TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION AND ORGANIZATION

This section provides an introduction to the preliminary Caribou Habitat Restoration Plan (Preliminary CHRP) for the North Montney Mainline (Project) and outlines how this document is organized.

1.1 INTRODUCTION

NOVA Gas Transmission Ltd. (NGTL), a wholly owned subsidiary of TransCanada PipeLines Limited (TransCanada), filed an application with the National Energy Board (NEB or Board) on November 8, 2013 for a Certificate of Public Convenience and Necessity pursuant to section 52 of the *National Energy Board Act* (NEB Act) to construct and operate the Project and other approvals pursuant to section 58 and Part IV of the Act. For the Project regional location, see Figure 1-1. On June 11, 2015, the Governor in Council directed the Board to issue Certificate of Public Convenience and Necessity GC-125 to NGTL for the Project, subject to the terms and conditions in the GH-001-2014 Report (NEB Report) issued by the Board on April 15, 2015.

The Project is split into two sections: Aitken Creek Section and Kahta Section. The Aitken Creek Section is approximately 182 km, of which 8.1 km occurs in the Graham caribou range (see Figure 1-2), while the Kahta Section is approximately 119 km, of which 19 km occurs in the Pink Mountain caribou range (see Figure 1-3). No compressor or meter stations are proposed in the Graham caribou range and there are two proposed meter station sites in the Pink Mountain caribou range. Project scheduling was designed to avoid the critical timing period for caribou from January 15 to July 15.

This Preliminary CHRP was prepared for the Project pursuant to Certificate Condition 15 and outlines NGTL's plan to minimize Project effects on caribou and restore affected caribou habitat of the Aitken Creek and Kahta Sections,. This document also incorporates:

- feedback from applicable regulators, technical experts and Aboriginal communities
- lessons learned from field experience
- industry experience
- updated results from ongoing literature review

The goal of both the Preliminary and Final CHRP will be to minimize residual effects of the Project on caribou habitat. Residual effects are environmental effects predicted to remain after mitigation is applied.

Tailored to site-specific conditions, restoration measures related to the disturbance of caribou habitat will be implemented in the Project footprint throughout the pre-construction, construction and post-construction phases of the Project.

The Final CHRP will detail the location and type of restoration that will be implemented along the Project right-of-way (ROW). The residual effects requiring caribou habitat offsetting measures presented in the Final CHRP will consider the length of time required for restoration measures to reach maturity (lag time) and factor in uncertainty associated with offsets, and will be further detailed in the Offset Measures Plan for Residual Impacts on Caribou Habitat (OMP) that will be prepared pursuant to Condition 36. The Final CHRP will be filed on or before November 1 after the first complete growing season following the Project being placed into service.

The approach to validate residual effects predictions (direct and indirect) and restoration success is described in this Preliminary CHRP, and the detailed adaptive management plan will be described in the Caribou Habitat Restoration and Offset Measures Monitoring Program (CHROMMP) for the Project. Pursuant to Condition 37, NGTL will file the CHROMMP with the Board on or before February 1 after the first complete growing season following the Project being placed into service. The CHROMMP will explain the Program for monitoring and verifying the effectiveness of the caribou habitat restoration and offset measures implemented as part of the CHRP and OMP. The monitoring period for the CHROMMP will be a minimum of 10 years.

NGTL will also develop an OMP to address Project residual effects on critical caribou habitat for the Aitken Creek Section pursuant to Condition 36. The Preliminary OMP will detail a plan to offset all residual effects of the Aitken Creek Section (the only section that includes critical caribou habitat) resulting from directly and indirectly disturbed critical habitat for caribou, after taking into account implementation of the Environmental Protection Plan (EPP) and CHRP measures, and will further detail the method used to quantify the offsets. The Preliminary OMP will be filed with the Board at least 90 days before requesting Leave to Open the Aitken Creek Section of the Project.

NGTL filed the Access Management Plan (AMP) pursuant to Condition 16 on June 3, 2015 (NEB Filing ID: A70510). The AMP detailed a plan for managing access along the ROW for non-parallel disturbances for each of the Aitken Creek and Kahta Sections.

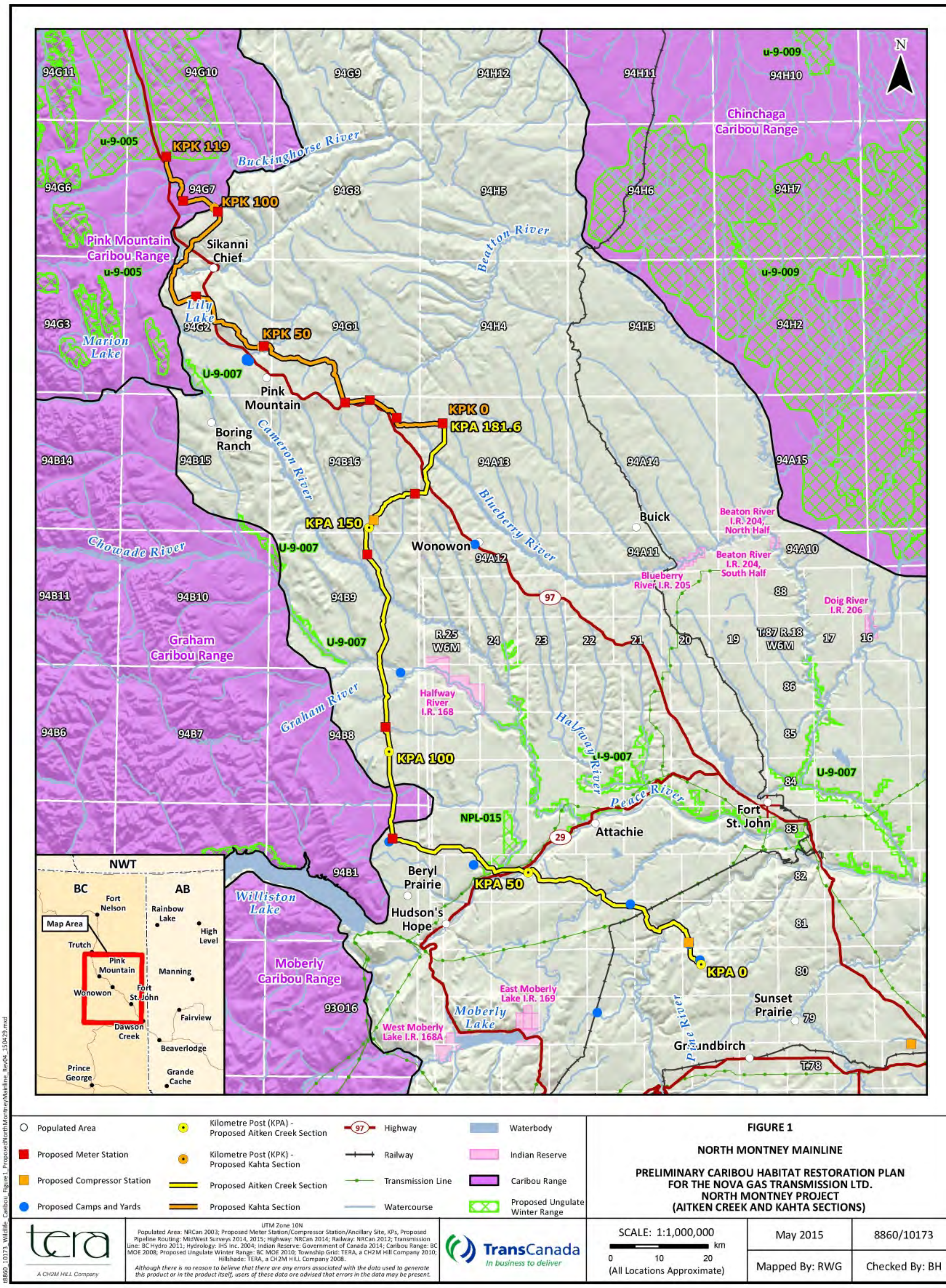


Figure 1-1: Regional Location

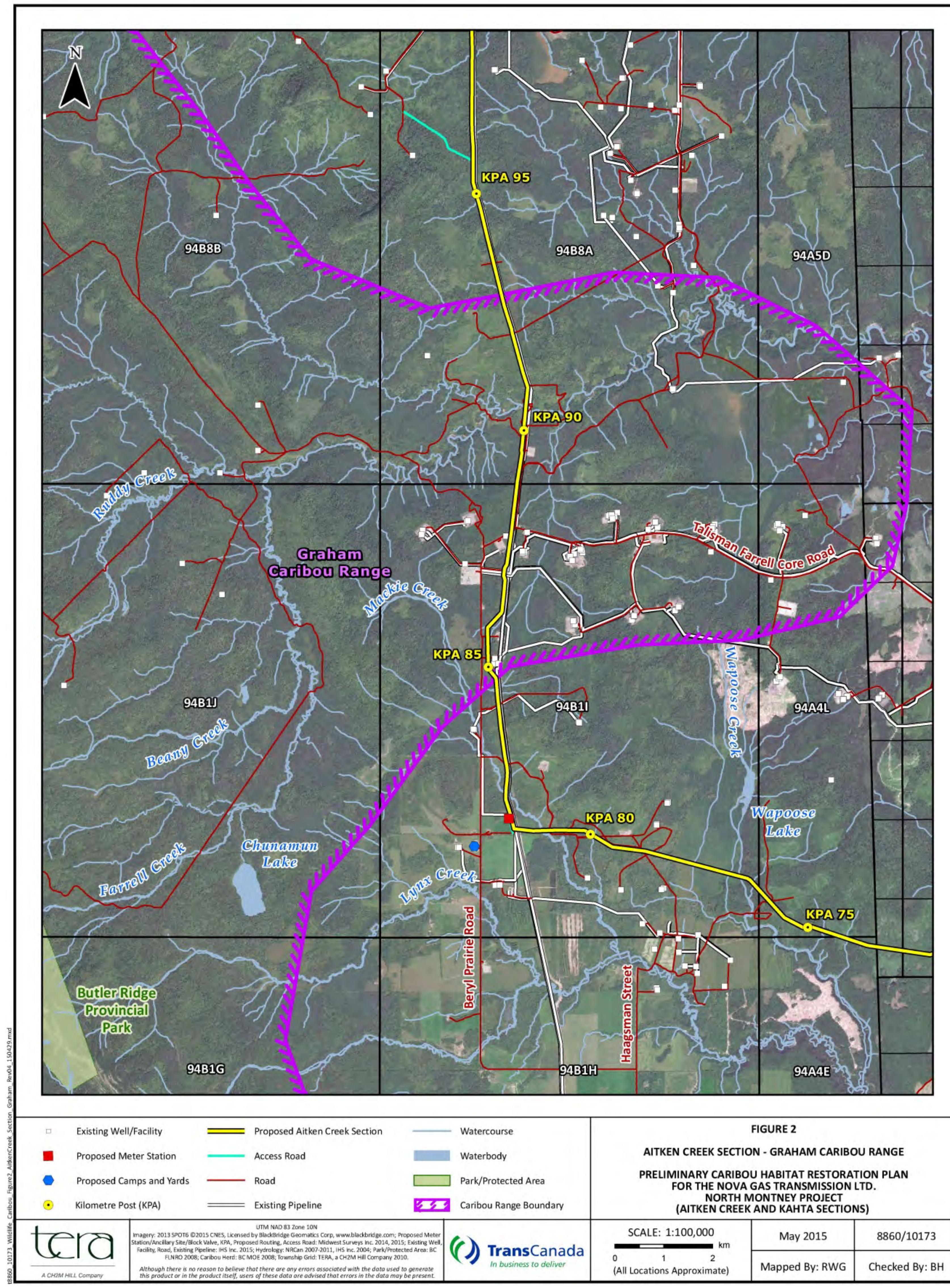


Figure 1-2: Aitken Creek Section – Graham Caribou Range

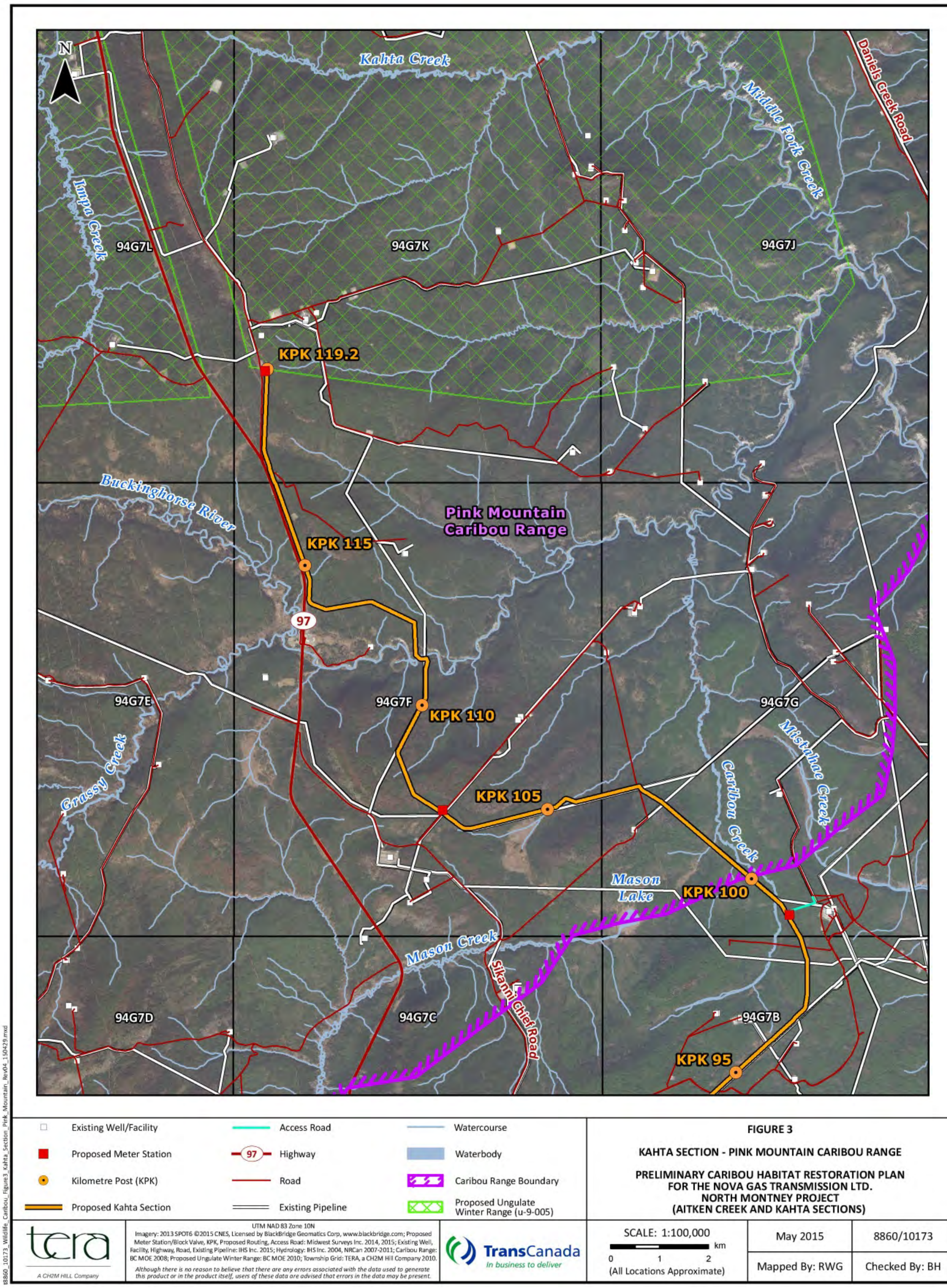


Figure 1-3: Kahta Section – Pink Mountain Caribou Range

1.2 ORGANIZATION OF THE PRELIMINARY CHRP

This Preliminary CHRP is organized in nine sections, as follows:

Section 2: introduces the goal, objectives and quantifiable targets.

Section 3: introduces the habitat restoration decision framework used to decide on potential caribou habitat restoration sites and to determine restoration measures in different site types, considering typical site factors that could constrain implementation.

Section 4: outlines quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects, extent to which goals and objectives have been met and the need for consequent compensation offsets.

Section 5: includes a description of how the spatial disturbance will be calculated (as the calculation will not be completed until the Final CHRP is prepared), habitat restoration, monitoring, adaptive management and the proposed implementation schedule for each of the Aitken Creek and Kahta Sections.

Section 6: describes how field innovations and previous experience have been incorporated into this Preliminary CHRP for the Project.

Section 7: provides a summary of caribou-specific consultation with Aboriginal communities and applicable regulators to-date, as well as a summary of how feedback was incorporated in this Preliminary CHRP.

Section 8: is a literature review, on which the decision framework for this document is based, that includes:

- identification of temporal and spatial caribou habitat restoration methods applicable to both boreal and mountain caribou
- assessment of the relative effectiveness of the identified methods
- description of the literature review approach

Section 9: cites references used throughout the document.

This Preliminary CHRP is organized to address each requirement of GC-125 Condition 15. For the locations in this document that outline how each condition has been met, see Table 1-1.

