Reclamation Pathway Choices for Industrial Disturbances to Meet the 2010 Reclamation Criteria for Forested Lands in Alberta

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Introduction

The 2010 Reclamation Criteria for Forested Lands has significantly changed the requirements for the vegetation growing on site in order for the site to receive a Reclamation Certificate. The historical purpose of vegetation establishment on industrial sites was to minimize erosion and to aid in the management of weed species. Various agronomic species such as clover, timothy and smooth brome were used for this purpose, as they were readily available in sufficient quantities, were cost effective and occupied the site very quickly. However, these species are not native to forested lands.

The Alberta Land Conservation and Reclamation Council (Reclamation Research Technical Advisory Council, RRTAC) published the second edition of the "Manual of Plant Species Suitability for Reclamation in Alberta" in 1989. The Manual listed many native species but continued to list agronomic species such as crested wheatgrass, even in the forested areas. In the early 1990's, there were some areas of the Province where native species were being recommended, but availability of sufficient quantities of seed were difficult to acquire, and there success in rapidly establishing site cover was inconsistent. (Jordan Jonston, pers. comm.) The 1995 Update of the Reclamation Standards states "The use of native species for revegetation is encouraged". An option to use "Natural Recovery" was instituted which allowed for slower vegetation establishment through natural ingress of species from the surrounding forest where erosion was not a risk. The 2010 Criteria now state that "desirable" forest species cover a minimum percentage of the reclaimed area.

Developing successful operational programs require knowledge of the current state of the site, the desired future state, and the suite of tools and techniques available to move the site from the current state to the desired state. This document will discuss the different points at which a vegetation management plan would begin, and strategies to achieve the successful endpoint of a reclamation certificate under the 2010 Standards.

Starting Points

The reclamation process can begin soon after a disturbance, or may take place years later when a producing facility has become uneconomical and is abandoned. There is also an inherent diversity of ecosites upon which disturbances have taken place. As a result, the starting point for the establishment of native vegetation is highly varied.

Contamination from the exploration and extraction phases will have been remediated prior to any revegetation work. It is assumed for this exercise that soil decompaction treatments will have been completed where necessary.

Determining the ecological data, disturbance type and existing vegetation on site due to past practices provides the starting point.

Ecoregions and Ecosites: The boreal forests of Alberta have been classified using various guides as described in Section 2.4 and 7.0. These other sections cover the topic of choosing suitable species for revegetation. This topic will not be discussed further except to highlight that the initial conditions will be affected by the type of site involved.

Types of disturbances: The focus of this exercise is upland conventional oil and gas disturbances. Wellsites, access roads and associated facilities such as camp sites, borrow pits and remote sumps will be the focus of this discussion.

- Drilled and abandoned wellsites: There are several types of wellsites that may occur.
    - Minimal disturbance. Sites where minimal site preparation has occurred, often due to sensitive sites such as sandy soils or permafrost. These are usually drilled in frozen conditions.
    - Natural Recovery site. Sites where the topsoil has been stripped and re-spread, but erosion is not a concern, allowing the company to wait for natural recovery of vegetation from the surrounding forest. Minimal disturbance sites will be a subset of this type of site.
    - Conventional sites with agronomic species deployed. These are similar to the natural recovery sites, but will have agronomic species on site due to past practices, or erosion concerns.
- Operated wellsites: There are many types, sizes and ages of operated wellsites, but from a vegetation management perspective, these will all have some degree of agronomic species on sites. In the future, there may be operated sites that will have had partial reclamation completed. These partially reclaimed sites would be treated as two strata, one treatment similar to the drilled and abandoned wellsites above, and the second strata being the operated area.
- Campsites
- Remote sumps
- Borrow pits

Existing Vegetation: The existing vegetation on site is classified into the three categories of woody vegetation, herbaceous (grasses and forbs) and weeds.

