Appendix F Conservation and Reclamation Plan for the Well Pads

Quest Carbon Capture and Storage Project

CONSERVATION AND RECLAMATION PLAN FOR THE WELL PADS

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November 2010

Executive Summary

Alberta's *Environmental Protection and Enhancement Act* and the *Conservation and Reclamation Regulation* require that, after an upstream oil and gas facility has been decommissioned, the operator must obtain a reclamation certificate. Shell Canada Limited (Shell) has completed a pre-disturbance assessment and site-specific conservation and reclamation (C&R) plan for the existing Well Pad 8-19, the proposed Well Pads 7-11, 10-06, 12-14 and 15-29 and their access roads and borrow pits, to provide data that will enable successful reclamation. Shell will modify this C&R Plan, as the remaining wells of the CO_2 storage area become more defined.

Well Pad 8-19 was constructed in the summer of 2010 and its location, and that of the proposed well pads, is north of the Scotford Upgrader. Well Pad 8-19 has an area of 2.4 ha, consisting of 1.6 ha for the well pad alone, 0.3 ha for the access road and 0.5 ha for the associated borrow pit. The total pre-disturbance assessment area for other well pads ranges between 2.1 and 3.2 ha; 1.7 ha for the well pads alone and between 0.4 and 1.5 ha for the access roads.

Soils vary from well to poorly drained upland soils of the Kavanagh, Kehwin, Norma, Onoway, Spedden and Uncas series, and also include poorly drained organics of the Manatokan series.

No rare plants, non-native or invasive species were found within the well pad pre-disturbance assessment areas, as sites are either located on cultivated or pasture land.

Post-reclamation agricultural capability of the well pads, access roads and borrow pits is expected to remain the same as that under pre-development conditions. Reclamation is targeted to develop a stable and sustainable landscape capable of supporting similar land uses for all disturbed areas at the end of the operational life of the Project.

Table of Contents

List of Tables

List of Figures

List of Attachments

Acronyms and Abbreviations

AENV	Alberta Environment
AEP	Alberta Environmental Protection
C&R	conservation and reclamation
CCS	carbon capture and storage
ND	no data
NR	not rated
Shell	Shell Canada Limited
the Project	Quest Carbon Capture and Storage Project

1 Introduction

1.1 Background

The Quest Carbon Capture and Storage (CCS) Project (the Project) includes development of 3 to 10 CO_2 injection wells. Shell Canada Limited (Shell) has currently identified five injection well locations:

- 08-19-059-20W4M (existing Well 8-19)
- 07-11-59-20 W4M (proposed Well 7-11)
- 10-06-60-20 W4M (proposed Well 10-06)
- 12-14-60-21 W4M (proposed Well 12-14)
- 15-29-60-21 W4M (proposed Well 15-29)

Shell is providing the following background information to allow successful reclamation during the operation phase and at decommissioning and abandonment of the wells. Alberta's *Environmental Protection and Enhancement Act* and the Conservation and Reclamation Regulation require that after an upstream oil and gas facility has been decommissioned, the operator must obtain a reclamation certificate.

The purpose of the pre-disturbance assessment and this Conservation and Reclamation (C&R) Plan is to identify:

- baseline terrain, soil, vegetation and drainage in the areas of the well pad disturbance
- soil conservation measures based on site-specific terrain, soil and vegetation information
- reclamation activities that, at the end of the Project, will achieve equivalent land capability in terms of soil conditions, topography and vegetation establishment and growth
- sensitive environmental conditions and appropriate mitigation measures

As part of the Project, Shell conducted field investigations for soils and vegetation during the summer of 2010, and obtained data for the well pads. However, data used in this document for Well Pad 8-19 are extracted from TERA (2010).

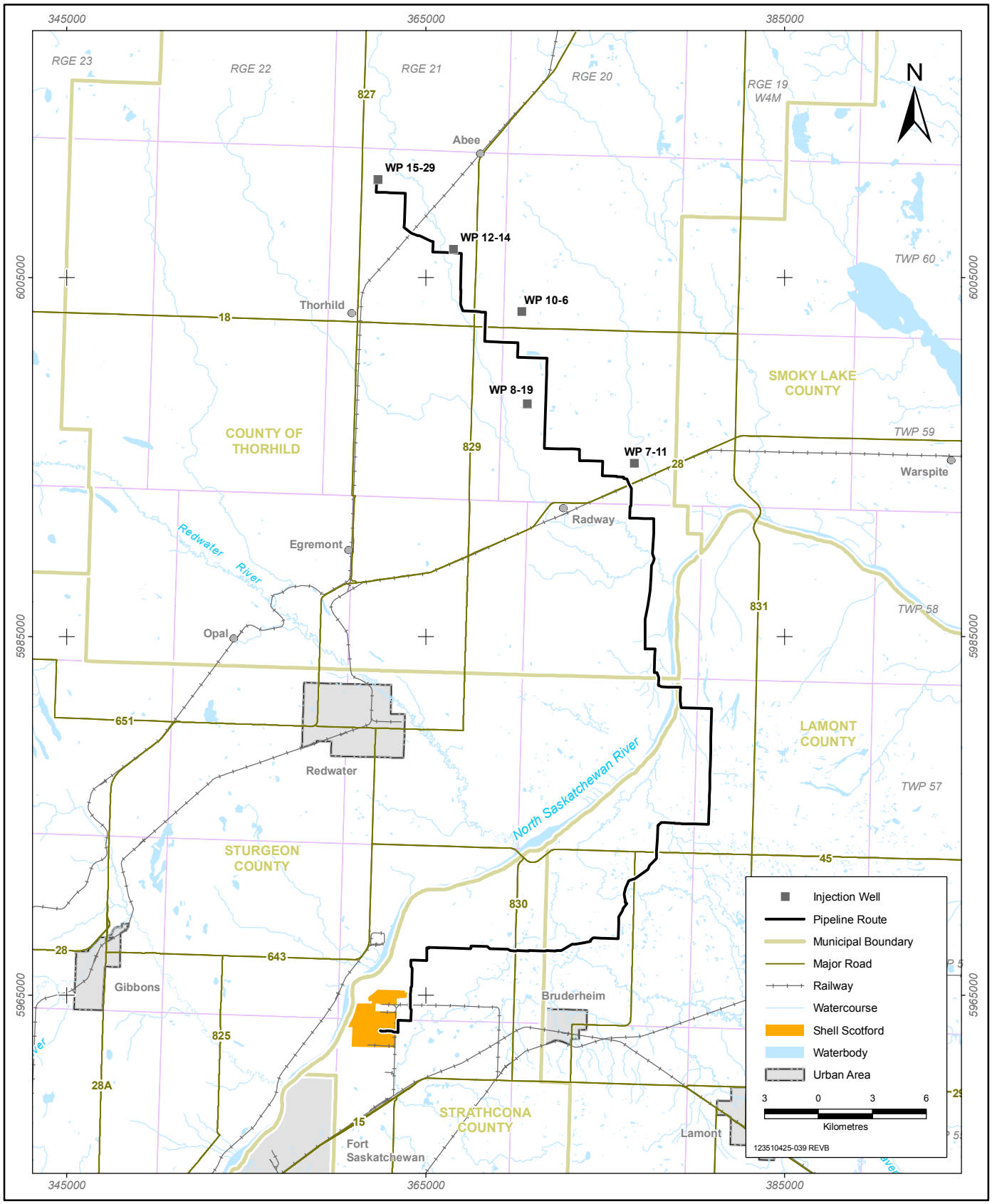
Pending regulatory approval, Shell proposes to construct and drill the injection wells during Q4 2013 and Q1 2014.

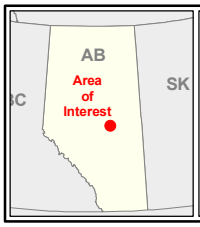
1.2 Project Description

The injection wells, 3-m wide high-grade access roads and the borrow pits will be tied into the CO_2 pipeline to allow injection of captured CO_2 into the Basal Cambrian Sands (BCS) at a depth of about 2 km below ground surface. For a detailed description of the Quest CCS Project, see Volume 1, Section 2.

For an overview of the locations of the well pads in the context of the overall Quest CCS Project, see Figure 1-1.

The well pad pre-disturbance assessment area includes the well pads, access roads and borrow pits.





QUEST CARBON CAPTURE AND STORAGE PROJECT

Quest CCS Project Overview

Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010, Wells: Shell August 26, 2010, Basedata: National Road Network, Canvec, Altalis

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FIGURE NO. **1-1**

Last Modified: Sept 15, 2010 By: aolson

2 Methods

2.1 Soils

For soils information for the existing Well Pad 8-19, see TERA (2010). For a detailed description of the objectives, field methods and data collection, laboratory analyses, mapping techniques and soil characteristics evaluated for Well Pads 7-11, 10-06, 12-14 and 15-29, see Volume 2, Appendix 9A, Soils and Terrain Baseline.

2.2 Vegetation and Wetlands

For vegetation information for the existing Well Pad 8-19, see TERA (2010). For a detailed description of the objectives, field methods and data collection, laboratory analyses and mapping techniques for Well Pads 7-11, 10-06, 12-14 and 15-29, see Volume 2, Appendix 10A, Vegetation Baseline.

3 Existing Environment

3.1 Soil Series and Land Capability

3.1.1 Topography

3.1.1.1 Well Pad 8-19

Topography in the pre-disturbance assessment area for Well Pad 8-19 is flat to gently undulating, with a northwest to southeast grade and imperfect to poor drainage along the eastern side. A 2-m high ridge cuts through the eastern side of the site. Uncas soils have developed on medium- to fine-textured till, and Solonetzic soils of the Kavanagh series, which occupy the northwest portion of the well pad pre-disturbance assessment area, have formed on medium- to fine-textured weathered bedrock.

3.1.1.2 Well Pads 7-11, 10-06 and 12-14

Topography in the pre-disturbance assessment areas for Well Pads 7-11, 10-06 and 12-14 is predominantly gently undulating to undulating. Norma soils have formed on moderately fine glacial till that has saline-sodic properties, and although the Onoway soils share similar parent material, they are not saline-sodic. The greater parts of the pads and access roads are located in low-lying, poorly drained terrain.

3.1.1.3 Well Pad 15-29

Topography in the pre-disturbance assessment area for Well Pad 15-29 is predominantly low-lying and flat to depressional. The Manatokan soils are organic deposits between 0.5 m and 1.0 thick, whereas the Onoway has formed on clay loam to clay-textured glacial till that is saturated for part of the year. Spedden soils are also formed on glacial till, but in locations that have better drainage.

3.1.2 Soil Series in the Well Pad Areas

For maps showing the spatial distribution of soil units, see Figures 3-1 to 3-5. For detailed descriptions of the soils and inspection sites, see Attachment A.

3.1.2.1 Well Pad 8-19

Well Pad 8-19, and the associated borrow pit and access road are located partially on well-drained Kavanagh soils. These are Black Solodized Solonetzics with a sodium-enriched B horizon (upper subsoil). The soils occupy the northwest corner of the pad and extreme east end of the access road. The greater part of the pad and access road are on Dark Grey and gleyed Dark Grey Luvisols of the Uncas series (see Tables 3-1 and 3-2).

The Solonetzic subsoil properties adversely affect agricultural capability (Class 4), and result in subsoil with a rating of Unsuitable for reclamation suitability. Topsoil reclamation suitability is Fair for both the Uncas and gleyed Uncas soils, but Fair to Poor for Kavanagh. Compaction and rutting risk throughout the well pad area pre-disturbance assessment area are generally moderate, but high for the gleyed Uncas units. Erosion risk by wind and water are not a concern.

3.1.2.2 Well Pads 7-11, 10-06 and 12-14

Well Pads 7-11 and 10-06 and the associated access roads are located on well to imperfectly drained Norma (NRM) and gleyed Norma (NRMgl) soils.

Well Pad 12-14 and the associated access road is located on poorly drained Columbine (CMB), Rochester (RCS) and gleyed Dirleton (glDRN) soils. The Columbine soils have a high sodium content, resulting in the upper subsoil being rated as Unsuitable for reclamation.

These soils are Solonetzic intergrades of the Chernozemic order (see Tables 3-1 and 3-2). The Solonetzic subsoil properties do not adversely affect agricultural capability (Class 2), but do result in Fair to Poor reclamation suitability. Topsoil reclamation suitability is Fair for both NRM soil map units, but for different reasons. The Onoway (ONW) soil map unit is poorly drained, which limits its agricultural capability. Its peaty surface is not rated for reclamation suitability, but like the other two units in the well pad areas, its upper subsoil is of Fair reclamation suitability. Compaction and rutting risk throughout the well pad areas are generally moderate to high. Erosion risk by wind and water are not a concern.

3.1.2.3 Well Pad 15-29

Well Pad 15-29 is located in a transitional area, from well-drained Spedden (glSDN) soils in the northwest to poorly drained Onoway (ONW) soils in the middle of the well pad, and with a small unit of organic Manatokan (MNT) soils in the southeast corner (see Tables 3-1 and 3-2). Overall the site and soils are wet for much of the year, which presents construction challenges. The Spedden soil is rated Fair for both topsoil and subsoil agricultural suitability, whereas the organic Manatokan series is not rated for either. The Onoway (ONW) soil map unit is poorly drained, which limits its agricultural capability. Its peaty surface is not rated for reclamation suitability, but its upper subsoil is of Fair reclamation suitability. Compaction and rutting risk throughout the well pad area are generally high. Erosion risk by wind and water are not a concern.

Table 3-1 Soil Units in the Well Pad Pre-Disturbance Assessment Areas

Soil Map Unit	Well Pad	Access Road	Borrow Pit	Total Extent	
	(ha)	(ha)	(ha)	(ha)	(%)
Well Pad 8-19					
Kavanagh (KVG)	0.47	0.09	0.0	0.56	23
Gleyed Uncas (glUCS)	0.21	0.09	0.13	0.43	18
Uncas (UCS)	0.92	0.12	0.37	1.41	59
Total for Well Pad 8-19	1.6	0.3	0.5	2.4	100

Table 3-1 Soil Units in the Well Pad Pre-Disturbance Assessment Areas (cont'd)

Soil Map Unit	Well Pad	Access Road	Borrow Pit	Total Extent	
	(ha)	(ha)	(ha)	(ha)	(%)
Well Pad 7-11					
Norma (NRM)	0.5	0.2	N/A	0.7	28
Gleyed Norma (NRMgl)	0.7	0.5	N/A	1.2	49
Onoway (ONW)	0.5	0.1	N/A	0.6	23
Total for Well Pad 7-11	1.7	0.8	N/A	2.5	100
Well Pad 10-06					
Gleyed Kehiwin (KHWgl)	1.3	0.3	N/A	1.6	50
Onoway (ONW)	0.1	0.1	N/A	0.2	8
Spedden (SDNgl)	0.3	0.3	N/A	0.6	20
Reclaimed Lands (PR)	0.0	0.7	N/A	0.7	22
Total for Well Pad 10-06	1.7	1.5	N/A	3.2	100
Well Pad 12-14					
Columbine (CMB)	0.8	0.4	N/A	1.2	57
Gleyed Dirleton (glDRN)	0.5	0.0	N/A	0.5	25
Rochester (RCS)	0.4	0.0	N/A	0.4	18
Total for Well Pad 12-14	1.7	0.4	N/A	2.1	100
Well Pad 15-29					
Manatokan (MNT)	0.2	0.0	N/A	0.2	6
Onoway (ONW)	0.8	0.1	N/A	0.9	28
Spedden (SDN)	0.7	1.4	N/A	2.1	66
Total for Well Pad 15-29	1.7	1.5	N/A	3.2	100

NOTE:
N/A – not applicable

Table 3-2 Summary of Soil Unit Properties and Ratings for the Well Pad Pre-Disturbance Assessment Areas

