Conservation and Reclamation

INFORMATION LETTER

Land Capability Classification for Forest Ecosystems in the Oil Sands Region – Revised

NOTE

This Information Letter and the accompanying report replace C&R/IL/96-1 and the report that accompanied that Information Letter.

CHANGES TO PREVIOUS VERSION

Following are the major changes to the 1996 version of the *Land Capability Classification System for Forest Ecosystems in the Oil Sands Region*:

- **Available water holding capacity (AWHC) by texture** – Based on the results of further testing and supportive tree productivity measurements, AWHC values for sandy loam and coarser soils, and peat-mineral mixes, have been modified. It has been established that AWHC values for sandy loam to sand textured soils and peat-mineral mixes are more closely related to field capacity at –10 kPa than the previous use of –33 kPa. Field capacity of loam and finer textured soils remains at –33 kPa. This change results in deep sandy soils being half to one class better than previously rated.
- **Nutrient retention deductions** – The significance of organic carbon content in contributing to nutrient retention in topsoil and upper subsoil has been increased. Deductions for nutrient retention are now based on both texture and organic carbon content to allow for the role of organic carbon (OC) additions. For example, a peaty sand textured topsoil and upper subsoil to 50 cm with greater than 4% OC would have received a 20 percent deduction under the 1996 system. It now receives a 10 percent deduction, or a half-class improvement.
- **Moisture regime classes/Edaphic regime multipliers** – The moisture regime classes have been revised to suit the boreal forest and to correspond to those used in forest site classification. Moisture regime is a key parameter in calculating forest productivity. Comments on selecting the appropriate corresponding nutrient regime have been updated.
- **Landscape factors (slope steepness)** - The emphasis in this section has shifted from a concern with operations to one of productivity. Consequently, since trees grow well on slopes too steep for conventional machinery, deductions related to slope steepness have decreased, resulting in a one class improvement on slopes of 20% to 50%.
- **Land Capability Classes** – The name for Class 4 has been modified from “Currently Non-Productive” to “Conditionally Productive”, reflecting the importance of opportunities for effective forest management.
- **Appendix** – Provides summaries of forest site-index vs. soil index relationships from relevant studies conducted in 1996 and 1997.

BACKGROUND

Salvage and replacement of soils are critical steps in ensuring the success of oil sands reclamation. They can also be the most expensive steps in the process. Thus, it is important for operators and regulators to make soil salvage and replacement decisions that are environmentally effective and cost efficient. To achieve this, a joint industry and government working group developed the *Land Capability Classification System for Forest Ecosystems in the Oil Sands Region*. The document was released in 1996 and is now being updated based on field experience.

This Information Letter provides a brief introduction to the System and its uses. More details may be found in the document *Land Capability Classification System for Forest Ecosystems in the Oil Sands Region – Revised Edition* available from the Queen's Printers in Edmonton or Calgary.

The System provides the basis for soil handling decisions to support the return of equivalent land capability. It provides a framework for evaluating the capability of pre-disturbance and reclaimed landscapes to support northern boreal forest ecosystems. The primary tree species to be supported by the reclaimed lands include white spruce, jack pine, or aspen. The reclaimed lands must also be capable of supporting a diverse community of tree, shrub and forb species.

The System allows for the development of soil handling decisions on reclaimed

tailings sand and overburden. Once the System has been tested in the field on alternative substrates such as consolidated/composite tailings, it can be modified, if necessary, to apply to these substrates.

