

# **2010 Reclamation Criteria for Wellsites and Associated Facilities for Native Grasslands**

(Updated July 2013)

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ISBN: 978-0-7785-8981-5 (Printed Edition)

ISBN: 978-0-7785-8982-2 (On-line Edition)

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This document may be cited as:

Environment and Sustainable Resource Development (ESRD). 2013. 2010 Reclamation Criteria for Wellsites and Associated Facilities for Native Grasslands (July 2013 Update). Edmonton, Alberta. 92 pp.

***Disclaimer: The July 2013 Update replaces previous releases of the 2010 Reclamation Criteria. The references used in the document were current at the time of publication: assessors are advised to check with the appropriate websites for possible updates.***

# 1. Preface

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The Government of Alberta protects the province's land resources by ensuring land used for industrial activities is reclaimed in an environmentally sound manner. This is directed through the *Environmental Protection and Enhancement Act* (EPEA), and the *Conservation and Reclamation Regulation*. Under EPEA, after an upstream oil and gas facility has been decommissioned, operators must obtain a reclamation certificate. Reclamation certificates are managed through the Alberta Upstream Oil and Gas Reclamation and Remediation Program.

In 2005, the Reclamation Criteria Advisory Group (RCAG) was established to review and provide recommendations for upgrading the 1995 Updated Reclamation Criteria for Wellsites and Associated Facilities (Alberta Environment, 1995). The review of the 1995 Reclamation Criteria was done according to Alberta Environment's Sustainable Resource and Environmental Management (SREM) model, which requires specified outcomes and science-based policy development. The process brought together representative stakeholders to ensure balanced and thorough outcomes.

RCAG included representation from Alberta Agriculture and Rural Development (AARD), Alberta Energy Regulator (AER), Alberta Forest Products Association (AFPA), Canadian Association of Petroleum Producers (CAPP), Environment and Sustainable Resource Development (ESRD), and landowners (independent, Alberta Surface Rights Federation, Wildrose Agricultural Producers). RCAG members attended task groups for cultivated, native grasslands, forested and peat lands in order to address the unique issues for each land type. Reclamation criteria were completed for cultivated lands, native grasslands, and forested lands while, criteria are still under development for peat lands.

A review of reclamation standards for upstream oil and gas facilities was needed because of improvements in reclamation practices, scientific developments and creative recommendations received for improving the 1995 Criteria. Thus, the Reclamation Criteria Advisory Group (RCAG) began its work with an assessment of the 1995 Criteria; in order to identify and retain the features that worked and to improve or replace the components that are now more fully understood.

Task groups for cultivated, native grasslands, forested and peat lands addressed the unique issues for the respective land type. Ecological health & function and land operability were objective indicators of equivalent land capability after successful reclamation. Accordingly, the following litmus tests were applied to ensure the criteria are:

- Science-based, reproducible and testable as they address ecosystem and management functions on a landscape basis.
- Workable as they offer alternatives or options, where applicable, to promote efficiency and recognize constraints.
- Enforceable as they compel compliance through explicit performance measures and decisions, acceptable to all stakeholders.

- Equitable as per cost vs. benefit analysis for all stakeholders after agreed upon changes in land use.
- Transparent as they offer clear rationale for assumptions and decisions (e.g., choice of parameters).

It is recommended that the 2010 Criteria be updated periodically as knowledge of ecosystem processes improves.

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END OF SECTION

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## 5. List of Updates

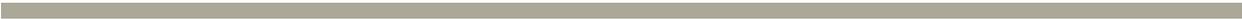
Update	Section	Description
		Citation changed to: Environment and Sustainable Resource Development (ESRD). 2013. 2010 Reclamation Criteria for Wellsites and Associated Facilities for Native Grasslands (July 2013 Update). Edmonton, Alberta. 99 pp.
	1	3 <sup>rd</sup> Paragraph, 1 <sup>st</sup> Sentence: The following name changes were made: Environment and Sustainable Resource Development (ESRD) replaced Alberta Environment (AENV) and Sustainable Resource Development (ASRD). Alberta Energy Regulator (AER) replaced Energy Resources Conservation Board (ERCB)  *Note: Similar name and abbreviation changes have been made through the document where appropriate.
July 2013	3	List of Tables added
July 2013	4	List of Figures added
July 2013	5	List of Updates added
July 2013	6 – 21	Section titles updated accordingly
July 2013	6.1	3 <sup>rd</sup> Paragraph, 3 <sup>rd</sup> Sentence was revised: The <u>assessor</u> , <u>operator</u> , inspector or reviewer is not limited to the methods identified in the criteria to make his/her assessment.  6 <sup>th</sup> Paragraph, 1 <sup>st</sup> Sentence, 1 <sup>st</sup> Bullet for the Land Manager Definition was revised: <b>Land Manager:</b> For <b>Public Lands</b> , this includes staff from <u>Environment and Sustainable Resource Development (ESRD)</u> responsible for stewarding public/crown lands. For <b>Provincial Parks and Protected Areas</b> this will include staff from Tourism, Parks and Recreation. For <b>Special Areas</b> this will include the Special Areas Board. For <b>Private Lands</b> , this includes the landowner, their designate, or occupant.  6 <sup>th</sup> Paragraph, 1 <sup>st</sup> Sentence, 2 <sup>nd</sup> Bullet for the Regulator Definition was revised: <b>Regulator:</b> On <b>Public Lands, Private Lands and Special Areas</b> this refers to Environment and Sustainable Resource Development (ESRD).
July 2013	7.1	1 <sup>st</sup> Paragraph, 1 <sup>st</sup> Sentence was revised to read: If a site changes land use (Figure 1), the Land Manager <u>must</u> be involved in the discussion but any such changes will require their written agreement.  Callout box revised, moved up from Section 7.1.2  Figure 1 caption revised: Selection process for native grasslands <u>for</u> selecting an appropriate land use criteria for sites which may or may not have undergone a land-use change. The Peatland Criteria refers to the 1995 Update which will remain in effect until a new criteria <u>or guide</u> has been released.
	8.1	3 <sup>rd</sup> Paragraph, 5 <sup>th</sup> Sentence was revised: These areas are defined as: <ul style="list-style-type: none"> <li>▪ <b>Undisturbed Areas:</b> include areas of the lease or access where there has been no surface soil disturbance and the native plant community has remained relatively intact (i.e., the on/offsite vegetation community and layers are similar). Generally, this applies where slopes are minimal and lease leveling was not necessary</li> <li>▪ <b>Disturbed Areas:</b> include areas of the lease or access have undergone</li> </ul>

		stripping (e.g., stripping, or storage and including points like well-centre and flare pits and longitudinal effects like ruts). In some cases (e.g., soils that were not frozen) even though soil stripping was not conducted traffic may have caused compaction, pulverized soil, rutting or clodding to the extent that the native community (i.e., species and/or layers) has been altered or removed.
July 2013	8.2	Table 8.2 revised to simplify and reduce wording and make it consistent with Table 7.
July 2013	8.2	Table 8.2 column heading revised to Constructed on or after January 1, 1993
July 2013	8.3	1 <sup>st</sup> Paragraph, 1 <sup>st</sup> Sentence: % community changed to % desirable species cover.
	8.4	1 <sup>st</sup> Paragraph, 1 <sup>st</sup> Sentence was revised: <b>Contamination:</b> Drilling waste and other oilfield wastes must be properly disposed of according to AER Directives.
July 2013	8.5	Callout box revised, 1 <sup>st</sup> Paragraph, last sentence revised: When these situations arise, assessors should discuss with the Regulator prior to conducting the assessment, <i>when possible</i> , to discuss options.
July 2013	8.6.1	Callout box added Note: The Assessment Tool questions apply to the site as a whole. Questions should be answered as though they apply to the entire site including associated infrastructure being assessed.  Section revised to reflect changes in the naming within the RoO and Assessment Tool.
July 2013	8.6.2	1 <sup>st</sup> Paragraph, 1 <sup>st</sup> Sentence revised: This information is contained within the electronic tool that accompanies the 2010 Reclamation Criteria  Section revised to reflect changes in the naming within the RoO and Assessment Tool.
July 2013	8.8.2	In Table 4, under Measured Parameters for the Litter Assessment: ...of the litter threshold value for the control plant community changed to of the litter threshold value
July 2013	9.1.3	The following sentence was deleted: <i>See ERCB Directive (in progress)</i> . This Directive has not been completed.
July 2013	9.5.1	Figure 7 added
July 2013	9.5.2	1 <sup>st</sup> paragraph, 1 <sup>st</sup> Sentence was revised: Surface Stoniness/ <i>Coarse Fragment Content</i> :  Figure 8 was added
July 2013	10	3 <sup>rd</sup> Paragraph was revised with the following added (last sentence: Guidance for different recovery strategies for industrial development in native prairie are currently under development by natural subregion. The first, Dry Mixed Grass Natural Subregion: Recovery Strategies for Industrial Development has been completed ( <a href="http://www.foothillsrestorationforum.ca">www.foothillsrestorationforum.ca</a> ; Gramineae Services, 2013).  In Table 6, under Litter Production, Litter Quantity and Litter Quality information for the Rating changed from 'Yes' to 'No'. There is no litter quantity rating required.
July 2013	10.3	Terms 'Native Species' and 'Infilling Species' combined and renamed to 'Native-Infilling Species'  Native-Infilling Species definition revised: <b>Native-Infilling species:</b> are a combination of native species from the controls or were seeded that are establishing on the disturbed area and are indistinguishable as to their source.. They are considered desirable
July 2013	10.3	Definitions revised for:  <b>Acceptable Substitutions:</b> for the purposes of the 2010 Reclamation Criteria,

		<p>include seeded native (Type 1 and 2) species that <i>may</i> not be present on the control but are part of the natural subregion (See the RoO for a species list of native species to the individual subregions). Their presence is considered temporary as succession proceeds, but in the short-term they are considered desirable species as they provide ecological benefits such as sheltering canopy, site stabilization and litter accumulation. Acceptable substitutions include the following:</p> <ul style="list-style-type: none"> <li>▪ <b>Prior to Jan 1, 2010:</b> All Type 1 and 2 species that are not present in the control but are native to the natural subregion;</li> <li>▪ <b>On or After Jan 1, 2010:</b> Type 1 and 2 species, but their contribution to the percent cover requirement may be limited based on the Allowable Acceptable Substitution calculations.</li> </ul> <p>Infilling species renamed to Native-Infilling species</p> <ul style="list-style-type: none"> <li>▪ <b>Native-Infilling Species:</b> are a combination of native species from the controls or were seeded that are establishing on the disturbed area and are indistinguishable as to their source. They are considered desirable as they are part of the local native plant community and their presence is a measure of native species recruitment and progress along a successional pathway.</li> </ul>
July 2013	10.4	<p>For Equation 2 'Before January 1, 2010 the term 'Compatible Species' was added to the overall calculation.</p> <p>For Table 8, the following changes were made:</p> <ul style="list-style-type: none"> <li>▪ The term 'Infill' was replaced with 'Native-Infill Species'</li> <li>▪ Under the 'Allowable Acceptable Substitutions' example, 'Fowl Bluegrass' was replaced with 'Slender wheatgrass'; for the 'Other' category, this was changed to 'Other (Not Native to Subregion)'</li> </ul>
July 2013	10.7.2	<p>First paragraph, 2<sup>nd</sup> sentence revised: The accumulation and establishment of litter is a process, so using mature thresholds as the standard is not appropriate for a 3 to 5 year-old reclaimed site.</p> <p>First paragraph, 2<sup>nd</sup> last sentence 'ecological site' replaced with 'range site'.</p> <p>Callout box added: Note: If the undisturbed area is not fenced and grazed in conjunction with the adjoining control, the undisturbed litter quantity can be compared to 65% of the control. This exception does not apply to the disturbed area litter quantity comparison.</p>
July 2013	11.1.4	<p>The following sentence was added: Ratings in GRT.4 (Appendix D) are used for comparing soil color and must be recorded in the Assessment Tool and the RoO.</p> <p>2<sup>nd</sup> Paragraph, 2<sup>nd</sup> Sentence was revised: To aid in the determination of soil colour, collect a representative handful from the A horizon, crush it by hand, and determine its colour using the Munsell Soil Colour Chart.</p>
July 2013	11.1.5.1	<p>The 3<sup>rd</sup> paragraph was revised: For all assessment points, topsoil and subsoil consistency and structure need to be assessed and rated separately and results recorded in the Record of Observation (RoO) datasheet .</p>
July 2013	12.1.3	<p>Callout box added: Note: The two year waiting period also applies If amendments, including fertilizer, are only applied onsite so that the management practices between on- and offsite.</p>
	Appendix – A: 13.1.3.2	<p>In the heading ERCB, 2008 was replaced by AER, 2008</p>
	Appendix - D	<p>Rating table revision:</p> <p>GRT 3. Descriptions revised so that comparisons should be made using the reference plant community and not the Control.</p> <p>GRT 4: Table was revised to remove the instructions regarding conducting soil</p>

		structure assessments based on soil consistence results.
	Appendix – F	<p>Reference changed from:</p> <p>Energy Resources Conservation Board (ERCB). 2008. Directive 056: Energy Development Applications and Schedules. Energy Resources Conservation Board, Calgary, AB. July 2008. 320 pp. [Online: <a href="http://www.ERCB.ca">http://www.ERCB.ca</a>]</p> <p>To:</p> <p>Alberta Energy Regulator (AER). 2008. Directive 056: Energy Development Applications and Schedules. Alberta Energy Regulator, Calgary, AB. July 2008. 320 pp. [Online: <a href="http://www.AER.ca">http://www.AER.ca</a>]</p>
July 2013	Appendix – G	<p>Definitions revised for:</p> <p><b>Acceptable Substitutions:</b> For the purposes of the 2010 Reclamation Criteria, these include seeded native (Type 1 and 2) species that <i>may</i> not be present on the control but are part of the natural subregion (See the RoO for a species list of native species to the individual subregions). Their presence is considered temporary as plant succession proceeds but in the short-term they are also considered desirable species as they provide ecological benefits such as sheltering canopy, site stabilization and litter accumulation.</p> <p><b>Compatible Species:</b> For the purposes of the 2010 Reclamation Criteria for Forested Lands, these are the seeded species that were part of a seed mix that was appropriate to the time period or as outlined in historical agreements with the Land Manager. For the purposes of the 2010 Reclamation Criteria for Native Grasslands, these are species used for reclamation on sites prior to 2010. These species are comprised of native species but may not be native to the subregion and agronomics that are suitable for grazing purposes. They do not include weeds, Problem Introduced Forages, mosses or lichens.</p> <p><b>Disturbed Areas:</b> areas of the lease or access have undergone stripping (e.g., stripping, or storage and including points like well-centre and flare pits and longitudinal effects like ruts). In some cases (e.g., soils that were not frozen) even though soil stripping was not conducted traffic may have caused compaction, pulverized soil, rutting or clodding to the extent that the native community (<i>i.e.</i>, species and/or layers) has been altered or removed.</p> <p><b>Native species:</b> A plant species that is indigenous to the ecosite. For the purposes of the 2010 Native Grassland Reclamation Criteria, native species refer to those species existing offsite found within the control area.</p> <p><b>Native-Infilling Species:</b> For the purpose of the 2010 Reclamation Criteria for Native Grasslands are a combination of native species from the controls or were seeded that are establishing on the disturbed area and are indistinguishable as to their source. They are considered desirable as they are part of the local native plant community and their presence is a measure of native species recruitment and progress along a successional pathway.</p> <p><b>Percent Native-Infill Vegetation:</b> For disturbed wellsites, the percent cover of Native-Infill species on the reclaimed area, relative to the total cover of native species on the control. Need to have greater than 15% of the control for a pass.</p> <p><b>Regulator:</b> For the purposes of the 2010 Reclamation Criteria on <b>Public Lands, Private Lands and Special Areas</b> this refers to Environment and Sustainable Resource Development (ESRD).</p> <p><b>Third-party impacts:</b> pre-oil and gas, Land Manager, Landowner (or designate) activities, such as, recreational or industrial use, trails, wildlife.</p> <p><b>Undisturbed Areas:</b> include areas of the lease or access where there has been no surface soil disturbance and the native plant community has remained relatively</p>

		intact ( <i>i.e.</i> , the on/offsite vegetation community and layers are similar). Generally, this applies where slopes are minimal and lease leveling was not necessary.
July 2013	Appendix – H	<p>Address changed: Energy Resources Conservation Board - Main Office: Suite 1000, 250 – 5 Street, SW; Calgary, AB T2P 0R4; Phone: 403-297-8311; Fax: 403-297-7040 ; Email: <a href="mailto:Infoservices@ercb.ca">Infoservices@ercb.ca</a></p> <p>Changed to: Alberta Energy Regulator - Main Office: Suite 1000, 250 – 5 Street, SW; Calgary, AB T2P 0R4; Phone: 403-297-8311; Fax: 403-297-7040 ; Email: <a href="mailto:Infoservices@AER.ca">Infoservices@AER.ca</a></p>



END OF SECTION

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## 6. Introduction

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### 6.1. Background

The aim of reclamation under Environmental Protection and Enhancement Act is to obtain equivalent land capability. “**Equivalent land capability**” is defined in the Conservation and Reclamation Regulation as “**the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical.**” The 2010 Criteria are to be used to evaluate whether a site has met equivalent land capability. The criteria are based on land function and operability that will support the production of goods and services consistent in quality and quantity with the surrounding landscape.

The intent of the 2010 Criteria is to measure appropriate parameters and evaluate whether land function and operability is comparable to the surrounding area or an appropriate reference community. The certification criteria describe the allowable changes in site conditions and typically require landscape, vegetation and soils assessments. In special cases, the operator may have to find representative land, soil and vegetation a short distance from the site, or use available reference plant community or ecological site descriptions, for the control comparison.

***The reclamation criteria apply to wellsite leases and access roads, and associated facilities such as pits, campsites, and offsite sumps. With written agreement from the Land Manager, they do not apply to facilities or features that are left in place as developed (e.g., roads, pads, dugouts) although these facilities or features will be covered by the reclamation certificate. These facilities or features must be stable, non-erosive, non-hazardous and have no impact to off-lease lands.***

***For the purposes of these criteria, the term Specified Land, means land that is being or has been used or held for or in connection with the construction, operation or reclamation of a well, battery or pipeline (excerpt from the Conservation and Reclamation Regulation (115/93))***

It is necessary to characterize the natural variability associated with various land uses and landscapes and make a reasonable comparison using appropriate sampling methodologies. Given the complexity of the different land use types, soil zones and landscapes in Alberta, it is acknowledged that the 2010 Criteria may not be applicable to all sites under all circumstances. The assessor, operator, inspector or reviewer is not limited to the methods identified in the criteria to formulate his/her conclusion on ‘equivalent capability’. Where such circumstances occur and the operator is satisfied that the site is ready to certify, an application can be submitted but must be accompanied with a detailed justification as to why the methodologies in the criteria do not support certification yet the site does meet ‘equivalent capability’. This application

will be a **Non-Routine Application** and may require consultations with the Inspector or regulatory Land Manager (ASRD) prior to submission to avoid a refusal if the justification is found unacceptable.

Based on experience with the 1995 Update (Alberta Environment, 1995), the RCAG made a consensus decision to streamline the assessment of satisfactorily reclaimed sites (*i.e.*, that will qualify for *Reclamation Certification* after an Undisturbed Area assessment) versus sites that have anomalies that might still pass after a more detailed (Disturbed Area) assessment. Sites that fail either the Undisturbed or Disturbed assessments must have the cause(s) of failure mitigated and then the site reassessed.

A fundamental principle carried forward in these criteria is that the success of land reclamation is measured against the representative (adjacent) site conditions with due consideration for construction norms at the time of development. The criteria will be used to judge reclamation success and issue the reclamation certificate. The operator must supply information relative to the criteria on the Wellsite Reclamation Certificate Application. The 2010 Reclamation Criteria is comprised of two components that include:

- **Assessment Process and Criteria:** This outlines the standards and methodology used for assessing various components of the Landscape, Vegetation, and Soil Assessments that make up the 2010 Reclamation Criteria.
- **Assessment Tool and Record of Observation (RoO) Datasheets:** The Assessment Tool for each land type pose Yes/No questions based on what is present onsite compared to offsite and whether it meets the standard set out in the Criteria.

For the purpose of this 2010 Reclamation Criteria the following definitions apply:

- **Land Manager:** For **Public Lands**, this includes staff from Environment and Sustainable Resource Development (ESRD) responsible for stewarding public/crown lands. For **Provincial Parks and Protected Areas** this will include staff from Tourism, Parks and Recreation. For **Special Areas** this will include the Special Areas Board. For **Private Lands**, this includes the landowner, their designate, or occupant.
- **Regulator:** On **Public Lands**, **Private Lands** and **Special Areas** this refers to Environment and Sustainable Resource Development (ESRD).

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END OF SECTION

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## 7. Land Types in the 2010 Criteria

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Under the 2010 Criteria, the following land types have been identified: Native Grasslands, Cultivated Lands, Forested Lands, and Peatlands. The definitions of the land uses follow:

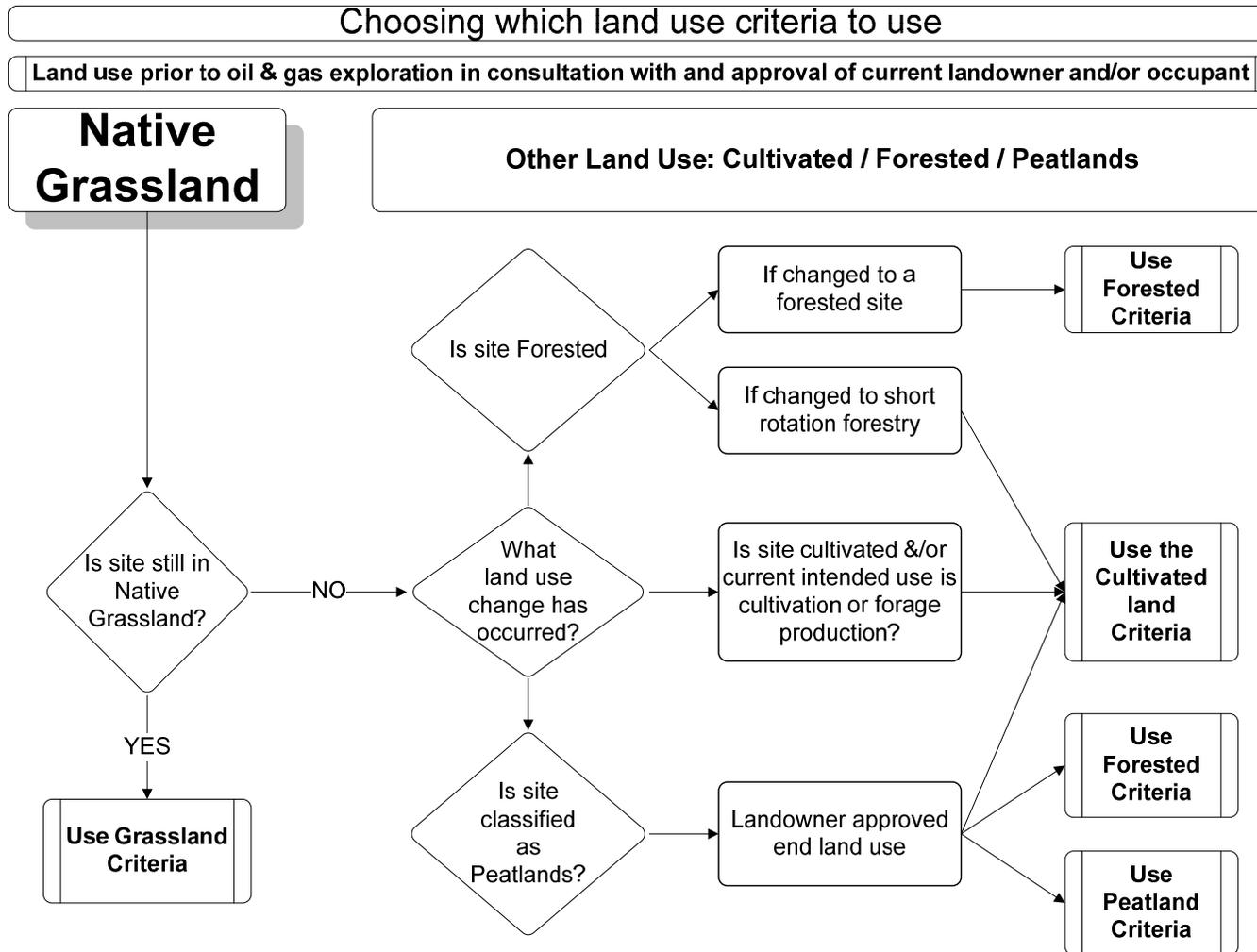
**Native Grasslands** include lands that are permanently vegetated by native herbaceous species. Native grasslands commonly present a mixture of different native grass species, forbs (i.e., flowering/broad-leaved species), shrubs (i.e., woody species) and tree species, whereas tame grasslands (i.e., forage and tame pasture) produce agronomic seeded grass and legume species such as timothy and alfalfa. Grasslands occur primarily in the Grassland Natural Region, but they can also be found in other Natural Regions of Alberta, including the Parkland, Rocky Mountains and Foothills Natural Regions. Grasslands include range improvement areas, grazing dispositions on public lands (White Zone and Green Zone areas), native prairie and grassland areas, Special Areas, and the Eastern Irrigation District. Riparian areas may also occur in Grassland sites. Riparian areas are the moist habitats found along creeks and sloughs, that include wetland grasses, forbs, shrubs and trees. For grasslands that have been cultivated/seeded to agronomic species and the land use goal is to be managed as tame forage for hay or pasture, they shall be assessed under the Cultivated Land criteria.