Soil Map Unit	Soil Series	Topsoil Depth (cm)	Agricultural Capability[1]	Reclamation Suitability[2]		Erosion Risk		Compaction		Rutting Risk
				Topsoil	Upper Subsoil	Wind	Water	Topsoil	Upper Subsoil	
Well Pad 8-19										
KVG	Kavanagh	20	4D	Fair (SAR)	Unsuitable (SAR)	Low	Moderate	Low	Low	Low
glUCS	gleyed Uncas	20	3DT	Fair–Good (pH)	Fair (texture)	Low	Low–moderate	Moderate	Moderate–high	High
UCS	Uncas	20	3DW	Fair–Good (pH)	Fair (texture)	Low	Low–moderate	Moderate	Moderate	Moderate
Well Pad 7-11										
NRM	Norma	25, 40	2HMT	Fair (reaction)	Poor (consistence)	Low	Low	Low	Moderate	Moderate
NRMgl	Gleyed Norma	40	2HT	Fair (saturation percentage)	Fair (conductivity, consistence)	Low	Low	Moderate	Moderate–high	Moderate
ONW	Onoway	25	6HOW	Not Rated	Fair (texture, consistence)	Low	Low	High	High	High
Well Pad 10-06										
KHWgl	Gleyed Kehiwin	19/16-22	3	Fair (saturation percentage)	Fair (texture)	Low	Low	Moderate	High	Moderate
ONW	Onoway	19/17-21	6	Not Rated	Fair (texture, consistence)	Low	Low	High	High	High
PR	Reclaimed Land	17/16-18	Not rated	Not rated	Not rated	Not rated	Not rated	Not rated	Not rated	Not rated
SDNgl	Gleyed Spedden	22/15-31	4	Fair (reaction, organic carbon)	Fair (texture, consistence)	Low	Low	Moderate	High	Moderate

Table 3-2 Summary of Soil Unit Properties and Ratings for the Well Pad Pre-Disturbance Assessment Areas (cont'd)

Soil Map Unit	Soil Series	Topsoil Depth (cm)	Agricultural Capability[1]	Reclamation Suitability[2]		Erosion Risk		Compaction		Rutting Risk
				Topsoil	Upper Subsoil	Wind	Water	Topsoil	Upper Subsoil	
Well Pad 12-14										
CMBsa	Columbine	20	4HTNW	Fair (reaction, salinity, sodicity, saturation percentage)	Unsuitable (sodicity)	Low	Low	Moderate	Moderate	Moderate
glDRN	Gleyed Dirleton	16 27	3H	Good	Fair (consistence)	Moderate	Low	Low	Low	Low
RCSaa	Rochester	24	3HDWI	Poor (reaction, saturation percentage)	Poor (reaction)	Moderate	Low	Low	Moderate	Moderate
Well Pad 15-29										
MNT	Manatokan	85	7HBV	Not rated	Not rated	Low	Low	High	High	High
ONW	Onoway	36	6HOW	Not rated	Fair (texture, consistence)	Low	Low	High	High	High
SDNg	Gleyed Spedden	23	4HTW	Fair (reaction, organic carbon)	Fair (texture, consistence)	Low	Low	Moderate	High	Moderate

NOTES:
[1] For a description of the agricultural land capability rating system used for Well Pad 8-19, see TERA (2010, Appendix B, Section 3.4).
[2] For a description of the soil suitability for reclamation rating system used for Well Pad 8-19, see TERA (2010, Appendix B, Section 3.3).

3.2 Vegetation and Wetlands

A vegetation and wetlands survey of the Well Pad 8-19 pre-disturbance assessment area determined that the entire area is pasture. The western pad area is dominated by grasses, while the eastern part of the pad, borrow pit and access is shrub-dominated pasture (mixed aspen, willow, rose, dogwood and Saskatoon). Two small wetlands are near, but not within the pre-disturbance assessment area. For the land unit distribution in the pre-disturbance assessment area, see Table 3-3.

A vegetation and wetlands survey of the other well pad pre-disturbance assessment areas showed that either the entire area or most of the area is under cultivation, so no classifiable ecosites or wetlands were identified. However, in the southwest corner of the Well Pad 10-06 pre-disturbance assessment area, a small wetland of 0.05 ha is present. For the Well Pad 15-29 pre-disturbance assessment area, a small area at the west end of the access road is an aspen grove, while the southeast corner of the well pad is a marsh fringed with balsam poplar-aspen. The remaining area is under cultivation. For the land unit distribution in the pre-disturbance assessment areas, see Table 3-3. For maps showing the spatial distribution of land units, see Figures 3-1 to 3-5.

Table 3-3 Land Unit Distribution for the Well Pad Pre-Disturbance Assessment Areas

Land Unit	Well Pad		Access Road		Borrow pit	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Well Pad 8-19						
Pasture – grass dominated	0.8	50	0.0	0	0.0	0
Pasture - shrub dominated	0.8	50	0.3	100	0.5	100
Total	1.6	100	0.3	100	0.5	100
Well Pad 7-11						
CL – cultivated land	1.7	100	0.8	>90	N/A	N/A
DL – existing disturbed lands	0.0	0	<0.1	<10	N/A	N/A
Total	1.7	100	0.8	100	N/A	N/A
Well Pad 10-06						
CL – cultivated land	1.7	>95	1.5	>95	N/A	N/A
MONG – ephemeral/temporary marsh	<0.1	<5	<0.1	<5	N/A	N/A
Total	1.7	100	1.5	100	N/A	N/A
Well Pad 12-14						
CL – cultivated land	1.7	100	0.4	100	N/A	N/A
Total	1.7	100	0.4	100	N/A	N/A
Well Pad 15-29						
CL – cultivated land	1.4	82	1.5	99	N/A	N/A
d1 – low-bush cranberry/aspen	0.0	0	<0.1	1	N/A	N/A
e1 – dogwood/balsam poplar-aspen	0.3	17	0.0	0	N/A	N/A
MONG – ephemeral to temporary marsh[1]	<0.1	<1	0.0	0	N/A	N/A
Total	1.7	100	1.5	100	N/A	N/A

NOTES:
N/A – not applicable
[1] MONG is a small corner in the extreme southeast of the pad within the e1 unit.

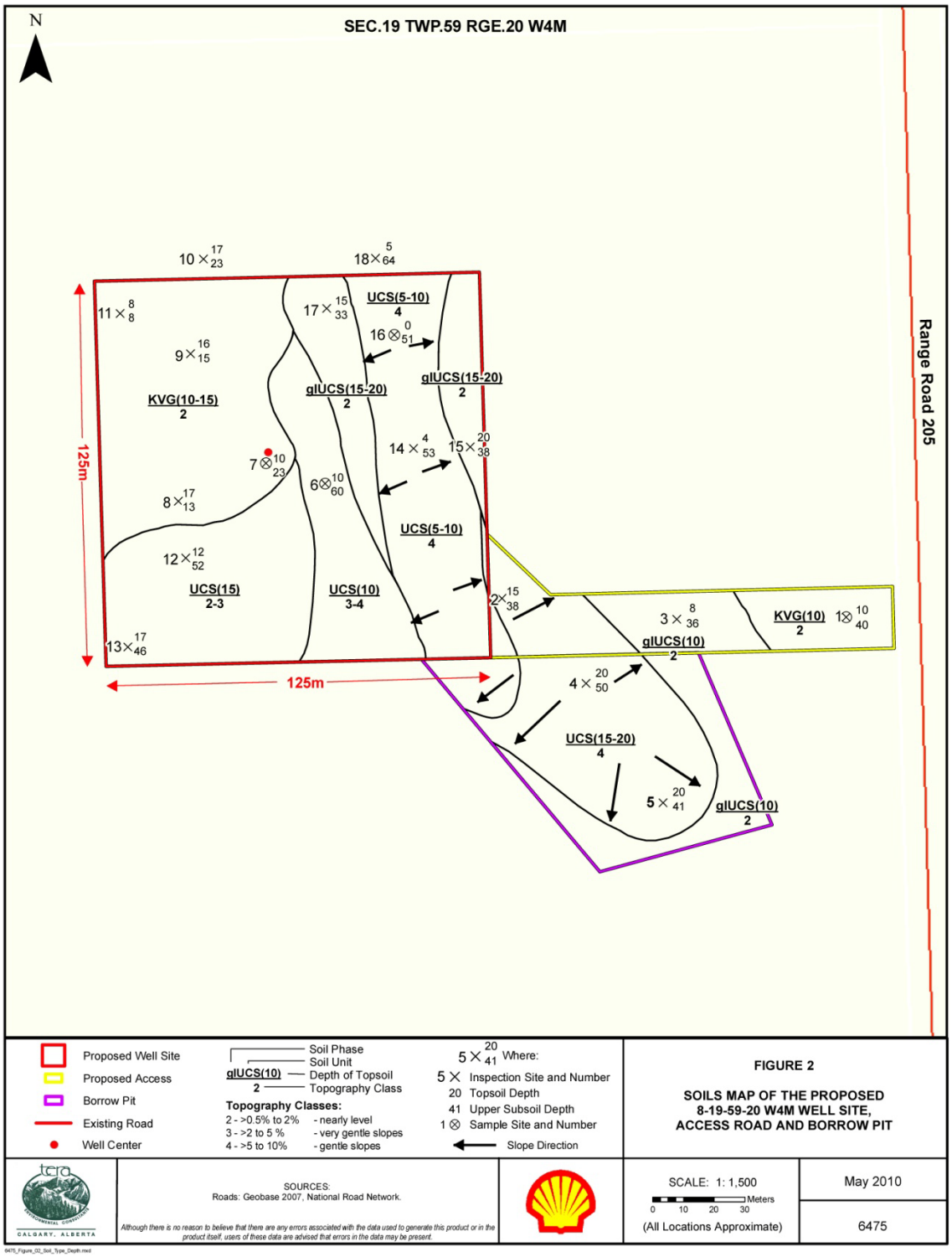
3.2.1 Rare Plants

No rare plants were observed in the well pad pre-disturbance assessment areas during the 2010 field investigations.

3.2.2 Non-native and Invasive Species

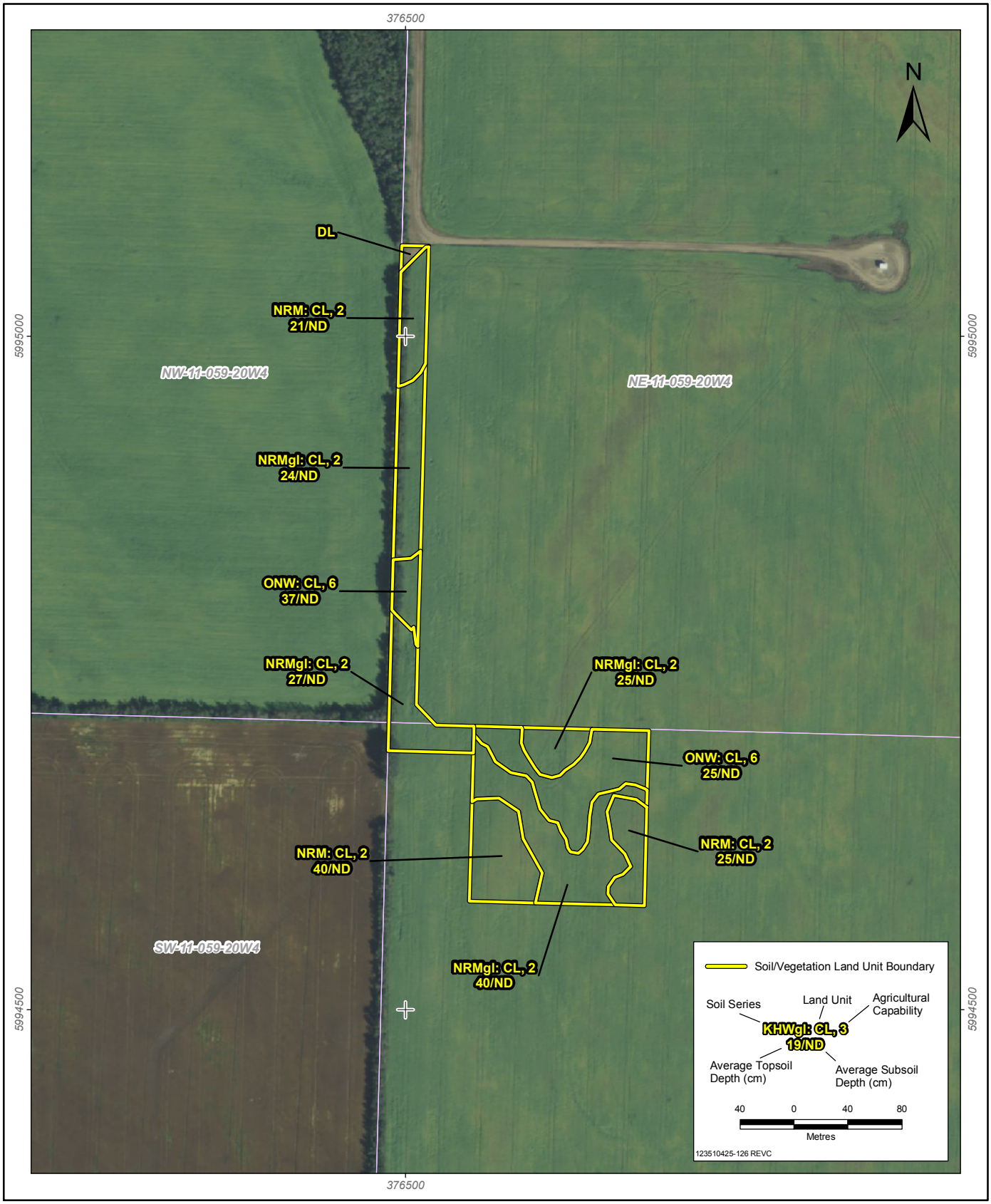
During the field visit to Well Pad 8-19, two noxious weed species, common tansy (*Tanacetum vulgare*) and creeping thistle (*Cirsium arvense*) were observed. Small numbers of both species were observed throughout the Well Pad 8-19 pre-disturbance assessment area, primarily in the grass-dominant pasture on the west side.

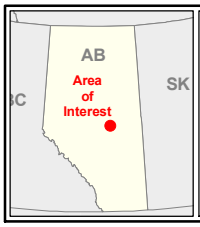
No non-native or invasive species were identified in the other well pad pre-disturbance assessment areas during the 2010 field investigations.



SOURCE: Figure 2 from Appendix B in *Environmental Assessment for the Proposed Shell Canada Limited Site 4A 8-19-59-20 W4M Well Site and Access Road*. TERA Environmental Consultants. (TERA 2010).

Figure 3-1 Soils Map of the Proposed 8-19-59-20 W4M Well Site, Access Road and Borrow Pit





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Soils and Vegetation Units for the Well Pad 7-11 Pre-Disturbance Assessment Area

Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008.