Table 1-1: GC-125 Condition 15: Caribou Habitat Restoration Plan

Condition	Details and Location in Report
15. Caribou Habitat Restoration Plan (CHRP) NGTL shall file with the Board for approval, in accordance with the timelines below, preliminary and final versions of a CHRP for each of the Aitken Creek and Kahta Sections of the section 52 Facilities. At the time of filing with the Board, NGTL shall provide a copy of the filings to Environment Canada and the appropriate provincial authorities.	This document addresses the restoration plan for each of the Aitken Creek and Kahta Sections of the Project in Section 5. All other sections of this document are applicable to both the Aitken Creek and Kahta Sections of the Project.
a) Preliminary CHRP to be filed at least 90 days prior to commencing construction. This version of the CHRP shall include, but not be limited to:	
i) the goals and measureable objectives of the CHRP;	Section 2 of the Preliminary CHRP introduces the goal, objectives and quantifiable targets.
ii) decision frameworks that will be used to prioritize potential caribou habitat restoration sites and to prioritize mitigative actions to be used at different types of sites, including consideration of typical site factors that may constrain implementation;	Section 3 provides a decision framework.
iii) a review of literature upon which the decision frameworks are based including: i. an identification of temporal and spatial caribou habitat restoration methodologies applicable to mountain caribou; ii. an assessment of the relative effectiveness of the identified methodologies; iii. detailed methodology of how the literature review was conducted.	Section 8 of the Preliminary CHRP summarizes relevant literature and describes the method for the literature review.
iv) the quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects, the extent to which the goals and objectives have been met, and the need for consequent compensation offsets;	Section 2 and Section 4 of the Preliminary CHRP describe quantitative criteria to evaluate effectiveness, and include a brief description of monitoring and adaptive management measures. Further information on monitoring and offsets will be provided in the OMP and CHROMMP under separate cover in accordance with GC-125 Conditions 36 and 37.
v) a schedule indicating when measures will be initiated and completed;	Section 5.8 of the Preliminary CHRP provides the schedule for construction and habitat restoration activities for each of the Aitken Creek and Kahta Sections.
vi) a table summarizing any differences or updates from the last previous NGTL CHRP filed with the Board for other projects; and	Section 6.4 provides a table summarizing differences and updates since the last NGTL CHRP filed with the Board.
vii) evidence and a summary of how consultation feedback from Environment Canada and appropriate provincial authorities is integrated into the CHRP.	Section 7 summarizes consultation and feedback from EC, BC MFLNRO, and potentially affected Aboriginal communities.

Table 1-1: GC-125 Condition 15: Caribou Habitat Restoration Plan (cont'd)

Condition	Details and Location in Report
b) Final CHRP to be filed on or before 1 November after the first complete growing season following the commencement of operation for the Section 52 Facilities. This updated version of the CHRP shall include, but not be limited to: i) the preliminary CHRP, with any updates identified in a revision log that includes the rationale for any changes to decision making criteria; ii) a complete table describing caribou habitat restoration sites, including but not limited to location, spatial area, description of habitat quality, site-specific restoration activities and challenges; iii) specification drawings for the implementation of each restoration method; iv) maps or Environmental Alignment Sheets showing the locations of the sites; v) evidence of how further consultation feedback from Environment Canada and appropriate provincial authorities is integrated into the plan; and vi) a quantitative and qualitative assessment of the total area of direct disturbance to caribou habitat that will be restored, the duration of spatial disturbance, and the aerial extent of the resulting residual effects to be offset, which also includes indirect disturbance.	The Final CHRP will be filed on or before November 1 after the first complete growing season following the Project being placed into service. For schedule information, see Section 5.8.

2.0 GOAL, OBJECTIVES AND QUANTIFIABLE TARGETS

This section describes the goal, objectives and quantifiable targets of the CHRP.

2.1 GOAL

The overarching goal of NGTL's caribou habitat restoration plan is to minimize the predicted residual effects of the Project and the Project's contribution to cumulative effects on caribou and caribou habitat in a manner that aligns with provincial and federal policies.

2.2 OBJECTIVES

The objectives of the CHRP were designed to achieve the goal in a way that incorporates the best information available, and can be implemented and measured to quantify residual effects on caribou and impacted caribou habitat. The three objectives of the CHRP are:

1. **Habitat restoration**: revegetation of the Project footprint that achieves establishment, survival and growth of target species in the short term, so natural ecosystems, consistent with adjacent ecosystems, are expected to regenerate over the long term. For example, caribou habitat will be restored in the Project footprint through revegetation, mounding, bioengineering and berms to provide both immediate and sustainable functional habitat that supports caribou recovery over the long term.
2. **Access control**: effectively discourages access in the Project footprint as an interim measure until results of the monitoring program indicate long term habitat restoration has been successful. For example, access and use of the ROW is controlled through placement of coarse woody debris, tree felling, sign placement and rollback to limit access.
3. **Line-of-sight blocking**: reduce lines-of-sight along the Project footprint using barriers such as screens and vegetation. For example, tree planting, tree felling, vegetative and fabricated site screening are intended to reduce visibility along the ROW.

The CHRP goal to minimize Project residual effects on impacted caribou habitat will be attained by implementing the three objectives identified above. The Final CHRP will assess the objectives from a qualitative and quantitative perspective.

2.3 QUANTIFIABLE TARGETS

Quantifiable targets are the criteria that will be used to determine whether the CHRP objectives identified in Section 2.2 have been achieved:

- extent of predicted residual effects
- whether the CHRP objectives have been achieved
- need for compensation offsets

For more information on quantifiable targets and performance measures, see Section 4.

3.0 DECISION FRAMEWORK

The decision framework (see Figures 3-1, 3-2 and 3-3) will be used to guide the Project in meeting the goal of the CHRP. The decision framework NGTL has developed is a principle based logic model that supports each of the three objectives and forms the basis for quantifiable targets.

The decision framework was initially developed by NGTL from information obtained in the literature review, as well as industry best management practices and industry consultation. However, the decision framework included in this Preliminary CHRP has been revised to reflect recent lessons learned from field experience on other NGTL projects that impact caribou habitat. In particular, the decision framework has been revised to incorporate lessons learned in implementing line of sight blocks and access control measures on the recently constructed Chinchaga Project.

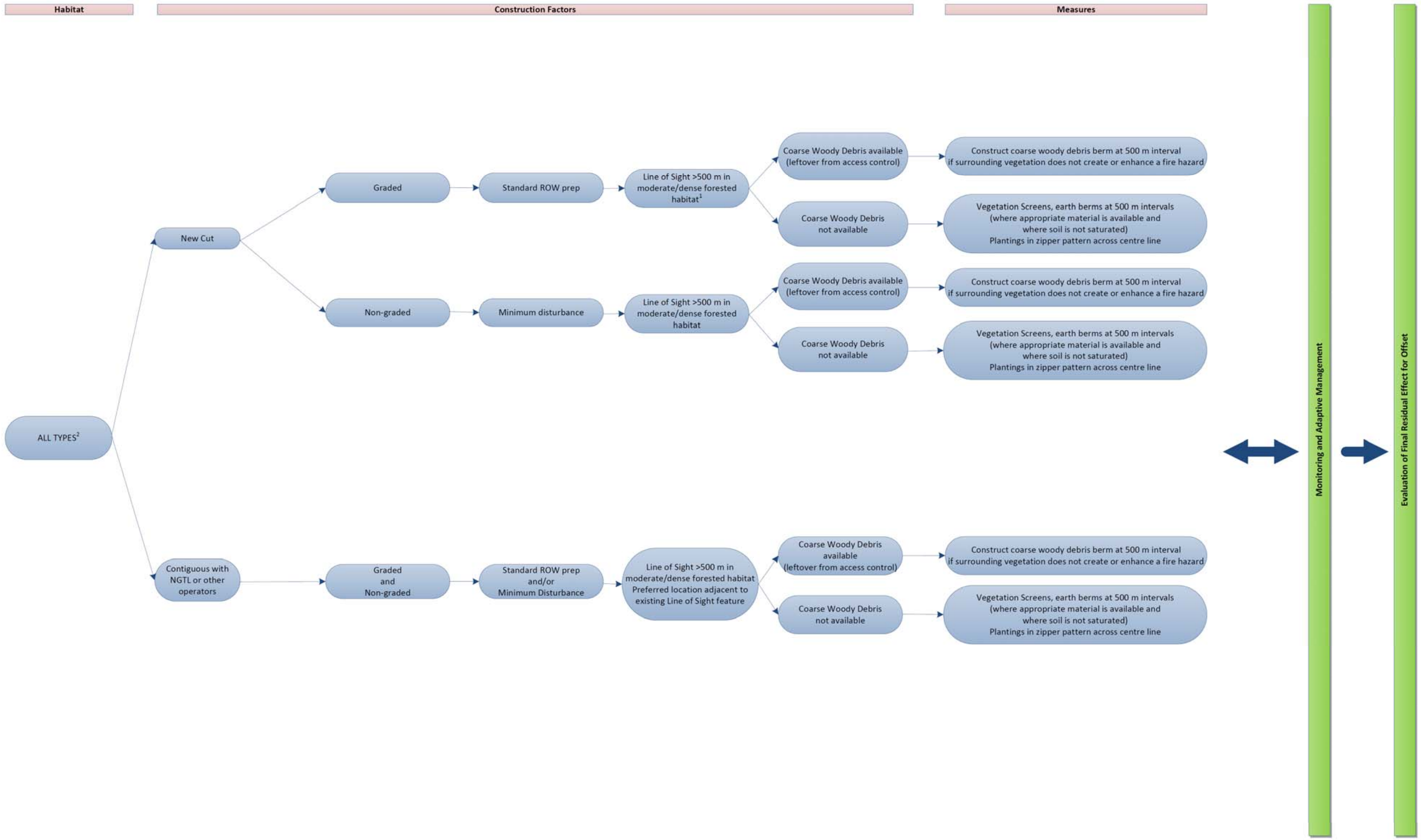
The decision framework will be applied at the start of construction to identify candidate sites for mitigation measures and reviewed during construction to identify any changes in inputs. Mitigation will be applied during final cleanup.

Figures 3-1, 3-2 and 3-3 are presented in chronological order in which they are implemented: access control, line of sight blocking and habitat restoration. These figures show restoration measures or tools that can be applied to the Project footprint in order to meet the CHRP goal. However, only restoration measures or tools applicable to the Project will be applied. These are outlined in Section 5, Table 5-3.

Key factors in the choice of these restoration measures or tools include:

- natural site characteristics
- existing disturbance and activities
- regulatory requirements
- site-specific construction methods

Figure 3-1: Revised Access Control Decision Framework ~~(for Upland Mixedwood/Upland Coniferous/Transitional Habitat)~~



Note: (1) Line of Sight breaks will not be implemented in open habitat where line of sight naturally exists. See Section 5.
(2) Wetland or open habitats will be evaluated on a case-by-case basis (see Table 4-1).

Figure 3-2: Revised Line of Sight Decision Framework ~~(for Treed Lowlands and Wetlands)~~

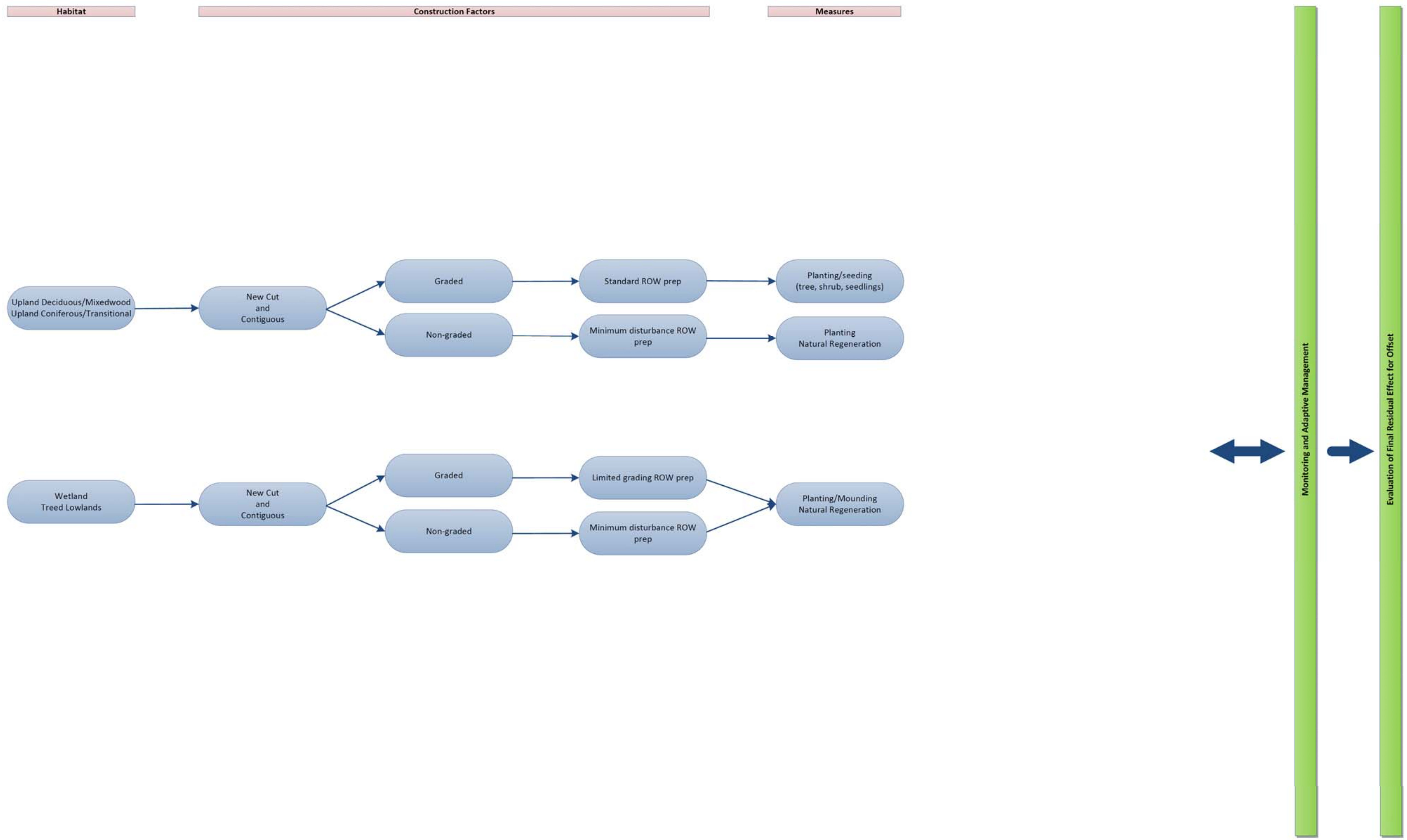


Figure 3-3: Revised Habitat Restoration Decision Framework ~~(for Line of Sight and Access Control)~~

4.0 QUANTIFIABLE TARGETS AND PERFORMANCE MEASURES

This section describes:

- quantifiable targets and performance measures used to evaluate the extent of predicted residual effects
- the extent to which CHRP goal and objectives have been met
- the need for compensation offsets for any residual effects remaining after implementation of CHRP measures

For a summary of the quantifiable targets and performance measures available to the Project, see Table 4-1. The quantifiable targets and performance measures selected for the Project work in conjunction with the decision framework described in Section 3.

Table 4-1: Quantifiable Targets and Performance Measures

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Habitat Restoration	• Successful native vegetation re-establishment using the proposed habitat restoration measures will achieve trajectories toward natural ecosystem types, which will eventually re-establish native wildlife habitat. • The Project footprint in a caribou range is the proposed clearing of new area (i.e., excludes overlapping/shared areas with existing disturbances). • NGTL's operation and maintenance practice includes vegetation control over the pipe centreline (approximately 6–10 m wide area centred over the pipeline) as a corporate mechanism to meet compliance with CSA-Z662-15. This Standard requires that vegetation is controlled along rights-of-way to maintain clear visibility from the air and provide ready access for maintenance crews (CSA 2015). Although, there is flexibility in NGTL's vegetation control practice to allow for wildlife habitat objectives yet remain in compliance with CSA Z662-15. NGTL acknowledges limitations for sustained revegetation success along the pipe centreline while the pipeline is in operation. NGTL understands its obligations for achieving equivalent land capability at end of pipeline life.	Upland Deciduous/Mixedwood/Transitional/ Upland Coniferous • Achieve $\geq$80% or higher survival rate for planted seedlings within 10 years following implementation of CHRP measures.. • Demonstrate sustained growth trends across $\geq$80% of restoration locations within 10 years following implementation of CHRP measures.	• Quantitative measures of success will include comparisons of regeneration parameters (e.g., vigour, height, percent cover, species composition) between Years 1, 3, 5 and 10 following start of operation, with the objective of ensuring establishment of each habitat type and a trend toward achieving equivalent land capacity. If regeneration parameters are not met, adaptive management measures will be implemented to meet vegetation reestablishment trajectory. It is intended that plantings will be monitored for 10 years pursuant to Condition 37. • GPS location, number and type of restoration treatments and the frequency of monitoring sessions will be defined and mapped in thefinal CHRP.