**Cultivated Lands** include all agricultural lands managed under conventional, minimum, zero till or forage production practices. The Cultivated land use criteria will be used to assess perennial forage and grasslands that are seeded to agronomic species as well as to agroforestry tree farms. Cultivated lands include lands changed from peatland, forested land or grassland to cultivated land.

**Forested Lands** includes any treed land, whether or not the forest vegetation is utilized for commercial purposes. Treed (bush) lands in the White Area (deedable land) that is to be maintained as 'treed' shall meet the forested criteria. Land in the White Area where a land use has been changed to cultivation must meet the cultivated criteria. In the Green Area (crownland), native meadows or range improvement areas in grazing dispositions may be assessed using the grasslands or cultivated lands criteria, with approval from the Land Manager.

**Peatlands** include functioning bogs or fens. Where disturbed peatlands are to be reclaimed to an alternative end land use (e.g., cultivated or forested land), agreement with the Land Manager must be reached around the reclamation criteria that will be used for the assessment purposes based on the intended end land use.

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**Figure 1. Selection process for Native Grasslands for selecting an appropriate land use criteria for sites which may or may not have undergone a land-use change. The Peatland Criteria refers to the 1995 Update which will remain in effect until a new criteria or guide has been released.**

## 7.1. Land Use Changes

If a site changes land use (Figure 1), the Land Manager must be involved in the discussion, but any such changes will require their written agreement. Should a landuse change occur Assessors shall refer to (Figure 1) for the appropriate Criteria to use for conducting the reclamation assessment.

***Note: If the land use (i.e., forested to cultivated) has changed at a site a signed agreement from the private or public land owner/manager, or their designate is required. Figure 1 can be used to determine the appropriate criteria to be used for the assesment. The application is still considered a Routine Application.***

### 7.1.1. Changed from Cultivated Lands

A land use change from cultivated (tame pasture) to grassland is acceptable provided that the Land Manager requests it (or agrees to it) in writing. Thereafter the Land Manager needs to be involved in site landuse changes. The reclamation assessment will follow the grassland criteria although representative controls should include sample points from the adjacent cultivated land soil. The vegetation assessment, however, will be applied on a nearby representative grassland or appropriate reference plant community.

### 7.1.2. Changed from Forested Land

A land use change from forested to grassland is acceptable provided that the Land Manager requests it (or agrees to it) in writing. Thereafter the Land Manager needs to be involved in site landuse changes. The reclamation assessment will follow the Native Grassland Criteria although representative controls could include sample points from the adjacent forested soil or from comparable deforested/cultivated lands. The vegetation assessment, however, will be applied on a nearby representative grassland or appropriate reference plant community.

***Note: If a site changes land use, written approval from the Land Manager is required.***

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END OF SECTION

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## 8. The Assessment Process on Native Grasslands

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### 8.1. 2010 Approach to Native Grassland Reclamation Criteria

**Native Grasslands:** include lands that are permanently grassed that include a native component. Grasslands may be native or modified native. Since the 1995 Wellsite Reclamation Criteria, the land-use objectives for native grassland reclamation have changed. Key distinctions have been made between the criteria developed for native grasslands and tame grasslands in order to support their differences in structure and land use. The reclamation assessment for native grasslands recognizes the importance of knowing the Grassland Natural Subregion and associated native plant community, environmental and site parameters prior to the disturbance.

The 2010 Reclamation Criteria for Native Grasslands should be used for native grasslands and modified native grasslands, (not tame grasslands which are dominated by agronomic species and have been ploughed or tilled). Native grasslands commonly present a mixture of different native grass species, forbs (flowering/broad-leaved species), shrubs (woody species) and tree species. Modified native grasslands are ones where native species integrity has been altered by past disturbance, and where more than 70% of community is composed of non-native plant species. Grazing management needs may be different for modified native than native communities (more like tame pastures). Tame grasslands produce agronomic seeded grass and legume species such as timothy and alfalfa. Tame grasslands commonly have a well-defined Ap (topsoil modified by tillage) horizon. Grasslands that have been cultivated/seeded to agronomic species with the goal of management as a tame pasture should be assessed under the 2010 Reclamation Criteria for Cultivated Land criteria. Table 2 outlines the various construction periods that shall apply to the implementation of the 2010 Reclamation Criteria for Native Grasslands. The assessment includes sections on Landscape, Vegetation and Soils. Ecosystem Function is maintained when the onsite plant community and its associated natural processes are functioning and intact (*i.e.*, proper drainage, moisture retention and cycling, soil and site stability, and nutrient cycling as expressed by litter formation). The process involves a landscape assessment and methodologies for assessing vegetation and soils for areas delineated and identified as being either Undisturbed and Disturbed (section Minimum Disturbance Sites: Undisturbed versus Disturbed Areas). These areas are defined as:

- **Undisturbed Areas:** include areas of the lease or access where there has been no surface soil disturbance and the native plant community has remained relatively intact (*i.e.*, the on/offsite vegetation community and layers are similar). Generally, this applies where slopes are minimal and lease leveling was not necessary
- **Disturbed Areas:** include areas of the lease or access have undergone stripping (e.g., stripping, or storage and including points like well-centre and flare pits and longitudinal effects like ruts). In some cases (e.g., soils that were not frozen) even though soil stripping was not conducted traffic may have caused compaction, pulverized soil, rutting

or clodding to the extent that the native community (i.e., species and/or layers) has been altered or removed.

Under the **Landscape Assessment**, landscape criteria are assessed by looking at the site as a whole and comparing to adjacent land and if available, the pre-disturbance conditions. Differences observed onsite, compared with the adjacent land must not interfere with normal land use and must not show a negative impact onsite or offsite.

For the **Vegetation Assessment**, there is a greater emphasis on native grassland vegetation as an indicator of equivalent land capability, ecosystem function and/or operability. The range plant community information describes the unique characteristics of each Natural Subregion in terms of climate, soils, vegetation, landform and topography (Alberta Sustainable Resource Development, 2007b). Competency with native and invasive species identification and familiarity with grassland plant community succession is necessary in order to complete the vegetation assessment. Natural Plant Community Guides for many of the Natural Subregions Region (Table 1) can be found online (Alberta Sustainable Resource Development, 2009 ).

**Table 1. Natural Regions and Natural Subregions that contain grassland ecosystems.**

Natural Region	Relative Occurrence of Native Grasslands	Natural Subregions
Grassland	Minor to Dominant	Dry Mixedgrass, Foothills Fescue, Mixedgrass, Northern Fescue
Parkland	Minor to Common	Foothills Parkland, Peace River Parkland, Central Parkland
Foothills	Secondary to Minor	Upper Foothills, Lower Foothills
Rocky Mountain	Secondary to Common Rare to Minor	Montane Alpine, Subalpine

For the **Soil Assessment**, Level 1 and Level 2 (if necessary) soils assessments are conducted on any area that is delineated and identified as disturbed. Disturbed soils may include locations where soil handling, storage and/or reclamation were conducted, or where the soil was impacted by processes such as by compaction or rutting.

If an assessment fails the Level 1 Soils assessment and passes the Vegetation assessment, then the following options apply:

- Conduct a Level 2 Soils (i.e., lab investigations on the parameters in question);
- Allow the site more time for recovery prior to reassessment; or,
- Mitigate the area and reassess.

If the Level 2 *is* completed and clearly shows that there are no site limitations (i.e., the site is stable and that time is the only factor for a full recovery) then the site passes the Level 2. If the cause of the grid(s) failure is identified during the Level 2, it must be mitigated and the questionable grid(s) re-assessed prior to applying.

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## 8.2. Implementation of the 2010 Grasslands Criteria

- A. Sites constructed after January 1, 1993 and reclaimed after January 1st, 2010 shall comply with all aspects of the 2010 Reclamation Criteria.

B. Sites reclaimed before January 1st, 2010 shall be assessed as follows:

- 1) **Landscape Criteria:** Sites are required to meet all of the landscape components of this document regardless of the construction period, unless otherwise documented as a third-party impact (C&R/IL/97-4; Alberta Environment, 1997).
- 2) **Soils Criteria:** Sites are required to meet all elements of the soils criteria except for topsoil replacement, which shall be according to the construction period (Table 2).
- 3) **Vegetation Criteria:** Sites are required to meet the following for:
  - (a) **Desirable Species:** Sites shall be assessed according to the construction period (Table 2) .
  - (b) **Litter Quality:** All sites should have the presence of functional litter.
  - (c) **Litter Quantity:** For all sites, disturbed areas, must be  $\geq 15\%$  of the litter threshold value and undisturbed areas  $\geq 65\%$  of the litter threshold value.
  - (d) **Structural Layers:** Only sites reclaimed after January 1, 1993 must meet the structural layer requirement.
  - (e) **Weeds:** All sites must be managed as per the Weed Control Act. Enforcement of the Act falls under the jurisdiction of the local authority.

**Note:** *These terms outlined in Table 2 do not preclude the need to meet specific requirements identified prior to the activity commencing by the local Authority (e.g., Municipality, Special Areas Board) and/or in an agreement.*

*Problem introduced forage species must meet the requirements set out in R&R/03-5 for Problem Introduced Forages (Alberta Environment, 2003).*

*No problem introduced forage species are allowed on sites constructed after January 1, 1993.*

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### 8.3. Vegetation Override

Where the site has met the landscape and vegetation criteria (*i.e.*, % desirable species cover, litter quantity and quality), but not the soil criteria, and where activities to meet the conditions described in this criteria risk existing ecosystem functioning, a vegetation override may be appropriate. Equivalent capability for grassland landscapes **must** be demonstrated. The use of a vegetation override will result in a **Non-Routine Application** and will result in greater scrutiny by the Regulator.

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**Table 2. Implementation dates for the new reclamation criteria for Grasslands.**

**Vegetation Pass or Fail Conditions by Construction Period:**

Constructed Before January 1, 1993			Constructed on or after January 1, 1993	
*Sites Abandoned and/or Reclaimed:			*Sites Abandoned and/or Reclaimed:	
Pre-1993	1993-2001	After 2001	1993-2010	After 2010
<p>The vegetation cover must be <math>\geq 70\%</math> when compared to control.</p> <p>Comprised of native species, all acceptable substitutions, and compatible species which consist of native and non-native varieties, including problem introduced forages suitable for grazing purposes.</p> <p>Vegetation cover does not include weeds, mosses or lichens.</p> <p>**Sites may be certified with whatever problem introduced forages come up from the seedbank.</p>			<p><b>Undisturbed Assessment:</b></p> <p>The composition of native species cover must be <math>\geq 70\%</math> compared to control.</p> <p>Species composition must reflect the representative off-site species.</p> <p>Native species do not include weed species or problem introduced forages.</p> <p><b>Disturbed Assessment****:</b></p> <p>The composition of all acceptable substitutions and native species cover must be <math>\geq 50\%</math> compared to control.</p> <p>Species composition must reflect the representative off-site species.</p> <p>Native species do not include weed species or problem introduced forages.</p> <p>All acceptable substitutions.</p>	
		<p>**Where problem introduced forages exist, sites may be certified after reasonable effort is documented to control or reduce their presence.</p>		<p>Must have <math>\geq 15\%</math> native-infill species component</p> <p>Only includes allowable acceptable substitutions***</p>

**Topsoil Replacement Pass or Fail Conditions by Construction Period**

Constructed Before April 30, 1994	Constructed After April 30, 1994
Less than 40% variance between lease mean and control mean	Less than 20% variance between lease mean and control mean

Note: If the average control thickness is <15 cm, topsoil should be distributed across the entire disturbed area but the minimum requirement does not apply.

*†*If a site is re-disturbed after the construction date, "Reclaimed" with respect to implementation of the criteria refers to sites that have had site re-contouring, soil replacement and seeding completed. If there is no indication of the reclamation date assessors will need to provide justification based on the timelines outlined above. For areas not re-disturbed during reclamation, it is encouraged such areas also meet the vegetation requirements as above, and shall be eligible for certification with reasonable, documented effort.

\*\*R&R/03-05 - Problem Introduced Forages (Alberta Environment, 2003).

\*\*\* "Allowable Acceptable Substitutions" must be calculated as outlined in the Section 7.3.

\*\*\*\* All vegetation assessment components of the 2010 Reclamation Criteria applies.

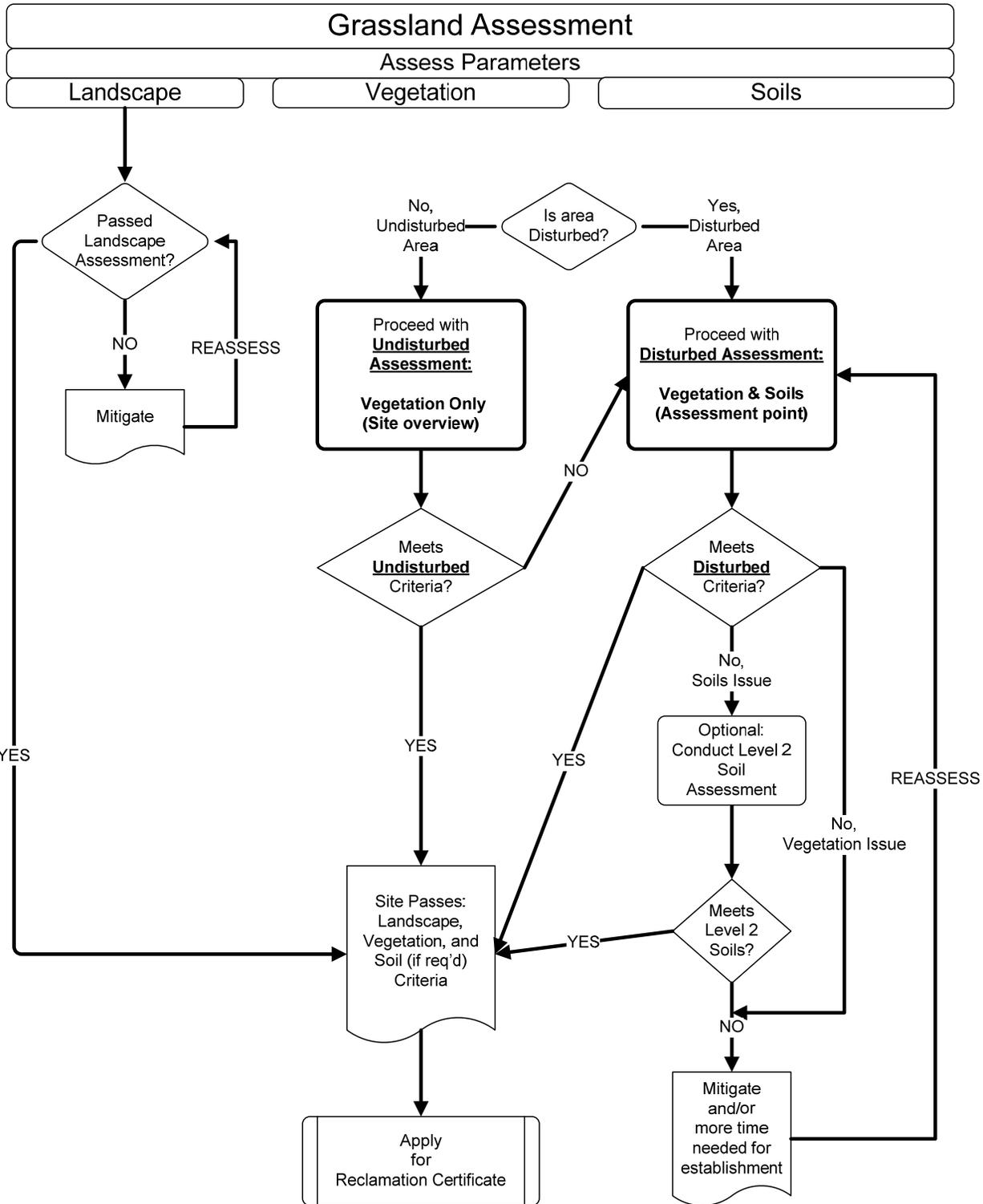


Figure 2. Native Grassland Criteria assessment process pathways for the Landscape, Soils, and Vegetation Assessments.

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#### 8.4. Items Out of Scope

**Contamination:** Drilling waste and other oilfield wastes must be properly disposed of according to AER Directives. All contamination must be remediated prior to application for certification. All contamination must be treated prior to application for certification. Specific criteria for the assessment and remediation of contaminants (e.g., salts, metals, sterilants, organic chemicals) are addressed by Alberta Environmental Tier 1 (Alberta Environment, 2010a) and 2 (Alberta Environment, 2010b) criteria.

**Previous Contractual Agreements:** A fundamental principle carried forward in these criteria is that the success of land reclamation is measured against the representative (adjacent) site conditions with due consideration for construction norms at the time of development. However, if there are previous contractual agreements between interested parties, it is the responsibilities of the parties involved to uphold those agreements.

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#### 8.5. Use of Professional Judgement

When assessors are using the 2010 Reclamation Criteria for Native Grasslands every attempt should be made to utilize adjacent lands as a representative control and/or reference community for the assessment. However, there may be situations that arise where the use of representative controls is not an option, such as:

- Restricted Access (i.e., assessors aren't granted access offsite);
- Representative controls are not available (i.e., native grassland onsite surrounded by forest and/or cultivated lands)

***Note: The use of a justification to explain why a site should pass indicates a Non-Routine Application which triggers further technical review by the Regulator (Appendix E). When these situations arise, assessors should discuss with the Regulator prior to conducting the assessment, when possible, to discuss options.***

***Under these circumstances assessors can use their professional judgement for determining whether a site should pass or fail. For situations where justifications are applied, the assessor must provide supporting rationale for their decision supported by acceptable references (i.e., soil surveys applicable to Alberta).***

***This information must be included with the application and will be subject to further review as a Non-routine Assessment.***

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#### 8.6. Assessment Tool and Record of Observation Datasheets

The 2010 Reclamation Criteria include additional tools for conducting the landscape, soil and vegetation assessments. A summary of the electronic tools that accompany the

2010 Reclamation Criteria are provided in the following sections, along with a description of whether the information is required in the form provided, or if an alternative containing equivalent information can be submitted.

### 8.6.1. Required Information, No Alternatives Permitted

This information is contained within the electronic tool that accompanies the 2010 Reclamation Criteria for Native Grasslands. This information **must** be submitted with the application, no substitution or alternative form is permitted.

- **Assessment Tool:** Contains questions related to the Landscape, Vegetation and Soils Criteria which may or may not require either a Yes/No answer, rating, measurement or some combination thereof.

*Note: The Assessment Tool questions apply to the site as a whole. Questions should be answered as though they apply to the entire site including associated infrastructure being assessed.*

- **Record of Observation (RoO) - Soil and Vegetation Datasheets:** Datasheets for recording soil and vegetation information, measurements and observations

### 8.6.2. Required Information, Alternative Forms Permitted

This information is contained within the electronic tool that accompanies the 2010 Reclamation Criteria. This information **must** be submitted with the application, however, alternatives to these forms are permitted provided they contain the equivalent information

- **Title Page and Tab Index (TP-ToC):** Title page and Table of Contents for the Assessment Tool Workbook.
- **Site Background:** For documenting the site background, special land management conditions, Land Manager comments.
- **Site and Lease Sketches:** The site sketch should delineate the areas of the lease affected by soils handling or other activities. Careful attention shall be paid to these areas. The site sketch should include changes to drainage patterns, slope, vegetation and any anomalies of offsite versus onsite. Site and lease sketches must be included with the application, the Tool contains examples of the site and lease sketch forms that could be included in the application.

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## 8.7. Assessing and Sampling the Site

The assessment methodologies and level of detail described in the following sections are the minimum that is acceptable for assessing native grassland sites.

### 8.7.1. Minimum Disturbance Sites: Undisturbed versus Disturbed Areas

Minimum disturbance sites are sites that have been reclaimed where construction practices have minimized the level of disturbance on the lease resulting in two different management zones (i.e., Undisturbed and Disturbed). The **Undisturbed/Disturbed**

areas must be delineated and mapped (Figure 3, next page). The entire site must undergo the landscape assessment to allow confirmation that the native community has remained relatively intact and verification of the areas identified as being either Undisturbed or Disturbed.

- **Undisturbed Areas** of the lease that pass the Vegetation assessment do not undergo a Soils Assessment. Areas of the site that do not meet the Undisturbed definition, are considered to be disturbed and therefore must undergo a Disturbed Assessment.
- **Disturbed Areas** of the lease require a complete Level 1 assessment (i.e., landscape, vegetation and soil assessments). A site that fails either the Landscape or Vegetation Assessment indicates the site is not ready for a reclamation certificate application and mitigation or additional time may be required. Portions of the site that fail the Level 1 Soil Assessment may proceed to a Level 2 Soil Assessment, or mitigate and re-assess, or additional time may be required.



**Figure 3. Examples of a lease sketch for a full disturbance site (left) and a lease sketch for minimal disturbance site (right).**

### 8.7.2. Sampling on Variable Sites

It is important to understand the nature of the variability of a site. In order to provide an understanding of this variability, it is suggested that prior to assessing the site assessors should review published information for the appropriate area, or conduct assessments at several control locations. The key is to have controls in representative conditions (e.g., slope positions) comparable to the lease. If a site has two or more distinct landscape types or management units assessors should consider stratifying the site, which involves subdividing the site into the respective units and drawing this on the site sketch (Figure 4; see next page Options #2, #3, or #4). Examples of sites that could be considered variable are those:

- with greater than 5% slope percentages;
- highly variable topography but no distinct landscape units;
- with different land management or soil landscape units; and/or
- with minimum control measurements <50% of the control average; and/or
- with maximum control measurements >150% of the control average

It is at the discretion of the assessor whether a site is considered to be variable. However, if determined to be a variable site, the site **must** meet at least one of the conditions outlined above (unless another option is justified) **and must** contain a minimum of 16 control assessment points.