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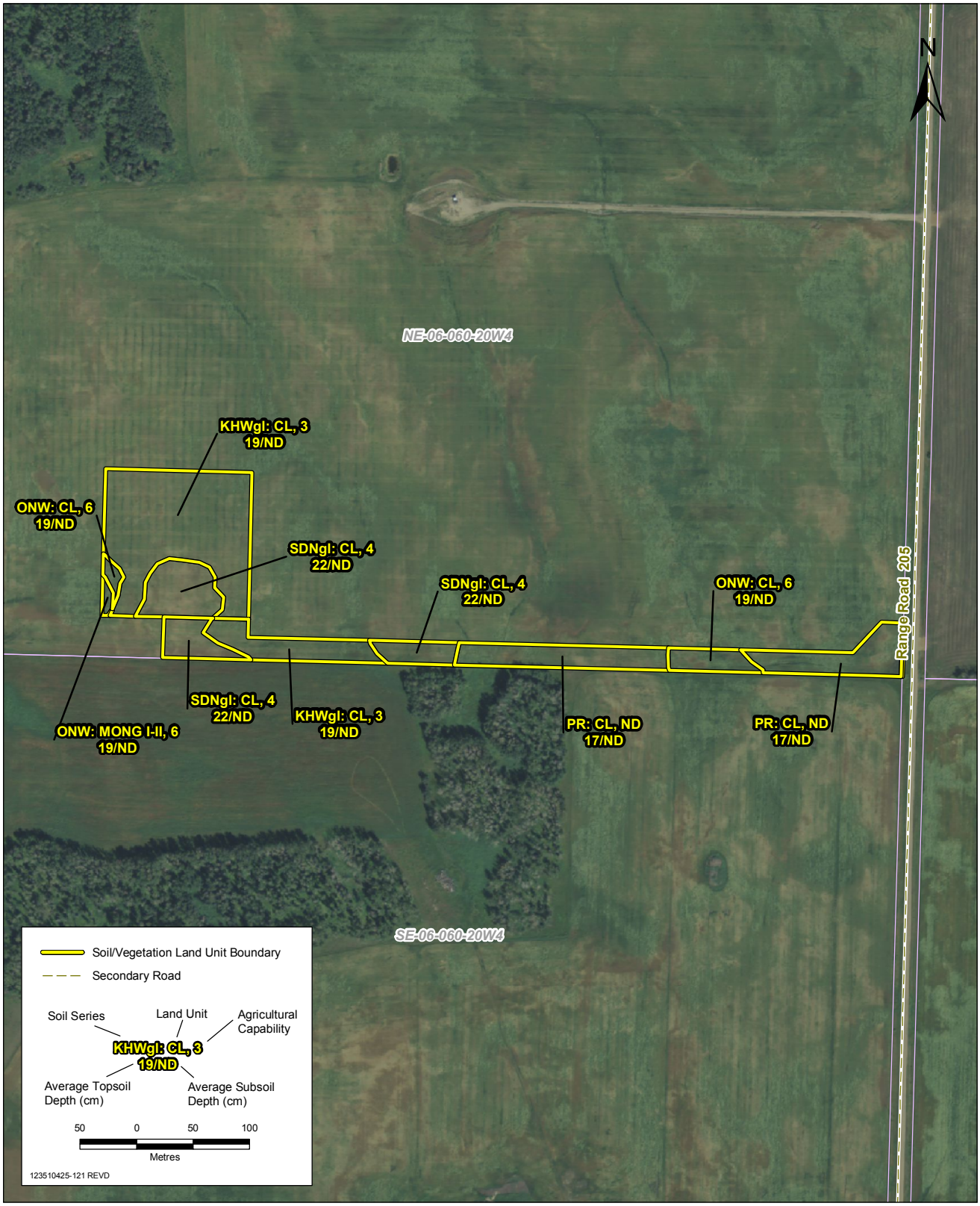
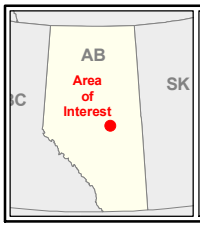
FIGURE NO. 3-2

Last Modified: Oct 21, 2010 By: jpetho





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Soil and Vegetation Units for the Well Pad 10-6 Pre-Disturbance Assessment Area

Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008.

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FIGURE NO. 3-3

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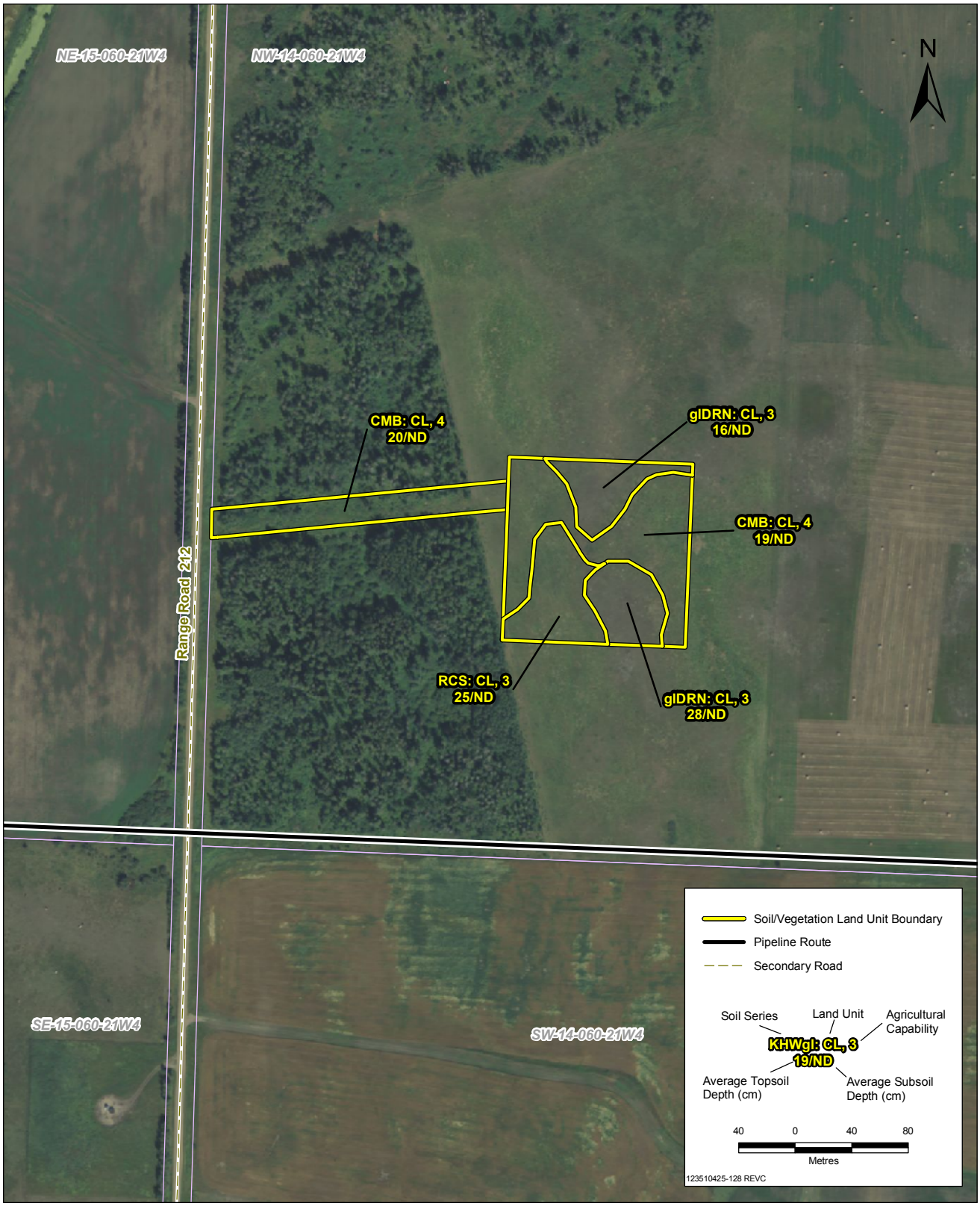

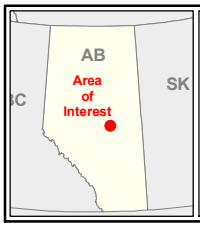

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Distribution of Soils and Vegetation Units for the Well Pad 12-14 Pre-Disturbance Assessment Area

Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008.

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FIGURE NO. 3-4

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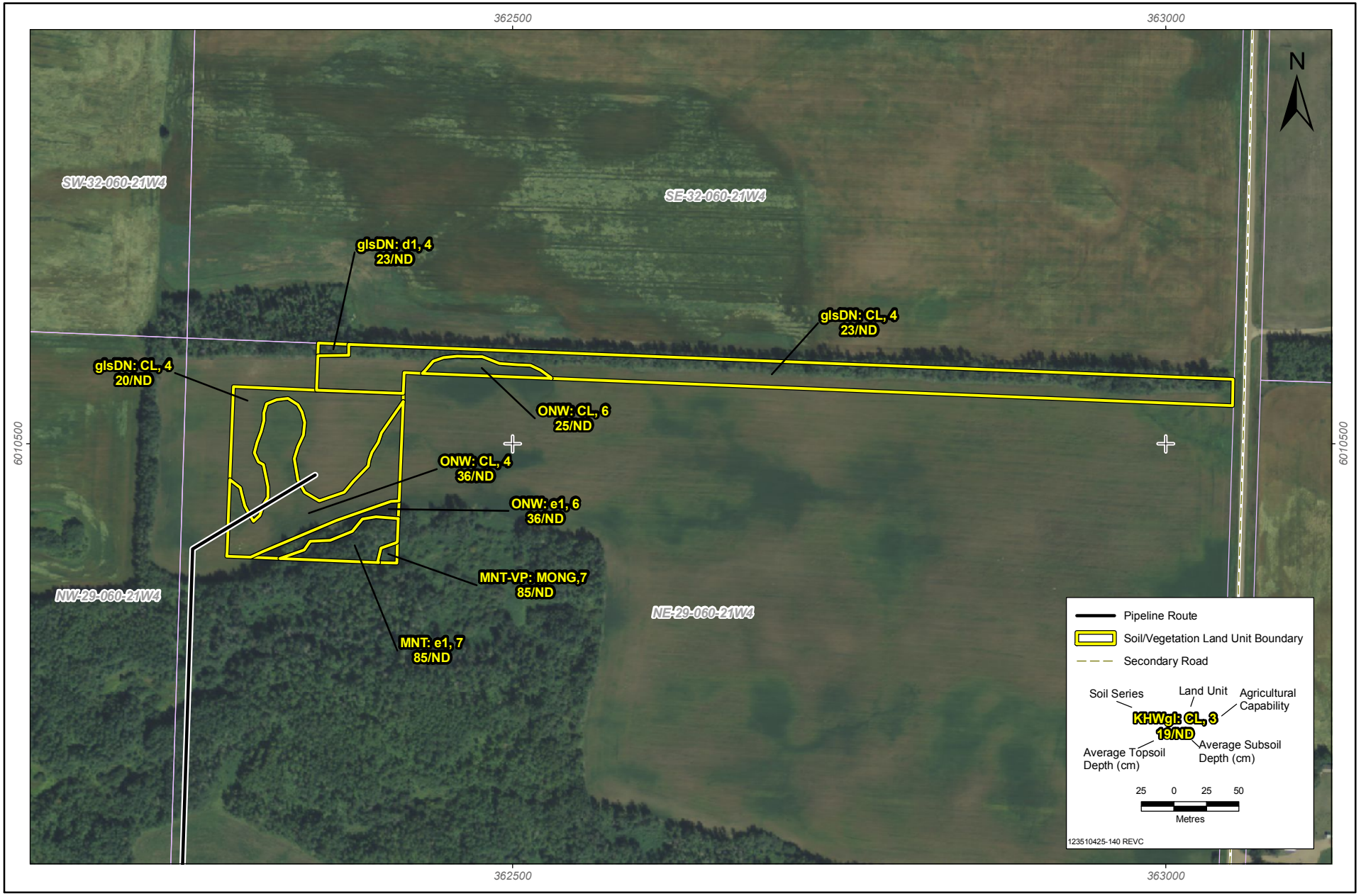

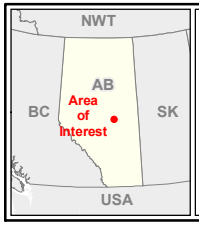

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Soils and Vegetation Units for the Well Pad 15-29 Pre-Disturbance Assessment Area

Acknowledgements: Original Drawing by Stantec.
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008.

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FIGURE NO. 3-5

Last Modified: Oct 21, 2010 By: jpetho

4 Conservation and Reclamation Plan

4.1 Reclamation Goals

The goals of a C&R plan are to present strategies for:

- limiting potential Project environmental effects
- returning land disturbed by the Project to equivalent land capability at closure
- ensuring a stable, self-sustaining closure landscape (including landforms, soil, vegetation and hydrological regime)
- obtaining reclamation certificates for all disturbed areas after final decommissioning, abandonment and reclamation

4.2 General Measures

4.2.1 Introduction

Potential Project environmental effects and mitigation are discussed in general terms in this section. For site-specific measures, see Section 4.4. The general guidelines provide direction and might have to be adapted to suit site-specific conditions in the field.

All construction activities will follow accepted industry best management practices.

4.2.2 Vegetation Clearing

4.2.2.1 Well Pad 8-19

For Well Pad 8-19, the entire pre-disturbance assessment area is either grass-dominated or shrub-dominated pasture land. During construction in summer 2010, no special conservation measures were warranted, because the site was heavily grazed. The shrub cover was cleared and burned on an area of exposed subsoil.

4.2.2.2 Well Pads 7-11, 10-06 and 12-14

For Well Pads 7-11, 10-06 and 12-14, the well pad and access road pre-disturbance assessment areas are mostly cultivated land. Exceptions are the access roads associated with Well Pads 7-11 and 10-06, where <0.1% of each is previously disturbed land, and the extreme southwest corner of Well Pad 10-06, which is a wetland (marsh). No native vegetation, forestry resources or wildlife habitat were identified during the field studies, so no development procedures or conservation measures will be required except for the wetland area. If this small area cannot be avoided, it should be covered with geotextile and padded with fill. Regulatory approvals to develop this wetland area will need to be obtained before disturbance occurs.

4.2.2.3 Well Pad 15-29

For Well Pad 15-29, the aspen trees at the west end of the access road will require clearing. Although the balsam poplar–aspen in the southeast corner of the well pad will need to be cleared and authorizations regarding the wetland will need to be received, the rest of the well pad and access road is cultivated land, so no clearing is required. The Manatokan (MNT) unit will be avoided, if possible, covered with geotextile, and padded with fill when Well Pad 15-29 is being developed.

4.2.3 Soil Salvage and Stockpile Management

During construction in summer 2010, the soil salvage and stockpile management practices for Well Pad 8-19 adhered to the same guidelines as those outlined in the following section for the proposed well pads.

The proposed injection wells, 7-11, 10-06, 12-14 and 15-29, are being developed to allow for CO_2 injection. So, although the wells will be active injection wells, they will not be hydrocarbon producers. The soil management practices are based on the assumption that the full well pad areas and access roads will be disturbed and reclamation will not occur until the end of the Project's life.

The soil stockpiles will be stabilized, seeded down, and the materials retained until final site reclamation.

4.2.3.1 Soil Management Goals

The goal of soil salvage and management is to preserve and provide valuable topsoil and subsoil for reclamation, by stripping and storing all soil in a way that limits loss and degradation, until the soil is required for future replacement and reclamation. Through proper handling and conservation, degradation of soil by erosion, compaction, rutting, loss of viable plant material and admixing with underlying soil is reduced.

The following general guidelines may have to be adapted to site-specific field conditions and consultation with the landowner. Final decisions will be largely based on the experience and professional judgment of the on-site construction supervisors and Shell's environmental coordinator.

4.2.3.2 Topsoil Salvage and Stockpile Management

General Salvage Measures

All topsoil (the LFH–organic layer and any underlying mineral A horizon) will be salvaged in areas of the well pad and access road that are to be graded, excavated, capped with fill material or designated for location of subsoil stockpiles.

Where topsoil is being stripped, activities will be suspended immediately if soils become excessively wet, or if other field conditions such as rutting or high winds may potentially degrade topsoil or subsoil quality (Alberta Environmental Protection [AEP] 1998). Where the surface disturbance occurs on wet terrain, stripping will occur during appropriate (dry or frozen trafficable) conditions.

Some of the terrain in the well pad pre-disturbance assessment areas may have near-surface water tables (e.g., the g1UCS soils in the Well Pad 8-19 pre-disturbance assessment area). Therefore, if construction is planned during non-frozen conditions, appropriate mitigation measures, such as the use of swamp mats, geotextile–geogrid, padding, and low-ground-pressure equipment, will be considered.

Where winter stripping is proposed, heavier soils might require surface ripping to reduce the potential for mixing of topsoil and subsoil layers.

