ACKNOWLEDGEMENTS

The Reclamation Working Group (RWG) of the Cumulative Environmental Management Association (CEMA) would like to acknowledge the Co-chairs of the RWG in 2011, Stephen Tuttle from Canadian Natural Resources Ltd., and Tanya Richens from Alberta Environment, as well as all the Members who participated in the work of the group throughout the year. The RWG would also like to thank Program Administrator, Kyle Harrietha, and the Technical Program Managers, Gillian Donald and Théo Charette, for keeping the RWG on schedule and budget, proposing project/program approaches, and advancing the work of the group. The RWG Members and group Chairpersons devoted a great deal of time in providing leadership and feedback, and reviewing/approving reports as they were finalized.

The RWG would also like to thank the numerous consultants and researchers who produced theses and reports that contributed greatly to the development of reclamation guidelines.

Jessica Coles Editing & Document Design edited and produced the template and layout for this report.
EXECUTIVE SUMMARY

The mandate of the Reclamation Working Group (RWG) is to produce and maintain guidance documents that provide recommendations and best practices to ensure that reclaimed landscapes within the Athabasca Oil Sands Region meet regulatory requirements, satisfy the needs and values of stakeholders, and are environmentally sustainable. The RWG provides these guidance documents to the CEMA Board as recommendations to Government. In 2011, three projects were forwarded to the CEMA Board as recommendations to Government. These included the Best Management Practices in Conservation of Reclamation Materials for the Mineable Oil Sands (Contract UCR-0411), the Alberta Regeneration Standards for the Mineable Oil Sands Data Collection Field Protocols (Contract 2010-0026), and the Ecosite Area Summary Table (Contract 2010-0032). The Government accepted and implemented each of these recommendations in 2011.

The RWG significantly advanced the progression of its mandate in 2011. During this time, approximately 56 projects were initiated or completed that advanced knowledge in:

1. Establishing forest vegetation, riparian, wetland and aquatic habitats, and biodiversity in reclamation areas;
2. Defining best management practices for conservation of reclamation materials;
3. Establishing end pit lakes;
4. Defining integrated boundaries and evaluating procedures for initiating closure planning integration;
5. Evaluating monitoring protocols to develop recommendations for assessing reclamation areas; and
6. Developing a reclamation certification framework.

The annual report describes each of these projects in detail (scope sheets) and includes terms of reference and budgets for the RWG, TSG, and ASG. Information on all 2011 RWG activities are provided in this document.
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**ACRONYMS & ABBREVIATIONS**

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<th>Description</th>
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<tr>
<td>ARTG</td>
<td>Alternative Regeneration Standards Task Group</td>
</tr>
<tr>
<td>ASG</td>
<td>Aquatics Sub-Group</td>
</tr>
<tr>
<td>ASRD</td>
<td>Alberta Sustainable Resource Development</td>
</tr>
<tr>
<td>BTG</td>
<td>Biodiversity Task Group</td>
</tr>
<tr>
<td>CCTG</td>
<td>Closure Coordination Task Group</td>
</tr>
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<td>CEMA</td>
<td>Cumulative Environmental Management Association</td>
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<tr>
<td>CNRL</td>
<td>Canadian Natural Resources Limited</td>
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<tr>
<td>CONRAD</td>
<td>Canadian Oilsands Network for Research and Development</td>
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<tr>
<td>DUC</td>
<td>Ducks Unlimited Canada</td>
</tr>
<tr>
<td>EIA</td>
<td>environmental impact assessment</td>
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<td>end pit lake</td>
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<td>End Pit Lake Modelling Task Group</td>
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<td>Energy Resources Conservation Board</td>
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<tr>
<td>FPTG</td>
<td>Forest Productivity Task Group</td>
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<tr>
<td>GYPSY</td>
<td>Growth and Yield Projection System</td>
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<tr>
<td>LCCS</td>
<td>Land Capability Classification System</td>
</tr>
<tr>
<td>LTPN</td>
<td>long-term plot network</td>
</tr>
<tr>
<td>NA</td>
<td>naphthenic acid</td>
</tr>
<tr>
<td>OSPW</td>
<td>oil sands process-affected water</td>
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<td>PHC</td>
<td>petroleum hydrocarbons</td>
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<td>Plot Network Task Group</td>
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<td>Riparian Classification and Reclamation Guide</td>
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<td>Reclamation Classification System Task Group</td>
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<td>Revegetation Manual</td>
<td>Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (AEW 2010)</td>
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<td>RSDS</td>
<td>Regional Sustainable Development Strategy</td>
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<td>Reclamation Working Group</td>
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<td>state-and-transition model</td>
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<td>TEK</td>
<td>traditional environmental knowledge</td>
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<td>traditional knowledge</td>
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<td>technology transfer</td>
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<td>Wetlands Manual</td>
<td>Guideline for Wetland Establishment on Reclaimed Oil Sands Lease (AEW 2008)</td>
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<td>Wildlife Task Group</td>
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</table>
1.0 RECLAMATION WORKING GROUP INITIATIVES

1.1 The Reclamation Working Group Mandate

The Cumulative Environmental Management Association (CEMA) is a planning forum for community, government, regulatory bodies, environmental groups, local health authorities, and industry stakeholders in the Regional Municipality of Wood Buffalo. Its purpose is to facilitate discussions and consensus-driven decision-making on issues related to cumulative environmental effects in the Athabasca Oil Sands Region. CEMA accomplishes its work through technical working groups, including the Reclamation Working Group (RWG).

To that end, the RWG oversees and approves the work plans of task groups and sub-groups, each with a specific reclamation directive.

These task groups and sub-groups are responsible for producing and periodically updating reclamation guidelines. The RWG may then approve the guidelines and/or seek additional knowledge. Guidelines produced in this way include:

- Land Capability Classification System (LCCS) for Forest Ecosystems in the Oil Sands;
- Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region;
- Best Management Practices for Conservation of Reclamation Materials in the Mineable Oil Sands Region;
- Guideline for Wetland Establishment on Reclaimed Oil Sands Leases; and
- End Pit Lake Guidance Document.

The RWG also undertakes cross-discipline projects, such as producing reclamation syntheses and general planning and design tools (e.g., the Guide to the Landscape Design Checklist in the Athabasca Oil Sands Region). These documents are presented to the CEMA Board, who may then choose to advocate for their adoption by government.

Figure 1-1 outlines the RWG organizational structure. Appendix A includes the Terms of Reference for the RWG and the Aquatic and Terrestrial Sub-Groups.
FIGURE 1-1: Redamation Working Group Structure

- Steering Committee
  - Redamation Working Group (RWG)
    - Terrestrial Sub-Group (TSG)
      - Alternative Regeneration Standards Task Group (ARTG)
      - Plot Network Task Group (PNTG)
      - Forest Productivity Task Group (FPTG)
    - Aquatic Sub-Group (ASG)
      - Technology Transfer Task Group (TTTG)
      - End Pit Lake Guide Task Group (EPLGTG)
      - End Pit Lake Modelling Task Group (EPLMTG)
    - Redamation Classification System Task Group (RCSTG)
    - Closure Coordination Task Group (CCTG)
    - Biodiversity Task Group (BTG)
    - Wildlife Task Group (WTG)

- Technical/Administrative
## 1.2 RWG 2011 Members

The RWG membership in 2011 consisted of the individuals listed below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Representative</th>
<th>Task Group Membership/Role</th>
</tr>
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<tbody>
<tr>
<td>AEW</td>
<td>Tanya Richens</td>
<td>RWG Co-chair</td>
</tr>
<tr>
<td></td>
<td>Brett Purdy</td>
<td>TSG Co-chair; CCTG Co-chair</td>
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<tr>
<td></td>
<td>Roderick Hazewinkel</td>
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<tr>
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<td>Lelaynia Cox</td>
<td>WTG Co-chair</td>
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<td>Abimbola Ojekanmi</td>
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<td>Total E&amp;P Canada</td>
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### 1.2.1 Biodiversity Task Group (BTG)

The BTG membership in 2011 consisted of the individuals listed below.

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<tr>
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<td>Fort McKay Sustainability Department</td>
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<td>Syncrude Canada</td>
<td>Carla Wytrykush, Audrey Lanoue</td>
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</table>

### 1.2.2 Closure Coordination Task Group (CCTG)

The CCTG membership in 2011 consisted of the individuals listed below.

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<tr>
<td>Shell Albian Sands</td>
<td>Fred Kuzmic</td>
</tr>
<tr>
<td>Suncor Energy</td>
<td>Bruce Anderson, Melina Mamer</td>
</tr>
<tr>
<td>Syncrude Canada</td>
<td>Audrey Lanoue (Co-chair), Gord Campbell</td>
</tr>
</tbody>
</table>

### 1.2.3 Reclamation Classification System Task Group (RCSTG)

The RCSTG membership in 2011 consisted of the individuals listed below.
1.2.4 Wildlife Task Group (WTG)

The WTG membership in 2011 consisted of the individuals listed below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASRD</td>
<td>Murray Anderson, John Begg</td>
</tr>
<tr>
<td>CEMA Program Administrator</td>
<td>Kyle Harrietha</td>
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<tr>
<td>CNRL</td>
<td>Joanne Hogg, Stephen Tuttle</td>
</tr>
<tr>
<td>Fort McKay Sustainability Department</td>
<td>Lorne Gould (Co-chair)</td>
</tr>
<tr>
<td>Imperial Oil</td>
<td>Tyler Colberg, Rachel Nobel-Pattinson</td>
</tr>
<tr>
<td>RWG Technical Program Manager</td>
<td>Gillian Donald</td>
</tr>
<tr>
<td>Suncor</td>
<td>Josh Martin (Co-Chair), Bruce Anderson</td>
</tr>
<tr>
<td>Syncrude Canada</td>
<td>Jamie Sullivan</td>
</tr>
</tbody>
</table>

1.3 RWG 2011 Meeting Dates

The RWG and its task groups each held between two and nine meetings in 2011. Summary notes from the meetings are available to CEMA Members as a separate document.

<table>
<thead>
<tr>
<th>No.</th>
<th>RWG</th>
<th>BTG</th>
<th>CCTG</th>
<th>RCSTG</th>
<th>WTG</th>
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<td>9.</td>
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</table>
1.4 Published Reports


1.5 Scope Sheets

1.5.1 Projects Completed in 2011

This section includes scope sheets for the following RWG projects that were completed in 2011.

- Biodiversity Traditional Knowledge Study Phase III Regional Workshop and Phase IV Plain Language Document
- Define “Integrated Boundary” in the Closure Coordination Context
- Literature Review – Land Classification Systems for Disturbed Lands
- State and Transition Models: Potential Role in Development of Reclamation Classification System
- Technical Review of the Riparian Classification and Reclamation Guide for the Athabasca Oil Sands Region
- Revision and Completion of Shell/ Suncor Riparian Classification and Reclamation Guide
- Synthesis of Habitat Models Used in the Oil Sands Region
Biodiversity Traditional Knowledge Study Phase III Regional Workshop and Phase IV
Plain Language Document

RWG Project Number
R-1101

Project Linkage to Terms of Reference
Supports objective of “re-establishing biodiversity of the reclaimed landscape.”

CEMA Contract Number
2010-0022

Principal Investigators/Consultant
SENES Consultants Ltd.

Contract Budget
$90,000 + $60,320 amendment to do Phase IV

Project Description
The Biodiversity Task Group (BTG) sponsored a three-year, multi-phase Biodiversity Traditional Knowledge (TK) Study in the Athabasca oil sands region that was undertaken during 2008-2011. The core objective of the study was to develop recommendations and guidance based on traditional knowledge for reclamation planning for biodiversity as part of the workplan of the RWG. The holistic nature of the scientific concept “biodiversity” required a more open approach to research with aboriginal people than had been the standard when projects were more narrowly scoped based on the scientific definition of biodiversity. In Phase I (CEMA Contract 2008-0032), aboriginal participants identified an alternative concept of biodiversity that expanded the scientific focus on the environmental and biophysical realm to include social and cultural aspects of the landscape. Phases I and II (CEMA Contract 2009-0031) identified a new methodology, referred to as the Two Roads approach, involving a team of community researchers which defined a distinct space for aboriginal questions, objectives, and ways of knowing. To further develop the concept of the Two Roads approach, the RWG sponsored a regional workshop as a third phase of the study. The regional workshop was used to test and validate the Two Roads approach with the four aboriginal communities who participated in Phases I and II and with members of other aboriginal communities from the region that were not involved in Phases I and II.

The study also demonstrated that a cross-cultural Two Roads approach requires the process and results to be documented in two written forms: one that is a technical document summarizing methods, results, discussion, and theory to fulfill the scientific component and communicate to RWG; and another that is a plain language document targeted for the aboriginal participants summarizing the results and conclusions of the Biodiversity TK Study using stories, quotes, photographs, written contributions from community researchers, and other formats. The final deliverable of the Phase III Regional Workshop component was written as a technical report documenting the social science methodologies used throughout the Biodiversity TK Study to gather traditional knowledge and the theoretical aspects of defining an indigenous research methodology (referred to as the Aboriginal Road in the Two Roads approach). The BTG and the lead author of the technical report and main facilitator of the study identified that a plain language document, summarizing the achievements of the study for the aboriginal participants, was required to provide culturally appropriate documentation for the aboriginal participants.
Phase IV was initiated to develop a plain language document of the Biodiversity TK Study for the aboriginal participants of the study and to provide validation of the document and more generally the Two Roads approach. The plain language document was designed and developed with the community researcher team during a four-day workshop on September 27 to 30, 2011. During November and December, five community researcher team members distributed the draft plain language document with a cover letter requesting feedback to all study participants, and conducted interviews with select individuals.

**Project Deliverables**
Regional Workshop was held November 16-17, 2010.

Technical Document and Plain Language Document were submitted December 2011.


The Two Roads Research Team. 2011. An Aboriginal Road to Reclamation A Study Summary for Aboriginal Communities of the Oil Sands Region. Prepared for the Biodiversity Task Group of the Reclamation Working Group of the Cumulative Environmental Management Association, Fort McMurray, AB.

**Project Timelines**
August 2010 to December 2011

**Project Status**
Complete

**Highlights/ Milestones/ Key Findings**
The technical document provides a comprehensive methodology for the Two Roads approach, setting an established and tested framework for future traditional knowledge projects.

The plain language document contains six chapters (1. Lay of the Land; 2. Reclaiming Our Land; 3. Two Roads to Reclamation; 4. Blazing Our Trail; 5. Biodiversity the Aboriginal Way; and 6. Looking Forward). Each community researcher contributed individual stories to different chapters and some aboriginal participants of the study also contributed stories supporting the chapter themes. The validation process used for the plain language document resulted in constructive and informative feedback from the aboriginal participants, which was incorporated into the final plain language document.

The Biodiversity TK Study resulted in two main achievements:

1. The aboriginal participants of the study shared traditional knowledge of the oil sands describing the aboriginal perspective of what scientists call biodiversity, and RWG gained an understanding of how traditional knowledge can be applied to reclamation research in the oil sands region.

2. An indigenous research methodology using a team of community researchers was successfully developed and tested in Phases II, III, and IV. This methodology was validated by aboriginal participants of the study in Phases III and IV.
Definition of “Integrated Boundary” in the Closure Coordination Context

RWG Project Number
R-1102

Project Linkage to Terms of Reference
Supports the objective of “providing guidance for reclamation on appropriate design, construction, integration, reclamation and maintenance of landforms and landscapes.”

CEMA Contract Number
UCR-0311

Principal Investigators/ Consultant
BGC Engineering

Contract Budget
$14,470

Project Description
- Participate in the RWG Workshop ‘Designing Oil Sands Mining Landforms for Natural Appearance and Landform Integration’ on February 7, 2011, at the Syncrude Research Centre in Edmonton, Alberta, Canada.
- Present a report prepared for Alberta Environment and Water (AEW).
- Lead a workshop around the findings of the report.
- Obtain input and prepare a scope of work, based on the workshop, to address landform integration.

Project Deliverables
- Develop the workshop agenda.
- Present the report.
- Prepare meeting minutes and scope of work.

Project Timelines
January 2011 to December 2011

Project Status
Complete

Highlights/ Milestones/ Key Findings
The scope of work presents a path forward to address natural appearance and landform integration that will give further RWG discussions on the matter.
Literature Review – Land Classification Systems for Disturbed Lands

RWG Project Number
R-1104

Project Linkage to Terms of Reference
Supports objectives of “appropriate design, construction, integration, reclamation and maintenance of landforms and landscapes”; “land capabilities for forest ecosystems on natural and reclaimed lands”; and “other reclamation guidance as agreed upon by RWG and the CEMA Board.”

CEMA Contract Number
2011-0020

Principal Investigators/ Consultant
Summit Environmental Consultants Inc.

Contract Budget
$81,107

Project Description
The purpose of this project was to examine the literature to determine whether an applicable or adaptable disturbed ecosystem classification exists currently and to apply the learning from this exercise in making recommendations for the direct application, modification, or development of a Reclamation Classification System for the mineable oil sands region of north eastern Alberta. The Reclamation Classification System will fulfill the need for an approach to classifying ecological communities that develop on reclaimed oil sands mining disturbances in the Boreal Plain. Oil sands mining disturbances in the region must be reclaimed to a productive state; this requires detailed and up-to-date knowledge on re-creating landforms, rehabilitating hydrologic functions, reconstructing soil resources, and re-establishing vegetation. Aggregate ecosystem development responses to these reconstruction/rehabilitation strategies are not well understood. Additionally, current land capability classification and reclamation practice guidance documents used in the oil sands region do not provide sufficient information to classify developing ecosystems on mining disturbances. A Reclamation Classification System will serve this purpose.

The specific project objectives were to:

1. Conduct a global literature review of ecological classification systems used to classify ecosystems that have developed on disturbed lands (terrestrial to and including wetlands);
2. Compile a database of citations, abstracts, and attributes of the classification system;
3. Summarize and synthesize the literature review into categories; and
4. Provide recommendations regarding the reviewed classification systems and how they may be informative to building the Reclamation Classification System.

Project Deliverables
Database summarizing the literature identified during the literature review.

Project Timeline
April to December 2011

Project Status
Complete

Highlights/ Milestones/ Key Findings/ Etc.
The literature review determined that no single document provided a comprehensive approach for the ecological classification of disturbed ecosystems that would be applicable to the mineable oil sands region of northeastern Alberta. Many international studies presented a posteriori classifications of disturbed ecosystems, with some of these studies providing descriptions of habitat templates as the basis for biotic interactions with descriptions of trajectories. The majority of the studies were restricted to localized disturbances and not linked to a formal national classification schema.

Based on the interpretation of the available scientific literature on the subject, the most suitable approach for developing a Reclamation Classification System for the mineable oil sands region is a hierarchal system based on biotic characteristics or functional in nature (bottom-up or ascending typology) that includes landforms, substrates, and hydrogeological dynamics as a foundation.
State and Transition Models: Potential Role in Development of Reclamation Classification System

RWG Project Number
R-1104

Project Linkage to Terms of Reference
Supports objective of “appropriate design, construction, integration, reclamation and maintenance of landforms and landscapes”; “land capabilities for forest ecosystems on natural and reclaimed lands”; and “other reclamation guidance as agreed upon by RWG and the CEMA Board.”

CEMA Contract Number
UCR-0911

Principal Investigators/Consultant
Apex Resource Management Solutions Ltd.

Contract Budget
$18,314

Project Description
The Reclamation Classification System Task Group (RCSTG) has a mandate to develop a reclamation classification system for as-built landforms and conceptual planning based primarily on substrate (soil and below) conditions and landform morphology to delineate homogeneous reclamation units that will correspond to ecological (primarily vegetation) response. Two of the objectives of this mandate are to:

1. Identify the components of a classification system needed to develop a conceptual model; and
2. Define requirements and class units of each component of conceptual model.

State-and-transition modelling was identified as one approach with the potential to assist in the development of the reclamation classification system. A state-and-transition model (STM) is a tool for organizing information and understanding an ecological system. STMs characterize a landscape according to a set of vegetation states; each parcel of land is assigned to one a particular state at any given point in time, with transitions then defined that move land from one state to another over time. Transitions between states can be triggered by both natural events (e.g., succession, fire) and management actions (e.g., clearing, planting).

The purpose of this project was to present a mock-up case study prepared by the developer of Path Landscape Model (STM software package see http://www.apexrms.com/path) to demonstrate how STMs could be used to support the development of the reclamation classification system.

Project Deliverables
RCSTG Workshop December 7, 2011.


Project Timeline
September to December 2011
Project Status
Complete

Highlights/Milestones/Key Findings/Etc.
The final report documents the discussion and recommendations of a workshop held with the RCSTG in Fort McMurray on December 7, 2011, the purpose of which was to explore options for using state-and-transition models to support the development of the reclamation classification system. The remainder of this report is structured as follows:

- Section 2 provides background information on state-and-transition modelling;
- Section 3 describes a simple demonstration STM for oil sands reclamation; and
- Section 4 lists possible next steps in developing STMs for the RCSTG.

A sample land classification system was prepared for the demonstration. The key concepts associated with the sample system are summarized as follows:

1. The focus of the example was on upland (i.e., forested) areas, although a few wetland classes were shown to indicate how the system could be extended to include wetlands.
2. The system was developed to integrate with the site type classification system outlined in the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region, 2nd edition (AEW 2010).
3. Only a sample of disturbed classes were shown.
4. Reclaimed classes were stratified according to the following biophysical variables: soil moisture and nutrients (through site type), topography (through slope), and aspect (through solar radiation).

References Cited
Technical Review of the Riparian Classification and Reclamation Guide for the Athabasca Oil Sands Region

RWG Project Number
R-1105

Project Linkage to Terms of Reference
Supports the objective of “providing guidance for reclamation on riparian ecosystem establishment.”

CEMA Contract Number
2009-0050

Principal Investigators/Consultant
The Forestry Corp.

Contract Budget
$52,369

Project Description
In the fourth quarter of 2009, the Riparian Classification and Reclamation Guide (RCRG) for the Athabasca Oil Sands Region, completed by GDC for Shell Albian Sands and Suncor Energy, was submitted to the ASG to be considered for approval by the RWG and CEMA Board and subsequently by the Government of Alberta. The ASG decided that, in line with the process undertaken for the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (AEW 2010), it would conduct a technical review of the RCRG before advancing the verification and approval process.

The project followed the tasks outlined below:

1. Develop an assessment matrix, with evaluation criteria and criteria weights, against which the RCRG will be evaluated;
2. Undertake a technical review of the RCRG;
3. Evaluate the RCRG using the assessment matrix;
4. Identify gaps in the RCRG, focusing on heavily weighted evaluation criteria that are not adequately addressed;
5. Make recommendations for RCRG revisions and for further research to address identified shortcomings; and
6. Facilitate third-party reviews (up to three) of The Forestry Corp.’s technical review.

Completion of the technical and peer reviews provided detailed, quantitative assessments of aspects of the RCRG that required revision or augmentation. Along with input from the peer reviewers and CEMA, the project team formulated a detailed plan by which the RCRG can be improved.

Project Deliverables
1. Assessment matrix, complete with evaluation criteria and criteria weights.
2. Completed assessment matrix with weighted scores for the RCRG.
3. Final report identifying deficiencies/ gaps in the RCRG and recommendations for testing/verifying and revision of the RCRG.
Project Timelines
March 2011

Project Status
Complete. The Forestry Corp. initial review was completed and received. The three peer reviews of The Forestry Corp. review have been completed. The final report from The Forestry Corp. that consolidates the three reviews into a final review document was received.

Highlights/ Milestones/ Key Findings
In the Assessment Matrix Scoring, the Guide earned 58.5% of all possible points available across all Assessment Criteria. The Guide provided a good synthesis of species that are effective for riparian reclamation, as well as the environmental conditions appropriate for each. Much weaker was the acknowledgement of, and the accounting for, the role of environmental disruptions and stimuli (vegetative competition, diseases, herbivory, flooding, drought, fire, windthrow, etc.) that affect and determine species assemblages. The Guide also suffered from a lack of guidance for operational implementation of riparian reclamation, and for direction on assessing the requirements or opportunities for interventions.

References Cited
Revision and Completion of Shell/Suncor Riparian Classification and Reclamation Guide

RWG Project Number
R-1105

Project Linkage to Terms of Reference
Supports the objective of “providing guidance for reclamation on riparian ecosystem establishment.”

CEMA Contract Number
2011-0025

Principal Investigators/Consultant
Incremental Forest Technologies Ltd.

Contract Budget
$38,945

Project Description
In the fourth quarter of 2009, the Riparian Classification and Reclamation Guide (RCRG) for the Athabasca Oil Sands Region, completed by GDC for Shell Albian Sands and Suncor Energy, was submitted to the ASG to be considered for approval by the RWG and CEMA Board and subsequently by the Government of Alberta. The ASG decided that, in line with the process undertaken for the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (AEW 2010), it would conduct a technical review of the RCRG before advancing the verification and approval process. The technical review was completed by The Forestry Corp. in March 2011.

The purpose of the project was to revise/complete the Riparian Reclamation Report recently reviewed for CEMA by The Forestry Corp. and a team of third party reviewers. Specifically, CEMA requested that Incremental Forest Technologies Ltd. address eight areas of potential improvement identified in the review process and two additional areas arising from CEMA’s decision to reposition this project from guideline to report status.

Project Deliverables
Three documents were delivered:
2. Revised Riparian Guide.
3. Revised Appendices to the Riparian Guide.

Project deliverables for the revisions were met as listed below:
1. Make the report consistent in its application of assembly theory - Guide text has been revised to present a consistent application of assembly theory.
2. Incorporate Wet Areas Mapping - A brief discussion on the potential of wet areas mapping has been added as Section 4.3.
3. Professional review of kriging - A separate report describing modifications to the kriging was provided and the methods were updated in the guide and guide appendices.
4. Short discussion on the effects and importance of beavers - Included in the guide as Section 3.5.
5. **Strengthen the Plant Community Stability Assessment Tool** - The tools have been developed on a new more stable platform and have been substantially revised based on new analysis. Also, wherever possible Traditional Ecological Knowledge for each of the 70 species used in the tool has been added to the individual species fact sheets.

6. **Copy edit** - A copy edit has been completed.

7. **Glossary** - A document specific glossary has been added at the end of the guide.

8. **Discuss/acknowledge climate change** - A discussion of climate variability has been added to Section 3.1 of the guide.