### 8.7.3. Determining Sampling Intensity on the Lease

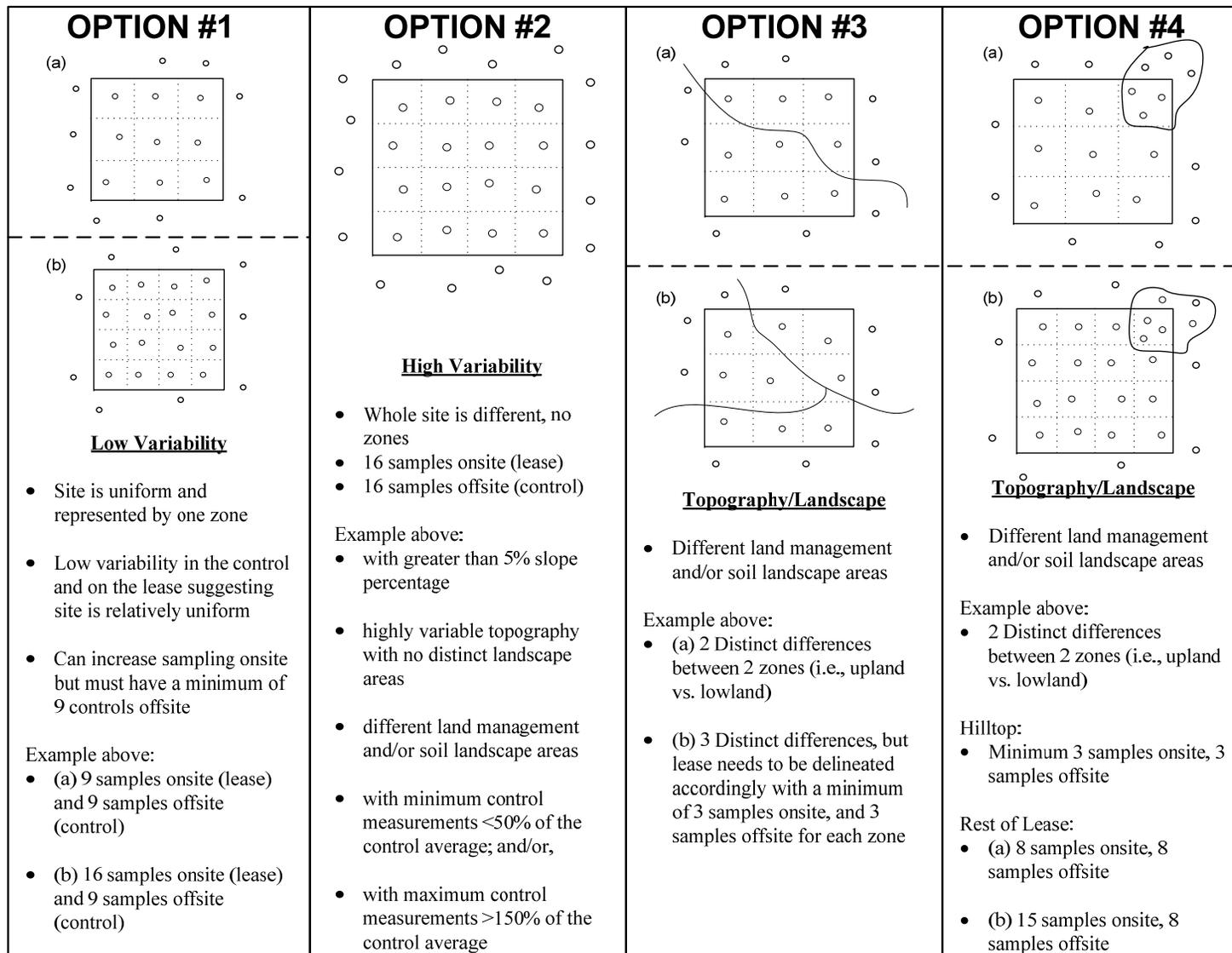
Assessment on the lease must address variability in site conditions while also considering the spatial distribution of both the onsite and offsite assessment locations. For the Native Grassland Criteria, the use of assessment locations randomly located within the lease can compensate for the anticipated variability.

The following guidelines should be followed when developing or conducting a sampling plan for assessing the lease under the the 2010 Reclamation Criteria for Native Grasslands.

- Assessment point spacing shall be adjusted to evenly cover the entire lease. Spacing shall be adjusted for different sized and shaped leases (Table 3). An increase in sampling intensity can also be triggered by a variable site requiring stratification, larger lease sizes, or different landscape units.

**Table 3. Sampling intensity based on size of disturbance on the site.**

Maximum disturbance size (m)	Minimum number of onsite sampling points	Minimum number of offsite sampling points
Up to: 40 m x 40 m (1600 m <sup>2</sup> )	3	3
80 m x 80 m (6400 m <sup>2</sup> )	4	4
120 m x 120 m (14, 400 m <sup>2</sup> )	9	9
>120 m (>14, 000 m <sup>2</sup> )	9 (+1 more for each additional 1600 m <sup>2</sup> )	9
<b>*Variable Sites</b>	16	16



**Figure 4. Potential sampling schemes depending on variability, topography, or land management areas (examples sites shown would have lease sizes of approximately 110 m x 110 m).**

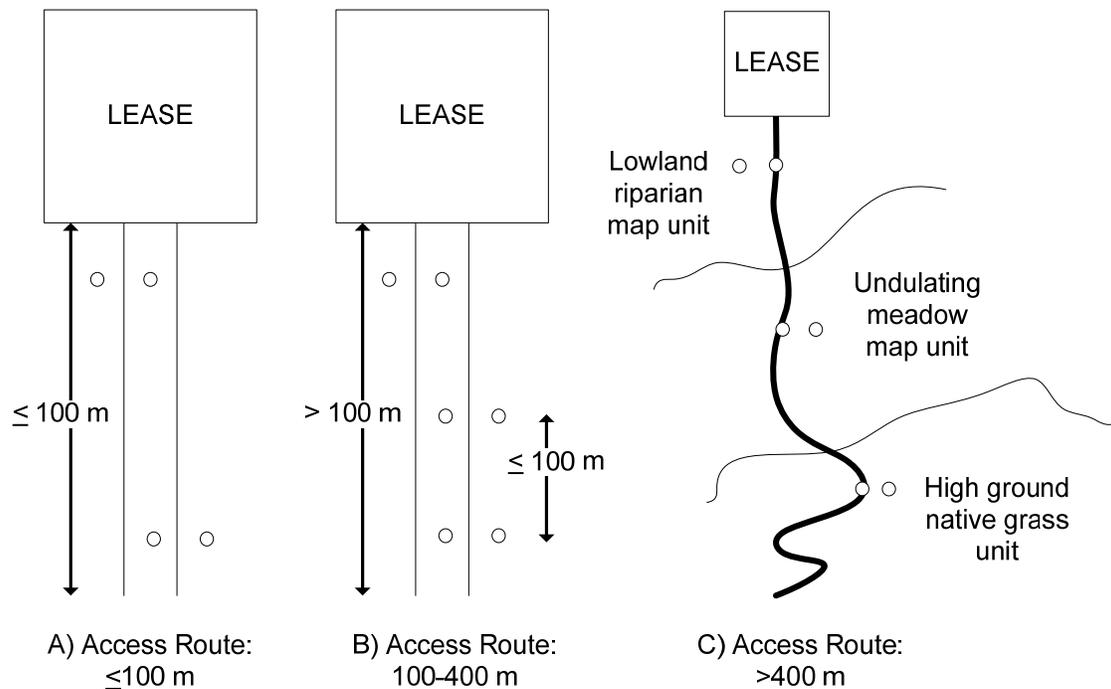
- Assessment points should be adjusted to ensure coverage of the following five locations if known: well centre, sump, flare pit, production area and entrance to the lease.
- Assessors should select an assessment point location within the grid area that best represents the grid.
- Assessment point spacing onsite must be  $\leq 40$  m and meet minimum sampling requirements. Additional assessment points should be added as required (i.e., 1 assessment point per additional 1600 m<sup>2</sup>, or 40 m x 40 m).
- In situations where sampling intensity has been increased onsite (i.e., step-outs are used, larger lease sizes) that may not coincide with a need to increase sampling intensity offsite, this would be acceptable (NOTE: this does not apply when sampling intensity is being increased because the site is being described as variable).
- If sampling intensity has been increased onsite (i.e., anomalies, step-outs ) an equivalent number of assessment points **do not** need to be taken offsite. However, sites **must** meet minimum sampling and spacing requirements as outlined above including the following:
  - **Full Disturbance Site:** requires a minimum of 9 assessment points onsite and 9 assessment points offsite. For sites where the lease edges are >120 m (including odd shaped leases), begin with 9 assessment points.
  - **Minimum Disturbance Site:** requires a minimum of 3 assessment points onsite and 3 assessment points offsite for any sized landscape or management area.
  - **Variable Site:** requires a minimum of 16 assessment points onsite and 16 assessment points offsite. The assessor will need to provide supporting rationale as to why the site was considered to be variable as part of the application.
- Quantity and quality of replaced surface soil will be assessed on a grid basis to a depth of 50 cm (typically the rooting zone). If a soil limitation (i.e., rooting restrictions and consistence) is encountered offsite, soils should be assessed to a comparable depth onsite; if no limitation is encountered offsite assess to a depth of 50 cm. If a soil limitation is encountered onsite, assess to the point of concern and/or a maximum depth of 1 m.
- Where sites have been stratified (i.e., different landscape or land management units) a minimum of 3 assessment points onsite and 3 assessment points offsite are required for any sized unit. A separate record of observation (RoO) datasheets must be submitted for for each area.

#### 8.7.4. Determining Sampling Intensity on the Access

On **Disturbed** accesses, the quantity and quality of replaced surface soil shall be assessed on a paired basis (one on the access and one in a control area). Assessment points should be adjusted so they are representative of disturbed and control areas, but must also address variability in site conditions. Assessment points should be adjusted so that the access approach and side hill cut areas are inspected. If the topography is variable, more assessment points shall be used to compare upper, mid and lower slope positions. At each assessment point, quantity and quality of replaced surface soil will be assessed on a grid basis to a depth of 50 cm using the same approach outlined in Determining Sampling Intensity on the Lease

The access should be assessed as follows:

- <100 m: a minimum of 2 paired assessment points shall be assessed along the access (Figure 5A, see next page).
- 100 to 400 m: paired assessment points shall be assessed along the access at intervals no greater than 100 m apart (Figure 5B, see next page).
- > 400 m: paired assessment points shall be located to reflect different mapping units (*i.e.*, topographic, vegetation and/or soils variability) with a minimum of one (1) assessment point per per map unit or a minimum of one (1) assessment point per 800 m (Figure 5C)



**Figure 5. Soil assessment locations along accesses that are (from left to right)  $\leq 100$  m, 100-400 m, or  $> 400$  m. It should be noted that for access roads  $< 100$  m a minimum of 2 paired assessment locations are required.**

### 8.7.5. Use of Step-outs

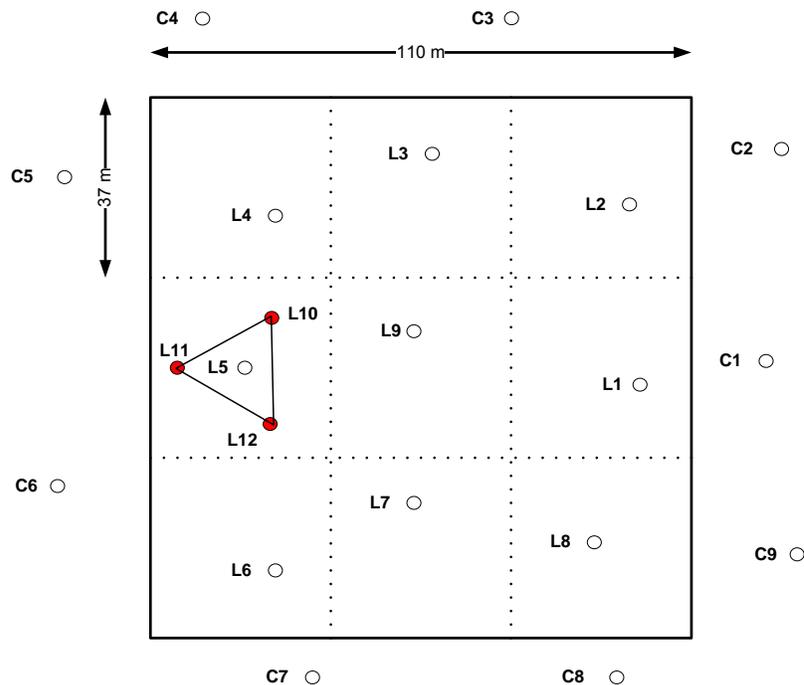
When an anomaly is encountered on the lease or along the access, a 'step-out' inspection can be conducted to determine if it is still representative. A step-out consists of assessing a minimum of 3 additional points, located up to 10 m in a triangular shape from the original assessment point (Figure 6). Assessment point intensity and spacing will change depending on size of disturbance, or landscape complexity. In the example shown in Figure 6, a step-out is shown on the lease around assessment point L5. The original assessment point is removed from the calculation of the overall lease average, it is replaced with three additional points which are now added to the overall calculation. Now 11 assessment points from the lease area will be compared against 9 assessment points from the control area). It is recognized that additional step-outs will result in an

increase in sampling intensity and will affect initial sample spacing. Where step-outs are used for verification of those parameters where measurements are required (*i.e.*, soil depth) the assessor:

- Should conduct as many step-outs as necessary to confirm data and increase confidence;
- Must record and report the data from the original assessment point location and reference it on the site diagram;
- Must record and report all the data from the three additional assessment points added from the step-out and reference them on the site diagram;
- Must include only the three (3) new assessment points in the new calculation and comparison of onsite to offsite measurements. These are not averaged prior to being included in the overall calculation, but included as individual points in the new calculation.

If a number of step-outs are required on a site, the assessor(s) should consider the following:

- Increase the sampling intensity onsite and offsite to verify this is not a variable site (see Assessing and Sampling the Site); or,
- Stratify into two or more landscape and/or management units using the appropriate sampling requirements (see Assessing and Sampling the Site).



**Figure 6. Disturbed assessment assessment points for soils with an approximate 37 m x 37 m assessment point spacing on a fully stripped lease.**

## 8.8. Assessment Comparisons

This assessment comparison methodology is a hybrid of a capability assessment system and criteria. The parameters that are assessed as surrogates of ecosystem function and subsequently compared are outlined in Table 4.

### 8.8.1. Vegetation and Soil Comparisons

For the Vegetation Assessment, in addition to documenting the plant species on the lease compared to the control, assessors must also provide ratings for the number of structural layers, litter quality and weeds present. For the soil assessment, the assessment evaluates one (1) measured parameter (i.e., Topsoil Depth) plus an additional nine (9) rated parameters. The difference in the average rating onsite is the compared to the average of the offsite rating(s).

#### 8.8.1.1. ON THE LEASE

The average ratings are compared between onsite and offsite measurements for each of the parameters measured and/or rated as part of the vegetation or soil assessments. For rated parameters the difference in the average rating onsite compared to the average rating offsite cannot be greater than **0.30** if an equivalent number of controls are assessed. The difference in the average rating onsite compared to the average rating offsite cannot be greater than **0.15** if there are fewer assessment points offsite than onsite (e.g., 9 offsite and 16 onsite). No parameter can drop more than two rating categories onsite compared to the lowest rating category offsite.

#### 8.8.1.1. ON THE ACCESS

No parameter can drop more than one rating category onsite compared to the lowest rating category offsite (Table 4). As part of the pass/fail for the vegetation or soil assessments the measured parameters must meet the specific tolerances for the construction period requirement outlined in (Table 4).

### 8.8.2. Methods for Variable Sites

For variable sites, such as those defined above under the section Sampling on Variable Sites, alternative comparison methods may be applied. The use of an alternative method can only be applied to sites where 16 assessment points were assessed offsite and 16 assessment points assessed onsite. In these cases, alternative comparison methods for physical measurements (i.e., 95% Confidence Interval – CI, Standard Error) can be applied to compare onsite and offsite measurements; alternative comparison methods cannot be used for rating categories. The method, reason for use, and the comparison value **must** be recorded in the Assessment Tool.

***Note: If an alternative method is used, assessors should discuss with the Regulator prior to submission of the Application. When alternative comparison methods are used, these applications will be considered a Non-Routine Application and subject to further technical review by the Regulator.***

**Table 4. Tolerances for rating categories and physical measurements for the vegetation and soil criteria according to the number of assessment points onsite**

	Number of Assessment Points		
	Access 1	≤9	Lease ≥9
Pass			
A) Parameter Comparison			
a Allowable Rating Drop			
1) Compared to Control			
i) Structural Layers	1: There cannot be a difference greater than 1 in the number of structural layers between the onsite and offsite. For the calculation, the average number of structural layers onsite and offsite should be rounded to the nearest whole number		
2) Compared to Lowest Control Rating			
i) Structural Layers	1	1	2: There cannot be a difference of more than 2 structural layers between the lowest control assessment and the lowest lease measurement
ii Remaining Parameters	1	1	2: There cannot be a difference >2 ratings categories between the lowest control rating and the lowest rating at any assessment point on the lease.
b) Average Rating	Must meet average rating comparison <0.30	<b>Equivalent number of controls:</b> average rating onsite compared to the average rating offsite cannot be greater than 0.30. <b>Fewer controls:</b> average rating onsite compared to the average rating offsite cannot be greater than 0.15.	
B Measured Parameters <sup>a</sup> :	----- Lease and Access -----		
a) Vegetation:			
1) %-Cover Assessment			
i) <i>Undisturbed Assessment</i>	≥ 70% of the Average Control % Cover Assessment		
ii) <i>Disturbed Assessment</i>	≥ 50% of the Average Control % Cover Assessment		
2) Litter Assessment			
i) <i>Undisturbed Assessment</i>	≥ 65% of the litter threshold value		
ii) <i>Disturbed Assessment</i>	≥ 15% of the litter threshold value		
b) Soil:			
1 Lease - Overall			
i) <i>After April 30, 1994</i>	≥ 80% of Average Control Measurement (Less than 20% Variance)		
ii) <i>Before April 30, 1994</i>	≥ 60% of Average Control Measurement (Less than 40% Variance)		
2 Access - Assessment Point			
i) <i>After April 30, 1994</i>	≥ 80% of Average Control Measurement (Less than 20% Variance)		
ii) <i>Before April 30, 1994</i>	≥ 60% of Average Control Measurement (Less than 40% Variance)		
Fail	Does not meet above conditions		

<sup>a</sup> Tolerances for measured parameters must be met prior to assigning and conducting rating comparisons.

END OF SECTION

## 9. Landscape Assessment

Landscape criteria are assessed by looking at the site as a whole (Table 5), from several vantage points on the site. The landscape criteria will be assessed by comparing the site with the adjacent land. Differences between the site and the adjacent land must not interfere with normal land use and cannot have a negative impact onsite or offsite. To meet the landscape criteria, the reclaimed site must not pose a negative impact to site capability. The measurements for each assessment location shall be recorded in the Assessment Tool and RoO.

**Table 5. Landscape Parameters for 2010 Grasslands Reclamation Assessment. The landscape parameters require a qualitative assessment with a 'yes/no' response, and comments can also be provided.**

Parameter	Assessment Criteria	Assessment Tool Question	Pass / Fail Point
<b>Drainage</b>	Site drainage shall be consistent with the original patterns, directions and capacity or be compatible with the surrounding landscape. Facilities or features left in place (e.g., clay pads) must not negatively impact drainage.	Surface Water Flow; Ponding; Riparian Areas	Yes
<b>Erosion</b>	No more erosion gullies or blowouts than on adjacent land allowed.	Erosion	Yes
<b>Stability</b>	No visible evidence of slope movement, slumping, subsidence, or tension cracks allowed.	Subsidence	Yes
<b>Bare Areas</b>	Number and size of bare areas shall not be greater than original or control vegetation.	Bare Areas	Yes
<b>Operability</b>	<b>Contour:</b> Contour and roughness must conform and blend with adjacent contours or be consistent with present or intended land use.  <b>Gravel and Rock:</b> May not be piled, windrowed or concentrated in one area.	Macro-contour; Meso-contour; Gravel and Rock	Yes
<b>Debris</b>	No industrial or domestic debris allowed.	Organic Debris; Refuse	Yes

### 9.1. Drainage

Pre-disturbance aerial photographs, observations of the surrounding landscape and consultation with the Land Manager can help to establish what the normal direction and dispersion patterns should be. Visually assess the direction/dispersion of onsite drainage to determine whether it conforms to the drainage of the surrounding area. If ponding is found, its presence must be documented and an explanation given regarding the site-specific conditions which indicate ponding is consistent with adjacent lands. For example, ponding may be normal depending on the pre-disturbance conditions, the surrounding landscape (e.g., knob and kettle landscape) and/or the timing of assessment relative to moisture events (i.e., snow melt or recent precipitation).

### 9.1.1. Surface Water Flow

**Onsite Drainage:** The presence of water-tolerant vegetation (alive or recently dead) or lack of vegetation may indicate poor soil water drainage. Sites with significant soil compaction, presence of sub-surface hard-pans or that have been poorly re-contoured will often result in ponding and this situation must be mitigated. The presence of standing water does not in itself constitute evidence of poor reclamation.

**Offsite Drainage (cross-site flow):** Surficial water movement is often more readily apparent than sub-surface flow, however, the impact of the lease to soil conditions may extend into the immediate subsurface and disrupt water movement. Cross-site flow disruptions are most likely to occur with long linear features (roads) or large facilities, but the extent of the impact depends upon the local hydrology and sub-surface topography.

### 9.1.2. Ponding

Evidence of offsite (upstream) ponding could indicate that the lease has interrupted subsurface and/or cross surface drainage. The presence of onsite ponding must be documented and should be consistent with offsite conditions. For example, standing water 'ponding' may be 'normal' depending on the pre-disturbance conditions, the surrounding landscape (e.g., knob and kettle landscape) and the timing of assessment relative to moisture events (i.e., snow melt or recent precipitation). The assessment is visual and there shall be no evidence of excessive ponding as a result of the reclaimed lease.

### 9.1.3. Riparian Functions

Riparian lands are transition zones between land and water bodies and include any geographic area that adjoins or directly influences a water body (e.g., streams, lakes, ponds, and wetlands which may include floodplains) and land that directly influences alluvial aquifers and may be subject to flooding. These lands fall under the Water Act, which protects all water resources in the the province (Appendix A).

#### 9.1.3.1. BANK OR SHORE STABILITY

AER Directive 056 (Energy Development Applications and Schedules) along with other applicable provincial and federal legislation (i.e., Environmental Protection and Enhancement Act, Water Act, Public Lands Act and the Navigable Waters Protection Act) requires water bodies be protected during construction and through the operating life of the project.

For reclamation, if the lease abuts a water body's bank or shore, there should be no evidence of shore/bank instability (e.g., slumping, channeling within banks ) greater than is found on the offsite bank or shore. The vegetation must be a comparable, self-sustaining native vegetative community or provide evidence that it is on the corresponding successional trajectory to the surrounding area. Short lived, non-native species may be appropriate to assist with shore/bed stabilization.

