Regional Sustainable Development Strategy for the Athabasca Oil Sands Area (RSDS) Work Plan Progress Analysis

Contract #2011-0019

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Introduction

This report represents an assessment of the status of completion of the issues assigned to CEMA in the Regional Sustainable Development Strategy document (https://rowan.biology.ualberta.ca/courses/biol595/uploads/public/Oilsands%20regional%20sustainable%20dev%20strategy.pdf).

From the Executive Summary of the RSDS document -

In September 1998, based on anticipation of further oil sands resource development in northern Alberta, Alberta Environment (AENV) committed to leading the creation of the Regional Sustainable Development Strategy (RSDS) for the Athabasca Oil Sands region. The development was led by the Northeast Boreal Region of AENV, with a strong partnership involving regional stakeholders and regulators. The partners include First Nations and Aboriginal Communities, industry, environmental interest groups and government agencies (provincial [Alberta and Saskatchewan], municipal and federal) ...

An inventory of environmental and resource management systems, the identification and analysis of issues, and the drafting of the RSDS were completed on July 30, 1999. ***The 72 issues addressed by the RSDS were identified from project-specific environmental impact assessments in the region, the Athabasca Oil Sands Cumulative Effects Assessment Framework Report1, and from issues raised during Alberta Energy and Utilities Board (EUB) hearings on oil sands mines and in situ bitumen production projects.*** *The issues were grouped according to similarities in their information gaps, and a list of 14 themes was created. Blueprints for action were then developed to resolve the issues within these theme groups.*

From the CEMA website -

A ***Stakeholder Group, the Cumulative Environmental Management Association (CEMA), was formed, therefore, in partnership with Alberta Environment and Alberta Sustainable Resources Development, to address 37 of the RSDS issues.*** *The remaining RSDS issues not falling under CEMA's mandate were to be addressed by existing government mandate or other regional initiatives. CEMA's goal was to provide recommendations to Regulators on managing potential cumulative environmental effects using an array of environmental management tools such as environmental limits or thresholds.*

Priority Issues Areas
CEMA's current priority-level environmental issues were developed through the Regional Sustainable Development Strategy (RSDS) issues by Alberta Environment in July 1999. The initiative identified 72 priority environmental issues in the oil sands area. CEMA is responsible for addressing 37 of those issues. The CEMA priority issues include research and recommendations on the following:
Acidification
Air Contaminates
Biodiversity
Culture and historical resources
Fish habitat
Ground level ozone

Landscape diversity
Reclamation
Surface water quality
Trace metals
Wildlife habitat

My assessments are organized by Issue number. A summary of my results are presented in the accompanying spreadsheet – in it issues are colour-coded based on the the subject matter and (generally) the CEMA working group assigned to the issue. A complete review of each issue is in the main body of the report. Each full report includes: a description of the issue, an assessment of its status based on internal CEMA review @2004/2005, some history of the work on the issue, a discussion section where I review the documents and reports produced by CEMA on the issue and then a concluding summary.

A numerical assessment of completeness (0-100%) is provided at the end of each report. Clearly this numeric assessment is subjective. It could be argued that if scientific research is ongoing in the subject areas of the issues then work is incomplete. I believe this is not the appropriate determination because completeness is measured more by the extent to which regulators have adequate information to make good management decision. I take this from the Goals statement on CEMA's website:

CEMA's Goals are to:

- *Recommend management frameworks, best practices and implementation strategies that address cumulative effects on air, land, water and biodiversity to protect, sustain and restore the environment and to be protective of human health.*
- *Follow-up with members on the status of implementation of management frameworks, best practices and implementation strategies.*

I was interested in whether or not the work undertaken by CEMA has been summarized in a Management Framework (MF) or Recommendations/Guidelines document which is available (even if not adopted) by regulators. In some instances a MF may be demonstrated to be out of-date in which case the issue would be incomplete. In some cases additional monitoring is required before sufficient information is available to make informed management decisions. I would argue in those cases that even though CEMA's role is effectively complete, the issue is still not finished until the monitoring program has been implemented.

In general I was extremely impressed with the effort of CEMA's Working Groups in tackling the challenges assigned to them in the RSDS. Issues are complicated and the multi-stakeholder process has inherent complications, yet for each issue there exists a large body of literature (reviews and original research) on-line in the CEMA database library. CEMA should also be commended for making this database publicly accessible and searchable. Some improvements to the CEMA website could be considered which would enhance the presentation of the reports, recommendations and frameworks. A first step would be for Working Groups to organize their respective libraries into categories such as frameworks, recommendations, guidelines, reviews, proposals, original research (published and unpublished), theses and dissertations. Providing Executive Summaries as a separately downloadable file would be extremely valuable.

The range of subject matter covered in these 37 issues is large, although I have a Ph.D. In Biological

Sciences, I am not conversant with the literature in every field. Therefore, my assessments rarely touch on the quality of the science involved rather I am reviewing reports to see if they answer the key questions posed in the RSDS document.

I would to thank CEMA staff and working group co-chairs who assisted me with comments and input into this analysis.

W. Bruce McGillivray
September 14, 2011

Issue 1

Effects of deposition of heavy metals and acidifying compounds on traditional plants used by First Nations and Aboriginal Communities in and around the oil sands developments.

History
Linked with Issue 14 (Impacts of increasing levels of heavy metal deposition on soil, vegetation, fish wildlife and/or human health). Lead by Trace Metals and Air Contaminants Working Group (TMAC) (now Air Working Group -AWG as of 2010. Acidification as an issue was moved to the NOx/SO2 working group (NSMWG) which merged with TMAC in 2010 to form the AWG. Issues 3, 5 and 6 also deal with acidification effects on vegetation

CEMA Status
Heavy metal component considered complete in 2001 through publication of the Trace Metal Management Framework (TMMF). Acidification effects considered complete through publication of Acid Deposition Management Framework (ADMF) 2004.

Discussion
Heavy Metals: The TMMF states "there appears to be a link between oil sands air emission and aluminum, nickel and vanadium concentration in lower plants. The Dillon Consulting Ltd. (2001) report ("Review and Assessment of the Deposition and Potential Bio-accumulation of Trace Metals") from which this conclusion was reached actually states "data available tend to indicate a ***strong*** (my emphasis) link between oil sands emissions and the levels of some metals in vegetation such as lichens and mosses. The relationship is ***particularly strong*** (my emphasis) for nickel and vanadium..." In the TMMF, there is a rejection of the suggestion found in the 2000 Golder study (Trace Metals in Traditional Foods Within the Athabasca Oil Sands Area) conducted for the Terrestrial Environmental Monitoring Program (TEEM) of the Wood Buffalo Environmental Association (WBEA) that proximity to oil sands emissions affected metal levels in some higher plants. e.g., blueberries; and to my knowledge the suggestion in Golder for: *A focused scientifically designed follow-up study should be considered to further investigate the possible trends with distance from the stacks observed for aluminum, nickel, vanadium and zinc in blueberries and Labrador tea leaves and the potential causes for the observed trends,* was never acted upon (although TEEM/WBEA nine years later - in 2010 - began a multi-year project to evaluate the historical use, plant health status and food properties of blueberries in the Boreal Forest.

In response to the two papers by Kelly et al (2009 and 2010), The Alberta Government established an expert panel to review water quality issues on the Athabasca. Their report - Evaluation of Four Reports on Contamination of the Athabasca River System by Oil Sands Operations Water Monitoring Data Review Committee (Peter Dillon, George Dixon, Charles Driscoll, John Giesy, Stuart Hurlbert, Jerome Nriagu, 2011) is available at: http://environment.alberta.ca/documents/WMDRC_-_Final_Report_March_7_2011.pdf. Details on issues raised in this report are covered under Issue 14 but their work casts doubt on all metals monitoring data collected before 2004. Of particular relevance here is their conclusion: *Their (i.e., Kelly et al) results, therefore, carry the implication that considerably more particulate matter and trace metals are being released from the oil sands facilities than is being reported in the National Pollutant Release Inventory, or that there are other airborne sources*.

Acidification: The ADMF document specifies that it does not address specific biological receptors. e.g., plants, rather it addresses certain soil and water chemical conditions and relies on monitoring data WBEA (air), TEEM (soil) and RAMP (water) to provide monitoring evidence for implementing management action. The ADMF also has model-based management action triggers which rely on modelling of past, current and possible future acidifying emissions to determine if actions need to be taken to prevent possible future acidification impacts. A number of studies and model development project needs were identified in the 2004 ADMF before the Framework could be fully implemented and these needs have largely been addressed. The effects of soil chemistry changes on vegetation was to be assessed in a Literature Survey completed as part of Phase 1 of ADMF implementation. This issue was addressed for aquatic species and upland and peatland soils as part of the 5 year MAGIC (time to effect) model work (Watmough et al. 2009. Spatial and temporal impacts of acid deposition in the oil sands region – final report). One study (Weider and Vitt – The effects of atmospheric nitrogen deposition on the nitrogen cycle of boreal bogs: A tracer study. Years Five and Six) was extended and should be published soon. These studies however, did not focus on traditional food related vegetation. There are related studies: Nitrogen Loading and Terrestrial Vegetation-Assessment Of Existing Regional Vegetation Data and Recommendations For Future Monitoring (Contract Number: 2007-0021 NSMWG) and Traditional Food Consumption and Risk Communication Project in the RMWB Phase 1 (Contract Number: 2007-0027 TMAC) and Peer Review - Traditional Food Consumption and Risk Communication Report (Contract Number: 2009-0003 TMAC)] but none of these specifically addresses effects of soil chemistry change on vascular plants and none of these was published as promised in 2005. The consumption study shows that Blueberries are the most consumed vegetative resource but many others are used. I would expect to be able to find information on how blueberries and other regularly consumed native plants are affected by soil chemistry changes but it is currently not available within the CEMA database. As noted earlier TEEM/WBEA has initiated a monitoring study of Blueberry plant health and consumption in 2010.

WBK(2005) - Health Risk Literature Review: Current Approaches and Data Used to Assess Health Risks Associated with Emissions in the Oil Sands Region (Contract Number: 2004-0029 TMAC) noted concern by residents over the abundance and condition of plants (and wildlife) that form part of the local diet. Generally however, every study looking at contaminant levels has found them to be low relative to provincial, national and international standards. The monitoring that is essential to alert regulators of concerns is limited and has been heavily criticized in peer-review assessments. Follow up studies called for in TMMF on elevated levels of aluminum in rat-root and in wildlife (and repeated in the ACMF) do not appear to have been undertaken. TMMF indicates that improvements in emissions technology may in fact decrease the output of contaminants in the future – is this being assessed?

Conclusion

Trace Metals in vegetation were not found to be of significant concern in 2001 except in some lower plants but the ongoing monitoring and laboratory testing has been shown to be inadequate and specific studies called for have not been conducted or are just beginning. Information on current emission amounts is not easily located. The basic question whether distribution abundance and quality of traditional use plants is affected by oil sands acid emissions is not clearly addressed. In the TMMF, a system evaluation perhaps by TEEM was called for in 2005 to retest conclusions in the framework. Given the recent review by Alberta environment (Dillon et al 2011), a review of TMMF is in order.

Completion @75%.

Issue 3

Air - acid deposition-soils: Impacts on productivity and vegetation composition of local and regional acid-sensitive soils.

History
Lead by NSMWG, included in Acid Deposition Management Framework (ADMF).

CEMA Status
Considered complete in 2009 with publication of ADMF

Discussion
Despite the focus on vegetation and plant productivity in this issue, the current management framework does not address or identify specific biological receptors that would provide an indication of environmental effects; rather the framework seeks to protect the chemical characteristics of soil and water, which are intended to ensure that acid deposition related impacts to soils and vegetation never reach levels that will adversely impact ecosystems. The ADMF document specifies that it relies on monitoring data WBEA (air), TEEM (soil) and RAMP (water) to provide monitoring evidence for implementing monitoring-based management actions and there is also a set of model-based management triggers and actions. The criteria used in the ADMF are based on considerable/extensive studies in Europe and North America on key indicators of acidification and the potential biological effects of certain changes in these indicators. The ADMF recognized that actual regional monitoring of vegetation, lichens, soil biota etc. were however the only tangible way to determine if acid deposition was having impacts and this is the reason for the TEEM monitoring work. The effects of soil chemistry changes on vegetation was to be assessed in a Literature Survey completed as part of Phase 1 of ADMF implementation. This publication is not obvious in the CEMA database - see Issue 1 but as noted there, some relevant studies have been initiated recently and are ongoing. TEEM publications reviewing changes to Jack Pine trees in high and low deposition areas and publications looking at vegetative stress in the vicinity of Syncrude operations are relevant but the latest appears to be from 2003. These studies simultaneously consider the effects of various stressors—fire, drought, air pollution and acidification. It is difficult to isolate the effects due to a single agent like acid deposition. The latest reports by TEEM were in 2007 and summarized 1998, 2001 and 2004 monitoring programs. In the 2007-2009 period TEEM undertook a review and modification of its monitoring program and the first sampling program under the new program is in 2011 so it will likely be a few years before final reports on the work are available.

Conclusion
Without completion of a literature study or research which reviews the direct effects of acid-deposition on boreal forest plant growth and survival as well as changes to plant composition in acidic soils, it is difficult to categorize this issue as fully complete. TEEM monitoring has not been subject to the same peer review process that resulted in heavy criticism of RAMP. Therefore even if soil chemistry responses to acid deposition are well-known, there is uncertainty about the adequacy of ongoing monitoring to test model assumptions. Outstanding issues with respect to the ADMF are improving regional emission inventories, getting more regional soils data and finalizing the MAGIC model application on a regional scale.

Completion 80%

Issue 4

Air- Acid Deposition – Surface water. Impacts on buffering capacity, biological productivity and species composition of acid-sensitive rivers and lakes

History
This issue was assigned to NSMWG (now part of the AWG).

CEMA status
Considered complete with publication of the Acid Deposition Management Framework (ADMF) in 2004 and the Eutrophication Interim Guidelines in 2008

Discussion
ADMF will provide a system for managing emissions of oxides of nitrogen (NOx) and sulphur dioxide (SO2). The goal of the framework is to maintain the chemical characteristics of soils and lakes to avoid adverse effects on ecosystems, plants, or animals in the management area. Acidification management objectives, in support of this goal, are defined for soils and lakes in terms of limits in change to monitored and model-predicted soil and water chemistry.

Research on lake chemistry in northeastern Alberta lakes e.g., Saffran and Trew 1996 (Sensitivity of Alberta Lakes to Acidifying Deposition: An Update of Sensitivity Maps with Emphasis on 109 Northern Lakes. Alberta Environmental Protection, Edmonton, Alberta. 75 pp) and summarized in: A Paleolimnological Assessment of Environmental Change in Eight Northeastern Alberta Lakes Hazewinkel (2006) shows that lakes in the oil sands regions are generally well buffered against acidification. The most recent study is: Paleolimnological study of selected lakes in the Wood Buffalo Region involving collection and analysis of surface, bottom and full core lake sediment samples. Curtis et al. 2008 – final project report contract #2008-0004. They concluded: *The strongest evidence of industrial contamination of lakes in Northern Alberta from the present study comes mainly from one site northeast of Fort McMurray (NE7) which shows both recent acidification since about 1970 and increasing fluxes of mercury to lake sediments since the 1980s. Of the other 11 cored lakes, most do show strong evidence of environmental change,* ***but rather than acidification, nutrient enrichment appears to be the cause of changes in diatom communities.*** *This apparent eutrophication occurs over various timescales from the last 20 -30years to over 100 years, suggesting several potential drivers including climatic change, forest fires and possibly increased nitrogen deposition in the region.*

RAMP maintains an acid-sensitive lake monitoring program. It was criticized by the recent review panel (Alberta Innovates) for its sampling design, lack of episodic sampling and inadequate biological component monitoring but nonetheless it still provides the most current estimate of the impact of acid emissions from the oil sands on northeastern Alberta lakes. With improvements to the sampling design this program should provide CEMA with ongoing data to assess this issue. A recent study in the Journal of Limnology argues that sampling of benthic invertebrates is a more effective measure of impacts of acid deposition in lentic systems than is water chemistry monitoring. (Relationships between lake water chemistry and benthic macroinvertebrates in the Athabasca Oil Sands Region, Alberta. Parsons, B.G., Shaun A Watmough, Peter J. Dillon and Keith M. Somers. J. Limnol. 69: 118:125 2010.)

Conclusion

The issue includes rivers and includes **biological** parameters as well as assessment of chemical change in lakes. The NSMWG in the ADMF focussed on lake water chemistry as the prime issue and in that sense this issue is complete. RAMP acid-sensitive lake data should be reviewed on an ongoing basis for evidence of change. The biological component is missing from the Framework and before this issue is considered complete CEMA should review the findings in the Parsons et al 2010 study and if appropriate ensure that appropriate benthic macroinvertebrate monitoring is in place. It should be noted that chemistry was selected as an indicator of acid deposition changes and at the time was probably the best indicator available and the current chemistry limit is quite (very) protective. Also the ADMF notes that enhanced aquatic monitoring may be required if changes in lake chemistry are discovered to assess the ecological significance of the changes. The historical response of diatom communities as an indicator of lake chemistry changes implies that ecological consequences of acidification/eutrophication are important to monitor. As noted in Issue 3, ADMF requires improved regional emission inventories.

Completion 90%

Issue 5

Air - Acid deposition vegetation - impacts on biological productivity of acid-sensitive vegetation and changes in species composition and diversity, including impacts on the success and sensitivity of re-vegetation on reclaimed areas

History

A NSMWG issue from the beginning. Some consequences of increased nitrogen deposition originally called acidification are now referred to as eutrophication. This issue is linked with issues 3, 4 and 6. (and 73) as noted with those issues. NSMWG agreed to look at soil and water chemistry as mediators of effects on biological receptors and left direct assessment of plant communities to WBEA (TEEM).

