deteriorating habitat quality or bear-induced early calf mortality conditions then a low-density equilibrium (0.2-0.4 moose/km2) is predicted.

There is limited high quality moose habitat adjacent to the Pierre River Mine and Jackpine Mine Expansion Projects (Figure 7; Appendix 5-4; Shell, 2007). The average density of moose in the oil sands region is approximately 0.18 moose/km^2 (average calculated from data in Table V-1; Appendix V; Shell, 2007). The average moose density for the Regionally Municipality of Wood Buffalo is 0.13 moose/km^2 (n=16) based on SRD data presented in Westworth (2002).

[95-96] Moose Populations

[95] Recommendation

Based on available research and observed data. What data does Shell have that supports the prediction that moose densities will at least double (i.e., 0.44 moose/km^2) in the areas adjacent to the Pierre River Mine and Jackpine Mine Expansion?

[96] Recommendation

Provide documentation of a situation that shows that higher moose density is sustained adjacent to a major industrial project such as a mine.

[97] Habitat Preservation

[97] Recommendation

High quality moose habitat needs to preserve adjacent to the projects. Does Shell plan on preserving high quality moose habitat adjacent to their mine projects by acquiring and setting aside land with high quality moose habitat? Shell needs to support a conservation offset plan.

Shell indicates that "the carrying capacities for moose and black bear used in the EIA modelling were appropriate for an EIA level of assessment" (Response 492 a; Shell 2009). Shell does not provide a good explanation what an "EIA level of assessment" is and how it relates to carrying capacity.

[98] Level of Assessment

[98] Recommendation

Shell indicated that the carrying capacity used in modelling was appropriate for an EIA level of assessment. How was an appropriate level was determined (statistical power, statistical significance)? What is an appropriate level?

In the section entitled Sensitivity Analysis, Shell indicates that a decrease in survival and fecundity of 10% would lead to a population decline and a decline of 20% would lead to extirpation of moose in the region. A survival rate of 0.78 ± 0.03 and fecundity of 0.601 ± 0.20 was used by Shell for the PVA (Appendix 5-4 Wildlife Modelling; Shell 2007). Shell states that they have moderate confidence in the survival and fecundity rates presented (Response 494c; Shell 2009).

In their review, Alberta Environment requested a list of the data used to determine fecundity and survival (Question 494; PRM SIRs, Shell 2009). Shell provided a list of report authors (Response 494; Shell 2009) but did not provide the fecundity and survival data used.

[99-100] Population Viability Assessment

[99] Recommendation

Fort McKay requests that Shell provide the values, calculation methods, and references for the data used to calculate the moose fecundity and survival parameters used in the PVA model.

[100] Recommendation

Fort McKay does not have full confidence in Shell's population viability models. Model predictions need to be tested with moose (and other wildlife) survey data to determine and monitor populations. Fort McKay requests that Shell use regional population data (e.g., as requested by Fort McKay in Recommendations 73, 74, and 77) to update their models.

10.7 Wildlife Movement

One of Shell's key questions is regarding effects on wildlife movement. The Alberta Environment Terms of Reference for the EIA required that Shell explain how it will ensure the protection and maintenance of riparian habitats, interconnectivity of such habitat and the unimpeded movement of wildlife species using the habitat. The Muskeg River passes through the proposed Jackpine Mine Expansion project area. The Wildlife Assessment states:

> *"The Muskeg River is located within the JEMA LSA. During operations and before reclamation, the Project is predicted to have a high magnitude effect on wildlife movement in the LSA. The development of the JEMA including Jackpine Mine – Phase I, in conjunction with Muskeg River Mine and Muskeg River Mine Expansion (i.e., Application Case), will create a long (approximately 20 km) remnant corridor about 400 m wide along the Muskeg River from the Athabasca River to the Fort Hills. The degree to which wildlife would use this corridor through the active mining area is unknown."(EIA Volume 5, Shell 2007)*

The distance from the Athabasca River to the west boundary of the Muskeg River Mine Expansion LSA is approximately 20 km.

The Jackpine Mine Expansion local study area is part of *ongoing* wildlife corridor research program (Figure 5.7-1, Wildlife Environmental Setting Report, Shell 2007b). Shell says that it is working with the Integrated Landscape Management Group at the University of Alberta on a regional wildlife movement study (EIA Volume 5, Shell 2007a). In addition, Shell states that it is committed to wildlife monitoring that considers existing programs and being statistically defensible (EIA Volume 5, Shell 2007a).

[101-102] Wildlife Corridors

[101] Recommendation

How will Shell ensure the protection and maintenance of riparian habitats, interconnectivity, and the unimpeded movement of wildlife species using the habitat through the mine projects, as per the Alberta Environment Terms of Reference?

[102] Recommendation

Fort McKay is concerned about the Muskeg River corridor and its importance for the maintenance of moose and other wildlife populations in Fort McKay's Traditional Lands. Wildlife use of the Muskeg River corridor is not well understood according to Shell. Shell should agree to maintain the Muskeg River corridor through the Jackpine Mine Expansion area until the wildlife corridor research program is complete (i.e., with statistically defensible results) and then use the results to develop a mine plan.

10.8 Mitigation

In the Jackpine Mine Expansion and Pierre River Mine Project application Shell proposed mitigation that would reduce impacts to wildlife habitat and provide for the reestablishment of destroyed habitat. The mitigation is as follows:

- Reclaiming habitat will establish associated wildlife habitat;
- Leaving remaining forested areas undisturbed where practical;
- Maintaining a 250-m wildlife corridor along the Athabasca River from the wetted edge in a 100-year flood event;
- Providing for wildlife passage under the Athabasca River bridge on both the east and west banks of the river;
- Retaining treed buffers around or near watercourses;
- Planning and sharing access with other industrial partners;
- Reclaiming the landscape to an equivalent capability, optimizing the value of watershed, forest productivity, fish and wildlife habitat or traditional use, in consultation with key stakeholders; and
- Reclaiming and revegetating progressively.

Shell's mitigation involves a combination of maintaining existing habitat (e.g., near water courses and leaving forest undisturbed) and through the reclamation of habitat. Maintaining habitat may be important on a small scale for some wildlife species (e.g. small animals) but overall this represents a small quantity of habitat. Reclamation will be difficult and slow Shell will need to create ecosystems (wildlife habitat) and areas suitable for traditional uses.

[103-104] Wildlife Corridors

[103] Recommendation

Shell states that it will retain treed buffers around or near watercourses. Does this include the Muskeg River through the Jackpine Mine Expansion?

[104] Recommendation

Shell states that it will retain treed buffers around or near watercourses. What width of corridor will be maintained?

[105] Reclamation Claims

[105] Recommendation

Shell states that it will reclaim the landscape to an equivalent capability, optimizing the value of watershed, forest productivity, fish and wildlife habitat and traditional use, in consultation with key stakeholders. Fort McKay expects to be consulted by Shell and the Regulators regarding equivalent capability for traditional use.

[106] Wildlife Passages Beneath Bridge

[106] Recommendation

Shell will provide wildlife passage under the Athabasca River bridge. Provide details of passage area and supporting documentation that passage is suitable for wildlife movement.

Photographic bait stations were used to determine the presence of carnivores in the project areas. These bait stations appear to be successful at attracting carnivores and allowing photographs to be taken. It is unclear how bait stations contribute to answering the Key Questions regarding wildlife abundance and movement since individual animals are not identified.

[107] Usefulness of Wildlife Photographs

[107] Recommendation

How do bait stations and photographs contribute to the understanding of wildlife abundance and movement?

10.9 Monitoring

Shell has committed to wildlife monitoring that considers existing programs and being statistically defensible. Specific examples include wildlife monitoring of reclaimed areas and working with the Integrated Landscape Management Group at the University of Alberta on a regional wildlife movement study.

Fort McKay commends Shell for working with the University of Alberta and committing to completing monitoring that is statistically defensible.

[108] Recommendation

Fort McKay would like Shell to provide updates on the progress of this regional wildlife movement study.

10.9.1 Wildlife Health Assessment

Two studies have been completed in the oil sands region regarding trace metals in the environment and their potential impacts. The Terrestrial Environmental Effects Monitoring (TEEM) subcommittee of the Wood Buffalo Environmental Association (WBEA) retained Golder Associates Ltd. to coordinate a community-based study of traditional foods in the Oil Sands area. More recently, the Cumulative Environmental Management Association's (CEMA) Trace Metal and Air Contaminant (TMAC) working group retained Environ International Corporation (ENVIRON) to complete an investigation within the Regional Municipality of Wood Buffalo (RMWB) to identify trace metals detected in the environment that exceed concentration levels considered safe for wildlife ecological receptors (ENVIRON 2009).

ENVIRON used data obtained primarily from Environmental Impact Assessments (EIAs), data gathered by the Regional Aquatics Monitoring Program (RAMP) and Wood Buffalo Environmental Association (WBEA). This data was collected within Fort McKay's Traditional Lands.

The trace metals that were found to exceed concentration levels considered safe for invertebrates, vegetation, birds, and mammals are indicated below:

- **Invertebrates:** aluminum, chromium, iron, manganese, and zinc.
- **Plants:** aluminum, arsenic, boron, chromium, manganese, selenium, vanadium, and zinc.
- **Birds:** arsenic, copper, lead, and nickel.
- **Mammals:** antimony, cadmium, and selenium.

Based on their findings, ENVIRON made several recommendations for additional work and sampling in the oil sands region to determine the potential impacts of metals in the environment. The recommendations are provided in the FMSA.

[109] Accumulation of Chemicals of Concern in the Environment

[109] Recommendation

Chemicals of concern to wildlife are accumulating in the environment. The impacts of these chemicals to wildlife and wildlife users need to be studied and understood on a regional scale.

[110] All available data was used in Wildlife Health Assessment

[110] Recommendation

Shell provided data for the studies mentioned above. How much of the chemical data from the above studies (e.g., from RAMP and other EIAs) was incorporated into the Wildlife Health Assessment?

[111] Appropriateness of Toxicity Reference Values (TRVs)

[111] Recommendation

TRV for masked shrews were developed from mouse data. Shrews are very small and have a high metabolic rate. Provide scientific literature that supports using mouse data to assess impacts on shrews.

[112] Appropriateness of Ingestion Rates and Body Masses

[112] Recommendation

Provide the sources and values used as ingestion rates and body masses for the wildlife species assessed in the Wildlife Health Assessment.

[113] No Wildlife Health Assessment on Amphibians

[113] Recommendation

Shell states that TRVs were not available for amphibians and reptiles. Shell uses a reference from 1999. Have any TRVs for amphibians and reptiles been developed since 1999?

Some adverse effects from oil sands operations have been found in bird species. Indirect exposure to the tailings materials also may be impacting wildlife. Gentes *et al.* (2007a, 2007b, 2006) studied the effects of exposure to oil sands process materials on wild Tree Swallows (*Tachycineta bicolor*). Tree swallows breeding adjacent to a wetland that had never received mine tailings (Poplar Creek Reservoir) were compared to those breeding adjacent to wetlands that had last received mine tailings in 1993 (Demo Pond), 2001 (Natural Wetland), or were continuing to receive mine tailings (Consolidated Tailings Wetland). Nestlings raised in wetlands that had or were receiving mine tailings had elevated levels of the thyroid hormones triiodothyronine (T3) and thyroxine (T4) (Gentes *et al.* 2007a), increased hepatic detoxification activity (Gentes *et al.* 2006), and lower masses (Gentes *et al.* 2006) compared to those nestlings raised in the Poplar Creek Reservoir. The lower masses of the nestlings likely contributed to increased mortality during a breeding season of poor weather compared to the nestlings in the Poplar Creek Reservoir (Gentes *et al.* 2006). The authors' cautioned that limiting biomonitoring to the pre-fledgling stage could underestimate the effects of exposure to contaminants (Gentes *et al.* 2006).

The purpose of the above paragraph is to show how difficult it is to determine effects from chemicals of concern used in the oil sands region. To determine wildlife health effects, it may take years of intense research to determine small effects.

[114-115] Wildlife Health Assessment

[114] Recommendation

The methods used in the Wildlife Health Assessment have been used for many years. Fort McKay requests that Shell provide documentation (i.e., a case study) that provides evidence that Shell's approach accurately predicts impacts to wildlife and has provided adequate protection of wildlife health, wildlife user health (e.g., hunters) and wildlife populations.

[115] Recommendation

Fort McKay is concerned that Shell's health model are not detecting potential health impacts to wildlife and requests that Wildlife Health Assessment results are verified.

Table 10-2: Wildlife Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
80	Incorporation of Traditional Knowledge	Explain how it was specifically incorporated into the Wildlife Assessment.	Regulatory, Response, Agreement
81	Water bird deterrent systems	We recommend that: • Shell's water bird deterrent should be considered the industry standard. • Shell participate in regional bird/wildlife protection committees • Fort McKay would like to be a member in a regional bird/wildlife protection committee. Fort McKay would like Shell's support of this endeavor.	Regulatory Agreement
82	Water bird deterrent systems	Collection of 68 dead birds and a manufactures claim are not appropriate to assess the impacts of tailings ponds. Fort McKay's view is that the conclusion of low magnitude impact is invalid for tailings ponds; Shell needs to determine the site specific effectiveness of their bird deterrent system through site-specific monitoring.	Regulatory, Response Agreement
83	Water bird deterrent system	Shorebirds may not be effectively deterred from ponds less than 400 m across. Will Shell use additional methods (e.g., pond construction) to prevent shorebirds from being landing on ponds?	Regulatory, Response

Number	Fort McKay Key Concern	Recommendation	Category
84	Water bird deterrent system	A regional scale cumulative impact assessment should be a joint effort funded by all oil sands operators.	Regulatory
85	Water bird deterrent system	A regional monitoring program to assess tailings pond impacts on water birds needs to be designed and implemented by impartial scientists.	Regulatory
86	Moose populations	Moose populations may be declining in parts of the oil sands region. We recommend: • ASRD immediately reduced harvest levels for moose in the region until additional population information is available • Surveys to determine moose and wildlife populations are required in the oil sands region within the next 2 years. • Shell should contribute to these surveys. • Once surveys are completed, ASRD needs to consult with Fort McKay and implement appropriate management	Regulatory Agreement
87	Wildlife populations	We recommend that ASRD determine the remaining population of Canada Lynx, Marten, Fisher, Beaver and other wildlife populations. The population levels for these species are currently poorly understood. Once populations are determined, ASRD should develop management methods in consultation with Fort McKay.	Regulatory
88	Loss of wildlife habitat in Fort McKay's Traditional Lands	We recommend: • Conservation offsets including protected areas are established, in consultation with Fort McKay, to preserve wildlife habitat, wildlife populations and provide opportunities for traditional land use in proximity to the Community of Fort McKay.	Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
88	Loss of wildlife habitat in Fort McKay's Traditional Lands (cont'd)	• Reclamation of disturbed areas in the mineable oil sands area be accelerated; that additional new development approval be based upon reclamation performance and re-establishment of effective wildlife habitat.	Regulatory
89	Reclamation	Shell has indicated that impacts to wildlife are "*negligible or low*" because of the reclamation of habitat. An Approval should state that reclamation certification is based on habitat suitability for wildlife, rather than forest capability.	Regulatory
90	Impacts to black bears	Shell has not provided enough data to make conclusions about removal of nuisance black bears on their populations. Additional data is required to assess impacts on black bears. A regional monitoring program to determine black bear populations is needed. Shell should contribute to a program to assess black bear populations.	Regulatory Agreement
91	Vehicle/wildlife collisions	Additional data is required to assess impacts on wildlife from vehicles.	Regulatory
92	Sensory disturbances	Additional data is required to assess impacts on wildlife from sensory disturbances. Shell should be required to monitor effects of sensory disturbance on their existing facilities to determine the effects of noise and light.	Regulatory
93	Sensory disturbance	Shell appears to have based their conclusions on anecdotal information. This is inappropriate for an environmental impact assessment. Additional work is required.	Regulatory, Response
94	Model verification and conclusions	The model verification results (i.e., Spearman-rank correlations) are not sufficiently strong to allow the wildlife assessment conclusions. Wildlife abundance needs to be determined and monitored.	Regulatory, Response
95	Moose populations	What data does Shell have that supports the prediction that moose densities will at least double (i.e., 0.44 moose/km^2) in the areas adjacent to the projects?	Regulatory, Response

Number	Fort McKay Key Concern	Recommendation	Category
96	Moose populations	Provide documentation of a situation that shows that higher moose density is sustained adjacent to a major industrial project such as a mine.	Regulatory, Response
97	Habitat preservation	High quality moose habitat needs to be preserved adjacent to the projects. Does Shell plan on preserving high quality moose habitat adjacent to their mine projects by acquiring and setting land with high quality moose habitat? Shell needs to support a conservation offset plan.	Regulatory, Response, Agreement
98	Level of assessment	Shell indicated that the carrying capacity used in modelling was appropriate for an EIA level of assessment. Explain.	Regulatory, Response
99	Population viability assessment	Provide the values, calculation methods and references for the data used to calculate the moose fecundity and survival parameters	Regulatory, Response
100	Population viability assessment	Model predictions need to be tested with moose (and other wildlife) survey data to determine and monitor populations.	Regulatory, Agreement
101	Wildlife corridors	How will Shell ensure the protection and maintenance of riparian habitats, interconnectivity, and the unimpeded movement of wildlife species using the habitat?	Regulatory, Response
102	Wildlife corridor	Prior to disturbance of the Muskeg River, the importance of corridors for the maintenance of wildlife populations needs to be determined. Shell should agree to maintain the Muskeg River corridor through the Jackpine Mine Expansion area until the wildlife corridor research program is complete and then use the result to development a mine plan.	Regulatory, Response, Agreement
103	Wildlife corridors	Will treed riparian areas include the Muskeg River through the Jackpine Mine Expansion?	Regulatory, Response
104	Wildlife corridors	Discuss the width of wildlife corridors adjacent to watercourses	Regulatory, Response

Number	Fort McKay Key Concern	Recommendation	Category
105	Reclamation claims	Shell state that it will reclaim the landscape to an equivalent capability, optimizing the value of watershed, forest productivity, fish and wildlife habitat or traditional use. Fort McKay expects to be consulted by Shell and the Regulators regarding equivalent capability for traditional use	Regulatory, Response
106	Wildlife passages beneath bridge	Provide details of passage area and supporting documentation that passage is suitable for wildlife movement.	Regulatory, Response
107	Usefulness of wildlife photographs	Explain how bait stations and photographs contribute to the understanding of wildlife abundance and movement.	Regulatory, Response
108	Regional corridor study	Fort McKay would Shell to keep Fort McKay apprised of the progress of the regional wildlife corridor study.	Regulatory, Response, Agreement
109	Accumulation of Chemicals of Concern in the Environment	The impacts of these chemicals to wildlife and wildlife users need to be studied and understood on a regional scale.	Regulatory
110	All available data was used in Wildlife Health Assessment	How much of the chemical data from the above studies (e.g., from RAMP and other EIAs) was incorporated into the Wildlife Health Assessment?	Response, Regulatory
111	Appropriateness of Toxicity Reference Values (TRVs)	Provide scientific literature that supports using mouse data to assess impacts on shrews.	Response, Regulatory
112	Appropriateness of Ingestion Rates and Body Masses	Provide the sources and values used as ingestion rates and body masses for the wildlife species.	Response, Regulatory
113	No Wildlife Health Assessment on Amphibians	Have any TRVs for amphibians and reptiles?	Response, Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
114	Wildlife Health Assessment	Fort McKay requests that Shell provide documentation (i.e., a case study) that provides evidence that Shell's approach accurately predicts impacts to wildlife and has provided adequate protection of wildlife health, wildlife consumers' health, and wildlife populations.	Response, Regulatory
115	Wildlife Health Assessment	Fort McKay requests that Shell provide verification of the Wildlife Health Assessment results	Response, Regulatory, Agreement

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

10.10 References

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11.0 HEALTH HUMAN HEALTH RISK ASSESSMENT REVIEW

With respect to human health impacts, the proposed Jackpine Mine Expansion (JME) and Pierre River Mine Project (PRM) are expected to release chemicals of potential concern (COPC). A Human Health Risk Assessment (HHRA) has been undertaken as part of the Environmental Impact Assessment (EIA).

