CARIBOU MITIGATION PLAN FOR THE PROPOSED GRAND RAPIDS PIPELINE GP LTD. GRAND RAPIDS PIPELINE PROJECT

AERCPP-Grand Rapids-2014-2015-89

October 2014
8395

Prepared for:

Prepared by:

Grand Rapids Pipeline GP Ltd.
in its capacity as general partner on behalf of
Grand Rapids Pipeline Limited Partnership

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1.0 INTRODUCTION

Grand Rapids Pipeline GP Ltd. (Grand Rapids), in its capacity as general partner on behalf of Grand Rapids Pipeline Limited Partnership, has applied to the Alberta Energy Regulator (AER) pursuant to Part 4 of the *Pipeline Act* to construct and operate pipelines and associated installations, collectively named the Grand Rapids Pipeline Project (the Project). The AER issued Decision 2014 ABAER 012 on October 9, 2014 granting approval for select Project applications, subject to the conditions outlined in Appendix 1 of the AER Decision 2014 ABAER 012. Pending regulatory approval, construction of the Project is scheduled to begin in October 2014 and be completed by spring 2017, and will involve the construction of the following components:

- one approximately 460.5 km pipeline, with an O.D. of 508 mm, from the Grand Rapids MacKay Terminal to terminals in the Edmonton area (the 508 mm pipeline) to:
  - initially transport approximately 90,000 barrels per day (bbl/d) of blended crude bitumen from the Grand Rapids MacKay Terminal at SE 34-89-14 W4M, approximately 30 km northwest of Fort McMurray, to the Edmonton area at 8-5-53-23 W4M; and
  - subsequently, transport approximately 330,000 bbl/d of diluents from the Edmonton area or Heartland areas to delivery points in the west Athabasca oil sands area;
- one approximately 460.5 km pipeline, with an O.D. of 914 mm, from the Grand Rapids MacKay Terminal to terminals in the Edmonton area to transport approximately 900,000 bbl/d of blended crude bitumen from the west of Athabasca oil sands area to the Edmonton and Heartland areas (the 914 mm pipeline);
- one 4.1 km, 610 mm O.D. pipeline to transport approximately 400,000 bbl/d of blended crude bitumen from the Grand Rapids MacKay Receipt Station to the Grand Rapids MacKay Terminal (the 610 mm lateral pipeline);
- one 4.1 km, 406 mm O.D. pipeline to transport approximately 200,000 bbl/d of diluents from the Grand Rapids MacKay Terminal to the Grand Rapids MacKay Receipt Station (the 406 mm lateral pipeline); and
- 7 associated pipeline installations, which include 2 tank farms and 5 pump stations located at the following 5 pipeline installation sites:
  - Grand Rapids MacKay Terminal, located at NW 34-89-14 W4M, which includes a tank farm and pump station;
  - Grand Rapids Thornbury Terminal, located at NE 29-79-14 W4M, which includes a pump station;
  - Grand Rapids Wandering River Pump Station, located at NW 19-73-16 W4M;
  - Grand Rapids Grassland Pump Station, located at NE 15-67-18 W4M; and
  - Grand Rapids Heartland Terminal, located at SE 28-55-21 W4M, which includes a tank farm and pump station.

The pipeline route is located within the West Side of the Athabasca River (WSAR) and East Side of the Athabasca River (ESAR) caribou ranges for approximately 144.1 km. The Grand Rapids MacKay Terminal is located within the WSAR caribou range and the Grand Rapids Thornbury Terminal and Wandering River Pump Station are located within the ESAR caribou range.

The WSAR and ESAR caribou are federally designated as Threatened on Schedule 1 of the *Species at Risk Act* and by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and are provincially designated as At Risk and Threatened under the *Wildlife Act* (Alberta Environment and Sustainable Resource Development [AESRD] 2014a, COSEWIC 2014, Environment Canada 2014). The

ESAR is further divided into caribou herds, and the pipeline route crosses the Agnes, Algar, Egg-Pony, Wiau and Wandering caribou herds. Figures are provided in Appendix A, details related to the pipeline are provided in Table 1 and details related to the facilities are provided in Table 2.

TABLE 1

CARIBOU RANGES CROSSED BY THE PIPELINE

Caribou Range	Caribou Herd	Legal Location (W4M)	KP	Length in Caribou Range (km)	Length Paralleling Existing Disturbance (km)	Length of New Cut (km)
WSAR	WSAR	9-11-90-14 to 6-34-89-14	0.0 to 4.1 (610 mm and 406 mm lateral pipelines)	4.1	4.1	0
		6-34-89-14 to 14-35-88-15	0.0 to 12.5	12.5	12.5	0
		13-1-88-16 to 9-19-86-18	24.3 to 54.9	30.6	30.6	0
		3-6-86-18 to 2-10-84-18	61.5 to 81.8	20.3	17.5	2.8
		2-2-84-18 to 16-28-82-17	84.3 to 99.1	14.8	14.8	0
ESAR	Agnes	11-14-82-17 to 8-30-81-16	105.5 to 114.6	9.1	9	0.1
	Algar	1-28-81-16 to 14-7-80-14	117.8 to 138.8	21.0	20.9	0.1
	Egg-Pony	6-5-80-14 to 13-11-78-15	141.9 to 160.5	18.6	16.5	2.1
	Wiau	5-20-76-15 to 13-17-76-15	180.0 to 180.5	0.5	0.5	0
	Wandering	3-30-73-16 to 6-19-72-16	211.8 to 224.2	12.4	11.7	0.7

Note: Lengths and KPs are approximate.

TABLE 2

PROPOSED FACILITIES WITHIN CARIBOU RANGES

Facility	Caribou Range	Legal Location (W4M)	Facility Area (ha)	Access Road Requirements (m)
MacKay Receipt Station	WSAR	NE 11-90-14	0.5	373 m
MacKay Terminal		NW 34-89-14	36.0	4,555 m
		NE 25-85-19	36.0	220 m
Thornbury Terminal	ESAR, Egg Pony	NE 29-79-14	15.4	n/a (existing)
Wandering River Pump Station	ESAR, Wandering	NW 19-73-16	9.0	279 m

Note: Areas are approximate.

1.1 Purpose of Document

TERA, a CH2M HILL Company (TERA) has been retained by Grand Rapids to prepare the following Caribou Mitigation Plan (CMP) for the Project. The CMP is being submitted by Grand Rapids to the AER to describe planning considerations and available mitigation measures that could be feasibly implemented on the Project footprint to reduce potential effects of the Project on caribou and their habitat. The planning and mitigation measures identified in this CMP comprise the "toolbox" of measures available to Grand Rapids to avoid impacts and to minimize residual effects on caribou and caribou habitat through effective mitigation and, in certain circumstances, restoration. A combination of tools will be implemented to achieve the desired outcome, dependent on engineering and construction constraints, as well as habitat and terrain considerations.

Following the standard hierarchy of mitigative actions, Grand Rapids will first identify feasible measures to avoid Project effects on caribou and caribou habitat, then apply feasible mitigation measures to minimize Project effects and, finally, implement habitat restoration measures based on industry best practices, professional judgement and in consultation with AER. Mitigation measures and considerations for three main phases of the Project as defined below:

- pre-construction phase involves initial Project routing and siting, planning and design, consultation, regulatory approvals and permitting;

- construction phase involves pre-construction survey, clearing, construction (including final clean-up), and initial reclamation measures implemented at the time of construction and final clean-up; and
- post-construction phase involves activities that extend into the operations phase of the Project, such as reclamation and monitoring.

1.2 Regulatory Context

The CMP has been developed in consideration of the current regulatory policies related to caribou. These include: the *Alberta Woodland Caribou Recovery Plan, 2004/05 to 2013/14*, *A Woodland Caribou Policy for Alberta* and the federal *Recovery Strategy for the Woodland Caribou* (Rangifer tarandus caribou), *Boreal Population, in Canada* (Alberta Woodland Caribou Recovery Team 2005, Government of Alberta 2011, Environment Canada 2012). In general, regulatory guidelines provide recommendations for industrial development to protect caribou habitat, to avoid sensory disturbance during sensitive periods and to control human and predator access. Further information on each of the documents listed above is summarized in the following paragraphs.

The *Woodland Caribou Policy for Alberta* (Government of Alberta 2011) identifies recovery strategies that include maintenance and restoration of caribou habitat, establishment of range-specific habitat objectives, management of other wildlife populations (predators and primary prey), adaptive management, as well as legislative and social considerations. A key strategy adopted by the *Woodland Caribou Policy for Alberta* is the development of range-specific assessments and objectives, which builds on the work of previous recovery strategies, such as the *Alberta Woodland Caribou Recovery Plan 2004/05 – 2013/14* (Alberta Woodland Caribou Recovery Team 2005). Range-specific plans have yet to be developed.

Similar to the provincial policy, the *Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* (Environment Canada 2012) stresses the importance of landscape level planning, such as planning development activities at appropriate temporal and spatial scales, incorporating caribou habitat requirements into fire management plans, establishing key protected areas and adaptive management. One of the management approaches suggested in the federal recovery strategy to address effects of habitat alteration on boreal caribou is to undertake coordinated actions to reclaim boreal caribou habitat through restoration efforts. This might include restoration of industrial features such as roads, seismic lines, pipelines, cut lines and clearings (Environment Canada 2012).

Grand Rapids will continue to facilitate open communication with regulatory agencies throughout Project planning and execution in regards to regulatory policies related to caribou and caribou habitat.

2.0 WOODLAND CARIBOU THREATS AND LIMITING FACTORS

2.1 Caribou Ecology

The boreal population of woodland caribou is listed as Threatened on Schedule 1 of *SARA*, by COSEWIC and under the Alberta *Wildlife Act*, and is listed as At Risk in Alberta (AESRD 2014b, Alberta Sustainable Resource Development [ASRD] 2010, COSEWIC 2014, Environment Canada 2014).

Woodland caribou in Alberta are found in bogs and fens with low to moderate tree cover and tend to avoid marshes, uplands, heavily forested wetlands, water and areas of human use (Thomas and Gray 2002). Local caribou population ranges encompass areas large enough for all life processes (calving, rutting, wintering, etc.). Therefore, woodland caribou require large tracts of continuous undisturbed habitat since they generally disperse when calving to reduce predation risk (Vistnes and Nellemann 2001, Environment Canada 2011). Preferred habitat is typically mature old coniferous forest (*e.g.*, Jack pine and black spruce) with abundant lichen, muskeg and peatlands intermixed with upland or hilly areas (Brown *et al.* 1986, Bradshaw *et al.* 1995, Stuart-Smith *et al.* 1997, Neufeld 2006, O'Brien *et al.* 2006, Brown *et al.* 2007, Rettie and Messier 2000, Courtois and Ouellet 2007). In general, sufficient canopy-cover or wind-exposed areas are required to keep snow depth at low enough levels to allow foraging (LaPerriere and Lent 1977, Collins and Smith 1991, Schaefer and Pruitt 1991).

Boreal woodland caribou do not undergo seasonal migrations and remain within the forest and peat habitats throughout the year (Alberta Woodland Caribou Recovery Team 2005). Forested peat complexes are the primary habitat for boreal caribou and they require large contiguous tracts of this preferred habitat in order to maintain low population densities across their range as an anti-predator tactic (Alberta Woodland Caribou Recovery Team 2005). Boreal caribou separates itself from other ungulates by occupying habitat that has a lower density of other ungulates species year round (Alberta Sustainable Resource Development [ASRD] and Alberta Conservation Association [ACA] 2010).

The rutting season occurs in early to mid-October, and caribou have a gestation period of approximately 7.5 to 8 months. In northern Alberta, most calves are born in the first two weeks of May (ASRD and ACA 2010). In comparison to other forest-dwelling ungulate species, woodland caribou exhibit low reproductive potential. Adult cows are typically three years of age before they begin producing young and only produce a single calf annually (ASRD and ACA 2010).

West Side of the Athabasca

The population size estimate in the WSAR caribou ranges is 204-272 individuals and the population trend is declining (Environment Canada 2012). The WSAR caribou range is 1,572,652 ha in area (Environment Canada 2012). Environment Canada (2012) reports that 69% (68% anthropogenic, 4% fire; note that anthropogenic and fire disturbances that overlap are not counted twice in the total) of the WSAR caribou range is disturbed, which exceeds the threshold level of disturbance (35%) that will support a self-sustaining caribou population.

East Side of the Athabasca

The ESAR caribou range is located east of the Athabasca River, and includes the following seven small populations of caribou that are largely independent from each other: Algar, Egg-Pony, Agnes, Wandering, Wiau, Bohn and Christina (ASRD and ACA 2010). Radio-telemetry data has indicated that very little movement occurs between caribou ranges (ASRD and ACA 2010). The Project is in the Agnes, Algar, Egg-Pony, Wiau and Wandering herd caribou ranges (AESRD 2014b) (see Sections 1.0 and 5.7 for more project-specific details). The population size estimate in the ESAR caribou range is 90-150 individuals and the population trend is declining (Environment Canada 2012). The ESAR caribou range is 1,315,980 ha in area (Environment Canada 2012). Environment Canada (2012) reports that 81% (77% anthropogenic, 26% fire) of the ESAR caribou range is disturbed.