Salvage depths and areas in this document should be considered guidelines, because conditions encountered in the field may vary and require some adaptation of these practices.

Stockpile Locations

Guidelines for selecting stockpile locations include the following:

- Stockpiles will be located on stable foundations in approved workspace areas.
- Stockpile design will incorporate setbacks to ensure materials are not inadvertently displaced outside approved areas.
- Stockpiles will be located on level ground, where possible.
- Where topsoil stockpiles must be located on sloping ground, silt fencing or berms will be installed along the downslope edge of the piles, as necessary, to prevent loss or erosion of material.
- Stockpiles will be located outside the required work areas, so they do not interfere with construction or operational activities.
- Stockpiles will be accessible and retrievable for temporary reclamation or final reclamation at Project closure.
- Topsoil storage areas do not require stripping before material placement.
- Subsoil storage areas must have topsoil stripped before stockpiling the subsoil.
- Topsoil and subsoil stockpiles require a separation of at least 1 m to limit potential admixing. Where spacing limits or prevent complete separation, stockpiles will be separated by geotextiles or markers.

4.2.3.3 Stockpile Erosion-Control Measures

All stockpile locations will have stable foundations, and stockpile side slopes will not exceed a 3:1 gradient (horizontal:vertical) for stability and safety reasons. Any requirement for immediate erosion-control measures from potential water or wind erosion (e.g., sediment fences, erosion-control matting or tackifying agents), will be determined by the environmental inspector and construction supervisor on a stockpile-specific basis.

4.2.3.4 Subsoil Salvage and Stockpile Management

General Measures

Subsoil, defined as the B horizon, will be salvaged to a depth not exceeding 30 cm for the well pad, from those areas where it is suitable for reclamation purposes. However, no subsoil salvage is proposed for the access roads or the borrow pit. Subsoil piles will be situated to ensure at least a 1 m separation from topsoil piles, to prevent accidental admixing of topsoil and subsoil. (Admixing has the potential to reduce topsoil quality and compromise, or delay, successful site reclamation.) Where spacing limits or prevent complete separation, stockpiles will be separated by geotextiles or markers. Before placement of any subsoil materials for temporary or long-term storage, topsoil will be stripped from the stockpile location and added to the topsoil stockpile.

Stockpile Locations and Erosion Control Measures

Location and erosion-control considerations for subsoil stockpiles are the same as those described for topsoil stockpiles.

4.3 Existing Site Disturbances

Existing site disturbances for the well pads are as follows:

- Well Pad 8-19 – no disturbed area that required particular attention
- Well Pad 7-11 – at the extreme north end of the proposed access road where it links into the access to another well pad. This area is less than 0.1 ha in extent.
- Well Pad 10-06 – at the extreme east end of the proposed access road where it intersects a county grid road. This area is less than 0.1 ha in extent, i.e. the road-side ditch,
- Well Pad 12-14 – no existing disturbed areas
- Well Pad 15-29 – no existing disturbed areas

4.4 Site-Specific Conservation and Reclamation

The topsoil salvage guidelines outlined in the following section were derived by reviewing the data provided previously (see Tables 3-1 and 3-2). Soil salvage depths and areas are estimates and are meant to provide guidance only for Shell's construction supervisors and environmental coordinator. Conditions encountered in the field might vary.

4.4.1 Topsoil and Subsoil Salvage Measures

Inspection point data do not include subsoil depth measurements (see Figures 3-2 to 3-5, where ND = no data). The salvage depth is set at 30 cm for the mineral soils in areas of subsoil salvage in the following well pad-specific discussions. Generally, subsoil is not salvaged where the reclamation suitability ratings for the upper subsoil are Unsuitable.

4.4.1.1 Well Pad 8-19

The proposed well pad, borrow pit and access road are on mineral soils of the Kavanagh, gleyed Uncas and Uncas series (see Figure 3-1, shown previously). All topsoil and a maximum of 30 cm of subsoil were salvaged for the mineral soils series on the well pad and borrow pit, but no subsoil was salvaged for the access road. For specific topsoil and subsoil salvage depths, areas and volumes of material generated at the well pad, see Table 4-1.

The inspection point data indicated that topsoil depths on mineral soil ranged between 8 and 17 cm for Kavanagh, 4 to 20 cm for Uncas and 8 to 20 cm for the glUCS soils (combined LFH + A horizon). Subsoil depths varied, so a uniform depth of 30 cm for the glUCS and UCS soils, and no salvage for the KVG series, was established for the well pad and borrow pit. No subsoil was salvaged for the access road.

The salvaged topsoil was stockpiled on undisturbed topsoil, but the area for the subsoil stockpile had the topsoil salvaged first. Precise locations and dimensions of the stockpiles were determined at the site by the construction supervisor.

Table 4-1 Topsoil and Subsoil Stripping Depths and Volumes for Well Pad 8-19, Borrow Pit and Access Road

Soil Series	Area (ha)	Topsoil Stripping Depth (cm)	Area of Topsoil Salvage (ha)	Volume of Topsoil Salvaged (m^3)	Subsoil Stripping Depth (cm)	Area of Subsoil Salvage (ha)	Volume of Subsoil Salvaged (m^3)
Well Pad							
KVG	0.47	20	0.47	940	N/A	0	N/A
glUCS	0.21	20	0.21	420	30	0.21	630
UCS	0.92	20	0.92	1,840	30	0.92	2,760
Subtotal	1.6	N/A	1.6	3,200	N/A	1.13	3,390
Access Road							
KVG	0.09	20	0.09	180	N/A	N/A	N/A
glUCS	0.09	20	0.09	180	N/A	N/A	N/A
UCS	0.12	20	0.12	240	N/A	N/A	N/A
Subtotal	0.3	N/A	0.3	600	N/A	N/A	0
Borrow Pit							
KVG	0.0	N/A	N/A	0	N/A	0	N/A
glUCS	0.13	20	0.13	260	30	0.13	390
UCS	0.37	20	0.37	740	30	0.37	1110
Subtotal	0.5	N/A	0.5	1,000	30	0.5	1,500
Total	2.4	N/A	2.4	4,800	N/A	1.63	4,890

NOTE:
N/A – not applicable

4.4.1.2 Well Pads 7-11 and 10-06

The proposed well pads and access roads will be constructed on mineral soils of the Norma, gleyed Norma and Onoway series (see Figures 4-1 and 4-2). All topsoil and a maximum of 30 cm of subsoil will be salvaged for the mineral soils on the well pads. There will be no subsoil salvage on the access roads. For specific topsoil and subsoil salvage depths, areas and volumes of material generated at the well pads, see Tables 4-2 and 4-3.

Well Pad 7-11

The inspection point data indicate that topsoil depths on mineral soil range between 13 cm and 43 cm and generally average 25 cm of Onoway and shallow Norma, and 25 to 40 cm of Norma and gleyed Norma soils (combined LFH + A horizon) for the various soil series observed. The inspection data do not include subsoil depths, so salvage is set at a uniform 30 cm for the pad.

The topsoil stockpile will be about 3.0 m high by 30 m wide by 80 m long, and the subsoil stockpile will be about 3.0 m high by 30 m wide by 70 m long. For approximate areas from which topsoil and subsoil will be stripped, topsoil salvage depths and locations for topsoil and subsoil stockpiles, see Figure 4-1.

Well Pad 10-06

The inspection point data indicate that topsoil depths for the Kehiwin soils range between 16 and 22 cm, while for the Spedden series the range is 15 to 31 cm. In all cases the reclamation suitability is the same for both topsoil and subsoil. Therefore, a certain amount of overstripping should not adversely affect the reclamation quality of the topsoils. Pedocan (1993) notes that for both the Kehiwin and Spedden soil series, the colour change from topsoil to subsoil is obvious, so this will assist in setting the salvage depth during stripping.

The topsoil stockpile will be about 25 m wide by 100 m long by 2.0 m high, and the subsoil stockpile will be about 3.0 m high by 25 m wide by 100 m long by 2.5 m high. For approximate areas from which topsoil and subsoil will be stripped, topsoil salvage depths and locations for topsoil and subsoil stockpiles, see Figure 4-2.

4.4.1.3 Well Pad 12-14

The proposed well pad and access road will be on poorly drained mineral soils of the Columbine, gleyed Dirleton and Rochester series (see Figure 4-3). All topsoil and a maximum of 30 cm of subsoil will be salvaged for the mineral soil series. For specific topsoil and subsoil salvage depths, areas and volumes of material generated at the well pad, see Table 4-4.

The inspection point data indicate topsoil depths ranging between 14 and 27 cm for the Columbine soils, 16 cm for one Dirleton unit and 17 to 41 cm for a second unit, and 20 to 30 cm for the Rochester soils. The inspection data do not include subsoil depths but given the Unsuitable and Poor ratings for subsoils of the Columbine and Rochester series, which comprise approximately 70% of the area, no subsoil salvage is required for these two units.

It is estimated that the topsoil stockpile will be about 3.0 m high by 25 m wide by 80 m long and the subsoil stockpile will be 25 m wide by 40 m long by 3 m high. For approximate areas from which topsoil will be stripped, topsoil salvage depths, and locations for the topsoil stockpile, see Figure 4-3.

4.4.1.4 Well Pad 15-29

The proposed well pad and access road will be developed on mineral soils of the Gleyed Spedden and Onoway series. Handling of the Manatokan soils will be avoided (see Figure 4-4). All topsoil and a maximum of 30 cm of subsoil will be salvaged for the mineral soils series on the well pad. No subsoil will be salvaged on the access road. For specific topsoil and subsoil salvage depths, areas and volumes of material generated at the well pad, see Table 4-5.

The inspection point data indicate topsoil depths (combined LFH + A horizon) on mineral soils range between 15 and 35 cm for the Spedden soils, 22 to 41 cm for Onoway and 85 cm for the organic Manatokan series. The inspection data do not include subsoil depths, so salvage is set at a uniform 30 cm for the pad.

The topsoil stockpile will be about 3.0 m high by 25 m wide by 90 m long, and the subsoil stockpile will be 3.0 m high by 30 m wide by 65 m long. For approximate areas from which topsoil and subsoil should be stripped, topsoil salvage depths and locations for topsoil and subsoil stockpiles, see Figure 4-4.

4.4.1.5 Access Roads

For the Well Pad 8-19 access road, only the topsoil (the LFH-organic layer and A horizon) on the mineral soils was salvaged.

For the proposed access roads, all topsoil (the LFH-organic layer and A horizon) on the mineral soils will be salvaged. Topsoil salvage will begin at the centreline of the roads, and the materials will be windrowed on the edge of the rights-of-way, parallel to the access roads. Upon completion of construction, the topsoil windrows will be spread back onto the backslopes and shoulders then seeded to stabilize the surface and prevent erosion.

The depths and locations of the topsoil should be noted on as-built drawings, so the material can be recovered for use when the road is reclaimed.

No subsoil will be salvaged on the access roads.

Table 4-2 Topsoil and Subsoil Stripping Depths and Volumes for Well Pad 7-11 and Access Road

Soil Series	Area (ha)	Topsoil Stripping Depth (cm)	Area of Topsoil Salvage[1] (ha)	Volume of Topsoil Salvaged[1] (m^3)	Subsoil Stripping Depth (cm)	Area of Subsoil Salvage[2] (ha)	Volume of Subsoil Salvaged [2] (m^3)
Well Pad							
Norma	0.5	25 40	0.2 0.25	500 1,000	30	0.25	750
Gleyed Norma	0.7	40	0.63	2,520	30	0.7	2,100
Onoway	0.5	25	0.5	1,250	30	0.5	1,500
Subtotal	1.7	N/A	1.58 [1]	5,270 [1]	N/A	1.45 [2]	4,350 [2]

Table 4-2 Topsoil and Subsoil Stripping Depths and Volumes for Well Pad 7-11 and Access Road (cont'd)

Soil Series	Area (ha)	Topsoil Stripping Depth (cm)	Area of Topsoil Salvage[1] (ha)	Volume of Topsoil Salvaged[1] (m^3)	Subsoil Stripping Depth (cm)	Area of Subsoil Salvage[2] (ha)	Volume of Subsoil Salvaged[2] (m^3)
Access Road							
Norma	0.2	25	0.2	500	0	0	0
Gleyed Norma	0.5	25	0.6	1,500	0	0	0
Onoway	0.1	40	0.1	400	0	0	0
Subtotal	0.8	N/A	0.8	2,400	0	0	0
Total	2.5	N/A	2.38	7,670	N/A	1.45	4,350

NOTES:
N/A – not applicable
[1] Assumes topsoil stripping under subsoil stockpile, no topsoil stripping in areas designated for topsoil stockpile.
[2] Assumes no subsoil stripping under topsoil and subsoil stockpiles

Table 4-3 Topsoil and Subsoil Stripping Depths and Volumes for Well Pad 10-6 and Access Road

Soil Series	Area (ha)	Topsoil Stripping Depth (cm)	Area of Topsoil Salvage[1] (ha)	Volume of Topsoil Salvaged[1] (m^3)	Subsoil Stripping Depth (cm)	Area of Subsoil Salvage[2] (ha)	Volume of Subsoil Salvaged[2] (m^3)
Well Pad							
Gleyed Kehiwin	1.3	25	1.1	2,750	30	1.0	3,000
Onoway	0.1	0	0	0	0	0	0
Gleyed Spedden	0.3	30	0.3	900	30	0.3	900
Subtotal	1.7	N/A	1.4 [2]	3,650 [2]	N/A	1.3	3,900
Access Road							
Gleyed Kehiwin	0.3	20	0.1	200	0	0	0
Onoway	0.1	20	<0.1	175	0	0	0
Gleyed Spedden	0.3	20	<0.1	175	0	0	0
Reclaimed Lands	0.7	20	0.3	600	0	0	0
Subtotal	1.4	N/A	0.5	1,150	N/A	0	0
Total		N/A	1.4	4,800	N/A	1.3	3,900

NOTES:
N/A – not applicable
[1] Assumes topsoil stripping under subsoil stockpile, no topsoil stripping under topsoil stockpile.
[2] Assumes no subsoil stripping under topsoil or subsoil stockpile.