This review of the Human Health Risk Assessment (HHRA) of the JME and PRM is intended as a critically objective review of the content and limitations of the HHRA with a specific focus on the increased health risks to the community of Fort McKay.

Documents reviewed included information contained in the following:

- Project Descriptions and EIA, December 2007(Shell 2007)
- EIA Update, May 2008 (Shell 2008)
- Supplemental Information, May 2009 (Shell 2009)

The project application describes the construction and operation of major open pit development of oil sands. The Human Health Risk Assessment within the EIA uses a conventional HHRA approach which seeks to:

- identify chemicals of concern expected;
- estimate emission concentrations of each COPC;
- model exposure pathways and exposure concentrations to 'groups' of human receptors based on their lifestyle category, including: transient, cabin resident, aboriginal resident, community resident and worker. Further the HHRA further differentiated age groups when appropriate to include: infant, toddler, child, adolescent and adult; and
- quantify the expected health risk by comparing modeled emission concentrations to established health limits.

Further, within the EIA for the JME & PRM, three scenario cases are developed for the HHRA:

- Base Case (current, existing levels of emissions + approved emissions)
- Application Case (Base Case + Project emissions)
- Planned Development Case (Application Case + emissions from planned projects)

The sections in the EIA which pertain directly to the HHRA is primarily contained within Section 5.3 pages 5-26 through 5-152 (Volume 3, Shell 2007) along with associated references, cross-references and appendices.

This review of the HHRA is presented in two sections. Section 11.1 critically reviews the HHRA and highlights key areas of concern for Fort McKay. Section 11.2 introduces important areas of Human Health Impact embodied in Ecosystem

Health, which are entirely absent HHRA portion of the JME and PRM EIA. Section **Error! Reference source not found.** contains a summary of HHRA key concerns and recommendations

11.1 Traditional HHRA with JME & PRM EIA

11.1.1 Challenge to Conservative Assumptions within the HHRA

Within an HHRA, a series of steps are sequentially followed in order to estimate human health risk. These sequential steps include:

1. identification of chemicals likely to be contained within the industrial emissions
2. estimation of emission concentrations to various media (mainly air)
3. estimation of dilution rates
4. estimation of exposure dose (inhalation, ingestion, absorption)
5. estimation of 'safe' exposure limits – these are often derived from a combination of sources from Canada, US, Europe and international organizations (e.g., World Health Organization), and are more often than not based on occupational exposure risks relating to health and safety of the work-force
6. estimation of risk to human health from individual chemical and chemical group exposures
7. estimation of risk to human health from exposure to mixtures of chemicals

Various estimates are made throughout the steps inherent within the HHRA process. Estimates are needed because the HHRA process incorporates many unknowns and uncertainties. HHRA is not an exact science, it is more a best guess prediction based on science. Because of the consequences of getting a HHRA wrong, conservatism should be built into responsible HHRA process as a priority.

As with all traditional HHRA there are a great many estimated factors to take into account before concluding the presence or absence of significant risk to human health. Some examples include extrapolating toxicity data between chemicals of similar molecular structure & therefore assumed similar toxicity (itself often a leap of faith); extrapolating toxicity data from laboratory animal test species to human beings; extrapolating healthy worker health based limits to the general population (including young, old and sick).

Because health risk assessment is an imprecise science, conservative safety factors are built into the process. Safety factors are needed to 'offset' the potential of synergistic interaction between chemicals, which may have disproportionately high impact on health compared to chemicals acting in simply an additive manner. Ideally, conservative risk assessment will introduce large safety factors such as 10-fold or 100-fold to err well on the side of caution and promotion of conservatism. However, the realities of multiple estimates often preclude use of

larger more desirable safety factors as they inevitably lead to a high provisional estimate of risk. Thus, there is pressure to adopt smaller safety factors within the step-by-step approach to HHRA (e.g., 2-, 3-, or 5-fold).

The choice of what safety factors to incorporate is a controversial one, as higher or lower adopted factors can easily lead to different conclusions on estimated health risk. The choice of what safety factor to use is influenced by the viewpoint and purpose driving the risk assessment. For example, an environmental or public health group may opt for higher safety factors to be employed to ensure public health protection is more likely to be achieved, whereas industry proponents may argue for lower safety factors to be used to help ensure industrial developments are approved. That EIA of the JME and PRM is undertaken on behalf of industry cannot be ignored in reviewing and evaluating the choice of safety factors incorporated within the HHRA process.

HHRA is an imprecise science as evidenced by many well accepted uncertainties used within the HHRA derivation, including:

- estimation of underlying emissions, dilutions, and exposure estimations;
- lack of human epidemiological data on exposure effect;
- knowledge gaps in toxicity of common chemicals;
- large knowledge gaps in toxicity of uncommon chemicals, leading to uncertainties in use of chemical surrogates;
- uncertainties in the extrapolation of toxicity data for individual chemicals to exposure matrices involving many 100s of different chemicals;
- potential for synergism between different chemical moieties as they interact with human biochemistry; and
- selection of low-fold and high-fold safety factors within the HHRA process and the necessity to balance pressures to ensure public safety with the perceived need for industrial development.

Given this background, it is clear that western science is not able to define human health risk with certainty and precision. Therefore, HHRA can be usefully viewed as less of precise science and more as educated guess, often biased by the purpose of the risk assessment, which attempts to estimate the real risk to human health from variable exposures to complex matrices of industrial chemicals.

It is good HHRA practice to err on the side of caution and safety when assumptions are made. The same conservative philosophy should be maintained in interpreting HHRA and summarizing conclusions – otherwise public safety is not served.

With this background, it is Fort McKay's view that the overall conclusion of the HHRA embodied in the Jackpine Mine Expansion & Pierre River EIA dismisses the underlying uncertainty of the HHRA. The HHRA presents a biased view of the

extent of its imbedded conservatism. The HHRA discussion highlights certain assumptions that lead to increased conservatism in the HHRA, while seemingly side-lining discussion concerning assumptions made within the HHRA that do not promote conservatism. The following section reviews these limitations within the HHRA.

[116] Chemical Surrogates and Chemical Groupings

The project HHRA identifies a large number of individual chemicals and chemical groupings that are expected to be emitted to air during development and operation of the mines. This inventory list of chemicals of concern is presented in Table 5.3-2 (Volume 3, Shell 2007).

A cursory count of the COPCs within Table 5.3-2 indicates that over 300[4] compounds have been identified. However, of these, only 65 (22%) have undergone specific risk assessment as a distinct chemical. The majority (78%) of the 300 or so identified COPCs have not been individually assessed at all. This majority of chemicals have been either been presumed to the have similar toxicity as a selected 'surrogate' (61/300 or 21%) or assessed as part of a chemical group (174/300 or 58%). The reason for this is that many chemicals simply do not have much supporting health reference literature and little is known about their specific toxicity. Though this is not ideal, the use of surrogates and chemical groupings is necessary because there are so many gaps in knowledge of the human health effects across such a myriad range of chemical moieties. However unavoidable in conventional risk assessment, the practice is far from ideal, as it introduces uncertainty into the risk assessment process.

Given this background, it is a contradiction to argue in the Discussion of Conservatism in Table 5.3-14 (second row from last; Volume 3, Shell 2007), that these practices promote conservatism. The reality is that the vast majority of the COPCs identified and included in the emission inventory have little or no health related information and as a result the health risk from each have not been assessed directly. Instead, the majority of COPCs are assessed indirectly either as surrogate chemicals or chemical groupings with no guarantee the surrogate being used has similar toxicology. The HHRA suggests that compounds of similar structure often present similar toxicity and while this is sometimes the case, it is not a universal truth and more of a hopeful guide than reliable fact.

In the HHRA discussion of Conservative Assumptions, summarized in Table 5.3-15 (Volume 3, Shell 2007), it is not clear that the majority of chemicals identified within HHRA have not been directly assessed – the majority were indirectly assessed as part of a chemical group or using a surrogates. While it may be true that there exists insufficient information to conduct specific risk assessments on

[4] The count of 300 chemicals was based on Table 5.3-2, as is the breakdown of 65 chemicals being individually assessed, 61chemicals assessed indirectly as with a surrogate, and 174 chemicals being assessed indirectly as part of a larger chemical grouping.

each and every chemical, the HHRA should highlight the need to include conservatism throughout the HHRA because of the widespread use of surrogates and chemical groupings to manage the risk assessment process.

[116] Recommendation

Shell should justify how the widespread use of surrogates and chemical groupings supports conservatism in their HHRA.

[117] Chemical Mixtures and Synergism

The HHRA includes consideration only of potential additive effects in its assessment of chemical mixture. There is no consideration of potential synergistic effects between the 300 identified chemicals. This is a serious limitation. The absence of any reference to synergism does not support the 'conservative' nature claimed to have adopted throughout this HHRA.

[117] Recommendation

Shell should present clear justification for not including potential synergism in their JME and PRM HHRA.

[118] Transient receptors in additive mixture assessment

In developing the HHRA for chemical mixtures on page 5-69, the HHRA states that chemical interactions were not assessed for transient persons "because predicted concentrations along the fence-line where maximum chemical concentrations would occur differed between the COPCs". While this may be true, it would also be true that this would be true for all receptors. By not adopting the same mixture risk assessment strategy for transient persons as with all other receptor groups, the HHRA does not support conservatism. The transient receptor is particularly relevant to Fort McKay as the JME are PRM are being developed on Fort McKay Traditional Lands and Fort McKay community members spend varying amounts of time on the land.

[118] Recommendation

We recommend that Shell revisits the need to undertake HHRA to mixtures for transient receptor.

[119] Acrolein

In page 5-84, the HHRA summarizes the risk assessment for acrolein. In part, the HHRA relies on a 2005 Golder report *Acrolein Monitoring in the Oil Sands Region* (Golder 2005). The HHRA claims this 2005 Golder report indicated no detectable concentrations of acrolein were detected in all laboratory samples collected "where MDL ranged between 0.04 and 2.6 $\mu g/m^3$ (page 5-87, second paragraph)". The HHRA seems to have confused units. Detection limits quoted in the Golder report are quoted in units of 'µg'. The sample air volume (L) needs to be

converted to m^3 and integrated as a denominator with the 'µg' MDL to arrive at a MDL airborne concentration factor in 'µg/m^3'. That the HHRA has quoted the MDL in the Golder 2005 report in units of 'µg/m^3' is a serious error.

Further, the 2005 Golder report is referenced as an important piece of scientific monitoring conducted in the oil sands for airborne acrolein concentrations. The main finding of the 2005 Golder report is summarized in the final sentence of the executive summary as follows:

> *"The results of this monitoring program, where all of the samples were below detection limits, suggest that the assumptions made with respect to possible acrolein emissions … are likely very conservative."*

However, examination of content within the Golder 2005 report contradicts the conclusion of the executive summary.

The 2005 Golder report contains 23 pages which introduce and summarize dozens of acrolein measurements taken in the oil sands region June 13 – July 2, 2005. All laboratory results were reported as 'BDL' or Below Detection Limit which were quoted in units of 'µg' (e.g., 0.15 µg or 2.00 µg). This, in and of itself, does not imply airborne acrolein was necessarily low, as this depends on the sampled volume of air. For example, on page 13 of the Golder 2005 report, Table 1 indicates that an acrolein sample taken at the Suncor Borealis Camp had a 'BDL' lab result with detection limit of 2.00 µg. The sampling time was 256 minutes at a flow rate of 2.0 L/min yielding a calculated sample volume of 512 L – this equates to 0.512 m^3. In order to determine what airborne concentration equated to the detection limit, one must divide the detection limit, in this case 2.00 µg, with the sample volume, in this case 0.512 m^3 as follows:

$$2.00\ \mu g / 0.512\ m^3 = 3.9\ \mu g/m^3$$
as the minimum detectable concentration

The 2005 Golder report did not explore this calculation, or the consequences. The calculation can be repeated for all the data points presented in the 2005 Golder report and this yields values and averaging between 1-2 µg/m^3 but including values above 20 µg/m^3.

In comparison, the US EPA reference concentration value used in the HHRA is 0.02 µg/m^3. This USEPA exposure limit is two to three orders of magnitude BELOW the calculated minimal detectable concentration limits embodied in the 2005 Golder report. This implies that the limitations in laboratory detection limits embodied in the 2005 Golder report, from the very start, insured that little if any detectable amounts of acrolein would be found in the sampling program.

The 2005 Golder report is seriously flawed. It is difficult to justify any rationale explaining why these values were not calculated and compared to established limits within the 2005 Golder report. The 2005 Golder report should not make any conclusions what-so-ever in relation to airborne concentrations of acrolein in

the oil sands – the report basically contains meaningless information embodied in 'non-detects' without any explanation. Finally, it is disturbing that the poor science embodied within the 2005 Golder report, and the misleading results it contains, has passed whatever internal control systems within Golder, which should be in place within such a major consultancy purporting expertise in the field of environmental pollution.

Finally, it is disturbing that the Human Health Risk Assessment of Shell's Pierre River Mine and Jackpine Mine Expansion Project relied on the 2005 Golder report as a key reference to support its case that acrolein levels have been found to be low in the oil sands region and raises a question over how many other HHRA references are similarly fatally flawed.

[119] Recommendation

Shell re-evaluate the integrity of the measurements contained in the 2005 Golder report, and validity of its conclusions, and respond, as appropriate in the HHRA for acrolein.

[120-121] Chemicals of Particular Concern Identified in the HHRA

The HHRA has identified a number of chemicals that present an increase in health risk associated with chemical emissions from the projects (section 2.4.1.1) (Volume 3, Shell 2007). Chemicals presenting acute inhalation health risks include: acrolein, $PM_{2.5}$, eye irritant mixtures and respiratory tract irritant mixtures. Chemicals presenting chronic inhalation health risks include: methyl mercury, molybdenum, the 'neurotoxicants' mixture, and the 'reproductive and developmental toxicants' mixture.

[120] Recommendation

In order to reduce the impact on the health of community members of Fort McKay, Shell should pursue best available technology to reduce emissions in general, and specifically to the following substances: Acrolein, $PM_{2.5}$, methyl mercury, molybdenum; and further pursue best available technology to reduce emissions to chemicals contained within the mixtures: eye irritants, respiratory tract irritants, neurotoxicants, reproductive and developmental toxicants.

Further, the increased health risks of the Shell JME and PRM in conjunction with current and future overall industrial development in the oil sands area will invariably progressively impact human health. Routine monitoring of pollutant levels in and around Fort McKay would provide assurance that emission and exposure modeling systems are valid and direct inhalation exposure and indirect exposure through ingestion of contaminated wildlife and plants presents low health risk.

[121] Recommendation

We recommend that Shell continues to conduct air quality monitoring and support the monitoring station at Fort McKay. An appropriate health monitoring program be developed in consultation with Fort McKay.

[122] Health Risk Increase vs Health Impact

The summary statement of this HHRA in Section 2.4.1.1 (Volume 3, Shell 2007) reads as follows:

> *"Overall, the Project emissions alone, and in combination with other sources of COPCs are not expected to result in a noticeable increase in health risks in the Oil Sands Region …"*

This summary statement *'… not expected to result in a noticeable increase in health risks…'* contradicts the body of HHRA. The body of the HHRA identifies some 300 chemicals that have undergone direct or indirect risk assessment. All of these identified chemicals have been shown to result in either no change or an increase in health risk to a greater or lesser degree – none of the 300 identified chemicals have resulted in a health risk decrease. Therefore the summary statement in section 2.4.1.1 (Volume 3, Shell 2007) contradicts the findings of the HHRA.

[122] Recommendation

We recommend that Shell revise the concluding HHRA summary statement to recognize that emissions from JME and PRM are expected to lead to increased risk human health.

11.2 Human Health Impact of JME & PRM using Ecosystem Health

Human health is not solely related to the presence or absence of toxic chemicals in the environment. Medical textbooks will define health in relation to key determinants. These include the following (WHO 2003, Public Health Agency of Canada):

- *Income and Social Status*
- *Social Support Networks*
- *Education and Literacy*
- *Employment/Working Conditions*
- *Social Environments*
- *Physical Environments*
- *Personal Health Practices and Coping Skills*
- *Healthy Child Development*

- *Biology and Genetic Endowment*
- *Health Services*
- *Gender*
- *Culture*
- Mental Well-being - including stress

Within the EIA the primarily purpose of the HHRA must be to determine an estimate for the likely health impact on human health from the Jackpine Mine Expansion and Pierre River Mine Projects.

For the sake of argument, let us accept at face value the HHRA conclusions (which can never have absolute certainty) that there are categorically no acute or long-term health risks associated with the project.

The general public at large, and the Fort McKay community members in particular, have persistent concerns over their health relating to development of industry within the Alberta Oil Sands, which are intimately connected with Fort McKay traditional lands. It would be unreasonable to expect any community in the air and water shed of the Alberta Oil Sands not to be concerned. These concerns are evident in listening to Fort McKay community members. Community members are under considerable stress because of rapid industrial development within their traditional lands, and fear or pollution on their health. This fear has been fed by various reports/incidents including:

- Increased rare cancers within Fort Chipewyan community brought to attention of press and since confirmed by a review undertaken by Alberta Cancer Board (Alberta Cancer Board 2009)
- High Arsenic levels in moose-meat (Alberta Health and Wellness 2007)
- Tailing ponds contamination and death of migrating wildfowl (Syncrude 2009)

These and other issues continually emerge.

Discussions with many community members indicate that there is real fear within the community about widely reported health issues and contaminated wildlife. Community members rely on land use as an anchor to traditional culture. Harvesting traditional foods has been, and remains, a fundamental part of community identity [also see CHA Baseline (Fort McKay IRC 2010)]. The sense of community and culture surrounding traditional food harvesting and sharing runs deep in the Fort McKay community, as it does with many aboriginal peoples in Canada.

The very serious concerns within the Fort McKay community relating to the health of the land, water, air and wildlife act to increase stress within individuals, between family members, and within the community at large. Stress is very much related to health (blood pressure, mental well-being, social and cultural stability). Examination of all health determinants is an unconventional addition in the

current EIA paradigm to the traditional HHRA approach, but none-the-less a valid and important consideration. The determinants of health listed above cannot be disputed, and the impact the planned projects have on these health determinants has not been assessed as part of the HHRA within the Jackpine Mine Expansion & Pierre River EIA. Further, it is evident from interviewing and listening to the Fort McKay community members that they have serious concerns over industrial development in general and the human health impact of Shell's proposed Jackpine Mine Expansion & Pierre River Project in particular. These concerns are affecting and will continue to affect the mental and physical health of Fort McKay individuals, family groups and the wider Fort McKay community at large.

Other national and international organizations recognize the wider more holistic approach to health, including the US CDC[5], the World Health Organization[6], as well as Health Canada[7].