9. **Develop a Foreword that identifies the rationale for the Riparian Reclamation Report and provide a discussion of how the Riparian Reclamation Report, the Wetlands Reclamation Guidelines 2007 and the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (2nd edition)** - A brief forward has been added to the guide.

10. **Briefly discuss and summarize the Peer and Third Party Review processes to provide background and context** - Peer review description has been added to the foreword.

**Project Timelines**
December 2012

**Project Status**
Complete

**Highlights/ Milestones/ Key Findings**
Major improvements to the riparian guide are the inclusion of a consistent application of assembly theory and an acknowledgment of the potential impact of beavers and climate variability.

The modification to the analysis resulted in substantial changes to the tools and the 70 species fact sheets upon which the tools were based. The functionality of the tools has also been greatly improved by use of an alternative platform.

**References Cited**
Synthesis of Habitat Models Used in the Oil Sands Region

RWG Project Number
R-1108

Project Linkage to Terms of Reference
Supports objective of “forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2010-0034

Principal Investigators/ Consultant
LGL Limited environmental research associates

Contract Budget
$74,250 + $7,515

Project Description
The scope of work for this project consisted of four tasks:

- Task 1: Review and summarize habitat models used in the oil sands region for Environmental Impact Assessments (EIAs) for oil sands project applications and for other projects such as wildlife habitat mapping conducted by the Sustainable Ecosystems Working Group or for the Lower Athabasca Regional Plan.
- Task 2: Review and summarize how regional wildlife habitat mapping data, EIA habitat model data, and habitat models are used to develop oil sands closure plans.
- Task 3: Summarize the validation method and status of existing validated models.
- Task 4: Provide recommendations for validation procedures of non-validated models.

The budget was amended to provide funds to develop a web-enabled version and user guide of the database documenting the validation status of each habitat model reviewed for the project.

Project Deliverables
Web-enabled database and user guide documenting the validation status of each habitat model reviewed for the project.


Project Timelines
October 2010 to August 2011

Project Status
Complete
Highlights/ Milestones/ Key Findings
Twenty-two oil sands operations EIAs and 228 species habitat models in the EIA documents were reviewed. The number of models in an EIA varied from 4 to 15, with a median of 12 models. The majority of these models (82.0%) were reused from previous EIAs, often with some degree of modification. Three types of species habitat models were mainly used. Habitat suitability index (HSI) models were used the majority of the time (74.1%), with resource selection functions (RSFs) and CAPSU models used 7.9% and 16.7%, respectively. Of the 228 models, 101 (44.3%) had some validation documented in an EIA, with RSF models most likely to be validated (66.7%) followed by HSI models (52.1%). Only one of the CAPSU models was validated. Data gaps were the main reason given for performing limited or no model validation. Statistical methods were used in 42.0% of the validated HSI models and in all instances of validated RSF models. The HSI models were validated using various methods; however, there was no evidence of validating the model structure or calibrating the model as recommended in the reviewed literature. The procedures recommended in the scientific literature for validating HSI and RSF models are summarized in the report.
1.5.2 Projects Initiated or Ongoing in 2011

This section includes scope sheets for RWG projects that were initiated or ongoing in 2011.

- Synthesis: Applying the Reference Condition Approach for Monitoring Reclamation Areas in the Athabasca Oil Sands Region
- Framework for Reclamation Certification and Indicators for Mineable Oil Sands – Production of Content and Guidance on Use
- Early Successional Wildlife Monitoring Program on Reclaimed Plots in the Oil Sands Region
- Phase 2: Validation Procedures for Habitat Models in the Oil Sands Region
Synthesis: Applying the Reference Condition Approach for Monitoring Reclamation Areas in the Athabasca Oil Sands Region

RWG Project Number
R-1101

Project Linkage to Terms of Reference
Supports the objectives of “re-establishing biodiversity of the reclaimed landscape”; “reclamation certification”; and “other guidance as agreed upon by RWG and the CEMA Board."

CEMA Contract Number
2010-0025

Principal Investigators/ Consultant
University of Windsor

Contract Budget
$70,000 + $140,000 amendment to complete Phase II

Project Description
The purpose of Phase I of this project was to conduct a synthesis and compile seven fact sheets on the use of the reference condition approach to assess the re-establishment of functional ecosystems on reclaimed landscapes in the oil sands region. The synthesis includes fact sheets that 1) document the assumptions associated with using the reference condition approach in the oil sands region; 2) define factors for selecting reference sites; 3) define factors for grouping reference sites; 4) define methods for selecting indicators based on reference site groupings; 5) define methods for comparing test and reference sites; 6) define factors for interpreting and evaluating the results of the comparison of test and reference sites; and 7) propose recommendations for using the reference condition approach in the oil sands region.

Phase II of the project will apply the direction provided in the fact sheets to specific examples outlined in RWG’s workplan and/or in the guidance documents as examples and case studies of how to use the information in the fact sheets. The examples and case studies will be used to develop the suggested appendices and support the goal of developing a conceptual model for a biodiversity monitoring program in the oil sands region based on the reference condition approach. The BTG will develop a conceptual model to help understand how the diverse components of a biodiversity monitoring program interact, and to promote integration and communication among stakeholders from different disciplines.

Project Deliverables

Final report with appendices to be submitted December 2012.

Project Timelines
October 2010 to December 2012

Project Status
Ongoing

Highlights/ Milestones/ Key Findings
To be determined when the final report is submitted.
Framework for Reclamation Certification and Indicators for Mineable Oil Sands - Production of Content and Guidance on Use

RWG Project Number
R-1103

Project Linkage to Terms of Reference
Supports the objective of “providing guidance for reclamation on reclamation certification.”

CEMA Contract Number
2010-0028

Principal Investigators/ Consultant
Opabin Environmental Ltd.

Contract Budget
$107,625

Project Description
In December 2009, CEMA approved a report entitled “A Framework for Reclamation Certification Criteria and Indicators for Mineable Oil Sands.” The criteria and indicators framework proposed is based on a Goal – Objective – Criteria – Indicator – Standard – Method hierarchy. That is, there can be multiple objectives to a goal, multiple criteria to an objective, and multiple indicators to a criterion. The criterion determines what has to be met to qualify that the objective has been achieved. The indicator describes what specifically is measured to determine whether the criterion has been met. The standard describes the regulatory target. The method sets a common procedure for measuring the indicator. In this report, a number of objectives, criteria, and indicators were derived; however, these are considered draft. Recommendation 3 of the report calls for a review of the content.

The goal of this project is to populate the Criteria and Indicators Framework for Reclamation Certification Criteria and provide rules for its use.

Project Deliverables
A final report demonstrating a populated Framework for Reclamation Certification Criteria and Indicators for Mineable Oil Sands.

Project Timelines
October 2010 to December 2012

Project Status
Ongoing. RWG met a number of times throughout the year to discuss and approve concepts for the use of the Framework and the specific objectives and criteria that populate the framework. In late summer 2011, the RWG met with its subgroups to request their assistance in developing indicators that fall under the criteria. In the fall, the TSG, BTG, and WTG presented indicators to the RWG. The ASG will provide its list of indicators early in 2012, after which the RWG will decide which indicators will go into the Framework.

Highlights/ Milestones/ Key Findings
- An interim report was produced, titled “Concepts for the use of criteria and indicators for oil sands mine reclamation.”
- Indicators submission forms were completed and submitted to the RWG from the TSG, WTG, and BTG.
Early Successional Wildlife Monitoring Program on Reclaimed Plots in the Oil Sands Region

**RWG Project Number**
R-1108

**Project Linkage to Terms of Reference**
Supports objective of “forest vegetation (ecosystems) establishment.”

**CEMA Contract Number**
2010-0023

**Principal Investigators/ Consultant**
LGL Limited environmental research associates

**Contract Budget**

**Project Description**
The purpose of this project is to conduct monitoring of early successional species at locations within the long-term plot network managed by the TSG. The monitoring consists of 1) fall and spring small mammal trapping surveys; 2) winter tracking and browsing surveys; and 3) spring bird count surveys. The species and species groups surveyed are moose, small mammals (red-backed vole, meadow vole, deer mouse, and sympatric species), snowshoe hare, and mixed wood birds.

The monitoring program is composed of the following survey techniques:

1. Winter Tracking for all furbearers, small mammals, snowshoe hare, ungulates, and galliformes (grouse type). The winter tracking surveys provides data on the presence or absence of moose and snowshoe hare within reclaimed areas.

2. Spring and fall small mammal live-trapping of red-backed voles, deer mice, and meadow voles to associate their presence and densities with habitat change.

3. Point counts in spring of mixedwood songbirds. The data collected provide information on the corresponding changes in bird communities as the area changes through time.

**Project Deliverables**
Monitoring program – field surveys.


**Project Timelines**
August 2010 to August 2013

**Project Status**
Ongoing
Highlights/ Milestones/ Key Findings
Year 1 of the study achieved the following goals:

1. An assessment of the return and re-establishment of early successional wildlife to reclaimed terrestrial systems.

2. An assessment of the feasibility of the recommended protocols for monitoring wildlife on reclaimed terrestrial systems.

3. The development of recommendations for the wildlife appendix of the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region, 2nd edition for early successional wildlife monitoring based on the monitoring program results.

4. The collection of monitoring data to assist in identifying and developing wildlife indicators for reclamation certification.

Early indications suggest the proposed methods are suitable for documenting wildlife use of reclaimed plots; however, the frequency and duration of monitoring needs to be increased to determine patterns of re-establishment and use by wildlife. A history of the reclamation sites included in the pilot study is provided along with an overview of the current status and use of those sites by wildlife. Recommendations are made regarding the program scope and changes to the monitoring protocol in terms of frequency, duration, and study design.
Phase 2: Validation Procedures for Habitat Models in the Oil Sands Region

**RWG Project Number**
R-1108

**Project Linkage to Terms of Reference**
Supports objective of “forest vegetation (ecosystems) establishment.”

**CEMA Contract Number**
2011-0034

**Principal Investigators/ Consultant**
LGL Limited environmental research associates

**Contract Budget**
$115,653

**Project Description**
The purpose of the Habitat Model Validation Phase 2 work is to address the recommendations outlined in the Phase 1 report (CEMA Contract 2010-0034) and to cross-reference the literature reviews completed by the ASG and Surface Water Working Group to determine whether the data sources identified could be used to validate existing species habitat models.

The objectives of the Habitat Model Validation Phase 2 are to:

1. Review existing data sources to determine whether the data can be used to validate existing species habitat models identified in the Phase 1 report;
2. Develop a data collection program to address data gaps limiting procedures to validate remaining models; and
3. Describe validation procedures for existing species habitat models based on available data and the data collection program.

**Project Deliverables**
Final report to be submitted July 2012.

**Project Timeline**
September 2011 to July 2012

**Project Status**
Ongoing

**Highlights/ Milestones/ Key Findings/ Etc.**
To be determined when the final report is submitted.
2.0 **TERRESTRIAL SUB-GROUP INITIATIVES**

2.1 **The Terrestrial Sub-Group Mandate**

The Terrestrial Sub-Group (TSG) was originally formed as the Soils and Vegetation Sub-Group in 1999 to function as a working group under the RWG. Prior to 1999, the Soils Working Group existed outside of CEMA.

The mandate of the TSG is to develop recommendations that support establishment, assessment, monitoring, criteria and indicators for certification, and adaptive management of reclaimed terrestrial ecosystems on oil sands leases in the Regional Municipality of Wood Buffalo.

The TSG fulfills this mandate through the development and maintenance of the following guidance documents and decision support tools:

- A guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands;
- A guidance document for forest vegetation (ecosystems) establishment;
- A guidance document for management practices for soil salvage and placement; and
- Other reclamation guidance documents and tools as agreed upon by the RWG.

These guidance documents support the creation of a range of sustainable terrestrial ecosystems in reclaimed landscapes. The TSG provides these guidance documents and tools as recommendations to the RWG.

In 2011, the TSG forwarded three recommendations to the RWG (Contracts 2010-0026, 2010-0032 and UCR-0411).

See Appendix A for the history and Terms of Reference for the TSG.
### 2.2 TSG 2011 Members

The TSG membership in 2011 consisted of the individuals listed below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEW</td>
<td>David Bergstrom, Chi Chen, Brett Purdy (Co-chair), Tanya Richens</td>
</tr>
<tr>
<td>ASRD</td>
<td>Isaac Amponsah, Grant Klappstein, John Begg</td>
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<td>CEMA Program Administrator</td>
<td>Kyle Harrietha</td>
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<td>CNRL</td>
<td>Scott Johnson, Ben Sey, Stephen Tuttle</td>
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<td>ERCB</td>
<td>Chris Hale, Carmalee FarnBaker, Steven Van Lingen</td>
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<td>Fort McKay Sustainability Department</td>
<td>Carol Jones, Jeff Battigelli, Justin Straker</td>
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<td>Imperial Oil</td>
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<td>NAIT</td>
<td>Haneef Mian</td>
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<tr>
<td>Natural Resources Canada</td>
<td>Ruth Errington</td>
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<tr>
<td>OSRIN</td>
<td>Chris Powter</td>
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<tr>
<td>RWG Technical Program Manager</td>
<td>Gillian Donald</td>
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<tr>
<td>Shell Albian Sands</td>
<td>Clayton Dubyk, Xiao Tan</td>
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<tr>
<td>Suncor Energy</td>
<td>Bruce Anderson, Francis Salifu, Lelaynia Cox (Co-chair)</td>
</tr>
<tr>
<td>Syncrude Canada</td>
<td>Rob Vassov, Marty Yarmuch, Marie Keys</td>
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</table>

#### 2.2.1 Alternative Regeneration Standards Task Group (ARTG)

The ARTG membership in 2011 consisted of the individuals listed below.

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<tr>
<td>AENV</td>
<td>Brett Purdy</td>
</tr>
<tr>
<td>ASRD</td>
<td>Erin Fraser, Grant Klappstein (Co-chair), John Begg, Ken Greenway</td>
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<td>CEMA Program Administrator</td>
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<td>RWG Technical Program Manager</td>
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<td>Shell Albian Sands</td>
<td>Xiao Tan, Vivienne Wilson, Clayton Dubyk (Co-chair)</td>
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<td>Bruce Anderson, Francis Salifu, Lelaynia Cox</td>
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<tr>
<td>Syncrude Canada</td>
<td>Audrey Lanoue, Rob Vassov, Sylvia Skinner</td>
</tr>
</tbody>
</table>

#### 2.2.2 Forest Productivity Task Group (FPTG)

The FPTG membership in 2011 consisted of the individuals listed below.
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
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<tr>
<td>AEW</td>
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<tr>
<td>ASRD</td>
<td>Yuqing Yang, Ken Greenway, Shongming Huang</td>
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<td>RWG Technical Program Manager</td>
<td>Gillian Donald</td>
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<td>Shell Albian Sands</td>
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<td>Bruce Anderson, Lelaynia Cox, Francis Salifu, Zeid Eljundi</td>
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<td>Syncrude Canada</td>
<td>Rob Vassov (Chair)</td>
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</table>

### 2.2.3 Plot Network Task Group (PNTG)

The PNTG membership in 2011 consisted of the individuals listed below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
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<tr>
<td>AEW</td>
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<td>ASRD</td>
<td>Murray Anderson, John Begg</td>
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<td>Evelyne Thiffault, Ruth Errington</td>
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<td>Chris Powter</td>
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<td>RWG Technical Program Manager</td>
<td>Gillian Donald</td>
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<td>Suncor Energy</td>
<td>Lelaynia Cox</td>
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<tr>
<td>Syncrude Canada</td>
<td>Rob Vassov (Chair)</td>
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### 2.3 TSG 2011 Meeting Dates

The TSG and each of its task groups held between two and nine meetings in 2011. Summary notes from the meetings are available to CEMA Members as a separate document.

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<td>9</td>
<td>November 9</td>
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</table>
2.4 Published Reports


2.5  **Scope Sheets**

2.5.1  **Projects Completed in 2011**

This section includes scope sheets for the following TSG projects that were completed in 2011.

- Estimating Early Stand Mortality – Historical Data Synthesis and Field Sampling Program Design
- Development of Terms of Reference for Stem Analysis Project
- Forest Productivity Task Group Growth & Yield Model Development – Questionnaire and Synthesis
- Letter Agreement – Growth & Yield Model Development: Questionnaire – Contract UCR-0211
- Growth & Yield Model Development – Attendance at Field Tour and Technical Workshop – Contract UCR-0711
- Growth & Yield Model Development – Planning and Technical Assistance for Field Tour and Technical Workshop – Contract UCR-0711
- Soil Nitrogen Indicators for Land Reclamation Policy Development for Forest Ecosystems in the Oil Sands Region (Grant)
- Effects of PHCs in Mineral Soil Located Beneath Peat Deposits on Plants and Soils Fauna (Grant)
- Ecosite Area Summary Table
- Long-Term Soil and Vegetation Monitoring Program (Vegetation Component)
- Long-Term Soil and Vegetation Monitoring Program (Soils Component)
- Long-Term Soil and Vegetation Monitoring – 2010 Permanent Sample Program (Overstorey Component)
- Annual Data Management Services – CEMA Long-Term Soil and Vegetation Plot Network Data
- Alternative Regeneration Standards for the Mineable Oil Sands Pilot Sampling Program
- Field Protocol for Assessing Characteristic Species Thresholds in Polygons on Reclamation Areas
Estimating Early Stand Mortality - Historical Data Synthesis and Field Sampling Program Design

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline to “identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research,” and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands.”

CEMA Contract Number
2011-0021

Principal Investigators/Consultant
Associated Strategic Consulting Experts Inc.

Contract Budget
$33,952

Project Description
The Forest Productivity Task Group (FPTG), a task group of the TSG, identified the estimation of early stand mortality rates on reclaimed landscapes as a priority to be undertaken cooperatively within CEMA. A qualitative and quantitative assessment of early stand mortality rates on reclaimed landscapes was required to increase understanding of vegetation establishment through time and to validate the planting density guidance published in the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (AEW 2010; subsequently referred to as the Revegetation Manual). For the second edition of the Revegetation Manual, planting densities were determined using an arbitrary assumed value of 10% mortality between planting and a survey age of eight years. The 10% mortality was based on the assumptions that mortality is uniform and that no ingress is occurring. Knowledge of actual mortality rates for the stand types identified in the Revegetation Manual will assist in refining guidance for planting density estimates.

To qualitatively assess early stand mortality, a review of (1) historical reclamation practices; (2) monitoring conducted to date on reclaimed landscapes; and (3) research investigating early stand mortality on reclaimed landscapes is required. This review will lead to a definition of early stand mortality, identify the challenges to quantifying early stand mortality, and provide the background information for developing a sampling program design to conduct targeted surveys to collect mortality data and quantify early stand mortality rates.

The objectives of this project were to:

1. Review historical reclamation practices and monitoring and research conducted on reclaimed landscapes;
2. Define early stand mortality on reclaimed landscapes;
3. Identify the challenges to quantifying early stand mortality on reclaimed landscapes; and
4. Develop a sampling program design to assess early stand mortality.
Project Deliverables

Project Timelines
May to December 2011

Project Status
Complete

Highlights/ Milestones/ Key Findings
Early stand mortality was defined as the mortality of both planted and ingress trees prior to the onset of competition induced mortality (mortality that occurs due to inter-tree competition). An analysis of available historical data suggested that mortality rates were approximately 30% during the first eight years after planting. The review of available information on mortality documented the numerous potential causal factors of mortality and the need to track these factors to better understand mortality rates.

A sampling program consisting of a systematic grid sample with permanent re-measured plots including tagged trees was proposed to collect new information on early stand mortality. The target population is all reclaimed areas planted after the initiation of the program; as such, the target population will grow over time. The program recommends that plots should be established immediately after planting. The proposed grid system is designed to be flexible; it can be integrated with other sampling programs, and plots can be dropped after a specified number of measurements to control the size of the program. It is proposed that plot locations be linked to spatial databases containing treatment histories to allow for the exploration of causal factors.
Development of Terms of Reference for Stem Analysis Project

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline to “identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research,” and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands.”

CEMA Contract Number
2011-0039

Principal Investigators/Consultant
The Forestry Corp.

Contract Budget
$12,000

Project Description
The purpose of this project was to develop a terms of reference for a stem analysis project for reclaimed lands with input from Shongming Huang, Senior Research Scientist at Alberta Sustainable Resource Development. The terms of reference includes the following: Project Background, Project Objectives, Sampling Plan, Stem Analysis Methods, Data Reporting, Data Analyses, Project Report, and Meetings. The terms of reference were presented to the FPTG to review and develop a request for proposal.

Project Deliverables

Project Timelines
November to December 2011

Project Status
Complete

Highlights/Milestones/Key Findings
A terms of reference was provided to assist the FPTG in developing a request for proposal.
Forest Productivity Task Group Growth & Yield Model Development - Questionnaire and Synthesis

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline that the TSG will “develop monitoring protocols (and implement where appropriate), analytical techniques, assessment models and remedial measures related to the TSG guidance documents”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands” and “a guidance document for forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2010-0038

Principal Investigators/Consultant
The Forestry Corp.

Contract Budget
$23,741

Project Description
CEMA investigated options for how reclaimed forest vegetation might best be forecast. A foundational understanding of the capabilities and limitations of currently existing models and forecasting systems, and the potential of novel projection methods appropriate for oil sands reclamation will contribute to the development of an effective growth and yield program for reclaimed forests.

To glean the knowledge and understanding described in CEMA’s Growth and Yield Objectives for reclaimed systems, a questionnaire was developed and sent to forest growth and yield and reclamation ecology experts. CEMA solicited responses from these experts, and subsequently compiled the submissions of all questionnaire participants.

The objectives of this project were to:

1. Review the growth and yield program strategic recommendations technical document (CEMA Contract 2009-0046);
2. Develop a questionnaire for the purposes of soliciting growth and yield modelling expertise;
3. Distribute the questionnaire to experts; and
4. Summarize the answers in tabular format to present to the FPTG.

Project Deliverables

Project Timelines
November 2010 to August 2011
Project Status
Complete

Highlights/ Milestones/ Key Findings
Based on the questionnaire responses, a suite of recommendations was proposed to guide further CEMA Growth and Yield program development. Those recommendations are as follows:

1. CEMA should adopt a “linked-hybrid” modelling approach, using a process-based model such as FORECAST to produce forest productivity estimates, which are then passed on to empirical models (specifically, GYPSY and MGM) for forest growth projection.

2. CEMA should initiate a project to validate FORECAST for producing site index estimates for Alberta tree species in natural stands.

3. CEMA should initiate a project to use FORECAST for producing preliminary forest productivity estimates for a suite of typical reclaimed oil sands.

4. CEMA should initiate a forest productivity monitoring program, whereby observed ‘top-height’ tree growth is measured repeatedly over time in a manner such that:
   - Defensible Site Index estimates can be reported for typical reclaimed oil sands;
   - Natural stand site index equations can be either validated for reclaimed oil sands, or revised such that they can be appropriately applied in reclaimed oil sands; and
   - Data are provided to validate preliminary productivity estimates from FORECAST (Recommendation III).

5. CEMA should develop the capabilities of FORECAST for more completely projecting non-tree vegetation.

6. When FORECAST is fully calibrated for reclaimed oil sands application, CEMA should test the use of FORECAST for assessing and grouping typical reclaimed oil sands into units of homogeneity from a potential forest productivity perspective.

7. CEMA should revisit the current permanent sample plot (PSP) monitoring program to ensure that data required for calibration and validation of GYPSY, MGM, and FORECAST are collected.
Letter Agreement - Growth & Yield Model Development: Questionnaire - Contract #UCR-0211

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline to “identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research,” and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands.”

CEMA Contract Number
UCR-0211

Principal Investigators/ Consultant
Phil Comeau
Dick Dempster
Craig Farnden
Oscar Garcia
James Goudie
Gyula Gulyas
Norm Kenkel
John Kershaw
Hamish Kimmins
Simon Landhausser
Hans Pretzsch
Jim Thrower
Clive Welham

Contract: Budget
$2,000 each

Project Description
Each expert was invited to review the Reclamation and Growth and Yield Context Backgrounder, participate in a conference call, and complete the questionnaire developed under Contract 2010-0038.

Project Deliverables
Each expert submitted a completed questionnaire. The questionnaires are compiled as Appendix II of the final report for Contract 2010-0038.

Project Timelines
January to February 2011

Project Status
Complete

Highlights/ Milestones/ Key Findings
Please refer to Contract 2010-0038 for the highlights and key findings. The recommendations listed for Contract 2010-0038 were derived from the responses to the questionnaires.
Growth & Yield Model Development - Attendance at the Field Tour and Technical Workshop

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline to “identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research,” and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands.”

CEMA Contract Number
UCR-0711

Principal Investigators/ Consultant
Phil Comeau
Craig Farnden
Jim Goudie
Hans Pretzch
Clive Welham

Contract Budget
$3,000 to $6,000 plus travel and accommodation expenses

Project Description
Five of the questionnaire respondents from UCR-0211 were invited to attend a field tour and technical workshop hosted by the FPTG. Three of the invited experts are associated with the development of one of the growth and yield models reviewed in Contract 2010-0038 and two of the experts are academic researchers in the field of growth and yield. The purpose of the field tour and technical workshop was to discuss the recommendations developed in Contract 2010-0038 with the experts and to observe vegetation growth on reclaimed areas in the context of growth and yield model inputs and projections.

Project Deliverables
The technical experts provided input at the technical workshop which was synthesized into a summary report by The Forestry Corp. (see next scope sheet).

Project Timelines
September 2011

Project Status
Complete

Highlights/ Milestones/ Key Findings
Please refer to Contract UCR-0711 – The Forestry Corp. on the next scope sheet for the highlights and key findings. The input from the experts was summarized into the final report by The Forestry Corp.
Growth & Yield Model Development - Planning and Technical Assistance for Field Tour and Technical Workshop

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline to “identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research,” and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands.”

CEMA Contract Number
UCR-0711

Principal Investigators/ Consultant
Willi Fast, The Forestry Corp.

Contract Budget
$7,200

Project Description
The FPTG sponsored a field tour and technical workshop to follow up on the recommendations made in the report CEMA Growth and Yield Questionnaire Synthesis (CEMA Contract 2010-0038). The purpose of Contract UCR-0711 was to provide planning and technical assistance for the field tour and workshop, and to document discussions from the technical workshop into a summary report.