Table 4-1: Quantifiable Targets and Performance Measures (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria

Habitat Restoration (cont'd)	• Areas in the Project footprint that parallel existing footprints with grass cover could have limited successful survival of planted species, due to competition from species ingress from adjacent disturbance.
	• Overlapping dispositions such as a gravel roads or facilities could limit long-term restoration success.
		Treed Wetlands/Treed Lowlands
		• Where tree seedlings are planted (i.e., mounded sites):
		  • achieve ≥50% survival rate for seedlings/ transplants within 10 years following planting
		  • demonstrate sustained growth trends across ≥50% of restoration locations within 10 years following implementation of CHRP measures
		Shrub/Graminoid Wetland
		• Within 10 years following installation of CHRP measures:
		  • ≥50% cover of native vegetation species in the footprint
		  • no restricted weeds
			• Where revegetation success does not meet quantifiable targets, NGTL will determine appropriate adaptive management. For example, if seedling mortality is unexpectedly high, NGTL will do additional planting, improve site conditions for seedling success or improve restoration efforts at other sites.

Table 4-1: Quantifiable Targets and Performance Measures (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria

Access Control	• Access control measures are most effective when implemented at intersections of the Project ROW with existing perpendicular linear features (e.g., roads, utility corridors, seismic lines).
	• Access by NGTL staff and contractors, including operations personnel as well as reclamation and monitoring crews, will be recorded and monitored. Access by Project personnel within the footprint in caribou range will be limited to the extent practical. Traditional access will be maintained.
	• The access control evaluation might be guided by the Access Management Plan (AMP), which was prepared pursuant to Condition 16.
		Access Control:
		The following quantifiable targets will be used to measure the access control objective:
		• a lower measure (e.g., rate, proportion, count) of access along the segments of the Project ROW where access is controlled relative to uncontrolled segments
		• <20% increase in access (e.g., rate, proportion, count) from the baseline assessment as measured by remote cameras
		The quantifiable targets for access in the Project ROW are expected to be achieved within 5 years following CHRP implementation, though monitoring will continue over 10 years.
			• Evidence and level of access along Project ROW using criteria ratings such as:
			  • access evident: Yes/No
			  • access type: all-terrain vehicle (ATV)/ truck/ snowmobile/ non-motorized/
			  • predator/other
			• Access level:
			  • No access evident
			  • Low: tracks/trail evident but difficult to discern or appears to be infrequently used
			  • High: tracks/trails appear to be well-used; vegetation is trampled down, bare ground from frequent use might be visible)
			• Access level definitions will be refined in the Final CHRP.
			• An evaluation of whether the objective for access control is achieved will consider collected qualitative and quantitative data.

Table 4-1: Quantifiable Targets and Performance Measures (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Line-of-Sight Blocking	• Operating practices for energy development in sensitive caribou range in British Columbia (BC Ministry of Environment 2011) suggest implementing line-of-sight management every 500 m on linear features that do not share a ROW boundary with a road. Line-of-sight blocking as part of this Project will follow this guideline where it is not collocated with roads or other linear developments. • Bends in the pipeline (doglegs) can reduce line-of-sight, but opportunities to do this for the Project might be limited where the ROW parallels other linear developments. • Wetlands and some treed lowlands encountered by the Project footprint naturally have low and/or open vegetation structure. The line-of-sight distance in these areas is naturally long and, therefore, sightline management techniques are not practical for these locations. • Concern from provincial regulators regarding fire hazard and forest health (pathogen spread), availability of line of sight blocking material, suitability of substrate to support structures (i.e., peat does not support fencing), introduction of weeds from imported material and potential for alteration in surface hydrology (particularly from earth berms) can limit the use of line of sight blocking measures. • Appropriate locations for line-of-sight blocks will be identified post-construction when final clearing is complete and included and as-built drawings.	Line-of-Sight Blocking: • Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, achieve sightline distance of < 500 m within 10 years following implementation of CHRP measures. • Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, where planting for future vegetation screens in combination with or without rollback have been installed, achieve 80% or higher survival rate for planted seedlings that are intended as line-of-sight blocks within 10 years following implementation of CHRP measures.	• Establish line-of-sight blocks in forested areas of the footprint in caribou range that will achieve a sightline distance of 500 m or less in areas of new cut or in sections contiguous with, and adjacent to, NGTL lines only.

Table 4-1: Quantifiable Targets and Performance Measures (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Line-of-Sight Blocking (cont'd)	• A combination of measures, including vegetation screening, rollback and mounding will be applied. Feasibility of installing berms or fencing will be investigated post-construction. • Few limitations are associated with using vegetation screening to reduce line-of-sight. • Paralleling an existing linear corridor presents challenges for line-of-sight blocking where the adjacent line is owned by a company other than TransCanada. • Application of sightline management techniques should extend across the width of the Project footprint and adjacent disturbance to be effective.		

Note:
1 Restoration objectives will continue to be evaluated for the Final CHRP to consider any updated consultation with stakeholders or if any other relevant information becomes available.

5.0 THE RESTORATION IMPLEMENTATION PLAN

This section provides a high-level summary of Project impacts to affected mountain caribou habitat. This section also describes NGTL's plan to implement a decision framework (see Section 3) which will be used by the Project to achieve the overarching goal of the CHRP. The content of this section presents NGTL's plan to reduce residual and cumulative effects of the Project on caribou and impacted caribou habitat.

5.1 PROJECT IMPACTS TO CARIBOU HABITAT

The Environmental and Socio-Economic Assessment (ESA) for the Project identified potential direct and indirect effects of the Project on caribou and caribou habitat through changes in habitat conditions, herd movement and caribou mortality risk. The cumulative effects analysis completed as part of the ESA determined that the Project will have small, incremental contributions to the overall cumulative effects to the Graham and Pink Mountain caribou ranges (see Figure 1-1). The Project linear disturbance presented in Table 5-1 reflects the most recent Project design at the time this Preliminary CHRP was prepared. Final determination of linear disturbance in caribou range will be presented in the Final CHRP.

The NEB Report stated that the Project will still result in loss of habitat (and could result in disturbance to caribou) beginning with construction and continuing through the lifecycle of the Project, notwithstanding the proposed mitigation within NGTL's EPP and CMP. The Board stated that disturbances within caribou ranges should be minimized, and measures taken before and during construction to help accelerate the restoration of caribou habitat. The Board is of the view that Project proponents have a responsibility to not only reduce effects on caribou habitat, but to also restore affected habitat as soon as possible and as much as possible. The Board, therefore, imposed Condition 15 requiring NGTL to prepare a Preliminary and Final CHRP for the Project. The Board acknowledged NGTL's preparation and submission of the preliminary CMP and noted that the CHRP will supersede and replace the CMP.

5.1.1 Impacted Caribou Habitat

The Project will impact the Graham and Pink Mountain caribou ranges (see Section 8.3). The Aitken Creek Section of the Project will result in a linear disturbance of approximately 8 km within the Graham caribou range. The linear disturbance on the Kahta Section extends approximately 19 km within the Pink Mountain caribou range (see Table 5-1).

Table 5-1 also describes both the Graham and Pink Mountain herds listing status. Both herds are provincially designated northern ecotype caribou (BC Ministry of Environment [MOE] 2010), but are classified differently at the population level.

The Graham herd belongs to the Southern Mountain population, Northern Group, and is designated as Threatened on Schedule 1 of the *Species at Risk Act* (SARA) and by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and is blue-listed in BC (BC Conservation Data Centre [CDC] 2015; COSEWIC 2015; Environment Canada (EC) 2015).

The Pink Mountain herd is part of the Northern Mountain population, and is designated as Special Concern on Schedule 1 of SARA and by COSEWIC, and is blue-listed in BC (BC CDC 2015; COSEWIC 2015; EC 2015). COSEWIC has further divided each population into Designatable Units (DU), and both the Graham and Pink Mountain herds are included in Northern Mountain DU7 (COSEWIC 2011).

Species designated as Special Concern (SC) on Schedule 1 of SARA, such as the Pink Mountain herd, require management plans developed by the federal government for the species and its habitat, whereas species designated as Threatened or Endangered, such as the Graham herd, require a recovery strategy. Because the Pink Mountain caribou population is designated SC, a management plan was developed for this population, where it is referred to in the collective as Northern Mountain caribou.

Table 5-1: Caribou Nomenclature and Ranges that Interact with the Project

Project Component	Caribou Range	BC Provincial Status Designation and Nomenclature	Federal Status Designation and Nomenclature	Current Population Trend	Project Linear Disturbance in Caribou Range		
					Total Length in Caribou Range	Total Parallel to Existing Linear Disturbance	New Linear Disturbance
Aitken Creek Section (pipeline)	Graham	Blue[1] Northern ecotype[2] Northern caribou[3]	Threatened[4,5] Northern Group subpopulation of the Southern Mountain population[6] DU7[7]	Stable[8]	8.1 km	7 km (86.4%)	1.1 km (13.6%)
Kahta Section (pipeline and two meter station sites)	Pink Mountain	Blue[1] Northern ecotype[2]	Special Concern[4,5] Northern Mountain population[6] DU7[7]	Unknown[9]	19 km	13.3 km (70%)	5.7 km (30%)

Table 5-1: Caribou Nomenclature and Ranges that Interact with the Project (cont'd)

Note:
1 BC provincial status designation (BC CDC 2015).
2 Ecotypes assigned by BC MOE (2010).
3 Northern caribou as described in the Implementation Plan for the Ongoing Management of South Peace Northern Caribou (BC MOE 2013)
4 Status designation under Schedule 1 of SARA (EC 2015).
5 Status designation under COSEWIC (2015).
6 Caribou populations described by COSEWIC (2002) and the SARA Public Registry (EC 2015), and subpopulation described by EC (2014).
7 Northern Mountain DU7 assigned by COSEWIC (2011).
8 Population trend reported by EC (2014).
9 Population trend reported by EC (2012a).

5.2 QUANTIFICATION OF HABITAT DISTURBANCE

Restoration of disturbed habitat assumes that caribou will return to spatial separation from primary prey (moose and deer) and predators and, as a result, return to pre-disturbance levels of mortality risk (Athabasca Landscape Team 2009). Restoration of anthropogenic disturbances is also expected to reduce the degradation of functional habitat for caribou, since caribou will no longer exhibit reduced use on or near (i.e., in a zone of influence) the reclaimed disturbance (Oberg 2001). As such, restoration of caribou habitat is expected to alleviate the residual direct habitat disturbance over the long term.

By addressing residual direct habitat disturbance, indirect residual effects will also be addressed. Included in the direct disturbance footprint are the ROW, meter stations, temporary workspace, new temporary construction access and new permanent access. The Final CHRP will provide schematics that illustrate the quantification of direct and indirect residual effects of the Project on caribou habitat using as-built information. Indirect disturbance (i.e., reduced habitat effectiveness) is defined as the area within the 500 m buffer of anthropogenic disturbance features.

The spatial residual effect will be quantified using a method consistent with *Recovery Strategy for the Woodland Caribou Southern Mountain population* (Rangifer tarandus caribou) *in Canada* (EC 2014). The Recovery Strategy defines undisturbed caribou habitat in the Environmental Site Assessment Repository (ESAR) caribou range as habitat that has not burned in the last 40 years and is not in or within 500 m of anthropogenic disturbance. Although the Project footprint is in an area that has been burned by forest fires within the last 40 years, NGTL will still consider this non-permanent disturbance in its quantification of spatial residual effect.

Restoration of impacted mountain caribou habitat through implementation of the CHRP measures will not completely eliminate adverse Project effects on caribou habitat. During operations, NGTL will periodically manage vegetation within 5 to

10 m of the centreline of the operational pipeline, in accordance with TransCanada operational procedures for integrity monitoring under Canadian Standards Association (CSA) Z662-15 (CSA 2015). This area will be allowed to regenerate naturally, but will be periodically mowed or mulched. This theoretical access area will not achieve the quantifiable targets for the CHRP and is quantified as a residual direct disturbance of caribou habitat.

The area of direct disturbance in the Pink Mountain and Graham caribou ranges estimated during the application phase of the Project was approximately 162 ha and 29 ha. After application of the CHRP measures outlined in this document, the final disturbance footprint will be determined. Direct and indirect Project disturbance on caribou habitat will be quantified and presented in the Final CHRP, as outlined in Table 5-2.

Table 5-2: Quantification of Direct and Indirect Project Disturbance of Caribou Habitat

Area (ha)				
Length of Pipeline Segment	**Direct Project Disturbance**	**Restored Project Footprint**	**Residual Direct Project Disturbance**	**Incremental Indirect Disturbance**
TBD	TBD	TBD	TBD	TBD

To calculate the final offset requirements for the Graham herd within the Aitken Creek Section, pursuant to Condition 36, the first step involves calculating the remaining project effect after CHRP measures are applied to the Project footprint. The restored Project footprint will be categorized as either new alignment or parallel alignment. New alignment is assumed to have full effect on caribou use of this part of the range, whereas segments parallel to adjacent disturbances have less effect on caribou use (this will be further outlined in the OMP).

The second step (inherent project effect) involves categorizing the portion of total area for new alignment and parallel alignment in their respective habitat classes to apply the appropriate delay factors (i.e., time lags) associated with each mitigation measure.

The third step categorizes the proportion of total area for each mitigation measure in each habitat type. The proportion of total area for each mitigation measure in each habitat type will be used to estimate the remaining Project effect using the following equation:

Calculation 5-1:

$$Remaining\ Project\ Effect\ (ha) =$$
$$Inherent\ Project\ Effect\ (ha) \times \{1 - (Measure\ Effectiveness\ \times Delay\ Penalty)\}$$

The remaining project effect calculation will be used to populate Table 5-2 in the Final CHRP.

For previous NGTL projects that impacted caribou habitat, NGTL allowed intermittent alternating plantings of woody vegetation over the pipeline centreline. For the Project, trees will be planted across the centreline where open areas are left at alternating sides of the ROW. This will allow for a meandering access line over the centreline, and will in time, establish line-of-sight breaks (i.e., vegetation screens). Using this alternating planting method, the quantifiable targets for habitat restoration (revegetation) are expected to be achievable in the long term.

The entire width of the Project planted footprint will not be considered restored in the short term. In the short term, there will be a spatial residual effect on the area of operational access. . In the long term, the area of operational access is not expected to be a spatial residual effect where the ROW segment is planted with trees. The spatial residual effect is expected to be effectively addressed once the habitat regenerates in the long term.

Some restoration measures are designed to be effective immediately or in the short term. For example, retention of vegetated visual screens, mounding and tree felling (particularly if in conjunction with mounding) are expected to reduce Project residual effects on caribou habitat immediately.

The lag time required to achieve habitat value equivalent to pre-construction conditions is important and will be considered in the quantification of residual effects in the Final CHRP. Residual effects will also be presented in the Final CHRP and will consider lag time and also factor in uncertainty associated with offsets. Over the long term, the vegetation community composition and structure is expected to mature to a seral stage that will provide functional caribou habitat and restore pre-disturbance predator–prey dynamics.

NGTL will develop an OMP to address Project residual effects on critical caribou habitat for the Aitken Creek Section pursuant to Condition 36. The Preliminary OMP will further detail the method used to quantify the offsets. The Project OMP will use a method of offset quantification that aligns with NGTL’s previous OMPs for projects constructed in boreal woodland caribou range.

The residual effects to be quantified in the Final CHRP using the method described above will be modified in the calculation of residual effects in the OMP to factor in:

- uncertainty associated with effectiveness of the CHRP measures
- context of the footprint related to existing disturbance (e.g., contiguous or non-contiguous)
- time lag or duration of residual effects

5.3 HABITAT RESTORATION

The decision framework (see Section 3) and regulatory guidelines summarized in Section 8 provide the basis for the Preliminary CHRP and will further guide the Final CHRP. The decision framework provides direction on restoration factors such as variability in natural site characteristics, planting prescriptions, target vegetation, soil and site stability, and access management. This in-turn informs the quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects and the extent to which goals and objectives have been met.

For a suite of caribou habitat restoration measures, see Table 5-3. After applying the decision framework, suitable restoration measures will be selected. Several restoration methods described in the literature review and included in Table 5-3 are considered not suitable given the limitations to implementation or effectiveness. These measures could be reconsidered if additional information becomes available to support their use. For photos of potential restoration measures, including site conditions showing constraints and opportunities, see Appendix A.