CEMA Status

Expected to be complete after 2008 with the release of the Eutrophication Framework (combined with the ADMF in 2004 and the Bog, fen and lichen monitoring program established by WBEA as part of TEEM- http://wbea.org/content/view/105/233/ but a work in progress as the current "regional N critical load development project" will provide the information required to develop specific N deposition management criteria for the region. This is noted in Issue 73 discussion.

Discussion

Theme 9 of the RSDS is: effects of acid deposition on sensitive receptors. Besides targets and management actions the action plan called for specific research and information gathering goals. The Management Frameworks call for action based on soil and water chemistry values. In ADMF it is noted under short term research: *Soil acidification and vegetation response: A literature review will be conducted to assess the response of vegetation to the changes in soil pH, base saturation, and BC:Al associated with soil acidification. This information will contribute to future review, and possible revision, of management objectives.* TEEM (with CEMA invited) had a workshop that covered this issue (relevant reports included Chang et al. 2011. The role of N and S cycling in soil acidification in forest ecosystems in the Athabasca Oil sands region in Alberta Final report; Tominga et al. 2007 Review of Critical chemical limits of acidification and eutrophication for aquatic and terrestrial environments – final report). One on-line study shows an enrichment effect for mosses. (Effects of simulated acid rain on *Tomenthypnum nitens* and *Scorpidium scorpioides* in a rich fen. L. Rochfort and D.H. Vitt. The Bryologist 9(2) 121-129 1988). TEEM publications reviewing changes to Jack Pine trees in high and low deposition areas and publications looking at vegetative stress in the vicinity of Syncrude operations are relevant but the latest appears to be from 2003. These studies simultaneously consider the effects of various stressors—fire, drought, air pollution and acidification. It is difficult to isolate the effects due to a single agent like acid deposition.

The Acid Deposition Management Framework and the Eutrophication Interim Guidelines have staged implementation. ADMF was projected to have a stage 2 in 2006/09 and a stage 3 in 2009/11. I noted a document indicating that the first update is ongoing. Currently ADMF is in its original format from 2004, although AENV has a new Provincial Acid Deposition framework (2008). Similarly monitoring programs like TEEM 's acid deposition monitoring were to be updated and likely should be reviewed in keeping with other reviews of environmental monitoring in the province. This issue also considers impacts of acid deposition on **reclaimed** vegetation –this is difficult to do in the field with so little fully reclaimed area.

Conclusion

This issue is a work in progress - emission amounts are in doubt as is the use of best available

technology and the validity of current air quality objectives. Direct information on the effects of acid deposition on boreal forest plants and reclaimed areas is limited. There is some uncertainty in my mind about the distinction between acidification effects and eutrophication effects of NOx/SOx emissions (i.e., whether they should be treated separately or considered together) and how these will be dealt with in research and frameworks by CEMA

Completion 75%

Issue 6

Air - Acid deposition wetlands. Acidification of wetlands may impact mosses and lichens and cause sphagnum moss invasion in poor fens, resulting in changes to wetland composition/diversity

History
A NSWMG issue from the beginning. Some consequences of increased nitrogen deposition originally called acidification are now more properly referred to as eutrophication. This issue is linked with issues 3,4, 5. and 73.

CEMA Status
Considered complete after 2008 with the release of the Eutrophication Interim Management Recommendations (combined with the ADMF in 2004 and the Bog, fen and lichen monitoring program established by WBEA as part of TEEM - http://wbea.org/content/view/105/233/ The latest reports by TEEM were in 2007 and summarized 1998, 2001 and 2004 monitoring programs. In the 2007-2009 period TEEM undertook a review and modification of its monitoring program and the first sampling program under the new program is in 2011 so it will likely be a few years before final reports on the work are available.

Discussion
Theme 9 of the RSDS is: effects of acid deposition on sensitive receptors. Besides targets and management actions the action plan called for specific research and information gathering goals. All of these plus the requested monitoring programs appear to be in place. The Acid Deposition Management Framework and the Eutrophication Recommendations have staged implementation. ADMF was projected to have a stage 2 in 2006/09 and a stage 3 in 2009/11. These updates have been delayed. Similarly monitoring programs like TEEM 's acid deposition monitoring were to be updated and likely should be reviewed in keeping with other reviews of environmental monitoring in the province.

Conclusion
CEMA has generally completed its obligation under this issue with ADMF and Eutrophication Interim Recommendations. Both of these have staged implementation and work is ongoing. As these are highly dependent on monitoring programs under the control of other organizations, CEMA should have these reviewed independently to determine their adequacy. If MFs are being updated then this should be noted in association with the current (but soon to be out of date) MF on the CEMA website. A Nitrogen MF is a few years away.

Completion 80%

Issues 7 and 9

Air - air pollutant interactions: (7) Cumulative impacts from concentration and deposition of air pollutants on human health, wildlife and vegetation in the region (individual emissions and their interactions including synergistic effects of ozone); (9) Cumulative impact of concentration of air pollutants (Air Toxics Priority Substances Lists 1&2) on human health and wildlife (especially amphibians) due to air emissions

History

There is evidence of detailed work on Issue 7 but not for Issue 9 so my reading is that for practical purposes these two issues were considered redundant. TMAC had the largest responsibility with aspects of the work shifted to NSMWG

CEMA Status

Ozone components were considered complete with the Ozone MF in 2006 and the other contaminants with the Trace Air Contaminants Management Framework (TACMF) in 2009. Data for both these issues is heavily dependent on ongoing monitoring programs.

Discussion

These issues are large, multifaceted, complex, highly political and in a sense never ending. They encompass all environmental consequences of the discharge and deposition of air-based pollutants from the oil sands operations. CEMA has initiated key literature reviews and studies: Analysis of Airborne Ozone and Ozone Precursor Measurements in the Oil Sands Summer 2002 and 2002 (Contract Number: 2003-0013 NSMWG); Environ (2008) Assessment and Priority Ranking of Trace Air Contaminants in the RMWB-Priority Chemical Screening Tool (Contract Number: 2007-0019 TMAC) Intrinsk (2007) Wildlife Health Literature Review with Specific Reference to Wildlife Species and Chemicals of Potential Concern in the Oil Sands Region (Contract Number: 2007-0020 TMAC) and STI (2007) Characterization of Ambient Air Quality in the Oil Sands Area of Northern Alberta (Contract Number: 2006-0019 TMAC)

Intrinsik (2007) looked at concentration levels in the environment of ACs that are associated with adverse effects to wildlife, with a focus on the 39 priority compounds, but also including other known chemicals of potential concern that are environmentally persistent and associated with oil sands operations. The authors concluded that insufficient information exists to characterize the potential for adverse effects to terrestrial and aquatic mammals, birds, **amphibians**, and reptiles, but ecological soil screening levels (USEPA, 2007) and CCME guidelines (CCME, 2006) provide conservative guidelines for terrestrial wildlife and bird exposures to metals, metalloids and PAHs. The most comprehensive information for determining adverse effects to wildlife is available for metals and metalloids (Intrinsik, 2007).

A survey of locally harvested, traditional food consumption was completed in 2009 (Traditional Food Consumption and Risk Communication Project in the RMWB Phase 1 (Contract Number: 2007-0027 TMAC - Chan & Lawn, 2008) as recommended in an earlier report (WBK, 2005 Health Risk Literature Review: Current Approaches and Data Used to Assess Health Risks Associated with Emissions in the Oil Sands Region (Contract Number: 2004-0029 TMAC)). Some survey participants (28%) reported changes in the appearance and health of wild game, fish and birds over the past 10 years. The reported changes included decreases in number of wildlife and abundance of berries, poor condition or disease in moose, change in colour and deformities in fish, and change in taste. Concern was expressed

regarding health risk related to fish and berry consumption, air quality, and water quality.
The survey involved 180 people from 119 households in the RMWB. Amounts and types of traditional foods consumed were determined and perceptions of risk associated with that consumption were assessed. Over 70 species of locally harvested plants and animals were consumed; the most commonly consumed species were moose, blueberries, whitefish, pickerel, and rabbit. Almost all (98%) survey participants reported eating traditional food with a mean daily intake of 99 g. About 4% of calories, 15% of protein, 14% of iron, 17% of zinc, 12% of niacin, and 37% of vitamin B12 was obtained from traditional food with the remainder from market food, indicating that the relatively small amount of traditional food consumed contributed significantly to consumption of some important nutrients. There was no correlation between traditional food intake and self□reported health status or body mass index.

GOA has an elaborate Air Quality Program http://environment.alberta.ca/0947.html

This document presents an overview of the existing management system for controlling industrial air toxics emissions. Alberta's regulatory approach to industrial air toxics management system has been evolved over the past years. The system is consistent with the management program for criteria air pollutants (sulphur dioxide, nitrogen dioxide, hydrogen sulphide, carbon monoxide, ground level ozone, suspended particulates, ammonia, and static fluorides) and complementary to the federal program. The key components of the Alberta Industrial Air Toxics Management Program include goals, policies, ambient guidelines or prescribed ambient levels, source emission standards, plume dispersion modelling, ambient air and source emissions monitoring, environmental reporting, emission inventory, approvals, inspections/abatement, enforcement and research. The program was designed to ensure that air toxics emissions are minimized through the use of Best Available Control Technology for carcinogens and Best Available Demonstrated Technology that is economically achievable for other air toxics, and to ensure that ambient air quality meets Alberta's guidelines or prescribed ambient levels. The Alberta Ambient Air Quality Guidelines and prescribed ambient levels of air toxics used in the Alberta industrial air toxics management program are included.

GOA relies on national and international air quality standards related to human health. Effects on wildlife and vegetation are less well understood or of concern and as a consequence are not well-monitored.

Conclusion
CEMA arguably completed these issues through TACMF but it could only step away from this issue if it felt that monitoring programs were covering all areas of concern. Clearly they are not. Effects on all biota are still unknown, issue 9 singles out amphibians and I did not see particular attention to them in the relevant CEMA database (but see Wildlife Health Literature Review with Specific Reference to Wildlife Species and Chemicals of Potential Concern in the Oil Sands Region (Contract Number: 2007-0020 TMAC – page 29). I believe these issues should be combined and at the very least CEMA will be updating the literature every five years or so.

Completion 90%

Issue 13

Air-Ground level Ozone. Impact of ground-level ozone on human health and vegetation(Ground level ozone is a secondary pollutant formed from NOx and VOC emissions)

History
NSMWG from the start. This issue is also linked to issues 16 and 19.

CEMA Status
Considered completed 2006 with release of the Ozone Management Framework. AENV has multistakeholder process for developing and revising Alberta Ambient Air Quality

Discussion
From the Ozone MF:
In 2001, a multi-stakeholder team under the Alberta Clean Air Strategic Alliance (CASA) was formed to develop an Alberta implementation plan for the Canada-wide Standard (CWS) for PM2.5 and Ozone. The NSMWG subsequently delayed some of its ozone- related activities as it was thought that the CASA work would provide context for, and possible constraints on, any regional ozone management plan. In 2003, CASA produced a consensus Particulate and Ozone Management Framework for Alberta (refer to Appendix 1). This framework addressed the issue of regional ozone management and provided "planning" and "exceedance" ozone triggers that apply across the province. The regional management framework outlined in this document supports the Alberta provincial approach (Section 1.2).

The Canada-Wide Standards, which form the basis for this management framework, were set for the protection of human health and state: "Since the current CWSs are related primarily to protection of human health, their adequacy for the protection of vegetation, visibility impairment, material damage or other adverse effects may need to be assessed." ***It is therefore not clear whether they are also fully protective of vegetation. This is a national as well as a regional issue.*** *There has been tremendous effort by other research groups throughout the world to define the effects of ozone on vegetation and on health, to establish the environmental capacity of the ecosystem to ozone concentrations, and to develop ozone guidelines for Canada and for Alberta. These efforts should not be duplicated, but rather the learnings from these efforts should be applied to assist in addressing these issues in the Region. (from Ozone MF)*

The Ozone MF recommended

· A review of existing standards and/or criteria for ground level ozone related to vegetation protection;
• Comparison of those criteria with existing and projected ozone levels to determine if vegetation impacts may be an issue in the Region;
· If potential issues are identified, then AENV and/or EC will be requested to develop a provincial/ federal ambient ozone standard for vegetation protection that could be applied in the Region; and
• If AENV and/or EC identify the need, CEMA will assist with studies on ozone effects on vegetation in the Region to develop a vegetation effects ozone standard relevant to the Region.

After the Ozone MF was released CEMA completed a study looking at tools for assessing ozone effects on vegetation. From: Screening Level Review and Assessment of Metrics for the Assessment and Management of Ozone Effects on Vegetation (Contract Number: 2006-0025 NSMWG)

Management of ozone levels and evaluation of ozone levels that may be responsible for vegetative impacts is not possible without continuous monitoring data that provides 1-hour average ozone concentrations. Ozone monitoring is conducted within the region, however, at present the focus is primarily on ozone levels in occupied centres, notably Ft. McMurray, Ft. McKay and Ft. Chipewyan, or near industrial facilities (such as within areas of ozone-scavenging emissions). Expansion of this network into more remote locations within the region is required to support the derivation of critical levels (e.g., background, surveillance, management, exceedance levels) for the protection of forest vegetation, *to determine if exceedances are occurring and if so, what degree of environmental risk or effects may be present.*

A letter was sent by CEMA to WBEA requesting that this additional monitoring be undertaken and the WBEA ozone monitoring program is being expanded.

Conclusion
The absence of key information on the effects of ground-level ozone on vegetation makes this issue incomplete

Completion 80%

Issue 14

Air-Heavy Metals Deposition - Impacts of increasing levels of heavy metal deposition on soil and vegetation, fish, wildlife and/or human health.

History Assigned to Trace Metals and Air Contaminants Group (TMAC) (now part of Air Working Group AWG), Sustainable Ecosystems WG is providing support

CEMA Status
Considered complete in 2001 with the Trace Metals Management Framework– completed 2001 The framework calls for a periodic metal emission inventory by industry and research and monitoring recommendations to be implemented by TEEM or RAMP. A system evaluation was scheduled for 2008.

Discussion
The paper by Erin Kelly et al. (2010) Oil sands development contributes elements toxic at low concentrations to the Athabasca River and its tributaries PNAS 107(37) 16178-16183 (full text available at:http://www.pnas.org/content/107/37/16178.full.pdf+html) produced an explosion of assessments of monitoring programs in northeastern Alberta

In response to the two papers by Kelly et al 2009 and 2010, The Alberta Government established a expert panel to review water quality issues on the Athabasca. Their report - Evaluation of Four Reports on Contamination of the Athabasca River System by Oil Sands Operations Water Monitoring Data Review Committee (Peter Dillon, George Dixon, Charles Driscoll, John Giesy, Stuart Hurlbert, Jerome Nriagu, 2011) is available at: http://environment.alberta.ca/documents/WMDRC_-_Final_Report_March_7_2011.pdf. I have included here excerpts from their report that relate to heavy metal issues in the region. Key comments are highlighted in bold:

Their (i.e., Kelly et al) results, therefore, carry the implication that **considerably more particulate matter and trace metals are being released from the oil sands facilities than is being reported in the National Pollutant Release Inventory,** or that there are other airborne sources.

The Regional Aquatics Monitoring Program (RAMP) has a very extensive monitoring design. But the Committee believes the program is spending large amounts of time and resources on obtaining water quality data that are difficult to interpret because the systems they are monitoring are large, complex and variable, and their sampling frequencies are too low and the sampling locations are not adequate to account for this. Although many different trace metals are measured in the samples collected, only a few of these fit the program's monitoring criteria and hence the others are not reported. **Data for all trace metals measured in water samples should be included in future reports by RAMP.**

Taking into consideration all data and critiques, we generally agree with the conclusion of Kelly et al. that PACs and trace metals are being introduced into the environment by oil sands operations.

Although the Alberta Environment trace metals data from before 2004 are invalid, most of the data in these reports are valid.

The studies by Kelly et al. have served to focus attention on some critical issues that can be resolved in a new monitoring program now being designed by a committee set up by the Alberta

Minister of the Environment. This program can build on elements and concepts of the three existing programs to address the issues of whether the releases from oil sands production are causing adverse effects on aquatic and terrestrial organisms. This monitoring should consider effects in tributaries, especially during critical periods of flow in the river. T**he accumulation of residues in the delta, Lake Athabasca and their biota also merit special attention, with expanded**
biological monitoring and focused scientific investigations to assess risk.

Findings about concentrations of mercury in biota collected from the oil sands region may be relevant to this discussion Hebert *et al*. (in press). (Hebert, C.E., D.V. Chip Weseloh, S. MacMillan, D. Campbell and W. Nordstrom. 2011. Metals and polycyclic aromatic hydrocarbons in colonial water bird eggs from Lake Athabasca and the Peace-Athabasca delta, Canada. Env. Toxicology and Chemistry). First, mercury concentrations in California Gull eggs from Egg Island (in Lake Athabasca, 60 km NE of the delta) increased 40% between 1977 and 2009 ($P = 0.04$). Second, in 2009 mercury concentrations in Common Tern eggs from Mamawi Lake in the delta area had mercury concentrations 61% higher than in Common Tern eggs from a colony in a more pristine environment (Rocky Point), about 40 km up the Peace River from the delta **(**$P = 0.0074$). These observations suggest that more attention should be paid to concentrations of contaminants in the biota and sediments of the delta area.

McDonald and LeClair (2004) - (McDonald, D. and D. LeClair. 2004. Methods and quality assurance investigations for trace metals data from the Long-Term River Network, 2003. Env. Monit. and Eval. Br. Alberta Environment. 77 p.) - evaluated quality control data for trace metals from the Alberta Long-term River Network (LTRN) sampling program. **They summarized split and spiked samples and evaluated data from two analytical laboratories. The study found that a proportion**
of trace metal concentrations differed by more than 20% between the two laboratories, and that a number of blank samples contained metals at concentrations above method detection limits. This study draws attention to the need for AENV to provide some oversight on the quality of the work of the contract laboratories.

