

2010 Reclamation Criteria for Wellsites and Associated Facilities for Cultivated Lands

(Updated July 2013)

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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

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; Government of Alberta 2009a), 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* (1995 Reclamation Criteria; Alberta Environment, 1995). The review of the 1995 Reclamation Criteria was done according to Alberta Environment's (AENV) 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 is timely because of improvements in reclamation practices, scientific developments and recommendations for improving the former criteria. The Reclamation Criteria Advisory Group began with an assessment of the 1995 Reclamation Criteria: intending to retain the parts that worked and improving the parts that did not. These Criteria will be continually improved as knowledge of ecosystem processes improves.

Task groups for cultivated, native grasslands, forested and peat lands addressed the unique issues for each land type. Ecological health & function and land operability were objective indicators of equivalent land capability after successful reclamation.

Importantly, according to the following litmus tests these criteria are to be:

- 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 decision, acceptable to all stakeholders with risk transferred to the Government of Alberta.
- 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 reviewed periodically and updated as necessary as knowledge of ecosystem processes improves.

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 Cultivated Lands (Updated July 2013). Edmonton, Alberta. 99 pp.
	1	3 rd Paragraph, 1 st 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 rd Paragraph, 3 rd 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 th Paragraph, 1 st Sentence, 1 st Bullet for the Land Manager Definition was revised: Land Manager : For Public Lands , this includes staff from <u>Environment and Sustainable Resource Development (ESRD)</u> 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. 6 th Paragraph, 1 st Sentence, 2 nd Bullet for the Regulator Definition was revised: Regulator : On Public Lands , Private Lands and Special Areas this refers to Environment and Sustainable Resource Development (ESRD).
July 2013	7.1	1 st Paragraph, 1 st 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 cultivated lands <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.
July 2013	8	2 nd Paragraph, 3 rd Sentence was revised: 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.
	8.2	1 st Paragraph, 1 st Sentence was revised: Contamination: Drilling waste and other oilfield wastes must be properly disposed of according to AER Directives.
July 2013	8.3	Callout box revised: When these situations arise, assessors should discuss with the Regulator prior to conducting the assessment, <u>when possible</u> , to discuss options.
July 2013	8.4.1	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	8.4.2	1st Paragraph, 1st 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	8.5.3	Deleted the sentence: For the Native Grassland Criteria, the use of assessment locations randomly located within the lease can compensate for the anticipated variability.
July 2013	8.5.3	Callout boxes added: Note: For smaller disturbances it is recommended that assessors maintain a balanced sampling design (i.e., equal sample numbers on- and offsite). Note: For stratified sites, separate Record of Observation (RoO) datasheets for both soil and vegetation assessments are required to make the appropriate comparisons.
July 2013	8.5.4	2nd Paragraph, 5th Sentence, Bullets were revised: Assessing the access shall be as follows: ▪ <100 m: assessment points shall be located at a minimum of 2 paired assessment points (Figure 5). If the topography is variable, more assessment points shall be used. Adjust the assessment points so the access approach and side hill cut areas are inspected. ▪ ≥100 m: assessment points shall be located at intervals no greater than 100 m apart (Figure 5). If the topography is variable, more assessment points shall be used to compare upper, mid and lower slope positions.
July 2013	8.5.5	Callout box added: Note: It is recognized that additional step-outs will result in an increase in sampling intensity and will affect initial sample spacing.
July 2013	8.6	Callout box revised: Note: Unlike the 1995 Criteria that identified how many 'assessment points' could fail before a site fails, sites assessed using the

		2010 Reclamation Criteria for Cultivated Lands could fail due to: a) Changes onsite at an assessment point that result in a parameter, or combination of parameters, not being comparable to the representative control area; and/or, b) Changes onsite that lead to the parameter (e.g., topsoil depth, vegetation height) being assessed not being comparable to the representative control area.
July 2013	9.1.3	The following sentence was deleted: See ERCB Directive (in progress)
July 2013	9.5.1	Figure 7 was added
July 2013	9.5.2	Section renamed: Gravel and Rock 1 st paragraph, 1 st Sentence was revised: Surface Stoniness/ Coarse Fragment Content : on cultivated lands, surface stoniness and coarse fragment content (Figure 8) is assessed during the Soil Assessment Figure 8 was added
July 2013	10	Table 5 and Section 10 were revised to improve consistency. The following were added to the 'Parameter' column: Pod Density and Litter Quantity. Callout box revised: Data collected from yield monitors, aerial imagery, and satellite imagery can be used as supporting information for an application. This data may also offset some data collected as part of field assessments however; this must be discussed with the Regulator. Field assessments <u>must</u> still be conducted.
July 2013	10.1; 10.2; and, 10.3	Sections on Crop Type; Growth Stage and Growing Conditions; Seed Distribution/Germination were reordered to be consistent with Table 5
July 2013	10.4	1 st Paragraph, 1 st Sentence revised: For most crops, the assessor shall document the average crop height at the time of assessment in a representative area of where the plant density measurements were conducted. 2 nd Paragraph, 1 st Sentence revised: For assessments where plant height measurements are conducted, measure the plant height at each assessment point onsite and offsite and express as a % of the average control height. Callout box added: Note: Plant height measurements are not required for tame pasture.
July 2013	10.5	Under Specialty Crops the following bullet was added: ▪ Trees Farms: Assessors must assess tree height
July 2013	10.6	Under Specialty Crops the following bullet was added: ▪ Trees Farms: For trees, these measurements should include root collar diameter (RCD) and/or diameter at breast height (i.e., 1.2 meters; DBH). ▪ Removed section on Litter Quality
July 2013	10.11	2 nd Paragraph, 1 st Sentence was revised: For tame pasture sites that are grazed where litter is present, litter quantity can be assessed using a handrake method similar to the method outlined in the (Alberta Sustainable Resource Development, 2005).

		References corrected to Equation 1 for Example A & B.
July 2013	11.1.4	2nd Paragraph, 1st Sentence was revised: Ratings in CRT.3 (Appendix D) are used for comparing soil color and must be recorded in the Assessment Tool and the RoO. 2nd Paragraph, 2nd 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.
July 2013	11.1.5.2	3 rd 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.
July 2013	12.3.	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.
July 2013	Appendix – A: 13.1.3.2	In the heading ERCB, 2008 was replaced by <u>AER, 2008</u>
July 2013	Appendix - D	Rating table revision: CRT 1a: Table revised to revise column heading to 'Topsoil Depth Measurements' and also includes an example for calculating and assigning ratings for topsoil depth measurements. CRT 1b: Table revised to include a rating system for cereals. CRT 1c: Table revised to include plant measurement ratings. CRT 3: Table was revised to remove the instructions regarding conducting soil structure assessments based on soil consistence results.
July 2013	Appendix – F	Reference changed from: Energy Resources Conservation Board (ERCB). 2008. Directive 056: Energy Development Applications and Schedules. Energy Resources Conservation Board, Calgary, AB. July 2008. 320 pp. [Online: http://www.ERCB.ca] To: Alberta Energy Regulator (AER). 2008. Directive 056: Energy Development Applications and Schedules. Alberta Energy Regulator, Calgary, AB. July 2008. 320 pp. [Online: http://www.AER.ca]
July 2013	Appendix – G	Definitions revised/amended for: 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. 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>i.e.</i>, species and/or layers) has been altered or removed. 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. Native species: 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. 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. 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. 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). Third-party impacts: pre-oil and gas, Land Manager, Landowner (or designate) activities, such as, recreational or industrial use, trails, wildlife. 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>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	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: Infoservices@ercb.ca 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: Infoservices@AER.ca

END OF SECTION

6. Introduction

6.1. Background

The aim of reclamation under the *Environmental Protection and Enhancement Act* (EPEA) 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 Reclamation 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 Reclamation Criteria is to measure appropriate parameters and evaluate whether land function and operability is comparable to the surrounding area or an appropriate reference. The 2010 Reclamation Criteria describe the allowable changes in site conditions. They typically require landscape, vegetation and soils assessments as did the 1995 Update. In special cases, the operator may have to find representative land, soil and vegetation a short distance from the site or use available references applicable to Alberta.

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, it is acknowledged that the 2010 Reclamation 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 make his/her assessment. Where such circumstances occur and the site 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 deemed

a **Non-Routine Application** and will require consultations with the inspector prior to submission to avoid a reassessment 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 2010 Reclamation 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 Rationale.

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).

END OF SECTION

7. Land Types in the 2010 Reclamation Criteria

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

Cultivated Lands include lands managed under conventional, minimum or zero till practices for agricultural purposes. Land use changed from peatland, forested land or grassland to cultivated land is included. The cultivated land criteria also apply to trees planted for agroforestry (i.e., tree farms), tame forages, tame pasture, hay lands or areas seeded to perennial agronomic species.

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 (Crown land), 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.

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.

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.

7.1. Land Use Changes

If a site changes land use, the Land Manager must be involved in the discussion and any such changes will require their written agreement. Should a land use change occur

assessors should refer to (Figure 1, next page) 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 Grassland

A land use change from grassland to cultivated is acceptable provided that the Land Manager requests it and it is documented. The reclamation assessment will follow the Cultivated Land Criteria although the assessor will need to find representative controls which may or may not be adjacent to the site. Should representative controls not be available, professional judgement with supporting rationale shall apply.

7.1.1. Changed from Forested Land

A land use change from forested to cultivated is acceptable provided that the Land Manager requests it and it is documented. The reclamation assessment will follow the Cultivated Land Criteria although representative controls could include sample points from the adjacent forested soil or from comparable deforested/cultivated lands. Normally duff (LFH) plus Ah, Ahe and up to 15 cm of the Ae horizon will be salvaged. If the A horizon(s) are less than 15 cm, then a minimum of 15 cm of material will be salvaged unless the material is unsuitable. Should representative controls not be available, professional judgement with supporting rationale shall apply.

7.1.2. Changed from Peatland

Different approaches are taken on arable peatland regarding the removal of drilling pads. A land use change from peatlands to cultivated peatlands, and their subsequent reclamation requires input from the Land Manager. For sites on cultivated peatlands, assessors can use either the Cultivated Land Criteria or the Peatland Criteria. Some landowner (or designate)s/occupants want to use the pad as is or request mixing nearby peat into the pad surface to allow for cultivation. For peatland to be arable, it must be drained and drainage activities must comply with current legislation, i.e., the *Water Act* (Appendix A; *Water Act* and Riparian Areas). Should representative controls not be available, professional judgement with supporting rationale shall apply.

