



Enviro Q&A Services



GUIDE TO VARIANCE JUSTIFICATIONS FOR RECLAMATION CERTIFICATION OF WELLSITES AND ASSOCIATED FACILITIES

CASE STUDIES

Heather Tokay, Dean MacKenzie and Kevin Renkema,
Vertex Professional Services Ltd.

Chris Powter, Enviro Q&A Services

Bonnie Drozdowski, InnoTech Alberta Inc.

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INTRODUCTION

In 2020, the Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land (the Guide) (Tokay et al., 2020) was developed to provide guidance and consistency in applying for and approving variance requests for reclamation certificate applications for forested upstream oil and gas wellsites (and associated facilities) that meet equivalent land capability and are on a trajectory towards sustainable forest ecosystems but have one or more reclamation deficiencies according to Alberta's Forested Land Criteria (Alberta Environment and Sustainable Resource Development, 2013a). The Guide is not intended to encourage or promote the use of variances to avoid doing reclamation, or to justify poor reclamation practices or lack of site history. Neglecting timely reclamation in favour of waiting for conditions to develop on-site that will justify deficiencies is not considered acceptable. Variances are to remain the exception and not the rule. The purpose of the Guide is to inform decisions on whether additional reclamation is required to correct deficiencies on sites that have had vegetation establishment and ensure that the decision to forego additional reclamation is based on sound ecological principles.

Readers are strongly urged to review the Guide before reading this document.

Case Studies

This document provides five case studies to show how the Guide would be applied to real-world examples of reclamation certificate applications that have been submitted or are in the process of being evaluated for submission.

The case studies presented here start from the premise that an assessment (in most cases a detailed site assessment; DSA) has been completed on the site which has identified that there are one or more specific requirements of the Forested Land Criteria that are not met (called deficiencies in this document). The professional is now faced with deciding if the site meets equivalent land capability and is on a trajectory towards a sustainable forest ecosystem and if so, whether the site is eligible for a variance. If it is eligible for a variance, the professional must then determine what information to provide to the regulator to support an application for a variance. For all case studies except Case Study B, this document deals only with the decision process and does not take the next step of providing the justification for the variance.

For each of the common reasons to request a variance, the Guide identifies minimum requirements for a variance and some additional factors to consider in deciding whether it would be appropriate to submit a request for a variance. This document shows how the professional would evaluate the minimum requirements and additional factors for each deficiency based on the available site data to determine if the site eligible for a variance. The Guide provides a variance justification form that can be used to document the site conditions, deficiency type and the rationale for requesting a variance. A variance justification form has been completed for Case Study B only and is included in this document.

For each case study, basic site information, site diagrams and photographs are provided for context. Each site deficiency is evaluated separately in two tables – the first table discusses the minimum

requirements for a variance and the second table discusses the additional factors considered. In each table the condition or factor is listed and the details supporting the professional’s analysis is provided. In the tables, rows highlighted in green provide arguments that support a variance, while rows highlighted in blue support further reclamation work. Rows that are not highlighted are not considered factors one way or the other.

Eligibility for a variance is determined through professional judgement of where the balance lies between the green rows and blue rows. Where there are multiple deficiencies on a site professional judgement is first applied to each deficiency and then on the sum of the impacts of all deficiencies. As noted in the Guide, sites with multiple deficiencies may be harder to justify.

Case Study Summary

Case Study	Location	Nearby City/Town	Reclamation Deficiencies	Recommendation ¹	Reclamation Certification Status
A	083-01 W5M	Wabasca	Subsided areas with ponding Low desirable herbaceous species cover	Pass with Justification	Not yet submitted
B	066-03 W4M	Cold Lake	Subsided area Low desirable herbaceous species cover Noxious weeds	Pass with Justification	Certified
C	064-04 W4M	Cold Lake	Soil not replaced on portion of the site Noxious weeds	Pass with Justification	Not yet submitted
D	052-16 W5M	Edson	Soil not replaced Soil stockpiles left in place	Pass with Justification	Certified
E	077-23 W4M	Wabasca	Soil not replaced Soil stockpiles left in place Coarse woody debris pile Problematic species (noxious weeds and problem introduced weeds)	Fail	N/A

¹ The Recommendation is the conclusion arrived at through professional judgement of the deficiencies as described in the text above.

A summary of all of the case studies received from industry for this project is provided in Appendix A.

CASE STUDY A: SUBSIDED AREAS AND SPARSE DESIRABLE SPECIES COVER

The site includes a wellsite and an access road; a pipeline right-of-way is also present but will not be discussed in the case study. A detailed site assessment (DSA) was conducted in August 2019. The results of the assessment and a summary of the reclamation deficiencies that do not meet the Forested Land Criteria are as follows:

Wellsite

- Two subsided areas left in place; both are holding water
- Vegetation does not meet the Forested Land Criteria for desirable herbaceous species cover on portions of the site

Site Overview

Operator	Intentionally Left Blank						Criteria
Unique ID/ License #	083-01 W5						Forested
Facility and Disposition	Wellsite (MSL) and Access Road (LOC)						
Land Use		Surface Legal Land Locations(s) (Furthest Extent)					
Provincial Land Use Area	Green Area	Qtr	LSD	Sec	Twp	Rng	Mer
Provincial Land Use Type	Public Land				083	02	W5M
Grazing Lease (Yes/No)	No				083	01	W5M
Ecological Land Classification			Soil Classification				
Natural Region	Boreal Forest	Soil Order(s)		Luvisolic			
Natural Subregion	Central Mixedwood	Soil Great Group(s)		Gray Luvisol			
Nearby Populated Area(s)			Overlapping Dispositions (if applicable)				
Name	Distance (km)	-					
Wabasca	30						

Facility Information

	Facility	UTM Coordinates (NAD83)			Dimensions (m x m)	Ecosite Phase(s) ¹	Soil Series
		Zone	Easting	Northing			
1	Wellsite	12	123456	1234567	100 x 130	e3 low-bush cranberry – Aw-Sw-PI	-
2	Access Road	12	123456	1234567	8 x 1,275	e3 low-bush cranberry – Aw-Sw-PI	-

¹ Though located in the Central Mixedwood, the ecosite phase was more characteristic of those in the *Field Guide to Ecosites of West-central Alberta* (Beckingham et al., 1996)

Site History

Activity	Activity Description ¹	Date Range
Construction	Full Disturbance	Between 04/30/1994 and 06/01/2007
Abandonment	-	01/25/2017
Reclamation	Full Disturbance	After 06/01/2007
Revegetation	Planted Seeded Grasses Pre-2007	Planted: 07/21/2017 Seeded: 01/28/1999

¹ As per categories used in the Combined Assessment Tool and Record of Observations (CAT and RoO)

Eligibility for a Variance

The minimum requirements for a variance described in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020) must be met for the deficiencies on the wellsite to be eligible for a variance. The overarching goal is to ensure that the site has a functional ecosystem that is on a trajectory towards a forested ecosystem and thus meets the objective of equivalent land capability.

The site deficiencies (subsided areas and sparse desirable herbaceous species) are considered separately in the tables below. The tables provide an analysis of the minimum requirements and the additional considerations described in the Information Sheets and checklists in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020). In these tables, rows highlighted in green provide arguments that support a variance, while rows highlighted in blue support further reclamation work. Rows that are not highlighted are not considered factors one way or the other. Overall eligibility for a variance is determined through professional judgement of where the balance lies between the green rows and blue rows. Where there are multiple deficiencies on a site, professional judgement is first applied to each deficiency and then on the sum of the impacts of all deficiencies.

Subsided Areas Deficiency

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	There is less than the 25% cover of native herbaceous species and fewer than 5 stems/10 m ² plot required by the Forested Land Criteria on some portions of the site. There was greater than 85% cover of combined seeded tame forages and native herbaceous species. Most of the site had greater than 25% cover of native herbaceous and woody species combined. Seeding likely did have some impact on areas with lower stem densities; however, the site is moving towards a forested ecosystem. On-site vegetation can be considered to pass.

Requirement	Details Supporting Analysis
Dimensions and characteristics of deficiency	<p>There are two subsided areas on the wellsite, one approximately 4 x 6 m (24 m²) in size and up to 1 m deep, and the second approximately 2 x 3 m (6 m²) in size and 0.5 m deep; both are holding water. The total subsided area represents <1% of the 13,000 m² wellsite area.</p> <p>The location of the larger subsided area coincides with a drilling waste disposal area (mix-bury-cover) identified in the Phase 1 Environmental Site Assessment. The location of the smaller subsided area is near the former wellhead, within the pipeline right-of-way.</p>
Slopes of deficiency	<p>The bank slopes of the subsided areas were not assessed as they were predominantly under water during the assessment. During a dry year, it is possible that the slopes would be more exposed.</p>
Level of risk to the safety of land users, livestock and wildlife	<p>Because the subsided areas are filled with water, they are more visible and land users are more likely to see them and therefore less likely to fall into them, which reduces the level of risk of the subsided areas.</p> <p>The presence of water in the subsided areas does create a new risk of drowning if land users fall in; however, this risk may be no higher than the risk associated with similar small wetlands that occur in the region.</p>
1. Deterrents to access	<p>Spruce trees on the access road are >2 m tall in some cases and do provide a deterrent to site access; however, the site could be accessed through the pipeline right-of-way.</p>
Stability of deficiency	<p>The banks of subsided areas above the water are stable, well-vegetated and non-erosive.</p>
Comparison to off-site conditions and/or to typical regional conditions	<p>The subsided areas are holding water and have developed aquatic vegetation. They are comparable to the aquatic habitat provided by small natural wetland areas that occur within the region and will become more similar over time as the ecosystem develops.</p> <p>The addition of wetland/aquatic habitat on site increases overall ecosystem diversity on the site.</p>
Impacts of deficiency on ecological function	<p>Subsided areas are stable and non-erosive. Although the subsided areas are filled with water, the overall drainage of the site and the surrounding forest are not impacted by the subsided areas; any impact to ecological function is considered minor.</p>
Current, future and potential land uses of the site	<p>Current land use is predominantly wildlife habitat and commercial forestry; no active recreational trails were observed. Future and potential land uses include wildlife habitat, commercial forestry and recreation. None of these land uses will be impacted by the subsided areas on the site.</p>

Additional Factors Considered

Common reclamation options to correct the subsided area include:

- a) Importing fill material
- b) Re-stripping the topsoil that was replaced during original reclamation and recontouring the site to fill the subsided area and match the grade to the remainder of the site and the surrounding area.

Factor	Details Supporting Analysis
<p>Consequences of re-entering the site to conduct reclamation to correct the deficiency:</p> <p>1. Damage to existing vegetation</p>	<p>Forest vegetation on the reclaimed access road (1.2 km), which meets the Forested Land Criteria, would be damaged to re-enter the site. The access route includes an additional 4 km of road that appears to be revegetated before intersecting with a high-grade road. This portion of the route is not associated with the wellsite and was not assessed during the DSA, but portions of it may be in the process of being reclaimed or reclamation certified. On-site vegetation would also be damaged during reclamation activities, although admittedly the damage caused by this is less of a concern as a large component of the on-site vegetation is tame forage, though several woody plants are developing.</p>
<p>2. Soil re-disturbance</p>	<p>Soil disturbance (and subsequent re-disturbance) degrades topsoil quality and vegetation propagule abundance. Recovery from a second disturbance may not be as rapid as the first (Tokay et al., 2020). This is a factor to consider if reclamation option b) is chosen; option a) requires much less soil re-disturbance.</p>
<p>3. Delayed ecological recovery</p>	<p>Because the site is in a moist, rich ecosite, and conditions are not limiting, vegetation recovery is not expected to be unduly delayed by re-disturbance to correct reclamation deficiencies. However, the type of species that recover first may not be desirable native species, and additional time may be required for a desirable native plant community to develop. This will be exacerbated by the presence of forage species in the seed bank, which will likely re-establish if the site is re-disturbed. Removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem.</p>
<p>4. Rutting and compaction</p>	<p>Wellsite soils are medium textured and are susceptible to rutting and compaction during reclamation activities.</p>
<p>5. Potential for increased recreational use</p>	<p>As the site is only 5 km away from a high grade road (owned by a third party), there is potential for increased recreational use as a result of re-entering the site, especially if trees that were blocking access are removed.</p>

Factor	Details Supporting Analysis
6. Weed establishment and potential need for chemical weed control	No noxious weeds were observed on the site. The use of heavy equipment on-site could be a vector for weed introduction. Use of imported topsoil material to reclaim subsided areas may also result in the introduction of weeds. Site location is likely less of a factor in considering the potential for weed introduction. There are many other wellsites and associated facilities in the surrounding area, but no larger scale industrial plants. The surrounding area is predominantly forested and peatland, which does not present a major source of weeds compared to agricultural areas.
7. Potential for use of low impact reclamation options	Reclamation option a) is a low impact reclamation option while reclamation option b) is not.
8. Size of the disturbance area to correct the deficiency	The size of the disturbance area to correct the deficiency depends on whether reclamation option a) or b) is implemented. With option a) the disturbance area is small while with option b) it is much larger.
Comparison to post-reclamation conditions and features in other industries	The subsided areas are filled with water and not comparable to planned post-reclamation conditions in other industries, although in some cases mounding on in-situ oil and gas facilities does result in ponded conditions as well.

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the subsided areas deficiency, professional judgement leads to a recommendation to pass the site with justification.

Desirable Herbaceous Species Cover Deficiency

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
Erosion	No erosion was noted on the site.

Requirement	Details Supporting Analysis
On-site woody vegetation cover and/or density	Woody stem density on the portions of the site that do not meet the Forested Land Criteria for desirable herbaceous species cover (assessment grids S2 to S6 and S12) ranges from 3 to 6 stems/10 m ² plot. Four of these six assessment grids do not meet the Forested Land Criteria for woody stem density or cover for natural recovery sites. Woody stem density on the remainder of the site is 7 to 10 stems/10 m ² plot. Overall, the wellsite is on a trajectory to becoming a forest ecosystem.
Interim reclamation of the site	The wellsite was constructed prior to June 1, 2007, and abandoned after June 1, 2007. There was less than the 25% cover of native herbaceous species as required by the criteria, but greater than 85% cover of combined seeded and native herbaceous species, as the site was seeded in 1999 with tame forage species. Seeding likely did have some impact on areas with lower stem densities; however, the site is moving towards a forested ecosystem. Due to the interim reclamation that occurred in 1999, the pre-2007 reclamation criteria requiring 80% cover of compatible vegetation based on the seed mix (and no requirement for woody stems) can be applied to assessment points S2 to S6 and S12.
Non-native or undesirable herbaceous species cover	Other than the non-native seeded tame forage species, which can be considered compatible based on their seeding date, there were no other non-native species observed on the site.

Additional Factors Considered

Reclamation to correct the desirable species herbaceous cover could include seeding or planting to introduce desirable forest species or the use of herbicide to remove the tame forages. Treatments may be applied by hand or using equipment (e.g., quad-mounted seeder or sprayer).

Factor	Details Supporting Analysis
<p>Consequences of re-entering the site to conduct reclamation to correct the deficiency</p> <p>1. Damage to existing vegetation</p>	<p>The extent of damage to existing vegetation depends on the reclamation methods that are selected. Work by hand would cause minimal damage to existing vegetation while equipment-based methods will cause more damage. Use of herbicide can also damage existing vegetation, both through herbicide overspray and physical damage from equipment traffic on the site.</p> <p>If equipment is used, forest vegetation on the reclaimed access road (1.2 km), which meets the Forested Land Criteria, would be damaged to re-enter the site. The access route includes an additional 4 km of road that appears to be revegetated before intersecting with a high-grade road. This portion of the route is not associated with the wellsite and was not assessed during the DSA, but portions of it may be in the process of being reclaimed or reclamation certified. On-site vegetation would also be damaged during reclamation activities with equipment, although admittedly the damage caused by this is less of a concern as a large component of the on-site vegetation is tame forage, though several woody plants are developing.</p>
<p>2. Delayed ecological recovery</p>	<p>This factor is only applicable if equipment is used for reclamation or if herbicide is applied.</p> <p>Because the site is in a moist, rich ecosite, and conditions are not limiting, vegetation recovery is not expected to be unduly delayed by damage to vegetation during reclamation.</p> <p>However, the type of species that recover first may not be the desirable native species that are intended, and additional time may be required for a desirable native plant community to develop. Removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem. This will be exacerbated by the presence of forage species in the seed bank, which will likely re-establish if the site is re-disturbed and/or if herbicide is applied.</p>
<p>3. Rutting and compaction</p>	<p>This factor is only applicable if equipment is used for reclamation. Wellsite soils are medium textured and are susceptible to rutting and compaction during reclamation activities with equipment.</p>
<p>4. Potential for increased recreational use</p>	<p>This factor is only applicable if equipment is used for reclamation. As the site is only 5 km away from a high grade road (owned by a third party), there is potential for increased recreational use as a result of re-entering the site with equipment, especially if trees that were blocking access are removed.</p>

Factor	Details Supporting Analysis
<p>5. Weed establishment and potential need for chemical weed control</p>	<p>This factor is only applicable if equipment is used for reclamation or if herbicide is applied.</p> <p>No noxious weeds were observed on the site. The use of equipment on-site could be a vector for weed introduction. If use of herbicide results in a loss of vegetation cover, this could create an opportunity for weeds to establish.</p> <p>Site location is likely less of a factor in considering the potential for weed introduction. There are many other wellsites and associated facilities in the surrounding area, but no larger scale industrial plants. The surrounding area is predominantly forested and peatland, which does not present a major source of weeds compared to agricultural areas.</p>
<p>6. Potential for use of low impact reclamation options</p>	<p>Low-impact methods are available as work can be conducted by hand (e.g., spot spraying, transplanting, hand seeding); however, effectiveness of these small-scale, localized methods may be limited and take several years to achieve.</p>
<p>Availability of suitable seed mixes</p>	<p>Commercially available native seed mixes for forested areas are often grass dominated or contain a wider range of species than are desirable or seeds sourced from non-local origins (Powter et al., 2018).</p>

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the desirable herbaceous species cover deficiency, professional judgement leads to a recommendation to pass the deficiency with justification.