End Point

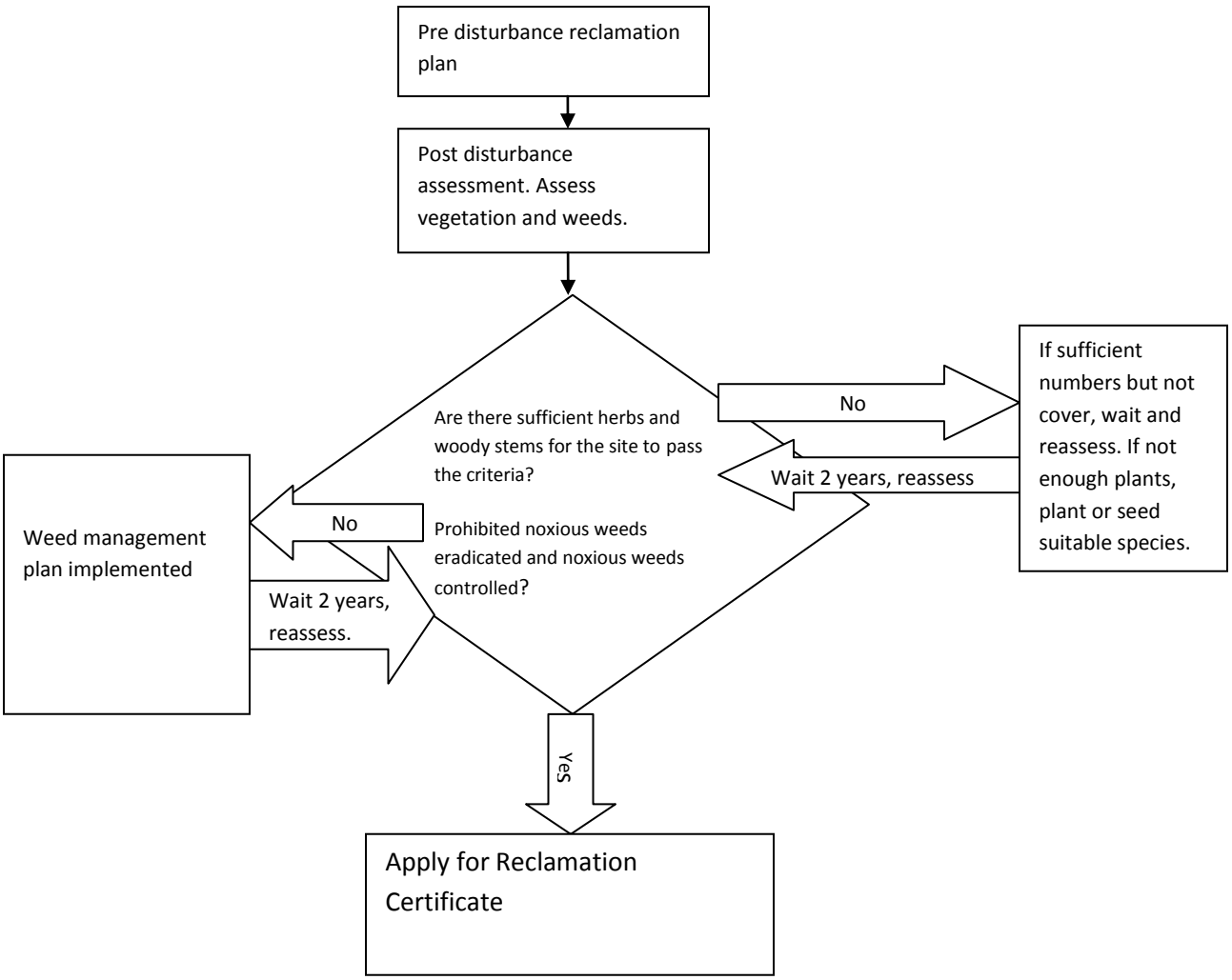
The endpoint is success achieving a Reclamation Certificate. The 2010 Criteria define successful revegetation as:

Woody: % cover and/or stem/plant count	- Visual quantitative estimate of percent cover (shrub and trees) and/or wood stem/plant count (trees and shrubs) using a 1.78 meter radius (10 m^2).
	- Target is to achieve >= 25% shrub cover of control/reference cover, or a stem/plant count of 5 if natural recovery, or 2 if planted.
Herbaceous: % cover	- Target is to achieve >= 25% herbaceous cover with a visual quantitative estimate of percent cover using a using a 1.78 meter circular radius (10 m^2)

Process to achieve the Endpoint

The following pages outline a process flow for the various starting points to achieve a successful endpoint.

