

## **Appendix D**

### **Technical Review Reports - Shell Pierre River Mine Project**

## **Appendix D-1**

**Shell Jackpine Mine Expansion and Pierre River Mine Project – Environmental  
Impact Assessment Methodology Review for Athabasca Chipewyan First Nation –  
April 5, 2010, by C. Dana Bush of Bush Ecology**

# **Shell Jackpine Mine Expansion and Pierre River Mine Project**

## **Environmental Impact Assessment Methodology Review for Athabasca Chipewyan First Nation**

**By:**

**C. Dana Bush (Bush Ecology)**

**April 5, 2010**

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### **1.0 Introduction**

The methods used in Environmental Impact Assessments (EIAs) have a direct bearing on the results of the impact assessment. Problems with environmental impact analysis, and in particular cumulative effects analyses, have been addressed in several key papers (Kennett 1999 and 2000; Duinker and Greig 2006). Several of their criticisms of cumulative effects assessments are pertinent to this EIA. In particular:

- Cumulative effects arise from individually insignificant but cumulatively important activities, and are not adequately addressed;
- The analysis of cumulative effects requires better baseline information and analysis on a regional level, at a scale appropriate to the Key Indicator Resource (KIR) being analyzed; and
- Determination of significance (or environmental consequence) requires clear definitions, and in lieu of biological thresholds, should use very conservative cut-offs.

The EIA for the Jackpine Mine Expansion (JME) and the Pierre River Mine Project (PRM) consists of several volumes and addenda:

- Volume 5: Environmental Impact Assessment, December 2007;
- Environmental Setting Report, December 2007;
- Environmental Assessment Update, May 2008 (excluding the Fort McKay lease and separating the JME and PRM);
- PRM Supplemental Information with an EIA update, May 2007;
- Shell Jackpine Mine Expansion and Pierre River Mine Project EIA Update, December 2009;
- Pierre River Mine Project Supplemental Information, May 2009.

In addition, the original EIA combined the data and discussion from the two projects, even though they were distinctly different projects, on different sides of the Athabasca River, with different soil and vegetation conditions, and with different issues. An update was issued in 2008 that separated the two projects. As a consequence of these numerous volumes, following the logic from methods to conclusion was difficult.

## 1.1 Environmental Setting and Scope

The Jackpine Mine Expansion (JME) Local Study Area (LSA) is in the Central Mixedwood Natural Subregion. The LSA is along the Muskeg River, east of the Athabasca River, and covers 18,348 ha, based on the project development area plus a 500 m buffer zone. The JME “is primarily composed of a large, intricate wetlands complex that follows the Muskeg River, which is bound by the Fort Hills to the north and uplands near Kearn Lake to the south. The wetlands complex is primarily fens, but also includes bogs and non-peatland wetlands”, including a patterned fen in the NE. Only 13% of the LSA is upland, with 59% of the area wetlands (mostly peatlands), 17% burn, and 11% disturbances such as cutblocks, borrow pits, well sites, borehole pads, clearings, roads, rights-of-ways, trails and seismic lines”.

The JME project is an expansion of the existing Jackpine open pit mine, and includes:

- Expanding the Jackpine Mine and adding more mining equipment;
- Constructing bitumen extraction and treatment facilities;
- Building an asphaltene fired co-generation plant;
- Increasing the annual water withdrawal from the Athabasca River;
- Constructing a new External Tailings Disposal Area.

The Pierre River Mine (PRM) LSA is in both the Central Mixedwood Natural Subregion and the Athabasca Plain Natural Subregion. The PRM LSA is on the west side of the Athabasca River, and covers 21,136 ha. The Athabasca Plain Natural Subregion is warmer and has sandier soils than the Central Mixedwood Natural Subregion, and therefore has more upland forest than is typical in the Boreal Forest. It includes a higher proportion of merchantable timber, and the Calamut Old Growth Forest, and the Eymundson Sinkhole Environmentally Significant Areas. Two thirds (66%) of the PRM LSA is upland.

The PRM is a new open pit mine which includes:

- Mining equipment, infrastructure, processing and support facilities
- Site access infrastructure including a bridge across the Athabasca River;
- Constructing bitumen extraction and treatment facilities;
- Building an asphaltene fired co-generation plant;
- Building a water intake from the Athabasca River;
- Building a worker camp;
- Constructing a raw water and wastewater system, power distribution system, cooling water system, instrument and utility air system, a flare system, and new buildings;
- Constructing a new External Tailings Disposal Area.

## 2.0 Discussion

This section includes a discussion of some problems with the EIA methods used by Shell in their assessment of the Pierre River Mine and Jackpine Mine Expansion projects. Further details on the issues discussed here, and issues on data and data analyses are discussed in each specialist section.

1. Cumulative effects from individually insignificant but cumulatively important activities, and cumulative effects from previous activities are not adequately addressed;
2. Regional study area is too large to determine significance;
3. Significance (or environmental consequence) definitions are arbitrary or not biologically relevant;
4. Time lags from clearing to reclamation are not adequately assessed for wildlife, vegetation, or aboriginal use
5. The assessment is based on reclamation and reversibility which rely on broad definitions of success not in line with aboriginal values, weak assumptions, and short term data;
6. Lack of confidence in the data, assumptions, or predictions.

### 2.1 Baseline Data

### 2.2 Cumulative assessment is done after the project assessment

Section 1.3.3 states that “ The Base Case includes consideration of the existing environmental conditions as well as existing and approved projects or activities within the study area” and the Planned Development Case (PDC) “assessment is completed only when the predicted residual impacts predicted for the Application Case are rated greater than negligible”.

In practice, this custom of conducting cumulative impact assessments only on residual project effects ignores the premise behind cumulative effects - that they are the result of many small impacts, most of which are negligible when considered in isolation. In addition, the assessment of residual impacts relies on several unsubstantiated assumptions for mitigation (this point is discussed further down).

Cumulative impact assessments would more effectively evaluate impacts if they were conducted first, to assess the cumulative impacts of prior developments, i.e. how has the vegetation been affected by development and is it already significant. If the impacts are already significant, then additional developments, even if less than 1 %, will contribute a *small incremental increase to an already significant impact.*

***Please justify why cumulative impacts should be assessed after project impacts.***

**2.2.1 Impact Description Criteria (Table 1.3-4, EIA) does not consider confidence in the final impact rating.**

Low or even moderate confidence in the predictions should influence the final classification and should be displayed in the table

*Please explain how confidence was included in the final impact rating and include confidence in the summary table*

**2.2.2 The use of a current Baseline Scenario does not support a cumulative effects assessment.**

The Base Case includes consideration of the existing environmental conditions as well as existing and approved projects or activities within the study area” (Section 1.3.3 EIA).

By using a current baseline case, the EIA is incapable of assessing the current impacts as there is no undeveloped scenario with which it can be compared. The predicted changes are meaningless from a wildlife or vegetation standpoint if it is not also understood how much change has already occurred to wildlife populations and habitat in the region. Satellite data and air photo data is available for pre-oil sands development period, and other EIAs have used a ‘hypothetical baseline’ where the developments are lifted off and the polygons joined together. This allows the assessment to evaluate the current impacts (and to determine if they are already significant), the project, the project and the current impacts, and planned developments.

*Use either a pre-development baseline or a hypothetical baseline to assess the current cumulative effects, and then assess the addition of the project.*

**2.3 Regional Study Area too large**

The large size of the Regional Study Area (RSA) obscures the cumulative effects. The JME comprises less than 1% of the RSA (10,036 ha / 2,277,376 ha = 0.48%) which increases the probability that the contribution of project-related effects will be assessed as ‘negligible’ under the effects assessment methods used in this EIA. In addition, the ‘one size fits all’ approach used in this assessment does not meaningfully address effects on all species. The RSA may be appropriate for large roaming animals such as moose, but it is inappropriate to smaller animals such as beaver and Canadian toad (see Wildlife and Vegetation for further discussion).

*Please justify the use of a large RSA and explain how any area based KIRs could be significant if the LSA is less than 1% of the RSA (for JME or PRM) or 1.7% (for both projects combined).*

## 2.4 Lack of Regional Data

Regional data is not available at a scale appropriate to analyze the cumulative impacts on KIRS of interest to the ACFN. As a result, Shell uses coarse scale maps (LANDSAT satellite image classification) at the RSA level to develop Land Cover Classes. Land Cover Classes are generalized vegetation types (6 upland and 3 wetland native vegetation types plus a burn category). These broad classes cannot differentiate the impacts on, for example, patterned fens (Section 7.5.2), or between a marsh and an open bog. Analyses of traditionally used plants or rare plant potential using these coarse scale maps is virtually meaningless, as they include vast areas of unsuitable habitat.

***Work with CEMA to develop ELC level maps for the regional study area. This will require data sharing and similar databases.***

## 2.5 Reclamation and Reversibility

Reclamation is a core part of any EIA (Environmental Impact Assessment), as the assumption of successful reclamation is used to mitigate the project impacts, resulting in low residual impacts. The definition of reclamation and reversibility, and the assumptions used in assessing reclamation success are therefore critical. The EIA states that

*“Shell’s reclamation goal is to achieve maintenance-free, self-sustaining ecosystems with a capability equivalent to predevelopment conditions (EIA Section 1.2 EIA)”*

*“The target vegetation communities identified in the C&R Plan are conceptual, and it is not currently possible to predict ecosystem succession over time.”*

*“Project areas will be reclaimed with native vegetation as soon as practical” (EIA Section 8.1.3.3.).*

*“Because ecosystems are dynamic, a site is considered to be restored if natural succession processes are restored. Reversibility does not necessarily require the establishment of a mature stage of the successional pattern, but can be achievement of a development stage that can be assumed to be moving towards an acceptability stage of maturity” (EIA Section 1.3.6.1).*

There is little discussion of diversity in the reclaimed landscape, and the time-line is considered long-term but is not specified. The final landscapes in the Jackpine Mine Expansion and Pierre River Mine Project will be noticeably different than the original, with more large hills, 4 times the area of open water with fewer peatlands and less riverine habitat, no old growth forest (within human generations), more non-native species, and far fewer native species than in an intact boreal forest. By using a low diversity reclaimed landscape in an unspecified time-line as a goal, the EIA can confidently claim that reclamation will be successful and most impacts will be reversible, and that the prediction confidence is high for uplands and moderate for riparian communities.

Several examples follows with further details in the Vegetation and Soils sections:

- peatlands cannot be reclaimed, however the EIA lumps marshes and treeless bogs as 'non-treed wetlands' and then assumes that a reclaimed non-treed wetland (i.e. a marsh) will offset the loss of the bogs. Marshes and treeless bogs are not biologically equivalent.
- direct placement of suitable material to reclamation areas will enhance site revegetation, however only 1/3 of the topsoil will be used for direct placement: the rest will be stored until final reclamation, by which time most seeds and propagules will have died.
- reclamation plans include trees and shrubs but very few forbs, and the size of the mine in addition to the proximity and size of neighboring mines will preclude the natural invasion of most native plant species.

In addition, the degree of success in reclaiming all of the tailings ponds (in-pit and external ponds) is uncertain, as new technology is required. The water, the shallow groundwater, and the soils in these areas are likely to be contaminated with process – affected water. This will result in salt-affected soils (saline and sodic soils) over an unknown percentage of the areas. The soils may also be contaminated with hydrocarbons and trace elements. These contaminated landscapes will be permanent and should be identified as long term, adverse effects

It is perfectly acceptable to use ecosite phase as a target, but to assume that reclamation will succeed to ecosite phase (which includes forbs), and to base an assessment on this assumption, exceeds the current scientific knowledge and presents the illusion of full restoration.

***Please provide scientific evidence that community and species biodiversity will be restored within the 80 year timeline.***

## **2.6 Time-Lags**

The EIA for the Jackpine Mine Expansion and Pierre River Mine Project states that clearing is planned to begin in 2010 but revegetation at JME is planned for 2034, 24 years later. Clearing is planned in 2010 at the PRM, soil salvage in 2017, with soil placement and revegetation beginning in 2039 (C&R Section 20.2), 29 years later. As a result, there will be a significant time-lag before the post-reclamation forest is useable by animals and people, especially by those species who require old growth forest. Mature lichen jackpine forests may take 60 years or more to develop (ESR Table 3.3-7), and it is not known how long it will take lichen to develop (for caribou), or for a blueberry and cranberry understory (for animals and people).

For fisheries, there will be a substantial time-lag between the clearing and the construction of compensation lakes and channels. The Muskeg River will be diverted through pipes and fish will be transported by truck to Kearl Lake for 30-40 years before the final channel system is constructed. A compensation lake will be constructed for the

PRM but there are no dates provided and no discussion of when they would be capable of supporting fish and other aquatic organisms.

The obvious conclusion is that for at least 34 years (24 years from clearing to reclamation and 10 years of growth) there will be a loss of moose habitat, 40 years for fish habitat, more than 85 years for caribou habitat, and more than 125 years for old growth forest. Shell uses 80 years.

The Wildlife and Vegetation Sections in the JME and PRM EIA assume that after this time-lag, plants, animals, and fish will move into the area without assistance. The EIA doesn't explain 1) what will happen to those animals in the meantime, and 2) where the plants and animals will migrate from to repopulate the areas specially if there are also adjacent mines with no animal habitat (i.e. the Jackpine mine to the south). The Wildlife Section of the EIA assumes that moose, for example, will move away from the lease into surrounding areas. This assumes that there is 'empty' habitat available, which is not substantiated in the report.

In addition, oil sands operators may not release their leases after reclamation because they need continuing access for operations, and because they prohibit access and/or firearms for safety reasons. The JME and PRM areas may be inaccessible for aboriginal users for many years after reclamation.

The result is a large area of forest that has 1) no access, 2) no or low numbers of traditionally used plants and animals for several human generations. The time-lags for clearing, construction and reclamation will result in a loss of cultural knowledge for two to four generations of people, as the ACFN can't hunt, trap, fish, or gather plants during operations and reclamation. Aboriginal users consider the physical loss of food and the cultural loss of knowledge to be a significant impact (Dersch and Bush 2008).

The second concern with the long timelines is the ability to detect slow developing problems. Monitoring may not detect problems with reclamation, with animal or plant immigration, or with seepage of contaminated water into the groundwater for 20 years. Detection may be too late for adaptive management, especially in the case of groundwater contamination.

## **2.7 Environmental Consequence and Thresholds**

Environmental Consequence ranks are used to determine whether or not a measurable impact will have significant impacts to the Key Indicator Resources (KIRs) (such as moose or traditionally collected plants). Proponents are required to assess magnitude, geographic extent, duration, reversibility, and frequency; however there is little guidance on what constitutes high, medium, or low impacts. The proponent generally develops these definitions and thresholds during the EIA process, and different EIAs have different thresholds.

While some thresholds are based on widely accept guidelines (i.e. Air Quality Guidelines), others are relatively arbitrary. For example, high magnitude impacts have been set at 10%, 14% or 20% change in other EIAs: in this EIA, Shell has chosen 20% as the cutoff for high magnitude impacts. In some EIAs, the magnitude is based on the

percentage of the KIR (e.g. peatlands) however the JME and PRM EIA uses the percentage of the Regional Study Area (RSA). Clearing in the JME and PRM “will result in the removal of 1,223 ha of the old growth forest, representing a loss of 2% of the LSA” (EIA Table 7.5-18). However, the table indicates that 40% of the old growth forest in the LSAs will be removed. The Residual Impact Classification assigned a low magnitude for old growth forests, based on the LSA not the resource (Table 7.5-34). This evaluation understates the impacts to old growth forests in the JME and PRM areas.

In addition, the rating systems used by Shell are ill defined or ignored in some sections. The rating system for Water Quality Guidelines (slightly, marginal and substantial) is unclear and subjective, and the impact ratings were inappropriately used for temperature changes to Eymundson Creek. In the Fisheries Section of the EIA, heavy metals were assessed against benchmarks, and then the benchmarks were disregarded. There is little value in assessing impacts and then disregarding the results because the methods were flawed.

Many of the thresholds used by Shell in the JME and PRM EIA have little biological relevance. For example, the Alberta Air Quality Guidelines are based on human health, not ecosystem health. Although other EIAs also use the more sensitive World Health Organization guidelines to assess the effects on vegetation, Shell relies on the provincial criteria which is not relevant to vegetation. From an aboriginal perspective the WHO guidelines make more sense, for if the ecosystem is not healthy then neither are the people.

Numerous traditional land use surveys report that aboriginal users are very concerned with tainted fish. Although there is evidence of tainting (CEMA, 2007), it is not known what causes the tainting nor is there an estimate of the proportion of tainted fish therefore tainting is not considered to be environmentally significant.

In the Hydrology Section of the EIA, the effects of water drawdown is considered high if it is greater than 1 m, and low if it is less than 10 cm. The significance of drawdown, however, will depend on the shape of the wetland: a wetland with a wide shallow margin may be significantly impacted by a 9 cm drawdown, whereas a wetland with a narrow shallow margin may not be. This arbitrary threshold has no biological relevance.

Synergistic effects are effects that work together so that the total effect is greater than the sum of the two (or more). Several of the concerns from ACFN may be due to synergistic effects, such as cancer rates or fish tainting, however none of the sections in the EIA discuss synergistic effects. In particular, there are no assessments of mixtures of chemicals in air or water, and their effects on aquatic organisms, fish, or terrestrial receptors. Research into fish tainting shows that it does occur, it is not due to naphthenic acids, but may be due to a mixture of compounds (CEMA, 2007). Synergistic effects may also be due to a combination of chemicals, changes in edaphic conditions and biotic conditions. Reclaimed areas will have high levels of PAI (Potential Acid Input), poor soil conditions, and impoverished vegetation diversity, but the EIA does not consider the synergistic effects, nor does it consider these factors in the confidence predictions.

Finally, the method of combining the results of the impact criteria into one rating, (magnitude, geographic extent, duration, reversibility and frequency), based on an

arbitrary score serves to obscure a number of impacts. The vegetation section of this review considers this in detail.

## 2.8 Confidence and Assumptions

An assessment is only as good as the data and the assumptions that are used in the maps, models or conclusions. An EIA is to clearly state where the data and/or assumptions are weak so that the reviewers can understand and have confidence in the conclusions. This EIA contains a number of cases where the data is missing or weak, or the assumptions are not supported by science. A number of examples are listed below, with greater details included in each specialist's section.

- The Vegetation Section of the EIA uses existing Alberta Vegetation Inventories (AVI) as a basis for developing ecosite phase maps for the LSA, and LANDSAT satellite image classification at the RSA level, but there is no discussion of the accuracy of the maps or whether field data was used to test the accuracy. The resulting maps are used as the basis of the vegetation and wildlife assessment leaving the reader to guess at the accuracy of the assessment.
- Old growth forest is assessed, in the EIA, using an 80 year fire cycle which estimates 20-28% old growth using modeling and air photo interpretation (AVI); however other peer reviewed research, some of which is based on actual data, estimates fire intervals at 34 years or 5% old growth in the RSA. This contradictory data is not discussed in the report leading to a lack of confidence in the assessment of old growth forest.
- In the Soils Section of the EIA, the Land Cover Class is used as a goal; however the text states that it is not to be used for assessment and only applies to white spruce-mesic soils. The reclamation assessment assumes that reclamation will achieve the specified landforms based on CEMA design guidelines, and that reconstructed soils will mimic natural soils, but there is little or no evidence to support these assumptions.
- The Reclamation Section of the EIA does not state how Shell intends to process mature fine tailings, nor does it describe how Shell will meet Guideline 74. The assessment assumes that small experimental ponds will predict the changes in large ponds that are becoming increasingly toxic as water is recycled.
- The Reclamation Section of the EIA is based on a broad definition of 'successfully reclaimed' which will result in a different terrain, a loss of peatlands and low biodiversity. In addition, reclamation has only been done on overburden sites not on tailing sands, and there is limited years of data.
- The Wildlife and Vegetation Sections of the EIA assume that the landscape will be reclaimed to ecosite phase and use ecosite phase for the predictive models. Shell presents no data to support this assumption.
- The assessment assumes that animals pushed out of the mine area will move into unfilled territory, but there is no research to support this.
- The Hydrology section of the EIA claims that changes in surface water upon disturbance of land between the Muskeg River and the McClelland Fen will not

impact McClelland Fen; however fens are fed by groundwater, which may be altered by construction. The water levels in the Athabasca River were at an all-time low in 2009. The EIA does not indicate if their models predicted the low years in 2007-2008. The report does not address sediment quality nor does it assess the impacts to water quality and fish health. The existing Jackpine mine has problems with their monitoring programme and the 2007 results and yet they are confident that future impacts can be accurately predicted.

- The Surface Water Quality Section of the PRM EIA relied upon the uncertainty analysis conducted for the JME. No independent uncertainty analysis was conducted for the PRM data or predictions. Considering different datasets were used and that some of the PRM predictions relied upon information provided and modelled by another project (CNRL Horizon), it would seem prudent to conduct an uncertainty analysis specific to this project.
- The Fish and Habitat Section of the PRM EIA did not provide a timeline for construction of the compensation lake or discuss how long fish habitat would be lost.
- The EIA contains no discussion or assessment of mercury in the no net loss ponds (end pit lakes), or how to remove the mercury.

In summary, the EIA contains several instances where model results were not verified or did not correlate with field data, where models relied heavily on unproven assumptions.

## 2.9 Monitoring

Hydrology - monitoring plans barely mention. Shell indicates that they will modify the existing network of flow and water level monitoring stations during operations. No details are given about hydrologic monitoring as required by the Terms of Reference Section 5.6.6 (iii) and 6.0. Shell provided the location of the monitoring plans (Vol. 4B, App 4-9, Section 3). They suggested that the request to review monitoring and research plans might be discussed as part of future negotiations towards an agreement.

**Recommendation:** ACFN should follow up on the requested commitment to be involved in future hydrologic monitoring and research plans.

## 3.0 References

- CEMA (Cumulative Environmental Management Association), 2007. Oil Sands End Pit Lakes: A Review to 2007.
- Duinker, Peter N. and Lorne A. Greig. 2006. The impotence of cumulative effects assessment in Canada: Ailments and Ideas for Redeployment. Environmental Management Vol. 37(2):153-161.

Geographic Dynamics Corp (GDC). 2002. Shrub species review for boreal ecosite reestablishment in the Oil Sands Region. A report prepared for the Oil Sands Soil and Vegetation Working Group, Fort McMurray, Alberta by Geographic Dynamics Corp., Edmonton, Alberta.

Hegmann, G. C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling and D. Stalker, and AXYS Environmental Consulting Ltd. 1999. Cumulative Effects Assessment Practitioners Guide.

Kennett, Steven A. 1999. Towards a New Paradigm for Cumulative Effects Management. CIRL Occasional Paper # 8. Canadian Institute of Resources Law. University of Calgary.

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## **Appendix D-2**

**Cumulative Effects Review of Shell Pierre River Mine and Shell Jackpine Mine  
Expansion Projects for Athabasca Chipewyan First Nation, August 2010, by Daniel  
Smith of DS Environmental Consulting Inc.**

# **Cumulative Effects Review of Shell Pierre River Mine and Shell Jackpine Mine Expansion Projects**

**For Athabasca Chipewyan First Nation**

**Daniel Smith (DS Environmental Consulting Inc.)**

**August 2010**

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## **1.0 Cumulative Effects**

### **1.1 Overview**

The assessment of both the Shell Pierre River Mine and Jackpine Mine Expansion Projects did not adequately assess or consider the cumulative effects and impact of the project in conjunction with other past, present, and future projects on the traditional lands, traditional use, and rights of the ACFN.

### **1.2 Assessment Review**

There are serious flaws with the approach and cumulative effects assessment methodologies used by Shell in this assessment. These include:

- Lack of a pre-industrial basecase – In both the Pierre River Mine and Jackpine Mine Expansion Projects assessments all impacts were compared against an artificially high basecase that is based on all current operating projects plus all previous approved (but not yet operating) project – all operating simultaneously at their maximum. This serves to mask any possible impact that the proposed project would have – especially when applied to an excessively large regional study area. A true cumulative effects assessment would have used a pre-industrial baseline. A 1970 pre-industrial baseline would be reasonable for the region since the first large industrial projects (i.e. Syncrude and Suncor) did not begin large scale operations until after this time.
- Unrealistic 'basecase' used in the assessment – Shell used three assessment cases in the assessment of the Pierre River Mine and

Jackpine Mine Expansion Projects. The ‘basecase’ (as required by the terms of reference) is an artificial construct that includes all currently operating and approved projects operating at their maximum levels. This does not consider the effects of historic impacts of all activities and impacts to-date. While the ‘Project Case’ does form a partial cumulative assessment (but only as far as adding in the proposed project on top of those which have already been approved), it is not at all adequate to address the impacts that have taken place due to previous industrial activities nor does it adequately address the future projects. The ‘Planned Development Case’ is supposed to include all reasonably expected and know projects, but this was only used by Shell on a limited number of impacts.

- Limited cumulative assessment of impacts - the current practice of only doing an assessment against the “Planned Development Case” (i.e. looking at the cumulative impacts of future projects) when project level impacts at the local or regional scale are shown to be significant is not a reasonable or pre-cautious approach to cumulative effects assessment and provides a biased assessment. It presumes that because the effects of any one project are determined to of low environmental consequence at a project level, that these effects will not be significant (or remain of low consequence) when the impacts of future projects are considered.
- The EIA, including the cumulative assessment, is narrowly scoped and, as such, it fails to address the issues of the ACFN related to Rights and traditional use. The cumulative assessment required by the Terms of Reference is limited and inadequate. Shell even fails to achieve this test. The current approach to cumulative assessments, as encouraged by Alberta, requires a narrow, project-specific approach that looks at the cumulative effects mostly when the the proposed project is predicted to have a significant effect at a local scale. However, it is well understood that cumulative effects can be relatively insignificant at the project-scale, but can be significant at larger scales of space and time.
- The cumulative assessment needs to consider the current baseline first. This should be inventoried and compared with the pre-industrial baseline to determine if the increment of change and impacts detected are acceptable. Next the assessment should verify that that anticipated impacts of the approved projects still meets the test of acceptability – given the new baseline. Finally, the new predicted impacts of the proposed project should be assessed and tested against the current and ‘approved’ cases.
- There are no regional management targets, policy guidelines, or thresholds for most of the traditional resources important to the ACFN. These are necessary to ensure that these resources are sustained at levels appropriate for and acceptable to the ACFN’s practice of their Rights. In absence of these targets, guidelines, and thresholds, the

predictions in the EIA, and the promises of the Proponent to monitor and restore (and the conditions of the government's approval) are of negligible value.

There are also a number of significant deficiencies with regards to cumulative effects that were identified in the review of both the Pierre River Mine and Jackpine Mine Expansion Projects. Many of these deficiencies affect the ability of the ACFN to use its traditional lands and to exercise their rights with respect to traditional use. These include:

- Land disturbance:
  - Direct loss of traditional lands - leads to a loss of harvesting areas, spiritual sites, oral traditions (stories linked to specific landscape features that transmit important traditional knowledge), hereditary harvesting and hunting rights (linked to a complex social network) - as well as traditional knowledge related to all the above;
  - Impacted access, connectivity, use, and occupancy of traditionally important areas.
- Aquatic ecosystem impacts:
  - Long-lasting and adverse impacts on groundwater and surface water quality, and their potential use by ACFN members, due to seepage from the proposed external tailings disposal area (ETDA);
  - Impacts on water quality, aquatic health, fish, and fish habitat - plus a persistent uncertainty about the quality and integrity of these resources from project-related and cumulative effects to water;
  - Diversions, withdrawals, and watershed disturbances which will contribute to flow reductions in the Athabasca River and to impacts on the Peace-Athabasca Delta.
- Air ecosystem impacts:
  - Increases in foul odour occurrences at some cabin locations and, potentially, at the ACFN's Poplar Point Reserve;
  - Impacts of degraded air quality on human health, wildlife health, and plant health - plus a persistent uncertainty about the quality and integrity of these resources from project-related and cumulative effects to air;
  - Increased acidic deposition affecting water and traditional plants.
- Terrestrial ecosystem impacts:
  - Restricted wildlife movement along the Athabasca River (a major regional wildlife movement corridor) and related effects on the

exercising of the ACFN's Rights within their traditional territories, including the success and quality of those hunts.

- Loss of wildlife, wetlands, and traditionally important plants;
- Long-lasting (or permanent) changes in biodiversity and habitat;
- Unproven reclamation, resulting in simplified landscapes and more open water (in the form of pit lakes).

## 1.3 Key Concerns

Several key concerns were identified with regards to cumulative effects during the review. These include:

### 1.3.1 Water Quality

1. Cumulative Impacts on Athabasca River from process-affected seepage. Tailings ponds (both in-pit and out-of-pit varieties) are a major physical feature of conventional oil sands operations. Current estimates are that the present ponds contain 840 000 Mm<sup>3</sup> of contaminated water (ERCB, 2010). Both the Pierre River Mine and Jackpine Mine Expansion Projects would add to this inventory. These ponds leak and their seepage is known to contaminate underlying groundwater and contribute toxins from baseflow to the Athabasca River. The current and future cumulative effects of all the current and planned tailings ponds in the region on the Athabasca River are unknown. The residual impacts on groundwater and surface waters could last decades if not centuries after these ponds are closed and reclaimed.

Because the Athabasca River will receive process-affected seepage from tailings ponds located on both sides of the river, a cumulative effects assessment on tailings ponds seepage was required for the Pierre River Mine Project. Shell concluded that the net cumulative impact of the seepage on the Athabasca River would be insignificant. However, there is new information indicating that concentrations of toxins in the Athabasca River are significantly elevated downstream of the current oil sands projects relative to the concentrations upstream (Kelly et al., 2009, Kelly et al., 2010; Timoney & Lee, 2009).

#### ➔ Recommendations:

- i. Discuss the apparent contradiction between modeled forecast for the concentrations of toxins in the Athabasca River and current data presented in Timoney & Lee (2009) that suggests that the impacts are already significant.*

- ii. Identify the impact of the cumulative effects of regional tailings seepage on groundwater and surface water quality and on downstream ecosystems (including the sediments of the Athabasca River and the Peace-Athabasca Delta), against a pre-industrial baseline.*
- iii. Discuss how the cumulative impacts of regional tailings seepage will affect the ACFN's Rights and use of traditional resources.*

2. Cumulative effects of the discharges from multiple end pit lakes into the Athabasca River not adequately assessed.

Shell did not adequately assess the cumulative effect of simultaneous water discharge from multiple end pit lakes into watercourses connected to the Athabasca River. Many of the region's oil sands projects are operating on similar timelines and consequently will have pit lakes working at the same time. If several end pit lakes are discharged within similar timeframes into the Athabasca River, there may be incremental increases in contaminant and nutrient loadings to the Athabasca River, the Athabasca Delta and the western portion of Lake Athabasca, possibly impacting their water quality. The lack of guidelines for the release of pit lake waters adds to the uncertainties related to contaminant concentrations of regional water quality. Diluting water quality constituents to below guidelines levels does not diminish the issue of the incremental and cumulative effects of multiple releases on receiving waters.

➔ **Recommendations:**

- i. Assess the cumulative impact of the discharges of multiple pit lakes in the region on water quality in the Athabasca River and, on downstream ecosystems.*
- ii. Identify how the cumulative impact of multiple pit lakes discharges in the region would affect the ACFN's Rights and traditional use of the River.*

### 1.3.2 Aquatics

3. Regional and cumulative effects on fish populations and habitat productivity not assessed. Oil sands operators plan to replace disturbed fish habitat with constructed habitat on a case-by-case basis as required by the federal Fisheries Act. However, the process for replacing fish habitat is experimental and unproven. In addition, there has never been an assessment of the cumulative impact of all of the regional No Net Loss (NNL) projects. Ideally, each NNL pond would replace the habit lost to oil sands projects in advance of the destruction and on a 2:1 basis. However, since there are no functioning NNL projects in the region, it is uncertain

how well compensation habitats will work or how long before they reach their full productivity (i.e. minimally replacing lost habitat, and possibly contributing to gains in fish habitat). Fisheries and Oceans Canada will require long-term monitoring to verify the habitat replacement and productivity gains. There should be a contingency plan in case the NNL plan(s) does not meet expectations.

With the mining-related loss of fish habitat and the construction of NNL habitat, there will be a shift of riverine (stream and river) habitat to lacustrine (lakes) habitats. On a regional scale this could be significant and should be assessed.

In addition, there is a concern about the release of mercury, from the construction of the NNL reservoirs into aquatic environments and subsequently into fish and other aquatic organisms, and ultimately humans. This is likely also a cumulative effect due to the number of NNL reservoirs being planned or built in the region, which may affect the Athabasca River and downstream ecosystems. No assessment of the cumulative effects of the release of mercury from all regional NNL reservoirs has been completed.

**→ Recommendations:**

- i. Assess the regional and cumulative effects on fish populations (including species richness) and habitat productivity of multiple NNL fish habitat compensation projects. Include impacts on:
  - a. regional fish population and species richness;*
  - b. total effective habitat units (by fish species);*
  - c. productivity of habitat;*
  - d. form of habitat – change from riverine to lacustrine;*
  - e. mercury levels in fish and aquatic systems from NNL projects.**
- ii. Identify the impact of the cumulative effects noted above on the ACFN's traditional resource use and their Rights. Specifically, identify how the shifts in species and habitat types, along with the time lags and mercury contamination of fish, would affect the ACFN's traditional use and ability to exercise their Rights. Provide documentation to the regulators that these predicted effects have been submitted to the ACFN for verification. Provide documentation that the ACFN have provided this verification.*

4. Inadequate assessment of impacts from losses of multiple streams in the region. Many small streams are being impacted or lost by increasing

regional disturbances. There are many unknowns about the role these streams play, collectively, on regional aquatic health and hydrology.

→ **Recommendations:**

- i. Assess the cumulative effects of the loss of the region's many smaller tributary streams on aquatics and hydrology:*
- ii. Document changes in species richness and quality of habitat, range and populations of affected species, and predicted timeframe(s) to replace these losses in quality and quantity of habitat.*

### 1.3.3 Hydrology

5. Cumulative impacts to the Athabasca Delta not assessed. Shell assesses changes in water depths and flows in the Athabasca River, but does not assess the effect of cumulative changes in water depths on the Athabasca Delta. Changes in depth and flow affect the Delta and reduce flushing of side channels and perched water bodies. Changes to the delta directly affect area residents.

→ **Recommendations:**

- i. Extend the Regional Study Area (RSA) for surface water hydrology from Embarras Portage to the inflow of Lake Athabasca (i.e. encompass the Athabasca Delta).*
- ii. Re-calculate the impacts, including those on the Athabasca Delta.*
- iii. Given the significance of the Delta to the ACFN, commit to provide the predictive results to the ACFN and to seek the ACFN's verification of these predictions based on the TEK of the ACFN.*

### 1.3.4 Air Quality / Emissions

6. Cumulative effect of multiple projects on regional air quality inadequately assessed. Incremental increases in air emissions from each new project in the region adversely affect the overall regional air quality and, ultimately, the health of the ecosystem and animals (including humans). Shell's method of assessing effects, using an artificially high baseline, masks the true magnitude of this effect. Prior to major industrial projects in the late 1960's emissions of air pollutants were near zero. These days there can be no denying the massive amounts of air contaminants being emitted in the Oil Sands Region.

→ **Recommendations:**

- i. Assess and provide an analysis on the cumulative effects of the growth of air emissions in the region using a pre-industrial baseline and projecting this out by 100 years – (i.e. from 1965 to 2065).*
- ii. Provide a summary table of the projects included in the various assessment cases with their projected emissions listed over the same time frame as above.*

### 1.3.5 Wildlife

7. Cumulative effects of tailings ponds on migratory bird populations not assessed. Because of the proximity of the Pierre River Mine and Jackpine Mine Expansion Projects to regionally or provincially significant migratory staging areas (Athabasca River, McClelland Lake, Kearn Lake, etc.), risks of exposure of migrating water birds to tailings might be increased. Cumulative effects of tailings ponds in the oil sands region on wildlife (including migratory birds) have not been assessed.

The ACFN are concerned with mortality of migratory birds exposed to tailings ponds. An assessment of the cumulative effects of all existing, approved, and planned oil sands tailings ponds should be included in the EIA – using a pre-industrial baseline.

**→ Recommendations:**

- i. Provide the results of a comprehensive assessment of the cumulative effects of oil sands tailings ponds on migratory bird populations and health – based on a pre-industrial baseline.*
  - ii. Discuss the effects of these changes on traditional use and on the ACFN's Rights.*
8. Cumulative effect of multiple projects on wildlife inadequately assessed. Incremental increases in disturbed land area from each new project in the region adversely affect both local and regional wildlife. Shell's method of assessing effects, using an artificially high baseline, masks the true magnitude of this effect. Prior to major industrial projects in the late 1960's impacts on wildlife were restricted to local hunting pressures. Currently wildlife are impacted by many more factors, the majority of which are related to the oil sands industry

**→ Recommendations:**

- i. Provide estimates of wildlife populations, habitat availability, and vegetation communities (including wetlands) under pre-industrial conditions, and compare these to the present day and 'Base Case' scenarios.*

- ii. Identify the expected area of land from which wildlife and vegetation would migrate back into the reclaimed land, taking into consideration any nearby operations which would be also be cleared.*
- iii. Discuss and assess the impacts of the changes in wildlife in the region on traditional use and on the Rights of the ACFN.*
- iv. Given the significance of the wildlife to the ACFN's traditional use and Treaty and Aboriginal rights, commit to provide the predictive results to the ACFN and to seek the ACFN's verification of these predictions based on the TEK of the ACFN.*

### **1.3.6 Vegetation & Wetlands / Biodiversity**

9. Project-related and regional loss of wetlands inadequately assessed. The Pierre River Mine and Jackpine Mine Expansion Projects are just one of many projects that would lead to the destruction and loss of natural wetlands in the region. As stated in the *CEMA Guideline for Wetland Establishment on Reclaimed Oil Sands Leases* (Harris, 2007), “Natural boreal wetlands are a critical habitat for many important wildlife species, including woodland caribou, moose, muskrat, waterfowl (particularly diving ducks) and amphibians”, and “Wetlands in the oil sands region are indelibly linked to the traditional way of life... People of the Fort McKay, Anzac, and Fort Chipewyan communities continue to use wetlands for subsistence hunting and trapping, for food and medicinal plant collection, and for spiritual well-being”. A realistic assessment of the cumulative loss of wetlands in the region and the effects of this loss on the traditional use and Rights of the ACFN, using a pre-industrial baseline, has not yet been conducted.

**→ Recommendations:**

- i. Discuss and assess the cumulative impacts arising from the Pierre River Mine and Jackpine Mine Expansion Projects predicted permanent wetland loss, as well as the total loss of wetlands in the entire Oil Sands Region on biodiversity, habitat loss, wildlife, traditional users, groundwater, surface water, and vegetation. Use a pre-industrial baseline for all assessments.*
- ii. Discuss the impact of the loss of wetlands on traditional use and on the Rights of the ACFN.*

10. Impacts of combined air emissions on vegetation key indicator resources unclear. The increase in nitrogen causing eutrophication is a concern - nitrogen accumulates in the environment causing long-term to permanent changes.

While nitrogen is a naturally occurring nutrient, most northern vegetation communities are adapted to low nitrogen levels. The addition of nitrogen to treed bogs and poor fens may result in a shift in species, and, potentially, an increase in sedges and shrubs and a decrease in mosses and lichens (depending on the species). Plant species particularly adapted to low nutrient conditions, such as pitcher plant (which is both rare and collected for use by Aboriginal users) may be out-competed in a more nutrient-rich environment. Although the area potentially affected is small, the long-term impacts may be noticeable to Aboriginal users and wildlife.

The combined effects of acid deposition, sulphur dioxide, nitrogen dioxide, and eutrophication on treed / poor bogs may cause more permanent changes than anticipated. The interrelationships between these elements and northern Canadian ecosystems are not well understood, and therefore the confidence level in these assessments is not high.

**→ Recommendation:**

*Provide a qualitative description of how air emissions (Potential Acid Input, SO<sub>2</sub>, NO<sub>2</sub>, and eutrophication) might cumulatively affect plants around the mine during operations and reclamation, taking synergistic effects into consideration.*

### 1.3.7 Reclamation

11. Reclamation of wetlands as upland forest inadequately assessed and planned. Loss of large landscape-sized wetlands is happening at every oil sands mine in the region, including the Pierre River Mine Project. Much of the large areas of wetlands removed as a result of oil sands mining is expected to be reclaimed as upland forests, constituting a major shift in the ecosystem of the region.

**→ Recommendation:**

*Present the area of wetlands in the region that would be converted into uplands.*

### 1.3.8 Traditional Land Use

12. Cumulative impacts to traditional users not fully addressed. The ACFN are concerned that the impacts from both the Pierre River Mine and Jackpine Mine Expansion Projects, and the regional industrialization as a whole,

would have near permanent impacts on the ACFN's use of this area for traditional purposes.

**→ Recommendation:**

*Re-assess the cumulative impacts from both the Pierre River Mine and Jackpine Mine Expansion Projects and nearby operations, using actual data from reclamation efforts from these neighbouring operations. After identifying the gaps between what was promised and what was delivered, identify what mitigations Shell would consider. Use a pre-industrial baseline for the assessment.*

13. Industrial activities directly and indirectly impact on Traditional Land Uses and practice of Aboriginal and Treaty rights. The incremental and increasingly prevalent impacts of industrial activity, both in the region and locally, will have a significant and long-lasting impact on First Nation members. With each new industrial project in the region there are incremental and cumulative impacts that cause increased traffic and congestion; light pollution; noise; odours; off-road use; hunting pressures; displacement of wildlife; habitat loss and fragmentation, loss of traditional plants and berries; contamination of traditional foods, air, water, etc. In turn there is increased competition for traditional resources; impediments to access to preferred harvesting areas; deteriorated quality and quantity of traditional resources; deteriorated aesthetic and spiritual qualities of harvesting and occupancy areas; psychosocial barriers to harvesting; and, a decreased ability to pass traditional knowledge and cultural practices to younger generations. The additional stress and anxiety among ACFN members that results from both a lack of confidence in the quality and safety of traditional foods and from impacts to cultural and community well-being as traditional practices begin to decline, is an important effect that goes unexamined and unaccounted for. While the impacts of each individual project may seem insignificant and go unnoticed, over time the additive effects may result in considerable and permanent environmental, socioeconomic, and cultural losses.

Combined, these impacts result in a decreased ability to practice Treaty and Aboriginal rights, and ultimately in a loss of culture and connection to the land. People use the land less; they take fewer trips and collect fewer foods and medicines; their ability and desire to use the land for traditional purposes is significantly and irreversibly impacted, resulting in more store bought foods, less exercise, fewer social gatherings, loss of language, and poorer health and well-being. In short, industry's presence impacts the ACFN and its practice of Treaty and Aboriginal rights

**→ Recommendations:**

- i. Assess the direct and indirect effects of both the Pierre River Mine and Jackpine Mine Expansion Projects, in combination with all other regional projects, on the well-being and culture of the ACFN.*

*Take into consideration the incremental and cumulative effects of industry and other activities in the region.*

- ii. Assess the direct and indirect effects of the Pierre River Mine and Jackpine Mine Expansion Projects in combination with all other regional projects (in the past, present, and future) on the ability of the ACFN to practice their Aboriginal and Treaty rights.*

## **2.0 Literature Cited**

Kelly, E.N., J. W. Short, D. W. Schindler, P.V. Hodson, M. Ma, A.K. Kwan, and B.L. Fortin. 2009. Oil sands development contributes polycyclic aromatic compounds to the Athabasca River and its tributaries. Proceedings of the National Academy of Sciences of the United States of America. Volume 106 no. 52.

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Timoney, Kevin P. and Lee, Peter. 2009. "Does the Alberta Tar Sands Industry Pollute? The Scientific Evidence" *The Open Conservation Biology Journal*, 3 (2009): 65-81.

## **Appendix D-3**

**Shell Pierre River Mine Project – Environmental Impact Assessment Report –  
Review for Athabasca Chipewyan First Nation – Groundwater Component –  
September 2008, by Lew Fahner of Agua Consulting**

**Shell Pierre River Mine Project  
Environmental Impact Assessment Report  
Review for Athabasca Chipewyan First Nation**

**By:  
Agua Consulting  
September, 2008**

**Groundwater Component**

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## **1.1 Groundwater Component**

### **1.1.1 Overview**

Several of the activities associated with the Shell Pierre River Mine Project (PRMA) will impact the groundwater resources in the project area. These impacts may result in changes to groundwater levels, changes in groundwater flows and flow directions and changes in the groundwater quality. 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). Terrestrial vegetation can also be impacted by the proposed project.

Activities which are specific to the PRMA 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
- Mine pit backfill
- Reclamation and the mine closure landscape

#### **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 dewatering 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 local study area (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 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 range from 1,000 to 3,000 metres west from the mining area and up to 5,000 metres north and south from the mining area. Overburden dewatering may affect wetlands as well as terrestrial ecosystems and may induce seepages from the Athabasca River, although this seems unlikely based on current geological data.

The 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.

The dewatering 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 to be small, due to the low permeability of the underlying bedrock which naturally limits downward movement of groundwater.

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.

The water derived from this dewatering will be discharged to sedimentation ponds and then to the surface environment if the water quality is satisfactory. This will mitigate some of the losses of groundwater normally discharged to the surface water features.

### **Basal Aquifer Depressurization**

The Basal Aquifer is a geological unit occurring below the zone to be mined and is more extensive on the eastern side of the mining area near the plant site location. 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. Depressurization of the Basal Aquifer will have an effect on groundwater levels, flows and flow patterns of limited lateral extent in the Pierre River mine area and immediate vicinity.

The Basal Aquifer water level will be lowered in the mine area by pumping groundwater from the Basal Aquifer using depressurizing water wells. As pumping proceeds, the water level associated with the basal aquifer will decline to the maximum needed for mining to proceed. Depressurization of the Basal Aquifer will result in seepage from the Basal Aquifer from the area surrounding the mine. The water level decline, which will be greatest in the immediate vicinity of the pumping wells will gradually decrease with increasing distance from the depressurization wells. The decline is predicted to be limited to the mine area and immediate vicinity. The drawdown may result in changes to the amount of groundwater recharge/discharge from the Basal Aquifer to the shallow groundwater and surface water.

Basal Aquifer depressurization will 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, the hydrogeological conditions between the surface and the Basal Aquifer are of low permeability and the increase in the amount of groundwater moving downward is predicted to be minimal.

Groundwater from the depressurization of the Basal Aquifer will be incorporated into the mining operation via an expanded closed-circuit system collecting process-affected water and the External Tailings Disposal Area, and will not be released to the environment. This will offset some of the loss of Basal Aquifer groundwater discharge to the surface environment.

### **Pierre River Mine 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 ETDA is to be located away from the mining area and as such will be surrounded by undisturbed land. Construction and operation of the PRMA ETDA will result in changes to the local topography and groundwater levels and quality. The ETDA will be about 50 metres 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 and will minimize the amount reaching the Basal Aquifer. 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 from the ETDA, through the shallow groundwater flow system, will reduce the quality of the groundwater seepages to Big Creek and the Athabasca River valley.

During operations seepage from the ETDA to the Quaternary deposits (surface deposits) will be intercepted Toe ditches, seepage collection wells and collection sumps using toe ditches, seepage collection wells and collection sumps and returned to the tailings facility as part of the tailings management. 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.

### **Overburden Disposal Area**

Overburden will be stored in the north overburden disposal area, west of the plant site. Some of the precipitation which would normally recharge the groundwater system will be intercepted and discharged to the surface around the overburden disposal area. This will result in minor reduction to the amount of recharge and possibly reduce groundwater discharge to the surface water system. Perimeter ditches will collect runoff from the overburden area and direct it towards sedimentation ponds for release to the surface water system if the quality is satisfactory. This will mitigate some of loss of groundwater discharge to the surface.

### **Plant Site**

Construction and operation of the plant facilities have the potential to impact groundwater quality in the Quaternary deposit beneath the site. Various chemicals and materials are stored at the plant site. Storage and handling of these chemicals and materials can result in spills which could affect the groundwater quality below the spill. Potential effects were not specifically considered in the modelling. Potential plant site upsets are to be mitigated by use of a ditching and emergency dump pond collection system. Groundwater monitoring will provide additional protection against possible groundwater quality impacts.

## **Mine Pit Backfill**

Tailings will be stored in the mining pits as soon as there is sufficient space available to accommodate in-pit disposal. Once the backfilling commences, seepage from these deposits will begin and continue through operation of the mine and closure. 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.

Tailings will be placed behind low-permeability barriers to reduce the amount of seepage from the backfill. Tailings that will be placed in areas where there are sands and gravels will be separated from the sands and gravels by low-permeable materials to minimize seepage. During operations any seepage from backfilled areas within the mining pits will be contained within a closed water system, to prevent it from entering the environment, and will be used offsetting some process water demand

## **Reclamation and the Mine Closure Landscape**

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. The groundwater flow system which develops after mining ceases will be controlled by the precipitation infiltration rates that develop for the reclaimed landscape.

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, groundwater flow will remain permanently altered. Reduced groundwater flow to the Pierre River is predicted to continue after closure and reclamation due to the alteration of the topography and drainage patterns.