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## 9.2. Erosion

Risk of erosion is often inherent based on the method chosen to reclaim the native grassland. Methods such as natural recovery may extend the time the site is at risk because of the length of time required to establish vegetation. The test of whether the risk and degree of erosion found at the assessment time is acceptable requires judgment as to whether the erosion type/rate occurring is compromising the ultimate goal of establishing native vegetation. If the site, or portions thereof, is unstable, reclamation should not create conditions that would exacerbate these natural conditions.

### 9.2.1. Water Erosion

**Gullying:** This is evidence of a major flow problem and its presence cannot exceed the surrounding landscape or pre-disturbance conditions. Gullying may be part of the normal processes on certain sites, but evidence must be provided to substantiate that the degree, spatial extent, rate and severity of the documented onsite gullying is consistent with the surrounding area.

**Rilling, pedestaling or presence of depositional fans:** These are evidence of loss of soil and excessive overland water flow. Loss of topsoil can seriously deplete a site's nutrients and productivity. Evidence of excessive flow may suggest poor re-contouring and/or presence of subsoil compaction.

*Note: Micro-erosion within the micro-topography (on the order of cm) does not normally constitute a risk to the function at a site*

### 9.2.2. Wind Erosion

Erosion due to wind is evidenced by leaf abrasion, plant pedestaling and soil deflation, which may result in a loss of vegetative health. Evidence of wind erosion cannot be greater onsite than in the surrounding landscape.

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## 9.3. Soil Stability

### 9.3.1. Slumping/Wasting

Slumping and wasting (mass movement of soil) is not a common occurrence; however, locations may exist where naturally unstable slopes move and slumping/wasting are considered 'normal'. Any slumping and/or wasting on a reclaimed site must be documented and evidence from adjacent areas (or pre-disturbance information) included that demonstrates that the scale and amount of slumping/wasting seen onsite is 'normal' for the area.

### 9.3.2. Subsidence

Subsidence is the result of a structural failure (e.g., sunken areas, etc.) and additional work is needed to stabilize the site in most cases. If ecosystem function and operability

are not impaired, a case may be made for not disturbing the site to repair the subsidence.

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#### **9.4. Bare Areas**

Bare areas, described as areas devoid of vegetation with exposed mineral soil, can be common in native grasslands (e.g., blowouts on solonchic landscapes). The extent of natural bare areas will vary depending on the natural subregion and range ecological site. For example, in the Foothills Fescue, the extent may be less than 1%, while in the Dry Mixedgrass, it may be as high as 50%. During the initial stages of reclamation, it is important that the amount of bare areas does not create an accelerated erosion problem. Assuming the site's revegetation is on the correct trajectory, it is sufficient to know that the extent of bare areas is being reduced to within the natural variation of the adjacent control areas. In natural encroachment or natural recovery, moss or lichen recovery takes many years, hence it cannot be expected on a recently reclaimed site.

Areas with sparse or patchy vegetation and/or areas between seed rows can include exposed mineral soil; these should be referred to as bare ground rather than bare areas and assessed in the total cover measurement. If there are differences in bare areas caused by third party impacts (e.g., cattle trails, badger holes) this is not a failure but needs to be documented.

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#### **9.5. Operability**

On native grasslands, operability refers to land management practices such as grazing. The measure of operability is a visual assessment during the landscape assessment comparing the lease and access to adjacent control lands.

##### **9.5.1. Contour**

**Micro-contour:** Micro-contour is not assessed in the Native Grassland Criteria.

**Meso-contour (integration with surrounding landscape):** (10-30 m width scale; see Figure 7 next page), things seen at an assessment location like settled cut and fill, ponding.

**Macro-contour (integration with surrounding landscape):** (30-100 m width scale; see Figure 7 next page) should be comparable to the offsite landscape and not result in excessive erosion, slumping/wasting or water flow issues.

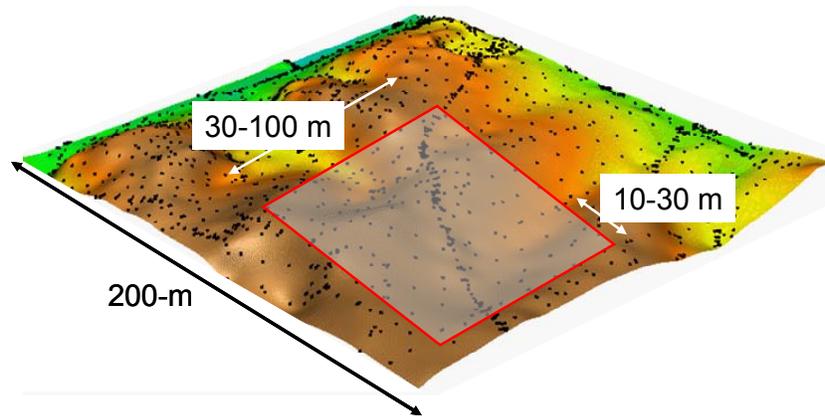


Figure 7. Figure showing examples for macro- (30-100 m) and meso-contour (10-30 m).

### 9.5.2. Gravel and Rock

**Surface Stoniness/Coarse Fragment Content:** The presence of naturally occurring stones within reclaimed areas presents no significant risks to the ecosystem's functioning, or normal land use, and can often aid in creating small-scale roughness which enhances the establishment and development of vegetation. Generally, stoniness is not an issue, but stones/rocks shall not be piled or concentrated such that it could affect operability. The assessment criteria should also capture any detrimental effects caused from the excessive concentration of stones/rocks (*i.e.*, inadequate vegetation cover). Record the data in the Assessment Tool.



Figure 8. Figures showing examples for surface stoniness (figure left) and coarse fragment content (figure right)

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## **9.6. Debris**

### **9.6.1. Organic debris**

The presence of litter is an indicator that ecological function has been restored and is noted in the Vegetation assessment. Coarse debris (*e.g.*, branches and woody stems), sourced from or consistent with the surrounding community, can also contribute to site stability and revegetation and provide habitat for native species. In addition, organic debris can reduce evapotranspiration and moderate the ground surface temperature. Fine organic debris (*e.g.*, hydro mulch, sawdust, clean straw) should not be excessive, as it can be detrimental to soil thermal conditions and plant recruitment or may be allelopathic. Excess debris may have to be removed from the site (Alberta Sustainable Resource Development, 2007a). The use of fine organic material may introduce undesirable plants to the reclaimed site so introduced material should be inspected prior to application.

### **9.6.2. Industrial and domestic refuse**

Industrial and domestic refuse is not acceptable and must be removed.

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END OF SECTION

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## 10. Vegetation Assessment

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For the 2010 Reclamation Criteria, native grasslands are defined as lands where the dominant vegetation is comprised of native graminoid species and associated forbs and woody species.

The desirable plants on a native grassland lease should comprise a suite of species representative of the adjoining native grassland control. To achieve reclamation success, there must be assurance that the site will achieve a plant community similar to that of the control. However, sites may not reach a condition suitable for the establishment of later seral stage and climax species for many years. Therefore, reclamation success is measured by the evidence of a positive successional trajectory (pathway). Evidence of a positive successional trajectory can be inferred by measuring the cover of desirable species that have re-established on the **Disturbed** area (e.g., seeded native species and native encroachment). The measurement of litter, site stability, weeds or invasive species provide additional important indicators of successful reclamation.

Natural Recovery and Assisted Natural Recovery are methods of re-establishing the native plant community. For example, native species cultivars, in situ native seed banks, annual or noncompetitive species (for erosion and weed control) can be used to revegetate sites. The methods of using native species cultivars or short-lived early successional perennials may minimize the invasion of undesirable agronomic and weedy species such as brome, timothy, clover, kentucky bluegrass, Canada thistle and leafy spurge. Guidance for different recovery strategies for industrial development in native prairie are currently under development by natural subregion. The first, Dry Mixed Grass Natural Subregion: Recovery Strategies for Industrial Development has been completed ([www.foothillsrestorationforum.ca](http://www.foothillsrestorationforum.ca); Gramineae Services, 2013).

The primary method for assessing the success of reclaimed Native Grasslands is an assessment of the species present and a grouping according to their grazing response. The approach outlined requires the practitioner to carefully identify the plant species present, these species are then assigned to an appropriate grazing response (Type 1, 2, 3 and 4 species) allowing reclamation success to be calculated. In the species list provided, for each natural subregion species have been the appropriate grazing response and structural layer. These grazing response groups have been incorporated into the 2010 Reclamation Criteria for Native Grasslands to assess the status of reclaimed sites, range plants are grouped as follows:

- **Type 1 Species** (Decreasers): These native species decrease in abundance due to disturbance. These are normally considered as the most desirable and productive native species in the native plant community.
- **Type 2 Species** (Increaser – Sub Type 1): These species increase in abundance as decreaseers decline. They are commonly shorter, less productive species more resistant to grazing and other disturbances. Initially, Type 1 species increase with disturbance but

then decrease in abundance later on as grazing or other disturbance pressures continue to increase.

- **Type 3 Species (Invaders):** Invaders are introduced non-native species and not normally a component of the reference plant community.
- **Type 4 Species (Increaser – Sub Type 2):** This is a minor group of native increasers that increase in abundance as grazing or other disturbances increase (e.g. low sedge, fringed sage or blue grama grass). These species are highly adapted to disturbance. A high abundance of these species on a reclaimed site may provide a false indication of successful reclamation indicating that the plant community remains at a juvenile stage of succession. Type 4 species are used in the criteria (sites constructed after 1993, reclaimed after 2010) as an indicator of ecological health (Section 7.3).

Table 6 summarizes the parameters to be assessed for the Vegetation Assessment component for the 2010 Reclamation Criteria for Native Grasslands.

**Table 6. Vegetation methodology parameters and their respective Assessment Tool Questions**

Parameter:	Assessment Tool Questions	<sup>a</sup> RoO Information Required (Yes / No)		Pass / Fail Point
		Measurement	Rating	
<b>Desired Plants Presence and Cover</b>	Undisturbed Assessment; Disturbed Assessment	Yes, document species type	No	Yes
<b>Plant Community Structure</b>	Structural Layers	Yes	Yes	Yes
<b>Weeds</b>	Prohibited Noxious; Noxious; Problem / Volunteer	Yes	Yes	Yes
<b>Litter Production</b>	Litter Quantity	Yes	No	Yes
	Litter Quality	Yes	No	Yes

<sup>a</sup> Yes = Assessment Tool question plus a measurement or rating are required; No = Only an answer to the Assessment Tool question is required.

### 10.1. Undisturbed vs. Disturbed Assessments Methodology

When assessors are conducting the Vegetation Assessment of the 2010 Reclamation Criteria for Native Grasslands every attempt should be made to utilize adjacent lands as the representative control. If presite data is available it can be used as a control but, assessors should consider the timelag, relevance, and quality of the data. If representative controls are not available (i.e., native grassland onsite surrounded by forest and/or cultivated lands ) assessors shall select the appropriate reference plant community (i.e., Range Plant Community Guides; Alberta Sustainable Resource Development ) as the control.

The Undisturbed vegetation assessment applies to a lease or contiguous portion of a lease (delineated on a site map; Figure 1) with no evidence of soil disturbance. In the Undisturbed assessment, plant species cover is assessed on a polygon basis,

consisting of the undisturbed lease area and adjoining control. For guidance on the polygonal assessment, the Alberta Rangeland Health Assessment protocol for Grasslands (Alberta Sustainable Resource Development, 2005) can be used. This approach requires all species identified during the polygonal assessment onsite and offsite to be recorded in the RoO. All plant species with a cover value of 2% or greater should be included and documented in the Tool. If plot frame control locations were completed for the disturbed assessment, they may be used as the control for the undisturbed areas.

By comparison, the Disturbed assessment is for sites that are being revegetated after surface disturbance or which have a history or evidence of soil disturbance. In the Disturbed assessment, plant species cover is assessed using plot frame assessments (Figure 9; 0.10 m<sup>2</sup>). The protocol requires cover measurements of each assessment location be recorded in the RoO using the seven letter latin abbreviation.

Record the cover for each species to a minimum of 1% (list all species that exist within the plot frame that have a canopy cover  $\geq 1\%$ ). For guidance on estimating vegetation cover see page 22 of the Alberta Rangeland Health Assessment Workbook (Alberta Sustainable Resource Development, 2005).



**Figure 9. Example plot frame assessment of cover (0.10 m<sup>2</sup>) and also used for litter estimation 0.25 m<sup>2</sup> (Disturbed areas)**

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## 10.2. Desirable Species Cover

Desirable species cover is calculated based on the class of species that were required at the time of reclamation (Table 7). These classes must be selected in the RoO carefully, to ensure percent cover and Desirable Species components are correct for specific implementation date requirements (Table 2).

The classes within the drop down RoO include:

- *Native-Infill* – Native-Infill (Section 7.3)
- *Accept-Sub* - Acceptable Substitutions (Section 7.3)
- *Comp* - Compatible species (Glossary)
- *Prob-Intro* - Problem Introduced Forages (R&R/03-05 IL; Alberta Environment, 2003)
- *Weeds-proh* -Prohibited Noxious weeds (Section 7.4)
- *Weeds – nox* - Noxious weeds (Section 7.4)

### 10.3. Calculating Percent Cover of Native-Infill and Allowable Acceptable Substitutions

- The **Undisturbed** and **Disturbed** assessments differ with regards to desirable plant species presence and cover reflecting the impact of disturbance to vegetation.
- The **Undisturbed** assessment species composition should be directly reflected in the control. If species composition in the undisturbed area is not reflected in the representative controls, it is an indicator of disturbance and the area should be assessed with the **Disturbed** assessment.
- The percent desirable species for the **Disturbed** assessment is determined by combining the allowable percent cover of native-infill species and percent cover of allowable acceptable substitutions, as defined below.
- **Native-Infilling species:** are, for the purposes of the 2010 Reclamation Criteria, a combination of native species from the controls or were seeded that are establishing on the disturbed area and are indistinguishable as to their source. They are considered desirable as they are part of the local native plant community and their presence is a measure of native species recruitment and progress along a successional pathway. When calculating native-infill for sites constructed after 1993 and reclaimed after 2010:
  - Native-Infill must comprise 15% of the desirable species, relative to the control.
  - Native-Infill percentages **cannot exceed the percentage** found within the control. This is automated in the tool. For example, if the average off-site percentage of slender wheatgrass was 3% and slender wheatgrass was 15% on-site, only 3% would contribute to the 15% native-infill requirement. If seedmixes are designed to include offsite native species, these will contribute to the percent native-infill.
  - Type 4 native-infill species are limited to comprise up to a maximum of 5% of the native-infill requirement. This threshold is automated in the Tool when the “Identify Type 4 species” column is populated.
- **Acceptable Substitutions:** for the purposes of the 2010 Reclamation Criteria, include seeded native (Type 1 and 2) species that *may* not be present on the control but are part of the natural subregion (See the RoO for a species list of native species to the individual subregions). Their presence is considered temporary as succession proceeds, but in the short-term they are considered desirable species as they provide ecological benefits such as sheltering canopy, site stabilization and litter accumulation. Acceptable substitutions include the following:
  - **Prior to Jan 1, 2010:** All Type 1 and 2 species that are not present in the control but are native to the natural subregion;
  - **On or After Jan 1, 2010:** Type 1 and 2 species, but their contribution to the percent cover requirement may be limited based on the Allowable Acceptable Substitution calculations.

**Table 7. Vegetation classes for calculating total percent cover for each of the implementation periods.**

Constructed Before January 1, 1993; but Sites Abandoned and/or Reclaimed:		Constructed After January 1, 1993; but Sites Abandoned and/or Reclaimed:	
Before 2001:	After 2001:	From Jan 1, 1993 to Jan 1, 2010:	On or after January 1, 2010:
<i>Native Infill</i>	<i>Native Infill</i>	<i>Native Infill</i>	<i>Native Infill</i>
+ <i>All Acceptable Substitutions</i>	+ <i>All Acceptable Substitutions</i>	+ <i>All Acceptable Substitutions</i>	+ <i>Allowable<sup>3</sup> Acceptable Substitutions</i>
+ <i>Compatible Species</i>	+ <i>Compatible Species</i>	+ <i>Compatible Species</i>	
+ <i>Problem Introduced Forages<sup>1</sup></i>	+ <i>Problem Introduced Forages<sup>1</sup></i>		
-----	-----	-----	-----
= % <i>Cover</i>	= % <i>Cover</i>	= % <i>Cover</i>	= % <i>Cover</i>
<sup>1</sup> R&R/03-05 Problem Introduced Forages (Alberta Environment, 2003)	<sup>1</sup> R&R/03-05 Problem Introduced Forages (Alberta Environment, 2003) After reasonable documented effort has been made to control the Problem Introduced Forages.		<sup>3</sup> See how to calculate Allowable Substitutions in Section 7.3
<b>Undisturbed Assessment:</b>			
• Not Applicable	• Not Applicable	• ≥ 70% Cover in Control	• ≥ 70% Cover in Control
<b>Disturbed Assessment:</b>			
• % Cover ≥ 70% Cover in Control	• % Cover ≥ 70% Cover in Control	• ≥ 50% Cover in Control	• ≥ 50% Cover in Control • ≥ 15% Native-Infill, native species must be found onsite

- **Allowable Acceptable Substitutions:** Is the percent cover of “Acceptable Substitutions” that are allowed to contribute to the percent cover requirement, (sites constructed after 1993 and reclaimed after 2010). The presence of Type 4 species in the controls is used as the indicator of ecological health and the amount of “Allowable Acceptable Substitutions” that can contribute to the percent cover requirement. The percent “Allowable Acceptable Substitutions” is calculated by subtracting the total Type 4 percent cover in the control from the total percent Type 4 cover onsite (Equation 1). The difference is the maximum “Acceptable Substitutions” (of seeded, native to the subregion Type 1 or 2 species), that are allowed to contribute to the percent cover requirement.
- The “Allowable Acceptable Substitution’s” calculation is designed as a simple method to ensure grasslands are reclaimed to a similar level of ecological health as offsite. For example, where Type 4 species such as Blue grama and Fringe Sage have high cover values offsite, this indicates that the control is of lower ecological health and the allowable percentage of “Acceptable Substitutions” will increase. In contrast, where the controls and thus surrounding area is ecologically intact, with a minor component of Type 4 species, the calculation will reflect the increase in ecological health, by decreasing the “Allowable Acceptable Substitutions”.

**Equation 1. “Allowable Acceptable Substitutions Calculation (the amount of acceptable substitutions that are allowed to contribute to the total desirable species cover).**

$$\begin{array}{r}
 \text{(Total \% Cover of Type 4 Species in Control Area)} \\
 - \text{(Total \% Cover of Type 4 Species Onsite)} \\
 \hline
 = \text{(Total \% Cover of Allowable Acceptable Substitutions)}
 \end{array}$$

**Note: “Allowable Acceptable Substitutions” are only calculated for sites constructed after 1993 and reclaimed after 2010. Sites constructed and/or reclaimed prior to the above, percent cover requirement includes ALL “Acceptable Substitutions” found onsite.**

#### **10.4. Desirable Species Percent Cover Calculation**

For determining the percent cover of desirable species, “Percent Desirable Species” is calculated by combining the “Percent Cover Of Infill Species” with the portion of seeded native species deemed either “Acceptable Substitutions” or “Allowable Acceptable Substitutions” (Equation 1).

The Undisturbed assessment is based on a visual estimate of plant species cover. The threshold for a pass for the Undisturbed assessment is ≥70% desirable species cover compared to the control.

The Disturbed assessment is based on sampling a number of locations within the control and lease, sample intensity being appropriate to the size and complexity of the disturbed area. “Percent Desirable Plant Species” is calculated by combining the “Percent Cover Of Infill Species” with the portion of seeded native species deemed

“Allowable Acceptable Substitutions” (see Equation 2 and 3). For a Pass, “Percent Desirable Species” must meet the following criteria:

- Allowable acceptable substitutions and infill requirements as outlined above.
- Percent Desirable Species must be ≥50% of the **control**. Native-Infill must comprise a minimum of 15% of the desirable species cover (of the 50% desirable species cover, a minimum 15% cover must be native-infill).

**Note: Sites constructed after 1994 and reclaimed after January 1, 2010 must meet the Percent Desirable Species requirement of 50% of the control, with a 15% or greater Native-Infill Species component. Sites constructed prior must meet the appropriate vegetation criteria outlined in Table 2.**

For a detailed example see Table 8.

**Equation 2. Desirable species calculation, calculations shown are for sites constructed after 1993 and reclaimed:**

<i>Before January 1, 2010</i>	<i>On or after January 1, 2010</i>
<i>* (see Table 7 for specific requirements)</i>	
<i>(Compatible Species)</i>	
<i>+ (% Acceptable Substitutions)</i>	<i>(% Allowable Acceptable Substitutions)</i>
<i>+ (% Native Infill Species)</i>	<i>+ (% Native Infill Species upto Control% *)</i>
<i>-----</i>	<i>-----</i>
<i>= (% Desirable Species)</i>	<i>= (% Desirable Species)</i>

\* See Section 7.3 for how to calculate

Once the percent Total Cover for the “Percent Desirable Species” has been calculated for the lease, it is compared to the percent Total Cover for native species in the control (Equation 3).

**Equation 3. Threshold calculation to compare “Percent Desirable Species” on the lease to the Total Cover of native species in the control.**

$$\frac{\text{Total \% Cover of Percent Desirable Species on the Lease}}{\text{Total \% Cover of Native Species on the Control}} = \text{Threshold}$$

**Table 8. Example of using the desirable species calculation for an example site from the Dry Mixed Grass subregion constructed in 1998 and reclaimed in July 2010 with example calculations of a pass (Example A) and a fail (Example B).**

CONTROL DATA:			
Needle and thread grass	25%	Total Percent Cover	68%
Western wheatgrass	15%		
Blue grama grass	10%		
Scarlet mallow	10%		
June Grass	8%		
EXAMPLE A: Disturbed Onsite (Total % Cover)		EXAMPLE B: Disturbed Onsite (Total % Cover)	
Native-Infill Species		Native-Infill Species	
Needle and thread grass	10%	Needle and thread grass	40%
Western wheatgrass	10%	Blue grama grass	10%
June Grass	15%	Acceptable Substitutions	
Blue grama grass	2%	Slender wheatgrass	15%
Acceptable Substitutions		Northern wheatgrass	15%
Fowl Bluegrass		Other	
Northern wheatgrass	8%	Fringed Brome	
	8%	Alpine timothy	15%
			10%
Allowable Contributions to "Desirable Species Cover"			
Native-Infill Species		Native-Infill Species	
Needle and thread grass	10%	Needle and thread grass	25%*
Western wheatgrass	10%	Blue grama grass	5%**
June Grass	8%*	Percent Cover	
Blue grama grass	2%	Native-Infill Contribution	30%****
Percent Cover		Native-Infill Contribution	
Native-Infill Contribution	30%****		
Allowable Acceptable Substitutions:			
Blue grama 10% -2% =	8%***	Blue grama 10% -10% =	0%***
Fowl Bluegrass	8% <u>OR</u>	Slender Wheatgrass	0%
Northern wheatgrass	8%	Northern wheatgrass	0%
		Other (Not native to subregion)	0%*****
		Fringed Brome	0%*****
		Alpine timothy	0%*****
Allowable Acceptable Substitutions	8%		0%
Desirable Species:			
A: 30% + 8% = 38% 38% / 68% = 56% (Pass) *****		B: 30% + 0% = 30% 30% / 68% = 44% (Fail)	

\* Native-Infill species cannot exceed what was found in the control

\*\* Type 4 species can contribute a maximum of 5% to Native-Infill

\*\*\* "Allowable Acceptable Substitutions" (native to the subregion Type 1 and 2) are calculated by subtracting the total percent cover of Type 4 species in the control from the total percent cover of the Type 4 species onsite.