Minimal disturbance wellsites



Pre-disturbance Data Collection and Reclamation Plan: Developing a plan prior to construction of the site allows, firstly, the gathering site data such as soil depths, ecological variation, watercourse and secondly, the planning of woody debris placement and, thirdly, the development of interim steps such as choice of vegetation for soil stability while the well operates and partial reclamation possibilities. Most existing sites will not have this information, but gathering it planned sites will ensure better reclamation outcomes in the future.

Post disturbance Assessment: Minimal disturbance wellsites should not require operational vegetation establishment, as the propagules should be on site already. The post site assessment will be

to ensure the operations were truly minimal disturbance and to ensure vegetation is regenerating. If the site is progressing well, a full Detailed Site Assessment can be completed, or a simple walk through completed when obvious deficiencies exist. The two questions to assess are the number of propagules and the presence of weeds.

- Desirable woody and herbaceous species: The standard required 25% cover of each type of vegetation. The woody stems can miss the 25% target if there are 5000 stems per hectare of naturally established stems, or 2000 stems per hectare of planted seedlings. If the number of herbaceous plants is high, but they are small (young) simply prescribing a reassessment in two years will probably be sufficient, otherwise planting or seeding may be required. If the woody stems count, or cover will be insufficient, planting or seeding will also be required. (see BMP on planting). Planting may require some site preparation if there are some limiting factors such as wet soils or competition. (see BMP for site preparation)
- Weeds: If Prohibited Noxious are detected, they must be eradicated. Noxious weeds must be controlled as per the weed act. (see BMP on weed control) Treatments for weeds will require several years of annual visits, prior to seed development, to ensure that they are properly controlled. A missed year will allow the weeds to seed, creating a seed bank that will take several more years to control.

Wellsite that was operated with no prior reclamation work completed.

Oil or gas wells may produce for very short periods up to decades. The current condition of the disturbance will vary depending on the time period of the original construction, as well as activities in the operational phase.

- Pre-disturbance information may have been collected for some of the more recently constructed wells, but this will not be the norm.
- Any work done on the soils will require line locating for safety reasons.
- The longer a well has produced, the higher the probability of subsoil compaction.
- The access road will probably have a gravel surface.
- The topsoil may have been stored in wells constructed after 19**, but rarely in older ones.
- The topsoil pile will have a lot of vegetation on it, often in the form of weeds.
- The working surface of the disturbance will probably have agronomic species for cover. The amount of native forest species on site will vary considerably.

Data Collection and Reclamation Planning

Pre-disturbance Data Collection and Reclamation Plan: Where pre-disturbance assessments and reclamation plans are available, use them as a resource for all of the next steps.

Post disturbance Reclamation Assessment: For this exercise, we will assume that the Phase 1 and, where required, Phase 2 along with decontamination, will have been completed. Information will be gathered to build a reclamation plan. Information required will be on the landscape, soils and vegetation parameters to assess current condition.

- Background data:
  - Year of construction will be required to know if topsoil salvage was required.
  - Year of abandonment will inform the reclamation standard that must be met.
  - Year of any reclamation work completed to date.
  - Any other??
- Landscape:
  - Where a pre-disturbance assessment is not available, an assessment of how the site should look like after re-contouring will be made using historical photos and field assessments. This involves approximating previous contours, as well as any drainages that may need to be restored.
  - Search using databases, photography and onsite visit to determine existence and location of other dispositions in the area that need to be considered prior to reclamation work being done.
  - Location of existing sumps, offsite and onsite.
  - The location of borrow pits, offsite and onsite.
  - Access road and tear drop status. If it needs to be removed, where to put the material. (sump, borrow pit or elsewhere)
  - Riparian function… (what to include??)
  - Infrastructure of refuse to be removed.
- Soils:
  - The subsoil will require an assessment of compaction/massing to determine if de-compaction is required. Use rooting of existing vegetation, signs of impeded drainage compared to offsite, soil consistency and structure
  - Soil texture on and off site, to ensure that treatments attain the texture of the off-site control.