Table 4-4 Topsoil and Subsoil Stripping Depths and Volumes for Well Pad 12-14 and Access Road

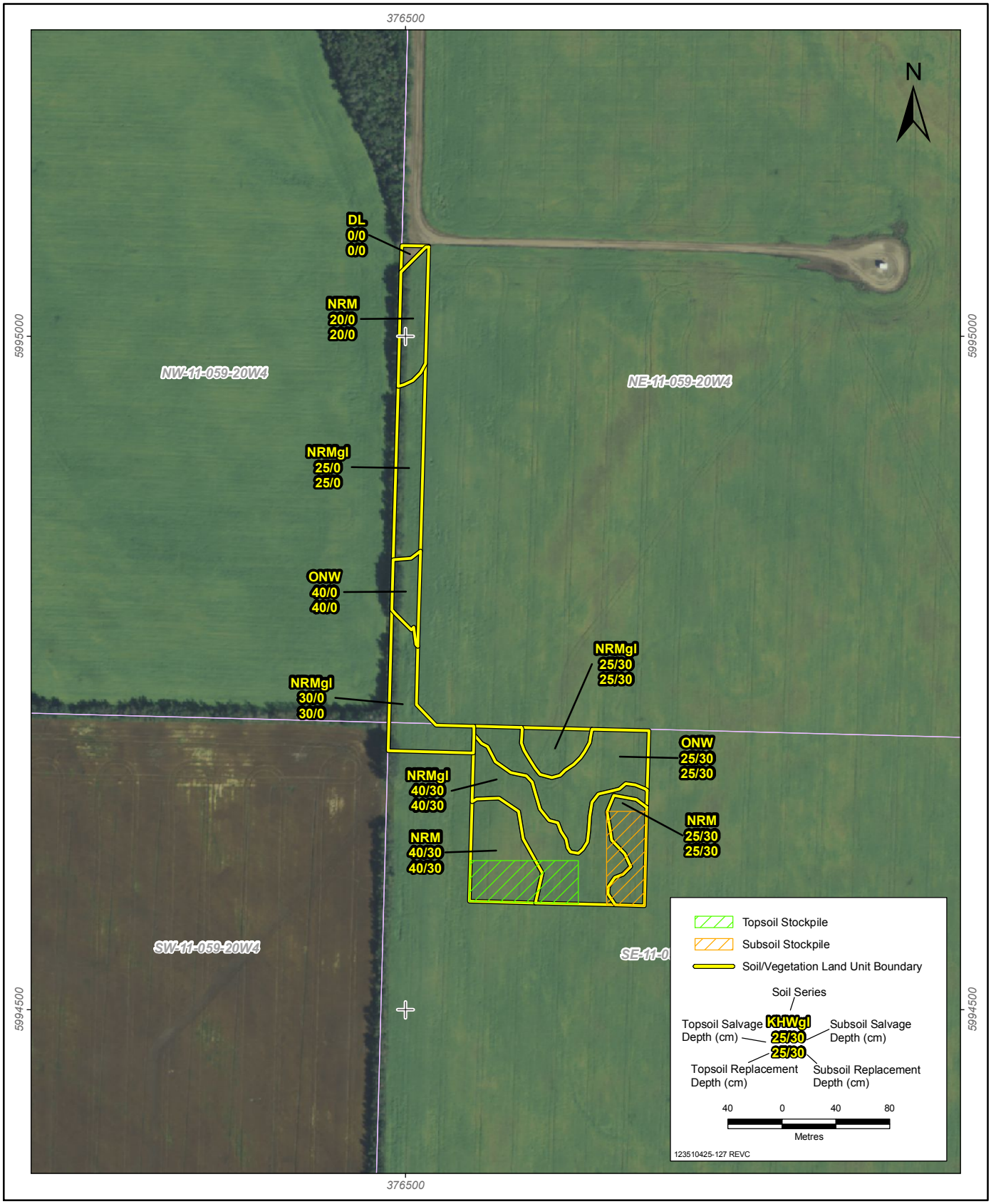
Soil Series	Area (ha)	Topsoil Stripping Depth (cm)	Area of Topsoil Salvage[1] (ha)	Volume of Topsoil Salvaged[1] (m^3)	Subsoil Stripping Depth (cm)	Area of Subsoil Salvage[1] (ha)	Volume of Subsoil Salvaged[1] (m^3)
Well Pad							
Columbine	0.8	20	0.6	1,200	0	0	0
glDirleton	0.25 0.25	15 25	0.25 0.25	375 625	0	0	0
Rochester	0.4	25	0.4	1,000	0	0	0
Subtotal	1.7	N/A	1.5	3,200	N/A	0	0
Access Road							
Columbine	0.4	25	0.4	1,000	0	0	0
Total	2.1	N/A	1.9	4,200	N/A	0	0

NOTES:
N/A – not applicable
[1] Assumes no topsoil stripping in area designated for topsoil stockpile.

Table 4-5 Topsoil and Subsoil Stripping Depths and Volumes for Well Pad 15-29 and Access Road

Soil Series	Area (ha)	Topsoil Stripping Depth (cm)	Area of Topsoil Salvage[1] (ha)	Volume of Topsoil Salvaged[1] (m^3)	Subsoil Stripping Depth (cm)	Area of Subsoil Salvage[2] (ha)	Volume of Subsoil Salvaged[2] (m^3)
Well Pad							
glSpedden	0.7	20	0.7	1,400	30	0.5	1,500
Onoway	0.8	35	0.7	2,450	30	0.7	2,100
Manatokan	0.2	0	0	0	0	0	0
Subtotal	1.7	N/A	1.4 [1]	3,850 [1]	N/A	1.2 [2]	3,600 [2]
Access Road							
glSpedden	1.4	25	1.4	3,500	0	0	0
Onoway	0.1	25	0.1	250	0	0	0
Subtotal	1.5	N/A	1.5	3,750	0	0	0
Total	3.2	N/A	2.9 [1]	7,600 [1]	N/A	1.2 [2]	3,600 [2]

NOTES:
N/A – not applicable
Assumes topsoil stripping under subsoil stockpile, no topsoil stripping in areas designated for topsoil stockpile.
[2] Assumes no subsoil stripping under topsoil and subsoil stockpiles.



AB
Area of Interest
SK

QUEST CARBON CAPTURE AND STORAGE PROJECT

Soil Salvage and Replacement Depths and Stockpile Locations for Well Pad 7-11 and Access Road

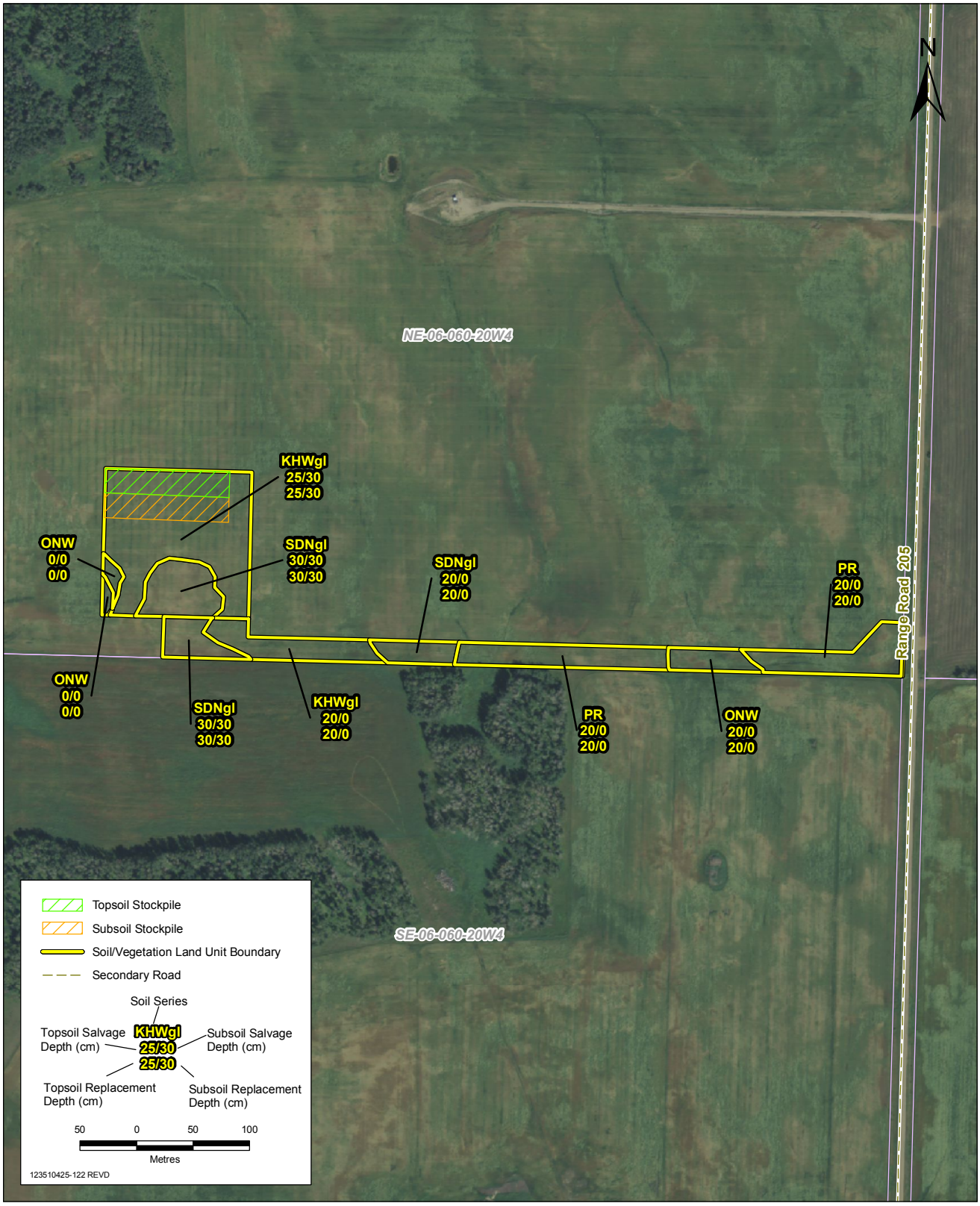
Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008.

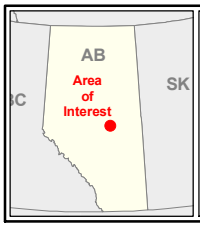
PREPARED BY Stantec

PREPARED FOR

FIGURE NO. 4-1

Last Modified: Oct 21, 2010 By: jpetho





QUEST CARBON CAPTURE AND STORAGE PROJECT

Soil Salvage and Replacement Depths and Stockpile Locations for the Well Pad 10-6 and Access Road

Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008.

PREPARED BY Stantec

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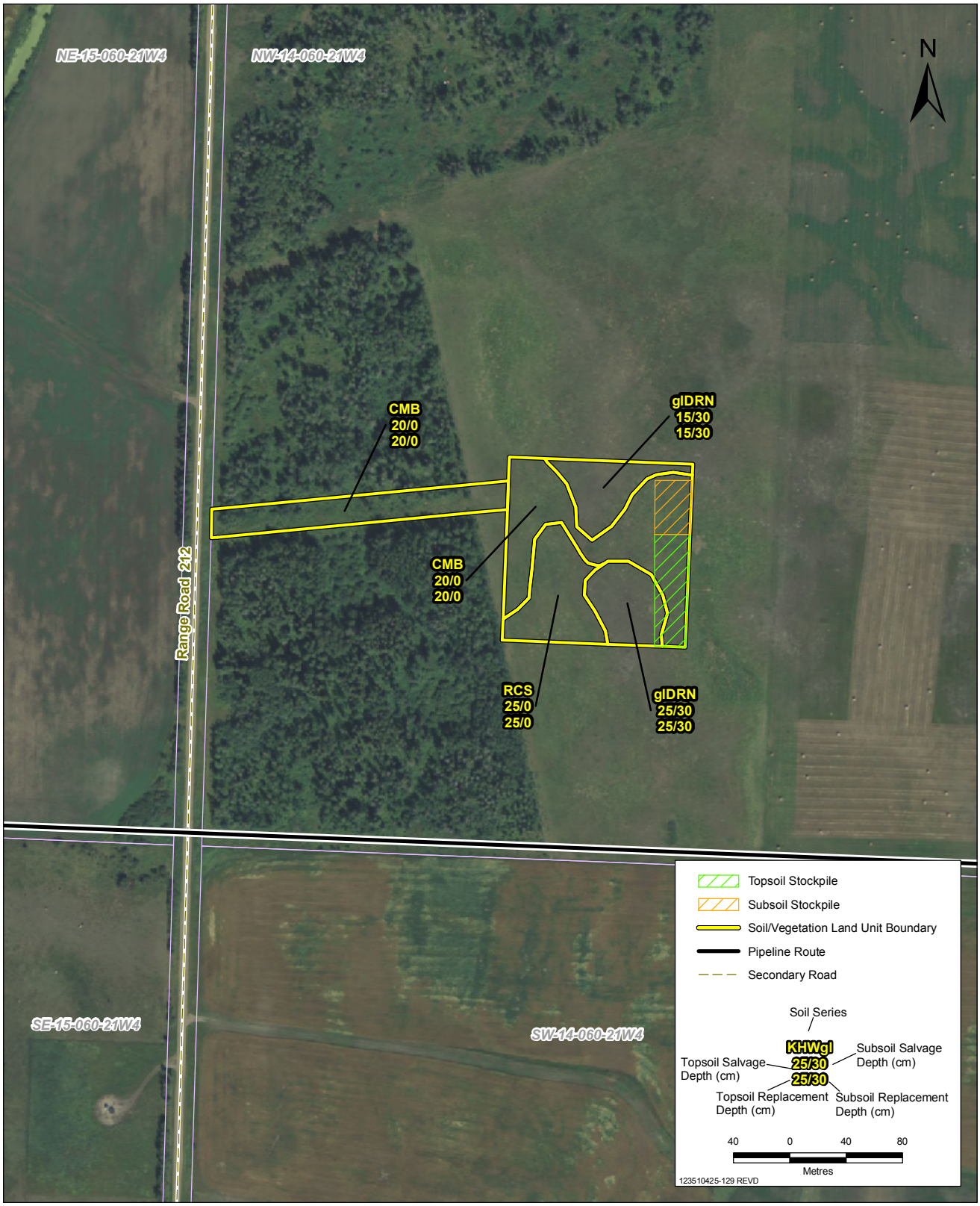
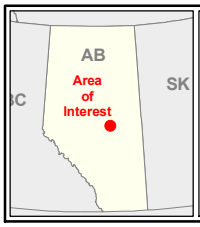
FIGURE NO. **4-2**

Last Modified: Oct 21, 2010 By: jpetho





QUEST CARBON CAPTURE AND STORAGE PROJECT

Soil Salvage and Replacement Depths and Stockpile Locations for Well Pad 12-14 and Access Road

Acknowledgements: Original Drawing by Stantec
Wells: Shell August 26, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008.

PREPARED BY Stantec

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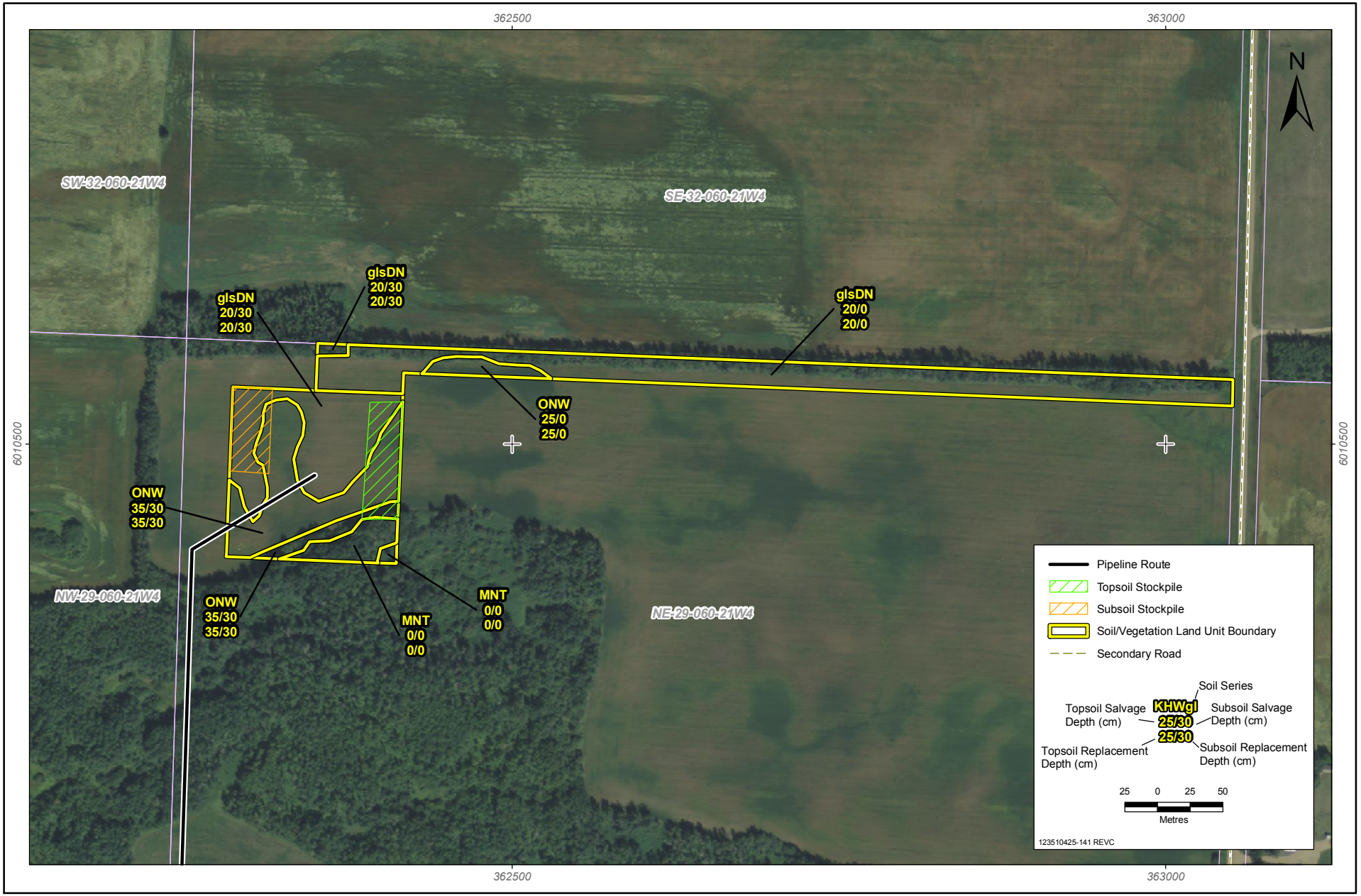
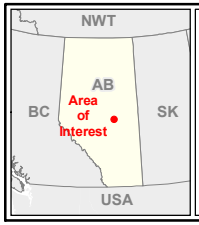
FIGURE NO. 4-3

Last Modified: Nov. 3, 2010 By: jpetho





QUEST CARBON CAPTURE AND STORAGE PROJECT

Soil Salvage and Replacement Depths and Stockpile Locations for Well Pad 15-29 and Access Road

Acknowledgements: Original Drawing by Stantec.
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008.