Concentrations of many trace metals at the Old Fort sampling location exceeded the guideline values on some occasion (Hebben, 2009). (*Hebben, T. 2009. Analysis of water quality conditions and trends for the Long-term River Network: Athabasca River, 1960-2007. Alberta Environment, Water Policy Branch, Environmental Assurance. 341 p.*) The CCME guideline of 300 μg/L for total iron was exceeded 58% of the time while the 100 μg/L guideline for aluminum was exceeded 51% of the time. The hardness-based total cadmium guideline was exceeded in 47% of samples that were analyzed. Copper concentrations in 42% of samples exceeded the hardness-based guideline, and the exceedances for total lead and total zinc were about 13% each. Hexavalent chromium exceeded the CCME guideline (1.0 μg/L) in two of 18 samples. **The exceedances of many trace metals above the CCME guideline with high frequency at this site is significant and consistent with the observations by Kelly *et al.* (2010).**

Although Hebert (2009) maintained that the exceedences were likely due to natural suspended sediments in the lower Athabasca River and its tributaries, he did suggest that "at the same time, however, anthropogenic contributions from both point-(wastewater treatment plant effluents, pulp mill effluents) and non-point sources (resource extraction, forestry, agriculture) cannot be ruled out".

Sampling and analysis of trace metals in aquatic ecosystems by Alberta Environment (AENV) has been changing and evolving over time in a manner that makes it impossible to make comparisons between the historic data and currently collected data. Therefore these data are of limited use for achieving the goals of the monitoring program. Too many measurements for trace metals and PAHs are reported as non-detects. In 2004, the government laboratory

developed new analytical procedures that allowed detection to the ng/L level for most metals, and as a result, fewer non-detects are being observed.

... the RAMP monitoring program has been concentrated in the Focus Study Area (FSA) defined in the Technical Report as those projects owned and operated by the 2009 industry members of RAMP. An important function of RAMP is to address many of the approval-related monitoring needs for the oil sands industry. Viewed from the priority of work, RAMP monitoring program may be considered to be a service to the oil sands industry to a large extent. Low priority is given to monitoring and reporting on any contaminants that do not fit these criteria. **Although a large number of trace metals are apparently measured in the samples collected, only the following metals fit the monitoring criteria and hence are included in the RAMP report: total and dissolved aluminum, total arsenic,**
total boron, total molybdenum, total strontium and mercury.

RAMP also reported a parameter for sediments called "total metals" said to vary from less than 30 mg/kg to nearly 500 mg/kg. Metals included in this parameter were As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, Ni, Se, Ag, U, V and Zn. How this aggregate measure was derived was not explained in the RAMP report – whether based on absolute concentration, equivalent concentrations, toxic equivalent or other functional relationships. **We feel that the term "total metals" is meaningless, unless done on a toxic unit approach where an index of total metal toxicity equivalents is determined.** This could be done for some metals with similar modes of action and for which there is no or little non-additivity of toxicity. However, this cannot be done for all of the metals listed by RAMP.

It is notable that over the past decade (RAMP IT 2010a -RAMPIT (RAMP Implementation Team) 2010a. Regional Aquatics Monitoring Program 2009 Technical Report. Prep. for RAMP Steering Committee. 803 p.) found no detectable trend for arsenic concentrations in Athabasca delta sediments. In contrast, between 1970 and 1990, arsenic concentrations increased 5-fold in the sediments of Lake Athabasca (Bourbonniere *et al.* 1996 - Bourbonniere, R.A, S.L. Telford and J.B. Kemper. 1996. Depositional history of sediments in Lake Athabasca: geochronology, bulk parameters, contaminants and biogeochemical markers. Project Report 72, Northern River Basins Study, Edmonton.)).

The Kelly *et al.* papers have served a useful purpose in pointing out some deficiencies in the current monitoring programs in the oil sands area. The committee thinks that this is now accepted by all, as evidenced by the Alberta Premier appointing yet another panel to develop a more rigorous monitoring program for the future. We believe that this was the goal of Prof. Schindler's team when they initiated their studies. They did what they could do with limited funds, and while not perfect and limited in scope, the results have received considerable attention.

Subsequent to the studies by Kelly et al., the Alberta government has begun some studies of deposition and included some elements of the air-monitoring program just recently set up by the
Wood Buffalo Environmental Association. These new initiatives will be addressing some of the deficiencies noted by Kelly et al. Alberta Environment has also launched a contaminant study in the area.

Detailed year-round and multi-year measurements of air mercury species and wet deposition of mercury and other toxic metals (similar to the Mercury Deposition Network) should be implemented for the oil sands region to provide improved characterization of local sources of mercury emissions and mercury deposition. The occurrence of elevated measurements of atmospheric mercury and toxic metal concentrations or depositions at these sites could be evaluated by back trajectory analysis to determine the source area. This program may be part of the plans for the Wood Buffalo Environmental Association atmospheric chemistry and deposition program. If so, this program should be closely coordinated (by co-

locating the sampling sites for instance) and hence able to provide additional insight on mercury and other toxic metal deposition to the region and the contribution of the oil sands activities to the atmospheric flux.

A detailed survey of trace metals and PAHs in snow should be conducted to repeat the observations of Kelly *et al.* (2009, 2010). However this snow survey should involve more transects away from the oil sands development site and across the diverse landscape to better characterize the transport and deposition of mercury from the site.

A paleolimnological study should be initiated to evaluate historical trace metals, mercury and PAC deposition in lake and bog sediments from undisturbed watersheds proximate and remote from the oil sands development area. Sediment cores should be collected from several lakes both near and remote from the oil sands area. These cores should be age dated (by 210Pb or other geochronological methods) and measured for mercury and other relevant contaminants. Profiles of stable metal isotopes, metal ratios, and changes in carbon contents of various organic compounds can provide information on historical deposition to the region and help quantify the influence of emissions from oil sands activities on contaminant burdens in sediments.

The contract laboratories should develop methods for trace metals, PAHs and other organic contaminant analyses that are sensitive enough to determine the actual concentrations of contaminants in environmental media and reduce the number of non-detects being reported. Alberta Environment should endeavour to establish clear performance standards (or tighten them up if they exist already) that stipulate the level of quantification of PAH and trace metals especially in water samples, and establish a performance assessment process for providers of analytical support to the LTRN program.

Measurements of trace metals should include total and filtered forms, and methyl mercury, coincident with measurements of dissolved organic carbon and particulate organic carbon (or total suspended solids). These measurements would provide a better understanding of the characteristics of surface water trace contaminants. These fluvial measurements could be coupled with discharge measurements to calculate the mass flux of trace contaminants. These fluxes should be compared to estimates of atmospheric deposition of trace contaminants.

Conclusion

Based on these new studies and reviews, the Trace Metals Management Framework is out of date and needs to be reviewed . Key conclusions from the Dillon (2001) report that are listed in and integral to the Framework can no longer be supported. A recent (2009) CEMA literature review is movement in this direction Review and Assessment of Deposition and Potential Bioaccumulation of Trace Metals in the Athabasca Oil Sands Region (Contract Number: 2007-0055 TMAC). Trace Metals are now included in the Air Contaminants Management Framework (2009) but without appropriate monitoring and laboratory analyses no Framework can ensure protection of the environment. **I recommend that CEMA point out to readers that the current Metals Framework is out-of-date.**

Completion – 75% (based on the need to update)

Issue 15

Air – inhalable particulate matter PM_{10} and $PM_{2.5}$– impact of inhalable particulate matter on human health and wildlife

History
Lead by TMAC (now AWG) with support from SEWG

CEMA Status
Considered complete with publication of Trace Air Contaminants Management Framework 2009 . It was noted that PM_{10} emissions are captured by the National Pollutant Release Inventory (NPRI) but according to the 2010 guidelines both PM_{10} and $PM_{2.5}$ must be reported. One issue is that mine fleet emissions, which are significant, are not covered by the NPRI so this source of particulate emissions are not accounted for in NPRI. Also ammonia contributes to particulate formation and there is a level of uncertainty regarding regional ammonia emissions and ambient levels.

Discussion
In high concentrations, suspended particulates may cause human health problems. The amount of damage depends on the chemical composition of the particles. Inhaling particulate matter can make breathing more difficult, or aggravate existing lung and heart problems. Smaller particles have the ability to travel deeper into the lungs where they may cause permanent lung damage. Particulates are derived from stack emissions, combustion, and windblown coke dust, dry tailings, and tar sands . Both the quantity and the chemical constituents of the particulates pose health concerns, as they contain not only organic contaminants such as PAHs but also a suite of metals such as vanadium, arsenic, and mercury. Occupational exposure to tar sands employees may be significant. Elevated levels of mercury and arsenic in the local fishes are a concern. Health Canada recommended that consumption of large predatory fish should not exceed one meal per week for adults. Due to the nutritional value of fish, and the traditional-cultural and economic importance of fish to Ft. Chipewyan residents, fish mercury levels pose a serious dilemma. The effects on other mammals and birds would be expected to be similar. Alberta ambient air quality objectives 2007 $PM_{2.5}$ is 30microgram/m3 on a 24 hour average. $PM_{2.5}$ is being monitored by WBEA .Particulates also play a role in the production of smog and can contribute to acid deposition, reductions in visibility, and possible changes to our climate. These secondary impacts could have a wide range of impacts on plants and wildlife.

From the Clean Air Strategic Alliance Framework re the Canada Wide Standard (CWS) for coarse particulates (PM2.5-10):

There is some evidence of health effects of coarse fraction particulate (PM2.5-10), and it is observed that there will be a review of the health science associated with coarse fraction PM in 2005 as part of the national CWS process. A significant portion of coarse particulates in Alberta comes from natural sources or sources such as agricultural land use, sometimes reaching levels of 200µg/m3 or more. Because many primary Alberta sources are not manageable, an ambient coarse fraction standard may be meaningless. It is recognized that the national Joint Action Implementation Coordinating Committee (JAICC) will be making a recommendation to the CCME on a coarse fraction standard in fall 2003.

Recommendation

With respect to consideration of a Canada Wide Standard for coarse fraction particulate, it is recommended that Alberta Environment take forward the following two positions as input to the Canadian Council of Ministers of the Environment recommendation to Ministers in fall 2003:

(a) It is recommended that consideration of an ambient coarse fraction standard be deferred until further health science information is available as part of the national Canada Wide Standard health science review in 2005.
(b) It is recommended that consideration be given to the need for national source standards for sectors and activities that are significant sources of coarse fraction particulate and not currently subject to source standards.

Two recent studies of fine particulate concentrations in the Athabasca Oil Sands region funded by WBEA (Fine Particulate Matter Mass Concentrations in the Athabasca Oil Sands Region Kevin E. Percy & Yu□Mei Hsu Wood Buffalo Environmental Association AWMA International Speciality Conference: Leapfrogging Opportunities for Air Quality Improvement, Xian, China, May 10□14, 2010 and Wood Buffalo Environmental Association Ambient Air Quality Data Summary and Trend Analysis Summary (April 2010) W.B. Kindzierski, PhD, PEng, P. Chelme-Ayala, PhD, M. Gamal El-Din, PhD, PEng)indicate generally decreasing levels in the region. A caveat would be the concern over the quality of monitoring data as has been shown to be a problem for data from RAMP. A second concern is the effect of future oil sands expansion on these numbers. Regional emissions have increased significantly since 1999 and yet ambient levels of PM have not increased which indicates that the location and/or nature of the monitoring is not capturing the increases or some atmospheric transformations or reactions are occurring that are affecting PM2.5 formation, deposition and/or transport.

Conclusion

In the RSDS, the issue of particulates is separate from the issue of metal contamination. They are clearly linked and even though particulates are addressed here, the conclusion that metal levels in the areas around oil sands projects are likely greater than presumed in the TMMF would suggest caution in certifying that this issue has been fully addressed. CEMA has provided a Framework document, monitoring is in place and reporting is required. I would think it is important to assess the adequacy of monitoring before certifying that this issue is complete. Finally Timoney and Lee 2009 (Does the Alberta Tar Sands Industry Pollute? The Scientific Evidence. The Open Conservation Biology Journal 3:65-81) report on high levels of metal contamination in some individual fish and mammals. I do not see the link between particulate emissions and wildlife health addressed in the Framework or in a recent CEMA literature review of contaminant effects on Wildlife. It focused on the TMAC priority list of chemicals that is comprised of common air contaminants associated with oil sands operations (Clearstone and Golder 2002; AENV 2005). These include criteria air contaminants, polycyclic aromatic hydrocarbons and volatile organic compounds. In addition, the search for relevant information included other known chemicals of potential concern (COPC) that are environmentally persistent and associated with oil sands operations (i.e., metals). Chlorinated compounds (i.e., polychlorinated biphenyls - PCB, dioxins, and furans) were not included in the assessment because the primary sources of these chemicals are forestry and urban emissions (Clearstone and Golder 2002) and have not been evaluated as part of environmental impact assessments (EIA) in the region. (Wildlife Health Literature Review with Specific Reference to Wildlife Species and Chemicals of Potential Concern in the Oil

Sands Region (Contract Number: 2007-0020 TMAC)

Completion 75%

Issue 19

Air – oxides of nitrogen. Cumulative impact of increasing NOx emissions – These emissions can contribute to the increase of ambient NOx concentrations, formation of ground level ozone, acidification, vegetation and human health effects. NOx is produced by high temperature combustion processes.

History
Lead by NSMWG with support from TMAC (now collectively the AWG).

CEMA Status
Not specified by presumed complete through the Acid Deposition Management Framework (2004), the Ozone Management Framework, (2006), and the Eutrophication Interim Recommendations (2008).

Discussion
It is my feeling that this issue is simply a summary of all the other related NOx issues covered separately under acidification (Issues 1,3,4,5,7,9) Ozone (Issues 9,13), and Eutrophication (Issue 73). Monitoring programs (WBEA and TEEM) exist to monitor ambient levels and release amounts are estimated through EIAs and presumably known through on-site monitoring (although releases from vehicles are only estimated).

Conclusion
I would consider this Issue simply a summary of the other Nitrogen issues and would not longer treat it as distinct.

Completion 100%

Issue 20

Air-Sulphur Dioxide (SO2) - Impact of increasing SO2 concentrations on human health, vegetation and wildlife. SO2 ambient air quality guidelines are stipulated, major contributor to acid deposition

History
NSMWG/TMAC – planned completion 2009– possible duplication with CASA also see redundancy in Acid Deposition MF; and Ozone MF monitoring recommendations to WBEA

Discussion
I find it curious that there is no mention of any possible human health effects associated with SO2 on the Alberta Environment website (http://environment.alberta.ca/02048.html) when other governments acknowledge the potential.

This is the page from the Ontario Government website:

What are the effects of SO2?
Health effects caused by exposure to high levels of SO2 include breathing problems, respiratory illness, changes in the lung's defences, and worsening respiratory and cardiovascular disease. People with asthma or chronic lung or heart disease are the most sensitive to SO2. It also damages trees and crops. SO2, along with nitrogen oxides, are the main precursors of acid rain. This contributes to the acidification of lakes and streams, accelerated corrosion of buildings and reduced visibility. SO2 also causes formation of microscopic acid aerosols, which have serious health implications as well as contributing to climate change.
The following table shows the health effects of different Air Quality Index levels caused by sulphur dioxide.

Health effects of different Air Quality Index (AQI) levels caused by sulphur dioxide

Category	AQI	Pollutant Concentration Breakpoints (ppb)	Sulphur Dioxide (SO_2)
Very Good	**0 - 15**	**0 - 79**	No health effects are expected in healthy people.
Good	**16 - 31**	**80 - 169**	Damages some vegetation in combination with ozone.
	32 - 49	**170 - 250***	Damages

Moderate			some vegetation.
Poor	**50 - 99**	**251 - 1999**	Odour; increasing vegetation damage.
Very Poor	**100 or over**	**2000 or over**	Increasing sensitivity for asthmatics and people with bronchitis.

From: Characterization of Ambient Air Quality in the Oil Sands Area of Northern Alberta (Contract Number: 2006-0019 TMAC):

High concentrations of SO2 are typically seen only at the industrial monitoring sites (Albian Mine, Buffalo, Lower Camp, Mannix, Mildred, Millennium Mine, Syncrude UE 1), as expected, and are not seen at the population-oriented monitoring sites (Athabasca, Fort McKay, Patricia McInnes, Fort Chipewyan), indicating that SO2 concentrations are influenced by local sources [subsequent to this study levels in Fort McKay have exceed the AAAQO for SO2]. *SO2 ambient concentrations have not significantly increased overall or in terms of high concentration values. Millennium Mine shows an upward trend between 2001 and 2005, but the site was moved after 2002, after which no significant trend was observed*

Conclusion
SO2 levels are monitored and except for brief periods at both industrial and urban sites, levels are below provincial standards. Alberta Environment has produced a Draft Air Quality Management Framework for NO2 and SO2 for the Lower Athabasca Region (March 2011) which encompasses RMWB – however it is worth noting that 1 hr. SO2 levels in the region are currently at an action level. From section 5.1.1 of that document:*At this time, the framework focuses on managing ambient air quality with respect to ambient air concentrations of NO2 and SO2 because these substances: are two of the major substances being released in the region; are actively monitored throughout the Lower Athabasca Region; are predicted to increase with expanding development; are being detected at increasing and/or elevated levels in some areas of the region; are regulated under the Environmental Protection and Enhancement Act; have established AAAQOs; have sufficient monitoring data available to allow assessment of local ambient air quality against the air quality triggers and limits; and can be controlled through a range of options applied to the various sources. NO2 and SO2 are also precursors to particulate matter and ozone. Acid and nitrogen deposition and their long-term acidification and eutrophication impacts are other potential environmental issues associated with NO2 and SO2 emissions.* ***Ecosystem and environmental effects are monitored through regional programs, and effects are managed through regional and provincial management frameworks.***

Completion – 100% - from the air quality and human health perspective, acid deposition is another issue (see Issues 1,3,4,5,6)

Issue 27

Fisheries- Fish Conservation: Activities in the region will result in changes inflow(volume) which in turn will alter fish habitat.