Project Deliverables

Project Timelines
September to November 2011

Project Status
Complete

Highlights/ Milestones/ Key Findings
The key findings of the technical workshop were documented in the report as follows:

1. CEMA should undertake to develop a retrospective stem analysis project by which juvenile Top Height vs. Age trajectories in the oldest available reclaimed plantations can be determined.

2. When observed Top Height vs. Age trajectories are available, they should be used to validate projected Top Height vs. Age trajectories from each of GYPSY, MGM, and FORECAST.

3. As CEMA contemplates potential changes to the long-term plot network monitoring program, consideration should be given for inclusion of the additional attributes (i.e., Top Height) as they may be appropriate within the context of plot network.

4. Rather than looking to projection models for stratifying the reclaimed landscape into management or treatment units, CEMA could consider a physiographic approach for building “reclamation polygons.”
Soil Nitrogen Indicators for Land Reclamation Policy Development for Forest Ecosystems in the Oil Sands Region (Grant)

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline to “identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands.”

CEMA Contract Number
2008-0011

Principal Investigators/Consultant
Dr. Scott Chang, University of Alberta

Contract Budget
$136,000

Project Description
The purpose of this three-year project was to establish the relationship between soil nutrient regime (specifically soil nitrogen availability) and tree growth in the oil sands region, in order to further develop the equivalent land capability concept in the LCCS and to identify a suitable soil nitrogen availability indicator that supports ongoing long-term soil and vegetation monitoring activities by industry operators in the region.

The project examined soil nitrogen status and its relationship with forest productivity through laboratory and field investigations. The specific objectives of the project were:

1. To examine soil nitrogen availability indicators (soil total N, mineral N (NH$_4^+$-N, NO$_3^-$-N), different forms of mineralizable N) and their relationship with forest nitrogen nutrition status, tree growth rates, and productivity of the following major tree species: trembling aspen (Populus tremuloides), white spruce (Picea glauca), and jack pine (Pinus banksiana); and

2. To recommend nitrogen availability indicators to improve the LCCS for use in the oil sands region.

This grant was jointly funded by Shell Albian Sands, Alberta Environment, Alberta Innovates Technology Futures, OSRIN, and CEMA.

Project Deliverables
Final report was submitted March 2011.


Project Timelines
May 2008 to March 2011
Project Status
Complete

Highlights/ Milestones/ Key Findings
Soil N indicators were identified based on research conducted in natural stands.

The TSG recommends that the proposed soil N indicators be tested on reclamation areas to determine whether the indicators are appropriate for monitoring and assessing reclamation success.

The TSG recommends that the PNTG evaluate whether the recommended soil N indicators should be further developed for use in the Criteria & Indicators Framework or as soils monitoring parameters in the Long-Term Plot Network.
Effects of Petroleum Hydrocarbons (PHCs) in Mineral Soil Located Beneath Peat Deposits on Plants and Soils Fauna (Grant)

RWG Project Number:
R-1113

Project Linkage to Terms of Reference:
Supports the TSG operating guideline to “identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands” and “a guidance document for management practices for soil salvage and placement.”

CEMA Contract Number:
2009-0045

Principal Investigators/Consultant:
Dr. Suzanne Visser, University of Calgary

Contract Budget:
$65,503

Project Description:
Research was conducted to address the following questions:

1. What is the PHC profile of hydrocarbon-bearing Cg soil?

2. Are PHCs in Cg mineral soil toxic to plants being considered for mine site reclamation (barley, aspen poplar, jack pine, white spruce)?

3. Do PHCs associated with Cg mineral soil inhibit growth and reproduction of soil macrofauna (earthworms) and mesofauna (springtails)?

4. Are Cg PHCs degradable and what is their rate of removal in the presence of plants and soil fauna?

5. Does the addition of peat to reclamation soil mitigate any toxicity potentially associated with Cg PHCs? Is Cg PHC removal affected by the presence of peat in the soil mixture?

6. Does aspen poplar, a species sensitive to fresh PHCs, respond differently depending whether Cg PHC soil is mixed homogeneously into peat or Cg PHC soil is distributed discontinuously (i.e., in discrete lumps) in the peat?

The studies were conducted in the laboratory and greenhouse using plant and soil fauna bioassays similar to those described in the lean oil sands research conducted previously (Visser 2008).

Project Deliverables:
Final report was submitted March 2011.

Project Timelines
January 2010 to March 2011

Project Status
Complete

Highlights/ Milestones/ Key Findings
The results of the study demonstrated that:

- PHC Cg material presents a greater risk than tar balls.
- PHC Cg material is similar in toxicity to lean oil sands.
- The F4 measurement method is not effective for quantifying indigenous PHCs in Cg material.

References Cited
Ecosite Area Summary Table

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline to “make recommendations to RWG on regional reclamation planning and management, regulation and policy as they relate to terrestrial ecosystems”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands” and “a guidance document for forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2010-0032

Principal Investigators/Consultant
TECO Natural Resource Group Limited

Contract Budget
$25,744

Project Description
The scope of this project was to develop site productivity estimates by ecosite based on a natural stand baseline. The objectives of this project were to calculate mean site index values for individual species by ecosite using data from natural stands and to identify minimum site index values to represent entry level site index values for commercial forestry.

During the course of this project, a number of data sources were examined, and recommendations and options were developed for the FPTG about their suitability and inclusion for site index calculations. The selection of the data source to calculate the mean site index values and the minimum site index values was based on preliminary work completed by the FPTG in 2009 (CEMA Contract 2008-0038 – Assessment of Planting Densities in Reclaimed Landscapes Using the GYPSY Model) and earlier in 2010 (CEMA Contract 2009-0046 - Growth and Yield Strategic Plan Development).

This project did not include the review and calculation of site index from data collected in reclaimed areas. As reclamation data becomes available from ongoing sampling, a column for observed site index will be added to the ecosite area summary table.

Project Deliverables
Final report was submitted in February 2011.


Project Timelines
November 2010 to February 2011

Project Status
Complete
Highlights/ Milestones/ Key Findings

The ecosite area summary table was forwarded to the Government of Alberta as a recommendation by the CEMA Board. The Government accepted the recommendation.

The FPTG proposed the ecosite area summary table as a replacement for the Timber Productivity Rating table in the EPEA approvals. The FPTG recommended that the ecosite area summary table based upon reclamation hectares at closure be submitted to replace the Timber Productivity Rating table currently in the approvals in 2011 at the same time as the 2011 Closure Plan submissions. The FPTG also recommended that the ecosite area summary table be included in each operator’s Forest Resource Plan and that the Forest Resource Plan be submitted in 2011.

The ecosite area summary table includes the following components:

- Natural stand data is used to derive individual species site index by ecosite (Mean Site Index).
- An entry site index value for commercial forestry purposes is identified (Minimum Site Index).
- Operators will partition their land base into both non-commercial and commercial forestry end-uses, thereby gaining greater clarity and focus.
- Data will be presented by ecosite phase based on reclamation hectares at closure.
- Data will be presented for based on the reclamation hectares outlined in the Closure Plan following the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region.
- As data becomes available, a column for observed site index will be added to the table.

References Cited


**Long-Term Plot Network Assessment**

**RWG Project Number**
R-1114

**Project Linkage to Terms of Reference**
Supports objective of “forest vegetation (ecosystems) establishment.”

**CEMA Contract Number**
2011-0024

**Principal Investigators/ Consultant**
LGL Limited environmental research associates

**Contract Budget**
$97,510

**Project Description**
In 2000, the TSG established a long-term plot network (LTPN). The purpose of the long-term monitoring program is to measure soil, vegetation, and forest parameters to provide an assessment of change over time in reclamation and natural sites. The reclaimed sites include a variety of soil and planting prescriptions that have changed over time based on advancements in best management practices. This program includes both natural and reclaimed plots.

The objectives of this project are to:

1. Evaluate the current status of the LTPN;
2. Evaluate the newly defined goals and objectives of the LTPN; and
3. Identify modifications and provide recommendations for addressing the modifications to the existing LTPN.

As part of the data review and analysis, any errors identified in the database housekeeping project (Contract 2009-0047) or through the analysis process were documented and corrected.

**Project Deliverables**
Cleaned database file submitted to The Forestry Corp. November 2011.


**Project Timeline**
May to December 2011

**Project Status**
Complete

**Highlights/ Milestones/ Key Findings/ Etc.**
The current status of the LTPN established in the Athabasca Oil Sands Region in 2000 was assessed for its ability to address the 2010 objectives posed for the LTPN. The assessment was accomplished through a review of relevant literature (published and unpublished), by summarizing what the LTPN is, how it was established, how plots were selected, and by reviewing the basic structure of the plots...
within the LTPN with respect to age class, ecosite phase, and reconstructed soil series. Data exploration combined with statistical analyses deemed appropriate for the LPTN dataset were used to understand its capacity for statistical comparisons between vegetation on reclaimed areas and natural stands and to predict vegetation trajectories on reclaimed sites (where possible). An overview of the field data collection methods was also completed to assess whether methods changed over time, and if they did, how the changes might affect future analyses associated with those data. Lastly, the LTPN was assessed relative to the ten principles of an ideal experiment to determine whether the experimental design of the LTPN will ensure that data collected on the LTPN can be used to address the 2010 objectives.

Seventeen recommendations for modifications to the LTPN were presented in the report. These changes are suggested because the LTPN has not been established as an effectiveness monitoring program with an adaptive management feedback loop that functions to inform on the relative successes and failures of reclamation practices. Doing so requires the formation of management questions to guide the collection of data from the LTPN. By answering management questions associated with each objective, it will be possible to meet the objectives of the LTPN. The assessment of the LTPN revealed issues with the experimental design that will make it impossible to address the 2010 objectives. Changes are required that, if implemented, will make it possible to address the objectives while increasing the overall utility of the LTPN as an effectiveness monitoring tool.
**Long-Term Soil and Vegetation Monitoring Program (Vegetation Component)**

**RWG Project Number**

R-1114

**Project Linkage to Terms of Reference**

Supports the TSG operating guideline that the TSG will “develop monitoring protocols (and implement where appropriate), analytical techniques, assessment models and remedial measures related to the TSG guidance documents”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands” and “a guidance document for forest vegetation (ecosystems) establishment.”

**CEMA Contract Number**

2010-0018

**Principal Investigators/ Consultant**

Stantec Consulting Ltd.

**Contract Budget**

$132,780

**Project Description**

The TSG established a long-term monitoring soil, vegetation, and forestry plot network in the Athabasca Oil Sands Region of Alberta in 2000. The purpose of the long-term monitoring program is to measure soil, vegetation, and forest parameters to provide an assessment of change over time in reclamation and natural sites. The reclaimed sites include a variety of soil and planting prescriptions that change based on best management practices. This program includes both natural and reclaimed plots.

In 2010, no new plots were established. Fourteen plots were re-measured. Five of the plots were natural plots and were up for the first re-measurement cycle since the plots were established. The number and location of the natural plots are as follows: plot 2 is at Suncor; plots 4, 6, and 10 are at Syncrude; and plot 8 is at Shell Albian Sands. Five of the plots were reclaimed plots that were up for the first re-measurement cycle since the plots were established; two of these plots are at Suncor and three are at Syncrude. Four of the plots were up for the second re-measurement cycle since the plots were established; two of these plots are at Suncor and two are at Syncrude.

**Project Deliverables**

Field monitoring program – August 2010.


**Project Timelines**

August 2010 to April 2011

**Project Status**

Complete
Highlights/ Milestones/ Key Findings

The three primary indices (species richness, diversity, and evenness) were relatively easy to calculate for each plot and were compared over time by site type, age class, and reclamation treatment. Nothing out of the ordinary was observed; however, it was recommended that the percent cover estimate protocols be changed to assign a cover class to each plant in the 1 x 4 m and 2 x 20 m subplots, instead of simply indicating its presence. Percent cover can always be converted to presence but not the other way around. Abundance is the fourth community composition index listed in the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region, 2nd edition that was summarized for a variety of assessment groups. In this report, characteristic species cover was summarized by plots re-measured in 2010 to show plant community change over time, and ordinations were used to illustrate structural and compositional relationships among reclaimed and natural sites. This was the first year where the CCA ordination technique was used, and it proved useful in expressing site, soils, and vegetation data together to achieve a more holistic analytical approach.

NMS ordinations in this report showed a clear vegetation gradient from reclaimed sites of various treatments without canopy to those with a canopy and their relationship to natural regeneration and mature stands. Specific trajectories or pathways may be further explored as more species cover data are collected. It was recommended that the TSG continue to explore the integration of natural regeneration stands less than 40 years old into the monitoring program. Some discussion has started around this idea but a concentrated sampling effort is needed to fill this data gap within the plot network program. It was also recommended that the TSG continues to monitor (re-measure) sites in reclaimed areas to supplement knowledge in this area and continue to develop the classification of reclaimed sites using site, soil, and vegetation characteristics as more data become available.
Long-Term Soil and Vegetation Monitoring Program (Soils Component)

RWG Project Number:
R-1114

Project Linkage to Terms of Reference
Supports the TSG operating guideline that the TSG will “develop monitoring protocols (and implement where appropriate), analytical techniques, assessment models and remedial measures related to the TSG guidance documents”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands” and “a guidance document for forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2010-0019

Principal Investigators/ Consultant
Paragon Soil and Environmental Consulting Inc.

Contract Budget
$59,483

Project Description
The TSG established a long-term monitoring soil, vegetation, and forestry plot network in the Athabasca Oil Sands Region in Alberta in 2000. The purpose of the long-term monitoring program is to measure soil, vegetation, and forest parameters to provide an assessment of change over time in reclamation and natural sites. The reclaimed sites include a variety of soil and planting prescriptions that change based on best management practices. This program includes both natural and reclaimed plots.

In 2010, no new plots were established. Fourteen plots were re-measured. Five of the plots were natural plots and were up for the first re-measurement cycle since the plots were established. The number and location of the natural plots are as follows: plot 2 is at Suncor; plots 4, 6, and 10 are at Syncrude; and plot 8 is at Shell Albian Sands. Five of the plots were reclaimed plots that were up for the first re-measurement cycle since the plots were established; two of these plots are at Suncor and three are at Syncrude. Four of the plots were up for the second re-measurement cycle since the plots were established; two of these plots are at Suncor and two are at Syncrude.

Project Deliverables
Field monitoring program – August 2010.


Project Timelines
August 2010 to May 2011

Project Status
Complete
Highlights/Milestones/Key Findings
The TSG does not support the statistical approach employed in this report and disputes some of the conclusions drawn from the approach. In particular:

1. The scope of the annual soils monitoring contract is identified above. The TSG did not outline the statistical techniques that should be used to evaluate the 10-year dataset that accounts for changes in protocols over time (e.g., plot location selection) and believes the data analyses and conclusions presented in this report do not account for spatial and/or temporal variation or the effect of small sample sizes.

2. A monitoring approach that accounts for the relative contributions of spatial and temporal variation within and across plots is required. The TSG is assessing how best to account for spatial and temporal variability in the plot network.

3. The monitoring protocols for soils in the plot network are not designed to answer all questions. Any interpretation of the data collected using the monitoring protocols needs to consider the limitations of these protocols and that not all questions can be addressed by the monitoring program. The TSG is assessing the capabilities of the long-term monitoring program and defining specific objectives and questions to address with the program.

4. Nutrient availability on reclaimed plots may be influenced by fertilizer practices in reclamation areas. The monitoring protocols for soils in the plot network are not designed to identify fertilizer contributions to nutrient availability on the reclaimed plots.

5. The sustainability of nutrients in reclaimed soils is unknown. Further research is required to determine the persistence of nutrients in aging reclamation areas and the effects of fertilization on nutrient pools.
Long-Term Soil and Vegetation Monitoring - 2010 Permanent Sample Program (Overstorey Component)

RWG Project Number
R-1114

Project Linkage to Terms of Reference:
Supports the TSG operating guideline that the TSG will “develop monitoring protocols (and implement where appropriate), analytical techniques, assessment models and remedial measures related to the TSG guidance documents”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands” and “a guidance document for forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2010-0027

Principal Investigators/Consultant
TECO Natural Resource Group Limited

Contract Budget
$73,082

Project Description
The TSG established a long-term monitoring soil, vegetation, and forestry plot network in the Athabasca Oil Sands Region in Alberta in 2000. The purpose of the long-term monitoring program is to measure soil, vegetation, and forest parameters to provide an assessment of change over time in reclamation and natural sites. The reclaimed sites include a variety of soil and planting prescriptions that change based on best management practices. This program includes both natural and reclaimed plots.

In 2010, no new plots were established. Fourteen plots were re-measured. Five of the plots were natural plots and were up for the first re-measurement cycle since the plots were established. The number and location of the natural plots are as follows: plot 2 is at Suncor; plots 4, 6, and 10 are at Syncrude; and plot 8 is at Shell Albian Sands. Five of the plots were reclaimed plots that were up for the first re-measurement cycle since the plots were established; two of these plots are at Suncor and three are at Syncrude. Four of the plots were up for the second re-measurement cycle since the plots were established; two of these plots are at Suncor and two are at Syncrude.

Project Deliverables
Field monitoring program – August 2010


Project Timelines
August 2010 to June 2011

Project Status
Complete
Highlights/Milestones/Key Findings
All re-measured plots were on natural or reclaimed sites in Syncrude, Suncor, and Shell Albian Sands areas. The field work was done after the growing season in late September and early October of 2010. All natural plots were upgraded using the upgraded (new) measurement standards (Timberline 2007).

References Cited
Annual Data Management Services - CEMA Long-Term Soil and Vegetation Plot Network Data

RWG Project Number
R-1114

Project Linkage to Terms of Reference
Supports the TSG operating guideline that the TSG will “develop monitoring protocols (and implement where appropriate), analytical techniques, assessment models and remedial measures related to the TSG guidance documents”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands” and “a guidance document for forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2010-0020

Principal Investigators/ Consultant
The Forestry Corp.

Contract Budget
$31,000

Project Description
The objective of the project was the continued management of TSG long-term plot data, ongoing maintenance and updating of the long-term plot database, uploading of 2009 and 2010 plot network data into the database, and fulfillment of data requests. The project scope is outlined in the tasks below. The Forestry Corp. was also responsible for responding to ad hoc requests for data from contractors and CEMA Members.

The following is a list of tasks expected for this project:

- Update routines/ standard operating procedures for collection protocol changes;
- Data packaging and delivery of database templates (to consultants);
- Seasonal data loading (2009 and 2010 field programs);
- Documentation (Annual Report);
- Project management (general);
- Database maintenance (backup/ recovery); and
- Attendance of annual plot network meeting with long-term plot network field consultants (March 2011 TSG meeting).

The Annual Report documented the following:

- Summary of data loaded;
- Summary of any issues associated with data loading;
- Summary of fulfillment of data requests; and
- Any recommendations for enhancements or modifications to the database or data management process.
**Project Deliverables**

**Project Timelines**
January 2010 to November 2011

**Project Status**
Complete

**Highlights/ Milestones/ Key Findings**
Database template maintenance was completed and templates were provided to the field monitoring contractors for data entry. The 2009 data loading was completed. Four data requests were fulfilled.
Alternative Regeneration Standards for the Mineable Oil Sands Pilot Sampling Program

RWG Project Number
R-1115

Project Linkage to Terms of Reference
Supports the TSG objective to develop and maintain “other reclamation guidance documents and tools as agreed upon by the RWG.”

CEMA Contract Number
2010-0026

Principal Investigators/Consultant
TECO Natural Resource Group Limited

Contract Budget
$171,681

Project Description
The purpose of this project was to test the first approximation field protocols and to address soft spots identified in the rationale document prepared as part of Contract 2010-0008 in the Alternative Regeneration Standards Task Group (ARTG). The purpose of the project was to carry out a regeneration standards pilot field data collection project encompassing a range of reclamation areas of differing sizes, ages, and species composition to meet two objectives:

1. Provide data to allow the setting of class limits (“standards”) for ecosystem and timber types; and
2. Provide data and experience to allow the resolution of outstanding sampling issues identified during the ARTG’s production of an interim regeneration sampling manual (Timberline Natural Resources Group Ltd. 2010).

Project Deliverables
The following deliverables were submitted in March 2011 and May 2011:

- Revised soft spots documentation
- Shapefile of selected sample polygons and pre-located plots
- Database containing cleaned digital plot data
- Scanned (.pdf) versions of field maps
- Compiled complete plot dataset (includes both Suncor and Syncrude data)
- Compiled Suncor plot dataset and Syncrude plot dataset
Regeneration Standards Task Group of the Terrestrial Sub-Group of the Reclamation Working Group of the Cumulative Environmental Management Association, Fort McMurray, AB).

**Project Timelines**
August 2010 to May 2011

**Project Status**
Complete

**Highlights/ Milestones/ Key Findings**
The Alberta Regeneration Standards for the Mineable Oil Sands Data Collection Field Protocols were forwarded to the Government of Alberta as a recommendation by the CEMA Board. The Government accepted the recommendation.

The Summary of Scientific Report and Consolidation of Documentation includes six appendices:

- Appendix I   Data Collection Field Protocols
- Appendix II  Field Protocols: Guide to Implementation
- Appendix III Rationale and Soft Spot Documentation
- Appendix IV  Straw Dog Process: Setting and Evaluating Revegetation Targets
- Appendix V   Pilot Project Field Report
- Appendix VI  Pilot Project Analysis Report

The information in the appendices provides the supporting materials for the Data Collection Field Protocols specific to reclamation areas in the Mineable Oil Sands Region.

**References Cited**
Field Protocol for Assessing Characteristic Species Thresholds in Polygons on Reclamation Areas

RWG Project Number
R-1115

Project Linkage to Terms of Reference
Supports the TSG objective to develop and maintain “a guidance document for forest vegetation (ecosystems) establishment”

CEMA Contract Number
2011-0016

Principal Investigators/ Consultant
Stantec Consulting Ltd.

Contract Budget
$147,305

Project Description
The purpose of this contract was to collect data on reclamation areas to understand species composition and distribution in space and time (years since reclamation) by site type, and to test the application of Table 5.3 in the Guidelines for Redamation to Forest Vegetation in the Athbasca Oil Sands Region, 2nd edition, to these surveyed reclaimed vegetation communities.

The objectives of the project were to:
1. Develop field protocol for assessing characteristic species thresholds in polygons on reclamation areas;
2. Collect data on reclamation areas to understand species composition and distribution in time and space by site type, and to test application of Table 5.3 to reclaimed vegetation communities; and
3. Assess and provide comment on utility of characteristic species thresholds as an indicator of reclamation success.

Project Deliverables
Field program completed August 2011.


Project Timeline
March to December 2011

Project Status
Complete
Highlights/ Milestones/ Key Findings/ Etc.

It was affirmed that plant community composition can be effectively assessed by the identification of all species within a given plot area and an estimate of species distribution in time and space by site type. A plot area of 100 m$^2$ is of appropriate size to reliably capture sufficient characteristic species to use evaluation tools outlined in the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region, 2nd Edition, such as Table 5.3.

It was determined that a minimum of four plots should be established within a reclamation polygon 6 ha in size or smaller, and a sample size equivalent to the area of the target polygon in hectares minus 2 (n = A - 2) should be established in polygons between 6 and 13 ha to determine and evaluate the mean number of characteristic species. It was also determined that variability within polygons should be reduced to the extent possible prior to final polygon delineation and characteristic species assessment.

Based on the evaluation of Table 5.3 of the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region, 2nd Edition, using plot data collected for this project, it would appear that reclamation polygons 15 to 19 years of age can have sufficient species composition to be evaluated using the characteristic species methods outlined in the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region, 2nd Edition, and can even be considered to be successfully reclaimed with respect to this indicator. However, with the data collected for this project, it is not clear what inferences can be made about whether reclaimed sites move along a particular successional trajectory similar to natural sites. It is recommended that additional data needs to be collected over a period of time within the target reclamation (polygon) area and be compared directly over time.
Technical Editor for Best Management Practices Document - Contract #UCR-0411

RWG Project Number
R-1115

Project Linkage to Terms of Reference
Supports the TSG objective to develop and maintain “a guidance document for management practices for soil salvage and placement”

CEMA Contract Number
UCR-0411

Principal Investigators/Consultant
Chris Powter, Oil Sands Research and Information Network (OSRIN)

Contract Budget
$7,000

Project Description
The objectives of this project were to conduct the following on the Best Management Practices document (Contract 2008-0040):

1. Structural editing;
2. Stylistic editing;
3. Copy editing; and
4. Proofreading.

Project Deliverables

Project Timeline
February 2011

Project Status
Complete

Highlights/Milestones/Key Findings/Etc.
The edited document was forwarded as a recommendation to the Government of Alberta by the CEMA Board. The Government accepted the recommendation.
2.5.2 Projects Initiated or Ongoing in 2011

This section includes scope sheets for the following TSG projects that were initiated or ongoing in 2011:

- Water, Energy, and Carbon Balance Research: Recovery Trajectories for Oil Sands Reclamation and Disturbed Watersheds in the Western Boreal Forest
- Soil and Vegetation Data Management
- Annual Data Management Services – CEMA Long-Term Soil and Vegetation Plot Network Data
- CEMA Long-Term Soil and Vegetation Plot Network Database Clean Up
- Table 5.3 Characteristic Species Thresholds Evaluation and Revision
Water, Energy, and Carbon Balance Research: Recovery Trajectories for Oil Sands Reclamation and Disturbed Watersheds in the Western Boreal Forest (Grant)

RWG Project Number
R-1113

Project Linkage to Terms of Reference
Supports the TSG operating guideline to “identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research,” and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands.”

CEMA Contract Number
2011-0006; 2011-0007

Principal Investigators/ Consultant
Dr. Sean Carey, Carleton University
Dr. Richard Petrone, Wilfred Laurier University

Contract Budget

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Project Description
The research objectives are to:

1. Directly compare existing and historical water and energy balances from reclamation sites and the natural analogues located at Red Earth Creek. In this process, evapotranspiration rates and controls will be established for each ecosystem. Soil moisture and suction within the rooting zone will be assessed and linked to ecosystem age, disturbance and/or placement strategy, and its trajectory towards reclamation. The comparative influence of soil, vegetation, and climate along the recovery sequence will be evaluated. This data will be compared with the BOREAS and BERMS datasets of mature boreal species.