The ETDA will be a topography high, about 50 metres higher than the original ground surface elevation, and will become a groundwater recharge feature. 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 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.

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. The computer modelled 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.

## **1.1.2 Discussion**

### **Dewatering and Removal of the Overburden**

Mitigative measures to counter the effects of dewatering and removal of the overburden and the resulting reduction in discharge of groundwater to surface water features are planned and are likely to be effective. 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.

### **Basal Aquifer Depressurization**

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.

### **Pierre River Mine Project ETDA**

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. An outcome should be process-affected free groundwater in the surficial deposits around the ETDA. Mitigation should 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. The improvement in groundwater quality will be very slow.

### **Overburden 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.

### **Plant Site**

Although the storage and handling of chemicals and materials at the plant site have 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.

### **Pit Backfill**

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.

### **Reclamation and the Mine Closure Landscape**

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. The existing projects are insufficiently advanced to have long-term experience with some planned mitigative measures and the proposed outcomes.

### 1.1.3 Assessment Review

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 existing and approved developments (the base case), the proposed PRMA 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 Quaternary (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”.

Several computer model simulations have been used to predict changes and impacts of the proposed development on the groundwater resources of the area. 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 PRMA is located on the west side of the Athabasca River and further north than most previous mining projects and as a result there 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.

### 1.1.4 Key Concerns

1. The PRMA may affect the ability of the ACFN to harvest traditionally-used plants that are dependent on groundwater flow for survival.

ACFN people could be impacted by the loss of groundwater-supported wetland areas which may contain traditionally used plants that are dependent on groundwater for survival. 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 impacted by process-affected groundwater from areas where tailings have been stored and may be less desirable areas for the collection of plants.

### Recommendation

It is recommended that the ACFN discuss the locations of traditionally-used plants, that may be in the area impacted by the PRMA, with the proponent and to confirm

that the proponent is aware of where they exist and that where necessary, mitigative measures to protect the growing environments are planned.

2. The PRMA may affect the ability of the AFCN to access traditionally used groundwater sources.

ACFN people could be impacted if any groundwater sources (waterwells, dugouts, muskegs or springs) which are used by AFCN residents when visiting traditional lands (for hunting, gathering or trapping) in the proposed mine or the immediate surrounding area. Any groundwater sources located in the mining area will be permanently impacted and/or be unsuitable for further use. Any groundwater sources located in the surrounding area may be permanently or temporarily impacted and may or may not be unsuitable for further use after closure and reclamation.

### **Recommendation**

It is recommended that the AFCN discuss the locations of traditionally used groundwater sources that may be in the area impacted by the PRMA and to confirm that the proponent is aware of where they exist and that where necessary, mitigative measures to protect the sources are planned.

3. Groundwater incidents (unexpected groundwater quantity and/or quality changes) are reported to the authorities.

The AFCN may want to be advised of any groundwater incidents reported to the authorities and to be provided with the outcome of any investigations.

### **Recommendation**

It is recommended that the AFCN 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.

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

Groundwater monitoring must demonstrate that project activities are proceeding without unreasonable impacts on the groundwater resources in the area. AFCN may want to have copies of the proposed groundwater monitoring programs made available to, and discussed with, the community. Any discussions should focus on how the proposed groundwater monitoring will confirm that computer-predicted impacts are accurate.

### **Recommendation**

It is recommended that the proponent be asked to prepare a table summarizing computer-predicted and professional judgment impacts and to outline the groundwater level and/or quality monitoring to be undertaken to verify the predictions. As monitoring data becomes available it should be added to the table and the updated table should be shared with the ACFN. Deviations from the predicted impacts which indicate that impacts have been underestimated should result in a reassessment of those impacts, updating of the table and reassessment of mitigative measures. The ACFN should be provided with the results of any reassessment of mitigative measures.

### **Other Items**

1. The PRMA ETDA is predicted to be filled by 2029; reclamation is planned for 2049 when the ETDA will be capped and reclaimed.

What conditions prevent reclamation from being done earlier?

This is particularly important since the ETDA is located on undisturbed surface and is isolated from the mining area. Many mines have the ETDA surrounded, or partially surrounded, by backfilled mine pits which help control some of the process-affected seepages entering undisturbed surficial materials and possibly discharging as baseflow to nearby surface water bodies.

## **Appendix D-4**

**Shell Jackpine Mine Expansion and Pierre River Mine Projects Responses to ACFN  
SIRs – Environmental Impact Assessment Report Review for Athabasca Chipewyan  
First Nation – Groundwater Component, August 2009, by Lew Fahner of Agua  
Consulting**

**Shell Jackpine Mine Expansion and Pierre River Mine Projects  
Responses to ACFN SIRs**

**Environmental Impact Assessment Report  
Review for Athabasca Chipewyan First Nation**

**By:  
Agua Consulting  
August, 2009**

**Groundwater Component**

The groundwater SIRs were essentially the same for the two projects and Shell's responses are therefore essentially the same. The following comments apply to both sets of SIRs for the groundwater resources component.

**SIR #1** – Shell acknowledges that there will be an impact on traditional plants and that the most feasible mitigation is to re-establish areas capable of supporting traditional plants after reclamation. However, CEMA (2007) indicates that, based current reclamation knowledge and experience in the region, organic bogs and fens cannot be reclaimed. ACFN community member's access to plants in the local study area will be impacted for a significant period of time. If ACFN community members gather plants from the area to be effected, further discussion may an appropriate during agreement negotiations.

**SIR #2** – Groundwater from fens is often used during traditional pursuits as a water source as the inflow-outflow of groundwater makes it suitable for consumption. Shell indicates that it is not aware of any groundwater use, other than possibly at trapper's cabins. If ACFN community members use groundwater in the local study area, further discussion may an appropriate during agreement negotiations.

**SIR #3** – Shell agrees to discuss groundwater incident reporting with the ACFN as part of future negotiations towards an agreement.

**SIR #4** – Shell included a proposed groundwater monitoring program in Volume 4B, Appendix 4-9 Section 2.1. The proposed monitoring program has not been designed to confirm computer-predicted and professional judgements impacts on groundwater resources, which is desirable from the ACFN's perspective to confirm that impacts are not under-estimated on any traditionally-used land. Shell indicated that it may agree to reassess mitigative measures as part of future negotiations but did not express any willingness to develop a groundwater monitoring table to simplify the presentation of monitoring data and make it easier to review by ACFN community residents.

Reference: CEMA, 2007. Guideline for wetland establishment on reclaimed oil sands leases (revised second edition) Prepared by M.L. Harris for CEMA Wetlands and Aquatic Subgroup of the Reclamation Working Group, Fort McMurray, Alberta December 07.

This update to the review of the Pierre River Mine EIA, dated August 2008, is based on the Supplemental Information (May 2009) filed by Shell Canada Limited.

Additional fieldwork has primarily enhanced the understanding of the geology of the area. However, the update has some important groundwater-related items from the perspective of ACFN.

Shell has committed (Response 319 b) to the installation of mitigation measures along the perimeter of the External Tailings Disposal Area (ETDA) to manage ETDA seepage and ensure that groundwater quality is acceptable, which has been indicated to be when the seepage can be released without adverse effects on the health of aquatic, terrestrial or human receptors.

Shell will comply (Response 209g) with ERCB Directive 074 (Tailings Performance Criteria and Requirements for Oil Sands Schemes) which will result in reduced-fluid tailings allowing for earlier trafficable deposits with reclamation to commence within 5 years.

Shell plans (Response 405f) to avoid local groundwater discharge zones at closure to prevent salinization by directing groundwater discharge to wetlands and end-pit lakes. ACFN should discuss what fieldwork will be done after closure to confirm that no such discharge zones develop with time, as the groundwater flow system re-establishes. (Is there an opportunity for ACFN employment here?)

Shell's supplemental information and responses to AENV and ERCB SIRs confirm that significant groundwater monitoring is being planned. However, there is still a need to have background and ongoing monitoring data presented in a form which will facilitate assessment by community members to confirm that professional judgment and computer-predicted outcomes are valid in areas of concern regarding the ability of the ACFN community to continue to use Traditional Lands as they have in the past.

## **Appendix D-5**

**Shell Pierre River Project Environmental Impact Assessment Report - Review for  
Athabasca Chipewyan First Nation, September 25, 2008, by Fay Westcott of  
Clearwater Environmental Consultants**

# Shell Pierre River Project

## Environmental Impact Assessment Report Review for Athabasca Chipewyan First Nation

By:

Clearwater Environmental Consultants Inc.

Sept. 25, 2008

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### 1.1 Introduction

As a part of their application of approval of expansions to their current oil sands operations, Shell Canada Limited (Shell) has submitted an Application and Environmental Impact Assessment (EIA) for the Jackpine Mine Expansion and Pierre River Mine Project. This application and EIA are also used to support their request for operating approvals under the Alberta Oil Sands Conservation Act, Alberta Environmental Protection and Enhancement Act (EPEA) and Alberta Water Act. Shell is seeking approval for development of a new mine located on the west side of the Athabasca River (Pierre River Mining Area – PRMA). The project would specifically affect portions of the Pierre River, Asphalt Creek, Eymundson Creek, Big Creek and Redclay Creek watersheds, as well as reaches of the Athabasca River. This application and EIA have been reviewed on behalf of the Athabasca Chipewyan First Nation (ACFN).

The objectives of this review of these Applications and the EIA are to:

- Assess whether the EIA is based on adequate data
- Determine if the analysis and conclusions presented are adequate
- Identify potential issues of concern for the ACFN and provide recommendations

**Note to Dan: This review did not assess whether the EIA adequately addresses the Terms of Reference, as this information was in another binder and not on the CD.**

This review includes the following components:

- Surface Water Quality
- Aquatic Health
- Fish and Fish Habitat

The following documents were consulted in order to conduct this review of Shell's Pierre River Mine Project:

- Volume 4A: Aquatic Resources
- Volume 4B: Aquatic Resources Appendices

## 1.2 Overview

Overall, the Aquatic Resources components of the Shell JEMA and PRMA Project EIA were well done, well detailed and logical. However, the combination of two completely separate projects into one Application and EIA was very difficult to review. I would recommend that this approach not be permitted in the future. The rationale for the inclusion of both projects was unclear and not described in the EIA. The projects are on the opposite sides of the Athabasca River, and not physically connected. If Shell were concerned about providing a better cumulative effects impact assessment for these two projects, then that was not achieved, as cumulative effects on the Athabasca River (the only common LSA and RSA areas for the two projects) was done in a cursory manner and not a true cumulative effects analysis.

In reality, it appears that the only reason that these two projects (JEMA and PRMA) were combined into one Application and EIA is that the compensation plans for both projects have been consolidated into one area, located in the Pierre River Mine area. It is alarming that the Muskeg River watershed will be so disturbed by existing, approved and planned projects, that there is no room for locating on-site compensation efforts for one of the many projects within the watershed.

When impacts were identified, their significance was often downplayed. For example, several metals were found to exceed the benchmarks for aquatic health, but the impacts were considered negligible because the benchmarks didn't really represent an impacted state or were not appropriate for the area. In addition, other metals for which impacts were predicted were considered to be overestimated due to the conservative assumptions used to complete the assessment. If the benchmarks can be so easily disregarded, then perhaps a more stringent method of determining benchmarks should be employed, so that meaningful results can be determined. There is little value in assessing impacts, and then disregarding the results because the methods were flawed.

Some information on End Pit Lakes and the research going on into them was provided, which was good, as little information has been provided in previous oil sands mine EIAs.

The Conceptual Compensation Plan puts forward a combined plan for both the PRMA and JEMA projects. The habitat units and actual productive capacity of fish habitat to be lost in either the PRMA or JEMA projects were not determined at this stage, nor was the productive capacity of the proposed compensation habitats. The proposed compensation would be a lake and two channels, which are intended to compensate for the habitat losses for both projects. Similar to other regional mine plans, the majority of the compensation appears to be for

lacustrine habitat, while the majority of losses would be for riverine habitat. Without additional information, and in particular, habitat unit information, it is not possible to assess the adequacy of this compensation plan.

Overall, the major concerns for the PRMA project regarding surface water quality, aquatic health and fish and fish habitat components are:

- Water quality effects of construction of the bridge over the Athabasca River and the intake within the Athabasca River are not discussed and no mitigations are provided
- The water quality limits for pit lake discharges are unknown
- A cumulative effects analysis on water quality, aquatic health and fish and fish habitat on the Athabasca River was not conducted (Note to Dan: I am not entirely sure on this, because the full PDC is in another binder that I didn't have)
- Aquatic health benchmark exceedances were dismissed
- The Conceptual Compensation Plan does not determine the productive capacity of lost habitat or compensation habitat, therefore it is not possible to determine whether the proposed plans are sufficient.

## 1.3 Surface Water Quality

### 1.3.1 Overview

The Pierre River Mine (PRMA) would be located about 100 km north of Fort McMurray, Alberta, on the west side of the Athabasca River. Fort McKay is the closest community, and is about 35 km to the south. The new development would produce up to 200,000 bbl/cd of bitumen and would include a new mining area and associated processing facilities, utilities and infrastructure. A new bridge over the Athabasca River would also be associated with this project.

The key environmental issues arising from the projects with respect to surface water quality are:

- Changes in constituent concentrations in water and sediment of watercourses and waterbodies
- Changes in the thermal regime and dissolved oxygen levels of receiving waters
- Effectiveness of mitigation and environmental management plans to reduce effects
- Attainment of relevant water and sediment quality guidelines
- Water quality of pit lakes and their releases
- Confidence in water quality predictions
- Climate change effects on water quality and water temperatures

- Acidification of surface waters resulting from air emissions

An Aquatics LSA has been defined for PRMA to encompass the aquatic resources which may be potentially affected by the development area. The LSA and RSA boundaries for Water Quality are the same as those for Fish and Fish Habitat, Surface Water Hydrology and Aquatic Health.

The south end of the PRMA includes the lower drainage areas of Pierre River, Asphalt Creek and Eymundson Creek watersheds. Diversion channels, polishing ponds, reclaimed mine pits, overburden disposal areas and pit lakes within PRMA would potentially affect the water quality of these areas.

The north end of PRMA includes the lower drainage areas of First Creek, Big Creek and Redclay Creek watersheds. Development in this area will include construction of stream diversion channels, raw water storage, a compensation lake and an ETDA. The Raw Water Storage Facility would be used as a Treatment Lake for reclamation waters from the ETDA from closure to the Far Future.

As a result of these physical plans, the LSA for the PRMA consists of the following areas:

- Big Creek watershed (Big Creek, First Creek, Cranberry Lake [unnamed Waterbody 15], Unnamed Waterbody 7)
- Pierre River watershed (Pierre River)
- Asphalt Creek watershed (Asphalt Creek, Eymundson Creek)
- Redclay Creek watershed (Redclay Creek)
- Athabasca River reach from the Pierre River to Redclay Creek

The RSA for the PRMA includes the LSA and the Lower Athabasca River from Fort McMurray to Embarras.

Potential effects of the Project are evaluated under conditions of pre-development, Base Case, Application Case and Planned Development Case (PDC). The Base Case assesses surface water and sediment quality due to existing environmental conditions as well as present and future activities of currently operating projects or approved developments that haven't been built yet. The Application Case considers the effects of the existing and approved developments and the Project. The PDC considers existing and approved developments, the Project, plus other potential developments that have been publicly disclosed. Currently, there are no existing or approved developments within the LSA, therefore the Base Case is the same as for pre-development conditions.

Surface water and sediment quality predictions and assessments are based on the environmental setting water and sediment quality, chemistry and toxicity for release waters and flow, seepage and water releases from within the LSA and RSAs. Historical or literatures records were used to characterize existing conditions of the water and sediment quality of major streams, rivers, lakes and ponds, including data collected by AENV, RAMP, AOSERP, Northern River

Basins Study, industry field studies and Shell's specific water and sediment quality field programs. Additional information was also provided by field studies on water and sediment quality up to July 2007.

### **1.3.1.1 Water Quality Baseline Conditions – LSA**

Currently, there are no existing or approved developments within the LSA, therefore the Base Case is the same as for pre-development conditions. However, a proposed Pierre River diversion channel will be merged with a 3 km long segment of an operational and closure diversion channel for CNRL's approved Horizon Project. Therefore, water quality of the proposed diversion in PRMA under Base Case conditions is characterized using water quality for Pierre River under pre-development and predicted constituent levels in the Horizon Project EIA.

Dissolved Oxygen (DO) conditions in surface waters of the PRMA are generally high in spring through fall and low in winter, with the exception of the Pierre River. DO concentrations in the Pierre River are consistently higher than acute and chronic aquatic life guideline values.

The watercourses and waterbodies occasionally have high concentrations of Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC), especially in Big Creek during the winter. TOC, DOC and TSS concentrations are typically lower in lakes with associated lighter colour than in streams, especially during open-water periods. The watercourses are generally alkaline with pH values within guidelines. Some waterbodies exceed the upper pH guideline.

Concentrations and seasonal trends of hardness, TDS, alkalinity and conductance and major ions in watercourses are generally similar to those in the Muskeg River. Similar to other small watercourses and waterbodies in the Oil Sands Region, sulphide concentrations frequently exceed the aquatic life guideline.

Concentrations of TSS in the Pierre River and Redclay Creek watersheds are generally low and similar to TSS levels in the Muskeg River watershed. However, TSS levels are higher in the watercourses in the Eymundson and Big Creek watersheds. High TSS values are more common in winter and spring, and are related to beaver activity, geology and local topography. These values are associated with high levels of particulate-bound phosphorus, nitrogen and metals, resulting in concentrations of these parameters that exceed aquatic guidelines.

Metal concentrations are significantly higher in Eymundson and Big Creek watersheds than in the Pierre River and Redclay Creek watersheds, especially for metals associated with TSS, and have more guideline exceedances. The Horizon Diversion Channel is predicted to have elevated concentrations of aluminum, cadmium, copper, silver, sulphide and total phenolics that will exceed guidelines.

Concentrations of organics are generally low in the LSA. Naphthenic acids and total recoverable hydrocarbons are often below or are only slightly higher than the detection limits. However, total phenols in every season are often higher than the

aquatic life guideline, likely due to high TSS levels. The Pierre River, Eymundson Creek and Big Creek have no significant acute or chronic toxicity, tailing potential or labile naphthenic acids (the most toxic form), although toxicity testing indicates occasional toxic impacts on mortality and growth.

#### **1.3.1.2 Water Quality Baseline Conditions – Athabasca River RSA**

DO concentrations in the Athabasca River are often high, but can occasionally be lower than the chronic aquatic guideline. The river is slightly alkaline and moderately soft. Its hardness, alkalinity, TDS and major ions concentrations generally increase in the winter, under low flow conditions. Concentrations of TSS and particulate-bound nutrients and total metals increase in spring and summer, under higher flows. Guideline exceedances are found for total phosphorus and total nitrogen in all seasons, while guideline values are exceeded periodically for several metals (aluminum, arsenic, cadmium, chromium, hexavalent chromium, copper, iron, lead, mercury, nickel, selenium, silver and zinc). Levels of organics and PAHs are generally low. Naphthenic acids are often lower than 1 mg/L but occasionally have localized levels as high as 20 mg/L. Sulphide occasionally exceeds the guideline in the Athabasca River upstream of the Firebag River. There is little to no toxicity of the river. The data indicates that developments in the Lower Athabasca basin are not affecting local water and sediment quality.

#### **1.3.1.3 Sediment Quality Baseline Conditions – LSA**

The sediments of Pierre River and Big Creek are characterized by a high sand fraction and low carbon content. While both Eymundson and Redclay Creeks have mixed texture soil, Eymundson Creek has much lower carbon content. Concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) and metals occasionally exceed sediment quality guideline values, including arsenic, naphthalenes and another PAH. Sediment toxicity measurements show slight reductions in survival and growth.

#### **1.3.1.4 Sediment Quality Baseline Conditions – Athabasca River RSA**

Particle size distribution and carbon content in the lower Athabasca River sediments are generally similar to those in the Muskeg River downstream of Jackpine Creek, with high sand and inorganic carbon contents. Several metals exceed the ISQG values (chromium, arsenic, cadmium, lead and mercury). Concentrations of metals are also higher in the Athabasca River than in the Muskeg River. Several PAH concentrations exceed sediment quality guidelines.

#### **1.3.1.5 Impacts - PRMA**

The following PRMA activities would have potential impacts on surface water quality:

- Construction of a bridge across the Athabasca River
- Diversion of flows from the headwaters of the Pierre River and Asphalt, Eymundson, Big and Redclay creeks
- Dewatering of muskeg and overburden and their releases into Eymundson Creek and the Athabasca River

- Surface mining
- Construction and use of a water intake on the Athabasca River
- Construction of access roads, overburden disposal areas, other infrastructure and bitumen extraction facilities
- Closed-circuiting of areas within the Pierre River and Asphalt, Eymundson and Big Creek watersheds
- Construction of a cogeneration plant
- Construction of diversion channels, reclaimed mine pits, polishing ponds, raw water storage, an External Tailings Disposal area (EDTA), compensation lake and pit lakes
- Water releases from mine development areas, plant site and mining infrastructure
- Reclamation landscape, including pit lakes and wetlands

The key factors that could potentially impact surface water and sediment quality include:

- Release of muskeg drainage and overburden dewatering flows
- Closed-circuit of development areas
- Discharge of pit lake outflows
- Seepage of groundwater and process-affected water

Impacts on surface water quality were determined by assessing several water quality constituents, similar to those used in previous oil sands EIAs. Key indicators included naphthenic acids, tainting potential, acute and chronic toxicity and total dissolved solids (TDS). Different water quality models and approaches were used for specific issues or key questions, and the corresponding watercourse or waterbody. The Athabasca River Model (ARM), small streams model (HSPF) and pit lake model (CE-QUAL-W2) were all used in the assessment. Monte Carlo simulations were used to determine the incremental contribution that climate change could have on the water quality predictions in the EIA. Potential changes to water and sediment quality due to the project were assessed by determining if non-compliance with guidelines or appreciable increases in constituent concentrations would occur compared to the Base Case condition.

The PRMA would result in the diversion of portions of the Pierre River, Asphalt, Eymundson, Big and Redclay creek watersheds, altering their assimilative capacities. Muskeg drainage and overburden dewatering would be released into Eymundson Creek and the Athabasca River.

Flows will be diverted around the PRMA during the operational phase via channels that would become the permanent flow paths for the Pierre River and Big Creek. At closure, Unnamed, Asphalt and Eymundson creeks would be

rerouted through the Pierre North Pit Lake and the Pierre South Pit Lake before discharge to the Athabasca River.

Water sources would primarily be the Athabasca River, but connate water from within the oil sands, tailings reclaim water, groundwater from basal aquifer dewatering and surface runoff would also be used. To reduce the use of river water and in order to meet the IFN requirements for the Lower Athabasca River, up to 30 days worth of water would be stored in a Raw Water Storage Facility.

Following mine decommissioning, the reclamation landscape would consist of one ETDA, engineering drainage channels, wetlands and two new pit lakes. A process-affected water Treatment Lake would replace the Raw Water Storage Facility. The Treatment Lake would receive runoff and process-affected sand seepage from the ETDS. Once water quality is acceptable, the ETDA would discharge to the Athabasca River. The North Pit Lake would discharge to the South Pit Lake. The South Pit Lake would contain Mature Fine Tailings (MFT) and would discharge to the Athabasca River.

Seepage and mine-related flows may affect water quality in the Pierre River, Asphalt, Eymundson and Big creeks, but not Redclay Creek. The Athabasca River may receive inputs from several sources, including drainage, dewatering and reclamation waters. Indirect discharges may also occur.

#### ***Water Quality Impacts – LSA***

The only process-affected water that would enter the Pierre River is a small mine-related seepage. Key water quality constituents (acute and chronic toxicity, tainting potential, naphthenic acids and TDS concentrations) would increase under the Application Case. However, Shell states that these increases are not a result of the PRMA project. All other constituents were also predicted to remain within Base Case levels, but the data were not shown in the EIA tables (Table 6.5-16).

Process-affected water would not be released into Eymundson Creek. Shell states that key water quality constituents (acute and chronic toxicity, tainting potential, naphthenic acids and TDS concentrations) would be similar to the Base Case. Non-toxic, refractory naphthenic acids are predicted to increase due to muskeg drainage and overburden dewatering. In addition, the project would result in increases for beryllium and several PAH groups due to muskeg drainage and overburden dewatering. Spring and summer temperatures would be lower, while fall and winter temperatures would be higher, due to discharges from a polishing pond and a pit lake. Dissolved oxygen concentrations would be unaffected.

Big Creek would be diverted to the Redclay Compensation Lake around the ETDA and other treatment waterbodies. Because it would receive no mine-related waters, naphthenic acids, acute and chronic toxicity, tainting potential and TDS would not change. The diversion, however, would increase metals concentrations (including aluminum, antimony, chromium, cobalt, iron, manganese, potassium and vanadium). No additional water quality guidelines would be exceeded.

Overall, the project was predicted to have low to negligible effect on key water quality constituents, including acute and chronic toxicity, labile naphthenic acids, TDS and tainting potential of the Pierre River and Eymundson and Big creeks. Negligible impacts on water temperature were predicted for the Pierre River, and Asphalt, Eymundson, Big and Redclay creeks.

### ***Water Quality Impacts – Pit Lakes and Treatment Lake***

Two pit lakes would be created in the project area. While the North Pit Lake would contain MFT, only the upstream cell of the South Pit Lake would contain MFT (its downstream cell would contain no MFT). The North Pit Lake would discharge to the South Pit Lake, which would discharge to the Athabasca River in 2049. The North Pit Lake would have a water volume of 17 Mm<sup>3</sup>, which would be underlain by an MFT volume of 117 Mm<sup>3</sup>. The South Pit Lake upstream cell would have a water volume of 131 Mm<sup>3</sup>, which would be underlain by an MFT volume of 163 Mm<sup>3</sup>. The South Pit Lake downstream cell would have a water volume of 26 Mm<sup>3</sup> (and no MFT) and a residence time of 2 years. The North and South pit lakes would have residence times of 1 and 8 years, respectively.

Because they would receive reclamation runoff, process-affected water and mine tailings, high concentrations in the pit lakes would be expected at least during the initial period after filling. Water and sediment quality of the pit lakes would be expected to change over time, as treatment would occur as a result of dilution, biodegradation and further settling prior to discharge to surface waters.

At the beginning of pit lake discharge in 2049, key constituents (acute and chronic toxicity, tainting potential) would be below guidelines or threshold values in the pit lakes. The pit lake discharges would meet water quality guidelines for all constituents that do not naturally exceed guidelines, except PAH Group 2. Natural PAH Group 2 levels do not currently exceed the guideline, but would in the pit lakes. Several other constituents, (including metals, TDS, sodium, tainting potential, chronic and acute toxicity and both the labile [toxic] and refractory [non-toxic] naphthenic acids) would also be higher than natural levels in the region. Additional guideline exceedances would occur for iron. These waters would ultimately discharge to the Athabasca River.

The Raw Water Storage Facility would become a Treatment Lake in 2039, and would receive and treat seepages and runoff from the ETDA, after which it would discharge to the Athabasca River. Like the pit lakes, the concentrations of several metals, TDS, sodium, PAH Group 2, tainting potential, chronic and acute toxicity and both the labile [toxic] and refractory [non-toxic] naphthenic acids) would exceed natural levels, and additional guideline exceedances would occur for iron.

### ***Sediment Quality Impacts – LSA, Diversion Channels and Redclay Compensation Lake***

The potential mobilization of soluble PAHs and metals and the transport of particulate-bound constituents from oil sands to surrounding surface waters could impact sediment quality. The transport of sediments into the Pierre River and Eymundson and Big creeks is predicted to be low to negligible. The potential effects of direct seepage and surface waters on sediment quality were considered

negligible, therefore any changes to sediment quality was considered negligible. No additional exceedances of the ISQG levels were predicted, and no constituents were predicted to exceed the PEL.

Note to Dan: The actual sediment quality appendices and tables were not included in the CD and binder. Usually, I use the actual tables and look at the data, because the EIA text is sometimes misleading or incomplete in its description of the results. In this case, then, I had to rely on the EIA text to summarize the water quality of pit lakes. I normally would report which parameters increased from the Base Case. Although no additional ISQG levels were exceeded, I would normally look at the level of increase to see if it were slight, if it doubled, or if it increased by an order of magnitude, for example.

### ***Sediment Quality Impacts –Pit Lakes and Treatment Lake***

The EIA did not include a discussion or any data regarding the sediment quality of the pit lakes or the treatment lake, despite their receipt of MFT and/or process-affected water. The summary section does mention that “the PAH concentrations in bottom sediment in the North Pit Lake and South Pit Lake upstream cell that will receive MFT may be higher than guideline values”.

### ***Water Quality and Sediment Quality Impacts – Athabasca River***

The water quality of the Athabasca River could be affected by direct or indirect discharges from the project site, including muskeg drainage and overburden dewatering, pit lake discharge, seepage of process-affected water or groundwater. However, the Application Case found that acute and chronic toxicity were lower than guidelines and tainting potential was below the threshold. Indeed, under the Application Case, every constituent listed in Table 6.5-22 would apparently decrease downstream of the confluence with the Pierre River (Node A2), in comparison to the Base Case. These declines as a result of the project include naphthenic acids (both labile and refractory), tainting potential, TDS and acute and chronic toxicity.

At Node A3 (downstream of the confluence with Big Creek), most of the water quality constituents of the Athabasca River listed in Table 6.5-22 would also decrease as a result of the project. Declines were predicted for labile and total naphthenic acids, tainting potential, TDS and acute and chronic toxicity. A slight increase was predicted for refractory naphthenic acids, although decreases were predicted for both the labile and total naphthenic acids, and the total does not add up correctly. No other water quality data, including general chemistry, metals, nutrients and other PAHs were presented for impacts on the Athabasca River.

Shell states that these small changes in water chemistry are unlikely to cause a significant change in the sediment quality of the Athabasca River. Overall, negligible effects on the water and sediment quality of the Athabasca River were predicted as a result of the project. For the Planned Development Case (existing, approved and planned projects) at Nodes A2 and 3, negligible increases are predicted for boron, acute and chronic toxicity, labile and refractory naphthenic acids, TDS and tainting potential in the Athabasca River.

Note to Dan: The full details of the Planned Development Case are in Appendix 4-8, which I don't have in either the binder or the CD, therefore, I can't really go into any more detail or fully assess this section of the report.

Note to Dan: The impacts from atmospheric deposition and potential acidification is included in the air section, and not in the binder or CD that I have, therefore, I couldn't assess this component.

### 1.3.1.6 Mitigations

The above impacts are based upon the assumption that existing and approved developments will implement the specified mitigations, including those for the PRMA project. A summary of mitigations include:

- Intercept, capture and recycle seepage from backfilled cells through the closed-circuit drainage system
- Place tailings below the top of the McMurray Formation or behind low-permeability barriers such as dykes to minimize seepage
- Isolate non-segregated tailings pit backfill from Quaternary sand and gravel deposits through a layer of low-permeability material
- Manage ETDA seepage to ensure groundwater discharge quality to the Athabasca River is acceptable
- At closure, wetlands and/or pit lakes will be built at the downstream end to provide treatment for the tailings porewater releases before they are discharged to the Athabasca River
- Implement a closed-circuit water management and recycling system for process-affects waters during operation
- Direct muskeg and overburden drainage waters to polishing ponds prior to release to receiving surface waters
- Construct perimeter ditches around ETDA's to capture and pump tailings pond seepage back into the pond during operation and closure
- Design sustainable closure drainage systems that direct mine water releases to wetlands and pit lakes before being released to existing waterbodies and watercourses
- Direct tailings pond seepages that are not captured by perimeter ditches to wetlands with sufficient residence time for natural treatment of organic constituents and to reduce associated tailings potential and whole effluent toxicity
- Increase the volume of the wetlands that provide treatment to runoff prior to discharge
- Comprehensive monitoring program may include the assessment of streamflows, water levels and discharge rates, channel stability and morphology, water and sediment quality, littoral zone development, growth

of aquatic vegetation as well as benthic invertebrate communities, fish populations and riparian zone vegetation

- Active participation and support to CEMA, its working task ground and the End Pit Lake task group
- Continue to participate in RAMP, CEMA, CONRAD and other regional initiatives to monitor water quality and to confirm performance of mitigations

### **1.3.2 Discussion**

An uncertainty analysis was not carried out for the PRMA. Instead, the results of the Jackpine Expansion Mine uncertainty analysis were used to determine prediction confidence. Because similar approaches were used, and the quality of the input data were similar, the JEMA results were used to imply that the PRMA assessment must also have high confidence. The lack of an independent uncertainty analysis for the PRMA is included in the key concerns noted below.

The data regarding PAHs and metals in sediments was considered to provide a reasonable level of prediction confidence. Because many of the parameters are below detection limits, the actual concentrations are likely to be much less than the values used in the assessment, indicating that they are conservative estimates.

The water and sediment quality data for pit lakes was based on the CE-QUAL-W2 model, and used the same water quality data as above. The estimates of constituent levels and flow rate predictions are considered to have a high level of certainty. Conservative decay rates were used, and no settling of suspended solids was assumed, another conservative assumption that ensures the worst case scenario was assessed.

The Athabasca River model was used to predict changes in the Athabasca River from Fort McMurray to Embarras. The water quality data source for the model was from Alberta Environment, RAMP, industry and field programs. The data for most constituents, including key water quality constituents is rates of moderately higher quality. Concerns are the fact that analytical detection limits haven't improved over time, and different sources of data are used. Modelling was conservative, and assumed that seepages from the ETDA would enter the Athabasca River directly. Conservative estimates were also achieved by excluding decay in the river. Sensitivity analysis showed that the EIA predictions are robust. However, the model assumes that mitigation success will be achieved, and that the treatment efficiency of wetlands and pit lakes is able to minimize changes to the water quality of the Athabasca River.

This approach appears reasonable, with the exception of the exclusion of an uncertainty analysis for the PRMA, and reliance on the results of the JEMA uncertainty analysis instead.

### 1.3.3 Key Concerns

Several key concerns were identified with regards to surface water components during the review. These include:

1. Unclear source of impacts on water quality of the LSA.

Table 6.5-16 shows that relative to the Base Case, the Application Case would result in increases in naphthenic acids (both labile and refractory), and chronic toxicity in the Pierre River. However, these increases are not ascribed to the PRMA. Similarly, increases in several key water quality constituents in Eymundson Creek and Big Creek are only partially ascribed to the project, or not at all. The potential changes to these streams as a result of CNRL's Horizon Mine are included in the Base Case, so it is unclear what other sources of inputs would be present in the Application Case to cause these water quality changes.

→ **Recommendation:**

*If the PRMA is not responsible, clearly state the source of the increases in key water quality parameters from the Base Case to the Application Case within the LSA.*

2. Few constituents included in the LSA water quality assessment.

While key constituents (acute and chronic toxicity, tainting potential, naphthenic acids and TDS) for the Pierre River were assessed and presented, no other water quality parameters appear to have been included, or at least, were not included in Table 6.5-16. Shell notes that all other constituents were within the Base Case range, but no other data is provided. Shell also states that only those constituents modelled for the Horizon Project EIA could be assessed in this EIA, but that appeared to only include mercury. It is unclear why metals, nutrients, PAHs (other than naphthenic acids) and other important water quality parameters were not assessed and/or included in Table 6.5-16.

A few additional parameters are included in the assessment tables for Eymundson Creek and Big Creek (including some metals and PAHs), but a full suite of water quality parameters is still missing.

→ **Recommendation:**

*Provide justification for the lack of assessment for general water quality parameters including metals, nutrients and other PAHs within the LSA streams. If these parameters were modelled, please include the results in Table 6.5-16. Reassess the overall low to negligible impact rating, if necessary, to include the results of all water quality parameters.*

3. Uncertainty analysis was not completed for LSA impacts of the PRMA.

The PRMA EIA relied upon the uncertainty analysis conducted for the Jackpine Expansion Project. No independent uncertainty analysis was

conducted for the PRMA data or predictions. Considering different datasets were used and that some of the PRMA predictions relied upon information provided and modelled by another project (CNRL Horizon), it would seem prudent to conduct an uncertainty analysis specific to this project.

→ **Recommendation:**

*Provide an uncertainty analysis that is specific for the LSA impacts of the PRMA.*

4. Inappropriate impact ratings for temperature changes to Eymundson Creek.

The release of waters from a pit lake in 2049 would result in relatively large changes in temperature in Eymundson Creek during the spring, summer and fall. For example, the mean monthly temperature for May would decrease almost 3 °C, from 5.8 °C in the pre-development scenario to 3.1 °C. The mean monthly temperature for September would increase almost 6 °C from 3.6 °C to 9.4 °C. Despite these large differences, the impact rating was considered negligible, which appears inappropriate.

While the EIA states that thermal equilibrium would quickly be achieved, no mention on the actual extent of the impact was provided. Only mitigations for impacts of the polishing pond releases, which would result in relatively small changes (a maximum change of 0.3 °C) were discussed. No mitigation for pit lake discharges were mentioned, despite this being the major impact on temperature.

In addition, the ramifications of these large temperature effects on other water quality parameters (e.g. dissolved oxygen) are not mentioned.

→ **Recommendation:**

*Reassess the impact rating for temperature changes to Eymundson Creek that better reflect the predicted data. Describe the extent of the changes in temperature along the length of the river. Discuss the effects of these temperature changes on other water quality constituents, particularly dissolved oxygen.*

5. For parameters with guidelines, only guideline exceedances are considered as part of the rating criteria, and not increases in the values themselves.

The EIA concluded that for the Pierre River, Eymundson and Big creeks, the impacts on water quality were low to negligible. Table 1.3-4 outlines the impact description criteria when a constituent has a guideline available, and when there is no guideline. The implications of these ratings differ substantially, such that when a parameter has a guideline associated with it, only guideline exceedances are considered to be significant, any absolute increases in the actual values are completely discounted.

Within the EIA, several of the metals within Big Creek were predicted to double or triple, but because the guideline wasn't exceeded, or the guideline was exceeded already under the Base Case, there was no impact. While I can understand that guideline exceedances would certainly be the key criterion, absolute value increases should also be considered, because they represent a change from existing conditions. I understand that the guidelines have been developed as representative end points of change in survival, growth, reproduction, behaviour etc. However, substantial changes in water quality may still impact aquatic organisms, even if guidelines are not exceeded, particularly within natural systems and not a controlled laboratory.

**→ Recommendation:**

*Please provide additional discussion on the impacts of absolute increases in parameters with and without guidelines, irrespective of whether guideline exceedances occurred.*

**6. Insufficient information provided in the water quality impact tables.**

Although the ratings criteria used the percent increase to determine the magnitude of change for water quality constituents, no percent increase values were provided in the text or tables. As a result, it was very difficult and inconvenient to check the results tables against the ratings criteria to determine how the ratings had been applied and whether they had been applied correctly.

**→ Recommendation:**

*Please provide the percentage change, rather than just the absolute change, in the results tables for the water quality assessment to allow comparison with the ratings criteria.*

**7. Unclear ratings system for constituents with guidelines.**

Where guideline exceedances were found to result from the project, it was unclear whether the ratings criteria used the higher acute guideline or the lower chronic guideline, or both, to determine the ratings impact. For example, Table 6.5-18 shows that median chromium concentrations in Big Creek from 2015 to 2049 would triple from 0.0021 mg/L (Base Case) to 0.0062 mg/L (Application Case). The acute guideline for chromium is 0.016 mg/L, while the chronic guideline is 0.001 mg/L. Clearly, these exceedances would occur over a chronic time period, therefore, the 0.001 mg/L guideline should be applied. The question becomes whether this increase (a difference of 0.0041 mg/L) is considered to be negligible, low, moderate or high. The ratings criteria are vague and give subjective criteria (low is when the release contributes slightly to existing background values over guidelines, medium is a marginal contribution and high is a substantial contribution). It is unclear what the definitions of "slightly", "marginal" and "substantial" are, but I would offer that a 300% increase in the Base Case value would not be considered slight.

**→ Recommendation:**

*Please provide additional rationale and clear ratings classifications for the ratings system when guidelines are present. State whether the rating is provided against changes to the acute guideline, chronic guideline or both. Define “slightly”, “marginal” and “substantial” exceedances.*

8. Pit lakes would have relatively small littoral zones.

Shell states that the littoral zones of the pit lakes would be adequate to provide biological activity and support a viable ecosystem. The littoral zones would be up to 15% of the total value area. This is on the small size of other reclamation waterbodies, in which generally 20 to 30% of the area of the lake is comprised of littoral zone. Since the littoral zone is the most productive part of a lentic system, its relative area should be maximized, not minimized.

➔ **Recommendation:**

*Please discuss the adequacy of a maximum 15% littoral zone area for these end pit lakes in light of the more standard 20 to 30% area, and redesign if necessary.*

9. Unclear if pit lake and treatment lake discharge to surface waters would exceed water quality guidelines.

Shell states that the pit lakes will discharge to surface waters only when water quality is of sufficient quality and when discharge water quality limits are met. It is unclear what is considered sufficient quality and what these discharge limits would be. It would be reasonable to hope that the limits would be the same as the water quality guidelines, however, this is not likely the intent, since at closure, when discharge will begin, natural concentrations (for many constituents) and guidelines (for PAH Group 2 and iron) will be exceeded in the pit lakes.

The EIA does not provide a statement that the Treatment Lake would discharge to the Athabasca River only if discharge water quality limits are met.

➔ **Recommendation:**

*Please define what is considered to be sufficient quality for the water of the pit lakes and what the discharge limits would be. Discuss the rationale behind discharging water from pit lakes that exceeds water quality guidelines. Provide a statement that the Treatment Lake will only discharge to the Athabasca River when discharge limits are met.*

10. Sediment quality of pit lakes or the Treatment Lake has not been modelled or discussed in any detail.

Shell does not provide the sediment quality of the MFT to be added to the bottom of the pit lakes. In addition, Shell does not characterize the sediment quality of the pit lakes, and assumes that they would be similar to those of the Jackpine Expansion Project. However, the MFT are likely to be different for

each mine site, and therefore, the sediment quality of the pit lakes for each mine site is unlikely to be the same. The EIA did not include a discussion or any data regarding the sediment quality of the Treatment Lake.

→ **Recommendation:**

*Please provide sediment quality data for the pit lakes and Treatment Lake.*

11. No explanation given for declines in the concentrations of several water quality constituents in the Athabasca River as a result of the project.

As shown in Table 6.5-22, several water quality parameters (including naphthenic acids) are predicted to decrease at Nodes A2 and 3 as a result of the project. No explanation for this is given. Considering that the project's discharges to the Athabasca River (from seepage and pit lakes) are predicted to have higher concentrations of some constituents than natural levels (including naphthenic acids), it is unclear how these results could occur. In addition, for Node A3, a slight increase was predicted for refractory naphthenic acids, although decreases were predicted for both the labile and total naphthenic acids, and the total does not add up correctly.

→ **Recommendation:**

*Please discuss the reasons behind decreased values in some of the water quality parameters of the Athabasca River as a result of the project when compared to the Base Case. Resolve the discrepancy in the naphthenic acid values for Node A3.*

12. The effects of construction of the bridge over the Athabasca River and the intake within the Athabasca River are not discussed in terms of changes in water quality of the Athabasca River. No mitigations are provided.

The construction of a bridge over the Athabasca River, and the construction and use of a new water intake in the Athabasca River are included in early mentions of the potential impacts of the project on the Athabasca River. However, in the assessment section and discussion of water quality of the Athabasca River, this bridge and intake are not mentioned. No mitigations involved in the construction or ongoing use of the bridge or intake are included.

→ **Recommendation:**

*Please discuss the potential impacts and recommended mitigations regarding the construction and use of the bridge and intake for the Athabasca River.*

## 1.4 Fish and Fish Habitat

### 1.4.1 Overview

The Fish and Fish Habitat and Aquatic Health assessment sections were combined in this one review section. The key environmental issues arising from the projects with respect to fish and fish habitat and aquatic health are:

- Changes in water quality and/or sediment quality and direct or indirect effects on aquatic health
- Increased uptake of substances into fish tissues from sediment and water and direct effects on fish health
- Changes in water quality due to acidifying emissions and direct effects on aquatic health
- Changes in habitat area, streamflows, channel regime/geomorphic condition, water levels and effects on fish habitat
- Changes in water quality, sediment yield and deposition and aquatic health and effects on fish habitat and fish abundance
- Changes in benthic invertebrate communities or invertebrate drift
- Changes in habitat accessibility to fish
- Changes in fishing pressure and effects on fish abundance

The LSA and RSA boundaries for Fish and Fish Habitat/Aquatic Health are the same as those for Water Quality and Surface Water Hydrology.

Development activities to be assessed include those activities during mine construction, operations, closure and reclamation that could alter the condition or area of fish habitat as these relate to stream flow and water level, sediment loading, channel regime and water quality.

Potential effects of the Project on Aquatic Health were assessed in relation to fish populations and other aquatic organisms (invertebrates, algae and aquatic plants). The Key Indicator Resources (KIRs) are the key fish species and benthic invertebrate communities that act as sentinels for the aquatic ecosystem. The toxicity data from fish and other aquatic life are used to derive chronic effects benchmarks. Results from the water quality modelling was the basis for this assessment. Uptake to fish tissue was modelled using site-specific Bioaccumulation Factors. Substances of Potential Concern (SOPCs) were identified, as those higher than the Base Case that also exceed water quality guidelines. Chronic effects benchmarks were used to assess how the SOPCs may affect aquatic health. The benchmarks are concentrations beyond which changes to aquatic health could occur on the scale of individual organisms. The benchmarks are less conservative than water quality guidelines, but are considered to be conservative thresholds.

Potential effects to fish and fish habitat from the Project and drainage integration were assessed in relation to Key Indicator Resources (KIRs) for each of the watercourses and waterbodies in the LSA and RSA. The biological receptors of fish and fish habitat include benthic invertebrate populations, fish abundance and aquatic diversity. All KIRs are used to provide information, within a relatively short time frame, about potential responses to environmental changes that may occur. The effects of the Project on KIR fish species were assessed in relation to the various life stages and their habitat needs.

Data sources included historical aquatic studies and field studies conducted within the LSA. Additional data was provided by government agencies (Alberta Sustainable Resource Development), industries, consultants, government research programs (AOSERP, Northern River Basins Study), multi-stakeholder group research and monitoring (CONRAD, RAMP and CEMA), Traditional Knowledge and Land Use information and information from other related disciplines within this EIA.

#### **1.4.1.1 Fish and Fish Habitat Baseline Conditions – LSA**

The Pierre River mainstem provides suitable open water habitat for several fish species and life stages. At the mouth, the Pierre River is low gradient, depositional and consists of run habitat with silt and sand substrate. The lower reaches provide spring spawning and summer rearing habitat for species such as northern pike and Arctic grayling from the Athabasca River. Seasonal rearing and feeding habitat may also be present for occasional migrants, such as burbot, mountain whitefish and walleye.

Habitat use potential for resident fish species in the Pierre River and its tributaries is limited by poor-quality overwintering habitat (i.e. shallow depths and low winter DO). Beaver ponds may improve the potential of this area for overwintering because they increase pool depths.

The fish community within the Pierre River is relatively diverse, with a total of 17 species recorded. This includes five sport, two non-sport and 10 forage fish species. The distribution of sport fish species in the Pierre River is essentially confined to the lower reach, near the confluence with the Athabasca River.

Mean benthic invertebrate density at two depositional watercourse sites in the Pierre River was highly variable, ranging from 1,200 to 63,000 organisms/m<sup>2</sup>. Total taxonomic richness ranged from 23 to 40 taxa/site, indicating a rich benthic invertebrate community. The dominant taxa were midges and bristle worms.

Eymundson Creek provides suitable habitat for forage fish and some seasonal habitat for large-bodied fish species from the Athabasca River. Habitat is composed of run, flat, riffle and impoundments associated with beaver dams. Shallow depths and low DO levels restrict the range of large fish in this area overwinter. A total of 11 fish species, primarily forage fish, have been documented in the watershed, primarily in the lower reaches. This watershed supports a diverse benthic invertebrate community dominated by seed shrimp, midges and bristle worms.

The Big Creek mainstem provides habitat for several fish species and life stages due to the availability of cover, presence of spawning substrate and suitable water quality. It has riffle, run and flat habitat, but limited overwintering potential. Small channel size, shallow depth, low discharge volume, poor habitat diversity and the presence of fine sediment limit fish populations. Eleven fish species, primarily forage fish, have been observed in the watershed. The area supports a moderately rich and diverse benthic invertebrate community dominated by seed shrimp, midges and bristle worms.

Suitable open-water habitat is present in much of the Redclay Creek mainstem. The habitat is primarily riffle-run and there are a number of pools and some rocky substrate. The lower reaches of the creek provide summer habitat for a number of sport fish species from the Athabasca but winter habitat is limited. Fifteen fish species have been documented in the watershed, including sport, non-sport and forage fish species. Sport fish species are concentrated in the lower reaches of the creek. Benthic invertebrate communities were moderately diverse and were dominated by midges.

There are no existing or approved developments within the LSA, therefore, the Base Case and Pre-development Case are the same.