Table 5-3: Habitat Restoration Measures

Restoration Measure	Objectives	Rationale	Comments
Berms	Access control Line-of-sight blocking	Berms can be constructed of coarse woody debris and timbers, or a combination of coarse woody debris and earth. Supported berms are constructed using timber cleared from the ROW. To effectively block line-of-sight, berms should be constructed to an approximate minimum height of 1.5-2 m. Promote rapid shrub/tree regeneration at ends of berms (e.g., shrub staking/transplants, seedling planting) to increase effectiveness as access control. Earth berms were 76% effective at excluding vehicles over 50 inch wide and 22% effective at excluding all vehicles including off-road vehicles (Esri User Conference 1996). Berms create a barrier that can be effective immediately following implementation. Coarse woody debris/timber berms are dependent on approval from provincial authorities to retain coarse woody debris on-site, as well as sufficient space to store the material during construction. Woody debris berms may present an increased fire hazard, depending on composition and location. NGTL has found on its existing ROWs where this measure was used, that woody debris berms deteriorate relatively quickly after installation (within several years), particularly if berms are moved to allow access to the ROW. Quantity of source material is usually not sufficient for earth berm construction in areas where minimum disturbance construction techniques are employed. Importing material is not preferred given the risk of introducing invasive plants. Earth berms should not be located in peatlands due to potential for settling and alteration of surface hydrology.	Limitations of this measure reduce its value. Woody material available for inclusion in berms is often limited, which can make this option less useful. Woody debris berms might be used as CHRP measures if sufficient wood exists at the Project site. Earth berms will not be considered a viable option for the Project as NGTL has found that there is generally insufficient source material to create earth berms.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Bioengineering • shrub staking/planting • tree seedling planting	Habitat Restoration Access control Line of sight blocking	Bioengineering in combination with stabilization measures (e.g., soil wraps) might be suitable at watercourses crossed with an open cut method. Bioengineering is the use of existing live vegetation to stabilize and revegetate a site (e.g., transplants; installing cuttings) and is a technique often used on slopes or riparian banks (Polster 2002). Species and planting densities used for bioengineering are site-dependent (Golder 2012a). Vegetation used is typically collected either from the disturbance site (i.e., before or during clearing), or from the adjacent area, in the form of cuttings (Golder 2012a). Vegetation might be planted during the growing season or during winter. 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 (Golder 2012a). Nursery-grown shrub seedlings might be planted where staking is not practical due to lack of available material, limitations associated with collecting material off-site, or where a restoration prescription calls for shrub planting of species that do not readily regenerate through cuttings/staking (e.g., alder). Alder 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 inter-planting alder with conifers. When alder is interspersed with conifer plantings, line-of-sight and 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 (Courtin and Brown 2001; Simard and Heineman 1996). The fast growth of alder can reduce growth rates of conifer plantings due to competition when alder densities are high (CRRP 2007b; Simard and Heineman 1996). Species are determined based on the adjacent forest stand and restoration objectives (e.g., low palatability for ungulates). Combined plantings of shrub and tree seedlings can be appropriate, depending on site conditions and anticipated natural revegetation of both species. Procurement of shrub seedlings (container or bare-root) can be challenging given limited seed availability. Planted shrubs can be slow to establish.	Shrub planting is a suitable CHRP measure for select site-specific locations if a need for combined conifer/shrub plantings is identified. Many shrub species can attract prey species such as moose and deer, which can attract wolves, thus its application will be limited as these species can have a negative effect on caribou (see Section 8).

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Conifer seedling planting	Habitat restoration Access control Line of sight blocking	Restoration species are determined based on the biophysical characteristics of the site, adjacent forest stand composition, and restoration objectives (e.g., low palatability for ungulates). Tree seedling planting is considered a long-term restoration treatment (full effectiveness is expected to take longer than 10 years). Planting densities for reclamation of forested areas in Canada have been based on forestry standards, ranging from 1,500–2,500 stems/ha (MacDonald et al. 2012). In the Prince George Forest Region of BC, target stocking densities for coniferous trees range from 400-1,200 stems/ha and the minimum stocking standards range from 200-700 stems/ha (BC MOF 2000). Target stocking density for deciduous trees is 2,500 stems/ha and the minimum stocking densities range from 1,700-2,000 stems/ha (BC MOF 2000). Given the relatively harsh growing conditions inherent to boreal ecosystems, mortality of planted seedlings is anticipated to range from approximately 5% to 20% in most site types (Golder 2012a,b). A planting density of 2,000-2,500 stems/ha is recommended for restoration of linear disturbances in boreal caribou ranges in northeast BC (Golder 2015). Although the above information was used to determine seeding densities there is no direct information or literature available on appropriate planting densities in the mountain caribou range where this Project occurs. The Project terrain includes more upland habitat than would typically be commercially harvested and researched. For example, Kahta has mineral soils within the top 50 cm or less in peat so mounding might be necessary to create suitable growing conditions. Given this information and the literature specified above, the following planting prescription has been formulated for this CHRP: • minimum seedling density of 1,200-1,600 stems/ha on sites that are not mounded • minimum seedling density of 900-1,100 stems/ha (combined planted seedlings and/or natural regeneration) on mounded sites (dependent on mound density)	Conifer seedling planting is a suitable CHRP measure for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Mounding	Restore vegetation (create microsites) 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 to enhance seedling survival. Mounding treed wetlands (e.g., bogs, 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 (Golder 2012a; Macadam and Bedford 1998). Soil properties (e.g., substrate, drainage) affect the ability of mounds to retain their structure. Mounding has been used as an access control measure on old roads and seismic lines to discourage off-road vehicle activity. It can be effective immediately following implementation. For access control purposes, mounds should be created using an excavator to 0.75 m deep, where site conditions allow (Golder 2012a). The excavated material is dumped beside the hole (Macadam and Bedford 1998). Transitional areas, or places with shallow peat (< 50 cm) are preferred for mounding. Suggested densities of mounding for access management or microsite creation purposes vary from 1,400-2,000 mounds/ha (Golder 2012a). Implementation of this mound density might be suitable for restoring disturbances such as seismic lines where specialized equipment is used and where frost is not driven into the soils to allow heavy equipment access. The mound density that can realistically be achieved on pipeline ROWs is lower (approximately 700-1,400 mounds/ha on previous NGTL projects). The limitations of mounding on pipeline ROWs include scheduling mounding for restoration during final cleanup, which typically depends on freezing-in of soils, availability of specialized equipment and minimum spatial separation of 5 m between mounds and the centreline of the operating pipeline.	Mounding is a suitable CHRP measure that will be used in conjunction with conifer seedling planting for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Minimum disturbance construction	Habitat Restoration Line of sight blocking	Construction during winter conditions allows for minimum disturbance construction techniques, which reduce the need for soil salvage and grading, and limit the width of grubbing to the trench area where grading is required. Reduced disturbance to vegetation and root systems is achieved by cutting, mowing or walking down and mulching shrubs and small-diameter trees at ground level. Intact root systems and seed beds with little soil disturbance facilitate rapid regeneration of vegetation. Use of snow padding or matting can limit the need for cutting or mowing shrubs and small trees, thereby speeding regeneration of native vegetation. The extent of minimum disturbance construction might be limited by scheduling to avoid the restricted timing window for caribou (January 15 to July 15). Soil conditions limit the applicability of minimum disturbance construction methods. Construction in well to moderately drained sites during non-frozen conditions requires grubbing and grading to salvage surface soils so they can be stored separately from subsoils and replaced following construction. This prevents admixing and loss of the productive surface soils that facilitate regeneration of vegetation.	Minimum disturbance construction is a suitable CHRP measure for the Project, and will be implemented where scheduling and soil conditions (e.g., frozen) allow.
Transplanting	Habitat Restoration Access control Line of sight blocking	Transplanting has the advantage of immediately establishing relatively large trees/shrubs (e.g., saplings). There are limitations to 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). Other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison (Golder 2012a). See Section 8.6.2 for more details.	Transplanting native vegetation is not a suitable CHRP measure for the Project as it has been shown to be a difficult technique to implement on a large scale, with multiple limitations. This technique could prove more suitable for future projects if advances in the method improve survival success rates.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Tree felling or bending	Access control Habitat Restoration Line of sight blocking	Mechanically bending or felling live trees onto a linear disturbance has been tested as a measure to restore habitat and manage access on seismic lines in caribou range (COSIA 2012).Trees are typically bent or felled from both sides of the linear disturbance. Tree felling involves deliberately felling trees over the linear disturbance. It does not require specialized machinery. Tree bending requires specialized machinery to mechanically bend live stems over the linear disturbance. Mechanical tree bending can be expensive and time consuming. These measures are often used in conjunction with other restoration techniques such as mounding and conifer seedling planting. Tree felling/bending is only initially being evaluated and its utility remains unverified (Neufeld 2006). It is recommended that if tree felling is to be used as a line of sight blocking measure, it should be investigated more thoroughly, and not solely be relied on as a mitigation tool (Neufeld 2006). Preferably, line of sight blocking with tree felling (or tree bending) should be used in combination with other management actions such as habitat restoration (Neufeld 2006), and continue to be evaluated for effectiveness using an adaptive management approach. Tree felling/bending can promote natural revegetation by increasing cone deposition onto the ROW, creating microsites through shading and dropped dead woody debris, and protecting planted seedlings from extreme weather, wildlife trampling and damage from access. Application in pipeline ROWs might be limited due to the width (i.e., much wider than typical seismic lines where tree bending/felling has previously been implemented). Furthermore, NGTL has narrowed the construction ROW for the Project to minimize the footprint as much as site conditions and construction requirements allow, leaving inadequate space for tree retention along the edges of the footprint for tree felling. Provided regulatory permitting (e.g., temporary field authorization to fell trees adjacent to the approved construction ROW) could be obtained, this measure could be a valid option for non-contiguous portions of the Project footprint.	Tree felling might be an option for the CHRP; however, due to the uncertainty of its effectiveness and limitations to application to pipeline ROWs, its use will be on a limited and/or trial basis for the Project. Another consideration for tree felling is the amount of available trees that can be used for the technique and that will be determined after final construction. Tree bending is not a suitable CHRP measure for the Project, given constraints associated with specialized machinery and time necessary to implement. As well, this technique is still being studied and as new research on the technique emerges, it could be considered for future projects.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Tree/shrub seeding	Habitat Restoration Access control Line of sight blocking	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 ROWs 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 might 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. Predation of conifer seed might be a problem when this technique is used for reforestation (BC MOF 1997).	Seeding is not a suitable CHRP measure, given logistical constraints (i.e., availability of native seed, accessibility of seeding equipment), likelihood of native seed ingress from vegetation in the adjacent undisturbed areas and predation of seed.
Coarse woody debris	Access control Habitat restoration Reduce Line of Sight	Coarse woody debris rollback might be used for access control and to enhance restoration of natural habitat characteristics (e.g., conserve soil moisture, moderate soil temperatures, provide nutrients as debris decomposes, prevent soil erosion, provide microsites for seed germination and protection for introduced tree seedlings [Pyper and Vinge 2012; Vinge and Pyper 2012]). Mulch depths less than 3 cm are preferred to avoid limiting natural ingress and vegetation growth (Pyper and Vinge 2012; Vinge and Pyper 2012).	Woody debris rollback is a suitable CHRP measure for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Coarse woody debris (cont'd)	Access control Habitat restoration Reduce Line of Sight (cont'd)	Coarse woody debris should be spread evenly across the entire footprint width at a coverage/density that will not restrict ability to plant seedlings or limit planted or natural seedling growth. Woody debris should be applied at a density/volume that does not exceed 400 t/ha to deter access (Osko and Glasgow 2010). Where sufficient material is available, woody debris coverage can range from 60-100 m^3/ha on upland sites and 25-50 m^3/ha on lowland sites, to mimic natural processes (Pyper and Vinge 2012; Vinge and Pyper 2012). Where sufficient material is available, woody debris coverage of 150-250 m^3/ha along ROWs might be appropriate to manage access (Vinge and Pyper 2012). Research presented at the North American Caribou Workshop (2014) suggested that application of high densities (200 m^3/ha) of salvage logs (i.e., rollback) at linear feature intersections reduces human use of the intersection by 100%, wolf use by 90%, and deer use by 50%. NGTL has found on previous caribou habitat restoration projects that coverage ranging from 200-300 m^3/ha can deter access while allowing sufficient spaces between the debris to allow seedling planting. Rollback can be effective immediately following implementation, provided adequate material is available and properly applied (Vinge and Pyper 2012). The implementation and length of a rollback segment is dependent on sufficient quantities of coarse woody debris during clearing of new disturbance and the tradeoff between its use and the ability/space to store it during construction (CRRP 2007b). Long rollback segments are more effective at managing human access because ATV riders will be less inclined to try to ride through the debris or traverse around it in adjacent forest stands. Sections of rollback ≤100 m long might not be effective at deterring motorized access (Vinge and Pyper 2012). An expert opinion survey cited 400 m long rollback segments as sufficient length (Golder 2007). NGTL has found on previous caribou habitat restoration projects that material availability often limits the segment length that can be achieved to 50–100 m (approximately 75 m on average). Fire risk is a consideration when using or storing materials for rollback. Fire risk can be minimized through proper storage and placement of materials (Pyper and Vinge 2012; Vinge and Pyper 2012). A 25 m rollback-free fuel break placed at 250 m intervals along rollback segments is suggested (Pyper and Vinge 2012).	

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Coarse woody debris (cont'd)	Access control Habitat restoration Reduce Line of Sight (cont'd)	Coarse woody debris rollback blocks constructed at 500 m intervals can be used as reducing line of sight measures. To allow operational access, the blocks consist of three segments placed in a staggered pattern approximately 10 m apart. Guidelines for application of rollback where materials are available recommend placement of rollback across the entire pipeline/easement width for a distance of at least 200 m from all points of intersection with wellsites, plant sites, roads and permanent watercourses (AER 2013). NGTL has found on previous caribou habitat restoration projects that material availability often limits the segment length that can be achieved to 50–100 m (75 m on average). Fire risk is a consideration when using or storing materials for rollback. Fire risk can be minimized through proper storage and placement of materials (Pyper and Vinge 2012). A 25 m rollback-free fuel break placed at 250 m intervals along rollback segments is recommended by the *Integrated Standards and Guidelines for the Enhanced Approval Process* (AER 2013).	Woody debris rollback is a suitable CHRP measure for the Project.

Site-specific caribou habitat restoration measures implemented for the Project will be described in the Final CHRP, which will include maps or Environmental Alignment Sheets showing the locations of selected sites.

For an illustrative table showing site-specific restoration methods and location details that may be included in the Final CHRP, see Appendix B. The Final CHRP table will also include the rationale for restoration measure selection, additional site-specific details to inform implementation and implementation status. Accomplishments and lessons learned from implementing and monitoring NGTL's other caribou habitat restoration initiatives will be included in the Final CHRP, and will inform the rationale for selection of restoration methods and locations. The Final CHRP will also include specification drawings of the restoration measures, in accordance with Condition 16 b (iii).

5.3.1 Natural Regeneration

Minimum disturbance construction is a promising approach for promoting native vegetation re-establishment. Minimal disturbance procedures relate to the removal of vegetation, work area preparation and clean-up activities associated with construction of the Project. The objective of this construction technique is to minimize impacts on the soils and vegetation substructure, with the goal of allowing the Project footprint to re-vegetate to a similar pre-construction condition, subject to land-use guidelines specific to the disposition. NGTL will, therefore, implement minimal disturbance construction techniques to facilitate natural regeneration to restore habitat along the ROW. This construction technique is restricted to areas where grading is not required. Stripping and grading will be required in areas of significant cross-fall of the ROW (i.e., greater than 1.0 m), irregular ground profile along the pipeline, and at tie-in sites (road bores and pipeline crossings). Minimal disturbance installation is most suitable for straight pipe installation.

5.3.2 Tree Planting

Established reclamation and forestry reforestation practices will be applied to promote revegetation where natural regeneration might not achieve the quantifiable targets. Restoration measures that incorporate tree planting techniques, such as site preparation (e.g., mounding) and planting trees/shrubs, will be considered where site conditions allow (including construction methods and level of disturbance).

For a summary of habitat types that will be disturbed in caribou habitat as a result of the Project footprint, see Table 5-4 (Aitken Creek Section) and Table 5-5 (Kahta Section).

Table 5-4: Aitken Creek Section – Habitat Types in Graham Caribou Range

Habitat Types	TEM Unit/Ecosystem Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree Species[4]	Area (ha)	Percent of Total (%)
Aitken Creek Section – Graham Caribou Range					
Upland/Transitional – Conifer	Black spruce– lingonberry – coltsfoot	BWBSmw-04	Pl(Sb)	4.5	12.5
	White spruce – trembling aspen – step moss	BWBSmw-01	Sw, At, Pl, Ep, Acb	7.6	20.9
Upland/Transitional – Deciduous	Trembling aspen – creamy peavine	BWBSmw-01$	At	9.9	27.1
Riparian	Mountain alder – common horsetail	BWBSmw-Fl01	-	1.0	2.6
	Cottonwood – spruce – red-osier dogwood	BWBSmw-Fm02	Sb/Sw, Acb	<0.1	<0.1
Treed Wetland	Black spruce – lingonberry – peat moss	BWBSmw/BWBSwk-Wb03	Lt, Sb	0.4	1.0
	Tamarack – water sedge – fen moss	BWBSmw-Wb06	Lt	<0.1	0.1
Non-Vegetated	Exposed soil	-	-	0.4	1.2
	Gravel bar	-	-	0.1	0.3
	River	-	-	<0.1	0.2
	Rock outcrop	-	-	0.2	0.6
Anthropogenic	Cultivated field	-	-	3.6	9.9
	Corridor and/or industry-related disturbance	-	-	5.1	13.9
	Rural	-	-	0.9	2.4
	Road surface	-	-	1.2	3.2

Note:

1 TEM was completed as part of the Project Application (Stantec 2013). The area and percentage calculations are based on the entire TEM polygon (i.e., the deciled TEM polygon data are assumed to be reflective of the area and percent of ecosystem units affected by the Project footprint).

2 Site series are derived from TEM data (Stantec 2013) based on *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*, *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region* and *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia Land Management Handbooks* (DeLong 2004, DeLong et al. 1990, DeLong et al. 2011). The “$” denotes seral stage, indicating early seral communities, usually deciduous-dominated.

3 Cutblocks are incorporated in the TEM unit classifications (site series).

4 Tree codes: Acb – balsam poplar; At – trembling aspen; Ep – common paper birch; Lt – tamarack; Pl – lodgepole pine; Sb – black spruce; Sw – white spruce.