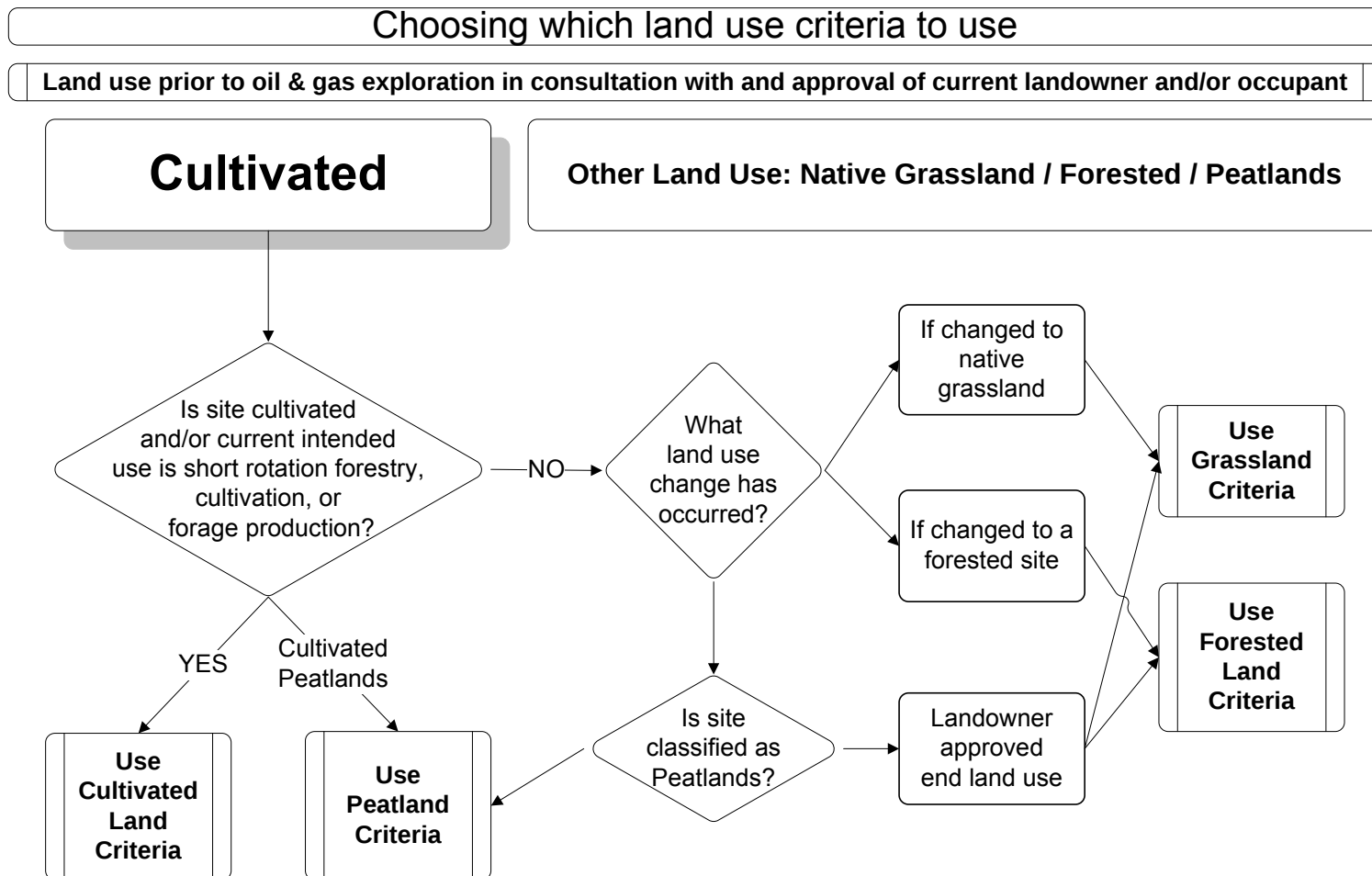


Figure 1. Selection process for cultivated lands for selecting an appropriate land use criteria for sites which may or may not have undergone a land-use change. The Peatland Criteria refers to the 1995 Update which will remain in effect until a new criteria or guide has been released.

END OF SECTION

8. The Assessment Process on Cultivated Lands

Cultivated Lands: includes all lands that have been tilled to prepare a seed bed at some time in their history and have a defined Ap horizon, including land use changed from either peatland, forested land or grassland to cultivated land. 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.

The process (Figure 2, next page) involves a landscape assessment and methodologies for assessing vegetation and soils for areas delineated and identified as being either Undisturbed and Disturbed (see Assessing and Sampling the Site). The methods and level of detail described within each of the three assessment components (i.e., Landscape, Vegetation, and Soils) are the minimum acceptable. These areas are defined as:

- **Undisturbed Areas:** include areas of the lease or access where it is documented that there has been no surface soil disturbance. Generally, this applies where slopes are minimal and lease leveling was not necessary
- **Disturbed Areas:** include areas of the lease or access that 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.

Under the **Landscape Assessment**, landscape criteria are assessed by looking at the site as a whole in the context of adjacent land and, if available, the pre-disturbance conditions if information had been documented. Differences between the site and the adjacent land must not interfere with normal land use and not show a negative impact on or offsite.

For the **Vegetation Assessment** there is a greater emphasis on vegetation as an indicator of equivalent land capability, ecosystem function and/or productivity. This equates to greater assessment requirements for vegetation.

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.

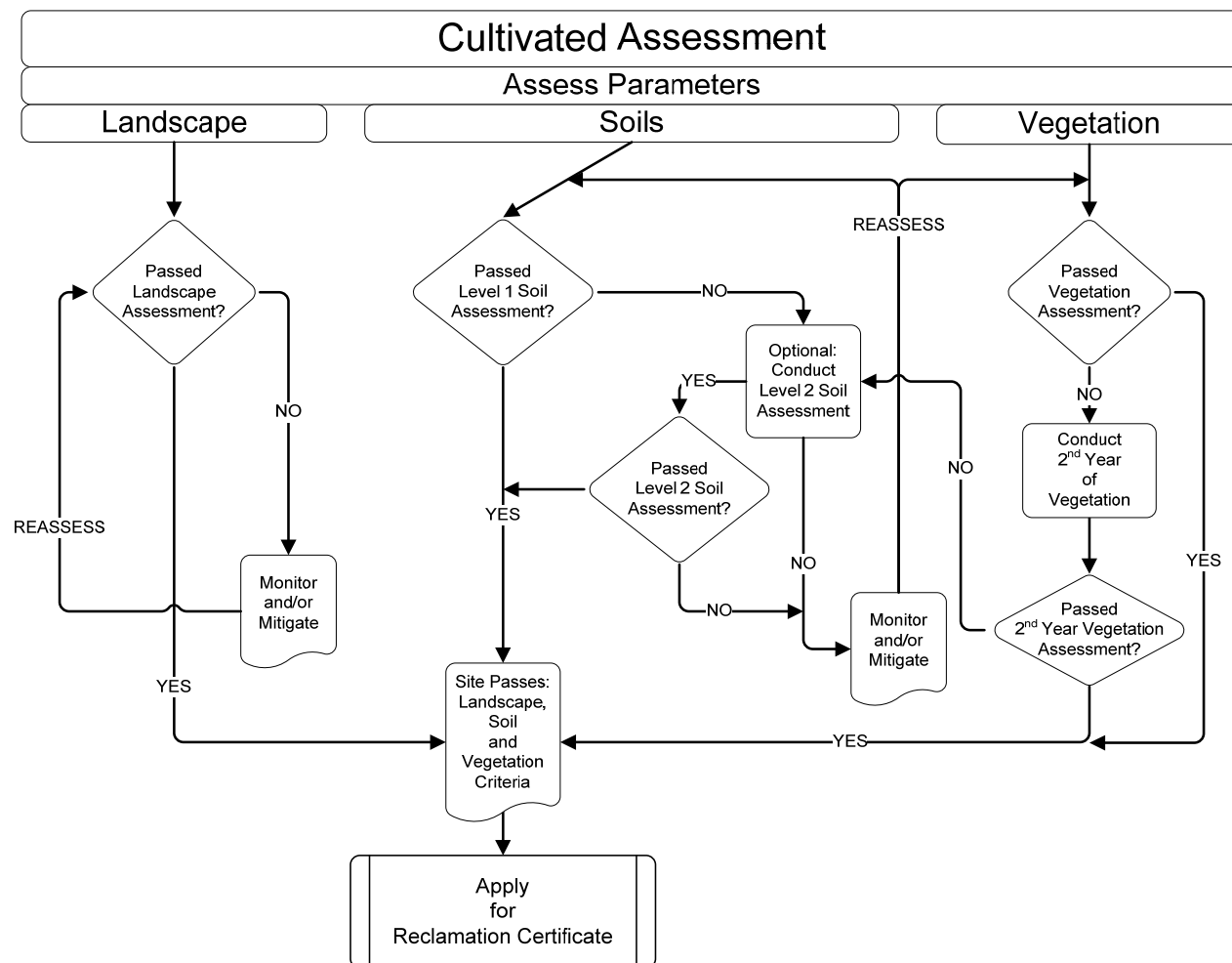


Figure 2. Cultivated Land Criteria assessment process pathways for the Landscape, Soils, and Vegetation Assessments.

8.1. Implementation of the 2010 Cultivated Criteria

Table 1 (see next page) outlines the various construction periods that shall apply to the implementation of the 2010 Reclamation Criteria for Cultivated Lands.

Table 1. Implementation of Reclamation Criteria as per Construction Period for the Landscape Criteria, Vegetation, and Topsoil Depth Measurements.

Landscape Pass or Fail Conditions		
Before Jan. 1, 1983	Jan.1, 1983-April 30, 1994	On or After April 30, 1994
----- Are expected to comply with all aspects of the 2010 Landscape Criteria -----		
Vegetation Pass or Fail Conditions		
Before Jan. 1, 1983	Jan.1, 1983-April 30, 1994	On or After April 30, 1994
----- Less than 15% variance between lease mean and control mean -----		
----- No assessment point onsite can be less than 80% of the lowest control measurement -----		
Average Topsoil Replacement by Construction Period		
Before Jan. 1, 1983	Jan.1, 1983-April 30, 1994	On or After April 30, 1994
Less than 40% variance between lease mean and control mean.	Less than 30% variance between lease mean and control mean	Less than 15% variance between lease mean and control mean
----- No assessment point onsite can be less than 80% of the lowest control measurement -----		

NOTE: For sites constructed prior to April 30, 1994, applications can be submitted as a Non-Routine Application for further review of sites that meet the following criteria:

1) Average Topsoil Depth onsite meets the topsoil replacement requirements for the respective construction period; but,

2) Fail the topsoil depth rating comparison.

Applications that meet the above criteria shall include in the application the data with supporting explanation showing that all assessment points onsite met the required replacement depth for the respective construction period (i.e., 60%*Control Average, 70%*Control Average).

8.2. 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 dealt with 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 and Tier 2 Guidelines* (Alberta Environment, 2010a, as amended; 2010b, as amended).

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.

8.3. Use of Professional Judgement

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

- Restricted Access (e.g., assessors aren't granted access offsite);
- Representative controls are not available (e.g., tame pasture on the lease 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 Application.

8.4. 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.

8.4.1. Required Information, No Alternatives Permitted

This information is contained within the electronic tool that accompanies the 2010 Reclamation Criteria. 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

8.4.2. Required Information, Alternative Forms Permitted

This information is contained within the electronic tool that accompanies the 2010 Reclamation Criteria for Cultivated Lands. 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.

8.5. Assessing and Sampling the Site

For the 2010 Reclamation Criteria for Cultivated Lands, the assessment locations are point assessments. To accommodate soil and vegetation variability, assessments shall be completed at points that are representative of the entire grid (Figure 3). On sites with a great deal of variability, or sites where justification for deviation from the criteria is submitted, more detail may be required. If some parameters do not pass, an application may still be submitted if it is accompanied by a defensible rationale, or justification, of why the site is eligible for certification.

8.5.1. Sampling on Variable Sites

It is important to understand the nature of the variability of a site. In order to provide an understanding of natural variability, it is suggested that several controls be assessed, or published information on variability consulted for the appropriate area prior to site assessment. On variable sites more than the standard nine (9) assessment points will be required to accurately estimate the rated (*i.e.*, plant health, head health, seed development, etc.) and measureable parameters (*i.e.*, soil depth, plant height, plant density, head/pod/tuber length, head/pod/tuber weight).