Site Recommendation

Upon reviewing the site conditions and combined impacts of the two deficiencies, professional judgement leads to a determination that the site meets equivalent land capability and is on a trajectory towards a sustainable forest ecosystem and therefore to a recommendation to pass the site with justification.

Site Location Map

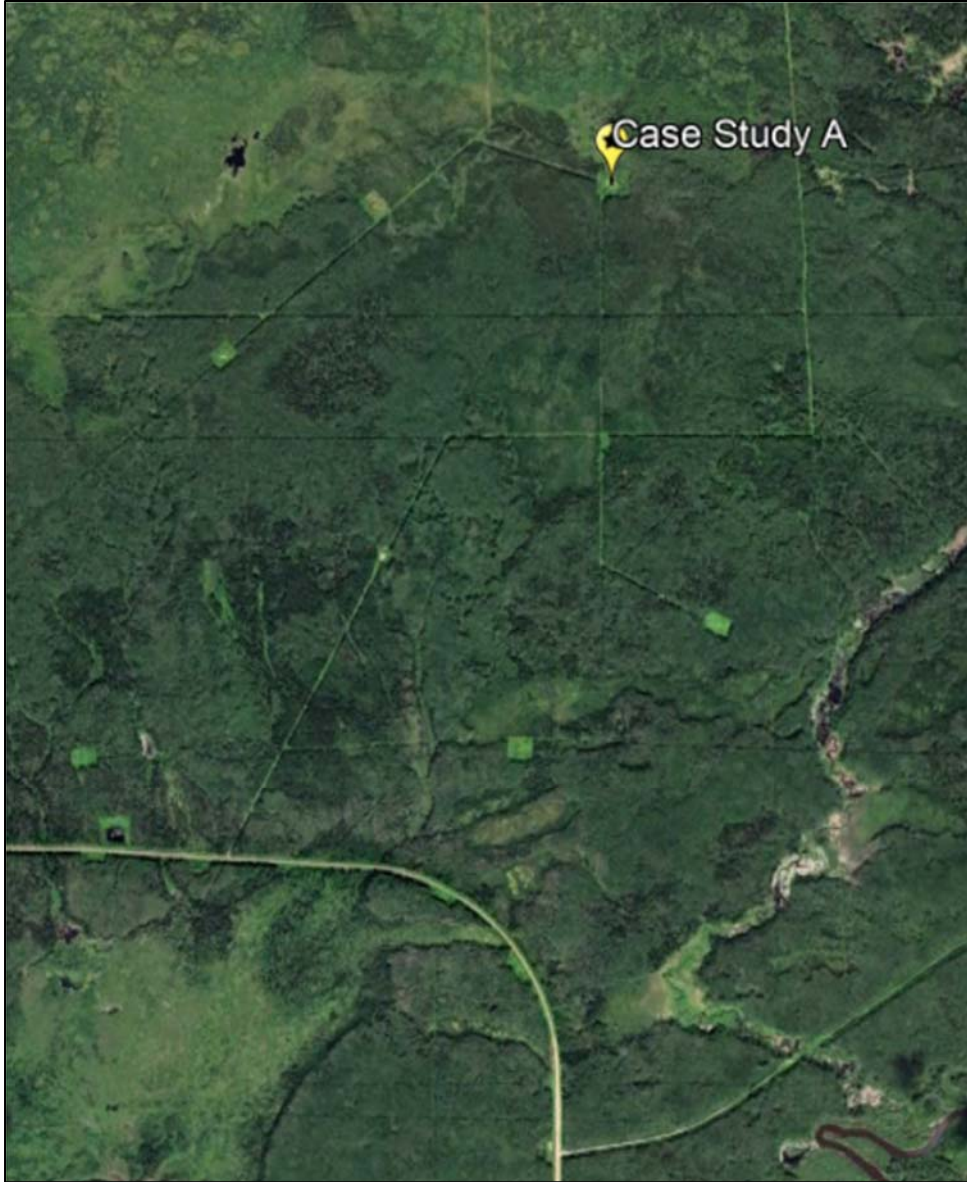
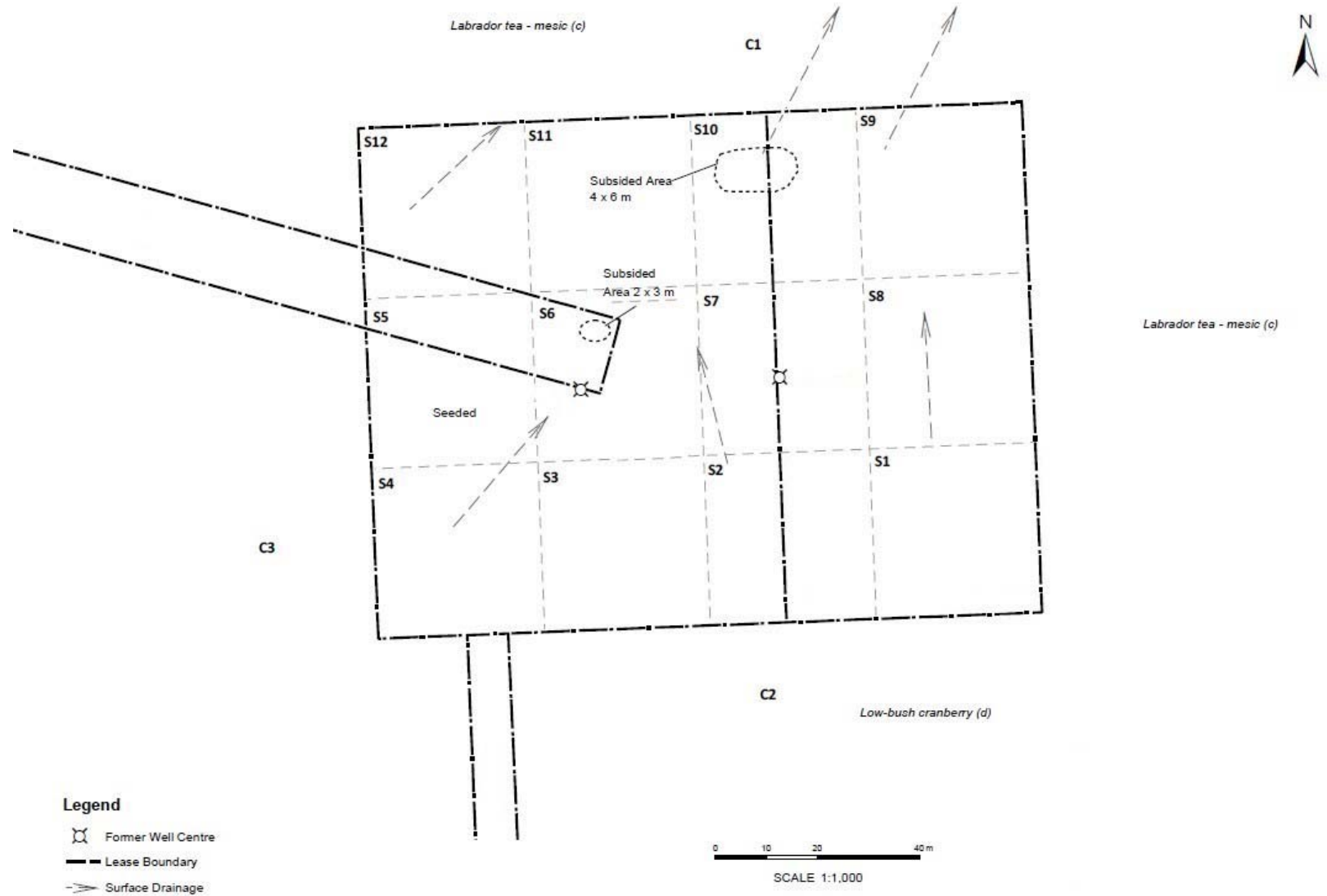
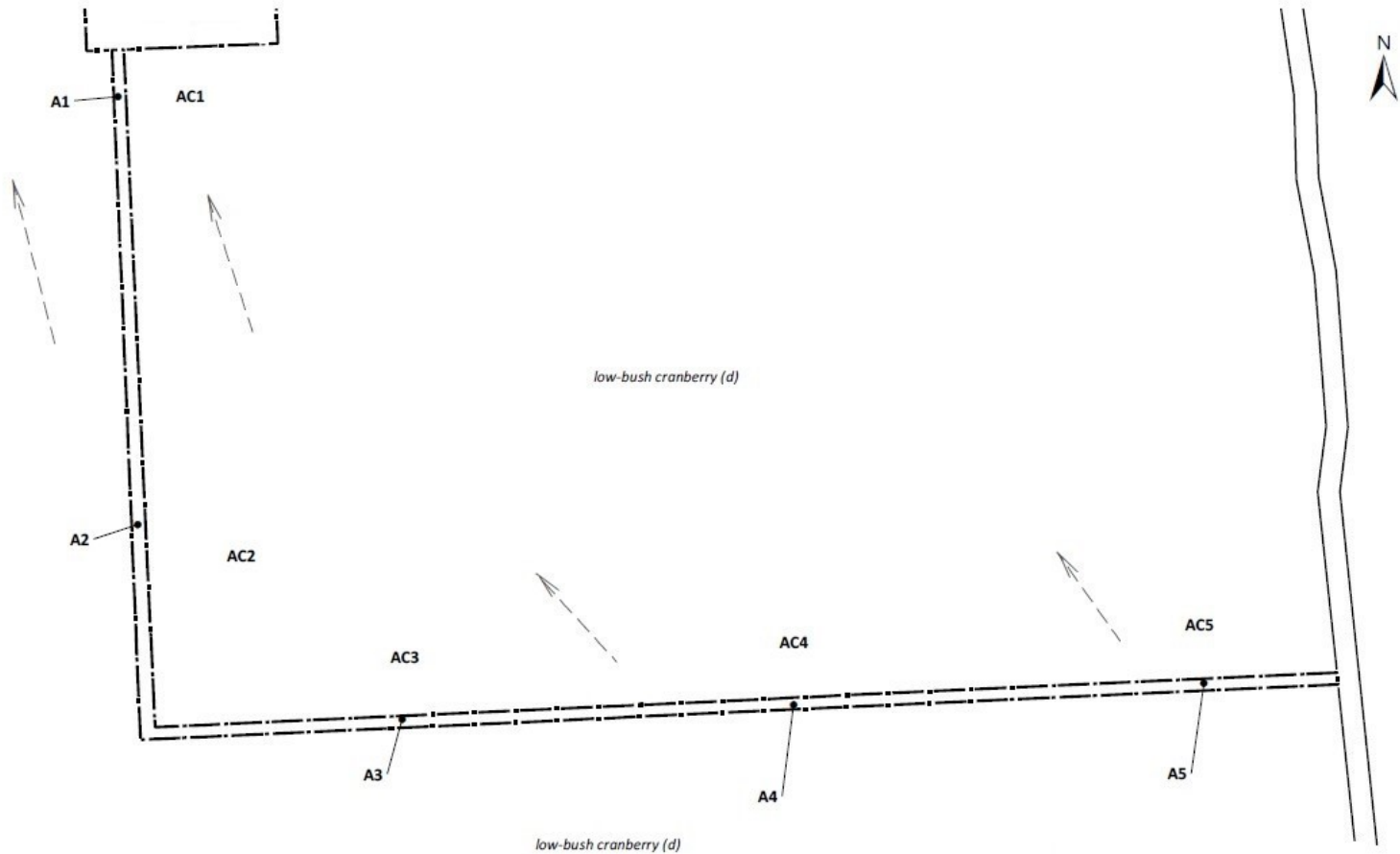


Image Source: Google Earth™ (Google Inc.)

Site Diagram - Wellsite



Site Diagram – Access Road



- Legend**
- Former Wellhead
 - Lease Boundary
 - Disposition
 - Surface Drainage



Site Photographs



Photo 1. Viewing east from the west side of the wellsite

Photo Date: August 11, 2019



Photo 2. Viewing west from the east side of the wellsite

Photo Date: August 11, 2019

Site Photographs



Photo 3. Viewing northeast from the entrance of wellsite

Photo Date: August 11, 2019



Photo 4. Viewing west from 5 m east of well centre

Photo Date: August 11, 2019

Site Photographs



Photo 5. Viewing northwest from the southeast corner of wellsite

Photo Date: August 11, 2019



Photo 6. Viewing southeast from the northwest corner of wellsite

Photo Date: August 11, 2019

Site Photographs



Photo 7. Viewing southwest from the northeast corner of wellsite

Photo Date: August 11, 2019



Photo 8. Viewing northeast from the southwest corner of wellsite

Photo Date: August 11, 2019

Site Photographs



Photo 9. Subsided area near well centre (2 x 3 m)

Photo Date: August 11, 2019



Photo 10. Subsided area along the north side of the wellsite (4 x 6 m)

Photo Date: August 11, 2019

Site Photographs



Photo 11. Vegetation on wellsite

Photo Date: August 11, 2019



Photo 12. Vegetation on a wellsite control location

Photo Date: August 11, 2019

Site Photographs



Photo 13. Viewing south along the access road from entrance of wellsite

Photo Date: August 11, 2019



Photo 14. Viewing south along access road from entrance of wellsite

Photo Date: August 11, 2019

CASE STUDY B: SUBSIDED AREA, SPARSE DESIRABLE HERBACEOUS SPECIES COVER AND NOXIOUS WEEDS

The site includes a wellsite, the reclaimed portion of the access road (hereafter referred to as “access road”) and a log deck. A detailed site assessment (DSA) was conducted in September 2016. The results of the assessment and a summary of the reclamation deficiencies that do not meet the Forested Land Criteria are as follows:

Wellsite

- One subsided area
- Vegetation does not meet the Forested Land Criteria for desirable herbaceous species cover or for noxious weeds

Reclaimed portion of the Access road

- Vegetation does not meet the Forested Land Criteria for desirable herbaceous species cover

Log deck – Not included in the case study

Site Overview

Operator	Intentionally Left Blank						Criteria
Unique ID/ License #	066-03 W4						Forested
Facility and Disposition	Wellsite (MSL), Reclaimed Portion of Access Road (LOC)						
Land Use		Surface Legal Land Locations(s) (Furthest Extent)					
Provincial Land Use Area	Green Area	Qtr	LSD	Sec	Twp	Rng	Mer
Provincial Land Use Type	Public Land				066	03	W4
Grazing Lease (Yes/No)	No				066	03	W4
Ecological Land Classification			Soil Classification				
Natural Region	Boreal Forest	Soil Order(s)		Luvisolic			
Natural Subregion	Central Mixedwood	Soil Great Group(s)		Gray Luvisol			
Nearby Populated Area(s)			Overlapping Dispositions (if applicable)				
Name	Distance (km)	-					
Cold Lake	26 km						
-	-						

Facility Information

	Facility	UTM Coordinates (NAD83)			Dimensions (m x m)	Ecosite Phase(s) ¹	Soil Series
		Zone	Easting	Northing			
1	Wellsite	12	123456	1234567	60 x 100	d2 low-bush cranberry – Aw-Sw	-
2	Access Road ²	12	123456	1234567	10 x 26	d2 low-bush cranberry – Aw-Sw	-

¹ As defined in Beckingham and Archibald (1996) and/or Willoughby et al. (2019).

² Reclaimed portion of the access road (total access road is 10 x 1,450 with 10 x 1,424 m remaining in use)

Site History

Activity	Activity Description ¹	Date Range
Construction	Full Disturbance	02/26/1991 (Before 04/30/1994)
Abandonment	-	03/03/2014
Reclamation	Full Disturbance	After 06/01/2007
Revegetation	Seeded Grasses Pre-2007 Natural Recovery	Seeded: Unknown Natural recovery: After 06/01/2007
Weed Control	Herbicide Application	Unknown

¹ As per categories used in the Combined Assessment Tool and Record of Observations (CAT and RoO)

Eligibility for a Variance

The minimum requirements for a variance described in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020) must be met for the deficiencies on the wellsite to be eligible for a variance. The overarching goal is to ensure that the site has a functional ecosystem that is on a trajectory towards a forested ecosystem and thus meets the objective of equivalent land capability.

The site deficiencies (subsided area, sparse desirable herbaceous species and noxious weeds) are considered separately in the tables below. The tables provide an analysis of the minimum requirements and the additional considerations described in the Information Sheets and checklists in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020). In these tables, rows highlighted in green provide arguments that support a variance, while rows highlighted in blue support further reclamation work. Rows that are not highlighted are not considered factors one way or the other. Overall eligibility for a variance is determined through professional judgement of where the balance lies between the green rows and blue rows. Where there are multiple deficiencies on a site, professional judgement is first applied to each deficiency and then on the sum of the impacts of all deficiencies.

Subsided Area Deficiency on the Wellsite

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	Woody stem density meets the Forested Land Criteria. There is less than the 25% cover of native herbaceous species required by the Forested Land Criteria, but there is greater than 80% cover of combined seeded tame forages and native herbaceous species. On-site vegetation can be considered to pass.
Dimensions and characteristics of deficiency	The subsided area is 8 m ² and 0.5 m deep. The total subsided area represents <1% of the 6,000 m ² wellsite area.

Requirement	Details Supporting Analysis
Slopes of deficiency	Slopes of the subsided area are gentle (<3:1).
Level of risk to the safety of land users, livestock and wildlife	Because the slopes of the subsided area are gentle, the level of risk to the safety of land users and wildlife is low.
1. Deterrents to access	Access to the site is not blocked by physical features that would deter access (e.g., large trees and shrubs, soils mounds or boulders). This factor is not relevant because the level of risk to the safety of land users is low.
Stability of deficiency	The subsided area is stable and non-erosive.
Comparison to off-site conditions and/or to typical regional conditions	No attempt was made to find comparable off-site conditions; however, the subsided area, though larger in size, has a similar difference in elevation as naturally occurring windthrow pits. Windthrow pits can range from 15 to 55 cm deep, depending on the forest type (Kuuluvainen and Juntunen, 1998; Lee and Sturgess, 2002).
Impacts of deficiency on ecological function	Because the subsided area is stable, non-erosive and is not affecting site drainage, there is no impact on ecological function.
Current, future and potential land uses of the site	Current land use is predominantly wildlife habitat and commercial forestry; no active recreational trails were observed. Future and potential land uses include wildlife habitat, commercial forestry and recreation. None of these land uses will be impacted by the subsided area on the site.