2.2 Threats and Limiting Factors

Threats to boreal caribou identified by the federal Recovery Strategy, in descending order of direct impact to caribou population trend, are: predation; habitat alteration from human land-use activities; natural disturbance of habitat; hunting; and climate change and severe weather (Environment Canada 2012). Other threats that are considered to have a lower level of concern include parasites and disease, stress responses associated with sensory disturbance (noise and light), vehicle collisions and pollution.

Available literature generally supports apparent competition as the likely causal pathway for woodland caribou population declines, whereby primary prey species (*e.g.*, moose, deer) increase with increasing proportions of early seral habitat on the landscape, causing a numerical response of predators (COSEWIC 2002, Environment Canada 2012, Latham 2009, Wittmer *et al.* 2005). Increases in predator numbers subject caribou to unsustainable levels of predation, causing population decline (Wittmer *et al.* 2005). Predator densities capable of causing caribou declines are usually sustained by abundant alternate prey sources, such as moose or white-tailed deer (COSEWIC 2002, Peters *et al*. 2012, Wittmer *et al.* 2005). Predation on caribou is thought to be largely incidental, given the low densities of woodland caribou compared to much more abundant prey species (Wittmer *et al.* 2005).

Linear corridors create improved access for predators such as wolves, which are known to travel along pipeline rights-of-way. Several studies have found that linear corridors are attractive to wolves as easy travel routes (James 1999, Stuart-Smith *et al.* 1997, Thurber *et al.* 1994) and may affect wolf-prey dynamics (Bergerud *et al.* 1984, Edmonds and Bloomfield 1984, Rohner and Kuzyk 2000). Wolves travel faster along linear disturbances (James 1999, McKenzie *et al.* 2012) and encounter rates between wolves and caribou have been shown to increase near linear features (Whittington *et al.* 2011). However, McCutchen (2006) modelled dynamic use of the landscape by wolves, primary prey (moose) and caribou, and concluded that wolves experience no additional advantage accessing caribou from linear features, although they do benefit in accessing primary prey species (*i.e.*, moose). Latham *et al.* (2011) supports this by finding that kill sites were no closer to linear features than random.

The ultimate costs to caribou habitat suitability appear relatively less for linear feature-induced changes to predator functional response (predator kill rate) than forestry-induced changes to predator numerical response (predator density) (DeCesare *et al.* 2012). Evidence shows scale-dependent variation in caribou resource selection, where habitat selection at the population and individual seasonal home range scale is affected by forestry cutblocks (DeCesare *et al*. 2012), which are linked to increased predator densities (Latham *et al*. 2011). Conversely, caribou distribution is shown to be strongly influenced by linear disturbance at the finer (location level) scale (DeCesare *et al*. 2012).

Linear feature density thresholds have been reported in the available literature for woodland caribou. Linear feature density is indicative of caribou population response to disturbance (primarily as a result of predation), which arises from the complex interaction of early seral vegetation, numeric response of primary prey (*i.e.*, ungulates other than caribou) and predators, predator access and efficiency, access into remote locations historically preferred by caribou, and predator/caribou encounters (Environment Canada 2012). A road density threshold of 0.6 km/km^2 has been reported for northern ecotype caribou in west-central Alberta, and similarly, road densities greater than 0.6-0.9 km/km^2 were correlated with significant caribou declines in the Kuparuk Development Area in Alaska (Nelleman and Cameron 1998). Linear density thresholds that incorporate linear disturbances in addition to roads tend to be higher. For example, a corridor density threshold of 1.8 km/km^2 has been suggested for boreal woodland caribou (Salmo *et al.* 2003). Model simulations of boreal woodland caribou predicted a dramatic decline in caribou populations as a result of cumulative effects in areas where the linear corridor (roads and seismic line) density exceeds a threshold of 1.2 km/km^2, and moose densities were low (Weclaw and Hudson 2004). When the simulation was run with reduced wolf densities rather than reduced moose densities, the results indicated a linear density threshold of 0.8 km/km^2 (Weclaw and Hudson 2004). The Athabasca Landscape Team (2009) reports linear feature density strata based on risk to boreal woodland caribou population persistence, where there is a low risk when the linear density is less than 0.6 km/km^2, a moderate risk when the linear density is between 0.6 km/km^2 and 1.2 km/km^2, and a high risk when the density exceeds 1.2 km/km^2.

Long-term reduction in habitat effectiveness adjacent to linear features may occur as caribou have been shown to partially avoid habitats near rights-of-way (Dyer 1999, Oberg 2001). This avoidance of habitat near linear disturbances, well sites, facilities and cutblocks leads to indirect habitat loss through reduced habitat effectiveness for caribou (Dyer *et al.* 2001), and is often referred to as a zone of influence. Methodologies and study populations vary between sources that demonstrate caribou avoidance of disturbances by varying distances: 70 m (seismic lines and maintained trails [DeCesare *et al*. 2012]); 250 m (roads and seismic lines [Dyer *et al.* 2001]); 500 m (Environment Canada 2011); and 1,000 m (industrial developments such as well sites [Dyer *et al.* 2001]).

The federal Recovery Strategy identifies critical habitat for the boreal population of woodland caribou as:

- the area within the boundary of each caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a minimum of 65% of the area as undisturbed habitat; and

- biophysical attributes required by boreal caribou to carry out life processes (Environment Canada 2012).

Therefore, the habitat threshold that provides a measureable probability for a local caribou population to be self-sustaining is considered to be 65% undisturbed habitat within the range (Environment Canada 2012).

3.0 CONSULTATION

The CMP has been developed in consideration of ongoing consultation with stakeholders, Aboriginal groups and provincial regulators (AESRD and AER). Grand Rapids will continue to work with stakeholders, Aboriginal groups and provincial regulators to ensure that any concerns regarding caribou are addressed prior to construction, and will continue to facilitate open communication throughout Project execution.

3.1 Traditional Ecological Knowledge

Traditional Ecological Knowledge (TEK) has been used to gain a stronger understanding of baseline conditions and traditional land and resource use in the vicinity of the Project. This allowed for an assessment of cumulative effects that considered both western science and TEK, resulting in a more robust assessment that reflected issues identified by both professional biologists and Aboriginal communities.

To identify potential Project effects on current use of land for traditional purposes, Grand Rapids relied on best available information, including Project-specific information provided by Aboriginal communities through Project-specific studies and participation in TEK field programs, publicly available reports, Grand Rapids' operating experience and ongoing engagement with Aboriginal groups. The overall objective was to gain an understanding of and to document current use of land and resources for traditional purposes, characterize anticipated Project effects and identify mitigation strategies.

During the regulatory approval and construction phases of the Project, Grand Rapids will follow its Aboriginal engagement process. Grand Rapids will continue to work with Aboriginal communities to reasonably address any Project-specific issues raised. Grand Rapids is committed to working with Aboriginal communities to understand and, where possible, address Project-specific concerns.

3.2 Provincial Regulators

Consultation with provincial regulators has been used to gain a stronger understanding of regulatory requirements and caribou status in the vicinity of the Project. Grand Rapids has initiated consultation and will continue to work with provincial regulators to ensure that the measures implemented to avoid, minimize and mitigate Project effects on caribou and caribou habitat align with relevant government policy.

3.2.1 Project-Specific Consultation

A summary of Project-specific consultation completed to date is provided in Table 3.

TABLE 3

SUMMARY OF CONSULTATION FOR THE PROJECT RELATED TO CARIBOU

Name and Title	Date and Method	Details
Alberta Environment and Sustainable Resource Development		
Joanne Skilnick Senior Wildlife Biologist Fort McMurray, AB	November 21, 2012 Email	AESRD confirms a Caribou Protection Plan will be required.
Laurie Kirkpatrick Forest Officer Fort McMurray, AB	February 19, 2013 Email	AESRD confirms a Caribou Protection Plan will be required and provides information regarding caribou management. There is an expectation that Grand Rapids indicate how they will support the objectives of Alberta's Caribou Policy.
Laurie Kirkpatrick Forest Officer Fort McMurray, AB	February 20, 2013 Meeting	Grand Rapids and AESRD met to discuss Pipeline Agreement drawings, Environmental Field Reports, caribou and Key Wildlife and Biodiversity Zones.
Bill Black Acting Approvals Manager Athabasca, AB	April 12, 2013 Phone call	Janice Skiffington, Wildlife Biologist at TERA phoned Bill Black, AESRD Land Management Specialist to discuss Protective Notation 930006, an Ungulate Habitat Protection Area.
Joanne Skilnick Senior Wildlife Biologist Fort McMurray, AB	July 9, 2013 Email	AESRD provides a list of questions. Several pertain to caribou and what the Project will commit to (*e.g.*, measures to reduce disturbance in caribou range, the use of rollback, use of best management practices and reforestation).

TABLE 3 Cont'd

Name and Title	Date and Method	Details
Ed Barnett Forest Officer Wandering River, AB Grant Chapman Senior Wildlife Biologist Lac La Biche, AB Joanne Skilnick Senior Wildlife Biologist Fort McMurray, AB Marvin Pearce Forest Officer Athabasca, AB Laurie Kirkpatrick Forest Officer Fort McMurray, AB	July 24, 2013 Meeting	AESRD noted that key considerations for mitigation plans are access management (predators, snowmobiles, line-of-sight) and habitat restoration (mounding, vegetation screens, woody debris). There is an expectation that restoration will be completed for this Project. Grand Rapids notes that this meeting is an introduction to the Project scope, a caribou plan will be developed and consultation with AESRD will be ongoing over the duration of the Project.
Ed Barnett Forest Officer Wandering River, AB Joanne Skilnick Senior Wildlife Biologist Fort McMurray, AB Laurie Kirkpatrick Forest Officer Fort McMurray, AB	October 15, 2013 Email	TERA provided a Caribou Protection plan for geotechnical work for the Project.
Ed Barnett Forest Officer Wandering River, AB Joanne Skilnick Senior Wildlife Biologist Fort McMurray, AB	October 21, 2013 October 28, 2013 Email	AESRD provides a list of questions requesting additional information regarding the Project scheduling, level of disturbance, access requirements, soil stripping and reclamation. October 29, 2013: A follow-up response is provided to address AESRD's questions
Joanne Skilnick Senior Wildlife Biologist Fort McMurray, AB	November 19, 2013 Email	AESRD provides a list of questions requesting additional information regarding camp locations, timing considerations, caribou protection measures, access management and restorations measures.
Joanne Skilnick Senior Wildlife Biologist Fort McMurray, AB Tom MacMillan	March 12, 2014 Meeting	AESRD and AER met with Grand Rapids to discuss the AER process updates including caribou zones.

4.0 CARIBOU MITIGATION AND HABITAT RESTORATION

Available information on mitigation measures and habitat restoration methods applied in caribou habitat was compiled and is summarized in Appendix B. This identifies previous and ongoing habitat restoration initiatives and their successes and failures. Grand Rapids will review and consider the most applicable measures for the Project.

Recent research has shown positive results for establishing native vegetation on seismic lines and other linear features using techniques such as planting tree and shrub seedlings, and creating microsite conditions (*i.e.*, mounding) that are conducive to seedling growth and natural vegetation encroachment (Caribou Range Restoration Project 2007b, OSLI 2012). Measures such as slash rollback can address site condition issues including competition from non-target or undesired plant species, erosion, frost, and heat or moisture deficiencies (Caribou Range Restoration Project 2007b). Natural revegetation and successful planting initiatives have also benefited from construction practices that minimize disturbance during development of the footprint. Minimal disturbance pipeline construction techniques that avoid grubbing and grading are effective at facilitating rapid regeneration of native vegetation within the right-of-way, in particular in deciduous habitats (TERA 2011a,b, 2012).

5.0 PRE-CONSTRUCTION PHASE

The pre-construction phase involves initial Project routing, planning and design, consultation, regulatory approvals and permitting. At this stage, potential effects may be avoided or minimized through routing and siting, Project design and scheduling. Many of the actions that are completed during the pre-construction phase involve collecting sufficient information to support planning and implementation of site-specific mitigation and restoration measures during the construction and post-construction phases.

5.1 Project Routing, Siting and Project Design

Routing decisions are driven in consideration of technical, economic and environmental considerations. A key milestone in Project planning is to consider any and all feasible options to avoid or minimize potential Project effects on caribou and caribou habitat at the pre-construction phase, through implementing the following:

- considering alternative route options that avoid defined caribou range;
- paralleling existing linear disturbances to avoid fragmenting habitat and creating new linear disturbance features;
- using existing disturbed areas (*i.e.*, overlap existing clearings) and/or shared workspace to minimize habitat loss; and
- using existing access, minimizing shoo-flies and minimizing construction of new and/or permanent access.

In order to reduce the overall footprint of the proposed Project, Grand Rapids will use existing rights-of-way and third-party disturbances, where feasible. The pipeline route parallels existing linear disturbances (*i.e*., pipeline and transmission line rights-of-way, all-season roads and railways) for approximately 91.9% of the total Project length.

5.2 Documenting Baseline Information

Grand Rapids has documented baseline information relevant to the Footprint that will support planning and implementation of site-specific mitigation and restoration measures, including existing literature and data, field survey data, TEK and information received through consultation. Baseline conditions are described in the Conservation and Reclamation Report (TERA 2013) and Environment Field Reports to support the Pipeline Agreement applications for the Project.