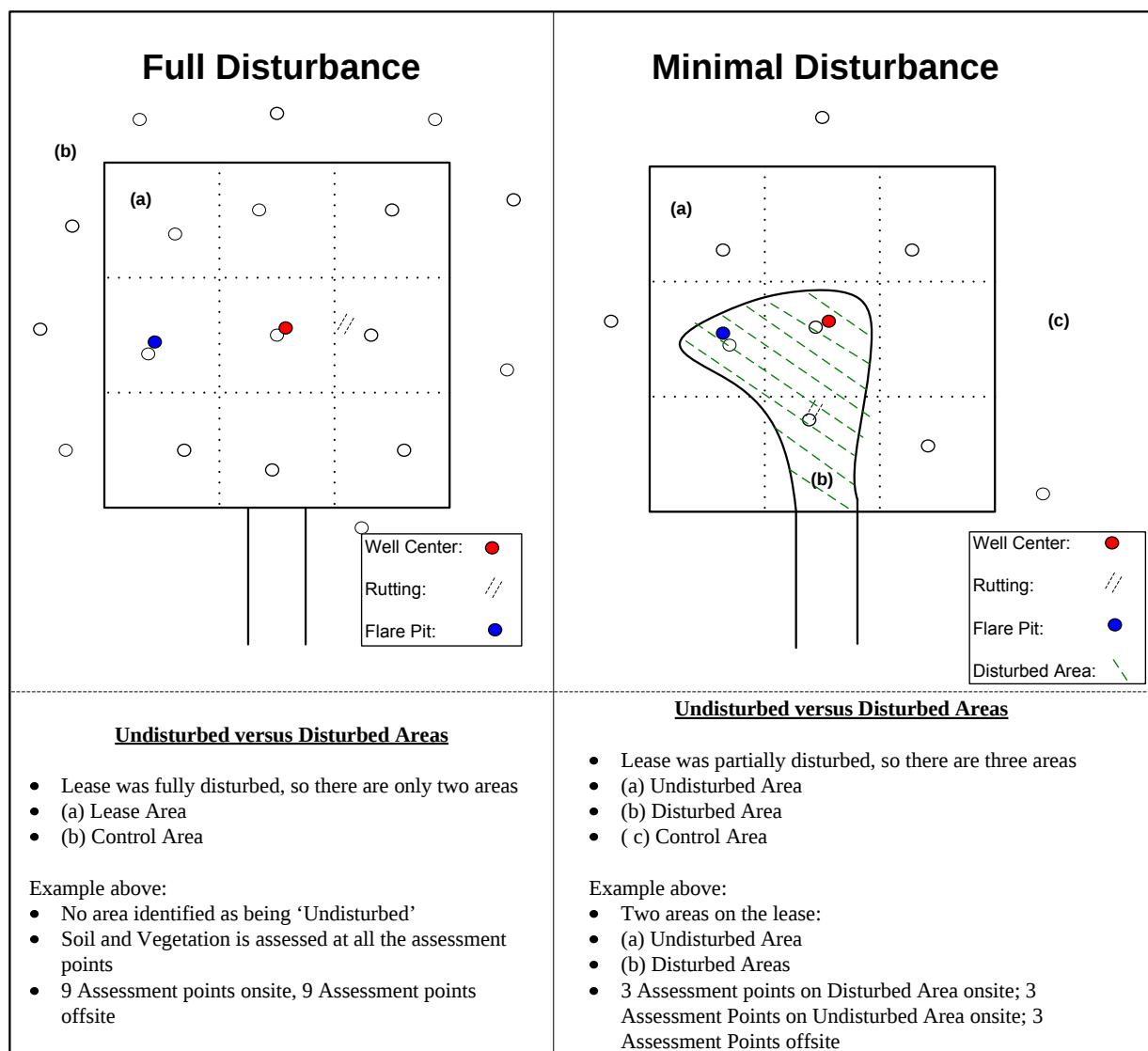


Figure 3. Examples of a lease sketch for a full disturbance (left) site and a lease sketch (right) for minimal disturbance site. Note: The Undisturbed Area is not to be confused with the offsite, the two still require separate assessments and must be sampled accordingly.

For variable sites, the use of alternative methods for comparing assessment points onsite to assessment points offsite can only be applied to measureable parameters. 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 areas assessors should consider stratifying the site, which involves subdividing the site into the respective areas (see Option #3 or #4 in Figure 4) This should be drawn on the site sketch. Examples of sites that could be considered variable are those:

- with greater than 5% slope;
- highly variable topography but no distinct landscape units;

- land with different 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 points.

8.5.2. 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). As a result, a reduction in sampling intensity for vegetation and soils can be justified although this must still meet the minimum sampling requirements on the undisturbed portion of the site only. Assessment points located within the undisturbed area on the lease shall not be used as controls. The reduced sampling intensity must be discussed and agreed to by the Land Manager.

For these sites, the undisturbed and disturbed areas **must** be delineated (mapped) clearly on the application (Figure 3, previous page). The entire site must undergo the landscape assessment to allow confirmation and verification of the areas identified as being either Undisturbed or Disturbed, as defined in The Assessment Process on Cultivated Lands.

Note: For Minimal Disturbance sites where a reduced sampling intensity is being proposed and confirmed through sampling in the field this must be discussed and agreed to by the Land Manager. The application is still considered a Routine Application.

8.5.3. 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.

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

- The assessment point spacing shall be adjusted to evenly cover the entire lease. Spacing shall be adjusted for different sized and shaped leases (Table 2). An increase in sampling intensity can also be triggered by a variable site requiring stratification, larger lease sizes, or different landscape units (Figure 4).
- 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.
- Quantity and quality of replaced surface soil will be assessed to a depth of 50 cm on a grid basis onsite, with appropriate offsite measurements. If there is a suspected soil

limitation (i.e., rooting restrictions, consistence), assessment must continue to the point of concern and/or to a maximum depth of 1 m.

- Assessors should select an assessment point location within the grid area that best represents the grid.

Table 2. 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 ²)	3	3
80 m x 80 m (6400 m ²)	4	4
120 m x 120 m (14, 400 m ²)	9	9
>120 m (>14, 400 m ²)	9 (+1 more for each additional 1600 m ²)	9
*Variable Sites	16	16

- A minimum of 3 assessment points onsite and 3 assessment points offsite are required for any sized landscape or management area. It should be noted, that there may be situations where sampling intensity has been increased onsite (i.e., step-outs are used) that may not coincide with a need to increase sampling intensity offsite, this would be acceptable.

Note: For smaller disturbances it is recommended that assessors maintain a balanced sampling design (i.e., equal sample numbers on- and offsite)

- For sites identified or considered to be variable, a minimum of 16 assessment points offsite are required. The assessor will need to provide supporting rationale as to why the site was considered to be variable as part of the application.

Note: For stratified sites, separate Record of Observation (RoO) datasheets for both soil and vegetation assessments are required to make the appropriate comparisons

- The distance between assessment locations must be ≤ 40 m.
- For sites stratified into two or more distinct areas a separate record of observation (RoO) datasheets will be required for each area.
- For sites where the lease edges are < 120 m (including odd shaped leases), begin with 9 assessment points, each ≤ 40 m apart; but adjust sample numbers accordingly if necessary.
- For sites where the lease edges are > 120 m (including odd shaped leases), begin with 9 assessment points, each ≤ 40 m apart; additional assessment points should be added as required (i.e., 1 assessment point per additional 1600 m², or 40 m x 40 m).
- Assessment point spacing shall be ≤ 40 m apart. For partially disturbed sites (i.e., only a portion of the site was stripped or shows evidence of a soil disturbance), a minimum of 3 sample points is required only in the areas of disturbance.

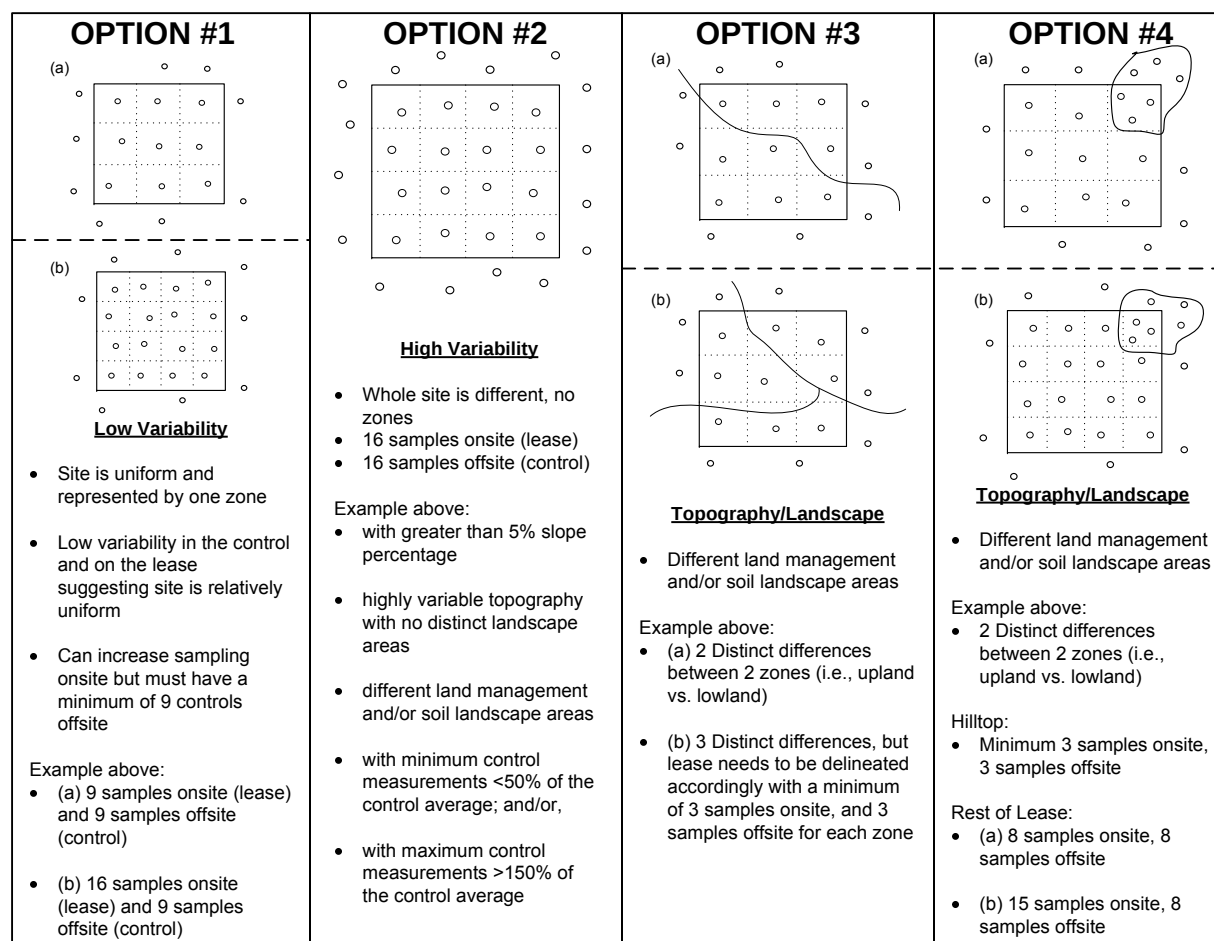


Figure 4. Potential sampling schemes depending on variability, topography, or land management areas on example sites. For the examples, the sites shown would have lease sizes of approximately 110 m x 110 m. For larger leases sample numbers on- and offsite may need to be adjusted accordingly.

- 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:
- The maximum distance between assessment locations must be ≤ 40 m
- A minimum of 3 samples onsite and offsite for any sized landscape or management area; and,
- A minimum of 9 offsite assessment points unless the site is considered to be variable, for which a minimum of 16 assessment points need to be assessed.

8.5.4. 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 Sampling on Variable Sites.

Assessing the access shall be as follows:

- < 100 m: assessment points shall be located at a minimum of 2 paired assessment points (Figure 5). If the topography is variable, more assessment points shall be used. Adjust the assessment points so the access approach and side hill cut areas are inspected.
- ≥ 100 m: assessment points shall be located at intervals no greater than 100 m apart (Figure 5). If the topography is variable, more assessment points shall be used to compare upper, mid and lower slope positions.

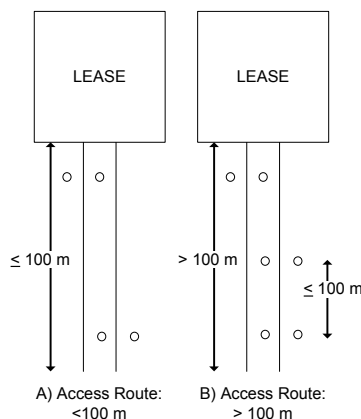


Figure 5. Soil assessment locations along access routes that are ≤ 100 m (Figure A) or > 100 m (Figure B).

8.5.5. 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. Now 11 assessment points from the lease area will be compared against 9 assessment points from the control area).

Note: It is recognized that additional step-outs will result in an increase in sampling intensity and will affect initial sample spacing.