PREPARED BY Stantec

PREPARED FOR

FIGURE NO. 4-4

Last Modified: Oct 21, 2010 By: jpetho

4.4.1.6 Reclamation Material Balances

For topsoil and subsoil material balances for the well pads, access roads and borrow pit, see Tables 4-6 to 4-15. The materials balances in the tables were calculated on the assumption of 100% replacement as the reclamation objective. Although losses may occur during handling, it is not possible to quantify these in advance.

Table 4-6 Well Pad 8-19 Reclamation Materials Balances – Topsoil

Project Component	Area Stripped of Topsoil (ha)	Depth of Topsoil Salvaged (cm)	Volume of Topsoil Salvaged (m^3)	Area Requiring Topsoil Replacement[1] (ha)	Required Topsoil Replacement Depth[1] (cm)	Volume of Topsoil Required (m^3)	Topsoil Surplus or Deficit (m^3)
Pad							
KVG	0.47	20	940	0.47	20	940	0
glUCS	0.21	20	420	0.21	20	420	0
UCS	0.92	20	1,840	0.92	20	1,840	0
Subtotal	1.6	N/A	3,200	1.6	N/A	3,200	0
Access Road							
KVG	0.09	20	180	0.09	20	180	0
glUCS	0.09	20	180	0.09	20	180	0
UCS	0.12	20	240	0.12	20	240	0
Subtotal	0.3	N/A	600	0.3	N/A	600	0
Borrow pit							
KVG	0.0	N/A	0	0.0	N/A	0	0
glUCS	0.13	20	260	0.13	20	260	0
UCS	0.37	20	740	0.37	20	740	0
Subtotal	0.5	N/A	1,000	0.5	N/A	1,000	0
Total	2.4	N/A	4,800	2.4	N/A	4,800	0

NOTES:
N/A – not applicable
Topsoil and subsoil replacement areas and depths equal salvage areas and depths.

Table 4-7 Well Pad 8-19 Reclamation Materials Balances – Subsoil

Project Component	Area Stripped of Subsoil (ha)	Depth of Subsoil Salvaged (cm)	Volume of Subsoil Salvaged (m^3)	Area Requiring Subsoil Replacement (ha)	Required Subsoil Replacement Depth (cm)	Volume of Subsoil Required (m^3)	Subsoil Surplus or Deficit (m^3)
Pad							
KVG	0[1]	N/A	N/A	0	N/A	N/A	0
glUCS	0.21	30	630	0.21	30	630	0
UCS	0.92	30	2,760	0.92	30	2,760	0
Subtotal	1.13	N/A	3,390	0.13	N/A	3,390	0

Table 4-7 Well Pad 8-19 Reclamation Materials Balances – Subsoil (cont'd)

Project Component	Area Stripped of Subsoil (ha)	Depth of Subsoil Salvaged (cm)	Volume of Subsoil Salvaged (m^3)	Area Requiring Subsoil Replacement (ha)	Required Subsoil Replacement Depth (cm)	Volume of Subsoil Required (m^3)	Subsoil Surplus or Deficit (m^3)
Access Road							
Subtotal	0	0	0	0	0	0	
Borrow Pit							
KVG	0[1]	N/A	N/A	0	N/A	N/A	0
glUCS	0.13	30	390	0.13	30	390	0
UCS	0.37	30	1,110	0.37	30	1,110	0
Subtotal	0.5	N/A	1,500	0.5	30	1,500	0
Total	1.63	N/A	4,890	1.63	N/A	4,890	0

NOTE:

[1] No salvage of Solonetzic subsoils for the Kavanagh series.

Table 4-8 Well Pad 7-11 Reclamation Materials Balances – Topsoil

Project Component	Area Stripped of Topsoil (ha)	Depth of Topsoil Salvaged (cm)	Volume of Topsoil Salvaged (m^3)	Area Requiring Topsoil Replacement[1] (ha)	Required Topsoil Replacement Depth[2] (cm)	Volume of Topsoil Required (m^3)	Topsoil Surplus or Deficit (m^3)
Well Pad							
Norma	0.5	25, 40	1,700	0.5	25, 40	1,700	0
Gleyed Norma	0.7	40	2,800	0.7	40	2,800	0
Onoway	0.5	25	1,250	0.5	25	1,250	0
Subtotal	1.7 [1]	N/A	5,750 [1]	1.7 [1]	N/A	5,750 [1]	0
Access Road[3]							
Norma	0.2	25	500	0.2	25	500	0
Gleyed Norma	0.5	25	1,500	0.6	25	1,500	0
Onoway	0.1	40	400	0.1	40	400	0
Subtotal	0.8	N/A	2,400	0.8	N/A	2,400	0
Total	2.5	N/A	7,670	2.5	N/A	8,150	0

NOTES:

N/A – not applicable

[1] Area under subsoil stockpile 0.27 ha, salvaged topsoil volume 555 m^3 are not included in the mass balance but will be reclaimed as part of the site.

[2] Topsoil replacement depths equal topsoil salvage depths.

[3] Assumes a stripping width of 10 m.

Table 4-9 Well Pad 7-11 Reclamation Materials Balances – Subsoil

Project Component	Area Stripped of Subsoil (ha)	Depth of Subsoil Salvaged (cm)	Volume of Subsoil Salvaged (m^3)	Area Requiring Subsoil Replacement (ha)	Required Subsoil Replacement Depth (cm)	Volume of Subsoil Required (m^3)	Subsoil Surplus or Deficit (m^3)
Well Pad							
Norma	0.5	30	1,500	0.5	30	1,500	0
Gleyed Norma	0.7	30	2,100	0.7	30	2,100	0
Onoway	0.5	30	1,500	0.5	30	1,500	0
Subtotal	1.7	30	5,100	1.7	30	5,100	0
Access							
Subtotal	0	0	0	0	0	0	
Total	1.7	30	5,100	1.7	30	5,100	0

Table 4-10 Well Pad 10-06 Reclamation Materials Balances – Topsoil

Project Component	Area Stripped of Topsoil (ha)	Depth of Topsoil Salvaged (cm)	Volume of Topsoil Salvaged (m^3)	Area Requiring Topsoil Replacement[1] (ha)	Required Topsoil Replacement Depth[2] (cm)	Volume of Topsoil Required (m^3)	Topsoil Surplus or Deficit (m^3)
Well Pad							
Gleyed Kehiwin	1.1	25	2,750	1.1	25	2,750	0
Onoway	0	0	0	0	0	0	0
Gleyed Spedden	0.3	30	900	0.3	30	900	0
Subtotal	1.4	N/A	3,650	1.4	N/A	3,650	0
Access Road[3]							
Gleyed Kehiwin	0.1	20	200	0.1	20	200	0
Onoway	<0.1	20	175	<0.1	20	175	0
Gleyed Spedden	<0.1	20	175	<0.1	20	175	0
PR	0.3	20	600	0.3	20	600	0
Subtotal	0.5	N/A	1,150	0.5	N/A	1,150	0
Total	1.9	N/A	4,800	1.9	N/A	4,800	0

NOTES:

N/A – not applicable

[1] Area under subsoil stockpile and salvaged topsoil volume are not included in the mass balance but will be reclaimed as part of the site.

[2] Topsoil replacement depths equal topsoil salvage depths.

[3] Assumes a stripping width of 10 m.

Table 4-11 Well Pad 10-06 Reclamation Materials Balances – Subsoil

Project Component	Area Stripped of Subsoil (ha)	Depth of Subsoil Salvaged (cm)	Volume of Subsoil Salvaged (m^3)	Area Requiring Subsoil Replacement (ha)	Required Subsoil Replacement Depth[1] (cm)	Volume of Subsoil Required (m^3)	Subsoil Surplus or Deficit (m^3)
Well Pad							
Gleyed Kehiwin	1.0	30	2,750	1.0	30	2,750	0
Onoway	0	0	0	0	0	0	0
Gleyed Spedden	0.3	30	900	0.3	30	900	0
Subtotal	1.3	N/A	3,650	1.3	N/A	3,650	0
Access Road							
Subtotal	0	0	0	0	0	0	0
Total	1.3	N/A	3,650	1.3	N/A	3,650	0

NOTE:
N/A – not applicable

Table 4-12 Well Pad 12-14 Reclamation Materials Balances – Topsoil

Project Component	Area Stripped of Topsoil (ha)	Depth of Topsoil Salvaged (cm)	Volume of Topsoil Salvaged (m^3)	Area Requiring Topsoil Replacement[1] (ha)	Required Topsoil Replacement Depth[1] (cm)	Volume of Topsoil Required[1] (m^3)	Topsoil Surplus or Deficit (m^3)
Well Pad							
Columbine	0.6	20	1,200	0.6	20	1,200	0
glDirleton	0.25 0.25	15 25	375 625	0.25 0.25	15 25	375 625	0
Rochester	0.4	25	1,000	0.4	25	1,000	0
Subtotal	1.5[1]	N/A	3,200[1]	1.5[1]	N/A	3,200[1]	0
Access Road							
Columbine	0.4	25	1,000	0.4	25	1,000	0
Total	1.9[1]	N/A	4,200[1]	1.9[1]	N/A	4,200[1]	0

NOTES:
N/A – not applicable
[1] Excludes area under the topsoil stockpile.

Table 4-13 Well Pad 12-14 Reclamation Materials Balances – Subsoil

Project Component	Area Stripped of Subsoil (ha)	Depth of Subsoil Salvaged (cm)	Volume of Subsoil Salvaged (m^3)	Area Requiring Subsoil Replacement (ha)	Required Subsoil Replacement Depth[1] (cm)	Volume of Subsoil Required (m^3)	Subsoil Surplus or Deficit (m^3)
Well Pad							
glDirleton	0.5	30	1500	0.5	30	1,500	0
Subtotal	0.5	30	0	0.5	30	1,500	0
Access Road							
Subtotal	0	0	0	0	0	0	
Total	0	0	0	0	0	0	0

Table 4-14 Well Pad 15-29 Reclamation Materials Balances – Topsoil

Project Component	Area Stripped of Topsoil (ha)	Depth of Topsoil Salvaged (cm)	Volume of Topsoil Salvaged (m^3)	Area Requiring Topsoil Replacement (ha)	Required Topsoil Replacement Depth[2] (cm)	Volume of Topsoil Required (m^3)	Topsoil Surplus or Deficit (m^3)
Well Pad							
glSpedden	0.7	20	1,400	0.7	20	1,400	0
Onoway	0.7	35	2,450	0.7	35	2,450	0
Manatokan	0.	0	0	0	0	0	0
Subtotal	1.4[1]	N/A	3,850[1]	1.4[1]	N/A	3,850[1]	0
Access Road							
glSpedden	1.4	25	3,500	1.4	25	3,500	0
Onoway	0.1	25	250	0.1	25	250	0
Subtotal	1.5	N/A	3,750	1.5	N/A	3,750	0
Total	2.9	N/A	7,600	2.9	N/A	7,600	0

NOTES:
N/A – not applicable
[1] Excludes area under topsoil.
[2] Topsoil replacement depths equal topsoil salvage depths.

Table 4-15 Well Pad 15-29 Reclamation Materials Balances – Subsoil

Project Component	Area Stripped of Subsoil (ha)	Depth of Subsoil Salvaged (cm)	Volume of Subsoil Salvaged (m^3)	Area Requiring Subsoil Replacement (ha)	Required Subsoil Replacement Depth (cm)	Volume of Subsoil Required (m^3)	Subsoil Surplus or Deficit (m^3)
Well Pad							
glSpedden	0.5	30	1,500	0.5	30	1,500	0
Onoway	0.7	30	2,100	0.7	30	2,100	0
Manatokan	0	0	0	0	0	0	0
Subtotal	1.2	N/A	3,600	1.2	N/A	360	0
Access Road							
Subtotal	0	0	0	0	0	0	
Total	1.2	30	3,600	1.2	30	3,600	0

4.4.2 Potential Environmental Effects and Mitigation Measures – Vegetation and Soils

No rare plants or non-native species were found in the well pad pre-disturbance assessment areas, except for the noxious weeds in Well Pad 8-19. Therefore, no mitigation measures related to vegetation, rare plants or non-native species are required.

Construction of the proposed well pads and access roads will entail topsoil and subsoil stripping, as outlined previously. In most cases, no soils were encountered that require specific mitigation or handling measures. Therefore, by following the topsoil and subsoil salvage procedures discussed previously, sufficient resources should be available for successful reclamation at decommissioning and abandonment (for site-specific information, see the following).

4.4.2.1 Well Pad 8-19

For Well Pad 8-19, as the Solonetzic subsoils of the Kavanagh soils have a high sodium content, they were not salvaged. Otherwise, no soils were encountered that required specific mitigation or handling measures.

4.4.2.2 Well Pads 7-11 and 10-06

For Well Pads 7-11 and 10-06, no soils were encountered that will require specific mitigation or handling measures.

4.4.2.3 Well Pad 12-14

For Well Pad 12-14, 70% of the soils encountered had subsoils that are ranked Poor or Unsuitable for reclamation. Therefore, no subsoil salvage and stockpiling is required for these specific areas.

4.4.2.4 Well Pad 15-29

The Manatokan soils that occupy the southeast corner of the well pad are not suitable for salvage or construction. They will be covered with geotextile and padded with fill to make a suitable working surface. Otherwise, no soils were encountered that will require specific mitigation or handling measures.

4.5 Reclamation during Operation

Shell will require the full extent of the well pad areas for operation and maintenance during the operational life of the Project. Therefore, any interim reclamation will likely be limited to small areas around the edges of the pads that require the application of topsoil and seeding, for stabilizing the surface to prevent erosion.

The borrow material used on Well Pad 8-19 came from an elevated knoll on the land. The area providing the borrow material has been graded and contoured flat to match the surrounding land. This area was seeded and reclaimed after the original material was taken, and is currently fenced off to prevent access of equipment or storage.

4.5.1 Erosion Control

Any requirement for immediate erosion control measures or prevention of siltation into the areas surrounding the disturbances before the vegetation cover becomes established (such as sediment fences, erosion-control matting or tackifying agents) will be determined on a site-specific basis to ensure the best techniques are used. Depending on the end land use such measures may not be applicable.