History
Although in the original list of 37 CEMA issues this one appears to be led be provincial (AENV) and federal (DFO) agencies. SWWG is identified as a support group. This issue is one of two Fisheries issues (the other, issue 26 not in the original 37 looks at increased human access and its effects on fish populations) that are separated from CEMA Surface Water Issues – 36 to40, 45 and 47 which invariably consider impacts to fish populations. Why these were separated is unclear to me.

CEMA Status
Unspecified

Discussion
It is self-evident that if water use by oil sands projects reduces flow in some tributaries to the point of freezing solid in winter then they will be unsuitable for fish. Obviously determining this with some precision is the point of numerous studies on in-flow needs of the Lower Athabasca undertaken by SWWG e.g., Golder and Assoc. (2009) Dissolved Oxygen Levels in Side Channels and Tributaries in the Lower Athabasca River - Winter 2009 . These various studies are summarized in the Phase II Water Management Framework. In Terms of Reference for EIAs there is a requirement for an assessment of fish populations in areas affected by a project and the impact on these species of water use by the project. The Regional Aquatics Monitoring Program monitors fish populations for the following: Collect fish population data to characterize the natural variability in fish populations, assess predictions documented in EIAs, and meet monitoring requirements found in regulatory approvals. Monitor potential changes in fish populations resulting from stressors (physical, chemical, or biological) linked to oil sands developments, by assessing attributes such as growth, reproduction, and survival. Determine the suitability of fish in the oil sands region for human consumption. RAMP also monitors aquatic environments for cumulative effects and trends.

Conclusion
I do not know how specifically this issue differs from similar ones that look at river flow and fish but the combination of CEMA's work on the in flow needs of the Athabasca system, RAMP monitoring and EIA requirements should have it covered. Tributaries and other river systems (e.g., Muskeg) are not as well studied. RAMP monitoring has been criticized - the review committee felt that RAMP water balance model to assess cumulative effects and to detect trends was insufficient. Similarly RAMP's testing of EIA predictions and fish population sampling were judged to be inadequate. Consequently, even though this issue is one of CEMA's 37, further work on the modelling of fish habitat changes associated with oil sands projects and monitoring of stream flows falls to both levels of government and RAMP rather than CEMA.

Completion 100%

Issues 36 and 37

Surface water (36)- Changes in flows, sediment concentrations and channel regime in receiving streams in local basins and their impacts on fish habitat. Surface water (37) – Drainage Regime. Restructuring of drainage regimes may contribute to increased erosion and result in impacts to wetlands and change flow rates in tributaries, increase sediment and have an impact on fish habitat

History

Although part of the original 37, these issues have been lead by AENV with support from SEWG and SWWG

CEMA Status

Considered complete in 2009

Discussion

This issue is broad reaching and not related to specific watersheds, or studies. I read it as a mandate to ensure that fish populations are protected despite increased oil sands development.

The EIA process makes it clear that physical characteristics of streams, rivers, their watersheds and sub-surface water populations are not to be permanently impacted by development

3.4.2 Impact Assessment

[A] Discuss changes to watersheds, including surface and near-surface drainage conditions, potential flow impediment, and potential changes in open-water surface areas caused by the Project.
[B] Describe the extent of hydrological changes that will result from disturbances to groundwater and surface water movement:
a) include changes to the quantity of surface flow, water levels and channel regime in watercourses (during minimum, average and peak flows) and water levels in water bodies;
b) assess the potential impact of any alterations in flow on the hydrology and identify all temporary and permanent alterations, channel realignments, disturbances or surface water withdrawals;
c) discuss both the Project and cumulative effect of these changes on hydrology (e.g., timing, volume, peak and minimum flow rates, river regime and lake levels), including the significance of effects for downstream watercourses; and
d) identify any potential erosion problems in watercourses due to the Project.
[C] Discuss changes in sedimentation patterns in receiving waters resulting from the Project.
[D] Describe impacts on other surface water users due to the Project. Identify any potential water use conflicts.
[E] Describe potential downstream impact if surface water is removed.
[F] Discuss the impact of low flow conditions and in-stream flow needs on water supply and water and wastewater management strategies.
[G] Discuss how potential impacts of temporary and permanent roads and well pads on the wetland hydrology will be minimized and mitigated.
[H] Describe mitigation measures to address impacts during all stages of the Project, including:
a) alteration in flow regimes;
b) potential water use conflicts; and
c) increased sediment loadings

CEMA undertook a study to look at baseline stream conditions (Natural Range of Variability of Physical Chemical and Biological Characteristics of Streams in the Athabasca Oil Sands Region (Contract Number: 2004-0012 SWWG))

*As a result of surface mining, rivers, creeks, and swales that drain the landscape towards the Athabasca River may require relocation, after regulatory review and approval, to allow for resource extraction. After mine closure in the reclaimed landscape, diverted streams may pass through natural and reclaimed material. Understanding pre-disturbance stream channel characteristics and variability thereof is one of the initial steps required to design streams. This report examines the natural variability of baseline data that are required to design fish channel habitat for key fish species l. As such the report focus includes both natural variability of stream physical, biological and water and sediment quality characteristics and how these data relate to the development of stream design criteria. Knowledge of existing stream conditions and characteristics will help formulate design objectives and criteria for newly created stream channel*s.

From RAMP website http://www.ramp-alberta.org/management/policies/habitat/no+net+loss.aspx

No Net Loss of Fish Habitat

The federal Fisheries Act is Canada's strongest legislation protecting the aquatic environment. Over time, policies have been created to enhance and improve the legislation, including the No Net Loss of Fish Habitat (external link), which aims to maintain habitat for fish production. The no net loss policy is governed by the Department of Fisheries and Oceans, Environment Canada and often includes a provincial authority. **Although the destruction of fish habitat is prohibited under the Fisheries Act, there can be project exclusions. These exclusions allow a project to proceed even though the destruction of fish habitat is inevitable. In this case the no net loss policy comes into effect. According to Fisheries and Oceans Canada, the No Net Loss policy can be implemented in the following ways, in order of preference (Department of Fisheries and Oceans Canada, 2006): Maintain the productive capacity of the habitat of concern by redesigning the project or mitigating any potential impacts. If maintenance is not possible then explore like-for-like compensation, which involves creation of similar habitat nearby or on the site. If compensation is not possible then consider artificial habitat production, an option which must meet very specific objectives outlined by FOC**

The physical characteristics, water quality, and productive capacity of river ecosystems are dependent, in part, on maintaining a minimum flow in the river, known as the in-stream flow needs (IFN) (Schindler et al. 2007). In the Athabasca River, successful feeding, migration, rearing and overwintering of various fish species depend on sufficient flows. The perched lakes, wetlands, and waterways of the Athabasca River delta also are highly sensitive to small changes in the level of the Athabasca River (Schindler et al.). Oil sands mining is currently the largest consumer of water from the Athabasca River basin, with approximately 2% of the average annual water flow in the Athabasca River allocated to oil sands projects (AENV 2007). Withdrawal of water during natural low-flow conditions in the river is of concern due to the potential for water levels to drop below the in-stream flow needs.

Potential impacts from withdrawal of water from the Athabasca River have been addressed in Alberta's "Athabasca River Water Management Framework" (AENV 2007), which was designed to protect the ecological integrity of the Athabasca River during oil sands development by setting maximum withdrawals under various natural flow conditions. Phase 1 was implemented on July 1, 2007, and requires operators to reduce water withdrawals during environmentally sensitive periods. Phase 2 will build on Phase 1 and will develop a long-term strategy based on additional data and considerations.

Written Submission: Federal Parliamentary Committee Hearing on Water and the Oil Sands Simon Dyer (2009) http://pubs.pembina.org/reports/oil-sands-and-water-submission.pdf

Previous instream flow needs (IFN) studies in Alberta have determined that a fully protective IFN prescription for the aquatic ecosystem of a river would involve the establishment of an ecosystem base flow (EBF): a flow threshold below which no withdrawals are permitted. In the current Management Framework during the red zone, water withdrawals of up to 5.2% of the historical median flow are permitted. During extremely low daily flows, water withdrawals could be a much higher proportion than this median. Recommendation: No new approvals or water licenses for oil sands mines should be granted until the establishment of a scientifically-based Ecosystem Base Flow for the Athabasca River, beyond which withdrawals by all oil sands operations during the red zone or low flow periods would be prohibited.

From AENV website http://environment.alberta.ca/01229.html
Further work underway on the Framework (Phase Two) includes development of an ecological base flow to ensure the aquatic ecosystem remains protected into the future. Phase Two will utilize further scientific and traditional knowledge of the Lower Athabasca River gathered over the years.

Conclusion
CEMA has addressed these issues through their research and participation in AENV led management framework development. Outstanding concerns expressed by critics include the weak presence of DFO in the area and final resolution of the water management plan for the Athabasca River. Once a revised MF is in place, the future role for CEMA needs to be re-assessed.

Completion 90%

Issue 38 and 40

Surface Water – End Pit Lake (EPL)Water Quality - (38) Impact of on habitat conditions for biota in the lake itself and for the river/creek into which it will discharge. Uncertain water quality in the EPL which is a final landscape feature. This results from the proposal to put tailings in the lake and cap it with water and the quality of water that will be in these lakes from local runoff. (40) Use of chemical specific guidelines for toxic elements of water discharges instead of Toxic Units: e.g., from End Pit Lakes

History

Issue 38 was an RWG issue from the start. Issue 40 is linked to AENV

CEMA Status

In 2007 and End Pit Lake Guidance Document was prepared. This was peer-reviewed in 2009 (Synthesis of Reviewer Comments on the CEMA End Pit Lake Technical Guidance Document (Contract Number: 2008-0026 RWG). Based on this review a revised Guidance Document is anticipated for 2012.

Discussion

According to the reviewers of the EPL Tech Guidance document, the path forward to creating a viable EPLTGD for 2012 is relatively straightforward.

1) Hire expert authors and peer-reviewers. Provide forums for coordination and exchange of information across disciplines.
2) Use the peer review process to define research needs.
3) Conduct research, using reviewers or authors to steer and review research.
4) Hire managing editors to review document unity and expunge redundancy.

Although there are organizational challenges inherent to this process, managing such a program is well within the capacity of the consulting community.

It seems clear that the concept of Toxic Units has been eliminated with research on actual chemicals as per issue 40. For instance in the Guideline documents it notes: one toxicity issue specific to the oil sands industry is the presence of naphthenic acids (NAs). NAs are naturally occurring carboxylic acids with surfactant properties that are associated with petroleum. Oil sands process-affected water is toxic to aquatic organisms, and NAs are the primary group of compounds responsible for the toxicity (Holowenko and Fedorak 2001). In 2011 Chris Weisener, an assistant professor of aqueous geochemistry at the University of Windsor who specializes in mine waste management and environmental reclamation strategies, received $385,000 from the Natural Sciences and Engineering Research Council and industry partners to investigate the biogeochemical evolution of tailings that go in to end pit lakes in the Alberta oil sands. Very little is known about the potential environmental effect of tailings on the end pit lakes in which they are proposed to be stored. Clearly even by 2012, work on EPLs will not be finalized.

Additionally, through EPEA, EPLs will require an application and must obtain approval for its reclamation procedures. EPEA requires an operator to conserve and reclaim land disturbed or affected by an industrial activity such as an oil sands mine and to obtain a reclamation certificate. In addition to EPEA approval, Water Act approvals are also necessary for the reclamation certificate. The criteria for assessing reclamation certification are EPL-specific and are based on

an assessment of whether or not the EPL is built in compliance with the application. A major component of EPEA is the expectation for public consultation in the preparation of applications and the provision for public involvement in their review. This is expected to be carried out in preparation of reclamation plans for EPLs.

Conclusion
The new EPL Technical Guidance Document is required before these issues can be considered complete. It is unlikely that the research required will be completed in 2012

Completion 50%

Issue 39

Surface water- Changes in open water areas, including lakes and streams. This is an overall issue of watershed management and cumulative changes in flow regimes due to development

History
Lead by AENV with support from SWWG

CEMA Status
not specified

Discussion
This issue is difficult to assess because it is so vague but likely it was designed to look at tributaries, sloughs, lakes and streams, not the main stem of the Athabasca River. Has CEMA addressed cumulative impacts on watersheds with particular emphasis on flow regimes? The short answer is yes in: this 2009 report (Estimating Effects of Water Withdrawals from the Lower Athabasca River IFNTTG Final Report (Contract Number: 2007-0033 SWWG) there is this paragraph in the Executive Summary:

This report provides a history and overview of the environmental flow work completed over a nine year period, 2000 to 2009, on the lower Athabasca River. The work was undertaken to accomplish an understanding of hydrology, hydrodynamics, hydraulics, geomorphology, water quality and aquatic communities in relation to river discharge. ***The work is represented by 64 consultant study reports, 17 internal Instream Flow Needs Technical Task Group (IFNTTG) reports and five published scientific papers all of which are referenced in this report.*** *Copies of the consultant and IFNTTG reports are provided in the Appendices and data files that accompany this report and many of them are on file in the Cumulative Environmental Management Association (CEMA) offices in Fort McMurray, Alberta, Canada.*

AENV and DFO provided guidance on the development of a Phase 2 WMF for the LAR in a letter to CEMA in April 2007 (Letter to Randall Barrett from E. Hui and R. Lambe re: Progress on Phase 2 of the Athabasca River Water Management Framework and Proposed CEMA Implementation, dated April 26, 2007 (AENV/DFO 2007)). The two agencies recommended that CEMA address the instream flow requirements for the river by continuing some activities already initiated by SWWG and by adding additional work groups. SWWG accepted these recommendations and began by creating a management group, the Phase 2 Framework Task Group (P2FTG) comprised of stakeholders; government, industry, Aboriginal and environmental organizations. Later in 2007, P2FTG embraced the multi-stakeholder structured decision-making (SDM) process that had been shown to be successful at achieving water management and monitoring programs for BC Hydro hydro-generation projects on BC rivers (BC WUP; Failing et al 2007). At that time P2FTG changed its name to the current Phase 2 Framework Committee (P2FC).

AENV and DFO expected CEMA, or some other similarly inclusive stakeholder process, to develop the longer term Phase 2 WMF. CEMA SWWG agreed to continue the development of scientifically defensible methods to determine an IFN for the LAR that would deliver the original objective; a defensible, science-based IFN recommendation that would provide full, long-term protection to the

aquatic ecosystem of the LAR.

From another CEMA report from 2009 - Review of Water Management Alternatives on Water Depth in the Lower Athabasca River (Contract Number: 2009-0009 SWWG):
Alberta Environment (AENV) and Fisheries and Oceans Canada (DFO) have jointly developed the Phase 1 water management framework based on the research conducted by CEMA with the goal to protect the Athabasca River ecology and instream flow needs. The aim of the Phase II framework is to expand on the Phase I framework and look at the potential impacts of various water extraction scenarios on socio-economic and environmental parameters.

Under the Phase II framework analysis, there is an understanding that future development of resource based industries in the Athabasca River basin will put increasing pressure on instream flows as industries increase the demand for extraction of water from the river for use in the industrial process. In order to maintain instream flow needs for environmental and sociological uses, there is a need to evaluate the impact of future water extractions related to industrial build-out.

The vast majority of flow studies have looked at the Athabasca River but other rivers and lakes have received attention e.g., A Paleolimnological Assessment of Environmental Change in Eight Northeastern Alberta Lakes (Contract Number: 2003-0024 NSMWG) and State of the Muskeg River Watershed Report (Contract Number: 2007-0014 SWWG). AENV has produced an interim Framework for the Muskeg Watershed but the final Framework was not completed as promised by 2009.

Conclusion
The contributions of CEMA to Phase 1 and now Phase 2 of the Management Framework for the Athabasca support completion of that issue. It is true that there are other issues such as a suitable monitoring program to field test assumptions about the ecological impacts of various flow regimes, about the effects of groundwater removal from the watershed, about the environmental effects of removal of water into containment facilities during high flow events to provide industry access to water if removal is restricted during low flow periods (e.g., will the Peace Athabasca Delta perched lake system be affected if more water is captured upstream in the spring to fill containment "lakes." Hence in the narrow sense this issue is complete but in fact much is unknown about the effects of water removals from these systems so in the broad sense research, modelling and monitoring could continue indefinitely. I see the development of a comprehensive monitoring program and completion of the Muskeg River Framework as a priority before the issue is formally considered complete. The debate is whether a industry and government funded multi-stakeholder group can design a monitoring program or should this be left to "independent scientists" (see a note on this in the Conclusion section of Issue 47).

Completion 80%

Issue 45

Surface Water-water quality - Silt and other contaminants increase from logging and developments

History
Assigned to SEWG , linked to issue 36 (sediment concentrations) and possibly issues 52 (reclaimed landscapes).

CEMA Status
unspecified perhaps covered by TEMF (triad land management) and RAMP

Discussion
This issue is quite specific in its scope and may have been intended to consider the planned Muskeg River developments (oil sands not logging) which have the capacity to disturb 50-60% of the watershed area. The spirit of the issue however is water quality and in that sense CEMA has undertaken 37 studies where water quality has been considered. Key studies related to this issue are:

Review and Compilation of Surface Water Research and Reports for Selected Waterbodies in the Municipal District of Wood Buffalo (Contract Number: 2001-0015 SWWG)

A task group from the WWG, which included community liaison workers from the Athabasca Tribal Council and Alberta Environment staff, determined specific water bodies of concern. The waterbodies selected were chosen based on several broad criteria and were intended to provide a wide geographic coverage of the municipality. The rivers and lakes of concern that were assessed as part of the assignment included:

Water bodies of Concern

Lakes	***Rivers***
Winefred Lake	*Christina River*
Grist Lake	*Steepbank River*
Gregoire Lake	*Firebag River*
Christina Lake	*Gregoire River*
McClelland Lake	*Muskeg River*
Richardson Lake	*MacKay River*
Lake Claire	*Clearwater River*
Lake Mamawi	*Lower Athabasca River (below Fort McMurray)*

A variety of documents were reviewed for data pertaining to water research in each of the water bodies of concern. ***Specific data targeted included water quality,*** *water quantity, fisheries and* ***fish contaminant levels,*** *and water use (industrial, recreational, etc.). Documents reviewed included Environmental Impact Assessments, contractor reports, monitoring program results, and provincial government data.* ***The majority of water quality data was available from Alberta Environment through the Water Data System database and the ongoing Regional Aquatics Monitoring Program.*** *The focus of the review of water quality data was on biotic parameters (e.g., bacterial levels), metals,*

organic contaminants, nutrients, suspended solids, and water pH. Alberta Environment also provided flow and water level data for selected locations, as well as information regarding industrial water use (e.g., water diversions, municipal water licenses, etc.).