2. Synthesize and analyze all existing carbon flux data that has been collected to date in reclamation watersheds and the Red Earth Creek sites. In this process, water use efficiencies of different ecosystems will be assessed with the objective of identifying sites that are under-performing. Carbon flux rates and water use efficiencies will be related to hydrological and energy fluxes and linked to reclamation strategy and age. This data will be compared with the mature BOREAS and BERMS datasets of mature boreal species.

3. Continue to monitor water/energy and carbon balances at key reclamation and Red Earth Creek sites to build invaluable data and capitalize on infrastructure investment (which is in excess of $500K to date). Most of these sites have or are undergoing significant change that significantly affects water and carbon dynamics. It is unclear whether at certain stages of reclamation ecosystem water use efficiency changes due to limitations in water.
4. Provide oil sands operators with information relating directly to the approvals process by establishing comparative indices of performance with natural and other disturbed ecosystems.

**Project Deliverables**
Final report to be submitted in January 2014.

**Project Timelines**
January 2011 to January 2014

**Year 1 (2011)**
- Flux measurements using the eddy covariance will be conducted on three reclamation sites and four natural analogue sites.
- Historical data analysis will occur for reclamation sites (four in total) dating back to 2003 with the emphasis on C analysis.

**Year 2 (2012)**
- Flux measurements using the eddy covariance will be conducted on three reclamation sites and four natural analogue sites.
- Historical data analysis will be completed for the reclamation sites.
- Site inter-comparison will begin.

**Year 3 (2013)**
- Flux measurements using the eddy covariance will be conducted on three reclamation sites and four natural analogue sites.
- Site inter-comparison will be completed, and factors controlling water/energy and carbon balances will be assessed.
- Report writing, technology transfer, and publication.

**Project Status**
Ongoing

**Highlights/ Milestones/ Key Findings**
To be determined when the final report is submitted.
Soil and Vegetation Data Management

RWG Project Number
R-1114

Project Linkage to Terms of Reference
Supports the TSG operating guideline that the TSG will “develop monitoring protocols (and implement where appropriate), analytical techniques, assessment models and remedial measures related to the TSG guidance documents”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands,” and “a guidance document for forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2009-0047

Principal Investigators/ Consultant
The Forestry Corp.

Contract Budget
$40,050

Project Description
The TSG will continue improving the processes and tools associated with the data management of the long-term plot network data. Consistent with the strategy outlined in the Long Term Soil and Vegetation Database – Data Management Options (The Forestry Corp. 2008), the TSG will move ahead with the development and implementation of an internet-based application that will support the data management process. This data management application will provide broad access to:

- Submit Metadata and Program Data Files for secure storage within the central database;
- Search and view Metadata and Program Data Files that exist within the central database;
- Request Program Data Files that exist within the central database; and
- Manage and log details regarding the “request-authorization-distribution” process associated with Program Data Files or Program Data.

The project was expanded in scope in 2011 to include an Open ID authentication procedure to enable CEMA members to connect to the database query system via the CEMA DMS library.

Project Deliverables
Web-based Data Management Process

Project Timelines
Initiated December 2009; report submitted October 2010; testing phase of web-based data query system to be completed in February 2011; request for streamlining of login procedures from members following testing period. Development of Open ID authentication underway from February to December 2011. Final report to be submitted January 2012.

Project Status
Ongoing

Highlights/ Milestones/ Key Findings
To be determined.
References Cited

CEMA Long-Term Soil and Vegetation Plot Network Database Clean Up

RWG Project Number
R-1114

Project Linkage to Terms of Reference
Supports the TSG operating guideline that the TSG will “develop monitoring protocols (and implement where appropriate), analytical techniques, assessment models and remedial measures related to the TSG guidance documents”; and the TSG objective to develop and maintain “a guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands” and “a guidance document for forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2010-0030

Principal Investigators/Consultant
The Forestry Corp.

Contract Budget
$36,750

Project Description
In October 2008, the final historic data loading exercise was completed on the TSG soil and vegetation plot network database. Since then, new plot data collected in 2008 and 2009 have also been loaded. Several requests for the compiled data have been processed and provided to members. Through the analysis of the requested data, some errors and inconsistencies have been discovered in the data. As a result, the TSG has requested information on how they will proceed with identifying errors and inconsistencies in the data so that it can be fixed.

In addition to the data cleaning exercise, the TSG would also like to track the data collection protocols used to capture the data. Data collection protocols have changed and will continue to change over the years, so the TSG feels it is important to link the data to the protocols under which it was collected.

The proposed project scope is as set out in the tasks outlined below:

- Task 1: Data analysis activities
- Task 2: Data edits
- Task 3: Protocol tracking
- Task 4: Preparation and presentation of a summary report.

In May 2011, the database was provided to LGL Limited environmental research associates to complete the error checking and corrections as part of Contract 2011-0024. The corrected database was returned to The Forestry Corp. in November 2011.

Project Deliverables

Project Timelines
September 2010 to January 2012

Project Status
Ongoing

Highlights/Milestones/Key Findings
To be determined when the final report is submitted.
**Annual Data Management Services - CEMA Long-term Soil & Vegetation Plot Network Data**

**RWG Project Number**
R-1114

**Project Linkage to Terms of Reference**
Supports objective of “forest vegetation (ecosystems) establishment.”

**CEMA Contract Number**
2011-0010

**Principal Investigators/ Consultant**
The Forestry Corp.

**Contract Budget**
$35,650

**Project Description**
The following is a list of tasks expected for this project:

- Update routines/ standard operating procedures for collection protocol changes
- Data packaging and delivery of database templates (to consultants)
- Maintenance of online database management and query system
- Facilitation of data requests/ questions through online database management and query system
- Seasonal data loading (2010 field program)
- Documentation (Annual Report)
- Project Management (general)
- Database Maintenance (backup/ recovery)
- Produce a map of the LTPN at the end of the field season
- Attendance of annual plot network meeting with LTPN field consultants.

The Annual Report will document the following:

- Summary of data loaded
- Summary of any issues associated with data loading
- Summary of fulfillment of data requests
- Summary of online database maintenance and query system maintenance/ issues
- Any recommendations for enhancements or modifications to the database or data management process.

**Project Deliverables**
Annual report to be submitted January 2012.

**Project Timeline**
January 2011 to January 2012

**Project Status**
Ongoing

**Highlights/ Milestones/ Key Findings/ Etc.**
To be determined when the annual report is submitted.
Table 5.3 Characteristic Species Thresholds Evaluation and Revision

RWG Project Number
R-1115

Project Linkage to Terms of Reference
Supports the TSG objective to develop and maintain “a guidance document for forest vegetation (ecosystems) establishment.”

CEMA Contract Number
2011-0029

Principal Investigators/Consultant
LGL Limited environmental research associates

Contract Budget
$126,745

Project Description
In 2010, the second edition of the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (Revegetation Manual; AEW 2010) was released. Section 5 of the Revegetation Manual defines criteria and indicators of reclamation success. For oil sands mining operations, there are a number of generalized objectives for reclamation areas. One of these is to require that reclamation activities target locally common, sustainable, boreal forest ecosystems. At the time of assessment for Reclamation Certification, reclaimed sites should have enough characteristic species to be identifiable as a site type or sub-category (ecosite, ecosite phase, plant community type). Characteristic species are defined as those species that either:

1. Are present in a minimum of 70% of the sample plots for a given vegetation class; or
2. Have a prominence value of 20 or greater, where prominence value = \( \sqrt{(\% \text{ cover} \times \% \text{ frequency})} \).

The threshold example used for the characteristic species indicator in Table 5.3 is the lower 95% confidence interval of an estimate of central tendency and normal distribution derived from regional plot data per site type, where possible from juvenile stands (see GDC & FORRx 2008 and GDC 2009). Sites that do not meet this threshold have less than a 5% chance of being comparable to a “locally common, sustainable, boreal forest ecosystem” in terms of vegetation community composition.

Threshold numbers of species by site type are presented in Table 5.3, along with mean values for this parameter and values from older stands (to provide an indication of progression in this parameter as stands mature). The thresholds and means were determined using data described in the Vegetation Data Synthesis (see GDC & FORRx 2008, Table 2.1). Additional plot data used to supplement the dataset for Ecosites f, g, and h were obtained with permission from three proponents from baseline vegetation surveys conducted to support environmental impact assessments (see GDC 2009).

The purpose of this project is to address the limitations of Table 5.3 described below:

1. The baseline data used to derive the thresholds in Table 5.3 are limited for several site types and age classes. The shaded cells are based on an arbitrary assumption about the amount of required data and are not definitive for this RFP.

2. The thresholds were derived based on the lower 95% confidence interval. Other approaches to deriving the thresholds were not evaluated.
The objectives of this project are to:

1. Review availability of post-harvest and fire origin natural juvenile stand data and identify potential survey locations within the boundaries described in the Assumptions below;
2. Collect data using protocols consistent with current baseline data (i.e., 100 m² plots) on post-harvest and fire origin natural juvenile stands to support evaluation of characteristic species thresholds in Table 5.3;
3. Recommend approaches to derivation of thresholds for Table 5.3 from data collected in Objective 2 and as combined with existing baseline data, considering ecosystem reclamation goals discussed in the Background and as refined by discussions with PNTG;
4. Present variations of Table 5.3 based on recommended approaches in Objective 3; and
5. Provide feedback on the suitability of using natural stand disturbance dynamics to develop reclamation targets for the mineable oil sands.

**Project Deliverables**
Reconnaissance field program completed August 2011.
Juvenile stand sampling program to be completed July 2012.
Final report to be submitted October 2012.

**Project Timeline**
June 2011 to October 2012

**Project Status**
Ongoing

**Highlights/ Milestones/ Key Findings/ Etc.**
To be determined when final report is submitted.

**References cited**


3.0 AQUATICS SUB-GROUP INITIATIVES

3.1 The Aquatic Sub-Group Mandate

The Aquatics Sub-Group (ASG) directs the work previously managed by the Wetlands and Aquatics Sub-Group (WASG) and End Pit Lakes Sub-Group (EPLSG), which function as task groups within ASG.

The mandate of the ASG is to develop recommendations that support establishment, assessment, monitoring, criteria and indicators for certification and adaptive management of reaimed aquatics ecosystems on oil sands leases in the Regional Municipality of Wood Buffalo.

The ASG fulfills this mandate through the development and maintenance of the following guidance documents and decision support tools:

- A guidance document for wetland and aquatics establishment;
- A guidance document for end pit lake establishment;
- Other aquatic reclamation guidance documents and tools as agreed upon by the RWG (e.g., riparian areas and streams); and
- Predictive models for the assessment of end pit lake and wetland development scenarios.

These guidance documents support the creation of a range of sustainable aquatic ecosystems in reclaimed landscapes. The ASG provides these guidance documents as recommendations to the RWG.

Wetlands are a critical component of natural landscapes and watersheds in the oil sands region. They constitute a key mechanism for water retention and distribution in boreal ecosystems of northeastern Alberta, and their presence on reclaimed landscapes is likely essential for long-term sustainability in a region with an average annual precipitation-evaporation deficit. End pit lakes constitute a second mechanism for surface water storage in the region, in a setting suggestive of reservoirs or natural boreal lakes. Their reclamation requires integrated planning and design, and thoughtful adaptive management processes. In some instances, wetlands and end pit lakes might be directly linked in reclamation landscapes, both spatially and functionally. Streams and riparian zones constitute other habitats of reclamation interest to the ASG.

Whereas some direction for wetlands reclamation was provided by a guideline that pre-dated the formation of CEMA (Oil Sands Wetlands Working Group 2000), end pit lakes reclamation did not benefit from a similar regional compilation. A second edition to the wetlands guideline was produced by WASG in 2007 (Harris 2007). A draft end pit lakes guideline was produced by EPLSG, also in 2007 (Westcott & Watson 2007). In both instances, sub-group members identified further information needs and untested potential for reclamation in the oil sands region. The identification of data gaps and pursuit of targeted research continues to advance guidance provisions in future revisions of both documents.

The terms of reference for the ASG are provided in Appendix A.
3.2 ASG 2011 Members

The ASG membership in 2011 consisted of the individuals listed below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEW</td>
<td>Rod Hazewinkel (Co-chair), Danielle Cobbaert, Ernst Kerkhoven, Zvonko Burkus</td>
</tr>
<tr>
<td>ASRD</td>
<td>Gerry Haekel</td>
</tr>
<tr>
<td>CEMA Program Administrator</td>
<td>Kyle Harrietha</td>
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<tr>
<td>CNRL</td>
<td>Richard Kavanagh, Stephen Tuttle</td>
</tr>
<tr>
<td>Ducks Unlimited Canada</td>
<td>Eric Butterworth, Rick Shewchuk</td>
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<tr>
<td>Environment Canada</td>
<td>Ian Droppo</td>
</tr>
<tr>
<td>ERCB</td>
<td>Tara Rogers, Paul Aguas</td>
</tr>
<tr>
<td>Fort McKay Sustainability Department</td>
<td>Carol Jones</td>
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<tr>
<td>Husky Oil</td>
<td>Gord Jesse</td>
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<tr>
<td>Imperial Oil</td>
<td>Rachel Nobel-Pattinson (Co-chair), Diana Young</td>
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<tr>
<td>NAIT</td>
<td>Haneef Mian</td>
</tr>
<tr>
<td>OSRIN</td>
<td>Chris Powter</td>
</tr>
<tr>
<td>RWG Technical Program Manager</td>
<td>Théo Charette, Gillian Donald</td>
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<tr>
<td>Shell Albian Sands</td>
<td>Ainslie Campbell</td>
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<tr>
<td>Suncor Energy</td>
<td>Christine Daly, Xiaoying Fan, Jon Hornung</td>
</tr>
<tr>
<td>Syncrude Canada</td>
<td>Carla Wytrykush, Samantha Tavener</td>
</tr>
<tr>
<td>Total E&amp;P Canada</td>
<td>Andrews Takyi</td>
</tr>
</tbody>
</table>

3.2.1 End Pit Lake Guide Task Group (EPLGTG)

The EPLGTG membership in 2011 consisted of the individuals listed below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
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<tbody>
<tr>
<td>AEW</td>
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<td>CEMA Program Administrator</td>
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<td>Environment Canada</td>
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<td>Fort McKay Sustainability Department</td>
<td>Carol Jones</td>
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<td>Imperial Oil</td>
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<td>Suncor Energy</td>
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<td>Syncrude Canada</td>
<td>Samantha Tavener, Carla Wytrykush</td>
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<tr>
<td>Total SA</td>
<td>Andrews Takyi</td>
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<tr>
<td>RWG Technical Program Manager</td>
<td>Théo Charette</td>
</tr>
<tr>
<td>West Hawk Associates</td>
<td>David Wylynko, James Hrynyshyn (Managing Editors for EPL Guide)</td>
</tr>
</tbody>
</table>
3.2.2 End Pit Lake Modelling Task Group (EPLMTG)

The EPLMTG membership in 2011 consisted of the individuals listed below.

<table>
<thead>
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<th>Organization</th>
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<td>AEW</td>
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<td>CEMA Program Administrator</td>
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<td>Syncrude Canada</td>
<td>Tara Penner, Warren Zubot, Samantha Tavener</td>
</tr>
<tr>
<td>Total</td>
<td>Andrews Takyi (Chair)</td>
</tr>
<tr>
<td>RWG Technical Program Manager</td>
<td>Théo Charette</td>
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</table>

3.2.3 Technology Transfer Task Group (TTTG)

The TTTG membership in 2011 consisted of the individuals listed below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
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<tbody>
<tr>
<td>ASRD</td>
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<tr>
<td>CEMA Program Administrator</td>
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<tr>
<td>RWG Technical Program Manager</td>
<td>Théo Charette</td>
</tr>
<tr>
<td>Suncor Energy</td>
<td>Jon Hornung</td>
</tr>
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<td>Syncrude Canada</td>
<td></td>
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<tr>
<td>Technology Transfer Technical Lead</td>
<td>Marsha Trites</td>
</tr>
</tbody>
</table>

3.3 ASG 2011 Meeting Dates

The ASG and its task groups each held between one and ten meetings in 2011. Summary notes from the meetings are available to CEMA Members as a separate document.

<table>
<thead>
<tr>
<th>No.</th>
<th>ASG</th>
<th>EPLGTG</th>
<th>EPLMTG</th>
<th>TTTG</th>
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<td>1.</td>
<td>February 22</td>
<td>January 12</td>
<td>January 21</td>
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<td>2.</td>
<td>April 20-21</td>
<td>June 2</td>
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<td>June 27-28</td>
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<td>July 13</td>
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<td>9.</td>
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3.4 Published Reports


3.5 Scope Sheets

3.5.1 Projects Completed in 2011

This section includes scope sheets for the following ASG projects that were completed in 2011.

- The Effects of Nutrient and Peat Amendments on Oil Sands Reclamation Wetlands: A Microcosm Study
- Fort McKay Indigenous Values in Wetlands of the Athabasca Oil Sands Region
- The State of Existing Empirical Data and Scientific Knowledge on Habitat-Species Relationships for Wildlife that Occupy Aquatic Habitats, with a Focus on the Boreal Region of Alberta
- Process Assessment of Wetland Criteria and Indicator Frameworks
- Minimum Ecological Management
- Development of Regional Geotechnical Design Criteria for Oil Sands End Pit Lakes
- Workshops: Wetland Technology Transfer and Development of a Regional Monitoring Program to Assess the Effects of Oil Sands Development on Wetland Communities
The Effects of Nutrient and Peat Amendments on Oil Sands Reclamation Wetlands: A Microcosm Study

RWG Project Number
R-1109

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
2007-0024

Principal Investigators/ Consultant
Dr. D.G. Dixon

Contract Budget

Project Description
The overall goal was to assess the impact of nutrient additions on the rate and type of plankton, benthos, and macrophyte colonization. Objectives to be addressed included:

- Effect of nutrient loading at no, low, and high rates of addition on shallow (<1 m) wetland systems;
- Effect of fertilization on productivity and plankton composition;
- Impact of algal biomass on dissolved oxygen (DO) levels in both pelagic and epibenthic zones;
- Changes in benthic invertebrate abundance and diversity;
- Rate and quality of detrital layer deposition;
- Fate and cycling of added nutrients; and
- Determination of limiting nutrient in various OSPM-impacted environments.

Project Deliverables
A final report and a student thesis on the role of nutrient enrichment on development of wetlands.

Project Timelines

Project Status
Complete. The student thesis was defended in November 2010 and revisions were made accordingly. The thesis was delivered to CEMA.

Highlights/ Milestones/ Key Findings
Year 1 (Phase 1) preliminary research determined the optimal rates of primary production/sedimentation following nutrient additions to mesocosms and evaluated the techniques and applicability of the experimental design. The use of mesocosms is preferred as it allows for the control of factors that may influence productivity, particularly temperature, salinity, and naphthenic acid (NA) concentration. Once the optimal sedimentation rate and experimental design were determined, an expanded mesocosm study (Phase 2) assessed the rate and type of colonization for phytoplankton, periphyton, plants, zooplankton, and benthic invertebrates (Years 2 and 3). Peat amendments significantly increased the growth of phytoplankton and periphyton by providing sufficient nutrients
to the system over the entire duration of the experiment. Nutrient enrichment insignificantly improved the phytoplankton and periphyton growth because it only temporarily (less than 3 weeks) elevated nutrient levels as the nutrients added were quickly used by the system.
Fort McKay Indigenous Values in Wetlands of the Athabasca Oil Sands Region

RWG Project Number
R-1109

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
2008-0037

Principal Investigators/Consultant
Michael O’Flaherty

Contract Budget
$267,079

Project Description
The broad goal of this project was to support the consideration of First Nation and Métis values in future wetland reclamation processes. Although the goal of this project was to provide input into future reclamation efforts, the meetings and other activities associated with this project were not part of a consultative process or any other planning process associated with oil sands development.

The principal objective of the first phase (Scoping Study) was to develop the scope and method for a Pilot Study with a single First Nation and Métis community. A second objective of that phase was to provide First Nation and Métis communities that are not participating in the Pilot Study with an overview of the project and the approach chosen for the second phase.

The goal of the second phase (Pilot Study) was to produce a set of community-identified wetland values that will contribute to the development of an indigenous ecological wetlands classification on a regional scale. This was achieved through a field research program working with the elders of a single community. The Pilot Study was also used to test and refine the research approach identified in the Scoping Study so that this approach can be more readily adopted in other areas.

Project Deliverables
A final report was drafted that describes the outcomes of this research, including a set of Fort McKay indigenous ecological wetlands values that incorporates both First Nation and Métis input on equal terms. The report also provides recommendations for how to implement future wetland reclamation in a manner that respects Fort McKay indigenous knowledge.

Project Timelines
December 2011

Project Status
Complete. The data-collection (interviews and field) component of this project is completed. The draft report was provided and reviewed. A final report was delivered.
Highlights/Milestones/Key Findings
In general terms, project results can be summarized as follows:

- Wetlands are important sites for the harvesting of customary use values that contribute to the health and well-being of Fort McKay people, including by supporting social reproduction and cultural continuity.
- The contribution wetlands make to the health and well-being of other animals is as important as the provision of customary use values.
- Wetlands play a primary role in the maintenance of clean flowing waters throughout the landscape.
- Ecological values are intrinsic; their importance does not rely on being valued by people.
- The value of wetlands in providing benefits to all living beings depends on wetlands being clean, structurally intact, and functionally connected to the beings that depend on them, to other wetlands, and to all other lands.
- Wetlands are an integral part of a larger landscape that serves as a repository for the personal, family, and cultural histories of Fort McKay people and a context for the re-telling (reproduction) of that history.
- Changes to the land that are seen to interfere with use of the land diminish realization of the values of functional connectivity and cultural continuity.
The State of Existing Empirical Data and Scientific Knowledge on Habitat-Species Relationships for Wildlife that Occupy Aquatic Habitats, with a Focus on the Boreal Region of Alberta

RWG Project Number
R-1109

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining guidance documents for wetland and aquatics and end pit lake establishment.

CEMA Contract Number
2009-0049

Principal Investigators/ Consultant
Dr. Brian Eaton, Dr. Jason Fisher, Dr. Jim Schieck, Alberta Innovates – Technology Futures

Contract Budget
$7,000 (2010); $48,589 (2011)

Project Description
The present project focused on determining the available data and information from the literature and relevant datasets to produce guidance for reclamation of wildlife habitat in aquatic ecosystems. The overall project has two main objectives:

1. To produce management support tools for the creation of wetland habitat in the oil sands region, with the assumption that constructed wetlands that mimic natural wetlands are more likely to evolve into functional habitats similar to natural habitats; and

2. To develop habitat models for species of interest, to provide guidance in constructing habitat types that attract and support these species or species guilds.

Production of management support tools for wetland construction (Objective 1) will focus on determining the characteristics of natural wetlands relevant to the oil sands region, including consideration of both landscape-scale (e.g., size and distribution of wetlands in a watershed) and local-scale habitat features (e.g., bank sinuosity). In addition, the terrestrial matrix in which wetlands are embedded must be considered, as many of the aquatic or semi-aquatic species that are of interest to stakeholders use both aquatic and terrestrial habitats.

A thorough review of literature related to wetland habitats relevant to the oil sands region, wetland design, reclamation, restoration, and construction was conducted to gather information that could be used for formulating guidance tools for wetland habitat design. Other datasets that could be used to generate descriptions of wetlands that occur in the boreal region, including the natural range of variation for these habitats in the region, were identified and described. This information can be used to generate targets for the design of constructed wetlands. Phase 1 entailed determining the quantity and quality of existing data on wetland habitats, and related topics, relevant to the oil sands region to ensure that design recommendations and tools constructed during Phase 2 of the project will produce scientifically defensible management decisions.

Objective 2 of the project is the creation of empirical species-habitat models that describe the relationship between aspects of a species’ habitat — such as vegetative cover, creek-bank sinuosity, ground conditions, and tree canopy — and the probability of species occurrence. These relationships describe the current associations between a species and its habitat on the landbase. It is assumed that
these relationships can also serve as a prescription for reclaiming altered habitat; that is, if habitat elements are introduced at a site within a landscape where species occur, recolonization of a reclaimed site will be made more likely by including these habitat elements.

Before modelling species-habitat relationships, we must know whether sufficient data exist to feed these models. Therefore, a primary activity for Phase 1 of this project was to locate and assess existing databases containing suitable information. Databases included the primary scientific literature, environmental impact assessments, monitoring done by oil sands companies as part of the approval process, the Alberta Biodiversity Monitoring Institute, and Ducks Unlimited Canada’s Wetland Inventory dataset. Other datasets we explored were the Province of Alberta’s Fish and Wildlife Management Information System dataset and the Alberta Conservation Information Management System (formerly Alberta Natural Heritage Information Centre) dataset, though these were usually limited to species observations exclusive of habitat.

The report from this project includes a proof-of-concept of how species-habitat models might work for this application, given existing data and the current objective of providing guidance on reclamation. Data on the snowshoe hare (Lepus americanus), one of the indicator species identified for the oil sands area, was sufficient to create a species-habitat model to illustrate model form and output, and discuss how these could translate into actual recommendations for ground-level reclamation activities. This key scoping exercise demonstrates the feasibility of proceeding to Phase 2 under the proposed framework.

In summary, the report from the present project covers Phase 1 of the overall project: identification and assessment of potential information and data sources for producing a design guidance document related to aquatic habitat reclamation in the mineable oil sands region, and modelling species-habitat associations to guide efforts to return species of interest to the reclaimed landscape. In addition, this report provides proof-of-concept modelling for one species to demonstrate the utility of species-habitat association modelling in designing reclamation programs.

**Project Deliverables**
Final report for Phase 1 and recommendations for Phase 2 of the project.

**Project Timelines**
February 2010 to February 2011

**Project Status**
Complete. A final report was submitted to CEMA.

**Highlights/ Milestones/ Key Findings**
During this project, we found that the quality and quantity of both literature and datasets related to aquatic landforms and species-habitat relationships for the mineable oil sands region were extremely variable. Data on species-habitat associations collected in a statistically rigorous manner were relatively sparse, though enough exist to initiate data-based empirical models for many indicator species considered in this report. Sufficient literature exists to inform expert-based Habitat Suitability Index models for the remainder. Data on existing wetlands in the mineable oil sands region were also variable, though basic information can be obtained for many types of habitat in the region. Unfortunately, these data are sometimes only in paper form in reports. However, it should be possible to build a dataset that would provide guidance on naturally occurring wetlands in a boreal context relevant to the mineable oil sands region. There are also numerous papers on different types of wetland reclamation, though relatively few of them are from Alberta. However, it should be possible to extract the relevant lessons from this body of work and apply it to the Alberta oil sands context. Development of a guidance document for design of wildlife habitat for aquatic reclamation is the next step in the overall project.
Process Assessment of Wetland Criteria and Indicator Frameworks

RWG Project Number
R-1109

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
2010-0014

Principal Investigators/Consultant
Opabin Environmental Ltd.