#### **1.4.1.2 Fish and Fish Habitat Baseline Conditions – Athabasca River RSA**

The Athabasca River within the Aquatics LSAs and RSA for the Project is a large-volume, low-gradient mainstem river that provides turbid, cool-water habitat for a variety of fish. The river is wide but generally shallow, with dynamic, shifting sand channels. Instream cover is limited, and provided by depth and turbidity. Structural cover is limited here. Only 17% of the bank habitats are composed of rocky materials and hardened soils.

Thirty-one fish species occur in the lower Athabasca River, including 12 sport species, two non-sport species, and 17 forage fish species. Of these, 11 species are common, abundant, or seasonally abundant. The Athabasca River in the RSA provides juvenile rearing habitat and adult feeding habitat for regionally significant commercial, subsistence and sport species, and also provides some fry nursery habitat and overwintering habitat. The Athabasca River in the RSA provides an important migratory route for fish from Lake Athabasca to the Peace-Athabasca Delta, and tributary confluences provide important habitat for a variety of life history functions.

Benthic invertebrate diversity is not high in the Athabasca River and historical surveys have found population density to be variable. Midges are typically the dominant group in depositional areas. Bristleworms, roundworms, stoneflies and caddisflies are common in erosional habitats.

There is the potential for the Athabasca River to be affected by several existing or approved developments. Flow and water level reductions may occur in the river due to cumulative water withdrawals from oil sands and other developments and users, and could affect fish habitat. The total water withdrawals are small on an annual basis, relative to the large flows of the Athabasca river. The net annual water allocation to all existing and approved oil sands projects results in a

reduction of the mean annual flow of about 2.1%. However, operators are required to meet the Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River, recently developed by Alberta Environment and Fisheries and Oceans Canada. This includes water withdrawal restrictions that are designed to minimize habitat effects during sensitive time periods, such as low winter flows.

#### **1.4.1.3 Fish and Fish Habitat Baseline Conditions – Traditional Ecological Knowledge**

Several fish species have been identified as traditional resources through the collection of TEK. The TEK confirmed that the range of species selected as KIRs included most of the species of value and importance to local Aboriginal communities. Lake trout was the only species with a high use ranking that was not included as a KIR because they are not typically present in the LSA, but are found in Lake Athabasca.

#### **1.4.1.4 Impacts – Aquatic Health – Pierre River Watershed**

The levels of chronic and acute toxicity in the Pierre River, Big Creek and Eymundson Creek were predicted to be below guidelines, therefore, no effects for sensitive aquatic organisms were predicted. Elevated TDS concentrations were expected to have negligible effects on aquatic health, because of reports of fish species surviving in lakes with even higher TDS concentrations.

In Big Creek, other SOPCs (several metals) were below guideline levels, therefore, no toxic effects on aquatic health were expected for those constituents. However, aluminum, chromium and iron levels were predicted to exceed the chronic effects benchmarks, but no real assessment on aquatic health was provided, beyond statements that the impacts were low in magnitude, high in frequency, localized and long term.

In Eymundson Creek, other SOPCs (beryllium and PAH groups 1, 2 and 5) were below guideline levels, therefore, no toxic effects on aquatic health were expected for those constituents. Impacts were considered negligible.

Predicted changes in fish tissue metal concentrations were predicted to be below toxicological benchmarks for all parameters considered in the Pierre River. As a result, negligible changes to fish tissue quality, and negligible impacts to aquatic health were projected.

No impacts to fish tainting were expected within the LSA. Overall, potential changes to aquatic health resulting from the project and its integrated drainage were considered negligible for the Pierre River, Big Creek and Eymundson Creek.

#### **1.4.1.5 Impacts – Aquatic Health – Pit Lakes**

The capability of the pit lakes to support aquatic life was evaluated in terms of the predicted water, sediment and fish tissue quality within each pit lake, both when they initially begin discharging to the environment and in the far future.

Acute and chronic toxicity in the pit lakes and the Raw Water Storage Facility were predicted to be below the thresholds when they begin to discharge to the receiving environment. These results indicated that there is a high level of confidence that the pit lakes will be able to support aquatic life. Other SOPCs (several metals, naphthenic acids, TDS, PAH Groups 2 and 6) were below guideline levels, therefore, no toxic effects on aquatic health were expected for these constituents. Iron, manganese and strontium levels were predicted to exceed the chronic effects benchmarks, but were then dismissed, because of naturally high baseline levels (iron and manganese) and the benchmark may not be appropriate for the area (strontium).

Fish tissue concentrations in pit lakes and Raw Water Storage Facility were predicted to be below benchmarks for all metals parameters. No impacts to fish tainting were expected.

Overall, no residual impacts are predicted for aquatic health of the pit lakes and the Raw Water Storage Facility, and they are expected to be able to support a viable aquatic ecosystem.

#### **1.4.1.6 Impacts – Aquatic Health – Athabasca River**

The levels of chronic and acute toxicity in the Athabasca River downstream of the Pierre River, Big Creek and upstream of Embarras were predicted to be below guidelines, therefore, no effects for sensitive aquatic organisms were predicted.

No SOPCs were identified for the Athabasca River immediately downstream of the Pierre River, Big Creek or Embarras.

Negligible impacts on fish tissue concentrations in the Athabasca River were predicted, because the median concentrations of all parameters were essentially unchanged between the Base Case and Application Case.

Overall, the project was expected to result in negligible effects to aquatic health of the Athabasca River.

#### **1.4.1.7 Impacts – Fish Habitat and Fish Abundance – LSA**

Fish habitat and riparian areas lost due to the project would occur in the lower Pierre River, lower Eymundson Creek, lower Asphalt Creek, lower Big Creek, lower First Creek, unnamed tributaries to Pierre River, Eymundson Creek, Big Creek, Redclay Creek and the Athabasca River, and unnamed waterbodies within the Pierre River, Eymundson Creek, Big Creek and Redclay Creek watersheds. These habitat losses amount to 1,880,074 m<sup>2</sup> of habitat, the largest single losses would occur in the unnamed waterbodies of Big Creek (559,410 m<sup>2</sup>) and the unnamed tributaries of the Athabasca River (205,697 and 225,553 m<sup>2</sup>). Additional losses of 452,467 m<sup>2</sup> would occur at closure, due to the repositioning of diversion channels, with the largest loss in an unnamed tributary of Big Creek (100,578 m<sup>2</sup>). The closure diversion channels would be designed to provide fish habitat that meets compensation requirements.

The Conceptual Compensation Plan would offset these losses and eliminate potential adverse effects due to changes in habitat area. The CCP is described in

Section 1.4.1.10 below. Overall, a net gain in the productive capacity of available fish habitat would be predicted. As a result, there are no predicted adverse impacts on fish habitat due to changes in habitat area.

Changes in the thermal regime of Eymundson Creek could impact fish habitat, with delayed warming in the summer and delayed cooling in the fall and winter. Shell states that any effects of the changes in temperature would be localized and receiving waterbodies and watercourses would quickly attain thermal equilibrium. The overall adverse impacts were considered negligible.

The elimination of habitat would result in a temporary loss of the benthic invertebrate community. However, after compensation, these impacts were predicted to have negligible impacts on fish habitat.

All stream diversions would be designed to provide fish passage and maintain connectivity with upstream watercourses during construction, operations and on closure. Therefore, impacts on habitat accessibility were considered negligible. In particular, the Pierre River would be diverted south in 2016 around the mine to the Athabasca river. This diversion has the potential to affect fish passage from the Athabasca River to the Pierre River, particularly since the escarpment is very steep. Fish passage provisions would be installed as required to maintain connectivity. At closure, a permanent diversion channel would be constructed and designed to allow for fish movement. The downstream reach of this channel would likely be integrated with the CNRL Horizon closure drainage channel, and will accommodate flows from both the diversion of the Pierre River and the Horizon Project. Overall, no measurable impacts on habitat accessibility were expected for the Pierre River.

During operations, Eymundson and Asphalt creeks would be diverted north around the mine to the Athabasca river. Fish accessibility would be maintained. This diversion channel would be maintained during closure until the water quality in the pit lakes is suitable for release. At this time, the diversion channel would be decommissioned and the Eymundson and Asphalt creeks would flow into the Pierre North Pit Lake. Impacts on habitat accessibility were predicted to be negligible for Eymundson and Asphalt creeks.

Similarly, diversions for Unnamed Creek 1, First Creek, Big Creek were also expected to have negligible impacts on fish habitat accessibility.

Overall, the EIA concludes that with mitigation and compensation, there would be no environmental consequence of the residual impacts on fish habitat or fish diversity in the LSA.

#### **1.4.1.8 Impacts – Fish Habitat and Fish Abundance – Athabasca River**

The placement of a freshwater intake on the west bank of the Athabasca river, and the new bridge across the Athabasca river would result in a permanent small-scale loss of habitat. However, the portion of the intake on the Athabasca River consists entirely of common erosional habitat, and provides low to moderate suitability for use by key species during the open water period. For the bridge, instream piers would be installed in the river, resulting in habitat losses, and

riparian habitat losses would occur on either side of the bridge. Negative impacts would occur, and compensation would likely be required. The detailed design for this intake and bridge are not available yet, and these losses have not been incorporated into the CCP yet. They will be included in the detailed No Net Loss Plan.

The project, in addition to existing and approved projects, would contribute to predicted changes in mean seasonal flows of the Athabasca River. The reduction in mean seasonal flows due to oil sands water withdrawals is 2.1% in the summer and 14.1% in the winter. Shell would meet the Water Management Framework requirements for the lower Athabasca River. As a result, no measureable impacts to fish habitat are expected in the Athabasca River, beyond those outlined in the Framework. The Framework does mention that cumulative water withdrawals, even the restricted withdrawals permitted under the Framework, may result in negative effects on fish habitat. Any incremental changes to fish habitat will be addressed through the Phase 2 process of the Water Management Framework. Habitat compensation requirements, if necessary, will be developed for the project through consultation with DFO.

The losses of the waterbodies and watercourses in the LSA could potentially alter benthic invertebrate drift into the Athabasca River. However, invertebrate drift from tributaries represents less than 1% of total drift in the Athabasca River. As a result, the overall effect is expected to be negligible.

Overall, the EIA concludes that with mitigation and compensation, there is no environmental consequence of the residual impacts on fish habitat on the Athabasca River.

Note to Dan: The full details of the Planned Development Case are in Appendix 4-8, which I don't have in either the binder or the CD, therefore, I can't really go into any more detail or fully assess this section of the report.

#### 1.4.1.9 Mitigations

A summary of mitigations for the PRMA are provided in Table 1.7-1 and include:

- Water quantity and quality mitigations identified previously
- Minimize effects on flows and water levels by distributing muskeg drainage operations through the life of the mine
- Minimize sediment loading by routing muskeg drainage, overburden dewatering to polishing ponds before release to receiving streams
- Minimize effects of closed circuit operations by diverting natural streams around the mining area
- Design operational diversions and closure channels to provide for fish passage where required
- Schedule construction activities and use best practices
- Develop a self-sustaining closure drainage system by:

- Direct mine water releases to wetlands and pit lakes before release to existing waterbodies and watercourses
- Minimize sediment yields from reclaimed surfaces by developing final topography and soil moisture conditions
- Minimize gully and channel erosion
- Design watercourses, waterbodies and wetlands during reclamation for bioremediation of tailings porewater releases, groundwater seepage and runoff from reclaimed areas
- Implement a fish salvage program for fish habitats permanently lost
- Implement a transport and/or stocking program for effects of habitat accessibility
- Compensate habitat losses and alterations by developing appropriate compensation habitat to ensure the No Net Loss objective is achieved
- Develop fish habitat of equivalent or higher productive capacity
- Continue to participate in RAMP, CEMA, CONRAD and other regional initiatives to monitor water quality and to confirm performance of mitigations
- Design all stream diversions to provide fish passage and maintain connectivity with upstream watercourses during construction, operations and on closure
- Comprehensive monitoring program may include the assessment of streamflows, water levels and discharge rates, channel stability and morphology, water and sediment quality, littoral zone development, growth of aquatic vegetation as well as benthic invertebrate communities, fish populations and riparian zone vegetation

#### **1.4.1.10 Fish Habitat Conceptual Compensation Plan**

A habitat compensation plan was developed to address the impacts to fish and fish habitat associated with development activities in the JEMA and PRMA watersheds.

In JEMA, fish habitat losses would occur throughout portions of the upper Muskeg River watershed, including Wapasu Creek. The proposed developments would also alter some aspects of the JEMA –Phase 1 development, including Khahago Lake and the repositioned Muskeg Creek. In PRMA, fish habitat losses would occur throughout portions of the Pierre River, Eymundson Creek, Big Creek and Redclay Creek. The impacts of the Athabasca River and the direct habitat losses due to the construction of the bridge and water intake (for the PRMA project) have not been identified or included in this CCP.

The fish habitat compensation plan is developed with consideration of the “No Net Loss Guiding Principle” for fish habitat, to satisfy the requirements of Fisheries and Oceans Canada, under the Fisheries Act. Watercourse segments

that would result in the HADD of fish habitat due to the JEMA and PRMA are identified.

Several habitat compensation options were evaluated with respect to developing the Conceptual Compensation Plan (CCP) for the Project. The selected option would consist of constructing riverine and lacustrine compensation habitats, including a compensation lake in the lower Big Creek and lower Redclay watersheds (Redclay Compensation Lake) to provide year-round habitat for a species assemblage similar to those species affected by the Project. This option was selected because it is on the Shell lease area, has the potential to provide large habitat gains, and has design flexibility in terms of overall size and configuration. Included with the design of this lake is the construction of natural geomorphic channels that incorporate fish habitat features and facilitate fish passage from the Athabasca River to the Redclay Compensation Lake and upper reaches of Big Creek watershed.

Redclay Compensation Lake would be constructed immediately adjacent to the PRMA's Raw Water Storage Facility. The lake size would be approximately 4 km<sup>2</sup>. The compensation lake would be constructed to provide habitat diversity in the lake (varying gradients, substrate types, and depths). Design features would include spawning, nursery, rearing, feeding and overwintering habitats to support self-sustaining fish populations. It would provide suitable habitat for a proposed fish community consisting of walleye, lake whitefish, cisco, northern pike, yellow perch, burbot, white sucker, longnose sucker and several forage fish species. The compensation lake would be connected to upstream and downstream riverine habitat.

In addition to the above lake design, two channels would be constructed as a part of the lake development to provide riverine compensation habitat. The lake outlet channel would be constructed to connect the lake to the Athabasca River and would be 15 km in length. A diversion channel would be constructed to connect the lake to the upper reaches of the Big Creek watershed and would be 13 km in length. Where appropriate, both channels would be designed to provide riverine spawning habitat for select species that prefer flowing water with rocky substrate for spawning (e.g. suckers). Permanent closure channels associated with the project would be geomorphically designed to provide fish habitat and fish accessibility and would be included as compensation in the detailed No Net Loss Plan.

The development of the compensation lake habitat would occur at the start of the project. Development of the diversion channel compensation habitat would be variable, but would generally occur later in the project life as most are closure channels. The first losses of fish habitat would occur in 2016, with the initial diversions of the PRMA. Other impacts would occur later, including losses in the Muskeg River, would start in 2046.

#### **1.4.2 Discussion**

The impact predictions for aquatic health within the LSA and RSA were based on conservative modelling and multiple lines of evidence, including predicted levels

of while effluent chronic and acute toxicity and concentrations in water and fish tissue. Uncertainty analyses indicated that the water quality predictions were robust, particularly for whole effluent toxicity. Confidence in the overall predictions was considered high. Those metals for which low impacts were predicted were considered to be overestimated due to the conservative assumptions used to complete the assessment.

The predictions of the pit lake and Raw Water Storage Facility water quality were also considered robust, with a number of adaptive management practices available to ensure suitable water quality within the lake.

The level of confidence in the fish habitat and fish abundance predictions is moderate to high. There is a moderate to high level of confidence in the Base Case information, assessment techniques and proposed mitigation measures. Decreased confidence is found in the analytical techniques that include estimates of changes in habitat areas and the effects of changes in flow on fish habitat. This analysis was done based on estimates, which are preliminary and based on historical and field measurements. A more detailed assessment of habitat changes would be made during the development of the detailed No Net Loss Plan in the future.

The level of confidence in the predictions made for fish diversity is moderate, as there is moderate confidence in interpreting the specific effects of habitat changes on habitat diversity. The assessment is based primarily on professional judgement regarding how habitat changes translate into specific effects on diversity.

Shell is committed to monitoring and providing compensation for the Project impacts, and as such, the confidence of the proposed mitigation and planned compensation is high. There is high confidence in the sediment and erosion controls. Overall, the CPP is predicted to have a high probability of success. The Redclay Compensation Lake and closure channels will be designed to provide habitat that is predicted to provide a net gain in productive capacity.

The level of confidence in predictions for fish and fish habitat on the Athabasca River is moderate to high. There is moderate confidence in the Base Case information and assessment techniques, and high confidence in the proposed mitigation and compensation measures. Shell has also committed to operate under Phase 1 of the Water Management Framework for the Lower Athabasca River while it is in place, and Phase 2 when it is developed.

### **1.4.3 Key Concerns**

Several key concerns were identified with regards to the Fish and Fish Habitat / Aquatic Health components during the review. These include:

1. Benchmark exceedances dismissed.

The results of the aquatic health analysis found that several constituents (TDS, aluminum, chromium, iron, manganese and strontium) would exceed the toxicological benchmarks. However, these findings were rated as having a

negligible impact on aquatic health, which was justified in several ways. These justifications included the following: the benchmarks didn't really represent an impacted state, baseline levels were already high, or the benchmarks were overestimated due to the conservative assumptions used to complete the assessment.

If the benchmarks can be so easily disregarded, then perhaps a more stringent method of determining benchmarks should be employed, so that meaningful results can be determined. There is little value in assessing impacts, and then disregarding the results because the methods were flawed.

**→ Recommendation:**

*Provide appropriate and meaningful benchmarks, such that compliance and non-compliance can be better assessed. If this is not possible, discuss the utility of these benchmarks and how they may be improved in the future.*

**2. Lack of assessment on aquatic health for benchmark exceedances.**

Several metals were found to exceed their benchmarks within the LSA and the pit lakes, including TDS, aluminum, chromium, iron, manganese and strontium. While the impacts were rated in terms of duration, frequency, location etc., no information on the actual impacts of these exceedances was included. It would be helpful to know the potential impacts of the metals, individually and synergistically, on the survival, growth, reproduction and behaviour of aquatic life.

**→ Recommendation:**

*Please provide a discussion of the potential effects of these benchmark exceedances on aquatic health.*

**3. Inconsistent extents of littoral zone in pit lakes.**

The Water Quality assessment noted that the littoral zones of the pit lakes would be up to 15% of the total area. The Aquatic Health assessment noted that the littoral zones would be between 10 to 30% of the area.

**→ Recommendation:**

*Please provide the correct littoral zone area for the pit lakes.*

**13. Unclear fish habitat impacts due to thermal changes in Eymundson Creek.**

As mentioned in the surface water quality section, the release of waters from a pit lake in 2049 would result in relatively large changes in temperature in Eymundson Creek during the spring, summer and fall. For example, the mean monthly temperature for May would decrease almost 3 °C, from 5.8 °C in the pre-development scenario to 3.1 °C. The mean monthly temperature for September would increase almost 6 °C from 3.6 °C to 9.4 °C. Despite these large differences, the impact rating on fish habitat is considered negligible. While the EIA states that thermal equilibrium would quickly be achieved, no

mention on the actual extent of the impact was provided. Only mitigations for impacts of the polishing pond releases, which would result in relatively small changes (a maximum change of 0.3 °C) were discussed. No mitigation for pit lake discharges were mentioned, despite this being the major impact on temperature.

→ **Recommendation:**

*Please provide more information on the extent of the thermal changes to Eymundson Creek and the potential impacts on fish habitat, including stress and/or avoidance behaviours.*

4. Effects on fish habitat are not extrapolated to fish abundance.

While the assessment discusses the impacts on fish habitat as a result of several impact pathways and linkages, these potential changes are not extrapolated to the implications for fish abundance or populations. For example, there is no discussion of the implications on fish abundance as a result of the elimination of many of the LSA watercourses and waterbodies, and replacement by diversion channels. Because some of these channels will be temporary, they will not be built to the same specifications as closure diversion channels would. Presumably there would be some impact on fish abundance within the LSA until permanent, self-sustaining channels were constructed and capable of supporting fish populations. Similar concerns exist for impacts of decreased fish passage and accessibility on fish abundance.

→ **Recommendation:**

*Please discuss the potential impacts of changes to fish habitat on fish abundance and local and regional fish populations, where appropriate.*

5. No determination of productive capacity of fish habitat.

The compensation of losses to existing fish habitat is based on the productive capacity of fish habitat. However, the productive capacity of fish habitat has not been determined for any of the habitat losses proposed as a result of the project. Shell states that this will be completed as part of the detailed No Net Loss Plan. However, until the productive capacity of all the existing and compensation habitats have been calculated, it is impossible to determine whether the compensation efforts proposed are comparable, appropriate and adequate for the project.

Shell states that a lake with an area of 4 km<sup>2</sup> is sufficient to provide adequate compensation. The lengths of the compensation channels would be 13 and 15 km. Generally, this project would require at least a 2:1 habitat compensation ratio, but no information is provided to document that the proposed habitat would meet this ratio. Despite this, Shell states that a net gain in the productive capacity of available fish habitat would occur with no predicted adverse impacts on fish habitat. However, without the detailed habitat unit

information, it is impossible to determine whether the goal of no net loss of productive capacity will be achieved.

In addition, without species-specific habitat losses, it is not possible to determine if the project would exacerbate the stresses and population declines already experienced by several fish species in the region.

➔ **Recommendation:**

*Please provide the detailed No Net Loss Plan when available, including the productive capacity of the habitat losses and compensation habitat. Provide all information necessary to prove that the compensation habitat will provide at least a 2:1 compensation ratio. Provide species-specific habitat losses, and discuss these impacts on fish species currently experiencing stress and population declines in the region.*

6. Lack of compensation riverine habitat.

As mentioned, the CCP does not determine the proportion of riverine or lacustrine habitat units lost or created as a result of the project. Presumably, the majority of fish habitat losses are from riverine habitat, however, the CCP can be assumed to consist primarily of lacustrine habitat (the Redclay Compensation Lake). More effort to creating riverine habitat may be warranted. While opportunities for compensation in the form of newly created riverine habitat or enhancement of existing habitat may be limited in the region, this was not discussed in the CCP. No explanation is given for why more riverine habitat cannot be recreated locally or enhanced regionally in order to replace lost habitat with like habitat. At the least, there should be a discussion of the issue within the report.

➔ **Recommendation:**

*Please discuss the lack of riverine habitat and the regional implications of this and other compensation plans that focus almost entirely on lacustrine habitat compensation.*

7. Little information on the timing of compensation.

Shell states that the compensation lake would be constructed early in the project and that the compensation channels would generally be constructed later in the project, but no dates are provided. As a result, it is unclear how the compensation habitats would be developed in a timely manner to provide available fish habitat. While construction of the compensation lake may occur at the same timeline as the beginning of the existing habitat losses, the former is not the same as providing habitat actually capable of supporting fish. There would be a timelag between construction and actual use by fish. This timescale differences and the potential impacts on local fish populations are not clearly outlined in the CCP. Regional impacts were not discussed, although this same timelag issue exists for all mine developments.

**→ Recommendation:**

*Please provide details regarding the timing of the construction of compensation habitat, and when they would be capable of supporting fish and other aquatic organisms as part of a sustainable and diverse ecosystem. Discuss the local and regional implications of this and other compensation plans that will not provide compensation habitat at the same time as habitat losses.*

## **Appendix D-6**

**Shell Pierre River Mine Project – Application Amendment and Response to the  
ACFN Review, October 4, 2009, by Fay Westcott of Clearwater Environmental  
Consultants**

February 7, 2010

Dan Smith  
DS Environmental Consulting Inc.  
Box 2678  
Three Hills, AB T2K 5B8

**Re: Shell Pierre River Mine Project – Summary of Water Quality and Aquatic Resources Concerns**

---

Dear Dan:

This summary updates the review of the EIA and Supplemental Information for Shell Canada's proposed Pierre River Mine Project. This summary provides a technical review and identifies deficiencies and concerns regarding the project. Responses from Shell Canada regarding the ACFN Technical Review Clarification Questions have been reviewed. Below is a list of the issues raised during the initial ACFN review and the adequacy of Shell's responses. The numbered questions noted below are the same numbers used in the Shell response. Please note that this letter does not include a summary of the Supplemental Information provided by Shell, nor does it summarize Shell's responses to the ERCB or AENV SIRs. These have been completed previously under a different letter, and are not repeated here. Also note that a new question has been identified and is presented in this letter.

## **1.0 Responses to ACFN Questions**

### *4.1 Surface Water Quality*

Section 2 Question 5: Changes to the water quality of the LSA not clearly ascribed.

Shell states that while several constituents were predicted to increase due to seepage from the Project, the magnitude of the increases was so small that they were listed in the table as "no increase".

Section 2 Question 6: Few constituents included in the LSA water quality assessment.

Shell states that the details regarding the full suite of water quality parameters was included in Volume 4, Section 6.5, 6.5.5.3, 6.5.2.7 and Appendix 4-7. Shell also states that a few parameters were unavailable for the CNRL Diversion Channel, and therefore were not modeled. Shell does not state which parameters these were. **Please provide a list of the parameters that were not modeled due to data unavailability.**

Section 2 Question 7: Uncertainty analysis not completed for the LSA Project impacts.

Shell states that they are willing to discuss this request as part of future negotiations towards an agreement. **I would expect that this information would be a basic part of the EIA and not linked with an agreement with the ACFN. The request remains.**

Section 2 Question 8: Inappropriate impact ratings for temperature changes to Eymundson Creek.

Shell states that the temperature changes indicated for Eymundson Creek compare the existing Eymundson Creek to the diversion channel constructed at Closure, and appears to suggest that the comparison is not valid. While it is clear that this comparison is for two completely different channels, Shell is responsible for assessing the impacts of their project on the existing environment. If Shell is planning to eliminate Eymundson Creek and replace it with a diversion channel, then those impacts should be evaluated. The resulting channel will have a temperature difference of up to 6 °C from the existing Creek, as stated in the EIA. The question remains as to whether an impact rating of negligible is therefore appropriate. In addition, Shell does not provide information on the extent of the impact along the length of the channel, or the impact on other water quality constituents. Shell states that the question is a statement of disagreement with their methods, and should be discussed following completion of the technical review. It is unclear why justification of their methodology and impact ratings can't be provided in these responses to the ACFN questions. **The question remains.**

Section 2 Question 9: Only guideline exceedances were considered, not increases in the values.

Shell states that the most stringent guidelines (of AENV, CCME and US EPA) were applied. Shell then discusses that guidelines are meant to protect the most sensitive life stage of the most sensitive species over the long term. I would agree with Shell's statements, however, they don't answer the question. Absolute changes in the numerical values of the water quality parameters were not discussed. Sole reliance on guideline compliance does not necessarily ensure that the ecosystem remains unimpacted or unchanged. **The question remains unanswered.**

Section 2 Question 10: Percentage change of water quality impacts is lacking.

Shell states that there is sufficient information for ACFN to calculate the percentage change of the data. This is true, but it isn't ACFN's responsibility to complete tables for the EIA. Information presented should be clear and informative. Is Shell really requesting that reviewers conduct their own manipulations of the data? The calculation of percentage change and its application to the ratings criteria is a minor point, but in the bigger picture, this is not an approach that Shell should promote. **The request to provide percentage change information remains outstanding.**

Section 2 Question 11: Ratings system for constituents with guidelines is unclear.

Shell clarified that the chronic guideline is applied when both chronic and acute guidelines are present. Shell did not clarify the ratings system provided in the EIA. The ratings criteria in this section of the EIA are provided as low (when the release contributes slightly to existing background values over guidelines) medium (a marginal

contribution) and high (a substantial contribution). Definitions of “slightly”, “marginal” and “substantial” were not provided in the EIA and were requested. Shell stated that these terms were not used to rate guidelines exceedances. This explanation appears to combine two separate approaches to assess data: first the actual water quality assessment, and then the use of the water quality data in the subsequent Aquatic Health and Human Health components. This request applies only to the ratings of the water quality component. **The request to provide the definitions remains.**

Section 2 Question 12: Discuss the adequacy of a maximum 15% littoral zone for the end pit lakes, rather than the standard 20 to 30%.

Shell states that the littoral zones of the pit lakes will be between 10 to 30% and that the exact areas will be determined during the detailed design stage. **The request to ensure that littoral zones are 20 to 30% and not on the lower end of the expected range, remains.**

Section 2 Question 13: Unclear water quality of pit lake discharges.

Shell states that the management of pit lakes and Treatment Lake will meet discharge criteria as are currently being developed by CEMA and will be enforced by AENV in the future. This response is adequate in that this is how the process has been established, however, I have reservations about the approval and construction of mines without clear details and specific commitments as to the quality of water discharged by these pits to the environment.

Section 2 Question 14: Sediment quality of the pit lakes at closure hasn't been characterized.

Shell states that the MFT that will be added to the pit lakes is expected to be comparable to the MFT for existing oil sands operations. However, every oil sands operation is slightly different, with unique geology, and variations in the extraction and processing technology used. Therefore, the wastes, including the MFT, will be unique with different constituents. Regardless, the question asked was what the sediment quality of the pit lakes would be at closure, not the quality of the MFT initially added. **The request for pit lake sediment information at closure remains.**

Section 2 Question 15: No explanation given for declines in water quality in the Athabasca River.

Shell states that this issue was identified as an error and has been corrected in the Project Update for the Pierre River Mine. As Shell notes, the numbers are slightly different, however, the conclusions of the EIA are not changed.

Section 2 Question 16: The effects of the construction of the bridge and water intake on water quality of the Athabasca River are not discussed.

Shell states that the impacts are described in Section 6.7.7.3.

## 4.2 Fish and Fish Habitat

### Section 3 Question 17: Exceedances of the toxicological benchmarks were disregarded.

Shell states that the question is a statement of disagreement with their methods, and should be discussed following completion of the technical review. It is unclear why justification of their methodology can't be provided in these responses to the ACFN questions. **The request remains.**

### Section 3 Question 18: Chronic effects benchmark exceedances were not assessed for impacts on aquatic health.

Shell states that the findings of the assessment were that none of the parameters would pose long-term impacts to aquatic health. Any exceedances of benchmarks were flagged for further assessment. It is unclear whether Shell is planning on conducting additional assessment of these exceedances. The potential impacts on aquatic life were not discussed, apart from the conclusion that impacts would be negligible. **The request remains.**

### Section 3 Question 19: Inconsistent littoral zone areas within EIA sections.

Shell clarified that the littoral zones of the pit lakes will be between 10 to 30% and that the exact areas will be determined during the detailed design stage. **The response is adequate, however, see Question 12.**

### Section 3 Question 20: Impacts on fish due to thermal changes of Eymundson Creek unclear.

Shell states that Eymundson Creek will be diverted in 2016 (the large temperature changes would occur in 2049). Because of the operational diversions of Eymundson Creek, full compensation for the estimated loss of fish habitat is included in the Conceptual Compensation Plan. Because it is assumed that this plan will fully compensate for any fish habitat losses, the impacts by the mine are considered to be negligible. **This response does not answer the question, which was not about compensation for the losses, but what the losses and impacts actually will be. Will Eymundson Creek have fish or other aquatic life in it in 2049 that will be exposed to these large thermal changes? If so, what will those impacts be?**

### Section 3 Question 21: Impacts on fish habitat are not extrapolated to fish abundance.

Shell states that additional information will be provided in their No Net Loss Plan, once completed. Shell notes that the ACFN withdrew from the No Net Loss consultation process and asks that they reconsider this decision. This response is adequate in that this is how the process has been established, however, I have reservations about the approval and construction of mines without a clear understanding of the impacts on fish and fish habitat.

### Section 3 Question 22: Productive capacity of fish habitat was not determined.

Shell states that the adequacy of the estimated compensation requirements will be confirmed in the future when the No Net Loss Plan is prepared. Shell notes that the

ACFN withdrew from the No Net Loss consultation process and asks that they reconsider this decision. This response is adequate in that this is how the process has been established, however, I have reservations about the approval and construction of mines without a clear understanding of the fish habitat compensation plans.

Section 3 Questions 23: No riverine habitat included in the Conceptual Compensation Plan.

Shell states that this should be discussed as part of the No Net Loss consultation process. See concerns noted in Question 22.

Section 3 Question 19: No information on the timing of fish habitat compensation construction and function.

Shell states that these specifics are being determined in the No Net Loss Plan. See concerns noted in Question 22.

## **2.0 Additional Question**

New Question: No information on the potential risks of mercury were provided regarding the construction and operation of the Compensation Lake.

Shell did not discuss the potential for the formation of methylmercury during development of the planned Compensation Lake. Please discuss the potential for the mobilization and conversion of mercury to methylmercury during the construction and operation of the lake. Discuss the concentrations of mercury and methylmercury likely to be present within the aquatic ecosystem (including sediment, water column, aquatic plants, plankton, benthic invertebrates and fish), at a variety of time-scales (e.g., construction, 1 year post-construction, 5 years post-construction, far future, etc.). Discuss the issue of methylmercury bioaccumulation within the Compensation Lake. Discuss mitigations planned to minimize mercury mobilization and conversion to methylmercury. Discuss monitoring plans to document the presence of mercury and methylmercury within the aquatic ecosystem of the Compensation Lake. This issue should also be examined under the terrestrial, human health and traditional land use components.

In summary, many of the responses were inadequate and did not answer the question posed. Other answers recommended that discussions be held with the ACFN following the review process. These questions are part of that review process, and should be discussed at this time. In addition, Shell states that many of the questions regarding fish and fish habitat will be answered when the detailed No Net Loss Plan is prepared. Shell states that ACFN withdrew from this process in May, 2009 and requests that they reconsider this decision so they can remain part of the process. A new question was also identified and requires a response from Shell.

Please give me a call if you have any questions at all about this response.

Sincerely,

Fay Westcott, M.Sc., P.Biol.  
Clearwater Environmental Consultants Inc.

## **Appendix D-7**

**Shell Pierre River Mine Project – Summary of Water Quality and Aquatic Resources  
Concerns, February 7, 2010, by Fay Westcott of Clearwater Environmental  
Consultants**

October 4, 2009

Dan Smith  
DS Environmental Consulting Inc.  
Box 2678  
Three Hills, AB T2K 5B8

**Re: Shell Pierre River Mine Project – Application Amendment and Response to the ACFN Review**

---

Dear Dan:

As requested, Clearwater Environmental Consultants Inc. has reviewed the Supplemental Information for the proposed Pierre River Mine Project and provided a technical review, summarizing the findings and any additional concerns. In addition, responses from Shell Canada regarding the ACFN Technical Review Clarification Questions have been reviewed. Below is a list of the issues raised during the initial ACFN review and the adequacy of Shell's responses. The numbered questions noted below are the same numbers used in the Shell response. Note that many of the questions, and therefore, the answers are identical to those of the Jackpine Mine Expansion Project.

## **1.0 Supplemental Information Summary and Review**

### *2.1 EIA Update – Water Quality*

In the spring and summer of 2007, additional water quality data were collected in the vicinity of the Project. This information was included in the Environmental Setting Report, but not in the EIA. The EIA was subsequently updated to include this information. The results of including this data did not change the overall findings or conclusions of the water quality assessment section of the EIA.

Some errors made in the original EIA (and identified in the ACFN technical review questions) were corrected. The water quality predictions related to the CNRL diversion ditch were modeling differently in the Base Case and Application Case, affecting the predictions of water quality at Nodes A2 and A3 of the Athabasca River. In the original EIA, some constituents were predicted to be higher in the Base Case than in the Application Case. The total loading from the diversion channel releases was mistakenly lower in the Application Case, resulting in the error. Revised modeling was conducted and new tables were produced. The water quality constituents were then predicted to increase from the Base Case to the Application Case, as would be expected. However, these increases were predicted to be small or negligible, and the overall conclusions of the EIA did not change.

Incorrect nickel concentrations were provided for the Syncrude Aurora North reclaimed overburden lands and Aurora Pit Lake and wetlands. The concentrations were initially unrealistically high, and were corrected to more representative values. Again, the overall conclusions of the EIA did not change.

No new concerns or questions arose from the review of the supplemental information.

## **2.0 Responses to ERCB Aquatic SIRs**

In the SIRs identified by the ERCB, the pertinent answers provided by Shell regarding water quality or aquatic resources include:

- A setback of 100 m from the Athabasca River and its tributaries is appropriate for streams and habitat protection as it is the guideline provided by ASRD and DFO to minimize the potential for a HADD (Harmful Alteration, Disruption or Destruction) of fish habitat
- Shell understands that the ERCB generally views pit lakes as unlikely to cause significant adverse environmental effects, as long as mitigations and additional ERCB recommendations are followed. The ERCB recommended the following for Shell's Muskeg River Mine Expansion:
  - Continue to work to provide assurance as to wetland and lake operations constructs and performance
  - Participate in CEMA working groups on surface water quality-related matters
  - Implement any recommendations made by CEMA or modeling procedures
  - Develop a schedule that includes the testing of pit lake predictions and design features, with a physical test case undertaken in conjunction with other oil sands companies
  - Complete sufficient work to verify pit lake feasibility within 15 years of 2003
- Shell identified several alternatives to end pit lakes if they do not perform as expected, including drying/dewatering/freeze drying the MFT and disposing of them as solids, or constructing polders (trenches within overburden disposal areas).
- Shell could possibly remediate and actively treat contaminated pit lake waters using ozonation (which oxidizes naphthenic acids), absorptive media, conventional treatment (carbon filtration, nanofiltration, oxidation) or deep well injection, if necessary. Shell could not provide an estimate of the cost of treating pit lake water.
- Shell will have a physical test pit lake in place by, or before, 2018
- Shell defined success for end pit lakes by providing definitions and features of self-sustaining and biologically productive systems
- Shell provided details on the sediments of reclamation waterbodies with MFT that suggested that they will develop into self-sustaining and biologically productive systems, including results from Syncrude and the University of Waterloo
- Shell stated that they currently have no details on emergency containment of any rupture of their pipeline crossing the Athabasca River, as the design for the crossing hasn't been completed. The design will consider fractures such as leak detection, emergency shutoff

and secondary containment, and will have a spill contingency plan. Mitigations in the event of a spill were briefly outlined

- Shell's water request will not affect current instream flow needs threshold values
- Shell acknowledges that low-flow periods need protection, and that there are no studies that have evaluated the maximum number of simultaneous mining operations that the Athabasca River can tolerate. Shell is actively participating in developing the Phase 2 Water Management Recommendations for the Athabasca River
- Shell states that AENV is working on developing cumulative water quality criteria for the Athabasca River (note: Daniel Andrews and I have written this draft report, which is currently being reviewed by AENV)
- Shell states that they are not planning to develop Watershed Frameworks for Water Quantity and Quality for the Pierre River or Big Creek. Shell assumes that AENV will include these watersheds in their frameworks for consideration, if necessary

### 3.0 Responses to ASRD Aquatic SIRs

In the SIRs identified by ASRD, the pertinent answers provided by Shell regarding water quality or aquatic resources include:

- Shell states that connectivity for fish habitat will be temporarily lost in some fish-bearing waterbodies, including the Pierre River, Eymundson Creek, Asphalt Creek, Unnamed Creek 1 and Big Creek, but only by a few hours or days until diversion and closure channels become operational
- Shell stated that algae and aquatic plants were not used as KIRs because they respond primarily to light and changes in dissolved nutrients, and are not as reliable for indicating the overall quality of fish habitat. Most changes occurring for algae and aquatic plants would also be reflected to some degree in the benthic invertebrate community, which was included as a KIR

### 4.0 Responses to ACFN Questions

#### 4.1 *Surface Water Quality*

Section 2 Question 5: Changes to the water quality of the LSA not clearly ascribed.

Shell states that while several constituents were predicted to increase due to seepage from the Project, the magnitude of the increases was so small that they were listed in the table as "no increase".

Section 2 Question 6: Few constituents included in the LSA water quality assessment.

Shell states that the details regarding the full suite of water quality parameters was included in Volume 4, Section 6.5, 6.5.5.3, 6.5.2.7 and Appendix 4-7. Shell also states that a few parameters were unavailable for the CNRL Diversion Channel, and therefore were not modeled. Shell does not state which parameters these were. **Please provide a list of the parameters that were not modeled due to data unavailability.**

Section 2 Question 7: Uncertainty analysis not completed for the LSA Project impacts.

Shell states that they are willing to discuss this request as part of future negotiations towards an agreement. **I would expect that this information would be a basic part of the EIA and not linked with an agreement with the ACFN. The request remains.**

Section 2 Question 8: Inappropriate impact ratings for temperature changes to Eymundson Creek.

Shell states that the temperature changes indicated for Eymundson Creek compare the existing Eymundson Creek to the diversion channel constructed at Closure, and appears to suggest that the comparison is not valid. While it is clear that this comparison is for two completely different channels, Shell is responsible for assessing the impacts of their project on the existing environment. If Shell is planning to eliminate Eymundson Creek and replace it with a diversion channel, then those impacts should be evaluated. The resulting channel will have a temperature difference of up to 6 °C from the existing Creek, as stated in the EIA. The question remains as to whether an impact rating of negligible is therefore appropriate. In addition, Shell does not provide information on the extent of the impact along the length of the channel, or the impact on other water quality constituents. Shell states that the question is a statement of disagreement with their methods, and should be discussed following completion of the technical review. It is unclear why justification of their methodology and impact ratings can't be provided in these responses to the ACFN questions. **The question remains.**

Section 2 Question 9: Only guideline exceedances were considered, not increases in the values.

Shell states that the most stringent guidelines (of AENV, CCME and US EPA) were applied. Shell then discusses that guidelines are meant to protect the most sensitive life stage of the most sensitive species over the long term. I would agree with Shell's statements, however, they don't answer the question. Absolute changes in the numerical values of the water quality parameters were not discussed. Sole reliance on guideline compliance does not necessarily ensure that the ecosystem remains unimpacted or unchanged. **The question remains unanswered.**

Section 2 Question 10: Percentage change of water quality impacts is lacking.

Shell states that there is sufficient information for ACFN to calculate the percentage change of the data. This is true, but it isn't ACFN's responsibility to complete tables for the EIA. Information presented should be clear and informative. Is Shell really requesting that reviewers conduct their own manipulations of the data? The calculation of percentage change and its application to the ratings criteria is a minor point, but in the bigger picture, this is not an approach that Shell should promote. **The request to provide percentage change information remains outstanding.**

Section 2 Question 11: Ratings system for constituents with guidelines is unclear.

Shell clarified that the chronic guideline is applied when both chronic and acute guidelines are present. Shell did not clarify the ratings system provided in the EIA. The ratings criteria in this section of the EIA are provided as low (when the release contributes slightly to existing background values over guidelines) medium (a marginal

contribution) and high (a substantial contribution). Definitions of “slightly”, “marginal” and “substantial” were not provided in the EIA and were requested. Shell stated that these terms were not used to rate guidelines exceedances. This explanation appears to combine two separate approaches to assess data: first the actual water quality assessment, and then the use of the water quality data in the subsequent Aquatic Health and Human Health components. This request applies only to the ratings of the water quality component. **The request to provide the definitions remains.**

Section 2 Question 12: Discuss the adequacy of a maximum 15% littoral zone for the end pit lakes, rather than the standard 20 to 30%.

Shell states that the littoral zones of the pit lakes will be between 10 to 30% and that the exact areas will be determined during the detailed design stage. **The request to ensure that littoral zones are 20 to 30% and not on the lower end of the expected range, remains.**

Section 2 Question 13: Unclear water quality of pit lake discharges.

Shell states that the management of pit lakes and Treatment Lake will meet discharge criteria as are currently being developed by CEMA and will be enforced by AENV in the future. This response is adequate in that this is how the process has been established, however, I have reservations about the approval and construction of mines without clear details and specific commitments as to the quality of water discharged by these pits to the environment.

Section 2 Question 14: Sediment quality of the pit lakes at closure hasn't been characterized.

Shell states that the MFT that will be added to the pit lakes is expected to be comparable to the MFT for existing oil sands operations. However, every oil sands operation is slightly different, with unique geology, and variations in the extraction and processing technology used. Therefore, the wastes, including the MFT, will be unique with different constituents. Regardless, the question asked was what the sediment quality of the pit lakes would be at closure, not the quality of the MFT initially added. **The request for pit lake sediment information at closure remains.**

Section 2 Question 15: No explanation given for declines in water quality in the Athabasca River.

Shell states that this issue was identified as an error and has been corrected in the Project Update for the Pierre River Mine. As Shell notes, the numbers are slightly different, however, the conclusions of the EIA are not changed.

Section 2 Question 16: The effects of the construction of the bridge and water intake on water quality of the Athabasca River are not discussed.

Shell states that the impacts are described in Section 6.7.7.3.

## 4.2 Fish and Fish Habitat

### Section 3 Question 17: Exceedances of the toxicological benchmarks were disregarded.

Shell states that the question is a statement of disagreement with their methods, and should be discussed following completion of the technical review. It is unclear why justification of their methodology can't be provided in these responses to the ACFN questions. **The request remains.**

### Section 3 Question 18: Chronic effects benchmark exceedances were not assessed for impacts on aquatic health.

Shell states that the findings of the assessment were that none of the parameters would pose long-term impacts to aquatic health. Any exceedances of benchmarks were flagged for further assessment. It is unclear whether Shell is planning on conducting additional assessment of these exceedances. The potential impacts on aquatic life were not discussed, apart from the conclusion that impacts would be negligible. **The request remains.**

### Section 3 Question 19: Inconsistent littoral zone areas within EIA sections.

Shell clarified that the littoral zones of the pit lakes will be between 10 to 30% and that the exact areas will be determined during the detailed design stage. **The response is adequate, however, see Question 12.**

### Section 3 Question 20: Impacts on fish due to thermal changes of Eymundson Creek unclear.

Shell states that Eymundson Creek will be diverted in 2016 (the large temperature changes would occur in 2049). Because of the operational diversions of Eymundson Creek, full compensation for the estimated loss of fish habitat is included in the Conceptual Compensation Plan. Because it is assumed that this plan will fully compensate for any fish habitat losses, the impacts by the mine are considered to be negligible. **This response does not answer the question, which was not about compensation for the losses, but what the losses and impacts actually will be. Will Eymundson Creek have fish or other aquatic life in it in 2049 that will be exposed to these large thermal changes? If so, what will those impacts be?**

### Section 3 Question 21: Impacts on fish habitat are not extrapolated to fish abundance.

Shell states that additional information will be provided in their No Net Loss Plan, once completed. Shell notes that the ACFN withdrew from the No Net Loss consultation process and asks that they reconsider this decision. This response is adequate in that this is how the process has been established, however, I have reservations about the approval and construction of mines without a clear understanding of the impacts on fish and fish habitat.

### Section 3 Question 22: Productive capacity of fish habitat was not determined.

Shell states that the adequacy of the estimated compensation requirements will be confirmed in the future when the No Net Loss Plan is prepared. Shell notes that the

ACFN withdrew from the No Net Loss consultation process and asks that they reconsider this decision. This response is adequate in that this is how the process has been established, however, I have reservations about the approval and construction of mines without a clear understanding of the fish habitat compensation plans.

Section 3 Questions 23: No riverine habitat included in the Conceptual Compensation Plan.

Shell states that this should be discussed as part of the No Net Loss consultation process. See concerns noted in Question 22.

Section 3 Question 19: No information on the timing of fish habitat compensation construction and function.

Shell states that these specifics are being determined in the No Net Loss Plan. See concerns noted in Question 22.

In summary, many of the responses were inadequate and did not answer the question posed. Other answers recommended that discussions be held with the ACFN following the review process. These questions are part of that review process, and should be discussed at this time. In addition, Shell states that many of the questions regarding fish and fish habitat will be answered when the detailed No Net Loss Plan is prepared. Shell states that ACFN withdrew from this process in May, 2009 and requests that they reconsider this decision so they can remain part of the process.

Please give me a call if you have any questions at all about this response.

Sincerely,

Fay Westcott, M.Sc., P.Biol.  
Clearwater Environmental Consultants Inc.

## **Appendix D-8**

**Shell Pierre River Project Conceptual Fish Habitat Compensation Plan Review for  
Athabasca Chipewyan First Nation, September 25, 2008, by Fay Westcott of  
Clearwater Environmental Consultants**

# Shell Pierre River Project

## Conceptual Fish Habitat Compensation Plan Review for Athabasca Chipewyan First Nation

By:

Clearwater Environmental Consultants Inc.

Sept. 25, 2008

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### 1.1 Introduction

As a part of their application of approval of expansions to their current oil sands operations, Shell Canada Limited (Shell) has submitted an Application and Environmental Impact Assessment (EIA) for the Jackpine Mine Expansion and Pierre River Mine Project. This application and EIA are also used to support their request for operating approvals under the Alberta Oil Sands Conservation Act, Alberta Environmental Protection and Enhancement Act (EPEA) and Alberta Water Act. Shell is seeking approval for development of a new mine located on the west side of the Athabasca River (Pierre River Mining Area – PRMA). The project would specifically affect portions of the Pierre River, Asphalt Creek, Eymundson Creek, Big Creek and Redclay Creek watersheds, as well as reaches of the Athabasca River. This application and EIA have been reviewed on behalf of the Athabasca Chipewyan First Nation (ACFN).