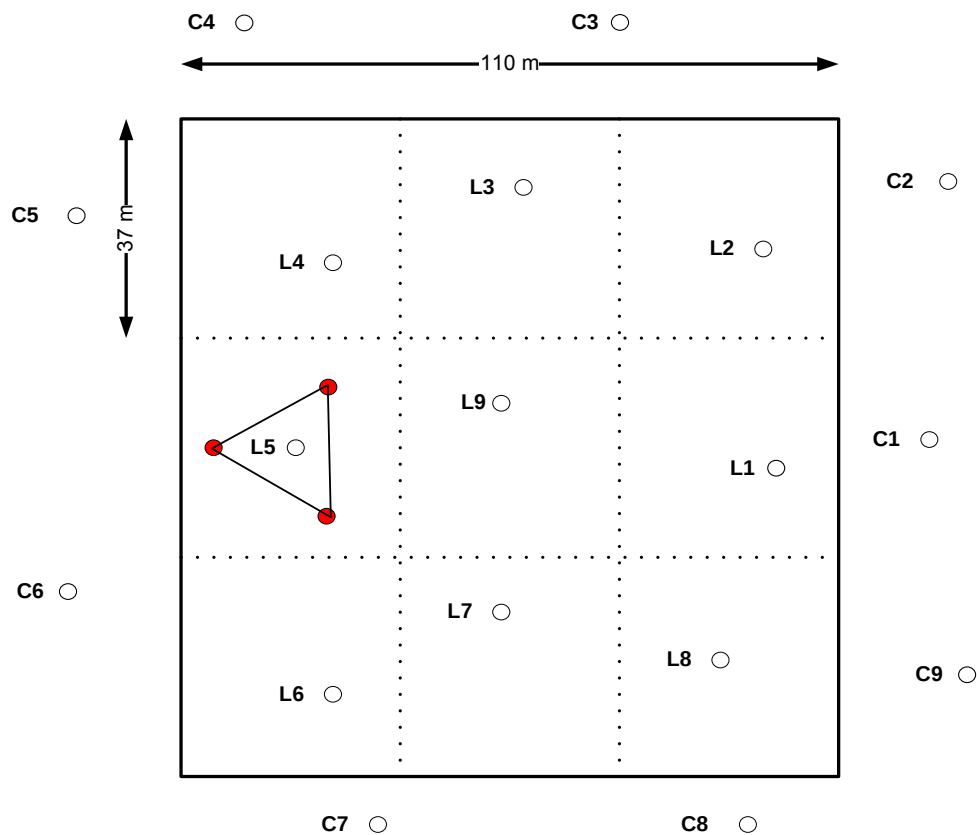


Figure 6. Disturbed assessment assessment points for soils with an approximate 37 m x 37 m assessment point spacing on a fully stripped lease.

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).

8.6. Assessment Comparisons

This assessment comparison methodology is a hybrid of a capability assessment system and criteria. The assessment comprises pass/fail decisions based on rating comparisons and surrogates of ecosystem function between onsite and offsite assessments. Sampling differences resulting from variability are observed in undisturbed settings, even over relatively short distances. Therefore, tolerances have been incorporated into the rating system to account for site variability and variability in measurement; these are outlined in Table 3 (see next page). The system is designed so that no individual assessment point can have a demonstrable adverse effect.

Note: Unlike the 1995 Criteria that identified how many 'assessment points' could fail before a site fails, sites assessed using the 2010 Reclamation Criteria for Cultivated Lands could fail due to:

a) Changes onsite at an assessment point that result in a parameter, or combination of parameters, not being comparable to the representative control area; and/or,

b) Changes onsite that lead to the parameter (e.g., topsoil depth, vegetation height) being assessed not being comparable to the representative control area.

Table 3. 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 onsite	
	<9	≥ 9
Pass		
Assessment Point Comparisons		
Lease and Access Road	Maximum rating drop in rating sums allowable onsite is 1 compared to the maximum control rating sum.	
Parameter Comparisons		
Allowable Rating Drop		
Compared to lowest control rating	1	2
Average Rating	Must meet average rating comparison	<u>Equivalent number of controls: average rating onsite compared to the average rating offsite cannot be greater than 0.30.</u> <u>Fewer control assessment points: average rating onsite compared to the average rating offsite cannot be greater than 0.15. Note: A minimum of 9 control assessment points must be assessed.</u>
Measured Parameters ^a :		
Vegetation:		
Lease - Minimum allowable	≥80% of Lowest Control Measurement; No assessment point can be less than 80% of the Lowest Control measurement (i.e., no assessment point can receive a #4 Rating)	
Lease - Overall	≥85% of Control Measurement (Less than 15% Variance)	
Access Road - Overall	≥85% of Control Measurement (Less than 15% Variance)	
Soil:		
Lease - Minimum allowable	≥80% of Lowest Control Measurement; No assessment point can be less than 80% of the Lowest Control measurement (i.e., no assessment point can receive a #4 Rating)	
Lease and Access - Overall		
After April 30, 1994	≥85% of Control Measurement (Less than 15% Variance)	
Jan 1, 1983 to April 30, 1994	≥70% of Control Measurement (Less than 30% Variance)	
Before Jan 1, 1983	≥60% of Control Measurement (Less than 40% Variance)	
Fail	Does not meet above conditions	

^a Tolerances for measured parameters must be met prior to assigning and conducting rating comparisons.

8.6.1. Vegetation and Soil Comparisons

8.6.1.1. ON THE LEASE

The vegetation assessment can consist of a combination of measured parameters and rated parameters. For assessment point comparisons, measured parameters are also

converted to a rating value based on the comparison to the control averages (expressed as a % of the control average); these ratings are found in CRT.1. For assessment point comparisons, the rated parameters are grouped into three categories that include:

- Crop Measurement Ratings: plant height, plant density, head/pod/tuber length, and head/pod/tuber weight
- Crop Health Ratings: Germination/Seed Distribution, Plant Health, Head/Pod/Tuber Health, and Seed Development
- Weeds: Prohibited Noxious, Noxious and Undesirable Plants (e.g., Nuisance, Problem, and Volunteer Weeds).

The soil assessment consists of an evaluation of one (1) measured parameter (i.e., Topsoil Depth) plus any additional rated parameters. For assessment point comparisons, the measured parameter is also converted to a rating based on the comparison to the control averages, ratings can be found in CRT.1. For assessment point comparisons, the rated parameters are grouped into four categories that include:),

- Topsoil Depth Rating, Site Rating (i.e., Meso-contour, Micro-contour, Stone Content)
- Topsoil Quality (i.e., Color, Texture, Consistence, Structure, and Rooting Restrictions)
- Subsoil Quality (i.e., Texture, Consistence, Structure, and Rooting Restrictions)

Measured parameters from assessment points onsite that are less than the lowest control measurement (LCM) **cannot** be less than 80% of the lowest control measurement, or they will result in a failure. For assessment points on the access road, these measurements **cannot** be less than the construction period requirements (i.e., 85% of the control), and if so, will result in a failure.

ASSESSMENT POINT COMPARISONS

At each assessment point, once each parameter has been assigned a rating between 1 and 4 these ratings are then summed to determine a total sum for each category. This is done for assessment points onsite and offsite. Once this has been completed for all three categories onsite, the three onsite values are then compared to the maximum sum plus one rating, in their respective controls. In order for assessment points to pass the total rating sum must be less than the maximum control rating sum plus one (1). For example, if the maximum rating sum in the control of the Plant Measurement Category was 6, the Plant Measurement Category rating sums at each assessment point onsite must be less than or equal to 7 in order to pass.

PARAMETER COMPARISONS

Ratings for each of the parameters measured and/or rated as part of the vegetation assessment are also compared between onsite and offsite measurements. 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 assessment points are used (Table 3).

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). Furthermore, no individualNo parameter can drop more than two rating categories onsite compared to the lowest rating category offsite. As part of the pass/fail, the overall average onsite must be $\geq 85\%$ of the average control measurement for measured parameter; tolerances for measurements are outlined in Table 3.

8.6.1.2. ON THE ACCESS

No parameter can drop more than one rating category onsite compared to the lowest rating category offsite (Table 3). 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 3.

ASSESSMENT POINT COMPARISONS

At each assessment point, once each parameter has been assigned a rating these are then summed to determine a total sum for each category. For assessment point comparisons, for each category the difference between onsite and offsite must be less than or equal to the maximum control rating sum plus one (1). For example, if the maximum rating sum in the control is 6, rating sums onsite must be less than or equal to 7 in order to pass.

PARAMETER COMPARISONS

To pass the parameter comparison, the average rating onsite compared to the average rating offsite cannot be greater than 0.30.

8.6.2. 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 or more assessment points were assessed offsite and an equivalent number 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.

END OF SECTION

9. Landscape Assessment

Landscape criteria are assessed by looking at the site as a whole (Table 4) from several vantage points both surrounding and 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 4. Landscape Parameters for 2010 Cultivated Lands 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 Questions	Pass / Fail Point
Drainage	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 overall drainage.	Surface Water Flow; Drainage; Ponding; Riparian Areas	Yes
Erosion	No more erosion gullies or blowouts than observed on adjacent land allowed.	Erosion	Yes
Stability	No visible evidence of slope movement, slumping, subsidence, or tension cracks allowed.	Subsidence	Yes
Bare Areas	Number and size of bare areas shall not be greater than original and/or control vegetation.	Bare Areas	Yes
Operability	Contour and roughness must conform and blend with adjacent contours or be consistent with present or intended land use.	Macro-contour	Yes
Vegetation	Growth stage of small seeded crops. BBCH ratings must be comparable onsite and offsite. The difference in the BBCH ratings must be less than or equal to 2.	Growth Stage	Yes
Debris	No industrial or domestic debris allowed.	Organic Debris; Refuse	Yes

9.1. Drainage

Pre-disturbance aerial photographs, observations of the surrounding landscape and/or landowner (or designate) consultation can help to establish what the normal direction of drainage and its dispersion patterns should be. Visually assess the direction/dispersion of onsite drainage to determine whether it conforms to the drainage of the surrounding area.

9.1.1. Surface Water Flow

Onsite Drainage: The presence of water-tolerant vegetation or lack of any 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 sub-surface and disrupt water movement. The slope position of a lease may create conditions where offsite drainage patterns are disrupted. These criteria require that the surrounding contours be recreated on the lease and that the landscape features adjacent to it are conserved. When onsite drainage results in collection and/or re-direction of water, offsite impacts are possible. Erosion and/or ponding on the up- or down-slope of adjacent land is evidence of potential offsite disruption(s) of surficial drainage. Cross-site flow disruptions are most likely to occur with long linear features (roads) or large facilities, but the extent of the impact depends on the local hydrology and sub-surface geology. The assessment of this criterion is done visually. There shall be no evidence of offsite drainage disruptions due to the lease.

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. If ponding is found, its presence must be documented and an explanation given regarding the site-specific conditions which indicate ponding is consistent with the site's normal state. 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). 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 province (Appendix A).

9.1.3.1. BANK OR SHORE STABILITY

There shall be no evidence of shore/bank instability (slumping, channelling within banks) greater than is found on the offsite bank or shore.

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.

9.2. Erosion

9.2.1. Water Erosion

Gullying: This is evidence of a major flow problem and its presence cannot exceed that of 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 and can negatively affect offsite areas. Evidence of excessive flow may suggest poor re-contouring and/or presence of subsoil compaction.

9.2.2. Wind Erosion

Leaf abrasion, plant pedestaling and soil deflation and/or accumulation are evidence of wind erosion, which may result in a loss of vegetative health. Evidence of wind erosion cannot be greater onsite than in the surrounding landscape.

9.3. Soil Stability

9.3.1. Slumping/Wasting

Slumping and wasting (mass movement of soil) is not normally seen on most cultivated sites, however, locations may exist where naturally unstable slopes move and slumping and/or wasting is considered normal. Any slumping and/or wasting on a reclaimed site must be documented and evidence from adjacent areas (or pre-disturbance information) should demonstrate that the scale and amount of slumping/wasting seen onsite is characteristic of the area.

9.3.2. Subsidence

Subsidence is a structural failure (e.g., sunken areas) in the reclamation efforts and additional work is needed to stabilize the site where operability and/or vegetation are adversely affected. It is not to be confused with cracks caused by shrinkage during droughts.

9.4. Bare Areas

Bare areas are devoid of vegetation perhaps because of a lack of topsoil, contamination or third-party impacts (e.g., vehicle rutting, herbicides, hay bale storage or livestock). Bare areas should not be confused with bare ground which are the areas exposed between seed rows. Bare soil (blow outs) are normal on solonetzic landscapes and duned landscapes with deflation hollows. The presence of bare areas in reclaimed cultivated sites shall be documented; their extent cannot be greater than the surrounding landscape. If contamination is suspected, investigate and remediate as necessary.

9.5. Operability

On cultivated lands, operability refers to equipment operation and land management. 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

Macro-contour: (30-100 m width scale; Figure 7 left) shall be comparable to (e.g., integration with surrounding landscape) the offsite landscape and not result in excessive erosion, slumping/wasting or water flow issues or workability with implements.

Meso-contour: (10-30 m width scale; Figure 7 left) on cultivated lands, meso-contour is assessed during the Soil Assessment.

Micro-contour: (<10 m width scale; Figure 7 right) on cultivated lands, meso-contour is assessed during the Soil Assessment.