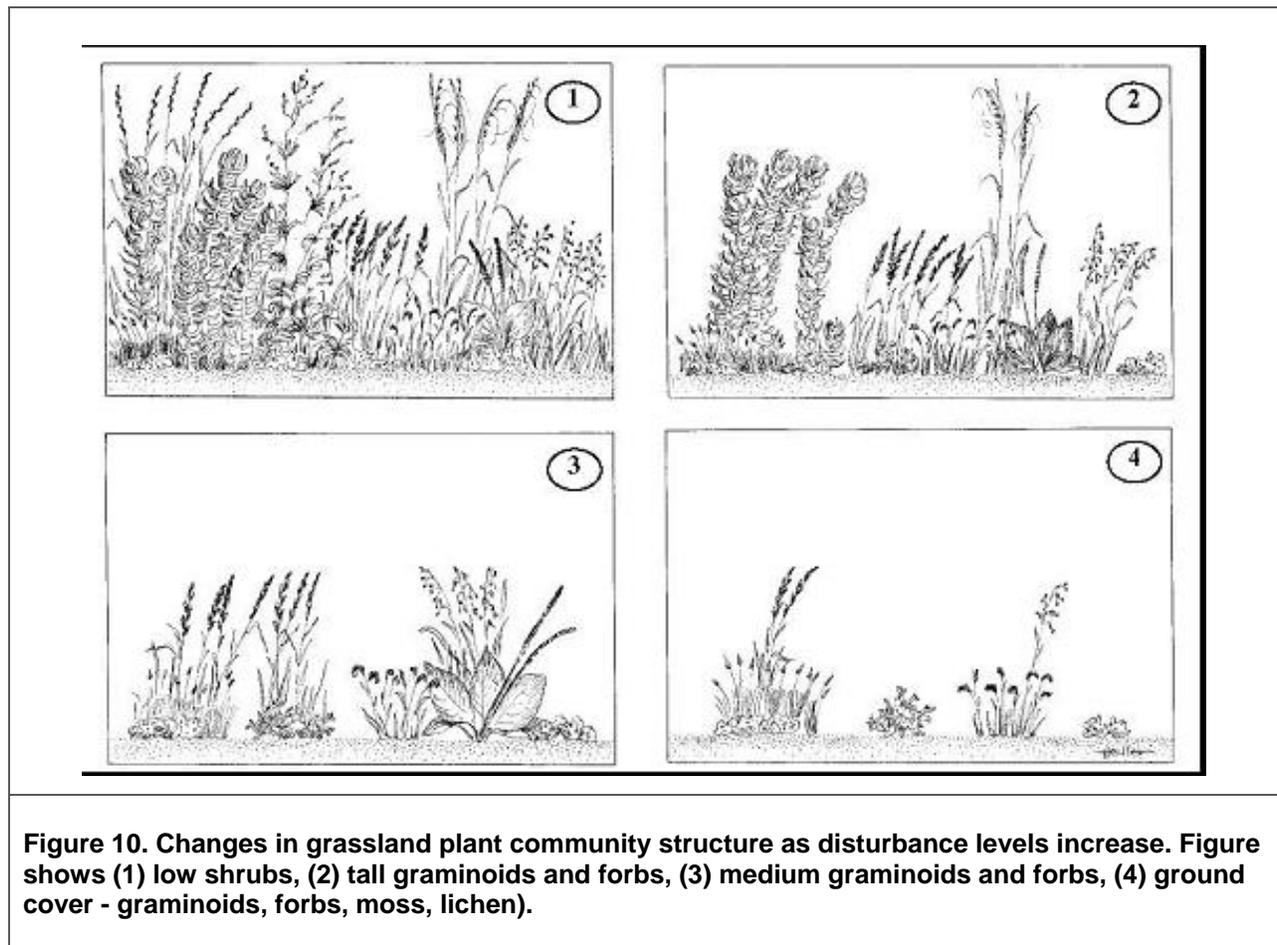
\*\*\*\* Native-Infill contribution must be greater than 15%, relative to the control.

\*\*\*\*\* These species are not included in the desirable species calculation, as they are not native to the subregion. See RoO for species list by subregion.

\*\*\*\*\* Desirable species percent cover threshold is 50% and is relative to the total average percent cover in the control.

## 10.5. Plant Community Structure and Layers

Native grassland communities have a diversity of plant species varying in breadth, height and rooting depth. When plants occupy different layers they access the sunlight, water and nutrients from that respective zone. The characteristic of plants growing in different 'layers' is called structure (Figure 10). Community structure contributes to nutrient cycling, supports forage production and is important for wildlife habitat. Healthy and functional native grasslands have predominantly deep-rooted desirable species adapted to drought. Where seeding is required to re-establish the layers the successional process may take several years. In some cases, ground cover species such as club moss will not establish for many years.



For Undisturbed assessments, a decrease in structural layer is not expected. If a structural layer decreases in the undisturbed area, this is an indicator the area should be included in the disturbed assessment.

For the Disturbed assessments, community structure and layers are assessed on a assessment point basis for both the lease area and the adjoining control area. Plant

community layers are assessed and rated using GRT.1 (Appendix D). When compared to the control average, the following criteria must be met:

- The difference between the average number of layers offsite and the average number of layers onsite must be less than or equal to 1; and,
- The difference in the number of structural layers present at each assessment point onsite compared to the control average must be less than or equal to 2.

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## 10.6. Weeds / Undesired Plants

Weeds are generally defined as undesirable or unwanted plants. The distribution of weeds may have been influenced by wellsite activity, particularly in adjacent offsite areas. Therefore, ensure that the control assessments are representative.

For the Undisturbed/Disturbed assessments, undesirable plants are assessed on a polygon basis for the lease area and the adjoining control. Agronomic species are considered invasive and undesirable in a reclaimed native grassland. These species will often have a barrier effect on not achieving a positive trajectory (pathway).

***Note: For the purposes of rating comparisons for the 2010 Reclamation Criteria, the following applies for:***

***Prohibited Noxious Weeds: These must be "destroyed" onsite (i.e., the assessment points on the lease cannot have a rating greater than 1, if so, the site fails)***

***Noxious Weeds: These must be "controlled" onsite (i.e., the average rating onsite cannot be greater than the average rating offsite, and the difference in the average ratings between onsite and offsite must be  $\leq 0$ . Example, if one assessment point offsite has noxious weeds, i.e., rating of 4, there could be noxious weeds present onsite but these must have ratings  $\leq 4$ )***

***Undesirable/Problem Weeds: These should be "controlled" onsite but not require change in management practice onsite compared to that applied offsite. There cannot be a difference  $>2$  ratings categories between the lowest control rating and the lowest rating at any assessment point on the lease. The difference in average ratings of 0.30 (or, 0.15 depending on sample intensity) still apply.***

At the same assessment point where plant measurements are conducted, the assessor shall document the type of weeds and the presence of undesirable plants and rate their distribution based on GRT.2 (Appendix D). Weeds are to be managed as per the *Weed Control Act*, and local authority requirements, with prohibited noxious weeds destroyed and noxious weeds controlled (Government of Alberta, 2010). Undesired plants (i.e., incompatible species ) shall be controlled so that they do not impede Land Manager operability and/or management or the functioning of the native plant community. Data shall be recorded in both the Assessment Tool and RoO.

***Note: Enforcement of the Weed Control Act falls under the jurisdiction of the local authority. There are two main classifications of weeds: Prohibited Noxious and Noxious. Weeds must be assessed and managed as per the Weed Control Act: prohibited noxious weeds destroyed with noxious weeds controlled (Government of Alberta, 2010).***

When the vegetation assessment/trajectory is oncourse, the presence of low density, noncompetitive, nuisance weed species may not be a sufficient reason to fail a site. The nuisance weed species will be out-competed as the desirable native species begin to dominate the site. The low density distribution of annual nuisance weeds provide shade, litter and organic matter benefits, that support to the end-goal.

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## **10.7. Litter Production**

Litter plays an important role in grassland ecosystem function. It provides a physical barrier to heat and water flow at the soil surface. Litter aids in the conservation of moisture by reducing evaporation, improving infiltration, and cooling the soil surface. Litter in grasslands has a positive correlation with biodiversity.

### **10.7.1. Litter Quality**

The fundamental charactersitic of functional litter is the presence and accumulation of decomposing organic material. It accumulates from previous growing seasons and is the product of established and establishing desirable native perennial vegetation. It will appear gray and oxidized in colour.

For sites for which a certificate has not been issued, the continued protection of the site (by fencing) or the absence grazing or mowing may result in the accumulation of too much litter. Should this occur, the litter may limit biodiversity and facilitate invasion of undesirable species (*i.e.*, weeds and invasive grasses such as Kentucky bluegrass). To achieve the end-goal, it may be necessary to mow or to remove the fence to allow grazing animals access

Use the following qualitative descriptions of what litter should look like in terms of accumulation, decomposition, and distribution and record in the Tool:

- **Class 1** = There is clear evidence of plant litter accumulation and decomposition is starting to take place. At the base of established grasses one should be able to see whole parts of leaves and stems, and decomposing fragments of these vegetative parts of the plants on the soil surface. Distribution of accumulated and decomposing litter covering the majority of the soil surface. **If Class 1, Pass**
- **Class 2** = There is evidence of litter accumulation, but no evidence of decomposition. **If Class 2, Fail**
- **Class 3** = There is no evidence of litter accumulation or decomposition. **If Class 3, Fail**

### 10.7.2. Litter Quantity

Native grasslands exhibit a range of above-ground biomass production. The average amount of litter will vary depending on the natural subregion, *ecological site* and species. The accumulation and establishment of litter is a process, so using mature thresholds as the standard is not appropriate for a 3 to 5 year-old reclaimed site. Litter should be compared to the reference value for the applicable subregion and range site. Litter quantity is calculated using Equation 4.

Using the 'hand rake method' in a 0.25 m<sup>2</sup> frame, qualitatively estimate the amount of litter (lbs/acre) on the reclaimed site. To make the qualitative assessment use the prepared photo reference standards from the Range Health Assessment workbook and located in the Tool or to prepared zip-lock sample bags (with known dry weight litter samples).

On the **Undisturbed area**, if the litter value is  $\geq 65\%$  (Equation 4; Example A, see next page) of the litter threshold value for the reference plant community, then the site passes the litter criteria. Data shall be recorded in both the Assessment Tool and RoO.

***Note: If the undisturbed area is not fenced and grazed in conjunction with the adjoining control, the undisturbed litter quantity can be compared to 65% of the control. This exception does not apply to the disturbed area litter quantity comparison.***

On the **Disturbed area**, if the value is  $\geq 15\%$  (Equation 4; Example B, see next page) of the litter threshold value (GRT.3; **Appendix D**) for the reference plant community then site passes the litter criteria. Data shall be recorded in both the Assessment Tool and RoO.

**Equation 4. Litter quantity calculation with examples for the Undisturbed Assessment (A) and Disturbed Assessment (B) for a Mixedgrass (dark brown and loamy) site with an average litter threshold of 900 lb/ac (1007 kg/ha).**

<p>A) <math>Pass = \geq 65\% * Litter\ Threshold</math> <math>= \geq 65\% * 900\ lb / ac</math> <math>= \geq 585\ lb / ac\ (654\ kg / ha)</math></p>	<p>B) <math>Pass = \geq 15\% * Litter\ Threshold</math> <math>= \geq 15\% * 900\ lb / ac</math> <math>= \geq 135\ lb / ac\ (151\ kg / ha)</math></p>
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END OF SECTION

## 11. Soil Assessment – Disturbed Areas Only

Surface soil or topsoil is defined as the uppermost mineral/organic material, valued as a growing medium. Minimum disturbance or multiple-lift stripping construction techniques are encouraged, as they will increase the success of meeting the reclamation criteria. All surface soil (100%) must be salvaged and replaced. The depth of topsoil distribution onsite must be similar to the measured natural variability offsite. Topsoil replacement requirements/tolerances acknowledge different eras in construction practices, natural variability and sampling error. Horizons that may be considered relevant topsoil to the Grasslands are found in Appendix C.

**Table 9. Soil parameters and their respective Assessment Tool questions that may or may not also require either a rating and/or physical measurement.**

Parameter:	Assessment Tool Questions	<sup>a</sup> RoO Information Required (Yes / No)		Pass / Fail Point
		Measurement	Rating	
<b>Soil Disturbance</b>	Soil Disturbance	Yes	No	No
<b>Surface Characteristics</b>	Topsoil Depth and Distribution	Yes	No	Yes
<b>Topsoil Colour</b>	Topsoil Colour	No	Yes	Yes
<b>Vertical Processes</b>	Texture (Manual); Consistence; Structure; Rooting Restrictions	No	Yes	Yes
<b>Level 2 Parameters (Optional)</b>	Texture (PSA); %-Clay; Organic Carbon; pH; Electrical Conductivity (EC); Sodium Adsorption Ratio (SAR)	Yes	Yes	Yes

<sup>a</sup> Yes = Assessment Tool question plus a measurement or rating are required; No = Only an answer to the Assessment Tool question is required.

A soils assessment will not be required for soils that have not been disturbed by stripping or compaction. The determination of soil physical properties (*i.e.*, compaction and soil structure) may be restricted to the well-centre and access locations as appropriate. The assessment includes measurements (Table 9) that are to be recorded in the Assessment Tool and RoO. The Soil Assessment is broken into two components.

- **Level 1 Assessment:** This assessment is the standard to be conducted at all sites. The Level 1 Assessment does not require samples to be sent to a laboratory for analyses. If a problem with the soil is indicated at Level 1, the assessor can apply the following options:
  - Conduct targeted Level 2 assessment;
  - Allow more time for recovery and reassess; or
  - Mitigate and reassess.

- **Level 2 Assessment:** This assessment is optional as indicated in Table 9 and can be used at the discretion of the assessor to verify observations made during the Level 1 assessment. The level 2 soil assessment is based on laboratory sample results of any of the following: %-clay, organic carbon (OC), pH, electrical conductivity (EC), and sodium adsorption ratio (SAR).
- 

## **11.1. Level 1 Soil Assessment: Soil Quantity and Quality**

Relevant soil parameters include the presence, quality and consistence/structure of topsoil. The absence of rooting restrictions is an indication of soil quality.

### **11.1.1. Evidence of Soil Disturbance**

Areas defined as being disturbed on the lease or access have undergone stripping (e.g., storage, etc.) and include points like well-centre, flare pits and longitudinal effects such as ruts. In some cases (i.e., soils that were not frozen) even though soil stripping was not conducted traffic may have caused compaction, pulverized soil, rutting or clodding. The assessor should document the evidence of soil disturbance in both the Assessment Tool and RoO.

### **11.1.2. Operability**

On native grasslands, operability refers to land management practices such as grazing.

#### *11.1.2.1. CONTOUR*

On native grasslands, contour is assessed during the landscape assessment.

#### *11.1.2.2. SURFACE STONINESS/COARSE FRAGMENT CONTENT*

On native grasslands, surface stoniness and coarse fragment content are assessed during the landscape assessment.

### **11.1.3. Surface Characteristics**

The ability of plants to germinate and grow is the required outcome for the reclamation of cultivated soils. Crusting and compaction are two conditions (assuming adequate volume and quality of soil) that may inhibit seed germination and growth.

Compacted soils and/or the presence of compacted soil layers can severely affect the function of the soil and the development of vegetation. Ponding, surface or subsurface flow disruption, (beyond the adjacent offsite) may result from impeded vertical and site drainage. Its presence is assessed in the Landscape Assessment outlined above.

The presence of massive, dense or layered structures (compacted horizons within the soil profile) or abrupt textural or structural changes are indicators of poor vertical moisture flow (i.e., infiltration). The presence of hardpan layers in offsite areas (e.g., solonchic soils) shall be documented.

At each assessment point the assessor shall identify whether soils have been disturbed and record information in the Assessment Tool and RoO.

#### 11.1.3.1. TOPSOIL DEPTH AND DISTRIBUTION

Topsoil (surface soil or layer) is defined as the uppermost mineral/organic material, valued as a growing medium. Salvage the surface layer (A horizon). Very deep surface soils are salvaged in two lifts: the first to a maximum of 40 cm and the second to a maximum of 70 cm. Very shallow surface soils (< 15 cm) are salvaged to a minimum of 15 cm unless the underlying material is unsuitable (e.g., Bnt, bedrock, gravel, rock). This must be documented in the Site Assessment Report.

The goal is that all salvaged material be replaced and returned to the site to enable the re-establishment of the desired plant communities and to support the functions outlined in the 2010 Approach to Native Grassland Reclamation Criteria section discussed previously. The goal is to ensure all topsoil is replaced and that the replacement of topsoil is consistent with the control. Where average topsoil depths are <15 cm, effort must be made to distribute the soil across the lease although the minimum requirement does not apply. Therefore, the distribution tolerances are higher for grasslands than cultivated lands.

For each assessment point, measure topsoil depth and calculate its percentage of the control mean. Record the topsoil depth and distribution in the Assessment Tool and the RoO. Depending on the construction period and number of assessment points, the average topsoil depth measurement onsite is then compared to the average topsoil depth offsite employing the tolerances outlined in Table 2 and Table 4.

***Note: Step-outs can be used to verify data. If the site does not meet the criteria for the applicable construction period, sampling intensity can be increased. If the site does not pass, mitigate.***

***If sampling intensity has been increased and anomalies are observed in additional sampling points, record this data as well.***

#### 11.1.4. Topsoil Colour

Soil colour (using the Munsell Soil Colour Chart) is a proxy for estimating organic carbon content at each assessment point. In cases where material from the subsoil (e.g., B or C horizon) has been admixed with the A horizon, lower organic matter contents may reduce soil productivity (Agronomic Interpretations Working Group, 1995).

Ratings in GRT.4 (Appendix D) are used for comparing soil color and must be recorded in the Assessment Tool and the RoO. To aid in the determination of soil colour, collect a representative handful from the A horizon, crush it by hand, and determine its colour using the Munsell Soil Colour Chart. The state of moisture must be equivalent between onsite and offsite (i.e., compare moist versus moist, or dry versus dry). If the colour between the A and the B horizon is not distinguishable (for example, in the Brown soil zone, where often both horizon colours may be 10YR 4/3), record horizon differences by texture instead. The 'value' from the Munsell Soil Colour Chart can be used to evaluate the soil colour.

## 11.1.5. Vertical Processes

### 11.1.5.1. SOIL TEXTURE

The soil textural class is an indicator of water-holding capacity, nutrient storage and soil tilth. It shall be comparable on the reclaimed site to that of the undisturbed landscape. Changes to texture may result in a change in land capability and productivity.

To maintain similar quality, soil textures onsite and offsite shall be in the same class. Improvements in texture class, or water holding capacity, on the lease compared to the control would be acceptable. These conditions are reflected in the ratings. To determine soil texture collect a representative handful from the A horizon, crush it by hand, and determine by hand the texture of the soils and rate using GRT.4 (Appendix D). Topsoil and subsoil textures need to be rated separately and recorded in the Assessment Tool and the RoO.

Imported topsoil must stay within the same textural classification as the control (i.e., "S" Sandy or "C" Clay) and must remain in the same control texture rating range of the control (sandy "S": 1, S2, S3, and S4) or, clay "C": 1, C2, C3, and C4).

### 11.1.5.2. SOIL CONSISTENCE AND STRUCTURE

Consistence (the strength of soil described as friable, firm, plastic ) and structure (the shape of soil aggregates resulting from the combination and arrangement of sand, silt and clay held together by net charges and organic matter) provides a qualitative measure of the soil's ability to allow root penetration, and air and water movement through the profile. Consistence refers to the combination of soil properties that determines its resistance to having its structure changed either through crushing or being remolded into a different shape. Degradation of structure and progression to firmer consistence are indicators of admixing, compaction or poor reclamation procedures, which make the soil vulnerable to water and/or wind erosion inhibit rooting, which may impair productivity. A large change in soil structure, particularly to a massive structure, would constitute a significant limiting condition that could negatively impact normal soil processes and vegetation development. Soil moisture conditions at the time of the assessment should be noted. Moist conditions are the most suitable for determining consistence.

Rating tables provide descriptions and corresponding ratings for consistence (GRT.4; Appendix D) and structure (GRT.5; Appendix D). Use the mesostructure (e.g. subangular or angular blocky) rather than the macrostructure (e.g. prismatic) when rating unless the macrostructure is more limiting to roots. For example, in Solonchic soils the columnar macrostructure often takes precedence over the angular blocky mesostructure. Similarly, in compacted soils, the compacted macroscale layers take precedence over the angular blocky peds.

For all assessment points, topsoil and subsoil consistency and structure need to be assessed and rated separately and results recorded in the Record of Observation (RoO) datasheet.

### 11.1.5.3. ROOTING RESTRICTIONS

Research has also indicated that restrictions to water or air movement within the soil profile (*i.e.*, vertically and horizontally) are one of the major inhibitors to the establishment of a native ecosystem; therefore, newly reclaimed sites must not have any profile restrictions. Evidence of exped rooting or root mats may indicate restrictions in vertical moisture processes. Presence of rooting restrictions at each assessment point is to be documented and supporting rationale provided that root depth and distribution are consistent with that found offsite. Indicators identified in Table 10 provide operationally feasible examples of impaired vertical moisture conditions. Rooting restrictions need to be assessed using the process outlined in the section Assessing and Sampling the Site. The rooting pattern restrictions shall be rated using the ratings provided in GRT.4 (Appendix D) and shall be recorded in the Assessment Tool and the RoO.

**Table 10. Commonly observed indicators or root, permeability and aeration restrictions**

Vertical Root Elongation	Water Permeability	Soil Aeration
<ul style="list-style-type: none"> <li>• Presence of root mats and bunches;</li> <li>• Presence of flattened and highly branched roots;</li> <li>• Presence of exped roots;</li> <li>• Presence of soil layers or abrupt texture or structure changes;</li> <li>• Absence of roots within or below reconstructed soil zones;</li> <li>• Absence of roots within soil aggregates;</li> <li>• Uneven crop height and density in cropland</li> </ul>	<ul style="list-style-type: none"> <li>• Presence of surface ponding;</li> <li>• Presence of surface vehicle (equipment) ruts;</li> <li>• Presence of stratified or abrupt moisture changes within the soil profile;</li> <li>• Presence of dense, massive, or layered structure (compaction);</li> <li>• Presence of flooded (yellow or stunted) conditions;</li> <li>• Presence of abrupt texture or structure transitions.</li> </ul>	<ul style="list-style-type: none"> <li>• Presence of dense, massive, or layered soil structure (compaction);</li> <li>• Presence of reduced pore size and pore space;</li> <li>• Presence of brownish-red ped surfaces;</li> <li>• Presence of sour odors</li> </ul>

## 11.2. Level 2 Soil Assessment (Optional)

A Level 2 assessment is an optional assessment that can be used at the discretion of the assessor that may be triggered by a problem in either the vegetation or soils. The need for a Level 2 Soil Assessment is triggered on sites where anomalies in parameter measurements and/or ratings are encountered at a Level 1 and further investigation is needed to assist in making a Pass/Fail decision.

Level 2 is used to quantify relative differences between onsite and off the site as flagged by the Level 1 assessment (*i.e.*, rooting, consistence/structure, vegetation productivity, soil fertility, pH, salinity, sodicity); the process of which may help to isolate the problem requiring mitigation. The Level 2 is therefore focused and/or systematic. Topsoil samples collected as part of the Level 2 assessment are analyzed for %-clay, organic

carbon (OC), pH, EC, and SAR while, subsoil samples collected as part of the Level 2 assessment are analyzed for pH, EC, and SAR.