Additional Factors Considered

Common reclamation options to correct the subsided area include:

- a) Importing fill material
- b) Re-stripping the topsoil that was replaced during original reclamation and recontouring the site to fill the subsided area and match the grade to the remainder of the site and the surrounding area.

Factor	Details Supporting Analysis
<p>Consequences of re-entering the site to conduct reclamation to correct the deficiency</p> <p>1. Damage to existing vegetation</p>	<p>Vegetation on the wellsite and access road (south of the site) would be damaged during reclamation activities. Although this damage could be considered less critical as a large component of the on-site vegetation is tame forage, the woody stem density is very high in some areas (up to 58 stems/10 m² plot) and therefore the damage to existing vegetation is still an important factor to consider. Additionally, the original access route (based on the survey) extends approximately 50 km to the northeast, much of which is likely revegetated.</p> <p>An alternative access route to the site is via a reclaimed access road and wellsite to the north; using this route, the site in question is only 300 m from a high-grade road. Although this route is also revegetated, the damage to existing vegetation would be substantially reduced.</p>
<p>2. Soil re-disturbance</p>	<p>Soil disturbance (and subsequent re-disturbance) degrades topsoil quality and vegetation propagule abundance. Recovery from a second disturbance may not be as rapid as the first (Tokay et al., 2020). This is a factor to consider if reclamation option b) is chosen; option a) requires much less soil re-disturbance.</p>
<p>3. Delayed ecological recovery</p>	<p>Because the site is in a moist, rich ecosite, and conditions are not limiting, vegetation recovery is not expected to be unduly delayed by re-disturbance to correct reclamation deficiencies.</p> <p>However, the type of species that recover first may not be desirable native species, and additional time may be required for a desirable native plant community to develop. This will be exacerbated by the presence of forage species in the seed bank, which will likely re-establish if the site is re-disturbed. Removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem.</p>
<p>4. Rutting and compaction</p>	<p>Wellsite soils are medium textured and are more susceptible to rutting and compaction during reclamation activities.</p>
<p>5. Potential for increased recreational use</p>	<p>As the site is only 300 m away from a high-grade road, there is a potential for increased recreational use as a result of re-entering the site.</p>

Factor	Details Supporting Analysis
6. Weed establishment and potential need for chemical weed control	During reclamation there are several sources of weeds on the site that could result in weed growth and spread throughout the disturbance area: 50 Canada thistle plants observed on the site, heavy equipment used during reclamation and imported topsoil (if used). Additionally, the site is near an in-situ plant as well as many other wellsites and associated facilities. However, the surrounding area is predominantly forested and peatland, which presents less of a source of weeds than agricultural areas. Refer to the table below on noxious weeds for further discussion.
7. Potential for use of low impact reclamation options	Reclamation option a) is a low impact reclamation option while reclamation option b) is not.
8. Size of the disturbance area to correct the deficiency	The size of the disturbance area to correct the deficiency depends on whether reclamation option a) or b) is implemented. With option a) the disturbance area is small while with option b) it is much larger.
Comparison to post-reclamation conditions and features in other industries	The subsided area, though larger in size, has a similar difference in elevation as microtopographical features created during reclamation in other industries to improve forest species establishment and promote ecological diversity (Bentham and Coupal, 2015; Shunina et al., 2016; Tokay et al., 2020).

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the subsided areas deficiency, professional judgement leads to a recommendation to pass the deficiency with justification.

Desirable Herbaceous Species Cover Deficiency on the Wellsite and Access Road

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirement for a Variance

Requirement	Details Supporting Analysis
Erosion	No erosion was noted on the site.
On-site woody vegetation cover and/or density	Woody stem density on the wellsite and access road meets the Forested Land Criteria (6 to 58 stems/10 m ² plot).

Requirement	Details Supporting Analysis
Interim reclamation of the site	The wellsite and access road were abandoned and reclaimed post-2007 and there is less than the 25% cover of native herbaceous species as required by the Forested Land Criteria, but there is greater than 80% cover of combined seeded tame forages and native herbaceous species. Introduction of tame forages prior to 2007 was a common accepted reclamation practice. Due to the interim reclamation that occurred pre-2007 and minimal soil disturbance post-2007, the pre-2007 criteria requiring 80% cover of compatible vegetation based on the seed mix was applied to the wellsite. There is approximately 80% cover of agronomic species and 12% native herbaceous cover.
Non-native or undesirable herbaceous species cover	In addition to the non-native seeded tame forage species, which can be considered compatible based on their seeding date, there are approximately 50 Canada thistle plants on the wellsite; however, canopy cover is less than half of the desirable herbaceous species cover in that assessment grid.

Additional Factors Considered

Reclamation to correct the desirable herbaceous species cover could include seeding or planting to introduce desirable herbaceous species or the use of herbicide to remove the tame forages. Treatments may be applied by hand or using equipment (e.g., quad-mounted seeder or sprayer).

Factor	Details Supporting Analysis
<p>Consequences of re-entering the site to conduct reclamation to correct the deficiency</p> <p>1. Damage to existing vegetation</p>	<p>The extent of damage to existing vegetation depends on the reclamation methods that are selected. Work by hand would cause minimal damage to existing vegetation while equipment-based methods will cause more damage. Use of herbicide can also damage existing vegetation, both through herbicide overspray and physical damage from equipment traffic on the site.</p> <p>Vegetation on the wellsite and access road (south of the site) would be damaged during reclamation activities. Although this damage could be considered less critical as a large component of the on-site vegetation is tame forages, the woody stem density is very high in some areas (up to 58 stems/10 m² plot) and therefore the damage to existing vegetation is still an important factor to consider. Additionally, the original access route (based on the survey) extends approximately 50 km to the northeast, much of which is likely revegetated.</p> <p>An alternative access route to the site is via a reclaimed access road and wellsite to the north; using this route, the site in question is only 300 m from a high-grade road. Although this route is also revegetated, the damage to existing vegetation would be substantially reduced.</p>
<p>2. Delayed ecological recovery</p>	<p>This factor is only applicable if equipment is used for reclamation or if herbicide is applied.</p> <p>Because the site is in a moist, rich ecosite, and conditions are not limiting, vegetation recovery is not expected to be unduly delayed by damage to vegetation during reclamation.</p> <p>However, the type of species that recover first may not be desirable native species, and additional time may be required for a desirable native plant community to develop. This will be exacerbated by the presence of tame forage species in the seed bank, which will likely re-establish if the site is re-disturbed.</p> <p>Removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem.</p>
<p>3. Rutting and compaction</p>	<p>This factor is only applicable if equipment is used for reclamation. Wellsite soils are medium textured and are more susceptible to rutting and compaction during reclamation activities.</p>
<p>4. Potential for increased recreational use</p>	<p>This factor is only applicable if equipment is used for reclamation. As the site is only 300 m away from a high-grade road, there is a potential for increased recreational use as a result of re-entering the site.</p>

Factor	Details Supporting Analysis
5. Weed establishment and potential need for chemical weed control	This factor is only applicable if equipment is used for reclamation or if herbicide is applied. During reclamation, the two main sources of weeds on the site that could result in weed growth and spread throughout the disturbance area are the 50 Canada thistle plants observed on the site and heavy equipment used during reclamation. Additionally, the site is near an in-situ plant as well as many other wellsites and associated facilities. However, the surrounding area is predominantly forested and peatland, which presents less of a source of weeds than agricultural areas. If use of herbicide results in a loss of vegetation cover, this could create an opportunity for weeds from any of these sources to establish. Refer to the table below on noxious weeds for further discussion.
6. Potential for use of low impact reclamation options	Low-impact methods are available as work can be conducted by hand (e.g., spot spraying, transplanting , hand seeding); however, effectiveness of these small-scale, localized methods may be limited and take several years to achieve.
Availability of suitable seed mixes	Commercially available native seed mixes for forested areas are often grass dominated or contain a wider range of species than are desirable or seeds sourced from non-local origins (Powter et al., 2018).

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the desirable herbaceous species cover deficiency, professional judgement leads to a recommendation to pass the deficiency with justification.

Noxious Weeds Deficiency on the Wellsite

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	Woody stem density meets the Forested Land Criteria. There is less than the 25% cover of native herbaceous species required by the Forested Land Criteria, but there is greater than 80% cover of combined seeded tame forages and native herbaceous species. Further justification is provided in the preceding table; on-site vegetation can be considered to pass.
Trends over time and previous weed control on-site	Data from multiple years are not available.

Requirement	Details Supporting Analysis
Distribution of the weed population and native vegetation on-site	Approximately 50 Canada thistle plants were noted on the wellsite and were handpicked during the DSA; no noxious weeds were found off-site. Canada thistle plants were small and were not flowering. The distribution of the noxious weed plants and/or patches among the on-site vegetation was not recorded. On-site vegetation is well established and covers the entire site; there are no sparse or bare areas on-site.
1. Problematic species, phenology and ecology and impacts of weeds on on-site vegetation and ecosystem development	Although Canada thistle can be an aggressive competitor, because the total number of Canada thistle plants is relatively small, and the plants are not large and flowering, they are not expected to grow and spread on the site and negatively impact the growth and establishment of desirable forest vegetation. The noxious weed plants are expected to be out-competed by desirable on-site vegetation. The noxious weeds are considered to be “controlled” as required by the <i>Weed Control Act</i> (Province of Alberta, 2010).
Movement of noxious weeds into off-site areas	No movement of noxious weeds into off-site areas was observed.
1. Third party activity as a dispersal agent of noxious weeds	Third party activity was not noted on-site; the potential for the spread of the noxious weed into off-site areas by third party activity is reduced.
Third party activity as a source of weeds	Third party activity was not noted on-site and likely does not represent an ongoing source of noxious weeds. There is industrial activity in the area that could be a source of weeds and could result in weed establishment if the site was re-disturbed for reclamation, as discussed in preceding tables, but if the site is not re-disturbed, the on-site vegetation is expected to prevent future weed establishment.

Additional Factors Considered

Factor	Details Supporting Analysis
Site and soil conditions	Site and soil conditions are not expected to be a factor in weed establishment or spread.
Previous weed control on the site	Herbicide application dates for this site are not known.
Negative consequences of continued weed control	Weed control may damage existing desirable woody and herbaceous vegetation, both through herbicide overspray and physical damage from equipment traffic on the site and increases the risk of introducing additional weeds to the site or spreading weeds more widely across the site.

Factor	Details Supporting Analysis
<p>Damage to the access road required to access the site to conduct weed control</p>	<p>Vegetation on the access road (south of the site) would be damaged during access to the site for weed control. Although this damage could be considered less critical as a large component of the vegetation is tame forages, woody stems are present (approximately 16 stems/10 m² plot) and therefore the damage to existing vegetation is still a factor to consider. However, as the access road is very short, the damage that would be incurred is minor.</p> <p>Beyond the access road, the original access route to the site (based on the survey) extends approximately 50 km to the northeast, much of which is likely revegetated.</p> <p>An alternative access route to the site is via a reclaimed access road and wellsite to the north; using this route, the site in question is only 300 m from a high-grade road. Although this route is also revegetated, the damage to existing vegetation would be substantially reduced.</p>

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the noxious weeds deficiency, professional judgement leads to a recommendation to pass the deficiency with justification.

Site Recommendation

Upon reviewing the site conditions and combined impacts of the three deficiencies, professional judgement leads to a determination that the site meets equivalent land capability and is on a trajectory towards a sustainable forest ecosystem and therefore to a recommendation to pass the wellsite and access road with justification.

Variance Justification Form

Site Overview

Operator								Criteria
Unique ID/ License #	066-03 W4						Forested	
Facility and Disposition	Wellsite (MSL), reclaimed portion of Access Road (LOC)							
Land Use		Surface Legal Land Locations(s) (Furthest Extent)						
Provincial Land Use Area	Green Area	Qtr	LSD	Sec	Twp	Rng	Mer	
Provincial Land Use Type	Public Land				066	03	W4	
Grazing Lease (Yes/No)	No				066	03	W4	
Ecological Land Classification		Soil Classification						
Natural Region	Boreal Forest	Soil Order(s)		Luvisolic				
Natural Subregion	Central Mixedwood	Soil Great Group(s)		Gray Luvisol				
Nearby Populated Area(s)		Overlapping Dispositions (if applicable)						
Name	Distance (km)	-						
Cold Lake	26							
-	-							

Facility Information

	Facility	UTM Coordinates (NAD83)			Dimensions (m x m)	Ecosite Phase(s)¹	Soil Series
		Zone	Easting	Northing			
1	Wellsite	12	123456	1234567	60 x 100	d1 low-bush cranberry – Aw	-
2	Access Road ²	12	123456	1234567	10 x 26	d1 low-bush cranberry – Aw	-
3	Log Deck	12	123456	1234567	15 x 30	d1 low-bush cranberry – Aw	-

¹ As defined in Beckingham and Archibald (1996) and/or Willoughby et al. (2019).

² Reclaimed portion of the access road (total access road is 10 x 1,450 with 10 x 1,424 m remaining in use)

Site History Information

Facility		Survey Date	Construction Date	Abandonment Date	Reclamation Date	Revegetation Date
1	Wellsite	12/04/1990	02/26/1991 (Before 04/30/1994)	03/03/2014	After 06/01/07	Seeded: Unknown Natural recovery: After 06/01/2007
2	Access Road	12/04/1990	02/26/1991 (Before 04/30/1994)	03/03/2014	After 06/01/07	Seeded: Unknown Natural recovery: After 06/01/2007
3	Log Deck	The log deck would normally be included in the variance form, but excluded for the purposes of this example for simplicity				

Facility 1

Pre-existing Conditions and Pre-disturbance Biophysical Information (if available)

Information not available

Level of Disturbance at Construction: Full Disturbance

Description of Construction Activities or Limitations (e.g., soil salvage limitations) (if available)

Information not available

Level of Disturbance at Reclamation: Full Disturbance

Description of Reclamation Activities and/or Amendments (if available)

Information not available

Description of Herbicide Application History (if applicable)

Information not available

Revegetation Approach: Grasses: Pre-2007 and Natural Recovery

Description of Revegetation Activities

Information not available

Facility 2

Pre-existing Conditions and Pre-disturbance Biophysical Information (if available)

Information not available

Level of Disturbance at Construction: Full Disturbance

Description of Construction Activities or Limitations (e.g., soil salvage limitations) (if available)

Information not available

Level of Disturbance at Reclamation:	Full Disturbance
Description of Reclamation Activities and/or Amendments (if available)	
Information not available	
Description of Herbicide Application History (if applicable)	
Information not available	
Revegetation Approach:	Grasses: Pre-2007 and Natural Recovery
Description of Revegetation Activities	
Information not available	

Detailed Site Assessment Information (if available)

Facility		Category Failed (Yes/No)			
		Landscape	Vegetation	Level 1 Soil	Level 2 Soil
1	Wellsite	Yes	Yes	No	N/A
2	Access Road	No	Yes	No	N/A
Landscape Assessment Date		Soils Assessment Date		Vegetation Assessment Date	
09/21/2016		09/21/2016		09/21/2016	
Additional Site Biophysical Information					
Information not available					
Evidence of Third-party Use					
No evidence of third-party use					
Other Comments					
-					

Justification

Deficiency Type(s)	Subsided area, sparse desirable herbaceous species cover and noxious weeds
Current Criteria Requirements	
<p>For subsided areas, the following landscape criteria apply:</p> <ul style="list-style-type: none"> • Stability: Subsidence <ul style="list-style-type: none"> ○ Areas of subsidence are <4 m², stable and unlikely to risk the site's stability (note that stability is assessed by the absence of ongoing slumping and erosion). ○ >4 m² subsided areas occurring on-site are consistent with conditions observed off-site. • Operability: Contour <ul style="list-style-type: none"> ○ Macro-, meso- and micro- contours on-site are comparable to off-site ○ Macro-, meso- and micro-contours are not affecting site management ○ Macro- and meso-contours on-site should be integrated with adjacent off-site landscape features ○ Macro- and meso-contours shall not result in excessive erosion, slumping/wasting or altered water flow patterns 	
<p>For desirable herbaceous species cover, for a site that was reclaimed after June 1, 2007, the following vegetation criterion applies: A minimum of 25% canopy cover of herbaceous species and the plants are healthy, in addition to cover requirements for woody vegetation.</p>	
<p>For noxious weeds, both the requirements of the Forested Land Criteria (Section 10.4) and the <i>Weed Control Act</i> (Government of Alberta, 2008) must be met:</p> <ul style="list-style-type: none"> • Noxious weeds must be controlled on-site. • Noxious weed ratings on-site must be comparable to those off-site: the average rating on-site cannot be greater than the average rating off-site, and the difference in the average ratings between on-site and off-site must be <0. For example, if one off-site assessment point has a noxious weeds rating of 4, there could be noxious weeds present on-site but these must have ratings <4. 	
Description of Deficiency (including location and extent/dimensions of the deficiency)	
<p>The subsided area is 8 m² and 0.5 m deep and has gentle slopes (<3:1). The total subsided area represents <1% of the 6,000 m² wellsite area.</p>	
<p>There was less than the 25% cover of native herbaceous species as required by the Forested Land Criteria, but greater than 85% cover of combined seeded and native herbaceous species. The wellsite was constructed prior to June 1, 2007, and abandoned after June 1, 2007, but interim reclamation (including seeding) likely occurred prior to June 1, 2007.</p>	
<p>Approximately 50 Canada thistle plants were noted on the wellsite and were all controlled via handpicking during the DSA; no noxious weeds were found off site.</p>	
Rationale for Variance	
<p><u>Subsided area</u></p> <p>The subsided area is well vegetated. Woody stem density on site meets the Forested Land Criteria. There is less than the 25% cover of native herbaceous species required by the Forested Land Criteria, but on site vegetation can be considered to pass based provided in the justification of the desirable herbaceous species cover below. Because the subsided area is stable, non-erosive and is not affecting site drainage, there is no impact on ecological function. The subsided area has gentle slopes and the level of risk to the safety of land users and wildlife is low.</p> <p>Comparable off-site conditions were not specifically located; however, the subsided area, though larger in size, has a similar difference in elevation as naturally occurring windthrow pits in aspen stands in the region, which can have pit depths up to 25 cm and adjacent mound heights up to 50 cm (Lee and Sturgess, 2002), as well as microtopographical features created during reclamation in other industries to improve forest species establishment and promote ecological diversity (Shunina et al., 2016; Bentham and Coupal, 2015; Tokay et al., 2020).</p> <p>Current land use of the site is predominantly wildlife habitat and commercial forestry; no active recreational trails were observed. Future and potential land uses include wildlife habitat, commercial forestry and recreation. None of these land uses will be impacted by the subsided area on the site.</p>	

There would be several ecological consequences associated with re-entering the site to conduct reclamation to correct the deficiency. As no fill material is available to be imported, reclamation will involve re-stripping the topsoil that was replaced during original reclamation and recontouring the site to fill the subsided area and match the grade to the remainder of the site and the surrounding area. This reclamation strategy will result in a larger disturbance area on site than the use of imported fill material would.