5 Wetland codes: Fl and Fm – flood association; Wb – bog; Wf – fen; Ws – swamp.

Table 5-5: Kahta Section – Habitat Types in Pink Mountain Caribou Range

Habitat Types	TEM Unit/Ecosystem Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree Species[4]	Area (ha)	Percent of Total (%)
Kahta Section - Pink Mountain Caribou Range					
Upland/Transitional – Conifer	White spruce– trembling aspen – step moss	BWBSmw-01	Sw, At, Pl, Ep, Acb	0.6	0.7
	Black spruce – lingonberry – coltsfoot	BWBSmw-04	Pl(Sb)	35.7	44.7
	White spruce – currant – horsetail	BWBSmw-07	Sw	1.3	1.6
Upland/Transitional – Conifer	White spruce – huckleberry – step moss	BWBSwk2-01	Sw, Pl	9.7	12.1
	Lodgepole pine – lingonberry – velvet-leaved blueberry	BWBSmk-02	Pl, At, Sb, Sw	<0.1	<0.1
Upland/Transitional – Deciduous	Trembling aspen – creamy peavine	BWBSmw-01$	At	0.1	0.2
	Trembling aspen – highbush cranberry	BWBSwk2-01$	At	2.3	2.8
	Trembling aspen – Labrador tea	BWBSmw-04$	At	1.0	1.2
	Trembling aspen – Labrador tea – lingonberry	BWBSwk2-03$	At	0.3	0.4
Riparian	Mountain alder – common horsetail	BWBSmw-Fl01	–	0.7	0.9
	Bebb's willow – mountain alder – bluejoint swamp	BWBSmk-Ws03	–	0.3	0.4
	Scrub birch – willow – water sedge fen	BWBSmk/BWBSmw/BWBSwk2-Wf02	–	<0.1	<0.1
Treed Wetland	Black spruce– lingonberry – peat moss	BWBSmk/BWBSmw/BWBSwk2-Wb03	Lt, Sb	17.9	22.4
	Tamarack – water sedge – fen moss	BWBSmk/BWBSwk2-Wb06	Lt	< 0.1	< 0.1
Graminoid/ Shrub Wetland	Water sedge – beaked sedge fen	BWBSmk/BWBSmw/BWBSwk2-Wf01	–	0.5	0.6
Non-Vegetated	Cutbank	–	–	0.1	0.1
	Exposed soil	–	–	0.3	0.4
	River	–	–	<0.1	<0.1
Anthropogenic	Corridor and/or industry-related disturbance	–	–	7.1	8.9

Table 5-5: Kahta Section – Habitat Types in Pink Mountain Caribou Range (cont'd)

Habitat Types	TEM Unit/Ecosystem Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree Species[4]	Area (ha)	Percent of Total (%)
Kahta Section - Pink Mountain Caribou Range					
Anthropogenic (cont'd)	Reservoir	–	–	0.3	0.4
	Road surface	–	–	<0.1	<0.1

Note:

1 TEM was completed as part of the Project Application (Stantec 2013). The area and percentage calculations are based on the entire TEM polygon (i.e., the deciled TEM polygon data are assumed to be reflective of the area and percent of ecosystem units affected by the Project footprint).

2 Site series are derived from TEM data (Stantec 2013) based on *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*, *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region* and *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia Land Management Handbooks* (DeLong 2004, DeLong et al. 1990, DeLong et al. 2011). The "$" denotes seral stage, indicating early seral communities, usually deciduous-dominated.

3 Cutblocks are incorporated in the TEM unit classifications (site series).

4 Tree codes: Acb – balsam poplar; At – trembling aspen; Ep – common paper birch; Lt – tamarack; Pl – lodgepole pine; Sb – black spruce; Sw – white spruce.

5 Wetland codes: Fl – flood association; Wb – bog; Wf – fen; Ws – swamp.

Implementation targets and specifications for habitat restoration (e.g., seedling planting densities, mounding densities) will be designed to meet the quantifiable targets for the CHRP. These will be informed by available guidelines and standards (see Section 8), NGTL's experience implementing caribou habitat restoration measures and complementary research.

For the planting prescription for each habitat type, see the Quantifiable Targets column in Table 4-1. The quantifiable targets and performance measures in Table 4-1 should be considered preliminary and subject to change. The restoration methods and targets will be affected by variables such as extent of grading, construction method and availability of shared workspace and access.

The proposed habitat restoration quantifiable targets are designed to demonstrate restoration success in terms of survival and sustained growth trends of conifer and deciduous trees within 10 years following completion of restoration. These targets are to be met over the portion of the Project footprint available for restoration (i.e., excluding overlap with third-party developments or operational access outside planted areas).

5.4 ACCESS CONTROL

Access control principles outlined in this CHRP were guided by the Project's AMP. The goals of access control for the Project in caribou habitat are to:

- manage access along the pipeline ROW in a manner that discourages all forms of access
- maintain accessibility necessary for safe pipeline operations compliant with applicable regulations and guidelines
- maintain existing access at identified locations (e.g., third-party industry access, traditional access identified by Aboriginal communities through engagement activities)

5.4.1 Baseline Data on Access Control

Geographic Information System (GIS) will be used to mark selected locations of monitoring plots in order to establish the baseline assessment for this Project. The locations will be chosen based on a review of the Project's construction alignment sheets and proposed access control treatment locations.

Based on early review of the Project's spatial configuration, 32 existing linear features (for example, seismic lines, utilities corridors or roads) have been identified that intersect with the Project ROW. NGTL will control access where the Project intersects active crossings, and will assess these areas as potential treated sites.

An assessment of these potential control sites will include the deployment of Reconyx remote cameras over a six week period. However, several of the sites cross wetlands with little or no trees and may not be good candidates for access control treatments. NGTL intends to deploy cameras prior to construction in order to collect baseline data. The Final CHRP will outline a detailed review of the baseline access study and further detail the final locations of the monitoring plots.

5.4.2 Access Control Measures

Access control measures are most effective when implemented on non-contiguous segments of the Project ROW, and at intersections of the pipeline portion of the Project ROW with existing perpendicular linear features (e.g., roads, utility corridors, seismic lines). Quantifiable targets and criteria used to evaluate the effectiveness of access control measures will align with those in the CHROMMP.

Access control measures considered for the Project, but not necessarily utilized, include:

- vegetation screens
- rollback
- fencing and signs
- vegetation planting
- mounding
- installation of berms
- tree felling over the ROW

Rollback, mounding and planting vegetation will be the key access control measures implemented for the Project. Some of these measures might not be selected for final restoration because of site-specific conditions. For example, lack of materials necessary for the installation of berms could limit the applicability of berm installation for this Project.

NGTL has engaged the British Columbia Oil and Gas Commission (BC OGC) and BC MFLNRO regarding use of merchantable timber for access management purposes in caribou ranges. BC MFLNRO has indicated that merchantable timber may be used for rollback for the Project with the following provisions (to which NGTL has agreed):

- Provide BC OGC and BC MFLNRO with the locations of proposed access management areas.
- Identify if any mitigation measures will be required for fire hazard abatement.
- Identify if any mitigation measures will be required for forest health issues.
- Identify how merchantable timber will be accounted for post clearing.

Locations for access control measures on the pipeline ROW will focus on intersections with other linear features, such as roads, utility ROWs, seismic lines or watercourses and non-contiguous sections of the ROW. NGTL might install signs at select locations to discourage access.

5.5 LINE OF SIGHT BLOCKING

Line-of-sight blocks include planting vegetation (e.g., tree planting or willow staking), fabricated site screens and minimal disturbance construction to preserve vegetation. Line-of-sight blocks will be implemented in locations with sightlines >500 m, particularly where they intersect with existing road access. Trees will be planted in an alternating pattern across the pipeline centreline along portions of the ROW. Specifically, trees will be planted across the centreline with open vegetation left at alternating sides of the ROW along some sections. This alternating vegetation pattern will create a line-of-sight break. Details on exact configuration of seedling planting to achieve line-of-sight breaks depend on as-built location of the pipe centreline and adjacent linear disturbances.

Measures to reduce sightlines might discourage access and might also decrease predator efficiency. In nature, sightlines are often longer in more open habitats of lowland muskeg communities compared with upland forest communities. As a result, line-of-sight distances can vary, depending on the location and structure of the adjacent vegetation community. In forested areas of the Project footprint where sightlines are 500 m long or more line-of-sight blocks will be established.

Operating practices for energy development in sensitive caribou range in British Columbia (BC Ministry of Environment 2011) suggest implementing line-of-sight management every 500 m on linear features that do not share a ROW boundary with a road. Line-of-sight blocking as part of this Project will follow this guideline where it is not co-located with roads or other linear developments.

NGTL has implemented 500 m line-of-sight breaks to be consistent across provincial boundaries regardless of the location of the pipeline segment and has incorporated this approach in other Project CHRPs. Previously, NGTL attempted to apply the line of sight and access control features on the landscape as suggested in the Alberta Energy Regulator (AER) Enhanced Approval Process (EAP); however, it has become apparent that over the course of implementing those features on other NGTL projects that impact caribou habitat (Leismer, NWML, Chinchaga) meeting the recommended intervals was not feasible. In particular, recent field experience on the Chinchaga Section provided several examples of why these features cannot be applied at EAP recommended intervals. For lessons learned on other NGTL projects about implementing line of sight blocking intervals see Section 6.3.

As science is still emerging in this area, the long term monitoring of this and other NGTL CHRP measures will be modified based on monitoring results to determine the appropriate line-of-sight breaks.

Topography bends in the ROW, minimum disturbance construction to preserve vegetation and willow staking create immediate line-of-sight blocks (i.e., create visual barriers after restoration activities are implemented). Line-of-sight measures such as tree plantings will be implemented in areas where sightlines are not blocked by terrain or bends. Planting at staggered intervals across the pipeline centreline will establish these 500 m line-of-sight breaks in the long term.

The exact locations for implementing line-of-sight breaks will be determined after construction and presented in the Final CHRP.

5.6 MONITORING AND ADAPTIVE MANAGEMENT

NGTL will create a CHROMMP for the Project to monitor effectiveness of planned habitat restoration measures that will be fully described in the Final CHRP. Adaptive management, i.e., the systematic process of monitoring and assessing outcomes and modifying restoration measures if necessary, will be implemented by adjusting and/or supplementing restoration measures, where warranted, to achieve the objectives of the CHRP.

Given that science is still emerging on caribou habitat restoration methods and effectiveness, adaptive management principles will be an important means of addressing uncertainty.

Adaptive management might be necessary to address uncertainty relating to planting trees in mountain caribou range. There might be soil limitations (e.g., poor nutrients and drainage, soil temperatures) that do not support tree seedling establishment without silvicultural site preparation (e.g., mounding). If seedling survival rates and/or sustained growth trends are not meeting the quantifiable targets (i.e., poorly understood planting conditions in higher-elevation habitat) this measure might need to be re-evaluated considering site-specific conditions.

Monitoring will be conducted on each pipeline segment for up to 10 years, starting one year after CHRP measures have been implemented. At each monitoring interval, performance measures will be evaluated and compared with quantifiable restoration targets. If measures indicate that restoration has achieved or is on a trajectory to achieving targets, no further restoration measures will be undertaken. If, however, at any point in the monitoring program evaluations indicate that targets are unlikely to be achieved after 10 years, restoration measures must be adjusted and additional monitoring (longer than 10 years) added.

This could include implementation of existing restoration measures or new measures, discovered through research or industry practice, that are proving to be successful. For example, NGTL is engaged in linear feature restoration research with the Regional Industry Caribou Collaboration in northeastern Alberta and lessons learned from this research can be applied to the Project.

Monitoring results, as well as any necessary adaptive management actions, will be reported to the NEB, EC and BC MFLNRO following the end of each monitoring interval.

Habitat restoration measures that require adaptive management at the conclusion of the 10 year monitoring program will require additional ground-based monitoring until they are successful. If adaptive management actions fail, a revised monitoring program and timeframe will be developed to address unsuccessful measures.

This Preliminary CHRP includes brief descriptions of the restoration targets and how they will be measured. The Final CHRP will detail the actual habitat restoration methods implemented and their locations in the Project footprint for each pipeline segment. The residual disturbance to critical caribou habitat resulting from the Project will be calculated and finalized in an OMP for Aitken Creek. Specific details on the quantitative framework of the monitoring program, frequency, timing and locations will be included in the CHROMMP. The CHROMMP will describe a comprehensive monitoring program for Project CHRP measures and potential offset areas, as finalized in the OMP, to compensate for residual effects in caribou habitat.

5.7 QUANTITATIVE FRAMEWORK

NGTL will implement a monitoring program to verify the effectiveness of CHRP and OMP, which will be prepared pursuant to Condition 36, measures and plans to integrate monitoring outcomes into future decision-making as part of a continual improvement process. The monitoring program will employ a quantitative framework using both aerial and ground-based sampling protocols to assess the effectiveness of habitat restoration, access control and line of sight blocking measures. As discussed above, specific details concerning the monitoring program methods will be discussed in the CHROMMP, which will be prepared pursuant to Condition 37. The following provides a brief example of the quantitative framework used to assess habitat restoration effectiveness (i.e., revegetation) in upland/transitional coniferous forest as a preliminary guide.

5.7.1 Experimental Design

A one-way repeated measures experimental design will be used to evaluate restoration effectiveness for each individual habitat type separately due to the inherent differences associated with their biophysical characteristics. Repeated measure designs are generally preferred over other factorial designs as they improve the precision of estimates derived on the response variable (Montgomery 2001; Kuehl 2000). Quantifiable targets associated with each restoration measure collected during the monitoring program will be repeated at each monitoring plot location for each monitoring year. The experimental design is represented by the following model:

$$y_{ik} = \mu + \alpha_i + \tau_j + \varepsilon_{ij}$$

where y_{ik} is the estimated response of the quantifiable target, μ is the overall mean, α_i is the effect of each monitoring year, τ_j is the effect of each monitoring plot and ε_{ij} is the natural variability (i.e., error) (Montgomery 2001). The model term τ_j denotes the repeated measure effect associated with each monitoring plot, each monitoring year. The degree to which restoration measures achieve their respective targets will be determined by a positive difference of the mean for each quantifiable target between each monitoring year, where the first monitoring year will act as a baseline.

5.7.2 Results

Table 5-6 provides an example subset of data for upland/transitional coniferous forest with vegetation height (m) as the quantifiable target. To illustrate the proposed repeated measure design, statistical analysis and results, the following example in Table 5-6 is demonstrated for five sample plots across five monitoring years.

.

Table 5-6: Example Data Subset for Upland/Transitional Coniferous Forest (Vegetation Height)

Monitor Plot ID	Habitat Type	Description	Location (KP)	Monitoring Year	Vegetation Height (m)
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	1	0.19
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	1	0.13
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	1	0.15
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	1	0.19
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	1	0.16
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	2	0.22
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	2	0.16
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	2	0.22
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	2	0.26
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	2	0.27
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	3	0.41
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	3	0.48
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	3	0.49
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	3	0.40
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	3	0.40
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	4	1.20
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	4	1.12
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	4	1.32
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	4	1.41
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	4	1.36
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	5	2.10
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	5	2.23
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	5	2.56
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	5	2.80
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	5	2.65

Habitat restoration is achieved when a positive increase in mean vegetation height is observed between the first monitoring year (i.e., baseline) and each subsequent monitoring year. As such, the analysis focuses on the mean difference in vegetation height for the fixed effect monitoring year, with monitoring plots treated as random effects to control for natural variability associated with each monitoring plot.

Table 5-7 provides a summary of the model output and pairwise comparisons used to identify differences in mean vegetation height between the first monitoring year and each subsequent monitoring year. In the example, a significant difference is observed for the fixed effect monitoring year (p<0.001). Pairwise comparisons of mean vegetation height (m) between the first monitoring year and each subsequent year demonstrate a positive increase in mean vegetation height between each monitoring year, with the exception of the second monitoring year (p=0.940). Ongoing review and monitoring comparisons will be integral in determining if vegetation targets can be met and then can be used in effectiveness determination.

Table 5-7: Example Results for Upland/Transitional Coniferous Forest (Vegetation Height)

Model Output

Factor	Type	Levels Values
Monitoring Year	Fixed	1, 2, 3, 4, 5
Monitor Plot ID	Random	Liege U 1, Liege U 2, Liege U 3, Liege U 4, Liege U 5

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Monitoring Year	4	19.073	4.7683	282.80	**<0.001**
Sample Plot ID	4	0.1493	0.0373	2.21	0.113
Error	16	0.2698	0.0168		
Total	24	19.492			

Pairwise Comparisons of Mean Vegetation Height (m)

Monitoring Year	N	Mean Vegetation Height	Grouping
5	5	2.468	A
4	5	1.282	B
3	5	0.436	C
2	5	0.226	CD
1	5	0.164	D

Means that do not share a letter are significantly different.

Monitoring Year Comparison	SE of of Means	Simultaneous Difference	Adjusted 95% CI	T-Value	P-Value
2 – 1	0.062	0.0821	(-0.1894, 0.3134)	0.75	0.940
3 – 1	0.272	0.0821	(0.0206, 0.5234)	3.31	**0.031**
4 – 1	1.118	0.0821	(0.8666, 1.3694)	13.61	**<0.001**
5 – 1	2.304	0.0821	(2.0526, 2.5554)	28.06	**<0.001**

5.8 SCHEDULE

Scheduling and logistical coordination before restoration implementation for each pipeline segment will consider seasonal access constraints, critical timing periods for caribou (see Section 5.7.1) and other valued components, production of nursery seedlings and appropriate timing for restoration efforts (e.g., season of planting).