If a problem with the soil is indicated during the Level 1 assessment, targeted Level 2 soil parameters are checked. After ruling out any problems in Level 2, the site passes. If the site fails any of the Level 2 soils parameters, then the site fails, unless failure is clearly unrelated to the wellsite (*i.e.*, third-party impacts). If a problem persists, mitigation will be necessary and a re-assessment performed starting at Level 1. Use the ratings provided in GRT.6 (Appendix D) for the Level 2 soil parameters and record data in the Assessment Tool and the RoO.

### **11.2.1. Sampling**

Sample the assessment points that failed the Level 1 Soils Assessment on the lease, access, or both where appropriate. Delineate the area of concern and record it on the site sketch. Use the same process as a step-out to collect a minimum of three soil samples onsite and offsite for the Level 2 Soil Assessment information. There shall be an equal number of control and lease sample points, with a minimum of three on-lease and three control sample points. The control sample points should represent a cross-section of quality (based on ratings assigned for the Level 1 Soils Assessment).

### **11.2.2. Using Laboratory Measured Values**

For assessment points where a Level 1 Soil Assessment showed too great a rating drop and a Level 2 Soil Assessment was conducted to validate infield measurements assessors should examine the laboratory value for the assessment location. For sites where the lab analyses results indicate the site was within the acceptable range identified by the comparison to the control values, the site passes; if not, the site should be mitigated and re-assessed. The ratings are provided in the Assessment Tool (GRT.5 and GRT.6). The ratings are based on the unit differences (*i.e.*, percentage for clay and OC, dS/m for electrical conductivity (salinity)).

#### *11.2.2.1. SOIL TEXTURE*

The Level 2 Assessment of soil consists of a particle size analysis (PSA) for texture and the Pass/Fail threshold is based on a change in clay content. If the average of the control samples for %-Clay was 29.1%, and an assessment point in the control had a clay content of 25.6% (a difference of 3.5% from the control), it would be given a #1 Rating. If an assessment point on the lease had a clay content of 35.6%, it would be given a #2 rating (a difference of 6.5% from the control).

#### *11.2.2.2. ORGANIC CARBON*

The Level 2 Assessment of topsoil organic carbon (%-OC) and the Pass/Fail threshold is based on a change in the percent organic carbon content. If the average of the control samples for %-OC was 7.2%, and an assessment point in the control had a %-OC content of 6.4% (a difference of 0.8% from the control), it would be given a #1 Rating. If an assessment point on the lease had a %-OC content of 4.2%, it would be given a #2 rating (a difference of 3.0% from the control).

### *11.2.2.3. SOIL PH*

The Level 2 Assessment of soil pH and the Pass/Fail threshold is based on a change in pH. If the average pH on the lease was 7.1, and an assessment point in the control had a pH of 6.4 (a difference of 0.7 from the control average), it would be given a #2 Rating. If an assessment point on the Lease had a pH of 6.9, it would be given a #1 rating (a difference of 0.2 from the control average).

### *11.2.2.4. SOIL ELECTRICAL CONDUCTIVITY (EC) AND SODIUM ADSORPTION RATIO (SAR)*

The Alberta Tier 1 Soil and Groundwater Remediation Guidelines (AENV, 2010), as amended, are used for EC and SAR to determine pass/fail.

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END OF SECTION

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## 12. OTHER CONSIDERATIONS

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### 12.1.1. Pests and Weeds

Alberta's Agricultural Pests Act and Weeds Control Act name a number of serious disease, insect and weed pests that spend all or most of their life cycle in the soil and/or attack below-ground parts of plants. Preventing their introduction is the first approach followed by restricting their spread. Preventive strategies include, using pest-free seed or transplants, disinfecting equipment used to work the soil, applying chemical and biological control products, and using caution when importing straw, manure and topsoil.

### 12.1.2. Topsoil Additions

Although not recommended, at times additional topsoil may be acceptable (*e.g.*, to avoid re-stripping a site where desirable vegetation is already established), it should be adequately described (*e.g.*, source, texture, volume, weed count) and/or sourced locally where possible (*i.e.* from the Land Manager) to ensure it is as similar as possible to the control topsoil (*e.g.*, addition of Orthic Black Chernozem to Orthic Black Chernozem). The date and method of application and incorporation, and documentation showing Land Manager acceptance are required on private lands, while approval by the Regulator is required for Public Lands.

Where topsoil is added to improve soil quantity and/or quality (and controls are not similarly amended), the physical (*e.g.*, texture, color, etc.) and chemical properties (*e.g.*, pH, routine salinity package, etc.) of the topsoil require characterization prior to their use.

***Note: Topsoil additions do not include soil amendments (see section on Amendments)***

Although preferable, where the soil is not being sourced directly from the Land Manager, it must not be imported from areas of known weed and disease populations/levels. In these cases, it is recommended that testing be conducted for foreign weeds (*i.e.*, weeds not normally found in that area) and potential problematic diseases for the area.

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### 12.1.3. Amendments

Importation of organic amendments is generally not desirable on native grasslands but may be acceptable for site stabilization purposes or soil amelioration.

Amendments (*i.e.*, biosolids, hydro mulch, manure, compost, gypsum, sawdust, clean straw, peat) can provide physical, biological and nutrient improvements to soils.

Amendments (including peat) are **not** topsoil replacements. Any use of amendments

**must** be documented (i.e., type, application rate), comply with the applicable guidelines, and have agreement from the Land Manager on private lands, while approval from the Regulator is still required for use of amendments on public lands.

Application rates of amendments which cause or result in an imbalance (i.e., salinity issues, nutrient immobilization, fertilizer effects like increased nitrogen ) from the control area should be avoided. Where amendments are added to improve soil quality (and controls are not similarly amended), the physical and chemical properties of the amendments require characterization prior to their use.

***Note: Where documentation cannot be provided on the use of amendments assessors should discuss with the Regulator prior to submitting an application.***

A minimum waiting period of two years is required following the use of an amendment before doing a vegetation assessment.

***Note: The two year waiting period applies when amendments, including fertilizer, are only applied onsite.***

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END OF SECTION

## 13. Appendix A

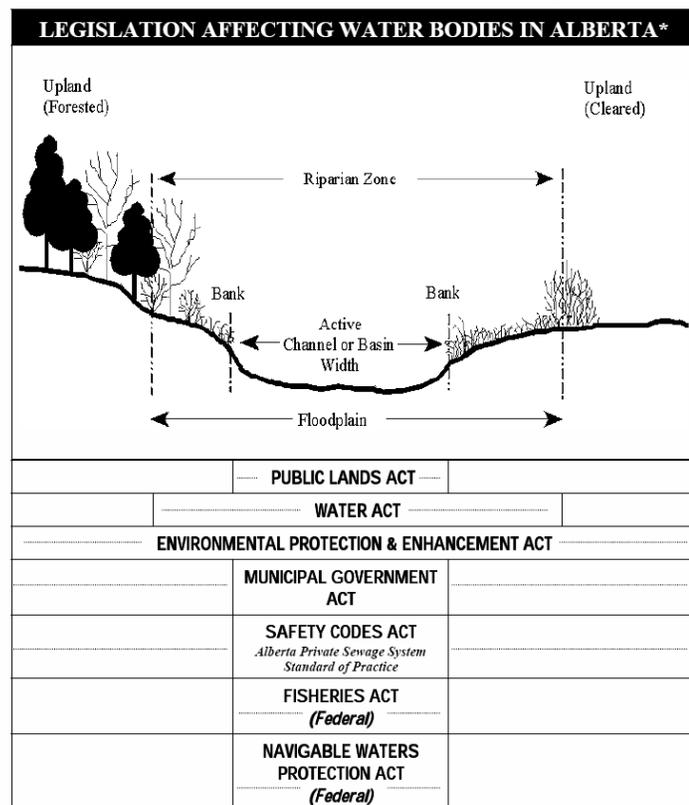
### 13.1. Water Act & Riparian Areas (WR)

#### 13.1.1. Landscape - Indicators of Riparian Areas

The Water Act<sup>1</sup> specifies that a water body is any location where water flows or is present, whether or not the flow or the presence of water is continuous, intermittent or occurs only during a flood, and includes, but is not limited to, wetlands and aquifers (generally excluding irrigation works)<sup>2</sup>. There are, therefore, direct implications of the Water Act regarding riparian lands.

Riparian lands are transition zones between the land and the water and include any geographic area that adjoins or directly influences a water body (e.g., streams, lakes, ponds, wetlands including floodplains) and land that directly influences alluvial aquifers and may be subject to flooding (Fitch et al. 2001). In west central Alberta, fens, bogs and marshlands represent a large proportion of riparian areas. Healthy, intact riparian lands deliver broad benefits to society including water quality improvement, flood control and water storage, reduced erosion and the maintenance of terrestrial and aquatic biodiversity.

The protection of riparian zones is therefore a key element of integrated land-water management and an important consideration in the development of these new reclamation policy and guidelines<sup>3</sup>. Conserve slough/marsh wetlands in a natural state; Mitigate degradation or loss of slough/marsh wetlands benefits as near to the site of



<sup>1</sup> <http://www.qp.gov.ab.ca/Documents/acts/W03.CFM>

<sup>2</sup> Except for clause (nn) and section 99), any 'water body' that is part of an irrigation works unless the regulations specify that the location is included in the definition of water body.

<sup>3</sup> As per Interim Wetland Policy; Administrative guidelines to protect surface water bodies; Alberta Flood damage reduction program; and, Wetland Compensation Guide.

disturbance as possible; and, Enhance, restore or create wetlands in areas where wetlands have been depleted or degraded.

The *Mitigation Sequence* includes: (1) Avoidance of impacts to wetlands; (2) Minimization of impacts and the provision of applicable compensation; and, (3) Compensation of impacts that cannot be avoided or minimized.

*Restored Wetlands* should be: (1) Located within the same watershed; (2) As close to site of impact as possible; (3) Similar wetland class as impacted site; and, (4) An area based upon size of the destroyed wetland and distance from site.

**Exemptions** can include: Refer to the *Water Act*.

### **13.1.2. Vegetation - Indicators of Riparian Areas**

Riparian areas can be classified using hydrologic indicators as indicated by the types of vegetation and soils. Vegetation indicators are hydrophytic plants classified by their frequency of occurrence in wetlands including cattails, bulrushes, most sedges, some mosses, and many willows (SWCD, 2005). Hydrophytic vegetation occurs in distinct zones adjacent to streams and wetlands. Vegetation zones associated with riparian and aquatic areas include low prairie, wet meadow, shallow and deep marsh, and permanent open water (Stewart and Kantrud, 1971). Descriptions and photographs of the vegetation zones are provided in the City of Calgary's Wetland Conservation Plan (City of Calgary, 2004). Descriptions of plant community types in Alberta can be found in various sources (Thompson and Hansen, 2002; Thompson and Hansen, 2003) including helpful photographic and descriptive guide for key riparian plant species in Alberta (Hale et al., 2003).

### **13.1.3. Soils - Indicators of Riparian Areas**

Riparian soils are typically hydric (*i.e.*, usually saturated and subject to flooding or ponding during a portion of the growing season). Detailed wetland soils criteria have been documented by the USDA (NRCS, 2003). Drainage classes found in riparian areas include: moderately well, imperfect, poor, and very poor. Imperfect and moderately-well drained soils can only indicate riparian areas at locations where hydrology and vegetation indicators are also consistent with riparian conditions as imperfect and moderately-well drained soils can also occur in uplands. For example, in central and northern Alberta these soils can also occur in fine-textured parent materials.

### **13.1.4. Riparian Function: Hydrology**

Hydrology is the driving force that creates all wetlands. Hydrologic indicators include standing (lentic) or flowing (lotic) water during at least part of the growing season, water marks or drift lines of debris on trees or shrubs, or thin layers of sediment coating the ground or objects on the ground (SWCD 2005). Riparian areas usually occur in depressional and toe-slope positions, but groundwater springs can occur in mid- and lower-slope positions.

### 13.1.5. Wellsites In or Near Riparian Areas

Reclamation criteria: The reclamation criteria for riparian lands are addressed in each Land use group. A framework for the health assessment of Alberta wetlands is provided by the Cows and Fish program's user's manual (Cows and Fish, 2004). Legislation that applies to wellsites in and/or near riparian areas:

#### 13.1.5.1. WATER ACT (GOVERNMENT OF ALBERTA, 2009B):

No person may commence or continue an activity without approval unless it is otherwise authorized under the Act; Section 36(1) Subsection 2.

#### 13.1.5.2. DIRECTIVE 056 (AER, 2008):

**Clause 41:** States that the well centre must be sited a minimum of 100 m from a water body.

**Clause 42:** Provides allowable conditions or measures that can allow a well to proceed if it does not meet the 100 m setback requirement including the availability of a vacuum truck or containment structures using impermeable materials.

**Clause 42b:** States that the applicant must maintain natural drainage if there is intermittent drainage or a spring/ artesian flow across the well site or access road on freehold or Crown land.

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END OF SECTION

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## 14. Appendix B

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### 14.1. Supplemental Information for Vegetation

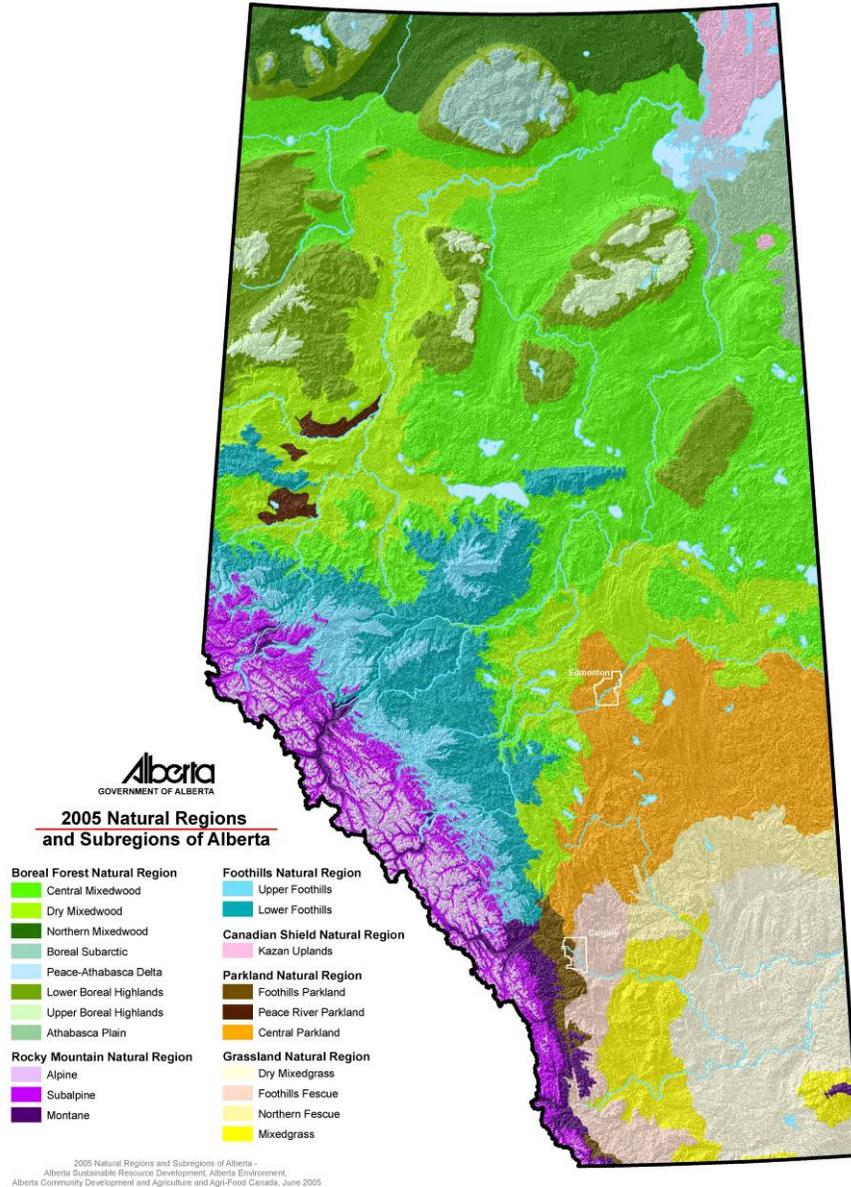


Figure 11. Natural regions and subregions of Alberta (Tourism, Parks, and Recreation, 2005).

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END OF SECTION

## 15. Appendix C

### 15.1. Supplemental Material for Soils

#### 15.1.1. Topsoil Definitions

Within the Canadian System of Soil Classification (SCWG 1998), native grassland topsoil (mainly Ah) horizons are usually enriched with organic matter, have 17% or less organic carbon by weight, and soil colour values are at least one unit lower (darker) than the underlying horizon, or possess 0.5% more organic carbon than the underlying parent material (SCWG 1998). The most common grassland soil order is Chernozemic and Ah or Ap horizons are typically 10 cm, or more, thick, have a colour value darker than 5.0 dry and 3.5 moist, and have a chroma of at least 3.5 moist. In Alberta, grassland soils can include other soil orders for which the following potential soil horizons can qualify as topsoil (Table 11). Solonetzic and Regosolic soils are secondary to Chernozemic soils. Vertisolic, Brunisolic and Gleysolic soils are expected to be uncommon to rare occurrences for application of the 2010 Grasslands Criteria.

**Table 11. Soil horizons that can qualify as Grassland topsoil, arranged by soil Order.**

Chernozem	Solonetz	Brunisol	Regosol	Vertisol	Gleysol
Ah	Ah	Ah	Ah	Ah	Ah
Ahe	Ahe	Ahe	----	AB	AB
<sup>1</sup> Ap	<sup>1</sup> Ap	<sup>1</sup> Ap	<sup>1</sup> Ap	<sup>1</sup> Ap	<sup>1</sup> Ap
Aeh	Ae	Aeh	<sup>2</sup> AC	Ahgj	Ahgj
Ae	Aeh	Ae	<sup>2</sup> CA	Apgj	Apgj
Aegj	AB	Aegj		ABv	Ag
AB	ABgj	AB		<sup>3</sup> BA	Ahe
<sup>3</sup> BA	<sup>3</sup> BA	<sup>3</sup> BA			Aeh
<sup>4</sup> Bp		<sup>4</sup> Bp			Ae
<sup>5</sup> Bpk					<sup>5</sup> Aegj
					<sup>3</sup> BA
					<sup>3</sup> BAg

<sup>1</sup> Ap horizons occur in disturbed grassland settings (e.g. on-site lease subject to soil handling).

<sup>2</sup> If the C horizon in a Regosol occurs at <15 cm, a CA or an AC horizon above the C is considered topsoil, provided the quality (texture, structure, consistence and chemistry) is similar or better.

<sup>3</sup> If the B horizon occurs at <15 cm, a BA horizon above the B is considered topsoil, provided the quality (texture, structure, consistence and chemistry) is similar or better.

<sup>4</sup> For eroded sites that lack an A horizon, but include a B horizon, the B horizon is termed the Bh or Bp.

<sup>5</sup> The tabular listing covers the majority of potential topsoil horizons, but it is not meant to be a complete list.

Examples are provided using less common suffixes, which include j, k, and ca. These less common suffixes may occur with many principal suffixes for most of these soil orders.

## 15.1.2. Soil colour – definitions

### 15.1.2.1. VARIABLES IN THE MUNSELL COLOUR SYSTEM

- **Hue:** The hue notation indicates the colour's relation to Red, Yellow, Green, Blue and Purple. Topsoils in Alberta are typically on the 10YR Hue page, but may occasionally be found on the 7.5YR or 2.5Y pages.
- **Value:** Indicates the colour's lightness. The notation for value ranges from 0 for absolute black to 10 for absolute white. Most topsoils are dark values generally range from 2 to V-Moist colours will typically have values one unit lower than dry colours.
- **Chroma:** Indicates the colour's purity, saturation or strength (or departure from a neutral of the same lightness). Chromas are typically reported in units ranging from 1 to 8, although 0 values occur on some hue pages. The numbers beginning at 0 represent neutral grays.

Soil colour is reported as hue, value and chroma. The reported soil colour must also include aspect, as described below.

### 15.1.2.2. ASPECT

- **Aspect** is a combination of the type of soil ped (typical soil structure) and the moisture condition. Soil moisture for topsoil conditions are reported as either dry or moist. Soil ped refers to the dominant structure and size fraction. For example, a topsoil horizon may be medium subangular blocky. The four possible types of soil peds used in the soil colour classification are as follows.
- **Matrix:** the natural material in which soil constituents are imbedded.
- **Exped:** on the surface of the soil ped
- **Inped:** within the soil ped
- **Crushed:** a broken or collapsed soil ped

### 15.1.2.3. RULES FOR REPORTING SOIL COLOUR

The determination of soil colour requires a consistent approach as outlined below.

- **Reporting on Colour.** The reported soil colour must include Hue, Value, Chroma and Aspect, as indicated in the table. It is acceptable to report colour values and/or chromas as ".5" for soil colours that are mid- way between colour chips. The numbering convention should always be used, rather than soil colour names, because the numbering is more precise and valuable for comparative purposes.
- **Aspect.** The same aspect must be used in order to properly compare topsoil colour at the Control vs. the Lease.
- If colour is determined on a moist soil at one location, soil colour at other locations must also be determined on moist soils. If soils are moist at some sample points and dry at others, air dry all samples and record soil colour air dry.
- Ensure that soil colour is determined on the same type of ped. For example, if one site is a matrix sample, ensure that the other sample is also that of the matrix.
- **Light Conditions.** Soil colour should always be determined with sunlight or the sun source coming over your shoulders, and the Munsell Colour Chart should be held at or near eye level. Do not wear sunglasses for one set of soil colours, and then remove

them at another location. If the light is alternating between shade and sun, ensure that colour is evaluated under the same conditions.

- **Use of the Munsell Chart.** It is most desirable to place a small soil sample on a small knife, and to pass the knife surface under the page to compare soil colours from the adjacent open circles. If this method does not provide a strong determinant, it is also acceptable to place a small soil sample on or nearby the most appropriate chips of the Munsell colour chart. However, never brush the sample off, as it may stain the chart. Instead, shake it off and the Munsell colour chart will have a long life. Plastic pages are supplied, but they distort the true determination of colour.