5.3 Maintaining Caribou Habitat

Project planning during the pre-construction phase also provides the opportunity to minimize Project effects and facilitate habitat restoration in the later phases of the Project intended to minimize the Project's contribution of threats to caribou and their habitats. Measures to be considered during the pre-construction planning phase include the following:

- identifying areas where minimum ground disturbance techniques can be implemented (*e.g.*, areas where grading is not required);
- considering opportunities to extend trenchless crossings (*e.g.*, third-party roads and lines, and watercourses) to reduce habitat disturbance and maintain natural access barriers and line-of-sight blocks;
- considering opportunities to slightly narrow the cleared width of the construction right-of-way; and
- retaining trees/shrubs along the edges of the right-of-way that may be bent or felled over the right-of-way following construction to reduce access and line-of-sight, and to promote rapid revegetation.

5.4 Planning Access Control

Access control measures may include rollback, vegetation planting, mounding, installation of berms or "line-blocking" (*i.e.*, felling of individual trees). Installation of gates may be appropriate to control public access in some locations where access roads are required for operations. Locations for access control measures on the pipeline right-of-way will focus on intersections with other linear features, such as roads, utility rights of way, seismic lines or watercourses. Where possible, access control techniques that are conducive to habitat restoration will be selected. Since public awareness of the reasons for access restrictions may influence the effectiveness of access control measures, Grand Rapids will consider whether installing signs may be appropriate at select locations to facilitate understanding and respect for access restrictions.

Planning considerations during the pre-construction phase include limiting the creation of new access for construction activity and identifying existing intersecting linear features. Locations for retention of rollback will be refined based on factors such as availability of material and storage space.

5.5 Planning Line-of-Sight Blocks

Measures to reduce line-of-sight may discourage human use and may also decrease predator efficiency. Appropriate locations for line-of-sight blocks include areas with level terrain that have long sight-lines and where the pipeline intersects an existing road or other linear feature. Bends in the right-of-way (*e.g.*, dog-legs) are an effective method of limiting line-of-sight distances. Extending planned bored crossings of foreign dispositions (pipelines and roads) and either using alternate or reduced access at bored crossings, which will retain the existing vegetation, will also create effective line-of-sight and access barriers.

Line-of-sight can also be reduced through the use of short-term measures that have an immediate effect (*e.g.*, slash or earth berms constructed to an approximate height of 2 m and fences) and/or long-term measures (*e.g.*, vegetation screening). Although slash berms and fences can be an effective measure to create immediate breaks in lines-of-sight (TERA Environmental Consultants 2011a, Westland Resource Group 2011), the feasibility of their use is limited by increased fire hazard and pest outbreak risks. Berms and fencing may not be feasible in some situations, such as areas where surface drainage may be affected or the soil substrate does not support fencing material. Earth berms may also be impractical if sufficient source material is not available, which is often the case for pipeline construction projects, particularly in locations where minimal disturbance construction is employed (*i.e.*, reduced surface disturbance and grading). Spreading of weed seeds is a concern associated with earth berms that are constructed using imported material. In consideration of these factors, the installation of earth berms is not a practical approach in many cases.

Vegetation screening, combined with bends in the right-of-way, are better-suited for reducing line-of-sight in caribou range. In addition to natural regeneration, vegetation screens that avoid forage species attractive to ungulates (*e.g.*, willows and legumes) can be planted across the right-of-way.

Planning considerations during the pre-construction phase of the Project include identifying candidate sites for short-term (*e.g.*, slash, fences or berms) and/or long-term measures (*e.g.*, vegetation screening) for line-of-sight blocks.

5.6 Implementing Opportunities and Constraints

Certain opportunities and constraints exist when considering appropriate site-specific mitigation measures for the Project. Site-specific factors that may constrain or restrict the effectiveness or feasibility of certain measures include:

- locations necessary for access during operations and maintenance;
- locations that are recognized by other resource users for future developments (*i.e.*, publicly disclosed, applied for and/or approved, but not yet completed projects) that would require habitat disturbance within or adjacent to the Project footprint;

- seasonal constraints (*e.g.*, some restoration techniques may be limited by ground conditions or by season); and
- locations that are considered traditional access are not suitable for access control measures.

In contrast, site-specific factors that provide opportunities to apply site-specific mitigation measures include:

- intersections of the Project footprint with other linear features where trenchless (*e.g.*, bored) crossings may be extended, construction access may be limited to retain existing vegetation or alternate access control and line-of-sight break measures may be applied;
- locations adjacent to watercourse crossings, where extending riparian construction methods and restoration efforts beyond the riparian area is feasible;
- areas that are easily accessible to crews and equipment;
- locations where suitable material is available for rollback or berms (note that consideration must be given to perceived fire and pest hazards, and use of merchantable timber for commercial purposes);
- locations where terrain and construction requirements allow for retaining some trees along the edge of the construction right-of-way, which may be bent/felled over the right-of-way following construction; and
- segments of the right-of-way that deviate from paralleling existing linear features (*i.e.*, new cut), temporary access (*i.e.*, shoo-flies) and false rights-of-way used to string pipe at bored crossings.

Selection for the habitat restoration measures will require as-built construction information to allow for validation of site-specific conditions and input from the Grand Rapids construction and operation/maintenance staff, Project biologists and reclamation specialists, as well as appropriate regulatory agencies. Information pertaining to proactive construction methods employed, such as extending bored crossings to retain vegetation, narrowing the right-of-way, reducing temporary workspace, will be derived from as-built information and communication with Grand Rapid's Environmental Inspectors. A thorough review of site characteristics and construction methods will facilitate determination of the suitability of particular sites for restoration and selection of appropriate restoration treatments. Experience from implementing caribou habitat restoration measures on other Grand Rapids pipeline projects will be incorporated in the decision process.

5.7 Project Schedule

Subject to regulatory approvals, clearing and construction of the pipeline is scheduled to commence in October 2014, with a target completion date in spring 2017. Clearing and construction activities will be initiated as soon as ground conditions permit. The pipeline will be constructed in eight spreads, generally to be completed in a north to south direction. Clean-up and post-construction reclamation of disturbed portions of the right-of-way will be conducted immediately following construction or as soon as weather, ground and seasonal conditions allow.

A timing restriction of February 15 to July 15 applies for new site preparation and construction within caribou ranges (Government of Alberta 2013). Exceptions to this timing restriction include: site preparation/construction that was initiated prior to February 15; activities using Class V roads; and activities within 100 m of an all-weather road, providing ground conditions are favourable. Work can continue until adverse ground conditions are encountered (Government of Alberta 2013).

5.7.1 Pipeline Activity in Caribou Range

Table 4 provides the clearing and construction schedule for the pipelines. The spreads located in caribou range are Spreads C,D and 1,2,3 and 4.

TABLE 4

PIPELINE CLEARING AND CONSTRUCTION SCHEDULE IN CARIBOU RANGE

Caribou Range	Caribou Herd	Legal Location (W4M)	KP	Pipeline Construction Spread	Clearing Timing	Construction Timing
WSAR	WSAR	9-11-90-14 to 6-34-89-14	610 mm and 406 mm lateral pipelines	Spreads C and D	TBD	November 2016 to March 2017
		6-34-89-14 to 14-35-88-15	0.0 to 12.5	Spread 1	November 2014 to April 2015	20 inch: November 2015 to April 2016 36 inch: November 2016 to April 2017
		13-1-88-16 to 9-19-86-18	24.3 to 54.9	Spread 1	November 2014 to April 2015	20 inch: November 2015 to April 2016 36 inch: November 2016 to April 2017
		3-6-86-18 to 11-19-85-18	61.5 to 66.4	Spread 1	November 2014 to April 2015	20 inch: November 2015 to April 2016 36 inch: November 2016 to April 2017
		11-19-85-18 to 2-10-84-18	66.4 to 81.8	Spread 2	Complete	20 inch clean-up: November 2014 to January 2015 36 inch: November 2016 to April 2017
		2-2-84-18 to 16-28-82-17	84.3 to 99.1	Spread 2	Complete	20 inch clean-up: November 2014 to January 2015 36 inch: November 2016 to April 2017
ESAR	Agnes	11-14-82-17 to 8-30-81-16	105.5 to 114.6	Spread 2	Complete	20 inch clean-up: November 2014 to January 2015 36 inch: November 2016 to April 2017
	Algar	1-28-81-16 to 15-27-80-15	117.8 to 131.9	Spread 2	Complete	20 inch clean-up: November 2014 to January 2015 36 inch: November 2016 to April 2017
	Algar	15-27-80-15 to 14-7-80-14	131.9 to 138.8	Spread 3	November 2014 to April 2015	20 inch: November 2015 to April 2016 36 inch: November 2017 to April 2018
	Egg-Pony	6-5-80-14 to 13-11-78-15	141.9 to 160.5	Spread 3	November 2014 to April 2015	20 inch: November 2015 to March 2016 36 inch: November 2017 to March 2018
	Wiau	5-20-76-15 to 13-17-76-15	180.0 to 180.5	Spread 3	November 2014 to April 2015	20 inch: November 2015 to March 2016 36 inch: November 2017 to March 2018
	Wandering	3-30-73-16 to 6-19-72-16	211.8 to 224.2	Spread 4	October 2014 to April 2015	20 inch: October 2014 to April 2015 36 inch: November 2015 to April 2016

5.7.2 Facility Activity in Caribou Range

The facilities schedule is listed below.

MacKay Receipt Station (West Side of the Athabasca River Caribou Range)

- Site work: November 3, 2014 to January 15, 2015.
- Mechanical, pipe and electrical work: January 5, 2015 to January 21, 2016.
- Commissioning: January 22 to May 4, 2016.

MacKay Terminal (West Side of the Athabasca River Caribou Range)

- Site work: November 3, 2014 to February 27, 2015.
- Mechanical, pumps, pipe and electrical work: December 1, 2014 to January 21, 2016.
- Commissioning: January 22 to June 30, 2016.

Thornbury Terminal (Egg-Pony Herd)

- Site work: January 5 to June 25, 2015.
- Mechanical, pumps, pipe and electrical work: June 1 to August 5, 2015 and April 2 to August 29, 2016.

- Commissioning: September 25, 2015 to May 13, 2016 and August 5, 2016 to February 13, 2017.

Wandering River Pump Station (Wandering Herd)

- Construction is proposed to commence in summer 2015. A finalized schedule will be provided prior to construction.

6.0 CONSTRUCTION PHASE

The construction phase involves pre-construction survey, clearing, construction (including final clean-up), and initial reclamation measures implemented at the time of construction. The caribou mitigation measures outlined in Table 5 will be implemented, where feasible and upon further discussion with the AER, during the construction phase of the Project. The mitigation measures are consistent with best practices recommended in the following documents:

- *Alberta Woodland Caribou Recovery Plan, 2004/05 to 2013/14* (Alberta Woodland Caribou Recovery Team 2005).
- *A Woodland Caribou Policy for Alberta* (Government of Alberta 2011);
- Caribou Protection Plan Guidelines and Caribou Calving (AESRD 2012);
- *Integrated Standards and Guidelines Enhanced Approval Process* (Government of Alberta 2013); and
- Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada (Environment Canada 2012).

TABLE 5

CARIBOU MITIGATION MEASURES DURING CONSTRUCTION

Activity/Concern	Mitigation Measures
Education and Awareness	1. Controlled copies of this CMP and associated documents will be made available to all key Project construction and Contractor staff during construction.
	2. All personnel working on-site will be made aware of Grand Rapids' commitment to caribou conservation and the requirements outlined in this CMP. Education and awareness will be conducted at various on-site meetings (*i.e.*, kick-off meeting, Project orientation and daily tailgate meetings, where appropriate).
	3. Site-specific construction measures will be emphasized at on-site meetings and provided on the Project Environmental Alignment Sheets.
	4. Post signage and bulletins at the Project trailers, alerting workers to the sensitivities associated with entering and working in caribou range.
	5. An Environmental Inspector will ensure that the caribou protection measures are implemented during Project clearing, construction and clean-up activities.
Consultation with the AER	6. Grand Rapid representatives will maintain an open line of communication with the appropriate regulators prior to and for the duration of the Project (Appendix B).
	7. Grand Rapids will submit an as-built map at the end of the construction season describing the work that has been completed on the Project.
Caribou Timing Windows and Scheduling	8. AESRD recommends a timing restriction of February 15 to July 15 within caribou range to reduce impacts to pregnant cows and their calves. Exceptions include site preparation/construction that is initiated prior to February 15, pipeline installations using Class V roads and activities within 100 m of an all-weather road. Work can continue until adverse ground conditions are encountered (Government of Alberta 2013). In general, employ an early in/early out approach to reduce disturbance of caribou by initiating activities as early as possible in the winter and working expeditiously to limit late winter activities.