Vegetation on the wellsite and access road (south of the site) would be damaged during reclamation activities. Although this damage could be considered less critical as a large component of the on-site vegetation is tame forage, the woody stem density is very high in some areas (up to 58 stems/10 m² plot) and therefore the damage to existing vegetation is still an important factor to consider. In terms of the access road, there are two possible access routes to the site. Use of the access route to the north via a reclaimed access road and wellsite to the north, although not the original access route to the site, results in only 300 m of disturbance compared to 50 km. Conditions on this access route was not assessed as part of this site, but is assumed to be at least partially revegetated based on aerial imagery.

Soil disturbance (and subsequent re-disturbance) degrades topsoil quality and vegetation propagule abundance. Recovery from a second disturbance may not be as rapid as the first (Tokay et al., 2020). Because the site is located in a moist, rich ecosite, and conditions are not limiting, vegetation recovery is not expected to be unduly delayed by re-disturbance to correct reclamation deficiencies. However, the type of species that recover first may not be desirable native species, and additional time may be required for a desirable native plant community to develop. This will be exacerbated by the presence of forage species in the seed bank, which will likely re-establish if the site is re-disturbed. Removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem.

Other factors to consider in terms of reclamation to correct the subsided area are rutting and compaction, the potential for increased recreation use of the site and the potential for weed establishment and the need for weed control. Wellsite soils are medium textured and are more susceptible to rutting and compaction during reclamation activities. As the site is only 300 m away from a high grade road, there is a potential for increased recreational use as a result of re-entering the site. During reclamation there are two main sources of weeds on the site that could result in weed growth and spread throughout the disturbance area: 50 Canada thistle plants observed on the site and heavy equipment used during reclamation. Additionally, the site is near an in-situ facility as well as many other wellsites and associated facilities. However, the surrounding area is predominantly forested and peatland, which presents less of a source of weeds than agricultural areas. Noxious weeds are discussed further below.

Desirable Herbaceous Species Cover

Due to the interim reclamation that occurred, the pre-2007 reclamation criteria requiring 80% cover of compatible vegetation based on the seed mix can be applied. Despite the sparse desirable herbaceous species cover, woody stem density did meet the Forested Land Criteria, ranging from 6 to 58 stems/10 m² plot. A variance for desirable herbaceous species cover can also be justified by the lack of erosion and the limited number non-native species. Non-native tame forages are considered compatible based on their seeding date; however, there are approximately 50 Canada thistle plants on the wellsite. Canopy cover of noxious weeds is less than half of the desirable herbaceous species cover. Overall the site is on a trajectory towards a forested ecosystem.

There would be several ecological consequences associated with re-entering the site to conduct reclamation to correct the deficiency. Reclamation will first involve the use of herbicide to remove the tame forages followed by seeding or planting to introduce desirable herbaceous species. Regardless of whether equipment is used for reclamation, damage to existing vegetation is likely to occur through the use of herbicide. Removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem. This will be exacerbated by the presence of forage species in the seed bank, which will may re-establish after herbicide is applied. Other consequences of reclamation will be similar to those described for subsided areas above (with the exception of soil re-disturbance).

Otherwise, the availability of suitable seed mixes to correct sparse desirable herbaceous species cover is limited. Commercially available native seed mixes for forested areas are often grass dominated or contain a wider range of species than are desirable or seeds sourced from non-local origins (Powter et al., 2018).

Noxious weeds

The Canada thistle plants that were noted on the wellsite were controlled via handpicking during the DSA (occurrence of previous weed control is not known as herbicide application records for the site were not

available). Canada thistle plants were small and were not flowering. The distribution of the noxious weed plants and/or patches among the on-site vegetation was not recorded, nor were trends over multiple years. On-site vegetation is well established and covers the entire site; there are no sparse or bare areas on-site.

Woody stem density meets the Forested Land Criteria. There is less than the 25% cover of native herbaceous species required by the Forested Land Criteria, but there is greater than 80% cover of combined seeded tame forages and native herbaceous species. Further justification is provided in the preceding justification for desirable herbaceous species cover; on-site vegetation can be considered to pass.

Although Canada thistle can be an aggressive competitor, because the total number of Canada thistle plants is relatively small, and the plants are not large and flowering, they are not expected to grow and spread on the site and negatively impact the growth and establishment of desirable forest vegetation. The noxious weed plants are expected to be out competed by desirable on-site vegetation. Additionally, no movement of noxious weeds into off-site areas was observed and no third party activity was not noted on-site and therefore the potential for the spread of the noxious weed into off-site areas by third party activity is reduced. Overall, the noxious weeds are considered to be “controlled” as required by the *Weed Control Act* (Province of Alberta, 2010).

An additional factor to consider is the negative consequences of continued weed control. Weed control may damage existing desirable woody and herbaceous vegetation, both through herbicide overspray and physical damage from equipment traffic on the site, and increases the risk of introducing additional weeds to the site or spreading weeds more widely across the site. Assuming that the access route to the north via a reclaimed access road and wellsite to the north, although not the original access route to the site, is used, the damage to existing vegetation is minimized to a 300 m distance. Conditions on this access route was not assessed as part of this site, but is assumed to be at least partially revegetated based on aerial imagery.

Conclusion

Despite the noted deficiencies, the site has achieved equivalent land capability and a functional ecosystem that is on a trajectory towards a forested ecosystem has been established on-site. The benefits of additional reclamation do not outweigh the negative consequences that could occur and is not warranted in this case. A variance for the subsided area, sparse desirable species cover and noxious weeds is justified.

Literature or Case Studies Cited

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- Lee, P. and K. Sturgess. 2002. The Effects of Logs, Stumps, and Root Throws on Understorey Communities within 28-Year-Old Aspen-Dominated Boreal Forests. *Canadian Journal of Botany* 79: 905–916.
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- Shunina, A., T.J. Osko, L. Foote and E.W. Bork. 2016. Comparison of Site Preparation and Revegetation Strategies within a Sphagnum-Dominated Peatland Following Removal of an Oil Well Pad. *Ecological Restoration* 34: 225–235.
- Tokay, H., D. MacKenzie, C.B. Powter, B. Drozdowski and K. Renkema 2020. Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land. Prepared for the Petroleum Technology Alliance of Canada, Calgary, Alberta. 82 pp.

Sign-off

Person Preparing Justification	John Doe	Reclamation Specialist
	Name (Print)	Title
	<i>John Doe</i>	07/27/2020
	Signature	Date (mm/dd/yy)
Name of Regulatory Official Approving Variance	Jane Doe	08/27/2020
	Name	Date (mm/dd/yy)

Attached Supporting Information

X	Site diagram (including overlapping dispositions, location of deficiency, comparable conditions off-site)
X	Survey plans
X	Detailed Site Assessment (DSA), including combined assessment tool (CAT) and record of observation (RoO), photographs and any supporting reports (e.g., previous DSAs)
	Aerial photographs
	Construction records
	Pre-disturbance biophysical information
	Other:
	Other:
	Other:

Site Location Map

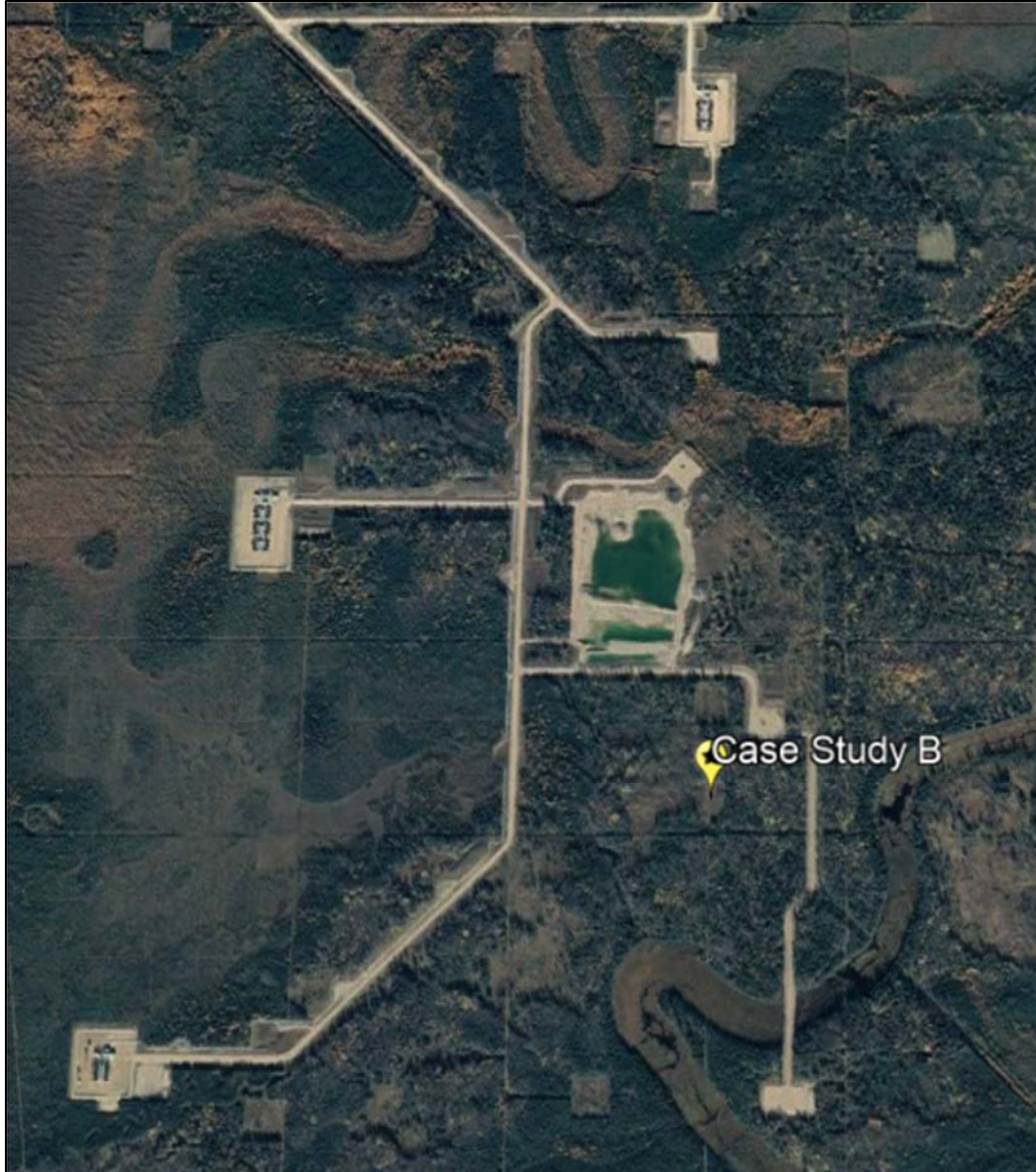
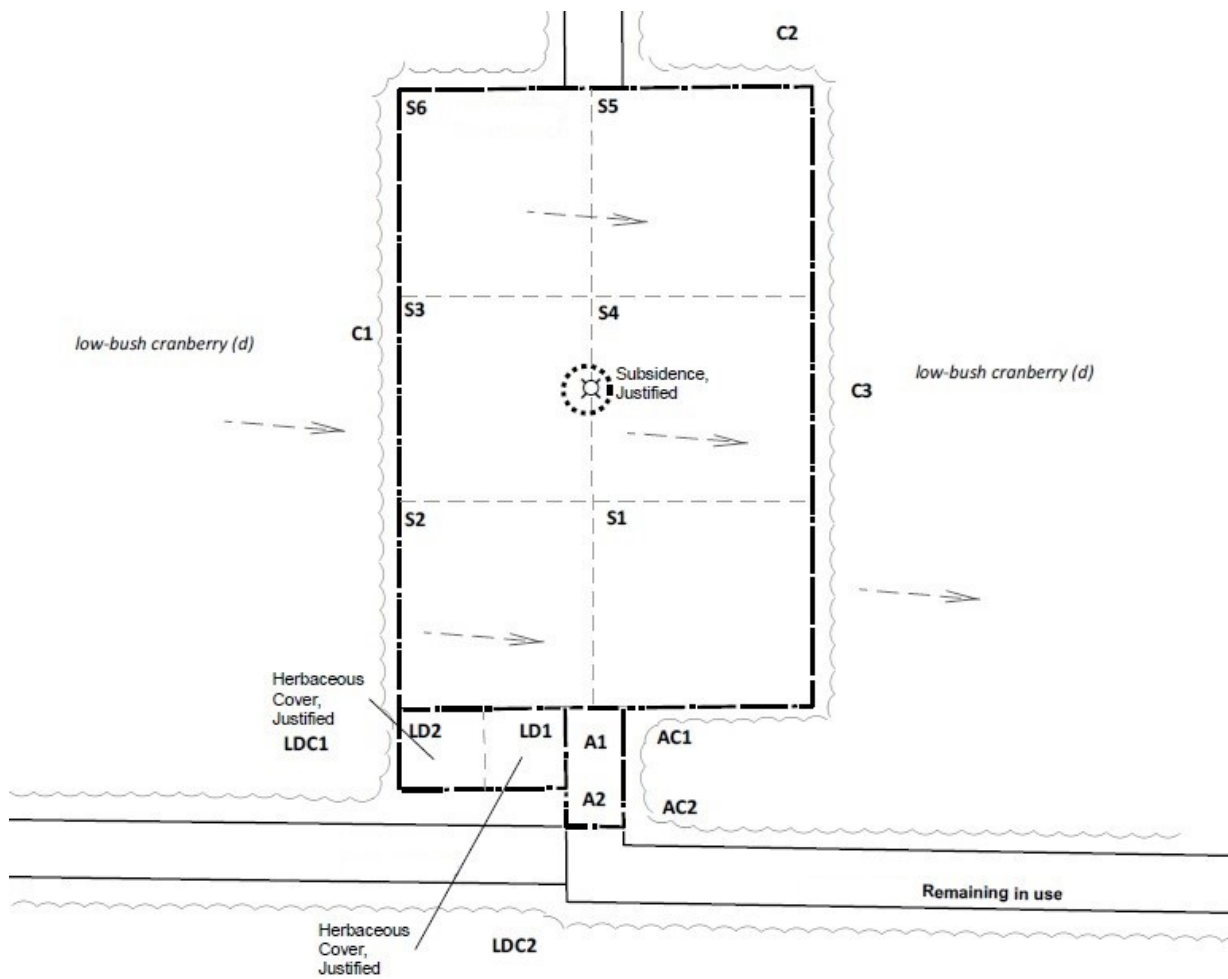





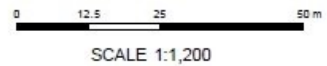
Image Source: Google Earth™ (Google Inc.)

Site Diagram



Legend

-  Former Wellhead
-  Lease Boundary
-  Surface Drainage



Site Photographs



Photo 1. Viewing northeast from the southwest corner of the wellsite

Photo Date: September 21, 2016



Photo 2. Viewing northwest from the southeast corner of the wellsite

Photo Date: September 21, 2016

Site Photographs



Photo 3. Viewing southwest from the northeast corner of the wellsite

Photo Date: September 21, 2016



Photo 4. Viewing southeast from the northwest corner of the wellsite

Photo Date: September 21, 2016

Site Photographs



Photo 5. Vegetation on the wellsite

Photo Date: September 21, 2016



Photo 6. Vegetation on a wellsite control location

Photo Date: September 21, 2016

Site Photographs



Photo 7. Subsidence at well centre

Photo Date: September 21, 2016



Photo 8. Viewing south along the access road from the entrance of the wellsite

Photo Date: September 21, 2016

CASE STUDY C: LACK OF TOPSOIL AND NOXIOUS WEEDS

The site includes a wellsite and an access road. A detailed site assessment was conducted in July 2012. A summary of the reclamation deficiencies that do not meet the Forested Land Criteria are as follows:

Wellsite

- An area south of the well centre with exposed subsoil
- Noxious weeds (perennial sow-thistle and Canada thistle) were present on-site in greater concentrations than in surrounding areas

Access road – overlaps an ATCO easement and is not discussed in the case study

Site Overview

Operator	Intentionally Left Blank						Criteria
Unique ID/ License #	064-04 W4						Forested
Facility and Disposition	Wellsite (OSE)						
Land Use		Surface Legal Land Locations(s) (Furthest Extent)					
Provincial Land Use Area	Green Area	Qtr	LSD	Sec	Twp	Rng	Mer
Provincial Land Use Type	Public Land				064	04	W4
Grazing Lease (Yes/No)	No	-	-	-	-	-	-
Ecological Land Classification		Soil Classification					
Natural Region	Boreal Forest	Soil Order(s)		Luvisolic			
Natural Subregion	Central Mixedwood	Soil Great Group(s)		Gray Luvisol			
Nearby Populated Area(s)		Overlapping Dispositions (if applicable)					
Name	Distance (km)	The wellsite was surveyed as running parallel to an existing road allowance. The survey drawing shows a 21 m by 2 m access road on the easement. This access road is not discussed in this case study.					
La Corey	20						
Cold Lake	25						

Facility Information

	Facility	UTM Coordinates (NAD83)			Dimensions (m x m)	Ecosite Phase(s) ¹	Soil Series
		Zone	Easting	Northing			
1	Wellsite	12	123456	1234567	70 x 80	d2 low-bush cranberry – Aw-Sw	-

¹ As defined in Beckingham and Archibald (1996) and/or Willoughby et al. (2019).