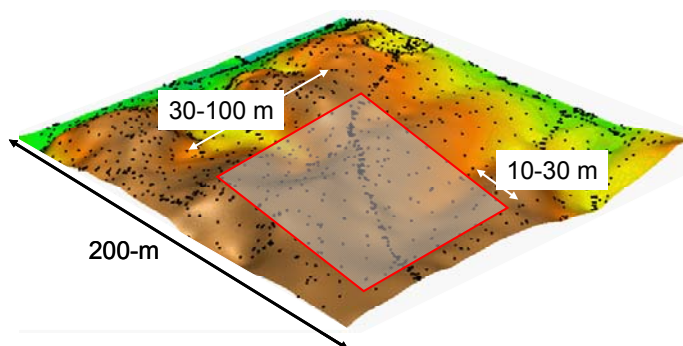


Figure 7. Figures showing examples for macro- (30-100 m) and meso-contour (10-30 m) (figure left) and micro-contour (<10 m width) (figure right)

9.5.2. Gravel and Rock

Surface Stoniness/Coarse Fragment Content: on cultivated lands, surface stoniness and coarse fragment content (Figure 8) is assessed during the Soil Assessment.



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

9.6. Debris

9.6.1. Organic debris

Organic debris (*e.g.*, straw, wood) should not impede Land Manager operability.

9.6.2. Industrial and Domestic Refuse

Industrial and domestic refuse (*i.e.*, garbage) is not acceptable and must be removed.

END OF SECTION

10. Vegetation Assessment

The assessor first answers the questions on the cropping system in the Assessment Tool, in order to establish the crop type and production system. The following sections outline methodology suggestions, alternatives can be used but must be documented and included in the application. This section identifies vegetation parameters (Table 5) and their respective questions that need to be answered in the Assessment Tool and/or RoO datasheets.

Table 5. Vegetation parameters and their respective Assessment Tool or RoO questions which may or may not also require either a rating and/or physical measurement.

Parameter:	Assessment Tool Question	RoO Information Required ^a (Yes / No)		Pass / Fail Point
		Measurement	Rating	
Crop Type	Crop type; Agronomic Practice	Yes	No	No
Crop Type	Residue Management	No	No	No
Growth Stage	Germination/Seeding Distribution	No	Yes	Yes
Plant Height	Plant Height	Yes	No	Yes
Plant Density	Plant Density	Yes	No	Yes
Head/Tuber Length	Head/Tuber Length	Yes	n/a	Yes
Head/Pod/Tuber Weight	Cereal Crop / Pulse Crops Other crops	Yes	n/a	Yes
Plant Health	Plant Health; Head/Pod/Tuber Health	No	Yes	Yes
Seed Development	Seed Development	No	Yes	Yes
Pod Density	Oilseed / Pulse Crops	No	Yes	Yes
Litter Quantity	Tame Pasture and Forage	Yes	Yes	Yes
Weeds and Undesired Plants	Prohibited Noxious; Noxious; Problem / Volunteer	No	Yes	Yes

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

At each assessment point, a combination of measurables (e.g., plant height, plant density, head length, head/pod weight) and ratings (e.g., plant health, head health, seed quality) will be used to compare the onsite to offsite. Section Assessment Comparisons identifies tolerances for the parameters that are either measured or rated based on rating tables provided in the Criteria. Assessors shall record data where appropriate in either the Assessment Tool or RoO.

Note: If the assessor plans to use alternative method(s) for measuring vegetation productivity, these methods should be discussed with the Regulator prior to submitting the assessment.

Data collected from yield monitors, aerial imagery, and satellite imagery can be used as supporting information for an application. This data may also offset some data collected as part of field assessments however; this must be discussed with the Regulator. Field assessments must still be conducted.

Any alternative methods must be documented in the Assessment Tool.

10.1. Crop Type

The assessor shall document the crop type present at time of assessment, the distribution, and whether an appropriate control can be used for comparison purposes. The assessor shall record information in both the Assessment Tool and RoO. This should also include the timing and/or stage of the crop at the time of the assessment. If the assessment is conducted outside of the prime assessment stage, two assessments of vegetation must be done over two growing seasons at different stages of growth.

Crop selection should be made in consultation with the Land Manager. Normally in annual crop rotations, the lease and access road are seeded in conjunction with the rest of the field by the Land Manager. Under some circumstances, the site may be seeded at a different time than the adjacent land and assessors should ensure that these instances are documented and appropriate comparisons for the vegetation assessment are made.

10.2. Growth Stage and Growing Conditions

The first measured criterion is the timing of the assessment with regard to the stage of the crop. For all crops, every attempt should be made to conduct the assessment during the prime assessment stage identified using the BBCH scale (i.e., BBCH 70+; Meier, 2001; Appendix B). If not possible, then two assessments of vegetation must be done over two growing seasons at different stages of growth. Vegetation can provide evidence of site limitations; therefore, productivity is measured. Where growth is lacking relative to the adjacent land, this can indicate stress conditions. However, it is possible that the stress conditions may not be linked to inadequate site reclamation but be caused by grazing, natural soil variability or third-party impacts. Stress conditions must be documented to explain why productivity is not comparable to offsite.

- **Cereal Crops:** Cereal crops should be assessed during the prime assessment period that would begin at heading for cereals (BBCH 70+) and prior to the crop being removed. If this is not possible, then two assessments of vegetation must be done over two growing seasons at different stages of growth.
- **Pulse Crops:** Pulse crops should be assessed during the prime assessment period that would begin with the development of podding (BBCH 70+) and prior to the crop being removed. If this is not possible, then two assessments of vegetation must be done over two growing seasons at different stages of growth.

- **Small Seeded Crops (i.e., <2 mm in diameter; e.g., canola, flax, grass species for seed):** Crops should be assessed during the prime assessment period that would begin at podding or heading (BBCH 70+) and prior to the crop being removed. If this is not possible, then two assessments of vegetation must be done over two growing seasons at different stages of growth. For small seeded crops, at each assessment point ratings outlined in CRT.1 (Appendix D) must be used to compare the growth stage of small seeded crops onsite and offsite.

Note: For small seeded crops a comparison between the growth stage onsite and the growth stage offsite is required. At each assessment point Assessors must document the growth state and assign a rating. These ratings are then used in the comparisons at each assessment point and for the comparison between the average onsite to the average offsite

- **Specialty Crops:** Where applicable, assessors should consult the appropriate BBCH scale for the beginning of the reproductive structure phase for the crop to be assessed (Meier, 2001). If this is not possible, then two assessments of vegetation must be done over two growing seasons at different stages of growth.
- **Perennial Crops:** When assessing perennial crops the seed mix and intended purpose should be documented, one overwintering period is required. For example, if the site was seeded in the fall, do one assessment in the following year (year 2) and the other in year 3; if the stand is healthy and non-weedy then it is a pass. Alternatively, if the site is seeded in the spring, check for establishment in the fall and re-check the following year.

10.3. Seed Distribution / Germination

At each assessment point the assessor should determine the germination or seeding distribution. Germination can be affected by site factors such as soil saturation, soil chemistry issues and can be indicative of soil related problems. Vegetation can provide evidence of site limitations; therefore, productivity is measured. Where growth is lacking relative to the adjacent land, this can indicate stress conditions. However, it is possible that the stress conditions may not be linked to inadequate site reclamation but be caused by grazing, natural soil variability or third-party impacts (e.g., recreation, weather). Stress conditions must be documented to explain why productivity is not comparable to offsite.

- **All Crops:** Assess the seeding distribution or germination at each assessment point using ratings outlined in CRT.1 (Appendix D).

10.4. Plant Height

For most crops, the assessor shall document the average crop height at the time of assessment in a representative area of where the plant density measurements were conducted.

Note: Plant height measurements are not required for tame pasture.

For assessments where plant height measurements are conducted, measure the plant height at each assessment point onsite and offsite and express as a % of the average control height. At each assessment point a minimum of 10 plants should be measured to provide an average plant height. In situations where the crop has been cut, but not removed from the field the height can be estimated by combining the stubble height plus the height of the crop swath near the assessment point location. These measurements are then converted to ratings using the ratings outlined in CRT.1 (Appendix D). The assessor shall record the information in both the Assessment Tool and RoO.

10.5. Plant Density

For all crops, measure plant density at each assessment point, onsite and offsite, using the method outline below for the appropriate crop. The plant density of the crop at each assessment point, should be expressed as a % of the average control plant density measurement. These measurements are then converted to ratings using ratings outlined in CRT.1 (Appendix D).

The assessor shall document the germination/seeding distribution (CFig 1.) and average number of productive stems at each assessment point at the time of assessment of a representative area within each grid. Data is then recorded in the RoO. For row crops the assessment shall include the average number of productive stems or tillers in four (4) x 1-meter (m) rows. Assessors must also document row spacing. For sites with poorly defined rows a minimum area of 0.5 m² needs to be assessed. In situations where the crop onsite has been broadcast as a method of seeding, the plant density should be expressed as the number of plants per unit area (e.g., m²). The assessor shall record information in both the Assessment Tool and RoO. Depending on the crop type the following methods can be used:

- **Cereal Crops:**
 - **A) That have produced heads:** Count the total number of head producing stems in each of the four (4) x 1 m rows and calculate an average.
 - **B) That have not produced heads:** Count the total number of tillers in each of the four (4) x 1 m rows and calculate an average. It should be noted that tillers are not to be confused with the number of plants per row; more than one tiller can be produced from the base of the stem of the plant.
- **Pulse Crops:** Count the total number of plants in each of four (4) x 1 m rows and calculate an average. Alternatively, the assessor shall document the number of head producing stems in one (1) 0.10 m² area.
- **Small Seeded Crops (i.e., <2 mm in diameter; e.g., canola, flax, grass species for seed):** Count the total number of plants in each of four (4) x 1 m rows and calculate an average. Alternatively, the assessor shall document the number of head producing stems in one (1) 0.10 m² area.
- **Specialty Crops:** For specialty crops, or exceptions to the above (i.e., wider spacings) the methodology used for the assessment must be provided in the Assessment Tool as part of the submission. The average value should be recorded in the RoO.

- **Row Seeded Crops:** Count the total number of plants in each of the four (4) x 1 m rows and calculate an average
 - **Broadcast Crops:** Assessors must assess a minimum area of 0.5 m²
 - **Trees Farms:** Assessors must assess tree height.
 - **Perennial Crops:** The assessor shall document the % cover of live desirable plants in one (1) 0.10 m² area.
-

10.6. Head Length and Tuber Length

For some crops, the length of the seed producing portion of the crop can be used as a measurement (i.e., length of the head for cereals; tubers for root crops). This may not be applicable to all crops; alternative measurements and measurement location (i.e., caliper of the tuber in potatoes and sugar beets) must be documented and recorded in the RoO. The length measurement should be conducted at the location where the plant density measurements were conducted and should be representative of the plants at this location. The assessor shall record information in both the Assessment Tool and RoO. Depending on the crop type the following methods can be used:

- **All Crops (when applicable):** Measure lengths at each assessment point, onsite and offsite, using the method outline below for the appropriate crop. The average length at each assessment point, should be expressed as a % of the average control measurement. These measurements are then converted to ratings using ratings outlined in CRT.1 (Appendix D).
 - **Cereal Crops:** For cereals the measurement must not include the awns. For this measurement, ten (10) heads shall be measured and the average length documented. These same heads can be used for the head weight measurements.
 - **Pulse Crops:** Pod length measurements for pulse crops are not required.
 - **Small Seeded Crops (i.e., <2 mm in diameter; e.g., canola, flax, grass species for seed):** Not required.
 - **Specialty Crops:** For specialty crops, crops such as potatoes, sugar beet, etc. the tuber portion of the plant shall be measured and the average length/caliper documented. These same portions of the plant can be used for the weight measurements.
 - **Trees Farms:** For trees, these measurements should include root collar diameter (RCD) and/or diameter at breast height (i.e., 1.2 meters; DBH).
 - **Perennial Crops:** Where applicable, for this measurement, ten (10) heads shall be measured and the average documented. These same heads (or tubers) can be used for the head weight measurements.
-

10.7. Head Weight, Pod Weight, and Tuber Weight

Depending on the number of assessment points for each site, the assessor shall collect samples from the seed producing portion of each plant. The location on the plant where samples are taken and portion of the plant sampled for comparison must be consistent onsite and offsite. Samples shall be taken from the assessment point within each grid

where the vegetation assessment is being conducted. Assessors should collect samples:

- Initially, at one offsite (i.e., control) location enough heads/pods/tubers should be collected to meet a minimum weight of 50-grams (Field scales used must have an accuracy of ± 1 gram)
- Based on the number of heads/pods/tubers collected at that offsite assessment point, the same number of heads/pods/tubers is then collected at each subsequent assessment point onsite and offsite

NOTE: The 50-gram weight is a minimum weight to determine the number of heads/pods/tubers that need to be collected. For the comparison, it is important that the same number of heads/pods/tubers be collected at each assessment point.