Activity/Concern	Mitigation Measures
Caribou Timing Windows and Scheduling (cont'd)	9. Consult with AER in regards to activity that may occur in caribou range during the period of February 15 to July 15. 10. Contact AER if there are circumstances that lead to delays with the construction schedule.
Reduce Habitat Loss/Area of Project Footprint	11. Confine Project activities to the approved and surveyed right-of-way. 12. Vegetation clearing will be limited to what is required within the right-of-way and temporary workspace. 13. Clearly mark locations where clearing is to be narrowed or avoided to retain vegetation (*e.g.*, for access control, line-of-sight block and material for felling/bending over the right-of-way to facilitate restoration after construction).
Project-Related Traffic Management	14. Share existing access with other industrial users, wherever feasible. 15. Multi-passenger vehicles will be used to transport crews, where feasible. 16. Speed limits will be established and enforced on all access used for the Project. 17. If caribou are encountered, stop vehicles/equipment and allow the caribou to move through the area undisturbed. Advise others working nearby of the presence of caribou in the area. 18. Restrict access to the Project area during construction to those specifically given authority (*e.g.*, staff and contractors). 19. When plowing snow, create breaks in snow berms by placing berms on alternate sides of any access routes at regular intervals.
Habitat Disturbance During Construction	20. Locate log decks in previously disturbed areas, where possible. 21. Narrow the footprint to the extent feasible in sensitive areas (*e.g.*, watercourse crossings, wetland and riparian areas) and where trenchless (*e.g.*, bored) crossings are implemented. Consider extending narrowed segments beyond the immediate crossing, where feasible. 22. Limiting grading and grubbing where feasible. 23. Reduce disturbance to ground level vegetation and root systems by cutting or mowing shrubs and small diameter trees at ground level along portions of the right-of-way where grading is not required. Rapid regeneration of deciduous trees will be facilitated by keeping the root systems intact. 24. When conditions are appropriate, take advantage of temperature and snow to pack down the right-of-way to protect ground level vegetation and surface soils. 25. Fell all timber onto the right-of-way during clearing to minimize damage to vegetation off right-of-way. Remove damaged or leaning trees only if necessary for safety concerns. 26. Push slash and non-merchantable timber into piles along the centre line of the right-of-way or to a side of the right-of-way that has been previously cleared in a manner that does not drag soil into the pile. Consider using a brush rake attachment on a dozer to facilitate preservation of any strippings.

Activity/Concern	Mitigation Measures
Habitat Disturbance During Construction (cont'd)	27. Where segments of the right-of-way require rollback for access management or erosion control, ensure sufficient timber of appropriate size is available. 28. Reduce the introduction of non-native species.
Barriers to Caribou Movement During Construction	29. Ensure pipeline construction will not be a barrier to caribou movement. Periodic gaps will be left in association with terrain features (*i.e.*, slope changes), crossings (*i.e.*, watercourse, road and right-of-way), and bends. Breaks in set-up and welded pipe shall be coincident with gaps in strippings, spoil, snow and rollback windrows. Locations where gaps are appropriate will be determined in the field by the Environmental Inspector(s). 30. The right-of-way, temporary workspace and access will be cleared of snow, only as required for construction. Ensure gaps in snow berms are retained at periodic intervals to allow wildlife movement. 31. Minimize the amount of open trench at any time. Trenching will be conducted as close as possible to lowering-in and backfill operations. 32. Ensure the open trench does not impede caribou movements. Provide a break in the open trench at regular intervals to allow wildlife to cross the trench. 33. Welded pipe should not remain on the ground for extended periods of time if it is higher than 0.75 m above ground. 34. Ensure any open excavations such as a sumps used for horizontal directional drill sites are fenced to prevent wildlife from becoming trapped or ingesting material.
Caribou Disturbance	35. Recreational use of all-terrain vehicles (ATVs) or snowmobiles by Project personnel on the right-of-way and Project access will be prohibited. 36. Project personnel will be prohibited from having pets on the right-of-way. 37. Continuously collect and dispose of all construction garbage at an approved facility to avoid attracting animals. Waste containers shall accompany each working unit. No waste material shall be disposed of on the right-of-way, on adjacent lands or in the trench at any time. 38. Ensure construction materials such as cables, wires, fencing (etc.) are properly stored to avoid potential contact and harm with wildlife. 39. Harassment or feeding of caribou or other wildlife by Project personnel will not be tolerated. 40. Recreational hunting/shooting/firearms will not be permitted by Project personnel on the work site. 41. Any incidents with wildlife or collisions with wildlife will be reported to the AESRD Fish and Wildlife Division.
Revegetation	42. Where feasible, delimb some coniferous trees at the stump and retain limbs on-site to provide a seed source. 43. Collect seed from cleared trees and shrubs during clearing, if needed to supplement restoration seed source for nursery stock (*e.g.*, alder seed may not be readily available; tree seed from the appropriate zone may not be available).

Activity/Concern	Mitigation Measures
Revegetation (cont'd)	44. At identified locations, spread coarse, woody debris over the construction right-of-way to: conserve moisture; moderate soil temperatures; provide nutrients; reduce soil erosion; provide a seed source; provide micro-sites for seed germination and protection for regenerating seedlings; and prevent damage to regenerating vegetation from human use (*e.g.*, off-road access).
Retention of Timber/Woody Debris	45. Retain salvaged timber and coarse, woody debris (slash) in locations identified for implementation of access control (rollback), line-of-sight blocks (berms), erosion control and creating microsite conditions that enhance seed germination and seedling survival. 46. Salvage remaining merchantable timber in accordance with the applicable permits and approvals. Notify timber haulers and timber mills prior to commencing clearing to inform them of anticipated volumes and proposed schedule. Remove decked wood from the right-of-way as soon as possible to facilitate pipeline construction.
Access Management	47. Access control will be implemented using methods determined in consultation with AER and may include a variety of techniques such as line blocking with available timber/woody debris (rollback or berms), excavator mounding, signage, fencing or gates.
Line-of-Sight	48. Retain coarse, woody debris during clearing for use as a line-of-sight measure (*i.e.*, debris berm), in locations where for this measure is identified. Line-of-sight berms should be constructed to a minimum height of 2 m. Ensure sufficient material is retained to construct a berm to this height across the entire width of the construction right-of-way. 49. Extend bored/drilled crossings of third-party dispositions, where feasible and in accordance with crossing agreements, to retain vegetation screens. Avoid or minimize cleared access at bored/drilled crossings, to the extent feasible.
Soil and Slope Stability	50. Where seeding is warranted during initial or final clean-up to address soil erosion (*e.g.*, slopes, riparian areas and watercourse banks), use an appropriate annual cover crop seed and/or native seed mix. Do not accept seed that contains any restricted or Noxious weeds.
Mounding	51. Where mounding is to be implemented for access control, mounds should be excavated to approximately 0.75 m deep, with the excavated material placed adjacent to the hole. Where mounding is applied for the creation of microsites suitable for tree establishment, mounds should ideally be shallower than those for access control (*e.g.*, approximately 0.3-0.5 m deep).
Clean-Up and Reclamation	52. Initial clean-up activities will commence as soon as possible following backfill operations. Final clean-up will be completed within 1 year of construction. 53. Conduct final clean-up and reclamation work with the caribou range outside the timing window of February 15 to July 15. 54. Natural recovery is the preferred method of reclamation on level terrain where erosion is not expected. 55. Use a combination of natural recovery and reclamation methods that accelerate vegetation regeneration. Accelerated reclamation measures may include: site preparation (*e.g.*, mounding) to enhance microsite conditions that promote seed germination and/or seedling growth; planting conifer seedlings; and willow/shrub staking at riparian areas.

Activity/Concern	Mitigation Measures
Clean-Up and Reclamation (cont'd)	56. Use natural recovery in peatland and non-peatland wetlands. 57. Install live willow stakes or salvaged willow/shrub plugs in the banks of all watercourses and where shrubs were present prior to construction. 58. Avoid seeding of legume-based seed mixes that create competition for naturally regenerating native species. 59. Where appropriate and in discussion with AER, use slash rollback. Rollback can conserve soil moisture, moderate soil temperatures and provide nutrients as it prevents soil erosion. Rollback provides a source of seed for natural revegetation and microsites for seed germination, and protection for introduced tree seedlings. 60. Replace grade material to pre-construction contours, except if otherwise authorized by the Environmental Inspector(s) or designate.
Wildlife Sightings	61. Grand Rapids personnel and Contractors will record all wildlife/caribou sightings on wildlife sighting cards during construction and operation (cards are provided in Appendix C). This information will be provided to AESRD.
Documentation	62. The Environmental Inspector will document construction methods, rationale, mitigation measures and issues encountered. This information will be communicated to resource specialists to support planning and selection of habitat restoration measures within caribou range.

7.0 POST-CONSTRUCTION PHASE

Avoidance and minimization measures are implemented during the pre-construction and construction phases of the Project. The post-construction phase includes reclamation and monitoring activities that occur following final clean-up, and may extend into the operations phase of the Project. Activities associated with reclamation and monitoring during the post-construction phase also adopt mitigation measures to minimize adverse effects, such as scheduling work outside of sensitive timing windows.

7.1 Habitat Restoration

Restoration of disturbed habitat within caribou range will be achieved through implementation of the following three actions.

1. **Vegetation restoration**: revegetation of the Footprint that achieves establishment, survival and growth of target species in the short-term, such that natural ecosystems, consistent with adjacent ecosystems, are expected to regenerate over the long-term.
2. **Access control**: effective access control within the Footprint.
3. **Line-of-sight blocking**: limit lines-of-sight along the Footprint using a combination of long-term techniques (*e.g.*, vegetation screens) and measures that may be more effective in the short to medium-term (*e.g.*, constructed visual barriers such as berms or slash piles combined with vegetation plantings).

Examples of habitat restoration measures that may be implemented during the post-construction phase of the Project to reduce the Project's residual effect are described in Table 6. The selection of restoration measures will be guided by site-specific information, including construction methods and outcomes. Potential limitations, including conditions that may present specific challenges, are provided where applicable.

TABLE 6

POTENTIAL POST-CONSTRUCTION HABITAT RESTORATION MEASURES

Restoration Measures	Objectives	Specifications and Comments
Conifer seedling planting	• Restore vegetation (speed recovery of disturbed conifer forests). • Encourage revegetation to species that are not high value forage for early seral ungulates (*i.e.*, non-palatable). • Access control. • Reduce line-of-sight.	Species are determined based on the biophysical characteristics of the site, adjacent forest stand composition and restoration objectives (*e.g.*, low palatability for ungulates). Seedling planting is considered a long-term restoration treatment (effectiveness is expected to take longer than 10 years).
Bio-engineering and shrub staking	• Restore vegetation. • Access control. • Erosion control. • Reduce line-of-sight.	Species and densities utilized are site-dependent. Vegetation used is typically collected either from the disturbance site (*i.e.*, prior to or during clearing) or from the adjacent area, in the form of cuttings. Willows and poplar can be used as cuttings. Both species are fast growing, which establishes line-of-sight breaks quickly and works well for riparian restoration. Bio-engineering is the use of live vegetation to revegetate a site (*e.g.*, transplants and installing cuttings) and is often implemented in combination with slope or bank restructuring or stabilization measures, such as soil wraps. Bio-engineering is considered a medium to long-term restoration treatment.

TABLE 6 Cont'd

Restoration Measures	Objectives	Specifications and Comments
Shrub planting	• Restore vegetation. • Access control. • Erosion control. • Reduce line-of-sight.	Nursery-grown shrub seedlings may be planted where staking is not practical due to lack of available material, limitations associated with collecting material off-site or where restoration prescription calls for shrub planting of species that do not readily regenerate through cuttings/staking (*e.g.*, alder). Alder generally has low browse value for ungulates such as moose and deer. Compacted sites that are difficult to treat using mechanical site preparation methods can benefit from interplanting alder with conifers. When alder is interspersed with conifer plantings, human access on linear features can be reduced relatively quickly (compared to conifers alone). The nitrogen-fixing characteristics of alder can provide soil enhancement (Sanborn *et al.* 2001, Sweeney 2005), potentially promoting improved conifer growth over the long-term (Simard and Heineman 1996, Courtin and Brown 2001). The fast growth of alder may reduce growth rates of conifer plantings due to competition when alder densities are high (Simard and Heineman 1996, Caribou Range Restoration Project 2007a).
Tree/shrub seeding	• Restore vegetation. • Access control. • Erosion control. • Reduce line-of-sight.	Species and application rates required are site-dependent. Seeding is considered a long-term restoration treatment. Given the relatively narrow disturbance associated with linear developments such as pipeline rights-of-way in forested landscapes, native seed dispersal readily covers the disturbed area. Conifer cone crops can vary dramatically from year to year and, in some areas, good cone crops are relatively predictable (given documented cycles and climatic conditions). Seeding may be a suitable measure if poor cone crops are expected for several years following reclamation or if target species differs from the adjacent stand. Accessibility (*i.e.*, distance to airport) can be a technical limitation if seeding is to be conducted aerially.
Tree/shrub transplanting	• Restore vegetation. • Access control. • Erosion control. • Reduce line-of-sight.	Transplanting has the advantage of immediately establishing relatively large trees/shrubs (*e.g.*, saplings). There are limitations to implementation of transplanting, including: inconsistent availability of vegetation suitable for transplant; potential for degradation of neighbouring vegetation communities if transplants are sourced from adjacent stands; transplanting programs often result in the storage of plant materials under less than ideal conditions due to uncontrollable factors (*i.e.*, weather); and other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison (Golder 2012a).
Excavation mounding	• Create microsite conditions conducive to tree/shrub establishment. • Access control.	For the purposes of enhancing microsites for planted seedlings, mounding is a well-researched and popular site preparation technique in the silviculture industry. It is commonly used in wet, low-lying areas to create better drained microsites for seedlings. Mounding treed wetlands (*e.g.*, bogs and fens) can enhance a site to promote natural revegetation over time, as higher, drier spots are created that seed can eventually settle into and germinate. Mounding has been used as an access control measure on old roads and seismic lines to discourage off-road vehicle activity. It is effective immediately following implementation. For access control purposes, mounds should be created using an excavator. Mounds should be approximately 0.75 m deep, if feasible. The excavated material is dumped right beside the hole. Target density of mounding for access control and/or microsite creation purposes can vary from 1,400 to 2,000 mounds/ha.