General Assumptions

Use of the System is based on the assumptions that:

- The decision to establish the capability for a forest ecosystem on a portion of the reclaimed landscape has already been made. This decision is made through discussions with regional stakeholders, traditional land users and regulators. The System does not make judgements regarding the comparative value of forest communities versus other vegetation communities. For further information on the subject of other land uses, see C&R/IL/98-5 *Oil Sands End Land Use Committee Report and Recommendations*.
- The System forms the basis for agreement on the percentage of the various forest capability classes that must be returned in the reclaimed landscape. The System provides information on the potential for developing various capability classes in the reclaimed landscape but does not make decisions regarding the acceptability of tradeoffs between classes. Tradeoff decisions must be made in advance through discussions with regional stakeholders, traditional land users and regulators.
- The System provides a rating of the capability of land to grow various forest tree species. The capability ratings do not directly imply a commercial value of the resulting forest stand. Decisions about whether or not a forest stand is commercial depend on a number of factors that are not included in this System as they do not directly impact whether or not trees will grow on the land. These factors include, among others, stand size, proximity to waterbodies, and effects of slope steepness on logging equipment and resulting erosion.

PREDICTING CAPABILITY

Capability Classification System

The Capability Classification System provides a framework for evaluating soils and landscape. The numeric values assigned to the soil and landscape categories help determine the overall capability of the reclaimed site.

Soil characteristics are a good indicator of productivity (e.g., Site Index, Mean Annual Increment). Soil interacts with climate, physiography and vegetation to govern productivity by providing air, water and nutrients to roots. Soil characteristics are measurable based on technical data and professional judgement and are used to infer changes in productivity.

A 20% reduction in inherent soil productivity potential is the target used for establishing threshold values between classes of soils (Classes 1 to 5). As a guideline, and given a similar level of inputs, Class 2 soils would have 20% lower yields than Class 1 soils, Class 3 soils would have 20% lower yields than Class 2 soils, and so forth. Yields on Class 4 soils are less than 40% of those on Class 1 soils.

Reclamation success is dependent upon favourable conditions in the root zone for optimum forest growth. Soil and landscape parameters influencing growth can be quantitatively measured, and these measurements are integrated to estimate the sustained productivity of reclaimed lands.

Rating Procedure

Each component (soil and landscape) is given a numeric rating derived from values assigned to defined categories for key factors.

The major components (soil and landscape) are considered separately and each is assessed a value between 0 and 100. Conventionally, the final rating is based on the most limiting of the two. In reclaimed land settings, this rating system provides the user a choice of individual components, or the most limiting of soil and landscape components, to attain the equivalent capability.

The system also identifies specific limiting factors and the relative contribution of each. The regional climate and ecoregion remain the same, but soils and landscape features can be upgraded, or tradeoffs can be negotiated, through specific management strategies.

The Classes

Class 1 (Index 81 to 100) High Capability Land having no significant limitations to supporting productive forestry, or only minor limitations that will be overcome with normal management practices.

Class 2 (Index 61 to 80) Moderate Capability Land having limitations which in aggregate are moderately limiting for forest production. The limitations will reduce productivity or benefits, or increase inputs to the extent that the overall advantage to be gained from the use will be still attractive, but appreciably inferior to that expected on Class 1 land.

Class 3 (Index 41 to 60) Low Capability Land having limitations which in aggregate are moderately severe for forest production. The limitations will reduce productivity or benefits, or increase inputs to the extent that the overall advantage to be gained from the use will be low.

Class 4 (Index 21 to 40) Conditionally Productive Land having severe limitations, some of which may be surmountable through management, but which cannot be corrected with existing knowledge.

Class 5 (Index 0 to 20) Non-Productive Land having limitations which appear so severe as to preclude any possibility of successful forest production.

In EPEA approvals for oil sands mining operations, Classes 1, 2 and 3 are described as productive forest while classes 4 and 5 are described as non-productive forest.

The classes are an assessment of the degree or intensity of limitation. For example, Class 3 land has limitations which are more severe and may be different than Class 2. Subclasses describe the kind of limitations responsible for class designation. When pre-

senting System results, identification of one or two major limitations (each serious enough to downgrade one or more capability classes) is recommended. Such information is useful in landuse planning, soil handling for reclamation and subsequent land management.