The following documents were consulted in order to conduct this review of Shell's Pierre River Mine Project:

- Volume 4A: Aquatic Resources
- Volume 4B: Aquatic Resources Appendices

### 1.2 Overview

Overall, the Aquatic Resources components of the Shell JEMA and PRMA Project EIA were well done, well detailed and logical. However, the combination of two completely separate projects into one Application and EIA was very difficult to review. I would recommend that this approach not be permitted in the future. The rationale for the inclusion of both projects was unclear and not described in the EIA. The projects are on the opposite sides of the Athabasca River, and not physically connected. If Shell were concerned about providing a better cumulative effects impact assessment for these two projects, then that was not achieved, as cumulative effects on the Athabasca River (the only common LSA and RSA areas

for the two projects) was done in a cursory manner and not a true cumulative effects analysis.

In reality, it appears that the only reason that these two projects (JEMA and PRMA) were combined into one Application and EIA is that the compensation plans for both projects have been consolidated into one area, located in the Pierre River Mine area. It is alarming that the Muskeg River watershed will be so disturbed by existing, approved, and planned projects, that there is no room for locating on-site compensation efforts for one of the many projects within the watershed.

The Conceptual Compensation Plan puts forward a combined plan for both the PRMA and JEMA projects. The habitat units and actual productive capacity of fish habitat to be lost in either the PRMA or JEMA projects were not determined at this stage, nor was the productive capacity of the proposed compensation habitats. The proposed compensation would be a lake and two channels, which are intended to compensate for the habitat losses for both projects. Similar to other regional mine plans, the majority of the compensation appears to be for lacustrine habitat, while the majority of losses would be for riverine habitat. Without additional information, and in particular, habitat unit information, it is not possible to assess the adequacy of this compensation plan.

Overall, the major concerns for the PRMA project regarding surface water quality, aquatic health and fish and fish habitat components are:

- The Conceptual Compensation Plan does not determine the productive capacity of lost habitat or compensation habitat, therefore it is not possible to determine whether the proposed plans are sufficient.

## **1.3 Fish and Fish Habitat**

### **1.3.1 Overview**

The Fish and Fish Habitat and Aquatic Health assessment sections were combined in this one review section. The key environmental issues arising from the projects with respect to fish and fish habitat are:

- Changes in habitat area, streamflows, channel regime/geomorphic condition, water levels and effects on fish habitat
- Changes in water quality, sediment yield and deposition and aquatic health and effects on fish habitat and fish abundance
- Changes in benthic invertebrate communities or invertebrate drift
- Changes in habitat accessibility to fish
- Changes in fishing pressure and effects on fish abundance

The LSA and RSA boundaries for Fish and Fish Habitat/Aquatic Health are the same as those for Water Quality and Surface Water Hydrology.

Development activities to be assessed include those activities during mine construction, operations, closure and reclamation that could alter the condition or area of fish habitat as these relate to stream flow and water level, sediment loading, channel regime and water quality.

Potential effects to fish and fish habitat from the Project and drainage integration were assessed in relation to Key Indicator Resources (KIRs) for each of the watercourses and waterbodies in the LSA and RSA. The biological receptors of fish and fish habitat include benthic invertebrate populations, fish abundance and aquatic diversity. All KIRs are used to provide information, within a relatively short time frame, about potential responses to environmental changes that may occur. The effects of the Project on KIR fish species were assessed in relation to the various life stages and their habitat needs.

Data sources included historical aquatic studies and field studies conducted within the LSA. Additional data was provided by government agencies (Alberta Sustainable Resource Development), industries, consultants, government research programs (AOSERP, Northern River Basins Study), multi-stakeholder group research and monitoring (CONRAD, RAMP and CEMA), Traditional Knowledge and Land Use information and information from other related disciplines within this EIA.

#### **1.3.1.1 Fish and Fish Habitat Baseline Conditions – LSA**

The Pierre River mainstem provides suitable open water habitat for several fish species and life stages. At the mouth, the Pierre River is low gradient, depositional and consists of run habitat with silt and sand substrate. The lower reaches provide spring spawning and summer rearing habitat for species such as northern pike and Arctic grayling from the Athabasca River. Seasonal rearing and feeding habitat may also be present for occasional migrants, such as burbot, mountain whitefish and walleye.

Habitat use potential for resident fish species in the Pierre River and its tributaries is limited by poor-quality overwintering habitat (i.e. shallow depths and low winter DO). Beaver ponds may improve the potential of this area for overwintering because they increase pool depths.

The fish community within the Pierre River is relatively diverse, with a total of 17 species recorded. This includes five sport, two non-sport and 10 forage fish species. The distribution of sport fish species in the Pierre River is essentially confined to the lower reach, near the confluence with the Athabasca River.

Mean benthic invertebrate density at two depositional watercourse sites in the Pierre River was highly variable, ranging from 1,200 to 63,000 organisms/m<sup>2</sup>. Total taxonomic richness ranged from 23 to 40 taxa/site, indicating a rich benthic invertebrate community. The dominant taxa were midges and bristle worms.

Eymundson Creek provides suitable habitat for forage fish and some seasonal habitat for large-bodied fish species from the Athabasca River. Habitat is composed of run, flat, riffle and impoundments associated with beaver dams.

Shallow depths and low DO levels restrict the range of large fish in this area overwinter. A total of 11 fish species, primarily forage fish, have been documented in the watershed, primarily in the lower reaches. This watershed supports a diverse benthic invertebrate community dominated by seed shrimp, midges and bristle worms.

The Big Creek mainstem provides habitat for several fish species and life stages due to the availability of cover, presence of spawning substrate and suitable water quality. It has riffle, run and flat habitat, but limited overwintering potential. Small channel size, shallow depth, low discharge volume, poor habitat diversity and the presence of fine sediment limit fish populations. Eleven fish species, primarily forage fish, have been observed in the watershed. The area supports a moderately rich and diverse benthic invertebrate community dominated by seed shrimp, midges and bristle worms.

Suitable open-water habitat is present in much of the Redclay Creek mainstem. The habitat is primarily riffle-run and there are a number of pools and some rocky substrate. The lower reaches of the creek provide summer habitat for a number of sport fish species from the Athabasca but winter habitat is limited. Fifteen fish species have been documented in the watershed, including sport, non-sport and forage fish species. Sport fish species are concentrated in the lower reaches of the creek. Benthic invertebrate communities were moderately diverse and were dominated by midges.

There are no existing or approved developments within the LSA, therefore, the Base Case and Pre-development Case are the same.

### **1.3.1.2 Fish and Fish Habitat Baseline Conditions – Athabasca River RSA**

The Athabasca River within the Aquatics LSAs and RSA for the Project is a large-volume, low-gradient mainstem river that provides turbid, cool-water habitat for a variety of fish. The river is wide but generally shallow, with dynamic, shifting sand channels. Instream cover is limited, and provided by depth and turbidity. Structural cover is limited here. Only 17% of the bank habitats are composed of rocky materials and hardened soils.

Thirty-one fish species occur in the lower Athabasca River, including 12 sport species, two non-sport species, and 17 forage fish species. Of these, 11 species are common, abundant, or seasonally abundant. The Athabasca River in the RSA provides juvenile rearing habitat and adult feeding habitat for regionally significant commercial, subsistence and sport species, and also provides some fry nursery habitat and overwintering habitat. The Athabasca River in the RSA provides an important migratory route for fish from Lake Athabasca to the Peace-Athabasca Delta, and tributary confluences provide important habitat for a variety of life history functions.

Benthic invertebrate diversity is not high in the Athabasca River and historical surveys have found population density to be variable. Midges are typically the

dominant group in depositional areas. Bristleworms, roundworms, stoneflies and caddisflies are common in erosional habitats.

There is the potential for the Athabasca River to be affected by several existing or approved developments. Flow and water level reductions may occur in the river due to cumulative water withdrawals from oil sands and other developments and users, and could affect fish habitat. The total water withdrawals are small on an annual basis, relative to the large flows of the Athabasca river. The net annual water allocation to all existing and approved oil sands projects results in a reduction of the mean annual flow of about 2.1%. However, operators are required to meet the Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River, recently developed by Alberta Environment and Fisheries and Oceans Canada. This includes water withdrawal restrictions that are designed to minimize habitat effects during sensitive time periods, such as low winter flows.

### **1.3.1.3 Fish and Fish Habitat Baseline Conditions – Traditional Ecological Knowledge**

Several fish species have been identified as traditional resources through the collection of TEK. The TEK confirmed that the range of species selected as KIRs included most of the species of value and importance to local Aboriginal communities. Lake trout was the only species with a high use ranking that was not included as a KIR because they are not typically present in the LSA, but are found in Lake Athabasca.

### **1.3.1.4 Impacts – Fish Habitat and Fish Abundance – LSA**

Fish habitat and riparian areas lost due to the project would occur in the lower Pierre River, lower Eymundson Creek, lower Asphalt Creek, lower Big Creek, lower First Creek, unnamed tributaries to Pierre River, Eymundson Creek, Big Creek, Redclay Creek and the Athabasca River, and unnamed waterbodies within the Pierre River, Eymundson Creek, Big Creek and Redclay Creek watersheds. These habitat losses amount to 1,880,074 m<sup>2</sup> of habitat, the largest single losses would occur in the unnamed waterbodies of Big Creek (559,410 m<sup>2</sup>) and the unnamed tributaries of the Athabasca River (205,697 and 225,553 m<sup>2</sup>). Additional losses of 452,467 m<sup>2</sup> would occur at closure, due to the repositioning of diversion channels, with the largest loss in an unnamed tributary of Big Creek (100,578 m<sup>2</sup>). The closure diversion channels would be designed to provide fish habitat that meets compensation requirements.

The Conceptual Compensation Plan would offset these losses and eliminate potential adverse effects due to changes in habitat area. The CCP is described in Section 1.4.1.10 below. Overall, a net gain in the productive capacity of available fish habitat would be predicted. As a result, there are no predicted adverse impacts on fish habitat due to changes in habitat area.

Changes in the thermal regime of Eymundson Creek could impact fish habitat, with delayed warming in the summer and delayed cooling in the fall and winter. Shell states that any effects of the changes in temperature would be localized and receiving waterbodies and watercourses would quickly attain thermal equilibrium. The overall adverse impacts were considered negligible.

The elimination of habitat would result in a temporary loss of the benthic invertebrate community. However, after compensation, these impacts were predicted to have negligible impacts on fish habitat.

All stream diversions would be designed to provide fish passage and maintain connectivity with upstream watercourses during construction, operations and on closure. Therefore, impacts on habitat accessibility were considered negligible. In particular, the Pierre River would be diverted south in 2016 around the mine to the Athabasca river. This diversion has the potential to affect fish passage from the Athabasca River to the Pierre River, particularly since the escarpment is very steep. Fish passage provisions would be installed as required to maintain connectivity. At closure, a permanent diversion channel would be constructed and designed to allow for fish movement. The downstream reach of this channel would likely be integrated with the CNRL Horizon closure drainage channel, and will accommodate flows from both the diversion of the Pierre River and the Horizon Project. Overall, no measurable impacts on habitat accessibility were expected for the Pierre River.

During operations, Eymundson and Asphalt creeks would be diverted north around the mine to the Athabasca river. Fish accessibility would be maintained. This diversion channel would be maintained during closure until the water quality in the pit lakes is suitable for release. At this time, the diversion channel would be decommissioned and the Eymundson and Asphalt creeks would flow into the Pierre North Pit Lake. Impacts on habitat accessibility were predicted to be negligible for Eymundson and Asphalt creeks.

Similarly, diversions for Unnamed Creek 1, First Creek, Big Creek were also expected to have negligible impacts on fish habitat accessibility.

Overall, the EIA concludes that with mitigation and compensation, there would be no environmental consequence of the residual impacts on fish habitat or fish diversity in the LSA.

#### **1.3.1.5 Impacts – Fish Habitat and Fish Abundance – Athabasca River**

The placement of a freshwater intake on the west bank of the Athabasca river, and the new bridge across the Athabasca river would result in a permanent small-scale loss of habitat. However, the portion of the intake on the Athabasca River consists entirely of common erosional habitat, and provides low to moderate suitability for use by key species during the open water period. For the bridge, instream piers would be installed in the river, resulting in habitat losses, and riparian habitat losses would occur on either side of the bridge. Negative impacts would occur, and compensation would likely be required. The detailed design for

this intake and bridge are not available yet, and these losses have not been incorporated into the CCP yet. They will be included in the detailed No Net Loss Plan.

The project, in addition to existing and approved projects, would contribute to predicted changes in mean seasonal flows of the Athabasca River. The reduction in mean seasonal flows due to oil sands water withdrawals is 2.1% in the summer and 14.1% in the winter. Shell would meet the Water Management Framework requirements for the lower Athabasca River. As a result, no measureable impacts to fish habitat are expected in the Athabasca River, beyond those outlined in the Framework. The Framework does mention that cumulative water withdrawals, even the restricted withdrawals permitted under the Framework, may result in negative effects on fish habitat. Any incremental changes to fish habitat will be addressed through the Phase 2 process of the Water Management Framework. Habitat compensation requirements, if necessary, will be developed for the project through consultation with DFO.

The losses of the waterbodies and watercourses in the LSA could potentially alter benthic invertebrate drift into the Athabasca River. However, invertebrate drift from tributaries represents less than 1% of total drift in the Athabasca River. As a result, the overall effect is expected to be negligible.

Overall, the EIA concludes that with mitigation and compensation, there is no environmental consequence of the residual impacts on fish habitat on the Athabasca River.

#### **1.3.1.6 Mitigations**

A summary of mitigations for the PRMA are provided in Table 1.7-1 and include:

- Minimize effects of closed circuit operations by diverting natural streams around the mining area
- Design operational diversions and closure channels to provide for fish passage where required
- Implement a fish salvage program for fish habitats permanently lost
- Implement a transport and/or stocking program for effects of habitat accessibility
- Compensate habitat losses and alterations by developing appropriate compensation habitat to ensure the No Net Loss objective is achieved
- Develop fish habitat of equivalent or higher productive capacity
- Continue to participate in RAMP, CEMA, CONRAD and other regional initiatives to monitor water quality and to confirm performance of mitigations

- Design all stream diversions to provide fish passage and maintain connectivity with upstream watercourses during construction, operations and on closure
- Comprehensive monitoring program may include the assessment of streamflows, water levels and discharge rates, channel stability and morphology, water and sediment quality, littoral zone development, growth of aquatic vegetation as well as benthic invertebrate communities, fish populations and riparian zone vegetation

### **1.3.1.7 Fish Habitat Conceptual Compensation Plan**

A habitat compensation plan was developed to address the impacts to fish and fish habitat associated with development activities in the JEMA and PRMA watersheds.

In JEMA, fish habitat losses would occur throughout portions of the upper Muskeg River watershed, including Wapasu Creek. The proposed developments would also alter some aspects of the JEMA –Phase 1 development, including Khahago Lake and the repositioned Muskeg Creek. In PRMA, fish habitat losses would occur throughout portions of the Pierre River, Eymundson Creek, Big Creek and Redclay Creek. The impacts of the Athabasca River and the direct habitat losses due to the construction of the bridge and water intake (for the PRMA project) have not been identified or included in this CCP.

The fish habitat compensation plan is developed with consideration of the “No Net Loss Guiding Principle” for fish habitat, to satisfy the requirements of Fisheries and Oceans Canada, under the Fisheries Act. Watercourse segments that would result in the HADD of fish habitat due to the JEMA and PRMA are identified.

Several habitat compensation options were evaluated with respect to developing the Conceptual Compensation Plan (CCP) for the Project. The selected option would consist of constructing riverine and lacustrine compensation habitats, including a compensation lake in the lower Big Creek and lower Redclay watersheds (Redclay Compensation Lake) to provide year-round habitat for a species assemblage similar to those species affected by the Project. This option was selected because it is on the Shell lease area, has the potential to provide large habitat gains, and has design flexibility in terms of overall size and configuration. Included with the design of this lake is the construction of natural geomorphic channels that incorporate fish habitat features and facilitate fish passage from the Athabasca River to the Redclay Compensation Lake and upper reaches of Big Creek watershed.

Redclay Compensation Lake would be constructed immediately adjacent to the PRMA’s Raw Water Storage Facility. The lake size would be approximately 4 km<sup>2</sup>. The compensation lake would be constructed to provide habitat diversity in the lake (varying gradients, substrate types, and depths). Design features would include spawning, nursery, rearing, feeding and overwintering habitats to support

self-sustaining fish populations. It would provide suitable habitat for a proposed fish community consisting of walleye, lake whitefish, cisco, northern pike, yellow perch, burbot, white sucker, longnose sucker and several forage fish species. The compensation lake would be connected to upstream and downstream riverine habitat.

In addition to the above lake design, two channels would be constructed as a part of the lake development to provide riverine compensation habitat. The lake outlet channel would be constructed to connect the lake to the Athabasca River and would be 15 km in length. A diversion channel would be constructed to connect the lake to the upper reaches of the Big Creek watershed and would be 13 km in length. Where appropriate, both channels would be designed to provide riverine spawning habitat for select species that prefer flowing water with rocky substrate for spawning (e.g. suckers). Permanent closure channels associated with the project would be geomorphically designed to provide fish habitat and fish accessibility and would be included as compensation in the detailed No Net Loss Plan.

The development of the compensation lake habitat would occur at the start of the project. Development of the diversion channel compensation habitat would be variable, but would generally occur later in the project life as most are closure channels. The first losses of fish habitat would occur in 2016, with the initial diversions of the PRMA. Other impacts would occur later, including losses in the Muskeg River, would start in 2046.

### **1.3.2 Discussion**

The impact predictions for aquatic health within the LSA and RSA were based on conservative modelling and multiple lines of evidence, including predicted levels of while effluent chronic and acute toxicity and concentrations in water and fish tissue. Uncertainty analyses indicated that the water quality predictions were robust, particularly for whole effluent toxicity. Confidence in the overall predictions was considered high. Those metals for which low impacts were predicted were considered to be overestimated due to the conservative assumptions used to complete the assessment.

The predictions of the pit lake and Raw Water Storage Facility water quality were also considered robust, with a number of adaptive management practices available to ensure suitable water quality within the lake.

The level of confidence in the fish habitat and fish abundance predictions is moderate to high. There is a moderate to high level of confidence in the Base Case information, assessment techniques and proposed mitigation measures. Decreased confidence is found in the analytical techniques that include estimates of changes in habitat areas and the effects of changes in flow on fish habitat. This analysis was done based on estimates, which are preliminary and based on historical and field measurements. A more detailed assessment of habitat

changes would be made during the development of the detailed No Net Loss Plan in the future.

The level of confidence in the predictions made for fish diversity is moderate, as there is moderate confidence in interpreting the specific effects of habitat changes on habitat diversity. The assessment is based primarily on professional judgement regarding how habitat changes translate into specific effects on diversity.

Shell is committed to monitoring and providing compensation for the Project impacts, and as such, the confidence of the proposed mitigation and planned compensation is high. There is high confidence in the sediment and erosion controls. Overall, the CPP is predicted to have a high probability of success. The Redclay Compensation Lake and closure channels will be designed to provide habitat that is predicted to provide a net gain in productive capacity.

The level of confidence in predictions for fish and fish habitat on the Athabasca River is moderate to high. There is moderate confidence in the Base Case information and assessment techniques, and high confidence in the proposed mitigation and compensation measures. Shell has also committed to operate under Phase 1 of the Water Management Framework for the Lower Athabasca River while it is in place, and Phase 2 when it is developed.

### 1.3.3 Key Concerns

Several key concerns were identified with regards to the Fish and Fish Habitat / Aquatic Health components during the review. These include:

1. Unclear fish habitat impacts due to thermal changes in Eymundson Creek.

As mentioned in the surface water quality section, the release of waters from a pit lake in 2049 would result in relatively large changes in temperature in Eymundson Creek during the spring, summer and fall. For example, the mean monthly temperature for May would decrease almost 3 °C, from 5.8 °C in the pre-development scenario to 3.1 °C. The mean monthly temperature for September would increase almost 6 °C from 3.6 °C to 9.4 °C. Despite these large differences, the impact rating on fish habitat is considered negligible. While the EIA states that thermal equilibrium would quickly be achieved, no mention on the actual extent of the impact was provided. Only mitigations for impacts of the polishing pond releases, which would result in relatively small changes (a maximum change of 0.3 °C) were discussed. No mitigation for pit lake discharges were mentioned, despite this being the major impact on temperature.

➔ **Recommendation:**

*Please provide more information on the extent of the thermal changes to Eymundson Creek and the potential impacts on fish habitat, including stress and/or avoidance behaviours.*

2. Effects on fish habitat are not extrapolated to fish abundance.

While the assessment discusses the impacts on fish habitat as a result of several impact pathways and linkages, these potential changes are not extrapolated to the implications for fish abundance or populations. For example, there is no discussion of the implications on fish abundance as a result of the elimination of many of the LSA watercourses and waterbodies, and replacement by diversion channels. Because some of these channels will be temporary, they will not be built to the same specifications as closure diversion channels would. Presumably there would be some impact on fish abundance within the LSA until permanent, self-sustaining channels were constructed and capable of supporting fish populations. Similar concerns exist for impacts of decreased fish passage and accessibility on fish abundance.

➔ **Recommendation:**

*Please discuss the potential impacts of changes to fish habitat on fish abundance and local and regional fish populations, where appropriate.*

3. No determination of productive capacity of fish habitat.

The compensation of losses to existing fish habitat is based on the productive capacity of fish habitat. However, the productive capacity of fish habitat has not been determined for any of the habitat losses proposed as a result of the project. Shell states that this will be completed as part of the detailed No Net Loss Plan. However, until the productive capacity of all the existing and compensation habitats have been calculated, it is impossible to determine whether the compensation efforts proposed are comparable, appropriate and adequate for the project.

Shell states that a lake with an area of 4 km<sup>2</sup> is sufficient to provide adequate compensation. The lengths of the compensation channels would be 13 and 15 km. Generally, this project would require at least a 2:1 habitat compensation ratio, but no information is provided to document that the proposed habitat would meet this ratio. Despite this, Shell states that a net gain in the productive capacity of available fish habitat would occur with no predicted adverse impacts on fish habitat. However, without the detailed habitat unit information, it is impossible to determine whether the goal of no net loss of productive capacity will be achieved.

In addition, without species-specific habitat losses, it is not possible to determine if the project would exacerbate the stresses and population declines already experienced by several fish species in the region.

➔ **Recommendation:**

*Please provide the detailed No Net Loss Plan when available, including the productive capacity of the habitat losses and compensation habitat. Provide all information necessary to prove that the compensation habitat will provide at least a 2:1*

*compensation ratio. Provide species-specific habitat losses, and discuss these impacts on fish species currently experiencing stress and population declines in the region.*

4. Lack of compensation riverine habitat.

As mentioned, the CCP does not determine the proportion of riverine or lacustrine habitat units lost or created as a result of the project. Presumably, the majority of fish habitat losses are from riverine habitat, however, the CCP can be assumed to consist primarily of lacustrine habitat (the Redclay Compensation Lake). More effort to creating riverine habitat may be warranted. While opportunities for compensation in the form of newly created riverine habitat or enhancement of existing habitat may be limited in the region, this was not discussed in the CCP. No explanation is given for why more riverine habitat cannot be recreated locally or enhanced regionally in order to replace lost habitat with like habitat. At the least, there should be a discussion of the issue within the report.

➔ **Recommendation:**

*Please discuss the lack of riverine habitat and the regional implications of this and other compensation plans that focus almost entirely on lacustrine habitat compensation.*

5. Little information on the timing of compensation.

Shell states that the compensation lake would be constructed early in the project and that the compensation channels would generally be constructed later in the project, but no dates are provided. As a result, it is unclear how the compensation habitats would be developed in a timely manner to provide available fish habitat. While construction of the compensation lake may occur at the same timeline as the beginning of the existing habitat losses, the former is not the same as providing habitat actually capable of supporting fish. There would be a timelag between construction and actual use by fish. This timescale differences and the potential impacts on local fish populations are not clearly outlined in the CCP. Regional impacts were not discussed, although this same timelag issue exists for all mine developments.

➔ **Recommendation:**

*Please provide details regarding the timing of the construction of compensation habitat, and when they would be capable of supporting fish and other aquatic organisms as part of a sustainable and diverse ecosystem. Discuss the local and regional implications of this and other compensation plans that will not provide compensation habitat at the same time as habitat losses.*

## **Appendix D-9**

**Shell Canada – Pierre River Mine Project – Environmental Impact Assessment  
Report. Review for Athabasca Chipewyan First Nation, February 17, 2009, by Brenda  
Miskimmin, Summit Environmental Consultants Ltd.**

**Shell Canada – Pierre River Mine**  
**Environmental Impact Assessment Report**  
**Review for Athabasca Chipewyan First Nation**  
**By:**  
**Summit Environmental Consultants Ltd.**  
**17 February 2009**

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## **1.1 Introduction**

The Environmental Impact Assessment (EIA) for the Pierre River Mine (PRMA) provides baseline environmental information, and assesses impacts related to the base case (existing and approved projects) and to the application case (all projects including PRMA). The PRMA is one of the first projects in the area, and the watersheds are currently in their natural condition. The base case hydrologic conditions for the streams that will be impacted by the project are the same as the pre-development conditions, except for a portion of Pierre River that will be disturbed by the CNRL Horizon project.

The goal of this review was to evaluate the basic hydrological aspects of the EIA. While some data were used for directed calculations, it was beyond the scope of this review to examine mathematical models and resulting predictions in detail.

## **1.2 Overview**

The PRMA is expected to span more than 40 years. Construction is planned to begin in 2010, with mining to start in 2018 and end in 2039. Closure is planned to begin in 2049. The PRMA will cause changes to flows in several natural streams that originate in the eastern slopes of the Birch Mountains, including:

- Pierre River,
- Asphalt Creek,
- First Creek,
- Eymundson Creek,
- Big Creek,
- Redclay Creek, and
- Several unnamed creeks.

The PRMA will require a water intake on the Athabasca River to obtain some of their process water. Shell proposes to withdraw 55 M m<sup>3</sup>/y from 2018-2028 (Stage 1) and 45 M m<sup>3</sup>/yr from 2028-2039 (Stage 2). Water will also be required from the Athabasca River to initially fill a long, narrow compensation lake (Redclay Lake), an adjacent “raw water storage facility” (later called a “treatment lake”), and to speed the filling of Pierre South Pit Lake at closure. The compensation lake combined with the adjoined raw water storage facility will be over 8 km in length and approximately 600 m in width. Volumes required and timing for filling the various water bodies were not described in this EIA.

Activities of the project that will affect local hydrology include:

- land clearing, muskeg drainage and overburden dewatering,
- closed-circuiting of project-related water,
- diversion of flows of all of the creeks listed above, and
- creation of large new open water areas in the form of the compensation lake, raw water storage and end pit lakes.

The above activities will cause extensive changes to local hydrology and large increases in open water areas on the landscape.

## 1.3 Hydrology

### 1.3.1 Overview

Shell is aware that reduced water levels and flows in the Athabasca River are concerns of ACFN and other local stakeholders. The Water Management Framework (WMF) for the Athabasca River is intended to protect the water resource. The Framework currently considers a total withdrawal for all projects combined of 26.5 m<sup>3</sup>/s or 15% of average weekly flows to be within the “green zone”. The highest withdrawal indicated for PRMA alone is 4.2 m<sup>3</sup>/s during seasons when river flows are highest.

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

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 PRMA. 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.

A larger area will be affected by the closure drainage plan than during operations due to the final configuration of the many artificial channels and pit lakes. Redclay Creek mainstem and some tributary reaches will be lost when they are inundated by the compensation lake.

The application case (existing and approved projects, including PRMA) will affect Athabasca River flows during land clearing and muskeg drainage, as well as through closed-circuiting and diverting tributaries. Shell compares impacted flows and land areas to the entire Athabasca River basin, concluding the impact on total flows is less than 1%. Considering other projects not yet approved (planned development case), a similar comparison results in the conclusion of a minor affect on the entire Athabasca basin's flows.

Mitigation is minimally described and refers to following the same program as for the Jackpine Expansion project. Mitigation during operations is briefly described as “progressive construction and development of reclamation drainage systems” to replace lost natural water bodies.

### **1.3.2 Discussion and Assessment Review**

The main hydrologic concerns with the PRMA are the replacement of large sections of several undisturbed streams and their tributaries with drainage ditches, the diversion of flows to large open water areas, and the resulting impact on the Athabasca River and delta.

Shell designates reservoir outflows as the mouths of the major streams that feed those reservoirs. In terms of water flows to the Athabasca River, this may be valid at some points in time when the outflow is a similar discharge as existed in the natural streams. However, for much of the time, flows to the River are reduced for an undisclosed period of time to fill the reservoirs, or by retention for project purposes.

By closure, open water areas will increase almost four times from 7.2 km<sup>2</sup> (pre-development) to 28.2 km<sup>2</sup> (application case). Reduced flows to the Athabasca River for the period of pit lake filling must occur. Given the size of the pit lakes relative to the inflowing and diverted streams, it would seem to be a significant loss of streamflows for the period of time required to fill the pit lakes. Shell does not discuss the time period required for pit lake filling, or estimate how long the Athabasca River will be deprived of these flows.

Pit lakes and constructed wetlands at closure are described as beneficial to attenuate floods, “bioremediate the tailings porewater releases” and capture runoff from reclaimed areas. In reality, the large open water areas are formed by the interception of water that would naturally flow to the Athabasca River and the delta downstream. While the release of pit lake water to the river is planned to begin in 2049, the adequacy of large pit lakes for bioremediation is still unknown.

Shell concluded that there would be no unacceptable environmental impacts provided the recommended mitigation and monitoring are undertaken. The mitigation plan specific to this project is not well described, and the monitoring plan is missing. Traditional ecological knowledge is generally described (S. 6.4.4) but not specifically related to this project's water quantity issues for the lower Athabasca River and delta.

### 1.3.3 Key Concerns

Several specific key concerns were identified for PRMA during the review of hydrologic aspects. These include:

1. Loss of several mainstem sections of pristine creeks

The PRMA will remove portions of watersheds and the lower reaches of several watercourses that have never been directly impacted by any development. Reporting these results separately and in several tables made it difficult to evaluate the overall impact of the project on hydrology.

➔ **Recommendation:**

*Provide one clear table of the water balance changes caused by the loss of portions of the watersheds and the lower sections of mainstem creeks for the life of the project. Describe the significance and assess qualitative relevance of the anticipated changes through time.*

2. Watercourse flows to the Athabasca River not clearly represented

The general assumption that outflows from reservoirs represent flows in lost watercourses is misleading. For example, the outflow of Redclay Lake has been arbitrarily assigned as the mouth of Big Creek. Big Creek flows near the "mouth" are predicted to change less than 5% even though the site is not a river mouth, but this large reservoir's outflow. In reality, the mouths of Big Creek, Unnamed Creek 7 and Redclay Creek will contribute flows into and out of Redclay Lake.

Secondly, all flows of Unnamed Creek 1, Asphalt Creek and Eymundson Creek will go to PRMA pit lakes at closure. The outflow of Pierre South Pit Lake in the far future is compared to pre-development Eymundson Creek flows at the mouth. This approach combines the flows of all creeks and results in little change in the outflow of the pit lake at some point in the "far future". Again, the lower reaches of these watercourses will no longer exist (as riverine systems) because they are replaced with pit lakes.

➔ **Recommendations:**

a) *Re-calculate inflows to Redclay Lake based on each of the inflowing tributaries on a timescale that captures*

*major changes and provides a relevant scenario for changing inflows to the Athabasca River.*

- b) Re-calculate inflows to Pierre North Pit Lake based on each of the inflowing tributaries on a timescale that captures major changes and provides a relevant scenario for changing inflows to the Athabasca River.*

### 3. Cumulative Impacts to the Athabasca River and Delta

Shell discusses changes in water depths and flows in the Athabasca River, but does not discuss the effect of cumulative changes in water depths on the Athabasca Delta. Changes in depth and flow affect the delta and reduce flushing of side channels and perched water bodies. Changes to the delta directly affect residents of that area.

#### → **Recommendations:**

*a) Extend the Regional Study Area (RSA) for surface water hydrology from Embarras Portage to the inflow of Lake Athabasca (i.e. encompass the delta),*

*b) Given that industry was directed under the WMF to reduce water withdrawals when the Athabasca River entered the “yellow zone” in January, 2009, what is Shell’s plan for water storage and use when restrictions are imposed in the future (including beyond 30 days planned storage)?*

*b) Will Shell commit to ACFN that they will abide by the lower Athabasca River WMF restrictions, notably during low flow periods?*

### 4. Open water areas created during operations

During operations, Shell indicates that a 2.5 km<sup>2</sup> water reservoir will be created as part of the diversion system to maintain Redclay Lake. In addition, Redclay Lake alone may be 5 km<sup>2</sup>. Yet the summary section for open water areas only accounts for 1.2 km<sup>2</sup> in new open water areas created by 2039 during PRMA operations (refer to Table 6.4-19).

#### → **Recommendation:**

*Re-calculate open water areas in Table 6.4-19 to account for all new open water areas created during project operations.*

5. Compensation lake water requirement is not accounted for

The plan for filling the compensation lake with water from the Athabasca River is not shown, nor is it clear whether this water is a component of the 55 M m<sup>3</sup>/yr requested for the early phase of the project.

→ **Recommendation:**

*Clarify whether water from the Athabasca River required to fill Redclay Lake is included in the requested 55 M m<sup>3</sup>/yr. If it is not, provide details of the timing and quantity of water withdrawals for this purpose.*

6. No discussion of length of time required to fill pit lakes

At closure (2049), runoff from Eymundson Creek, Asphalt Creek and Unnamed Creek1 will be directed to PRMA pit lakes. Athabasca River water will be used to shorten the time to fill the pit lakes because the streams may not provide enough water in a timely fashion. This would suggest that flows from the tributaries to the Athabasca River will be nil for the period of time required to fill the lakes. Yet by combining 2049 with “far future” in Table 6.4-21, Shell indicates that mean open water flows in these creeks will only be reduced by 23%.

→ **Recommendation:**

*Provide a realistic and more detailed description of the sources and length of time required to fill the pit lakes.*

7. Modelling uncertainty for Pierre South Pit Lake outflows

Shell applied uncertainty analysis to mean annual flows, 10-year flood peaks and mean ice cover flows. In other sections of the report, Shell also analysed mean open water flows. It isn't clear whether uncertainty analysis was not applied to open water flows to the pit lake because they were 100% certain, very uncertain, or whether it was an oversight.

→ **Recommendation:**

*Complete modelling uncertainty analysis for open water flows from the pit lakes to be created for this project.*

8. No mitigation planned to prevent new channel erosion

Shell does not plan to use settling ponds or other suitable erosion prevention in newly constructed drainage channels to minimize the potential for excessive sediments to be introduced to the Athabasca River. They indicate that flows are expected to be low and the size of settling ponds required would be impractical.

Since flows will be tripled in the Pierre River/CNRL combined diversion (C11b), a plan to prevent erosion and scouring is required (beyond

“selected overburden” and “in situ material” described in Appendix 4-4, Fig. 11). Sediment erosion is likely to occur in all new diversions during the conditioning period, and in the Pierre River/CNRL diversion at many times of the year on an ongoing basis.

→ **Recommendation:**

- a) *Given the severe incident of sediment washout in the neighbouring Tar River in 2008, will Shell commit to providing a mitigation strategy to prevent excessive erosion in the Pierre River/CNRL (C11/C11b) combined drainage channel?*
- b) *Provide a mitigation strategy to prevent erosion in all new channels that drain to fish-bearing waters in the event of storm flows or other high runoff, and*
- c) *Will Shell commit to provide ACFN with the opportunity to review any erosion-protection plans?*

9. Monitoring plan is not described

Shell indicates that they will modify the existing network of flow and water level monitoring stations during operations. No details are given about hydrologic monitoring as required by the Terms of Reference Section 5.6.6 (iii) and 6.0.

→ **Recommendation:**

*Will Shell commit to provide ACFN with the opportunity to review and make recommendations about the hydrologic monitoring and research plans for all phases of the PRMA?*

## 1.4 Conclusions

This project and other oil sands projects in the area will significantly impact the local hydrology of Pierre River, and several other local rivers. They will also contribute to cumulative impacts on regional hydrology including the Athabasca River and delta. Pit lakes that will total four times the size of existing surface water bodies will be among the local changes that will occur. Mitigation plans are not well described, and monitoring plans are barely mentioned. A number of commitments to ACFN by Shell are recommended for future environmental agreements.

## **Appendix D-10**

**Shell Canada - Pierre River Mine Project – Review of Shell’s Responses to 1) ACFN’s Key Concerns, and 2) ERCB/AENV’s Supplemental Information Requests, August 24, 2009, by Brenda Miskimmin, Summit Environmental Consultants Ltd.**

# **Shell Canada – Pierre River Mine**

## **Review of Shell's Responses to 1) ACFN's Key Concerns, and 2) ERCB/AENV's Supplemental Information Requests**

**By:**

**Summit Environmental Consultants Ltd.**

**August 24, 2009**

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### **1.1 Introduction**

The Pierre River Mine (PRM) is one of the first projects proposed in the area, and the watercourses are currently in their natural condition. The base case hydrologic conditions for the streams to be impacted by the project will be the same as the pre-development conditions, except for some tree clearing and a portion of Pierre River watershed that will be disturbed by the CNRL Horizon project.

The goal of this review was to evaluate the written responses provided by Shell to the technical review questions on hydrology that were submitted by ACFN earlier this year. In order to better understand Shell's position and to focus follow-up recommendations, we also considered Shell's responses to the Supplemental Information Requests (SIRs) of the ERCB and AENV (May 2009).

### **1.2 Hydrology**

#### **1.2.1 Overview of Responses to Key Concerns**

Most of Shell's tabulated responses to ACFN's concerns about hydrology were very brief, deferred to a later stage, or did not answer the question. Of the concerns or requests submitted (#25-34), acceptable responses were received for five, responses were deferred to future agreement negotiations for three, and no suitable response was provided for three.

Shell considered some questions to be inappropriate in that we disagreed with their methodology as opposed to a "request for clarification". For unknown reasons, they did not consider ACFN's submission to be the

technical review of the EIA. Most questions that touched on the fish habitat compensation plan were not responded to.

## 1.2.2 Review of Responses to Key Concerns

The main hydrologic concerns with the PRM are the replacement of the lower reaches of several undisturbed streams with drainage ditches that divert water either to closed circuit areas, the compensation lake, or to the Athabasca River. The diversions and watershed disturbances will contribute to flow reductions in the Athabasca River and delta. For further details of the hydrologic impacts, refer to our technical review of the EIA dated February 2009.

In general, the responses to ACFN's requests were far less detailed than those provided to the SIRs of ERCB or to AENV. Some additional information was available where the SIRs overlapped or were similar to ACFN's requests. In some cases, insufficient information was provided following a review of the responses within all documentation.

### Key concern #25 – Loss of several pristine creeks:

*ACFN requested a single, concise table of the water balance changes caused by the loss of portions of the watersheds and the lower sections of mainstem creeks and a description of the significance and relevance of the anticipated changes through time.*

Shell referenced "Table 6.4-23 Effect on the Runoff from Local Study Area for Application Case". A check of the individual streamflows from each of Pierre, Eymundson and Big Creeks confirmed that this table indeed summarized flows in the three creeks including flows diverted to and from them. However, in order to better understand the fate of surface waters, it would be helpful to know the physical dimensions of some of the large water holding areas proposed.

**Recommendation:** ACFN requests a table summarizing the maximum surface areas and filled water volumes for the EDTA, pit lakes, the compensation lake, and water storage areas.

### Key concern #26 – Unclear presentation of flow changes to Athabasca River

*ACFN requested recalculation of the local inflows from tributaries to Redclay Lake, to Pierre South Pit Lake and to the Athabasca River. This included providing information on a relevant timescale that reflects major expected changes.*

Shell did not address this request, but suggested they might do so "following ACFN's technical review of the EIA".

**Recommendation:** This question should be re-submitted with the clarification for Shell that it was a technical review question.

### Key concern #27 – Expand RSA to the Delta

*ACFN requested that Shell extend the regional study area to encompass the Athabasca delta.*

Shell did not address this request but suggested this “may be discussed as part of future negotiations towards an agreement”. AENV SIR #287a proposed a similar concern about water quality in the delta. Shell responded that because negligible changes are expected at the Embarras location, negligible water or sediment quality changes in the delta or Lake Athabasca are expected.

**Recommendation:** ACFN should follow up on the requested commitment to extend the RSA to Lake Athabasca, and request that Shell address cumulative effects of reduced flows on the delta, especially for low flow seasons or years.

### Key concern #28 – Water storage plans

*ACFN requested clarification of Shell’s plans for water storage and use beyond 30 days’ storage, when restrictions related to the WMF are imposed in the future.*

Shell did not describe their plans beyond stating that they would comply with the Water Management Framework for the lower Athabasca River. AENV asked the same question (SIR 318), to which Shell’s only response was that they would “consider *several options* if either insufficient water storage capacity or insufficient recycle water quality affected its ability to meet its water requirements”. None of the several options were described.

**Recommendation:** The question of water supply plans should be re-submitted to Shell.

### Key concern #29 – Quantify open water areas at closure

*ACFN requested clarification of the total open water areas that would be created for the PRM project because of discrepancies in various sections of the EIA, and summarized in Table 6.4-19.*

Shell did not address this request, but suggested they might do so “following ACFN’s technical review of the EIA”. This question was recommended in Key concern #25 above.

### Key concern #30 – Clarify Redclay Lake water source

*ACFN requested clarification as to whether water from the Athabasca River to fill Redclay Lake was a component of the 55 M m<sup>3</sup>/y requested in their water licence.*

While the water licence indicates that the purpose for the river water was for industrial process and domestic use, the response provided in Shell’s

document for ACFN was that filling the lake was one of the uses for the 55 M m<sup>3</sup>/y. Yet in response to ERCB SIR 316c, Shell states that “Over 90% of the water consumed by the projects goes to filling tailings pore space” with the rest being lost to evaporation and seepage. These responses are contradictory making it unclear as to the source of water to be used for the compensation lake. The compensation lake is still in the planning stages.

This was one of the responses where Shell encouraged ACFN to reconsider its decision to withdraw from consultation on the NNL plans. They may not respond to further questions about the lake at this time.

#### Key concern #31 – Source and timing to fill end pit lakes

*Shell was asked for a better description of the water sources and length of time required to fill the pit lakes.*

The response was that Athabasca River water would begin to fill the lakes during a ten-year “closure management period” from 2039 to 2049. At the end of this period, the diverted streams that were used for operations will be diverted to the pit lakes, and water quality in the pit lakes is presumed to be acceptable for release. The loss of Eymundson Creek flows to pit lakes is apparent in Table 280-8 of the SIR response document.

**Recommendation:** If the pit lakes will be filled by 2049 and water quality is expected to be suitable for release at that time, clarify the reason for diverting stream water to pit lakes after 2049 (as opposed to routing them directly to the River).

#### Key concern #32 – Pit lake flow analysis

ACFN requested uncertainty analysis for open water flows from the pit lakes. Table 32-1 was provided with acceptable uncertainty analysis.

#### Key concern #33 – Erosion control mitigation plans

*ACFN requested Shell’s mitigation strategy to prevent excessive erosion in the Pierre River/CNRL drainage channel (C11/C11b). They also asked for a discussion of Shell’s commitment to allow ACFN to review any erosion-protection plans.*

Shell provided a detailed response concerning mitigation plans to prevent erosion. They stated they might discuss the development of mitigation plans in future negotiations towards an agreement with ACFN.

**Recommendation:** ACFN should follow up on the requested commitment to be involved in future erosion control mitigation plans.

#### Key concern #34 – Monitoring and research plans

*ACFN requested 1) Shell’s surface water hydrologic monitoring and research plans for all phases of the PRM, and 2) a commitment to provide*

*the ACFN with the opportunity to be involved in monitoring and research plans.*

Shell provided the location of the monitoring plans (Vol. 4B, App 4-9, Section 3). They suggested that the request to review monitoring and research plans might be discussed as part of future negotiations towards an agreement.

**Recommendation:** ACFN should follow up on the requested commitment to be involved in future hydrologic monitoring and research plans.

### **1.2.3 Overview of ERCB and AENV SIR responses**

ERCB and AENV submitted hydrology-related supplemental information requests (SIR) to Shell about the PRM project. These were provided as two volumes on a CD dated May 2009, entitled "Supplemental Information".

#### ERCB responses

Volume 1 presented responses to the SIRs of ERCB. There were only four questions in the Aquatics section related specifically to hydrology (#311, 316, 318 and 319). The questions were about the volumes of warm water recovered during thickening of fine tailings, water management and consumption, water storage plans, and evaporative/seepage water losses.

#### AENV responses

In Volume 2, a total of 27 numbered SIRs from AENV were addressed by Shell in the Hydrology section. Of these, 10 were PRM-related hydrology questions, 11 were not answered because they were deferred to the JME responses (not yet received), and six were not hydrology questions (most were water quality questions).

The 10 PRM hydrology SIRs were numbered 280, 289, 290, 294, 295, 296, 301, 302, 303 and 306. Where these responses provided additional information for ACFN's concerns, it was indicated in Section 1.2.2 above. In general, the responses were thorough, with the notable exception of questions about Shell's plans about water storage for use during low flow periods (See Key Concern #28 above).

Some new and helpful information was provided in the SIR responses with respect to:

- Monthly flow analysis for Pierre River, Eymundson and Big Creeks (SIR 280);
- Detailed water balance discussion (SIR 289);

- QA/QC utilized for the hydrology datasets (SIR 290);
- Impacts to the hydrology of wetlands in the PRM project area (SIR 294);
- Clarification of discrepancies in flows reported for Pierre River (SIR 295);
- Changes under the Application Case to flows in the Athabasca River (SIR 296);
- The importance of sublimation (transformation from solid to gas, typically referring to snow or ice sublimation to the atmosphere, SIRs 302 and 303); and
- Discussion of karst landscape sinkholes in relation to groundwater/surface water interactions (SIR 306).

SIR 301 was a question about efforts made by Shell to integrate project information with other proposed projects through CEMA or RAMP in relation to climate change. ACFN may wish to follow up on both proposed project-specific and RAMP-related monitoring plans for this project. None of the Athabasca River tributaries for the PRM project area are currently monitored by RAMP.

### **1.3 Conclusions**

Shell provided adequate responses in writing to less than half of the questions about hydrology from ACFN. These responses were minimally further supplemented in some cases by responses to SIRs from ERCB or AENV. Some useful additional information resulted from the more detailed responses that Shell provided to the regulators. However, a number of ACFN's questions require re-submission or re-stating as indicated in this review.

## **Appendix D-11**

**Shell Canada – Pierre River Mine Project – Review of Shell’s Responses to  
ERCB/AENV’s SIR #2, May 3, 2010, by Brenda Miskimmin, Summit Environmental  
Consultants Ltd.**

**Shell Canada – Pierre River Mine**  
**Review of Shell’s Responses to**  
**ERCB/AENV’s SIR #2**

**By:**  
**Summit Environmental Consultants Inc.**  
**May 3, 2010**

## **1.1 Introduction**

The Shell Canada Pierre River Mine (PRM) will impact streams and wetlands in an area on the west side of the Athabasca River that are in pristine condition. The ACFN has been consulted by Shell for input on their plans and responses concerning this mining project.

The goal of this review was to evaluate the written responses provided by Shell to the Supplemental Information Requests round 2 (SIR2) presented by the ERCB and AENV (April 2010). The objective is to consider how these responses affect our previous reviews including whether Shell’s responses:

1. address our specific questions or issues;
2. provide further support for the issues already raised by us; or
3. provide a new issue or question that we didn’t raise.

This document is intended to become a component of the overall review of the hydrology component on behalf of the ACFN with the intent of combining it with reviews dated February 17 and August 31, 2009. ACFN has indicated that they would like more focus on impacts on their ability to carry out traditional activities in the region.

## **1.2 Hydrology**

### **1.2.1 Overview of SIR2 Responses**

A total of 20 second round SIR questions from both ERCB and AENV that touched on hydrology were located in Sections 7, 8 and 12 of the response document (“Supplemental Information Round 2”) dated April 2010. ERCB’s questions related to pit lakes, water storage contingency plans, tailings water usage and budget, and diversion plan links with other companies (CNRL, UTS). AENV’s questions related to pit lakes, evapotranspiration rates in water modeling, wetland impacts, diversion channels, and waste water treatment. There was some direct and indirect

overlap with concerns previously presented by ACFN, and some new information provided.

### **1.2.2 Review of Responses to ERCB's SIR2 questions**

ERCB's concerns about hydrology were addressed in Part 2, Sections 7 and 8 (# 46, 47, 48, 49, 52, 53, 54, 80).

#### Pit Lakes – SIR2 #46, 47

The questions related to Shell's diligence in contributing to research and understanding the design and functioning of end pit lakes. Shell advised that they are participating in research with Syncrude's Base Mine demonstration pit lake, and that they will not have their own pit lake available for research until 2018. While the main concern is about water quality in the lakes, ERCB and ACFN are concerned about the landscape change caused by the large size of end pit lakes that replace the existing landscape.