Site History

Activity	Activity Description ¹	Date Range
Construction	Full Disturbance	12/18/2008 (After 06/01/2007)
Abandonment	-	01/02/2009
Reclamation	Minimum Disturbance	After 06/01/2007
Revegetation	Natural Recovery	Spring 2009 (After 06/01/2007)

¹ As per categories used in the Combined Assessment Tool and Record of Observations (CAT and RoO)

Eligibility for a Variance

The minimum requirements for a variance described in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020) must be met for the deficiencies on the wellsite to be eligible for a variance. The overarching goal is to ensure that the site has a functional ecosystem that is on a trajectory towards a forested ecosystem and thus meets the objective of equivalent land capability.

The site deficiencies (topsoil depth and noxious weeds) are considered separately in the tables below. The tables provide an analysis of the minimum requirements and the additional considerations described in the Information Sheets and checklists in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020). In these tables, rows highlighted in green provide arguments that support a variance, while rows highlighted in blue support further reclamation work. Rows that are not highlighted are not considered factors one way or the other. Overall eligibility for a variance is determined through professional judgement of where the balance lies between the green rows and blue rows. Where there are multiple deficiencies on a site, professional judgement is first applied to each deficiency and then on the sum of the impacts of all deficiencies.

Topsoil Depth Deficiency

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	On-site vegetation meets the Forested Land Criteria. A DSA conducted in 2012 found that there was <25% vegetation cover in the area of exposed subsoil, but vegetation has naturally regenerated since then and is now very dense throughout the site. The lack of topsoil on a portion of the site does not appear to be limiting vegetation establishment and recovery.
Age of the site	The site was constructed in 2008 and abandoned and reclaimed in 2009. As of 2020, the site will have had 11 years of woody vegetation growth and development through natural recovery.

Requirement	Details Supporting Analysis
Rooting restrictions	No rooting restrictions were noted.
Consequences of re-entering the site to conduct reclamation to correct the deficiency	<p>Common reclamation options to correct topsoil depth include:</p> <ul style="list-style-type: none"> a) Importing fill material b) Re-stripping the topsoil from the entire site or from portions of the site that have an excess and re-distribute it evenly across the site <p>Consequences of re-entering the site are discussed in the following rows of this table.</p>
1. Damage to existing vegetation	<p>Access to the site is via high grade roads (township road 644A off public highway 892); there would be minimal damage to vegetation on the access road.</p> <p>On-site vegetation, which meets the Forested Land Criteria, would be damaged during reclamation activities.</p>
2. Delayed ecological recovery	<p>Because the site is located in a d2 ecosite, which is considered a moist, rich site type (Alberta Environment, 2010), the potential for delayed ecological recovery after re-disturbance is lower than for nutrient poor or dry sites (Tokay et al., 2020).</p> <p>Additionally, if reclamation option a) is selected, the area that would require additional reclamation would be small, which would limit the disturbance area, and result in faster recovery due to ingress from surrounding areas that were not re-disturbed.</p>
3. Rutting and compaction	Wellsite soils are medium to fine textured and are more susceptible to rutting and compaction during reclamation activities.
4. Potential for increased recreational use	As the site is already located along a publicly accessible high-grade road and could be readily accessed by recreational users, re-disturbance of the site would not increase the potential for recreational use.
5. Weed establishment and potential need for chemical weed control	Both Canada thistle and perennial sow-thistle were observed on the site between 2012 and 2018. Because their propagules are already present on-site, re-disturbance of the site could result in the spread of perennial sow-thistle and Canada thistle throughout the disturbance area. The use of heavy equipment and imported topsoil (if used) to reclaim the site could also be vectors for weed introduction. Site location could also play a role in the likelihood of weed establishment after re-disturbance. The site is located in an area with several industrial facilities nearby. Refer to the table below on noxious weeds for further discussion.
6. Potential for use of low impact reclamation options	Reclamation option a) is a low impact reclamation option while reclamation option b) is not.

Additional Factors Considered

Factor	Details Supporting Analysis
Woody vegetation growth and productivity	Not assessed.
Comparison to off-site, pre-disturbance and/or typical regional conditions	Not assessed.
Current, future and potential land uses of the site	Current land use is predominantly wildlife habitat and commercial forestry; no active recreational trails were observed. Future and potential land uses include commercial forestry, wildlife habitat, and recreation. None of these land uses will be impacted by the lack of topsoil deficiency.
Soil salvage limitations during construction	None noted.
Soil suitability	Not assessed.
Presence of soil stockpiles	None noted. Lack of topsoil on a portion of the site is not due to a failure to re-spread soil stockpiles but rather to uneven re-spreading of topsoil during reclamation.
Availability of forest topsoil for import	No sources of topsoil appropriate for a forested site and available for import were identified.

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the topsoil depth deficiency, professional judgement leads to a recommendation to pass the deficiency with justification.

Noxious Weeds Deficiency

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	On-site vegetation meets the Forested Land Criteria. The DSA conducted in 2012 found that there was <25% vegetation cover in the area of exposed subsoil, but vegetation has naturally regenerated since then and is now very dense throughout the site.

Requirement	Details Supporting Analysis
Trends over time and previous weed control on-site	<p>The number of perennial sow-thistle (PST) plants initially increased between 2011 and 2012 and then declined substantially between 2012 and 2016; no PST was observed on the site after 2016. The number of Canada thistle (CT) plants declined between 2011 and 2016; between 2016 and 2018 there were small increases but overall the number is relatively stable.</p> <p>Weed control history of the site is as follows:</p> <ul style="list-style-type: none"> • September 24, 2011: spot sprayed 105 CT and 40 PST with Transline (Lontrel) • July 25, 2012: spot sprayed CT and PST with Lontrel • September 20, 2012: spot sprayed 55 CT and 450 PST with Lontrel • June 25, 2013: spot sprayed PST and CT with Lontrel • September 18, 2013: spot sprayed annual sow thistle, PST and CT with Lontrel • July 5, 2015: handpicked 50 CT • September 20, 2016: spot sprayed 40 PST and 20 CT with Truvist • June 22, 2017: Handpicked 30 CT • July 6, 2018: Handpicked 35 CT
Distribution of the weed population and native vegetation on-site	<p>The distribution of the noxious weed plants and/or patches among the on-site vegetation was not recorded.</p> <p>On-site vegetation is well established and covers the entire site; there are no sparse or bare areas on-site.</p>
1. Problematic species, phenology and ecology and impacts of weeds on on-site vegetation and ecosystem development	<p>Although Canada thistle can be an aggressive competitor and perennial sow-thistle an aggressive colonizer, because the total number of noxious weed plants has been reduced over time to a relatively small number, they are not expected to spread on the site and negatively impact the growth and establishment of desirable forest vegetation. The noxious weed plants are expected to be out-competed by desirable on-site vegetation. The noxious weeds are considered to be “controlled” as required by the <i>Weed Control Act</i> (Province of Alberta, 2010).</p>
Movement of noxious weeds into off-site areas	<p>No movement of noxious weeds into off-site areas was observed.</p>
1. Third party activity as a dispersal agent of noxious weeds	<p>Third party activity was not noted on-site; the potential for the spread of the noxious weeds into off-site areas by third party activity is reduced.</p>

Requirement	Details Supporting Analysis
Third party activity as a source of weeds	Third party activity was not noted on-site and likely does not represent an ongoing source of noxious weeds. There is industrial activity in the area that could be a source of weeds and could result in weed establishment if the site was re-disturbed for reclamation, as discussed in the previous table, but if the site is not re-disturbed, the on-site vegetation is expected to prevent future weed establishment.

Additional Factors Considered

Factor	Details Supporting Analysis
Site and soil conditions	Although there is an area without topsoil that may have been susceptible to weed invasion and establishment, desirable vegetation recovery has occurred in this area; soil conditions are not expected to be a factor in future weed establishment or spread.
Negative consequences of continued weed control	Continued access to the site to conduct weed control will cause damage to existing vegetation on-site, both through herbicide overspray and physical damage from equipment traffic on the site, and increases the risk of introducing additional weeds to the site or spreading weeds more widely across the site.
Damage to the access road required to access the site to conduct weed control	Access to the site is via high grade roads (township road 644A off public highway 892); there would be minimal damage to vegetation on the access road.

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the noxious weeds deficiency, professional judgement leads to a recommendation to pass the deficiency with justification.

Site Recommendation

Upon reviewing the site conditions and combined impacts of the two deficiencies, professional judgement leads to a determination that the site meets equivalent land capability and is on a trajectory towards a sustainable forest ecosystem and therefore to a recommendation to pass the site with justification.

Site Location Map

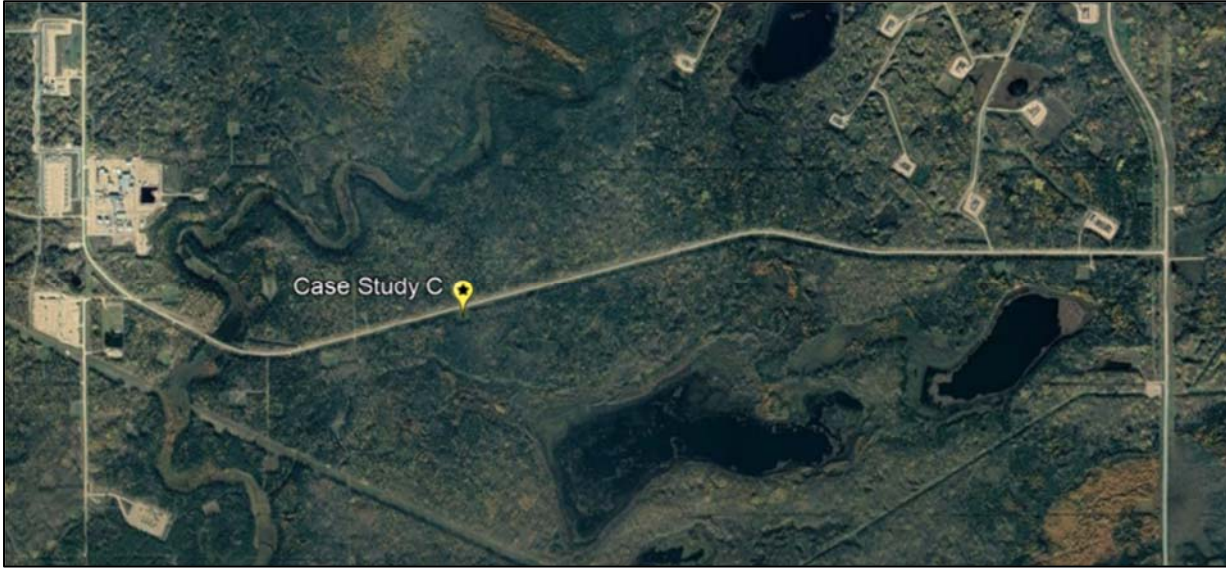


Image Source: Google Earth™ (Google Inc.)

Site Photographs



Photo 1. Site overview

Photo Date: June 22, 2017



Photo 2. Southeast quadrant of the wellsite, where the area lacking topsoil occurs

Photo Date: June 22, 2017

Site Photographs



Photo 3. Dense regeneration on area lacking topsoil

Photo Date: June 22, 2017



Photo 4. Dense regeneration on area lacking topsoil

Photo Date: June 22, 2017

CASE STUDY D: LACK OF TOPSOIL AND SOIL STOCKPILES

The site includes a wellsite, an access road and a log deck. A detailed site assessment (DSA) was conducted in June 2018. The results of the assessment and a summary of the reclamation deficiencies that do not meet the Forested Land Criteria are as follows:

Wellsite

- Topsoil not been replaced
- Topsoil stockpiles were present on-site
- One noxious weed plant (perennial sow-thistle) was found on-site, while none were present in the surrounding areas; because this is such a minor occurrence, this will not be discussed as part of the case study.

Access road – Pass

Log deck – Pass

Site Overview

Operator	Intentionally Left Blank						Criteria
Unique ID/ License #	052-16 W5M						Forested
Facility and Disposition	Wellsite (MSL), Access Road (LOC), Log Deck						
Land Use		Surface Legal Land Locations(s) (Furthest Extent)					
Provincial Land Use Area	Green Area	Qtr	LSD	Sec	Twp	Rng	Mer
Provincial Land Use Type	Public Land				052	16	W5
Grazing Lease (Yes/No)	No				052	16	W5
Ecological Land Classification				Soil Classification			
Natural Region	Foothills	Soil Order(s)		Gleysolic			
Natural Subregion	Lower Foothills	Soil Great Group(s)		Orthic Gleysol			
Nearby Populated Area(s)				Overlapping Dispositions (if applicable)			
Name	Distance (km)		-				
Edson	17						

Facility Information

	Facility	UTM Coordinates (NAD83)			Dimensions (m x m)	Ecosite Phase(s) ¹	Soil Series
		Zone	Easting	Northing			
1	Wellsite	11	123456	1234567	130 x 105	h1 Labrador tea – Subygric – Sb-Pl	-
2	Access Road	11	123456	1234567	8 x 954	h1 Labrador tea – Subygric – Sb-Pl	-
3	Log Deck	11	123456	1234567	93 x 35	h1 Labrador tea – Subygric – Sb-Pl	-

¹ As defined in Beckingham et al. (1996) and/or Willoughby et al., 2020.

Site History

Activity	Activity Description ¹	Date Range
Construction	Wellsite: Full Disturbance Access Road and Log Deck: Low/Minimum Disturbance	02/02/2006 (Between 04/30/1994 and 06/01/2007)
Abandonment		01/14/2008
Reclamation	Minimum Disturbance	After 06/01/2007
Revegetation	Natural Recovery	After 06/01/2007

¹ As per categories used in the Combined Assessment Tool and Record of Observations (CAT and RoO)

Eligibility for a Variance

The minimum requirements for a variance described in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020) must be met for the deficiencies on the wellsite to be eligible for a variance. The overarching goal is to ensure that the site has a functional ecosystem that is on a trajectory towards a forested ecosystem and thus meets the objective of equivalent land capability.

The site deficiencies (topsoil depth and topsoil stockpiles) are considered separately in the tables below. The tables provide an analysis of the minimum requirements and the additional considerations described in the Information Sheets and checklists in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020). In these tables, rows highlighted in green provide arguments that support a variance, while rows highlighted in blue support further reclamation work. Rows that are not highlighted are not considered factors one way or the other. Overall eligibility for a variance is determined through professional judgement of where the balance lies between the green rows and blue rows. Where there are multiple deficiencies on a site, professional judgement is first applied to each deficiency and then on the sum of the impacts of all deficiencies.

Important Note

This site was constructed in 2006 and abandoned in 2008; however, active reclamation to remove the soil stockpiles was not completed when the site was abandoned. This case study violates our principle that sites (especially those abandoned and reclaimed after 2007) should be reclaimed in a timely manner and that variances are not to be used to avoid doing reclamation. However, in the real world, these situations do arise and can be used as learning tool. Justifications may still be warranted for this site through an ecologically-based analysis (as presented below); however, because of its construction, abandonment and reclamation dates, it should be considered an exception.

Topsoil Depth Deficiency

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
<p>On-site vegetation</p>	<p>On-site vegetation is well established and meets the Forested Land Criteria. There are up to 42 woody stems/10 m² plot in some assessment grids. Substantial moss cover (up to 5 cm thick) has established at almost half of the assessment points.</p> <p>Development of healthy forest species and moss does not appear to be limited by the lack of topsoil (and associated reduced organic matter and nutrients).</p>
<p>Age of the site</p>	<p>The site was constructed in 2006 and abandoned and reclaimed in 2008. When the DSA was conducted in 2018, the site had had 10 years of woody vegetation growth and development through natural recovery.</p>
<p>Rooting restrictions</p>	<p>No rooting restrictions were noted.</p> <p>Poor drainage was noted in a ring around the tear drop area and at the former well centre, which may be areas of potential concern for root growth, but no restricted root growth was observed. (Note that drainage in these areas was considered comparable to off-site conditions (h ecosite) so it was not considered to have failed the Forested Land Criteria for landscape.)</p>
<p>Consequences of re-entering the site to conduct reclamation to correct the deficiency</p> <p>1. Damage to existing vegetation</p>	<p>The access route to the site is approximately 20 km from Highway 16. A portion of the access route includes active oil and gas and logging roads (noting that some of these roads are only accessible in the winter); there would be minimal damage to vegetation on these roads.</p> <p>The access road associated specifically with the wellsite in question (the final 950 m portion of the access route) has been reclaimed and vegetation meets the Forested Land Criteria; vegetation on this access road would be damaged during reclamation activities.</p> <p>Existing well-established forest vegetation on the wellsite would also be damaged during reclamation activities.</p>
<p>2. Delayed ecological recovery</p>	<p>The site is located in an h1 ecosite (Beckingham et al., 1996), which can be a wet, poor site type, and may not recover from disturbance as rapidly as richer site types, especially considering the large disturbance area that would be required to correct the deficiency. Damage or removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem.</p>
<p>3. Rutting and compaction</p>	<p>Wellsite soils are fine textured and are more susceptible to rutting and compaction during reclamation activities.</p>

Requirement	Details Supporting Analysis
4. Potential for increased recreational use	Recreational users may already use the powerline-right-of-way adjacent to the site, and with that as a potential access point for recreational users, opening up the access road during reclamation would increase the potential for recreational use of the site.
5. Weed establishment and potential need for chemical weed control	During reclamation, sources of weeds that could result in weed growth and spread throughout the disturbance area could include heavy equipment used during reclamation and propagules present in the on-site soil (as indicated by the perennial sow-thistle plant that was observed on-site). Site location could also play a role in the likelihood of weed establishment after re-disturbance, although this influence is expected to be lower than for sites in agricultural areas. Sources of weeds in the surrounding area include the power line right-of-way, other wellsites, associated facilities and forestry cutblocks. The site is in a predominantly forested and peatland area.
6. Potential for use of low impact reclamation options	As most of the site would require re-disturbance to correct the deficiency, low impact reclamation options are not available.