TABLE 6 Cont'd

Restoration Measures	Objectives	Specifications and Comments
Berms	• Access control. • Reduce line-of-sight. • Create microsites and protection for natural seed ingress and vegetation growth.	Berms may be constructed of slash and timbers or earth. Supported berms resemble log fences or walls, constructed using timber cleared from the right-of-way. Feasibility of slash/timber berms may depend on approval from provincial authorities/forestry operators to retain and pile slash or timber on-site, and availability of material. Availability of source material is unlikely sufficient for earth berm construction in areas where minimal disturbance construction techniques are employed. Earth berms should not be located in peatlands to avoid potential for settling and alteration of surface hydrology. Berms are effective immediately following implementation. For effective line-of-sight breaks, berms should be constructed to an approximate height of 2 m. Promote rapid shrub/tree regeneration at the ends of berms (*e.g.*, shrub staking and seedling planting) to increase effectiveness as access control.
Woody debris rollback	• Control of human access during snow free periods. • Erosion control, particularly along steep slopes. • Protect planted seedlings from extreme weather, wildlife trampling and damage from off-road vehicles (human access). • Provide nutrients to introduced planted seedlings as the slash decomposes over time. • Provide microsites for natural seed ingress.	The use and length of a slash rollback segment is dependent on sufficient quantities of slash during clearing of new disturbance and the trade-off between its use and the ability/space to store it during construction. Longer segments are more effective at controlling human access since ATV riders will be less inclined to try to ride through the debris or traverse around it in adjacent forest stands. Rollback can also conserve soil moisture, moderate soil temperatures and provide nutrients as debris decomposes, prevent soil erosion, provide a source of seed for natural revegetation, provide microsites for seed germination and protection for introduced tree seedlings, and protect seedlings from wildlife trampling and browsing. Rollback is effective immediately following implementation, provided adequate material is available and properly applied. Debris should be spread evenly across the entire footprint width at a coverage/density that will not restrict the ability to plant seedlings or limit planted or natural seedling growth. Where sufficient material is available, the target woody debris coverage at selected locations is 100 m^3/ha, to both mimic natural processes and control access (Vinge and Pyper 2012). Although higher volumes may be more effective at precluding access and will be considered (up to 150 m3/ha), the amount and placement of wood needs to consider reducing ladder fuels from a forest fire perspective (Pyper and Vinge 2012). Locations where slash rollback are considered effective include the following: • on each side of an intersection with a linear feature that is not an all season road; • for 100-200 m or more on each side of roads and permanent watercourses crossed by the right of way, depending on site suitability; • on segments of the right-of-way that deviate from paralleling existing linear features (*i.e.*, new cut) to discourage new access trails from developing; • on slopes > 10%; and • on temporary access (*i.e.*, shoo-flies) and false rights-of-way (*e.g.*, pull-back sections).

7.2 Monitoring and Adaptive Management

Grand Rapids will design and implement a five year monitoring program to determine the effectiveness of planned habitat restoration measures and the standards and specifications applied. The monitoring program will allow for the identification of restoration measures and/or specifications that are not feasible or successful in particular restoration units or scenarios. Adaptive management will be implemented by adjusting and/or supplementing restoration measures, where warranted, to achieve the objectives of the CMP. Given that science is still emerging on caribou habitat restoration methods and standards, adaptive management principles (the planned systematic process for monitoring outcomes and modifying unsuccessful measures to continuously improve) will be an important means of addressing uncertainty.

Given the uncertainty associated with caribou habitat restoration related to the impact to caribou populations and the balance of predator/prey and movements, assumptions are made in the development of measurable targets and residual effects. The ability to successfully achieve the measurable targets has been demonstrated within certain restoration units, based on previous habitat restoration programs. However, there is a degree of uncertainty within some restoration units given the current lack of monitoring/research and the temporal disparity between habitat recovery (*e.g.*, long-term) and research programs.

7.3 Operation and Maintenance

Grand Rapids will consult with AESRD in regards to scheduling operation and maintenance activity within caribou range. Particularly sensitive periods will be avoided if feasible. Where operation and maintenance activities result in disturbance of caribou habitat, the measures described above for construction, post-construction habitat restoration and monitoring will be implemented, where warranted, and in consultation with AESRD.

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APPENDIX A

BOREAL WOODLAND CARIBOU HABITAT RESTORATION – LITERATURE REVIEW

The information in this Appendix relates to restoration of boreal woodland caribou habitat and is intended to supplement Section 4.0. The information in this Appendix was prepared by Golder.

Recovery and Restoration of Boreal Caribou Habitat

The main challenge of mitigating the effects of industrial development (*e.g.*, forestry, seismic, oil and gas, and mining) in Alberta is reclamation/restoration of a development footprint that is either a linear feature (*e.g.*, pipeline) or a polygon (*e.g.*, cutblock, mine). A common approach in reclamation of forested land in Alberta is the application of provincial standards developed to achieve equivalent land capability to support target end land uses, often with a focus on merchantable forest stands (*e.g.*, Alberta Environment 2011). In relation to oil sands mining in northeastern Alberta, Straker and Donald (2011) and Hawkes (2011) have suggested that current reclamation standards may not be suitable where there is a broader set of management objectives such as maintenance of biodiversity, creating functional forest ecosystems, or restoration of species-specific wildlife habitat.

Although restoration ecology specific to caribou habitat is a relatively new science, some key initiatives have identified important learnings related to oil and gas development in caribou range. Initiatives have generally focused on revegetation and access control, as well as limiting growth and establishment of plant species favourable to primary prey (*e.g.*, Caribou Range Restoration Project 2007a,b, Golder 2010, Osko and Glasgow 2010). These include tree planting initiatives, coarse woody debris management best practices, habitat enhancement programs and habitat restoration trials in caribou range (Caribou Range Restoration Project 2007a,b, Enbridge 2010, Golder 2010, 2011, Oil Sands Leadership Initiative [OSLI] 2012). Blocking line-of-sight has been implemented through land use guidelines as a tool aimed at mitigating increased risk of predation in the short-term, while longer term goals of revegetation of lines-of-sight are achieved. Common among many of these initiatives are learnings on: which plant species to use, and when and where to replant; development of effective techniques to promote natural revegetation; and a better understanding of methods to control access. Lessons learned from these initiatives have been incorporated into large scale habitat restoration projects near Grande Prairie, Cold Lake and Fort McMurray, Alberta.

Table A1 provides a summary of habitat restoration initiatives and the accomplishments and lesson learned.

TABLE A1

HISTORIC AND CURRENT HABITAT RESTORATION INITIATIVES

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
Consortium composed of oil/gas companies, Environment Canada, Alberta Conservation Association, the Alberta Caribou Committee, and Alberta Environment and Sustainable Resource Development [AESRD]) (previously referred to as Alberta Sustainable Resource Development[ASRD])	CRRP	• Program active from 2001 to the end of 2007. • Mandate was to use an adaptive management approach to restoring caribou habitat while testing methods to speed recovery of man-made linear disturbance. • Involved trials to increase the recovery path of seismic and other linear corridors to treed cover, studying the effect of access management techniques on wildlife and humans, performing a cost/benefit analysis, and drafting recommended operating practices and planning strategies from the construction through to the reclamation phases of oil and gas developments. • Field treatments included: transplanting trees and shrubs, seeding, tree seedling planting, using planting enhancements, soil decompaction, mounding, slash rollback, and installation of wooden fences for line-of-site breaks. • Planning strategies included the use of aerial imagery for collecting vegetation inventories, and developing logistical best practices for tree seedling planting in wetland areas during the summer.	• Tested site preparation techniques as they pertain to promoting revegetation and limiting human use of linear corridors, including excavator mounding, decompaction and slash rollback. • Researched and tested the use of aerial imagery and LiDAR for collecting vegetation inventories on linear disturbances, of which aerial imagery was proven to be successful and adopted for other habitat restoration programs. • Managed the macro-scale Suncor/ConocoPhillips Caribou Habitat Restoration Pilot implemented within the Little Smoky caribou range in 2006: – over 100 km of linear corridors treated, encompassing several townships; – included site preparation techniques (excavator mounding and slash rollback); – included planting of tree seedlings on a variety of different ecosites, treatment types and disturbances; – included the installation of wooden fences at the beginning of linear corridors to serve as line-of-sight breaks; – focused on access management by using excavator mounding at the beginning of linear corridors; and – installation of signs at treatment sites. • Produced an unpublished draft document on recommended practices for implementing a habitat restoration program, from the planning through to the treatment and monitoring phases. • Produced an unpublished monitoring manual for collecting revegetation data on linear corridors. • Conducted trials of transplanting existing trees under winter and summer conditions. • Sponsored trials of frozen tree seedling planting. • Sponsored trials for the use of encapsulated seed products for reclamation purposes. • Sponsored a line-blocking study, as part of L. Neufeld's Master's Thesis on wolf/caribou dynamics in the Little Smoky caribou range.	Caribou Range Restoration Project 2007a,b,c Neufeld 2006
Suncor Energy	Accelerated Seismic Line Restoration	Program initiated in 2000. • Objective was to promote revegetation of seismic lines through the use of tree seedling planting, bioengineering (willow staking) and transplanting existing vegetation. • Techniques tried on upland, transitional wetlands and wetland ecosites. • No follow-up monitoring beyond this program.	Four years post-treatment: • upland black spruce transplants survived but showed signs of stress; • black spruce and willow plugs worked better than transplants; • poor results for lines with mulch on them; • transitional wetland black spruce transplanting showed high survival but low growth or vigour rate; and • wetland black spruce and willow transplants and plugs had poor survival, but slightly better survival when planted in elevated microsites.	Golder 2005

TABLE A1 Cont'd

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
Canadian Natural Resources Limited (CNRL), Diversified Environmental Services	Ladyfern Pipeline Re-vegetation Program (natural gas pipeline running from northeast BC into northwest Alberta)	Pipeline construction occurred in 2002: • Promoted revegetation on a pipeline development by: minimizing root disturbance during construction; mechanical seeding of the right-of-way on areas of erosion concern only; promoting the growth of native species from seed; planting of tree seedlings; and transplanting of existing trees. • Goal was to create line-of-sight breaks as introduced trees grow over time. • Upland habitat: tree seedlings were planted primarily with white spruce and lodgepole pine. • Lowland habitat: planted larger, locally collected and transplanted black spruce.	• Annual monitoring of species composition and percent vegetation ground cover was conducted for two growing seasons. • Survival rates were higher in upland sites than lowland sites (focus on lowland sites was black spruce transplants). • Poor survival of locally collected transplanted black spruce. • Coniferous tree seedling (nursery stock white spruce and lodgepole pine) survival and growth appeared to be more successful than using locally collected transplants. • Natural regeneration in both upland and lowland sites was noted in areas that had minimized root disturbance during construction of the pipeline and where there was no mechanical seeding of grass seed. • Re-colonization of coniferous species provided the best visual barrier; deciduous species effective more quickly. • Recommended that transplants should be conducted in the fall when trees are dormant, but still have sufficient time to establish roots. • Recommended that the most effective method for establishing a line-of-sight break is to concentrate efforts on productive uplands. • Recommended that smaller trees (20-30 cm) be selected for further transplants.	Diversified Environmental Services 2004
Axys Environmental	Recommended Peatland Restoration Techniques for Oil and Gas in Boreal Forest	• Axys conducted a literature review of successfully used peatland reclamation techniques within wildlife habitats in the boreal forest.	• A mean water table level higher than 40 cm and preferably within 20 cm promotes peatland growth[1]. • Removing drainage ditches following decommissioning will help restore peatlands[2]. • Water table management is essential to ensure successful re-vegetation of peatlands and to guide the direction of re-vegetation. Soil chemistry adjustment may be required for problem soils[3]. • To achieve improved black spruce seedling growth and environmental quality, use selected mycorrhizal fungi when reclaiming dense black spruce bogs[4]. • Re-establish site hydrology, site topography, and appropriate bog vegetation to reclaim raised bogs. • Patches of discontinuous permafrost (*e.g.*, in northeastern Alberta) are not yet possible to reclaim[5].	Axys 2003 Tedder and Turchenek 1996 Girard *et al*. 2002 Naeth *et al*. 1991 Khasa *et al*. 2001 Robinson and Moore 2000 Turetksy *et al*. 2000 Camill 1999
Enbridge Pipelines (Athabasca)	Waupisoo Pipeline Habitat Restoration	Pipeline construction occurred in the winter of 2007/2008. • Promoted revegetation on a pipeline development within critical moose and caribou habitat by: mechanical seeding of the right-of-way on areas of erosion concern only; promoting the growth of native species from seed; planting tree and shrub seedlings; transplanting existing shrubs; and using slash rollback for access control and micro-site creation for seedling and seed establishment. • Goal was to use growth of planted trees to create line-of-sight breaks, directly restore habitat and control access.	• Approximately 250,000 seedlings were planted at strategic locations over 3 summers. Locations included: – intersections with other linear corridors; – upland sites to create line-of-sight breaks; and – riparian areas. • Slash rollback was applied on some steeper slopes and at some intersections with all-season and winter roads. • Shrub species (alder and willow) transplanted successfully on the banks of the Christina River during the winter. • Planting sites are currently subject to monitoring over a five year period. • Good survival of seedlings was observed on upland sites; lowland site seedling survival to be evaluated during monitoring in the fall of 2012. • Vegetation ingress of clover and native grasses has had a negative impact on seedling survival in some areas. • Where no access control measures were applied, human use of the right-of-way by ATV damaged many seedlings. • Seedlings planted in conjunction with slash rollback were not damaged.	Enbridge 2010 Golder 2011