4.5.2 Weed Control

4.5.2.1 Regulatory Requirements

According to Alberta's *Weed Control Act*, species defined as prohibited noxious or noxious in Weed Control Regulation must be eliminated or controlled.

4.5.2.2 Weed and Non-Native Plant and Pest Control Methods

On topsoil and subsoil stockpiles, cultural control of weeds (i.e., seeding of competitive species) will be used. Mechanical control will be implemented along ditches, adjacent to aboveground pipelines and around structures. For control of noxious and restricted weeds, non-residual herbicides will be applied as necessary. Hand-picking and disposal at an approved site might be required if herbicides fail to control infestations.

A licensed industrial pesticide applicator will be contracted to select and apply all herbicides in compliance with the weed control plan, the Code of Practice for Pesticides and any relevant terms and conditions of the approval. Soil sterilants will not be used on any Project areas.

There is a potential for clubroot to be present in the areas designated for the well pads. For Shell's best management practice to minimize the spread of clubroot, see Volume 1, Appendix I, Pipeline Environmental Protection Plan.

5 Closure

5.1 Goals

At decommissioning and abandonment, successful conservation during construction and reclamation will result in a closure landscape that achieves the following:

- erosion control and site stability
- return of all disturbed areas to land capability that is equivalent to the pre-disturbed conditions, or consistent with the approved end land use or uses, to the degree practical
- revegetation of all disturbed areas to the targeted end land use or uses, if applicable
- control of noxious and restricted weeds, if applicable
- development of a self-sustaining landscape, if applicable
- reclamation certification

5.2 Permanent Reclamation

The basic activities for final reclamation and establishing the closure landscape include, but are not limited to:

- abandoning and decommissioning facilities
- removing infrastructure
- remediating contaminated areas (if required)
- restoring grade and drainage
- alleviating compaction
- replacing subsoil and topsoil
- revegetating

The goals of the C&R Plan are to achieve a closure landscape that is as similar to pre-disturbance conditions as practical, with respect to topography, land capability (equivalent, not identical) and vegetation community structure and distribution. Soil handling during reclamation activities could be affected by ground surface conditions and weather conditions. These conditions will also influence the time of seeding and transplanting in reclaimed areas.

Shell will monitor reclamation of soils and vegetation according to Alberta Environment's (AENV's) *Reclamation Criteria for Wellsites and Associated Facilities*, as may be amended.

5.2.1 Soil Remediation

Contaminated soil will be remediated upon decommissioning and abandonment, if required. Remediation of soils will meet the regulatory standards current at the time of abandonment.

5.2.2 Post-Reclamation Topography

Upon completion of any required remediation, the post-reclamation topography will be designed to blend into the surrounding landforms, by removing the all-weather surface (gravel), and any fill or geotextile, decompacted by deep ripping or disking, as appropriate. The site will be rough graded to restore drainage patterns close to those of pre-development, and to allow farm operation to resume unimpeded.

5.2.3 Soil Replacement

5.2.3.1 Subsoil Replacement

Where relevant, subsoil replacement will start only after remediation is complete, post-reclamation topography has been established and compaction has been alleviated. Specifically, stockpiled subsoil will be redistributed over the disturbed areas and fine contoured to blend into the surrounding terrain. Subsoil compaction will be alleviated by ripping or disking before topsoil replacement, if required.

5.2.3.2 Topsoil Replacement

Stockpiled topsoil material will be replaced to a uniform depth across the recontoured well pad area and access road when surface conditions are suitable (dry and trafficable), to limit potential rutting, compaction or admixing. Topsoil replacement will be suspended immediately if wet conditions or high winds lead to admixing and degradation or topsoil loss.

5.2.3.3 Erosion Control

Site-specific erosion control measures will be developed when the end land use objectives have been determined. These methods may include, but are not limited to:

- installing silt fencing
- applying tackifiers
- seeding a fast-growing annual cover crop
- installing erosion control matting

5.2.4 Site-Specific Land Use for Closure

5.2.4.1 Agricultural Capability

Agricultural capabilities in the reclaimed landscape should approximate those of pre-disturbance conditions to the degree practical (see Tables 5-1 to 5-5).

For Well Pads 7-11 and 10-06, the rating of the reclaimed not rated (NR) units as Class 6 may be conservative, but will allow the current land management practices to be resumed.

Table 5-1 Pre-Development and Post-Reclamation Agricultural Capabilities for Well Pad 8-19, Borrow Pit and Access Road

Project Component	Pre-Development Capability (ha)			Post-Reclamation Capability (ha)[1]		
	Class 3	Class 4	Total	Class 3	Class 4	Total
Well pad	1.13	0.47	1.60	1.13	0.47	1.60
Access road	0.21	0.09	0.30	0.21	0.09	0.21
Borrow pit	0.50	0.00	0.50	0.50	0.00	0.50
Total	1.84	0.56	2.4	1.84	0.56	2.4

NOTE:
[1] Assumes borrow pit will be reclaimed as upland at closure.

Table 5-2 Pre-Development and Post-Reclamation Agricultural Capabilities for Well Pad 7-11 and Access Road

Project Component	Pre-Development Capability (ha)				Post-Reclamation Capability (ha)		
	Class 2	Class 6	NR[1]	Total	Class 2[1]	Class 6	Total
Well pad	1.2	0.5	<0.1	1.7	1.2	0.5	1.7
Access road	0.7	0.1	0.0	0.8	0.7	0.1	0.8
Total	1.9	0.6	<0.1	2.5	1.9	0.6	2.5

NOTES:
NR – not rated
[1] Less than 0.1 ha of previously disturbed or reclaimed land is not rated and occurs at the north end of the access road that. It will be reclaimed to Class 2 at closure, based on the occurrence of a Class 2 unit immediately south of the NR unit.

Table 5-3 Pre-Development and Post-Reclamation Agricultural Capabilities for Well Pad 10-6 and Access Road

Project Component	Pre-Development Capability (ha)					Post-Reclamation Capability (ha)			
	Class 3	Class 4	Class 6	NR[1]	Total	Class 3	Class 4	Class 6[1]	Total
Well pad	1.3	0.3	0.1	0.0	1.7	1.3	0.3	0.1	1.7
Access road	0.3	0.3	0.1	0.7	1.4	0.3	0.3	0.8	1.4
Total	1.6	0.6	0.2	0.7	3.1	1.6	0.6	0.9	3.1

NOTES:
NR – not rated
[1] 0.7 ha of previously disturbed or reclaimed land occurs along the access road and will be reclaimed to Class 6 at closure. This is based on the occurrence of a Class 6 unit between the two NR units.

Table 5-4 Pre-Development and Post-Reclamation Agricultural Capabilities for Well Pad 12-14 and Access Road

Project Component	Pre-Development Capability (ha)			Post-Reclamation Capability (ha)		
	Class 3	Class 4	Total	Class 3	Class 4	Total
Well pad	0.8	0.9	1.7	0.8	0.9	1.7
Access road	0.4	0.0	0.4	0.4	0.0	0.4
Total	1.2	0.9	2.1	1.2	0.9	2.1

Table 5-5 Pre-Development and Post-Reclamation Agricultural Capabilities for Well Pad 15-29 and Access Road

Project Component	Pre-Development Capability (ha)				Post-Reclamation Capability (ha)			
	Class 3	Class 6	Class 7	Total	Class 3	Class 6	Class 7	Total
Well pad	0.7	0.8	0.2	1.7	0.7	0.8	0.2	1.7
Access road	1.4	0.1	0.0	1.5	1.4	0.1	0.0	1.5
Total	2.1	0.9	0.2	3.2	2.1	0.9	0.2	3.2

5.2.4.2 Revegetation and Weed Control

As previously described, the timing, method and type of revegetation and seeding will be outlined in the agreement between the landowner and Shell. This may be reviewed and revised over time and will be directed by the terms conditions in place at closure.

Weed control measures will depend upon the land use and access agreements.

5.3 Post-Reclamation Monitoring and Assessment

5.3.1 Post-Reclamation Soils Assessment

Shell will monitor reclamation of soils in accordance with AENV's *Reclamation Criteria for Wellsites and Associated Facilities,* as may be amended.

5.4 Reporting and Regulatory Compliance

Results from the monitoring program will be reported to AENV or the responsible authority, as required under the terms and conditions of Project approval.

5.5 Summary

The detailed C&R Plan is Shell's commitment to reclaim the well pads, access roads and borrow pit to equivalent capability after Project decommissioning and abandonment. If industry best management practices evolve over time, Shell, in consultation with the appropriate regulatory agencies, will incorporate such developments in the plan to ensure successful realization of end land use objectives.

6 References

6.1 Literature Cited

Alberta Environmental Protection (AEP). 1998. *Voluntary Shutdown Criteria for Construction Activity or Operations*. C&R/IL/98-4. Edmonton, AB.

Pedocan Land Evaluations (Pedocan). 1993. *Soil Series Information for Reclamation Planning in Alberta*, Volumes 1 and 2. Report # RRTAC 93-7. Edmonton, AB.

TERA. 2010. *Environmental Assessment for the Proposed Shell Canada Limited Site 4A 8-19-59-20 W4M Well Site and Access Road*. TERA Environmental Consultants, May 2010. Calgary, AB.

Attachment A Detailed Soil and Site Descriptions

Table A-1 Inspection Site Data – Well Pad 8-19, Access Road and Borrow Pit

Inspection Site	Horizon	Depth (cm)	Colour	Texture	Structure	Consistence	Stoniness	Mottling	HCl eff.	Salts
1	Ah	0-10	10YR 2/2	L	m.f.gran.	fri	S1	-	x	-
	Aegj	10-23	10YR 5/3	SiL	m.m.plty.	fri	S0-1	-	x	yes
	Bntgj	23-63	10YR 5/4	SCL	s.c.column.	vfirm	S1-2	-	x	yes
	Cskgj	63-120	2.5Y 5/4	SL	ma.	firm	S1-2	-	w-m	yes
2	Ah	0-15	10YR 2/2	L	m.f.gran.	fri	S1	-	x	-
	Ae	15-22	10YR 5/3	SiL	m.f.plty.	fri	S0-1	-	x	-
	Bt	22-60	10YR 5/4	L-CL	m.f.sbk	firm	S1	-	x	-
	Ck	60-100	2.5Y 5/4	L	ma.	firm	S1	-	w-m	-
3	L-H	7-0	10YR 2/2	O	-	vfri	S0	-	x	-
	Ah	0-8	10YR 2/2	L	w.f.gran.	fri	S1	-	x	-
	Aegj	8-24	10YR 5/2	SiL	w.f.plty.	fri	S0-1	yes	x	-
	Btgj	24-60	10YR 6/4	L-CL	m.f.sbk.	firm	S1	yes	x	-
	BCgj	60-90	10YR 6/3	L-CL	ma.	firm	S1	yes	x	-
4	L-H	10-0	10YR 2/2	O	-	vfri	S0	-	x	-
	Ahe	0-20	10YR 2/2	L-SiL	w.f.gran.	fri	S1	-	x	-
	Bt	20-70	10YR 4/4	L	m.m.sbk.	firm	S1	-	x	-
	BC	70+	10YR 4/3	L	w.f.sbk.	firm	S1	-	x	-
5	L-H	7-0	10YR 2/1	O	-	vfri	S0	-	x	-
	Ahe	0-20	10YR 2/2	L-SiL	w.f.gran.	fri	S0-1	-	x	-
	Ae	20-24	10YR 5/3	L-SiL	w.f.plty.	vfri	S0-1	-	x	-
	Bt	24-65	10YR 4/4	L-CL	m.f.sbk.	firm	S1-2	-	x	-
	BC	65-120	10YR 4/3	L-CL	w.f.sbk.	firm	S1	-	x	-

Table A-1 Inspection Site Data – Well Pad 8-19, access Road and Borrow Pit (cont'd)

Inspection Site	Horizon	Depth (cm)	Colour	Texture	Structure	Consistence	Stoniness	Mottling	HCl eff.	Salts
6	L-H	10-0	10YR 2/2	O	-	vfri	S0	-	x	-
	Ahe	0-10	10YR 2/1	SiL-L	m.f.plty.	fri	S1	-	x	-
	Bt	10-70	10YR 5/6	L	m.m.sbk.	firm	S1	-	x	-
	Ck	70-120	2.5 Y 5/4	L	ma.	firm	S1	-	w-m	-
7	Ap	0-10	10YR 2/2	L	w.f.gran.	fri	S1	-	x	-
	Aegj	10-12	10YR 5/3	L-SiL	m.m.plty.	fri	S1	yes	x	-
	Bntgj	12-35	10YR 3/3	L	s.c.column.	vfirm	S0	yes	x	-
	Cskgj	35-100	10YR 6/3	L	ma.	firm	S0	yes	w-m	yes
8	Ap	0-17	10YR 2/1	L	m.f.gran.	fri	S1	-	x	-
	Bntgj	17-30	10YR 3/2	L	s.c.column.	vfirm	S0	yes	x	-
	Cskgj	30-90	10YR 6/3	L-CL	ma.	firm	S0	yes	w-m	yes
9	Ap	0-16	10YR 2/1	L	m.f.gran.	fri	S1	-	x	-
	Aegj	16-20	10YR 5/2	SiL-L	m.m.plty.	vfri	S1	yes	x	-
	Bntgj	20-35	10YR 3/3	CL	s.c.column.	vfirm	S0	yes	x	-
	Cskgj	35-100	10YR 5/3	CL	ma.	firm	S0	yes	w-m	yes
10	Ap	0-17	10YR 2/2	L	m.f.gran.	fri	S1	-	x	-
	Bntgj	17-40	10YR 4/3	CL	s.c.column.	vfirm	S0	yes	x	-
	Cskgj	40-90	10YR 5/3	CL	ma.	firm	S0	yes	w-m	yes
11	Ap	0-8	10YR 2/1	L	w.f.gran.	fri	S1	-	x	-
	Aegj	8-15	10YR 5/3	SiL	w.f.plty.	vfri	S1	yes	x	-
	Bnt	15-23	10YR 3/3	CL-C	s.c.column.	vfrim	S0	-	x	-
	Cskgj	23-100	10YR 5/3	CL	ma.	firm	S0	yes	w-m	yes
12	Ap	0-12	10YR 2/2	L	m.f.gran.	fri	S1-2	-	x	-
	Bt	12-64	10YR 5/4	SCL	m.f.sbk.	firm	S1-2	-	x	-
	Ck	64-120	10YR 5/3	SCL	ma.	firm	S1-2	-	w-m	-

Table A-1 Inspection Site Data – Well Pad 8-19, access Road and Borrow Pit (cont'd)

Inspection Site	Horizon	Depth (cm)	Colour	Texture	Structure	Consistence	Stoniness	Mottling	HCl eff.	Salts
13	Ap	0-17	10YR 2/1	L	m.f.gran.	fri	S1-2	-	x	-
	Ae	17-24	10YR 5/3	L	m.f.plty.	vfri	S1-2	-	x	-
	Bt	24-70	10YR 5/4	L-CL	m.f.sbk.	firm	S1-2	-	x	-
	Ck	70-110	2.5Y 5/4	L-CL	ma.	firm	S1-2	-	w-m	-
14	L-H	7-0	1 0YR 2/2	O	-	vfri	S0	-	x	-
	Ah	0-4	10YR 2/2	L	w.f.gran.	vfri	S1	-	x	-
	Ae	4-12	10YR 5/3	L-SiL	w.f.plty.	vfri	S1	-	x	-
	Bt	12-65	10YR 5/4	L-CL	m.f.sbk.	firm	S1-2	-	x	-
	BC	65-90	10YR 5/4	L-CL	w.f.sbk.	firm	S1-2	-	x	-
15	L-H	8-0	10YR 2/2	O	-	vfri	S0	-	x	-
	Ah	0-20	10YR 2/1	L	w.f.gran.	fri	S0-1	-	x	-
	Aegj	20-32	10YR 5/2	L-SiL	w.f.plty.	vfri	S0-1	yes	x	-
	Btgj	32-70	10YR 4/3	SCL	m.f.sbk.	firm	S1	yes	x	-
	Ckgj	70-90	2.5 Y 4/4	SCL	ma.	firm	S1	yes	w-m	-
16	L-H	0-9	10YR 2/2	O	-	vfri	S0	-	x	-
	Ae	9-14	10YR 5/3	L-SiL	w.f.plty.	vfri	S1	-	x	-
	Bt	14-65	10YR 5/6	CL	m.m.sbk.	firm	S1-2	-	x	-
	BC	65-97	10YR 5/6	L-CL	w.f.sbk.	firm	S1-2	-	x	-
	Ck	97+	10YR 4/3	L-CL	ma.	firm	S1-2	-	w-m	-
17	L-H	10-0	10YR 2/1	O	-	vfri	S0	-	x	-
	Ah	0-15	10YR 2/1	L	m.f.gran.	fri	S0-1	-	x	-
	Btgj	15-48	10YR 4/4	CL	m.f.sbk.	firm	S1	yes	x	-
	Ckgj	48-90	10YR 5/2	CL	ma.	firm	S1	yes	w-m	-