A second key study is:
Reach-Specific Water Quality Objectives for the Lower Athabasca River (Contract Number: 2006-0034 SWWG)
*The Water Quality Task Group (WQTG) is a part of the SWWG and was formed to develop and recommend reach specific quality objectives for the lower Athabasca River (LAR). T**he WQTG (WQTG) is undertaking a comprehensive program to investigate water quality objectives for the LAR, based on science with the goal of no negative change in water quality that impairs the aquatic ecosystem.***

A third is :
Natural Range of Variability of Physical Chemical and Biological Characteristics of Streams in the Athabasca Oil Sands Region (Contract Number: 2004-0012 SWWG)

As noted earlier RAMP monitoring has been a prime source of data – this is from their website:
*The specific objectives of the RAMP Water Quality component are to:Collect data that can be used to characterize natural variability in water quality throughout the region, **assess water quality predictions found in oil sands EIAs, and meet the monitoring requirements found in regulatory approvals. Monitor changes in water quality that may indicate chemical inputs from point or non-point sources.** Assess the suitability of water bodies to support aquatic life. Provide data to support interpretation of RAMP biological surveys (i.e., fish and benthic invertebrate components).**Water quality samples are collected at stations on rivers, streams, and lakes throughout the RAMP study area.***

Conclusion
Although silt and contaminant inputs from logging are not specifically addressed in CEMA reports or in RAMP monitoring (but they may be picked up through the EIA process for relevant projects), it is clear to me that Water Quality studies particularly on the extensively examined Athabasca River will address silt and contaminant issues. If the issue was intended to focus on tributaries rather than the river main stem then the adequacy of current monitoring is a significant question. Whether RAMP monitoring is sufficient in general is an area of concern and is being addressed by GOA. Until the new provincial monitoring plan is in place it is unclear that water quality issues can be considered fully addressed.

Completion 90%

Issue 47

Surface water-water quality. In-stream flow needs in the Athabasca River and developed tributaries

History

Assigned to AENV/DFO with support from SWWG.

CEMA Status

Completion assumed based on input to Phase 2 of the Water Management Framework in 2009

Discussion

The history of this issue is summarized in (Estimating Effects of Water Withdrawals from the Lower Athabasca River IFNTTG Final Report (Contract Number: 2007-0033 SWWG). CEMA struggled to find the scientific evidence to provide an in-stream flow needs assessment so AENV and DFO produced a Phase 1 water management framework for the Athabasca River. Phase 2 which is not available publicly yet will, I assume, use the results of CEMA work from 2001-2009. While questions remain and implementation of a comprehensive monitoring scheme is required CEMA has successfully contributed both scientific and traditional knowledge to the question of the environmental and social (Review of Water Management Alternatives on Water Depth in the Lower Athabasca River (Contract Number: 2009-0009 SWWG) impacts of water withdrawals from the Athabasca by the oil sands industry.

Conclusion

The contributions to the Phase 2 management framework have been made. As I indicated in Issue 39, this issue should not be considered complete until a monitoring program is in place. Should CEMA retain responsibility for a monitoring program or should that be more "arms-length from industry and government than is possible for CEMA to develop? Presumably CEMA could contribute to its development.

In that regard, from a recent CEMA report, (Feasibility Study For Implementation of Aboriginal Community Based Monitoring Programs in the RMWB (Contract Number: 2010 -0017 TEK), I note that :

In 2010, the Province of Alberta has established Terms of Reference for a Provincial Environmental Monitoring Panel for Monitoring Evaluation & Reporting for the Lower Athabasca River. *``Building a provincial scale, world recognized, third party verified monitoring system for all environmental media, air, land, water and biodiversity is an ultimate goal of the Government of Alberta....*

*...**CEMA would contribute to the overall vision** for the integrated regional monitoring and research system and facilitate the building of the broadest possible foundation for cooperation in integrating a regional effort.*

This role for CEMA needs some refining

Completion 90%

Issue 48

Terrestrial Wetland Assessment – The undetermined impact on wetland vegetation communities due and impacts to basal aquifer drawdown and the uncertainty of lateral distance of impact. This surface drawdown may cause the wetlands to dry up over a significant area, depending on the volume of water removal required to dry a wetland

History

Assigned to AENV with support from RWG

CEMA Status

Perhaps considered complete with the Guidelines for wetland establishment (2007). RAMP monitoring was mentioned in some documentation but may not be relevant

Discussion

The intent of this issue is not clear, it seems to relate to disruptions in water flow caused by mines or in-situ developments but also refers to groundwater removal and the resulting lowering of the water table. Following the implementation of the EPEA in 1993, all oil sands companies operating in the region have been required to monitor groundwater quality within and around their operations. **The goal of this monitoring is to ensure that constituents associated with their operations do not migrate off of operating leases and that groundwater conditions within the lease boundaries are managed to ensure that this does not occur.** In the event of a release off of an operating area, the requirement is to address these conditions to the satisfaction of Alberta Environment. The regulatory tools to address these types of situations include legislation (i.e. Acts), quality guidelines and objectives, enforcement actions, and control or stop orders if necessary.

The "compliance monitoring" required by the EPEA is designed to be protective of the environmental resources surrounding all operating facilities. With that intent in mind, the development of a regional issue should not occur as long as major pathways have been identified and management plans are in place to deal with situations that may arise. This concern relates to the potential issue of cumulative effects from existing and future developments on regional groundwater quality and surface water features interacting with the groundwater flow systems. This concern was made very clear in three oil sands mine hearings in 2006 (i.e. Suncor Voyageur Project, Shell Muskeg River Mine Expansion, and Imperial Oil Kearl Project).

The Athabasca River valley exists as the dominant discharge area with flow occurring towards that low-lying feature. Radial and semi-radial flow is also anticipated outward from the regional uplands.

Wetlands exist in areas where groundwater discharges to land surface or on landscapes that prevent rapid drainage of water from the surface. Wetlands can receive groundwater inflow, recharge the groundwater system, or do both. Wetlands that occupy depressions in the land surface have interactions with groundwater similar to lakes and streams. Unlike streams and lakes, wetlands do not always occupy low points and depressions in the landscape. They can be present on slopes (such as fens) or even on drainage divides (such as some types of bogs). The different types of wetlands include fens, bogs, swamps and marshes.

Ground water monitoring is essential to detect regional water quality and quantity issues resulting from oil sands activities. The ground water working group (GWWG) has completed two reports one

detailing issues to consider in establishing a groundwater network and the second reporting on the establishment of the network (Athabasca Oil Sands (AOS) Groundwater Quality Study and Regional Groundwater Quality Monitoring Network Study (Contract Number: 2007-0039 GWWG and Regional Groundwater Monitoring Network Implementation in the Northern Athabasca Oil Sands (Contract Number 2008-0033 GWWG)) Key elements of these reports relative to this issue are:
Monitoring sites were requested to be outside of the influence of any operating facility to reduce the chance of any bias to hydro chemical conditions or water levels from potential site-specific sources. This is because the regional network is intended to monitor regional groundwater conditions and not site-specific conditions, which are managed within individual facility EPEA Approvals. In general, a minimum stand-off distance of 2 to 3 km was used.

T*here are a number of potential inputs within the regional study area that could influence groundwater quality conditions in the various water-bearing intervals. These inputs take the form of both natural and anthropogenic (human-related), and occur at very different scales (both spatially and temporally). With respect to potential anthropogenic influences, the most obvious include:*
-seepage from tailings structures; -leaching of dissolved constituents from external tailings areas, mine pit back fill and overburden storage areas; -operational upsets (spills and leaks of chemicals and processed hydrocarbons from processing facilities); -effects from dewatering of surficial aquifer intervals and the basal McMurray Formation during mine development; -non-saline and/or saline water use and the resulting drawdown effects; disposal of mine de-pressurization water and process waste water via injection into deep bedrock formations; -effects from localized heating of local formations due to operations of SAGD wells; -discharge of municipal waste water and urban runoff to receiving water bodies; and -other up stream industry releases (e.g. pulp mills, agricultural runoff).

The other aspect of this issue is re-establishment of the wetland after physical disturbance. Two editions of a wetland guideline have been produced (Guideline For Wetland Establishment On Reclaimed Oil Sands Leases Revised (2007) Edition (Contract Number: 2005-0048 RWG)
Although this edition focuses on reclamation on surface-mined oil sands leases, there is also information provided regarding restoration of altered wetlands on or adjacent to surface-mined leases or on in-situ mine sites. Wetland reclamation is defined as the creation of wetlands on disturbed land where they did not formerly exist or where their previous form has been entirely lost. Wetland restoration is a process of returning wetland function of a remnant wetland site, as it was before disturbance.

*This second edition of the wetlands guideline has incorporated knowledge gains that have occurred through an accelerated research program since the first edition was issued in 1999. Although there is still much to be learned about reclaimed wetlands, there is the potential for healthy, dynamic and valuable ecosystems on closure landscapes in the future. T****he third edition planned for in five years time should be able to extend the existing recommendations for marshes and shallow water wetlands and potentially include guidelines for fen creation.***

The most recent assessment of this issue (A Gap Analysis of Knowledge and Practices for Reclaiming Disturbances Associated with In Situ Oil Sands and Conventional Oil & Gas Exploration on Wetlands in Northern Alberta (Contract Number: 2008-0024 RWG)) is not publicly accessible.

Conclusion
The EPEA/EIA process should capture wetland issues directly related to an operation and the

groundwater monitoring system should detect regional effects. While much remains to be known about groundwater flows, i.e., natural levels of contaminants in groundwater, the extent to which groundwater flows are essential to maintaining wetland communities and the contribution groundwater makes to Athabasca River flows; CEMA has addressed the key elements of this issue.

Completion 100%

Issue 49

Terrestrial End Land-Use – Continuity of landforms, watershed and vegetation communities across oil sands mine closure landscapes is necessary for the development of sustainable landscapes and a diverse ecosystem including a diversity of landforms, indigenous vegetation, near natural water patterns and wetlands and a natural experience.

History

Assigned to TWG with support from SEWG and AENV

CEMA Status

There are two observations, one is that the release of TEMF in 2008 was sufficient to complete this issue, another observation is that this issue is impossible for an organization like CEMA to resolve through stakeholder consultations. The issue is regulatory and requires GOA to order oil sands project operators to work collectively on landscape reclamation i.e., acknowledge that cumulative effects on a groundwater or river systems must be mitigated.

Discussion

Research has been undertaken to look into each one of the sub-issues mentioned here. Examples are found in the reports on Issues 60 and 62. The question is what about landforms, watersheds and vegetation communities that cross boundaries between oil sands projects? CEMA Landscape and Habitat Reclamation Summary (Contract Number: 2003-0038 - Background: The Biodiversity and Wildlife Subgroup are tasked with developing a set of guidelines for **successful wildlife habitat within a reclaimed landscape** and updating Appendix J of the Vegetation Manual. A literature review, which focused on techniques used in the reclamation of mines or similar disturbances to a variety of wildlife habitats in the boreal forest, was completed in 2003.

Landscape scale features are in part the responsibility of the Landscape Design Sub Group of the Reclamation Working Group. Collectively landscapes form "the region" and the TRIAD land management system in TEMF acknowledges that reclamation may never return landscapes to their original state but balances this outcome with large protected areas. A large network of protected areas (20-40% of RMWB) wold be insurance against failure to adequately reclaim intensively disturbed sites and against rapid destruction of large expanses of boreal forest through continued approval of oil sands projects.

The"Guide to the Landscape Design Checklist in the Athabasca Oil Sands Region" (Guide to the Landscape Design Checklist in the Athabasca Oil Sands Region (Contract Number: 2007-0054 RWG)) is primarily aimed at the land form scale but its intent is also applicable to landscapes.

From Reclamation Criteria Document Review: Criteria Gaps, Overlaps and Conflicts (Contract Number: 2005-0032 RWG):

Regulations

Clear regulatory criteria or guiding principles and processes are needed to allow operators to plan for reclaimed landscapes in the context of the natural landscapes *which will be disturbed and those that surround the planned disturbance.*

Pre Disturbance Landscape Evaluation Criteria and End Land Use Criteria

The basis for such principles might begin with the type and proportions of different landscapes present prior

to disturbance, and the type of use if any that those landscapes are subject to. Following disturbance the guiding criteria for reclamation might include the provision of landscapes in equivalent proportions and with equivalent land use capability to those present prior to disturbance. Land use capabilities which could be considered in the oil sands region include, forestry, wildlife, wetlands (lakes, rivers, streams, fens and bogs), and traditional land use criteria. The success of vegetation within the reclaimed landscape will also continue to be assessed
during evaluations. Criteria for judging vegetation success may need to more fully reflect plant community development benchmarked to natural boreal forest successional stages. ***The documents we reviewed did not provide criteria for traditional land uses, although many of the wildlife and aquatic criteria may be applied to meet the needs of traditional land uses. Certification criteria pertaining to travel corridors, trap lines, medicinal plants, and camp sites may also be useful. In addition guiding principles for integration of reclaimed landscapes with surrounding areas are needed, and might include providing surface drainage systems which tie to surrounding natural systems without significantly changing their characteristics.***

The latest gap analysis related to in-situ resource extraction is not publicly accessible yet:
A Gap Analysis of Knowledge and Practices for Reclaiming Disturbances Associated with In Situ Oil Sands and Conventional Oil & Gas Exploration on Wetlands in Northern Alberta (Contract Number: 2008-0024 RWG)

Goals are to: 1) investigate and compile present knowledge regarding reclamation or restoration of non-mineable petroleum exploration disturbances in wetland environments, including past, presently ongoing, and anticipated research; 2) identify and prioritize gaps in this knowledge; and 3) design and implement a research program that addresses some of the gaps and accelerates the development ....[not available]

Conclusion
As with other reclamation issues, this one is well addressed through research and review. I would argue that from the perspective of the RSDS, this issue is complete. Further research into reclamation issues should be coordinated with other agencies and directed by new goals.

Completion 100%

Issue 51

Terrestrial End Land Use -Re-establishing a diverse ecosystem including a diversity of landforms, indigenous vegetation, near-natural water patterns and wetlands in the reclaimed landscape.

History

Lead by RWG with support from SEWG

CEMA Status

Not specified

Discussion

This is one of the 11 original CEMA issues that has involvement of the Reclamation Working Group. There is considerable overlap in the issues, identifying which project is directly connected to this issue as opposed to another is difficult and summary reports like Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (2009) cover many issues simultaneously. Key CEMA/RWG research which focuses on diversity of reclaimed lands are:

(1)Land Capability Classification for Forest Ecosystems in the Oil Sands, Volume 1, Land Capability Determination (Contract Number: 2004-0023 RWG)

(2)Deriving multipliers and nutrient regime classes for the Land Capability Classification System Using the ecosystem simulation model FORECAST (Contract Number: 2003-0007 RWG)

A central goal of the Oil Sands reclamation program is to ensure that reclaimed sites have the capability to re-establish ***a diversity of habitat types*** *(Barker 1998), and to return forested areas to a* ***productivity equal to or better than pre-disturbance levels*** *(OSVRC 1998). One of the tools used in deriving effective reclamation practices is "The Landscape Capability Classification ...*

(3)Guideline For Wetland Establishment On Reclaimed Oil Sands Leases Revised (2007) Edition (Contract Number: 2005-0048 RWG)

T*his second edition of the wetlands guideline is an update of the state of knowledge regarding reclamation of wetlands in the oil sands region. It describes an integrated approach to the planning, design, construction, monitoring and adaptive management of reclaimed wetlands. The approach adopted by this guideline is founded on five basic principles: ...*

(4)Development and Evaluation of an Integrated Modelling Approach for a Risk Analysis of Alternative Reclamation Strategies (Contract Number: 2006-0029 RWG)

Introduction The Oil Sands mining industry in northern Alberta has made a commitment to return previously mined areas to functional forest ecosystems with a capability equivalent to the pre-mining condition . ***In general, successfully reclaiming Oil Sands mine spoil requires the construction of soil covers that provide a substrate to support the growth and development of self-sufficient forest*** *eco ...*

(5)Proposed Criteria and Indicators of ecosystem function for reclaimed oil sands site (Contract Number: 2005-0043 RWG)

(6)Guidelines and Review for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (Contract Number 2009-0025 RWG)

The concept of Criteria and Indicators (C&I). For the forest industry, the necessity for demonstrating responsible management practices has been recognized for over two decades. ***The core concept is sustainable forest management (SFM), which refers to stewardship and use of forests and forest land such that biodiversity, productivity, regeneration capacity and vitality are maintained in ...***

Despite all this research it is not clear to me that industry is being required by regulators or is even voluntarily following the recommendations provided by CEMA/RWG.