TABLE A1 Cont'd

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
Canadian Natural Resources Limited, Wolf Lake	Interconnect Pipeline	Pipeline construction occurred during the winter of 2007/2008. • Promoted revegetation on a pipeline development adjacent to the Cold Lake Air Weapons Range (CLAWR) by planting of tree and shrub seedlings. • Goal was to use growth of planted tree species to create line-of-sight breaks, limit the overall width of the developed corridor that the pipeline parallels, directly restore habitat and control access.	• Approximately 60,250 seedlings planted at strategic locations over 2 summers. Locations included: – intersections with other linear corridors; – upland sites to create line-of-sight breaks; and – riparian areas. • Planting sites are currently subject to monitoring over a five year period. • Good survival of seedlings where mechanical seeding was avoided. • Areas mechanically seeded to native grass mixtures had lower survival and vigour of planted seedlings, possibly due to increased competition for sunlight, water and nutrients, and graminoid vegetation falling over and smothering the seedlings when snowfall occurs. • Damage to seedlings from ATV use in many monitoring plots. • Other environmental factors such as frost and wetland encroachment possibly contributing to seedling mortality.	Golder 2012a
University of Alberta led project, supported by a number of oil/gas companies, Canadian Association of Petroleum Producers (CAPP), Forest Resource Improvement Association (FRIA), and Alberta-Pacific Forest Industries Inc. (ALPAC)	Integrated Land Management	• Ongoing study began in 2004 and focused on contributing to best practices for wellsite construction and reclamation on forested lands in the Green Area of northeastern Alberta. Techniques to enable appropriate revegetation and accelerate recovery of ecological processes after disturbance were studied. • Old wellsites component involved monitoring soils and vegetation. • New wellsites component researched methods to use during well-site construction that will promote the prompt revegetation of the site during the reclamation phase.	• Report produced in 2010, "Recommended Practices for Construction and Reclamation of Wellsites on Upland Forests in Boreal Alberta", that evaluated soil and vegetation responses to different winter construction and reclamation techniques. • Recommendations included: – maximizing low disturbance construction practices; – use of snow/water to level sites as opposed to stripping; – retain root zone when stripping and store soil layers in separate piles; – plant seedlings promptly after reclamation to lessen impact of native vegetation competition; – slash rollback is preferable to mulching; – mulch layers need to be less than 10 cm thick when present; – avoid planting tree and shrub species that may impact predator/prey dynamics and do not occur naturally in the area. For example, planting of species palatable to moose in caribou areas should be avoided; and – pre-disturbance assessments and prescription planning can pay dividends at the reclamation stage.	Osko and Glasgow 2010
OSLI	Faster Forests	• Ongoing since 2007, planting trees to increase the pace of reclamation.	• Planting shrubs along with trees allows for trees to grow healthier, faster and with less competition for nutrients and water from fast-growing grasses. • Planted 143,850 seedlings on 113 sites in 2009. • Planted 238,632 seedlings on 120 sites in 2010. • Planted >600,000 seedlings in 2011 on 200 sites (included 4 tree species, 7 shrub species).	OSLI 2012
	Winter Wetland Planting Trial	• Wetlands re-vegetation trials consisting of winter planting of black spruce seedlings to address challenges involved with planting disturbed wetland sites during the summer months. • Goal is to improve reclamation performance.	• Planted 900 trees in winter 2011. • >90% survival rate in spring 2011. • Findings were used to help develop a larger scale frozen seedling program for the on-going Algar Reclamation Program.	

TABLE A1 Cont'd

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
OSLI (cont'd)	Algar Reclamation Program	• Program targeting the restoration of seismic lines through re-vegetation and access control to improve wildlife habitat in a caribou area with historic seismic disturbance. • The Algar area of northeastern Alberta covers approximately six townships (each township is 6 miles by 6 miles).	• Inventory of linear disturbance completed using remote sensing methods. • Detailed restoration plan developed. • Stakeholder consultation led by AESRD on the closure of selected seismic lines to the general public (*i.e.*, to provide some level of protection to areas with restoration treatments). • Macro-scale restoration activities began in winter 2011/2012 and include: – excavator mounding; – slash rollback; and – frozen tree seedling planting.	
Alberta School of Forest Science and Management/OSLI	Coarse woody debris management - best practices	• Goal is to come up with consistent standards that industry users can implement when spreading woody debris on reclaimed sites.	• Developed a guide for improved management of coarse woody debris materials as a reclamation resource. • Best practices manual was prepared through consultation with resource managers and operators, consideration of economic and ecologic requirements, and synthesis of the most relevant and current scientific knowledge. • Wood mulch depths exceeding 3-4 cm form an insulating layer over the soil surface limiting plant growth. • Use of whole logs enhances forest recovery by creating microsites, which creates improved conditions for vegetation to establish and grow. • Total rollback of material along the entire length of exploration and access features is the most effective way to discourage recreational use of linear features. • Well designed scientific monitoring of wildlife use is needed to provide managers with an understanding of treatment effectiveness.	OSLI 2012
CNRL	Habitat Enhancement Program	• Program is part of the Terms and Conditions of the *Environmental Protection and Enhancement Act* (*EPEA*) approval for the construction, operation and reclamation of the Canadian Natural Primrose and Wolf Lake (PAW) Project. • Program targeted the restoration of seismic lines, old lease roads, and abandoned well and core hole sites through re-vegetation and access control to improve wildlife habitat on a caribou range within the CLAWR. • Focused on restoration of historic (pre-oil sands development) features on the landscape that are recovering poorly, either due to environmental conditions (cold, wet soils), historical clearing and reclamation practices, or recent clearing for winter access. • Focused on areas outside of 10 year development plan to avoid re-entry into areas where restoration treatments are placed.	• Used aerial imagery to conduct linear corridor vegetation inventories on all of CNRL's CLAWR operations, encompassing approximately nine townships. • Detailed restoration plan developed. • Ground-truthed sites that appeared on aerial imagery as having little to no woody plant regeneration. • Focused on access control and micro-site creation for introduced tree seedlings, using the following three treatments: – mounding; – tree seedling planting; and – slash rollback. • Planting sites are subject to monitoring over a five year period. • To date, only monitored black spruce seedlings planted in the summer on sites treated in the winter with excavator mounding in treed bog and fen sites. • Excellent survival and vigour of seedlings after one growing season at all monitored sites. • Additional site preparation and seedling planting scheduled for 2013.	Golder 2010

TABLE A1 Cont'd

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
ConocoPhillips, Canadian Association of Petroleum Producers and Suncor Energy	Caribou Habitat Restoration Pilot Study	• Remote camera study (summer 2008) initiated within the Little Smoky caribou range in Alberta. Objectives included comparing wildlife (caribou, deer, moose, bear, wolf, coyote, cougar and lynx) presence and use between naturally restored seismic lines and open cutlines.	• Pooled prey species (caribou, deer, moose) preferentially select restored seismic lines (> 1.5 m vegetation heights, average age of trees 23 years) over non-vegetated sites. • Deer had the strongest preference for restored sites, with the preference attributed to the increased forage within the restored sites, as well as reduced line-of-site and potentially predator avoidance. • Caribou were shown to have a slight preference for re-vegetated seismic line sites over non-vegetated sites, but with limited data there was no statistical difference. However, caribou on control sites were observed to be running much more frequently than on re-vegetated sites and engaged in standing related behaviours only while on re-vegetated sites. Data indicate that caribou are more likely to travel quickly through open seismic lines, which may be a response to the minimal vegetation cover.	Golder 2009

Note: Table modified from Golder 2012b.

Key Results

Recent research has shown positive results for establishing native vegetation on seismic lines and other linear features using techniques such as planting tree and shrub seedlings, and creating microsite conditions (*i.e.*, mounding) that are conducive to seedling growth and natural vegetation encroachment (Caribou Range Restoration Project 2007b, OSLI 2012). Measures such as slash rollback can address site condition issues including competition from non-target or undesired plant species, erosion, frost, and heat or moisture deficiencies (Caribou Range Restoration Project 2007b). Natural revegetation and successful planting initiatives have also benefited from construction practices that minimize disturbance during development of the footprint. Minimal disturbance pipeline construction techniques that avoid grubbing and grading are effective at facilitating rapid regeneration of native vegetation within the right-of-way, in particular in deciduous habitats (TERA 2011a,b, 2012). A trial natural revegetation response inventory program in west central Alberta reported that 85% of disturbed sites did not require artificial recovery, since a natural recovery projection was observed on previously disturbed sites (Caribou Range Restoration Project 2007c). Although regenerating conifers provide a better visual barrier, the faster growth rates of deciduous species provides for effective results more quickly (Diversified Environmental Services 2004). Recent research suggests that planting shrubs along with trees allows trees to grow healthier, faster and with less competition for nutrients and water from fast-growing grasses (OSLI 2012). It may also provide important habitat benefits for wildlife, compared to only planting tree seedlings, by providing hiding cover (Bayne *et al.* 2011).

Transplanting native vegetation appears to be difficult to implement on a large scale as part of a habitat restoration program for the following reasons (Golder 2012b):

- inconsistent availability of vegetation suitable for transplant;
- potential for degradation of neighbouring vegetation communities if transplants are sourced from adjacent stands;
- transplanting programs often result in the storage of plant materials under less-than-ideal conditions due to uncontrollable factors (*i.e.*, weather); and
- other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison.

Seismic lines have been reported to have very slow reforestation rates (Revel *et al.* 1984, Osko and MacFarlane 2000), and recovery is strongly influenced by the characteristics of the adjacent forests (*e.g.*, site productivity, tree and shrub species and heights) (Bayne *et al.* 2011). Conventional seismic lines cleared by bulldozer may take as long as 112 years to reach 95% recovery to woody vegetation in the absence of restoration efforts (Lee and Boutin 2006). Slow tree regeneration has been attributed to root damage from the original disturbance, compaction of the soil in tire ruts, insufficient light reaching the forest floor, maintenance of apical dominance from surrounding stands, introduction of competitive species (*i.e.*, planted seed mixes), drainage of sites (*i.e.*, regeneration slowest on poorly-drained sites with low nutrient availability such as bogs) and repeated disturbances (*e.g.*, all-terrain vehicles [ATVs], animal browsing, repeated exploration) on seismic lines (Lee and Boutin 2006, MacFarlane 1999, 2003, Revel *et al.* 1984, Sherrington 2003). However, tree regeneration on seismic lines is a key determinant of recovery success (MacFarlane 2003) and, therefore, factors that hinder revegetation efforts should be mitigated.

The ability of linear features to recover to a natural forested state is affected considerably by human use. Oberg (2001) identified that recovery of conventional seismic lines to functioning mountain caribou habitat occurs within 20 years following disturbance in west-central Alberta. Golder (2009) reports that in the Little Smoky caribou range, seismic lines that were allowed to revegetate naturally achieved an average height of 2 m, across all ecosite types, within 20 to 25 years, when they had not been recently disturbed by human activity (*e.g.*, re-cleared to ground level for winter access or seismic program use). The average age of trees on the control lines was only 10 years, suggesting sites that are continually disturbed or re-cleared by human activity take longer to regenerate. Restoration efforts have also failed when ATVs destroyed seedlings after planting (Enbridge 2010, Golder 2011, 2012a).

Subjective expert ratings suggest that effectiveness of most physical access control measures (*e.g.*, gates, berms, excavations, rollback, visual screening) vary considerably between negligible and high effectiveness in controlling human access (Caribou Landscape Management Association [CLMA] and the Forest Products Association of Canada [FPAC] 2007). Effectiveness of access control measures are likely dependent on suitable placement (*e.g.*, placed to prevent detouring around access control point), enforcement, and public education of the intent of the access control, which facilitates respect of the control measures (AXYS Environmental Consulting Ltd.1995). Mounding has been found to discourage human access (*i.e.*, truck and ATV) during snow-free periods and also creates microsites that improve vegetation establishment (review in CLMA and FPAC 2007). Excavator mounding is a well-researched and popular site preparation technique in the silviculture industry (Macadam and Bedford 1998, Roy *et al.* 1999, MacIsaac *et al.* 2004). Target density of mounding for access control and/or microsite creation purposes can vary from 1,400 to 2,000 mounds/ha (AENV 2011). Switalski and Nelson (2011) monitored human access on open and closed (*i.e.*, gated, barriered and recontoured) roads using remote cameras, and found that the frequency of detection of humans on closed roads was significantly lower than on open roads, but not significantly different among road closure types. Results of that study also indicated significantly higher levels of hiding cover and lower line-of-sight distances on barriered and recontoured roads compared to open roads (Switalski and Nelson 2011). Physical access control measures provide short-term solutions to manage access and allow for natural regeneration (Golder 2009). Once linear features have regenerated to a pole sapling or young forest structural stage, Sherrington (2003) suggested they no longer facilitate ATV access.