There is some overlap with previous responses to ACFN's concerns #29, 31 and 32. The main difference is that the SIR2 responses provided new information about Shell's direct involvement in pit lake research with a focus on water quality rather than quantity. ACFN stands to lose traditional uses of wetland and riverine environments where pit lakes will occupy the landscape.

#### Water Storage Plans #48

ACFN as well as the regulators have asked several times about Shell's water storage plans in the event of low flows or insufficient storage. The response to this question provided new and relevant information in response to ACFN's previous concern and response #28.

While Shell deferred their answer to AENV SIR2#16, they finally answered this question briefly. Their planned options were listed as:

- Ongoing and potentially increased use of groundwater;
- Use of untreated recycle water for "gland water"; and
- Reducing bitumen production to reduce water consumption.

Shell did not rank these options, but stated it was dependent on "prevailing environmental and mine operating circumstances". It may be worth requesting information about which specific circumstances might result in selecting each of the options. The third option would reduce profitability for the company and seems of lower likelihood than the other choices.

### Tailings Water Volumes #49, 52, 53, 54

ERCB requested further information about evaporative losses, clarification about total and porewater process affected water volumes, and the definition of “unplanned process affected water”. ACFN had not previously requested this information about tailings impoundments in the hydrology section, although response #52 partially addressed one of ACFN’s previous questions (#30) about water consumption and pore space.

With the exception of potential seepage or accidental release, the water in tailings impoundments will not be discharged to surface waters outside of the project. Shell provided more information about evaporative losses and explained how they estimate the volume of tailings remaining at the end of project life. They explained that unplanned process affected water refers to “clear water inventories in excess of the required clear water zone in the tailings disposal areas”. This excess inventory will be minimized as much as possible by re-using such clear waters.

### Updated Diversion plans considering other projects #80

ERCB asked for an updated water diversion plan that was integrated with future adjacent developers including UTS Energy (Equinox) and CNRL Horizon. Shell explained that the plans by UTS Energy were not available at the time of the preparation of the EIA, but indicated that they are in discussions with neighbouring companies and will incorporate their drainage plans in “the foreseeable future”.

This question was relevant to ACFN’s previous concern #26 about clarification of tributary flows to the Athabasca River. While the response did not provide new information at this time, the question about updated diversion plans should be followed up.

### **1.2.3 Review of Responses to AENV’s SIR2 questions**

AENV’s concerns about hydrology were addressed in Part 3, Section 12 (# 19, 22, 23, 25, 26, 27, 28, 46, 57, 58, 90). As previously noted, AENV’s questions were related to pit lakes, evapotranspiration rates in water modeling, wetland losses, diversion channels, and waste water treatment.

### Pit Lakes – SIR2 #19

The questions were related to the degradation of organic chemicals (e.g. phenolics, PAHs, naphthenic acids) in relation to water residence times (flushing rates) in pit lakes. AENV further requested modeled concentrations of each organic variable at the end of mining before filling the pit lakes, and the length of time required to reach acceptable concentrations. Shell stated that they had provided all of this information in the EIA Vol B Appendix 4-7 Section 4, including that acceptable levels of contaminants in pit lake water were expected by 2049.

Questions about pit lake water quality were not previously presented in ACFN's hydrology review. It is possible that pit lake water may support aquatic life and be considered suitable for discharge. However, there are many unknowns about pit lake functioning including sediment-water interactions and chronic effects to aquatic biota. These questions should be asked in the water quality and aquatic resources sections.

### Evapotranspiration rates in water models – SIR2 #22 and 23

AENV asked detailed questions about the estimated evapotranspiration rates and the chosen input model used for the HSPF water model. Shell responded with justification for the model input used compared with other available models.

ACFN did not previously ask questions about evapotranspiration in the hydrology review. The detailed description of each possible model in the literature that provides estimated evapotranspiration to the HSPF water model provides new information about water that moves through vegetation to the atmosphere.

### Wetlands – SIR2 #25, 26, 27

AENV asked about the impacts of water level changes on fens (groundwater fed), effects on key vegetative species and communities, wetland monitoring plans, wetlands in reclaimed landscapes, maps of marsh ecosite phases and specific recolonizing plant species. They also asked what is currently known about peat-forming processes on reclaimed landscapes in the oil sands region.

For this project, the reality is that much of the wetland landscape will be removed and replaced with open water and other mine-related footprint. Detailed responses including maps and tables were provided in response to the above questions. Since none of these questions was asked in the hydrology section, the responses provided new information. However, because the subject matter is more relevant to the groundwater and vegetation sections, the responses should be evaluated against questions within those sections.

#### Pit lake storage compared to wetlands – SIR2 #28

Shell was asked to provide data and information to demonstrate how pit lakes will be regulated to respond similarly to the way natural wetland systems operate (mimicking time lags), including fluxes, dessication, etc. This is a question that was not previously asked and that potentially will provide feedback for ACFN questions about pit lakes, #31 and 32.

Shell responded that the lakes would not attempt to mimic wetlands, and that the reclaimed landscape would respond quite differently than the natural system. They referred to the EIA Vol 4A Section 6.4.5 for the hydrologic response of pit lakes.

This question highlights a major difference in the natural water landscape of the area compared with the post-mine landscape. Traditional uses by ACFN of pit lakes cannot substitute for uses of riverine and wetland dominated landscapes.

#### Diversion Channels not described – SIR2 #46

AENV asked about the completeness of the EIA if some diversion channels were not evaluated (C6 and C11), and whether a new *Water Act* application is required. Shell responded that the channels that were omitted were not part of the local study area (LSA), but part of the regional study area (RSA). They said that the channels make up only 3% of the LSA, and their inclusion would not “affect the environmental consequences” for the EIA.

Regarding the *Water Act* question, the channels will be constructed a few years prior to 2049, and a *Water Act* approval is being sought. Response 46 c (ii) concerns soil and vegetation surveys that will be followed up with AENV and ASRD.

The information about excluding these drainage channels provides some new information that requires clarification. AENV and ACFN may wish to have Shell further explain their rationale for excluding from assessment certain portions of watersheds that are on or near their lease, regardless of their size.

#### Why mining through the Pierre River “strikes a balance” – SIR2 #57

AENV asked why Shell considered that mining through the Pierre River strikes a balance between resource recovery and impacts on the Pierre River as well as mitigating flow impacts on the Athabasca River. Shell justified this statement by indicating they prepared the EIA based on the requirements of the *Canadian Environmental Assessment Act*, and company policy on Sustainable Development.

Shell's view is that the predicted environmental impacts are acceptable when considering their "obligation to efficiently produce the oil sands resource for the benefit of all Albertans", and in light of certain criteria, including:

- Efficient management of natural resources;
- Generation of profitability; and
- Clear need to provide social and economic benefits on a local, provincial, and federal level.

This response is relevant to understanding the outlook of oil sands operators in view of the accepted "public interest" policy described in the *Oil Sands Conservation Act* (2000).

#### Wildlife buffer along the Athabasca River – SIR2 #58

AENV asked for a discussion of benefits and outcomes of maintaining an adequate buffer along watercourses. Shell responded with an essay on the subject, complete with references. The conclusion was that the company believes that a 250 m buffer along the Athabasca River, rather than 400m, is sufficient to protect wildlife and fisheries resources.

ACFN did not request this information in the hydrology review, but the response should be checked within the fisheries and wildlife section responses.

#### Water Treatment plans and effluent qualities – SIR2 #90

In the EPEA approvals SIR2 response section, AENV requested details about water treatment and expected effluent quality. Shell responded that waste water treatment had not yet been planned but said they would take provincial guidelines and standards at the time into account in their design. ACFN should request consultation about Shell's future plans for waste water treatment.

### **1.3 Conclusions**

Shell provided responses to many second round SIR questions from ERCB and AENV. While additional useful information was provided, little new information was provided in support of some previous hydrology questions submitted by ACFN that remain outstanding. This was similar to the conclusion of our previous review of ERCB or AENV SIR round 1 responses dated August 31, 2009. ACFN should request responses to their own review questions that were re-submitted to Shell.

## **Appendix D-12**

**Shell Canada Limited Jackpine Mine Expansion Project and Pierre River Mine Project  
– Environmental Impact Assessment Report - Review for Athabasca Chipewyan First  
Nation, October 2008, by Dr. Karen McDonald**

**Shell Canada Limited  
Jackpine Mine Expansion Project  
And Pierre River Mine Project**

**Environmental Impact Assessment Report  
Review for Athabasca Chipewyan First Nation**

**By:**

**Dr. Karen McDonald**

**October, 2008**

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## **1.1 Introduction**

This review focuses on Volume 3 of the Environmental Impact Assessment dated December 2007 specifically the air quality components.

## **1.2 Overview**

Shell Canada Limited has included two interdependent developments in this one application making the breadth of the resulting impacts much more understandable and this open approach is well appreciated. The model selection (CALGRID) and approaches employed in the air quality section are well established and appear well performed by the proponent based on the information supplied. There is little to no concern with the mechanics of the modeling and the maps produced.

In addition, Shell Canada Limited is commended for addressing the encroaching approach to environmental limits in a more judicious manner than other developers. However, it simply does not go far enough towards addressing concerns with the evaluation of significance process since the provincial and national objectives continue to be used as pollute-up-to levels rather than as tools for environmental management towards the goals of health and ecosystem protection. This is particularly disconcerting given the northerly encroachment of this development which necessarily means that the Keeping Clean Areas Clean management policy needs to be applied.

Shell also is clearly committed to utilizing the work of the CEMA working groups and for this section especially that of the NOx-SOx Management Working Group. The literature

information and expert conclusions from efforts on sulphur and nitrogen deposition have been appropriately applied and clearly presented. It is appreciated that Traditional Ecological Knowledge (TEK) is considered. This association is going through some difficulties with membership and funding, yet the results of the work to-date are useful and enlightening about regionally-specific issues. However, it is unfortunate that the only suggested management strategy is to participate in these groups.

Secondary air pollutants continue to be under-studied in the EIAs. Ozone and fine particulate matter are complex issues to be sure, but there is current technology to address these issues. Certainly, secondary PM due to organic compounds has not been addressed at all while the emissions and concentrations of organics are demonstrated to be increasing. While visibility is included in the Terms of Reference, the proponent has not considered regional haze at all and minimally considered plume blight.

Shell Canada Limited addressed climate change in Appendix 3-4 of the EIA but this important issue is not included in the summary to the EIA. The potential for impacts to the project itself have been considered. As with all recent EIAs from the Oil Sands Region, there is little incentive to further reduce or mitigate greenhouse gas emissions to a level that is technologically and economically achievable.

## **1.3 Air Assessment Approach**

### **1.3.1 Approach Review**

The approach described in Section 1.2.3 to integrate the two applications is much appreciated. It is clear that these projects are related spatially (Figure 1.1-1) and temporally (Table 1.3-1) and performing the impact assessment of them together is reasonable. It is noted that the development of the Fort McKay lease is not included in this assessment.

The proponent has made it specifically clear in Section 1.3.2 that they are including information from the regional processes through CEMA and WBEA within this assessment. This is also commended given the investment into those efforts on behalf of many stakeholders. However, several key stakeholders no longer participate in the regional initiative and it is unclear how they are to be consulted or represented

The impact scenarios described in Section 1.3.3 are those typically selected: Base Case, Application Case, and Planned Development Case. As in past assessments, it is clear that the Base Case is far from the current conditions and, therefore, does not reflect the changes that communities may expect from the situation they experience at the present time. Hence, the Application Case necessarily incrementalizes the changes to come from the Oil Sands Region developments as a whole minimizing the perceived impact to someone unfamiliar with the process.

The key questions raised in Table 1.3-3 demonstrate that the impacts from the air quality assessment will be carried into the assessments of ecological and human/wildlife health. One component to which air quality information is not clearly conveyed is the assessment of visual aesthetics. Since the spatial limit to this component is only 20km, at best direct emissions are considered as visible plumes, but regional haze due to enhanced particulate concentrations are not. In addition, the effects of ozone on terrestrial and wetland systems is evaluated, but the assessment does not undertake a modeling scenario including ozone.

The impact descriptions and numerical scorings in Table 1.3-4 are those typically employed. There is no concern with the numerical selections attached to each of the criteria. The concerns arise in the subjective decisions on what is deemed of negligible, low, moderate or high magnitude of impact.

Section 1.3.7 describes the use of Traditional Ecological Knowledge in the assessment. This is valued and valuable.

### 1.3.2 Key Concerns

Several key concerns were identified with regards to Air Assessment Approach during the review. These include:

1. The three assessment cases do not describe the changes that local community members can anticipate from what they experience today.

Because all three assessment cases are projections to a future condition, there is no way to compare the current existing situation (including monitoring data) with the modeling done for the case studies in the EIA. People living with the changes in the region are not readily able to extrapolate from today's situation to the Base Case and certainly not to the Planned Development Case. The best approach would be to perform another model case of the current situation; it is appreciated that this is done as part of the model evaluation in Appendix 3-8. Another option would be to consider a small change in Table 1.4-1 (and Table 3.3-1) that would provide some assistance to people in the region so that they may compare and better understand the time line of the future situations.

#### → Recommendation:

*To assist in providing clarity for the people living in the region, please identify the status of projects in the Base Case descriptions in Table 1.4-1. That is, to the ability that you are able, indicate those projects that are presently operating and at what air emission capacity, those that are under construction and when they are expected to begin operation and at what proposed air emission capacity, and those that are approved but pending development with the proposed air emission capacity.*

2. The only mechanism for managing air quality in the region is to conform to requirements of the local air working groups.

Of course, it makes sense that any proponent in the region would meet the requirements set out by the local air working groups through the Cumulative Environmental Management Association (CEMA) as described in Table 1.7-1. This agency has added significant information to the capacity for decision-making in the region. However, it is also going through some substantial challenges with membership, funding and related issues. Specifically, key environmental and First Nations groups are no longer participating in the processes. It is not clear, therefore, how or if any needs from these groups will be addressed by the proponent.

→ **Recommendation:**

*Clarify if and how needs of groups not participating in CEMA will be identified, addressed, and managed by the proponent.*

## 1.4 Summary of the Environmental Impact Assessment

### 1.4.1 Summary Review

In Section 2.2.2, it is not a surprise that all 129 parameters assessed are either classified as “negligible” or “low” environmental consequence. The surprise is that in the paragraph following this statement it is stated that “predicted PAI in the Base Case already exceeds the guidelines”. These two statements appear to be mutually exclusive. In addition, the project is expected to increase the PAI in 18 of the 20 grid squares.

The regional emissions summary in Table 2.2-1 demonstrates that the dominant emissions with these developments are the organic compounds represented by CO and VOC. Although the magnitude of NO<sub>x</sub> increase is greater than 12 t/d, this represents a smaller percent change than the increase in SO<sub>2</sub> at 7.8 t/d.

Consistent with past EIAs, this document removes any consideration of the ambient concentration changes that are within the developed areas. This minimizes the potential change as the total developed area increases with each new development stretching the affected area further. As the maxima within the developed zones increase in magnitude, the extent of the concentration or deposition contour lines broaden as the pollutants disperse.

Table 2.2-2 provides the maximum concentrations outside of the developed areas and further without including the eight highest predictions. It appears that there could be some double removal of higher conditions that needs to be explored. It is not clear if these eight highest are contained within the developed areas removed from consideration or if a further eight of the highest values outside of the developed areas have also been removed. Regardless, the 25-hour and annual NO<sub>2</sub> maxima remain above the Air Quality Guidelines.

The assessment of air quality employs a comparison with Alberta guidelines and the Canada-Wide Standard for PM<sub>2.5</sub>. This comparison does not comply with the principle of Keeping Clean Areas Clean as laid out in that standard for areas that are not covered by the standard (urban areas of greater than 100,000 people). It is generally acknowledged that the CWS are not based only on health but also include economic considerations.

#### 1.4.2 Key Concerns

Several key concerns were identified with regards to the Summary of the EIA during the review. These include:

1. The mechanism for removal of developed areas and maximum concentrations from the assessment is unclear.

Despite repeated statements regarding this concern, the developed areas are excluded from consideration of impact analysis in this EIA as well. The size of the area designated as developed increases and removes more land area from discussion with each new development. The extrapolation of this practice leads to the unacceptable conclusion that any developed areas of Alberta are not subject to the requirement to meet standards and guidelines. Certainly urban areas are “developed” areas as well and have been shown to have some comparable emissions, but are expected to meet the guidelines within their boundaries. Further, Table 2.2-2 stipulates that the eight highest modeled concentrations are also removed from consideration. However, this raises the questions about whether the eight highest are contained within the developed areas and removed anyway or if a further eight highest values are removed from outside of the developed areas. If it is the former, then there is no controversy. However, if it is the latter, then there needs to be some discussion about the appropriateness of this further elimination of cases of maximum values. The eight highest values are removed from consideration in the Alberta Modeling Guidelines because of concern that there can be errors in those values, but if the eight highest values are not within the developed areas already removed, then this concern is not valid and those points should be included.

**→ Recommendation:**

*Clarify that the eight highest values are contained within the developed areas already removed from consideration in the impact assessment. If they are not within this area, then please provide a re-assessment of the air quality including those eight values.*

2. Comparison with guidelines and standards does not address environmental health questions or Keeping Clean Areas Clean.

Comparison with existing standards and guidelines is an important part of any assessment. However, in Alberta, these are levels have been identified by stakeholders as concentrations that are not pollute-up-to levels. The provincial government and supporting bodies such as CASA have all employed this

protective approach. In addition, it is stated in Section 2.4 that the acute health risks due to air emissions are to be compared with health-based guidelines considered “protective of the most sensitive individuals”. The section then continues to compare maximum concentrations with the CWS – a standard that is not only health based but also includes economic considerations. Lastly, this province has been a national leader in the development of the concept of “Keeping Clean Areas Clean”. It is critical that this commitment be respected and maintained in order to protect health and ecosystems in these areas.

**→ Recommendation:**

*Consider a reassessment of the acute inhalation health risks employing a health-based air quality standard that is considered protective of the most sensitive individuals.*

## **1.5 Air Quality**

### **1.5.1 Overview**

Generally, this air quality assessment is extremely clear and well-performed. The work from the appendices is linked well with the assessment itself. There is little to no concern with the methodology of the modeling or data analyses performed.

There continues to be concern with the assessment of the impact criteria and the classification of the residual effects. This proponent has made a tremendous improvement of some other recent assessments by recognizing that reaching the Alberta air quality guidelines (or Canadian desirable objective) does result in an increase in the magnitude classification (low-to-moderate) instead of having the separation for negligible-to-low being at the guideline. This change described in Table 3.2-13 is greatly appreciated. Employing the Canadian acceptable air quality objective at the moderate-to-high limit is also a reasonable step forward. However, given that the Alberta government has a goal of staying below its guidelines, this still does not seem to be a deep enough change.

The TEK integration with the air quality in Table 3.3-2 is appreciated. However, none of the references to the text of the assessment actually point to the air quality section but rather only to the impacts sections. In addition, this component is incorporated in the Base Case assessment, but the people living in the region have no way to comment on the Base Case as this is a future condition perhaps never reached. This knowledge may be better compared with the model evaluation scenario and existing air quality.

In the Application Case impact analysis Section 3.4.3, SO<sub>2</sub> is expected to increase in emission by 7.88 t/d but decrease in concentration at all scales in Table 3.4-5. This seems counter-intuitive and is explained through a change in emission redistribution. Yet, these addition tonnes must go somewhere in the sulfur budget for the region. Table 3.4-6 presents the comparison for NO<sub>2</sub>

predictions. The issue of greatest concern is the exceedence of the 24-hour NO<sub>2</sub> AQO outside of the developed areas that increases in size by 8 hectares due to the project. For the VOCs, acrolein, benzene, cyclohexane, ethylbenzene and xylenes are all resulting in a “low” environmental consequence based on a change in magnitude due to the project.

The evaluation of PM<sub>2.5</sub> predictions is based on achievement of the Canada-Wide Standard. This is inadequate given the increasing body of literature that indicates this is a pollutant with no threshold for impacts to human health and that different components of PM have varying impacts on health. In addition, there is no evaluation of organic PM at all since only the CALGRID algorithms were used to assess secondary PM (sulphates and nitrates only). Also, regional visibility degradation due to PM concentrations has not been included in the assessment.

The evaluation of the PAI remains the most concerning. The area due to exceed the 1.0 keq/ha/yr level due to the project alone excluding the developed areas (defined as the Planned Development Area plus existing and approved complexes) is still another 475 hectares on top of the Base Case 3,887 hectares. This is listed as a 12% increase not including the land to be developed in the PDC. In the Ecological Receptors Section 5.5, the impact classification is ranked as negligible though this is difficult to understand given the PAI inputs over large areas of the domain.

Ground-level ozone is weakly evaluated in Section 3.4.5 and an environmental consequence ranking is provided. It is appreciated that Shell accepts that it is not reasonable to rank as negligible an issue that has such a high level of uncertainty as has been done in past EIAs. Nonetheless, although the issue has been raised in every impact assessment over the past decade at least, very little effort has been placed on the understanding and development of a regional conceptual model and resulting physical models to evaluate the oxidizing potential of the air in the region. This remains an issue that requires regional attention to remove this limiting perspective from EIAs.

While Section 3.4.7 clearly indicates that there is little risk of foul odour experiences within Fort Chipewyan yet some of the other receptor points at the cabins can expect foul odours from 2-9% of the time. It is appreciated that no impact classification is given for this, but when integrated with the TEK information, perhaps this issue should be given more thorough consideration.

Section 3.5 outlines the Planned Development Case. It is emphasized that this case contains projects that are unlikely to proceed. However, the current pattern in environmental approvals and proposed infrastructure throughout the province do not support that. Many of the planned projects appear to be extensions of existing operations and so it is highly unlikely that these will be denied approval to ensure effective utilization of the resource. Therefore, this is rather a probable scenario. Given that several of the environmental limits are already exceeded or are being encroached upon through the Base and Application Cases, it is unclear why there is further consideration of more of these emissions without advanced

mitigation plans. Specifically, regional annual NO<sub>2</sub> is expected to reach a “high” impact classification even within the conservative nature of the assessment and the forgiving magnitude classification. Acrolein and benzene are also given a “high” impact assessment. The proponent does not assess the impacts on the ecological receptors for the PAI under this scenario because the environmental consequence for the Application Case was negligible.

### 1.5.2 Key Concerns

Several key concerns were identified with regards to air quality during the review. These include:

1. Magnitude classification levels do not reflect the goal of keeping air concentrations below the Alberta ambient air quality guidelines and Canada-wide standards.

Shell has greatly improved on past assessments by using the AQOs as the low-to-moderate level instead of the negligible-to-low level. However, the evaluation of magnitude classifications still permits (and perhaps even encourages) emissions to increase beyond the AQOs by deeming the impact of doing so as only moderately of concern. Upon reaching the Alberta guideline, the magnitude classification should be “high” in order to demonstrate the commitment to staying below this value. In addition, it is not clear why there is no “moderate” characterization for the VOCs in Tables 3.2-15, 3.2-16, and 3.2-17 since a relative proportion of the single criteria could have been employed as an interim marker pending any future evaluation of these criteria.

**→ Recommendation:**

*To better identify which issues are approaching the environmental limits employed in the EIA, perform a reassessment of the environmental consequences employing the Alberta AAQO or CWS as the limit between the “moderate” and “high” rankings.*

2. Secondary pollutants and impacts continue to be weakly evaluated.

The PM<sub>2.5</sub> assessment is weak based on the CWS value while exposures at some of the cabins are potentially very high as shown in the Appendix 3-9. Visibility degradation is not considered. The ozone evaluation is not performed at all due to uncertainties. Odour is not evaluated due to human interferences. The PAI air assessment is so far from the impact results in the ecological section that questions are raised on both sides of the work. These cases demonstrate that the difficult questions around secondary pollutants (PM<sub>2.5</sub> and ozone) and impacts (visibility, odour, and acidification) continue to be poorly constrained in the assessment process.

**→ Recommendation:**

*Describe the current steps underway to support research and monitoring that will enhance the evaluation of impacts for those issues that are not able to be properly evaluated due to uncertainties and other challenges.*

## **1.6 Climate Change**

### **1.6.1 Overview**

Section 3.4.8 provides the evaluation of greenhouse gas emissions based on information presented in Appendix 3-4. Although the introduction states that an impact assessment has been completed, there is no impact classification provided. It is stated that it is not possible to compare directly with other projects that have integrated mine and upgrading activities, but the Shell contribution is broader than just the mine sites in the Oil Sands Region and should include the upgrading activities in the Heartland Region near Edmonton for a fuller comparison. The potential for impacts to the project due to proposed climate scenarios are evaluated.

### **1.6.2 Assessment Review and Key Concern**

#### **→ Recommendation:**

*Shell is asked to include all related operations in its consideration of increases in greenhouse gas emissions so that comparisons can be made between the operators in the region.*

## **Appendix D-13**

**Wildlife Review of the Shell Jackpine Mine Expansion and Pierre River Mine Projects – Review for: Athabasca Chipewyan First Nation, May 2010, by Dave Westworth of Puma Environmental Ltd.**

# **WILDLIFE REVIEW OF THE SHELL JACKPINE MINE EXPANSION AND PIERRE RIVER MINE PROJECTS, May 2010**

**Review for:  
Athabasca Chipewyan First Nation**

**By:  
Puma Environmental Ltd.**

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## **1.1 Introduction**

As a part of its application for approval to expand its current oil sands operations, Shell Canada Limited (Shell) submitted an Application and Environmental Impact Assessment (EIA) for the Jackpine Mine Expansion and Pierre River Mine Project in December 2007. Supplemental information and EIA updates were provided by Shell for the combined project in March 2009. This update contained a revised assessment for yellow rails for the combined project (Environmental Consequence still rated as Negligible) and additional discussion of the effects of the JME on wildlife movement (Environmental Consequence rated Low). In May 2009, supplemental information and an EIA update was provided for the Pierre River Mine Project. This update included an update to the ecological health risk assessment based on additional information collected from the Jackpine Mine area (no changes to original conclusions) and an assessment of impact significance based on federal (CEAA) criteria (no Significant adverse effects predicted for wildlife). In December 2009, supplemental information and an EIA update was provided for the Jackpine Mine Expansion Project. This update contained information on the proposed construction of a dyke around Kearl (Muskeg) Lake and updated information on groundwater drawdown for the Jackpine Mine (impacts on wildlife due to both the dyke construction and increased groundwater drawdown were rated as Negligible).

The following document contains a review of wildlife issues and concerns related to these projects based on our review of the above documents. The objectives of this review are to:

- Assess whether the EIA is based on adequate data
- Determine if the analysis and conclusions presented are scientifically sound

- Identify potential issues of concern for the ACFN and make recommendations

The primary purpose of this review is to assist ACFN members in understanding the risks that the proposed projects, together with other existing and planned oilsands projects, could have to regional wildlife populations. Based on information provided to us by the ACFN and through discussions with ACFN elders, we understand that access to healthy, free-ranging wildlife populations is fundamentally important to the traditional rights and culture of the ACFN. ACFN people are concerned about land use changes that affect their ability to harvest wildlife for food, clothing, medicine and commerce, or that may affect the health of animals and their suitability for human consumption. A secondary purpose of this review is to bring any concerns or deficiencies to the attention of regulatory agencies, to ensure that the interests of the ACFN are considered during the review of this application. And finally, it is hoped that this review will assist Shell Canada and their consultants in developing strategies to improve the environmental assessment process and further mitigate long-term, adverse effects of these projects to wildlife populations in the region and to the traditional rights of First Nations people.

## 1.2 Overview

The review attempted to identify specific issues related to the Jackpine Mine Expansion (JEMA) and the Pierre River Mine (PRMA). However, as Shell submitted the application for the two mines as part of a single application with a single EIA, it has proven difficult to distinguish between effects that are specific to either of these mine projects, or in some cases to the Phase 1 Jackpine Mine.

The EIA considers the following three development scenarios:

- Base Case – Includes existing and approved developments (Note that this is somewhat different than the conditions that exist at the present time since it includes projects that have been approved but not yet developed or fully-developed)
- Application Case – The Base Case plus the Project (JEMA and PRMA)
- Planned Development Case (PDC) – the Application Case plus other projects that are planned but have not yet been approved. This represents the Cumulative Effects Assessment (CEA). (Note that the PDC considers projects that had been disclosed by July 2007 and does not include any projects that may have been disclosed over the past two years)

### 1.2.1 Temporal and Spatial Boundaries

The application called for the start of construction on the JEMA to begin in 2012 and on the PRMA in 2010. Closure would begin in 2065 for the JEMA and in

2049 for the PRMA. The wildlife assessment considered three time periods – pre-development, full development and full closure.

The assessment considered both a Local Study Area (LSA) for assessing effects of the Project and a Regional Study Area (RSA) for the cumulative effects assessment. The LSAs for the two mines were limited to the development areas plus a narrow (up to 500m) buffer. The sizes of the two LSAs are reported to be:

- Jackpine Expansion (JEMA) - 18,348 ha (or 183.5 km<sup>2</sup>)
- Pierre River (PRMA) - 21,136 ha (or 211.4 km<sup>2</sup>)

A single RSA was used for the two mine projects. For this Project, the RSA is very large (2,277,376 ha or about 22,774 sq. km), extending east as far as Saskatchewan, south to the Clearwater River, west to the west side of the Birch Mountains and north as far as Poplar Point and the McIvor River. The report provides the following explanation for the selection of the RSA: “*The RSA boundary was defined with consideration of the following terrestrial resources:*

- *Ecodistrict boundaries;*
- *Geographic or topographic boundaries such as the eastern shoulder of the Birch Mountains;*
- *Defined woodland caribou habitat areas (e.g., Audet, Firebag and Steepbank caribou areas);*
- *Average distance of two moose home ranges from oil sands developments (about 26 km);*
- *Allowances for the major river systems (e.g., Athabasca and Clearwater Rivers) that act as natural study boundaries; and*
- *Inclusion of the community of Fort McMurray and other areas likely to expand in the future.”*

### **Comments on Validity of Assessment Boundaries**

We believe that neither the temporal nor spatial boundaries used in this EIA permit a meaningful assessment of the long-term effects of the proposed projects on wildlife populations in this area. In fact, one of the greatest failures of the CEA process as it is being applied in northeastern Alberta may be the approach that industry and government have collaboratively adopted to establish the analytic baseline for these assessments. These assessments estimate landscape and population changes against a ‘Base Case’ scenario. The Base Case is a regulatory or administrative reference point for an incompletely-defined, future point in time (the point at which all existing and approved projects will be in place). Using this baseline makes it very difficult for First Nations to understand what the Project is being compared to what the predicted changes actually mean. The predicted changes are meaningless from a wildlife standpoint if we do not also understand how much change has already occurred to wildlife populations and habitat in the region. Our opinion is that it is not possible to conduct a meaningful assessment of either project-specific or cumulative effects without

establishing a relevant, pre-industrial reference point. We know that wildlife populations and ecosystems in the boreal forest are dynamic and that the species that exist there have adapted to changing conditions associated with climate, wildfire, disease and other natural factors. The point of a cumulative effects assessment should be to evaluate whether these populations are also able to withstand the man-made changes that are taking place or that are expected to take place on the landscape.

The size of the RSA and the criteria that were used to define it raise some important questions with respect to the effectiveness of the cumulative effects assessment for different wildlife species. The list of wildlife indicators vary widely with respect to home range size and movement patterns. Although moose have large home ranges, smaller animals such as beaver and Canadian toad do not. We do not believe that the 'one size fits all' approach used in this assessment meaningfully addresses effects on all of these species. Some of the criteria used do not seem to apply at all to the wildlife species being assessed for these two projects. Why was the RSA extended to include the Audet, Firebag and Steepbank caribou areas when woodland caribou was not selected as a KIR? Wildlife health risks from air emissions do not seem to explain such a large RSA, as the Terrestrial Air Emissions Effects Study Area (TASA), which the proponent states reflects "the furthest measurable extent of predicted potential impact for PAI, NO<sub>2</sub> and SO<sub>2</sub> emissions for the Base Case, Application Case and PDC", is much smaller than the terrestrial resources RSA (see Figure 5.5-1). Lands traditionally used by the ACFN and other First Nations were apparently NOT used as a criterion in selecting the wildlife RSA.

The spatial boundaries used are not meaningful for understanding the effects of the Project on affected wildlife populations. Analysis at the level of the LSA is not overly helpful because past experience has shown that virtually all land within these LSAa (except the narrow leaseline buffer) is heavily impacted by surface disturbance. This project is no exception. Not even major natural features such as the Muskeg River and the Athabasca River valley are spared from development. The boundaries for the RSA are not meaningful for many (perhaps all) of the species assessed. The large size of the RSA perhaps masks real cumulative effects that could be occurring. We note that the LSAs for both projects comprise less than 1% of the RSA, which increases the probability that the contribution of project-related effects will be assessed as 'negligible' under the effects assessment methodology used.

Although the process of selecting meaningful study boundaries and assessment reference points is complex, it is technically feasible. Intensive development in the oilsands region has occurred relatively recently (little development existed prior to 1970). Our understanding of ecological conditions in the region prior to the current period of intensive development is relatively good, as a result of surveys conducted by provincial government agencies, interagency research programs (AOSERP), university research, and baseline surveys and research conducted by Suncor and Syncrude during the early stages of oilsands

development. Traditional knowledge can still be effectively used to define pre-development baseline conditions. Some elders can still speak knowledgeably of conditions in the region during the 1950s and 1960s. The Alberta Oil Sands Environmental Research Program (AOSERP), that conducted a broad range of research on the environment in the oilsands region during the 1970s and 1980s, prior to widespread development, provides an invaluable source of information on the area's ecosystems and wildlife populations. Models can also be developed to characterize the natural range of variation (NRV) associated with pre-development habitat conditions or wildlife populations in the region. Models developed for CEMA's Terrestrial Ecosystem Management Framework for the RM of Wood Buffalo (SEWG 2008) may provide a helpful starting point.

### 1.2.2 Wildlife Indicators

The EIA focuses on a number of Key Indicator Resources (KIRs) that have been identified by the Cumulative Environmental Management Association (CEMA). It provides a description of the baseline conditions and the potential impacts of the proposed project for each KIR. The wildlife species that were assessed (KIRS) were moose, lynx, black bear, fisher, beaver, barred owl, black-throated green warbler, yellow rail and Canadian toad. The list of KIRS includes several terrestrial species, several aquatic species, several species that depend on old growth forest and several species of importance to First Nations. The major oversight is the failure to include waterfowl or a waterfowl species (e.g., mallard) in the assessment, since geese and ducks (and their eggs) continue to be harvested by aboriginal people and some of the adjacent waterbodies (McClelland Lake, Kearl Lake, Athabasca River) are regionally or provincially important for waterfowl. The ACFN has expressed great concern over the effects of tailings ponds on waterfowl. Waterfowl that migrate through the oilsands region and may become exposed to tailings and process-affected water also pass through the Peace-Athabasca Delta, where they are consumed by local people.

### 1.2.3 Baseline Surveys

Various wildlife baseline surveys were conducted in the two LSAs during 2006-2007. The survey methods used are standard and were appropriate for these types of inventories. Although most of these surveys are considered adequate, there were some gaps in the survey coverage that should be noted.

SURVEY TYPE	JEMA	PRMA
Winter aerial ungulate	adequate	Northern end not surveyed
Winter track counts	adequate	adequate (note: surveys spread over 2 years – southern half in 2006, northern half in 2007)
Photographic surveys	adequate	adequate

Breeding bird surveys	Few plots within riparian zones of the Muskeg River	North half of LSA sparsely sampled
Owl call-back surveys	adequate	North end of LSA not surveyed
Bat mist netting	Few (only 1) sample points in riparian zones of Muskeg River	North half of LSA and riparian zones along the Athabasca River sparsely sampled
Waterfowl & beaver/muskrat aerial surveys	adequate	No surveys along streams (Big Creek, First Creek) in north half of LSA. Athabasca River was not sampled

The winter aerial surveys are effective primarily for moose. Smaller animals such as deer, wolves and lynx are occasionally seen from the air but ground surveys (track counts and photographic stations) indicate that these animals are more common than indicated from aerial survey results. The only survey method that provides information on bears is the wildlife cameras.

The baseline surveys show similar patterns of wildlife use to those seen in other surveys in the region. From the aerial survey and winter tracking surveys, moose appear to be more abundant in the JEMA than in the PRMA. Within the JEMA, most moose observations were in close proximity to the Muskeg River (Figure 5.3-1). Within the PRMA, most moose were observed close to the Athabasca River.

The baseline surveys strongly indicate that the presence of the Athabasca River and the Muskeg River affects wildlife use of these areas. Wildlife photographic surveys clearly show that most of the wolf, lynx and black bears recorded in the PRMA were along the Athabasca River (Figure 5.3-8 and Figure 5.3-12). Winter track surveys showed that marten and fisher made much more use of habitats adjacent to the Muskeg River (Figure 5.3-13).

## 1.3 Assessment Review

The EIA assesses the effects of the project on (a) wildlife abundance, (b) habitat loss, (c) wildlife movements and (d) wildlife health. Results of the assessment are summarized below and comments are made on the validity of the modeling results and impact predictions.

### 1.3.1 Wildlife Abundance

The EIA evaluated the effects of wildlife interactions with infrastructure, site clearing, removal of nuisance wildlife, increased collisions with vehicle and sensory disturbance on wildlife abundance. For the application case, the

assessment predicts that residual impacts will be low for black-throated green warbler and negligible for all other species (moose, black bear, lynx, fisher, beaver, barred owl, Canadian toad). Impacts on yellow rail are predicted to be high in the LSA but negligible at the scale of the RSA.

For moose and black bear, Population Viability Analysis (PVA) was conducted to predict population responses of these species to planned development in the RSA. PVA is a modeling technique that can be used to predict changes in population size and the probability of population persistence based on changes in habitat availability. Results of the PVA indicate that moose populations are currently increasing in the regional study area and predict that they will continue to increase under the Application and Planned Development scenarios (Figure 32, Appendix 5.4, Volume 5 EIA). The models predict that the black bear population will also increase over this period of time, although the rate of increase is less than in the case of moose (Figure 34, Appendix 5.4, Volume 5 EIA). Cumulative effects on the abundance of these species were therefore rated as negligible.

These results conflict with the observations of trappers and other First Nations people who consistently report declining moose numbers in the region. They also conflict with results of another recent modeling exercise that suggests that the moose population in the region is declining. Modeling conducted in conjunction with the development of a Terrestrial Ecosystem Management Framework for the RM of Wood Buffalo (CEWG 2008) concluded that several terrestrial ecosystem indicators including moose, black bear, and fisher are already below their natural range of variation (NRV) and will continue to decline given expected rates of landscape modification.

### **1.3.2 Habitat Loss**

The loss of habitat that will be associated with the development of these projects will be very large. Habitat loss is not only associated with the removal of the oil sand, as large areas of habitat will be removed for placement of overburden, external tailings ponds, water storage, and construction of roads and other facilities. When mining is completed these lands will be reclaimed. In many cases they will not or can not be reclaimed to the same type of habitat that existed prior to mining. The proponent uses habitat modeling to predict the long term changes in habitat that will result from these projects. Concerns we have with the accuracy of these predictions are discussed in a later section of this report.

The following paragraph summarizes predicted changes in habitat for three important types of wildlife habitat in the two mine areas - wetlands, riparian habitat and old-growth forest. These three habitat types account for much of the biodiversity in the region.

### ***Wetlands***

Wetlands provide important habitat for many species of plants and animals, including some species that are listed as being rare in Alberta. Loss of wetlands is an important conservation issue provincially, federally and globally. Both the Jackpine Mine Expansion and the Pierre River Mine project will result in extensive loss of wetlands. The December 2009 EIA Update report that the combined project (JME and PRM) will affect 20,967 ha of wetlands, including 13,814 ha that will be directly affected by clearing and construction and 7,153 of adjacent wetlands that will be affected by groundwater drawdown. It should be noted that areas that are predicted to be affected by groundwater drawdown do extend beyond the boundaries of the LSA. The report does not separate the overall losses that will be attributed to the two projects.

These are the net losses that are predicted after Closure and reclamation. Some wetland types, including wooded fens and bogs cannot be replaced through reclamation. End pit lakes may have some value as wildlife habitat but they will not provide the same type of habitat as the wetlands that currently exist in these areas. Loss of wetlands will affect many wildlife species, including the yellow rail, which the assessment predicts will experience an 80% loss of high quality habitat.

### ***Riparian Habitat***

Riparian habitat includes the forests, shrubland and wetland vegetation that occurs along the sides of creeks and rivers. Many studies have shown that riparian areas are important habitats for wildlife and traditional users often key on riparian areas to trap species such as beaver, mink, otter and fisher and to hunt moose. As discussed in other sections, riparian areas are also important buffers that maintain base flows and the water quality in creeks and rivers and help to maintain the quality of fish habitat.

Both projects will result in substantial loss of riparian habitat. The Jackpine project will result in the complete destruction of the middle reaches of the Muskeg River and some of its tributaries. The Pierre River project will result in loss of riparian habitat along the lower reaches of Pierre River, Asphalt Creek and Eymundson Creek, as well as sections of First Creek and Big Creek in the northern portion of the development area. Of particular importance will be the loss of riparian forest habitat along the Athabasca River from mine development and bridge construction.

The reclamation plan predicts that riparian habitat that will become established along drainage channels on the reclaimed minesite will eventually replace most of the riparian habitat that will be lost:

- Jackpine Expansion-           Decrease of 66 ha (2%)
- Pierre River-                    Increase of 227 ha (13%)

The December 2009 EIA Update indicates that an additional 598 ha of riparian areas could be affected by groundwater drawdown (areas affected are not broken down by mine area). Because of the prescriptive method used to define the

riparian zones along streams in the area, it is probable that the estimates of riparian habitat loss are not accurate. In this assessment, only ecosite phases and wetland types within 100m of a watercourse were considered as possible riparian habitat. In reality, the width of riparian zones is typically quite variable depending on topographic and hydrological considerations. Most scientists prefer a functional definition of riparian areas, such as the definition used by the Alberta Riparian Habitat Management Society : “*Riparian areas are the lands adjacent to streams, rivers, lakes and wetlands, where the vegetation and soils are strongly influenced by the presence of water*” (Alberta Riparian Habitat Management Society website). Along much of the Muskeg River for example, the riparian zone extends much more than 100m from the river, as indicated by the presence of willows and other wetland vegetation.

### **Old Growth Forest**

Old growth forest provides important habitat for a diversity of wildlife species, including some species that depend on the availability of large diameter trees, snags and deadfall for nesting or denning. Animals that nest, den or roost in cavities depend on these old forests. These include mammals such as marten, fisher and some species of bats, as well as birds such as pileated woodpeckers and boreal owls. Although lynx prefer younger stands where snowshoe hares are plentiful for foraging, females select older forests with large woody debris for denning. Several sensitive bird species, including the northern goshawk, broad winged hawk, western tanager, black-throated green warbler, Blackburnian warbler and Cape May warbler, depend on old growth forest. Because of the frequency of forest fires, old growth forests are uncommon in the boreal forest of northern Alberta. Additional losses of old growth forest therefore threaten the biodiversity of the region.

Both the Jackpine and Pierre River projects will result in substantial loss of old growth forest:

- Jackpine Expansion                      Loss of 514 ha (52% of Baseline)
- Pierre River                                Loss of 710 ha (34% of Baseline)

Because it takes 100 to 140 years for forest to become old growth, effects of loss of old growth forest will extend long after project closure.

### **Effects of Air Emissions on Wildlife Habitat**

In addition to potential effects of airborne contaminants on wildlife health, emissions from oilsands operations can indirectly affect wildlife by reducing the quality of their habitat. The effects of air emissions from the two projects on vegetation and wildlife habitat are addressed in Volume 3, Section 5 of the Application. The study area for the Terrestrial Resources Air Emissions Effects assessment (TASA) is much smaller than the area used for the aquatic resources assessment. The TASA encompasses 484,297 ha of land, an area that includes the footprints of all of the existing conventional oilsands projects (Figure 5.5-1).

This boundary reportedly reflects “the furthest measurable extent of predicted potential impact for PAI, NO<sub>2</sub> and So<sub>x</sub> emissions for the Base Case, Application Case and PDC”.

The assessment focuses on lichens, which are considered sensitive to air emissions. Under the Base Case, the TASA contains 103,182 ha (21% of the study area) of woodland caribou habitat with high lichen food value. The western edges of the Audet and Steepbank caribou areas extend into the TASA. The results of the assessment show that within the TASA there is potential for direct, adverse impacts of air emissions on lichens, as well as on trees, shrubs, herbs and mosses. Under the Application Case, emission levels will exceed safe guideline levels for vegetation; however, the effected area is predicted to constitute a small proportion of the TASA (1,773 ha including 806 ha of high quality caribou habitat). The assessment concludes that the overall effects of the Project (both the JEMA and PRMA) on vegetation health (and wildlife habitat) are negligible. On this basis the proponent concluded that it was not necessary to conduct a cumulative effects assessment for this issue.

### 1.3.3 Wildlife Movements

The ability to safely move across the landscape to access required habitats is important for the survival of wildlife populations. The role of movement corridors is very well established in science and the effects of oilsands developments on wildlife movements is addressed in considerable detail in this EIA. Steps that were taken in this assessment to evaluate the effects of development on wildlife movements included baseline surveys of wildlife use along river corridors and computer modeling of changes in habitat characteristics that may affect wildlife movements. A modeling technique known as Linkage Zone Analysis was conducted to assess the extent to which habitat fragmentation and the presence of man-made features affected the ability of moose to move across the landscape. Wildlife movements are discussed in Volume 5, Section 7.6.3 of the EIA.

It is clear that both the Jackpine Expansion and Pierre River mine developments will have a significant effect on wildlife movements in the region. With respect to the JEMA, the assessment concludes that “*The removal of the upper reaches of the Muskeg River for the development of the JEMA in combination with the effects of neighbouring developments (i.e., Syncrude Aurora North and Aurora South Mines Imperial Oil Kearl Oil Sands Project, Shell Jackpine Mine – Phase 1, Jusky Energy Inc. sunrise Thermal Project) will create barriers to movement in the upper Muskeg River basin that cannot be mitigated until after reclamation*” (p 7-147).

The report also acknowledges that development in the region is affecting the ability of the Athabasca River valley to function as a regional wildlife corridor, noting that “*before reclamation, planned and approved projects north and south*

*of the PRMA LSA on both banks of the Athabasca River (i.e., Canadian Natural Resources Limited Horizon Oil Sands Project, Albian Sands Energy Inc. Muskeg River Mine Expansion, Petro-Canada Oil Sands Inc. Fort Hills Mining Project) are predicted to adversely affect wildlife movement rates along the Athabasca River within the RSA” (p 7-147).*

Although the EIA is less clear about the effects that the PRMA is likely to have on wildlife movements along the Athabasca River valley, there is reason for concern that the project will further restrict wildlife movements. Development will occur to within 250 m of the river, resulting in a long (over 7 km), narrow strip of habitat that could be perceived as a barrier by some wildlife species. Disturbance effects of the development will certainly extend more than 250 m from the mine and plant site, reducing the effectiveness of this ‘wildlife corridor’ (Shell used a 500m buffer around the rest of the LSA to account for possible effects to wildlife). To reduce the barrier effect of the Athabasca River bridge, Shell is proposing to design the bridge to be high and long enough to allow wildlife passage along both banks and will use fencing and vegetation planting to promote wildlife passage under the bridge.

### ***Habitat Isolation and Loss of Connectivity***

In Section 6 of the Terrestrial Environmental Setting Report, Golder Associates provide an excellent review of issues related to biodiversity in the oilsands region. The authors note that habitat fragmentation and isolation are important factors affecting biodiversity and comment on the potential role of riparian corridors in maintaining landscape connectivity:

*In the JEMA LSA and PRMA LSA, riparian communities are potential corridors linking the adjoining landscapes at the regional scale. Wildlife studies along the Athabasca River and major drainages like Muskeg River indicate that ungulates and carnivores make use of these areas as habitat and corridors for movement (Section 5.6.3).*

We agree with these authors that riparian corridors likely serve an important function in linking important habitat across the region. Various authors have commented on the importance of habitats within major river valleys for moose and other wildlife species. In the oilsands region, moose have been documented moving into sheltered, browse-rich riparian forests along the Athabasca and other major rivers during severe winters. Smaller rivers such as the Muskeg River and Elys River may provide important landscape connections between the Athabasca River valley and higher elevation summer habitats near the Birch Mountains and Muskeg Mountain. Habitats within these riparian corridors are also likely important for breeding for many wildlife species. Moose often select islands in rivers or inaccessible riparian areas as secure calving habitat. We also agree with the idea that riparian corridors that link patches of natural habitat may facilitate recolonization of reclaimed lands (CEMA 2006).

Initial results of Wildlife Corridor Monitoring studies (see Section 5.6.3.1) indicate that the functionality of these corridors may already have been impaired by development. Results of monitoring along the Muskeg River adjacent to the Muskeg River Mine Project show lower levels of wildlife use than in either the JEMA LSA or the Athabasca River corridor and that disturbance-tolerant species such as white-tailed deer and coyotes are now common in disturbed areas along the Muskeg River and Athabasca River corridors.