Contract Budget
$117,856

Project Description
This work is seen as an extension of “A Framework for Reclamation Certification Criteria and Indicators for Mineable Oil Sands” and will provide the background information necessary to inform the development of specific criteria and indicators for wetland reclamation of the oil sands. The following step will be the development of specific criteria and indicators that will be used to assess wetland reclamation success in the oil sands and, ultimately, reclamation certification. We envision that this work will be done through consultation with wetland experts, regulators, and the ASG. These wetland criteria and indicators will guide and inform government, stakeholders, and industry on expectations for wetland reclamation outcomes.

The goal of this project is to examine wetland reclamation/restoration criteria and indicator frameworks that are currently operating in different jurisdictions as case studies to inform the development of a wetland reclamation criteria and indicator system in the oil sands. The ASG recognizes that development of wetland criteria and indicators has wide-ranging implications for government, industry, and stakeholders. Thus, a solid base of information is required to inform the development of the wetlands framework. The focus of this project is on the design, development, and use of frameworks, rather than an examination and evaluation of indicators used. This will inform our first steps in developing a framework.

The intention of this project is to focus on wetlands, but the information generated from this project should also be relevant to other aquatic systems.

Project Deliverables
A report that includes a recommended approach and process for a criteria and indicators framework for wetlands reclamation in the Athabasca Oil Sands Region.

Project Timelines
April 2010 to March 2011

Project Status
Completed
Highlights/ Milestones/ Key Findings
Results from four case studies (Nova Scotia, Michigan, Florida, and East Pit Lake in Alberta) are summarized in the report. Key considerations for developing a criteria and indicator management system for reclamation include the following:

1. Adaptation: An adaptive approach to set reclamation objectives and to select and update criteria and indicators within a management system is critical. New technologies, reclamation techniques, and policy changes will require adaptation of the criteria and indicators over time.

2. Rules: Rules and procedure are essential to describe the use of criteria and indicators to inform reclamation certification decisions. Jurisdictions where certification criteria are entrenched in regulation diminish the flexibility of reclamation practitioners to implement the most effective and efficient course of action.

3. Approval conditions: Criteria and indicators aligned with mine approval conditions remove the ambiguity and interpretation differences that can develop between the operator and regulator regarding the mine approval conditions that mandate specific reclamation outcomes.

Using criteria and indicators to inform reclamation certification decisions increases the credibility of the reclamation certification decision, improves equality between operators, and increases operational certainty for the operators by clearly defining reclamation certification requirements.
Minimum Ecological Management

RWG Project Number
R-1109

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
2010-0033

Principal Investigators/Consultant
Lisette Ross, Native Plant Solutions

Contract Budget
$30,000

Project Description
This document provides both background information and guidance to CEMA on what Ducks Unlimited Canada (DUC) considers its fundamental guiding principles for ensuring Minimum Ecological Management on its wetland projects. While these principles were initially established for their “wetland build projects,” they now apply to most of DUC’s habitat projects across Canada — uplands, wetland creation, and wetland restoration. It is important to note that DUC’s wetland builds are similar to what CEMA would consider wetland reclamation. It is also important to note that these fundamental principles have been put in place for all of DUC’s wetland builds regardless of their location in Canada. The document deliverables incorporate the findings from a series of task force documents completed over the last decade by DUC staff across Canada. These task force groups were commissioned within the company to review and provide guidance on a number of diverse challenges facing DUC when creating and maintaining wetland builds in a sustainable way, both ecologically and financially. These documents include:

- DUC’s guidelines for the management of existing and future wetland projects (MEM);
- Adaptive management (AM) and its role in ensuring the scientific integrity behind project planning and ongoing management;
- Habitat asset management (HAM) of DUC’s project infrastructure;
- DUC position paper on the role of potentially invasive species within DUC habitat programs; and
- Wetland restoration guidance for DUC’s Prairie/Western Boreal Region.

DUC’s MEM principles (sustainability, diversity, and goal setting) are used as the framework for the CEMA document. The bulk of the documentation occurs in the sustainability section. Regional DUC staff were used to provide two to three field examples of wetland projects/case studies that highlight the role MEM planning plays in project design, project execution, and maintenance. DUC engineering staff were used to provide additional knowledge to DUC’s existing HAM information. While this document is not designed to tell the reader how to build a wetland step-by-step, it discusses the processes to be followed so that wetland builds and ongoing maintenance are as successful as possible.

Project Deliverables
A final report describing DUC’s Minimum Long-Term Ecological Management approach.
Project Timelines
September 2010 to February 2011

Project Status
Completed

Highlights/ Milestones/ Key Findings
The most common causes of the failure of constructed wetlands to provide expected services may be unrealistic expectations or undefined objectives from the beginning. A lack of clearly stated objectives in addition to a lack of monitoring results in, at best, a subjective view of success. In too many cases, our assessment of what a wetland should be depends on observations made either too hastily, over too short a period of time, or across too narrow a landscape perspective. This can have long-term implications for the level of management required on projects over their lifetime. Constructed wetlands will continue to fail us until we can understand how variable a wetland is in its essential characteristics and the role that the landscape around the wetland plays in sustaining these characteristics. We have learned that succession seldom proceeds monotonically to a characteristic climax and that, depending on the objectives of the project, productivity is not necessarily always related to diversity.

AM studies play an important role in developing MEM strategies for projects. AM findings allow for the refinement of the level of management required as more information on a developing wetland is acquired. AM leads to better decisions on when to manage and how to manage. If AM studies are done well, then findings will help guide project planning and coordinate management activities on numerous wetland projects. If an important long-term goal of land planners is to achieve minimal ecological management on their wetland projects, then good initial planning, goal setting, and well-organized monitoring programs will be the answer to fewer management interventions on constructed wetland projects over their lifespan.
Development of Regional Geotechnical Design Criteria for Oil Sands End Pit Lakes

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2009-0019

Principal Investigators/ Consultant
AMEC Earth & Environmental

Contract Budget
$93,000

Project Description
The scope of work includes the following tasks:

▪ Formalize a list and definitions of the geotechnical design objectives, including a discussion of the feasibility of a maintenance-free approach and classification of containment structures;
▪ Carry out literature review on possible constructed and natural analogues;
▪ Provide information and discussion on the requirements and feasibility of each design objective;
▪ Recommend criteria, where possible, for dam/containment, outlet stability, bank erosion, and slope stability; preliminary design criteria would be prepared to facilitate further discussion and iteration;
▪ Organize workshops with industry and government experts to discuss issues, obtain input, and develop consensus; and
▪ Prepare a draft and a final report providing the geotechnical design criteria and the basis for the proposed criteria.

Project Deliverables
Report on geotechnical design criteria

Project Timelines
December 2008 to March 2011

Project Status
Complete

Highlights/ Milestones/ Key Findings
The report provides preliminary geotechnical design criteria that apply to key aspects of the geotechnical design of pit lakes in the oil sands region of Alberta. These criteria are proposed for further discussion with the oil sands geotechnical community and with input from the various environmental disciplines. These criteria are expected to evolve with input from the wider engineering community as well as with input from other technical and scientific disciplines and in particular with new knowledge developed from research and full-scale pit lake experiments currently underway. Moreover, these design criteria are expected to evolve as actual pit lakes are planned, designed,
implemented, and monitored. Therefore, as data and experience are acquired, the preliminary geotechnical criteria proposed in the report need to be reviewed and revised, as required.

Other CEMA subgroups are addressing environmental and reclamation issues related to pit lakes. CEMA is also starting an initiative to bring together the various multidisciplinary aspects of pit lakes into a cohesive set of guidelines for the design and construction of the reclaimed landscape that best integrate the current knowledge on pit lakes. The geotechnical guidelines proposed in this report are strictly geotechnical and build on the work done on the previous phase to propose geotechnical guidelines for the design of pit lakes. However, geotechnical and environmental design criteria for pit lakes cannot be developed in isolation. Therefore, the expectation is that the preliminary geotechnical design guidelines proposed in this report will be reviewed and most likely will be modified and adjusted with the input and interaction that will occur in the next phase of multidisciplinary work led by CEMA.
Peer Review of End Pit Lake Physical/Biogeochemical Model

RWG Project Number
R-1111

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
UCR-0811

Principal Investigators/ Consultant
Scott Wells, Portland State University
Judit Smits, University of Alberta
Chris Weisener, University of Windsor

Contract Budget
$20,270

Project Description
CEMA has contracted with Golder Associates and ERM to draft an EPL physical/biogeochemical model. The draft model was received in summer of 2011 and was sent to three peer reviewers. The peer review involved the following elements:

- Review of report – this is a review of the text of the Draft Report entitled: “CEMA Oil Sands Pit Lake Model” by ERM and Golder Associates. This would be a review of the basic theory as outlined in the report.
- Review of code sections – this is a selected review of sections of code to verify that the model report and the code are in agreement. This would not evaluate all the code, just selected sections of code to verify agreement with the model report.
- Test of model code – this involves using the code in a simple test application to verify that it is functioning properly. This would not test all aspects of the code, just selected sections of code.

Project Deliverables
Review comments in a technical memorandum from each reviewer.

Project Timelines
September to November 2011

Project Status
Complete

Highlights/Milestones/ Key Findings
The comments received from the reviewers were diverse and detailed. All reviewers viewed the document in a positive light but also made clear that edits and revisions are necessary. Golder and ERM are currently addressing the comments.
Workshops: Wetland Technology Transfer and Development of a Regional Monitoring Program to Assess the Effects of Oil Sands Development on Wetland Communities

RWG Project Number
R-1112

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
UCR-1111

Principal Investigators/Consultants
Suzanne Bayley, University of Alberta  
Jan Ciborowski, University of Windsor  
George Dixon, University of Waterloo  
Andrea Farwell, University of Waterloo  
Phil Fedorak, University of Alberta  
Lee Foote, University of Alberta  
John Headley, Environment Canada  
Gord McKenna, BGC Engineering Inc.  
Carl Mendoza, University of Alberta  
Kevin Devito, University of Alberta  
Cindy Paszkowski, University of Alberta  
Dale Vitt, Southern Illinois University  
Karsten Liber, University of Saskatchewan  
Judit Smits, University of Calgary  
Barry Warner, University of Waterloo  
Lee Barbour, University of Saskatchewan

Contract Budget
$88,242

Project Description
January 26 and 27 Tech Transfer Workshop - Bring together participants to discuss variables that would be useful to measure success of wetland reclamation.

January 28 Wetland Monitoring Workshop - Bring together participants to identify stressor and response variables.

November 2 Tech Transfer Workshop - Present draft report to participants and obtain feedback.

Project Deliverables
Input provided at the technical sessions and workshops to feed into the draft marsh tech transfer report and wetland monitoring program.

Project Timelines
January 26-28 and November 2, 2011

Project Status
Complete

Highlights/Milestones/Key Findings
To be described when the final marsh technology transfer and wetland monitoring program reports are submitted.
3.5.2 Projects Initiated or Ongoing in 2011

This section includes scope sheets for the following ASG projects that were initiated or ongoing in 2011:

- Assessment of Indices of Biotic Integrity and Performance Indicators of Wetland Health for Oil Sands and Natural Reference Wetlands
- Managing Editor for the Production of the Oil Sands End Pit Lake Guidance Document
- Technical Advisor for the Production of the Oil Sands End Pit Lake Guidance Document
- Technical Advisor and Author of Chapter 1 (“Context”) for the Production of the Oil Sands End Pit Lake Guidance Document
- Author of Chapter 2 (“Objectives”) of the Oil Sands End Pit Lake Guidance Document
- Author of Chapter 3 (“Other Pit Lakes”) of the Oil Sands End Pit Lake Guidance Document
- Author of Chapter 5 (“Water Balance”) of the Oil Sands End Pit Lake Guidance Document
- Author of Chapter 6 (“In-Lake Processes”) of the Oil Sands End Pit Lake Guidance Document
- Author of Chapter 7 (“Planning and Drivers”) of the Oil Sands End Pit Lake Guidance Document
- Author of Chapters 8 (“Design”) of the Oil Sands End Pit Lake Guidance Document
- Author of Chapters 9 (“Commissioning”), 10 (“Adaptive Management”), and 11 (“Knowledge Gaps”) of the Oil Sands End Pit Lake Guidance Document
- Oil Sands End Pit Lake Physical/Biogeochemical Model Development
- Investigation of the Biochemical Evolution of Mature Fine Tailings Associated with End Pit Lakes in the Alberta Oil Sands
- User Needs Assessment for the Oil Sands Wetlands Guidance Document
- Technical Lead for Wetland Reclamation Technology Transfer
- Development of a Regional Monitoring Program to Assess the Effects of Oil Sands Development on Wetland Communities
Assessment of Indices of Biotic Integrity and Performance Indicators of Wetland Health for Oil Sands and Natural Reference Wetlands

RWG Project Number
R-1109

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
2007-0015

Principal Investigators/Consultant
Dr. Suzanne Bayley

Contract Budget

Project Description
The overall purpose is to develop an Index of Biotic Integrity (IBI) to integrate indices of biological, chemical, and physical integrity that can be used to assess the health of marshes and shallow open water wetlands constructed in the oil sands region. The goal is to develop and test an approach to evaluate the ecological integrity across a range of disturbed and natural wetlands. Developing an IBI requires measurement of biological and environmental indicators across a gradient of conditions (water, nutrients, substrate, and plant sources) and disturbance, after which individual metrics for marsh and open water zones that are sensitive to disturbance will be identified. Finally, the indices (biological, chemical, physical) will be developed from the metrics and incorporated into an index for an entire wetland (IBI).

It is also the intent to test the developed index against other more simplified rapid assessment techniques that can provide a snapshot of conditions over a broad range of sites (~50) across boreal Alberta. The goal is to be able to simplify the analyses done on the oil sands wetlands and to assess the outcome of succession in the oil sands wetlands.

Project Deliverables
- Integrated final report (final report must include a proposed IBI and be submitted, regardless of whether the student theses are completed)
- Bound copies of student theses
- Database of all raw data and geographic coordinates of study sites

Project Timelines
Year 1 (April 1, 2007 - March 31, 2008) - Projects 1 and 2
- April 2007: selection and detailed assessment of selected sites; define suite of performance indicators to be collected and metrics that will be used.
- May to September 2007: begin collection and measurement of ecological characteristics in healthy (reference), degraded, and restored Alberta wetlands. A range of oil sands wetlands of different ages will be used to represent the degraded and restored wetlands. An attempt will be made to use the same wetlands as the CFRAW project, providing that project criteria are met.
Projects Initiated or Ongoing in 2011 | Criteria & Indicators Development (Aquatics)

- September - November 2007: analyze water chemistry and identify macrophyte and algal/diatom species.

**Year 2 (April 1, 2008 - March 31, 2009) - Projects 1 and 2**

- April 2008: prepare for new field season; adjust and add new metrics as required (based on preliminary analyses in Year 1).
- May - September 2008: collect ecological, chemical, and physical data; develop individual metrics of the primary indicators.

**Year 3 (April 1, 2009 - March 31, 2010) - Project 2: Rapid Assessment and Integration**

- April - November 2009: compare individual metrics of the primary indicators; develop integrated IBI and compare rapid assessment technique with the detailed assessments.

**Project Status**

One MSc thesis completed. Awaiting PhD thesis completion and delivery.


**Highlights/Milestones/Key Findings**

In the summers of 2007 and 2008, 49 boreal marshes were monitored, 20 of which were reclaimed oil sands wetlands. The results of site ranking identified seven metrics that were most predictive of wetland vegetation condition and level of disturbance: vegetation height in the wet meadow zone, % cover of Equisetum species (horsetails), biomass of obligate wetland species, % cover of perennial species, total % vegetation cover, relative cover of invasive species, and % cover of Carex atherodes (a native sedge). In addition, three wet meadow community groups could be distinguished using clustering techniques: natural (defined by the presence of Carex atherodes and Scutellaria galericulata), intermediate reclaimed sedge (with Carex aquatilis) and disturbed, saline (with Hordeum jubatum and Sonchus species). These communities were strongly influenced by sediment nutrient and water content, the “stress” score, and NAs in the open water.

The “stress” score was derived as a way to objectively rank wetlands in terms of their environmental condition without relying on the subjective “best professional judgment.” It required variable selection, standardization and weighting, and identified eight variables that could produce a reliable score: total cations in the water, total nitrogen in the water, % water content of emergent zone sediment, water depth, water transparency, amplitude (seasonal changes in water level), chloride content, and % oil in sediment.

Analyses of submersed aquatic vegetation determined that there were seven distinct species assemblages in the 63 wetlands sampled, but that only two were typically found in minimally disturbed or reference wetlands. The remaining five were characteristic of different types or intensities of disturbance.
Managing Editor for the Production of the Oil Sands End Pit Lake Guidance Document

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2010-0016

Principal Investigators/Consultant
WestHawk Associates

Contract Budget
$51,000 (2010), $44,700 (2011), $15,000 (2012)

Project Description
End pit lakes (EPLs), if proven as a viable technology, may be important components in lease-closure landscapes, with over 20 in planning. They are planned to contain large quantities of water that can include varying amounts of oil sands process-affected water at various degrees of ageing. To be deemed successful, these lake environments must perform at levels of productivity comparable to other lakes in the region and provide a suitable and sustainable aquatic habitat for biota and other users. As potential discharge points to the environment, pit lakes are proposed as a remediation solution for process-affected water and tailings, and seepage from reclaimed areas.

One objective of the ASG, as administered by the EPL Guide Task Group (EPLGTG), is to develop guidance for the establishment of EPLs in reclaimed landscapes. In 2007, the ASG produced an EPL Guidance Document (EPLGD). The EPLGD provided preliminary design and management recommendations for EPLs and will be used by industry and government to guide planning and research respecting the development and management of EPLs. The EPLGD provides guidance on design factors that can be addressed at present and critical paths for questions related to science and management needs for lake planning.

Deficiencies identified in a recent review of the current EPL technical guidance document have prompted the EPLGTG to revise their approach to the planned revision of this document. The focus of the next edition of the EPLGD is to work closely with EPL expert authors, through a systematic peer-review process, to produce a comprehensive guidance document that provides an accurate representation of the current state of knowledge and that can serve as a template to be updated as new information becomes available. The EPLGTG anticipates a document that is updated in content, clear in style, and tailored in format to practitioners’ needs of focusing on design guidance. Goals for the EPLGD are to provide regional design guidance to reclamation engineers and communicate to stakeholders issues and processes associated with the design of EPLs. Ultimately, another goal will be to seek acceptance by the Government of Alberta as a regional reclamation guidance document.

The goal of this project is to obtain the services of a managing editor to produce the EPLGD. The role of the managing editor will be to coordinate the production of the document as described in the proposed roles and responsibilities.
Answerable to the EPLGTG, the managing editor will:

- **Assist in identifying the target audience of the EPLGD**: the managing editor will work with the EPLGTG to identify the needs of the intended users of the EPLGD. This exercise will be led by the EPLGTG.

- **Assist in the finalization of the draft table of contents**: on the basis of his/her familiarity with the issues associated with EPL design and construction and an understanding of the needs of the target audiences, the managing editor will assist the EPLGTG with the finalization of the draft table of contents proposed in the recent EPLGD review, as amended.

- **Assist with author selection**: The managing editor will assist the EPLGTG with the selection of authors for individual chapters of the guidance document.

- **Coordinate chapter authors**: the managing editor will ensure that authors understand the intended scope of their submissions as laid out in the table of contents, that authors are able to adhere to relevant timelines, and that authors have access to relevant technical documents.

- **Manage content**: the managing editor will assure that the content of the submissions is consistent with the table of contents, that the style is generally consistent among authors, and that submissions meet the expectations of the EPLGTG.

- **Manage peer-review**: the managing editor will assure that chapters are reviewed by appropriate peers, that authors have the opportunity to respond to reviews, and that chapters reflect reviewer comments.

**Project Deliverables**
A multi-authored and peer-reviewed End Pit Lake Guidance Document.

**Project Timelines**
June 2010 to March 2012

**Project Status**
Ongoing. A process for the development of the EPLGD has been developed. World-class authors have been selected. A final outline for the EPLGD has been developed through an authors’ workshop. Chapters have been drafted and a complete layout and edit of the document is being done.

**Highlights/Milestones/Key Findings**
To be described when the final report is submitted.
Technical Advisor and Author of Chapter 1 (“Context”) for the Production of the Oil Sands End Pit Lake Guidance Document

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2010-0024

Principal Investigators/Consultant
BGC Engineering Inc.

Contract Budget

Project Description
EPLs, if proven as a viable technology, may be important components in lease-closure landscapes, with over 20 in planning. They are planned to contain large quantities of water that can include varying amounts of oil sands process-affected water at various degrees of ageing. To be deemed successful, these lake environments must perform at levels of productivity comparable to other lakes in the region and provide a suitable and sustainable aquatic habitat for biota and other users. As potential discharge points to the environment, pit lakes are proposed as a remediation solution for process-affected water and tailings, and seepage from reclaimed areas.

One objective of the ASG, as administered by the EPLGTG, is to develop guidance for the establishment of EPLs in reclaimed landscapes. In 2007, the ASG produced an EPLGD that provided preliminary design and management recommendations for EPLs and will be used by industry and government to guide planning and research respecting the development and management of EPLs. The EPLGD provides guidance on design factors that can be addressed at the present time and critical paths for questions related to science and management needs for lake planning.

Deficiencies identified in a recent review of the current EPL technical guidance document have prompted the EPLGTG to revise their approach to the planned revision of this document. The focus of the next edition of the EPLGD is to work closely with EPL expert authors, through a systematic peer-review process, to produce a comprehensive guidance document that provides an accurate representation of the current state of knowledge and that can serve as a template to be updated as new information becomes available. The EPLGTG anticipates a document that is updated in content, clear in style, and tailored in format to practitioners’ needs of focusing on design guidance. Goals for the EPLGD are to provide regional design guidance to reclamation engineers and communicate to stakeholders issues and processes associated with the design of EPLs. Ultimately, another goal will be to seek acceptance by the Government of Alberta as a regional reclamation guidance document.

BGC Engineering Inc. (BCG) provided a technical review of the first edition of the EPLGD and provided feedback with specific reference to geotechnical engineering and landform design for oil sands. One of the main concerns raised from many of the reviewers was that the guide did not focus on the technical needs of mine planners and designers; that is, it did not provide enough specific design
information. One of the objectives of the next version of the EPLGD is to address this shortcoming. BGC has been contracted to assist in this goal.

BGC is involved in various aspects of tailings and reclamation for most of the oil sands mines in the region, and has contributed to the designs of EPLs for Syncrude and Suncor and some of the tailings, hydrogeology, and surface water hydrology research for the oil sands.

BGC will provide:

1. Technical Guidance and Consultation to CEMA with respect to structuring the EPLGD, documenting oil sands history, aiding in selection of authors, providing guidance and review of chapters for the guide, and assisting with a hands-on workshop for authors; and

2. Authorship of Chapter 1, which will be about 20 pages and sets the context for the rest of the EPLGD.

**Project Deliverables**

Technical consultation and draft of Chapter 1 of the End Pit Lake Guidance Document.

**Project Timelines**

June 2010 to March 2012

**Project Status**

Ongoing. BGC has been an integral part of the EPLGD planning and development. They have provided insights on potential authors, reviewed outlines, and participated in authors' workshops.

**Highlights/ Milestones/ Key Findings**

To be described when the final end pit lake guide is submitted.
Author of Chapter 2 (“Objectives”) of the Oil Sands End Pit Lake Guidance Document

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2011-0014

Principal Investigators/ Consultant
James Hrnyshyn, West Hawk Associates

Contract Budget
$23,600

Project Description
 The chapter involves reviewing relevant regional plans and policies and synthesizing how these may influence the design and adaptive management of EPLs.
 Creating a template questionnaire and gathering the perspectives of stakeholders through a series of interviews and/or meetings with key representatives, as identified by the EPLGTG.
 Stakeholder groups to be interviewed will include local aboriginal groups, government, oil sands industrial operators, local NGOs, and other NGOs.

Project Deliverables
Chapter 2 of the End Pit Lake Guidance Document

Project Timelines
January 2011 to March 2012

Project Status
Ongoing. The chapter is undergoing review and revision.

Highlights/ Milestones/ Key Findings
To be described when the final end pit lake guide is submitted.
**Author of Chapter 3 (“Other Pit Lakes”) of the Oil Sands End Pit Lake Guidance Document**

**RWG Project Number**
R-1110

**Project Linkage to Terms of Reference**
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

**CEMA Contract Number**
2011-0012

**Principal Investigators/ Consultant**
Devin Castendyk, New York State University

**Contract Budget**
$12,500

**Project Description**
Describe the nature and distribution of non-oil-sands pit lakes in northern latitudes; to discuss key processes in existing pit lakes and their relevance to oil sands EPLs; and to identify key lessons learned from the operation, remediation, and closure of existing non-oil-sands pit lakes.

**Project Deliverables**
Chapter 3 of the End Pit Lake Guidance Document

**Project Timelines**
January 2011 to March 2012

**Project Status**
Ongoing. The chapter is undergoing review and revision.

**Highlights/ Milestones/ Key Findings**
To be described when the final end pit lake guide is submitted.
Author of Chapter 5 (“Water Balance”) of the Oil Sands End Pit Lake Guidance Document

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2011-0011

Principal Investigators/ Consultant
Brent Mooder, BGC Engineering Inc.

Contract Budget
$35,400

Project Description
The main focus of this work will be to provide a draft chapter for the EPLGD that describes the watershed geography of the region as well as local-scale watershed geography implications on EPL design and performance.

Project Deliverables
Chapter 5 of the End Pit Lake Guidance Document

Project Timelines
January 2011 to March 2012

Project Status
Ongoing. The chapter is undergoing review and revision.