Assessment of these wider health effects within the HHRA can be guided by the general principal and use of adopting conservative safety factors inherent in responsible HHRA when the underlying science is unknown or poorly understood. The Fort McKay community will be constantly reminded of the physical presence of the Jackpine Mine Expansion & Pierre River during construction and operation. Prudent HHRA should lead to the 'conservative' conclusion that the very presence of this large industrial development within Fort McKay traditional lands, and contributing to the air-shed and water-shed of the Fort McKay community will impact health. Further prudent HHRA leads to conservative assumptions erring on the side of safety that this health impact will be significantly negative.

To date, much effort has been put behind documenting a paper based HHRA. Correspondingly little effort has been devoted to a communication plan with provision of evidence to ensure Fort McKay community members have secure knowledge they will be 'safe'. Within the HHRA, there appears to be no plan for effective communication to Fort McKay community which would ensure they feel safe, or at least feel as safe as they can reasonably expect to be with such major adjacent industrial developments.

[123] Recommendation

Shell constructively discuss with Fort McKay IRC strategies to **effectively** communicate health risks associated with JME and PRM.

[5] http://www.cdc.gov/healthyplaces/hia.htm

[6] http://www.who.int/hia/en/

[7] http://www.hc-sc.gc.ca/ewh-semt/pubs/eval/index_e.html

[124] Recommendation

Shell consider the value of more holistic approach to human health risk assessment using an Ecosystem Health approach and adopts an Ecosystem Health component in its HHRA of the JME and PRM.

[125] Recommendation

We recommend that Shell explore with Fort McKay what programs could be supported or devised to promote health so as to offset potential negative health impacts of the JME and PRM. This would include support for Fort McKay's Community Health Strategy.

Table 11-1: Human Health Risk Assessment Summary Table

Number	Key Concerns	Recommendation	Response
116	The HHRA relies on mainly on indirect risk assessment.	Shell justifies how the widespread use of surrogates and chemical groupings supports conservatism in their HHRA.	
117	The HHRA does not include potential synergistic interactions within the HHRA	Shell present clear justification for not including potential synergism in their JME & PRM HHRA.	
118	The does not include transient receptor in risk assessment of mixtures	Shell revisits the need to undertake HHRA to mixtures for transient receptor.	
119	Shell relies on a seriously flawed 2005 Golder report to inform support the HHRA for acrolein	Shell re-evaluate the integrity of the measurements contained in the 2005 Golder report, and validity of its conclusions, and respond as appropriate in the HHRA for acrolein.	
120	The HHRA concludes that a range of chemicals and chemical mixtures are expected to present increased acute and chronic health risk	In order to reduce the impact on the health of community members of Fort McKay, Shell should pursue best available technology to reduce emissions in general, and specifically to the following substances: Acrolein, $PM_{2.5}$, methyl mercury, molybdenum; and further pursue best available technology to reduce emissions to chemicals contained within the mixtures: Eye irritants, Respiratory tract irritants, Neurotoxicants, Reproductive and developmental toxicants.	

Number	Key Concerns	Recommendation	Response
121	HHRA demonstrates increased health risks from industrial emissions.	Shell participates and supports existing environmental and health monitoring programs within WBEA and CEMA.	
122	The concluding statement in the HHRA section contradicts the findings of the HHRA.	Shell revises the concluding HHRA summary statement to recognize that emissions from JME & PRM are expected to lead to increased risk human health.	
123	There is no effective risk communication plan within the EIA.	Shell constructively discusses with Fort McKay IRC strategies to **effectively** communicate health risks associated with JME and PRM.	
124	There is no HHRA relating to the wider impacts on determinants of health.	Shell considers the value of more holistic approach to human health risk assessment using an Ecosystem Health approach and adopts an Ecosystem Health component in its HHRA of the JME and PRM.	
125	Negative impacts on wider determinants of health are expected	Shell explore with Fort McKay what programs could be supported or devised to promote health so as to offset potential negative health impacts of the JME and PRM. This would include support for Fort McKay's Community Health Strategy.	

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

11.3 References

Alberta Cancer Board. Feb 2009. Cancer Incidence in Fort Chipewyan, Alberta 1995-2006. Alberta Cancer Board, Division of Population Health and Information Surveillenace. Prepared for Alberta Health Services, Nunee Health Board Society, Alberta Health and Wellness, Health Canada. Prepared by Yiqun Chen, Leader, Surveillance, Division of Population Health and Information, Alberta Cancer Board

Alberta Health and Wellness. March 2007. Assessment of the Potential Lifetime Cancer Risks Associated with Exposure to Inorganic Arsenic among Indigenous People living in the Wood Buffalo Region of Alberta. Prepared for Alberta Health and Wellness, Public Health Surveillance and

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Public Health Agency of Canada. What Determines Health? (website accessed November 25, 2009. *http://www.phac-aspc.gc.ca/ph-sp/determinants/index-eng.php*)

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12.0 MINE PLAN AND C&R PLAN

12.1 Mine Plan and Closure, Conservation and Reclamation Impacts

This application by Shell Canada Limited (Shell) adds to existing mining operations which had been approved earlier. The existing Muskeg River Mine was approved in 1999, began production in 2002 and achieved full production of 155,000 bbl/cd in 2004. In 2002 Shell applied for the Jackpine Mine Phase 1, lying immediately adjacent and to the east of the Muskeg River Mine, which was approved in early 2004 for a capacity of 200,000 bbl/cd. Start up of the Jackpine Mine Phase 1 is expected to occur in late 2009 with production ramping up through 2010.

In 2005 Albian Sands also applied for an expansion of the Muskeg River Mine and received approval in 2007 to increase its capacity to 270,000 bbl/cd.

Under this current application for the Jackpine Mine Expansion, Shell has applied for an amendment to the Jackpine Phase 1 approvals to increase bitumen production by 100,000 bbl/cd which will bring the Jackpine Mine's total production to 300,000 bbl/cd and to extend the mine life until 2059. In this same application Shell proposes to also develop the Pierre River Mine, a completely new mine located on the west side of the Athabasca River 35 km north of Fort McKay. The Pierre River Mine will produce up to 200,000 bbl/cd of bitumen and will include a new mining area and associated processing facilities, utilities and infrastructure. Its 22 year operating life will conclude in 2039.

The proposed Jackpine Mine Expansion will add 12,719 hectares (ha) to the already permitted 7,836 ha and will ultimately disturb a total of 20,555 ha during its mine life.

The proposed Pierre River Mine will disturb a total of 10,403 ha during its mine life.

[126] Tailings Management

Tailings from the Jackpine/Muskeg and Pierre River mines will both use the same tailings management technology. Shell will produce three tailings streams: a coarse stream of sand and water, a thickened tailings of silt and clay and solvent recovery tailings.

At Jackpine, Shell proposes to place these tailings in two external tailings areas. The coarse tailings will be deposited around the perimeter of the coarse tailings pond. The sands will settle quickly and the runoff water will contain about 40% of the fines in the original coarse tailings stream. These fines (thin fine tailings or TFT) will form mature fine tailings (MFT) in the pond over time. Although this is similar to existing oil sands operations, these fines will be much less as about half the fines will have been removed early in the process via cyclones and thickeners to make thickened tailings.

By 2019 the first in pit tailings storage area will become available in which Shell will deposit non-segregating tailings (NST) which is a mixture of sand, thickened tailings and gypsum.

At Pierre River, similar tailings technology is planned although NST will not be deposited into mined out pits until 2029.

Considerable additional research is underway or planned to improve the tailings efficiency, heat and water recovery, and to produce tailings that have geotechnical properties suitable for reclamation.

The Jackpine Mine Expansion Plan (Volume 1, Shell 2007) indicates that cells containing NST will be capped with at least 10 m of coarse sand tailings and a minimum of 2 m of overburden and slopes will be less than 1% except in drainage channels; however, the Closure Drainage Plan (Volume 5 – Appendix I, Shell 2007) indicates as little as 1 m of coarse sands covered by up to 8 m of overburden and shows slopes of 3 to 5%. Capped NST cells are considered to be a Land Capability Class (LCC) of 4 as a result of potential settlement and possible saline release water.

[126] Recommendations:

i. Fort McKay would like to review revised tailings strategies, which will undoubtedly be required as a result of the ERCB Tailings Directive 074.

ii. Fort McKay requests a clarification of the level of sand capping over NST as well as an explanation of how this sand capping and modification of the landscape to incorporate drainage channels will be operationally achieved.

12.2 Closure, Conservation and Reclamation Assessment

The detailed Closure, Conservation and Reclamation Plans (Plans) presented in Appendix 5.1 for the Jackpine Mine Expansion and Appendix 5.2 for the Pierre River Mine (Shell 2007) provide an excellent overview of the proposed reclamation concepts. Because detailed plans are only required for the first (or next) 10 years of mine life and little reclamation is planned or is possible during the first years of mine life, there is little detail of how or precisely when many of the concepts will be implemented. The Jackpine plan does provide sequential maps at five year intervals following the first 10 year mine life which is a large help in understanding the progress of mining and reclamation. They have addressed many of the issues of relevance to Fort McKay.

12.3 Mine Plan and Closure, Conservation and Reclamation Plan, Key Concerns and Recommendations

[127] Reclamation Goals and Principles

Shell's stated overall reclamation goal is to achieve maintenance-free, self-sustaining ecosystems with a capability equivalent to pre-development

conditions. They also list basic end land use goals of landscape reclamation to an equivalent capability, optimizing the value of watershed, timber, wildlife habitat, fish habitat, recreation or other resources. Included in these goals are returning equivalent pre-development levels of forest productivity, promoting aesthetic qualities of the landscape, and providing for traditional land uses. Shell will likely be able to achieve equivalent capability for forestry but this will be accomplished at the expense of replacing pre-mine peatlands with upland ecosites. Certainly, without restoration of peatlands it is difficult to see how many of the traditional land uses can be restored to equivalent capability.

[127] Recommendation

In order to achieve true equivalent capability Shell should look at ways of creating more gently sloping topography and the hydrological conditions suited to peatland formation in order to achieve equivalent capability on the final reclaimed landscape.

[128] Pace of Reclamation

The existing approved Shell mines (Muskeg River and Jackpine) and the proposed large scale mine developments will ultimately occupy a total of 44,000 ha of land. The proposed Jackpine Mine Expansion will cover 20,555 ha and the proposed Pierre River a further 10,403 ha. The Jackpine Mine (Figure 12-1) will not be fully reclaimed until 2060, with the likelihood that a further 10 to 20 years will be needed before the land can be certified as reclaimed, which means that the land covered by this mine expansion will be alienated from two to three generations of Fort McKay people. The Pierre River Mine as proposed will not be fully reclaimed until 2050. A further 15 to 20 years of vegetation establishment will likely be required before this land will be certified by government as reclaimed.

The proposed pace of reclamation is different between the Jackpine Expansion and Pierre River mines. At Pierre River Mine, land is disturbed during the first 30 years of mining (approximately one half of the area is disturbed within the first 10 years) but very little reclamation (less than 10%) is completed during mining (Figure 12-2). Reclamation is primarily undertaken during the 10-year period after mining is completed in 2040.

In contrast, at the proposed Jackpine Mine Expansion, the disturbance occurs over a longer time frame, approximately 40 years, and during that time period approximately 25 percent of the area is reclaimed. The remaining 75 percent of the area is then reclaimed over the next 20 year period after new mine disturbance has ceased (Figure 12-1). While this later scenario reclaims a higher percentage of land earlier in the mining process than the Pierre River scenario, reclamation at both of these projects occurs at a much slower pace than at the Muskeg River Mine where, after 2017, land reclaimed in each year keeps pace with new land disturbance (Figure 12-3).

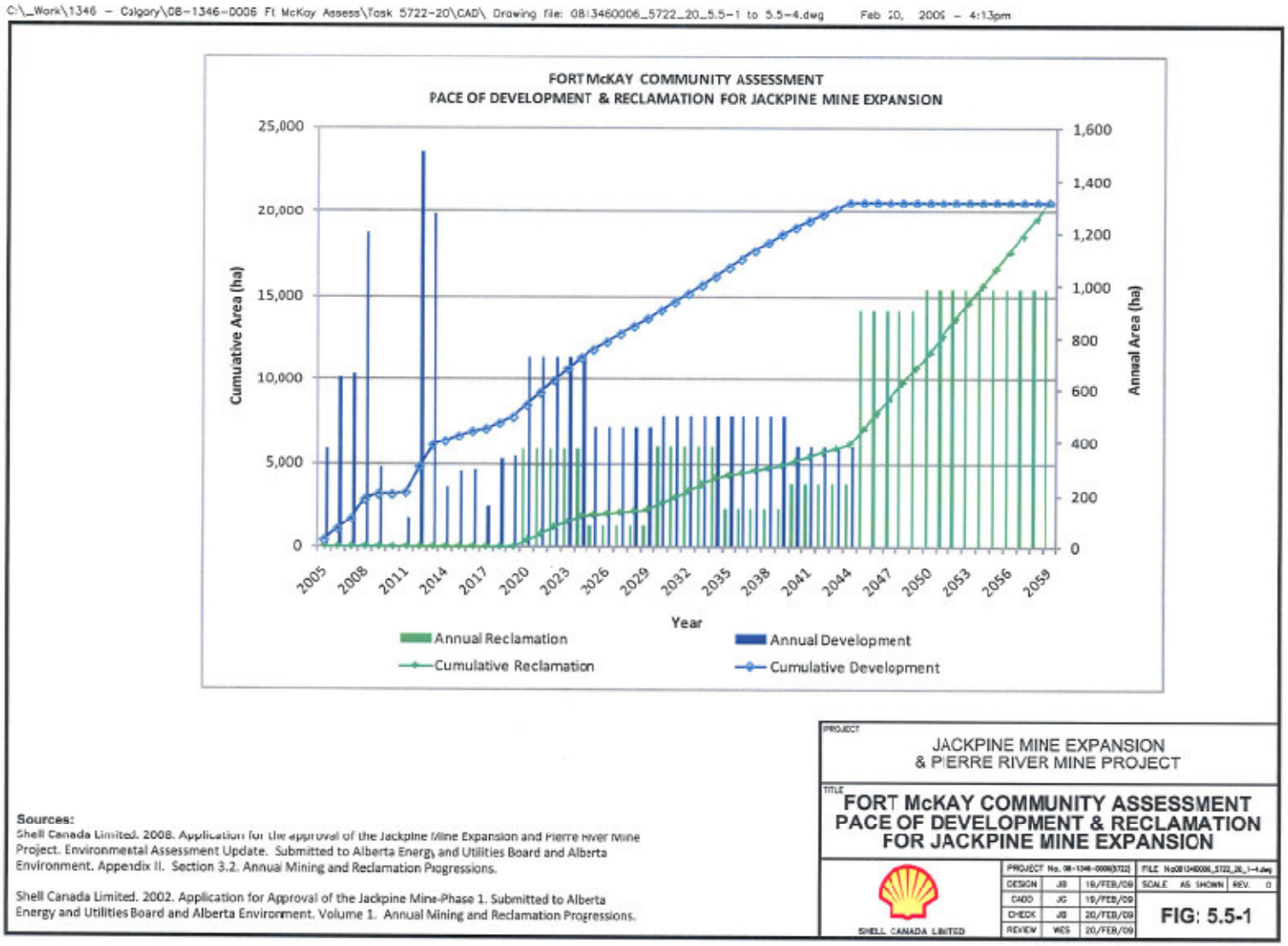

Figure 12-1: Fort McKay Community Assessment – Pace of Development and Reclamation for Jackpine Mine Expansion

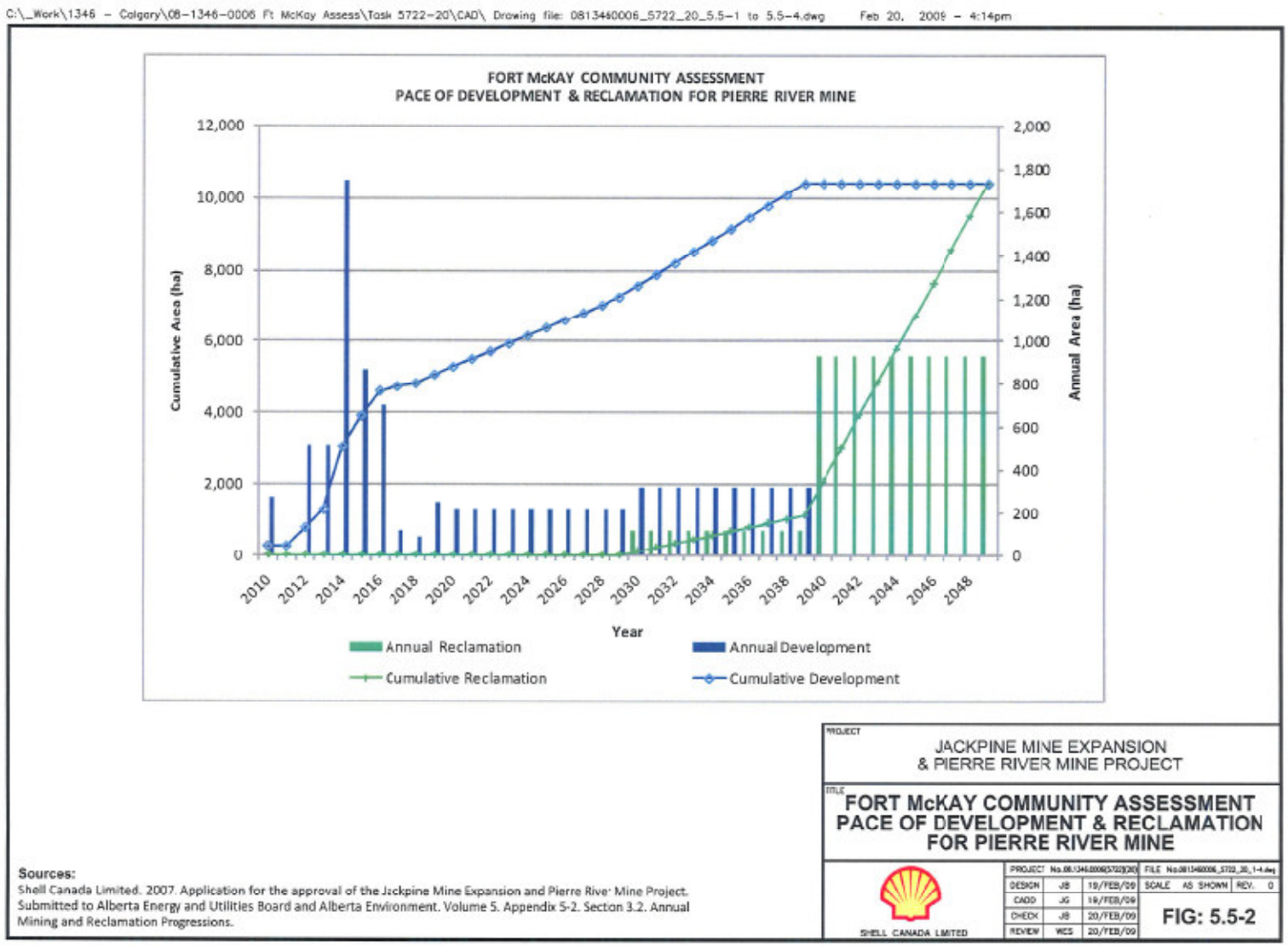

Figure 12-2: Fort McKay Community Assessment – Pace of Development and Reclamation for Pierre River Mine Expansion