Table A-1 Inspection Site Data – Well Pad 8-19, access Road and Borrow Pit (cont'd)

Inspection Site	Horizon	Depth (cm)	Colour	Texture	Structure	Consistence	Stoniness	Mottling	HCl eff.	Salts
18	L-H	9-0	10YR 2/2	O	-	vfri	S0	-	x	-
	Ah	0-5	10YR 2/2	L	w.f.gran.	fri	S1	-	x	-
	Ae	5-20	10YR 5/3	SL-L	w.f.plty.	fri	S1	-	x	-
	Bt	20-84	10YR 5/6	L-CL	m.f.sbk.	firm	S1-2	-	x	-
	BC	84+	10YR 5/4	L-CL	w.f.sbk.	firm	S1-2	-	x	-

Key to Site Assessments

Colour
Munsell Colour Notations

Structure
m.f.gran. - moderate, fine granular
w.f.gran. - weak, fine granular
w.f.plty. - weak, fine platy
m.f.plty. - moderate, fine platy
m.m.plty. - moderate, medium platy
m.f.sbk. - moderate, fine subangular blocky
w.f.sbk. - weak, fine subangular blocky
m.m.sbk. - moderate, medium subangular blocky
s.c.column - strong, coarse columnar
ma - massive

Texture
C - clay
CL - clay loam
L - loam
O - organic
SL - sandy loam
SiL - silt loam
SCL - sandy clay loam

Stoniness Classes
S0 - non-stony
S1 - slightly stony
S2 - moderately stony

Consistence
vfri - very friable
fri - friable
firm - firm
vfirm - very firm

HCl effervescence
X - non
w - weak
m - moderate

SOURCE: TERA (2010, Appendix B, Table 2)

Table A-2 Inspection Site Data – Well Pad 7-11 and Access Road

Site ID	UTM Zone	Easting	Northing	Profile Type	Soil Series	Soil Subgroup	Parent Material 1	Surface Expression	Surface Stoniness Class	Slope (%)	Landscape Slope Class	Topsoil Depth (cm)
SQ300KD	12	376662.4	5994588.2	D	FRYzz	O.BLC	TILL	Undulating	1 (0.01-0.1)	2	3 (2-5%)	13
SQ301EV	12	376625.6	5994594.0	D	ONWaaca	O.HG	TILL	Undulating	0 (<0.01)		3 (2-5%)	38
SQ302KD	12	376635.0	5994587.5	ND	VILzz	GL.BLC	TILL	Undulating		3	3 (2-5%)	38
SQ303EV	12	376609.1	5994680.9	D	VILzz	GL.BLC	TILL	Undulating	1 (0.01-0.1)	1	3 (2-5%)	34
SQ304IW	12	376564.2	5994586.5	D	NRM	SZ.BLC	TILL	Undulating			3 (2-5%)	14
SQ304KD	12	376564.2	5994586.5	D	FRYzz	O.BLC	TILL	Undulating		5	3 (2-5%)	21
SQ305EV	12	376560.6	5994637.3	D	FRYzz	O.BLC	TILL	Undulating	1 (0.01-0.1)	4	3 (2-5%)	43
SQ306KD	12	376612.0	5994636.1	D	VILzz	GL.BLC	TILL	Undulating	1 (0.01-0.1)	3	3 (2-5%)	43
SQ306VL	12	376612.0	5994636.1	D	NRMgl	GLSZ.BLC	TILL					27
SQ307EV	12	376661.3	5994646.5	D	FRYzz	O.BLC	TILL	Undulating	1 (0.01-0.1)	0	3 (2-5%)	23
SQ308KD	12	376666.9	5994690.8	D	MPV	HU.LG	TILL	Undulating	0 (<0.01)	0	3 (2-5%)	23
SQ309KD	12	376608.5	5994702.2	ND	VILcazz	GLCA.BLC	TILL					17
SQ310KD	12	376568.4	5994697.6	D	ONWaa	O.HG	TILL	Undulating	0 (<0.01)	0	3 (2-5%)	22
SQ330EV	12	376498.6	5994820.5	D	ONWaasa	O.HG	TILL	Undulating	0 (<0.01)	0	3 (2-5%)	37
SQ331KD	12	376495.3	5994727.0	D	FRYcazz	CA.BLC	TILL	Undulating	1 (0.01-0.1)	2	3 (2-5%)	27
SQ333IW	12	376505.2	5994924.3	ND	NRMglzt	GLSZ.BLC	TILL	Undulating			4 (6-9%)	24
SQ333KD	12	376505.2	5994924.3	D	DNTglzz	GLDG.SZ	TILL	Undulating	0 (<0.01)	1	3 (2-5%)	35
SQ334IW	12	376509.0	5995013.2	ND	NRM		TILL	Undulating			4 (6-9%)	18
SQ334KD	12	376509.0	5995013.2	D	DNTsczz	DG.SS	TILL	Undulating	1 (0.01-0.1)	2	2 (0.5-2%)	24

Table A-3 Inspection Site Data – Well Pad 10-06 and Access Road

Site ID	UTM Zone	Easting	Northing	Profile Type	Soil Series	Soil Subgroup	Parent Material 1	Parent Material 2	Surface Expression	Surface Stoniness Class	Slope (%)	Landscape Slope Class	Topsoil Depth (cm)
SQ400VL	12	370281.4	6003052.2	D	MPV	HU.LG	TILL		Undulating			2-3 (0.5-5%)	21
SQ401VL	12	370288.6	6003100.5	D	KHWglzt	GLSZ.DGC	TILL		Undulating		3	3 (2-5%)	17
SQ402VL	12	370305.0	6003155.5	D	KHWgl	GL.DGC	TILL		Undulating		3	3 (2-5%)	18
SQ403VL	12	370339.0	6003124.9	ND	KHWgl	GL.DGC	TILL		Undulating	1 (0.01-0.1)	3	3 (2-5%)	22
SQ404VL	12	370390.8	6003151.4	D	KHWgl	GL.DGC	TILL		Undulating	1 (0.01-0.1)	6	3 (2-5%)	21
SQ405VL	12	370388.1	6003093.0	D	KHWgl	GL.DGC	TILL		Undulating	1 (0.01-0.1)	3	3 (2-5%)	16
SQ406VL	12	370345.5	6003052.5	ND	SDNgl	GLD.GL	TILL		Undulating	1 (0.01-0.1)	0	3 (2-5%)	20
SQ407VL	12	370334.7	6003091.7	ND	KHWgl	GL.DGC	TILL		Undulating	1 (0.01-0.1)	6	3 (2-5%)	21
SQ410IW	12	370914.8	6002996.0	D	DL	.	ANTH	ORG	Level			2-3 (0.5-5%)	16
SQ411IW	12	370792.4	6003005.1	D	MPVdl	HU.LG	ANTH	TILL	Undulating	1 (0.01-0.1)		3 (2-5%)	17
SQ412IW	12	370714.9	6003005.6	D	ZPRzl	SZ.GL	TILL		Undulating	2 (0.1-3)	3	3 (2-5%)	18
SQ413IW	12	370607.7	6003008.9	D	ZPR	.	ANTH	TILL		1 (0.01-0.1)	1	2 (0.5-2%)	23
SQ414IW	12	370529.9	6003010.6	D	SDNglca	GLD.GL	TILL		Undulating	0 (<0.01)	4	3 (2-5%)	15
SQ415IW	12	370465.5	6003028.4	D		GL.HR	TILL		Undulating		2	2 (0.5-2%)	18
SQ416IW	12	370364.7	6003031.1	ND	SDNzt	SZ.GL	TILL		Undulating			3 (2-5%)	31

Table A-4 Inspection Site Data – Well Pad 12-14 and Access Road

Site ID	UTM Zone	Easting	Northing	Profile Type	Soil Series	Soil Subgroup	Parent Material 1	Parent Material 2	Parent Material 3	Surface Expression	Surface Stone Class	Slope (%)	Landscape Slope Class	Topsoil Depth (cm)
SQ311KD	12	366562.1	6006538.8	D	ONWsa	O.HG	TILL			Undulating	0 (<0.01)	1	2 (0.5-2%)	35
SQ312EV	12	366514.7	6006540.5	D	HLWgl	GL.DGC	GLFL			Undulating	0 (<0.01)	8	4 (6-9%)	23
SQ312IW	12	366514.7	6006540.5	ND	PHSzt	SZ.BLC	GLFL			Undulating		3	3 (2-5%)	26
SQ313EV	12	366487.0	6006543.4	D	HLWgl	GLCA.DGC	GLFL			Undulating	0 (<0.01)	6	4 (6-9%)	41
SQ313IW	12	366487.0	6006543.4	ND	DRNgl	GLCA.DGC	GLFL			Undulating				30
SQ314IW	12	366485.5	6006598.9	ND	MPV	HU.LG	TILL			Undulating				19
SQ314KD	12	366485.5	6006598.9	D	ONWaaca	O.HG	TILL	GLFL	TILL	Undulating	1 (0.01-0.1)	2	2 (0.5-2%)	23
SQ315EV	12	366551.0	6006600.6	D	CMBptsaxs	R.HG	GLLC	GLFL		Undulating	0 (<0.01)	0	4 (6-9%)	27
SQ316KD	12	366591.4	6006589.1	D	ONWaa	O.HG	TILL			Undulating	0 (<0.01)	2	2 (0.5-2%)	25
SQ317EV	12	366487.4	6006654.7	D	DRNcoglgr	GL.BLC	GLFL			Undulating	3 (3-15)	2	4 (6-9%)	16
SQ318KD	12	366550.5	6006646.1	D	ONWsazz	FE.HG	TILL	TILL		Hummocky	1 (0.01-0.1)	12	5 (9-15%)	24
SQ319EV	12	366558.3	6006654.5	D	DNTglsazz	GLDG.SZ	TILL			Undulating	1 (0.01-0.1)	0	4 (6-9%)	19
SQ320IW	12	366595.1	6006549.3	ND	KHWglzt	GLSZ.DGC	TILL			Undulating		3	3 (2-5%)	14
SQ320KD	12	366595.1	6006549.3	ND	DNTglsczz	GLDG.SZ	TILL			Hummocky		0	5 (9-15%)	23
SQ321KD	12	366587.3	6006649.7	ND	CMBsazz	O.HG	GLLC			Undulating		1	2 (0.5-2%)	22
SQ322KD	12	366398.3	6006634.0	D	CMBzz	O.HG	GLLC			Hummocky	0 (<0.01)	10	5 (9-15%)	20
SQ323EV	12	366301.7	6006616.1	D	CMBsaxtzz	O.HG	GLLC	TILL		Undulating	0 (<0.01)	4	3 (2-5%)	27
SQ323IW	12	366301.7	6006616.1	ND	MPVsa	HU.LG	TILL							
SQ324IW	12	366224.6	6006610.5	ND	MPV	HU.LG	TILL							
SQ324KD	12	366224.6	6006610.5	D	DNTglsaxt	GLDG.SZ	GLLC	TILL		Undulating	0 (<0.01)	2	3 (2-5%)	14
SQ420VL	12	366435.7	6006542.1	D	DRNglzr	GLR.DGC	EOLI			Undulating	0 (<0.01)	2	3 (2-5%)	20
SQ421VL	12	366445.0	6006570.3	ND	RCSaaxtzr	R.HG	GLFL	TILL		Undulating			3 (2-5%)	20
SQ422VL	12	366440.2	6006592.3	D	RCSaa	O.HG	GLFL			Undulating		0	2 (0.5-2%)	25
SQ423VL	12	366415.3	6006597.1	ND	KHWglzt	GLSZ.DGC	TILL			Undulating	1 (0.01-0.1)	5	4 (6-9%)	16

Table A-5 Inspection Site Data – Well Pad 15-29 and Access Road

Site ID	UTM Zone	Easting	Northing	Profile Type	Soil Series	Soil Subgroup	Parent Material 1	Parent Material 2	Parent Material 3	Surface Expression	Surface Stoniness Class	Slope (%)	Landscape Slope Class	Topsoil Depth (cm)
SQ424VL	12	366483.2	6006564.1	D	DRNglzt	GLSZ.DGC	GLFL			Undulating	1 (0.01-0.1)	3	3 (2-5%)	17
SQ335EV	12	362401.4	6010415.4	D	MNTaazz	THU.M	ORG	ORG	GLLC	Level	0 (<0.01)	0	2 (0.5-2%)	85
SQ336KD	12	362346.6	6010419.4	D	CMBpt	R.HG	GLLC			Level	0 (<0.01)	1	2 (0.5-2%)	35
SQ337KD	12	362296.4	6010422.2	D	CMBcazz	O.HG	GLLC			Undulating	0 (<0.01)	2	3 (2-5%)	41
SQ338EV	12	362300.6	6010479.9	D	SDNca	D.GL	TILL			Hummocky	1 (0.01-0.1)	2	4 (6-9%)	18
SQ339KD	12	362353.8	6010477.5	D	SDN	D.GL	TILL			Undulating	1 (0.01-0.1)	5	3 (2-5%)	22
SQ340KD	12	362326.4	6010482.3	ND	ONWaa	O.HG	GLLC			Undulating	0 (<0.01)	0	3 (2-5%)	27
SQ341KD	12	362389.7	6010487.5	D	SDNgl	GLD.GL	TILL			Undulating	1 (0.01-0.1)	5	4 (6-9%)	32
SQ342EV	12	362399.4	6010531.5	D	SDNgl	GLD.GL	TILL			Hummocky	1 (0.01-0.1)	2	4 (6-9%)	26
SQ343KD	12	362354.7	6010529.2	D	SDN	D.GL	TILL			Undulating		6	4 (6-9%)	15
SQ344KD	12	362297.5	6010537.4	D	SDN	D.GL	TILL			Hummocky	1 (0.01-0.1)	4	5 (9-15%)	15
SQ345KD	12	362470.0	6010556.8	D	CMBsazt	SZ.HG	GLLC			Undulating	0 (<0.01)	1	3 (2-5%)	28
SQ346EV	12	362564.7	6010553.8	D	SDNcrglsa	GLD.GL	TILL			Undulating	0 (<0.01)	2	3 (2-5%)	35
SQ347KD	12	362693.3	6010546.0	D	SDN	D.GL	TILL			Hummocky	2 (0.1-3)	6	5 (9-15%)	20
SQ348EV	12	362794.0	6010541.6	D	CMBzz	O.HG	GLLC			Undulating	1 (0.01-0.1)	1	3 (2-5%)	25
SQ349KD	12	362892.1	6010538.8	D	SDN	D.GL	TILL			Undulating	0 (<0.01)	1	3 (2-5%)	23
SQ350KD	12	363007.5	6010529.9	D	VILcr	GLCA.BLC	TILL			Undulating	1 (0.01-0.1)	1	2 (0.5-2%)	25