Conclusion

Reclamation Science continues to develop, in fact the latest edition of the Guidelines for Reclamation to Forest Vegetation notes: *... It is acknowledged that the state of knowledge around reclamation in the oil sands region remains incomplete, and that periodic revision of this manual will be required as new information becomes available.* ***It is an explicit assumption of this manual that it is to provide guidance on reclamation activities for the approximate period from date of issue until 2014-2019, or until reclamation knowledge has advanced sufficiently to justify a revision.*** A question for CEMA is the extent to which additional research is required in Reclamation, what are the important areas of focus and who should be doing the work? Even though questions remain, this issue is as thoroughly answered as any other issue on the original list of 37. RWG may well continue research into this area but the justification should no longer be the RSDS issue.

Completion 100%

Issue 52

Terrestrial End Land Use - The reclaimed landscape will be used for recreational purposes with the potential for intensive recreational activities including fishing and hunting pressures because of increased access. The capability to support and/or the land to recover after use from these types of activities has to be incorporated into the closure planing. Public information about the government policy with respect to assurances that the cost of end land-use will not be passed along to the public and information about how industry will finance end land-use over the long term

History
Although assigned to CEMA as one of the original 37, this issue is identified as lead by SRD with support from RWG. While research by RWG into reclamation and the associated end uses and costs is reasonable, any regulatory outcomes are clearly the obligation of the Alberta Government

CEMA Status
not specified

Discussion
To the specifics, from the Alberta Environment website:
http://www.oilsands.alberta.ca/reclamation.html

- Before any mining project begins, industry must develop and receive approval for closure plans that outline how affected areas will be reclaimed.
- Mine operators must provide a reclamation security bond as a guarantee that reclamation work will take place. For the year 2009, government held just over $800 million in reclamation security from the oil sands industry.
- in forested areas, the trees are harvested and some of the smaller wood may be conserved for use in reclamation.
- 80 per cent of the oil sands are accessible by in situ methods only (bitumen is separated from the sand underground and pumped to the surface).
- In situ's land disturbance is 10 to 15 per cent of a similar sized mining operation and produces no tailings ponds.
- Reclamation certificates are only issued when long-term monitoring demonstrates the reclaimed land meets the objectives of **equivalent land capability.**

Reclamation statistics to date:

Certified Reclaimed - 104 hectares If an area meets stringent requirements for reclamation, regulators will issue final certification and the land is returned to the Crown as public land. To date, one area called Gateway Hill is certified reclaimed.
Permanent Reclaimed - 4,654 hectares Land form design, soil placement, and re vegetation are complete (for both land and aquatic ecosystems). Companies must use local plant species to target the return of local boreal forest ecosystems. Soils are tested and tree and shrub growth is monitored for 15+ years. When ecological trends are achieved, the company can apply for reclamation certification.
Temporary Reclaimed - 854 hectares Some areas are reclaimed and re-vegetated to grasses for the purposes of stabilization and erosion control. These areas may also see future disturbance.
Soils Placed - 1, 015 hectares Soils have been placed as directed by each facility's reclamation and soil placement plans, as approved by regulators.
Ready for Reclamation - 944 hectares Areas that are no longer required for mine or plant purposes and are therefore available for reclamation. Reclamation activities have not begun.

Disturbed - 40,859 hectares Land is still part of the active operations of a facility.
Cleared - 17, 912 hectares Land is cleared of vegetation, but the soil is relatively undisturbed.

The following is all the Sustainable Resource Development Ministry has to say that is specific to reclamation of Oil sands project sites:From the SRD website:
(http://www.srd.alberta.ca/LandsForests/OilSands/Default.aspx)

SRD Oil Sands Branch
The Oil Sands Branch of SRD manages departmental participation in the Environmental Impact Assessment (EIA) and coordinated approvals processes, in accordance with the Environmental Protection and Enhancement Act. SRD's involvement in these processes focuses on public land and provincial resources such as forests, fish and wildlife. The Oil Sands Branch is also engaged in:

- *Biodiversity and **reclamation planning projects** for oil sands areas*
- *Cumulative effects projects for all oil sands areas*
- *Oil sands monitoring and compliance initiatives*

From the Royal Society of Canada Expert Panel report: Environmental and Health Impacts of Canada's Oil Sands Industry (December2010) their first point is: **Feasibility of reclamation and adequacy of financial security,** Reclamation is not keeping pace with the rate of land disturbance but research indicates that sustainable upland reclamation is achievable and ultimately should be able to support traditional land uses. Current practices for obtaining financial security for reclamation liability leave Albertans vulnerable to major financial risks

From the Pembina Institute's Report entitled Toxic Liability: (September 2010)
http://pubs.pembina.org/reports/toxicliabilityfactsheetfinal.pdf

In 2009 the total oil sands security in the Environmental Protection Security Fund was $820 million for 68,574 hectares of disturbed land, or only $11,964 per hectare. However, based on the limited government and industry data available, the Pembina Institute conservatively estimates the cost of reclaiming this disturbed land will be $10–$15 billion, or approximately $220,000 to $320,000 per hectare.

Public will carry burden of reclamation failure A reclamation security program is supposed to ensure that industry, not the public, is responsible for any unforeseen reclamation liabilities. If the program is underfunded, however, taxpayers might be on the hook for cleanup costs. Our report Toxic Liability suggests the underfunded security program could be exposing each Alberta taxpayer to a tax liability of $4,300 to $6,300.

Conclusion
The Reclamation Working Group of CEMA has 95 reports and reviews in its database on reclamation issues - details of soils, plant restoration, water movement, landscapes, biodiversity, long-term monitoring, shrubs selection, birds, mammals, TEK, etc... The list is very comprehensive on upland site reclamation and small but growing on wetland reclamation. RWG included recreation as an end land use in the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (AENV 2010) but does not specifically do work to develop reclamation techniques to address recreation as an end land use. Virtually none of RWG's work is evident on the public information fronts provided by Alberta Environment and SRD. GOA has not responded to concerns raised by the Royal Society and

Pembina Institute over the cost of reclamation. The excellent research by RWG does not appear to be informing reclamation policy at a senior GOA level even if it is well-received at working levels. RWG's work may be complete here but the issue is unresolved.

Completion 50%

Issue 54 and Issue 55

(54)Terrestrial Land Use – use of native species and traditional plant species in reclamation in the closure planning design; (55)Terrestrial Traditional Use Values and Mitigation - which vegetation species existed in the pre-disturbance landscape and which species will be established in the reclaimed landscapes and when

History
Issue 54 was assigned to RWG with support from SEWG whereas 55 initially was assigned to AENV with support from RWG.

CEMA Status
Issue 54 is considered complete based on EPEA approval requirements specified in Terms of Reference for Environmental Impact Assessments and the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region 1998 (updated 2010). Similarly issue 55 is considered complete based on the same references.

Discussion
These two issues are closely linked. Issue 54 expresses a concern that non-native species may be used in reclamation. The 1998 "Guidelines" document focuses on restoration of land to a equivalent capacity – this theoretically could be measured by its commercial value as lumber or pulp. If for argument's sake, this is the sole purpose of restoration then non-native species could be effective at achieving this goal. Issue 55 is concerned about the restoration of sites to their original state and the time this process will take.

The language of a recent (2009) Terms of Reference for Christina Lake Thermal Expansion: http://www.cenovus.com/operations/docs/christinalake/christina-lake-environmental-impact-assessment-report.pdf is evidence that over the ten year period, Alberta Environment is placing greater emphasis on land values for wildlife, biodiversity and traditional uses. Other similar examples are available at: http://environment.alberta.ca/02313.html

Clearly the regulatory requirement exists to achieve the goals of Issue 54 and 55 and the restoration/reclamation principles required are articulated in several CEMA recommendations e.g., Land Capability Classification System for Forest Ecosystems 3rd ed. 2006; Recommendations for Ecosystem Management Tools; Landscape Design Checklist and Wetlands Reclamation Guidelines 2007. **The 2010 Guideline for Reclamation reiterates the obligation to consider only native species in restoration but also advises on how to achieve different land use outcomes**

Conclusion
The methodology to restore upland forest sites is well-researched and documented by CEMA and the EIA process clearly defines the obligations of operators in this regard. The miniscule amount of land certified as reclaimed to date begs the questions for the future- is the political will in place to enforce the obligation and are the necessary funds available?

Completion 100%

Issue 58

Terrestrial Biodiversity Assessment – The Canadian Biodiversity Strategy recommends that environmental impact assessments address impacts to biodiversity. There is uncertainty about the acceptable level of detail and scope of assessments, and the expectations for restoration. Impacts to biodiversity include changes in landscape and community levels, changes in species and genetic levels, and impacts to rare species such as rare plants. Soils, plants and wildlife tend to be treated separately rather than in an integrated fashion as an ecosystem

History
Uncertain, no Working Group is identified as the lead but several – RWG, SEWG, NSMWG, and WBEA and TEEM are considered support groups. Page 51 of TEMF indicates that this issue has been the responsibility of SEWG

CEMA Status
There is no specific mention of a completion point but there is a comment that "ABMI is in place" which suggests that ABMI is sufficient to ensure that cumulative effects of oil sands development do not negatively impact biodiversity

Discussion
There are two elements to this issue: (1) regional biodiversity change associated with oil sands development and its associated footprint i.e., infrastructure, roads, urban expansion, increased human access, air and water pollution; and (2) restoration of specific sites impacted by mining, or in situ projects. Two CEMA-funded studies (Evaluation of the ABMI for monitoring reclaimed oil sands sites, Golder and Assoc. 2007; and Biodiversity Review for the Guidelines to Forest Vegetation in the Alberta Oil Sands Anthony, Schieck and Eaton 2010) point out that AMBI sampling intensity is insufficient to evaluate regional change due to oil sands development and also insufficient for evaluating the success of reclamation projects. The ABMI protocols are for the most part useful but the before and after biodiversity assessments that operators are required to undertake by current regulations (EPEA-EIA and Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region; Oil sands Vegetation Reclamation Committee 1998) and the recently produced update: Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region 2010 (Terrestrial Subgroup RWG) do not adequately measure biodiversity.

Conclusion
RWG and CEMA consultants clearly understand the challenge of biodiversity monitoring and of restoring pre-development biodiversity levels to impacted sites. Baseline (pre-impact) biodiversity values are simply unknown (or if measured were not collected in comparable fashion to ABMI protocols) for starters and reference control sites have to serve as substitutes in reclamation work. What I feel is missing on this issue is the summary statement from RWG on biodiversity in the form of a Framework or Guideline or Recommendation to GOA. Perhaps CEMA's work will be present in the GOA Biodiversity Action Plan or LARP, but from my perspective no direct link between research and regulation has been established.

Completion 80%

Issue 59

Terrestrial Biodiversity Conservation - Protection of areas in the lease that are not underlain by economic oil sands and are not specifically needed for a mine as biodiversity in-situ conservation areas.

History

This is another issue that was not initially assigned a lead group. The most relevant work is summarized in the Terrestrial Ecosystems Management Framework. Page 51 of TEMF states that this issue has been assigned to SEWG

CEMA Status

Not specified

Discussion

It is acknowledged in TEMF that areas of RMMB not underlain by commercially exploitable bitumen are the first places to consider for protected areas. However, other research and data (CPAWS/Pembina Institute) has shown that these areas do not include a sufficient breadth of habitats and species to ensure preservation of the biodiversity of the region. Some commitment to reduce the impact of bitumen extraction is required

The Triad (intensive, extensive, protected) of land uses designations is an established concept for natural resource management. It explicitly recognizes that intensive resource extraction activities will have numerous and long-lasting adverse effects on ecological values. Equally, the establishment of Protected Zones, where ecological values are maintained within the range of natural variation, will constrain opportunities for economic gain. All values cannot be experienced everywhere all the time; specific values can best be achieved from areas that have the inherent capacity to deliver them. Dividing the RMWB into large zones designated for specific purposes is an effective way to make first order value trade-offs to achieve desired results. A 20% protected areas scenario could potentially be accomplished with limited conflict with oil sands and forest tenure holdings as of mid-2007.

Recommendations in TEMF include:
An expansion of protected lands to 20-40% of the RMWB; this range is reflective of the diversity of perspectives among CEMA members. Building on the analysis of environmental criteria completed to date, specific boundaries should be identified immediately for candidate protected areas to enable their prompt establishment.

That the Government of Alberta initiate and lead a process for identifying new protected areas that involves stakeholders and takes into consideration environmental, social and economic values and concludes not later than December 31, 2010 (presumably the areas identified in the draft LARP).

Compensation be provided in those cases in which establishment of new protected areas affects some resource tenure.

The draft LARP calls for an additional 16% of protected areas. This is lower than the recommendations from CEMA and the selection of areas has been criticized (e.g., Pembina Institute review) for also allowing non-natural disturbances and for not adequately representing the diversity of regional habitats. Areas identified for preservation in LARP are those with low bitumen reserves (in keeping with the intent of this issue). Interestingly Suncor, a CEMA participant is also a member of the Canadian Boreal

Initiative (CBI) and has signed on to the Boreal Forest Conservation Framework, which supports a shared vision of combining responsible resource development with efforts to maintain the ecological and cultural integrity of the Canadian boreal forest region. This framework commits participants to:

- **protect at least 50% of the region in a network of large interconnected protected areas**
- support sustainable communities, world-leading ecosystem-based resource management practices and state-of-the-art stewardship practices in the remaining landscape.

Conclusion

SEWG has addressed this issue well from the perspective of RMWB but the game has changed and now CEMA needs to address the significant difference in the size and distribution of their recommended protected areas versus those seen in the draft LARP.

Completion 90%

Issue 60

Terrestrial- Diversity of soil types to promote potential for vegetation diversity. The recreation of a single type (homogeneous) topsoil across the reclaimed landscape may not provide an "equivalent capability" for the return of a diversity of native vegetation communities. Research is required to understand the soils and technology necessary to re-establish a diversity of vegetation types, in a reasonable period of time. The requirement to salvage all the presently existing mineral soils may be necessary to prevent the permanent loss of capability to re-establish and sustain equivalent vegetation and other biological diversity.

History

Even though this is one of the original 37 it is indicated that it is being lead by GOA (AENV/SRD) with support from RWG/CONRAD

CEMA Status

not specified

Discussion

Considerable CEMA research has been devoted to soils, their nutrient and moisture regimes and the relationship between these soils and associated plant communities. This work has lead to a soil classification system, permanent plots evaluating reclamation success, statistical links between LCCS and re-vegetation success, detailed analysis of plant and animal communities (biodiversity) and ultimately a second edition of a manual guiding re-vegetation of reclaimed lands. Samples from these studies that are relevant to this issue are:

Land Capability Classification for Forest Ecosystems in the Oil Sands Volume 1-Field Manual (Contract Number: 2003-0002 RWG)

... the goal of land reclamation in Alberta is to create land capability equivalent to that which existed prior to disturbance. ***A primary requirement is to salvage all topsoil and material that can be used as an amendment to topsoil***

Results from long term soil and vegetation plots established in the oil sands region (Contract Number: 2004-0016 RWG)

The key objectives of the long term plot establishment study are as follows:
• provide a practical and cost-effective monitoring program design that will allow the oil sands operators to track the progression of their reclaimed areas into vegetation community types that are comparable with those naturally occurring in the surrounding region;
• study the evolution of reclaimed vegetation communities to target ecosite phases in response to management practices with emphasis on tree productivity, biodiversity and wildlife habitat quality;
• examine the evolution of soils on reclaimed lands of different origin and possible changes to capability/productivity, also considering spatial and temporal variation;
• develop a standardized plot monitoring protocol, including database; and
• select plots in natural and reclaimed environments and characterize baseline/current soils and vegetation.

From a Comparison and Needs Assessment of Hydrological Models Used to Simulate Water Balance in Oil Sands Reclamation Covers - Final Report (Contract Number: 2005-0030 RWG):

The successful reclamation of Oil Sands mining areas requires the construction of soil covers that will provide a suitable substrate to support the growth and development of self-sufficient forest ecosystems. Adequate quantities of nutrients and water are the necessary prerequisites for a productive ecosystem. ***Thus, to be effective, soil covers must have the capacity to store soil water and to provide essential nutrients to support plant growth. Within the context of Oil Sands reclamation, there is considerable information on moisture dynamics as well as a variety of initiatives underway to measure nutrient availability in capping materials.*** *A series of field plots have also been established that will provide growth and yield data on previously reclaimed materials and on natural sites. In parallel with the empirical work, a variety of models have been developed and calibrated that simulate moisture dynamics and ecosystem productivity.*

From: Analyzing the Relationship Between LCCS Ratings and Site Productivity (Contract Number: 2008-0015 RWG):
The Soils and Vegetation SubGroup (SVSG) is developing a process to assess the equivalent capability of reclaimed lands as measured by tree height growth. The core of the process is the Land Capability Classification System (LCCS)1 and its relationship to site index (as the measure of tree height growth). ***The idea is to calculate an LCCS rating from soil properties on reclaimed land and predict the site index for that LCCS rating.*** *The reclaimed land is then considered to have equivalent capability if the predicted site index is the same or higher than the average site index expected from the same LCCS rating on undisturbed (natural) land....*[Currently the statistical evidence is weak in support of this relationship]

...The site index is the same or higher in reclaimed areas than in natural areas.

*The general observation in many studies in BC and Alberta is that trees grow significantly better on disturbed sites than on natural ecosystems in the same area. ...****The increase in site index provide some evidence that the reclamation efforts have been successful in providing equivalent capability for forest production; however most reclaimed areas are still very young. The real question is if increases in site index will be sustained in the future. Only long term monitoring will help answer this question.*** *We may also need to separate the effects of site (soil nutrient regime) from the effects of reclamation prescriptions, fertilization techniques, vegetation control and initial spacing of the planted trees. These can only be done under a controlled experiment.*

A concern raised in the latest review of the sample plot (Installation and Re-measurement of Permanent Sample Plots on Reclaimed Sites-2009 Year End Report (Contract Number 2009-0036 RWG)) data is:

The subjective location of the plots is a major issue when it comes to interpretation of the results. *We suggest that the objectives of the PSP program should be revisited and a statistically designed plot network should be considered. Such programs are routinely used in Alberta and BC to monitor the growth and yield of forest lands.*

Recent developments on reclamation are that the updated manual is a key resource for operators in meeting their reclamation requirements (the Revegetation Manual (2009) is intended to be used by

government and industry staff as outlined in the Environmental Protection and Enhancement Act Approvals for Operators) and that various end uses for reclaimed land are being considered.:

This updated version of the manual considers four primary end land-uses:

Commercial Forest, Wildlife Habitat, Traditional Use, and Recreation. The goal of this manual is to provide guidance on re-establishing the vegetation component of upland ecosystems on reclaimed landscapes, and on evaluating the success of this re-establishment. This goal is based on the following fundamental concepts:

1. That reclaimed plant communities should have species characteristic of native plant communities in the oil sands region.
2. That trends of vegetation community and structure development on reclaimed landscapes should be similar to native plant communities in the oil sands region.
3. That reclaimed ecosystems should have developmental trajectories that satisfy land-use objectives, and have characteristics that provide resilience against natural disturbance events.