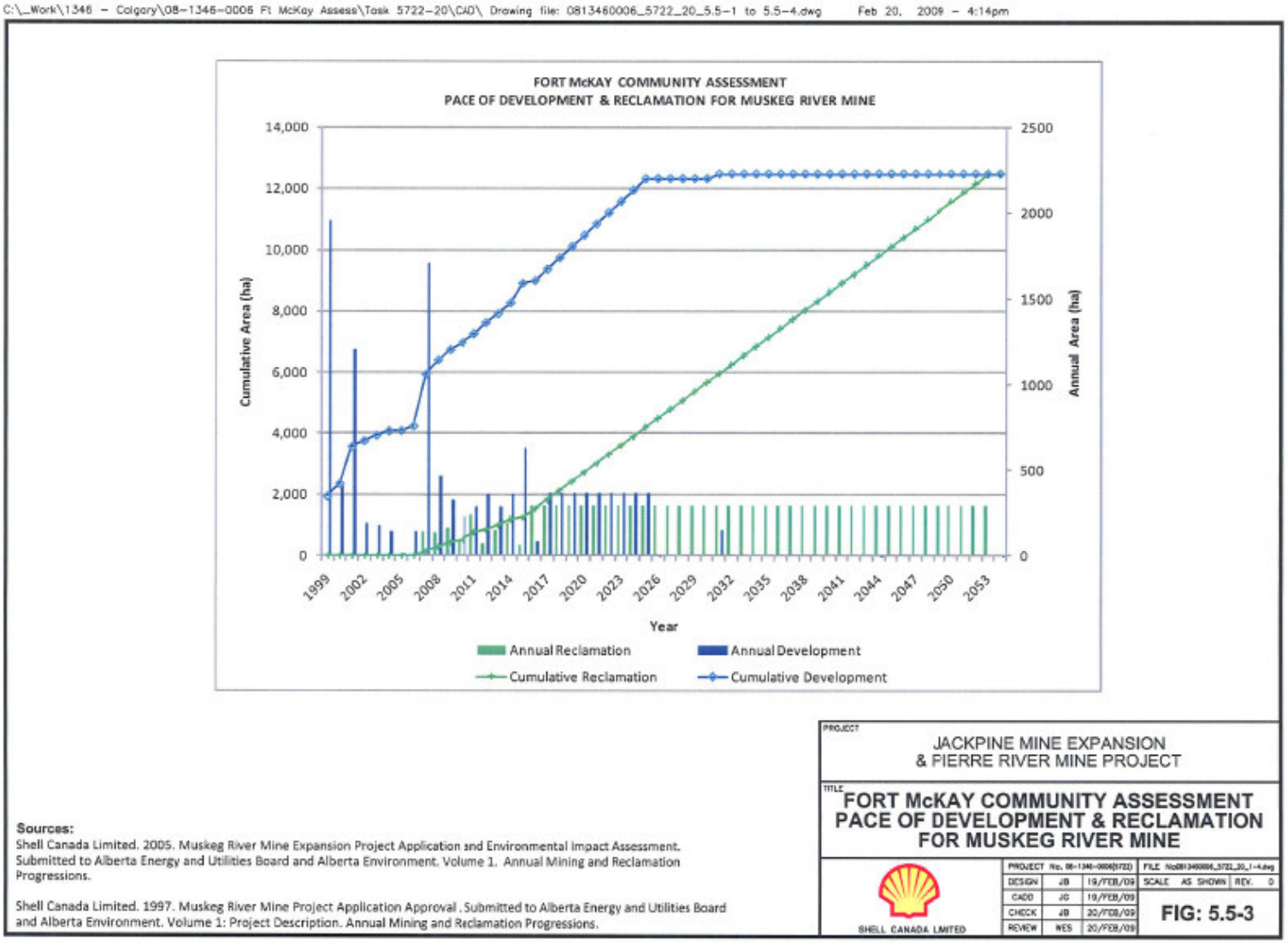

Figure 12-3: Fort McKay Community Assessment – Pace of Development and Reclamation for Muskeg River Mine

When the disturbance and reclamation from all three mines are considered together, it will take 45 years of mine operation before 50% of the disturbed land will be reclaimed, and the final 50% will be reclaimed during the last 15 years (Figure 12-4).

This concern reflects both the loss of the use of the land during the time of the disturbance and during revegetation. The duration of time that the land is unavailable for use is generally a result of the mine plan or design. If mine areas remain active for extended periods of time during the operating life of the mine, reclamation cannot proceed. The tailings management plan is a primary controlling factor in the timing of when land becomes available for reclamation activities in the oil sands.

Mine plans can be developed that allow reclamation to occur earlier in the mine's life, as demonstrated by the Muskeg River Mine example, and such plans would reduce the time that Fort McKay is unable to access and use its traditional lands. If oil sands mines are allowed to be developed on Fort McKay's Traditional Lands, the length of time that the land is unavailable for use by Fort McKay should be an important factor in the selection of mining plans. One major factor which will likely improve the pace of reclamation has been Tailings Directive 074 which was issued by the ERCB on February 3, 2009. The Jackpine and Pierre River mine plans were developed prior to this directive being issued and will undoubtedly need to be modified to comply. In summary, the directive will require most, if not all of the fine tailings material produced to be placed in a dedicated disposal area in such a fashion that it can be readily reclaimed. When fully incorporated into these mine plans, the pace of reclamation is expected to increase significantly, and the areas covered by end pit lakes will likely be reduced as well.

In the event that land is successfully reclaimed earlier there is a high likelihood that these reclaimed areas will remain within the active mining area and, therefore, still unavailable for traditional use activities.

The annual reclamation shown in Figure 12-1 to Figure 12-4 represents the date the land is proposed to be revegetated but some of the reclamation may not be successful and may require additional treatment. Even if the initial revegetation is successful it will often take an additional 20 to 25 years before these sites begin to mature into forests and 120 years before they would be considered old growth forests. It remains completely unknown as to how long it could take to create a functioning organic wetland on the reclaimed landscape as this has not been done in the oil sands to date. Even if marshes are established relatively quickly it could take hundreds or thousands of years for organic fens and bogs to develop on the reclaimed landscape, assuming they ever do develop from the marsh wetlands.

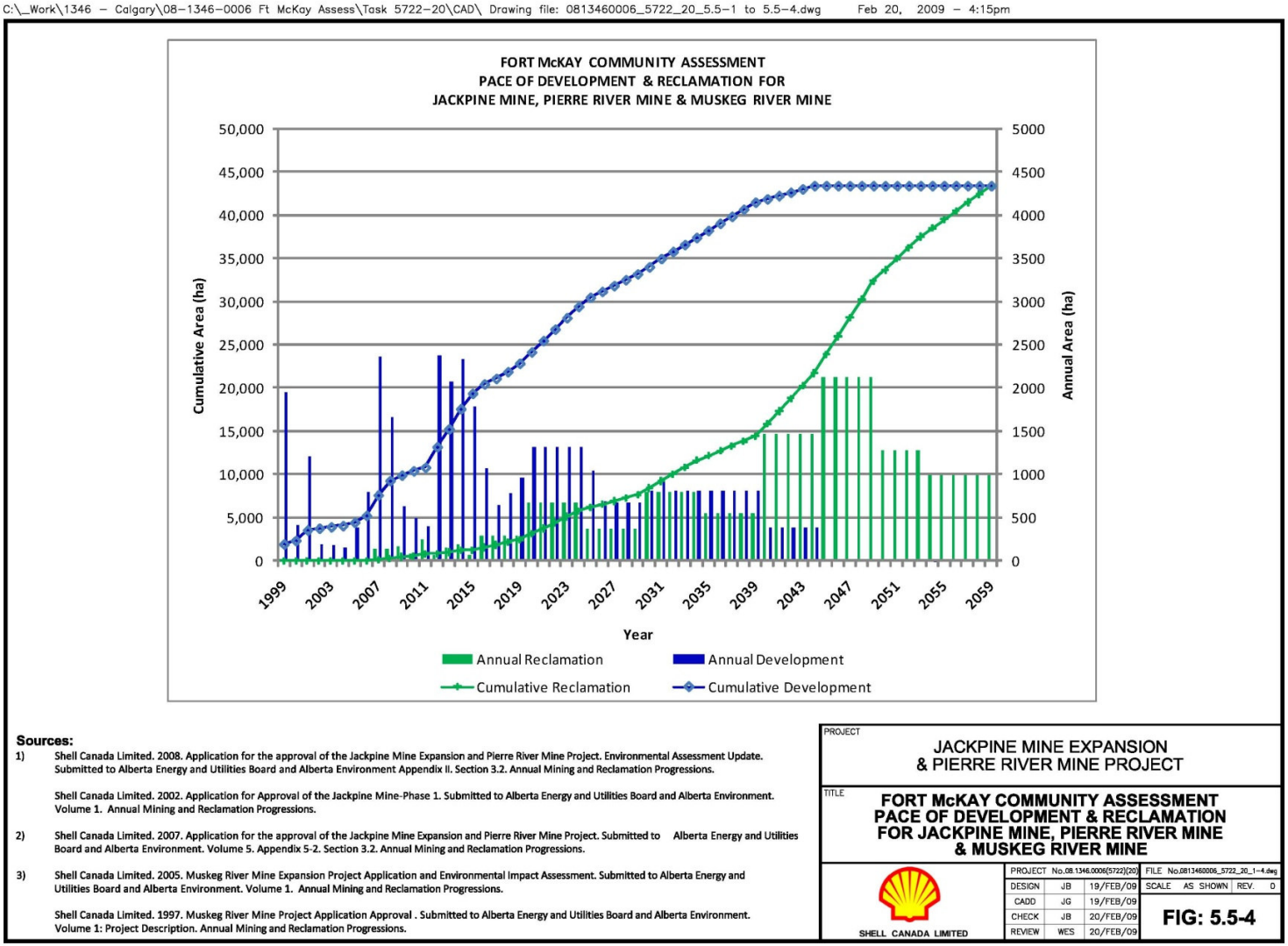

Figure 12-4: Fort McKay Community Assessment – Pace of Development and Reclamation for Jackpine Mine, Pierre River Mine and Muskeg River Mine

[128] Recommendations

i. Fort McKay requests that Shell increase the pace of reclamation on all their mines.

ii. Fort McKay would like to discuss alternative tailings management strategies, which will conform to ERCB Tailings Directive 074, and improve the pace of reclamation.

[129] Closure Drainage Plan

The proponent has prepared conceptual layouts of proposed closure drainage plans for both mine sites. At the Jackpine Mine drainages are integrated with closure drainage systems for both the Kearl Oil Sands project and Aurora South. In addition, there is an excellent discussion of geomorphic drainage channel design which will replicate natural systems and attempt to mimic the dynamic variability and self-healing capability of natural drainage systems. While the objectives and discussion are laudable, the conceptual layout presented does not seem to be consistent with design criteria. For example, if some of the drainages were typical of a small lowland stream then the channel would be placed in a wide floodplain which would ultimately be vegetated into a wetland ecosite. Such does not appear to be the case.

The discussion also recognizes the importance of beaver and the possible use of design features which would mimic the action of beavers until they become established. Design features for pit lakes also will include provisions to prevent overtopping in the case of beaver dams blocking the outlet in future.

In addition, the plan discusses the concepts for the design of aquatic and fish habitat but again, no details are provided.

[129] Recommendations

Shell should confirm that agreements are in place between Shell and Imperial Oil Ltd. (Kearl Oil Sands Project) and Syncrude Canada Ltd. (Aurora South Project) for coordinated long-term drainage control.

[130] End Pit Lakes

The current proposal is to have a total of three end pit lakes at the Jackpine Mine and two end pit lakes at the Pierre River Mine, all of which are designed to have a residence time of more than four years.

The plan is to pump MFT and TFT from both the Muskeg River Mines and Jackpine Mine to these end pit lakes at closure. Also, Shell will deposit MFT and TFT into an end pit lake at Pierre River prior to closure. Shell indicates that it will be following the preliminary design strategies for the design of pit lakes, one of which suggests limiting the introduction of residual tailings material into these pit lakes. Shell has carried out water-quality modelling of these pit lakes and has concluded that most parameters are low and typically lower than water-quality

guidelines. Nevertheless, some substances are predicted to exceed water-quality guidelines or have higher concentrations than the observed concentrations in the natural lakes. The proponent also admits that there has been no ideal natural or pit lake analogues which can be used to calibrate or test these pit lake models.

[130] Recommendations:

i. Fort McKay opposes the deposition of tailings into end pit lakes as a method of long-term tailings storage.

ii. In addition, Shell should determine the levels of water-quality parameters that will be necessary to achieve reclamation certification for fish habitat, estimate the time required to achieve these levels and design their material placement and drainage systems accordingly.

[131] Equivalent Capability

Shell will likely be able to achieve equivalent capability for forestry as it will be able to create sufficient upland conditions at the expense of wetland habitats that existed here previously. The Land Capability Classification System (LCCS) has recently been shown by work done under the RWG to be an unreliable predictor of productivity.

[131] Recommendations:

i. Shell should look at ways of creating more gently sloping topography in order to encourage wetland formation in the final landscape.

ii. Shell should monitor productivity on reclaimed landscapes to verify that equivalent capability for forestry, as predicted by the LCCS, has been achieved.

[132] Reclamation Security

Reclamation security deposits are one of the main tools that government has to ensure that mine reclamation is carried out. Fort McKay may wish to be satisfied that securities are placed to fund all costs associated with reclamation and possible long-term treatment of water should effluent discharging from the mine not meet acceptable water-quality standards.

[132] Recommendation

Fort McKay may want to see a breakdown of reclamation cost predictions to satisfy itself that the reclamation security will be sufficient. Costs must address the likelihood of long-term treatment of pit lake water should this be required.

[133] Revegetation

Shell has presented planting prescriptions based on target ecosite phases and has designed these according to landscape feature, soil capability and moisture regime. It has also proposed two shrubland prescriptions for wet drainages and

for buffer areas surrounding potentially saline drainage areas and margins surrounding open water. Their planting prescriptions do include many of the upland berry species of importance to Fort McKay. No doubt, many of these planting prescriptions will be modified based on operational results; however, as a general concept the planting prescriptions are good. Prior to mining at both the Jackpine and Pierre River mines, wetland (primarily peatland) ecosites would have occupied more than half of the land, none of which is proposed to be replaced during reclamation. Wetlands are a very important component for traditional use and their restoration is a strong desire of Fort McKay.

[133] Recommendations:

i. Fort McKay asks that the proponent look seriously at creating the landforms necessary for re-establishing peat accumulating wetland types.

ii. Fort McKay also asks that Shell undertake field-scale trials to establish peat accumulating wetlands.

iii. Fort McKay would like Shell to look at re-establishing other plant species of importance to traditional use including rat root.

[134] Soil Salvage and Replacement

Proposed reclaimed soil profiles appear to be well worked out for upland ecosites but will depend on good ground judgment during reclamation activities. The proponent has prepared a mass soil balance and there appears to be an excess of soils available for reclamation. At both mine sites the proponent will be salvaging and stockpiling all upland surface soil and subsoil that is rated good and fair. Peat-mineral mix will be salvaged to meet the material balance requirements when there is insufficient upland surface soil to meet reclamation objectives.

The proponent indicates that it will salvage and directly place upland soils whenever practical to do so, however, detailed timing and scheduling of this has not yet been done.

[134] Recommendations

i. Fort McKay may wish to include in its agreement with Shell, that it prepares a more detailed scheduling and direct placement of upland soils.

ii. Fort McKay may want to request a further commitment from Shell to ensure that a professional soil scientist will be on staff to schedule topsoil salvage and direct placement activity and closely plan and monitor work as soil salvage and replacement occurs.

iii. Fort McKay would like to see Shell investigate the potential for direct placement of organic soils in locations with high potential for peatland development.

[135] Traditional Use

The re-vegetation prescriptions proposed essentially follow the Oil Sands Vegetation Reclamation Committee guideline. Shell also intends to directly strip and place topsoil whenever it can to provide native species propagules. Shell also indicates that it is committed to re-establishing traditional uses on the reclaimed landscape.

[135] Recommendation

Shell should continue to work with Fort McKay during the development and implementation of reclamation programs in support of traditional use.

[136] Unsuitable Materials

One of Shell's conservation and reclamation goals is to sequester unsuitable materials, including the small volume of Clearwater Formation material and lean oil sand, at suitable depths, however, no details are provided as to how this will be achieved. Shell does, however, recognize that saline soils and saline drainage will be expected and has designed shrub ecosites composed of salt-tolerant species.

[136] Recommendation

Fort McKay strongly agrees with this goal of sequestering unsuitable materials and may want to see further details on the locations of unsuitable materials and the plans for management of these materials.

[137] Wildlife

The landform design and soil and vegetation prescriptions target upland ecosites as well as some wetland (non peat accumulating) ecosites. Although the reclamation plan recognizes the importance of wildlife, and is working on the assumption that once vegetation has been established then wildlife will quickly colonize these ecosites, little attention has been paid to the creation of habitat specifically targeted to wildlife species. Of particular importance to Fort McKay are moose and furbearers. The plan predicts that moose and bear habitat will be improved as a result of increased browse and berries which will be grown on upland ecosites. The plan does not appear to have considered other issues of importance such as thermal cover or, in the case of bears, denning sites.

[137] Recommendation

Fort McKay may want to see further details provided on the specific measures that Shell will be taking to develop wildlife habitat, especially for species of importance to Fort McKay.

[138] Biodiversity

The proponent has indicated that it will create site biodiversity by initially restoring soil properties which will in turn establish soil biota which, in turn, re-establish ecological function within terrestrial habitats. Shell also indicates that the loss of tree cavities during early reclamation can be mitigated through enhancement features such as nest boxes, but no details have been provided. It also concedes that the distribution and abundance of vegetation types will be permanently altered as peatlands are replaced with other wetland types and with upland vegetation types.

[138] Recommendations:

i. Shell should be asked to provide updates to Fort McKay on their plans to increase biodiversity.

ii. Fort McKay should ask Shell to ensure that it maximizes the direct placement of soils, and diversifies the landscape to ensure that a wide variety of ecosites will be established.

[139] Certification of Reclaimed Lands

The proponent has indicated that it will ultimately seek reclamation certification for all disturbed areas following reclamation. This is a very important issue for Fort McKay as only one small area of land has been certified in the oil sands region at this time despite almost four decades of mining. Shell should give some thought to a certification strategy including the criteria they will need to attain in order to reach certification including slopes, soils, vegetation, as well as the timing of certification applications. In addition, Shell should also set itself targets for eventual certification of watercourses including pit lakes.

[139] Recommendations:

i. Fort McKay may wish to see a progressive and proposed schedule of when Shell intends to apply for certification.

ii. Fort McKay would like to have the opportunity to comment on any future applications for certification, and to participate in any field inquiry.