- The location and amount of any topsoil and coarse wood debris will have to be noted, with plans to spread the material prior to decompaction, depending on the method of decompaction used.

- Vegetation:
  - An assessment of current vegetation can be used to project what will return after the sub-soils have been re-contoured and topsoil/woody debris replaced.
  - A description of the surrounding forest that will inform the desired target vegetation.
  - A description of weeds (as per the Weed Regulations) on site. Any presence of weeds will require a weed management plan that should start as soon as possible. Treatment of weeds prior to soil movement, and for several years after soil movement will be required to control most weeds. A missed year will allow the weeds to seed, creating a seed bank that will take several more years to control.

Reclamation Plan

A reclamation plan will be developed that describes all of the work to be completed and the timelines for the work to be done.

- Removal of any structures or refuse on site. Ensure Cut & Cap is completed. This step will be done first, whenever access allows the work to be done.
- Subsoil: this will often require heavy equipment, so ensure access is considered in the timing of the proposed work.
  - Removal of the teardrop and placement of the material in a suitable location.
  - Recontouring to the original contour as much as possible, including any drainages that need to be restored.
  - Decompaction of subsoil may occur at this stage depending on tools used
- Topsoil:
  - Spread topsoil as evenly as possible. The year of abandonment will dictate the target percentage of the control topsoil that is required. Where the topsoil on site is insufficient to achieve the target, topsoil may have to be imported.
- Coarse Woody Debris (CWD):
  - If CWD has been mulched, it can be spread as well, but should not be greater than 10 cm thick, or it will hinder the re-vegetation of the site.
  - CWD will not be common on operated wells. Where it exists, spread the coarse woody debris evenly across the site. In amounts greater than 100 tonnes per hectare, some of the material will have to be piled and burned, as it will be too thick on the site.
- Decompaction:

  - Final decompaction will occur at this point. There is debate on the best tool and point of entry in the spreading cycle to decompact, but this will be the last opportunity. Decompaction type and timing is an area that is still being researched at this time.

- Vegetation Establishment: A Vegetation Management Plan should be assembled for every site, based on its particular ecosite (target species) and existing vegetation. Items to consider are:
  - Weeds: If the site had a weed problem prior to reclamation, they will re-colonize the site very quickly. Even if they were treated prior to the soil work, they will reappear quickly. The strategy may be to let them regenerate, and treat them prior to establishing any preferred vegetation. A vegetation management strategy will have to be implemented with many visits to ensure weeds are not allowed to go to seed.
  - The vegetation management plan will dictate what species and when to deploy the planted or seeded vegetation.
- Monitoring and Vegetation Management: This is critical to establishing desirable plant species and to achieving reclamation objectives. The following documents has been developed to guide vegetation management for wellsite reclamation.
  - **Principles of Vegetation Management** describes the fundamentals of successful vegetation management and provides linkages to both the vegetation establishment technical note and to operational vegetation management treatments and processes.
  - **Vegetation Management Treatment Options** identifies an array of vegetation management treatment categories and discusses their strengths and weaknesses.
  - **Operational Vegetation Management** provides guidance on prescribing, integrating and deploying vegetation management treatments to cost effectively achieve reclamation objectives.
  - **Special Considerations in Herbicide Use** provides specific guidance around herbicide use for vegetation management - particularly with respect to regulatory requirements, safety, environmental protection and prescription.
- Detailed Site Assessment (DSA): If all actions above are completed properly, the site should be ready for a DSA two years after vegetation establishment. The annual monitoring visits will provide an opportunity to project when the vegetation will have grown sufficiently to pass the standards. (Refer to the BMP, or 2010 Criteria for process to do the DSA)