Assumptions

Assumptions to the present approach are:

- It is an interpretive system based on limitations for forest production and general productive capacity for common trees, including aspen, balsam poplar, pine and white spruce.
- Minimal soil management practices under a largely mechanized system of forest harvest will be used.
- Lands in each class are similar in degree, but not necessarily in kind, of limitations for forest production.
- Lands are classified according to continuing limitation, assuming improvements to minor problems could be made, for example, minor drainage, fertilization and site preparation.
- The capability class could change by altering topography, drainage or soils through reclamation practices.
- Economic or productivity factors are not considered directly, however, they are implied. A 20% growth reduction per class is used as a guide in setting point deductions for various parameters.
- Point deductions may change as additional research and testing is conducted.

HOW TO USE THE SYSTEM

Capability assessments using the System will be done before the surface is disturbed to provide a basis for reclamation planning. The System will also be used after reclamation to ensure that the planned reclamation methods have achieved the desired capability. **Note that users should use the same System (preferably this revised version) when making any comparisons between pre– and post-disturbance capability on a site or between sites.**

The System is used in the following sequence:

- Assess the various pre-disturbance forest ecosystem capability ratings on the site.

This defines the targets for the return of equivalent land capability required in the regulations. The areas to be disturbed should be assessed in advance of any clearing or drainage operations.

- Develop a map showing the a real extent and location of the various land capability ratings on the mine.
- Calculate the area of each capability class.
- Develop a table showing percent of each class on the mine.

Generally speaking, reclamation is expected to return the same percentages of each class. Increases in the percentage of higher capability classes are encouraged. The operator is encouraged to discuss tradeoffs in land capability classes with the regulator.

- Evaluate various soil landscape units to determine soil salvage and replacement schemes.

This provides the information required to specify soil salvage and replacement requirements in approvals for oil sands mines. There may be more than one soil and landscape combination proposed to meet each capability class.

- Assess the reclaimed landscape units to ensure reclamation objectives have been met.

Assessment of the reclaimed lands should be carried out to confirm that the reclamation methods, especially the soil replacement methods, have achieved the appropriate capability class. Soil salvage and replacement is done with the aim of replacing the same or better **soil capability**. The assessment should be done after the soils have had a chance to settle (at least one year after placement).

- Evaluate reclamation success by comparing capability before and after disturbance.

When assessments show that the methods are not working, the operator will be expected to discuss changes to the methods with the regulator. Where the operator and the regulators agreed on specific reclamation methods (e.g., specific slopes and soil replacement depths) the operator **will not** be expected to re-disturb the reclaimed site (e.g., add more soil or amendments) to change the rating if the methods were diligently employed in accordance with the approval. Where the operators reclaim land to a Class without specific reclamation methods being agreed upon, the operator may be required to undertake further work to meet the targeted Class.

- Assess the vegetation growing on the reclaimed site.

Following landscape reconstruction and planting, vegetation establishment and growth is assessed to confirm that the reclaimed landscape will support the target ecosystem. Vegetation performance indicators will depend on whether or not the site is being reclaimed to productive or non-productive forest.

The successful return of equivalent land capability, coupled with demonstrated revegetation success, allows the regulators to issue a reclamation certificate to the operator.

FUTURE WORK

The System is a "living document" that will be refined through testing and evaluation in the field. As more experience is gained, and different pre-disturbance soils and reclaimed landscapes are evaluated, the System will be modified through discussions with stakeholders.

The following short-term evaluations are required:

- continue to assess capability ratings for undisturbed sites in proposed mining areas on different landscapes, soils and vegetation

types

- Continue to rate capability for a variety of reclaimed sites, both on oil sands mines and on other disturbed areas such as gravel pits, wellsites, forest cutblocks

The following long-term evaluations are required:

- evaluate the long-term fate of organic matter in reclaimed soils
- correlate vegetation (tree) performance on reclaimed soils with the capability classes
- develop a relationship between capability class and Site Index or some other forest classification system
- compare vegetation growth on logged areas in the region and reclaimed landscapes with the same capability ratings
- evaluate factors that could have a long term impact on capability (e. g., water table depth changes, accumulations of salts in discharge areas)
- evaluate the ability of the System to address different substrates (e. g., studies on composite/ consolidated tailings have begun)

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