Additional Factors Considered

Factor	Details Supporting Analysis
Construction Period as per Forested Land Criteria	As the site was constructed between April 30, 1994, and June 1, 2007, and abandoned after June 1, 2007, the Forested Land Criteria allows for justification accommodations upon written request where extenuating conditions exist.
Woody vegetation growth and productivity	Not assessed.
Comparison to off-site, pre-disturbance and/or typical regional conditions	Not assessed.
Current, future and potential land uses of the site	Current land use is predominantly wildlife habitat and commercial forestry; no active recreational trails were observed. Future and potential land uses include wildlife habitat, commercial forestry and recreation. None of these land uses will be impacted by the topsoil depth deficiency.
Soil salvage limitations during construction	None noted.
Soil suitability	Not assessed.

Factor	Details Supporting Analysis
Presence of soil stockpiles	Soil stockpiles were present along the east and west sides of the site. Based on the analysis in the following table, leaving these soil stockpiles in place can be justified.
Availability of forest topsoil for import	Not applicable; imported topsoil is not required as forest topsoil is available on-site in stockpiles.

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the topsoil depth deficiency, professional judgement leads to a recommendation to pass the deficiency with justification.

Soil Stockpiles Deficiency

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	On-site vegetation is well established and meets the Forested Land Criteria. There are up to 42 woody stems/10 m ² plot in some assessment grids. Substantial moss cover (up to 5 cm thick) has established at almost half of the assessment points.
Dimensions and characteristics of deficiency	There are two soil stockpiles left in place, located along the east and west sides of the site. They are both less than 100 m long and 1 m tall. There are trees up to 3 m tall growing on the soil stockpiles.
Slopes of deficiency	Slopes of the soil stockpiles are less than 3:1
Level of risk to the safety of land users, livestock and wildlife	Because the slopes of soil stockpiles are less than 3:1, the level of risk to the safety of land users and wildlife is low.
1. Deterrents to access	This factor is not relevant because the level of risk to the safety of land users is low.
Stability of deficiency	The soil stockpiles are stable and non-erosive.
Comparison to off-site conditions and/or to typical regional conditions	No attempt was made to find comparable off-site conditions.
Impacts of deficiency on ecological function	Because the soil stockpiles are stable, non-erosive and are not affecting site drainage, there is no impact on ecological function.

Requirement	Details Supporting Analysis
Current, future and potential land uses of the site	Current land use is predominantly wildlife habitat and commercial forestry; no active recreational trails were observed. Future and potential land uses include wildlife habitat, commercial forestry and recreation. Soil stockpiles do represent a topographic feature that is not consistent with the remaining, nearly level, landscape; however, they do not prevent the use of the site for commercial forestry, recreation or wildlife habitat.

Additional Factors Considered

Factor	Details Supporting Analysis
Consequences of re-entering the site to conduct reclamation to correct the deficiency 1. Damage to existing vegetation	<p>The access route to the site is approximately 20 km from Highway 16. A portion of the access route includes active oil and gas and logging roads (noting that some of these roads are only accessible in the winter); there would be minimal damage to vegetation on these roads.</p> <p>The access road associated specifically with the wellsite in question (the final 950 m portion of the access route) has been reclaimed and vegetation meets the Forested Land Criteria; vegetation on this access road would be damaged during reclamation activities.</p> <p>Existing well-established forest vegetation on the wellsite would also be damaged during reclamation activities.</p>
2. Soil re-disturbance	Soil re-disturbance is not a relevant factor as soils were not replaced during original reclamation.
3. Delayed ecological recovery	The site is located in an h1 ecosite (Beckingham et al., 1996), which can be a wet, poor site type, and may not recover from disturbance as rapidly as richer site types, especially considering the large disturbance area that would be required to correct the deficiency. Damage or removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem.
4. Rutting and compaction	Wellsite soils are fine textured and are more susceptible to rutting and compaction during reclamation activities.
5. Potential for increased recreational use	Recreational users may already use the powerline-right-of-way adjacent to the site, and with that as a potential access point for recreational users, opening up the access road during reclamation would increase the potential for recreational use of the site.

Factor	Details Supporting Analysis
6. Weed establishment and potential need for chemical weed control	During reclamation, sources of weeds that could result in weed growth and spread throughout the disturbance area could include heavy equipment used during reclamation and propagules present in the on-site soil (as indicated by the perennial sow-thistle plant that was observed on-site). Site location could also play a role in the likelihood of weed establishment after re-disturbance, although this influence is expected to be lower than for sites in agricultural areas. Sources of weeds in the surrounding area include the power line right-of-way, other wellsites, associated facilities and forestry cutblocks. The site is located in a predominantly forested and peatland area.
7. Potential for use of low impact reclamation options	As most of the site would require re-disturbance to correct the deficiency, low impact reclamation options are not available.
8. Weed seed bank present within the soil stockpile	Weeds are not currently growing on the soil stockpile; however, seed bank testing was not conducted to determine the presence of weed seeds in the soil stockpile.
9. Size of the disturbance area to correct the deficiency	The disturbance area to correct the deficiency would include most of the wellsite.
Comparison to post-reclamation conditions and features in other industries	The soil stockpiles, though larger in length and width, have similar differences in elevation as microtopographical features created during reclamation in other industries to improve forest species establishment and promote ecological diversity (Tokay et al., 2020, Melnik et al., 2018).

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the topsoil stockpiles deficiency, professional judgement leads to a recommendation to pass the deficiency with justification.

Site Recommendation

Upon reviewing the site conditions and combined impacts of the two deficiencies, professional judgement leads to a determination that the site meets equivalent land capability and is on a trajectory towards a sustainable forest ecosystem and therefore to a recommendation to pass the site with justification.

Site Diagram – Wellsite and Log Deck



Site Diagram – Access Road



Site Photographs



Photo 1. Viewing north from well centre

Photo Date: June 15, 2018



Photo 2. Viewing east from well centre

Photo Date: June 15, 2018

Site Photographs



Photo 3. Viewing south from well centre

Photo Date: June 15, 2018



Photo 4. Viewing west from well centre

Photo Date: June 15, 2018

Site Photographs



Photo 5. Viewing northwest from the southeast corner, including poor drainage around the tear drop and well centre that is comparable to off-site

Photo Date: June 15, 2018



Photo 6. Poor drainage around the tear drop and well centre that is comparable to off-site

Photo Date: June 15, 2018

Site Photographs



Photo 7. East topsoil pile.

Photo Date: June 15, 2018



Photo 8. West topsoil pile.

Photo Date: June 15, 2018

Site Photographs



Photo 9. Vegetation on the wellsite

Photo Date: June 15, 2018



Photo 10. Soil on the wellsite, including recovering moss layer

Photo Date: June 15, 2018

Site Photographs



Photo 11. Viewing east at the beginning of the access road

Photo Date: June 15, 2018



Photo 12. Viewing east down the access road at assessment point AR1

Photo Date: June 15, 2018

CASE STUDY E: LACK OF TOPSOIL, SOIL STOCKPILES, COARSE WOODY MATERIAL AND PROBLEMATIC SPECIES

The site includes a wellsite and the reclaimed portion of the access road (hereafter referred to as “access road”). A reclaimed pipeline right-of-way overlaps with the access road, but will not be discussed as part of the case study. A detailed site assessment (DSA) was conducted in September 2017. The results of the assessment and a summary of the reclamation deficiencies that do not meet the Forested Land Criteria are as follows:

Wellsite

- Topsoil depth was insufficient on portions of the wellsite
- Topsoil stockpile was left in place
- Less than 25% desirable herbaceous cover on a portion of the wellsite and cover of agronomic species up to 65%

Access Road

- Pile of coarse woody material was left in place
- More than 100 Canada thistle plants were observed
- Agronomic species, were present on the access road with approximately 10 to 15% cover

Site Overview

Operator	Intentionally Left Blank						Criteria
Unique ID/ License #	077-23 W4M						Forested
Facility and Disposition	Wellsite (MSL), Reclaimed Portion of the Access Road (LOC), Pipeline Right-of-Way (PLA)						
Land Use		Surface Legal Land Locations(s) (Furthest Extent)					
Provincial Land Use Area	Green Area	Qtr	LSD	Sec	Twp	Rng	Mer
Provincial Land Use Type	Public Land				077	23	W4
Grazing Lease (Yes/No)	No				077	23	W4
Ecological Land Classification		Soil Classification					
Natural Region	Boreal Forest	Soil Order(s)		Luvisolic			
Natural Subregion	Central Mixedwood	Soil Great Group(s)		Gray Luvisol			
Nearby Populated Area(s)		Overlapping Dispositions (if applicable)					
Name	Distance (km)	-					
Wabasca	35 (60 by road)						

Facility Information

Facility	UTM Coordinates (NAD83)			Dimensions (m x m)	Ecosite Phase (s) ¹	Soil Series
	Zone	Easting	Northing			
1 Wellsite	12	123456	1234567	100 x 100	e2 dogwood – Pb-Aw	-
2 Access Road	12	123456	1234567	8 x 305 ²	e2 dogwood – Pb-Aw; b2 blueberry – Aw-Bw	-

¹ As defined in Beckingham and Archibald (1996) and/or Willoughby et al. (2019).

²The remainder of the access road will remain in use (8 x 1,240 m)

Site History

Activity	Activity Description ¹	Date Range
Construction	Full Disturbance	01/26/1995 (Between 04/30/1994 and 06/01/2007)
Abandonment	-	02/04/2015
Reclamation	Minimum Disturbance	After 06/01/2007
Revegetation	Natural Recovery	After 06/01/2007

¹ As per categories used in the Combined Assessment Tool and Record of Observations (CAT and RoO)

Eligibility for a Variance

The minimum requirements for a variance described in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020) must be met for the deficiencies on the wellsite to be eligible for a variance. The overarching goal is to ensure that the site has a functional ecosystem that is on a trajectory towards a forested ecosystem and thus meets the objective of equivalent land capability.

The wellsite deficiencies (topsoil depth, topsoil stockpiles and desirable herbaceous cover), access road deficiency (coarse woody material pile), and the problematic species: noxious weeds and problem introduced species deficiency on both the wellsite and access road are considered separately in the tables below. The tables provide an analysis of the minimum requirements and the additional considerations described in the Information Sheets and checklists in the *Guide to Variance Justifications for Reclamation Certification of Wellsites and Associated Facilities on Forested Land* (Tokay et al., 2020). In these tables, rows highlighted in green provide arguments that support a variance, while rows highlighted in blue support further reclamation work. Rows that are not highlighted are not considered factors one way or the other. Overall eligibility for a variance is determined through professional judgement of where the balance lies between the green rows and blue rows. Where there are multiple deficiencies on a site, professional judgement is first applied to each deficiency and then on the sum of the impacts of all deficiencies.

Topsoil Depth Deficiency on the Wellsite

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
<p>On-site vegetation</p>	<p>Woody vegetation meets the Forested Land Criteria (9 to 40 stems/10 m² plot). Desirable herbaceous species cover is less than the 25% required by the Forested Land Criteria on a portion of the wellsite (one assessment point) that has insufficient topsoil depth. Cover of agronomic species (timothy and red fescue) is 65% in this area. Other areas of the wellsite with insufficient topsoil depth have desirable herbaceous species cover ranging from 25 to 60% and do meet the Forested Land Criteria. Timothy, clover, red fescue, and Kentucky blue grass had approximately 15 to 20% cover throughout half of the wellsite, except as noted earlier. Creeping red fescue and Kentucky bluegrass were present on the access road with approximately 10 to 20% cover. Canada thistle was also noted on the access road. Noxious weeds and problem introduced species are discussed in a subsequent table below. Overall vegetation growth does not appear to be limited by the lack of topsoil (and associated lack of organic matter and nutrients). Areas without topsoil do have fewer native species' propagules, which has allowed increased establishment of agronomic species.</p>
<p>Age of the site</p>	<p>The site was constructed in 1995 and abandoned in 2015. When the DSA was conducted in 2017, the site had had two years of woody vegetation growth and development through natural recovery.</p>
<p>Rooting restrictions</p>	<p>No rooting restrictions were noted.</p>
<p>Consequences of re-entering the site to conduct reclamation to correct the deficiency</p> <p>1. Damage to existing vegetation</p>	<p>The access route to the site, from Highway 813, includes the 305 m portion that has been reclaimed and an additional 1,240 m portion that remains active. Although desirable woody and herbaceous vegetation that meets the Forested Land Criteria are present on the reclaimed portion of the access road, damage to this vegetation is less of a concern due to the short length of the reclaimed access road.</p> <p>Vegetation on the wellsite does not meet the Forested Land Criteria, although woody stems are developing and do meet Criteria; damage to these woody stems is a concern.</p>
<p>2. Delayed ecological recovery</p>	<p>The wellsite is in an e ecosite (Beckingham and Archibald, 1996), a moist, rich site type (Alberta Environment, 2010). Because the site conditions are not limiting, they are not a factor in delayed recovery after re-disturbance to correct reclamation deficiencies. However, the type of species that recover first may not be</p>

Requirement	Details Supporting Analysis
	<p>desirable native species, and additional time may be required for a desirable a native plant community to develop. This will be exacerbated by the presence of forage species in the seed bank, which will likely re-establish if the site is re-disturbed.</p> <p>Damage or removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem.</p> <p>A portion of the access road is in a b ecosite, a dry site type (Alberta Environment, 2010) which may not recover from disturbance as rapidly as wetter and richer site types.</p>
3. Rutting and compaction	Wellsite soils are coarse to medium textured and are not as susceptible to rutting and compaction during reclamation activities as finer textured soils.
4. Potential for increased recreational use	As the site is only 1.3 km away from a high-grade road, there is a potential for increased recreational use as a result of re-entering the site.
5. Weed establishment and potential need for chemical weed control	During reclamation, the main sources of weeds that could result in weed growth and spread throughout the disturbance area are the greater than 100 Canada thistle plants observed on the access road and heavy equipment used during reclamation. Site location is likely less of a factor in considering the potential for weed introduction. There are other wellsites and associated facilities in the surrounding area as well as forestry cutblocks, but no larger scale industrial plants. The surrounding area is predominantly forested and peatland, which does not present a major source of weeds compared to agricultural areas. Refer to the table below on noxious weeds for further discussion.
6. Potential for use of low impact reclamation options	As large portion of the site would require re-disturbance to correct the deficiency, low impact reclamation options are not available.

Additional Factors Considered

Factor	Details Supporting Analysis
Construction Period as per Forested Land Criteria	As the site was constructed between April 30, 1994, and June 1, 2007, and abandoned after June 1, 2007, the Forested Land criteria allows for justification accommodations upon written request where extenuating conditions exist.
Woody vegetation growth and productivity	Not assessed.

Factor	Details Supporting Analysis
Comparison to off-site, pre-disturbance and/or typical regional conditions	Not assessed.
Current, future and potential land uses of the site	Current land use is predominantly commercial forestry and wildlife habitat; no active recreational trails were observed. Future and potential land uses include commercial forestry, wildlife habitat and recreation. None of these land uses will be impacted by the topsoil depth deficiency.
Soil salvage limitations during construction	None
Soil suitability	Not assessed.
Presence of soil stockpiles	A soil stockpile was present on the south side of the site. Refer to the following table for further discussion.
Availability of forest topsoil for import	Not applicable; imported topsoil is not required as forest topsoil is available on-site in stockpiles.

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the topsoil depth deficiency, professional judgement leads to determination that the site does not currently meet equivalent land capability and there is not enough evidence to determine with certainty that it is on a trajectory towards a sustainable forest ecosystem; the site fails and is not eligible for a variance.

The top three contributing factors to the failure of the site:

- On-site vegetation – Forested Land Criteria not met
- Age of site – it has only been 2 years since reclamation
- Damage to existing vegetation – damage to access road will not be substantial and does not outweigh the benefits of re-entering the site for further reclamation

Although a professional undertaking this analysis could stop at this first failure of a deficiency, this report provides an analysis of each additional deficiency below to show how the process works and the outcomes for each deficiency and the site as a whole.

Soil Stockpile Deficiency on the Wellsite

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	As discussed in the previous table, vegetation does not meet the Forested Land Criteria as a direct result of the topsoil not being re-distributed from this soil stockpile.
Dimensions and characteristics of deficiency	There was one topsoil stockpile left in place on the southeast portion site. The topsoil stockpile was 45 x 15 m in size (height of the pile was not measured).
Slopes of deficiency	Slopes of the topsoil stockpile were less than 3:1.
Level of risk to the safety of land users, livestock and wildlife	Because the slopes of soil stockpile are less than 3:1, the level of risk to the safety of land users and wildlife is low.
1. Deterrents to access	While this factor is not relevant because the level of risk to the safety of land users is low, it should be noted that access to the site is blocked by the coarse woody material pile left in place on the access road.
Stability of deficiency	The soil stockpile is stable and non-erosive.
Comparison to off-site conditions and/or to typical regional conditions	No attempt was made to find comparable off-site conditions.
Impacts of deficiency on ecological function	Because the soil stockpile is stable, non-erosive and is not affecting site drainage, there is no impact on ecological function.
Current, future and potential land uses of the site	Current land use is predominantly commercial forestry and wildlife habitat; no active recreational trails were observed. Future and potential land uses include commercial forestry, wildlife habitat and recreation. The soil stockpile does represent a topographic feature that is not consistent with the surrounding landscape; however, it does not prevent the use of the site for commercial forestry, recreation or wildlife habitat.