Final cleanup will occur the summer/winter season following construction. As-built construction information will be compiled following construction and used to determine appropriate site-specific restoration measures and access management locations. Final site selection for caribou habitat restoration treatments will be completed during the first growing season following construction.

For the proposed schedule for construction and habitat restoration activities, see Table 5-8 and Table 5-9.

5.8.1 Caribou Timing Windows

There are multiple regulatory guidance documents for BC that identify timing windows that apply to caribou herds that overlap with the Project. The *Peace Region Least-Risk Timing Windows, April 2011 Update* (BC MFLNRO 2011) defines timing windows for northern ecotype caribou:

- **Low Risk:** July 16 to September 14 – Restrictions would not normally apply. Where ground conditions permit, plan development activities within these timeframes.
- **Cautionary:** September 15 to January 14 – Operators should avoid development activities during these timeframes.
- **Critical:** January 15 to July 15 – Development activities are not appropriate during this timeframe. Aerial activities should adhere to guidelines. In the event that working within a critical timing window is unavoidable, proponent should contact an appropriate qualified professional (e.g., Registered Professional Biologist with BC accreditation) to discuss alternatives, and potential mitigation and monitoring plans.

The recently released *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Interim Guidance)* (BC MFLNRO 2014) presents the same timing windows as the BC MFLNRO 2011 document, but includes an additional critical timing window for northern ecotype caribou that relates to the migration period (April 1 to May 20 and December 1 to January 1; BC MFLNRO 2014). There are no identified migration corridors for caribou in proximity to the Project in either the Graham or Pink Mountain caribou ranges.

NGTL's intent is to apply the January 15 to July 15 critical timing window described by BC MFLNRO (2011, 2014). The NEB Report for the Project requires that NGTL proactively plan construction activities in caribou ranges in compliance with provincial and federal timing restrictions. NGTL will file construction progress reports with the NEB pursuant to Condition 27. These progress reports will include information on any mitigation implemented to complete construction activity outside the critical timing window.

To minimize the potential need for work to occur within the critical timing window in the Graham and Pink Mountain caribou ranges, NGTL will potentially increase construction manpower or use alternate equipment (e.g., wheel ditcher in place of a hoe) to increase productivity, where feasible to do so. NGTL's ability to implement these measures might be affected by factors beyond NGTL's control, such as adverse weather conditions.

Depending on logistical constraints and site conditions, habitat restoration efforts are expected to be completed during the first or second growing season following final cleanup. These activities are part of the post construction phase, and will be scheduled outside the critical timing window for caribou in the Graham and Pink Mountain caribou ranges.

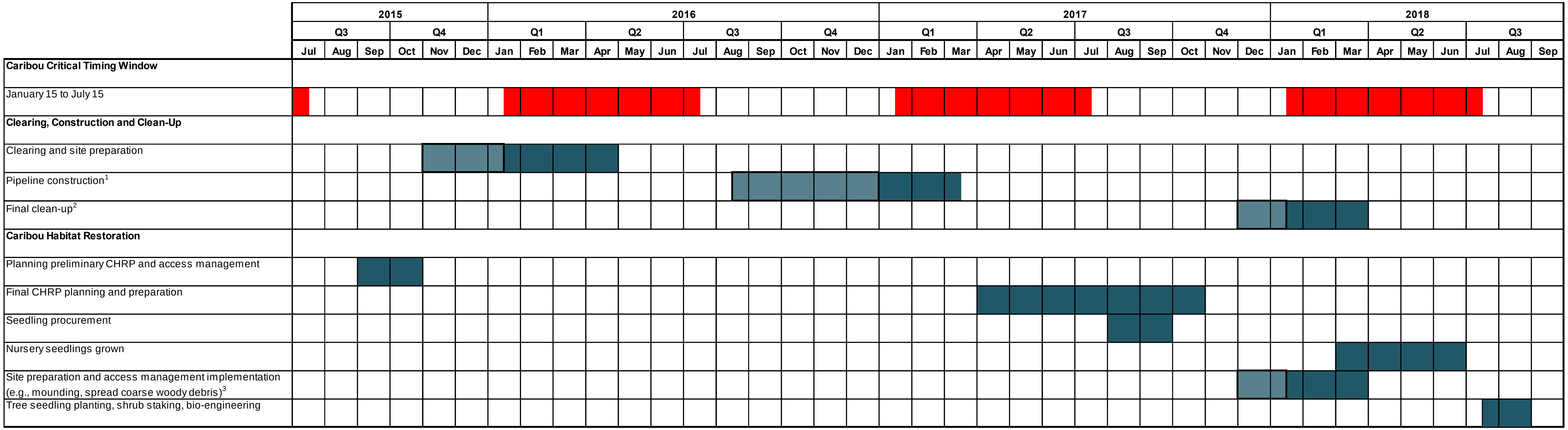
Table 5-8: North Montney Aitken Creek Section – Graham Caribou Range – Proposed Construction and Habitat Restoration Preliminary Schedule

	2015						2016												2017												2018								
	Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3		
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Caribou Critical Timing Window																																							
January 15 to July 15																																							
Clearing, Construction and Clean-Up																																							
Clearing and Pipeline Construction[1]																																							
Final clean-up[2]																																							
Caribou Habitat Restoration																																							
Planning preliminary CHRP and access management																																							
Final CHRP planning and preperation																																							
Seedling procurement																																							
Nursery seedlings grown																																							
Site preparation and access management implementation (e.g., mounding, spread coarse woody debris)[3]																																							
Tree seedling planting, shrub staking, bio-engineering																																							

Notes:

1. Project construction is scheduled between November 2015 and November 2016; construction work will be prioritized within the Graham Caribou range between August and October 2016.
2. Project final clean-up is scheduled between December 2016 and March 2017; clean-up work will be prioritized within the Graham Caribou range between December 2016 and January 15, 2017.
3. Site preparation and access management implementation will be prioritized within the Graham Caribou range between December 2016 and January 15, 2017.

Table 5-9: North Montney Kahta Section – Pink Mountain Caribou Range – Proposed Construction and Habitat Restoration Preliminary Schedule



Notes:

1. Project construction is scheduled between August 2016 and April 2017; construction work will be prioritized within the Pink Mountain Caribou range between August and December 2016.
2. Project final clean-up is scheduled between December 2017 and March 2018; clean-up will be prioritized within the Pink Mountain Caribou range between December 2017 and January 15, 2018.
3. Site preparation and access management implementation will be prioritized within the Pink Mountain Caribou range between December 2017 and January 15, 2018.

6.0 CONTINUOUS IMPROVEMENT

In regards to caribou habitat restoration, NGTL is committed to continuous improvement. Continuous improvement will come from NGTL's analysis in the short, near, and long term of applied practice, the monitoring program and pure research.

This section describes caribou habitat restoration initiatives, industry collaboration and lessons learned by NGTL on other projects that impacted caribou habitat. Because of NGTL's commitment to continuous improvement, NGTL will continue to monitor all of the aforementioned components and incorporate learnings into its caribou habitat restoration efforts.

This Preliminary CHRP has incorporated updated results from:

- ongoing literature assessment
- research completed by industry associations
- lessons learned from previous NGTL projects
- consultation with applicable regulators and resource managers
- adaptive management practices in the field

Most of the updated results from these sources reference boreal caribou. Since there is little research applicable to mountain caribou in the area affected by the Project and boreal and mountain caribou are the same species, boreal caribou data will be used to inform mountain caribou restoration and monitoring plans for the Project. The monitoring program developed for the Project will add to the emerging database on mountain caribou habitat restoration.

For a list of historic and current habitat restoration initiatives, see Appendix C.

6.1 CARIBOU HABITAT INITIATIVES

This section summarizes caribou habitat restoration initiatives planned or implemented in woodland caribou ranges. Given the limited available information specific to northern and mountain caribou range restoration, this section includes identification of temporal and spatial caribou habitat restoration methods compiled from boreal caribou ranges. Boreal woodland caribou habitat restoration provides context and lessons learned from caribou habitat restoration initiatives that have been implemented in the recent past, and where available, monitoring results and effectiveness of measures. As the monitoring program progresses for this Project in northern caribou range, lessons learned and emerging data will be incorporated in NGTL's plans as adaptive management.

Although restoration ecology specific to caribou habitat is a relatively new science, some key initiatives have identified important lessons learned related to oil and gas development in caribou range. Common among many of these initiatives are lessons learned on which plant species to use, when and where to replant, effective techniques to promote natural revegetation and a better understanding of effective methods to manage access.

Lessons learned from these initiatives were incorporated in large-scale habitat restoration projects near Grande Prairie, Cold Lake and Fort McMurray, Alberta, as well as NGTL's projects in caribou habitat. Though initiatives focused on revegetation and access management have been conducted in boreal caribou ranges (Caribou Range Restoration Project [CRRP] 2007a,b; Golder Associates Ltd. [Golder] 2010; Osko and Glasgow 2010); however, the research provides valuable information for the Project restoration program, as well as providing relevant information regarding limiting growth and establishment of plant species favourable to primary prey.

Oil sands-funded projects also included tree planting initiatives, coarse woody debris management best practices, habitat enhancement programs and habitat restoration trials in caribou range (CRRP 2007a,b; Enbridge Pipelines [Athabasca] Inc. [Enbridge] 2010; Golder 2010, 2011; COSIA 2012).

Another example of caribou habitat improvement initiatives is First Coal Corporation's proposed reclamation plan for a disturbed mine site, with the objective of restoring foraging habitat for caribou in the Burnt–Pine caribou range, while minimizing the creation or improvement of foraging habitat for early seral ungulate (primary prey) species (Turner et al. 2009). The Burnt–Pine caribou herd is part of the Central Group of the Southern Mountain Caribou Population located south of the Moberly (Klinse-Za) and Graham ranges. First Coal Corporation's reclamation plan adopted an ecosystem-specific approach, whereby reclamation strategies were developed considering biophysical site characteristics.

First Coal Corporation's proposed reclamation plan focused on introduction of terrestrial lichen as a mechanism for regenerating plants that might act as attractants to caribou, and manual brushing of "less desirable" vegetation was suggested to encourage establishment of plants attractive to caribou and to minimize forage for early seral ungulates (moose and deer). Transplanting conifers was suggested as a potential measure that would be considered for reclamation of engelmann spruce-subalpine fir (ESSF) forested sites. Research and monitoring of restoration trials was a key component of First Coal Corporation's proposed reclamation plan. The proponent withdrew the project in 2012, however, and the reclamation plan was not implemented.

Blocking line-of-sight will be implemented as a restoration tool for this Project because it is a tool believed to mitigate increased risk of predation in the short term, while longer-term goals of revegetation of sightlines are achieved. The Project monitoring program will feed into emerging science on this restoration tool.

6.2 INDUSTRY COLLABORATION

Canada's Oil Sands Innovation Alliance (COSIA) was launched in 2012 to enable responsible and sustainable growth of Canada's oil sands while delivering accelerated improvement in environmental performance through collaborative action and innovation (COSIA 2012).

The organization's four key focus areas are tailings, water, land and greenhouse gases. Part of the land focus area is a caribou habitat restoration initiative with the goal of improving woodland caribou habitat quality and herd survival through restoration of historic linear disturbances.

COSIA has developed the following habitat restoration initiatives:

- Determining effectiveness of different restoration techniques such as winter tree planting, mounding, seeding and placement of coarse woody debris. The winter tree planting trial was set up to determine the effectiveness of planting black spruce seedlings in wetland areas during winter. Results of the tree planting trial indicated 90% survival of the 900 seedlings planted.
- Development of the Landscape Ecological Assessment Planning (LEAP) tool to provide baseline levels of varying land use. LEAP can be used to determine the long-term effects of restoration in a given area, which can help guide planting initiatives.
- The Algar Historic Restoration Project takes an integrated regional approach, with six companies working together to repair fragmented habitat across an area of land outside their actual licence areas. This is a five-year program to replant trees and shrubs along the linear footprint in the Algar Region, covering an area approximately 570 km^2.
- The LiDea Project aims to restore linear disturbances using mounding and tree felling. Rigorous monitoring and measurement programs have been designed for the life of the project, and currently include 37,000 ha of active treatment area. During spring and summer, conifer seedlings are planted along older, mounded seismic lines. LiDea is also experimenting with forest stand modification, which involves bending tree stems from the adjacent forest across the seismic line to create physical barriers and reduce sightlines along the linear corridor.

The Regional Industry Caribou Collaboration (RICC) is part of COSIA, and is a multi-industry partnership focused on restoring caribou habitat through regional, collaborative, range-based efforts. The objectives of RICC are to coordinate habitat restoration in the short term and long term, coordinate future activity, support and lead scientific research, conduct applied trials and align caribou habitat restoration programs with provincially led Range Plans and Action Plans.

NGTL has recently joined RICC. A major RICC research effort is to verify the effectiveness of restoration measures using a multi-scale predator/prey collaring program to address current knowledge gaps in habitat use and function. As new information on habitat restoration becomes available, NGTL will incorporate it in the planning and implementation process for its projects in caribou habitat.

6.3 LESSONS LEARNED FROM NGTL HABITAT RESTORATION

Preliminary and Final CHRPs were completed for NGTL's Northwest Mainline Expansion Project, Leismer to Kettle River Crossover Project and Chinchaga Lateral Loop No. 3 Project (Chinchaga Section). A Preliminary CHRP was filed on June 30, 2015 (NEB Filing ID: A71014) for Liege Lateral Loop 2 and Leismer East Compressor Station and refiled on August 18, 2015 (NEB Filing ID: A4S5W1).

Based on NGTL's experience with these projects, the following lessons learned were incorporated in this Preliminary CHRP:

- Rollback was used as firewood by land users when stacked as ladders. A more random arrangement of wood piles to discourage wood removal might be used in the future.
- Line-of-sight breaks on co-located ROWs are not effective because of unrestricted access on parallel ROWs. NGTL has learned that such methods are better used in non-contiguous ROWs and that such line-of-sight breaks are redundant on contiguous ROWs. There have been structural stability issues with constructed line-of-sight blocks (versus vegetation screens). NGTL has, therefore, been experimenting with constructing alternative line-of-sight structures (e.g., snow fencing constructed with 2x4s was tested during winter 2014/15).
- Tree planting on a linear corridor appears to not be as effective as on cutblocks (typical silvicultural practices) because of shading. This could result in changes to the planting densities and configurations as the monitoring program progresses.
- Access control cannot be absolute because of safety, operating and maintenance activities that must occur. On previous NGTL projects, lack of access resulted in CHRP measures being destroyed or removed by TransCanada staff to access the ROW. In the future, access-control locations will be strategically placed to allow for maintenance and traditional use access.
- Where CHRP measures have failed or been removed, they have been replaced as part of adaptive management.
- As NGTL has attempted to apply the line of sight/access control features on the landscape as suggested in the EAP; however, it has become apparent that over the course of implementing those features on other NGTL projects that impact caribou habitat (Leismer, NWML, Chinchaga) meeting the recommended

intervals was not feasible. For further details about why NGTL has not adopted the EAP suggested intervals, see Section 5.5.

- Based on recent field experience on the Chinchaga Section with implementing access control and line of sight blocks, NGTL determined that there are several reasons why these features cannot be applied at EAP recommended intervals and the intervals that were identified within the decision framework from the Chinchaga Final CHRP:
    - Materials to construct line of sight blocks are not often available and limit the capacity to implement at the EAP recommended intervals (for example, 200m and 400m):
        - There would be insufficient woody material to implement line of sight blocks, even using merchantable timber, to construct these features every 200m to 400m.
        - There is often not enough suitable material to implement rollback at the EAP recommended intervals.
        - Limited opportunities to implement mounding due to the unsuitability of soil types and ecosite type.
    - Conflicting interests for timber and woody materials:
        - Timber salvage waivers must be approved prior to construction and acceptable to the Forest Management Agreement (FMA) holder
        - In regards to woody materials, merchantable timber is prioritized first and used for access control then the remaining materials go to FMA.
        - Any woody materials remaining must be distributed efficiently among the locations where CHRP measures are required (line of sight blocks, mounding).
        - Often NGTL has experienced a lack of available material to implement CHRP measure at 500m intervals.
    - Operational concerns:
        - From a safety and maintenance perspective, implementing CHRP measures at 200m and/or 400m makes operational access difficult and potentially unsafe in case of an emergency situation precious time would be lost removing the access control and line of sight measures.
        - For Leismer in particular, NGTL personnel had issues gaining access to the ROW as a result of access control measures. These measures were then removed to gain access. However, the integrity of the wood feature had degraded so replacement

of the feature was not possible. There were no additional replacement materials available to reconstruct the feature.

6.4 CHRP CONCORDANCE TABLE

For a summary of differences and updates from the most recent NGTL CHRP filed with the Board, which is the Liege Lateral Loop 2 (Thornbury Section) Preliminary CHRPrefiled on August 18, 2015 (NEB Filing ID: A4S5W1) , see Table 6-1 (compiled pursuant to Condition 15 a) vi). For a blackline comparison of this CHRP and the Liege Preliminary CHRP, see Appendix F.