The proposed development plan for the Jackpine Mine Expansion project involves the destruction of the middle reaches of the Muskeg River, eliminating much of this potentially important, regional riparian corridor. While it is fairly clear that the Muskeg River will cease to function as a wildlife corridor over the life of the project, the long-term effects on wildlife and biodiversity are not known.

There is also a great deal of uncertainty about the degree to which the narrow riparian corridor being proposed along the Athabasca River adjacent to the Pierre River mine will function as an effective wildlife corridor. Shell has predicted that a minimum of one migrant per generation of all wildlife species will pass through this corridor, which they feel will be sufficient to maintain genetic connectivity across the regional landscape. While this could be the case, it can be argued that corridors should be designed to function as travel routes for daily and seasonal movements, in addition to dispersal movements. There is concern that an inadequate corridor could act as a population 'sink', drawing animals away from source areas and exposing them to increased mortality (Soule' 1991).

### **1.3.4 Wildlife Health**

The wildlife health risk assessment (Section 5.4, Volume 3) is the best wildlife health assessment we have reviewed to date for the oilsands region. The wildlife receptors selected and the exposure assumptions appear sound. The assessment considered a list of 15 species of mammals and birds covering each of the primary trophic levels. Mammals assessed included beaver, black bear, lynx, fisher, meadow vole, masked shrew, moose and snowshoe hare. Birds included barred owl, great blue heron, mallard, ruffed grouse and spotted sandpiper. The assessment considered exposure through inhalation and ingestion of contaminants. Both acute and chronic exposure were considered.

Our primary concern with the assessment is that Toxicity Reference Values (TRVs) that currently exist may be too limited to conduct a meaningful wildlife health risk assessment. To assess wildlife health risks, the level of exposure at which health risks could occur must be identified. This usually requires controlled studies under laboratory conditions. As noted in the assessment "Virtually no studies could be located in which wildlife was exposed to the COPCs under controlled conditions". As a result, the assessment was based on extrapolation of toxicity information available for laboratory animals. As well, insufficient toxicological information existed to assess health risks for amphibians, which are likely one of the most sensitive groups of wildlife to pollution effects.

The report clearly acknowledges the limitations associated with extrapolating TRVs from laboratory animals and factors were applied to these toxicity data to reflect this uncertainty. As well, the exposure estimates used in this report were quite conservative, reflecting what might be a worst-case condition. The assessment concludes that risks to wildlife health will be low to negligible for each of the Chemicals of Potential Concern (COPC) evaluated. Note: the wildlife health risk assessment addressed the JEMA and PRMA as a combined project; however, we assume that since effects of the combined 'Project' were found to be low to negligible, individual effects of the JEMA and PRMA are also likely to be low to negligible.

Notwithstanding this assessment, we continue to have concerns about the long-term water quality in reclaimed wetlands and pit lakes and potential wildlife health effects. At closure, process-affected waters and runoff from the reclaimed mine area will be directed through a series of reclaimed wetlands, pit lakes and a treatment lake before these waters are released to the Muskeg or Athabasca Rivers. These lakes will be designed to have some shallow littoral zones designed to promote biological activity and attract wildlife. Shell (Section 19.7 Volume 1) predicts that pit lake water quality will be non-toxic before the pit lakes start discharging to the Muskeg or Athabasca Rivers. They predict that while some key constituents, including acute and chronic toxicity and labile naphthenic acids, will be below aquatic threshold values or within the natural variability of existing waterbodies, that some, including molybdenum and PAH Group 2, will exceed guideline levels, and others such as boron, refractory naphthenic acids, PAH Group 6, sodium, potassium, sulphate, strontium and vanadium, will exceed levels in natural surface waters in the region. Shell concludes however that the predicted concentrations will have "low to negligible effects on aquatic health". Although contaminant concentrations in pit lakes are predicted to decrease with time due to flushing of concentrations from porewater in tailings materials in the landscape (Section 6.1.4.2, Volume 4A), we believe there is likely considerable uncertainty about how long this will take and the effects of these contaminants on aquatic wildlife during the intervening period. Results of research showing that exposure to oil sands process-affected water and sediment is associated with reduced growth of ducklings (Gurney et al. 2005) and reduced growth and survival of amphibians (Gupta 2009, Hersikorn 2009) should raise a red flag about long-term risks to aquatic fauna.

There are also long-term health concerns for terrestrial wildlife. The chemistry of reclamation soils is expected to be considerably different than natural surface soils in the region. In addition to concerns related to the possible bioaccumulation of contaminants in wildlife food chains, there is also concern that elevated levels of certain chemicals (salts, metals, acids) in reclaimed soils could affect the palatability and nutritional value of browse and herbaceous vegetation for moose and other herbivores.

### ***Exposure to Tailings Ponds***

A wildlife concern with all conventional oilsands projects is the risk associated with exposure of wildlife to tailings and to wetlands containing process-affected water. This is both a wildlife health and a wildlife mortality issue. Water birds are particularly at risk during the spring migration period, when tailings ponds may represent the only sources of open water along the migration route. Waterfowl and shorebirds that come into contact with tailings water may be exposed to residual bitumen, naphthenic acids and other toxic contaminants. This may cause direct mortality of waterbirds through fouling of plumage with oily compounds or the uptake of contaminants may cause reduced fitness and survival.

Shell briefly addresses this concern in Section 7.5.3.2 (EIA Volume 5). The company forecasts that effects will be of low magnitude, citing a low frequency of bird fatalities recorded at the Muskeg River Mine and Shell's intention to use radar-activated scare canons to discourage birds from landing on the ponds.

We are concerned however, that the proximity of the Jackpine Mine Expansion project to McClelland Lake and Kearl Lake, two regionally significant migration lakes for waterfowl and shorebirds, may pose greater than predicted risk to migratory birds. During development of the mine, an external tailings disposal area and a series of large in-pit fluid tailings cells will be developed in close proximity (2 km) to Kearl Lake and just several kilometers south of McClelland Lake. The tailings ponds will be comparable in size to Kearl Lake.

Construction of external and in-pit tailings ponds on the Pierre River Mine site, also pose a potentially significant risk to birds. Oilsands development in the region has resulted in a network of large tailings ponds along the Athabasca River valley. Although major migratory pathways have shifted away from the Peace-Athabasca Delta during recent history, the Athabasca River continues to serve as an important route for waterfowl migrating to and from the Peace-Athabasca Delta and other northern breeding grounds. To date, we have not seen a review of the cumulative loss of birds from exposure to tailings ponds in the oilsands region.

### **1.3.5 Validity of Impact Predictions**

Shell, like most of the oilsands companies, relies on use of various computer models to predict the impact of its proposed operations on selected wildlife species. Of particular importance are habitat suitability models that are used to predict the amount of suitable habitat that currently exists (Base Case) and the amount of habitat that will remain when mining is completed and disturbed areas are reclaimed (Closure). Although habitat models are potentially useful tools for measuring changes in habitat supply over time, they are complex and difficult to understand. If they have not been properly tested and validated, they can also give very misleading results. The following paragraphs are

intended to provide the ACFN with a basic understanding of how habitat models are being used and how various weaknesses in the models may be affecting the validity of the company's impact predictions.

In the most commonly used habitat models, habitat availability is expressed in terms of 'habitat units', which is the term that modelers use to provide a combined measure of the quantity and quality of habitat that exists in an area (or is expected to exist in the future). The habitat suitability models predict habitat suitability for each ecosite phase (vegetation community type) as a fractional value between 0 and 1, where 0 represents habitat of no value and 1 represents the best habitat that is available in the region. For example, if a project results in the loss of 100 hectares of a particular habitat type (e.g., Ecosite phase b1), and the habitat suitability model indicates that Ecosite phase b1 is only of average quality (given a value of 0.5) for a particular species, then the habitat loss would be given as 50 Habitat Units (100 hectares X 0.5 = 50 HU).

The impact ('environmental consequence') ratings used in the assessment are largely based on a mathematical comparison of the number of Habitat Units that the models predict that exist now (Base Case) and following reclamation (Closure). Use of habitat suitability models has been widely criticized, primarily because the biologists that have been using the models have had difficulty proving that they actually work. This is termed model validation. To validate a model, biologists need to prove that the model predictions are reasonably comparable to field data showing the extent to which each habitat type is actually used by wildlife. In an effort to improve the reliability of their habitat models, Shell's consultants have incorporated the use of a newer modeling technique called Resource Selection Functions or RSF for some species. With this approach the consultants used field data (e.g., winter track counts) to construct and test habitat models for moose, lynx and fisher.

Whether or not the use of Resource Selection Function analysis represents a significant improvement over previous approaches to habitat suitability modeling remains to be seen. There are however, a number of important assumptions that the proponent uses in conducting the wildlife assessment that the ACFN and regulatory agencies should be aware of:

- In predicting changes in habitat supply the proponent is assuming that a particular habitat type (Ecosite phase) established on reclaimed lands will have the same value to wildlife as a natural, undisturbed ecosite phase. Given the diversity and complexity of natural ecosystems, this assumption seems highly unrealistic, at least under the time frames that are being predicted (e.g., 80 years). Where is the evidence to support this assumption? Although research is continuing on many fronts to improve our understanding of soil development and plant propagation on reclaimed oilsands sites, this research is clearly in its early stages and a number of serious problems have been discovered that must be overcome (see CONRAD Reclamation and Environmental Research Symposium, 2007). These assessments assume the most optimistic possible outcome despite the fact that research conducted to date has not yet shown that lands affected by oilsands mining and tailings can be reclaimed to ecosite phases that

have comparable biodiversity and support the same ecological functions as the natural ecosites they are intended to replace. Shell notes that while the reclamation goal is to “*achieve maintenance-free, self-sustaining ecosystems with a capability equivalent to predevelopment conditions*”,... “*the target vegetation communities identified in the C&R Plan are conceptual, and **it is not currently possible to predict ecosystem succession over time***” (Volume 1 Project Description). Recent reclamation guidelines for the oil sands region (Alberta Environment 2010) also acknowledge this uncertainty, noting that “*The long-term effects of these anthropogenic disturbances on wildlife populations are not known*”. That report includes a summary of wildlife monitoring work conducted on reclaimed sites (i.e., Tar Island Dyke) at Suncor. Reclamation work at Suncor, which was initiated several decades ago, represents the earliest reclamation work in the oil sands region. Monitoring results have shown that many wildlife species now use the reclaimed area but that many of these species are much less abundant than they are in natural forests (Alberta Environment 2010). Deer and coyote were found to make greater use of reclaimed areas, whereas boreal species such as moose, fisher, marten and lynx were much less abundant than in natural habitats. This may change over time as more native species colonize reclaimed sites; however, the degree to which reclaimed sites will converge with natural habitats and the time scales that will be required are not known. Given these uncertainties, the assumptions made in the wildlife assessment appear overly optimistic and may not be realistic. We note that the models adopted by the Sustainable Ecosystem Working Group (SEWG) for the development of CEMA’s Terrestrial Ecosystem Management Framework (TEMF) assumed that the wildlife habitat value of reclaimed surface mining footprints would be only 50% of the value of natural (pyrogenic) plant communities (SEWG 2008).

- Although it is seldom reported in EIAs, there is also an error rate associated with the classification and mapping of ecosite phases. An ecosite phase is actually a vegetation association (a group of vegetation species that have a high likelihood of occurring together). Another modeling technique is used to portray ecosite phases as mappable units. We understand that in many cases it is common for error rates (misclassified polygons) to be as high as 20-40%. There are also serious questions about whether these mapped units represent meaningful habitat divisions, at least for some wildlife species. This might be one of the reasons that biologists have had trouble validating their models using real field data.
- For some species, including moose, different RSF models are used to predict habitat suitability at the LSA and RSA scales. Because of differences in the availability of data on landscape attributes, different models were developed for the LSA and the RSA. The RSF models for the LSA were based on vegetation cover data available from the Alberta Vegetation Inventory (AVI), along with GIS data on distance to landscape features such as rivers and forest edges. In contrast, the models for the RSA used Landsat data for habitat classification and topographic information (slope, aspect, elevation) available from Digital Elevation

Model (DEM) data. The resulting models for moose in the LSA and RSA are very different, showing no overlap in the habitat/landscape variables selected. Not surprisingly, the results of the two models are also very different.

When model results were validated against the portion of winter track count data not used for model development (one-quarter of the data was set aside for model validation), results showed just a moderate correlation with the LSA models and a low correlation with the RSA models. The authors concluded that the RSA model lacked the necessary detail in terms of habitat and landscape features to achieve a good correlation with sampled field data. If they are correct, then conclusions based on the regional habitat model could be wrong. Although the moose habitat model for the LSA showed a better correlation to winter track count data than did the model for the RSA, the LSA model predictions did not correlate strongly with the field data. As a result, conclusions based on the LSA model may also be wrong.

The conclusion that habitat in the Jackpine Mine Expansion LSA (which comprises much of the central portion of the Muskeg River watershed) represents low quality habitat for moose conflicts with previous information provided by the Alberta Fish and Wildlife Division, which classified the broad floodplain of the Muskeg River as a Key Wildlife Area for moose in northeastern Alberta. It also contrasts with earlier TEK information that indicated that the Muskeg River watershed contained important moose habitat. Information provided by ACFN elders Pat Marcel and Charlie Voyageur in 2004 (see Muskeg River Mine Application) indicated that the riparian zones along the Muskeg River upstream of Jackpine Creek are used by cow moose during the spring calving period and that the Kearl Lake area contains important habitat for moose. These elders reported that moose move into the Muskeg River watershed in autumn from higher elevation ranges in the Muskeg Mountain area. Similar movements by radiocollared moose were previously reported by Hauge and Keith (1981). Hauge and Keith (1981) documented movements of moose from summer ranges in the Birch Mountains and Muskeg Mountain areas to lower elevation winter ranges near the Athabasca River and Muskeg River. They attributed these movements as a response to snow depths, with snow depths in the Birch Mountains and Muskeg Mountain averaging 10-15 cm greater than they were on winter ranges near the Athabasca and Muskeg Rivers. By late winter, these higher elevation summer ranges were almost devoid of moose. This research suggests that, during severe winters, access to these low elevation winter ranges could be vital for the regional moose population. It also supports the provincial government's previous classification of lowlands along the Athabasca and Muskeg Rivers as key moose winter range.

Although winter is believed to be a critical period for moose, habitat models that reflect only winter habitat use might not adequately reflect the overall value of an area for moose. For example, both TEK and the scientific literature recognize that moose require a number of different habitat types and that habitat use changes throughout the year. Habitat modeling may therefore require

consideration of the availability of each of these habitat types within the home range of a moose. The approach used in this assessment, which relies on data from winter track counts, may not identify some important habitats. An example would be shallow waterbodies (lakes, marshes and streams) which provide important habitat during spring and summer. Moose often enter water to avoid predators, forage on aquatic plants or to avoid biting insects. Moose often calve on islands or along the shorelines of waterbodies to provide increased protection to new-born calves. Habitat assessment for ungulates based strictly on winter data is standard practice in the industry and in this assessment Golder clearly states that the modeling results apply only to winter habitat use. Our point is that this approach may not realistically reflect the value of particular areas to moose.

One technical concern we have with the RSF modeling approach used is that the models apparently did not consider distances to industrial disturbance other than major roads. The authors indicate that the available GIS disturbance layers showed only estimated disturbance footprints and not actual disturbance that existed at the time of the surveys. Since most of these data would have been collected from proposed development areas and baseline winter wildlife surveys are frequently conducted following or coincident with exploratory seismic and drilling activity, a potentially large source of error could be introduced to the modeling (and validation) results. In other words, displacement of moose because of either current or previous industrial activities would affect winter tracking results, which in turn could compromise modeling results. From the report it was not clear whether efforts were made to include baseline data only from relatively undisturbed locations.

Another important concern relates to the use of the habitat models for predicting changes in habitat suitability from Base Case to Closure. Despite the fact that results of the model validation showed that the habitat models for moose, lynx and fisher for the RSA had a poor correlation to winter track count data, these models were used for the cumulative effects assessment (regional planned development scenario). A further complication is that different habitat models were used to estimate habitat supply within the LSA at Base Case and Closure for these three species. Because some of the variables that were found to be the strongest predictors of habitat quality in the LSA at Base Case (e.g., stand age, distance to edge, distance to disturbance features) were not available for Closure, the RSA models were used to predict habitat suitability at Closure.

- A failure of this and many other EIAs conducted in the oilsands region may be the unproven assumption that populations or ecosystems will respond linearly to cumulative impacts. In actuality, the consequence of incremental habitat loss may increase as these losses accumulate. For example, it is evident that a relatively large proportion of the key moose wintering habitat in the oilsands region has already been lost to development. The remaining portion may therefore have increased importance to the regional moose population. In other words, loss of a further 10% of the key moose winter range may have a much greater consequence than did the loss of the initial 10%. Similar concerns may

exist with respect to loss of secure calving habitat. As previously remote calving areas, such as riparian areas along the Muskeg River and Kearl Lake, are lost to development, remaining calving areas may be exposed to increased predation risk, particularly by black bears. Previous studies have shown that black bears are a major predator of moose calves. As secure calving sites disappear or become smaller and narrower, calf mortality rates could increase, adversely affecting the regional population. The same kinds of arguments apply to other species, including the species discussed above that depend on old growth forest for denning or roosting.

- Another concern with the habitat modeling approaches used in this and other oilsands applications is the failure to state the risks and level of uncertainty that are associated with the model predictions. Model predictions can never be made with total certainty and biologists should use sensitivity analysis or other tools to assist decision makers in understanding the risks and uncertainty that may be associated with model predictions (SEWG 2008). If, as some researchers have suggested, reclaimed areas only have 50% of the habitat value as natural habitats, how would the impact predictions change?

## 1.4 Key Concerns

The following table summarizes key wildlife issues and recommendations applicable to the Jackpine Mine Expansion and Pierre River Mine Projects.

<b>Issue</b>	<b>Concern</b>	<b>Project</b>	<b>Recommendations</b>
Assessment boundaries	The temporal and spatial boundaries used in this EIA do not permit a meaningful assessment of the long-term effects of the proposed projects on wildlife populations in this area. The assessment does not consider a pre-development baseline. Inappropriate criteria are used for selecting the RSA.	JEMA & PRMA	Identify changes to wildlife KIRs resulting from past (existing) development.  Determine natural range of variation (NRV) for each KIR
Wildlife Indicators	Although these mines are situated adjacent to regionally or provincially significant waterfowl habitats (e.g., McClelland Lake, Kearl Lake, Athabasca River) and ducks and geese are consumed by First Nations members, no waterfowl species were selected as KIRs.	JEMA & PRMA	The assessment should be expanded to include mallard or another appropriate waterfowl species.
Baseline	Gaps in baseline surveys prevent	JEMA	Conduct additional sampling of

Shell Jackpine Mine Expansion and Pierre River Mine Projects  
EIA Review (ACFN) – Wildlife Component

Surveys	full understanding of wildlife resources that might be at risk		breeding birds and bats in riparian habitats associated with the Muskeg River
		PRMA	<p>Conduct additional sampling for breeding birds and owls</p> <p>Conduct additional sampling of bats in the north half of the LSA and along the Athabasca River</p> <p>Complete waterfowl and beaver/muskrat surveys in north half of LSA</p>
Accuracy of Population Viability Analysis	Results of PVA, which predict growth in moose and black bear populations under all development scenarios, disagree with TEK and another modeling study that projects declining populations for these species.	JEMA & PRMA	<p>Rationalize differences in model predictions.</p> <p>Review assumptions and data requirements for PVA analysis and refine population models.</p>
Validity of habitat models.	Some of the RSF models developed to assess regional changes in habitat supply and habitat suitability of reclaimed lands at closure were not shown to be accurate when validated against field data. This may affect the validity of all impact predictions based on these models.	JEMA & PRMA	<p>Explain the implications of using an apparently invalid model to assess cumulative effects and the value of reclaimed lands for wildlife.</p> <p>RSF may have advantages over HSI models for some species. Further work to refine/develop accurate models is strongly recommended.</p> <p>Consider expanding the assessment for moose to include calving/post-calving habitat as well as winter habitat.</p>
Habitat loss	<p>Assessment predicts large net loss of wetland and old-growth habitat.</p> <p>(note that loss of riparian habitat question removed)</p>	JEMA & PRMA	Additional mitigation and compensation measures should be considered to offset permanent habitat losses.
Disruption of wildlife movements	The proposed JEMA will remove the middle section of the Muskeg River, eliminating what might be a regionally significant riparian corridor.	JEMA	<p>A conservation corridor of reasonable width (e.g., at least 400m) should be maintained along the mainstem of the Muskeg River.</p> <p>In addition to current corridor monitoring efforts, radiotelemetry studies should</p>

			be initiated to fill critical knowledge gaps in our understanding of the potential role of riparian corridors in supporting wildlife movements in a fragmented landscape.
	The proposed PRMA could restrict wildlife movements along the Athabasca River, which is recognized as a major regional wildlife movement corridor.	PRMA	Shell's proposed setback of 250m from the Athabasca River should be increased to at least 400m to protect vital riparian habitats and maintain wildlife movements.
Wildlife health risks	The concern is that the lack of research and toxicity reference data directly applicable to wildlife (as opposed to laboratory animals) may affect the validity of the assessment. It is also not clear to what extent the assessment considered potential long-term, residual effects of exposure of wildlife to contaminants in process-affected wetlands and end pit lakes. Effects of changes in soil chemistry on the palatability and nutritional value of browse are not identified.	JEMA & PRMA	Explain the possible risks associated with extrapolating toxicity data from lab animals to wildlife.  Clarify risks to wildlife resulting from long-term exposure to process-affected water.
Exposure to tailings ponds	Because of the proximity of these mines to regionally or provincially significant migratory staging areas (McClelland Lake, Kearl Lake, Athabasca River) risks of exposure of migrating waterbirds to tailings might be increased. Cumulative effects of tailings ponds in the oilsands region have not been assessed.	JEMA & PRMA	Conduct a detailed, cumulative effects assessment dealing with exposure of migratory birds to the expanding network of tailings ponds in the oilsands region.
Validity of reclamation assumptions	The wildlife impact predictions are based on the assumption that reclaimed lands will have the same wildlife habitat value as the undisturbed ecosite phases they are modeled after. No evidence is presented to support this assumption. The assessment fails to identify the risks or levels of uncertainty that are associated	JEMA & PRMA	Provide a detailed review of monitoring research that supports this assumption.  Use sensitivity analysis or another appropriate technique to identify levels of uncertainty associated with the models and variables that might affect the accuracy of these predictions.

	with habitat model predictions.		
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## 1.5 References Cited

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## **Appendix D-14**

**Jackpine Mine Expansion and Pierre River Mine Project - Environmental Impact Assessment Report - Review for Athabasca Chipewyan First Nation – Vegetation, Wetlands and Forest Resources Component, April 29, 2010 (revised), by C. Dana Bush of Bush Ecology**

# Jackpine Mine Expansion and Pierre River Mine Expansion

## Environmental Impact Assessment Report Review for Athabasca Chipewyan First Nation Vegetation, Wetlands and Forest Resources Component

By:

**C. Dana Bush (Bush Ecology)**

**April 29, 2010**

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### 1.0 Introduction

This section focuses on the Terrestrial Vegetation, Wetlands and Forest Resources Impact Analysis. To ensure that this review adequately covers the impacts to vegetation, portions of the Air Emissions, the Conservation and Reclamation Plan, and Traditional Land Use Sections were read.

- Undated Concerns and Requests, and those dated September 2007 refer to:
  - Environmental Impact Assessment: Volume 5, December 2007;
  - Environmental Setting Report, December 2007;
  - Environmental Assessment Update, May 2008 (excluding the Fort McKay lease and separating the JME and PRM).
- Concerns and Requests dated October 2008 refer to:
  - PRM Supplemental Information with an EIA update, May 2007;
- Responses to ACFN refer to Shell's responses to ACFN's first Information Requests (Technical Request Response Table);
- Concerns and Requests dated April 2010 refer to:
  - Pierre River Mine Project Supplemental Information, May 2009;
  - Jackpine Mine Expansion Supplemental Information, December 2009;
  - Shell Jackpine Mine Expansion and Pierre River Mine Project EIA Update, December 2009.

Most of this review focused on problems with the methods of the assessment, which are relevant for both mine areas. Issues with site specific data and data analyses are contained in the final sections.

## 2.0 Overview

This environmental assessment uses methods similar to many other Environmental Impact Assessments (EIAs), and has the same inherent problems. In brief, the methods serve to obscure the impacts of the project by:

- using a large regional study area relative to the footprint, resulting in low magnitude and negligible environmental consequence in the Regional Study Area (RSA),
- defining reversibility as “a site is considered to be restored if natural processes are restored”. Species richness is not included in the definition, therefore an impoverished but native and self-sustaining site will be considered restored,
- defining the Environmental Consequences (EC) in a way that makes it difficult to score a high EC for vegetation in the RSA,
- assessing the loss/alteration of a resource relative to the Local Study Area (LSA), not the resource.

Several unsupported assumptions about reclamation potential also affect the final assessment:

- reclamation of jack pine forests will include enough lichen to be a valuable resource for caribou within a meaningful time frame (to caribou),
- non-treed wetlands are ecologically equivalent (similar) to peatlands,
- rare plants will re-colonize reclaimed landscapes,
- shrubs and trees alone will restore an ecosystem,
- direct placement of 1/3 of the topsoil will be sufficient to supply native seed, propagules and mycorrhizae.

In addition, there are a few sections that have weak science supporting the methods and assumptions:

- assessing traditional use potential and rare plant potential instead of actual species,
- assuming that 16% of the RSA is old growth without the data to support it,
- calculating species richness using non-native species,
- inferring that aspen communities will eventually develop into spruce forests,
- assuming (by omitting any discussion) that weeds and non-native invasive species will not be introduced or spread during construction and reclamation,
- classifying large areas as burn rather than as ecosite phase or wetland class
- not presenting the accuracy of the maps.

### 3.0 Assessment Methods

#### 3.1 Environmental Consequence Rating System

Volume 5, Section 1.3.6.2, page 1-37: The Environmental Consequence rating combines the results of the impact criteria into one rating, based on magnitude, geographic extent, duration, reversibility and frequency (Table 1.3-4). Each criterion is given a score. Adding the scores gives you the environmental consequence.

##### Impact Description Criteria

Magnitude (Severity)	Geographic Extent	Duration	Reversibility	Frequency
Negligible: < 1% change (0)	Local: LSA (0)	Short-term: < 3 years (0)	Yes (-3)	Low: occurs once (0)
Low: < 10% (+5)	Regional: RSA (+1)	Medium-term: 3 to 20 years (+1)	no (+3)	Moderate: occurs intermittently (+1)
Moderate: 10-20% change (+10)	beyond regional (+2)	long-term: >20 years (+2)		High: occurs continuously (+2)
High: > 20% change (+ 15)	-	-	-	-

##### Environmental Consequence

- Negligible: 0 to 5
- Low: 6 to 10
- Moderate: 11 to 15
- High: greater than 15.

The CEAA guidelines recommend that environmental impact assessments discuss and assess the impacts using these criteria, but it does not describe how the criteria are to be used to assign consequence or significance. Each environmental consulting company develops it's own methods. The methods used in this assessment means that it is very difficult to score a high environmental consequence for vegetation. In addition, the criteria are used for each separate KIR (i.e. rare plants, old growth forests, wetlands, riparian areas), so it is difficult to picture the overall impact. There are three fundamental problems: the use of percentages for magnitude, the definition for reversible, and the methods used to score the criteria.

##### SIR Response

PRM Vol. 2, AENV SIR 390 and JME AENV SIR 374 questions the application of a (-3) reversibility value. Shell responded with "A numeric score of (0) for

reversibility would not account for the ecological endpoint's potential ability to recover, and would overstate the environmental consequence for the endpoint".

**Concern - October 2009**

The Impact Description Criteria denotes(0) as no or negligible impacts for magnitude, geographic extent, duration, and frequency, however (0) for reversibility is partially reversible. The consequence of this scale is that a 'reversible' impact (+3) outweighs the impact of a regional geographic extent (+2), long term impacts (+2), or continuous frequency (+2). A negative environmental impact, therefore could become a positive impact if it is deemed reversible.

**→ Request - October 2009**

*Please explain, in biological terms, how a reversible impact could be a positive force, rather than a neutral force.*

### **3.2 Magnitude**

Using percentages to establish magnitude ranking is a standard method; the problem is that the larger the study area, the smaller (and less significant) the impact. For example, if you disturb 21 ha in a 100 ha study area, you will have a 21% loss which is a high magnitude. However if you increase the study area to 125 ha, then the loss is only 17% which is a moderate magnitude.

Because the LSA is generally slightly larger than the development area, the local impact of clearing all vegetation will almost always be high. In this project, the LSA includes the mining area plus a 500 m buffer zone. The project will result in a total disturbance of 32,495 ha in an LSA of 50,640) which is 65%. Projects such as SAGDs, which cover a large area but disturb less of the landscape may have a low impact in the LSA.

The regional study area is 2,277,376 ha. The larger study area enables the proponent to assess the other projects that are approved and planned for the area, and allows impacts to be assessed for large roaming mammals such as moose and caribou. However, the more projects in an area, the larger the regional study area must be to include all the projects, and the less likely an individual project will be significant. In this case the project will result in a total disturbance of 32,495 ha in an RSA of 2,277,376 ha which is 1.4% (low). However, if the regional study area had been set at 227,737 ha, then the disturbance would be 14.2% (moderate); at 150,000 ha, the disturbance would have been 22% (high). Because Shell has used a large RSA, none of the KIRS relying on area calculations will ever rank higher than low magnitude.

### 3.3 Reversibility

Except for peatlands, rare plants, and to some extent old growth forests, and the areas that will be converted to endpit lakes; impacts to vegetation communities are considered reversible. “Because ecosystems are dynamic, a site is considered to be restored if natural succession processes are restored. Reversibility does not necessarily require the establishment of a mature stage of the successional pattern, but can be achievement of a development stage that can be assumed to be moving towards an acceptability stage of maturity” (EIA Section 1.3.6.1). This is a reasonable definition of reclamation (see below), but will result in a noticeably different landscape, with more large hills and lakes, fewer peatlands, and far fewer species than the original forest. It may be reclaimed: it is not, however, restored.

*Land Reclamation: The process of improving disturbed land (soil, vegetation, water) to achieve land capability equivalent to the predisturbed condition or for a specified end land use.*

*Ecosystem Restoration: The process of manipulation an ecosystem (soil, vegetation, water and wildlife) to achieve composition, structure and function similar to the predisturbed condition (Department of Renewable Resources, University of Alberta. [www.ales.ualberta.ca/rr/landreclamation.cfm](http://www.ales.ualberta.ca/rr/landreclamation.cfm)).*

By using a low diversity reclaimed landscape in an unspecified time-line as a goal, the EIA can confidently claim that reclamation will be successful, as long as the dominant species are native and soil formation is occurring.

#### **SIR Response - PRM May 2009, JME December 2009**

PRM ERCB SIR 379b and JME SIR 363b asked the proponent to “*Discuss the capability of reclaimed lands to support the pre-disturbance range of forest vegetation communities, species diversity, and productivity*”.

Shell responded that “The time frame required to such a return [to equivalent pre-development capability] has not been established because of a lack of precedent in oil sands reclamation. ...one rotation age is expected for most species to return...Full diversity will eventually return, based on positive reclamation results over the last 30 or more years. The time line to achieve full diversity is not yet known with certainty.”

PRM AENV SIR 384a and JME AENV SIR 368 asks the proponent: “*Based on the definition of reversibility criteria provided does Shell consider that all of the disturbances caused by the Project can be reversed?*”

Shell responded with “Shell is committed to reclaiming disturbed areas in a manner that supports and maintains natural successional processes, and provides functional ecosystem processes....The definition of reversibility criteria does not assume that only one successional pathway is available. For any reclaimed ecosystem, there are a number of potential pathways.”... “Reversibility indicates the potential for recovery of an ecological end point”

JME AENV SIR 368a mentions that the timeline of the assessment is 80 years.

### **Concern - October 2009**

Our conclusion still stands: “By using a low diversity reclaimed landscape in an unspecified time-line as a goal, the EIA can confidently claim that reclamation will be successful”, as long as Shell can demonstrate that the ecosystem is on a successional pathway where basic ecosystem functions will be established. There is an implied commitment to ensure that the reclaimed landscape will be dominated by native species, but it will look distinctly different from the original. Shell has provided no support for their assurance that the species diversity will recover in a meaningful timeline (i.e. to aboriginal users).

This is a reasonable assumption to make, given the current knowledge of reclamation. However, when coupled with the assumption that impacts to most vegetation communities are reversible, it leads to the conclusion that there will be no impacts, when very likely there will be long-term losses in biodiversity in upland as well as peatland vegetation communities.

### **Concern-April 2010**

Shell correctly states that for any reclaimed ecosystem, there are a number of potential pathways. These pathways are unpredictable, depending on the initial disturbance, climate change, the disturbance regime (i.e. fire), nitrogen addition, invasive species, biotic limitations (pollinators, symbiotic interactions of plants with mycorrhizae, dispersal limitations, and microsite limitations (Choi et al 2008; Johnson and Miyanishi 2008). The problem is that after clearly stating that there are a number of potential pathways, the EIA then assumes that ecosite phases will be restored, and that this will mitigate the losses in habitat and species diversity. There is a serious gap in logic here.

### **➔ Request -April 2010**

*Explain why ecosite phases are used in the assessment calculations and wildlife models even though Shell admits that it is not possible to predict the final community type.*

*If Shell maintains that ecosite phases will be restored (including the dominant forbs) then provide specific targets (number of species, species composition, cover etc.) for each ecosite phase/wetland type so that the success of reclamation can monitored and evaluated.*

*If Shell admits that ecosite phases will not be restored, then re-analyze the data using “ecosite analogues” or some other category that indicates the lack of similarity and unpredictability of the final landscape.*

Choi, Y.D., V.M. Temperton, E.B. Allen, A. P. Grootjans, M. Halassy, R.J. Hobbs, M.A. Naeth, K. Torok. 2008. Ecological Restoration For Future Sustainability In An Changing Environment. *Écoscience* 15(1):53-64.

Johnson, E.A. and K. Miyanishi. 2008. Creating New Landscapes and Ecosystems: The Alberta Oil Sands. *Ann. N.W. Acad. Sci.* 1134:120-145.

### 3.4 Environmental Consequence:

The method to determine environmental consequence will almost never result in a high environmental consequence for vegetation as a whole. In the example below, I have used a worse case scenario to determine the environmental consequence of clearing all vegetation for a mine.

I assumed that the RSA is relatively small. Clearing vegetation on 20% of the area would be a high magnitude impact (Table 2) and regional in the RSA. The duration of a mine is greater than 20 years, therefore it would be long-term. Reclamation for most of the vegetation is theoretically possible (although not for peatlands and only somewhat for old growth forest), therefore three points are removed. The final criterion is frequency. Although frequency is important for wildlife species who may be affected by frequent road traffic or occasional helicopter surveys over pipelines, impacts to vegetation are generally low: the vegetation is cleared once and then reclaimed. Frequency is almost always scored 0 for vegetation.

As you can see from this worst case scenario (Table 2), the only time that general vegetation impacts could score high, is if it is deemed irreversible (e.g. peatlands, old growth forest, rare plant populations), if the geographic extent is beyond regional (e.g. nationally listed rare plant species), or the frequency was intermittent or continuous. The actual size of the project is more or less irrelevant, because the RSA is generally 80% larger than the project, but it has the heaviest weighting in the system.

**Table 2: Example of environmental consequence**

Criteria	Rank
Magnitude: > 20% change	+15
Geographic Extent: Regional	+1
Duration: long-term	+2
Reversibility: yes	-3
Frequency: low	0
<b>Environmental Consequence</b>	<b>15 = moderate</b>

Three KIRs that were assessed as having greater than negligible environmental consequence at the local level, are evaluated for the RSA in the impact assessment: wetlands, old growth forests, and high rare plant potential. All of them are rated low environmental consequence, because they are all negligible or low magnitude, primarily because the total area disturbed is only 1.4% of the RSA. It is unclear why the frequency is rated high in this assessment, as it is low in the LSA (Volume 5, Table 7.5-34). The explanation (Volume 5, Section 7.6.2.1,

page 7-142) reads “As clearing to vegetation will occur into the future, the frequency is considered to be high”, however frequency refers to the number of occasions to the same KIR, so the time lag should be irrelevant.

**→ Request - September 2008**

*Explain why frequency is high in the RSA and low in the LSA.*

**Table 7.6-7: Residual Impact Classification for Terrestrial Vegetation, Wetlands and Forest Resources in the Regional Study Area: Planned Development Case**

Component Criteria	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Environmental Consequence
Wetlands (including peatlands)	Negative	Negligible (3,606 ha) (0)	Regional (+1)	Long-term (+2)	Irreversible (+3)	High (+2)	Low (+8)
Old growth forests	Negative	Low (+5)	Regional (+1)	Long-term (+2)	Irreversible / reversible (0)	High (+2)	Low (+10)
High rare plant potential	Positive	Low (+5)	Regional (+1)	Long-term (+2)	n/a/	High (+2)	Low (+10)

**Response to ACFN #52**

The difference in frequency rating referred to above is due to the difference between the Application Case and Planned Development Case (PDC), and is not the result of scale issues between the LSA versus the RSA. The difference in frequency rating is due to timing or rate of clearing in each case. In the Application Case, the only source of change to the environment is a single development (the Project) that will be cleared, and it is assumed that the entire area is cleared at once. Thus, the frequency rating is low for both the LSA and RSA at the Application Case. For the PDC, each planned or approved project is assumed to be 100% cleared as an individual event, thus the clearing of all developments are considered to be different events on the specific resource in the PDC. Therefore, a frequency rating of high is assumed for the PDC.

**→ Request #52**

*Please explain how clearing for different events, in different locations will be biologically relevant to vegetation.*

**3.5 Calculation Percentage of Loss/Alteration in the RSA**

Vegetation loss can be presented as the % loss within the LSA, or the % loss to the resource in the LSA, with very different numbers and meanings.

ESR, page 7-74, and Table 7.5-18 Old Growth Forests in the Local Study Area: “The project will result in the removal of 1,223 ha of the old growth forest, representing a loss of 2% of the LSA.” However, the table indicates that 40% of the old growth forest in the LSAs will be removed. This is a more meaningful measure.

➔ **Request #53**

*Please correct Table 7.5-34 Residual Impact Classification to show that the Magnitude of the impact in the LSA is high (>20%), and therefore the Environmental Consequence is high (+17). If not, then explain why using a 2% loss of the LSA is more biologically relevant than using a 40% loss of the resource.*

**Response to ACFN #53**

Magnitude of impacts is rated in terms of a geographic area in order to provide a scale of reference. Consider the following two scenarios:

- Scenario 1 – 1 ha of Old Growth Forest (OGF) in 1,000 ha study area; 100% of it removed by a project.
- Scenario 2 – 900 ha of OGF in a 1,000 ha study area; 100% of it removed by a project.

If the impact assessment was based on the percent of OGF affected, the result for both scenarios would be 100%. This determination would not provide information relating to the contribution of OGF to the overall ecosystem function in the study area. In Scenario 1, the contribution of OGF to the study area is 0.1% as compared to 90% in Scenario 2. It follows that the impact in Scenario 2 should be rated higher than the magnitude of effect in Scenario 1. This perspective is achieved by assessing the impact relative to the study area. While environmental consequence is not scored on percent of the resource, the change in amount of the resource is provided as an added perspective for the reader.

**Concern #53**

This is a disagreement over method. Perhaps both methods should be used throughout the assessment, as they reveal different issues.

Shell’s method does not show the impacts to uncommon ecosite phases, such as forested bogs, open bogs, shrubby bogs, wood bog with islands, wooded bogs with collapsed scars, forested fens, meadows. The loss of these communities would result in a decrease in biodiversity in the RSA. Consider these two scenarios:

- Scenario 1 - 25 ha of Old Growth Forest (OGF) in 1,000 ha study area: 23 ha/25 ha removed = 92% of resource (2.3% of study area)
- Scenario 2 - 250 ha of OGF in 1,000 ha study area: 23 ha/ 250 ha removed = 9% of resource (2.3% of study area)

Scenario 1 would have large effects on the OGF and on biodiversity, while Scenario 2 may not. This difference is not reflected in % of study area.

Table 7.5-11 does shows % of LSA and % of Resource, but neither the % of the resource or the discussion of impacts make it to the final assessment.

## 4.0 Vegetation - Reclamation

### 4.1 Lichen Jack Pine Communities

ESR: Section 3.3.6.1: “Lichen jack pine communities were selected as a community-level KIR because of their importance for caribou habitat and due to their restricted spatial distribution in the region.”

EIA update: Section 2.7.3.2: Lichen jack pine communities are predicted to increase by 450 ha (1%) from Base Case at closure with the exclusion of the Fort McKay Lease (Table 2.7-4) for the two LSAs. However, this assumes that reclamation will be successful is a meaningful time frame for caribou. Clearing begins before 2010 (C&R update, Section 3.4.1, Table 30), revegetation begins in 2029 (C&R update, Section 3.4.2, Table 31) and jackpine reclamation begins in 2034 (Volume 1, Table 20-10). If we assume that lichen develops on the jack pine in 50 years (a wild guess on my part), then the lichen jack pine community will not be useable for caribou until 2084. The loss/alteration to the lichen jack pine communities is up to 25% of the resource for approximately 75 years.

JMEA Table 2.2-2 (EIA update): Environmental Consequence = low (+7), and positive. (long term (+2). Reversibility n/a

#### → **Request September 2008**

*Please provide evidence that:*

- 1) Lichens will re-colonize the jack-pine communities, especially when they are isolated from contiguous stands by early seral reclamation communities, and in what time-frame;*
- 2) 75 years of reduced lichen will not affect caribou and therefore the impacts to lichen jack pine communities will not have a negative environmental consequence,*
- 3) explain why Reversibility is not applicable.*

### 4.2 Wetlands

Impacts to wetlands (including peatlands) are ranked as a low environmental consequence. Six percent of the treed fens and four percent of the treed bog/poor fens will be lost in the RSA (a low magnitude), and there will be an increase of 16% in non-treed wetlands, such as marshes, after reclamation. In the assessment, these numbers are combined together, and presented as a total loss of < 1%. The environmental consequence assumes that non-treed wetlands are

ecologically equivalent (similar) to peatlands, which is not supported in the report. If the assessment looked at peatlands only, the environmental consequence in the RSA would be moderate (magnitude +5, regional +1, long-term +2, irreversible +3, frequency 0 = +11).

➔ **Request #54**

*Support your assumption that reclaimed non-treed wetlands are ecologically equivalent to peatlands and explain why the increase in non-treed wetlands was used to offset the decrease in peatlands.*

**Response to ACFN #54**

Although non-treed wetlands are not identical to peatlands, the two wetland types are similar in many respects. As the identified KIR was all wetlands, the results were reported correctly. The assumption is that non-treed wetlands and peatlands reasonably fit into the same “wetland” category. Although they are not considered to be ecologically equivalent to peatlands in all respects, they are also not entirely ecologically distinct either. They have similar ecological functions with respect to many environmental components – examples include certain aspects of surface water hydrology, water quality, vegetation, wildlife habitat, traditional land use and biodiversity. The shift from peatlands to non-peat forming wetlands and wet area types is fully assessed in the respective EIA components.

➔ **Request #54**

*Peatlands and marshes are markedly dissimilar in vegetation, traditional land use and biodiversity. Please provide research supporting the assumption that reclaimed non-treed wetlands are ecologically equivalent to peatlands.*

### 4.3 Rare Plants

The report assumes that reclamation will compensate for the loss of rare plants by increasing the rare plant habitat, which is an assumption based on hope not fact.

➔ **Request:**

*Please support your assertion that rare plants will re-colonize reclaimed landscapes.*

### 4.4 Reclamation Goals

JPM Volume 1: Project Description: “Shell’s reclamation goal is to achieve maintenance-free, self-sustaining ecosystems with a capability equivalent to predevelopment conditions. This goal is shared with other oil sands mining operators, such as Canadian Natural (Horizons Oil Sands Project), Suncor (Voyageur South Project) and Imperial (Kearl Oil Sands Project).”

“The target vegetation communities identified in the C&R Plan are conceptual, and it is not currently possible to predict ecosystem succession over time.”

Section 20.2: “C&R activities for the first 10 years of activity on the expanded Jackpine Mine will be limited to soil salvage and stockpiling. ....”

Section 20.3, Table 20-5: Upland Surface soil and subsoil reclamation material; salvage begins in 2010, but placement does not begin until after 2019.

Table 20-10: Jack pine revegetation starts 2034

Page 20-22: “Direct placement of suitable material to reclamation areas enhances site revegetation. This is because dormant, in situ, native seed and viable root fragments are transferred with the soil amendment. Spreading the material on a reclamation area in early spring usually results in various native forbs, wildflowers, grasses, and woody-stemmed species emerging over the late spring and summer. Direct placement will be implemented wherever practical.”

Section 20.4: “Progressive reclamation will be implemented, including direct placement of the reclamation material, *when salvage and reclamation can occur concurrently.*”

Reclamation material stockpiles will remain intact until after 2019, and some will still be stored in stockpiles by 2049.

EIA: Appendix 5-1 Section 3.3.2, Table 27: According to this table, only 1/3 of the topsoil will be used for direct placement. The other 2/3s will be stored in reclamation material sites (RMS), where the seeds, propagules and mycorrhizae are not likely to survive in sufficient quantities to enhance site revegetation.

**→ Request - September 2008**

*Please estimate the area that will have topsoil placed directly on it, not stored in the RMS.*

Vol 1, Section 20.20, Table 20.5: Upland Surface Soil and Subsoil Reclamation Material Balance: The Stockpile Balance is the existing Stockpile Balance plus the Annual Salvage for each year. The Stockpile Balance is 8513,120 in 2019. The addition of 28,389,494 of Annual Salvage in 2049, minus 27,416,900 Annual Placement should equal 9,485,714 for the Stockpile Balance not 1,091,340 as shown in the table.

**→ Request - October 2009**

*Please explain the discrepancy.*

**→ Request - September 2008**

*Explain what you will do to enhance biodiversity in the areas where direct placement is not possible.*

**SIR Response:**

ERCB SIR 397, Pierre River Mine Supplemental Information Volume 1: “The proposed Pierre River Mine plan does not include areas planned for reclamation

(including direct placement) for the first 10 years of operation. However, if such areas become available, direct placement will be applied, where possible.”

PRM 2009 - ERCB SIR 397, Pierre River Mine Supplemental Information Volume 1: “Whenever possible, direct placement is the preferred choice for salvaging any reclamation soils....current...monitoring... indicate that in salvaged upland soil that has been in stockpile for one year, vegetation regeneration is proceeding effectively.”

PRM 2009 - ERCB SIR 400: “The potential for Labrador Tea establishment will be provided throughout the direct placement of 149 ha of muskeg soils at the Pierre River Mine”.

JME 2009 - AENV 384a: “The potential for Labrador Tea establishment will be provided through the direct placement of approximately 5,045 ha of muskeg soils at the Jackpine Mine Expansion.”

PRM 2009 - AENV SIR 403a: “About 35% of the soil salvage materials will be directly placed for reclamation. The remainder will be stored in reclamation material stockpiles”.

PRM 2009 - ERCB SIR 410 and AENV SIR 410: “Ecosite planning does not differentiate between directly placed soils and those coming from stockpiled areas, as care has been taken to minimize the stockpiled time of reclamation salvage materials.”

EIA Update: Section 3.4, Table 29. The Target Ecosite Phase Planting Prescription specifies native trees and shrubs. Forbs and shrubs will be used in two shrublands (Table 29).

The success of reclamation is based on several factors: the site conditions, the weather conditions during the establishment years, and the seed source available in the establishment years. Reclamation sites that are relatively small, and that are surrounded by vegetation communities with high species richness (a high number of native species) are likely to reclaim to rich/diverse communities. Reclamation sites that are large, such as mines, have large areas that are distant from seed sources. The centres of the reclamation areas, therefore, tend to have low species richness unless forbs (flowers, grasses and sedges) are seeded.

**→ Request - October 2009**

*If, as you explain, reclamation soils are valuable, and direct placement is preferred, where else can this reclamation soil be used (i.e. other projects in the RSA). Please explain how Shell is working with other mine operators to maximize the direct placement of reclamation soils.*

**→ Request - October 2009**

*Research shows that “stockpiles of LFH materials lose much of their viability after only three to six months” (New Trail, Autumn 2009 “Anne Naeth, Professor of Ecology and Land Reclamation). Please estimate the amount of reclamation soils that will be ‘directly’ placed within one year of salvage.*

**→ Request - September 2008**

*Please explain how you intend to enhance the species richness if you are directly placing only 1/3 of the topsoil and you are not seeding forbs (other than in two shrublands).*

**→ Combined Request #55**

*Estimate the area that will have topsoil placed directly upon it, rather than stored in the reclamation material sites. Explain how biodiversity will be enhanced in the areas where direct placement is not possible. Explain how species richness will be enhanced with the direct placement of one third of the topsoil and lack of seeding forbs (other than in two shrublands).*

**Response to ACFN #55**

The Reclamation Goals and Principles stated in Section 1.2 of the Closure, Conservation and Reclamation (CC&R) plans for both the JPME EIA Update (May 2008) and PRM (Appendix 5-2) clarify the revegetation strategy. For information on enhancing biodiversity, see Volume 5, Section 7.1.