The assessor shall record information in both the Assessment Tool and RoO. Depending on the crop type the following methods can be used:

- **All Crops (when applicable):** Measure weights from each assessment point, onsite and offsite, using the method outline below for the appropriate crop. The average weight at each assessment point, should be expressed as a % of the average control plant density measurement. These measurements are then converted to ratings using the rating tables outlined in CRT.1 (Appendix D).
- **Cereal Crops:** Collect the number of heads, as outlined above. For (for oats use the entire panicle), randomly from each assessment point, where plant density measurements were conducted, and weigh to obtain a fresh weight.
- **Pulse Crops:** Collect the number of pods, as outlined above, from the main (or tallest) stem just above the upper most branch from randomly selected plants, where plant density measurements were conducted, and weigh to obtain a fresh weight.
- **Small Seeded Crops (i.e., <2 mm in diameter; e.g., canola, flax, grass species for seed):** Do not require a weight measurement. Assessors must make a comparison between the growth stage (see section above on Growth Stage) onsite and the growth stage offsite, in addition to documenting plant health, pod/head density, pod/head health, seed health to support their decision.
- **Specialty Crops:** For specialty crops, crops such as potatoes, sugar beet, etc. the tuber portion of the plant shall be weighed to obtain a fresh weight. For other crops, such as trees, a weight measurements are not required.
- **Perennial Crops:** Collect the number of heads, randomly from each assessment point, where plant density measurements were conducted, and weigh to obtain a fresh weight.

10.8. Plant Health

Evidence of stressed vegetation may indicate onsite limiting conditions (e.g., excessive surface soil moisture, compacted subsoils, lack of topsoil). Presence of stressed vegetation must be documented as to the severity and spatial extent. Observation of stressed vegetation in a localized area may indicate limitations that may be remediated with minimal additional disturbance, whereas widespread onsite plant stress may indicate significant onsite limitations and a more widespread reclamation effort. If the

onsite and offsite vegetation stress is the same, it may be a general response to severe weather (e.g., drought), documented pre-existing soil limiting factors and/or disease.

10.8.1. Plant Health

Assessors doing plant measurements shall document and rate the crop health at time of assessment for a representative area within each grid. The assessor shall record information in both the Assessment Tool and RoO. The assessor shall evaluate and rate the plant based on overall growth and signs of stress or disease. Ratings for Plant Health can be found in CRT.1 (Appendix D).

10.8.2. Head/Pod/Tuber Health

Assessors doing plant measurements shall document and rate the health of the plant head, pods, or tubers of the crop at time of assessment for a representative area within each grid and record the data in the RoO. For other crops, this may include pod or tuber health. Ratings for Head Health can be found in CRT.1 (Appendix D). The assessor shall record information in both the Assessment Tool and RoO.

10.9. Seed Development Rating

At the same assessment point where plant measurements are taken the assessor shall evaluate and rate the seed or tuber producing portion of the plant based on the degree of seed fill and/or evidence of seed abortion, along with signs of stress or disease. The assessor shall evaluate and rate the seed based on degree of development, along with signs of stress or disease. Ratings for Seed Health can be found in CRT.1 (Appendix D). The assessor shall record information in both the Assessment Tool and RoO.

10.10. Pod Density

Depending on the growth stage of the crop, at each assessment point, the assessor shall visually estimate the podding density on canola or pulse crops. Podding density should be rated as none, light, medium, or heavy for the area (i.e., grid) being assessed and compared on- and offsite. Ratings for Pod Density can be found in CRT.1 (Appendix D). The assessor shall record information in both the Assessment Tool and RoO.

10.11. Litter Quantity for Tame Pasture

Litter is standing and fallen dead plant material that was produced naturally in pastures. It plays an important role as it acts as a physical barrier to heat and water flow at the soil surface. Litter conserves moisture by reducing evaporation, improving infiltration, and cooling the soil surface.

For tame pasture sites that are grazed where litter is present, litter quantity can be assessed using a handrake method similar to the method outlined in the (Alberta Sustainable Resource Development, 2005). Using the 'hand rake method' in a 0.25 m² frame, qualitatively estimate the amount of litter (lbs/acre) at each assessment point and compare that value with the litter quantity measured offsite. To meet the criteria, the litter on the lease must on average be greater than the litter offsite such that:

- For **Undisturbed Areas**, the measure of success is ≥65% of the control value. On the **Undisturbed area**, if the value is ≥65% (Equation 1; Example A) of the control value then site passes the litter criteria. If it is <65% then the site fails the litter criteria. Data shall be recorded in both the Assessment Tool and RoO.
- For **Disturbed Areas**, the measure of success is ≥15% of the control value. On the **Disturbed area**, if the value is ≥15% (Equation 1; Example B) of the control value then site passes the litter criteria. If it is <15% then the site fails the litter criteria. Data shall be recorded in both the Assessment Tool and RoO.

Equation 1. Litter quantity calculation with examples for the Undisturbed Assessment (A) and Disturbed Assessment (B) for a site with 300 lb/ac (336 kg/ha) of litter in the control area.

A) $Pass = \geq 65\% * Litter\ Threshold$ $= \geq 65\% * 900\ lb / ac$ $= \geq 195\ lb / ac\ (218\ kg / ha)$	B) $Pass = \geq 15\% * Litter\ Threshold$ $= \geq 15\% * 900\ lb / ac$ $= \geq 45\ lb / ac\ (50\ kg / ha)$
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10.12. 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 areas offsite. Therefore, ensure that the offsite assessment points are representative of the surrounding area or parcel of the land. Weeds are to be managed as per the *Weed Control Act*, and/or local authority requirements, with prohibited noxious weeds destroyed and noxious weeds controlled (Government of Alberta, 2010). Undesired plants (i.e., volunteer crop, incompatible species) shall be controlled so that they do not impede Land Manager operability and/or management.

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 ≤ 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 ≤ 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 undesirable plants present and rate their distribution based on the rating table (CRT.2; Appendix D). This information 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).

10.13. Residue Management

Crop residue and/or litter production will not be readily observable under annual cultivation. Surface litter directly minimizes soil moisture loss and reduces soil erosion by wind and water. It indirectly improves soil structure and water infiltration (through root channels and earthworm pores) and retains soil fertility resulting from the breakdown of organic material left at the soil surface. Whereas **conventional tillage** mixes the top 15-20 cm of soil and surface residues, **zero-tillage** (i.e., used to conserve moisture, soil and provide carbon storage) involves seeding directly into the standing stubble of the previous crop. Under **reduced** or **minimal tillage**, some level of cultivation may occur to control weeds, although a substantial amount (e.g., generally $>30\%$) of residue remains on the soil surface. The assessor shall record information in both the Assessment Tool.

END OF SECTION

11. Soil Assessment

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, conserved and replaced, however topsoil replacement requirements/tolerances acknowledge different eras in construction practices, natural variability and sampling error. Table 6 identifies soil methodology parameters and their respective questions that need to be answered in the Assessment Tool and/or RoO datasheets.

Table 6. 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	^a RoO Information Required (Yes / No)		Pass / Fail Point
		Measurement	Rating	
Soil Disturbance	Soil Disturbance	Yes	No	No
Surface Characteristics	Topsoil Depth and Distribution	Yes	No	Yes
Operability	Meso-contour; Micro-contour; Surface Stoniness; Coarse Fragment Content	No	Yes	Yes
Topsoil Colour	Topsoil Colour	No	Yes	Yes
Vertical Processes	Texture (Manual); Consistence; Structure; Rooting Restrictions	No	Yes	Yes
Level 2 Parameters (Optional)	Texture (PSA); %-Clay; Organic Carbon; pH; Electrical Conductivity (EC); Sodium Adsorption Ratio (SAR)	Yes	Yes	Yes

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

The Soil Assessment for the 2010 Reclamation Criteria 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 6 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) 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 cultivated lands, operability refers to equipment operation and land management. The measure of operability is a visual assessment based on the ratings provided in CRT.1 (Appendix D). It is focused on the smoothness of the surface as it affects operation of farm equipment. A rougher surface caused by wheel ruts, subsidence, uneven soil replacement is more dangerous and thereby more limiting. At each assessment point rate the following parameters using the ratings provided in CRT.1 (Appendix D). Record the data in the Assessment Tool and the RoO.

11.1.2.1. CONTOUR

Macro-contour: (30-100 m width scale; Figure 7 left) is assessed during the Landscape Assessment.

Meso-contour: (10-30 m width scale; Figure 7 left) Contour issues that can be observed at an assessment location (e.g., subsidence, settled cut and fill, ponding).

Micro-contour: (<10 m width scale; Figure 7 right) Contour issues that can be observed at an assessment location should not impede landowner (or designate) operability (e.g., rutting, edge cuts, fills). Consultation with the Land Manager regarding farming practices is recommended as reduced-tillage farming may be more affected by micro-contours than conventional farming practices. If the vertical difference between onsite and offsite is less than 5 cm, then micro-contour would be considered comparable.

11.1.2.2. SURFACE STONINESS/COARSE FRAGMENT CONTENT

Surface stoniness/Coarse Fragment Content: Surface stoniness (i.e., gravel and stones) may not be piled, windrowed or concentrated in one area to the extent that they impede Land Manager operability. The tolerance for impacts to operability will depend on the agricultural land use (i.e., pasture > cultivated crops > root crops and sod); therefore, consultation with the Land Manager is needed. At each assessment point rate the surface stoniness and coarse fragment content using the ratings provided in CRT.3 (Appendix D). Record the data in the Assessment Tool and the RoO.

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 layer of mineral and organic material, valued as a growing medium, and ordinarily stripped prior to construction of the wellsite and replaced during reclamation. Soil horizons normally considered to be surface soil include the Ap, Ah, Ahe, Ae and Bp (Table 8).

Normally, a minimum of 15 cm is salvaged during construction as the topsoil lift provided there is a suitable B horizon (*i.e.*, not a Bnt, bedrock, gravel, rock). If the A horizon(s) are less than 15 cm, then a minimum of 15 cm of material will be salvaged unless the material is unsuitable due to physical or chemical characteristics (*i.e.*, incompatible texture, hardpan/Bnt, bedrock, gravel or stones).

In recognition that the former 1995 Forest (White) Criteria have been removed, when forested areas are changed to cultivation, normally duff (LFH) plus Ah, Ahe and up to 15 cm of the Ae horizon will be salvaged. If the A horizon(s) are less than 15 cm, then a minimum of 15 cm of material will be salvaged unless the material is considered unsuitable.

If the A and B horizons are not distinguishable by colour (for example, in the Brown soil zone where both horizon colours may be 10YR 4/3), texture, structure and consistence shall be used to identify individual soil horizons.

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 3.

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 CRT.3 (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, crush it by hand, and rate accordingly (CRT.3). 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 control textural classification of 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. Soil moisture conditions at the time of the assessment should be noted. Moist conditions are the most suitable for determining soil consistence.

Consistence refers to the combination of soil properties that determine 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 and/or poor reclamation practices which may impair productivity by making the soil vulnerable to water and wind erosion or inhibit rooting. 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.

The rating tables CRT.3 (Appendix D) and CRT.4 (Appendix D) provide descriptions and corresponding ratings for consistence and structure. 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 root growth. For example, in Solonetzic 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 7 provide

Table 7. Commonly observed indicators or root, permeability and aeration restrictions

Vertical Root Elongation	Water Permeability	Soil Aeration
• Presence of root mats and bunches; • Presence of flattened and highly branched roots; • Presence of exped roots; • Presence of soil layers or abrupt texture or structure changes; • Absence of roots within or below reconstructed soil zones; • Absence of roots within soil aggregates; • Presence of early maturing crop with reduced height and density • uneven distribution of species in mixed pasture or haylands, • Uneven crop height and density in cropland	• Presence of surface ponding; • Presence of surface vehicle (equipment) ruts; • Presence of stratified or abrupt moisture changes within the soil profile; • Presence of dense, massive, or layered structure (compaction); • Presence of flooded (yellow or stunted) crop conditions; • Presence of abrupt texture or structure transitions.	• Presence of dense, massive, or layered soil structure (compaction); • Presence of reduced pore size and pore space; • Presence of brownish-red ped surfaces; • Presence of sour odors

operationally feasible examples of impaired vertical moisture conditions. Rooting restrictions need to be assessed to a depth below the rooting restriction to a maximum of 1-m. The rooting pattern restrictions shall be rated using the ratings provided in CRT.3 (Appendix D) and shall be recorded in the Assessment Tool and the RoO.