Table 6-1: Concordance Table

Component of CHRP	Location in Liege Preliminary CHRP	Location in Preliminary North Montney CHRP	Differences or Updates
Introduction and Organization	Section 1	Section 1	There are no significant differences in this section between the two CHRPs, other than tailoring to project-specific details.
Goal, Objectives and Targets	Section 2	Section 2	No differences or updates in this section in between the two CHRPs.
Decision Framework	Section 3	Section 3	The decision framework used for this Project is consistent with the framework used in past NGTL CHRPs and is intended to be used going forward.
Targets and Measures	Section 4	Section 4	There are no significant differences in this section between the two CHRPs other than tailoring to project-specific details.
The Plan	Section 5	Section 5	This section of the North Montney CHRP was tailored to both the Aitken Creek and Kahta Sections, and accommodates the differences between boreal and mountain caribou.
Continuous Improvement	Section 6	Section 6	Information from a reclamation plan for a disturbed mine site was included in Section 6.1. The concordance table in Section 6.4 has been added to the North Montney CHRP and was not included in the Liege CHRP.
Consultation	Section 7	Section 7	This section of the North Montney CHRP includes a summary of consultation with Aboriginal communities, which was not included in the Liege CHRP.
Literature Review	Section 8	Section 8	The North Montney CHRP includes BC-specific regulatory policies and guidelines for mountain caribou, mountain caribou ecology and caribou habitat restoration initiatives for previous industrial developments.

Table 6-1: Concordance Table (cont'd)

Component of CHRP	Location in Liege Preliminary CHRP	Location in Preliminary North Montney CHRP	Differences or Updates
References	Section 9	Section 9	There are no significant differences in this section between the two CHRPs other than tailoring in each CHRP relevant to boreal and mountain caribou.

7.0 CONSULTATION

This section provides a summary of consultation with Aboriginal communities and applicable regulators related to Project impacts on caribou and caribou habitat, as well as a summary of how feedback was incorporated in the Preliminary CHRP.

NGTL began consultation and working collaboratively with provincial regulators, Aboriginal communities, stakeholders and industry partners in 2011 regarding the Project. NGTL will continue to maintain open communication with federal and provincial regulatory agencies to align the CHRP measures with provincial and federal policy, as well as potentially affected Aboriginal communities, through the various Project phases. The Final CHRP will include updated consultation records.

7.1 ABORIGINAL ENGAGEMENT

Aboriginal communities had opportunities to inform the development of caribou mitigation through meetings, Information Requests (IRs), community-led Traditional Land Use (TLU) studies, Traditional Ecological Knowledge (TEK), independent technical review and through the hearing process for the Project (i.e., oral evidence, TLU studies).

Blueberry River First Nations, Prophet River First Nations, Saulteau First Nations and West Moberly First Nations all presented oral evidence at the North Montney Hearing in Fort St. John, BC. Each potentially affected and interested Aboriginal community received copies of the preliminary Caribou Management Plan (CMP) and updates, with requests by NGTL to review these documents and to provide input. Meetings have also been requested with each interested community to review the plan, respond to questions and receive further feedback from Aboriginal communities on the plan. For a summary of engagement activities related to caribou, see Table 7-1. The CMP preceded, and has been replaced by, this Preliminary CHRP.

In addition to comments and written evidence, NGTL has reviewed and considered the following reference documents submitted by Aboriginal communities for the Project:

- Saulteau First Nations and West Moberly First Nations provided, as an aid to cross-examination at the Project hearing, *Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada* (NEB Filing ID: A4E9U2).
- West Moberly First Nations submitted as part of their additional written evidence (AWE) Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace of British Columbia (Filing ID: A3Z0H2) and Action Plan for the Klinse-Za Herd of Woodland Caribou (Rangifer tarandus caribou) in Canada (Filing ID: A3X4D3).

Given differences in mapping approaches described in Section 8.2 (traditional knowledge about historic distribution and range of caribou versus caribou local population units and critical habitat in the federal Recovery Strategy), it was determined that the Preliminary CHRP would be developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.

NGTL has adopted the definition of critical habitat as defined in the Recovery Strategy (EC 2014). For the reasons described in NGTL's response to West Moberly First Nations IR No. 2 (Filing ID: A3Z6Y1), Final Argument (Filing ID: A64632) and Reply Argument to West Moberly First Nations (Filing ID: A4F7T5) (summarized in Section 8.2), NGTL will apply CHRP measures within the boundaries of the Recovery Strategy-delineated caribou herd ranges (equivalent to local population units). The caribou herd ranges are mapped by provincial and federal regulatory authorities responsible for management and recovery of the Graham and Pink Mountain caribou herds. However, mitigation measures described in the Environmental Protection Plan (EPP) and AMP will be applied for the entire Project.

The Independent Technical Review Group (Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations) commissioned a third-party consultant, LGL Ltd., to review the draft Preliminary CHRP and provide comments. The review provided by LGL Ltd. to NGTL supported the restoration measures and monitoring program detailed in the Preliminary CHRP. Comments focused mainly on differences in mapping of caribou critical habitat between the federal Recovery Strategy and Seven Herds report. LGL Ltd. also suggested the implementation of a lichen collection and transplantation program (see Table 7-1).

Table 7-1: Summary of Aboriginal Engagement

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Blueberry River First Nations			
July 21, 2014	NGTL emailed Blueberry River First Nations information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a Caribou Mitigation Monitoring Plan (CMMP) would be prepared. A PDF document of the Preliminary CMP was included for Blueberry River First Nations' review. NGTL noted that access management mitigation measures have been included in the project's EPP. NGTL requested to meet with Blueberry River First Nations to discuss the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input into the proposed plans.	N/A (no comments received)	–
September 8, 2014	NGTL emailed Blueberry River First Nations to request a meeting. Possible meeting dates were provided, with the request that Blueberry River First Nations provide alternative dates if the provided dates do not fit in with Blueberry River First Nations' schedule. The purpose of the meeting would be to discuss the CMP (NEB Filing ID: A4C5V4) and the access management measures and locations.	N/A (no comments received)	–
Doig River First Nation			
July 21, 2014	NGTL emailed Doig River First Nation information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Doig River First Nation's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Doig River First Nation to discuss the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A (no comments received)	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Halfway River First Nations			
July 21, 2014	NGTL emailed Halfway River First Nations information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Halfway River First Nations' review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Halfway River First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
August 21, 2014	NGTL conducted a meeting to present Halfway River First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and access management measures and locations. NGTL requested feedback on the access planning during the meeting. Halfway River First Nations commented that scoop-outs prevent trucks, but attract quads and motor bikes. It was also stated that signs are an informative way to deter access as well. Halfway River First Nations inquired about monitoring access points.	All Sections	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the three main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16).
McLeod Lake Indian Band			
July 21, 2014	NGTL emailed McLeod Lake Indian Band information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for McLeod Lake Indian Band's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with McLeod Lake Indian Band to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
McLeod Lake Indian Band (cont'd)			
September 8, 2014	NGTL emailed McLeod Lake Indian Band to request a meeting. Possible meeting dates were provided, with the request that McLeod Lake Indian Band provide alternative dates if the provided dates do not fit in with McLeod Lake Indian Band's schedule. The purpose of the meeting would be to discuss Serious Harm to Fisheries, the CMP (NEB Filing ID: A4C5V4) and the AMP.	N/A	–
Prophet River First Nation			
July 21, 2014	NGTL emailed Prophet River First Nation information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Prophet River First Nation's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Prophet River First Nation to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
September 24, 2014	NGTL conducted a meeting to present Prophet River First Nation with the Preliminary CMP (NEB Filing ID: A4C5V4) and access management measures and locations. No concerns specific to caribou or access management were recorded.	N/A	–
Saulteau First Nations			
February 28, 2012	NGTL attended the 2012 Caribou Workshop held by Saulteau First Nations. The purpose of the workshop was to bring together all proponents in the region whose activities might have an impact on caribou. Saulteau First Nations' goal was to develop a plan to protect boreal, northern and southern caribou herds.	N/A	Specific recommendations or comments related to planning or implementing caribou habitat restoration for the Project were not discussed.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
January 29, 2013	NGTL attended the Caribou Planning Session for the Peace Northern Caribou Committee on January 29-30, 2013. Approximately 35 people attended from industry, local First Nations communities and government. The workshop was a planning session to identify an appropriate governance structure for the committee and a discussion on how to immediately protect the Moberly caribou herd.	N/A	Specific recommendations or comments related to planning or implementing caribou habitat restoration for the Project were not discussed. The Project does not encounter the provincially/federally delineated range of the Moberly caribou herd.
April 25, 2013	NGTL met with Saulteau First Nations. Saulteau First Nations is concerned about caribou and how declining Moberly caribou population counts will be addressed.	8.2	The Project does not encounter the provincially/federally delineated range of the Moberly caribou herd. Regulatory objectives, including stopping decline of caribou populations, are reviewed and provide context for the development of the Preliminary CHRP. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
		8.3, 8.4	Ecology of the caribou herds encountered by the Project is discussed, including population trend, threats and limiting factors. This information provides ecological context considered in the development of the Preliminary CHRP, in particular, development of CHRP objectives.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
April 25, 2013 (cont'd)	See above	2,3,4,5	The goal of the CHRP is to reduce the residual effects of the Project on caribou and caribou habitat in a manner that aligns with provincial and federal policies, and will not affect the capacity for stated caribou recovery and habitat management objectives to be achieved. As noted above, regulatory policy identifies stopping caribou population decline as an objective. The toolbox of measures that NGTL can implement is detailed for all phases of the Project, from pre-construction through operations. Many of the relevant measures have already been implemented as part of the pre-construction (Project planning and design) phase. These, and the measures identified in Section 5 for the construction phase, will facilitate habitat restoration of the Project footprint in caribou range following completion of construction (post-construction phase).

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
September 6, 2013	NGTL emailed Saulteau First Nations requesting a list of priority areas to visit for the helicopter overflight with Saulteau First Nations representatives scheduled for September 11, 2013. Saulteau First Nations replied the same day with an attachment outlining the focal areas of interest for the overflight. Focal areas included: • Saturn Meter Station • Pine River crossing • Moberly River crossing • Entry into Peace Moberly Tract • Peace Moberly Tract Section • Peace River crossings East and Preferred Route • Caribou habitat crossing (north of Farrell Creek) • Prince Rupert Gas Transmission Project tie-in location (NEB Filing ID: A3Q6U2)	7.1	TEK presented during field studies is summarized in this section.
September 11, 2013	A helicopter overflight was conducted with Saulteau First Nations that included a flyover of the Graham caribou range. Saulteau First Nations was shown where NGTL proposed to parallel the existing pipeline corridor (NEB Filing ID: A3Q6U2).	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
		7.1	TEK presented during field studies is summarized in Section 7.1.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
September 25, 2013	Saulteau First Nations emailed NGTL a routing memo that: • outlined routing review work completed to date • listed Saulteau First Nations' concern with disturbance in Area of Critical Community Interest and Peace Moberly Tract • noted Saulteau First Nations' preferred route is the Chetwynd Route • stated that Tetra Tech agrees that the East Route is not feasible • requested implications for caribou habitat during construction (in vicinity of Farrell Creek) • requested NGTL comments on noted items (including suggestion for following the Chetwynd Route) (NEB Filing ID: A3Q6U2)	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
July 21, 2014	NGTL emailed Saulteau First Nations information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Saulteau First Nations' review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Saulteau First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
October 5, 2014	NGTL provided the links to the Preliminary CMP filed with the NEB (NEB Filing ID: A4C5V4).	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
October 6, 2014	NGTL presented Saulteau First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations.	All Sections	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the 3 main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16).
West Moberly First Nations			
February 14, 2013	NGTL met with West Moberly First Nations to discuss the Project and Community Agreements. West Moberly First Nations does not want pipelines through the Moberly caribou range west of Moberly Lake. West Moberly First Nations would like to have the government defer tenure in the northeast area of the Peace Moberly Tract, including the adjacent area to the east and would like NGTL to influence government to defer tenure in that area.	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
April 15, 2013	NGTL met with West Moberly First Nations to discuss the Project. West Moberly First Nations is concerned that the Project will open the door to further development through the Peace Moberly Tract and does not want pipeline development through critical caribou habitat. West Moberly First Nations is exploring the idea of a pipeline corridor to manage all the proposed pipelines in the area. West Moberly First Nations members would need a chance to provide feedback on the Project before a decision of support can be made (NEB Filing ID: A3Q6U2).	7.1	The routing criteria described in Section 4.1 of the ESA. The Peace Moberly Tract is outside provincially/federally delineated caribou range. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
West Moberly First Nations (cont'd)			
July 18, 2013	NGTL met with West Moberly First Nations to discuss the Project. West Moberly First Nations is concerned that the ROW will become an access point for hunters and predators; the community wants to monitor and limit the access to hunting areas. West Moberly First Nations is also concerned about a decline in wildlife (including caribou) (NEB Filing ID: A3Q6U2).	2,5.3,8.5	Access management is one of the objectives of the CHRP. Section 8.5 presents a summary of literature relevant to human access and interaction with habitat restoration. Section 5.3 presents information relevant to planning access control. The AMP for the Project will include additional information, and will be submitted under separate cover in accordance with Certificate Condition 16. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
July 21, 2014	NGTL emailed West Moberly First Nations information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for West Moberly First Nations' review. NGTL noted that access management mitigation measures were included in the Project's EPP. NGTL requested to meet with West Moberly First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
West Moberly First Nations (cont'd)			
October 15, 2014	NGTL conducted a meeting to present West Moberly First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management mitigation measures and locations. West Moberly First Nations suggested *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014) and *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013) be applied to the CMP.	7.1	The routing criteria described in Section 4.1 of the ESA. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations			
January 30, 2015	NGTL met with the Independent Technical Review Group to discuss NGTL caribou habitat restoration and access management plans. Questions were raised regarding the development of camps and yards and the potential impact on caribou. It was indicated that the Treaty 8 communities want to take an active role in the development of the CHRP and the AMP.	7.1	The routing criteria described in Section 4.1 of the ESA. Construction of the section 58 components of the Project (e.g., camps, pipe yards) is proposed to start during summer 2015; however, none of these ancillaries are proposed in the Graham or Pink Mountain caribou ranges.
March 3, 2015	NGTL met with the Independent Technical Review Group to discuss the independent technical review of the CMP and the access management mitigation measures and locations. Questions were raised regarding the method and utility of the proposed restoration and access management mitigation measures, and monitoring of the restoration and access management mitigation. Interest in collaboration on the caribou habitat restoration planning was expressed.	7.1	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the 3 main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16). The AMP is relevant to the entire Project.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations (cont'd)			
March 4, 2015	Email correspondence between LGL Ltd., representing the Treaty 8 collaborative Nations, and NGTL. LGL Ltd. requested a draft Preliminary CHRP to review before the meeting with NGTL tentatively scheduled on April 7, 2015 to discuss mitigation measures proposed for the Project.	N/A	–
March 23, 2015	NGTL provided a draft copy of the Preliminary CHRP to the Independent Technical Review Group and requested review and comment.	N/A	–
April 6, 2015 April 7, 2015 April 9, 2015 April 14, 2015	Email correspondence between LGL Ltd. (on behalf of the Independent Technical Review Group and NGTL related to the technical review of the draft Preliminary CHRP.	N/A	The tentative meeting for April 7, 2015 was cancelled. LGL Ltd. advised on April 9, 2015 that written comments on the draft Preliminary CHRP would be provided.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations (cont'd)			
April 28, 2015	LGL Ltd. provided the results of a technical review of the draft Preliminary CHRP to NGTL on behalf of the Independent Technical Review Group. It was again suggested that the caribou habitat mapping by West Moberly First Nations in *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014) and *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013) be applied to the CHRP. LGL Ltd. also suggested implementation of a lichen collection and transplantation program. LGL Ltd. acknowledged that this Preliminary CHRP describes planning considerations and provides mitigation measures and habitat restoration options that can be implemented during the pre-construction, construction and post-construction phases of the Project. It was further recognized that mitigation measures and habitat restoration options (specifically Tables 6 and 7) detailed in this Preliminary CHRP will likely be effective if they are implemented in appropriate locations and follow-up monitoring and adaptive management actions are applied.	8	Comments provided by LGL Ltd. were reviewed and considered by NGTL. Critical habitat as delineated by federal and provincial regulatory authorities will continue to be used to inform the Preliminary CHRP. Any changes to these boundaries will be considered in the development of the Final CHRP. NGTL has considered the use of lichen transplanting as a possible mitigation measure for the Project. Lichens are described throughout Section 8. NGTL is committed to continued engagement with the Treaty 8 collaborative Nations. The Final CHRP will incorporate updated records of consultation and engagement, including how additional information received from Aboriginal communities is incorporated in the Final CHRP.

7.2 REGULATORY CONSULTATION\

For a summary of caribou-related consultation for the Project with federal and provincial agencies, see Table 7-2. NGTL initiated consultation early (2011; 2013-specific to caribou) in the Project planning phase to enable regulatory agencies to provide relevant information and input in a timely manner. The two key recommendations received from BC MFLNRO were to:

- reduce the Project footprint by paralleling existing linear features
- avoid critical timing periods for caribou

A draft Preliminary CMP was provided to EC and BC MFLNRO regulators for review on April 21, 2014 and comments were received. The CMP was later replaced by this Preliminary CHRP following receipt of draft Conditions from the NEB, and also was provided to EC and BC MFLNRO regulators for review on March 20, 2015. NGTL has not received comments to the CHRP from EC or BC MFLNRO regarding caribou mitigation or habitat restoration planning at the time of finalizing this Preliminary CHRP. NGTL will continue to maintain open communication with EC and BC MFLNRO as the Project progresses.