**→ Request #55**

*Shell did not answer the question. The cited sections are overviews stating direct placement will be done where practicable, native species will be used where practicable, and biodiversity will be enhanced. Please answer the question.*

**→ Request #59**

*Provide evidence of the assertion that rare plants will re-colonize in reclaimed landscapes.*

**Response to ACFN #59**

The reclaimed landscape is predicted to provide the potential for the natural re-colonization of rare plants. Direct placement of reclamation materials will be undertaken whenever practical to maximize potential viability of native seed banks and propagules, which has the potential to include rare plants. Direct placement will account for approximately 2,500 ha of the reclaimed area for JPME and approximately 1,100 h for PRM. Natural invasion of native vegetation (including rare plants) will be encouraged in ecologically-receptive areas. The successful restoration of a river valley in Denmark provides one example of the natural invasion of two rare aquatic plant species in a reclaimed riverine landscape (Pedersen et al. 2007).

**Concern #59**

The likelihood of rare propagules surviving direct placement of reclamation materials is small. In some cases, rare plants are adapted for specific ecological conditions which will not be re-created immediately (if at all). The time lag will diminish the probability of the few surviving propagules germinating and establishing.

Shell cites (incompletely) a single scientific article about a very different ecosystem as evidence that all rare plants will re-colonize these projects. This

single article does not inspire confidence that rare plants can be successfully re-colonized in reclaimed landscapes. (As a side note, the research cited describe the restoration of 19 km of the Skjern River and 22 km<sup>2</sup> of the cultivated river valley in Denmark, and included a comprehensive monitoring program including hydrology, nutrients, fish, meadow vegetation, amphibians as well as rivermorphology, in-stream habitats, macrophytes and macroinvertebrates). This is an inadequate response.

**→ Request - April 2010 #59**

*Please provide scientific evidence, using multiple species with different habitat requirements and reasons for rarity, that rare plants will indeed move into reclaimed habitats.*

## **4.5 Weeds and Non-Native Invasive Species**

The EIA assumes (by omitting any discussion) that weeds and non-native species will not hinder successful restoration (or reclamation). This unspoken assumption leads the reader to picture the final landscape to be vegetated with native species. In fact, non-native species are common throughout the RSA, along roads and pipelines, in borrow pits and wellpads. Although not documented in this EIA (Section 3.5.1.7, Table 3.5-11), non-native invasive grasses such as smooth brome (*Bromus inermis*) and timothy (*Phleum pratense*) occur throughout the boreal forest, and can cause problems for reclamation, along with Kentucky bluegrass (*Poa pratensis*) and curled dock (*Rumex crispus*). Non-native invasive species and listed weeds can be introduced by construction and reclamation equipment and in reclamation seed mixes.

**→ Request - September 2007 #56**

*Please explain how you intend to control the introduction and spread of invasive non-native species during construction and reclamation. Support your contention that your control programme will indeed be successful. and what the environmental consequences will be if you are not completely successful.*

**Response to ACFN #56**

Please refer to PRM SIR #350, 381 and 511.

**→ Request #56**

*Shell did not answer the question:*

*# 381 refers to weed seed management plan, and does not describe how contractors are to clean their vehicles.*

*#350 refer to vegetation reclamation and to the monitoring program (Vol 5 Sect. 7.1)*

*#511 simply says that Shell will survey, treat and control weeds, and educate it's personnel about weed issues.*

*Please answer the question.*

**SIR Response PRM May 2009 and JME December 2009**

AENV SIR 381 and AENV SIR 365: *Will the vehicle wash facility also serve as the steam cleaning location used to remove potential weed seeds for new vehicles entering the site?*

Response: "...only clean equipment is allowed access for delivery and use on the sites. Contractors or personnel with vehicles new to the site must ensure that the vehicles are clean before entry."

**Concern**

Shell deferred the question by referring to the weed seed management plan for Muskeg River Mine and Jackpine Mine, but did not answer the question. The road from Fort McMurray north is gravel and is often extremely muddy. In addition, the roadsides have been revegetated with smooth brome, other agronomic grasses, and weeds. Contractors and personnel driving along these roads will arrive carrying mud and grass seeds on their vehicles.

**→ Request**

*Please clarify if the vehicle wash facility will serve as the steam cleaning location, or if not, how contractors will ensure that their vehicles are clean upon entering the site.*

## **5.0 Vegetation – General Questions**

### **5.1 Traditional Plant Potential**

ESR report: Section 3.3.2.6, referring to Table 3.3-1 Traditional Resource Uses: "Some of the information presented in the above studies was consolidated to create Table 3.3-1 which summarizes the plant and animal species used as part of a traditional lifestyle of the region, as identified by the community of Fort McKay. Rankings (high, medium and low) were given to the individual species based on the number of times that species were referred to and the number of times it was shown on the traditional land use maps or in tables that accompany the studies. *These rankings are not meant as a reflection of the importance of specific resources, nor to imply that certain species are important....*" [my italics].

EIA Section 7.5.2.2: These plants were then assigned to vegetation type and scored according to presence and cover, and the Traditional Plant Potential was assessed (Table 7.5-31). This method assumes that all of the plants are equally important to all the Aboriginal communities, which is clearly not correct. Most communities collect large quantities of blueberries, bog cranberries (locally known as low-bush cranberries or lingon berries), rat root, and mint (Bush and Dersch 2008; Garibaldi pers. comm. 2007). Some communities also highly value

balsam fir, valerian, pitcher plant, sweetgrass, and diamond willow fungus, and most of the tastier berries. Although kinnikinnick, dogwood, juniper, plantain, jackpine etc. were historically collected, few Aboriginal communities collect these in large or even moderate quantities. Including these species obscures the data by assuming that a community with red current is as valuable as one with bog cranberry. For example, ecosite phase e2 has 39 species and is scored high, containing balsam fir and low-bush cranberry (locally known as mooseberry) which are commonly collected, and buffalo berry which is occasionally collected, and numerous other species that are rarely collected. However, ecosite phase a1 which has high numbers of blueberry and bog cranberry and is considered valuable a collecting site, only has 19 and therefore scores low. In addition, rat-root, which is one of the most important species, has not been assigned a vegetation type at all.

Ann Garibaldi, Ethnobotanist. CE Jones and Associates, Sidney, British Columbia V8L 5X4. Tel 250.655.5373

Dersch, Ave, and C. Dana Bush. 2008. *Identifying Traditionally Used Plants in the Regional Municipality of Wood Buffalo*. Prepared for the Cumulative Environmental Management Association, Sustainable Ecosystems Working Group, Traditional Use Plants Task Group, Fort McMurray, AB.

**→ Request - September 2007, #57**

*Please re-analyze the impacts on the species considered most valuable to the Aboriginal communities.*

**Response to ACFN, #57**

This request appears to be a statement of disagreement with Shell's methodology and conclusions, as opposed to a request for clarification that would allow ACFN to complete its Technical Review of the EIA. As such, this may be more appropriately discussed following completion of ACFN's technical review of the EIA.

Shell funded ACFN to complete a TEK study for the EIA of the Projects.

**→ Request, #57**

*Recommend Shell describe which species are considered important by the Aboriginal communities, and then assess the impacts on those species.*

*A TEK study does not assess potential impacts. What threshold/criteria did Shell use for assessing potential impacts on traditional uses / Section 35?*

### 5.1.1 Rare Plant Potential

Impacts to high rare plant potential evaluates the areas that *might* have rare plants. Rare plants are...rare and it is difficult to predict their occurrences accurately (AXYS 2004; Gould 2007; Robson 1997). Rare plants may be rare for a number of different reasons; they may be associated with rare habitats, their populations may be controlled by insects or disease, and/or they may be remnant or peripheral populations. Pollination and seed movement of rare plants is limited

by the distance between populations, by insect pollinators, and by carriers for the seeds or roots, making migration and re-colonization difficult (Primack and Miao 1992).

Simply adding the number of species that could occur in an ecosite phase will overestimate the area in which rare plants are actually found. This method has very little science to support it. There is no evaluation of how many documented occurrences have actually been removed by approved projects, which would be more accurate. For example: northern slender ladies'-tresses (*Spiranthes lacera*) is ranked S1 in Alberta, indicating that there are five or fewer occurrences in Alberta. The EIA documented 3 occurrences in the LSA and 3 in the RSA (Table 7.5-26) (ANHIC may consider these to be fewer than 6 occurrences if they are within 1 km of each other). Two of the three occurrences in the LSA will be lost due to the project and an unknown number may have been removed by other projects. Because small infrequent populations are often susceptible to chance events (fire, flooding etc.) and inbreeding depression (the loss of genetic variability because of inbreeding), the removal of two populations might affect the genetics of the provincial population resulting in a larger than regional impact, with the potential for a high environmental consequence for the species.

AXYS Environmental Consulting Ltd. (Bush, C. Dana, J. Doubt, N. DeCarlo), 2004. *Rare Plant and Special Plant Communities: Mapping and Literature Review*. Presented to the Cumulative Environmental Management Association, Fort McMurray. Accessed May 29, 2008. Available at: [http://www.cemaonline.ca/component/option,com\\_frontpage/Itemid,1/](http://www.cemaonline.ca/component/option,com_frontpage/Itemid,1/).

Gould, Alice Joyce. 2007. *A habitat-based approach to rare vascular plant conservation in the northern Rocky Mountains of Alberta*. A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Conservation Biology. University of Alberta, Edmonton, AB.

Robson, Diana Bizecki. 1997. *Ecology Of Rare Vascular Plants In Southwestern Saskatchewan*. Thesis, Department of Crop Science and Plant Ecology, University of Saskatchewan, Saskatoon, SK.

Primack, R. B. and S.L. Miao. 1992. Dispersal can limit local plant distribution. *Conservation Biology* Vol. 6(4):513-519.

**➔ Request - September 2007, #60**

*Provide support for your assertion that rare plant potential accurately predicts rare plant occurrences.*

*Using the ANHIC records evaluate the impacts on actual rare plant occurrences.*

**Response to ACFN #60**

Rare plant potential (RPP) does not predict rare plant occurrences, but identifies those ecosite phases and wetlands types that have been identified as more likely to contain rare plants based on extensive field work in the Oil Sands Region. RPP is derived from an assessment of over 3,000 vegetation plots collected by Golder in the Oil Sands Region. This includes Project-specific vegetation plots accounting for 145 detailed and rare plant vegetation plots, 81 aerial survey plots

and 18 rare plant plots in the JPME LSA and 214 detailed and rare plant vegetation plots, 169 aerial survey plots and 13 rare plant plots in the PRM LSA. Rare plant frequency of occurrences was calculated for each ecosite phase or wetlands type, resulting in a rare plant potential ranking calculated for each (refer to Terrestrial Vegetation, Wetlands and Forestry Resources ESR, Volume 3, Section 3.3.6.2, Page 3-45 for Method Summary).

Information on existing rare plant occurrences and rare plant habitat was acquired from ANHIC for the JPME and PRM LSAs and the Project RSA. Rare plant occurrences and habitat data from ANHIC and rare plant occurrences documented during Project field work within the LSA is presented in the ESR (Volume 3, Section 3.3.6.2, Page 3-45 for methods and Section 3.5.1.4, Page 3-86 and Section 3.6.1.4, Page 3-138 for occurrence data). Tables 7.5-26, 7.5-27 and 7.5-28 in the EIA (Volume 5, Section 7, Pages 7-82, 7-83 and 7-84) provide specific information on the vascular, bryophyte and lichen species to be affected by the Project.

Rare plant data collected in the LSAs and acquired from ANHIC are integrated in to the rare plant assessment and subsequently used in the EIA (Volume 5, Section 7, Table 7.5-34, Page 7-94) to evaluate residual impacts in the LSA.

#### **Concern #60**

It is agreed that Rare Plant Potential does not predict rare plant occurrences. However, the method for evaluating rare plant potential is still based on weak science. Having some data does not assume biologically relevant methods or conclusions.

The evaluation of rare plant potential has four problems:

- 1) Overestimation of areas of rare plant habitat. Mapping rare plant frequency by ecosite phase assumes that any particular spot within the ecosite phase will have the same chance of having a rare plant. Because the factors governing the rarity of most species are unknown, assumptions cannot be made. For example, knowing that rare plant A occurs in BM-d1 is almost meaningless, given how much d1 occurs in the boreal forest.
- 2) Inability to distinguish between very rare species with only one or two occurrences and somewhat rare species with 20 occurrences.
- 3) Actual impacts to existing rare plant populations are not assessed.
- 4) Difficulties in predicting impacts when considering common/large ecosites versus uncommon/small ecosites. Common/large ecosite phases with several rare species are considered to be of greater importance than uncommon ecosite phases with fewer rare species, but the impact may be very different.

Scenario 1 - an uncommon ecosite with 3 rare species/occurrences: 50 ha/50 ha = 100% loss and the loss of 3 rare species/occurrences.

Scenario 2 - a common ecosite (i.e. BM-d1) with 5 rare species/occurrences: 50 ha /1,000 ha = 5% loss. The loss of rare species is unknown, but probably low given the large area in which they may occur.

The response is inadequate.

## 5.2 Rare Plant Occurrences

### **SIR Response - PRM May 2009:**

Vol. 2 SIR 438 (re. small butterwort and hairy-fruited sedge)

#### **Response**

Small butterwort is ranked S1 (less than five occurrences in Alberta *or especially vulnerable to extirpation because of other factors*) (Kemper 2009), with 12 occurrences (sub-populations?) noted in ANHIC.

An Element Occurrence (EO) is described and tracked by ANHIC and may include several sub-populations. Sub-populations are considered to be within the same EO if they are within 1 km of each other, or within 2 km if there is appropriate habitat between the sites (NatureServe website 2007).

#### **→ Request**

*Clarify if the 12 butterwort occurrences in ANHIC database are separate element occurrences as defined by ANHIC or are sub-populations. Assess the impact of the loss of one occurrence out of ?? occurrences on the provincial population.*

### **SIR Response - JME December 2009**

JME December 2009 AENV SIR 453 - "There are a number of species presented in the rare vascular plant, bryophyte, and lichens table that are not reported elsewhere in the RSA. Provide the results of additional directed surveys...."

Shell responded by acquiring more data from ANHIC and other oil sands operators and reporting it in Table 453-1.

### **Concern April 2010**

An Element Occurrence (EO) is described and tracked by ANHIC and may include several sub-populations. Sub-populations are considered to be within the same EO if they are within 1 km of each other, or within 2 km if there is appropriate habitat between the sites (NatureServe website 2007).

#### **→ Request - April 2010**

*Explain how 'occurrence' is defined and used in Table 453-1. Is 'occurrence' used in the sense of NatureServe, or as synonym for 'rare plant observation'? If it means observation then explain how this might change the assessment.*

#### **→ Request - April 2010**

*Table 453-2 in the JME Supplemental Information (December 2009) shows updated information for rare plant. Please explain the second to last column*

*(Total Number of Occurrences Outside of the Jackpine Mine and Pierre River Mine LSAs). Logically this would be a sum of the ANHIC Occurrences and Other Recent Occurrences in the Oil Sands Region, but that is obviously incorrect. Please explain the additional occurrences.*

### 5.3 Rare Plant Surveys

The ANPC Rare Plant Survey Guidelines recommend that surveyors for rare plants should have:

- Experience as a botanical field investigator
- The taxonomic experience to identify, in the field, most plant species they come across in the survey area, and the remainder later through taxonomic determination.
- A knowledge of plant ecology
- A knowledge of the local flora and of potential rare species in the habitats surveyed.

In addition, the guidelines recommend that the botanists should be identified in the reports.

- **→ Request:**
- *Please identify the botanists and their qualifications.*
- *Explain if these botanists were on all the detailed inventory surveys as well as the rare plant surveys.*

*Table 3.6-1: explain what the brackets indicate.*

### 5.4 Estimating Area of Old Growth

ESR, Section 3.3.6.1: The area of old growth forest is assumed to be between 20% and 28% of the forested land base, resulting in an estimate of 16% of the regional study area. This number is based on a modelling study by Andison (2003), using an 80 year fire cycle, and a study by Schneider (2001) who based his analysis on Phase 3 inventory and the current rate of burning of 0.4% per year. However, the AVI mapping in JEMA shows that only 5% of the JEMA LSA is old growth (ESR Table 3.5-19), and the total old growth forest in the LSAs (Table 7.5-18) is 6% of the LSA.

Research in Wood Buffalo National Park (based on pollen records) shows that the mean fire interval may be 34 years (Larson and MacDonald 1998); or 25-49 years prior to 1959, and 59-89 years between 1860 and 1989 (Larson 1997). Research in Prince Albert Saskatchewan (based on time since fire maps developed from basal tree cores) show that less than 5% of the area has gone

more than 125 years without a fire (Weir, Johnson and Miyanishi 2000). The more frequent the fires, the smaller the area of old growth remains, therefore using 80 years versus 34 years may overestimate the amount of old growth in the RSA.

Andison, D.W. Bandaloop Landscape-Ecosystem Services. 2005. *Natural Levels of Forest Ageclass Variability on the RSDS Landscape of Alberta*. Prepared for Cumulative Environmental Management Association (CEMA), Fort McMurray, AB.

Larsen, C.P.S. & G.M. MacDonald, 1998. Fire and vegetation dynamics in a jack and black spruce forest reconstructed using fossil pollen and charcoal. *Journal of Ecology* 86(5): 815-828.

Larsen, C.P.S. 1997. Spatial and Temporal Variations in Boreal Forest Fire Frequency in Northern Alberta. *Journal of Biogeography*, Vol. 24, No. 5: 663-673).

Schneider, R. 2001. *Old-Growth Forests in Alberta: Ecology and Management*. Alberta Centre for Boreal Studies. Available from <http://www.borealcentre.ca/reports>. Accessed February 19, 2002.

Weir, J.M.H., E.A. Johnson, and K. Miyanishi. 2000. Fire frequency and the spatial age mosaic of the Mixed-Wood Boreal Forest in Western Canada. *Ecological Applications*, Vol. 10, No. 4: 1162-1177.

Using a 6% estimate in the RSA in Table 7.5-19 gives and Estimated Base Case Old Growth in the RSA of 96,604 ha rather than 374,433 ha, resulting in a 1.3% loss of the resource. This is still a low magnitude, so the Environmental Consequence in the RSA will not change.

ESR, page 7-74, and Table 7.5-18 Old Growth Forests in the Local Study Area: “The project will result in the removal of 1,223 ha of the old growth forest, representing a loss of 2% of the LSA.” However, the table indicates that 40% of the old growth forest in the LSAs will be removed. This is a more meaningful measure.

### ➔ Request

*Support your use of Andison and Schneider’s work over other researchers in the field, and support your estimate that 16% of the regional study area is old growth forest. Explain why there is only 5 or 6% old growth in the LSAs and 16% in the RSA, or re-write the background section using the 6 (or 5%) estimate, and recalculate the impact table using a lower estimated occurrence of old growth in the RSA.*

## 5.5 Calculating Species Richness

Table. 7.2-3, p 7-23: Total species richness includes native and non-native vascular plant species, bryophytes, and lichens: Including non-native species in total species richness undermines the point of the indicator. Species richness is used to identify natural areas that have a high diversity. By including non-native

species, disturbed areas with a high diversity of weeds may be identified as worthy of protecting.

**→ Request - September 2007, #58**

*Please recalculate species richness excluding non-native species.*

**Response to ACFN #58**

As stated in Biodiversity Environmental Setting Report (Section 6.4.3, Page 6-25), Shell recognizes that non-native species can be detrimental to the natural balance of ecosystems. Relative to the total number of plant species, few non-native or exotic species occur in the Oil Sands Region and they tend to be associated with disturbed areas. Golder's vegetation database for the Oil Sands Region contains information on twenty-eight plant species that are provincially classified as exotic (ANHIC 2006). Excluding these species from the 'total species richness' calculation does not affect the overall biodiversity ranking of vegetation types because most non-native plant species were recorded in disturbed areas, which are automatically ranked low for biodiversity potential. Furthermore, this biodiversity indicator is based on relative plant species richness rather than absolute richness values and no natural vegetation type had a disproportionate number of non-native plant species. In reviewing the rankings, excluding non-native plant species from the species richness calculation did not change the ranking score. The overall assessment of biodiversity for the Project is not affected by the exclusion of non-native plant species from the species richness index for biodiversity potential.

**→ Request #58**

*Response to the questions was adequate; however, we recommend that in future, calculations of species richness not include non-native species.*

## 5.6 Forest Succession

ESR, Section 3.6.1.3., page 3-145. "Forest succession relationships are illustrated with the mean ages of 'b' ecosite phases of both Natural Subregions. Among these vegetation types, stand age increases as forest succession progresses from an aspen state (both "b2" ecosite phases, 74 and 78 years) to a mixedwood state (both "b3" ecosite phases, 85 and 91 years) and finally towards a pure coniferous state (both "b4" ecosites phases, 115 and 129 years)."

There are problems with the assumption that aspen stands are early seral stands of white spruce (Johnson and Miyanishi 2008). Aspen may be self generating (Cummings, Schmiegelow and Burton 2000), and white spruce is limited by seed source (Albani, Andison and Kimmins 2005), terrain, and proximity to water bodies. In addition, tree cores taken at breast height (DBH) are not effective methods for correctly aging trees, as aspen cores are very difficult to count, and white spruce trees need to be cored at the base to capture the early years growth

(Gutsell and Johnson 2002). DBH cores may, therefore, underestimate the ages in either species.

Gutsell, S.L. and E.A. Johnson. 2002. Accurately ageing trees and examining their height-growth rates: implications for interpreting forest dynamics. *Ecology* 90:153-166.

Albani, M. D.W. Andison and J.P. (Hamish) Kimmins. 2005. Boreal mixedwood species composition in relationship to topography and white spruce seed dispersal constraint. Vol. 209(3): 167-180.

Johnson, E.A., K. Miyanishi. 2008. Testing the assumptions of chronosequences in succession. *Ecology Letters* 11(5):419-431.

**→ Request**

*Please support your statement that b ecosites are successional states.*

## 5.7 Accuracy of Map Products

ESR Section 3.3.1, page 3-16 describes the methods used to map the LSA and the RSA. There is no discussion of the accuracy of the maps, therefore no way to evaluate the accuracy of the assessment.

**→ Request #62**

*Please describe the accuracy of the AVI data used, the LSA map and the RSA map.*

**Response to ACFN #62**

The most recent AVI data was purchased from Alberta Pacific Forest Industries Inc. (AIPac) and reviewed/approved by Alberta Sustainable Resource Development (ASRD). This data reflects the most up-to-date conditions on the ground and is further refined during the Local Study Area Mapping process. Although accuracy validation has not been conducted on this data set, accuracy is greater than that of the original AVI.

For additional information on vegetation mapping in the LSA, refer to Volume 3, Section 3.3.2.2.

For the RSA, an overall accuracy assessment of 80% was determined for the Landsat imagery classification.

**→ Request #62**

*Two uncertainties remain: the accuracy of the original AVI, and the accuracy of the model used to convert the AVI to Ecosite Phase. Apparently we do not know how accurate the LSA maps are, nor the resultant analysis.*

**Request #62 - April 2010**

*Was the accuracy of the RSA determined by ground data or from air photo interpretation?*

## 5.8 Effects of Air Emissions on Vegetation (Volume 3, Section 5.5.4.3)

### **Acidification - Potential Acid Input (PAI)**

“Nitrogen absorbed in terrestrial ecosystems does not contribute to the acidification of soils or surface waters. This assessment uses a more refined approach the estimate of potential acid input for both aquatic and terrestrial resources, by incorporating the retention of N by terrestrial ecosystems.”

This author does not have the background to critique the methods used by the air emission specialist, however the above statement makes biological sense and should represent the impacts more fairly than previous assessments.

EIA Figure 5.5-4: The figure shows that baseline PAI is already high enough to potentially affect sensitive vegetation in both the Pierre River Mine and the Jackpine Expansion Mine LSAs, and is high around the Syncrude/Suncor leases south of Fort McKay, and the leases north of Fort McKay. 1,836 ha are estimated to be above the critical load, primarily in townships 95-6 (16% of the township) and 96-11 (8% of the township). The total is less than 1% of the Terrestrial Resources Air Emissions Effects Study Area (TASA).

Table 5.5-10 shows that 304 ha of vegetation communities that are sensitive to PAI (aspen-balsam poplar, aspen-white spruce, jack pine – aspen, and jack pine) may be affected by acid deposition, and 660 ha of moderately sensitive communities (white spruce, jack pine-black spruce and treed bog/poor fen).

“Of the 1,780 ha potentially affected, 806 ha is considered woodland caribou habitat with high lichen food value.” This area remains unchanged with the addition of the project, and the total area potentially affected declines somewhat because the mine fleet was relocated.

### **Sulphur Dioxide (SO<sub>2</sub>)**

Both the base case SO<sub>2</sub> concentrations and the project concentrations exceed the WHO (World Health Organization) recommended guidelines for SO<sub>2</sub>. There is the potential for direct, chronic impacts from SO<sub>2</sub> on sensitive lichen species, and also forest trees, shrubs, herbs and mosses. The areas with high base case SO<sub>2</sub> levels occur appear to occur around Suncor, and north of Fort McKay near the Albian Sands, Horizon, Fort Hills, and Aurora mines (EIA, Figure 5.5-5, and Project Description, Figure 1.4-1) Table 5.5-7 predicts that 327 ha of vegetation communities with high lichen cover may be affected by SO<sub>2</sub>. These communities (jack pine, jack pine-black spruce and treed bog/poor fens) are considered to be caribou habitat.

Application Case: The project will not increase the maximum values, but will increase the area affected by 7 ha. The EIA suggests “that there is a possibility of chronic effects on vegetation from SO<sub>2</sub> emissions”.

### **Nitrogen Dioxide**

Annual and 24-hour base case already exceeds provincial criteria.

### **Eutrophication**

The European research on nitrogen deposition (Bobbink, et al. 2002) uses kg/ha/a to establish recommended critical loads for nitrogen deposition, rather than keq N/ha/yr as is used in the EAI, therefore I am unable to compare it to their recommended loads.

Bobbink, R., M. Ashmore, S. Braun, W. Flückiger and I.J.J. Van den Wyngaert. 2002  
Empirical nitrogen critical loads for natural and semi-natural ecosystems: 2002  
update. Accessible at: [www.iap.ch/german/pages/nworkshop-background.pdf](http://www.iap.ch/german/pages/nworkshop-background.pdf)  
Accessed January 14, 2005

At baseline, 35,270 ha of treed bog/poor fen may respond to 0.25 keq N/ha/yr, and 117 ha of treed bog/poor fen may potentially be negatively affected by 2.0 keq N/ha/yr.

The application shows a decline in the area affected by the lower N levels because the Jackpine mine fleet was relocated. There will be a marginal increase in the treed bog/poor fen areas exceeding the 2.0 keq N/ha/yr level by 2 ha, although the maximum deposition rate will double from 3 keq N/ha/yr to 6 keq N/ha/yr (Table 5.5-20).

The increase in nitrogen causing eutrophication is a concern, as nitrogen accumulates in the environment causing long-term to permanent changes. Nitrogen is a naturally occurring nutrient, however many northern vegetation communities are adapted to low nitrogen levels. The addition of nitrogen to treed bogs and poor fens may result in a shift in species; potentially an increase in sedges and shrubs and a decrease in mosses and lichens (depending on the species). Plant species particularly adapted to low nutrient conditions, such as pitcher plant, which is both rare and collected by aboriginal users, may be out-competed in a more nutrient rich environment. Although the area potentially affected is small, the long term impacts may be noticeable to aboriginal users and wildlife.

The combined effects of acid deposition, sulphur dioxide, nitrogen dioxide and eutrophication on treed/poor bogs may cause more permanent changes than anticipated. The interrelationships between these elements and northern Canadian ecosystems are not well understood, therefore the confidence level is reasonable but not high.

### **→ Request # 63**

*Please interpret the impacts of combined air emissions on the vegetation KIRs.*

### **Response to ACFN #63**

There is no accepted model to assess the effects of combined air emissions on Canadian boreal ecosystems. The models used to assess the potential effects of air emissions on vegetation are based on comparing reviewed vegetation sensitivities to applicable critical loads, objectives and guidelines. These standards have been adapted from recommendations by leading authorities (CASA, WHO and the provincial and federal governments). The scientific basis

behind these standards results in a reasonable level of confidence to the assessment.

For a review of the available knowledge of the effects of air emissions, see Appendix 3-13, Sections 2 and 3.

**→ Request # 63**

*Please write a qualitative description of how air emissions (PAI, SO<sub>2</sub>, NO<sub>2</sub> and eutrophication) might affect reclaimed landscapes.*

## 5.9 Burn Areas

Table 3.5-1 classifies 6 % of the JME area LSA as burned upland and 10% as burned wetland.

**Concern - April 2010**

Given that tree, shrub and forb regeneration begins shortly after a fire, it is feasible to classify the burn areas to ecosite phase. By classifying these as burn, the assessments underestimates the area of ecosite phases.

**→Request - April 2010**

*Please classify the burn areas to ecosite phase or justify why they should not be classified.*

*Table 3.4-15 and the text on page 3-113 analyzes the landscape heterogeneity of disturbed areas and includes burned areas as a disturbance.*

**→Request - April 2010**

*Please explain why burns are considered a disturbance in Table 3.5-15 but not in table 3.5-1.*

## 5.10 Monitoring

EIA Section 7.1.3: Shell will monitor the Project by expanding its existing, Alberta Environment (AENV) approved, Jackpine Mine - Phase 1 monitoring programs (Volume 5, Appendix 5-6). Shell will also design a wetlands monitoring program for areas adjacent to the Project to determine the effects of surficial aquifer drawdown. The lenticular patterned fen southeast of McClelland Lake is proposed to be included in the wetlands monitoring program.

Shell will continue to actively participate in CEMA Working Groups and be involved in research programs such as the Canadian Oils Sands Network for Research and Development (CONRAD).

**Concern - April 2010**

The proposed monitoring programme is too vague to comment on. More details are required to assess the efficacy.

**→Request - April 2010**

*Please provide details on the vegetation reclamation, biodiversity, and wetland monitoring programmes.*

## **6.0 Pierre River Mine**

### **6.1 Overview**

**Resources**

The Pierre River Mine (PRM) LSA is in both the Central Mixedwood Natural Subregion and the Athabasca Plain Natural Subregion. The PRM LSA is on the west side of the Athabasca River, and covers 21,136 ha. The Athabasca Plain Natural Subregion is warmer and has sandier soils than the Central Mixedwood Natural Subregion, and therefore has more upland forest than is typical in the Boreal Forest. It includes a higher proportion of merchantable timber, and the Calamut Old Growth Forest, and the Eymundson Sinkhole Environmentally Significant Areas. Two thirds (66%) of the PRMA LSA is upland.

## **7.0 Jackpine Mine Expansion**

### **7.1 Overview**

**Resources**

The Jackpine Mine Expansion (JME) LSA is in the Central Mixedwood Natural Subregion. The LSA covers is along the Muskeg River and covers 18,348 ha, based on the project development area plus a 500 m buffer zone. The JMEA “is primarily composed of a large, intricate wetlands complex that follows the Muskeg River, which is bound by the Fort Hills to the north and uplands near Kearl Lake to the south. The wetlands complex is primarily fens, but also includes bogs and non-peatland wetlands”, including a patterned fen in the NE. Only 13% of the LSA is upland, with 59% of the area wetlands (mostly peatlands), 17% burn, and 11% disturbances such as cutblocks, borrow pits, well sites, borehole pads, clearings, roads, rights-of-ways, trails and seismic lines.

EIA, Section xx, page 7-86: “The lenticular patterned fen special plant community) was found in the northeast corner of the JEMA, about 4 km southeast of McLelland Lake....The Project development area overlaps 37 ha (6%) of the southern edge of this lenticular patterned fen.” Clearing, pit construction, and

drawdown are “predicted to be high, affecting 124 ha (21%) Of the lenticular patterned fen”...”There is limited regional information on these special plant communities and their distribution within the RSA”.

The impact to this special plant community is considered local, although the lack of data indicates that it may be uncommon or rare in the boreal forest. It will have a high Environmental Consequence in the LSA, but negligible in the RSA. Losses or alterations to regionally rare plants or communities may have a regional impact, not just local.

**➔ Request - September 2008**

*Please explain why impacts to a special plant community that may be provincially rare, is considered negligible.*

**SIR Response - JME December 2009**

AENV SIR 454a - Shell notes the presence of a large lenticular patterned fen special plant community in the northeast corner of JME...Confirm the presence of other, similar lenticular patterned fend communities within the RSA that are not currently slated for development.”

Shell responded with “Shell is not aware of any other similar lenticular patterned fen communities within the regional study area.”

**➔Request April 2010**

*Please explain why impacts to a special plant community that is regionally rare is considered negligible.*

## 7.2 Peatlands

**SIR Response - JME December 2009**

SIR 373a Given that 80% of the peatlands (13,819 ha) will be lost, and since successful creation of peatland after mining has not been demonstrated, on what basis will environmental consequences be negligible or low.

Shell responded that “The project will have a high environmental consequence for wetlands (including peatlands and patterned fens) at the local level, but negligible at the regional level.

**Concern - April 2010**

Several wetland classes appear to be uncommon in the RSA (covering less than 3 percent of the LSA in 10 recent EIAs): BFNN, BONN, BONR, BTNI, BTNR, BTXC, FOPN, FTNI, FTNR, FTPN, MONG, and SFNN.

**➔Request - April 2010**

*Please present data showing the number and area of peatlands in the RSA and assess the loss of peatlands due to the JME relative to this number. Assess the cumulative loss in the RSA due to other projects in the RSA, as well as the anticipated drawdown, and the levee at Kearl Lake.*

**SIR JME AENV SIR 378a**

Under reclamation Shell states that it will be monitoring surficial aquifer drawdown effect....

Shell responded that “Since EIA submission, Shell has updated drawdown information for the Jackpine Mine Expansion showing that the drawdown due to the project goes farther into the lenticular patterned fen than originally predicted. Based on the updated drawdown information, Shell no longer proposes to include the lenticular patterned fen in the wetlands monitoring program.

**➔Request - April 2010**

*Is this a typo? It appears that because the impact is greater, Shell will no longer monitor the effect. Please explain.*

**SIR response - JME December 2009**

AENV SIR 455b - “If all the wetland losses in the Muskeg River watershed as a consequence of currently approved and disclosed mines are added together, what percentage of the RSA is affected?”

Shell responded that “48% of wetland in the Muskeg River watershed will be affected (prior to reclamation), but only 4% of wetlands in the RSA, and only 2% of the RSA.

**Concerns - April 2010**

This is clearly a scale issue. The magnitude is high in the watershed, but low in the RSA because the RSA is so much larger than the LSA.

**➔Request - April 2010**

*Explain why a 48% impact on a watershed is not biologically significant.*

**SIR response - JME December 2009**

AENV SIR 455c - “If all wetlands for all currently approved and disclosed projects within the RSA are added together, what percentage of the RSA is affected?”

Shell's response is that “In the PDC, all existing currently approved and disclosed projects are predicted to affect 200,980 ha (17%) of wetlands from the baseline conditions before oil sands developments in the RSA”... After closure, “treed bog or poor fen wetlands are predicted to decrease 107,179 ha (18% of this resource) while treed fens are predicted to decrease 44,603 ha (14% of this resource)”...

“Environmental consequence ratings are determined based on the incremental change of the project and planned developments from existing conditions, including existing oil sands developments. As the response to this question reflects baseline conditions before oil sands developments, it has no bearing on environmental consequence scoring for the project, and analysis is provided solely for this response.”

**Concern - April 2010**

Interesting response. It appears that Shell is unaware of the definition of cumulative impacts, or of their responsibility to conduct a cumulative impact

assessment. Cumulative effects should identify other past, present, and reasonably foreseeable future actions within the space and time boundaries that have been, are, or could contribute to cumulative effects (stresses) on the VECs or their indicators (Canter and Ross, IAIA). This custom of conducting cumulative impact assessments based on current baseline conditions ignores the basic premise of cumulative impacts - that they are the result of many small impacts that overlap in both time and space. Cumulative impact assessments would more effectively evaluate impacts if they were conducted first, to assess the cumulative impacts of prior developments, i.e. how has the vegetation been affected by development and is it already significant. If the impacts are already significant, then additional developments, even if less than 1 %, will contribute a small incremental increase to an already significant impact. It should be noted that other EIAs have used pre-development baselines to assess cumulative impacts.

**→ Request - April 2010**

*Explain how Shell defines cumulative impacts and why past impacts from oil sands operations and other developments are not relevant.*

### **7.3 Kearl Lake Levee and Drawdown Zone**

Shell Jackpine Mine Expansion and Pierre River Mine Project EIA Update, December 2009: The proposed integrate stream diversion system from Shell Jackpine Mine -Phase I, JME, Syncrude's Aurora South Mine, and Imperial Oil's Kearl Oil Sands Project will divert water into Kearl Lake. As a result, the inflows and consequently the water levels in Kearl Lake and the proposed Imperial Oil Kearl Compensation Lake will be increased, which will cause flooding around the lakes. Two of channels will be built to convey the lake outflows to the Muskeg River, which will then be replaced by three 1.5 m diameter pipes. (from 2032 to mine closure). The pipelines have a lower flow capacity compared to ditches and will result in the lake storing more flood waters. To prevent flooding the surrounding areas (include all three adjacent mines), Shell plans to build a levee around Kearl Lake.

Flows through the channels and then the pipelines will be managed by Shell to minimize changes to Kearl Lake and the compensation lake. "However, the JME and drainage integration will result in changes to Kearl Lake water levels compared with pre-development conditions....The predicted changes to lake levels are less than 0.30 m on average between 2032 and Closure." Shell contends that "changes in the mean annual water levels are negligible."

The effects of the impoundment on soils and vegetation are uncertain, "therefore the impoundment area was considered as permanently disturbed rather than assessing the potential for altered plant communities".

In addition, the effects on groundwater drawdown in the JME area were underestimated in the EIA and have been re-calculated in this EIA Update. The drawdown zone will affect wetlands both in and outside the LSA.

The Kearl Lake Levee and the increased water drawdown area is predicted to disturb riparian communities, old growth forest, peatlands (fens and bogs), patterned fens, economic forests, rare plants, and traditional plant potential, however the additional impacts do not change the overall ratings. Overall, the changes (loss of wetlands and increase in uplands due to the levee) “are less than 1% of the total clearing in the Project Application”.

**→ Request - April 2010**

*Please calculate the cumulative impacts of the JME, the Kearl Lake Levee, and the increased drawdown area, as well as the impacts of other developments in the RSA on the vegetation KIRs.*

**Rare Plants - Table 2.4-4**

Table 2.4-4 shows the rare plant observations in the Kearl Lake Area. Of the 12 species listed, 7 are considered rare (S1 or S2 on the ANHIC tracking list (Kemper 2009)).

**→ Request - April 2010**

*Please estimate the impacts of the loss of these rare plant locations on a provincial level, using the NatureServe definition of Occurrence. For example, what is the impact of losing a large population of an S1 species like white water-lily (*Nymphaea tetragona*)? Logically, if there are only 5 known occurrences, but 2 have been removed from previous projects, and 1 is lost for the levee, then only 2 out of 5 would remain. The cumulative impact of the loss of more than have the occurrences could justifiably be argued to be significant.*

**Traditional Land Use - Section 2.4.2.1**

Members of the Fort McKay First Nation report that rat root grows in Kearl Lake.

**→ Request - April 2010**

*What is the impact to First Nations of losing rat root, an important medicinal plant that grows in a limited number of areas.*

## 8.0 Conclusions

The field methods and the description of the baseline data appears to use standard, accepted techniques. The assessment methods and assumptions may also be currently accepted, but serve to bias the assessment in favour of the proponent by masking the environmental impacts. Impacts at the local level range from negligible to high, but all impacts at the regional level are considered negligible, based on several unsupported assumptions, and an arbitrary method for determining Environmental Consequence.

The science of environmental assessment is relatively young and the methods and details evolve as we learn what works and what doesn't. Each assessment is an opportunity to improve the methods so that they reflect the real impacts to the landscape in a biologically meaningful way.

## **Appendix D-15**

**Review of the Shell Pierre River Mine Project: Terrain, Soils, and Reclamation –  
Review for: Athabasca Chipewyan First Nation, May 2010, by Len Knapik of Pedocan  
Land Evaluation**

**REVIEW OF THE SHELL PIERRE RIVER MINE: TERRAIN, SOILS, AND RECLAMATION**

**Review for: Athabasca Chipewyan First Nation**

**By: Pedocan Land Evaluation Ltd. (Len Knapik)**

## Table of Contents

1. Pierre River Mine Application.....	1
2. Closure and Reclamation Land Use Goals and Assumptions.....	1
2.1 Comments on Land Use Goals 1 and 2 .....	2
2.1.1 Landscape Design .....	2
2.1.2 Adaptive Management .....	3
2.1.3 Use of previous EPEA Approval Conditions .....	6
2.1.4 Equivalent Capability using the LCCS .....	6
2.1.5 Reconstructed Soil Performance .....	8
2.1.6 Wetlands Reconstruction .....	9
2.1.7 End Land Use Constraints .....	9
2.2 Comments on Land Use Goals 3 and 4 .....	10
2.2.1 Visual Qualities of Terrain and Landforms .....	10
2.2.2 Traditional Land Uses and Values .....	11
3. Closure Landforms.....	12
3.1 Capped Tailings Closure Landforms .....	12
3.2 Tailings Sand Dikes and Beaches Closure Landforms.....	14
4. Eymundson Sinkholes .....	15
References and Background Publications .....	17

## **1. Pierre River Mine Application**

Shell has submitted an application and supplemental information to the Alberta Energy and Utilities Board and Alberta Environment for an approval to develop a new oil sands mine, the Pierre River Mine (PRM). This new development will produce up to 200,000 bbl of bitumen per day and will include a new mining area and processing facilities, utilities and infrastructure.

The planned size of the soil and vegetation disturbance area is 10,403 ha (approximately 25,000 acres). The proposed mine will have an operating life of 22 years, plus closure and reclamation time. However it seems likely that future expansions of the mine size and life will be announced, as Shell owns adjacent oil sands leases and is doing further exploration. Shell estimates the time required for reclamation to reverse impacts and achieve a state of equivalent capability and sustainable ecosystems will be 80 years. A more conservative estimate might be hundreds of years for some elements and that many impacts will not be reversible.

The mine area is located in townships 97, 98 and 99, ranges 10 and 11 west of the 4<sup>th</sup> M. It is west of the Athabasca River and north of the Horizon and Joslyn mines, in the area of the Pierre River, Asphalt Creek, Eymundsen Creek, Big Creek and Cranberry Lake.

## **2. Closure and Reclamation Land Use Goals and Assumptions**

Surface mining causes complete disruption of the landscape, the soils, the creeks and lakes, the wetland areas, and the vegetation and wildlife habitat. The impacts are extensive for the life of the mine and beyond. Shell claims that reclamation will be successful and almost all impacts are reversible.

The following discussion focuses on the closure and reclamation plans, and on the assumptions used to assess impacts of mining and the predicted reversal of impacts by reclamation.

The reclamation goals and assumptions used in the reclamation planning and impact assessment are the same for both the Expanded Jackpine Mine and the Pierre River Mine, and the review comments apply to both projects.

Shell has identified the following end land use goals for the closure landscapes

1. Reclamation of the landscape to an equivalent capability, optimizing the value of watershed, timber, wildlife habitat, fish habitat, recreation or other resources;
2. Returning equivalent pre-development levels of forest productivity;
3. Promoting the aesthetic qualities of the landscape;
4. Providing for traditional land uses; and
5. Leaving open the opportunity for other land uses.

## **2.1 Comments on Land Use Goals 1 and 2**

- 1. Reclamation to an equivalent capability for a variety of land uses.**
- 2. Returning equivalent pre-development levels of forest productivity.**

Shell's reclamation goal is to achieve maintenance-free, self-sustaining ecosystems with a capability equivalent to pre-development conditions. The closure planning process identifies a number of guiding principles and assumptions.

The following discussion evaluates the likelihood that the land use goals will be achieved by the closure, conservation and reclamation plan. The guidelines and assumptions used in estimating closure landscape quality and performance are critical to assessing adverse effects. Issues and questions are identified. Since the assessment of impacts to terrain and soils and land use is predicated on reclamation success or failure, the reclamation issues and questions are critical to the process.

### **2.1.1 Landscape Design**

**Shell will design landforms and landscapes using the CEMA Landscape Design Checklist (revised May 2005).**

**Concern:** The Landscape Design Checklist is a checklist of design items and required actions, but actual landform design requires guidance documents that will be included in a Proposed Landscape Design Manual. The manual will not be prepared until research and development fills technology gaps, and monitoring provides feedback to improve designs, and adaptive management results in designs and construction methods that are successful. The current situation is that major knowledge and technology gaps exist in many essential design areas, and planners do not have the models and descriptions of best practices that are needed to design or construct landforms.

The technology to stabilize and cap fine tailings and build stable, predictable landforms is not currently available. Design requirements for large scale hydrologic landscapes constructed on tailings dikes and beaches and on fine tailings that are dewatering, with various soil substrates, with expectations for erosion control and integrated wetlands and biodiversity are very complex. The building blocks are not available. Models of geomorphic and hydrologic processes are required to design topography and soil landscapes that will support desired ecosites. Understanding of changing climate and evapotranspiration and moisture deficits and soil water budgets and shallow groundwater systems in reclaimed landscapes are essential, but missing elements. The response of soil performance and function to landform is unknown. The response of plant communities to landform - controlled site conditions and processes is not known.

## 2.1.2 Adaptive Management

**Uncertainties in landscape performance and technology will be dealt with using the principles of adaptive management, and knowledge gaps will be filled through research programs.**

**Concern:** The knowledge gaps are very large and the issues are very complex. It will take many years of intensive research to develop trial systems that must be monitored and provide feedback to validate understanding and adjust designs and management and then test again. Reclamation trials have been going on for almost 40 years in the oil sands and the surface is barely scratched. It is unlikely that sufficient new knowledge will be available to fill the necessary gaps before end of mining at PRM. A high-quality knowledge base is an essential requirement, but it will take several decades of research to put in place.

Most of the reclamation research and development of guidelines and manuals (adaptive management) is done through the Cumulative Effects Management Association (CEMA). However there has been a widening gap between the needs and expectations for cumulative effects management and the results delivered by CEMA. The growing gap is documented in EUB and Joint Panel decisions (Kennett 2007). The Athabasca Chipewyan First Nation withdrew from CEMA because of their concerns about lack of progress. If CEMA is always several years behind in providing critical information on cumulative effects and methods of mitigation several critical thresholds and limits of acceptable change could be crossed before they are identified. As oil sands development grows at a rapid pace the gap between needs and knowledge also grows.

Shell has not demonstrated that they understand the pre-mine terrestrial ecosystems in the area. In order to support an ecosite-based reclamation plan it is essential that the reclamation scientists understand the natural ecosites they hope to mimic. This means there must be intensive inventories of the pre-disturbance ecosites, done in an integrated fashion, to develop data and models to understand the synecology of the ecosites. An integrated team of soil scientists, vegetation ecologists, wildlife biologists and traditional scientists working together to gather data on the same plot at the same time can develop the integrated models that are needed. Shell has not used an integrated approach, and in fact they appear to rely on surrogate information more than actual field plot data. The ecosite phase inventory was done by an interpretation of the AVI data. Soil mapping was done as a single discipline effort. Several soil series were not sampled for characterization analysis on-site; rather published data from elsewhere was used.

Understanding of soils and ecosystem function requires an understanding of effects of groundwater and fluctuations of depth to the saturated zone. Integration of soils and ecosite phase with groundwater information does not seem to be available.

The adaptive management approach is favored by Alberta Environment in its Regional Sustainable Development Strategy (RSDS) and by CEMA in several documents, and is a major strategy in Shell's approach to reclamation planning and impact assessment. In order for the adaptive management approach to work the knowledge gaps must be filled in timely fashion by research results and proven mitigation methods. If the management information is not available when needed, we cannot adapt until it is likely too late. The regulatory framework and policy decisions must also be in place when they are needed.

The knowledge base needed by regulators and stakeholders at the application stage is not sufficient to evaluate claims that terrestrial impacts can be reversed. Closure plans that promise equivalent capability and forest productivity and wildlife habitat based on ecosite phases that will establish on the reclaimed land is not based on scientific information or demonstrated ability; it is based on "adaptive management".

There is a widening gap between expectations for management and research and development results. Relying on adaptive management when the rate of knowledge growth is not keeping up with needs is not a wise management approach.

The EUB-CEAA Joint Panel on the Albian Sands Muskeg River Mine issued its decision in 2006, and stated its belief that "cumulative effects is the biggest issue facing the oil sands region". It would be logical to slow the pace of growth and to not approve new mines until scientific research, management methods and stakeholder input results in a more complete framework for addressing the effects of development.