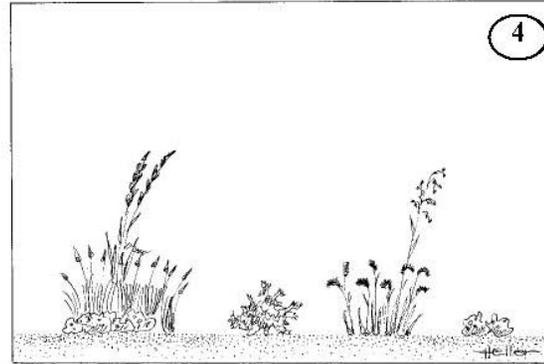
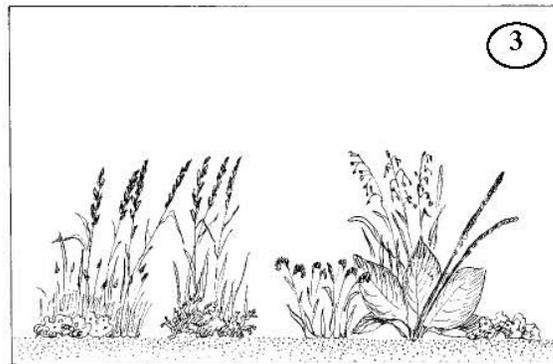
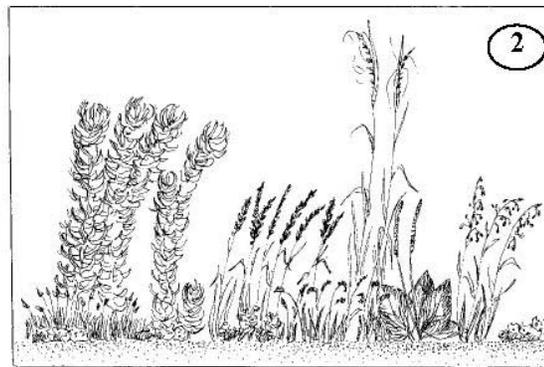
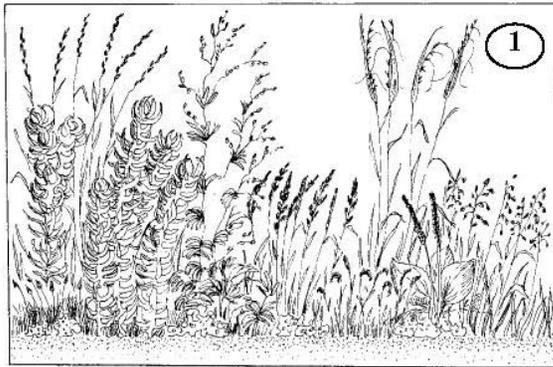
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END OF SECTION

## 16. Appendix D

### 16.1. 2010 Reclamation Criteria for Native Grassland Rating Tables

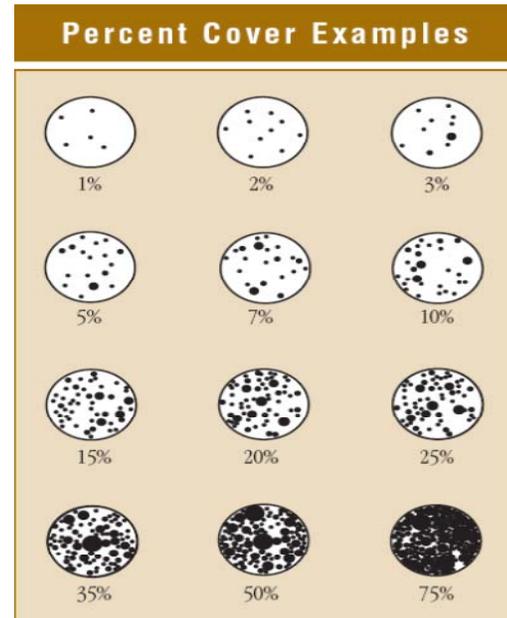
GRT.1 Changes in grassland plant community structure as disturbance levels increase.



Description	
1	The life form layers closely resemble the control or reference plant community
2	Compared to the control or reference plant community, one life form layer is absent or significantly reduced
3	Compared to the control or reference plant community, two life form layers are absent or significantly reduced
4	Compared to the control or reference plant community, three life form layers are absent or significantly reduced

## GRT.2 Undesirable plant/weed ratings

VEGETATION / WEED RATINGS			
Rating	Class	Description	
1	0	None	
2	1	Rare	
	2	A few sporadically occurring individual weeds and/or undesirable plants	
3	3	A single patch of weeds and/or undesirable plants	
	4	A single patch plus a few sporadically occurring weeds and/or undesirable plants	
4	5	Several sporadically occurring weeds and/or undesirable plants	
	6	A single patch plus several sporadically occurring weeds and/or undesirable plants	
5	7	A few patches of weeds and/or undesirable plants	
	8	A few patches plus several sporadically occurring weeds and/or undesirable plants	
6	9	Several well spaced patches of weeds and/or undesirable plants	
	10	Continuous uniform occurrences of well spaced weeds and/or undesirable plants	
7	11	Continuous occurrence of plants with a few gaps in the distribution of weeds and/or undesirable plants	
	12	Continuous dense occurrence of weeds and/or undesirable plants	



### GRT.3 Litter Thresholds - Option 1 - Visual Quantitative Estimate

Natural Sub-region	Range Site	Healthy (lb./ac)	% of Threshold	
			Assessment Criteria	
		Average	Undisturbed	Disturbed
Aspen Parkland (Black)	Loamy	1500	975	225
	Sandy	1100	715	165
	Sands	800	520	120
	Choppy Sandhills	400	260	60
Foothills Fescue, Foothills Parkland and Montane (Black)	Thin Black Loamy	1400	910	210
	Orthic Black Loamy	1200	780	180
	Shallow to Gravel and Limy	1000	650	150
	Thin Breaks	500	325	75
Mixedgrass (Dark Brown)	Loamy (>1100 m elevation)	900	585	135
	Loamy (<1100 m elevation)	600	390	90
	Thin Breaks	300	195	45
Dry Mixedgrass (Brown)	Loamy	400	260	60
	Blowout	250	162.5	37.5
	Thin Breaks	150	97.5	22.5
Northern Fescue	Loamy	1000	650	150
	Sandy	715	464.75	107.25
	Sands and Choppy Hills	520	338	78
	Sands and Choppy Hills	260	169	39

#### Undisturbed Assessment:

Target is to have  $\geq 65\%$  of the reference plant community value on site; Pass.

If less than 65%, site fails Undisturbed Assessment and should be reassessed with the Disturbed Assessment.

#### Disturbed Assessment:

Target is to have  $\geq 15\%$  of the reference plant community value on site; Pass.

If less than 15%, site fails and requires more time.

#### Overgrazed Sites:

**Note:** If the undisturbed area is not fenced and grazed in conjunction with the adjoining control, the undisturbed litter quantity can be compared to 65% of the control.

This exception does not apply to the disturbed area litter quantity comparison.

**GRT.4 Level 1 ratings and descriptions for Soil Consistence, Soil Texture, and Rooting Restriction for Grassland Soils**

Rating	Soil Color	Rooting Pattern	Coarse Fragment Content (% Volume)	Surface Stoniness (Stoniness Class)	TEXTURE Clay (C)      Sandy (S)		Topsoil (TS)		Subsoil (SS)	
							Consistence Moist      Dry		Consistence Moist      Dry	
1	Black	No restriction, inped	<3	S0 No stones on the surface	Loam, Silt Loam, Silt		Very friable - Friable	Soft - Slightly Hard	Loose, Very friable, Friable, Firm	Loose, Soft, Slightly hard, Hard
				S1 Occasional stones on surface; typically 8-25 m apart.						
2	Dark Brown or Dark Gray	Slight restriction, mostly inped roots.	3 to 20	S2 Numerous stones on surface; typically 1-8 m apart.	Sandy Clay Loam, Clay Loam, Silty Clay Loam	Sandy Loam	Loose - Firm	Loose - Hard	Very firm	Very hard
3	Brown, Gray	Moderate restriction, mostly exped roots.	20 to 50	S3 Many stones; serious impediment to surface activities (machinery, vehicles); typically 0.5-1 m apart.	Clay, Silty Clay, Sandy Clay	Loamy Sand	Very firm	Very hard	Extremely firm	Extremely hard
4	Light Gray	Severe restriction, root mats	>50	S4 Very many stones on surface; considerable clearing required before any surface activities possible; typically <0.5 m apart	Heavy Clay, Siltstone	Sand, Gravel, Unconsolidated Bedrock	Extremely firm	Extremely hard	NA	NA
				S5 Excessively stony on the surface; typically <0.1 m apart.						

## GRT.5 Soil Structure Rating for Grassland Soils

<i>Kind</i>	<i>Class</i>	<i>Size (cm)</i>	<i>Topsoil</i>	<i>Subsoil</i>	
Single grain ¼ loose, incoherent mass of individual particles as	-	sg.	<0.2	2	1
	Breaking to fine fragments	f. frag.	<2	2	1
Amorphous (massive) ¼ a coherent mass showing no evidence of any distinct arrangement of soil particles.	Breaking to medium fragments	m. frag.	2-5	3	2
	Breaking to coarse fragments	c. frag.	5-10	4	3
	Breaking to very coarse fragments	vc. frag	>10	4	4
	Fine blocky	f. bk.	<1	1	1
Blocky (angular blocky) ¼ faces rectangular and flattened less than 5 sided, vertices sharply angular.	Medium blocky	m. bk.	1-2	2	1
	Coarse blocky	c. bk.	2-5	3	2
	Very coarse blocky	vc. bk.	>5	4	3
	Fine subangular blocky	f. sbk.	<1	1	1
Subangular blocky ¼ faces subrectangular more than 5 sided, vertices mostly oblique, or subrounded.	Medium subangular blocky	m. sbk	1-2	2	1
	Coarse subangular blocky	c. sbk.	2-5	3	2
	Very coarse subangular blocky	vc. sbk.	>5	4	3
	Fine granular	f. gr	<0.2	1	1
Granular ¼ spheroidal, characterized by rounded vertices.	Medium granular	m. gr	0.2-0.5	1	1
	Coarse granular	c. gr.	0.5-1	2	2
	Fine platy	f. pl.	<0.2	1	1
Platy ¼ horizontal planes more or less developed.	Medium platy	m.pl.	0.2-0.5	2	2
	Coarse platy	c. pl.	0.5-1	3	3
	Fine prismatic	f. pr.	<2	2	1
Prismatic ¼ vertical faces well defined and edges sharp.	Medium prismatic	m. pr.	2-5	3	2
	Coarse prismatic	c. pr.	5-10	4	3
	Very coarse prismatic	vc. pr.	>10	4	4
	Fine columnar	f. cpr.	<2	3	2
Columnar ¼ vertical edges near top of columns not sharp. Columns may be flat-topped, rounded-topped, or irregular.	Medium columnar	m. cpr.	2-5	4	3
	Coarse columnar	c. cpr.	5-10	4	4
	Very coarse columnar	vc. cpr.	>10	4	4
	Fine compacted	f. comp.	<2	3	2
Compacted – relatively dense soil layers/lumps, more or less defined. These layers may break with vertices being sharply angular. Size reflects thickness of layers or diameter of lumps.	Medium compacted	m.	2-5	4	3
	Coarse compacted	c. comp.	5-10	4	4
	Very coarse compacted	vc.	>10	4	4

**GRT.6 Level 2 (EC, SAR, pH) Soil Parameters for Grassland soils. Values are the difference between the average control value and specific assessment point site being evaluated (Lease - Control).**

<b>Rating</b>	<b>PSA % Clay</b>	<b>Organic Carbon</b>	<b>pH</b>
<b>1</b>	0 - 5%	0 - 1%	0 - 0.5
<b>2</b>	5.1 - 10%	1.1 - 2%	0.6 - 1
<b>3</b>	10.1 - 30%	2.1 - 4%	1.1 - 2
<b>4</b>	>30%	>4.1%	>2.1

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END OF SECTION

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## 17. Appendix E

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### 17.1. Exemption Justification Form

**NOTE:** This is a sample of the form that must be completed when submitting a justification on trying to justify why a wellsite should pass a Landscape, Vegetation, and/or Soils Soils Assessment even though it did not meet the criteria. Justifications initiate a further technical review.

Site:		Category failed:	
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Write justification here and attach any supporting documentation:

**Name and Title of person preparing justification:**

\_\_\_\_\_  
(Name)                      \_\_\_\_\_  
(Signature)                      \_\_\_\_\_  
(Title)                      \_\_\_\_\_  
(Date Prepared)

**Name and Title of Approving Official (GoA):**

\_\_\_\_\_  
(Name)                      \_\_\_\_\_  
(Signature)                      \_\_\_\_\_  
(Title)                      \_\_\_\_\_  
(Date Approved)

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END OF SECTION

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## 18. Appendix F

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### 18.1. References used for the 2010 Reclamation Criteria

Agronomic Interpretations Working Group. 1995. Land Suitability Rating System for Agricultural Crops: 1. Spring-seeded small grains. Edited by W.W. Pettapiece. Technical Bulletin 1995-6E. Centre for Land and Biological Resources Research, Research Branch, Agriculture and Agri-Food Canada, Ottawa. 90 pages, 2 maps.

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END OF SECTION

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## 19. Appendix G

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### 19.1. Glossary

**A horizon (topsoil):** A mineral horizon formed at the surface in the zone of removal of material by leaching, or maximum accumulation of organic carbon, or both, as defined by the *Canadian System of Soil Classification (CSSC)*.

**Acceptable Substitutions:** For the purposes of the 2010 Reclamation Criteria, these include seeded native (Type 1 and 2) species that *may* not be present on the control but are part of the natural subregion (See the RoO for a species list of native species to the individual subregions). Their presence is considered temporary as plant succession proceeds but in the short-term they are also considered desirable species as they provide ecological benefits such as sheltering canopy, site stabilization and litter accumulation.

**Access:** In some cases the Land Manager may wish to have roads left in place. The roads must be stable, non-hazardous and non-erosive.

**Admixing:** The addition of nontopsoil material to topsoil resulting in a mixture. Nontopsoil materials could include subsoil, spoil and/or project wastes.

**Ae:** An A horizon that has had clay, iron, aluminum, or organic matter, or all of these, leached from it. Ae horizons are usually gray coloured with a platy structure, as defined by CSSC.

**Aggregate:** A group of soil particles cohering so as to behave mechanically as a unit.

**Agroforestry:** An ecologically based natural resource management system in which trees are integrated in farmland and rangeland. These typically, are tracts of land, on a farm, ranch or other private property, set aside primarily for the growing, management, and harvest of trees for sale as unprocessed logs and potentially a variety of other ancillary products.

**Ah:** An A horizon in which organic matter has accumulated as a result of biological activity, as defined by CSSC.

**Ahe:** An A horizon that has some organic matter accumulation, as well as some leaching of clay, iron, or aluminum, as defined by CSSC.

**Anomaly:** A result at an assessment location that does not appear representative of the entire grid being evaluated. If an anomaly is encountered, a 'step-out' assessment procedure may be used to see if the location is anomalous or representative of the grid.

**Ap:** An A horizon markedly disturbed by cultivation, as defined by CSSC.

**Arable:** Tillage; agricultural production based on cultivation practices; land that is cultivated or capable of being cultivated. Arable is used as a comparison to agriculture based on grazing (noncultivated) systems.

**Assessment Grid:** An approximately 30 m x 30 m grid, to 40 m x 40 m grid, established on the lease to provide a systematic method for collecting soils (and vegetation) data.

**Assessment Point:** The point that is positioned at a location within a grid (or access) that is representative of the entire grid (or mapped section of the access) where the soil (and vegetation) is to be assessed.

**Audit:** Refers to the Wellsite Audit System: This is a process of issuing reclamation certificates for wellsites (following application review), and then conducting a field assessment on a selected number of certified sites to ensure that criteria have been met.

**B horizon:** A subsoil horizon characterized by enrichment in organic matter, or clay; or by the development of soil structure; or by change of colour denoting hydrolysis, reduction, or oxidation, as defined by CSSC.

**Bare Areas:** Areas with exposed soil. For cultivated or forage lands, areas between seed rows are not included. Areas devoid of vegetation with exposed soil.

**Bare Ground:** Areas with sparse or patchy vegetation or areas between seed rows can include exposed mineral soil, in which case would be referred to as bare ground/soil rather than bare areas

**Bare Soil:** See Bare Ground

**Bedrock:** The solid rock underlying soils and the regolith or exposed at the surface.

**Bog:** A peat-covered or peat-filled wetland, generally with a high water table. The water of a bog is generally acid and low in nutrients. Bogs usually support a black spruce forest but may also be treeless. They are usually covered with sphagnum and feathermosses and ericaceous shrubs.

**Brunisolic:** An order of soils whose horizons are developed sufficiently to exclude them from the Regosolic Order but lack the degrees or kinds of horizon development specified for soils in other orders. They always have Bm or Btj horizons.

**C horizon:** A mineral subsoil comparatively unaffected by the pedogenic processes operative in the A and B horizons except for the process of gleying (Cg), or the accumulation of calcium carbonates (Cca) or other salts (Csa), as defined by CSSC. A naturally calcareous horizon is designated Ck.

**Calcareous soil:** Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with cold 0.1N hydrochloric acid.

**Canopy Cover:** The area of ground within a quadrat (2 dimensional frame) that is occupied by the above-ground parts of plants (live or dead), when viewed from above. Cover is usually estimated as a percent, but multiple layers of vegetation often result in cover values over 100%. Litter (dead vegetation) is included but weeds are not.

**Cation Exchange Capacity (C.E.C.):** A measure of the total amount of exchangeable cations that can be held by the soil; it is expressed in terms of mols *per* kg of soil (formerly meq/100g); CEC is largely controlled by the amount of clay and organic matter in the soil.

**Cemented horizon:** Any horizon that has a hard or brittle consistence because the particles are held together by cementing substances such as humus, calcium carbonate, or oxides of silica, ironite and aluminum. They are commonly represented by horizon designations such as Cc or x.

**Chernozemic:** An order of soils that have developed under xerophytic or mesophytic grasses and forbs, or under grassland-forest transition vegetation, in cool to cold, subarid to subhumid climates. The soils have a dark-coloured surface (Ah, Ahe or Ap) horizonsite and a B or C horizon, or both, of high base saturation. The order consists of the Brown, Dark Brown, Black and Dark Gray great groups.

**Chroma:** The relative purity, strength, or saturation of a colour; directly related to the dominance of the determining wavelength of the light and inversely related to grayness; one of the three variables of colour.

**Classification, soil:** The systematic arrangement of soils into categories and classes on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties.

**Clay pads:** Built-up wellsite.

**Clay:** As a particle-size term: a size fraction <0.002 mm equivalent diameter.

**Clod:** A compact, coherent mass of soil produced by digging, plowing or remoulding.

**Coarse fragments:** Rock or mineral particles greater than 2.0 cm in diameter. Rounded and sub-rounded rock fragments up to 7.5 cm in diameter are referred to as gravelly; 7.5 cm to 25 cm are cobbly; and over 25 cm are stony or bouldery.

**Coarse fragment content:** The volume (%) of coarse fragments within the soil profile. These coarse fragments represent constraints for the use of the soil and farming practices.

**Coarse texture:** The texture exhibited by sands, loamy sands, and sandy loams except very fine sandy loam. A soil containing large quantities of these textural classes.

**Compaction:** the result of bearing equipment and drilling activity onsite that exceeds the soil strength, increasing the density of the topsoil and/or subsoil, limiting root penetration and water infiltration.

**Compatible Species:** For the purposes of the 2010 Reclamation Criteria for Forested Lands these are the seeded species that were part of a seed mix that was appropriate to the time period or as outlined in historical agreements with the Land Manager. For the purposes of the 2010 Reclamation Criteria for Native Grasslands, these are species used for reclamation on sites prior to 2010. These species are comprised of native species but may not be native to the subregion and agronomics that are suitable for grazing purposes. They do not include weeds, Problem Introduced Forages, mosses or lichens.

**Consistence:** The resistance of a soil to deformation, or the degree of cohesion or adhesion of the soil mass. Terms used to describe a moist soil are: loose, very friable, friable, firm, very firm, compact, very compact, and extremely compact. Terms used to describe dry soils are: loose, soft, slightly hard, hard, very hard, and extremely hard.

**Construction period:** Period when site is being prepared for exploration and/or extraction.

**Contamination:** The condition or state of soil or water, caused by a substance release or escape that results in an impairment of, or damage to, the environment, human health, safety, or property. Introduction of foreign materials as a result of wellsite activity (construction, drilling, production, or reclamation). Types of contaminants include hydrocarbons, gas leaks, salts, sterilants

**Contouring:** Topographic features measured in centimeters (micro) meters (meso) and tens of meters (macro). Such can be lost due to cut and fill wellsite construction activities and need to be restored during reclamation.

**Control Depth:** Calculated as the depth of a single topsoil control (access).

**Control:** Refers to information collected offsite against which collected information from a reclaimed site will be compared. The control information is collected offsite from adjacent or representative land.

**Cover:** Usually defined as the area of ground covered by all living (includes stems and leaves) and dead (litter) plant material that is produced naturally on a site, expressed as a percentage of the total area. Bare soil is not cover. This definition of cover is also referred to as ground cover, canopy cover or aerial cover. This is the type of cover that is referred to in the vegetation criteria. In a grassland it is important that cover be estimated where possible, by looking directly down on the plants from above.

**Cultivated land:** Lands within the White Area that are currently or potentially arable, and utilized for production of field crops (cereals, oilseeds, pulses, hay, and pasture in rotation) (Leskiw 1997). See also the intext definition.

**Detailed Site Assessment (DSA):** The report that must be attached to the Wellsite Reclamation Certificate Application form that provides all the data collected on the site. The report will also contain the justification used to explain why a site should get a certificate if some of the criteria have not be met.

**Distribution Tolerance:** Level of acceptable variability as found in representative controls.

**Disturbed Assessment:** A Grasslands land use lease assessment that evaluates landscape, vegetation and soil components in areas of a lease where the soils have been subject to handling, storage, reclamation, compaction or rutting. The purpose is to evaluate reclamation success. A more intensive assessment of vegetation (cover and productivity) and soil (laboratory analyses) may be necessary to address apparent problematic conditions.

**Disturbed Areas:** areas of the lease or access have undergone stripping (e.g., stripping, or storage and including points like well-centre and flare pits and longitudinal effects like ruts). In some cases (e.g., soils that were not frozen) even though soil stripping was not conducted traffic may have caused compaction,

pulverized soil, rutting or clodding to the extent that the native community (*i.e.*, species and/or layers) has been altered or removed.

**Disturbed soils:** Soils that have been stripped, compacted, rutted or otherwise altered.

**Drainage:** Soil drainage refers to the frequency and duration of periods when the soil is not saturated. Terms used are: excessively, well, moderately, imperfectly and poorly drained.

**Droughty soil:** Sandy or very rapidly drained soil.

**Ecological (or ecosystem) goods and services** and services (EGS) are the benefits humans receive from the environment for free. EGS are categorized as: (1) *Regulating Services* - benefits obtained from an ecosystem's control of natural processes: air quality regulation, climate regulation, natural hazard regulation, water regulation, erosion control and sediment retention, waste treatment, pest regulation, pollination; (2) *Supporting Services* - underlying processes that are necessary for the production of all other ecosystem services: soil formation, primary production, nutrient cycling, photosynthesis, water cycling; (3) *Cultural Services* - nonmaterial benefits people obtain from ecosystem services: ethical values, existence values, recreation and ecotourism; and, (4) *Provisioning Services* - the goods or products obtained from ecosystems: water supply, fiber, food production, genetic resources, biomass fuel, biochemicals, natural medicines, and pharmaceuticals.

**Ecological site:** A distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation. In a grassland environment, **range site** refers to a broader description of soil landscape (*e.g.*, loamy, clayey, sandy, choppy sand hills) that might be further subdivided into ecological sites due owing to differences in plant community potential.

**Ecosystem function:** The interactions between organisms and the physical environment, such as nutrient cycling, soil development, water budgeting, and flammability.

**Eolian:** Material that has been deposited by wind action.

**Erosion:** The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

**Evapotranspiration:** The combined loss of water from a given area and during a specific period of time, by evaporation from the soil surface and by transpiration from plants.

**Facilities or Features Left in Place:** In some cases, the Land Manager may wish to have roads or pads left in place. In these cases, the vegetation criteria are not necessarily applied. In other cases, roads or pads may be left in place but will be expected to be vegetated (*e.g.*, peat lands in agricultural areas, roads in Green Area). In these cases, some form of root zone must be established and the vegetation portions of the landscape criteria have to be met.