Table 12-1: Mine Plan and Closure, Conservation and Reclamation Plan Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
126	Tailings Management	i) Fort McKay would like to review revised tailings strategies which will undoubtedly be required as a result of the ERCB Tailings Directive 074. ii) Fort McKay requests a clarification of the level of sand capping over NST as well as an explanation of how this sand capping and modification of the landscape to incorporate drainage channels will be operationally achieved.	Agreement Response
127	Reclamation Goals and Principles	In order to achieve true equivalent capability Shell should look at ways of creating more gently sloping topography and the hydrological conditions suited to peatland formation in order to achieve equivalent capability on the final reclaimed landscape.	Agreement, Regulatory
128	Pace of Reclamation	i) Fort McKay clearly wishes that Shell increase the pace of reclamation on all their mines. ii) Fort McKay would like to discuss alternative tailings management strategies which will conform to ERCB Tailings Directive 074, improve the pace of reclamation.	Agreement, Regulatory
129	Closure Drainage Plan	Shell should confirm that agreements are in place between Shell and Imperial Oil (Kearl Oil Sands Project) and Syncrude Canada Ltd. (Aurora South Project) for co-ordinated long term drainage control.	Agreement, Regulatory
130	End Pit Lakes	i) Fort McKay opposes the deposition of tailings into end pit lakes as a method of long term tailings storage. ii) In addition, Shell should determine the levels of water quality parameters that will be necessary to achieve reclamation certification for fish habitat, estimate the time required to achieve these levels and design their material placement and drainage systems accordingly.	Agreement, Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
131	Equivalent Capability	i) Shell should look at ways of creating more gently sloping topography in order to encourage wetland formation in the final landscape. ii) Shell should monitor productivity on reclaimed landscapes to verify that equivalent capability for forestry, as predicted by the LCCS, has been achieved.	Agreement, Regulatory
132	Reclamation Security	Fort McKay may want to see a breakdown of reclamation cost predictions to satisfy itself that the reclamation security will be sufficient. Costs must address the likelihood of long term treatment of pit lake water should this be required.	Agreement, Regulatory
133	Revegetation	i) Fort McKay asks that the proponent look seriously at creating the landforms necessary for re-establishing peat accumulating wetland types. ii) Fort McKay also asks that Shell undertake field scale trials to establish peat accumulating wetlands. iii) Fort McKay would like Shell to look at re-establishing other plant species of importance to traditional use including rat root.	Agreement, Regulatory
134	Soil Salvage and Replacement	i) Fort McKay may wish to include in its agreement with Shell, that it prepares a more detailed scheduling and direct placement of upland soils. ii) Fort McKay may want to request a further commitment from Shell to ensure that a professional soil scientist will be on staff to schedule topsoil salvage and direct placement activity and closely plan and monitor work as soil salvage and replacement occurs. iii) Fort McKay would like to see Shell investigate the potential for direct placement of organic soils in locations with high potential for peatland development.	Agreement, Regulatory
135	Traditional Use	Shell should continue to work with Fort McKay during the development and implementation of reclamation programs in support of traditional use.	Agreement

Number	Fort McKay Key Concern	Recommendation	Category
136	Unsuitable Materials	Fort McKay strongly agrees with this goal of sequestering unsuitable materials and may want to see further details on the locations of unsuitable materials and the plans for management of these materials.	Agreement, Regulatory
137	Wildlife	Fort McKay may want to see further details provided on the specific measures that Shell will be taking to develop wildlife habitat, especially for species of importance to Fort McKay.	Agreement, Regulatory
138	Biodiversity	i) Shell should be asked to provide updates to Fort McKay on their plans to increase biodiversity. ii) Fort McKay should ask Shell to ensure that it maximizes the direct placement of soils, and diversifies the landscape to ensure that a wide variety of ecosites will be established.	Agreement
139	Certification of Reclaimed Lands	i) Fort McKay may wish to see a progressive and proposed schedule of when Shell intends to apply for certification. ii) Fort McKay would like have the opportunity to comment on any future applications for certification, and to participate in any field inquiry.	Agreement, Regulatory

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

13.0 RESOURCE USE

13.1 Resource Use Impacts

Shell examined the following key resource use issues:

- Environmentally important areas
- Natural resource use:
  - Access
  - Surface and subsurface dispositions
  - Foresty harvest levels
  - Local resident consumptive use of resources:
    - Hunting
    - Fishing
    - Berry picking
  - Non- consumptive recreational activities

Traditional Land use was assessed in a different section of the EIA and our review of that section is presented in Section 15 of this review.

13.1.1 Environmentally Important Areas

There are several Environmental Significant Areas (ESAs) that overlap with Shell's LSAs (Westworth 1990, Sweetgrass 1997). The JME LSA overlaps with three regionally significant ESAs:

- **Muskeg River (North)** – important sports fishery,
- **Kearl Lake Moose Area** – wildlife corridor and moose habitat, and
- **Fort Hills** – upland ridge between two low-lying areas as well important moose habitat

The following ESA overlap with the PRM LSA:

- **Athabasca River – Tar Sands Reach (nationally significant)** – fish and wildlife habitat and extensive riparian forest;
- **the Eymundson Sinkholes (provincially significant)** – karst topography formation that is rare in Alberta except in the northeast corner of the province;
- **the Calumet Old Growth Forest (regionally significant)** – contains 175 year old balsam poplar trees;
- **Pierre River (regionally significant)** – wildlife movement corridor, important furbearer habitat, and important sport fishery; and
- **Firebag Marten Area (regionally significant)** – important furbearer habitat.

None of these ESAs are legally protected by Provincial or Federal legislation. However, as Shell indicates in Table 8.4-3 (Volume 5), the Integrated Resource Plan Guidelines (ASRD 2002) indicate that the Applicable Guideline for these lakes is as follows "Development proposals will mitigate adverse impacts on nationally or provincially significant natural features including the Athabasca River – Tar Sands Reach and Eymundson Sinkholes on Pierre River. The level of protection for each site will be determined through interagency review".

Shell's Application Case assessment indicates that the Firebag Marten Area is outside of the planned development area (PDA) and therefore will not be affected by the PRM. The Calumet Old Growth Forest ESA as mapped by Westworth (1990) is within the PRM PDA. However, when Shell conducted ground-truthing of vegetation they found that there is no old growth forest within the mapped ESA area. There is a clump of old growth forest in the area but it is located closer to the Athabasca River and not within Shell's PDA.

All of the ESAs that Shell could potentially disturb are or will be disturbed due to existing and approved developments. Base Case percentage disturbances are as follows: Fort Hills (33%), Kearl Lake Moose Area (67%), Muskeg River (North) (35%), the Pierre River ESA (2%) and Eymundson Sinkholes (<1%).

With regard to the Athabasca River – Tar Sands Reach ESA an additional 2.3% of the ESA will be disturbed by Shell's projects. Shell will maintain a 250 m buffer between the PDA and the Athabasca River (i.e., there will be no direct disturbance to the river bank).

Shell's project will disturb the other ESAs in the following percentages: Fort Hills (3.6%), Kearl Lake Moose Area (18.5%), Muskeg River (North) 22.3%, the Pierre River ESA (13%) and Eymundson Sinkholes (98%).

Shell concluded that the effects on ESAs are local, long-term (more than 20 years). Shell states that reclamation will reverse the effects, except for the Eymundson Sinkholes, which can not be re-created. Shell concluded the following in terms of the magnitude of effects: Eymundson Sinkholes ESA (high), Muskeg River (North) ESA (moderate), Athabasca River – Tar Sands Reach (low), Kearl Lake Moose Area (low), Pierre River ESA (low) and Fort Hills ESA (negligible).

Shell only conducted a cumulative effects assessment on the Eymundson Sinkholes, which was rated as high environmental consequence. There are no additional sinkholes that will be affected by the PDC.

13.1.2 Minerals and Surface Materials

The JME LSA contains one Surface Material Exploration (SME) application for sand and gravel (JH Drilling Inc.). Also Birch Mountain Resources owned metallic and mineral interests that overlap with the JME LSA (since Birch Mountain when into receivership and was sold to in 2008, it is not clear if the new owners also own these interests). Within PRM LSA there are four areas of limestone potential.

The Shell Projects would also use about 47 million tonnes of aggregate resources, which they would get from regional sources. The long-term regional impact on aggregate resources (which are non-renewable) is considered by Shell to be low and of low environmental consequence. There are existing aggregate sources (e.g., Susan Lake Gravel Pit, on-ste resources at various mines) as well as future supplies (Hammerstone Project, North Parsons Creek Project).

13.1.3 Access and Population

Shell indicates that the density of access routes is 0.57 km/km^2 in the RSA and 1.6 km/km^2 (JME) and 1.0 km/km^2 (PRM) in the LSAs.

Since there is already existing access to Shell's proposed Jackpine Mine Expansion site, only a small amount of new linear development will occur to access this site, which will be accessed by Highway 63 and Canterra Road (Shell 2007, Volume 1).

Currently vehicular access to the Pierre River Mine site is limited during the unfrozen part of the year. According to Shell, access is via the Horizon Project road (which is paved), then along the Deer Creek road (which is grvel) and then north of there the road is impassable to vehicles. The site is accessible in winter via Highway 63 and an ice bridge across the Athabasca River. An access road west from Highway 63 and a new bridge across the Athabasca River are proposed to allow permanent, all-year access to the Pierre River Mine site (Shell 2007, Volume 2). There would also be road and pipelines connecting the Athabasca River water intake, the raw water facility, the external tailings disposal area (which is not on the same lease as the plant site and mine) and the plant site. Shell states that the new bridge will not increase access since its use will be controlled by Shell during the duration of the project and then the bridge will be decommissioned after the project is over.

Shell indicates that it will use existing linear corridors for product, diluent, raw water and electrical power lines for the Jackpine Mine Expansion but that a new utility corridor will need to be built for the Pierre River Mine to transport natural gas, power, dilbit and diluent. This additional supporting linear infrastructure would be built by third parties.

Shell's proposed Projects, if approved, would bring additional workers into the area. The workforce for the Jackpine Mine Expansion construction is expected to be about 3,000 workers, peaking in about 2015 (Shell 2007, Volume 1, Section 18). The Pierre River Mine project is scheduled to begin later and its workforce would peak at about 3,000 in 2021.

Shell predicts that during operations the proposed Projects would add to the regional population. Their population model predicts an increase in the urban population of 8,000 people – from 90,000 at Base Case to 98,000 in the Application Case.

Shell indicates that the increased human population in the region is expected to result in increased pressure on resources (i.e., hunting, fishing, berry picking, and

recreation). Traditional users have also indicated that the east side of the Athabasca River used to be relatively inaccessible to non-traditional users but that due to access created by industrial development that this area is much more accessible to non-traditional users and has resulted in more competition for resources. As well traditional users interviewed for the TLU study say that some of Shell's camp residents fish in the Muskeg River and hunt within the area.

Shell rates the effect of increased population on resources as low magnitude and long-term and of low environmental consequence for the Application Case and as moderate and long-term and of moderate environmental consequence for the planned development case.

13.1.4 Agriculture

There are no agricultural activities in or near the JME and PRM LSAs. Hence, Shell predicts no impacts on agriculture due to their Projects.

13.1.5 Forestry

Al-Pac is the main Forest Management Agreement (FMA) holder within the RSA. Al-Pac plans to harvest in the JME LSA in 2007 and 2008 and in the PRM LSA in 2009 and 2010. Clearing due to the project is 20,257 ha for the JME and 10,034 ha for PRM and about 24% of the land cleared is rated as having good productivity for forestry. Shell predicts that at closure there will be a net increase forest capability class. This will take decades after the start of reclamation: 50 years for aspen and 80 to 120 years for conifers.

Both forestry companies will be compensated for project-specific losses. At the regional scale, Shell predicts negligible impacts on Al-Pac's long-term operations as their FMA is large and they will continue to have harvesting options. Northlands has indicated that their business will be negatively affected by regional development since they have a smaller area within which to harvest.

Under the Planned Development Case, Shell concludes that impacts to forestry are of low environmental consequence and are reversible with reclamation.

13.1.6 Hunting

JME is within Wildlife Management Unit (WMU) 530 and within this WMU there are 21 outfitters that hold hunting allocation for black bear, moose and white-tailed deer. Similarly, PRM is within WMU, where there are 15 outfitters that hold hunting allocations. Shell reports that its Resource Use Study for the region shows that 29% of the surveyed population hunt and about 3.5% hunt in and around the LSAs.

About 64% of the hunters surveyed by Shell indicated that hunting success has declined from five years ago for all species hunted – moose, deer, black bear and grouse. Respondents attributed this decline in hunting success to industrial development in the region. Three outfitters also participated in Shell's resource

use survey and they stated that they would eventually be out of business due to oil sands development.

Traditional users had similar observations of declining wildlife populations and hunting success and attribute this partly to increased access and human population in the region that has resulted in more hunting.

Shell's acknowledges that its projects would result in disturbance of 1% (22,125 ha) and 0.6% (10,369 ha) of WMU 530 and 531, respectively and that this would result in habitat loss for moose and black bear. Shell's states that its population viability models show no decline in wildlife populations at the regional scale.

Shell concludes that overall numbers of hunters in the region are low and that very few people in the region rely on hunting as way of making their living and that therefore, the impacts on hunting are low in magnitude.

13.1.7 Trapping

The LSAs overlap with six Registered Fur Management Areas (RFMAs), also called traplines. Three of these are held by Fort McKay community members and are within the JME LSA.

Shell reported harvesting data from all six RFMA's combined. 873 animals were harvested with beaver and squirrel being the most common, followed by marten.

13.1.8 Berry Picking

About 18% of people surveyed in Shell's Resource Use Study pick berries within the region and about 1% berry pick near the LSAs. About 7% of the JME LSA is blueberry habitat and about 5% is cranberry habitat. The PRM has a higher proportion of berry habitat: 16% blueberry and 44% cranberry/raspberry habitat. About 5,399 ha of berry habitat will be lost at JME LSA and 5,326 ha will be lost at PRM LSA during operations. Shell's reclamation plans include an increase in berry habitat. Shell concludes that there will be a low impact on berry picking since the LSAs are not common berry-picking areas for regional residents and the area cleared is such a small portion of the RSA.

13.1.9 Fishing

Shell found that about 37% of the people they surveyed in the Resource Use Study indicated that fishing is an important activity for them. Within the JME LSA (Muskeg River and its tributaries), Arctic grayling was the most commonly fished for species and the most commonly caught. Within PRM LSA (Pierre River, Eymundson Creek, Big Creek and Redclay Creek) and the most commonly fished for species are northern pike and walleye and walleye are the most commonly caught.

In the Application Case, Muskeg Creek and a portion of the upper reaches of Muskeg River will be lost as well as large portions of the Pierre River, Eymundson Creek, Big Creek and Redclay Creek.

Shell indicates that although Kearl Lake fish habitat will not be affected, the lake will be inaccessible during operations.

Shell concludes that since most of the fish habitat that is lost are not main fishing areas that the impacts are low and of short duration (until anglers start using compensation lakes).

13.1.10 Cultural and Spiritual Locations

Shell's Resource Use Survey of regional residents did not identify specific cultural and spiritual locations within the LSAs, beyond a general reference by some survey respondents to "forests, rivers and lakes". Fort McKay indentified some specific sites and these our discussed in our review of Shell's traditional ecological knowledge and traditional land use reports (see Section 15 of this review).

13.1.11 Recreation

About 44% of people surveyed in the Resource Use Survey participate in camping. Other recreational activities such as hiking, swimming, using All-Terrain Vehicles, boating and snowmobiling were also common. There are no formal recreational sites in the LSAs but there is one forest recreation campground (Clausen's Landing Remote Forest Recreation Area) near the PRM LSA.

Shell concludes that there will be a low local effect on recreation but that this is negligible at the regional scale.

13.1.12 TEK Regarding Resource Use

Shell reports (Table 8.4.-2) traditional knowledge and specific concerns from Fort McKay and other Aboriginal land users. The information recorded includes specific information about hunting and trapping activities and species as well as berry picking locations. I also includes concerns and observations regarding declines in wildlife populations, loss of berry picking areas, the increase in numbers of non-Aboriginal hunters, fishers and recreationalist and concerns about changes and increase in access. All of these concerns and observations are consistent with the findings of the Disturbance and Access section of the Fort McKay Specific Assessment (Fort McKay IRC 2010, Section 9).

13.2 Resource Use Assessment

Shell's baseline information on Resource Use was quite thorough. Shell commissioned a new resource use survey that was done by a company that

specializes in surveys. It provided good information on recreational use, hunting, fishing etc.

It was also nice to see some quantitative measure of linear density (access reported in km/km^2) as this is a measure that it important to track in managing access.

Shell's description of Application Case effects was detailed and thorough.

The Planned Development Case for the ESAs did not assess all of the ESAs that would be impacted by Shell's projects (see comment and recommendation [142] below).

13.3 Resource Use Key Concerns and Recommendations

[140] Regionally Significant ESAs

Shell indicates that it will impact a number of regionally significant ESAs. ESAs have no legislated protection, although federal and provincially significant areas have some general guidelines regarding development in the Integrated Resource Plan (IRP) Guidelines (ASRD 2002). Fort McKay continues to be concerned about the lack of protected areas within the oil sands region and its Traditional Lands. Especially when more and more areas that have been identified for specific ecological values are affected. (e.g. Kearl Lake Moose Area).

[140] Recommendation

The regulators should establish, in consultation with Fort McKay, protected areas within Fort McKay Traditional Lands that protect a range of ecological values and traditional uses.

Provincially Significant ESA - Eymundson Sinkhole Lakes

Eymundson Sinkhole Lakes are a Provincially Significant ESA. Fort McKay's concerns and recommendations regarding the potential impacts of the PRM Project on the Eymundson Sinkhole Lakes are discussed in the Water Quality and Aquatic Health section of this review (Section 6.6) in Recommendation 58.

[141] Planned Development Case for ESAs

Shell concluded low to moderate long term effects on the following ESAs: Muskeg River (North) ESA (moderate), Athabasca River – Tar Sands Reach (low), Kearl Lake Moose Area (low), Pierre River ESA (low) (page 8-97. Volume 5, Shell 2007). However, Shell's residual impact classification (Table 8.4-13, page 8-100, Volume 5, Shell 2007) reports the magnitude change for these ESAs as "negligible".

In the Planned Development Case impact analysis (p. 8-115, Volume 5, Shell 1997) Shell indicated that "site clearing impacts to all ESAs were negligible with the exception of Eymundson Sinkhole Lakes" and only conducted a PDC case for the Eymundson Sinkhole Lakes.

[141] Recommendations

Fort McKay may want to request that Shell:

i. comment on the discrepancy between the impact ratings in the text (page 8-97) and the impact classification table ratings for ESAs (page 8-100)

ii. evaluate and discuss the Planned Development Case effects for ESAs that were rated by Shell as having low to moderate magnitude long-term impacts (Muskeg River (North) ESA (moderate), Athabasca River – Tar Sands Reach (low), Kearl Lake Moose Area (low) and Pierre River ESA (low)

iii. Discuss the regional impacts on ESAs as a whole due to the Planned Development Case.

[142] Hunting

Both traditional users and non-aboriginal local hunters have observed that wildlife populations have declined and that consequently that hunting is more challenging and/or that hunting success has declined. Shell disputes these claims indicating that their population viability analysis modeling results predict no decline in wildlife populations on a regional level. Recent moose counts by ASRD (2009) indicate that for WMU 530 that moose population levels have declined. Shell's proposed Projects would clear another 22,125 ha of area within WMU 530 including about 4080 ha (18.5%) of the Kearl Lake Moose Area ESA.

[142] Recommendation

Fort McKay may want to request that in light of recent moose population study results (ASRD 2009), and the observations of both traditional users and local (non-aboriginal) hunters that wildlife populations have declined, that Shell comment on the validity of its population viability results that predict no decline wildlife populations.

Also see the Wildlife review recommendations [86] to [88] regarding hunted and trapped wildlife species populations.

Fishing

Fort McKay's comments on fishing and fish habitat as it affects Fort McKay are presented in the Fish and Fish Habitat review, Recommendations [60] to [66].

[143 - 144] Access Management

Currently, there is minimal regional management of access. There are no limits set on motorized access and linear density. There is also very little coordination of access by companies. As well, with the exception of restrictions to access within project boundaries (which companies are allowed to control) there are little or no restrictions on people's movement and access within Crown land.

Shell's assessment indicates that the density of access routes is 0.57 km/km^2 in the RSA and 1.6 km/km^2 (JME) and 1.0 km/km^2 (PRM) in the LSAs. The linear density rates in Shell's EIA are likely typical for development areas within the region.

CEMA's Sustainable Ecosystems Working Group determined that one of the most powerful tools for minimizing negative ecological effects in the region (especially for hunted and fished species) is through access management and in particular through restrictions on motorized access and through setting linear density limits.