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 (Figure 2).

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 CRT.5 (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 (CRT.5 and CRT.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.

END OF SECTION

12. Other Considerations

12.1. Pests and Weeds

Cultivated crops are subject to attack and/or competition from disease, insect, mite, nematode and weed pests that can reduce their survival, yield and/or the quality of harvested products. Some of these pests occur naturally in agricultural soils, while others may be introduced on seeds and transplants, by farm machinery, infested crop residues, imported soil, itinerant equipment, clothing, or be moved by the wind and/or water. It is essential that all equipment, large or small, be thoroughly sanitized before starting work at a new location to minimize the potential for soil-borne problems during the stages of pre-site, construction, reclamation and reclamation evaluation. Once introduced, these pests can quickly accumulate to damaging levels and may be difficult or impossible to eradicate or reduce (to below economic thresholds). Examples of introduced soil-borne pests include:

- 1) clubroot disease of canola and cruciferous vegetables;
- 2) wheat midge, an emerging insect pest of cereals; and,
- 3) specified 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 crop plants. Preventing their introduction is the first approach followed by restricting their spread within and between fields. Preventative strategies include crop rotation, using pest-free seed or transplants, disinfection of clothing and equipment used to work the soil, applying chemical and biological control products.

12.2. Topsoil Additions

Although not recommended, at times where additional topsoil is desirable (e.g., to avoid re-stripping a site where desirable vegetation is already established), it shall be described (e.g., source, texture, lab analyses, volume, weeds) and shall have similar or as close as possible chemical and physical properties as 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.

<i>Note: Topsoil additions do not include soil amendments (see section on Amendments).</i>

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.

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. If importing topsoil, it is recommended that testing be conducted for foreign weeds (*i.e.*, weeds not normally found in that area) and problematic diseases for the area (*e.g.*, club root).

12.3. Amendments

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, while approval by the Regulator is required for 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.

END OF SECTION

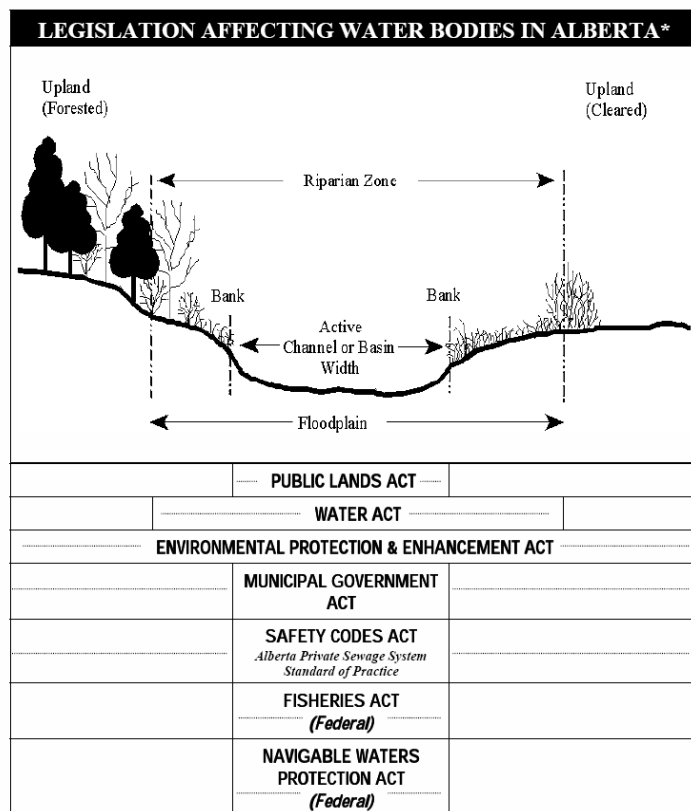
13. Appendix A

13.1. Water Act & Riparian Areas (WR)

13.1.1. Landscape - Indicators of Riparian Areas

The Water Act¹ 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)². 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 guidelines³. Conserve slough/marsh wetlands in a natural state; Mitigate degradation or loss of slough/marsh wetlands benefits as near to the site of disturbance as possible; and, Enhance, restore or create wetlands in areas where wetlands have been depleted or degraded.

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

² 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.

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

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.

END OF SECTION

14. Appendix B

14.1. Supplemental Information for Vegetation

The following was taken from “Growth stages of mono- and dicotyledonous plants: BBCH Monograph” which outlines the extended BBCH-scale used for describing growth states of various crops (Meier, 2001). The extended BBCH-scale is used within the 2010 Reclamation Criteria to define the prime assessment stage of the crop at time of assessment.

The extended BBCH-scale is a system for a uniform coding of phenologically similar growth stages of all mono- and dicotyledonous plant species. It results from teamwork between the German Federal Biological Research Centre for Agriculture and Forestry (BBA), the German Federal Office of Plant Varieties (BSA), the German Agrochemical Association (IVA) and the Institute for Vegetables and Ornamentals in Grossbeeren/Erfurt, Germany (IGZ). The decimal code, which is divided into principal and secondary growth stages, is based on the well-known cereal code developed by ZADOKS et al. (1974) in order to avoid major changes from this widely used phenological key. The abbreviation BBCH derives from Biologische Bundesanstalt, Bundessortenamt and Chemical industry.

14.1.1. The Basic Principles of the BBCH Scale

- The general scale forms the framework within which the individual scales are developed. It can also be used for those plant species for which no special scale is currently available.
- Similar phenological stages of each plant species are given the same code.
- For each code, a description is given, and for some important stages, drawings are included.
- For the description of the phenological development stages, clear and easily recognised (external) morphological characteristics are used.
- Except where stated otherwise, only the development of the main stem is taken into consideration.
- The growth stages refer to representative individual plants within the crop stand. Crop stand characteristics may also be considered.
- Relative values relating to species and/or variety specific ultimate sizes are used for the indication of sizes.
- The secondary growth stages 0 to 8 correspond to the respective ordinal numbers or percentage values. For example stage 3 could represent: 3rd true leaf, 3rd tiller, 3rd node or 30% of the final length or size typical of the species or 30% of the flowers open.

14.1.2. Organization of the BBCH Scale

The entire developmental cycle of the plants is subdivided into ten clearly recognizable and distinguishable longer-lasting developmental phases. These principal growth stages

are described using numbers from 0 to 9 in ascending order (see Figures 1a and b). The principal growth stages are described in Table 1. Owing to the very many different plant species there may be shifts in the course of the development or certain stages may even be omitted.

The principal growth stages need not proceed in the strict sequence defined by the ascending order of the figures, but can occasionally also proceed in parallel.

14.1.3. Principal Growth Stages

14.1.3.1. STAGE DESCRIPTION

- 0 Germination / sprouting / bud development
- 1 Leaf development (main shoot)
- 2 Formation of side shoots / tillering
- 3 Stem elongation or rosette growth / shoot development (main shoot)
- 4 Development of harvestable vegetative plant parts or vegetatively propagated organs / booting (main shoot)
- 5 Inflorescence emergence (main shoot) / heading
- 6 Flowering (main shoot)
- 7 Development of fruit
- 8 Ripening or maturity of fruit and seed
- 9 Senescence, beginning of dormancy

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), cultivated topsoil (Ap) 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 commonly cultivated soil order is Chernozemic and these Ap horizons are typically 10 cm, or more, thick and have a colour value darker than 5.5 dry and 3.5 moist, and have a chroma of at least 3.5 moist. In the agricultural region of Alberta, cultivated soils can include other soil orders for which the following potential soil horizons can qualify as topsoil (Table 8).

Table 8. Soil horizons that qualify as topsoil, arranged by soil Order

Chernozem	Solonetz	Luvisol	Brunisol	Regosol	Vertisol	Gleysol	Organic
Ap	Ap	Ap	Ap	Ap	Ap	Ap	Op
¹ Ah	¹ Ah	¹ Ah	¹ Ah	¹ Ah	¹ Ah	¹ Ah	Of
¹ Ahe	¹ Ahe	¹ Ahe	¹ Ahe	² AC	AB	AB	Om
Aeh	Ae	Aeh	Aeh	² CA	Ahgj	Ahgj	Oh
Ae	Aeh	Ae	Ae		Apgj	Apgj	Ofm
Aegj	AB	Aegj	Aegj		ABv	Ag	Ofh
AB	ABgj	AB	AB		³ BA	Ahe	⁵ Opca
³ BA	³ BA	³ BA	³ BA			Aeh	
⁴ Bp		⁴ Bp	⁴ Bp			Ae	
⁵ Bpk						⁵ Aegj	
						³ BA	
						³ BAg	

1 Ah or Ahe horizons may occur in deep topsoil if the Ah or Ahe occurs below the depth of cultivation.

2 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.

3 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.

4 For eroded sites that lack an A horizon, but include a B horizon, the B horizon is termed the Bp.

5 The tabular listing covers the majority of potential topsoil horizons, but it is not meant to be a complete list. Three 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 page.

- **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 5. 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.

END OF SECTION

16. Appendix D

16.1. Cultivated Land Criteria Rating Tables

CRT.1a Ratings for topsoil depth measurements, meso-contour, and micro-contour for Cultivated soils. Also shown is an example for calculating and assigning ratings for topsoil depth measurements (Note: the same approach also applies for plant measurements).

Rating	Topsoil Depth Measurements	Meso-contour (10-30 m)	Micro-contour (<10 m)
	NOTE: Values will need to be adjusted based on the construction period of the lease		
1	¹ Measurements Onsite $\geq$ 85% (or, 70%; or, 60%) of the Average Control Measurement	No evidence of ponding; No delay in cultivation in spring; and/or, Soils are usually well-drained	$\leq$ 5 cm vertical difference
2	¹ Measurements Onsite Are between the lowest control measurement (LCM) and 84.9% (or, 69.9%; or, 59.9%) of the average control measurement	Occasional ponding following spring melt or heavy rains; The area is usually cultivated and cropped, but may have occasional ponding that inhibits agricultural operations; and/or, Soils are usually 'Gleyed' subgroups.	5-15 cm vertical difference
3	80% of the LCM	Seasonal ponding and crops are frequently flooded; and/or Soils are usually Gleysolic.	16-30 cm vertical difference
4	Measurements on-site that are less than 80% of the LCM	Semi-permanent or permanent ponding, land too wet for cultivation; Surface water at least 1 month during the growing season (May to September); and/or, Soils are Gleysolic or Organic.	>30 cm vertical difference

Example:

Site constructed Post April 30, 1994:

	cm
Average Control Topsoil Depth:	29.3
Minimum Control Topsoil Depth:	21.0

	cm
Rating #1	$\geq$ 24.9
Rating #2	20.0 - 25.4
Rating #3	16.0 - 19.9
Rating #4	< 15.9

Assessment Point	Offsite (Control)		Onsite (Lease)	
	Depth (cm)	Rating	Depth (cm)	Rating
1	32	1	26	1
2	27	1	25	1
3	30	1	14	4
4	21	2	16	3
5	24	2	22	2
6	33	1	25	1
7	36	1	26	1
8	29	1	32	1
9	32	1	28	1

Average	29.3	1.2	23.8	1.7
Minimum	21.0	2.0	14.0	4.0

CRT.1b Ratings for the growth stage assessment of small seeded crops (i.e., seed diameter <2.0 mm) using the BBCH Scale for the Cultivated Lands Criteria