**Fen:** A peat-covered or peat-filled wetland with a water table which is usually at or above the surface. The waters are mainly nutrient-rich, minerotrophic waters from mineral soils. The vegetation consists mainly of sedges, grasses, reeds and brown mosses with some shrub cover and at times, a scanty tree layer.

**Fibre (rubbed):** Amount of fibre in an organic soil, greater than 0.15mm, remaining after a specified amount of abrasion (rubbing). A fibric soil has greater than 40% rubbed fibre, a mesic soil has 10% to 40% rubbed fibre and humic soil has less than 10% rubbed fibre.

**Fibric:** An organic layer containing large amounts of weakly decomposed material whose origins are readily identifiable.

**Fine texture:** Consisting of, or containing large quantities of the fine fractions, particularly of silt and clay.

**First lift:** The top layer of undisturbed soil materials salvaged and separated during excavation to be re-spread as topsoil.

**Fluvial:** Material that has been transported and deposited by streams and rivers. Also alluvial.

**Forage:** Perennial agronomic species grown for the purpose of feed.

**Friable:** A consistency term pertaining to the ease of crumbling of soils.

**Full Disturbance:** Full disturbance sites are sites that have had soil disturbances across the entire site.

**Gleysolic:** An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas, or prominent mottling, or both, in some horizons. The great groups Gleysol, Humic Gleysol and Luvic Gleysol are included in the order.

**Gravelly:** Containing an appreciable or significant amounts of gravel (particles 2 to 75 mm in diameter)

**Grazing response** - how the various kinds of plants on the range react when they are grazed. This may vary with soil and climate for any one species. Range plants are grouped as follows:

**Grazing Response – Type 1 Species (Decreasers):** Species that decrease in relative abundance as disturbance increases. They tend to be palatable to grazing animals and are the dominant species in the reference plant community (climax vegetation). Highly productive, palatable plants that grow in the original climax vegetation stand. They are palatable to livestock, and will decrease on a range when exposed to heavy grazing pressures.

**Grazing Response – Type 2 Species (Increaser – Type 1):** Species that normally increase in relative abundance as the decreaseers decline. They are commonly shorter, less productive species and more resistant to grazing and other disturbances. Type 1 increaser species increase at first but may decrease later as grazing or other disturbance pressures continue to increase. The increaser plants are normally shorter, lower producing and less palatable to livestock.

**Grazing Response – Type 3 Species (Invaders):** Invaders are introduced, non-native species and not normally components of the reference plant community (climax vegetation). They invade a site as the decreaseers and increasers are reduced by grazing or other disturbances. Invaders may be annuals, herbaceous perennials, or shrubs and have some (or no) grazing value. They are never considered desirable or acceptable vegetation.

**Grazing Response – Type 4 Species (Increaser – Type 2):** Species that normally increase in relative abundance as the decreaseers decline. They are commonly shorter, less productive species and more resistant to disturbance. Type 2 increaser species continue to increase in abundance with increasing disturbance pressures. When increaser type 2 species occur on a disturbed well site, we limit the amount of this cover that is considered desirable vegetation. The amount considered acceptable would be equal to the cover of the species found in the control or 5 % which ever is greatest.

**Green Area:** The green zone is the unsettled area, primarily northern Alberta and the boreal forest. These are forest lands not available for agricultural development other than grazing.

**Groundwater:** That portion of the hydrosphere which at any particular time is either passing through or standing in the soil and the underlying strata and is free to move under the influence of gravity.

**Gullying:** Erosion of soil or soft rock material by running water that forms distinct, narrow channels that are larger and deeper than rills and that usually carry water only during and immediately after heavy rains or following the melting of ice or snow.

**Horizon (soil):** A layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes. Soil horizons may be mineral or organic and differ from adjacent horizons in properties such as colour, structure, texture, and consistence, and in chemical, biological, and mineralogical composition.

**Hue :** One of the three variables of colour. It is caused by light of certain wavelengths and changes with the wavelength.

**Humic :** An organic layer of highly decomposed material containing little fibre.

**Hummocky :** Abounding in rounded or conical knolls or mounds, generally of equidimensional shape and not ridge-like.

**Hydraulic conductivity:** See Permeability.

**Immature soil:** A soil with indistinct or only slightly developed horizons.

**Impeded drainage:** A condition which hinders the movement of water through soils under the influence of gravity.

**Impervious :** Resistant to penetration by fluids or by roots.

**Industry Assessment:** The time (or times) when the site is assessed by the operator or his consultant. Data for the certificate application are collected at this time.

**Infiltration:** The downward entry of water into the soil.

**Irrigation :** The artificial application of water to the soil for the benefit of growing crops.

**Justification:** Explanation of why a site should get a certificate if some of the criteria have not been met. This information must be included in the Detailed Site Assessment Report (use Appendix Eas template). For sites where justification has been used, the assessment is now a Non-Routine Application.

**Lacustrine:** Material deposited in lake water and later exposed.

**Land capability:** The nature and degree of limitations imposed by the physical characteristics of a land unit for a certain use.

**Land Manager:** For **Public Lands**, this includes staff from Environment and Sustainable Resource Development (ESRD) responsible for stewarding public/crown lands. For **Provincial Parks and Protected Areas** this will include staff from Tourism, Parks and Recreation. For **Special Areas** this will include the Special Areas Board. For **Private Lands**, this includes the landowner, their designate, or occupant.

**Landowner:** person(s) holding the deed to the property.

**Layers:** Structural layers (life form layers) in grasslands include: 1) low shrubs, 2) tall graminoids and forbs 3) medium graminoids and forbs and 4) ground cover (graminoids, forbs, moss, lichen). In Forested, the layers would include trees, shrubs, grasses<sup>?</sup> and herbaceous.

**Lease:** For the purpose of the 2010 Reclamation Criteria this refers to the wellsite, not the access.

**Level 1:** A wellsite assessment that considers landscape, vegetation and soil components at a low level intensity. It's purpose is to detect any anomalies needing more indepth assessment.

**Level 2:** An optional assessment used at the discretion of the assessor. This involves a more intensive assessment soil through laboratory analyses to assess the apparent problematic conditions.

**Lithic:** A feature of a soil subgroup which indicates a bedrock contact within 50 cm of the soil surface.

**Litter:** Standing and fallen dead plant material that was produced naturally on site.

**Loam:** See soil texture. A mixture of sand, silt and clay. It is not related to colour.

**Loose:** A soil consistence term.

**Luvisollic:** An order of soils that have eluvial (Ae) horizons, illuvial (Bt) horizons in which silicate clay is the main accumulation product. The soils developed under forest or forest-grassland transition in a moderate to cool climate. The Gray Luvisol great Group is the most common in Western Canada.

**Management plan:** as established through the Site Conservation Plan.

**Medium texture:** Intermediate between fine-textured and coarse-textured soils. It includes the following textural classes: very fine sandy loam, loam, silt loam, and silt.

**Mesic:** An organic layer of intermediately decomposed material (between that of fibric and humic).

**Minimum Disturbance:** Minimum disturbance sites are sites that have been reclaimed where construction practices have minimized the level of disturbance on the lease resulting in two different management zones (i.e., Undisturbed and Disturbed).

**Moderately-coarse texture:** Consisting predominantly of coarse particles. In soil textural classification it includes all the sandy loams except the very fine sandy loam.

**Moderately-fine texture:** Consisting predominantly of intermediate-size soil particles. In soil textural classification it includes clay loam, sandy clay, sandy clay loam, and silty clay loam.

**Modified native grasslands:** Grasslands where native species integrity has been altered by past disturbance and where > 70% of the community is composed of non-native plant species and where grazing management needs may be different than native communities (more like tame pastures).

**Morphology, soil:** The makeup of the soil, including texture, structure, consistence, colour, and other mineralogical, physical, and biological properties of the various horizons of the soil profile.

**Mulch:** Dead plant material (*e.g.*, straw) that is added to a reclaimed site to help promote plant establishment by retaining soil moisture, increasing microbial activity and preventing soil erosion. It is not included in determining cover.

**Munsell soil colour system:** A colour designation system that specifies the relative degree of the three simple variables of colour: hue, value, and chroma. For example: 10YR 6/4 is a colour (of soil) with a hue of 10YR, value of 6, and chroma of 4. Value (grayness) can be used as a proxy for organic matter content.

**Native Species:** A plant species that is indigenous to the ecological site. For the purposes of the 2010 Native Grassland Reclamation Criteria, native species refer to those species existing offsite found within the control area.

**Native-Infilling Species:** For the purpose of the 2010 Reclamation Criteria for Native Grasslands are a combination of native species from the controls or were seeded that are establishing on the disturbed area and are indistinguishable as to their source. They are considered desirable as they are part of the local native plant community and their presence is a measure of native species recruitment and progress along a successional pathway.

**Natural recovery:** Long term re-establishment of diverse native ecosystems (*e.g.*, Prairie, forest) by establishment in the short-term of early successional species. This involves revegetation from soil seedbank and/or natural encroachment and no seeding of non-native agronomic species.

**Non-Arable Lands:** Land that has no capability for arable agriculture.

**Non-Surface Soil:** Nonsurface soil includes subsoil and other materials that do not normally comprise surface soil.

**Offsite:** Refers to information collected offsite against which collected information from a reclaimed site will be compared. The control information is collected offsite from adjacent or representative land. See also definition for "control".

**Offsite (remote) sump:** A low-lying place, such as a pit, used for temporary storage and/or containment of liquids produced from the site.

**Onsite:** Refers to information collected on the reclaimed site (*i.e.*, lease and access) against which collected information from the control (*i.e.*, offsite) will be compared. The control information is collected offsite from adjacent or representative land. See also definitions for "Lease" and "Access Road".

**Operability:** The effort required to implement management decisions and practices in order to achieve a desired level of return

**Organic matter (OM):** The decomposition residues of biological materials derived from plant and animal materials deposited on the surface of the soil; and roots and micro-organisms that decay within the soil.

**Organic soil:** An order of soils that have developed dominantly from organic deposits. The majority of organic soils are saturated for most of the year, unless artificially drained. The great groups include Fibrisol, Mesisol, Humisol and Folisol.

**Paralithic:** Poorly consolidated bedrock which can be dug with a spade when moist. It is severely constraining but not impenetrable to roots.

**Parent material:** The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil is developed by pedogenic processes.

**Particle size:** The effective diameter of a particle measured by sedimentation, sieving, or micrometric methods.

**Peat:** Unconsolidated soil material consisting largely of organic remains (mainly derived from mosses or sedges).

**Ped:** Fine soil particles held together in a single cluster, such as in a clod or a crumb. See Aggregate.

**Pedology:** Those aspects of soil science involving especially the constitution, distribution, genesis and classification of soils.

**Percent Acceptable Substitutions:** For disturbed wellsites, the percent cover of seeded native species that may not be present on the control but are part of the natural subregion. Their presence is considered temporary as plant succession proceeds but in the short term they provide ecological benefits such as sheltering canopy, site stabilization and litter accumulation.

**Percent Native-Infill Vegetation:** For disturbed wellsites, the percent cover of Native-Infill species on the reclaimed area, relative to the total cover of native species on the control. Need to have greater than 15% of the control for a pass.

**Percolation, soil water:** The downward movement of water through soil. Especially, the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

**Permeability (soil):** The ease with which gases and liquids penetrate or pass through a bulk mass of soil.

**Pits:** For the purposes of these criteria, the term Pits refers to a borrow pit from which earth was removed for constructing the Lease and/or the access.

**Plant Density:** The number of plants *per* unit area (e.g., *per* area). An individual plant can usually be defined as the sum of the aerial parts that correspond to a single root system. Plants that spread by underground roots may be more difficult to count. In this case it may be more appropriate to use a cover estimate only.

**Platy:** Consisting of soil aggregates that are developed predominately along the horizontal axes, laminated; flaky.

**Productivity:** A measure of the physical yield of a particular crop. It must be related to a specified management. Productivity may be used to describe or define suitability but it would be inappropriate as a definition of capability which puts more emphasis on vulnerability or flexibility – on available options – rather than simply yields. Calculated as the average unit productivity of all the assessment locations.

**Profile (soil):** A vertical section of the soil through all its horizons and extending into the C horizon.

**Public Lands:** land of the Crown in right of Alberta.

**Quality Tolerance:** An acceptable change in soil quality factors. The onsite quality tolerance reflects the offsite (representative control) variability.

**Rating Drop:** For the purposes of the 2010 Reclamation Criteria this refers to a negative variance of a rating category.

**Reaction, soil (soil pH):** The degree of acidity or alkalinity of soil, usually expressed as a pH value.

**Reclamation certification:** indicates the site has passed the criteria.

**Reclamation:** The process of reconvertng disturbed land to its former or other productive uses.

**Reconstructed soil:** A soil profile formed by selected placement of suitable overburden materials on reshaped spoils.

**Re-disturbance:** Going back on a site after reclamation and re-vegetation to address unresolved issues.

**Regulator:** For the purposes of the 2010 Reclamation Criteria on **Public Lands, Private Lands and Special Areas** this refers to Environment and Sustainable Resource Development (ESRD).

**Regosolic:** An order of soils having no horizon development or development of the A and B horizons insufficient to meet the requirements of the other orders. Included are Regosol and Humic Regosol great groups.

**Remediation:** A set of activities that results in the decontamination of a contaminated site.

**Residual:** Unconsolidated and partly weathered mineral materials accumulated by disintegration of consolidated rock in place.

**Rilling:** A rill is a narrow, very shallow, intermittent watercourse having steep sides. It presents no obstacle to tilling.

**Root zone:** The part of the soil that is occupied by plant roots.

**Saline soil:** A nonalkali soil containing soluble salts in such quantities that they interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 dS.m (formerly mmhos/cm), the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5.

**Salinization:** The process of accumulation of salts in soils.

**Sand:** A soil particle between 0.05 and 2.0 mm in diameter.

**SAR (Sodium Adsorption Ratio):** The proportion of sodium on the soil exchange complex in relation to the proportion of calcium and magnesium.

**Saturation percentage:** The amount of water required to saturate a unit of soil (often correlated with sodicity).

**Second lift:** The second layer of undisturbed soil material that underlies the first lift, which is salvaged and separated during excavation to be replaced as upper subsoil.

**Seral:** Successive changes in flora: the series of different communities of plants that occupy a specific site and create a stable system during the process of ecological succession.

**Silt:** A soil separate consisting of particles between 0.05 to 0.002 mm in equivalent diameter.

**Site:** Means the lease, access and any other associated facility (e.g., campsite, borrow pit, offsite sump, log deck) in this document or The lease and the access road in this document.

**Slaking:** Initial fragmentation of soil aggregates several millimetres in diameter which may disintegrate further to become microaggregates [*i.e.* < 250  $\mu$ m diameter] due to air trapped in the aggregates being compressed by the water as it is driven into the soil.

**Sodicity:** A measure of the amount of sodium on the exchange complex (often expressed as sodium adsorption ratio – SAR).

**Soil Assessment:** An evaluation of the characteristics of the replaced topsoil and the layer of subsoil just beneath it. The purpose of the assessment is to ensure that there are no restrictions to rooting, or to water or air movement. The soil is assessed to a minimum depth of 50 cm.

**Soil exchange complex:** The complement of ions adsorbed on soil particles.

**Soil fertility:** The status of a soil with respect to the amount and availability of elements necessary for plant growth.

**Soil map:** A map showing the distribution of soil types or other soil mapping units in relation to the prominent physical and cultural features of the earth's surface.

**Soil moisture:** Water contained in the soil.

**Soil Profile Assessment:** An evaluation of the characteristics of the replaced surface soil and the layer of subsoil just beneath it. The purpose of the assessment is to ensure that there are no restrictions to rooting, or to water or air movement. The soil is assessed to a depth of 50 cm.

**Soil structure:** The combination or arrangement of primary soil particles into secondary particles, units or peds. These secondary units may be, but usually are not, arranged in the profile in such a manner as to

give a distinctive characteristic pattern. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctiveness into classes, types, and grades, respectively. Common terms for kind of structure are – single grain, amorphous, blocky, subangular blocky, granular, platy, prismatic and columnar.

**Soil survey:** The systematic examination, description, classification, and mapping of soils in an area. Soil surveys are ranked according to the kind and intensity of field of field examination.

**Soil:** The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

**Solonetzic:** An order of soils developed mainly under grass or grass-forest vegetative cover in semiarid to subhumid climates. The soils have a stained brownish or blackish solonetz B (Bn, Bnt) horizon and a saline C horizon. The order includes the Solonetz, Solodized Solonetz, and Solod great groups.

**Solum (plural sola):** The upper horizons of a soil in which the parent material has been modified and within which most plants roots are confined. It consists usually of A and B horizons.

**Species Composition:** The different kinds, amounts, and proportions of plants present on a revegetated disturbed area. These can be grasses, forbs, shrubs, or trees.

**Specified land:** For the purposes of the 2010 Reclamation Criteria, the term Specified Land, means land that is being or has been used or held for or in connection with the construction, operation or reclamation of a well, battery or pipeline (excerpt from the Conservation and Reclamation Regulation (115/93))

**Staged approach:** including Level 1 and Level 2 assessments.

**Step-Out Assessment:** When an anomaly is encountered at an assessment location, the operator may opt to conduct a 'step-out' assessment to determine if it is representative of the whole grid or not. A step-out consists of assessing a minimum of an additional 3 locations. These additional locations will be <10 m from the original point in a triangular shape around it.

**Subsoil:** Although a common term it cannot be defined specifically. It may be the B horizon of a soil with a distinct profile. It can also be defined as the zone below the plowed soil in which roots normally grow. For Level 2 it refers to the soil material between 20 cm and 50 cm.

**Surface soil (topsoil):** The uppermost mineral or organic material, valued as a growing medium and salvaged. More detailed definitions are provided in the text of the criteria for each land use. The uppermost mineral/organic material, valued as a growth medium and salvaged.

**Surface Stoniness:** Stoniness is the relative proportion of stones on the soil surface. The number, size and spacing of these coarse fragments on the surface represent constraints for the use of the soil and farming practices. Stoniness affects tillage, selection of type of machinery and crop selection.

**Texture:** The relative proportions of sand, silt and clay in a soil. It is described in terms such as sand (S), loamy sand (LS), sandy loam (SL), loam (L), silt loam (SiL), clay loam (CL), silty clay loam (SiCL), and clay (C).

**Third-party impacts:** pre-oil and gas, Land Manager, Landowner (or designate) activities, such as, recreational or industrial use, trails, wildlife.

**Till:** Unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel, and boulders intermingled in any proportion.

**Tilth:** The physical condition of the soil in relation to plant growth  
Top soil replacement

**Topsoil:** Topsoil is normally referred to as the plough layer in agricultural soil and contains the majority of the roots. This is the A horizon including Ap, Ah, Ahe, Ae and sometimes AB as defined in The System of Soil Classification For Canada, 1987 (page 23).

**Total Acceptable Vegetation:** On disturbed wellsites, the combined cover of native-infilling species and acceptable substitution species. For reclaimed websites the total acceptable vegetation cover must be

greater than 50% cover relative to the control. For undisturbed wellsites, the total percent cover of native species on the wellsite relative to the corresponding native species in the control. Need more than 70% cover for a pass.

**Trajectory:** The probable course of plant community development through a series of dynamic changes in ecosystem structure, function and species composition over time (adapted from Dictionary of Natural Resource Management, UBC Press, 1996).

**Two-lift stripping :** The selective salvage of all surface soil as the first lift and of good quality upper subsoil as the second lift. The lifts are then replaced in the proper order.

**Undisturbed Assessment:** A Grasslands land use lease assessment that only evaluates landscape and vegetation components. The purpose is to evaluate reclamation success or to identify any anomalies requiring more in-depth assessment (soils and more detailed vegetation parameters).

**Undisturbed Areas:** include areas of the lease or access where there has been no surface soil disturbance and the native plant community has remained relatively intact (*i.e.*, the on/offsite vegetation community and layers are similar). Generally, this applies where slopes are minimal and lease leveling was not necessary.

**Value, colour:** The relative lightness or intensity of colour and approximately a function of the square root of the total amount of light. One of the three variables of colour.

**Vigour:** The relative health of a plant. If a plant is vigorous, it is healthy and is performing as expected, in comparison with the surrounding vegetation or control.

**Water table:** The upper surface of groundwater or that level below which the soil is saturated with water.

**Weed:** An undesirable or unwanted plant. Prohibited noxious and noxious weeds must be managed as per the Alberta Weed Control Act and/or the local authority.

**Wetland :** Land that has the water table at, near, or above the land surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soils, hydrophytic vegetation and various kinds of biological activity that are adapted to the wet environment.

**White Area:** The white zone is the settled areas of Alberta, This includes Privately owned lands as well as public lands in this area, which are suitable for the proposed use and are not required for conservation, recreational, wildlife habitat, forestry and other purposes, may be applied for pursuant to the Public Lands Act and associated regulations.

**Woodlots:** A tract of land, on a farm, ranch or other private property, set aside primarily for the growing, management, and harvest of trees for sale as unprocessed logs and potentially a variety of other ancillary products.

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END OF SECTION

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## 20. Appendix H

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### 20.1. Contact Information

#### Air Photo Distribution

Main Floor, 9920 – 108 Street NW  
Edmonton AB T5K 2M4  
Phone: (780) 427-3520  
Fax: (780) 422-9683  
Email: [Air.Photo@gov.ab.ca](mailto:Air.Photo@gov.ab.ca)  
Web: [www.srd.gov.ab.ca/lands/geographicinformation/airphoto](http://www.srd.gov.ab.ca/lands/geographicinformation/airphoto)

#### Environmental Law Centre

#800, 10025 - 106 Street NW  
Edmonton, AB T5J 1G4  
Phone: (780) 424-5099  
Fax: (780) 424-5133  
Toll Free: 1-800-661-4238  
Email: [elc@elc.ab.ca](mailto:elc@elc.ab.ca)

#### Alberta Energy Regulator main office:

Suite 1000, 250 – 5 Street, SW  
Calgary, AB T2P 0R4  
Phone: 403-297-8311  
Fax: 403-297-7040  
Email: [Infoservices@AER.ca](mailto:Infoservices@AER.ca)

#### ESRD Groundwater Information Centre

Fax: (780) 427-1214  
Phone: (780) 427-2770  
Email: [gwinfo@gov.ab.ca](mailto:gwinfo@gov.ab.ca)

#### Freedom of Information and Protection of Privacy Office

6 th Floor South Petroleum Plaza, 9915 - 108 Street  
Edmonton, AB T5K 2G8  
Phone: (780) 427-4429  
Fax: (780) 427-9838  
Email: [foip.environment@gov.ab.ca](mailto:foip.environment@gov.ab.ca)

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END OF SECTION

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## **21. Appendix I**

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### **21.1. Regional Offices**

#### **ESRD - SOUTHERN REGION**

2<sup>nd</sup> Floor, Deerfoot Square  
2938 - 11 Street NE  
Calgary, AB T2E 7L7  
Telephone: (403) 297-8295  
Fax: (403) 297-8232

#### **ESRD - CENTRAL REGION**

3<sup>rd</sup> Floor, Provincial Building  
4920 - 51 Street  
Red Deer, AB T4N 6K8  
Telephone: (403) 340-7052  
Fax: (403) 340-5022

#### **ESRD - NORTHERN REGION**

111 Twin Atria Building  
4999 - 98 Avenue  
Edmonton AB T6B 2J6  
Telephone: (780) 427-7617  
Fax: (780) 427-7824

#### **ESRD - District Offices**

For a complete list of all ESRD offices and contact information, visit  
<http://srd.alberta.ca/Default.aspx>

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