[143] Recommendation

Fort McKay may want to request that the regulators consult with them in developing access management plans within Fort McKay's Traditional Lands that include limits to motorized access, designated use areas and limits on the density of linear features. Density limits would require successful implementation of Integrated Landscape Management (coordination of access features between users).

[144] Recommendation

Fort McKay may want to request Shell commit to participating in the development of regional access corridors and management plans that are relevant to their existing and proposed Projects. This may include an east side corridor access management plan and/or an access management plan for the west side of the Athabasca River (to complement or expand on the Moose Lake Access Management Plan).

Also see TEK/TLU review Recommendations [157] and [158] for additional recommendations regarding access.

[145] Loss of Berry Picking Habitat

Shell predicted a loss of about 5,399 ha of berry habitat (blueberry and cranberry/raspberry) will be lost at JME LSA and 5,326 ha will be lost at PRM LSA during operations.

Blueberries and cranberries are Cultural Keystone Species for Fort McKay. The Disturbance and Access analysis of the FMSA (Section 9.3.4, Fort McKay IRC 2010) found that since berry harvesting cultural sensitive ecosystems (CSE) area is much smaller than other harvesting areas (e.g., large game, fur bearers) and is concentrated around the Community of Fort McKay and the Athabasca River, that berry harvesting areas are impacted proportionally more than other types of harvesting. Loss of berry habitat due to Shell's projects impacts Fort McKay's moderate use berry harvesting CSE.

Since many of the Resource Use Survey respondents indicate that they pick berries, there is potential more competition, especially for easily accessible berry picking sites.

[145] Recommendation

Fort McKay may want to request that Shell collaborate with Fort McKay on a mitigation and offset plan regarding lost berry habitat and berry picking sites (See Recommendation [154] in the TEK/TLU review).

[146] Impacts to Traditional Resource Harvesting Areas and Opportunities

Shell's resource use assessment provides information on impacts to resource producing areas resulting from project clearing (e.g. berry habitat, Kearl Lake Moose Area, WMU) as well as impacts to resource use that can result from a increase in access and changes in human population. These stressors affect both regional non-aboriginal resource users and Fort McKay's opportunities for traditional land use. Shell has also quantified losses to Fort McKay's harvesting areas in the Traditional Land Use section.

Fort McKay further quantified and described this in its Disturbance and Access section of the Fort McKay Specific Assessment (Fort McKay IRC, 2010).

Fort McKay has provided a number of recommendations regarding access and land use planning [Recommendations 143, 144,156, 158]. However, these mitigation measures will only partially mitigate the effects of land disturbance, access, regional population increases and other impacts of Shell's Projects and cumulative effects of existing, approved and planned developments.

[146] Recommendation

Fort McKay may want to request that the Government of Alberta consult with them regarding suitable offsets and accommodation for impacts to traditional resources (e.g., berry habitat, declining regional moose populations) and traditional land use opportunities.

Table 13-1: Resource Use Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
140	Impacts to ESAs and lack of protected areas	The regulators should establish, in consultation with Fort McKay, protected areas within Fort McKay Traditional Lands that protect a range of ecological values and traditional uses.	Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
141	PDC for ESAs	Fort McKay may want to request that Shell i) comment on the discrepancy between the impact ratings in the text (page 8-97) and the impact classification table ratings for ESAs (page 8-100) ii) evaluate and discuss the Planned Development Case effects for ESAs that were rated by Shell as having low to moderate magnitude long-term impacts (Muskeg River (North) ESA (moderate), Athabasca River – Tar Sands Reach (low), Kearl Lake Moose Area (low) and Pierre River ESA (low) iii) discuss the regional impacts on ESAs as a whole due to the Planned Development Case.	Response
142	Impacts on regional wildlife populations and hunting	Fort McKay may want to request that in light of recent moose population study results (ASRD 2009), and the observations of both traditional users and local (non-aboriginal) hunters that wildlife populations have declined, that Shell comment on the validity of its population viability results that predict no decline wildlife populations.	Response
143	Access management	Fort McKay may want to request that the regulators consult with them in developing access management plans within Fort McKay's Traditional Lands that include limits to motorized access, designated use areas and limits on the density of linear features. Density limits would require successful implementation of Integrated Landscape Management (coordination of access features between users).	Regulatory
144	Access management	Fort McKay may want to request Shell commit to participating in the development of regional access corridors and management plans that are relevant to their existing and proposed Projects. This may include an east side corridor access management plan and/or an access management plan for the west side of the Athabasca River (to complement or expand on the Moose Lake Access Management Plan).	Agreement, Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
145	Loss of berry-producing habitat	Fort McKay may want to request that Shell collaborate with Fort McKay on a mitigation and offset plan regarding lost berry habitat and berry picking sites (Also, see Recommendation [***] in the TEK/TLU review).	Agreement
146	Impacts to traditional resources and land use opportunities	Fort McKay may want to request that the Government of Alberta consult with them regarding suitable offsets and accommodation for lost traditional resources (e.g., berry habitat, declining regional moose populations) and traditional land use opportunities.	Regulatory

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

13.4 References

ASRD. (Alberta Sustainable Resource Development). 2002. Fort McMurray – Athabasca Oil Sands Subregional Integrated Resources Plan. Approved by Cabinet on May 7, 2006. Amended June, 2002. Publication No. I/358. Alberta Sustainable Resources Development. Edmonton, AB.

14.0 HISTORICAL RESOURCES

14.1 Context

This review of the Shell EIA for the proposed Jackpine Mine Expansion (JME) and the Pierre River Mine (PRM) Projects (collectively, the Projects; Shell 2007) was undertaken to identify potential issues and concerns related to Shell's assessment of Project impacts on Historical Resources. Focus was given to assessment methodology, conclusions, and proposed mitigation actions related to the Projects.

This review takes into consideration the conclusions and recommendations from the *Fort McKay Specific Assessment* (FMSA, Fort McKay IRC 2010a) - a pilot project undertaken by the Community of Fort McKay under an agreement with Fort McKay, Shell and the Governments of Alberta and Canada. The FMSA includes a *Cultural Heritage Assessment Baseline Study* that applies a pre-development to current timeframe (Fort McKay IRC 2010b), an assessment of the effects of the Shell Projects on Fort McKay's cultural heritage (Fort McKay IRC 2010c), and an environmental assessment (Fort McKay IRC 2010a).

14.2 Project Description

Shell's EIA seeks approval for two projects:

14.2.1 Jackpine Mine Expansion (JME)

The Jackpine Mine Expansion (JME) is an expansion of the existing Jackpine Mine (JPM1), which received approval in 2004. The JME is located 15 km east of the Community of Fort McKay on the east side of the Athabasca River, adjacent to the existing JPM1. The original Jackpine Mine has a production capacity of 200,000 bbl/cd; the JME will contribute an additional 100,000 bbl/cd bringing the total mine production to 300,000 bbl/cd. The JME will include development of additional mining areas, associated processing facilities, utilities and infrastructure. The proposed JME will disturb an additional 12,719 ha on top of the 7,836 ha already permitted under the Jackpine Mine, bringing the total disturbance to 20,555 ha. The proposed JME will extend the mine completion date from 2031 to 2049.

Shell predicts that an additional 2,130 full-time permanent employees will be needed for the JME. Additional construction employees will also be required, estimated as 28,790 work years of construction employment over 10 years. This project development area for the JME overlaps with four Registered Fur Management Areas (RFMAs, also referred to as traplines) #2331, #1716, #1714, #2137. The latter three RFMAs are held by Fort McKay Community members.

14.2.2 Pierre River Mine (PRM)

The Pierre River Mine (PRM) is a new development located 25 km north of the Community Fort McKay on the west side of the Athabasca River. This mine will produce 200,000 bbl/cd and will include a new mining area, associated processing facilities, utilities and infrastructure. The PRM will disturb a total of 10,403 ha throughout the life of the project. Shell anticipates a 22 year operating life (completion date scheduled for 2039) and requires an additional 2,130 full time employees for this operation. Additional construction employees will also be required, estimated as 28,790 work years of construction employment over 10 years. The project development area for the PRM overlaps with two RFMAs #1275 and #2939. These are not held by Fort McKay Community members, however this project development area does occur on Fort McKay traditional lands and the area is known and used by Fort McKay Community members.

14.3 Historical Resources Assessment Approach

The Historical Resources Impact Assessment (HRIA) included a full study of the 10-year Project footprint and a baseline testing of high-potential areas for the post 10-year Project footprint.

Shell used the following methods in their assessment:

- Pre-field review of existing historical resources;
- GIS modeling to determine sites with high, moderate and low historical resource potential;
- Field assessments which included shovel testing and surface examinations;
- An effects assessment of the Project in combination with existing, approved and planned development; and
- Proposed mitigation measures, where necessary, to protect the historical resources.

In addition to the above tasks, Shell indicates that this study attempted to integrate traditional environmental knowledge (TEK) in the HRIA through the participation of two Fort McKay Community assistants - Rose Desjarlais (in 2006) and Allan Cardinal (in 2007).

The study was designed to comply with the *Alberta Historical Resources Act* (Province of Alberta 2000) and the *Guidelines for Archaeological Permit Holders in Alberta* (ASA 1989). As cited in the *Historical Resources Act*, historical resources are “any work of nature or man that is primarily of value for its paleontological, archaeological, precontact, historic, cultural, natural, scientific or aesthetic interest, including but not limited to, a paleontological, archaeological, precontact, historic or natural site, structure or object” (Province of Alberta 2000). Shell categorizes historical resources as:

- **Precontact Archaeological Resources**: Sites, objects and affiliated material that date prior to European arrival (over the last 10,000 years).
- **Historic Archaeological and Structural Resources**: Artifacts and structures that date to post-contact use of the landscape by Aboriginal people, such as cabins, campsites and graves (within the past 250 years).
- **Paleontological Resources:** Physical remains of extinct multicellular plants and animals (fossils).

Prior to engaging in field studies, Shell reviewed the provincial *Listing of Significant Historical Sites and Areas* to identify all recorded historical sites in the development areas. Relevant literature (e.g., historical publications) was also reviewed including a search of sites recorded during previous regional studies. In addition to literature and inventory reviews, Shell used a GIS-based predictive model to determine areas with high, moderate and low potential to contain historic resources.

Shell used two study areas in the HRIA:

1. **Local Study Area (LSA):** the Project development footprint
2. **Regional Study Area (RSA):** based on the township grid, the RSA includes all existing oil sands development within the "core of the Oil Sands Region" (see Figure 8.6-2)

Shell indicates that the field study protocols closely followed those of HRIAs previously completed within the RSA, allowing for a reasonable comparison across data sets. Both visual examination and shovel-test were carried out using pedestrian transects, ATV surveys and helicopter flights. Though the forested environment of the LSAs would usually preclude subsurface exposures, the high degree of development activity in the LSA (cutlines, winter roads, previous exploration activities) provided subsurface visibility. Shovel tests were completed in areas without existing subsurface visibility that were deemed to have moderate or high historic resource potential. The pits were usually 20 to 40 cm below the surface. Results from these surveys were provided in Section 8.6 of the Project EIA as well as in HRIA Reports prepared to meet the Project permit requirements.

14.4 Historical Resources Assessment

14.4.1 RSA

Shell provided a summary of the archaeological research that has been conducted in the Oil Sands Region in the past 30 years. It was noted that most of the regional research has been industry-driven, therefore occurred on sites in advance of development. There are 1,174 historical resource sites identified within the RSA at Base Case (as recorded at the Alberta Tourism, Parks, Recreation and Culture's Historical Sites Service). Most of these sites are artifact scatters and isolated finds, both associated with elevated knobs, ridges and

terraces. These landscape features are desirable for camp and work sites, so tend to correspond with these types of historic artifacts. Out of these 1,174 sites, 100 of these sites are Historic Period Sites (i.e., within the past 250 years) and include ranger stations, fur trade posts, and cabins. The majority of the 1,174 historical resource sites are clustered near the confluence of the Athabasca and Muskeg Rivers, an area associated with very sandy well-drained soils. However, Shell indicates that "while there is a high-density cluster of sites around the Athabasca/Muskeg River confluence, there are other areas of activity within the Oil Sands Region that may represent multiple periods of human occupation in the vicinity of the LSA (Section 8.6.5, pg. 8-188)". It is important to note that this only reflects the findings from a particular set of HRIAs and that there are undoubtedly many more yet undocumented precontact and historic period resource sites in the RSA.

Shell provided a general brief discussion of the early historic settlement patterns within the region, highlighting the fort settlements of the Northwest Company and the Hudson's Bay Company. However, it appears that none of the discussed locations were included in the Base Case map of known archaeological sites and archaeological potential (Figure 8.6-6). The only Historic Period Sites that were included in the HRIA were the 100 that were listed at the Historical Sites Service.

The fossil-bearing Clearwater Formation has been identified in the Oil Sands Region but does not overlap with the JEMA LSA; therefore a paleontological field assessment was only conducted within the PRM. The southern portion of the PRM LSA was assessed and no fossils were noted from the McMurray Formation. Shell indicates that paleontological observations are best made during excavations associated with site development activities due to the extent of overburden concealing the bedrock. A field assessment was conducted on the southern portion of the PRMA LSA. They also indicated that a program *could* be implemented to train Shell staff in recognizing and recording significant fossils during major excavation activities. They did not say, however, if they would implement such a program. Previous studies have confirmed the presence of potentially fossiliferous waterways through the McMurray Formation bedrock within and immediately adjacent to the PRM.

14.4.2 LSA

The GIS predictive modeling for the LSA identified 16.5% (3,809 ha) of area with high historic resource site potential and 44.7% (10,277 ha) with moderate historic resource site potential.

Through work conducted during various stages of Project development, 12 recorded Historical Resource Sites (all of which were archaeological sites) were identified:

- **6 new sites** – JME (permit # 06-116); field work conducted in 2005 & 2006
- **2 new sites** – PRM (permit # 06-116); field work conducted in 2005 & 2006

- **4 new sites** – PRM (permit # 07-259); field work conducted in 2007

Of these 12 sites four were isolated finds, six were artifact scatters of less than 10, one was an artifact scatter of more than 10, and one was a trail. Shell recommends that further work is conducted on 2 sites:

- Site # HjOv 10 located on PRM (sub surface < 10) – 6 m^2 of Stage 1 mitigation
- Site # HiOt 3 located on JPME (lithic scatter >10) – 10 m^2 of Stage 1 mitigation

No further work is suggested for the other 10 new sites.

14.5 Historical Resources Impacts

Shell predicts that 483 of the known historic resource use sites within the RSA will be affected by existing, approved and planned developments. This is a low estimate because many historic resource sites are not yet known, and will only be identified in future HRIAs.

All 12 of the newly identified historical resource sites will be directly impacted as a result of Project development. The impacts are irreversible, long-term in duration, and mostly negative in effect. The limited positive effect of development on these resources is the increased general archaeological knowledge through study of the few sites identified in HRIA.

14.6 Historical Resources Recommendations

[147-148] Resource Recovery and Employee Education

Mitigation, in the case of historical resource use sites, is generally avoidance or information recovery. Shell indicates that successful recovery programs requires clear understanding of Project development schedules so that adequate time is available to carry out studies prior to disturbance. Successful recovery programs are the only positive effects of the development on these resources, so it is highly important to Fort McKay that these are completed in an effective manner.

Shell also states that during Project development "there is potential to encounter previously unknown historical resources", particularly for paleontological resources that lie within the bedrock. Education of the construction workforce (of both known historic resource locations and identification of new resources) would assist with monitoring and temporary avoidance and recovery of these resources when encountered. Employee training or orientation regarding the identification of historical resources would be of benefit.

[147] Recommendation

Fort McKay might wish to ask Shell to provide development schedules to archaeological consultants within an adequate time frame to effectively carry out studies prior to disturbance.

[148] Recommendation

Fort McKay might wish to request that Shell provide training and education to Project personnel regarding known locations of archaeological locations, and identification of new historic resources, so that these resources can be temporary avoided prior to resource recovery.

[149] Graves

In the traditional land use studies for the Project (Section 8.36, Shell 2007; FMA 2008), Fort McKay Community participants identified graves and spiritual sites within the Project lease boundary. In all cases these graves are outside of the Project development area (Figure 8.3-1, Section 8.3 Shell 2007; Figure 8, FMA 2008).

PRM - In both the TK and TKLU Reports four gravesites were identified on the PRM lease.

JPM - In the TKLU Report one gravesite was identified near the shore of McClelland Lake in RRMA #2331. The holder of RFMA #1716 was aware of several graves on his trapline, located along the Firebag River approximately one and a half miles from his cabin. Both of these locations are outside of the Project development area. An actively used sweat lodge is located near the east side of the JPM lease area (Figure 8, FMA 2008).

Despite the claim that TEK was integrated in the HRIA, there was no mention of these grave sites in HRIA. This is a notable disconnect between findings from the traditional land use studies and the HRIA. Historical resources, particularly grave sites, have extreme cultural importance to Fort McKay Community members and unless these sites are listed under the *Historical Resources Act* there is no guarantee of their protection. Fort McKay would like to see protection placed on these and other graves throughout their traditional territory.

Additional comments and recommendations regarding graves and spiritual sites are included in Fort McKay's review of the Traditional Knowledge and Land Use assessment (Section 15.0).

[149] Recommendation

Fort McKay would like to have grave sites identified during the TLU studies listed under the *Historical Resources Act* with the intent of guaranteeing their protection from current and future development.

[150] Mitigation

Shell recommended Stage I mitigation for 2 new sites identified in the HRIA (HjOv 10 and HiOt3). However, in this section of the EIA Shell did not indicate that they will implement the Stage I mitigation.

[150] Recommendation

Fort McKay would like to ensure that Shell will complete Stage I mitigation for HjOv 10 and HiOt3 and provide the findings to the Fort McKay IRC.

Table 14-1: Historical Resources Issues Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
147	Resource Recovery and Employee Education	Fort McKay may wish to ask Shell to provide development schedules to archaeological consultants within an adequate time frame to carry out studies prior to disturbance.	Agreement
148	Resource Recovery and Employee Education	Fort McKay may wish to request that Shell provide training and education to Project personnel regarding known locations of archaeological locations, and identification of new historic resources, so that these resources can be temporary avoided prior to resource recovery.	Agreement
149	Graves	Fort McKay would like to have grave sites identified during the TLU studies listed under the *Historical Resources Act* with the intent of guaranteeing their protection from current and future development.	Response, Agreement, Regulatory
150	Mitigation	Fort McKay would like to ensure that Shell will complete Stage I mitigation for HjOv 10 and HiOt3 and provide the findings to the Fort McKay IRC.	Agreement, Regulatory

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

14.7 References

Archaeological Survey of Alberta (ASA). 1989. *Guidelines for Archaeological Permit Holders in Alberta*. Alberta Culture and Multiculturalism, Alberta Community Development. Edmonton, Alberta.

FMA Heritage Consultants Inc (FMA). 2008. *Fort McKay First Nation Traditional Knowledge Report*. Prepared for Shell Canada Environmental Impact

Assessment for the Jackpine Mine Expansion and the Pierre River Mine Project.