Conclusion
As noted in Issue 51 and acknowledged in the latest Guidelines for Revegetation, the science of reclamation work is advancing and on average manuals and guidelines should be updated every five years. The RWG has compiled an excellent library of studies and resources for operators and relative to the basic questions presented in this issue have completed their work. There is a need for additional work but I would argue as I did earlier that this is no longer in response to the expectations from the original RSDS - a new Reclamation mandate is required.

Completion 100%

Issue 62

Terrestrial Diversity of Soil Types to Promote Potential for Vegetation Diversity – The productivity of soils used to support commercial forests are based on the use of a soil rating procedure called the "Land Capability Classification or Forest Ecosystems in the Oil Sands Region (LCCS)". The rating system is new and requires monitoring to determine the factors that influence productivity and the long-term sustainability of the forests established and the establishment and viability of other uses

History
Part of the original 37 but lead by the Government of Alberta (AENV and SRD) with support from RWG

CEMA Status
not specified

Discussion
Much of the comments on this issue are also covered in issue 60. Clearly a LCCS is well established and has been reviewed. A number of CEMA research contracts have looked at the system and its usefulness for reclamation work (e.g., Analyzing the Relationship Between LCCS Ratings and Site Productivity (Contract Number: 2008-0015 RWG)). Attitudes have changed towards end uses and no longer is commercial forest productivity the prime driver behind reclamation projects (e.g., various end uses for reclaimed land are being considered - Commercial Forest, Wildlife Habitat, Traditional Use, and Recreation. (Revegetation Manual (2009))

The Permanent Sample Plot Project (PSP) is the source of long-term monitoring of reclamation experiments. In 2000, the Soil and Vegetation Working Group (SVWG) of the Cumulative Environmental Management Association (CEMA) implemented a program to monitor changes and long-term development of vegetation, soil quality, and tree growth on reclaimed areas in the Athabasca Oil Sands area near Ft. McMurray, Alberta. Under the program, permanent sample plots (PSPs) are being established and re-measured on reclaimed sites to monitor these characteristics.

As of the end of 2007, 50 PSPs had been installed on reclaimed sites under this program. The 44 plots installed from 2000 to 2004 used the original measurement standards, with plots installed in 2005, 2006 and 2007 using upgraded (new) standards (e.g.,Installation and Re-Measurement of Permanent Sample Plots on Reclaimed Sites: 2007 Year End Report (Contract Number: 2008-0017 RWG)

In their review of oil sands monitoring, the Pembina Institute encourages the panel (the blue ribbon monitoring review panel) to examine the state (including rate and quality) of monitoring of oil sands reclamation performance and reclamation liabilities. Existing Alberta Environment policy only requires companies to submit paper copies of their annual conservation and reclamation reports. These reports are only available in the Government of Alberta library in Edmonton. These reports should be submitted in an electronic format that is comparable from report to report and publicly accessible. (http://pubs.pembina.org/reports/alberta-oilsands-monitoring-submission.pdfReclamation monitoring)

From ERRG/(Environmental and Reclamation Research Group) of CONRAD (Canadian Oil Sands Network for Research and Development , there are a number of projects that involve monitoring of reclamation sites, these experimental plots do not appear to be part of the PSP project. ERRG supports

the NSERC Industrial Research Chair in Forest Land Reclamation. The overarching objective of this NSERC Chair program is to develop strategies to return disturbed sites to fully self-sustaining forest ecosystems through the re-development of forest canopies and the soils that support and maintain their growth. One of the main challenges that will be addressed is the rapid development of a tree canopy (trembling aspen) to create conditions that initiate and sustain processes characteristic of a functioning forest ecosystem. A number of related studies are found in their 2010 Annual Review e.g.,
Use of woody debris in oil sands reclamation to enhance ecosystem development - Dr. M. Anne Naeth Department of Renewable Resources University of Alberta (http://www.conrad-errg.ca/AnnualReporting/Annual%20Reports/CONRAD_ERRG_2010_Annual_Update.pdf)

Conclusion: From the standpoint of the LCCS and monitoring of reclamation projects this issue is complete. There are two questions though, First, it is my understanding that CEMA is not a monitoring agency yet it seems that no other agency is monitoring the Permanent Sample Plots. An annual review of the plots is included in the CEMA RWG database. Should this continue to be a CEMA responsibility? Will this be part of the new GOA "world class" monitoring initiative? Second, ERRG/CONRAD is undertaking reclamation research also funded by industry and involving Canadian universities. What is the relationship between CEMA's research and that of CONRAD? Are work plans and projects co-ordinated? Nice to see these loose ends tied up

Completion 90%

Issue 63

Terrestrial Cumulative impacts on wildlife-habitat changes. The uncertainty about cumulative impact of individual and multiple oil sands developments on wildlife as a result of the habitat loss and larger scale (regional) fragmentation of the ecosystem has major implications to regional wildlife populations. This is particularly important for wildlife species of concern in Alberta such as Red, Blue and Yellow listed species. Changes in habitat availability, connectivity and diversity. Preservation of habitat or threatened animals, increased mortality risks due to industrial activity and increased traffic flow.

History
SEWG assigned as lead group with support from Sustainable Resource Development. Planned completion 2008.

CEMA Status
Complete in 2008 with publication of Terrestrial Ecosystem Management Framework

Discussion
SEWG realized that determining cumulative impacts resulting from oil sands development on a species by species basis was an expensive, effectively endless and ultimately useless exercise. Predicting when development will extirpate even a single, well-studied, observable species like Woodland Caribou is virtually impossible. Attempting to do so for individual species of songbirds, fish and invertebrates will never achieve a level of scientific rigour required for regulator action. The approach taken was to develop seven indicators (Silvatech Consulting Ltd. 2008. Indicator Synthesis: Selection rationale, modelling results and monitoring considerations for key indicators of the Terrestrial Ecosystem Management Framework) and monitor their status. The RMMB would be subdivided into three regions based on level of human impact ensuring sufficient protected areas to balance the intensive and extensive uses elsewhere. Models with various scenarios of development would establish a threshold (10% below natural range of variation) for each indicator at which point management action is taken to address the reasons behind the low level. Difficulties are (1) having good data to measure the natural range of variation of the indicators to establish trigger points.; (2) Implementing indicator monitoring and (3) Also difficult is knowing what the management response should be. Low numbers may be a response to local conditions or they may be the result of issues elsewhere (e.g., for migratory birds that experience high mortality on migration or on the wintering grounds, local conditions may not be driving numbers down) .

Conclusion
Even though specific impacts from oil sands development on individual species are not known, I would argue that this issue is essentially complete from CEMA's perspective through development of population models, the triad land designation system and recommendations to government found in the Management Framework. This is all moot however, if government does not accept the recommendation and the necessary land designation and indicator monitoring established. Some work is needed to achieve this goal.

Completion @90%

Issue 64

Wildlife Traditional Use Values and Mitigation – Impact of development on wildlife of high traditional value – moose, rabbits, aquatic fur bearers, grouse, waterfowl and squirrels.

History

Lead by SEWG and supported by AENV. Linked to Issue 26 (not CEMA) and CEMA issues 65 and 66.

CEMA Status

Presumably completed in 2008 with submission of Terrestrial Ecosystem Management Framework to SRD

Discussion

TEMF includes on page 48 a list of indices that will be monitored to ensure they do not drop below 10% below their normal range of variation. These issues were developed in consultation with scientists and the local community. These indices are surrogates for species by species assessment of impacts – hence they can be seen to replace the list in this issue.

Relevant to this issue are:

Woodland Caribou Habitat and population response
Moose Habitat and Population Response
Fisher Habitat
Black Bear habitat and Population Response
Index of native fish integrity

Models of changes to these indices under various development scenarios lead in part to the Triad land designation formulation. Also critical to this issue is the proposal in TEMF to expand the protection zone to from 20-40% of the RMMB. It is acknowledged in TEMF that monitoring is currently insufficient to track these indices.

Other monitoring programs fill some of the gap: waterfowl populations are monitored by Environment Canada (CWS) and SRD (Waterfowl Breeding Population and Habitat Survey) programs like NAWMP and Breeding Bird Surveys. Project proponents are required to complete an EIA with an intensive sampling of vertebrates found in the project impact area . ABMI monitors mammal tracks. In 2002 Westworth and Assoc conducted an extensive review for CEMA of the literature available on these key elements of the wildlife community in northeastern Alberta (A Review and Assessment of existing information for key wildlife and fish species in the regional sustainable development strategy study area). Additional CEMA-sponsored studies have looked at traditional knowledge related to wildlife habitat in reclamation projects - Report on Traditional Environmental Knowledge Input Into Wildlife Habitat Reclamation Recommendations (Contract Number: 2005-0039 RWG) and there have been extensive analyses of habitat requirements to support wildlife populations in reclaimed habitats - Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (Contract Number: 2006-0033 RWG); CEMA Landscape and Habitat Reclamation Summary (Contract Number: 2003-0038 RWG); and Literature Review of Reclamation Techniques for Wildlife Habitats in the Boreal Forest (Contract Number: 2002-0030 RWG).

The bottom line though is simply that reclamation work no matter how extensively modelled or analysed cannot guarantee that sustainable populations of wildlife will be supported after bitumen extraction has ceased. This is the rationale behind larger protected areas – an acknowledgement that extensively modified habitats likely will never be restored to pre-development conditions.

Conclusion

CEMA has done what it can to ensure that the information is available to protect wildlife populations through study of habitat needs, re-vegetation requirements for reclaimed habitats, wildlife monitoring needs, modelling impacts of future development and preservation of sufficient protected areas. GOA support of TEMF and an enhancement to ABMI's ability to monitor wildlife in the region are required before one can be confident of the future of various wildlife species in response to increased development. I would like to see more buy-in before this issue is considered complete.

Completion 95%

Issue 65

Terrestrial- End Land Use Uncertainty about the type of wildlife that reclaimed land will support and sustain and whether the wildlife (Moose, rabbits, aquatic fur bearers, grouse, waterfowl and squirrels) that will be sustained is congruent with traditional needs

History

RWG supported by SEWG have looked into this issue

CEMA Status

Considered complete through TEMF 2008 and the Guidelines to Reclamation (2009)

Discussion

The challenge in Issue 64 relates to the slow return of reclaimed habitats to pre-disturbance conditions. It is acknowledged in the Guidelines to Reclamation (2009) that: *Forests planted today on reclaimed landscapes will not reach mature seral canopy compositions for 60 – 160 years. Nonetheless, there are several priority species, particularly the predators and cavity-nesting birds, which require elements of mature and climax forests to reproduce successfully. These elements typically relate to decay structures (dead or dying standing trees, fallen & rotting logs) and complex forest floor structure (debris, moist micro- environments, cover diversity), which are difficult to adequately replicate in younger, engineered stands.* ***Engineering this complexity may be feasible for some of the smaller species (red-backed vole for instance), but will likely not succeed for the larger mammals and avian cavity-nesters. Therefore, guidance in this section will relate to long-term management, with the assumption that other avenues of habitat provision, such as the conservation of strategically-placed refugia,*** *will also be explored to satisfy the short- and long-term needs of wildlife associated with these forest age classes.*

Less work has been published on wetland restoration and the viability of reclaimed wetlands to support muskrat, beaver, moose, otter and waterfowl populations. The CEMA document Guideline For Wetland Establishment On Reclaimed Oil Sands Leases Revised (2007) Edition reviews the state of knowledge in this field extensively but there many uncertainties about the success of reclaiming wetlands, (e.g., contaminant levels, water quality, EPL water, ongoing maintenance, monitoring requirements) that cast doubt on the success of restoration of wetlands and raise questions of cost. The traditional needs part of this issue is mentioned in TEMF e.g.,*Traditional land use is expected to be impacted by industrial development in the Intensive Zone. Specific areas should be identified in all Triad zones where opportunities for traditional land use would be maintained,* ***recognizing that fewer opportunities for traditional land uses may exist in the Intensive Zone.*** This acknowledges that some traditional uses of lands will perhaps be lost permanently if those areas are part of the Intensive Zone.

Conclusion

There is evidence that forest habitats can be re-established but much less so for wetland habitats. Decades of management and considerable funding will likely be required to return these disturbed habitats to their "original" or "equivalent" value state. Some traditional uses may be lost permanently. No research or modelling work can guarantee heavily disturbed areas will sustainably support wildlife populations such as found on pre-disturbed habitats. This is the implicit message of TEMF yet it is not the reclamation message the public and community hears. What is the right message?

Completion 90%

Issue 66

Wildlife – Traditional Use Values and mitigation – Concern that increased activity in the region has and will result in increased "unregulated" tourism which may occur on traditional trap lines. What protection do trap line holders have against this?

History

Not assigned to any CEMA group. One data set implies it belongs to SRD another that it may have been assigned to SEWG. No funding appears to have been applied to this issue as of 2007

CEMA Status

unspecified, indirectly acknowledged in TEMF 2008

Discussion

This issue is very specific - will increased access "unregulated tourism" to trapping areas harm traplines? There is no specific answer to this question in TEK publications in the CEMA database, (although several are only accessible via a specific data request and were not examined (e.g., Traditional Land Use Mapping Study of the Lower Athabasca River - Phase 2 (Contract Number: 2009-0026 SWWG) neither is it discussed on the ASRD trapping website.

CEMA has not ignored traditional land use issues e.g., from: Feasibility Study For Implementation of Aboriginal Community Based Monitoring Programs in the RMWB (Contract Number: 2010 -0017 TEK):

In response to Aboriginal concerns related to the environmental impact, government and resource development stakeholder organizations in the region have initiated numerous environmental and health related studies and monitoring programs. In 2004, over eight million dollars were invested into regional environmental research and monitoring activities through multi-stakeholder organizations including the Cumulative Environmental Management Association (CEMA), the Wood Buffalo Environmental Association (WBEA), the Terrestrial Environmental Effects Monitoring Program (TEEM) and the Regional Aquatics Monitoring Program (RAMP). These programs currently provide the regional monitoring initiatives for systematic collection of regional environmental data and information that in turn, provide the basis for many adaptive environmental management initiatives in the region.

A few years ago, several First Nations withdrew from CEMA:

The main point of the withdrawal of the First Nations is that the cumulative environmental effects impacting the culture and livelihood of the Aboriginal people in this region are not being assessed or evaluated by the Association, nor are recommendations being passed. *This issue is in urgent need of review, before the consideration of additional oil sands lease approvals.* ***One might argue that it is probably illegal for the Government to continue to issue leases or development permits because neither the Industry nor the Crown have fully engaged in appropriate consultation processes; processes that would effectively assess the cumulative impacts on Aboriginal culture and their ability to continue their traditional hunting, fishing, and trapping activities.***

In 2001 CEMA published a study - Use of Traditional Knowledge in Project Planning and

Implementation in the Athabasca Oil Sands Areas (Contract Number: 2001-0010 TEK) which listed these regional concerns:

*1) **Major decline of wildlife populations in general and specific species***
*including; moose, migratory birds, frogs and toads, **muskrats, squirrels**, all birds, lakes have been "fished out"*
2) Health of wildlife including; shorter life spans of ravens, moose breaking their legs in areas that have been logged, weak loon egg shells, fish are not edible,
3) New animal and plant species including; cougars and grizzly bears, poisonous plants (perhaps planted by people) harming animals and other plant species
4) Government practices such as blowing up beaver lodges and depleting large game population through commercial hunting activities are hurting subsistence harvesters and wildlife populations.
5) Low water levels are affecting wildlife populations
6) Air pollution is affecting the health of people and wildlife and plants
7) Loss of TEK and survival skills
8) Loss of wildlife
9)Change in taste and colour of moose meat

I note that there is no specific mention of effects of development on trapping

Within TEMF, traditional land uses are noted but there is no assurance that trap lines will not be affected e.g.,
6.5 Traditional Land Use
The maintenance of opportunities for traditional land use is critical to the ongoing social, cultural, and economic health of Aboriginal citizens and communities and is one of the identified regional goals of this Framework. ***Opportunities for traditional land use exist where ecosystem integrity is maintained. This is accomplished in part through the management strategies contained in this Framework.***
Traditional land use is expected to be impacted by industrial development in the Intensive Zone. Specific areas should be identified in all Triad zones where opportunities for traditional land use would be maintained, recognizing that fewer opportunities for traditional land uses may exist in the Intensive Zone. *Proximity to Aboriginal communities is an important consideration to determine the potential for an area to be used for traditional purposes. This work should be guided in part by traditional land use studies that have been completed.*

Included in TEMF are these recommendations

-Aboriginal people be engaged to identify areas where traditional land use can be maintained. Information on the location and availability of certified reclaimed lands for potential traditional land use should be compiled every few years relative to the loss of similar traditional land use opportunities due to development.
-Government and industry continue to work with Aboriginal communities (e.g. through multi-stakeholder organizations) to coordinate reclamation activities to support traditional land use on undeveloped and reclaimed areas.
-Strategies be pursued for the conservation or management of opportunities for traditional land use within all three Triad zones.
-Methods of successfully reclaiming land for traditional use be a research priority.