Additional Factors Considered

Condition	Details Supporting Analysis
<p>Consequences of re-entering the site to conduct reclamation to correct the deficiency</p> <p>1. Damage to existing vegetation</p>	<p>The access route to the site, from Highway 813, includes the 305 m portion that has been reclaimed and an additional 1,240 m portion that remains active. Although desirable woody and herbaceous vegetation that meets the Forested Land Criteria are present on the reclaimed portion of the access road, damage to this vegetation is less of a concern due to the short length of the reclaimed access road.</p> <p>Vegetation on the wellsite does not meet the Forested Land Criteria, although woody stems are developing and do meet Criteria; damage to these woody stems is a concern.</p>
<p>2. Delayed ecological recovery</p>	<p>The wellsite is located in an e ecosite (Beckingham and Archibald, 1996), a moist, rich site type (Alberta Environment, 2010). Because the site conditions are not limiting, they are not a factor in delayed recovery after re-disturbance to correct reclamation deficiencies. However, the type of species that recover first may not be desirable native species, and additional time may be required for a desirable a native plant community to develop. This will be exacerbated by the presence of forage species in the seed bank, which will likely re-establish if the site is re-disturbed.</p> <p>Damage or removal of desirable vegetation, especially woody species, can alter the successional trajectory of the site and delay ecological recovery to a forested ecosystem.</p> <p>A portion of the access road is in a b ecosite, a dry site type (Alberta Environment, 2010) which may not recover from disturbance as rapidly as wetter and richer site types.</p>
<p>3. Rutting and compaction</p>	<p>Wellsite soils are coarse to medium textured and are not as susceptible to rutting and compaction during reclamation activities as finer textured soils.</p>
<p>4. Potential for increased recreational use</p>	<p>As the site is only 1.3 km away from a high-grade road, there is a potential for increased recreational use as a result of re-entering the site.</p>

Condition	Details Supporting Analysis
5. Weed establishment and potential need for chemical weed control	During reclamation, the main sources of weeds that could result in weed growth and spread throughout the disturbance area are the greater than 100 Canada thistle plants observed on the access road and heavy equipment used during reclamation. Site location is likely less of a factor in considering the potential for weed introduction. There are other wellsites and associated facilities in the surrounding area as well as forestry cutblocks, but no larger scale industrial plants. The surrounding area is predominantly forested and peatland, which does not present a major source of weeds compared to agricultural areas. Refer to the table below on noxious weeds for further discussion.
6. Potential for use of low impact reclamation options	As large portion of the site would require re-disturbance to correct the deficiency, low impact reclamation options are not available.
7. Weed seed bank present within the soil stockpile	Weeds are not currently growing on the soil stockpile; however, seed bank testing was not conducted to determine the presence of weed seeds in the soil stockpile.
8. Size of the disturbance area to correct the deficiency	A large portion of the site would require re-disturbance to correct the deficiency.
Comparison to post-reclamation conditions and features in other industries	The soil stockpiles, though larger in size, has a similar difference in elevation as microtopographical features created during reclamation in other industries to improve forest species establishment and promote ecological diversity (Tokay et al., 2020, Melnik et al., 2018).

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the soil stockpile deficiency, professional judgement leads to a recommendation to fail the wellsite.

The top contributing factors to the failure of the site:

- On-site vegetation – Forested Land Criteria not met
- Damage to existing vegetation – damage to access road will not be substantial and does not outweigh the benefits of re-entering the site for further reclamation

Coarse Woody Material Pile Deficiency on the Access Road

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirements for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	Woody vegetation meets the Forested Land Criteria while desirable herbaceous species and problematic species do not, as discussed in the previous tables.
Vegetation growth within the wood pile	There was some vegetation establishment within the wood pile that is growing up through the pile, but the majority of the pile does not have vegetation present.
Dimensions and characteristics of the wood pile	The pile of coarse woody material is approximately 7 x 7 m in size and 0.4 m high. It is composed of logs of a variety of diameters and lengths, including small branches.
Risk of wildfire	The coarse woody material has likely been in place since the site was constructed in 1995 and has begun to decompose and break down.
1. Age of wood pile and decomposition status	
2. Type of forest	The forest in the areas surrounding the wood pile is predominantly deciduous; wildfire risk is higher if the surrounding forest is coniferous (Alberta Environment and Parks, 2018a).
3. Dominance of grass on-site and growth habit of grass	Vegetation on the access road is a mixture of tall, dense grasses, herbaceous species and shrubs. Wildfire risk is higher if the vegetation on-site is grass dominated, particularly tall, dense grass populations (Canadian Association of Petroleum Producers, 2008).
4. Location of the pile relative to the edge of the site and presence of leaning logs	The wood pile is located near the edge of the access road but there are no logs leaning into the surrounding forest. Wildfire risk is higher if the woody debris pile is located on the edge of the site as opposed to a more central location, especially if woody debris is leaning against trees in the undisturbed forest (Canadian Association of Petroleum Producers, 2008)
5. Facility type	The wood pile is located on a linear feature, which does present a higher risk than other facility types (Canadian Association of Petroleum Producers, 2008); however, the pile itself is small in size and unlikely to act as a wick and result in the spread of wildfire over long distances.

Additional Factors Considered

Unlike the lack of topsoil and soil stockpile deficiencies, reclamation to remove the wood pile on the access road would be conducted by hand, without heavy equipment.

Factor	Details Supporting Analysis
Consequences of re-entering the site to conduct reclamation to correct the deficiency 1. Damage to existing vegetation	If woody material is distributed widely and is not concentrated in one area of the site, spreading woody material by hand would cause minimal damage to existing vegetation.
2. Delayed ecological recovery	No delays to ecological recovery are expected as a result of spreading woody material.
3. Rutting and compaction	Rutting and compaction would not occur as no heavy equipment will be used.
4. Potential for increased recreational use	The wood pile currently provides a deterrent to access to the site. Removal of the wood pile would remove this deterrent and allow easier access to the site.
5. Weed establishment and potential need for chemical weed control	During reclamation, reclamation personnel spreading woody material could act as a vector for weeds. As there will be no soil disturbance, a receptive seedbed for weeds to be established will not be available. Dense vegetation on the site will likely prevent weed establishment.
6. Potential for use of low impact reclamation options	Spreading woody material by hand is a low impact reclamation option.
7. Size of the disturbance area to correct the deficiency	The disturbance area to correct the deficiency will be small.
Merchantability of the timber within the woody debris pile	While not assessed in detail, overall the timber appears to be non-merchantable.
Management and reclamation of woody debris piles in other industries (e.g., forestry, OSE)	The wood pile is not comparable to reclamation practices with woody material in other industries.
Comparison to off-site conditions and/or to typical regional conditions	No attempt was made to find comparable off-site conditions.

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the coarse woody material pile deficiency, professional judgement leads to a recommendation to fail the access road.

The top three contributing factors to the failure of the site:

- On-site vegetation – Forested Land Criteria not met
- Lack of vegetation growth within the wood pile
- Consequences of re-entering the site to conduct reclamation to correct the deficiency do not outweigh the benefits

Problematic Species: Noxious Weeds and Problem Introduced Species Deficiency on the Wellsite and Access Road

The first table presents an analysis of the requirements that must be met for a variance. The second table presents additional factors that are considered.

Minimum Requirement for a Variance

Requirement	Details Supporting Analysis
On-site vegetation	Woody vegetation meets the Forested Land Criteria (9 to 40 stems/10 m ² plot). Desirable herbaceous species cover was less than the 25% required by the Forested Land Criteria on a portion of the wellsite (one assessment point) that has insufficient topsoil depth. Noxious weeds and problem introduced species were present, as discussed in the following rows.
Trends over time and previous weed control on-site	Data from multiple years are not available.
Distribution of the weed population and native vegetation on-site	More than 100 Canada thistle plant were found on the access road. Plants were found in sporadic patches and were flowering. On the wellsite, timothy, clover species and creeping red fescue were observed at half of the assessment points and had approximately 15 to 25% cover. Cover of desirable herbaceous species at these assessment points ranged from 25 to 60%. At one assessment point, timothy and creeping red fescue had approximately 65% cover and desirable herbaceous species cover was 15%. On the access road, creeping red fescue and Kentucky blue grass were present and had approximately 15 to 20% cover. Cover of desirable herbaceous species was 25 to 50%. Overall, vegetation cover on all facilities was high and there were no sparse or bare areas.

Requirement	Details Supporting Analysis
1. Problematic species, phenology and ecology and impacts of weeds on on-site vegetation and ecosystem development	<p>Although the overall vegetation cover is high and may deter further expansion of the Canada thistle population, weed control is likely required to ensure that the Canada thistle population does not expand and affect the growth and establishment of desirable forest vegetation.</p> <p>Based on the cover of problem introduced species relative to the desirable herbaceous species, there is a risk of the problem introduced species competing with the desirable vegetation and delaying its establishment on the site.</p>
Movement of noxious weeds into off-site areas	No movement of noxious weeds into off-site areas was observed.
1. Third party activity as a dispersal agent of noxious weeds	Third party activity was not noted on-site. The potential for the spread of the noxious weed into off-site areas by third party activity is reduced.
Third party activity as a source of weeds	Third party activity was not noted on-site and likely does not represent an ongoing source of noxious weeds. The other facilities and cutblocks in the area could be a source of weeds and could result in weed establishment if the site was re-disturbed for reclamation, as discussed in preceding tables, but if the site is not re-disturbed, the on-site vegetation is expected to prevent future weed establishment.

Additional Factors Considered

Factor	Details Supporting Analysis
Site and soil conditions	During the early stages of revegetation, areas without topsoil likely did have reduced growth of forest vegetation, which allowed problem introduced species to become established in these areas. Lack of topsoil will likely continue to be a factor in the dynamics between desirable vegetation and problem introduced species.
Previous weed control on the site	No weed control has been conducted at the site.
Negative consequences of continued weed control	Weed control may damage existing desirable woody and herbaceous vegetation, both through herbicide overspray and physical damage from equipment traffic on the site, and increases the risk of introducing additional weeds to the site or spreading weeds more widely across the site.

Factor	Details Supporting Analysis
Damage to the access road required to access the site to conduct weed control	The access route to the site, from Highway 813, includes the 305 m portion that has been reclaimed and an additional 1,240 m portion that remains active. Although desirable woody and herbaceous vegetation that meets the Forested Land Criteria are present on the reclaimed portion of the access road, damage to this vegetation is less of a concern due to the short length of the reclaimed access road.

Deficiency Recommendation

Based on analysis of the minimum requirements for a variance and the additional factors considered regarding the problematic species: noxious weeds and problem introduced species deficiency, professional judgement leads to a recommendation to fail both the wellsite and access road.

The top three contributing factors to the failure of the site:

- On-site vegetation – Forested Land Criteria not met
- Distribution of the weed population and native vegetation on-site – there is a potential for weeds to impact on-site vegetation and ecosystem development
- Damage to the access road will not be substantial and does not outweigh the benefits of further reclamation

Site Recommendation

As noted after the first deficiency, the site does not meet equivalent land capability and there is not enough evidence to determine with certainty that it is on a trajectory towards a sustainable forest ecosystem; the site fails and is not eligible for a variance.

Site Location Overview

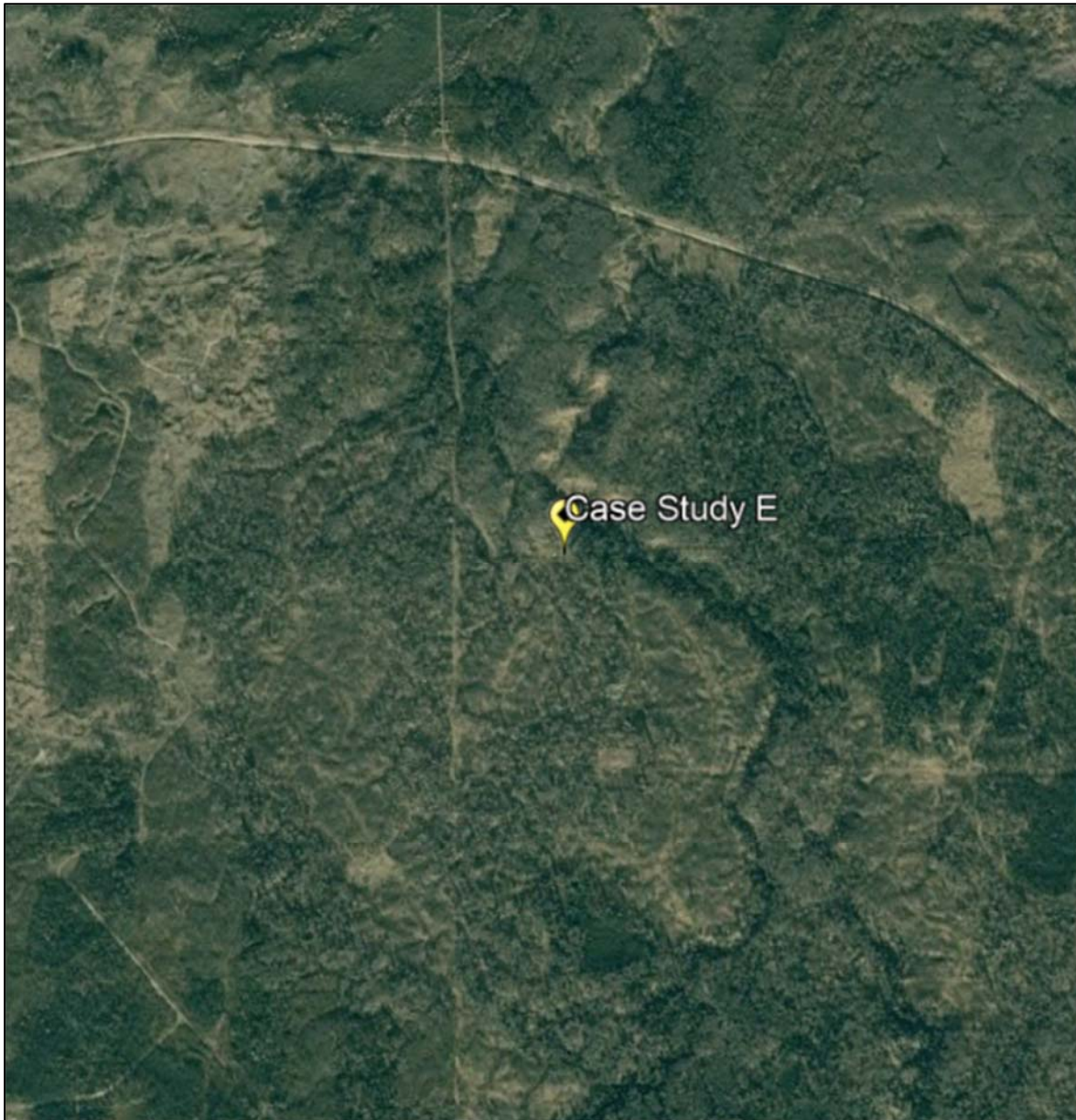
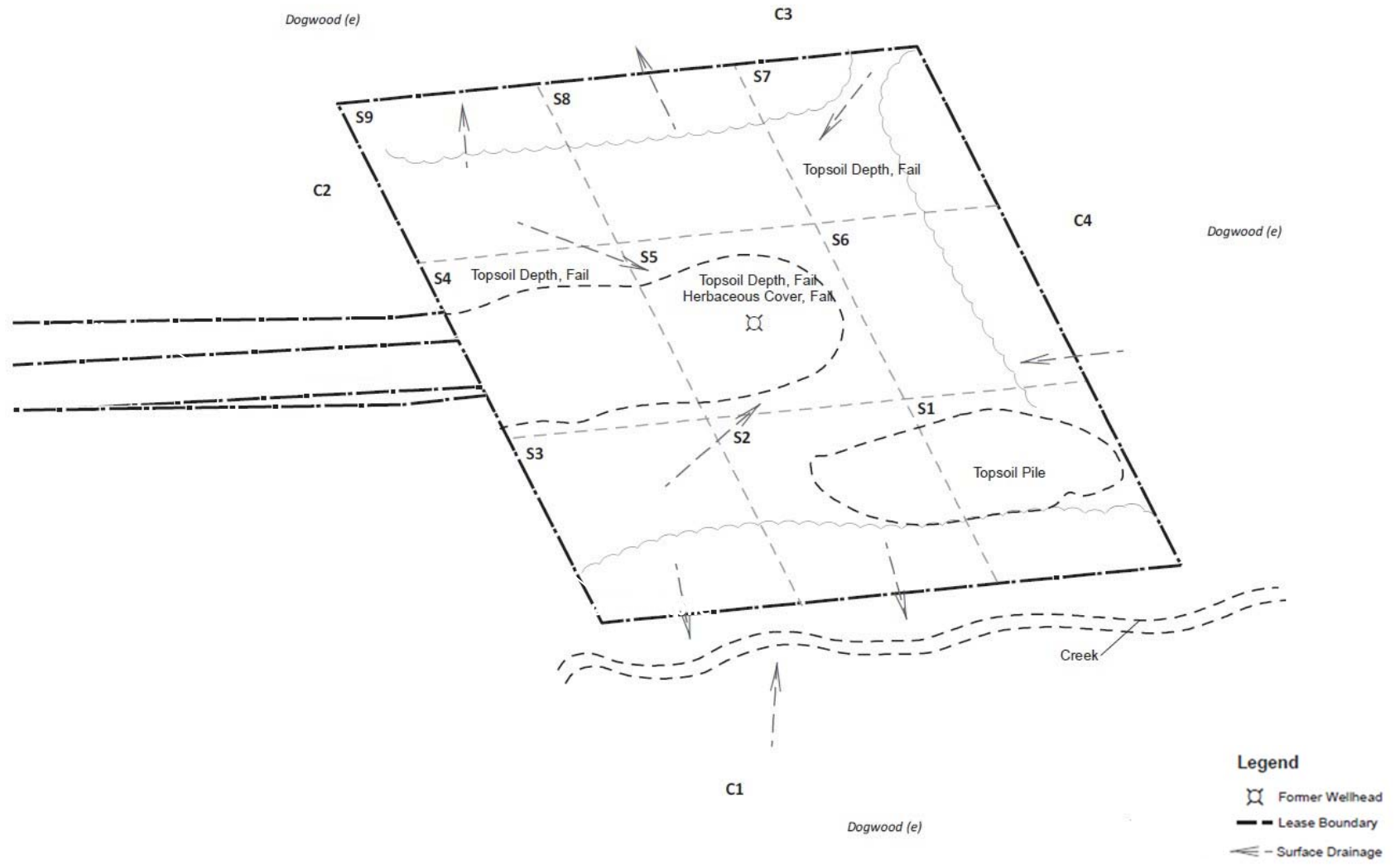
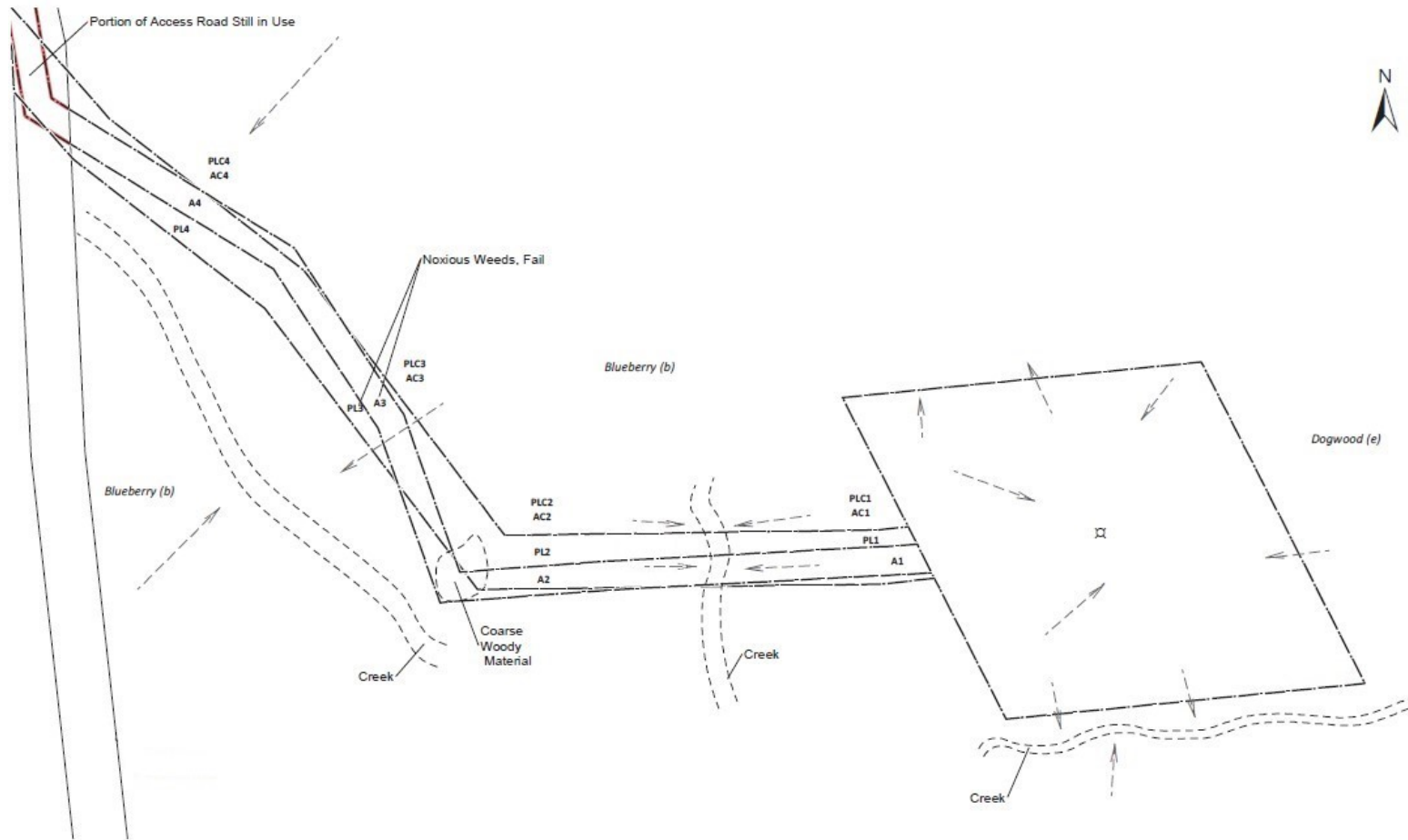