Highlights/ Milestones/ Key Findings, etc.: To be described when the final end pit lake guide is submitted.
Author of Chapter 6 (“In-Lake Processes”) of the Oil Sands End Pit Lake Guidance Document

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2011-0013

Principal Investigators/Consultant
Jerry Vandenberg, Golder Associates Ltd.

Contract Budget
$34,677

Project Description
The main focus of this work is to produce a draft chapter for the EPLGD that describes the physical, chemical, and biological processes that will determine the success of pit lake functioning.

Project Deliverables
Chapter 6 of the End Pit Lake Guidance Document

Project Timelines
January 2011 to March 2012

Project Status
Ongoing. The chapter is undergoing review and revision.

Highlights/Milestones/Key Findings, etc.: To be described when the final end pit lake guide is submitted.
Author of Chapter 7 (“Planning and Drivers”) of the Oil Sands End Pit Lake Guidance Document

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2011-0023

Principal Investigators/ Consultant
Aaron Sellick, Norwest Corporation

Contract Budget
$70,000

Project Description
- Defining of the objectives for EPLs;
- Identifying requirements for the EPLs in terms of physical components, contents, or design geometry needed to achieve chemical and/or biological process capabilities within the lakes;
- Water treatment technologies and operating practices; and
- Approaches to mitigation of potential EPL – ecosystem integration issues.

Project Deliverables
Chapter 7 of the End Pit Lake Guidance Document

Project Timelines
January 2011 to March 2012

Project Status
Ongoing. The chapter is undergoing review and revision.

Highlights/ Milestones/ Key Findings, etc.
To be described when the final end pit lake guide is submitted.
Author of Chapters 8 ("Design") of the Oil Sands End Pit Lake Guidance Document

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2011-0022

Principal Investigators/Consultant
Angela Kupper, A MEC Earth & Environmental

Contract Budget
$60,000

Project Description
- Defining the objectives for EPLs;
- Identifying requirements for the EPLs in terms of physical components, contents, or design geometry needed to achieve chemical and/or biological process capabilities within the lakes;
- Water treatment technologies and operating practices; and
- Approaches to mitigation of potential EPL – ecosystem integration issues.

Project Deliverables
Chapter 8 of the End Pit Lake Guidance Document

Project Timelines
January 2011 to March 2012

Project Status
Ongoing. The chapter is undergoing review and revision.

Highlights/Milestones/Key Findings, etc.
To be described when the final end pit lake guide is submitted.
Author of Chapters 9 ("Commissioning"), 10 ("Adaptive Management"), and 11 ("Knowledge Gaps") of the Oil Sands End Pit Lake Guidance Document

RWG Project Number
R-1110

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for end pit lake establishment.

CEMA Contract Number
2011-0046

Principal Investigators/Consultant
Gord McKenna, BGC Engineering

Contract Budget
$18,897

Project Description
Authorship for “Adaptive Management” Chapter to describe potential adaptive management approaches for use during the operational phase of an EPL.
Authorship for “Knowledge Gaps” Chapter to identify and describe assumptions and areas for additional research based on discussions with supporting authors and members of the CEMA EPLGTG.

Project Deliverables
Chapters 9, 10, and 11 of the End Pit Lake Guidance Document

Project Timelines
January 2011 to March 2012

Project Status
Ongoing. The chapter is undergoing review and revision.

Highlights/Milestones/Key Findings, etc.: To be described when the final end pit lake guide is submitted.
Oil Sands End Pit Lake Physical/Biogeochemical Model Development

RWG Project Number
R-1111

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining predictive models for the assessment of end pit lake and wetland development scenarios.

CEMA Contract Number
2009-0043

Principal Investigators/Consultant
Golder Associates Ltd.

Contract Budget
$196,000

Project Description
As potential discharge points to the environment, pit lakes are proposed as a remediation solution for process-affected water and tailings, and seepage from reclaimed areas. Accordingly, the ASG has been tasked with establishing design and management guidelines for these lakes to, among other things, achieve acceptable water quality and sustainable aquatic ecosystem. To this end, the ASG has been developing an EPL model that will enable testing scenarios to generate recommendations on pit lake design and management that will optimize water treatment. Modelling work to date has focused on the main drivers of lake NA concentrations such as water source, filling time, and aerobic and anaerobic NA degradation in relation to lake mixing and DO concentrations. The lake mixing module was modelled in relation to temperature and salt profiles. From this model, relationship matrices were developed that relate physical design features (lake size, etc.) and management options (filling source and rates, etc.) to the treatment performance of pit lakes.

The ASG is interested in continuing its modelling efforts aimed at understanding the relative importance of various physical and biogeochemical information and processes that control the evolution and composition of pit lakes. This project will focus on model development, which is building the code necessary to add functionality to meet our modelling needs. We expect the model to be built and tested by the successful proponent. After the model is built, we anticipate entering into a contract with a local consultant to build locally relevant input files and run scenarios based on issues of concern. This is not part of the current scope of work. However, the model must be built for easy transfer to a local consultant that has model-running expertise.

The ASG has drafted a conceptual model that includes a “wish-list” of main processes that eventually must be included in our models. We intend to tackle each process in a staged approach. We have identified three interrelated critical processes that can be addressed at this time:

1. Gas (methane, sulphide, ammonia, etc.) production and release from tailings may impact lake mixing and oxygen demand (see item 3 below).

2. Mature fine tailings consolidation rate. Lake deepening due to mature fine tailings consolidation is potentially a very important process. It impacts lake depth (and thus lake mixing, etc.) and tailings pore water release into the overlying water column.
3. Inclusion of a lake-bottom oxygen consumption module, which is a function of chemical and biological oxygen demand at the sediment/water interface and in the overlying water column. Oxygen is important in determining the NA degradation and concentration in surface waters. NAs are the most toxic component of oil sands mine process-affected water.

We expect the successful proponent to preserve the functionality of our existing Phase II model, as well as add the three functions identified above.

Tasks include:

1. Agreement on physical-biogeochemical model platform to describe spatial and temporal data in pit lake systems. Agreement on modelling approach, construction, inputs, etc.;
2. Model construction. Import existing Phase II model functionality and build new functions;
3. Rigorous model testing by proponent; and
4. Recommendation on work plan for future work and to compare model results with detailed field observations.

Project Deliverables
Model and Report

Project Timelines
March 2012

Project Status
Ongoing. Draft model produced. A peer review has been completed by four technical reviewers. Revisions are being addressed and a final draft report is being produced for task group review.

Highlights/ Milestones/ Key Findings
To be described when the final report is submitted.
Investigation of the Biochemical Evolution of Mature Fine Tailings Associated with End Pit Lakes in the Alberta Oil Sands

RWG Project Number
R-1111

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining predictive models for the assessment of end pit lake and wetland development scenarios.

CEMA Contract Number
2010-0013

Principal Investigators/Consultant
Dr. Chris Weisener, University of Windsor

Contract Budget
$78,750 (2010), $74,375 (2011)

Project Description
Processing oil sands for the extraction of bitumen produces large volumes of mine waste products (e.g., water, silt/clays, residual bitumen, metals, and residual solvents). The current waste practice is gravity settling and subsequent storage in large basins. The denser settled product (mature fine tailings) is then transferred into pits. At the facility in the Fort McMurray region, an ongoing sustainable strategy is creating a containment region by combining the mined-out pits, (e.g. West In Pit) into a series of end pit lakes. The current storage practice can affect the surrounding environment via several different mechanisms. For example, a number of processes can occur within bulk mature fine tailings that will affect both the volume and quality of the water cap in the final base mine lakes. These include both biological and chemical alterations of dissolved constituent levels driven by reduction-oxidation (REDOX) mediated reactions and general consolidation of the tailings layer over time.

The proposed research program will investigate the biogeochemistry and development of REDOX gradients of mature fine tailings at Syncrude and Suncor oil sand lease operations in Fort McMurray, Alberta. This information will be used to facilitate and support sediment oxygen demand environmental models currently being developed for end pit lake design and implementation. The research program will involve scientists from Syncrude Canada, Suncor Energy, and CEMA providing funding for one postdoctoral fellow, two PhD, one MSc, and three undergraduate students. All HQP in this program will gain multidisciplinary experience encompassing aspects of oil sands mining and processing, EPL remediation, geochemistry, electrochemistry, and molecular microbial identification (using novel T-RFLP analysis and qPCR) to investigate the long-term behaviour of freshly processed and stored mature fine tailings in EPL reclamation.

Project Deliverables
Three post-graduate theses.

Project Timelines
September 2010 to December 2013

Project Status
Ongoing. One Masters student has been working on tailings from Syncrude. C. Weisener has been successful at obtaining federal (NSERC) funding. Two post-doctoral fellows have been recently hired.

Highlights/Milestones/Key Findings
To be described when the thesis is submitted.
User Needs Assessment for the Oil Sands Wetlands Guidance Document

RWG Project Number
R-1112

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
2011-0040

Principal Investigators/Consultant
West Hawk Associates

Contract Budget
$24,600

Project Description
In 2007, the ASG produced a Guideline for Wetland Establishment on Redeemed Oil Sands Leases (the Wetlands Manual, AEW 2008) to guide the planning processes for design, construction, monitoring, management, and certification of wetlands reclaimed on surface-mined oil sands leases. The Wetlands Manual is meant to be flexible, adaptive, and responsive in its content. Since there is active research on oil sands wetlands, the intent is to update it every five years.

The intent of the current project is to conduct a “user needs assessment” for the upcoming 2013 Wetlands Manual. This document will be used as a basis for moving forward with the approach to the document and its preparation. Comments on the previous version of the Wetlands Manual suggest that the next version requires more design guidance and construction direction.

The contractor will undertake the following tasks: conduct client consultation and direction, review the previous wetlands manual, conduct research of associated relevant materials, devise an interviewee list in consultation with the ASG, conduct up to 10 “group” interviews, produce transcripts of interviews, prepare draft user needs assessment, conduct revision and final document, and attend one meeting with the ASG.

Project Deliverables
The contractor will, working from supporting materials and the interviews, draft the needs assessment document. Given that the document will reflect significant background research and the results of up to 10 group interviews, the length is likely to be 20 to 30 pages. The contractor will, subject to consultation with the Technical Program Manager and ASG members, organize the document into:

- Introduction,
- Background,
- Review of 2007 manual and CH2M HILL document,
- Other research,
- Major themes (5-10) that emerged from research/ interviews,
- Conclusion, and
- Appendices.
Project Timelines
April 2012

Project Status
Ongoing. The contractor has met with the ASG, drafted a questionnaire to be used interviews, and scheduled interviews for early 2012.

Highlights/ Milestones/ Key Findings
To be described once the project is completed.
Technical Lead for Wetland Reclamation Technology Transfer

RWG Project Number
R-1112

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
2009-0034

Principal Investigators/Consultant
Marsha Trites

Contract Budget
$63,847 (2010), $41,748 (2011)

Project Description
Since its inception in 2001, CEMA has worked towards “defining the process and standards needed to return developed land (in the oil sands region) to sustainable ecosystems with desired end land use values.” With respect to returning wetlands, a significant body of research has been developed by a number of key principal investigators. Principal investigators have focused on numerous pieces of work covering a number of aspects of pond and marsh reclamation in the region — from geotechnical constraints to hydrology to community level biological function.

The ASG believes that research and knowledge on marshes has reached a critical point that allows useful discussion and synthesis of these pieces into a larger picture for marsh reclamation in the oil sands region. To this end, ASG has initiated a technology transfer project (TT) for marsh reclamation in the oil sands region, with a Technology Transfer Task Group (TTTG) to lead and manage the wetlands TT project.

The main objective of this TT is to transfer knowledge and research on wetland processes and functions into practical applications and techniques that can be used in wetland reclamation practices by industry operators in the oil sands region. As knowledge-holders, the principal investigators’ active participation is critical. This project provides a rare opportunity for the principal investigators to collectively share scientific results, bounce ideas and concepts off other principal investigators, and push the boundaries of current knowledge to develop practical application. The TTTG considers that such a multidisciplinary process will synergistically elevate practitioners’ knowledge beyond their sole capability and develop a base from which wetland research within the oil sands can be used as a stepping-stone to accelerate research. Participants will develop a globally and practically oriented approach that will benefit them in other projects, such as future marsh research and fen reclamation. Perhaps most importantly, the information generated from this project will be used in the reclamation, management, and regulation of all wetland types in the oil sands region.

Based on past experience with TT within the oil sands, the TTTG proposes an approach that focuses both effort and message. Through a scoping exercise, the TTTG has developed four questions to be addressed by the principal investigators in technical sessions that cover issues and are intended to encompass the current knowledge in regard to marsh reclamation in the oil sands region. These questions are not exclusive, but rather represent categories to help focus the work. We expect that
elements not explicitly stated below will be indirectly addressed at the technical sessions and workshops. It is important to note that all questions concern marsh ecosystems, as this wetland type has been studied the most. The four questions are:

1. What is the threshold concentration of naphthenic acids to allow for “natural” marsh function?
2. How to manage salinity within the context of wetland biological function?
3. Do oil sands operators need to add capping materials to establish viable marshes?
4. What are the 10 parameters that should be measured to demonstrate “equivalent wetland capability” as a process to compare natural and reclaimed marshes?

The TT process will consist of three critical steps:

1. Information-gathering and development of key messages for relevant research through fact sheets.
2. Discussion and debate to generate outcomes for the questions described above through technical sessions.
3. Consensus on outcomes through workshops.

The TT process in regards to questions 1 and 2 will be completed first because the resulting outcomes presented in a preliminary report will serve as a basis for debating questions 3 and 4. In the end, a final report will be prepared by the TTTG and reviewed by principal investigators prior to being submitted to the ASG.

**Project Deliverables**
A final report to be incorporated in the Guidelines for Wetland Establishment on Reclaimed Oil Sands Leases.

**Project Timelines**
2012

**Project Status**
Ongoing. An interim report is being produced for January 2012. The ASG will then discuss next steps for completion.

**Highlights/ Milestones/ Key Findings**
To be described when the final report is submitted.

**References Cited**
Development of a Regional Monitoring Program to Assess the Effects of Oil Sands Development on Wetland Communities

RWG Project Number
R-1112

Project Linkage to Terms of Reference
Supports the ASG objective of developing and maintaining a guidance document for wetland and aquatics establishment.

CEMA Contract Number
2010-0029

Principal Investigators/Consultant
Jan Ciborowski, University of Windsor

Contract Budget

Project Description
The ASG is tasked with updating the Guideline for Wetland Establishment on Reclaimed Oil Sands Lease (the Wetlands Manual). The Wetlands Manual describes an integrated approach to the planning, design, construction, monitoring, and adaptive management of reclaimed wetlands and provides a good summary of knowledge and decision-making support tools to achieve wetland reclamation in general. The Wetlands Manual also informs the reader that “a fundamental component of the EPEA is the reclamation objective of returning disturbed landscapes to ‘equivalent land capability’,” which is described as reclaimed soils and landforms capable of supporting a self-sustaining, locally common boreal forest, regardless of the end land use. This presupposes an understanding of natural aquatic ecosystems as key to the evaluation of reclaimed sites.

Recent approvals reflect these concepts by requiring companies to develop a wetland monitoring program that shall include:

- A plan to monitor natural wetlands for natural variability;
- A plan to determine and monitor the potential effect of dewatering and mine development on wetland communities; and
- Corrective measures, where appropriate, to protect affected wetland communities.

The ASG has agreed to develop a plan for a Regional Wetland Monitoring Program to address the needs such as described in the EPEA approval clauses and the Wetlands Manual. The goal of the Program is to:

Monitor wetlands to assess the effects associated with oil sands development on wetland communities.

The Program will ensure that wetland monitoring in the oil sands region shares a minimum set of common objectives, study design, indicators, and sampling and reporting protocols so that results can be effectively applied towards regional outcomes.

The main objective of this project is to develop a Regional Wetland Monitoring Program that can address, at a minimum, the EPEA approval clauses but can be flexible enough to address other
outcomes related to oil sands development (e.g., support the assessment of reclamation success). The program would be based on defined regional objectives and outcomes, and it would be delivered in a collaborative manner (e.g., oil sands companies, Government of Alberta, possibly researchers).

Project Deliverables
- Define/confirm the purpose (goals and objectives) of the monitoring program, to ensure that requirements and expectations drive the design;
- Design the framework for a regional wetland monitoring program that would satisfy this purpose; and
- Identify suitable indicators that would be diagnostic of impending degradation far enough in advance of its expression that corrective actions can be taken before the community becomes significantly altered.

Project Timelines
December 2008 to March 2012

Project Status

Highlights/Milestones/Key Findings
- Submitted workshop, entitled “Identifying Monitoring Goals and Environmental Stressors for Wetland Communities in the Alberta Oil Sands Area,” was convened in November 2010 and was attended by members of the ASG.
- A workshop, entitled “Identifying Stressor and Response Variables Resulting from Mine Development,” was convened in January 2011 and was attended by 20 scientists with expertise in wetland hydrogeology, ecology, and ecotoxicology, as well as members of the ASG. The goal was to obtain expert opinion and best professional judgment to identify the links between the drivers of disturbance identified in the November 2010 workshop and response of wetland organisms.
- An extensive Geographic Information System (GIS) sampling and compilation initiative was undertaken to identify the various land areas within which to designate wetland sampling effort.
- A draft report was delivered in December 2011.

References Cited
Reclamation Working Group (RWG) Terms of Reference

Updated by RWG: February 24, 2010
Approved by CEMA Board: March 25, 2010

I. Purpose

The RWG will produce and maintain guidance documents that provide recommendations and best practices which ensure that reclaimed landscapes within the Athabasca Oil Sands Region meet regulatory requirements, satisfy the needs and values of stakeholders, and are environmentally sustainable. The RWG will provide these guidance documents to the CEMA Board as recommendations to government.

II. Objectives

Provide guidance for reclamation on oil sands leases in the Regional Municipality of Wood Buffalo on the following:

- Appropriate design, construction, integration, reclamation and maintenance of landforms and landscapes;
- Reclamation certification;
- Leading practices for conservation and reclamation;
- Re-establishing biodiversity of the reclaimed landscape;
- Riparian ecosystem establishment;
- Land capabilities for forest ecosystems on natural and reclaimed lands;
- Forest vegetation (ecosystems) establishment;
- Wetland & aquatics establishment;
- End pit lake establishment; and
- Other reclamation guidance as agreed upon by RWG and the CEMA Board.

III. Context

RWG focuses on providing guidance to operators and stakeholders to address environmental impacts (reclamation). The Regional Sustainable Development Strategy (RSDS) identified 72 major issues of concern in 14 theme areas. RWG’s scope of work comes from the RSDS Theme 1 (sustainable ecosystems and land-use) which was split into two separate objectives, one of which is being addressed by RWG: “To define the process and standards needed to return developed land to sustainable ecosystems with desired end land use values.” RWG’s work applies to surface mineable oil sands and other surface disturbances including In Situ.
IV. Operating Guidelines

The RWG will operate in a manner that is consistent with the principles, rules, policies, and procedures adopted by CEMA. The RWG will follow the CEMA’s policies and guidelines.

The RWG will:

- Oversee, coordinate, and integrate the work of technical sub-groups and task groups that focus on the development of guidelines for specific aspects of reclamation and closure;
- Develop greater understanding of all resource development operations and reclamation technologies and government regulations and policy;
- Promote a proactive and progressive integration of closure and reclamation planning across all industrial developments and within the regional context;
- Make recommendations to CEMA on regional reclamation planning and management, regulation and policy;
- Consider additional reclamation research to address knowledge gaps for guidelines. This may result in the formation of sub-groups or task groups and recommending research related to reclamation; and
- Conduct other activities agreed to by the group and CEMA Members.

The RWG will consider the need to formally interface with other CEMA working groups and other related groups. These may include, but is not limited to:

- the Canadian Oil Sands Network for Research and Development (CONRAD);
- the CEMA Traditional Environmental Knowledge (TEK) Advisory Committee;
- the Oil Sands Developer’s Group (OSDG)
- the Sustainable Ecosystem Working Group (SEWG);
- the Wood Buffalo Environmental Association (WBEA);
- the CEMA Surface Water Working Group (SWWG)
- the NOx SO2 Management Working Group (NSMWG);
- the Regional Aquatics Monitoring Program (RAMP);
- the Oilsands Research and Information Network (OSRIN); and
- the Alberta Biodiversity Monitoring Institute (ABMI).

Chairpersons are nominated by the membership and are selected by consensus by the RWG and a vote will occur should the group fail to reach consensus. The term for a chairperson is two years. The RWG will strive to have two chairpersons at a time, with overlapping terms to ensure effective transition. The RWG will also strive to have one chairperson from industry and one chairperson from Government/First Nations/NGO at any given time.
V. Report to CEMA Board

Key deliverables for RWG recommendations to be submitted to the CEMA Board are listed in Table 1. The RWG will provide a progress report at each CEMA General Meeting. This Terms of Reference will be reviewed and updated every two years. This will allow for a review and confirmation of the RWG purpose and objectives by CEMA Members.

Table 1: Key RWG Deliverables and Timelines

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Completion Timeline</th>
<th>Group/Sub-Group Responsible</th>
</tr>
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<tbody>
<tr>
<td>Guideline for the Establishment of Wetlands on Reclaimed Oil Sands Leases</td>
<td>Reviewed every five years and updated as necessary. Next revision expected Q4 2012. Versions include 1999 and 2007.</td>
<td>Aquatics Sub-Group (ASG)</td>
</tr>
<tr>
<td>End Pit Lake Technical Guidance Document (for oil sands mining)</td>
<td>Reviewed every five years and updated as necessary. Next revision expected Q4 2012.</td>
<td>Aquatics Sub-Group (ASG)</td>
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<tr>
<td>Guideline for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region</td>
<td>Reviewed every five years and updated as necessary. Next revision expected Q4 2014. Versions include 1998 and 2009.</td>
<td>Terrestrial Sub-Group (TSG)</td>
</tr>
<tr>
<td>Land Capability Classification System for Forest Ecosystems in the Oil Sands</td>
<td>Reviewed every five years and updated as necessary. Next revision expected Q4 2013.</td>
<td>Terrestrial Sub-Group (TSG)</td>
</tr>
<tr>
<td>Management Practices for Soil Salvage and Placement</td>
<td>Reviewed every five years and updated as necessary. First version expected in 2010.</td>
<td>Terrestrial Sub-Group (TSG)</td>
</tr>
</tbody>
</table>

VI. Membership

Any member of CEMA is eligible to join the RWG. The RWG will seek to maintain broad stakeholder representation. Details of membership responsibilities and chair rotation can be found in CEMA’s policies and procedures.

An RWG member is expected to:

- Be able to attend and participate on a regular, consistent basis;
- Be fully informed and up to date about the subjects to be discussed at meetings;
- Contribute to meetings; and
- Accept and abide by CEMA’s policies and guidelines.
Terrestrial Sub-Group (TSG) Terms of Reference

Updated by TSG: March 16, 2010
Approved by RWG: March 22, 2010

I. Purpose

The TSG is a sub-group of the Reclamation Working Group (RWG). The TSG will provide guidance and produce tools that facilitate the establishment of sustainable terrestrial ecosystems on the reclaimed landscape within the Athabasca Oil Sands Region.

II. Objectives

To develop recommendations that support establishment, assessment, monitoring, criteria & indicators for certification, and adaptive management of reclaimed terrestrial ecosystems on oil sands leases in the Regional Municipality of Wood Buffalo.

This will be accomplished through the development and maintenance of the following guidance documents and decision support tools:

- A guidance document and tool that facilitates the evaluation of land capabilities for forest ecosystems on natural and reclaimed lands;
- A guidance document for forest vegetation (ecosystems) establishment;
- A guidance document for management practices for soil salvage and placement; and
- Other reclamation guidance documents and tools as agreed upon by the RWG.

These guidance documents will support the creation of a range of sustainable terrestrial ecosystems in reclaimed landscapes. The TSG will provide these guidance documents and tools as recommendations to the RWG.

III. Operating Guidelines

The TSG will operate in a manner that is consistent with the principles, rules, policies, and procedures adopted by CEMA. The TSG will follow CEMA’s policies and guidelines.

The TSG will:

- Oversee, coordinate, and integrate the work of task groups that focus on the development of guidance documents for specific aspects of reclamation and closure as they relate to terrestrial ecosystems;
- Develop a greater understanding of all resource development operations, reclamation technologies and government regulations and policy as they relate to terrestrial ecosystems;
Contribute to proactive and progressive integration of closure and reclamation planning across all industrial developments and within the regional context;

Make recommendations to RWG on regional reclamation planning and management, regulation and policy (including reclamation certification) as they relate to terrestrial ecosystems;

Identify additional reclamation research to address knowledge gaps for guidance documents as they relate to terrestrial ecosystems, and facilitate participation by members in this research. This may result in the formation of task groups and recommending research related to reclamation;

Facilitate/ conduct the technology synthesis and transfer of research relating to guidance manuals developed by the TSG;

Develop monitoring protocols (and implement where appropriate), analytical techniques, assessment models, and remedial measures related to the TSG guidance documents; and

Conduct other activities as agreed to by the TSG and RWG members.

The TSG will consider the need to formally interface with other CEMA working groups and, through RWG, other related groups.

Chairpersons are nominated by the membership and are selected by consensus by the TSG. The term for a chairperson is two years. The TSG will strive to have two chairpersons at a time, with overlapping terms to ensure effective transition. The TSG will also strive to have one chairperson from industry and one chairperson from Government/ First Nations/ NGO at any given time.

IV. Report to RWG

Key TSG deliverables to be submitted to the RWG are listed in Table 1. The TSG will be prepared to provide a progress report at each RWG meeting. This Terms of Reference will be reviewed and updated every two years. This will allow for a review and confirmation of the TSG purpose and objectives by RWG Members.

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v. Membership

Any member of CEMA is eligible to join the TSG. The TSG will seek to maintain broad stakeholder representation. Details of membership responsibilities and chair rotation can be found in CEMA’s policies and procedures.