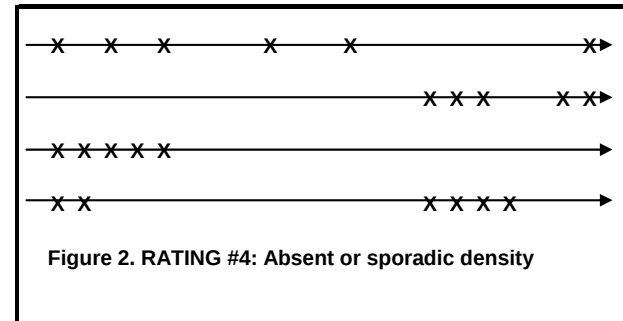
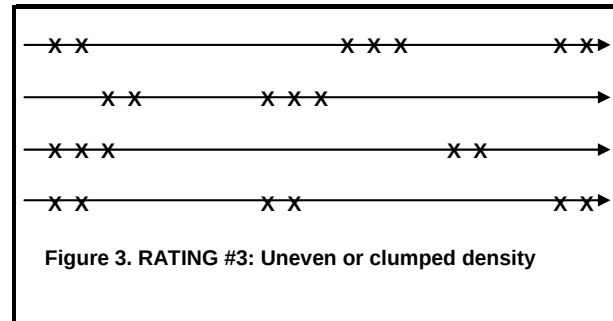
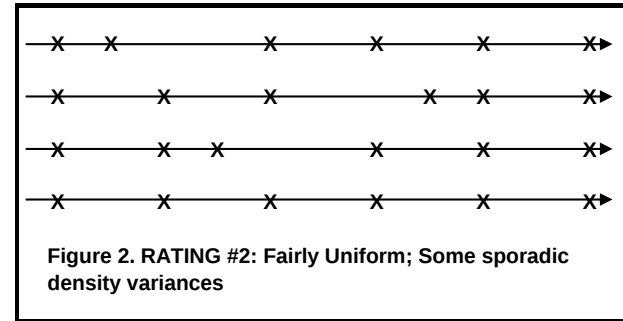
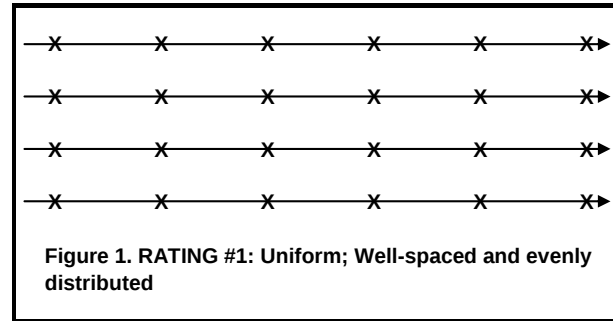
Rating	Description of BBCH Growth Stage in Canola			Description of BBCH Growth Stage in Cereals		
	BBCH Growth Stage #	Grouping of Growth Stage	Description	BBCH Growth Stage #	Grouping of Growth Stage	Description
1	99	Senescence	harvested	99	Senescence	harvested
	92	Senescence	plants dead and dry	97	Senescence	Plant dead and collapsing
	89	Senescence	fully ripe - nearly all pods ripe, seeds black and hard	92-93	Senescence	Over-ripe; grain very hard cannot be dented by thumbnail; Grains loosening in day-time
2	87	Ripening	70% of pods ripe, seeds black and hard	89	Ripening	Fully ripe: grain hard, difficult to divide with thumbnail
	85	Ripening	50% of pods ripe, seeds black and hard	83	Ripening	Early dough
3	83=79 (Overlap)	End of Podding	nearly all of pods at final size & 30% of pods ripe; seeds black and hard	77	Development of Fruit	Late Milk
	81=77 (Overlap)	Podding	77% of pods reach final size & 10% of pods ripe; seeds black and hard	75	Development of Fruit	Medium Milk; grain content milky, grains reached final size; still green
	76=80 (Overlap)	Podding	64% of pods at final size & ripening begins; seed green, filling pod cavity			
4	75	Podding	50% of pods reach final size	73	Development of Fruit	Early milk
	72=69 (Overlap)	Podding	Flowering ends and 20% of pods reach final size	71	Development of Fruit	Watery ripe; first grains have reached final size
5	71=67 (Overlap)	Flowering and Podding	flowering declining, majority of petals fallen & 10% of pods at final size	69	Flowering	End of flowering; all spikelets have completed flowering
	65	Flowering	full flowering - 50% of flowers on main raceme open, older petals falling	65	Flowering	Full flowering; 50% of anthers mature
	63	Flowering	30% of flowers open on the main raceme			
6	61	Flowering starts	10% of flowers on the main raceme open, main raceme elongating	61	Flowering starts	Beginning of flowering; first anthers visible
	60	Flowering starts	first flower opens			
	59	Flowering starts	first petals visible, but flower buds still closed (yellow bud)	59	Flowering starts	End of heading; inflorescence fully emerged
7	58	Inflorescence emergence	individual flower buds (secondary inflorescence) visible but closed	55-58	Inflorescence emergence	50-80% of inflorescence emerged
	55	Inflorescence emergence	individual flower buds (main inflorescence) visible but still closed	54	Inflorescence emergence	40% of inflorescence emerged
	53	Inflorescence emergence	flower buds raised above the youngest leaves	53	Inflorescence emergence	30% of inflorescence emerged
8	52	Inflorescence emergence	flower buds free, level with the youngest leaves	52	Inflorescence emergence	20% of inflorescence emerged
	51	Inflorescence emergence	flower buds visible from above (green bud)	51	Inflorescence emergence	Beginning of heading; tip of inflorescence emerged from sheath, first spikelet just visible
	50	Inflorescence emergence	flower buds present, but still enclosed by leaves			

CRT.1c Vegetation Assessment Level 1 ratings for comparisons between lease and control measurements and ratings for plant health, pod density, seed/head/pod/tuber health, and seed development for Cultivated soils

Rating	Plant Measurements (i.e., Height, Density)	Plant Health Aboveground	Pod Density	See Examples Below	
				Seed / Head / Pod / Tuber Health	Seed Development
1	¹ Measurements Onsite $\geq$ 85% of the Average Control Measurement	Vigorous; no evidence of disease or stress	Plants have a high podding density compared to the control	Complete head, full healthy seeds, no seed abortion	All full and evenly developed.
2	¹ Measurements Onsite Are between the lowest control measurement (LCM) and 84.9% of the average control measurement	Some (<25%) evidence of stress and/or disease or discoloration of vegetation	Plants have a medium podding density compared to the control	80% full, health seeds, 20% seed abortion	Unevenly developed
3	80% of the LCM	Discoloured (>25%), stunted and/or diseased	Plants have a low podding density (i.e., few pods on each stem) compared to the control	<80% of head filled, evidence of incomplete seed fill; noticeable reduction in seed size, >25% diseased	Reduced; shriveled
4	Measurements on-site that are less than 80% of the LCM	Diseased and/or necrotic	Plants have no pods	No seed set, diseased seeds/heads	Lack of maturity or no seed

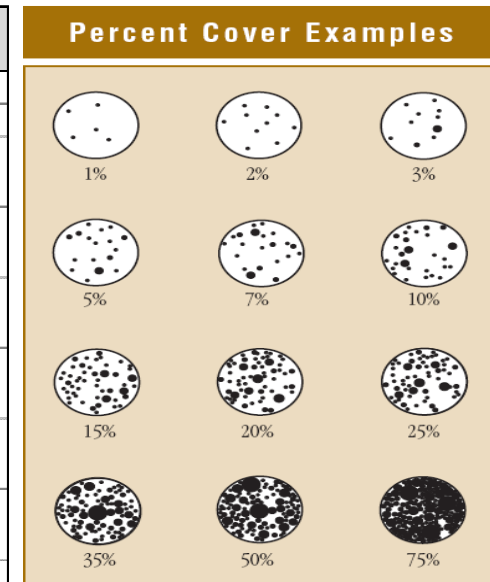
CRT.1d Ratings for germination / seeding distribution for soils for the Cutlivated Criteria, the figure on the right shows the corresponding visual assessment.

Rating	Germination / Seeding Distribution
1	Uniform, well-spaced evenly distributed
2	Fairly uniform, some sporadic density variances
3	Uneven or clumped density
4	Absent or sporadic density



CRT.2 Vegetation Assessment Level 1 ratings for undesirable plant/weed ratings for Cultivated soils

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	



CRT.3 Soil Assessment - Level 1 ratings for soil color, rooting pattern, coarse fragment content, surface stoniness, texture, and consistence for cultivated soils

Rating	Soil Color	Rooting Pattern	Coarse Fragment (% Volume)	Surface Stoniness (Stoniness Class)	TEXTURE		Topsoil (TS)		Subsoil (SS)	
					Clay (C)	Sandy (S)	Consistence		Consistence	
							Moist	Dry	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 expd 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.						

CRT.4 Soil Assessment - Level 1 ratings for soil structure for cultivated soils

Kind	Class		Size (cm)	Topsoil		Subsoil
Single grain ¼ loose, incoherent mass of individual particles as in	-	sg.	<0.2	2		1
Amorphous (massive) ¾ a coherent mass showing no evidence of any distinct arrangement of soil particles.	Breaking to fine fragments	f. frag.	<2	2		1
	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
Blocky (angular blocky) ¾ faces rectangular and flattened less than 5 sided, vertices sharply angular.	Fine blocky	f. bk.	<1	1		1
	Medium blocky	m. bk.	1-2	2		1
	Coarse blocky	c. bk.	2-5	3		2
	Very coarse blocky	vc. bk.	>5	4		3
Subangular blocky ¾ faces subrectangular more than 5 sided, vertices mostly oblique, or subrounded.	Fine subangular blocky	f. sbk.	<1	1		1
	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
Granular ¾ spheroidal, characterized by rounded vertices.	Fine granular	f. gr	<0.2	1		1
	Medium granular	m. gr	0.2-0.5	1		1
	Coarse granular	c. gr.	0.5-1	2		2
Platy ¾ horizontal planes more or less developed.	Fine platy	f. pl.	<0.2	1		1
	Medium platy	m.pl.	0.2-0.5	2		2
	Coarse platy	c. pl.	0.5-1	3		3
Prismatic ¾ vertical faces well defined and edges sharp.	Fine prismatic	f. pr.	<2	2		1
	Medium prismatic	m. pr.	2-5	3		2
	Coarse prismatic	c. pr.	5-10	4		3
	Very coarse prismatic	vc. pr.	>10	4		4
Columnar ¾ vertical edges near top of columns not sharp. Columns may be flat-topped, rounded-topped, or irregular.	Fine columnar	f. cpr.	<2	3		2
	Medium columnar	m. cpr.	2-5	4		3
	Coarse columnar	c. cpr.	5-10	4		4
	Very coarse columnar	vc. cpr.	>10	4		4
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.	Fine compacted	f. comp.	<2	3		2
	Medium compacted	m. comp.	2-5	4		3
	Coarse compacted	c. comp.	5-10	4		4
	Very coarse compacted	vc. Comp.	>10	4		4

CRT.5 Soil Assessment - Level 2 ratings for %-Clay (particle size analysis, PSA), organic carbon, and pH for cultivated soils. Values are the difference between the average control value and specific assessment point site being evaluated (Lease - Control).

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

END OF SECTION

17. Appendix E

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)

END OF SECTION

18. Appendix F

18.1. References Used for the 2010 Reclamation Criteria

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END OF SECTION

19. Appendix G

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 landowner (or designate) may wish to have roads left in place. The roads must be stable, non-hazardous and non-erosive.

Admixing: The addition of non-topsoil material to topsoil resulting in a mixture. Non-topsoil 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: The 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, ironsite 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 roads).

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 in-text 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* - non-material 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 landowner (or designate) 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: Public Lands General Land Classification. 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.

Infilling Species: For the purpose of the 2010 Reclamation Criteria for Native Grasslands these are considered desirable species because 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.

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 E as 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[?] and herbaceous.

Lease: The wellsite, not the access road, in this document.

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 in-depth assessment.

Level 2: An optional assessment used at the discretion of the assessor. This involves a more intensive assessment of vegetation (cover and productivity) and soil (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.

Luvisolic: 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 ecosite. 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: Non-surface soil includes subsoil and other materials that do not normally comprise surface soil.

Offsite: See definition for “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.

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 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 road 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 μ 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 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 site 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.

END OF SECTION

20. Appendix H

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

Web: 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

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

ESRD Groundwater Information Centre

Fax: (780) 427-1214

Phone: (780) 427-2770

Email: 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

END OF SECTION

21. Appendix I

21.1. Regional Offices

ESRD - SOUTHERN REGION

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

ESRD - CENTRAL REGION

3rd 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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