Fort McKay Industry Relations Corporation. 2010a. *Fort McKay Specific Assessment.*

Fort McKay Industry Relations Corporation. 2010b. *Fort McKay Specific Cultural Heritage Assessment (CHA) Baseline: Pre-development (1964) to Current (2008).*

Fort McKay Industry Relations Corporation. 2010c. *Fort McKay Project-Specific Cultural Heritage Assessment for the Jackpine Mine Expansion and Pierre River Mine Project.*

Province of Alberta. 2000. *Historical Resources Act.*

Shell Canada Limited. 2007. *Application for the Approval of the Jackpine Mine Expansion and Pierre River Mine Project.*

15.0 TRADITIONAL KNOWLEDGE AND TRADITIONAL LAND USE

15.1 Context

This review of the Shell EIA for the proposed Jackpine Mine Expansion (JME) and the Pierre River Mine (PRM) Projects (collectively, the Projects; Shell 2007) was undertaken to identify potential issues and concerns related to Shell's assessment of Project impacts on the Community of Fort McKay's Traditional Environmental Knowledge (TEK) and Traditional Land Use (TLU). Focus was given to assessment methodology, conclusions, and proposed mitigation actions related to the Projects.

This review examined three reports submitted by Shell that relate to potential impacts the Projects may have on TEK and TLU:

- Section 8.3 Traditional Knowledge and Land Use (Shell 2007),
- Fort McKay First Nation Traditional Knowledge Report (FMA 2008), and
- Traditional Land Use Environmental Setting for the Jackpine Mine Expansion & Pierre River Mine Project (Golder 2007).

Two of these reports, Section 8.3 Traditional Knowledge and Land Use (TKLU Report) and the Fort McKay First Nation Traditional Knowledge Report (TK Report), contain project effects assessments. The other report, Traditional Land Use Environmental Setting for the Jackpine Mine Expansion & Pierre River Mine Project (TKLU Setting Report), provides qualitative information on traditional knowledge and land use and was used to inform the TKLU Report assessment.

This review takes into consideration the conclusions and recommendations from the *Fort McKay Specific Assessment* (FMSA, Fort McKay IRC 2010a) - a pilot project undertaken by the Community of Fort McKay under an agreement with Fort McKay, Shell and the Governments of Alberta and Canada. The FMSA includes a *Cultural Heritage Assessment Baseline Study* that applies a pre-development to current timeframe (Fort McKay IRC 2010b), an assessment of the effects of the Shell Projects on Fort McKay's cultural heritage (Fort McKay IRC 2010c), and an environmental assessment (Fort McKay IRC 2010a).

15.2 Project Description

Shell's EIA seeks approval for two projects:

15.2.1 Jackpine Mine Expansion (JME)

The Jackpine Mine Expansion (JME) is an expansion of the existing Jackpine Mine (JPM1), which received approval in 2004. The JME is located 15 km east of the Community Fort McKay on the east side of the Athabasca River, adjacent to the existing JPM1. The original Jackpine Mine has a production capacity of 200,000 bbl/cd; the JME will contribute an additional 100,000 bbl/cd bringing the total mine production to 300,000 bbl/cd. The JME will include development of

additional mining areas, associated processing facilities, utilities and infrastructure. The proposed JME will disturb an additional 12,719 ha on top of the 7,836 ha already permitted under the Jackpine Mine, bringing the total disturbance to 20,555 ha. The proposed JME will extend the mine completion date from 2031 to 2049.

Shell predicts that an additional 2,130 full time permanent employees will be needed for the JME. Additional construction employees will also be required, estimated as 28,790 work years of construction employment over 10 years. This project development area for the JME overlaps with four Registered Fur Management Areas (RFMAs, also referred to as traplines) #2331, #1716, #1714, #2137. The latter three RFMAs are held by Fort McKay Community members.

15.2.2 Pierre River Mine (PRM)

The Pierre River Mine (PRM) is a new development located 25 km north of the Community Fort McKay on the west side of the Athabasca River. This mine will produce 200,000 bbl/cd and will include a new mining area, associated processing facilities, utilities and infrastructure. The PRM will disturb a total of 10,403 ha throughout the life of the project. Shell anticipates a 22 year operating life (completion date scheduled for 2039) and requires an additional 2,130 full time employees for this operation. Additional construction employees will also be required, estimated as 28,790 work years of construction employment over 10 years. The project development area for the PRM overlaps with two RFMAs #1275 and #2939. These are not held by Fort McKay Community members, however this project development area does occur on Fort McKay traditional lands and the area is known and used by Fort McKay Community members.

15.3 Traditional Environmental Knowledge (TEK) and Traditional Land Use (TLU) Assessments

Shell produced two reports, each containing a TEK and TLU assessment. The approach used by each is discussed below.

15.3.1 Section 8.3 Traditional Knowledge and Land Use Assessment (TKLU Report)

The TKLU assessment used both qualitative and quantitative studies for the Baseline, Application and Planned Development case. The qualitative study consisted of interviews with trapline holders and junior partners. A large portion of the interview findings used in the qualitative assessment are located in the *TKLU Setting Report* (Golder 2007). Additional qualitative information was derived through a regional literature review.

The quantitative assessment was comprised of three components:

- Loss of land for traditional activities within local RFMAs during the operation phase. The RFMA comprises the Local Study Area (LSA) for this assessment;

- Loss of land for traditional activities with the Culturally Significant Ecosystem (CSE) as defined by McKillop (2002). The CSE comprises the Regional Study Area (RSA) for this assessment; and
- Potential re-establishment of land for traditional activities within the RFMAs (i.e., LSA) following successful reclamation as articulated in Shells EIA Closure, Conservation and Reclamation Plan (Volume 5, Appendix 5-1).

The LSA for the TKLU Report is delineated by the six RFMAs that are directly impacted by project development. Three of these traplines are held by Fort McKay Community members (#1714 , # 1716, and #2137) and overlap with the JME project area.

In this report, Shell defines the RSA for purposes of this assessment in three ways: 1) CSE for All Traditional Uses 2) CSE for Large Game Harvesting and 3) CSE for Traditional Plant Harvesting (select berry harvesting sites). These data sets were based on the CSE approach identified in McKillop (2002) which utilizes data from Fort McKay's 1994 TLU study. Areas within the CSE are identified as having high, moderate and low intensity use.

Shell has indicated that they have shared relevant information gathering during the TLU assessment with other components of the EIA. We are pleased to see that this was done for select components of the EIA, and encourage continued sharing of information across disciplines if proposed Projects are approved. Fort McKay believes that ongoing dialogue throughout the life of the mine is essential for appropriate and meaningful collaboration between the Community and the proponent. Interdisciplinary discussions and integration of different ecological perspectives need to continue beyond the application process.

To determine traditional plant harvesting potential of the closure landscape, ecosites defined in the closure and reclamation plan were assigned a value based on:

- Species observed during vegetation surveys;
- Observed species abundance (i.e., frequency of occurrence and percent cover); and
- Known traditional plant species in the region.

This ranking system does not take into account species that may have low abundance but high cultural value. Such species (e.g., rat root) are given little, if any, significance in this system. Shell's traditional plant assessment if further discussed Fort McKay's review of Terrestrial Vegetation, Wetlands and Forest Resources Assessment review (Section 9.0).

Calculations were provided for Base Case and expected closure habitats within the LSA with potential to support beaver, lynx, moose and fisher populations. Information was presented for combined high and moderate habitat potential for each of these species. In this section, Shell indicated that these species were selected based on their high cultural value but did indicate how this ranking

system was developed. See Fort McKay's review of the Wildlife Assessment for discussion and recommendation on Shell's approach and findings (Section 8.0).

15.3.2 Fort McKay First Nation Traditional Knowledge Report Assessment (TK Report)

At the request of the Fort McKay Industry Relations Corporation, Shell completed the TK Report (Shell 2008) to complement the TKLU Report originally completed for their EIA (Golder 2007, Shell 2007). Both reports present similar findings though employ somewhat different approaches in their assessments. The TK Report relied on a more qualitative approach to ascertain Project impacts, Community concerns and proposed mitigation measures.

To determine the effects that this development will have on traditional land use practices and culture in Fort McKay, the TK Report assessed the environmental impacts of the Project using several methods including:

- A review of existing literature discussing traditional land use information;
- Information gathering sessions with the PRM and JME Elder Advisory Group;
- Interviews with Community members with direct knowledge of specific areas within or near the Project lease area;
- Report review and verification by the Fort McKay Environment Coordinator; and
- A cumulative effects assessment, nested within the results and recommendations from above discussions.

The TK Report defined the LSA as the Project lease areas and included the proposed bridge across the Athabasca River adjacent to the PRM. This is in contrast to the TKLU Report which defined the LSA by the boundaries of the directly affected RFMAs. The RSA was based on the boundary for the CSE for All Uses. The same RSA was utilized in the TKLU Report.

The TK Report assessment approach captures both perceived and direct effects on Aboriginal lifestyles, from both previous developments and the proposed Projects. Information gathered through these activities, including Community mitigation recommendations, was presented from a Fort McKay perspective. This is a valuable approach that reduces the filter between Community members' statements and third party interpretation.

While it is highly valuable to have concerns and mitigation strategies reported from the perspective of community members, a complimentary quantitative assessment is needed to relay the direct loss of land and resources within Fort McKay's traditional territory. However, though the TK Report lacks a quantitative component to their assessment, Shell did provide this in the TKLU Report. In this way, findings from these two reports complement each other. The quantitative data enables the Community to determine how much of their traditional land, including RFMAs, may be taken up by a proposed development. The qualitative

information provides information on Community response to the proposed and cumulative development. Both are needed for Fort McKay to prepare a meaningful and effective response to the application.

15.4 Summary of TEK and TLU Impacts

The JME and PRM will directly affect the traditional lands of the people of Fort McKay and impact their ability to pursue traditional activities. Below is a summary of the collective impacts identified in the three TEK and TLU reports submitted by Shell.

15.4.1 Impacts to Culturally Significant Ecosystems (RSA) and Traplines (LSA)

RSA - In the TKLU Report, Shell assessed the development impacts within the CSEs (i.e., RSA) and found that the Application Case will result in:

- CSE (All Uses) disturbance of 28% Intense Use Area, 21% Moderate Use Area and 6% Low Use Area. This represents an increase of disturbance from Base Case of <1%, 3%, and <1%, respectively.
- CSE (Large Game) disturbance of 22% Intense Use Area, 9% Moderate Use Area and 2% Low Use Area. This represents an increase of disturbance from Base Case of 3%, <1%, and 0%, respectively.
- CSE (Traditional Plants) disturbance of 39% Intense Use Area, 30% Moderate Use Area and 13% Low Use Area. This represents an increase of disturbance from Base Case of 0%, 4%, and <1%, respectively.

Each of these CSEs represents a large geographic area so the above analysis dilutes the real impacts to the Community by the proposed Project. Fort McKay Community members experience developmental impacts most acutely when a proposed Project is within close proximity to the hamlet, is located along the Athabasca River, and when the Project leases overlap with Community-held traplines. Shell's Projects fit all three of these criteria (see Figure 6, TK Report).

LSA - Each of the trapline holders interviewed actively use their land for traditional purposes and expressed concern about the increasing amounts of land taken up by development. According to the TKLU Report, traplines will experience the following disturbance increase from Base Case to Application Case due to the Projects:

- **RFMA #1275** – 11% increase
- **RFMA #1714 (held by Fort McKay Community member)** – 27% increase (a combined Base Case and Application Case total of 28,373 ha of disturbance, or 73% of trapline)
- **RFMA #1716 (held by Fort McKay Community member)** – 14% increase (a combined Base Case and Application Case total of 23,657 ha of disturbance, or 43% of trapline)

- **RFMA #2137 (held by Fort McKay Community member)** – 5% increase (a combined Base Case and Application Case total of 11,289 ha of disturbance, or 44% of trapline)
- **RFMA #2331** - <1% increase
- **RFMA #2939**– 2% increase

Two trapline cabins held by Fort McKay Community members (RFMA #s 1716 and 1714) are located within the JME Project development area (see Figure 8.3-1, TKLU Report and Figure 8, TK Report) and will need to be moved. Shell has indicated that they will compensate directly affected trapline holders according to industry standards. While this may address some financial considerations related to the loss of hunting and trapping opportunities it does not take into account long-term impacts on traditional knowledge transmission and maintenance resulting from loss of land access throughout the life of the mine. Long-term and sustained impacts on the traplines affect the Community as a whole.

15.4.2 Impacts to Traplines and Reclamation

According to the TKLU Report, traditional land use will not be possible in the Project development area during operations, leading to a high negative effect on traditional land use for 25 to 50 years. Even with successful reclamation, a minimum of two to three generations of Fort McKay Community members will be without access to significant portions of their traditional lands. Further, at closure reclamation activities will not result in a landscape that resembles pre-disturbance conditions. According to Shell Canada Limited (2007), a site is "considered to be restored if natural succession processes are restored" and does not require the establishment of a site to a mature stage. This impact reaches into the far future with regards to Fort McKay cultural heritage.

Shell has indicated that traditional land use is an important end land use of reclaimed areas and they will continue to directly consult with Fort McKay regarding reclamation. In this section, however, Shell did not discuss specific reclamation practices to reestablish habitat for culturally important large game and traditionally used plants. Shell has also indicated they that will continue to participate in regional multi-stakeholder initiatives that consider traditional land use in reclamation planning. However, the effectiveness of these initiatives to address cultural land use considerations is not yet known and Community member concern about the lack of demonstrable reclamation continues to grow. Community members continue to stress the importance of progressive reclamation and project planning that restores the possibility of traditional use in a timely manner (TK Report).

Additional information regarding the traditional plant potential is included in Fort McKay's review of the Closure, Conservation and Reclamation Plan (Section 12.0).

15.4.3 Traditional Plant Use

In Shell's Terrestrial Resources Assessment (Volume 5, Section 7.0), land classification units in the reclaimed landscape were ranked based, in part, on their ability to support traditional plants. Shell's assessment assumes successful reclamation of the developed area and the TKLUS Report indicates the following changes:

- RFMA #s 1275, 2137 (held by a Fort McKay Community member), 2939, and 2331 will have a change in traditional plant potential less than or equal to 1% from Base Case to Closure.
- RFMA #1714 (held by a Fort McKay Community member) is predicted at closure to increase high traditional plant potential by 3%, to decrease moderate traditional plant potential by 12%, and to increase low traditional plant potential by 10%.
- RFMA #1716 (held by a Fort McKay Community member) is predicted at closure to decrease high traditional plant potential by 1%, to decrease moderate traditional plant potential by 3%, and increase low plant traditional plant potential by 3% over the base case.

In addition to the above results, the Terrestrial Resources section of Shell's assessment indicates that the post reclamation landscape, in general, will have a greater area of the high ranked lands that support traditional use plants.

The traditional plant assessment rated areas based on abundance (i.e., frequency of occurrence and percent cover). However no value was assigned to species in the less abundant categories. It may be possible that this ranking system places too much weight on the value of the most abundant species. There may be value in assessing the unique and uncommon traditional use species separately or adding to the analysis. Separation based on uniqueness would determine if any species (such as rat root) associated with a particular ecosite and/or wetland would be lost completely or significantly impacted by the Project.

Community members interviewed for the TK Report identified the 'old Fort Hills' as being ideal for cranberries and recommended that these sites are protected. Concern was also expressed regarding the viability of the medicinal plants at Muskeg (Kearl) Lake with the dyke construction.

Shell concluded that "project activities will directly affect berry harvesting on two RMFAs" (TKLU Report, Volume 5, Section 8.3.6.2). While reclamation may have the potential to reestablish berry populations in the area this will not occur for multiple generations causing the project impact on berry harvesting to reach into the far future. In this section, Shell does not indicate specific reclamation practices (or target species) will be employed to ensure future harvesting opportunities.

Additional information regarding the traditional plant potential is included in Fort McKay's review of the Terrestrial Resources Assessment (Section 9.0).

15.4.4 Wildlife

Trappers have shared that Project development will add to the already existing pressure on wildlife populations through both the direct uptake of habitat for development and increasing hunting pressure by non-Fort McKay hunters. An observed decrease in moose and bear populations was noted by trappers. Shell assessed the ability of the closure habitat of both Projects to support beaver, lynx, moose and fisher. Though their findings indicate that overall much of the habitat will be reclaimed, successful reclamation for these and other culturally important species has yet to be demonstrated and will occur beyond the lifetimes of the current trappers. Therefore, the impacts to the trappers, their families and the Community in general reach into the far future.

Shell discussed potential Project effects on wildlife populations in Volume 5 Section 7.5. For a review of Shell's assessment on Wildlife see Section 10.0.

15.4.5 Fishing & Water Quality and Quantity

Neither of the trapline holders within the PRM indicated that they fished within the Project development area. Therefore, Shell concluded that the PRM would not affect traditional fishing opportunities. However, many fishing locations along the Athabasca River, adjacent to the Project lease boundaries, have been identified as traditional fishing locations (Fort McKay First Nation 1994; FRM 1998). Fort McKay Community members have ongoing concern about the water quality and quantity of the Athabasca River as result of cumulative oil sands development. These concerns have influenced people's trust in the ability of the Athabasca River to support viable populations of fish that are safe for consumption. Additional development along the Athabasca River corridor, such as Shell's proposed Projects, exacerbates these concerns.

Community members interviewed for the TK Report felt that the diversion of the Muskeg River will negatively impact fishing and fish habitat. Overall concern was expressed regarding potential pollution effects on the safety of drinking water and traditional foods. Community members recommended that a community health study is conducted, with specific focus on contamination of traditional foods and water sources.

Community members stressed the relationship between maintenance of pre-development water levels and muskeg (bogs and fens) health. Muskeg locations are highly valued on the landscape and supply food, medicine and habitat for culturally important species.

Additional comments regarding potential Project impacts on fishing are located in Fort McKay's review of the Fish and Fish Habitat assessment (Section 7.0).

15.4.6 Noise

All trappers interviewed expressed concerns about existing noise in their trapline area and the potential effects of the Projects to further contribute to the situation.

Comments and recommendations regarding noise are included in Fort McKay's review of the Noise assessment (Section 3.0).

15.4.7 Air Quality

Industrial impacts to air quality continue to be of high concern to Fort McKay Community members. Trappers experience strong unpleasant odours while on their traplines and noted haze, dust and "dirty snow" in winter. Not only does this detract from their enjoyment while on their trapline (and in the Community) they attribute these effects to changing wildlife movement patterns. Community members shared that change in air quality impact water quality, human health and overall quality of life. Community members interviewed for the TK Report recommended raising emissions standards.

Comments and recommendations regarding air quality are included in Fort McKay's review of the Air Quality assessment (Section 3.0).

15.4.8 Access

Decreasing and/or changing access to traplines resulting from regional development continues to be a concern for trapline holders. Among trapper concerns are increased public access to the traplines, longer travel times to trapline cabins, increasing hunting pressure from non-community hunters, and vandalism. Shell states that they will facilitate trapper access across the proposed Project area to their traplines, but in this section do not discuss how they will mitigate increased public access to land as a result of the Project development.

Fort McKay has prepared a section regarding disturbance and access in the FMSA which details Community specific concerns and recommendations for these issues (FMSA Section 9.0, Fort McKay IRC 2010). As well, Fort McKay has addressed access related concerns in the Socio-economic Impact Assessment Review (Molstad and Anderson 2010).

15.4.9 Graves & Spiritual Sites

Project participants identified graves and spiritual sites within the Project lease boundary. In all cases these graves are outside of the Project development area delineated in TKLU Report (Figure 8.3-1, TKLU Report; Figure 8 TK Report).

PRM - In both the TK and TKLU Reports four gravesites were identified on the PRM lease.

JPM - In the TKLU Report one gravesite was identified near the shore of McClelland Lake in RRMA #2331. The holder of RFMA #1716 was aware of several graves on his trapline, located along the Firebag River approximately one and a half miles from his cabin. Both of these locations are outside of the Project development area. An actively used sweat lodge is located near the east side of the JPM lease area (Figure 8 TK Report).