Also from TEMF is the observation that minimizing the linear footprint is an important management tool in protecting traditional land uses:

4.3 Learning from the Access Management Scenario
• Management of motorized human access to landscapes, reduction in linear footprints, and systematic reclamation of historic linear footprint are powerful management tools to mitigate impacts, particularly for moose, black bear, and fish.

Conclusion
This issue has been addressed obliquely through a number of initiatives at protecting traditional land values. There is nothing that I have found which involves mapping of current traplines and what might be expected to happen to their environments in the future. It would also seem that trapping and trappers might be able to provide CEMA with very good data sets useful for biodiversity monitoring, impacts on fur bearer populations through development, or contaminant analysis of pelts and carcasses. The Alberta Government also has some trapping data that may be applied to RMWB e.g., http://www.albertaregulations.ca/trappingregs/furbearer-management.htm#registration

FURBEARER MANAGEMENT
Furbearer Management Registration Information / Fisher and Wolverine Carcass Collection Program / Alberta 2009-2010 Fur Production / Primeness of Pelts / Trapping and Cougar Management / Diseases / Control of Problem Wildlife Furbearer Management Registration Information Mandatory registration of fisher, lynx and wolverine has been in effect since 1989; river otter was added in 1996 and bobcat in 2006. The information gained allows annual harvest comparisons to be made immediately after the trapping season so required changes in harvest quotas can be made for the next season. The following table provides a comparison of the number of furbearers registered during past seasons. More specific information can be obtained from regional Fish & Wildlife Division offices. ***Mandatory registration of certain pelts of fur-bearers provides valuable information to wildlife managers. However, there is need for additional biological information on fisher and wolverine to determine the age structure, reproductive capability and general health of these populations. Fish & Wildlife Division district offices will issue a direct payment of $5.00 to trappers for each fisher and wolverine carcass submitted.*** *Carcasses should be individually labelled with the date of harvest, the trapper's name, and the RFMA number. In order to provide the greatest benefit, carcasses must be submitted by March 10 of each year. Your participation in these programs is encouraged and appreciated. The information trappers provide allows quotas to be more accurately set, thus ensuring sustainability of the resource.*

Completion 50%

Issue 68

Surface water Sustainability - Impacts of multiple developments on long-term hydrological and biological integrity of watersheds such as Muskeg River and Kearl Lake

History

Assigned to SEWG with support from SWWG

CEMA Status

Linked to issues 36 (effects on fish populations of changes in flows, sediment concentrations and channel regimes in receiving streams) and 37 (restructuring of drainage regimes may lead to erosion, impacts to wetlands and changes in flow rates), Considered complete with release of TEMF in 2008, and State of the Watershed (Muskeg) also in 2008.

Discussion

An interim Management Framework for the Muskeg River was prepared by AENV, in it the work of CEMA is acknowledged. AENV has long-term river monitoring stations, RAMP has water stations on the Muskeg, project EIAs and CEMA studies provided the baseline data for the Interim Management Framework. The Framework establishes targets for water quantity and quality. It is acknowledged that monitoring is inadequate and AENV has committed to developing a monitoring plan involving stakeholders. **The complete water management plan was scheduled for completion in 2009. The interim framework has become the de facto Management Framework.**

CEMA's State of the Muskeg River watershed appeared in July 2008 (State of the Muskeg River Watershed Report (Contract Number: 2007-0014 SWWG – Dillon et al.) .This report includes more wildlife population and habitat data and expresses concern over groundwater e.g.,

A number of at risk, potentially at risk and sensitive wildlife species are found within the Muskeg River Basin. At risk wildlife species include woodland caribou (Rangifer tarandus) and western toad (Bufo boreas), while species that may be at risk include Canadian toad (Bufo hemiophrys) and wolverine (Gulo gulo). A number of bird species in the watershed are listed as sensitive including the cape may warbler (Dendroica tigrina), bay-breasted warbler (Dendroica castanea), sharp-tailed grouse (Tympanuchus phasianellus), great gray owl (Strix nebulosa) and pileated woodpecker (Dryocopus pileatus). Sensitive mammal species found within the basin include the Canada Lynx (Lynx canadensis) and northern-long eared bat (Myotis septentrionalis) (ASRD, 2005). There is potential for 183 rare plant species (76 vascular and 107 non-vascular) and 23 rare plant communities to occur in the boreal forest natural region. The majority of these rare plant species include sedges, lichens, mosses and liverworts (AMEC, 2005a).

The potential influence of human activities on fish habitat or populations in the Muskeg River Watershed includes angling, as well as industrial development. However, these impacts are largely undetectable, and therefore unknown, due to the limited period of record for fisheries studies in the Muskeg River (RAMP, 2007).

The main linkages between the Muskeg River Basin and the Athabasca River, are mostly aquatic and consist of the quantity and quality of the flows leaving the basin, the in and out migration of fish, and the use of habitats for various life stages of fish.

The regulatory requirement of no net loss of fish habitat will result in continued monitoring of the fisheries resources in the basin. Data collected to support mitigation strategies and fulfill the monitoring obligations of the owners of existing and approved developments will provide insight into future changes in species richness relative to the 2006 benchmark. Similarly, as new projects are proposed, approved and constructed,
additional fisheries data will be collected.

4.1.5 Groundwater
Key activities associated with development of the oil sands resource include the depressurization of the basal aquifer and dewatering of surficial aquifers, both as a consequence of surface mining, and by direct withdrawal of water from the basal and surficial aquifers for SAGD developments.

Recommendations
Worley Parsons Komex is currently developing a conceptual model for hydrogeology of the Athabasca oil sands region. It is anticipated that the results of their study will provide some insight into the baseline groundwater conditions in the Muskeg River Watershed as a subset of the larger regional focus. Preliminary information on the groundwater resource, indicator parameters for groundwater quality, as well as a proposed monitoring and data assessment strategy has been provided by Worley Parsons Komex to ensure consistency with their work.

Dillon et al recommend these additional indicators :

Indicators identified but not currently tenable include:
• Riparian Area
• End Pit Lakes and Tailings Ponds
• Habitat Fragmentation
• Benthic Invertebrates
• Kearl Lake Water Quality
Each indicator is described below, including potential metrics, a description of the data required to feed those metrics, and a discussion of the potential availability of these data and/or potential collection problem

and there is a recommendation that the report be updated

Going forward, the State of the Watershed report should be updated at minimum every 5 years, or as project development warrants. Industry, government and aboriginal groups should, as a matter of policy, incorporate the recommendations made in this report into their operational procedures such that required data are collected in an on-going and systematic manner. This effort will make subsequent updates of the State of the Watershed report faster, easier and more cost effective.

Conclusion
It is disappointing that substantial parts of CEMA's State of the Watershed Report are not incorporated into AENV's Interim (now apparently final) Management Framework. CEMA has completed this issue except for the ongoing updating that may or may not be a CEMA responsibility. CEMA could continue to push for a more complete Framework and enhanced monitoring of the watershed. I will leave this as

still incomplete because of the wording of the issue - it suggests that there are other watersheds besides the Muskeg to consider.

Completion 95%

Issue 69

Terrestrial – End Land Use – Mitigation of cumulative environmental effects through regional development planning and integrated mine plans for oil sands development

History

This is an odd issue for CEMA, it would seem to fall under provincial or municipal responsibility. It was considered linked through work plans with Issues 58,59 and 63. Nonetheless it was lead by SEWG with support from RWG and SWWG

CEMA Status

Considered complete with the publication of TEMF in 2008

Discussion

The short answer to this issue is that CEMA is all about regional planning and GOA with the Land Use Framework and LARP is clearly involved in regional planning even if LARP is different than RMWB. In the introduction to the Terrestrial Ecosystems Management Framework, it is noted that: *The Terrestrial Ecosystem Management Framework (Framework) is the Cumulative Environmental Management Association's (CEMA) recommended approach to managing the cumulative effects of development and resource use on ecosystems and landscapes in the* ***Regional Municipality of Wood Buffalo*** *(RMWB).* Further in the document under policy recommendations, CEMA recommends: (34). *Reconciling the processes for the issuance of surface and subsurface tenure to enable an* ***integrated*** *delivery of management objectives.*

There is criticism that GOA continues to look at individual projects through the EIA process rather than consider cumulative effects however, the Alberta environment website makes clear that:

ILM is a way of behaving. It embraces and accepts that:
• on-the-ground planning should consider past, current and potential future land and resource demands, cumulative effects, historic uses and land-use goals,
• adaptive approaches to land and resource use are required, recognizing that an approach appropriate for one area may not be appropriate for a different location.... The Government of Alberta uses the Land-use Framework to plan land use in the province. As they are developed, Regional Plans will guide the use of land and resources. Land use decisions will also take into account ***cumulative effects*** *and input from other planning processes (e.g., access management planning and municipal planning).*

From my perspective, the relationship among the various organizations with a mandate to advise government on environmental issues in the "Athabasca" region is confusing. The Land Stewardship Act takes precedence over any other legislation in Alberta involving environmental planning. This means that the regional planning process producing the LARP trumps any other frameworks or recommendations produced under different legislation or agreements. This casts doubt on the role of CEMA and on organizations like the Athabasca Watershed Council and WBEA whose geographic mandate is different than that found in the regional planning process. I would hope the GOA is taking steps to reduce the confusion particularly as its image as an environmental steward is under attack.

Conclusion

The proper language is in place in AENV policies and CEMA has contributed significantly with its Frameworks including TEMF. GOA does not always live up to the language of its stated planning model by continuing to approve individual projects without understanding their cumulative impacts. From my perspective, the fact that the boundaries of RMWB and LARP are different creates uncertainty about the the role of CEMA and its great body of work in the future of regional planning in the area. What about WBEA? Clarification is required before this issue is complete.

Completion 80%

Issue 72

Terrestrial – Forest Values Cumulative Impact of development on annual allowable cut and other forest values

History
Although assigned to CEMA, this issue appears to be lead by SRD with support from SEWG.

CEMA Status
Considered complete with the Terrestrial Ecosystem Management Framework

Discussion
In the introduction of TEMF, it is noted that: *Available timber for harvest is expected to be negatively impacted by continued development pressures in the mid- to long-term, in the absence of policy changes or management intervention.* Oil sands mining operations currently impact large areas of forest and will delay reforestation by decades or more. The current FMA with ALPAC (FMU A15) provides for salvage logging in advance of forest destruction through mining and places responsibility for reforestation on the oil sands operators not the forestry company.

From ALPAC's FMA - *FMU A15 contains the Mineable Oil Sands Area (MOSA). The area is expected to be largely developed for oil sands operations in the next decade or two, and the FMP assumes that the timber in the area will be salvaged and not reforested. Progressive reclamation is the responsibility of the oil sands operators when the mining operations are completed. The two timber operators affected are Al-Pac and Northland Forest Products Ltd.*

In TEMF, specific goal statements are aligned with the RSDS, CEMA's vision, and the provincial outcomes as described in the draft LUF. Goal 5 is: *Sustain a land base for timber harvest.* The RMWB Triad includes an Intensive Zone characterized by extraction of energy resources (bitumen mining and in situ development, oil and gas) and **salvage logging**, where aggressive efforts are made to minimize industrial footprints and to encourage rapid reclamation. **An Extensive Zone will allow for forestry and other activities based on the principles of forest ecosystem management. CEMA recommends that this zone be at least 46% of the RMWB.**

CEMA has also modelled the potential timber yield under various management scenarios in the region. From the summary of the methodology appendix to TEMF:

T*he Merchantable stand growth was simulated using average site growth and yield curves provided by Alberta Pacific as derived for use in their Detailed Forest Management Plan. Harvest targets were simulated on the RMWB to assess if they generate a non-declining (sustainable) cut level. Harvest levels needed to be reduced slightly as a result of age class imbalance on the landscape. Ultimately, a sustainable harvest level of 2,597,000 m3/yr was demonstrated by the achievement of stable long term growing stock over 400 years.*

Conclusion
Forest values are clearly addressed in TEMF

Completion 100%

Issue 73

Eutrophication

History
Even though this issue is an extra one not found in the original 72, it is considered fundamental and was assigned to NSMWG (now AWG)

CEMA Status
to be completed in 2016

Discussion
An interim Nitrogen Management Framework (Eutrophication) for the Regional Municipality of Wood Buffalo was published in 2008. Relatively recent research has shown that at low- to mid-levels of nitrogen deposition, certain plant species in nitrogen poor environments, like bogs and fens, can preferentially uptake nitrogen and increase their productivity. Evans (2006) noted that species changes are associated with N deposition. This suggests a shift toward those that prefer sites rich in nutrients (particularly N) while species that prefer N-deficient sites (such as N fixers), naturally found in the Boreal forest of Northern Alberta, are lost. He noted fertilization experiments have resulted in species changes at levels as low as 5 kg N·ha-1·yr-1 (ibid). From Cartwright (2009) S*ince plant growth in reclaimed oil sands mine areas have been observed to be better than modelled predictions (C. Welham, personal communication, February 1, 2006), it may be reasonable to assume that is due to the elevated N inputs in the region. This is supported by the findings of Callesen and Gundersen (2005).* *that nitrogen deposition can increase plant growth.*

In the Framework it is noted that: *at this time there is neither an urgent need, nor a sufficient basis due to uncertainties regarding deposition and critical loads, to implement a management framework with target/critical loads and associated management actions,* ***- a monitoring/research program should be commenced immediately to address key uncertainties regarding nitrogen deposition and critical loads, and - the need for a target/critical load based eutrophication management framework should be assessed after completion of the monitoring/research program.*** In 2008 a contract (Nitrogen loading and terrestrial vegetation- assessment of existing regional vegetation data and recommendations for future monitoring CEMA 2007-0021) was issued to elaborate on an appropriate monitoring program it acknowledged that: *The full recommended program is comprehensive and all components are complimentary to detect and understand potential vegetation response to N loading in the RMWB. However, this full program is will take years to implement and could be fairly costly. Thus, we suggested implementation following a phased approach. Initial focus should be on the implementation of the Process Plot network in sensitive ecosystems and in collaboration with existing monitoring and research efforts (as part of TEEM and CEMA).Following this, additional Target Plots should be added to the network to fill in understanding of ecosystem types of interest and to increase the number of monitoring plots. These Target Plots will not be fully instrumented and will therefore be more affordable. Finally, contingent on funding and support for full implementation for this monitoring program, the implementation of the Regional Plot network should proceed in collaboration with the ABMI program.*

Cartwright in her thesis points out that:

Evans (2006) also observed that in Europe, where monitored deposition rates exceed critical loads across a large portion of the area, emphasis is on reducing exceedances and projecting timelines for recovery. **By 2010 it is expected 70-80% of the critical load for NOx will be reached in the Fort McMurray area, based on anticipated deposition levels (McDonald, 2006).** Evans (2006) noted that since

critical loads have not yet been exceeded in Alberta, the current management emphasis is on avoidance of damage. This suggests there is still a small window of opportunity for the government of Alberta, specifically Alberta Environment, to address current information gaps, and to strengthen its approach to managing NOx emissions, before critical loads are exceeded.

The review of the provincial acid deposition management framework, by the Acid Deposition Assessment Group, suggested the framework may be over-estimating the acidifying effect of deposited Nitrogen and recommended this approach be reviewed (AENV, 2007). The framework is considered conservative since it assumes all nitrogen deposition is acidifying (AENV, 2008). The AENV website still maintains this position focussing only on the acidifying effects of nitrogen deposition:

Federal and provincial policies are in place to address acidifying emissions. These include the Canada-Wide Acid Rain Strategy and Alberta's framework for managing acid deposition. The CEMA Acid Deposition Management Framework is complementary and consistent with these existing policies. In addition, Alberta's Interim Emission Guidelines for Oxides of Nitrogen (NOx) for New Boilers, Heaters and Turbines using Gaseous Fuels for the Oil Sands Region in the Regional Municipality of Wood Buffalo North of Fort McMurray based on a Review of Best Available Technology Economically Achievable (BATEA). The purpose of this guideline is to update NOX emissions criteria for stationary sources. This guideline is interim and is intended for review and finalization in 2009.

Clearly future revisions of the AD framework and future monitoring should give greater consideration to the eutrophication impacts associated with NOx deposition.

From: Technical Review Acid Deposition Management Framework, Eutrophication Work Plan and Ozone Management Framework Submitted to: NOx/SO2 Management Working Group, Cumulative Environmental Management Association December 2010

Eutrophication Work Plan

Insufficient data and information are available in support of the development of a framework for management of nitrogen emissions and deposition, and the environmental eutrophication that could result. The NSMWG identified data and information gaps, published as a set of 15 recommendations in the EWP. ***Responsibility for completion of the recommendations is shared among the NSMWG, the Terrestrial Environmental Effects Monitoring (TEEM) committee of the Wood Buffalo Environmental Association (WBEA), the Regional Aquatics Monitoring Program (RAMP), and government agencies. These programs will conclude in about 2015, at which time the results will be examined and a decision on proceeding with the development of an eutrophication management framework will be made.***

Conclusion

Again from Cartwright (2009) it is recommended that the Government of Alberta conduct more monitoring and research in order to better quantify the level of NOx deposition associated with eutrophication (N enrichment), versus that associated with acidification (AENV, 2007). CEMA has initiated this work but with no accepted Eutrophication Management Framework (regional or provincial) a commitment seems to be lacking. Similarly WBEA initiated a literature review and biomonitoring recommendations (Allen undated – see below). I presume CEMA and WBEA are working together on this issue.

See: Cartwright, Shauna Lynn (2009) Impacts of oxides of nitrogen (NOx) emissions from oil sands operations on soils and vegetation. M.Sc. Thesis Royal Roads University ;

see also from WBEA

Allen, Eric Effects of Nitrogen Deposition on Forests and Peatlands: A Literature review and discussion of the potential impacts of nitrogen deposition in the Alberta Oil Sands Region
http://wbea.org/index2.php?option=com_docman&task=doc_view&gid=299&Itemid=104

Completion 75%