A TSG member is expected to:

- Be able to attend and participate on a regular, consistent basis;
- Be fully informed and up to date about the subjects to be discussed at meetings;
- Contribute to meetings; and
- Accept and abide by CEMA’s policies and guidelines.

vi. Historical Background of the Terrestrial Sub-Group

The Soils Working Group was assembled in 1995 and consisted of representatives from industry, government and research providers. The group was tasked to address the issue of reconstructed landscape and soil properties important in returning land capability, and as a result of their efforts the manual “Land Capability Classification System for Forest Ecosystems in the Oil Sands Region” (LCCS) was published in 1996. Following its publication, the manual was adopted as the template for soil handling and assessment in the region. It was utilized extensively in the classification of pre-disturbance and post-disturbance soils/landscapes throughout the region, a Master of Science thesis addressing one of the primary areas of concern was completed (Moskal 1998), and a revised version of the manual issued in 1998.

While the LCCS was being field tested, a second multi-party working group was convened to provide recommendations on the establishment of terrestrial ecosystems to support productive forest and wildlife habitat on reclaimed Oil Sands disturbances. This working group came to be referred to as the Vegetation Working Group. The manual, “Guidelines for Reclamation of Terrestrial Vegetation in the Athabasca Oil Sands Region”, was completed by this working group in 1998.

Both groups fulfilled their original mandates of providing guidelines/manuals for industry and government to utilize while engaging in the ongoing reclamation activities occurring in the North East Boreal Region. Both groups also recognized that their manuals were “living documents” that required further evaluation in the field through structured monitoring programs and focused research targeting “soft spots” in the assumptions. Because of the close link between soil placement and ecosite phase establishment, these monitoring and research programs were logically linked. In the fall of 1999, the Soil and Vegetation Working groups reconvened at a joint meeting to discuss the program required to “calibrate” the manuals. A long term monitoring and calibration program was reviewed and approved by the joint working group, with the pilot phase of the program being implemented in 2000.

Several issues around long-term needs/demands on information from these plots as well as requirements for this information from a variety of other user groups prompted the group to reflect on the need to formally merge the two working groups. The merged group would function over the
longer term life of the monitoring program and ensure that the manuals were in fact “living
documents” and responded to changes in knowledge/ needs/ technology with time.

This group integrated into CEMA as the Soils and Vegetation Sub-Group of the Reclamation Working
Group in 2001-2002. In April 2009 RWG underwent an approved reorganization and renamed the
SVSG the Terrestrial Sub-Group (TSG).
Aquatics Sub-Group (ASG) Terms of Reference

Updated by ASG: December 8, 2009
Approved by RWG: March 5, 2010

I. Purpose

The ASG is a sub-group of the RWG. The ASG will provide guidance and produce tools that facilitate the establishment of sustainable aquatic ecosystems on the reclaimed landscape within the Athabasca Oil Sands Region.

II. Objectives

To develop recommendations that support establishment, assessment, monitoring, criteria & indicators for certification and adaptive management of reclaimed aquatics ecosystems on oil sands leases in the Regional Municipality of Wood Buffalo.

This will be accomplished through the development and maintenance of the following guidance documents and decision support tools:

- A guidance document for wetland & aquatics establishment;
- A guidance document for end pit lake establishment;
- Other aquatic reclamation guidance documents and tools as agreed upon by the RWG (e.g., riparian areas and streams); and
- Predictive models for the assessment of end pit lake and wetland development scenarios.

These guidance documents will support the creation of a range of sustainable aquatic ecosystems in reclaimed landscapes. The ASG will provide these guidance documents as recommendations to the RWG.

III. Operating Guidelines

The ASG will operate in a manner that is consistent with the principles, rules, policies, and procedures adopted by CEMA. The ASG will follow CEMA’s policies and guidelines.

The ASG will:

- Oversee, coordinate, and integrate the work of task groups that focus on the development of guidance documents for specific aspects of reclamation and closure as they relate to wetlands, aquatics and end pit lakes;
- Develop a greater understanding of all resource development operations, reclamation technologies and government regulations and policy as they relate to wetlands, aquatics and end pit lakes;
- Contribute to proactive and progressive integration of closure and reclamation planning across all industrial developments and within the regional context;
• Make recommendations to RWG on regional reclamation planning and management, regulation and policy as they relate to wetlands, aquatics and end pit lakes;

• Identify additional reclamation research to address knowledge gaps for guidance documents as they relate to wetlands, aquatics and end pit lakes. This may result in the formation of task groups and recommending research related to reclamation; and

• Conduct other activities as agreed to by the ASG and RWG members.

The ASG will consider the need to formally interface with other CEMA working groups and, through RWG, other related groups.

Chairpersons are nominated by the membership and are selected by consensus by the ASG. The term for a chairperson is two years. The ASG will strive to have two chairpersons at a time, with overlapping terms to ensure effective transition. The ASG will also strive to have one chairperson from industry and one chairperson from Government/First Nations/Non-Governmental Organizations at any given time.

IV. Report to RWG

Key ASG deliverables to be submitted to the RWG are listed in Table 1. The ASG will be prepared to provide a progress report at each RWG meeting. This Terms of Reference will be reviewed and updated every two years. This will allow for a review and confirmation of the ASG purpose and objectives by RWG Members.

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V. Membership

Any member of CEMA is eligible to join the ASG. The ASG will seek to maintain broad stakeholder representation. Details of membership responsibilities and chair rotation can be found in CEMA’s policies and procedures.

An ASG member is expected to:

• Be able to attend and participate on a regular, consistent basis;

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<tr>
<th>GROUP</th>
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<th>PROJECT TITLE</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Comments</th>
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<td>RECLAMATION WORKING GROUP (RWG)</td>
<td>R-1101</td>
<td>Biodiversity Guidelines</td>
<td>$135,490</td>
<td>$225,000</td>
<td>$475,000</td>
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<td></td>
<td>R-1102</td>
<td>Closure Coordination Guidelines</td>
<td>$14,470</td>
<td>$70,000</td>
<td>$220,000</td>
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<td>OVERVIEW</td>
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## RECLAMATION WORKING GROUP (RWG) - 2011-2015 WORKPLAN

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<tr>
<td>R-1101</td>
<td>Biodiversity Guidelines Section</td>
<td>Develop a set of reclamation guidelines that include methods and specific enhancement techniques, including TEK, to apply to existing reclamation practices in the oil sands region for the creation of biodiversity.</td>
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<td>Biodiversity Report</td>
<td>Undertake an analysis of biodiversity indicators as defined in the Re-Vegetation Manual, TSG long term plot network protocols and Biodiversity Technical Review by ARC (produced in 2009) in the context of the Criteria and Indicators Framework. This analysis will evaluate the biodiversity indicators to determine how the indicators align with the C&amp;I framework and evaluate spatial and temporal scales that need to be considered for defining biodiversity indicators.</td>
<td>-</td>
<td>$25,000</td>
<td>$75,000</td>
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<td>This report will integrate current monitoring protocols with the proposed indicators in the Revegetation Manual and the Biodiversity Technical Review with the C&amp;I Framework to conduct a preliminary assessment of which indicators may be most appropriate to assess biodiversity in the context of the C&amp;I Framework.</td>
<td></td>
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<tr>
<td>Biodiversity Workshop / Tech Transfer</td>
<td>Work shop/ Tech transfer on biodiversity: define the reclamation trajectory for reclamation units delineated by the reclamation classification system as much as possible define the trajectory in the context of the hierarchical framework of biodiversity.</td>
<td>-</td>
<td>-</td>
<td>$100,000</td>
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<td>Propose that the knowledge synthesis use the basis of the knowledge synthesis to be conducted by the Reclamation Classification System Task Group to assess the current state of knowledge available to define the reclamation trajectory for reclamation units defined by the classification system. Once the trajectory is identified, the indicators reviewed in the above line item could be overlain on the trajectory to determine opportunities to define targets or to identify areas requiring further research.</td>
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<tr>
<td>Phase 2: Develop a Framework for Implementing the Reference Condition Approach in the Oil Sands Region</td>
<td>To conduct a broad based overview of the reference condition approach and propose a framework for selecting reference sites in the oil sands region. The product of this project will provide technical groups in RWG with a starting point for selecting reference sites. The goal is to provide a definition for how the reference condition approach would fit into the objectives of evaluating reclamation success and quantifying regional environmental effects of development. Would include a workshop.</td>
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<td>The Biodiversity Technical Report recommended adopting the reference condition approach as the framework for conducting biodiversity monitoring in the oil sands region. The report will evaluate the criteria to consider for selection of reference conditions and how spatial and temporal scales affect the selection criteria.</td>
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<td>2010-0025</td>
<td>University of Windsor (Jan Ciborowski)</td>
<td>Synthesis Applying the Reference Condition Approach for Monitoring Reclamation Areas in the Athabasca Oil Sands Region</td>
<td>To conduct a synthesis and compile seven fact sheets on the use of the reference condition approach to assess the re-establishment of functional ecosystems on reclaimed landscapes in the oil sands region.</td>
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<td>SINES Consultants</td>
<td>Biodiversity Traditional Knowledge Study: Phase II Regional Workshop</td>
<td>Expand awareness of the Biodiversity TK Study among different aboriginal organizations in the oil sands region, and share perspectives about key learnings from the Biodiversity TK Study. Review study recommendations, with a focus on the Two Roads approach. Develop understanding and consensus with RWG and TK research specialists about the nature of the Two Roads approach and how it can be applied in biodiversity reclamation. Build community researcher capacity with a view to supporting implementation of the Two Roads approach with respect to approved Biodiversity TK Study recommendations.</td>
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<td>R1101</td>
<td>TEK Reclamation Projects</td>
<td>For associated RWG TEK projects. The TK Biodiversity Study provided a 3-year implementation plan for the recommendations in the report. RWG will include appropriate TK Biodiversity recommendations into its Guidelines. To respond to CEMA Board decisions on recommendations in TK Biodiversity Report.</td>
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<td>Define Integrated Boundary in the Closure Coordination context &amp; Closure System Mapping</td>
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<td>Define Closure Landscape Criteria</td>
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<td>Contingent on RWG direction with respect to development of Criteria and Indicators. TOTAL: $180,000.</td>
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<td>Define Closure System Gaps and Develop Enhanced Closure System Map</td>
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<td>Module 1: Setting the Stage: Understanding of Current Initiatives</td>
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<td>Framework for Reclamation Certification Criteria and Indicators for Mineable Oil Sands</td>
<td>Module 2: Setting High Level Direction</td>
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<td>Module 4: Finalize Rules for C&amp;I Use</td>
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<td>Apex Resource Management Solutions</td>
<td>State and Transition Models Potential Role in Development of Reclamation Classification System</td>
<td>Present a mock-up case study, prepared by the developer of Path Landscape Model (ST Model software package see <a href="http://www.apexrms.com/path">http://www.apexrms.com/path</a>) to demonstrate how ST Models could be used to support the development of the reclamation classification system</td>
<td>$18,314</td>
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<td>Final Version of the LCCS Manual in Q3 2012. Added funds for the actual preparation of the manual in 2012. To be coordinated with Terrestrial Sub-Group. TOTAL: $18,314.</td>
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<td>Summit Environmental Consultants</td>
<td>Literature Review – Land Classification Systems for Disturbed Lands</td>
<td>1. Conduct a global literature review of land classification systems used for disturbed land (terrestrial to and including wetlands). 2. Compile a database of citations, abstracts, attributes of the classification system. 3. Summarize and synthesize the literature review into categories (to be defined in consultation with RCSTG). 4. Provide recommendations regarding the reviewed classification systems and how they may be informative to building the Reclamation Classification System</td>
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<td>Final Version of the LCCS Manual in Q3 2012. Added funds for the actual preparation of the manual in 2012. To be coordinated with Terrestrial Sub-Group.</td>
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<td>Riparian Classification &amp; Reclamation Guide (Research &amp; Revision)</td>
<td>Technical Review of Shell/Suncor Riparian Classification and Reclamation Guide</td>
<td>Develop an Assessment Matrix, with Evaluation Criteria and Criteria Weights, against which the RCRG will be evaluated. Undertake a Technical Review of the RCRG. Evaluate the RCRG using the Assessment Matrix. Identify Gaps in the RCRG, focusing on heavily weighted Evaluation Criteria which are not adequately addressed. Make recommendations for RCRG revisions, and for further research to address identified shortcomings. Facilitate Third Party Reviews (up to three) of The Forestry Corp.’s Technical Review.</td>
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<td>Incremental Forest Technologies</td>
<td>Revision and Completion of Shell/Suncor Riparian Classification and Reclamation Guide</td>
<td>Address eight areas of potential improvement identified in the review process and two additional areas arising from CEMA’s decision to reposition this project from guideline to report status.</td>
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<td>Annual symposium with presentations on RWG completed projects.</td>
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<td>Vid Bijelic</td>
<td>Data Management Services</td>
<td>Enhance and Update the CEMA Literature Review RWG Database DMS Library User Integration with LTPN query system Improvement to CEMA Website Maintenance/Support</td>
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<td>Jessica Coles</td>
<td>RWG Annual Reports</td>
<td>An annual summary of progress made on workplan, synthesis of results from projects, status of TBK incorporation, go-forward plans etc.</td>
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<td>Jessica Coles</td>
<td>RWG Annual Reports</td>
<td>An annual summary of progress made on workplan, synthesis of results from projects, status of TBK incorporation, go-forward plans etc.</td>
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<td>Donald Functional &amp; Applied Ecology Inc.</td>
<td>Technical Program Manager</td>
<td>To assist the RWG / Subgroup Co-Chairs with overseeing, implementing, and managing work plans; To provide technical guidance in the development of draft annual summary reports and 5-year strategic plans; To provide a high level of technical support to the administration and coordination of the projects undertaken within the work plan; To critically review technical documents; To assist in contracting consultant services; To assist consultants with any logistical or technical needs; To maintain/increase group capacity and effectively and efficiently</td>
<td>$150,000</td>
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<td>Tailwind Environmental Solutions Inc.</td>
<td>Technical Program Manager</td>
<td>To assist the RWG / Subgroup Co-Chairs with overseeing, implementing, and managing work plans; To provide technical guidance in the development of draft annual summary reports and 5-year strategic plans; To provide a high level of technical support to the administration and coordination of the projects undertaken within the work plan; To critically review technical documents; To assist in contracting consultant services; To assist consultants with any logistical or technical needs; To maintain/increase group capacity and effectively and efficiently</td>
<td>$133,751</td>
<td>$160,000</td>
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<td>R-1107</td>
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<td></td>
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<td>$283,751</td>
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**Wildlife Habitat Guidelines**

<table>
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<tr>
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<th>Contractor</th>
<th>Task</th>
<th>Task Description</th>
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<th>2012</th>
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<td>2010-0034</td>
<td>LGL Limited Environmental Research Associates</td>
<td>Phase 1: Synthesis of Habitat Models Used in the Oil Sands Region</td>
<td>To review and summarize habitat models used in oil sands region EIA submissions and regional wildlife habitat mapping; To review and summarize how habitat model data and habitat models are used to develop oil sands closure plans; To summarize the validation method and status of existing validated models; To recommend a list of models to be validated, provide recommendations for selecting candidate models and describe potential validation procedures of non-validated models.</td>
<td>$54,945</td>
<td>-</td>
<td>-</td>
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<td>2011-0034</td>
<td>LGL Limited Environmental Research Associates</td>
<td>Phase 2: Validation Procedures for Habitat Models in the Oil Sands</td>
<td>Review and summarize habitat models used in Environmental Impact Assessments for oil sands projects applications; Describe how habitat models are validated.</td>
<td>$43,685</td>
<td>$71,968</td>
<td>-</td>
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<td></td>
<td>Wildlife Monitoring on reclaimed landscapes to validate reclamation habitat enhancements, correlation to ecoregion mapping, HSI Modelling</td>
<td>This includes development of a monitoring program to validate assumptions in the 2nd ed. of the Revegetation Manual - Wildlife Appendix and the Biodiversity appendix. The intent is to undertake an assessment of information detailed in the 2nd ed. of the Revegetation Manual as it pertains to wildlife. This might include developing wildlife indicator targets. Could include wildlife monitoring on juvenile stands.</td>
<td>-</td>
<td>$34,329</td>
<td>$7,792</td>
<td>-</td>
<td>$310,380</td>
<td>This project would involve implementing monitoring programs derived through the Biodiversity Workshop / Tech Transfer specifically funding the wildlife indicator components. An estimate for implementing the early successional wildlife monitoring program design developed under contract 2009-0051 suggests a 3-year implementation &amp; testing process based on a spatial and spatiotemporal analysis of the LTPN.</td>
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<tr>
<td>Contract number</td>
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<td>Task</td>
<td>Task Description</td>
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<td>2010-0023</td>
<td>LGL Limited Environmental Research Associates</td>
<td>Early Successional Wildlife Monitoring Program on Reclaimed Plots in the Oil Sands Region</td>
<td>To assess the return and re-establishment of early successional wildlife species on reclaimed terrestrial systems. To evaluate the feasibility of the recommended protocols for monitoring on reclaimed terrestrial systems. To develop recommendations for the wildlife appendix of the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (AWB 2010) for early successional wildlife monitoring based on the monitoring program results. To collect monitoring data to assist in the development of wildlife indicators for the Criteria and Indicators Framework.</td>
<td>$181,283</td>
<td>$285,671</td>
<td>$192,208</td>
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<tr>
<td>2010-0034</td>
<td>LGL Limited Environmental Research Associates</td>
<td>Phase 1: Synthesis of Habitat Models Used in the Oil Sands Region</td>
<td>To review and summarize habitat models used in oil sands region EIA submissions and regional wildlife habitat mapping. To review and summarize how habitat model data and habitat models are used to develop oil sands closure plans. To summarize the validation method and status of existing validated models. To recommend a list of models to be validated, provide recommendations for selecting candidate models and describe potential validation procedures of non-validated models.</td>
<td>$54,945</td>
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<td>R1108</td>
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<td>TOTAL</td>
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# Cumulative Environmental Management Association | January 2012

## Reclamation Working Group 2011 Annual Report

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<td></td>
<td></td>
<td><strong>Projects for Future Consideration/Potential CONRAD Projects</strong></td>
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<td><strong>Closure Planning GIS work</strong></td>
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<td>100k returned on 05.10.10</td>
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<td><strong>Closure Planning Tools Development</strong></td>
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<td>-</td>
<td>-</td>
<td>100k returned on 05.10.10</td>
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<tr>
<td></td>
<td></td>
<td><strong>Evaluation of Early Successional Wildlife Program And Analysis of Results</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Added at WTG meeting on 08.09.10</td>
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<td></td>
<td></td>
<td><strong>Reclamation to meet the end land use objective of re-establishing wildlife habitat on reclaimed landscapes for priority species with large territories or species that use multiple habitat types will require coordination of wildlife management efforts.</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Added at WTG meeting on 08.09.10; liaise with the CCTG as necessary; look to budget work for 2012.</td>
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<tr>
<td></td>
<td></td>
<td><strong>Assessment of Reclamation Classification System as it relates to supporting wildlife monitoring programs and habitat construction.</strong></td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>Added at WTG meeting on 08.09.10; and coordination with RCSTG will be ongoing.</td>
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<td>RWG</td>
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<td><strong>TOTAL</strong></td>
<td>$965,716</td>
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<td>50</td>
<td>Terrestrial - End Land-Use</td>
<td>Landscape design to create landforms of mine structures that have a natural appearance is possible only if it is planned into the development from project inception (i.e., part of the approval process).</td>
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<tr>
<td>51</td>
<td>Terrestrial - End Land-Use</td>
<td>Re-establishing a diverse ecosystem including a diversity of landforms, indigenous vegetation, near-natural water patterns and wetlands in the reclaimed landscape.</td>
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<tr>
<td>52</td>
<td>Terrestrial - End Land-Use</td>
<td>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 planning. 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.</td>
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<tr>
<td>56</td>
<td>Human Health - Traditional Use Values and Mitigation</td>
<td>Impact of development on medicinal plants. Are the plants going to be available within a reasonable distance during development; are the plants, etc., going to be available on the reclaimed landscape; and in both cases, are they going to be safe to consume?</td>
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<tr>
<td>58</td>
<td>Terrestrial - Biodiversity Assessment</td>
<td>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.</td>
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<tr>
<td>60</td>
<td>Terrestrial - Diversity of Soil Types to Promote Potential for Vegetation Diversity</td>
<td>The re-creation 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 the capability to re-establish and sustain equivalent vegetation and other biological diversity.</td>
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<td>63</td>
<td>Terrestrial - Cumulative Impacts on Wildlife - Habitat Changes</td>
<td>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 the Red, Blue, and Yellow listed species. Changes in habitat availability, connectivity and diversity. Preservation of habitat for threatened animals. Increased mortality risks due to industrial activity and increased traffic flow.</td>
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<tr>
<td>64</td>
<td>Wildlife - Traditional Use Values and Mitigation</td>
<td>Impact of development on wildlife of high traditional value: moose, rabbits, aquatic fur-bearers, grouse, waterfowl and squirrels.</td>
<td></td>
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<tr>
<td>65</td>
<td>Terrestrial - End Land-Use</td>
<td>Uncertainty about the type of wildlife that the reclaimed land will sustain, and whether the wildlife (moose, rabbits, aquatic fur-bearers, grouse, waterfowl and squirrels) that will be sustained is congruent with traditional needs.</td>
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<tr>
<td>69</td>
<td>Terrestrial - End Land-Use</td>
<td>Mitigation of cumulative environmental effects through regional development planning and integrated mine plans for oil sands developments.</td>
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<td>2011-0006</td>
<td>Carleton University Dr. Sean Carey</td>
<td>Actual Basapotranspiration</td>
<td>Eddy correlation towers installed to provide measure evapotranspiration at sites, which may lead to revisions to LCCS calculator and manual</td>
<td>$133,000</td>
<td>$134,400</td>
<td>$135,800</td>
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<td>2011-0007</td>
<td>Wilfred Laurier University Dr. Richard Petrone</td>
<td>Actual Basapotranspiration</td>
<td>Eddy correlation towers installed to provide measure evapotranspiration at sites, which may lead to revisions to LCCS calculator and manual</td>
<td>$12,000</td>
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<td>2011-0039</td>
<td>The Forestry Corp</td>
<td>Growth &amp; Yield Model Development</td>
<td>Development of a terms of reference for stem analysis project.</td>
<td>-</td>
<td>$100,000</td>
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<td>2011-0039</td>
<td>Dr. Hans Pretzsch</td>
<td>Forest Productivity Definition</td>
<td>Growth and Yield Model Development</td>
<td>$33,952</td>
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<td>2011-0021</td>
<td>Associated Strategic Consulting Experts Inc. (ASCE)</td>
<td>Estimating Early Stand Mortality – Historical Data Synthesis and Field Sampling Program Design</td>
<td>Review historical reclamation practices and monitoring and research conducted on reclaimed landscapes. Define early stand mortality on reclaimed landscapes. Identify the challenges to quantifying early stand mortality on reclaimed landscapes. Develop a sampling program design to assess early stand mortality.</td>
<td>-</td>
<td>-</td>
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<td>2010-0038</td>
<td>The Forestry Corp</td>
<td>Growth &amp; Yield Model Development</td>
<td>Step 1: Issue Questionnaire Step 2: Development or modification of existing growth &amp; yield models for predicting growth &amp; yield on reclaimed landscapes.</td>
<td>$23,742</td>
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<td>UCR-0211</td>
<td>Various Experts</td>
<td>Growth &amp; Yield Model Development - Questionnaire &amp; Synthesis</td>
<td>Review the growth and yield program strategic recommendations technical document; Develop a questionnaire for the purposes of soliciting growth and yield modelling expertise; Distribute the questionnaire to experts; and Summarize the answers in tabular format to present to FPTG.</td>
<td>$26,526</td>
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<td>UCR-0711</td>
<td>Various Experts</td>
<td>Growth &amp; Yield Model Development - Field Tour and Technical Workshop</td>
<td>Growth and Yield Model Development Field Tour and Technical Workshop. Scheduled for September 27th and 28th in Fort McMurray.</td>
<td>$33,952</td>
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Cumulative Environmental Management Association | January 2012
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<tr>
<td>R-1113</td>
<td>University of Calgary; Dr. Suzanne Visser</td>
<td>Growth &amp; Yield Program Coordinator</td>
<td>-</td>
<td>-</td>
<td>$70,000</td>
<td>$70,000</td>
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<td>Considerable scoping of a G&amp;Y program is required by the PPTS to define what the role of the G&amp;Y program coordinator would be and how the G&amp;Y program would operate in relation to the long-term plot network.</td>
</tr>
<tr>
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<td>University of Calgary; Dr. Suzanne Visser</td>
<td>Web Enabled Database</td>
<td>-</td>
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<td>$150,000</td>
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<td>Funds added in 2012 to facilitate the development of a geospatial functionality in the web enabled data management system.</td>
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<td>2009-0045</td>
<td>University of Calgary; Dr. Suzanne Visser</td>
<td>Petroleum Hydrocarbons (PHCs) in Mineral Soil (Cg) Located Beneath Peat Deposits in the Athabasca Oil Sands Region: Their Potential for Degradation and Effects on Plants and Soil Fauna</td>
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<p>| 2010-0018       | Stantec Consulting | Long Term Soil and Vegetation Monitoring Program – Vegetation Component | Conduct the first re-measurement cycle on five natural plots; Conduct the first re-measurement cycle on five reclaimed plots; Conduct the second re-measurement cycle on four reclaimed plots; Compile the resulting data using a data form to be provided for inclusion in the Soil and Vegetation Long Term Monitoring Database; Compile an annual monitoring report. | $50,115.87 | - | - | - | - CONTRACT CLOSED |
| 2010-0019       | Paragon Soil | Long Term Soil and Vegetation Monitoring Program – soils Component | To resample five natural plots, resample five reclaimed plots, and conduct the second resample cycle on four reclaimed plots; To compile the resulting data using a data form to be provided for inclusion in the Soil and Vegetation Long Term Monitoring Database. | $21,938.21 | - | - | - | - |
| 2010-0027       | TECO Natural Resource Group | Long Term Soil and Vegetation Monitoring – 2010 Permanent Sample Program | Conduct the first re-measurement cycle on five natural plots; Conduct the first re-measurement cycle on five reclaimed plots; Conduct the second re-measurement cycle on four reclaimed plots; Compile the resulting data using a data form to be provided for inclusion in the Soil and Vegetation Long Term Monitoring Database; Compile an annual monitoring report. | - | - | - | - | - CONTRACT CLOSED |
| 2010-0027       | TECO Natural Resource Group | Plot network installation and re-measurement for LCCS and Revegetation Manuals development | Field based measurements and reporting for the long-term soil, vegetation and forestry plots on reclaimed and natural PSPs. Program includes annual measures on reclaimed sites with all PSPS measured every 5 years. The next full plot measures are scheduled for 2012. | - | $500,000 | $500,000 | $500,000 | - Field based measurements and reporting for the long-term soil, vegetation and forestry plots on reclaimed and natural PSPs. Program includes annual measures on reclaimed sites with all PSPS measured every 5 years. The next full plot measures are scheduled for 2012. |</p>
<table>
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<td>2011-0024</td>
<td>LGL Limited Environmental Research Associates</td>
<td>Long-Term Plot Network Assessment                                                   $97,510</td>
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<td>Annual Data Management Services – CEMA Long-Term Soil and Vegetation Plot Network Data</td>
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<td>Annual Data Management Services – CEMA Long-Term Soil and Vegetation Plot Network Data</td>
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<td>Summary Report and Presentation</td>
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<td>2011-0016</td>
<td>Stantec Consulting</td>
<td>Field Protocol for Assessing Characteristic Species Thresholds in Polygon on Reclamation Areas</td>
<td>$147,305.48</td>
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**Database maintenance**
Annual upload and maintenance of LTPN field program data and training for LTPN contractors use of database.