Community members interviewed for the TK Report recommended that the graves are not disturbed and that protective fencing is erected around the gravesites. As well, the elder who has buried a family member on the PRM wishes to visit the gravesite prior to lease development. There was no mention of these grave sites in Shell's Historical Resources Assessment and all sites identified in that assessment "are believed to represent precontact use of the area" (Volume 5, Section 8.6.6). This is a notable disconnect between findings from the TKTLU and TK Reports and the Historical Resource Assessment. Historical resources, particularly grave sites, have extreme cultural importance to Fort McKay Community members and unless these sites are listed under the Historical Resources Act there is no guarantee of their protection. In Shell's application, there is no indication that these sites were listed under the Historical Resources Act and this is of high concern to the Community. Fort McKay would like to see protection placed on these and other graves throughout their traditional territory.

The TK Report concludes that "although the increasing levels of planned regional development will provide benefits to the community in terms of economic opportunities, these benefits are likely to have a negative effect on the potential to sustain the traditional way of life as an option for community members."

15.5 Key Concerns and Recommendations

The recommendations below relate to information found in Shell's three reports regarding traditional knowledge and land use. In addition to the following comments and recommendations, there are several important recommendations related to traditional land use and access management presented in the:

1. Socio-economic Assessment Review (Molstad and Anderson 2009)
2. FMSA (Fort McKay 2010a-2010c).

[151] Intellectual Property Rights

Shell states that the TKLU Report assessment expands on the TLU assessment completed for the Muskeg River Mine Expansion (Shell 2005), the Jackpine Mine – Phase 1 (Shell 2002) and the Traditional Land Use Environmental Setting Report (Golder 2007). To ensure the respect for Fort McKay intellectual property rights, Fort McKay requests that copies of interview notes, audio recordings and spatial data gathered during this current application and past Shell projects are given to the Fort McKay IRC. As stated in the signed TEK Sharing Agreement between Shell and Fort McKay, Shell has agreed to "provide to the Holder and to the IRC any and all data and information collected as they relate to TEK or aspects of TEK so that a permanent record can be kept in Fort McKay."

As well, the TK Report indicates that interview recordings and transcripts were provided to the Fort McKay IRC, however it is unclear if spatial information was also provided.

[151] Recommendation

Fort McKay would requests that Shell provide copies of all interview notes, audio recordings and spatial data (in a shape file format) gathered during this current application and past Shell projects to the Fort McKay IRC.

[152-153] Reclamation Planning

Fort McKay has identified species with high cultural salience that play an important role in Community identity: moose (*Alces alces*), beaver (*Castor canadensis*), ratroot (*Acorus americanus*), bog cranberry (*Oxycoccus oxycoccus*), lowbush cranberry (*Viburnum edule*) and blueberry (multiple species). Fort McKay would like these species and their habitat to be considered during reclamation planning and Shell should indicate to Fort McKay how this is being done.

Although Shell indicated that traditional land use was an important end land use for reclaimed areas, they did not discuss specific reclamation practices to reestablish habitat for culturally important plants and wildlife. Fort McKay would like Shell to describe how they will reclaim land for traditional purposes, including which plant species and animal habitat will be targeted.

Additional discussion and recommendations regarding traditional use species in reclamation may be found in the Fort McKay reviews of Shell's Terrestrial Vegetation, Wetlands and Forest Resources Assessment (Section 9), Wildlife (Section 10), and Closure, Conservation and Reclamation Plan (Section 12).

[152] Recommendation

Fort McKay would like Shell to support reclamation research for Fort McKay's cultural keystone species and ensure that these species are considered in reclamation planning. In addition, Shell should provide regular updates on reclamation research and reclamation progress for these and other species.

[153] Recommendation

Fort McKay would like Shell to describe how they will reclaim land for traditional purposes, including which plant species and animal habitat will be targeted. As reclamation research and practices evolve, Fort McKay would like to Shell to provide updates and opportunities for discussion regarding the status of reclaiming land for traditional use.

[154] Disturbance

During the traditional knowledge and land use assessments trappers identified berry harvesting and other traditional use sites that will be directly impacted by the proposed Projects. These areas will no longer be available for traditional purposes during the operation phase of the Projects, and ability to reclaim these sites for traditional purposes remains unknown. The near-term and long-term

impacts on cultural land use opportunities are significant as a result of the Projects, particularly when combined with other project developments taking place within Fort McKay's Traditional Lands.

Not only are hunting, trapping, fishing and plant harvesting sites of concerns to Fort McKay. There is high concern for the long-term safety and protection of graves and spiritual sites near or adjacent to the proposed Projects. To address the collective concerns for the protection of these valued cultural locations, Fort McKay would like to collaborate with Shell to develop a mitigation and offset plan.

[154] Recommendation

Fort McKay would like to collaborate with Shell to develop a mitigation and offset plan in relation to the adverse effects and loss of key cultural and traditional use areas that would be affected by the JME and PRM.

[155-156] Cultural Retention and Trapper Compensation

Each of the trapline holders interviewed actively use their land for traditional purposes and expressed concern about the increasing amounts of land on and adjacent to their traplines being taken up by development. In response, Shell has indicated that they will compensate directly affected trapline holders according to industry standards. While this may address some financial considerations related to the loss of hunting and trapping opportunities it does not take into account impacts to traditional knowledge transmission and teaching. Further work is necessary to comprehensively address the significant adverse effects of industrial development on Fort McKay's cultural heritage related needs.

[155] Recommendation

Fort McKay would like Shell to contribute to further development of Fort McKay's Cultural Heritage Strategy and other programs aimed at strengthening individual and Community health.

[156] Recommendation

Fort McKay would like to confirm that Shell will continue ongoing consultation with affected trappers regarding project development and provide compensation or implement mitigation measures as needed following the Fort McKay Trapper Compensation Guidelines.

[157-158] Access Management

Though Shell has indicated that they will facilitate trapper access through the proposed Project area to their traplines, there was no discussion in this section regarding management of increased public access to traplines resulting from Project development.

In addition to concerns about trapline access within the Project lease boundary, the larger uptake of land by industrial development throughout Fort McKay's Traditional Lands has led to changing land use patterns and loss of land to pursue cultural activities. The cumulative impact of development is increasingly challenging the Community's land use rights. In partial response, Fort McKay has has developed their own Protected Areas Strategy and is a vocal and active participant in the Lower Athabasca Regional Plan.

[157] Recommendation

Fort McKay would like Shell to establish access management plans, in collaboration with the Fort McKay IRC, to facilitate Fort McKay Community member access to traplines and other traditional use areas throughout the life of the mines.

[158] Recommendation

Fort McKay would like the Government of Alberta to support and include the current and future submissions by the Community of Fort McKay in the Lower Athabasca Regional Plan.

[159] Wildlife

Recent surveys carried out by the Sustainable Resource Development as part of the Fort McKay Country Food Availability Study have shown that moose populations have declined within Wildlife Management Area 531, which overlaps Fort McKay's Traditional Lands west of the Athabasca River (SRD 2009). Additional studies are needed to ascertain the status of moose populations throughout Fort McKay's traditional lands (see wildlife recommendations in the FMSA, Fort McKay IRC 2010) as well as other species valued by the Community. Fort McKay would like to discuss with Shell and ASRD conducting population and habitat studies with species that are important to the Fort McKay Community members. For instance, trappers note that bear populations seem to be in decline and would like research completed to understand their status.

[159] Recommendation

Fort McKay would like to discuss with Shell and ASRD conducting population and habitat studies with species that are important to the Fort McKay Community members. Fort McKay may wish to be involved with the resulting research and monitoring.

[160-162] Graves and Spiritual Sites

Community members interviewed for the TK Report recommended that the graves are not disturbed and that protective fencing is erected around the gravesites. The interviewed elder who has buried a family member on the PRM lease site wishes to visit the gravesite.

[160] Recommendation

Fort McKay may want to request a trip to the gravesites for the elder who has family buried on the PRM lease site prior to lease development.

[161] Recommendation

Fort McKay may want to request that graves identified within the Project lease boundaries have protective fencing erected.

[162] Recommendation

Fort McKay would like to have grave sites identified during the TLU studies listed under the *Historical Resources Act* with the intent of guaranteeing their protection from current and future development.

[163] Monitoring

Current and long-term health and sustainability of Fort McKay's traditional lands remains of highest concern to the Community. Accurate and reliable baseline studies as well as ongoing monitoring of various ecological parameters as development and reclamation take place are critical to ensure environmental sustainability. Various regional multi-stakeholder organizations such as TEEM, CEMA and RAMP are engaged in regional monitoring efforts. As well, industrial developers in the regional engage in environmental monitoring within their leases. All of these monitoring efforts are taking place on Fort McKay Traditional Lands and Community members would like the opportunity for involvement (e.g., collect and assess environmental information) so that they may participate in monitoring and managing their traditional lands.

[163] Recommendation

Fort McKay may want to request that Shell discuss their environmental monitoring efforts, as both an individual operator and as part of a multi-stakeholder organization member, and identify opportunities for Community involvement.

[164] Cultural Heritage Assessment

Traditional knowledge and land use studies are an important component of any Environmental Impact Assessment, expressing information about project specific impacts on both current and future traditional land use opportunities. However, traditional knowledge and land use studies are generally limited to use of the land for cultural, spiritual and recreational purposes, and on their own do not fully address the larger cultural shifts a community experiences as a result of industrial development. For example, a lost opportunity to hunt moose reflects more than a loss of meat. Loss of hunting opportunities impacts cross-generational knowledge transmission, language, community cohesion through

sharing meat, and much more. The FMSA, particularly the CHA Baseline and CHA Project-Specific assessments (see Fort McKay IRC 2010a-2010c), offer a vital compliment to conventional traditional knowledge and land use studies by addressing a more comprehensive Community-specific perspective on developmental impacts on all aspects of cultural heritage.

Fort McKay has been actively engaged in regulatory processes associated with oil sands applications and approvals for the past two decades. As noted through continued comments on project Terms of Reference, resulting EIAs do not provide sufficient and appropriate information to determine the effects of the project on Fort McKay's cultural heritage as well as the environmental, traditional and cultural resources of importance to the Community. Following discussion and agreement with Governments of Canada and Alberta, and Shell, Fort McKay conducted its own assessment – the Fort McKay Specific Assessment (FMSA). Due to the importance and value of the information derived from this process, Fort McKay would like to request that the Governments of Canada and Alberta continue to support the assessment process developed for the FMSA in future applications.

[164] Recommendation

Fort McKay requests that the Governments of Canada and Alberta continue to support the FMSA process in future regional development applications.

Table 15-1: Traditional Knowledge and Land Use Issues Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
151	Intellectual Property Rights	Fort McKay would requests that Shell provide copies of all interview notes, audio recordings and spatial data (in a shape file format) gathered during this current application and past Shell projects to the Fort McKay IRC.	Response, Agreement
152	Reclamation Planning	Fort McKay would like Shell to support reclamation research for Fort McKay's cultural keystone species and ensure that these species are considered in reclamation planning. In addition, Shell should provide regular updates on reclamation research and reclamation progress for these and other species.	Agreement

Number	Fort McKay Key Concern	Recommendation	Category
153	Reclamation Planning	Fort McKay would like Shell to describe how they will reclaim land for traditional purposes, including which plant species and animal habitat will be targeted. As reclamation research and practices evolve, Fort McKay would like to Shell to provide updates and opportunities for discussion regarding the status of reclaiming land for traditional use.	Agreement, Regulatory
154	Disturbance	Fort McKay would like to collaborate with Shell to develop a mitigation and an offset plan in relation to the adverse effects and loss of key cultural and traditional use areas that would be affected by the JME and PRM.	Agreement, Regulatory
155	Cultural Retention and Trapper Consultation	Fort McKay would like Shell to contribute to further development of Fort McKay's Cultural Heritage Strategy and other programs aimed at strengthening individual and Community health.	Agreement
156	Cultural Retention and Trapper Consultation	Fort McKay would like to confirm that Shell will continue ongoing consultation with affected trappers regarding project development and provide compensation or implement mitigation measures as needed following the Fort McKay Trapper Compensation Guidelines.	Agreement
157	Access Management	Fort McKay would like Shell to establish access management plans, in collaboration with the Fort McKay IRC, to facilitate Fort McKay Community member access to traplines and other traditional use areas throughout the life of the mine.	Agreement
158	Access Management	Fort McKay would like the Government of Alberta to support and include the current and future submissions by the Community of Fort McKay in the Lower Athabasca Regional Plan.	Regulatory
159	Wildlife	Fort McKay would like to discuss with Shell and ASRD conducting population and habitat studies with species that are important to the Fort McKay Community members. Fort McKay may wish to be involved with the resulting research and monitoring.	Agreement, Regulatory

Number	Fort McKay Key Concern	Recommendation	Category
160	Graves and Spiritual Sites	Fort McKay may want to request a trip to the gravesites for the elder who has family buried on the PRM lease site prior to lease development.	Agreement
161	Graves and Spiritual Sites	Fort McKay may want to request that graves identified within the Project lease boundaries have protective fencing erected.	Agreement
162	Graves and Spiritual Sites	Fort McKay would like to have grave sites identified during the TLU studies listed under the Historical Resources Act with the intent of guaranteeing their protection from current and future development.	Response, Agreement, Regulatory
163	Monitoring	Fort McKay may want to request that Shell discuss their environmental monitoring efforts, as both an individual operator and as part of a multi-stakeholder organization member, and identify opportunities for Community involvement.	Agreement, Regulatory
164	Cultural Heritage Assessment	Fort McKay requests that the Governments of Canada and Alberta continue to support the FMSA process in future regional development applications.	Regulatory

***Recommendation Categories:**

Agreement - recommendation that Fort McKay consider this as an item to negotiate with Shell in their Agreement

Regulatory - recommendation that Fort McKay consider this an item to recommend to the regulators (e.g., potential approval or licence condition, assessment approach)

Response - recommendation that Fort McKay request a response from Shell providing clarification or more information as outlined

15.6 References

FMA Heritage Consultants Inc (FMA). 2008. *Fort McKay First Nation Traditional Knowledge Report*. Prepared for the Jackpine Mine Expansion and Pierre River Mine Environmental Impact Assessment. In *Pierre River Mine Supplemental information, Part 2 Supplements, Appendix A. Prepared for the Shell Canada Jackpine Mine Expansion and Pierre River Mine EIA.* Prepared at request of Fort McKay Industry Relations Corporation.

Fort McKay First Nation. 1994. *There is Still Survival Out There*.

Fort McKay Industry Relations Corporation. 2010a. *Fort McKay Specific Assessment.*

Fort McKay Industry Relations Corporation. 2010b. *Fort McKay Specific Cultural Heritage Assessment (CHA) Baseline: Pre-development (1964) to Current (2008).*

Fort McKay Industry Relations Corporation. 2010c. *Fort McKay Project-Specific Cultural Heritage Assessment for the Jackpine Mine Expansion and Pierre River Mine Project.*

FRM Environmental Consulting (FRM). 1998. *Traditional Fisheries of the Fort McKay First Nation*. Prepared for Alberta Pacific Forest Industries. Prepared by Slav Stanislawski. December 1998.

Golder 2007. *Traditional Land Use Environmental Setting Report*. Prepared for Shell Canada Ltd. in Shell Pierre River Mine and Muskeg River Mine Expansion EIA, Appendix 3.

Molstad and Anderson. 2009. *Socio-economic Impact Assessment Review* for Shell's Jackpine Mine Expansion and Pierre River Mine Project.

Shell Canada Limited. 2002. *Application for the Approval of the Jackpine Mine – Phase 1 Mine.*

Shell Canada Limited. 2005. *Application for the Approval of the Muskeg River Mine Expansion.*

Shell Canada Limited. 2007. *Application for the Approval of the Jackpine Mine Expansion and Pierre River Mine Project.*

16.0 VISUAL AESTHETICS

16.1 Visual Aesthetics Impacts

In Shell's visual asethitics Base Case description, they indicate that "there are no direct lines of site from Fort McKay to its projects". They also state that trappers cabins would not have views of the projects due to the forested landscape (AXYS 2005).

The Application Case includes a new bridge across the Athabasca River as well as a water intake. Shell included measures to address the IRP (ASRD 2002) that include finishing the bridge with low-glare materials, vegetation buffers near the bridge, water intake placed in an area not prominently visible to Athabasca River users and finished in materials that blend with the river bank, as well as minimal vegetation clearing and re-vegetation of cleared areas.

Shell produced a number of viewsheds maps that show where various features (visible air emissions, buildings at the plant sites, and mine landforms) of the JME and PRM projects will be visible from. The Community of Fort McKay is within the viewshed study area.

The visible air emissions (plumes) viewshed for both JME and PRM is quite large; meaning anyone with a view of the horizon could see the plumes. However most of the study area is forested, and due to forest cover, the plumes would not be visible if the viewer within a forested area.

Shell reports that the plant site viewshed for JME includes the plateau that surrounds the plant site ares but that due to forest its unlikely that the plant site would be viewable from many locations use. Mine features of the JME would be visible along the eastern shore of Kearl Lake as well as portions of the Muskeg River.

For the PRM, the plantsite would be visible from a few areas along the Athabasca River and from portions of the eastern shore of McClelland Lake. With regard to the PRM, Shell incates that the viewshed is limited and that it is unlikely that there would be clear views of landforms from the Athabasca River.

Shell did further analysis of views from the various points described above. In the figures presented by Shell the plumes are the most obvious feature (from viewpoints at Kearl Lake and along the Athabasca River). Mine landforms are also visible as homogeneous horozontal areas (from viewpoints at Kearl Lake and Muskeg River), which Shell indicates will blend fairly well with the surrounding environmental once reclamation is complete.

Shell concludes that there will be a moderate magnitude residual impact during operations for landscape units AE18, AW16, and AW18, which are all near the PRM along the Athabasca River. All other viewpoints were rated by Shell as having a neglible visual impact.

16.2 Visual Aesthetics Assessment

Shell's aesthetics assessment was thorough. The viewshed maps and viewpoint figures were very helpful in understanding the potential views of the facilties.

16.3 Visual Aesthetics Key Concerns and Recommendations

With regard to the Community of Fort McKay, Shell indicated that under the Base Case there were no direct visual lines of site from their projects. Shell did not comment specifically if this was the case with the Application Case.

The results of the viewshed analysis indicate that some of the project features would be noticeable at some locations along the Athabsca River, McLelland Lake, the Muskeg River and Kearl Lake. Therefore, any Fort McKay community members who are using these areas would potentially see features of Shell's Project's (plumes, plant sites and mine landforms) and that could affect their enjoyment of the land.

[165] Recommendation

Fort McKay may want to request that Shell comment specifically as to whether any of the proposed Project's features (plumes, plant sites and mine landforms) will be visible from Fort McKay. Fort McKay may also want to request that Shell consult with them regarding aesthetic changes to the landscape.

Table 16-1: Visual Aesthetics Issues Summary Table

Number	Fort McKay Key Concern	Recommendation	Category
165	Visual Aesthetics	Fort McKay may want to request that Shell comments specifically as to whether any of the proposed Project's features (plumes, plant sites and mine landforms) will be visible from Fort McKay or from cabins within the viewshed. Fort McKay may also want to request that Shell consult with them regarding aesthetic changes to the landscape.	Response, Agreement

16.4 References

ASRD. (Alberta Sustainable Resource Development). 2002. Fort McMurray – Athabasca Oil Sands Subregional Integrated Resources Plan. Approved by Cabinet on May 7, 2006. Amended June, 2002. Publication No. I/358. Alberta Sustainable Resources Development. Edmonton, AB.