Image Source: Google Earth™ (Google Inc.)



Site Diagram – Wellsite

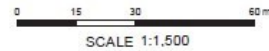


Site Diagram – Access Road and Pipeline Right-of-Way



Legend

-  Former Wellhead
-  Lease Boundary
-  Surface Drainage
-  Right-of-Way



Site Photographs



Photo 1. Viewing west from the east side of the wellsite

Photo Date: September 27, 2017



Photo 2. Viewing north from the south side of the wellsite

Photo Date: September 27, 2017

Site Photographs



Photo 3. Viewing east from the entrance of the wellsite

Photo Date: September 27, 2017



Photo 4. Viewing west from 5 m east of well centre

Photo Date: September 27, 2017

Site Photographs



Photo 5. Viewing northeast from the southwest corner of the wellsite.

Photo Date: September 27, 2017



Photo 6. West northwest from the southeast corner of the wellsite.

Photo Date: September 27, 2017

Site Photographs



Photo 7. Viewing southwest from the northeast corner of the wellsite.

Photo Date: September 27, 2017



Photo 8. Viewing southeast from the northwest corner of the wellsite.

Photo Date: September 27, 2017

Site Photographs



Photo 9. Vegetation on the wellsite.

Photo Date: September 27, 2017



Photo 10. Vegetation at a wellsite control location.

Photo Date: September 27, 2017

Site Photographs



Photo 11. Soil profile with no topsoil on the wellsite

Photo Date: September 27, 2017



Photo 12. Vegetation at well centre

Photo Date: September 27, 2017

Site Photographs



Photo 13. Viewing west along the access road from the entrance of the wellsite

Photo Date: September 27, 2017



Photo 14. Viewing east along the access road approximately 150 m west of the wellsite

Photo Date: September 27, 2017

Site Photographs



Photo 15. Viewing southeast along the access road from the west end of the reclaimed portion of the access road

Photo Date: September 27, 2017



Photo 16. Vegetation on the access road.

Photo Date: September 27, 2017

Site Photographs



Photo 17. Vegetation on an access road control location

Photo Date: September 27, 2017



Photo 18. Coarse woody material on the access road approximately 135 m west of the wellsite

REFERENCES

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APPENDIX A

Appendix A. Summary of Case Studies Received from Industry

Case Study No.	Site Type	Region	Site Access	Construction Date	Abandonment Date	Reclamation Date	Detailed Site Inspection (DSA) Completion Date	Site Summary and Reclamation Deficiencies	Variance Request and or Reclamation Certificated Application Submitted to AER?	Reason for Exclusion from Case Studies
1 (A)	Wellsite	Wabasca	Heli or Argo only	Between 04/30/1994 and 06/01/2007	01/25/2017	After 06/01/2007	08/11/2019	Subsided areas with ponding and low desirable herbaceous species cover	No	N/A - included in case studies
2 (B)	Wellsite and access road	Cold Lake	Road access	Before 04/30/1994 (02/26/1991)	03/03/2014	After 06/01/2007	09/21/2016	Subsided area, low desirable herbaceous species cover and noxious weeds	Yes, Reclamation Certified	N/A - included in case studies
3 (C)	Wellsite	Cold Lake	Road access	After 06/01/2007 (12/18/2008)	01/02/2009	After 06/01/2007	Completed in 2012 but conditions have changed	Soil not replaced on portion of the site and noxious weeds	No	N/A - included in case studies
4 (D)	Wellsite	Edson	Heli or Argo only	Between 04/30/1994 and 06/01/2007 (02/02/2006)	01/14/2008	After 06/01/2007	06/15/2018	Soil not replaced and soil stockpiles left in place	Yes, Reclamation Certified	N/A - included in case studies
5 (E)	Wellsite and access road	Wabasca	> 1 km from high grade road	Between 04/30/1994 and 06/01/2007 (01/26/1995)	02/04/2015	After 06/01/2007	09/27/2017	Soil not replaced and soil stockpiles left in place, coarse woody debris pile and problematic species (noxious weeds and problem introduced weeds)	No	N/A - included in case studies
6	Wellsite	Chinchaga	-	-	-	Not reclaimed	-	Cut and fill construction; no obvious topsoil salvage; adequate natural recovery of vegetation	-	Too far away for potential field tour
7	Wellsite	Chinchaga	-	-	-	Not reclaimed	-	Topsoil not replaced (stockpiles left in place); possible contour issues; excellent naturally recovery of deciduous trees and shrubs	-	Too far away for potential field tour
8	Wellsite	Wandering River	-	-	-	-	No	Topsoil piles left in place and overgrown with trees; low topsoil depths on-site; noxious weeds that have been controlled several times; very well vegetated	-	Limited background information
9	Wellsite	Wandering River	-	-	-	-	-	Slightly padded; low topsoil depths on-site	-	Padded sites were outside the scope of Stage 2A
10	Wellsite	Calling Lake	-	-	-	-	-	Padded; low topsoil depths on-site, more than 20 years of tree regrowth on most of the site	-	Padded sites were outside the scope of Stage 2A

Case Study No.	Site Type	Region	Site Access	Construction Date	Abandonment Date	Reclamation Date	Detailed Site Inspection (DSA) Completion Date	Site Summary and Reclamation Deficiencies	Variance Request and or Reclamation Certificated Application Submitted to AER?	Reason for Exclusion from Case Studies
11	Wellsite	Calling Lake	-	-	-	-	-	Slightly padded, low topsoil depths on-site; very well vegetated with herbaceous cover	-	Padded sites were outside the scope of Stage 2A
12	Wellsite, remote sump and borrow pit	NW of Peace River	-	-	-	-	Completed but date not known	Lack of topsoil and historical weeds. Generally well vegetated except some portions of the site do not pass the woody stem criteria	Variance request submitted, but denied by AER due to assessment points that do not meet the woody stem criteria	More difficult to justify due to failing vegetation parameters
13	OSE wellsite	Cold Lake	Adjacent to road	-	-	-	Completed but date not known	Third party weeds (long term weed control with fluctuating weed numbers); the presence of weeds have not inhibited the regeneration of desirable vegetation.	Plan to submit to AER in 2022 with the rest of the OSE program	Third party weeds could be a complicated justification
14	OSE wellsite	Cold Lake	Adjacent to road	-	-	-	2019	The wellsite and access road are located within an active grazing lease. Cattle activity on-site are impeding woody species establishment, limiting the species composition, and introducing noxious weeds (Canada thistle) and agronomic grasses (tufted hair grass).	Plan to submit to AER in 2020 with the rest of the OSE program	Grazing sites were not a focus of the project
15	Wellsite	Cold Lake	-	-	-	-	-	Stockpile, lack of topsoil, subsidence (testpits), vegetation fail and noxious weeds	-	More difficult to justify due to failing vegetation parameters
16	Wellsite	Cold Lake	-	-	-	-	-	Infrastructure (Cathodic Protection System), vegetation fail and noxious weeds.	-	Infrastructure present is an obvious fail. More difficult to justify due to failing vegetation parameters
17	Wellsite	Fox Creek/Hinton	Accessible by road, but long drive	-	-	-	No DSA completed	Cut and fill. Good vegetation establishment on-site with the exception of the tear drop and crown of the access road.	Submitted request for approval of minimum reclamation plan to only work on the teardrop and crown of access road to AER. Request was denied.	Uncertainty in the process for pre-approval of minimum reclamation plans (i.e. pre-approval before the reclamation plan has been carried out)
18	Wellsite	Fox Creek	> 1 km from high grade road	-	-	-	No DSA completed	Cut and fill. Very good vegetation establishment with the exception of the teardrop area.	Submitted request for approval of minimum reclamation plan to only work on the teardrop to AER. Request was denied.	Uncertainty in the process for pre-approval of minimum reclamation plans (i.e. pre-approval before the reclamation plan has been carried out)

Case Study No.	Site Type	Region	Site Access	Construction Date	Abandonment Date	Reclamation Date	Detailed Site Inspection (DSA) Completion Date	Site Summary and Reclamation Deficiencies	Variance Request and or Reclamation Certificated Application Submitted to AER?	Reason for Exclusion from Case Studies
19	Wellsite	Whitcourt	Easily accessible by road	-	-	-	Completed but date not known	Subsoil texture and weeds.	Yes, Reclamation Certified (2020)	Subsoil texture was not specifically addressed in the Guide
20	Wellsite	Edson	Easily accessible by road	-	-	Not reclaimed	No DSA completed	Lack of topsoil. Dense vegetation establishment on-site (including >4 m aspen and poplars) with the exception of the teardrop area.	Submitted request for pre-approval of minimum reclamation plan to only work on the teardrop and crown of access road to AER, and for a vegetation override for the remainder of the site. Request was approved and reclamation plan was executed.	Uncertainty in the process for pre-approval of minimum reclamation plans (i.e. pre-approval before the reclamation plan has been carried out)
21	Wellsite	Akuini	Road access	-	-	Not reclaimed	No DSA completed	Cut and fill (2 to 3 m high)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
22	Wellsite	Akuini	Road access	-	-	Not reclaimed	No DSA completed	Cut and fill; topsoil and subsoil piles on left in place; uneven contour within on lease remote sump (not holding water); noxious weeds (Canada thistle, scentless chamomile and tansy; sprayed in 2009, 2013 and 2015)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
23	Gravel Pit	Brintnell	Road access	-	-	Not reclaimed	No DSA completed	Topsoil not replaced (topsoil stockpile left in place); wood pile left in place; third party use of site for camping/ target practice (debris and garbage left requiring removal). Access road not recontoured and topsoil not replaced	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
24	Wellsite	Brintnell	Road access	-	-	Not reclaimed	No DSA completed	Access road not recontoured	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
25	Wellsite	Brintnell	Road access	-	-	Not reclaimed	No DSA completed	Access road not recontoured; dense agronomic species on-site	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
26	Remote sump	Brintnell	Road access	-	-	Not reclaimed	No DSA completed	Topsoil stockpiles left in place; northwest corner under water; noxious weeds (Canada thistle and scentless chamomile and tansy)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)

Case Study No.	Site Type	Region	Site Access	Construction Date	Abandonment Date	Reclamation Date	Detailed Site Inspection (DSA) Completion Date	Site Summary and Reclamation Deficiencies	Variance Request and or Reclamation Certificated Application Submitted to AER?	Reason for Exclusion from Case Studies
27	Wellsite	Brintnell	Road access	-	-	Not reclaimed	No DSA completed	Subsided area	-	Did not have enough information to assess eligibility for a variance (especially vegetation information)
28	Gravel pit	Brintnell	Road access	-	-	September 2019	No DSA completed	Noxious weeds (sow-thistle and scentless chamomile; sprayed in 2017)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
29	Wellsite	Brintnell	Road access	-	-	2014	-	Lack of topsoil; noxious weeds (scentless chamomile, Canada thistle and sow-thistle; sprayed in 2018 and 2019)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
30	Remote sump	Godin	Road access	-	-	-	-	Lack of topsoil; noxious weeds (scentless chamomile, Canada thistle and sow-thistle; sprayed in 2018 and 2019)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
31	Wellsite	Marten Hills	Road access	-	-	-	-	No information	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
32	Wellsite	Marten Hills	Road access	-	-	2015	-	Lack of topsoil; noxious weeds (Canada thistle present; sprayed in 2019)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
33	Remote sump	Marten Hills	Road access (close to HWY 754)	-	-	2015	-	Limited/admixed topsoil; noxious weeds (Canada thistle and tansy; sprayed in 2019)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
34	Wellsite	Mitsue	Road access	-	-	Not reclaimed	No DSA completed	Contour issues on wellsite and access road; culverts left in place; noxious weeds (Canada thistle; sprayed in 2015)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
35	Remote sump	Mitsue	Road access	-	-	-	DSA planned in 2020	Noxious weeds (Canada thistle; sprayed in 2019)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)

Case Study No.	Site Type	Region	Site Access	Construction Date	Abandonment Date	Reclamation Date	Detailed Site Inspection (DSA) Completion Date	Site Summary and Reclamation Deficiencies	Variance Request and or Reclamation Certificated Application Submitted to AER?	Reason for Exclusion from Case Studies
36	Well	Mitsue	Road access	-	-	2019	-	Lack of topsoil; heavy infestation of noxious weeds (sow-thistle).	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
37	Wellsite	Mitsue	Road access	-	-	-	-	Possible excess thick slash; noxious weeds (Canada thistle and scentless chamomile)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
38	Wellsite	Mitsue	Road access	-	-	-	-	Possible compaction; noxious weeds (Canada thistle and scentless chamomile)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
39	Wellsite	Mitsue	Road access	-	-	2019	-	Admixed topsoil; noxious weeds (Canada thistle; last sprayed in 2015).	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
40	Gravel Pit	Mitsue	Road access	-	-	2015	-	Lack of topsoil; noxious weeds (sow-thistle, Canada thistle and scentless chamomile; sprayed in 2015, 2017, 2018, 2019).	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
41	Wellsite	Mitsue	Road access	-	-	2019	-	Possible hill cut; noxious weeds (scentless chamomile and Canada thistle)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
42	Wellsite	Mitsue	Road access	-	-	2019	-	Admixed soils; excess woody debris	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
43	Remote sump	Mitsue	Road access	-	-	2019	-	Admixed topsoil; noxious weeds (Canada thistle and sow-thistle)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
44	Wellsite	Narrows Creek	Road access	-	-	2015	DSA not completed	Admixed topsoil; noxious weeds (Canada thistle, sow-thistle and scentless chamomile; sprayed 2016, 2018 and 2019); agronomic species	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)

Case Study No.	Site Type	Region	Site Access	Construction Date	Abandonment Date	Reclamation Date	Detailed Site Inspection (DSA) Completion Date	Site Summary and Reclamation Deficiencies	Variance Request and or Reclamation Certificated Application Submitted to AER?	Reason for Exclusion from Case Studies
45	Built not drilled wellsite and adjacent borrow pit	Nipisi	Road access	-	-	December 2013	DSA not completed	Subsided area; NW corner very wet; noxious weeds (scentless chamomile and Canada thistle; sprayed in 2009, 2010, 2013, 2015, 2016, 2019, 2018 and 2019; numbers have decreased over time)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
46	Wellsite	Nipisi	Road access	-	-	Not reclaimed	DSA not completed	Subsided area; cut and fill; noxious weeds (Canada thistle and sow-thistle; sprayed in 2013 and 2014)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
47	Wellsite	Nipisi	Road access	-	-	Not reclaimed	DSA not completed	Cut and fill along access road; noxious weeds (Canada thistle and sow-thistle; sprayed 2013 and 2014)	-	Did not have enough information to assess eligibility for a variance (e.g., vegetation information)
48	Wellsite	Nipisi	Road access	-	-	-	-	Padded wellsite (50 cm depth); very over grown location. Moderate infestation of noxious weeds (sow-thistle and Canada thistle; sprayed 2009, 2010, 2013, 2015, 2016 and 2019)	-	Padded sites were outside the scope of Stage 2A

"-" = information not available