R114 **TOTAL**
$205,214.08 $540,000 $550,000 $550,000 -

**R115**
Revegetation Manual (Calibration Research & Revision)

<table>
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<td>2010-0026</td>
<td>TECO Natural Resource Group</td>
<td>Regeneration Standards for Mineable Oil Sands                                    $7,998.37</td>
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<td>Alternative Regeneration Standards for the Mineable Oil Sands Pilot Sampling Program</td>
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<td>Assessment of Revegetation Manual Indicators</td>
<td>$200,000</td>
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<td>Develop survey protocols for assessing the Revegetation Manual Indicators, i.e., site index and plant composition</td>
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<td></td>
<td></td>
<td>Revegetation Manual - Calibration</td>
<td></td>
<td>$100,000</td>
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<td></td>
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<td>These will be site specific study to address data gaps identified in the 2008 Revegetation Manual and in advance of the 3rd Edition of the manual.</td>
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<tr>
<td>2011-0016</td>
<td>Stantec Consulting</td>
<td>Field Protocol for Assessing Characteristic Species Thresholds in Polygon on Reclamation Areas</td>
<td>$147,305.48</td>
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<td>Develop field protocol for assessing characteristic species thresholds in polygons on reclamation areas. Collect data on reclamation areas to understand species composition and distribution in time and space by site types; and to test application of Table 5.3 to reclaimed vegetation communities. Assess and provide comment on utility of characteristic species thresholds as an indicator of reclamation success;</td>
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<tr>
<td>Contract Number</td>
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<tr>
<td>2011-0029</td>
<td>LGL Limited Environmental Research Associates</td>
<td>Table 5.3 Characteristic Species Thresholds Evaluation and Revision</td>
<td>Review availability of fire origin natural juvenile stand data and identify potential survey locations within the boundaries described in the Assumptions below. Collected data using protocols consistent with current baseline data (i.e., 100 m² plots) on fire origin natural juvenile stands to support evaluation of characteristic species thresholds in Table 5.3.</td>
<td>$32,650</td>
<td>$88,060</td>
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<tr>
<td>UCR-0411</td>
<td>OSNIN</td>
<td>Technical Editor for BMP Document</td>
<td>The objectives of this project are to conduct the following on the Best Management Practices document: 1. Structural editing; 2. Stylistic editing; 3. Copy editing; and 4. Proofreading.</td>
<td>$7,000</td>
<td>-</td>
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<tr>
<td>UCR-0411</td>
<td>OSNIN</td>
<td>Revegetation Manual - Traditional Use Components</td>
<td>Conduct a review and improve the traditional use appendix and traditional use sections of the plant species fact sheets using the 'Two Roads' approach developed by the BWTG Biodiversity Traditional Knowledge Study. Develop a flowchart for traditional use planning.</td>
<td>-</td>
<td>-</td>
<td>$100,000</td>
<td>$100,000</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>Technology Transfer / Knowledge Synthesis</td>
<td>Technical workshops and document production to synthesize learnings from monitoring plots, TSG research and CONRAD work to Revegetation Manual. (What are strategies for Revegetation sites with known challenges?)</td>
<td>-</td>
<td>-</td>
<td>$100,000</td>
<td>$100,000</td>
<td>$150,000</td>
<td>Concept is to undertake a tech transfer process following publication of the Revegetation Manual to ensure research/data gaps are identified. Recommendations for work to address data gaps could be undertaken through TSG or CONRAD depending on the type of information required to progress the manual. Moved funding from 2009 to 2012 to better fit with CONRAD project completion schedule.</td>
</tr>
<tr>
<td>R-1115</td>
<td>TOTAL</td>
<td>Best Management Practices For Soil Salvage &amp; Placement</td>
<td>Development and documentation of BMPs for soil salvage and soil placement</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>$100,000</td>
<td>-</td>
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</table>
### Projects for Future Consideration/Potential CONRAD Projects

<table>
<thead>
<tr>
<th>Task Description</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>Root establishment in reclaimed soils</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Root Project: research to be conducted on different types of soil textures to investigate how roots develop. Multi-phase: phase I - characterization of what exists, phase II - moving into investigating the function.</td>
<td>-</td>
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<tr>
<td>Hydrocarbon Survey - Petroleum Hydrocarbons Soil Survey in the Oil Sands Region</td>
<td>-</td>
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<tr>
<td>Phase 1 was a descriptive survey (2006-0031 - Paragon). Phase 2 was contingent on the Hydrocarbon Task Group recommendations. Phase 3: Research project at University of Calgary being conducted by Suzanne Visser - Effects of PHCs in Mineral Soil Located Beneath Peat Deposits on Plants and Soils Fauna. Future work could be done follow-up on observations by soils contractor in LTPN of hydrocarbons in the LS layer on reclaimed plots.</td>
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<td></td>
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<tr>
<td>Nutrient Biogeochemistry Tech Transfer</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>To speak with CONRAD about process on this and then assess.</td>
</tr>
<tr>
<td>Retrospective Analysis of Reclamation Treatments</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Study to evaluate the 1 m capping requirement in the approval conditions. During the development of the BMP document members of BMPTG suggested an analysis of reclamation treatments would be useful for providing data to evaluate capping depth.</td>
</tr>
<tr>
<td>Root form of plan and pine</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Root egress in newly constructed clay soils</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>LCCS Manual Revision</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Final Version of the LCCS Manual in Q3 2012. Added funds for the actual preparation of the manual in 2012. To be coordinated with development of Reclamation Land Classification System.</td>
</tr>
</tbody>
</table>

**TOTAL**                                                                                           | -    | -    | -    | -    | -    |          |

**TSG PROJECTS TOTAL**                                                                                   | $817,861.86 | $1,318,460 | $1,362,800 | $1,170,000 | $150,000 |          |
<table>
<thead>
<tr>
<th>RSDS Issue #</th>
<th>Topic</th>
<th>RSDS Issues Description</th>
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<tbody>
<tr>
<td>51</td>
<td>Terrestrial - End Land-Use</td>
<td>Re-establishing a diverse ecosystem including a diversity of landforms, indigenous vegetation, near-natural water patterns and wetlands in the reclaimed landscape.</td>
</tr>
<tr>
<td>54</td>
<td>Terrestrial - End Land-Use</td>
<td>Use of native species and traditional plant species in reclamation in the closure planning design.</td>
</tr>
<tr>
<td>55</td>
<td>Terrestrial - Traditional Use Values and Mitigation</td>
<td>Which vegetation species existed in the pre-disturbance landscape and which species will be established in the reclaimed landscapes, and when.</td>
</tr>
<tr>
<td>60</td>
<td>Terrestrial - Diversity of Soil Types to Promote Potential for Vegetation Diversity</td>
<td>The re-creation of a single type (homogenous) topsoil across the reclaimed landscape may not provide an &quot;equivalent capability&quot; 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 the capability to re-establish and sustain equivalent vegetation and other biological diversity.</td>
</tr>
<tr>
<td>61</td>
<td>Terrestrial - Diversity of Soil Types to Promote Potential for Vegetation Diversity</td>
<td>Reclamation soil depths and types should be based on end land use needs, the soil depth may be adjusted for different vegetation types in different locations so as to maximize the speed and likely success of initial reclamation efforts.</td>
</tr>
<tr>
<td>62</td>
<td>Terrestrial - Diversity of Soil Types to Promote Potential for Vegetation Diversity</td>
<td>The productivity of soils used to support commercial forests are based on the use of a soil rating procedure called the &quot;Land Capability Classification for Forest Ecosystems in the Oil Sands Region (LCCS)&quot;. 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.</td>
</tr>
</tbody>
</table>
### AQUATICS SUB-GROUP (ASG) – 2011-2015 WORKPLAN

<table>
<thead>
<tr>
<th>Contract Number</th>
<th>Contractor</th>
<th>Task Description</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Comments</th>
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<tbody>
<tr>
<td>R-1109</td>
<td>Criteria &amp; Indicators Development (Aquatics)</td>
<td>Determine recent historic organic matter (OM) accumulation rates in boreal saline wetlands. Estimate current rates of OM accumulation in boreal saline wetlands and describe factors affecting those rates. Determine effects of water levels and salinity on growth, survival, OM accumulation potential and selected wetland plant species.</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Final thesis expected at end of 2011. To request hard copy and CD deliverables upon completion.</td>
</tr>
<tr>
<td>2005-0018</td>
<td>University of Alberta (Dr. Suzanne Bayley &amp; Marsha Tritts)</td>
<td>Effects of Salinity on Vegetation and Organic Matter Accumulation in Natural and Oil Sands Wetlands</td>
<td>-</td>
<td>-</td>
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<tr>
<td>2005-0022</td>
<td>University of Saskatchewan (Dr. M. Widdrom)</td>
<td>Amphibians as Indicators of Performance of Wetlands in Oil Sands Reclamation Areas</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Thesis complete. Have requested hard copy and CD deliverables of papers and thesis published to date.</td>
</tr>
<tr>
<td>2007-0015</td>
<td>University of Alberta (Dr. Suzanne Bayley)</td>
<td>Assessment of indices of biotic integrity and performance indicators of wetlands health for oil sands and natural reference wetlands</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Grant paid in full. Report expected in March 2012. To request hard copy and CD deliverables upon completion.</td>
</tr>
<tr>
<td>2007-0024</td>
<td>University of Waterloo (Dr. George Dixon)</td>
<td>Role of Nutrient Enrichment on Development of Wetlands for Oil Sands Reclamation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>GRANT CLOSED</td>
</tr>
<tr>
<td>2007-0028</td>
<td>University of Waterloo (Dr. B. Warner)</td>
<td>Microbial Community Dynamics and Performance Indicators</td>
<td>-</td>
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<tr>
<td>2007-0029</td>
<td>Wilfred Laurier University (Dr. Lucy Lee)</td>
<td>Application of a non-lethal bioassay based on indigenous fish cell lines for assessing toxicity in aquatics reclamation options within oil sands lease closure landscapes</td>
<td>Evaluation of the sensitivity of current fish cell-line bioassays to fresh and aged OSPW from various current operators; Comparison of the fish cell-line response and end-points to current acute and chronic bioassays (e.g., fathead minnow, Microtox); Collection of indigenous fish (walleye, yellow perch, whitefish) from the region for development of fish cell lines for toxicity testing; and Assessment of the application of these new cell-lines for predicting toxicity of OSPW that can be expected in aquatic reclamation components, such as End Pit Lakes and wetlands.</td>
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<tr>
<td>2008-0037</td>
<td>Dr. Michael O’Flaherty</td>
<td>Phase 2: Indigenous Ecological Classification of Wetlands</td>
<td>The principle objective of the first phase (Scoping Study) was to develop the scope and method for a Pilot Study with a single First Nation and Métis community. A second objective of that phase was to provide other First Nation and Métis communities which are not participating in the Pilot Study, with an overview of the project and the approach chosen for phase two. The goal of the second phase (Pilot Study) is to produce a set of community-identified wetland values that will contribute to the development of an indigenous ecological wetlands classification at a regional scale. This will be achieved through a field research programme working with the elders of a single community. The Pilot Study will also be used to test and refine the research approach identified in the Scoping Study (and described in this report) so that this approach can be more readily adopted in other areas.</td>
<td>X</td>
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<tr>
<td>2010-0033</td>
<td>Native Plant Solutions (NPS)</td>
<td>Minimal Ecological Management (MEM)</td>
<td>To be validated against practical oil sands experience and the experience of DU and other organizations over a period of time</td>
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<td>R-1109</td>
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<tr>
<td>R-1110</td>
<td>End Pit Lake Guidance Document (Research &amp; Revision)</td>
<td>Stakeholder Workshop</td>
<td>Two-day workshop to communicate end pit lake modelling and review Guidance document (Q3 07 and Q2 09)</td>
<td>-</td>
<td>$45,000</td>
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<tr>
<td>2009-0019</td>
<td>AMEC</td>
<td>Development of Regional Geotechnical Design Criteria for Oil Sands End Pit Lakes</td>
<td>The focus is on developing criteria for the primary geotechnical issue of containment and the secondary issue of safe and sustainable access to the lake.</td>
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<tr>
<td>2010-0016</td>
<td>West Hawk Associates</td>
<td>Managing Editor for the Production of the Oil Sands End Pit Lake Guidance Document</td>
<td>Assist in identifying the target audience; Assist in finalizing the draft table of contents; Assist with author selection; Coordinate chapter authors; David Wylkenko and James Hrynynshyn will travel to Fort McMurray to meet with the client at least once: Manage content; Manage peer review; Undertake production, including copy-editing, design, layout, and proofing of the final report.</td>
<td>$94,600</td>
<td>$15,000</td>
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<tr>
<td>2010-0024</td>
<td>BGC Engineering (Gord McKenna)</td>
<td>End Pit Lake Guide Technical Guidance, Consultation and Authorship of Chapter 1 for the Oil Sands End Pit Lake Guidance Document</td>
<td>Technical Guidance and Consultation Authorship of Chapter 1. Conduct interviews with mine staff and management, researchers, regulators, and industry consultants to learn more about their needs and wants for a design guide. Summarize key elements of the previous document and its review. Review the BPL designs proposed in closure plans for the oil sands.</td>
<td>$61,660</td>
<td>$2,500</td>
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<tr>
<td>2011-0011</td>
<td>BGC Engineering (Brent Mooder)</td>
<td>End Pit Lake Guide Water Balance Chapter</td>
<td>The main focus of this work will be to provide a draft chapter for the EPLTG that describes the watershed geography of the region as well as local-scale watershed geography implications on BPL design and performance.</td>
<td>$35,400</td>
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<td>2011-0012</td>
<td>Dr. Devin Castendyk</td>
<td>End Pit Lake Guide ‘Other Pit Lakes’ Chapter</td>
<td>Describe the nature and distribution of non-oil sands pit lakes in northern latitudes, to discuss key processes in existing pit lakes and their relevance to oil sands BPLs, and to identify key lessons learned from the operation, remediation, and closure of existing non-oil sands pit lakes.</td>
<td>$12,500</td>
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<tr>
<td>2011-0013</td>
<td>Golder (Jerry Vandenberg)</td>
<td>End Pit Lake Guide ‘In-Lake Processes’ Chapter</td>
<td>The main focus of this work is to produce a draft chapter for the EPLTG that describes the physical, chemical and biological processes that will determine the success of pit lake functioning. The following is a description of the proposed contents, listed as a formal table of contents below.</td>
<td>$34,677.06</td>
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<tr>
<td>2011-0014</td>
<td>West Hawk Associates</td>
<td>End Pit Lake Guide ‘Objectives’ Chapter</td>
<td>The chapter involves reviewing relevant regional plans and policies and synthesizing how these may influence the design and adaptive management of BPLs. Creating a template questionnaire and gathering the perspectives of stakeholders through a series of interviews and/or meetings with key representatives, as identified by the EPLTG. Stakeholder groups to be interviewed will include local aboriginal groups, government, oil sands industrial operators, local NGOs, and other NGOs.</td>
<td>$23,600</td>
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<tr>
<td>2011-0022</td>
<td>AMEC Earth &amp; Environmental</td>
<td>End Pit Lakes Guide ‘Planning, Design and Construction’ Chapters</td>
<td>defining of the objectives for BPLs; identifying requirements for the BPLs in terms of physical components, contents, or design geometry needed to achieve chemical and/or biological process capabilities within the lakes; water treatment technologies and operating practices; and approaches to mitigation of potential BPL – ecosystem integration issues.</td>
<td>$60,000</td>
<td>-</td>
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<tr>
<td>2011-0023</td>
<td>Norwest Corporation</td>
<td>End Pit Lakes Guide ‘Planning, Design and Construction’ Chapters</td>
<td>defining of the objectives for BPLs; identifying requirements for the BPLs in terms of physical components, contents, or design geometry needed to achieve chemical and/or biological process capabilities within the lakes; water treatment technologies and operating practices; and approaches to mitigation of potential BPL – ecosystem integration issues.</td>
<td>$70,000</td>
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Cumulative Environmental Management Association | January 2012
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<th>Task</th>
<th>Task Description</th>
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<th>2012</th>
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<th>2015</th>
<th>Comments</th>
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<tbody>
<tr>
<td>2011-0046</td>
<td>BGC Engineering (Gord McKenna)</td>
<td>End Pit Lake Guide 'Adaptive Management &amp; Knowledge Gaps' Chapters</td>
<td>Authorship for &quot;Adaptive Management&quot; Chapter to describe potential adaptive management approaches for use during the operational phase of an End Pit Lake (EPL). A proposed outline for this chapter is provided in Section 3.0. Authorship for &quot;Knowledge Gaps&quot; Chapter to identify and describe assumptions and areas for additional research based on discussions with supporting authors and members of the Cumulative Environmental Management Association (CEMA) EPL Task Group.</td>
<td>$18,897</td>
<td>-</td>
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<td>R-1110</td>
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<td>$537,049.06</td>
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<td>R-1111</td>
<td>End Pit Lake Modelling</td>
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</table>
| 2010-0013       | University of Windsor | Investigation of chemical REDOX gradient and their contributions to SOD associated with fresh MFT capping | To identify and quantify the chemical and biological contributions to the sediment oxygen demand of mature fine tailings during initial stages of aging. | $74,375 | - | - | - | - | Draft model received. Are addressing issues and contract to be amended with an extended timeline.
<p>| 2009-0043       | Golder (Jerry Vandenberg) | Peer Review of Phase 3 Oil Sands EPL Physical/Biogeochemical Model | This project focuses on model development that is building the code necessary to add functionality to meet ASG’s modelling needs. Model to be built and tested by the contractor. After the model is built, ASG anticipates entering into a contract with a local consultant to build locally-relevant input files and run scenarios based on issues of concern. The model must be built for easy transfer to a local consultant that has model-running expertise. | $42,500 | - | - | - | - | |
| UCR-0811        | Various Experts | Peer Review of Phase 3 Oil Sands EPL Physical/Biogeochemical Model | Peer Review of Phase 3 model completed by Golder | $20,270 | - | - | - | - | Budget to measure against Syncrude’s schedule in commissioning Base Mine Lake |
| R-1111          | TOTAL      |      |                  | $137,145 | - | - | - | - | |</p>
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<tbody>
<tr>
<td>R-1112</td>
<td>Wetlands Manual (Research &amp; Revision)</td>
<td>Development of a Regional Monitoring Program to Assess the Effects of Oil Sands Development on Wetland Communities</td>
<td>The contractor will define monitoring needs and draft recommendations for several sampling designs that when implemented will yield monitoring data in a format compatible with existing programs, regulatory requirements, and existing database formats. The proposal consists of undertaking 11 components and providing 10 deliverables as stipulated by the RPP, as well as other intermediate derivative products. Define/confirm the purpose (goals &amp; objectives) of the monitoring program to ensure that requirements and expectations drive the design. Determine and define what monitoring unit the program should be applied to (e.g., watershed, wetland only, include riparian?, etc.) and Recommend a science-based design that will meet the purpose.</td>
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<td>2010-0029</td>
<td>University of Windsor</td>
<td>Wetlands Manual User Need Assessment</td>
<td>ASG consultation and direction, review the previous wetlands manual, conduct research of associated relevant materials, devise an interviewee list in consultation with ASG, conduct up to 10 “group” interviews, produce transcripts of interviews, prepare draft user needs assessment, conduct revision and final document</td>
<td>$103,390</td>
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<td>2011-0040</td>
<td>West Hawk Associates</td>
<td>Wetlands Manual User Need Assessment</td>
<td>A managing editor to coordinate the development of the Wetlands Manual.</td>
<td>-</td>
<td>$80,000</td>
<td>$80,000</td>
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<td></td>
<td>West Hawk Associates</td>
<td>Wetlands Manual Development</td>
<td>Authors for manual Chapters including User Needs Assessment, Landform Design, and Case Studies.</td>
<td>-</td>
<td>$300,000</td>
<td>$300,000</td>
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<td></td>
<td>Peer Review of the Revised Wetlands Manual</td>
<td>Peer Review of the revised Wetlands Manual prior to CEMA Approval</td>
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<td>$50,000</td>
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<td>2009-0034</td>
<td>Marsha Trites</td>
<td>Technical Lead for Wetlands Technology Transfer</td>
<td>The objective of the project is to extract and transfer knowledge from a dozen experts through their participation in workshops where they will be asked to comment on pointed questions. The technology transfer document will be a synthesis of these workshops. Marsha Trites-Russell is designated as primary technical lead and her responsibilities are: To work with ASG and the Technology Transfer Task Group (TTTG) on an ongoing basis. To liaise with experts. To structure and organize workshops. To write the technology transfer document.</td>
<td>$41,757.97</td>
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<td></td>
<td>Marsha Trites</td>
<td>Wetlands Technology Transfer</td>
<td>Funds pool for development of synthesis of marsh work done in the oil sands region to date</td>
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<td>R-1112</td>
<td>Various</td>
<td>Workshops Wetlands Technology Transfer &amp; Development of a Regional Monitoring Programto Assess the Effects of Oil Sands Development on Wetland Communities</td>
<td>A synthesis of marsh work done in the oil sands region to date / Development of a Regional Monitoring Program to Assess the Effects of Oil Sands Development on Wetland Communities</td>
<td>$88,242</td>
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<td>Contract Number</td>
<td>Contractor</td>
<td>Task Description</td>
<td>Task</td>
<td>2011</td>
<td>2012</td>
<td>2013</td>
<td>2014</td>
<td>2015</td>
<td>Comments</td>
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<td>Traditional Classification of Wetlands</td>
<td>Phase 3 - University Research Project: Develop a classification system that incorporates traditional names, types, uses and management of wetlands with the standard Canadian Wetland Classification. This will allow accurate transfer of knowledge from traditional sources into the development of reclaimed wetlands. This project was recommended by the experts at the 2004 Technical Session and is an important step in seeing that TEK is integrated into ASG’s workplan.</td>
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<td>Red clawed wetlands will include restoring the structural and functional attributes that First Nation and Métis communities make use of. This, in turn, will depend on knowing how these communities understand the wetlands that they have historically made use of. For this reason, there is a need to tap into this knowledge to develop an Indigenous ecological classification of wetlands. The study is planned to proceed, but will be contingent on the results of the first two phases (Scoping Study and Case Study).</td>
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<td>Wetland Water Quality Modelling</td>
<td>Testing of the CEMA Oil Sands Reclamation Wetlands Model (model developed for WASG in 2005) by wetland specialists to determine its effectiveness. Inclusion of an oxygen module in the model.</td>
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<td>Wetlands Monitoring Performance Review</td>
<td>Review Results of Wetland Monitoring Programs for assisting in future editions of the wetlands manual.</td>
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<td></td>
<td>Treatment Wetlands</td>
<td>Overview of types and function of treatment wetlands.</td>
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<td>Design, construction, and study of fens</td>
<td>If all goes well, fens are planned to be built in 2008 (Albian) and 2009 (Suncor). The second edition of the Guidelines is to be used to design these fens. Price's hydrology model will also be used. Observations and comments from designers will be collected and incorporated in the next version. From discussions, it was determined that CEMA's role in fen construction be as follows: Carla and Christine to provide a summary of work on constructed fens at Syncrude and Suncor to date.</td>
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<td>Water Quality Objectives</td>
<td>Identify parameters of concern and approaches to develop the guidelines.</td>
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<td>Naphthenic Acids Research</td>
<td>Contingent of results of tech transfer.</td>
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<td>Treatment options for water release from EPLs</td>
<td>Analyze existing research on water treatment options.</td>
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<td>Develop scope for EPL Guidance Document research and model validation</td>
<td>Test Case research program including predevelopment study. Planning to be an academic study through a University - will validate the model.</td>
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<td>Work may be completed under CONRAD, but planning must occur in order to validate the model.</td>
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<td>ASG</td>
<td>PROJECT TOTAL</td>
<td>$932,184.03</td>
<td>$625,700</td>
<td>$430,000</td>
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<td>RSDS Issue #</td>
<td>Topic</td>
<td>RSDS Issues Description</td>
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<td>34</td>
<td>Surface Water - Consolidated Tailings (CT) Reclamation</td>
<td>The potential toxicity of CT release water and its duration on the landscape.</td>
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<td>38</td>
<td>Surface Water - End Pit Lake (EPL) Water Quality</td>
<td>Impact of EPL water quality 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.</td>
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<td>48</td>
<td>Terrestrial - Wetland Assessment</td>
<td>The undetermined impact on wetland vegetation communities due to impacts to basal aquifer and surface 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.</td>
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<td>49</td>
<td>Terrestrial - End Land-Use</td>
<td>Continuity of landform water shed 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 appearance.</td>
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<td>51</td>
<td>Terrestrial - End Land-Use</td>
<td>Re-establishing a diverse ecosystem including a diversity of landforms, indigenous vegetation, near-natural water patterns and wetlands in the reclaimed landscape.</td>
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<td>53</td>
<td>Terrestrial - End Land-Use</td>
<td>Rapid establishment of functional riparian areas similar to those present in the pre-development landscape following closure and ensuring that watershed structures do not require periodic long-term maintenance.</td>
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<td>55</td>
<td>Terrestrial - Traditional Use Values and Mitigation</td>
<td>Which vegetation species existed in the pre-disturbance landscape and which species will be established in the reclaimed landscapes, and when.</td>
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