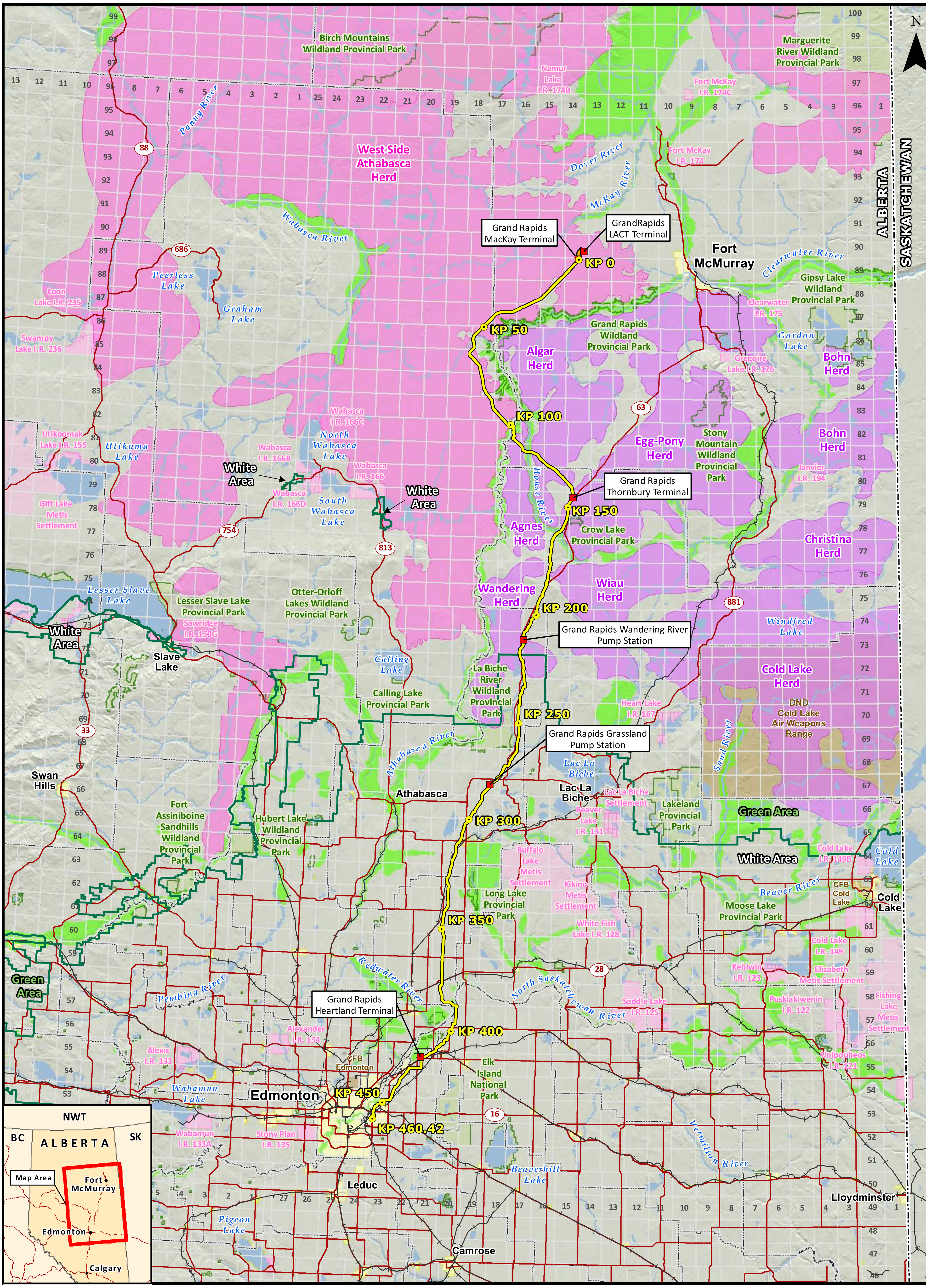
The above techniques to block human access also contribute to initiatives to block line–of–sight. Short-term management for access and line-of-sight blocking should ultimately lead to long-term access control by way of revegetation of disturbed areas (CLMA and FPAC 2007). Expediting growth of visual barriers along linear features can be achieved by concentrating restoration efforts on productive upland habitats, since conifer and shrub (*e.g.*, alder) species grow more quickly on these sites compared to lowland sites. Although regeneration of conifer species provides the best year round visual barrier, their growth can be slow. Therefore, encouraging deciduous woody species growth is important to quickly establish visual barriers in the short-term.

While there has been some effort to assess wildlife use of regenerating seismic lines (*e.g.*, Bayne *et al.* 2011) and reclaimed areas in the Athabasca Oil Sands Region (*e.g.*, Hawkes 2011), few researchers have assessed natural habitat recovery and wildlife responses to recovery with respect to caribou. A pilot study was conducted in the Little Smoky caribou range to measure the effects of revegetating linear disturbances on wildlife use and mobility (Golder 2009). Data were collected for a group of predators (*i.e.*, cougar, wolf, coyote, lynx, grizzly and black bears) and prey (*i.e.*, moose, deer and caribou). Results of the pilot study indicated that revegetated seismic lines (*i.e.*, minimum 1.5 m vegetation regrowth) were preferred by both predator and prey species compared to control lines (*i.e.*, vegetation regrowth of 0.5 m or less), and in general, control lines were used primarily for travel (*i.e.*, both predators and prey species were constantly moving as opposed to standing, foraging, etc.). In addition, human use was almost exclusively limited to the control lines. The line-of-sight measured on the revegetating lines was typically less than 50 m. Golder (2009) suggested that moose and deer may have been attracted to the revegetated lines for forage availability and perceived cover protection. The preference for regenerating seismic lines by wolves may be explained as a response to increased prey use of these lines (Golder 2009). The study also showed that caribou travelled more quickly (running more frequently) and did not engage in standing-related behaviours on control lines, whereas on revegetating lines running was rare and standing-related behaviours occurred more often.

To date, vegetation recovery in the medium and long-term following the creation of pipeline rights-of-way or other industrial activity has been poorly documented. Lack of time sequence recording for regenerating seismic lines and other developments reduces the ability to estimate natural rates and types of vegetation recovery. The focus of most initiatives has been on establishing vegetation along pipelines or seismic lines, with the goals of creating line-of-sight breaks, directly restoring habitat with transplanted vegetation, planting shrub and tree seedlings, sowing native shrub and tree seed, and controlling human access to reclaimed areas to allow undisturbed vegetation growth. Due to the lack of monitoring and the time lag that exists to restore caribou habitat, there is currently no direct link to indicate that implemented restoration techniques are having a positive effect on caribou populations. However, based on modelling scenarios of management options for caribou, restoration of habitat should have benefits in the long-term by contributing to the restoration of large contiguous habitat patches that are preferred by caribou.

APPENDIX B

FIGURES



Proposed Facility
Kilometre Post
Proposed Grand Rapids Pipeline - Mainline
Proposed Grand Rapids Pipeline - Lateral
63 Highway
Railway
Watercourse
Waterbody
Populated Area
Military
Indian Reserve
Park/Protected Area
Green/White Area
Municipal Boundary
Provincial Boundary
Key Wildlife and Biodiversity Zone

Caribou Range

East Side of the Athabasca River (ESAR)
West Side of the Athabasca River (WSAR)

Grand Rapids Pipeline Project

SCALE: 1:1,500,000

0 10 20 30 40 km

(All Locations Approximate)

FIGURE B1

REGIONAL LOCATION

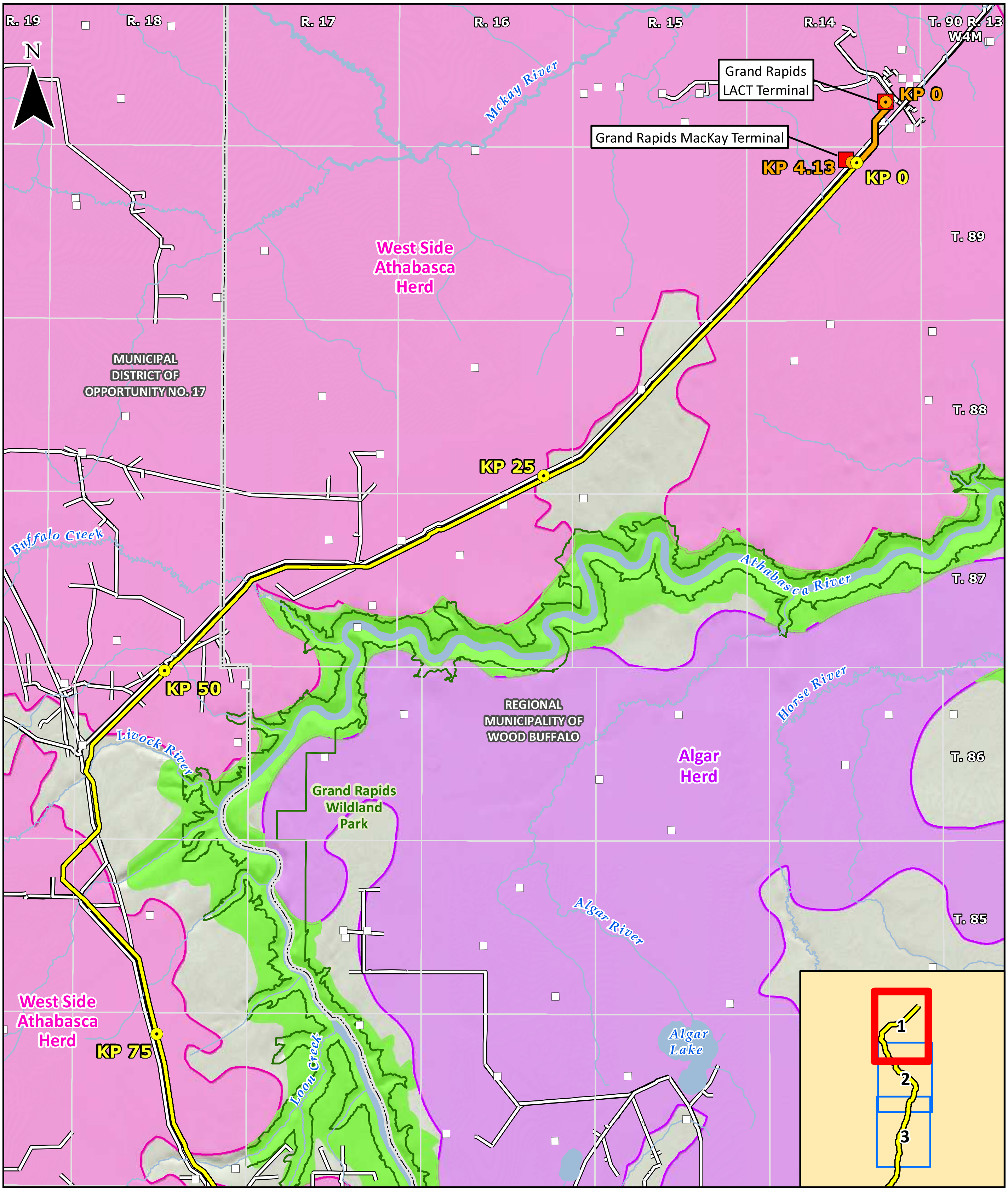
CARIBOU MITIGATION PLAN FOR THE PROPOSED GRAND RAPIDS PIPELINE GP LTD. GRAND RAPIDS PIPELINE PROJECT

tera
A CH2M HILL Company

UTM Zone 12N
Proposed Facility, Pipeline Routing, KP: Focus Corporation 2014; Highway: IHS Inc. 2014, Railway: NRCan 2012; Hydrology: IHS Inc. 2004;
Populated Area, Municipal Boundary: AltaLIS 2014; Military: IHS Inc. 2013; Indian Reserve: Government of Canada 2014, IHS Inc. 2013; Park/Protected Area: ATPR 2012; Green/White Area: AltaLIS 2010;
Provincial Boundary: AltaLIS 2009; Key Wildlife and Biodiversity Zone, Caribou Range: AESRD 2014; Hillshade: TERA Environmental Consultants 2008.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

October 2014	8395
Mapped By: SL	Checked By: DV



Proposed Facility
Kilometre Post (MKP) - Proposed Grand Rapids Pipeline - Mainline
Kilometre Post (KP) - Proposed Grand Rapids Pipeline - Lateral
Proposed Grand Rapids Pipeline - Mainline
Proposed Grand Rapids Pipeline - Lateral