Shell promises to conduct monitoring of reclaimed areas. Terrestrial systems monitoring should be highlighted as a major activity at all stages of a mine project. Monitoring natural systems before they are mined out is necessary to understand how the systems work in that area with local climate. Monitoring effects of drainage on ecosites; effects of salvage and storage on soil quality; effects of mining on land use; effects of alternate methods on reclamation success; early soil and site development, structure and limitations to use; maturing landscapes structure, function and use. The information gained from monitoring response to management is essential to the adaptive management approach. The monitoring results should be shared with the public, in a form that can be accessed easily. We do not see a framework in place that provides this information now.

**Table 1. Background Re: Reclamation Technology Gaps.**

Summarized from Syncrude (2006), Barbour et al. (2007) and other sources
<b>Wetland reclamation</b> <ul style="list-style-type: none"><li>• See Harris (2007) Guideline for Wetland Establishment Section 7 – Addressing Uncertainty</li></ul>
<b>Drainage Basin / Landform grading, shaping and drainage.</b> <ul style="list-style-type: none"><li>• How to construct vegetated waterways</li><li>• How to control salinity</li></ul>
<b>Ecosite Ecology</b> <p>For each landform / material / soil type (ecosite):</p> <ul style="list-style-type: none"><li>• What are the water and energy balances (capital and circulation rates, where and how much water is in the landscape, how is it moving around and why);</li><li>• What are the salt balances, including inorganics, organics, ions, nutrients, metals (capital and circulation rates);</li><li>• What are the plant and ecological responses to water, energy and salt balances;</li><li>• What are the vegetation succession sequences of reclaimed ecosites;</li> <li>• Identify best management practices for establishment of boreal plant communities in closure landscapes, including tailored planting, selective LFH and topsoil salvage and placement, and propagation techniques for plant species of concern.</li></ul>
<b>Soils Capping Research Needs</b> <ul style="list-style-type: none"><li>• Suitability of capping prescriptions for tailings sands for drier than mesic sites with water tables &gt; 1.5 m bgs.</li><li>• Macro and micro nutrient cycling and dynamics, including effects of fertilization in undisturbed and reconstructed soils.<ol style="list-style-type: none"><li>a. Order of priority: Nitrogen, phosphorous, micronutrients.</li><li>b. Impact of moisture regimes on nutrient dynamics.</li></ol></li><li>• Capping options other than “low risk” should be examined to raise level of confidence in long-term performance:<ol style="list-style-type: none"><li>c. Effects of climate cycling on salt and water balances on sand,</li><li>d. Effects of climate cycling on salt and water balances on SSOB,</li><li>e. Effects of elevated pH on ecosystem development,</li><li>f. Improved understanding of trajectories for plant community development on reclaimed sites to build confidence that reclaimed areas are moving towards desired end points,</li><li>g. Slope and aspect effects on water and salt balances, and</li><li>h. Desodification of sodium impacted soils. Flushing rates of dominantly mineral soil profiles.</li></ol></li></ul>

## **Recommendations:**

Shell should:

1. Clearly identify the limits of demonstrated reclamation technology to replace equivalent capability.
2. Discuss the technology gaps that prevent or put into question the successful reclamation of sustainable landscapes to provide the ecological goods and services to meet land use goals.
3. Discuss the potential for reclamation success or degree of success that is likely for various closure landscape areas, based on current knowledge and research programs.
4. Discuss the issues specific to stabilization and reclamation of non-segregating tailings.
5. Review impact assessments and confidence ratings based on demonstrated reclamation success.

The key to using adaptive management to reach a goal of successful reclamation is thorough knowledge and understanding of the pre-disturbance ecosystem. This requires extensive monitoring before and during the anticipated disturbance. The ecosystem should not be destroyed before it has been thoroughly monitored and understood.

### **2.1.3 Use of previous EPEA Approval Conditions**

Shell states that the detailed reclamation planning process is designed considering the following:

- **Reclamation practices detailed in the draft EPEA Approval conditions for the Muskeg River Mine Expansion will be used as the basis for soil salvage, reconstruction and revegetation.**

**Concern:** The CEMA SVGA Forest Productivity Task Group (2008) recommends “it would not be valid to suggest that all reclamation practices can now be shifted to the minimum treatments required by approvals, and still result in restoration of productive forest ecosystems. There are a number of reasons why variation in soil depths, layering and materials may be important to ultimate reclamation objectives, but these reasons are not fully understood or explored at this time.

### **2.1.4 Equivalent Capability using the LCCS**

- **The goal of equivalent capability will be met by using methods outlined in the Land Capability Classification System for Forest Ecosystems in the Oil Sands (2006).**

**Concern:** Shell states they will reclaim disturbed lands to meet or exceed equivalent land capability for forestry. This expectation is a fundamental cornerstone in the EIA process. Replacement of equivalent land capability is also a legislated requirement under EPEA.

Shell states they will use the Land Capability Classification System for Forest Ecosystems (LCCS) to ensure reclamation to equivalent capability standards will result (C&R Plan Section 20; CCR Plan, Section 2.3).

However; use of the LCCS **does not** ensure replacement of equivalent land capability. Note the following statements excerpted from the LCCS Field Manual, Third Edition (June 2006), Purpose of Manual and Statement of Limitations (page ii):

*“The first round of monitoring of the long term plots has not resulted in establishment of a clear correlation between LCCS-predicted forest site productivity and measured forest site productivity, particularly on reclaimed sites.”*

*“Because the link between LCCS rating and forest productivity is currently undemonstrated, the LCCS should be considered as one in a suite of tools for site evaluation and reclamation planning, rather than a comprehensive system that alone will ensure replacement and documentation of equivalent land capabilities.”*

And, in Section 1.1 (page 1) of the manual:

*“The use of the LCCS as a tool to calculate minimum soil requirements (i.e., thickness) necessary for the achievement of particular capability classes in the design of reclaimed soils is not recommended”*

Reviews of the LCCS system by J.S. Thrower (2004, 2005) found the system has low ability to distinguish site index differences between one soil capability class and another. Therefore the LCCS does not suit the intended purpose of predicting productivity / capability by the indirect method of measuring soil site parameters.

Analysis of the relationships between site index and LCCS ratings on reclaimed and natural plots by Timberline (2008) found that the LCCS is not effective in predicting site index on reclaimed sites.

**The CEMA Soils and Vegetation Sub Group (SVSG) Forest Productivity Task Group (in Timberline 2008) made the following recommendation: “A comprehensive analysis of data collected to date indicates that the LCCS does not have value for predicting tree growth performance (site index) on reclaimed sites, and that the LCCS should no longer be viewed as a predictive tool for tree height growth performance. The LCCS should be “de-coupled” from its stated task of predicting forest productivity classes.”**

The Forest Productivity Task Group also recommended a more holistic definition of forest productivity such as “Long-term ecosystem productivity is the capacity of the site to support forest ecosystems over generations of humans and trees, as measured against some defined references.” The Task Group stated that assessing restoration of ecosystem productivity on reclaimed sites may include evaluation of a wider suite of productivity indicators (e.g. assessing/modeling carbon assimilation, net primary productivity, below-ground biomass production, etc.).

The Government of Alberta accepted the recommendations of the SVSG and does not accept use of the LCCS to predict forest productivity or equivalent capability.

Shell appears to rely solely on the LCCS system to predict that: reclamation will meet equivalent capability requirements; and soil classes will equate to forest productivity levels. This approach appears to ignore the stated purpose and limitations of the LCCS, results of peer reviews and the position of the SVSG and the Alberta government. If Shell has no other data or information to support their assumption of attaining equivalent capability and forest productivity the assumption appears to be highly questionable. It needs to be backed up by scientific information and there should be a risk analysis of non-performance.

### **2.1.5 Reconstructed Soil Performance**

- **Reconstructed soil performance will mimic natural soils over time.**

**Concern:** Shell provided no estimate of time frame or references or background for this assumption in the C&R Plan. In response to supplementary information requests Shell related a communication by L.Leskiw that some surface soil structure has developed in 20 to 30 years on reclaimed soils at Syncrude. Shell expects reclaimed soils to develop to a stage of equivalent capability in 80 years.

Research by Naeth and students at the University of Alberta is finding that the organic matter in soils constructed with peat / mineral soil mix is very different from natural soil organic matter in form and function.

Review of the LCCS system and correlation of nutrient regime to tree growth showed differences between natural and reclaimed soils. The differences were attributed to different form and function of organic matter derived from peat replacement compared to natural soil organic matter.

Soil biogeochemistry research on reclaimed soils is in the early stages but the weathering rates and products from overburden and tailings sand and effects on macro and micro nutrient cycling and dynamics are unknown and cannot be estimated with confidence. Effects of fertilizers on constructed soils are unknown. Effects of climate on salt and water balances on soils built on sand are unknown.

Effects of high pH in constructed soils on growth of plants adapted to low pH and on ecosite development are unknown. Effects of salts, organic compounds, metals, and methane from tailings and process affected water are unknown. These unknowns were identified as soils capping research needs by Barbour et al. (2007).

Soils constructed with a coversoil mix of peat and sand or clay placed over tailings sand have many different physical and chemical properties from natural soils. Weathering of minerals and low grade bitumen in geological materials placed in the upper soil zone will take many tens or hundreds of years before the system mimics a natural soil.

Most research has focused on mesic moisture regime soils. There has been no research on constructing sandy soils that would support a blueberry – jackpine (b1) ecosite phase, a type of interest to First Nations people. The soil processes and function in natural b1 sites are unknown. There is also no knowledge base of soil processes and function and ecosite response on wet soils, both natural and constructed.

Shell has not demonstrated understanding of carbon assimilation or net primary productivity or nutrient pools and flux rates in reclaimed systems.

If we recognize that constructed soils will have several different properties from natural soils, and that properties usually correlate to function, we should expect that constructed soils will function differently than natural soils. We do not know how the reconstructed soils will function in terms of carbon and nitrogen cycles and water balance and ecosite development. Successional development of ecosite phases might be affected in ways we cannot anticipate.

### **2.1.6 Wetlands Reconstruction**

#### **Wetlands reconstruction practices will follow the 2007 draft Guideline for Wetland Establishment on Reclaimed Oil Sands Leases**

**Concern:** The Guideline for Wetland Establishment (2007) is an update of the state of knowledge regarding reclamation of wetlands in the oil sands region. It is not a “how to build a wetland” manual. It is focused on planning needs and issues, and it identifies many critical knowledge gaps.

The Guideline for Wetland Establishment emphasizes the need for involvement of First Nations people in the planning and construction process (see Land Use Goal #3 comments).

### **2.1.7 End Land Use Constraints**

#### **Shell states that the end land use options available will be constrained by the type of landforms to be constructed.**

**Concern:** The use of surface mining rather than in-situ methods constrains the land use options. The final landscape and landforms are determined largely by the mining plan and bitumen extraction/tailings technology. The large overburden

dump forms a large upland plateau because the miners do not want to replace it or distribute it across the landscape due to handling costs. The large external tailings pond is a result of extraction and wet tailings technology. The pond would be unnecessary if the miner converted to a dry tailings system. The landforms built on wet fine tailings have many long-term problems that could be avoided with a dry tailings system. Economics and currently available technologies drive this system.

The landscapes and landforms described in the closure plans will be very different from natural landscapes and landforms. The overall morphology of constructed plateau uplands with terraced sides and sand dykes and beaches with straight lines and square corners are designed to meet engineering standards. The landforms will not appear to mimic natural landforms. There will be a very small extent of wetlands in the landscape, which may or may not be wet all summer. The drainage channels will be constructed and are unlikely to appear natural.

There does not appear to be meaningful involvement of First Nations people and requirements for traditional use in the design of the landforms. Considerations of societal values in landform design would include aesthetic/spiritual values, trail access to hunting and gathering areas and camping locations near good water. If these options are not possible because of the constraints that relate to mining methods perhaps the mine plan should change.

## ***2.2 Comments on Land Use Goals 3 and 4***

- 3. Promoting the aesthetic qualities of the landscape.**
- 4. Providing for traditional land uses.**

### **2.2.1 Visual Qualities of Terrain and Landforms**

The closure landscapes will be very different in macro form and appearance from the baseline landscapes. The closure landscapes will have several high (200 feet high) hills made up of overburden dumps (overburden plateaus) and out-of-pit tailings ponds (tailings sand plateaus). These hills will have a constructed box appearance with straight sides and square corners. These terrain changes are the same as for the other mines (see Suncor and Syncrude for examples) in the area. There will be an extensive pattern of square hills with flat tops over a large part of the region. The land between the hills will be nearly flat, reclaimed tailings ponds with a few end pit lakes. The new landforms will not have natural appearance. There will be very few wetlands and no bogs or fens. These changes cause negative visual impact and the effects are cumulative in nature. In addition to visual changes, the changes will result in unnatural landscape influence on water movement and distribution of ecosites. The effect of these changes seems to be ignored in the environmental impact assessment.

There should be concerted effort made to design closure landscapes to mimic natural terrain. Terrain and landform design should consider form, pattern, color and diversity of upland and lowland, water, wetlands and creeks. Techniques for landscape analysis that document the components of the physical terrain and the aesthetic qualities could be employed. First Nations people should have input to design and construction of the terrain.

## **2.2.2 Traditional Land Uses and Values**

The goal of meeting traditional land use was not developed in the application. The conversion of the natural landscape with approximately 50 percent wetlands including extensive bogs and fens, to a closure landscape with perhaps one percent wetlands and no bogs or fens is a major impact on aesthetic qualities and on traditional use potential.

### Importance of wetlands to First Nations

As stated in the CEMA "Guideline for Wetland Establishment on Reclaimed Oil Sands Leases (Harris 2007)":

*"Natural boreal wetlands are a critical habitat for many important wildlife species, including woodland caribou, moose, muskrat, waterfowl (particularly diving ducks) and amphibians. They are linked to the traditional way of life of local Aboriginal people, because of the economic importance of fur-trading and the cultural significance of many wildlife species (moose, muskrat, beaver) and wetland plants (sphagnum moss, rat root, bog cranberry). Aboriginal knowledge and interpretations of wetland systems are based on long term empirical evidence and have much to contribute to western scientific research findings."*  
*"Wetlands in the oil sands region are indelibly linked to the traditional way of life".*  
*"People of the Fort McKay, Anzac, and Fort Chipewyan communities continue to use wetlands for subsistence hunting and trapping, for food and medicinal plant collection, and for spiritual well-being".*

### Importance of Wetlands for Alberta

*The Alberta Water for Life strategy gives wetlands, as fundamental components of watersheds, a high priority for conservation. It is to be expected that the structural and functional health of reclaimed wetlands will be considered within a landscape-scale action framework" (Guideline for Wetland Establishment, p.20).*

A Wetland Policy was to be established by 2007, which would require restoration or compensation and replacement but Alberta cannot seem to obtain buy-in by stakeholders and move past a draft policy level.

The CEMA Guideline for Wetland Establishment on Reclaimed Oil Sands Leases recommends a watershed : wetlands ratio of 2:1 is required to create sustainable ecosystems in the oil sands region. This means 33% of the reclaimed watershed should be wetlands, but the PRM closure plan shows less than 1 percent.

The Pierre River Mine area has 3774 ha of wetlands, including 3330 ha of bog and fen peatlands. The planned closure landscape has no peatlands and only 11 ha of non-peat wetlands. The project will destroy 3760 ha of wetlands. Most of the pre-disturbance wetlands are bogs and fens. Shell plans to replace 11 ha of marshes and shallow open water wetlands in the closure landscape, but there will be no replacement of bogs and fens do to limits of current reclamation knowledge.

Shell considers the loss of peat-forming wetlands to be irreversible. This same pattern of loss of large landscape-sized wetlands is happening at every oil sands mine. The total area deemed suitable for surface mining is approximately 253,500 ha, and about 50 percent is wetlands. If all of the area is mined about 125,000 ha of wetlands (mostly bogs and fens) will be impacted. That is a very large cumulative loss of wetland, especially bogs and fens. There is no compensation planned for irreversible loss of wetland. The EIA considers the environmental consequence of loss of wetlands to be low.

There are no bogs or fens planned for the reclaimed landscape. The result is the loss of wetlands, loss of biodiversity; and loss of habitat for rare plants, traditional use plants and wildlife. Effects on the ecohydrology of the area are unknown. The importance of peat in holding and slowly releasing water in an area with net deficit evapotranspiration should not be underestimated. If climate change results in warmer and drier summers shallow open water wetlands with no peat will not retain water unless they have flow-through or are fed by seepage (Guideline for Wetland Establishment 2007).

First Nation societal values are not being incorporated into planning guidelines. The Guideline for Wetland Establishment 2007 states “this guideline has not emphasized the values placed on wetlands. However, wetlands in the oil sands region have traditionally been highly valued for indigenous cultural and spiritual growth, and for economic prosperity as habitat for furbearers. There has been limited investigation of how reclaimed wetlands may be used to contribute to these community needs.”

### **3. Closure Landforms**

#### ***3.1 Capped Tailings Closure Landforms***

The tailings ponds will be the most difficult landforms to reclaim. The closure landscapes will have large areas of reclaimed fine tailings, including the external ponds and the in-pit ponds. The proposed reclamation requires stabilizing the tailings and capping them with 3 to 5 meters of overburden or sand capping. The degree of expected success in stabilizing and reclaiming the fine tailings is uncertain, as new technology is required, and successful reclamation has not been demonstrated.

Syncrude (2006) identified several technology gaps related to fine tailings reclamation, including:

- Methods of overburden or sand placement over tailings.
- Appropriate landscape design and special technologies to reclaim soft, mature fine tailings.
- Creation of swale and ridge topography on the sand cap for water table control.
- Wet tailings sand trafficability.

The groundwater surface will be close to the reclaimed ground surface. The groundwater will be of poor quality, with high dissolved salts, high sodium, high pH, hydrocarbons and naphthenic acids. This will result in salt-affected soils (saline and sodic soils) over an unknown percentage of the capped tailings areas. The soils may also be contaminated with hydrocarbons and trace elements. These soils have very different characteristics from the baseline soils, and the differences are seen to be negative for soil quality and productivity. When surface water infiltrates it is likely to mix with the process-affected water and raise the water table in swales and lower slopes, resulting in salt-affected soils. There are essentially no salt affected soils in the pre-mine landscapes. Saline – sodic soils are essentially non-productive.

For example, at the Pierre River Mine: Most of the closure land capability on reclaimed tailings (C&R Plan, Figure 20-1) is rated as “low capability” or “conditionally productive.” It would seem likely that if the actual quality of reclaimed soils is slightly less than hoped for, much of the area could be “non-productive.”

**Shell should document the state of knowledge regarding reclamation of oil sands tailings, and identify the knowledge gaps and research efforts that are underway to answer the many questions. Information requirements include:**

- anticipated properties of the tailings and the associated fluids,**
- methods to be used to cap the tailings,**
- schedule for capping,**
- the time-strength trajectory of capped tailings and associated subsidence and effects on the closure landscape and soils,**
- management of surface water and near-surface water table in the reclaimed landscape to avoid development of saline-sodic soils,**
- risk of contamination by organic compounds, salts, and released methane and hydrogen sulfide and effects on soil biology in reclaimed soils,**
- detailed soil reconstruction prescriptions to meet various ecosite targets,**
- soil water and nutrient dynamics in various ecosite types,**
- schedule for reclamation milestones for various ecosite types,**

- soil and vegetation parameters that will be monitored, and standards for assessing reclamation success, and**
- assessment of the risk that reclamation will not meet planned targets and there will be substantial long-term adverse effects.**

## **Tailings Management and Implications for Reclamation**

The ERCB issued Directive 074 in 2009. This directive specifies performance criteria for the reduction of fluid tailings and the formation of trafficable deposits. Large and growing inventories of fluid tailings that require long-term containment are causing growing public concern.

Decision reports issued by the EUB and joint panels of the EUB and CEAA identified several long-term objectives respecting tailings management:

- To minimize and eventually eliminate long-term storage of fluid tailings in the reclamation landscape.
- To create a trafficable landscape at the earliest opportunity (within 5 years) to facilitate progressive reclamation.
- To eliminate or reduce containment of fluid tailings in an external tailings disposal area during operations.
- To reduce stored process-affected water volumes on site.
- To maximize process water recycling.
- To minimize resource sterilization associated with tailings ponds.
- To ensure that the liability for tailings is managed through reclamation of tailings ponds.

**Suncor and Syncrude have announced new technologies to dewater tailings and have dry, reclaimable tailings within seven to ten years. We are not aware that Shell has announced new technologies that meet the objectives of recent joint panel decision reports and requirements of ERCB Directive 074. Major and fundamental changes are required, which will affect closure and reclamation plans and time schedules.**

**What changes is Shell proposing to eliminate external tailings ponds; eliminate long-term storage of wet tailings in the reclaimed landscape and in end pit lakes; and allow reclamation of tailings within five years? Will the external tailings pond be managed differently or downsized or turned into a dedicated disposal area?**

### ***3.2 Tailings Sand Dikes and Beaches Closure Landforms***

Reclamation of the tailings sand dikes and beaches presents many unsolved challenges. In addition to the limitations related to the stability and erosion control of tailings sand materials, there is the challenge of controlling the water table and seepage of process-affected water on the slopes. Long-term seepage is likely to result in saline – sodic soils on the slopes and toe berms. The moisture and

nutrient regimes of an ecosite established on these locations are likely to differ from what was planned. Rates and processes of erosion are unknown and slope failures are a significant risk. Existing mines have a history of revegetation failures on the tailings sand slopes.

Synchrude (2006 and 2008) identified several reclamation concerns and technology gaps after many years of operational practice and much research effort) related to:

- Lack of methods to assess and improve the performance of the tailings sand slopes.
- Uncertainty re rates and processes of erosion on closure landforms and effect on the landscape.
- Migration of salts in water and effects on soils and vegetation.

There appears to be significant risk that at least part of the reclaimed tailings sand slopes will not support planned ecosites, and will not contribute to equivalent capability for various closure land uses. The likelihood and extent of unexpected reclamation results has not been reported by Shell.

**Shell should identify their state of knowledge and uncertainties regarding reclamation methods and risk of failure on tailings pond dikes.**

#### **Stream Channels, Wetlands and Water Bodies Closure Landforms**

The reclaimed landscape will include a number of low areas, runoff channels and streams, wetland areas with high water table, and ponds. Poor groundwater quality due to seepage of process-affected water from tailings seems likely to result in saline wetlands with contamination by salts, hydrocarbons, naphthenic acids, and hydrogen sulfide.

How will Shell estimate the location of the long-term water table and seepage areas in an area when groundwater is being affected by other mines and climate change is likely but unpredictable?

How will surface water be separated from process-affected water in the fine tailings?

#### **4. Eymundson Sinkholes**

The Eymundson Sinkholes are apparent karst landform features (location T98 R10 W4M) that were initially mapped by the Alberta Research Council (Bayrock, 1971). These sinkhole lakes were identified as significant terrain features in the inventory of Significant Natural Features of the Eastern Boreal Forest Region of Alberta (Westworth Associates 1990). Karst sinkholes are restricted to northeastern Alberta, where the limestone formations are fairly close to the surface. There are several sinkholes in the immediate region, and all are probably at risk of being destroyed by oil sands mining. Other sinkholes in Alberta are north of the Peace – Athabasca delta.

These features have value as research sites to understand the development of karst features in areas with relatively thick geological cover over the limestone. The surface water must have communicated directly with water in a major fault system in the underlying Devonian limestone to form sinkholes (Carrigy 1959, Hackbarth and Nastasa 1979). It would seem prudent to preserve some of these features for scientific value. Detailed investigation of the sinkholes might provide better information regarding the value and significance of these features. The sinkholes have potential for rare species of micro-organisms, plants and animals but have not been investigated.

The sinkholes are very deep (30 to 40 meters or more), and are a reliable source of good quality water even in drought years. The unusually great depth and almost perfectly round shape suggest they may have had importance to pre-historic people and have potential for archaeological evidence. Has Shell investigated the pre-historic and historic significance of these sinkholes?

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## **Appendix D-16**

**Shell Canada Limited Jackpine Mine Expansion and Pierre River Mine Project  
Environmental Impact Assessment Report – Review for Athabasca Chipewyan First  
Nation – Traditional Land Use & Traditional Knowledge, October 2008, by Janelle  
Baker of Little Seed Consulting**

# Shell Canada Limited Jackpine Mine Expansion and Pierre River Mine

## Environmental Impact Assessment Report Review for Athabasca Chipewyan First Nation

### Traditional Land Use & Traditional Knowledge

**By:**

**Janelle Baker, Little Seed Consulting**

**October, 2008**

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#### **1.1 Introduction**

The Athabasca Chipewyan First Nation (ACFN) Industry Relations Corporation (IRC) requested that DS Environmental provide a review of the Shell Canada Limited Jackpine Mine Expansion and Pierre River Mine Environmental Impact Assessment (EIA). Both projects are included in one EIA and Shell submitted the application to Alberta Environment in December 2007 and an update in May 2007.

#### **1.2 Overview**

Information regarding traditional land use is provided for both projects in a combined fashion in this EIA so that it is not possible to separate the information provided according to each proposed project development. For that reason, both mines are included as one in this review. ACFN members were not directly consulted in regard to their traditional lands and therefore detailed nation-specific information is lacking in this EIA. Traditional land use for the ACFN is a way of life that includes spiritual, cultural, linguistic, medicinal, and subsistence activities. The many components of traditional land use are inseparable and crucial for the continuation of the way of life for the ACFN people.

## 1.3 Traditional Land Use

### 1.3.1 Overview

Traditional land use for the Jackpine Mine Expansion is discussed in several sections of the EIA including Human Environment (Volume 5, Section 8) and Public Consultation (Volumes, Section 15). More specifically, there are sections on traditional land use in sections 8.3 and 8.7.7 of the Human Environment component of the EIA. The traditional knowledge and land use section is required by the terms of reference for this EIA. The terms of reference (January 2008) for traditional ecological knowledge and land use are as follows:

Provide details on the consultation undertaken with Aboriginal communities with respect to traditional ecological knowledge and traditional land use. Determine whether there will be implications on traditional land use resulting from the Project. Discuss:

- a) the extent of traditional land use and cultural use in the Study Area. Discuss the vegetation and wildlife used for nutritional, cultural and medicinal purposes and identify cabin sites, spiritual sites and graves;
- b) Project and cumulative effects of development on traditional uses and mitigation strategies to prevent or minimize effects; and
- c) identify how Traditional Ecological Knowledge was incorporated into the EIA report.

The regional study area (RSA) for the ACFN is based on their traditional territory identified in the published books: “Traditional Land Use Study” and “Footprints on the Land”. The RSA is calculated as a total for both proposed projects in the EIA. The effects of the projects on traditional land use were evaluated in the local study areas based on the boundaries of six Registered Fur Management Areas that will be directly affected by the project. The band membership of the RFMA trappers is not revealed in the EIA.

The EIA identifies the following resources to be in the ACFN RSA:

- ACFN regional study area: 4,373, 856 ha
- Area that has already been disturbed: 449, 998 ha (10%)
- The RSA includes land available for hunting, trapping and plant harvesting
- Eymundson Sinkholes and other environmentally sensitive areas

The EIA identifies the following impacts:

- On a regional level, the project will increase the area of disturbances of ACFN traditional territories

- The activities associated with project construction and operation will result in a direct loss of land (either temporarily or permanently) that is available for hunting, trapping, and plant gathering within each of the RFMA's
- Planned developments will affect 482,492 ha (14%) of the ACFN RSA
- Two trap cabins (RFMA #1716 and #1714) will be relocated
- Two berry harvesting areas will be disturbed (Jackpine Mine expansion)
- Eymundson Sinkholes will be disturbed
- Increased population pressure might also result in low impacts on hunting, fishing, berry picking and recreation throughout the regional study area because of increased competition for resources
- Increasing levels of planned regional development are likely to have a negative effect on the potential to sustain the traditional way of life as an option for community members...with the temporary loss of land available for trapping and other traditional activities, and the attractiveness of opportunities outside the traditional life (i.e., wage labour), the Aboriginal communities face a challenge in maintaining a pool of traditional practitioners to sustain their cultural identity and to be able to face the time when industry leaves the region

The EIA lists the following trappers' concerns\*:

- Loss of wildlife habitat
- Noise, air, and light emissions and increased traffic negatively affect wildlife abundance
- A reduction in fish health and size due to industrial developments in the area
- A loss of enjoyment of their traplines due to industrial noise and odours and increased vandalism due to increased access into the area
- A concern that development makes it hard to pass on trapping skills to future generations
- In addition to dwindling animal populations outside hunters are increasing hunting pressure, especially for black bear and moose

The EIA lists the following mitigations:

- While reclamation should replace habitat with wildlife and traditional plant potential, this will take place until the Far Future
- Shell will provide compensation to trappers directly affected by the project
- Shell will continue to consult with all Aboriginal stakeholders
- Shell will facilitate access across the project area by trappers to their trapline

- Shell is committed to providing a system for cultural diversity awareness training for its employees and contractors to foster respect for traditional resource users, traplines, cabins, trails and equipment
- Shell will continue to actively participate in regional multi-stakeholder planning and research initiatives that consider the long-term sustainability of effective traditional land use including: CEMA, RWG, SEWG
- Incorporating resource use values, such as recreational, fishing, hunting, trapping and berry picking capabilities in reclamation plans

\*Note: The affected trappers provided detailed traditional environmental knowledge and listed their concerns regarding noise, air, and light pollution. This information can be found in the following sections: noise assessment (volume 3, section 4), air quality assessment (volume 3, section 3), and visual aesthetics assessment (volume 5, section 8.5).

### **1.3.2 Discussion**

The proposed mitigations do not address the listed impacts and concerns. Reclamation in the “far future” and financial compensation to trappers in the project area do not address the loss of traditional territory and associated use for the ACFN in its entirety. The term “far future” is not defined and so no timeline for reclamation is provided. Damage to wildlife populations and associated cultural activities is not mitigated. Also, engagement with CEMA is stated as a mitigation, but ACFN is not a member of that organization.

### **1.3.3 Assessment Review**

The major flaw in this application is that ACFN members were not directly consulted in regard to their traditional lands. The EIA traditional land use components are based on ACFN’s published documents and interviews with the six affected trapline holders (and their band memberships are not made clear). In the consultation sections of the EIA the following activities regarding ACFN traditional lands are listed:

- In the Jackpine Mine Expansion Public Consultation Section (Volume 1, Section 15) ACFN Council discussed “infringement of treaty rights related to not being able to access and use traditional lands”. They also “request site visits with Elders and youth before areas are disturbed”. These concerns are not identified in the traditional land use and associated mitigations sections of the EIA.
- In the Pierre River Mine Consultation Section (Volume 2, Section 15) it was on the agenda in a meeting on August 16, 2007 for Shell to “request for permission to use existing TLU information”, but it states that the opportunity to discuss the topic did not arise. There is no other mention of this topic being discussed in the consultation records therefore one could assume that permission was not granted to use the

books that are listed as the only sources for information from ACFN in the EIA.

Reclamation is listed as a main mitigation, however no timeline for reclamation is provided. The EIA does not comply with the terms of reference which state the EIA will discuss, “ the extent of traditional land use and cultural use in the Study Area” and “Project and cumulative effects of development on traditional uses and mitigation strategies to prevent or minimize effects” since ACFN was not fully consulted on these topics.

#### 1.3.4 Key Concerns

Several key concerns were identified with regards to traditional land use during the review. These include:

1. ACFN members were not consulted regarding impact of the project on their traditional lands

Only the six impacted trappers were interviewed, and their band membership is not made clear. Information regarding ACFN’s traditional territory in the project area is taken from published documents (without permission or an information sharing agreement).

**→ Recommendation:**

*Engage members of ACFN in a traditional land use assessment of the project areas. Invite Elders and youth to assess project area before construction as ACFN requesting in August 16, 2007 meeting.*

2. Direct loss of traditional territory

The EIA states that a section of ACFN’s traditional territory will be disturbed and not reclaimed until the far future. No actual timeline is provided for reclamation and only trappers were consulted regarding the loss of traditional territory.

**→ Recommendation:**

*Consult ACFN regarding the loss of their traditional territory. Work with ACFN to find mutually beneficial solutions to this problem. Some possibilities are to help ACFN preserve other traditional areas in exchange and fund traditional youth camps to continue the transmission of important traditional environmental knowledge.*

#### 1.3.5 Update on Pierre River Mine Project Supplemental Information May 2009

According to Shell’s supplemental information on the Pierre River Mine Project, Shell has supported Athabasca Chipewyan First Nation (ACFN) in the collection of traditional

land use (TLU) and traditional environmental knowledge (TEK) as it relates to the projects. The TLU and TEK study has been completed since the application was produced. The study contains project-specific TLU and TEK information provided by community members, as documented by consultants selected by ACFN. At the request of the ACFN, Shell has not included or cited material from its report in the Project Update.

Shell responded to the technical review clarification questions regarding by referring to the above-mentioned TLU and TEK work and by claiming that funding the technical review is a part of consultation. Shell also says that they are consulting ACFN on the potential impacts of the project on ACFN's traditional lands and Aboriginal and Treaty rights.

**Follow-up Questions:**

- How will the TLU and TEK information that ACFN has provided be considered in the project planning and operation?
- Will any identified sites be avoided or mitigated?
- Does the TEK information provided correspond with the scientific information in the EIA?
- How will Shell address ACFN member's concerns about TLU in the project area?

## **Appendix D-17**

**Human Health Risk Assessment: Review of Jackpine Mine Expansion Project and Pierre River Mine Project EIA, September 28 2008, by Dr. John Dennis, of SolAero Ltd.**

## **Human Health Risk Assessment: Review of Jackpine Mine Expansion Project and Pierre River Mine Project EIA**

**Submitted to ACFN IRC through DS Environmental  
Sept 28 2008**

**By  
John Dennis, PhD  
SolAero Ltd**

### **Introduction**

This review of the Human Health Risk Assessment (HHRA) of the Jackpine Mine Expansion & Pierre River Project is intended as a critically objective review of the content and limitations of the HHRA within the EIA. This review has a specific focus on health impacts of the proposed Jackpine Mine Expansion & Pierre River Project on the Fort Chipewyan and specifically the ACFN community residing in Fort Chipewyan.

Documents reviewed include:

- Project Descriptions and EIA. CD, 12/07, with specific focus on section 5.3
- Environmental Settings Report. CD 12/07
- EIA Update May 2008

This review is presented in two sections.

Section A critically reviews the HHRA and highlights areas which are considered weak.

Section B introduces an important area of Human Health Impact which is entirely absent from the Jackpine Mine Expansion & Pierre River HHRA portion of the EIA.

### **Section A. Critical Review of the Jackpine Mine Expansion & Pierre River EIA's HHRA.**

#### **A.1 Introduction**

The project application describes the construction and operation of a large industrial facility in the south of ACFN traditional territory. The Human Health Risk Assessment within the Environmental Impact Assessment (EIA) uses a traditional approach which seeks to identify emissions chemicals and estimated emission concentrations, models exposure pathways and exposure concentrations to human receptors, and, in comparison to established or developed 'safe' exposure limits ultimately seeks to quantify the expected health risk.

Further, within the EIA for the Jackpine Mine Expansion & Pierre River Project, 3 scenario cases are developed for the HHRA:

- Base Case (current, existing levels of 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 Volume 3 Section 5.3 pages 5-26 through 5-152 along with supporting references, cross-references and appendices. The HHRA is summarized in section 2.4.1.1 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 ...*

Further, throughout the EIA there are numerous statements made that conservative assumptions were routinely employed within the HHRA.

So, in summary, the HHRA portion EIA concludes that the project alone, and in conjunction with additional future industrial development are not expected to increase health risks in the oil sands region, and that conservatism has been widely applied in the HHRA in determining health risk.

## **A.2 Critical Review of the HHRA**

### **A.2.1 Challenging use of Conservative Assumptions within the HHRA**

The project HHRA identifies a large number of chemicals and chemical groups which will be emitted to air as part of normal plant development and operation. This inventory list of chemicals and chemical groups is presented in Table 5.3-2.

A count of the COCs within Table 5.3-2 indicate that some 60-70 individual chemicals have been specifically identified and undergone a risk assessment process.

Some 50 or so chemicals were also not assessed directly, but lumped together with a 'surrogate' which was assumed to have similar toxicity. – Table 5.3-14 suggests in its Discussion of Conservatism (2<sup>nd</sup> row from last) that this represents a conservative assumption. In fact, the result of not including such a great number and range of chemical moieties will produce quite the opposite as conservatism is not promoted.

Table 5.3-2 describes a great many chemicals identified as COPCs – around 250 in number – that have little literature describing a safe exposure limits. All of these were routinely excluded from the risk assessment process. This is evident in footnote 'a' in all the Tables reporting Risk Quotients summaries in all tables reporting risk quotients (Table 5.3-15 onwards). In the HHRA's discussion of Conservative Assumptions, summarized in table 5.3-15, no mention is apparent relating to the omission of these chemicals within the risk assessment process. While it may be true that there exists little information to include these chemicals in the risk assessment process, the HHRA should at the very least highlight the need for conservatism given the very real lack of information and impossible to predict nature of the

Further, for the minority of chemicals which have been identified and followed through within the HHRA, an impressive number of sequential steps have then been used to derive an estimate of risk to human health. These include:

- i. estimation of emission concentrations to various media (mainly air)
- ii. estimation of dilution rates
- iii. estimation of exposure dose (inhalation, ingestion, absorption)
- iv. estimation of 'safe' exposure limits – these are often derived from a combination of sources from Canada, US, Europe and international organizations (e.g. WHO), and are more often than not based on occupational exposure risks relating to health and safety of the work-force
- v. estimation of risk to human health from individual chemical and chemical group exposures
- vi. estimation of risk to human health from exposure to mixtures of chemicals

A great many estimates are made within the HHRA process. Estimates are needed because of the HHRA process incorporates so 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 a responsible HHRA process as a priority.

The manner in which the HHRA has dealt with chemical mixtures is worth discussion. The HHRA includes consideration only of potential additive effects of a chemical mixture. There is no mention of the potential for synergistic effects on health. This is a serious limitation and the absence of any reference to synergism does not support the 'conservative' nature adopted within this HHRA.

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. Because health risk assessment is an imprecise science, conservative safety factors are built into the process. For example, 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). 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 (e.g. >10-fold) to err well on the side of caution and safety. However, the realities of multiple estimates often preclude use of large safety factors as they will inevitably lead to a high provisional estimate of risk. Thus, smaller safety factors may be adopted within the step-by-step approach to HHRA (e.g. 3-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, and the choice of what safety factor to use is influenced by the driving purpose behind 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 ensure industrial developments are approved. That this HHRA is undertaken on behalf of industry cannot be ignored in considering the choice of multiple safety factors incorporated within the HHRA process. Particularly as the discussion of conservatism summarized

in Table 5.3-14 seems to enhance discussion of legitimate safety factors used in the HHRA, while sidelining very real aspects of this HHRA which increase the margin of error such as use of surrogates, and ignoring a great many COCs for which little or no literature exists.

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
- 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 that this background in western science underlies the traditional HHRA approach, we are not able to define human health risk with certainty. To conclude, at best HHRA is an educated guess which attempts to estimate the real risk to human health from complex exposure matrices to industrial chemicals.

With this background, the overall conclusion of the HHRA embodied in the Jackpine Mine Expansion & Pierre River EIA dismisses the underlying uncertainty of the HHRA. 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.

This HHRA review presents a biased view of the extent of its imbedded conservatism. While it promotes some legitimate inclusion of conservative assumptions, it ignores important aspects of prudent HHRA including:

- exclusion of a great number and diversity of COCs which are difficult to assess
- excludes any discussion of potential synergism between COCs resulting in enhanced health impact
- Excludes a realistic presentation of the complex series of sequential estimates which are embedded within the HHRA and are the basis for the argument to adopt conservatism objectively, meaningfully and responsibly.

Finally, the summary statement of this HHRA in section 2.4.1.1 is difficult to understand. The question should be whether the project will have a human health impact in the region. The Risk Assessment process indicates that some COCs demonstrate an impact, so risk is increased to some degree. However, the concluding statement 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 ...*

It is not clear to this reviewer what is a noticeable *increase in health risk* is supposed to mean. It is not clear who decides what is noticeable, and who if anyone, is monitoring health risk. It is predicting potential health impacts the HHRA is addressing - health risk assessment is the tool employed to predict if a health impact is expected to occur. This concluding statement is poorly constructed, unclear, and should be rephrased.

## **Section B. Holistic Impact on Human Health related to Jackpine Mine Expansion & Pierre River on ACFN Community**

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:

- 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

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

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 ACFN community members in particular, have persistent concerns over their health relating to development of industry within the Alberta Oil Sands. 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 interviewing the ACFN community members. ACFN community members are under considerable stress because of rapid industrial development within their traditional lands, and fear of pollution on their health. This fear has been fed by various reports including:

- rare cancers (Dr John O'Conner)
- Arsenic in moose-meat (Suncor EIA & Hearing)
- tailing ponds contaminating migrating wildfowl (Syncrude tailing ponds issues widely reported in the press)
- contaminated water and health effects (Dr Kevin Timoney)

These and other issues have emerged in 'scientific' reports and provincial and national press over the past 12 months alone.

Discussions with many ACFN community members indicate that there is real fear within the community about widely reported health issues and contaminated wildlife. Aboriginal community members more than others rely on land use as an anchor to

their traditional culture. Harvesting traditional foods has been, and remains, a fundamental part of the ACFN community identity. The sense of community and culture surrounding traditional food harvesting and sharing runs deep in the ACFN community as it does with many aboriginal peoples in Canada.

The very serious concerns within the ACFN 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 ACFN family that they have serious concerns over the human health impact of Shell's proposed Jackpine Mine Expansion & Pierre River Project. These concerns are affecting and will continue to affect the mental and physical health of ACFN community members

Other national and international organizations recognize the wider approach, including the US CDC<sup>1</sup>, the World Health Organization<sup>2</sup>, as well as Health Canada<sup>3</sup>.

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 ACFN 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 ACFN traditional lands, and contributing to the air-shed and water-shed of the Fort Chipewyan community will impact health of ACFN members. 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 allow the ACFN to have secure knowledge they will be 'safe'. There is no plan for effectively convincing the ACFN they will be safe, let alone feel safe.

### **HHRA Review Conclusions**

- 1) The HHRA summary conclusion is unclear and does not address potential health impact.
- 2) The HHRA does not incorporate conservative assumptions to the extend it suggests. Therefore the results of the HHRA overstate the certainty of the absence of health risk, and is unnecessarily dismissive of potential health impacts to ACFN community members.

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<sup>1</sup> <http://www.cdc.gov/healthyplaces/hia.htm>

<sup>2</sup> <http://www.who.int/hia/en/>

<sup>3</sup> [http://www.hc-sc.gc.ca/ewh-semt/pubs/eval/index\\_e.html](http://www.hc-sc.gc.ca/ewh-semt/pubs/eval/index_e.html)

- 3) The HHRA includes no assessment of the wider impacts on health from the proposed development on ACFN other than a narrow focus on chemical exposure.

### **HHRA Review Recommendations**

- 1) The potential for increased health impacts as a result of the HHRA be made clear.
- 2) That the HHRA is recognized as being over-confident in relation to the uncertainties inherent in risk assessment. Conservatism has not been adopted throughout this HHRA. The proponent should accept the uncertainties in HHRA and accept when conservatism has not been adopted.
- 3) That the wider impacts on health of the ACFN community be taken into account.
- 4) that the wider impacts of health of the ACFN be mitigated through an effective communication program which results in ensuring that the ACFN community should be able to 'feel safe' in their own homes, in their own community, at large on ACFN traditional lands, and harvesting and consuming traditional foods. Effective risk communication should be developed in collaboration with ACFN IRC.
- 5) Shell representatives be invited to actively and constructively participate in initiatives designed to promote health (to offset indirect negative health impacts). An example of a suitable program would be the Community Based Monitoring program being initiated through ACFN IRC.

## **Appendix D-18**

**Acrolein Issue within the Shell Pierre River Mine Project and Jackpine Mine  
Expansion Project Human Health Risk Assessments, by Dr. John Dennis, of SolAero  
Ltd.**

## **Acrolein Issue within the Shell Pierre River Mine Project and Jackpine Mine Expansion Project Human Health Risk Assessments**

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'. 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 ug/m<sup>3</sup>' (page 5-87 2<sup>nd</sup> para). The HHRA argues that the absence of detectable concentrations of acrolein within the 2005 Golder report provides further demonstrations that their modeled estimates of acrolein are 'overly conservative' as evidenced in the (1<sup>st</sup> bullet point) conclusion on page 5-90

*'Based on measured air concentrations of acrolein in the region (Golder 2005), it is likely that the predicted ground-level air concentrations overestimate acrolein concentrations in the region'*

There are some serious errors in both the fundamental science within the 2005 Golder report and Shell's interpretation of the findings of the 2005 Golder report.

### **Critical errors in the 2005 Golder Report**

The 2005 Golder report contains 23 pages which introduce and summarizes lab results from dozens of airborne acrolein measurements taken in the oil sands region June 13- July 2, 2005. All laboratory results were reported as 'BDL' or Below Detection Limit. These BDL values were quoted in units of 'ug' (e.g. 0.15 ug or 2.00 ug). This, in and of itself, does not imply airborne acrolein was necessarily low, as this would very much depend 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 ug. 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<sup>3</sup>. In order to determine what airborne concentration this detection limit might imply one must divide the detection limit, in this case 2.00 ug, with the sample volume, in this case 0.512 m<sup>3</sup> as follows:

$$\text{DL/sample volume m}^3 = 2.00 \text{ ug} / 0.512 \text{ m}^3 = 3.9 \text{ ug/m}^3$$

3.9 ug/m<sup>3</sup> would be the implied airborne detectable concentration of acrolein

The 2005 Golder report did not carry out calculations for any of the airborne detection equivalent concentrations. Nor did the 2005 Golder report explore the important consequences of not calculating these concentrations.

This calculation can be readily repeated for all the data points presented in the 2005 Golder report. As part the HHRA review on behalf of ACFN the values have been calculated, yielding average values between 1-2 ug/m<sup>3</sup>, but including higher values above 20 ug/m<sup>3</sup>. In comparison, the US EPA reference concentration value used in the HHRA is 0.02 ug/m<sup>3</sup>.

The USEPA exposure limit is 2-3 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 design of 2005 Golder report, from the very start,

insured that little if any detectable amounts of acrolein would be found in the sampling program unless values were very high - 100 or 1,000 times the accepted safe limit!.

Thus the 2005 Golder report is critically flawed and its contents at best meaningless, and at worst a serious and deliberate misinterpretation of the risks presented by acrolein in the oil sands region. For example, it is possible the actual acrolein concentrations is more than 10-fold the EPA limit and the Golder 2005 report was not designed to detect this exceedance!!!!

It is difficult to justify any rational explanation why these values were not calculated and compared to established limits within the 2005 Golder report. The 2005 Golder report should not have made any conclusions whatsoever in relation to airborne concentrations of acrolein in the oil sands – the report basically contains meaningless information embodied in ‘non-detects’ without any meaningful exploration of what the ‘non-detects’ may be hiding. 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.

### **Shell misinterpretation of the 2005 Golder Report**

First, Shell’s HHRA seems to have confused units within the 2005 Golder report. Detection limits quoted in the Golder report are in units of ‘ug’. To determine an estimate of airborne detection limit some mathematical manipulation is required: the sample air volume (L) needs to be converted to m<sup>3</sup>, and this needs to be divided into the ‘ug’ MDL to arrive at a MDL airborne concentration factor in ‘ug/m<sup>3</sup>’. That the HHRA has quoted the MDL in the Golder 2005 report in units of ‘ug/m<sup>3</sup>’ is a serious error as they are quoted in the 2005 Golder report in units of ‘ug’ – it being left up to the reader to determine the relevancy of the stated detection limit (as discussed above).

Second, the 2005 Golder report is referenced as an important piece of scientific monitoring conducted in the oil sands for airborne acrolein concentrations. Shell should have critically reviewed such an important reference before relying on its flawed contents within its HHRA. Even a cursory read of the 2005 Golder report by someone knowledgeable in the field would have uncovered these critical limitations. 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, as discussed above, examination of content within the Golder 2005 report contradicts the conclusion of its executive summary. The 2005 Golder report findings are in fact, at best essentially meaningless and tell us very little about airborne concentrations of acrolein in the region, and at worst a cynical attempt to falsely assure readers that an important regional industrial pollutant is seemingly under control.

Finally, given that the Human Health Risk Assessment of Shell's Pierre River Mine and Jackpine Mine Expansion Project relied on the critically flawed 2005 Golder report as a key reference to support its case that HHRA is low, raises a question over how many other HHRA references are similarly fatally flawed.

**Possible Recommendations:**

Shell re-evaluates the integrity of the measurements contained in the 2005 Golder report, and validity of its conclusions, and review it's HHRA for acrolein

Shell re-writes it's HHRA for acrolein with particular attention to a more realistic statement of conservatism.

Shell provide assurances that other Golder reports are not similarly flawed

Shell seek an explanation from Golder & Associates on the limitations of the 2005 Golder report

Shell accepts that conservatism is not as inherently strong in their HHRA as 1<sup>st</sup> suggested.

Shell accept that confusion and erroneous reports falsely promoting safety increase anxiety and perceived risks, and that Shell strongly support ACFN initiatives to promote health ....?