Existing Well
Existing Pipeline
Road
Watercourse
Waterbody
Park/Protected Area

Municipal Boundary
Key Wildlife and Biodiversity Zone

Caribou Range

West Side of the Athabasca River Herd
East Side of the Athabasca River Herd

FIGURE B2 - 1

PROPOSED PIPELINE ROUTE AND FACILITIES

CARIBOU PROTECTION PLAN FOR THE PROPOSED GRAND RAPIDS PIPELINE GP LTD. GRAND RAPIDS PIPELINE PROJECT

tera
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UTM Zone 12N
KP, Routing, Proposed Facility:Focus Corporation 2014; Existing Well: AESRD 2014; Existing Pipeline, Road: IHS Inc. 2014; Hydrology:IHS Inc. 2004; Park/Protected Area: ATPR 2012; Municipal Boundary: AltaLIS 2014; Key Wildlife Biodiversity Zone: AESRD 2014; Caribou Range: AESRD 2013; Hlilshade: TERA Environmental Consultants 2008.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Grand Rapids Pipeline Project

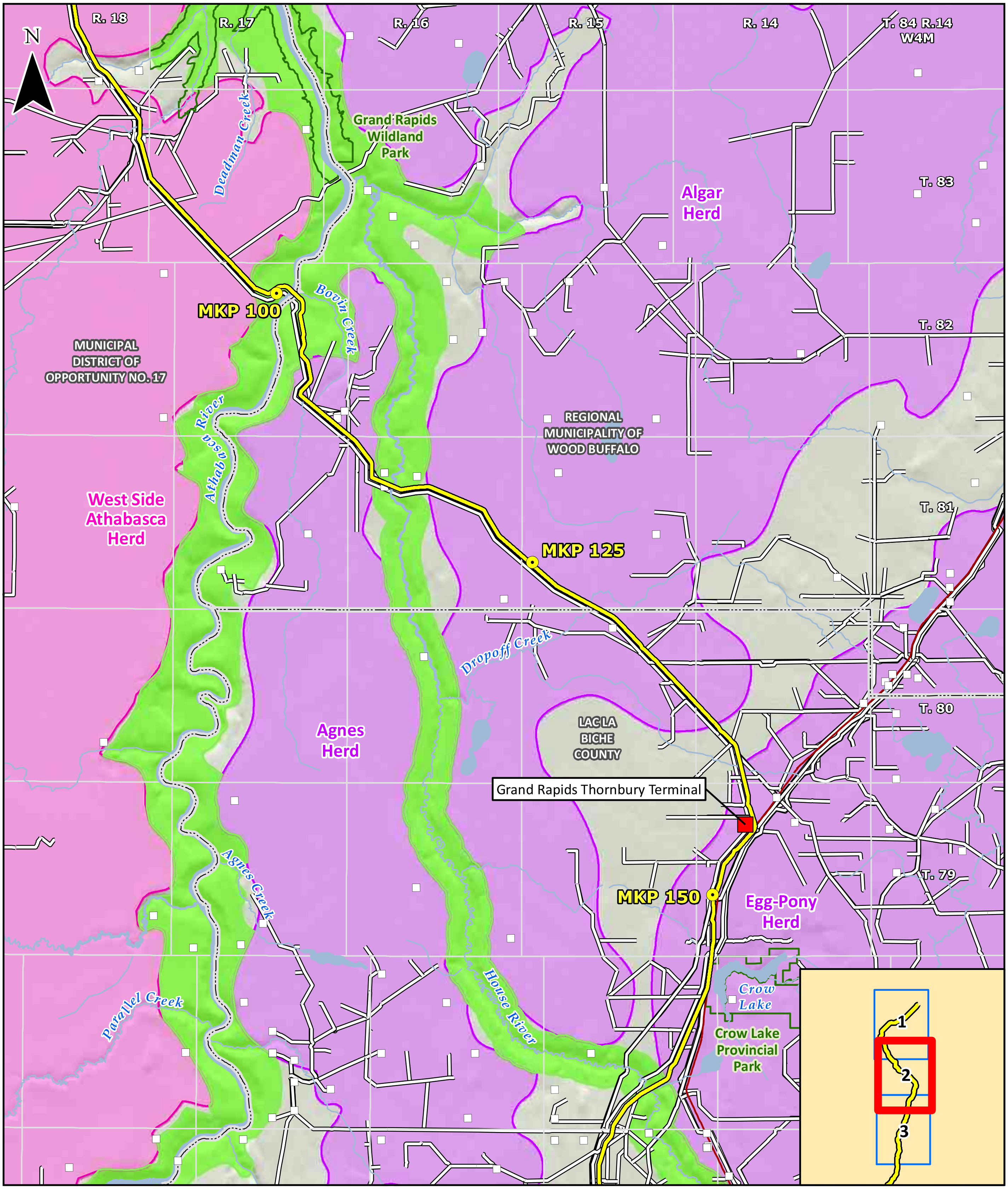
SCALE: 1:300,000

0 4 8 km

(All Locations Approximate)

October 2014	8395
Mapped By: SL	Checked By: DV

8395_CMP_FigureB2_1_ProposedPipelineRoute_Rev0_RouteRev6.mxd



Proposed Facility

Kilometre Post (MKP) - Proposed Grand Rapids Pipeline - Mainline

Kilometre Post (KP) - Proposed Grand Rapids Pipeline - Lateral

Proposed Grand Rapids Pipeline - Mainline

Proposed Grand Rapids Pipeline - Lateral

Existing Well

Existing Pipeline

Road

Watercourse

Waterbody

Park/Protected Area

Municipal Boundary

Key Wildlife and Biodiversity Zone

Caribou Range

West Side of the Athabasca River Herd

East Side of the Athabasca River Herd

FIGURE B2 - 2

PROPOSED PIPELINE ROUTE AND FACILITIES

CARIBOU PROTECTION PLAN FOR THE PROPOSED GRAND RAPIDS PIPELINE GP LTD. GRAND RAPIDS PIPELINE PROJECT

tera

A CH2M HILL Company

UTM Zone 12N

KP, Routing, Proposed Facility:Focus Corporation 2014; Existing Well: AESRD 2014; Existing Pipeline, Road: IHS Inc. 2014; Hydrology:IHS Inc. 2004; Park/Protected Area: ATPR 2012; Municipal Boundary: AltaLIS 2014; Key Wildlife Biodiversity Zone: AESRD 2014; Caribou Range: AESRD 2013; Hlilshade: TERA Environmental Consultants 2008.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Grand Rapids Pipeline Project

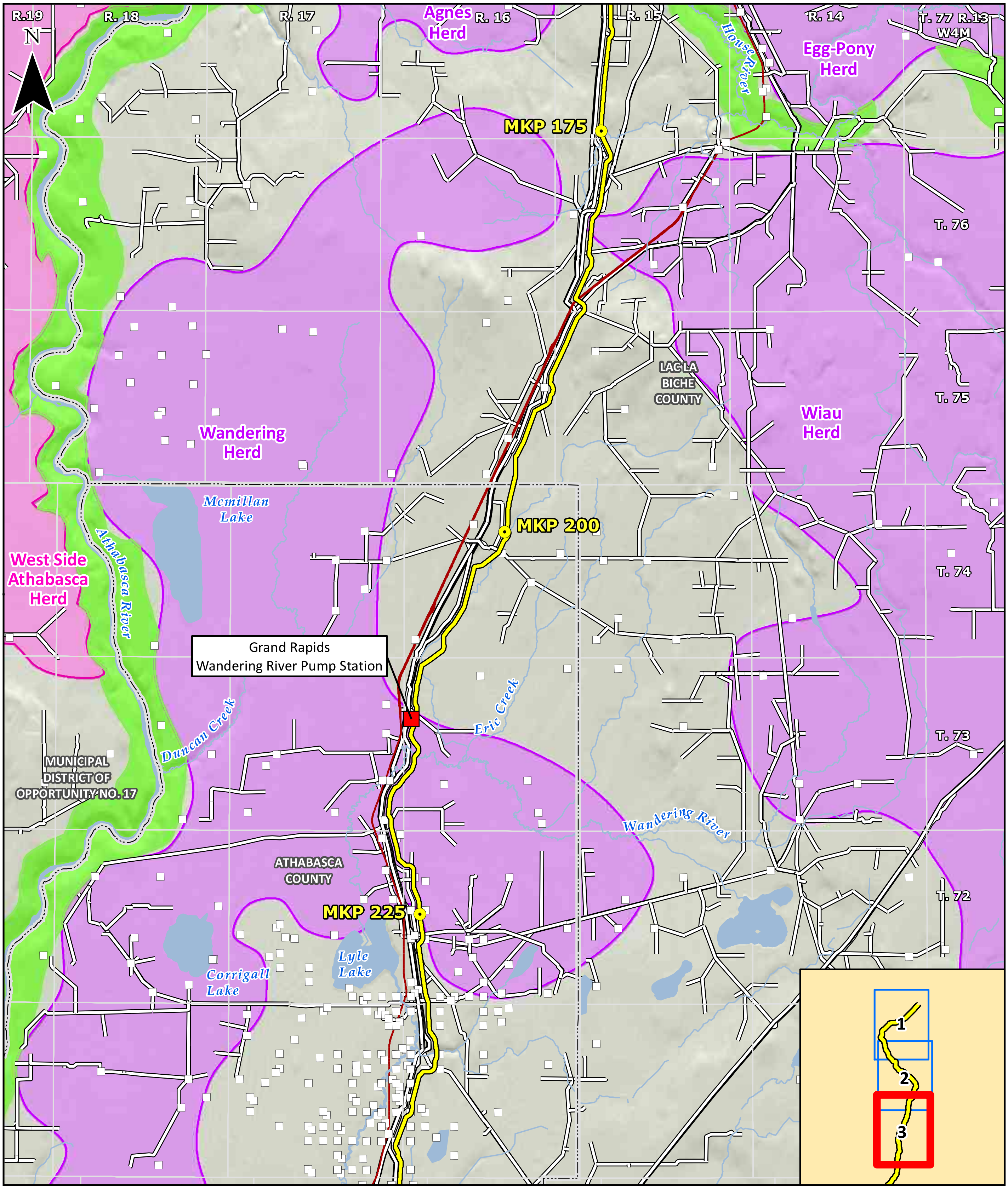
SCALE: 1:300,000

0 4 8 km

(All Locations Approximate)

October 2014	8395
Mapped By: SL	Checked By: DV

t8395_CMP_FigureB2_2_ProposedPipelineRoute_Rev0_RouteRev6.mxd



Proposed Facility
Kilometre Post (MKP) - Proposed Grand Rapids Pipeline - Mainline
Kilometre Post (KP) - Proposed Grand Rapids Pipeline - Lateral
Proposed Grand Rapids Pipeline - Mainline
Proposed Grand Rapids Pipeline - Lateral
Existing Well
Existing Pipeline
Road
Watercourse
Waterbody
Park/Protected Area
Municipal Boundary
Key Wildlife and Biodiversity Zone
Caribou Range
West Side of the Athabasca River Herd
East Side of the Athabasca River Herd

FIGURE B2 - 3

PROPOSED PIPELINE ROUTE AND FACILITIES

CARIBOU PROTECTION PLAN FOR THE PROPOSED GRAND RAPIDS PIPELINE GP LTD. GRAND RAPIDS PIPELINE PROJECT

tera
A CH2M HILL Company

UTM Zone 12N
KP, Routing, Proposed Facility:Focus Corporation 2014; Existing Well: AESRD 2014; Existing Pipeline, Road: IHS Inc. 2014; Hydrology:IHS Inc. 2004; Park/Protected Area: ATPR 2012; Municipal Boundary: AltaLIS 2014; Key Wildlife Biodiversity Zone: AESRD 2014; Caribou Range: AESRD 2013; Hlilshade: TERA Environmental Consultants 2008.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Grand Rapids Pipeline Project

SCALE: 1:300,000
0 4 8 km
(All Locations Approximate)

SCALE: 1:300,000	October 2014	8395
(All Locations Approximate)	Mapped By: SL	Checked By: DV

t8395_CMP_FigureB2_3_ProposedPipelineRoute_Rev0_RouteRev6.mxd

APPENDIX C

CONTACTS

Project Contacts

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Government Contacts

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Grant Chapman Senior Wildlife Biologist Fish and Wildlife Alberta Environment and Sustainable Resource Development PO Box 959, 2nd Floor, Provincial Building 9503 Beaverhill Road Lac La Biche, Alberta T0A 2C0 Phone: (780) 623-5475 Email: grant.chapman@gov.ab.ca	Wildlife Contact

APPENDIX D

WILDLIFE SIGHTING INFORMATION

Use this card to record caribou observations. If you observe other wildlife sightings that you feel are of interest, please fill in the card.

Project: Grand Rapids Pipeline GP Ltd. Grand Rapids Pipeline Project	
Date	
Name of Observer	
Company	
Phone Number	
Location of Observation - General Description	
Location of Observation Legal (Sec. Twp. Rge. Mer.)	
Location of Observation (Latitude/Longitude)	
Caribou Observation Total Number Observed, Number of Males, Cows, Calves (if possible)	
Other Wildlife Species, total Number Observed	
Comments	

Provide this information to Grand Rapids' Environmental Project Supervisor.