Comments and recommendations received from both EC and BC MFLNRO from their review of the Preliminary CMP were considered and incorporated in the Preliminary CHRP. Key comments and recommendations provided during consultation with regulators include:

- The Project is not anticipated to affect high-elevation winter or summer critical habitat, or low-elevation summer critical habitat for the Graham Local Population Unit. The Project is likely to destroy a small area of matrix critical habitat.
- Aboriginal groups should be appropriately engaged regarding potential Project impacts on caribou.
- The construction schedule should adhere to the critical timing window for caribou.
- Avoid activities likely to destroy critical habitat for mountain caribou by means of alternative pipeline construction and operation activities. Consider extending trenchless crossings to reduce habitat disturbance if it is found that trenchless crossings reduce impacts on caribou.
- Maximize paralleling existing linear infrastructure and minimize the Project footprint.
- Discourage early seral vegetation and avoid the use of palatable species for erosion control.
- Mitigate the potential effects of integrity inspections/maintenance associated with operations.

NGTL will continue to work with provincial and federal regulators to align the CHRP measures with provincial and federal policy. Any future comments provided to NGTL will be considered for incorporation into the Final CHRP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Environment Canada				
Joanne Kwok, Environmental Assessment Officer	August 28, 2013 November 25, 2013 Email(s)	NGTL indicated being aware that EC was developing a federal recovery plan. EC understood the recovery plan was for the Southern Mountain National Ecological Area (SMNEA). NGTL requested EC to comment whether Graham, Pink Mountain, or both, are included in EC's current planning work and to comment on when EC planned to have a draft of the current planning work available for public review EC provided comment on their current planning work in regard to the Graham and Pink Mountain herds. The Graham herd is included in recovery planning for the Southern Mountain population of Woodland Caribou, as it falls in the SMNEA, which is the current area that the recovery strategy will apply to. Under COSEWIC's DUs, this herd falls in DU7. EC explained the Pink Mountain herd is not included in the current recovery planning processes as it does not fall in the SMNEA, but is in the NMNEA and DU7. The Pink Mountain herd is included in the Management plan for the Northern Mountain population of Woodland Caribou. EC indicated plans to post a draft recovery strategy for the Southern Mountain population of Woodland Caribou on the *SARA* registry for public comment by spring 2014.	8.3,8.5	Conservation status and recovery/management planning for the Graham and Pink Mountain caribou ranges is provided in Sections 8.3 and 8.5
Joanne Kwok, Environmental Assessment Officer	December 4 and 6, 2013 Email(s)	NGTL suggested a meeting in January to introduce the project to EC, to discuss any issues/concerns/questions EC might have, and to speak further regarding project effects and mitigation for caribou. EC indicated they would like to take the opportunity to meet with NGTL and discuss various components of this project including some wildlife issues, wetlands, caribou. EC proposed to have a meeting in mid-February (February 14, 2014).	–	N/A
Cindy Hubbard, Environmental Assessment Officer Holly Middleton, Canadian Wildlife Service Jennifer Wilson, Special Projects Officer Joanne Kwok, Environmental Assessment Officer Darcy Peel, Canadian Wildlife Service Greg Ferguson, Canadian Wildlife Service Hugo Gherbavaz, Environmental Assessment Advisor	February 13, 2014 Meeting in Vancouver, BC February 14, 2014 Email	NGTL provided a Project overview and a summary of consultation with BC MFLNRO related to caribou (i.e., BC MFLNRO advised that the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* should be considered for both the Graham and Pink Mountain caribou ranges and the Project does not intersect high elevation range in the Graham range and therefore does not trigger the requirement for offset measures). NGTL indicated they will prepare a CMP to address Project effects on caribou and caribou habitat in caribou ranges crossed by the proposed Project. NGTL agreed to provide a draft of the preliminary CMP to EC for review before the NEB Hearing (scheduled in August 2014). A final CMP would be prepared following construction. EC requested comments on the draft *Recovery Strategy for the Woodland Caribou, Southern Mountain Population (*Rangifer tarandus caribou*) in Canada* and offered to meet with NGTL to discuss how the draft recovery strategy could affect the Project. NGTL followed up with an email (February 14, 2014) and provided a map that shows routing revisions (the re-route at the Sikanni Chief River and a reduction in length in the Pink Mountain caribou range). These revisions were made after the NEB application was filed and were addressed in the AWE filed with the NEB in April 2014. NGTL provided web-links to the most recently filed CHRPs prepared by NGTL as a helpful reference to EC and noted that this work has evolved with each NGTL Project.	8.2	*Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* exempts activities that occur outside identified high-elevation winter range (HEWR) for South Peace Northern Caribou from preparation of a CMMP. The Preliminary CMP and CHRP align with the first three levels of the mitigation hierarchy (i.e., avoid, minimize, restore onsite), and the associated principles and considerations described in the Implementation Plan have been considered. The Preliminary CMP is replaced by this Preliminary CHRP.
Cindy Hubbard, Environmental Assessment Officer	March 5, 10 and 11, 2014 Email(s)	An effort was made to meet with EC to discuss the draft Recovery Strategy but EC was busy with the preparation of the draft Recovery Strategy and offered to meet at a later date. NGTL indicated their interest in meeting to discuss and determine how the draft Recovery Strategy will affect the Project. NGTL advised of their intent to circulate the preliminary CMP in mid-April 2014 and request to incorporate EC's comments before filing the report with the NEB in June 2014. For the purposes of Project planning and mitigation, NGTL requested EC's early input, specifically in regard to clarity on critical habitat. Further, NGTL reminded EC of NGTL's approach (as discussed at the February 13, 2014 meeting) and sought to understand if this was reasonable. NGTL noted that the process of "march charting" (construction scheduling) is ongoing and will include important timing windows for caribou to the extent possible.	–	N/A
Cindy Hubbard, Environmental Assessment Officer	April 3 and 4, 2014 Email(s)	Before the meeting with EC on April 11, 2014, NGTL provided the following based on a request from EC: portions of the ESA that address Project residual and cumulative effects on wildlife and wildlife habitat; and maps that show the Project in caribou range. NGTL noted that the preliminary CMP will provide information on mitigation measures to reduce the predicted residual effects of the Project's construction and operation on caribou and caribou habitat. Since the Project does not intersect defined HEWR in the Graham caribou herd range, the Project does not trigger the requirement for a CMMP under the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC*, which would include a requirement for offset (compensation) measures. The Preliminary CMP will include information on: regulatory context; literature review; mitigation measures to be implemented before, during and following construction; and a summary of consultation with federal and provincial regulators. The Final CMP will document the onsite restoration measures implemented, identify their locations, and present them on Environmental Alignment Sheets. The Final CMP will be filed with the NEB following completion of final construction, cleanup and reclamation activities.	Figure 1-1 7,8	The relevant components are incorporated in the Preliminary CHRP. Detailed information will be filed with the Final CHRP following completion of reclamation activities.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Stephen Hureau, Head, Species at Risk Recovery Unit, Canadian Wildlife Service Jennifer Wilson, Special Projects Officer Joanne Kwok, Environmental Assessment Officer Greg Ferguson, Canadian Wildlife Service	April 11, 2014 Meeting in Vancouver, BC	NGTL began the discussion with an introduction to their approach to mitigating Project effects on caribou: As routed, the Project does not intersect any defined HEWR in the Graham range and, thus the Project is not subject to the *Implementation Plan for the Ongoing Management of South Peace Northern Caribou*, and does not trigger the requirement for a CMMP, which would include a requirement for offsets. NGTL, in its ESA, committed to develop a CMP to address project effects on caribou and caribou habitat. This plan will consider and incorporate the threats and mitigation presented in applicable regulatory guidelines. NGTL also noted that a follow-up plan with adaptive management, to monitor the effectiveness of habitat restoration measures will be implemented. NGTL noted that the pipeline length had been reduced in the Pink Mountain range and the portion of the route in the UWR had been removed. EC noted this was a reasonable or appropriate approach. EC indicated the comment period on the proposed Recovery Strategy ended mid-March 2014. The final Recovery Strategy will include more detail on disturbance type and matrix habitat. It was noted that the 65% threshold is the best available information at this time and that mapping disturbance is one of the top priorities.	8.2	The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km. NGTL is continuing to engage EC regarding spatial delineation of critical habitat, including matrix habitat.
Cindy Hubbard, Environmental Assessment Officer	April 21, 2014	NGTL provided a draft Preliminary CMP for review.	–	N/A
Alisha Drinkwater, Senior Environmental Assessment Coordinator	June 20, 2014 Letter response	EC provided comments on draft Preliminary CMP. EC advised the Project is not anticipated to affect high elevation winter or summer critical habitat, or low elevation summer critical habitat for the Graham Local Population Unit. However, EC advised the Project is likely to destroy a small area of matrix critical habitat. EC recommends that the Proponent work with the province to address Project effects in the range of the Graham local population unit that have the potential to result in the destruction of critical habitat. EC is prepared to share its critical habitat data with the Proponent. EC recommends avoidance of activities likely to destroy critical habitat for southern mountain caribou (i.e., Graham local population unit) by means of alternative pipeline construction and operation activities. EC recommends that the Proponent ensures that all activities that are in the Pink Mountain local population unit are consistent with the Northern Mountain Caribou Management Plan. Specific comments on the draft Preliminary CMP were provided in an attachment, and are addressed individually in the following rows.	8	NGTL has requested further clarification of the Project's interaction with critical habitat, and has been advised that critical habitat mapping for the area of the Graham Local Population Unit overlapping the Project is currently in development. NGTL will continue to consult with EC to obtain spatial data files for critical habitat for the Graham Local Population Unit. Information will be considered in Project design and mitigation planning. NGTL is aware of the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada, and has incorporated key elements of the plan into the Preliminary CHRP. Application of the identified management objectives and recovery goals to a specific project or proponent is limited, given the purpose of the Management Plan is to provide directives for the authorities responsible for management of the caribou populations discussed in the Plan. Please refer to entries beginning in the second section of this table for consultation to date with BC MFLNRO. NGTL will continue to consult with BC MFLNRO to address Project effects.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	A) Generally, EC recommends that the Proponent integrate the following criteria in the Preliminary Caribou Mitigation Plan: • goals and objectives regarding mitigation measures that would be implemented to minimize impacts on southern mountain caribou • criteria for measuring the plan's success in achieving these goals and objectives • a summary of related baseline information that would be collected and, if no additional information will be collected, justification • a list of sites where mitigation measures would be implemented, the mitigation measure(s) proposed at those sites, and the rationale for selecting those sites and measures • the methods for monitoring the effectiveness of mitigation measures implemented • a description of adaptive management measures available and of the criteria the Proponent would use to determine if and when adaptive management measures are warranted • a detailed description of the locations where mitigation measures are put in place specifically for construction, as well as those that would remain in place into operations and would be monitored for the life of the Project • a commitment to report on the results of the mitigation measures implemented, monitoring undertaken, and the success of mitigation measures in meeting the goals and objectives of the Preliminary Caribou Mitigation Plan, as part of NGLT's post-construction environmental monitoring reports	1.2	a) The goal of measures to be implemented under the CHRP is to reduce potential Project effects on caribou habitat. The certificate conditions for Caribou Habitat Restoration as well as organization of the Preliminary CHRP are described in Section 1.2. The planning and mitigation measures identified in the Preliminary CHRP comprise the toolbox of measures available to NGTL to avoid or minimize Project effects on caribou and caribou habitat. b, e, f, g) The criteria for measuring success, methods for monitoring effectiveness, description of adaptive management approach, and proposed timeline for monitoring will be included in the CHROMMP in accordance with Certificate Condition 37 and will be submitted under separate cover. c) Additional baseline information collected will include 360° aerial imagery. Detailed engineering design and construction planning information, and as-built documentation will also inform the CHRP. d, g) The Final CHRP will provide the list of sites where mitigation measures were implemented, including measures implemented during and following construction, in addition to the rationale for selecting those sites and measures. Detailed engineering and construction information is needed to determine the most appropriate mitigation tools on a site-specific basis. h) NGTL confirms their commitment to report results of mitigation and monitoring activities.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	B) EC recognizes that this is a preliminary mitigation plan and requests confirmation on when a final version would be filed with the NEB. In the case that the final version is filed after the environmental assessment process is complete, it will limit EC's ability to review the plan and provide recommendations.	1,7.2	The Final CHRP will be filed on or before November 1 after the first complete growing season following start of operation of the Section 52 facilities. NGTL will continue to engage EC through the development, implementation and monitoring phases of the CHRP, to the extent requested by EC.
		C) Section 3.1 discusses measures that could be used to minimize adverse effects, including extending trenchless crossings to reduce habitat disturbance. To evaluate the potential impacts of trenchless crossing methods on southern mountain caribou, EC recommends information on the likely effects on caribou for this pipeline construction method is provided for segment(s) that might overlap with the Graham local population unit. If it is found that trenchless crossings reduce impacts on caribou, then EC might recommend that the Proponent consider applying this installation method throughout caribou range.	5.3	Section 5.3 notes that NGTL is investigating opportunities for trenchless pipeline installation (e.g., extending trenchless crossings). There are no trenchless watercourse crossings planned in the Graham range. NGTL is considering opportunity to extend bored/drilled crossings of third-party dispositions, however, NGTL's options might be limited by the terms and conditions specified by the third party under their crossing agreement. Feasibility of trenchless crossings might also be constrained by technical considerations (e.g., access, additional workspace requirements, geological characteristics), as well as scheduling construction activities to avoid work during the critical timing window for caribou. Where extended trenchless crossings are not feasible, NGTL will consider other measures, as outlined in Section 5.3.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	D) Section 3.1 lists opportunities to minimize Project effects and facilitate habitat restoration, including considering opportunities to narrow the Project ROW. EC requests that the Proponent clearly state how much (in metre) the ROW would be narrowed.	5.1,5.2,5.3	NGTL balances environmental and stakeholder concerns, engineering design, and constructability when determining ROW width requirements. The ROW width requirements have been established to achieve this balance, and account for a safe and efficient progression of project activities. A minimum 32 m ROW is required for construction of the Project, based initially on pipe size. Additional workspace requirements will be necessary. NGTL will fully evaluate opportunities to reduce disturbance in caribou ranges. The extent and location of narrowing the construction footprint will be determined as the Project progresses through detailed engineering and construction planning phases.
		E) Section 3.2.3 considers identification of candidate sites for short-term and long-term measures for line-of-sight blocks to reduce predator access. EC requests clarification on when these candidate locations would be identified and finalized. EC also recommends the criteria used to determine a 500 m line-of-sight threshold be provided (i.e., peer-reviewed literature).	5.4	Candidate locations for line-of-sight blocks are best identified as part of detailed construction planning and refined following completion of construction. The reason for this is to allow for incorporation of topographic variation and final footprint configuration, which are key components in determining effective line-of-sight blocking locations. Line-of-sight locations will be identified in the Final CHRP. Standard distances for line-of-sight breaks and supporting literature are not available. There is considerable variation in recommended distances for line-of-sight breaks across provincial regulatory jurisdictions responsible for managing woodland caribou habitat in western Canada. In consultation with BC MFLNRO for the Project, NGTL was advised that BC MFLNRO does not specify distance frequency for line-of-sight breaks, but noted that the BC OGC recommends sight breaks at least every 200 m for seismic operations and although a different ecotype, *Interim Operating Practices for Oil and Gas Activities in Identified Boreal Caribou Habitat in British Columbia* suggest 500 m between visual breaks for linear features.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	F) Section 3.3 discusses implementation opportunities and constraints, and states that selection for habitat restoration measures would require as-built construction information. EC recommends that as-built information be provided for review in the environmental assessment process.	8.3	As-built information is collected following completion of construction and consists of a legal survey (showing areas disturbed by construction, including clearing and grading), as well as construction documentation, which would include change management documentation to address site-specific conditions. As such, this information cannot be provided before construction.
		G) Section 3.3.1 contains a hyperlink to a Decision Framework that does not link to anything. EC requests resubmission of the complete version of the Decision Framework for review in the environmental assessment process.	Figure 3-1,3-2,3-3	The decision framework was provided in the pdf version of the draft Preliminary CMP submitted to EC for review. The framework is provided as Figure 4 in this Preliminary CHRP.
		H) Section 3.4 discusses the scheduling of construction activities that would be initiated in caribou range. EC notes that pipeline installation activities would be initiated for the both sections of the pipeline (Atiken and Kahta) in Q3 2015. EC understands that the Q3 period is between July–September, which was proposed to avoid working in the critical timing window for caribou, which is January 15–July 15. EC advises that the proposed construction schedule would overlap with the end of the critical timing window for caribou. Accordingly, EC advises that the proposed construction schedule does not appear to adhere to the critical timing window for caribou as stipulated by BC MOE.	5.6	Construction will not start until after July 15 to align with the critical timing window for caribou.
		I) Section 3.4.1, Table 3 lists mitigation measures for work during the critical timing period for caribou. EC requests clarification on how “increase manpower resources to increase productivity” can be used as a mitigation measure, as this could result in additional noise disturbance or other effects for caribou.	Table 5-4	Increased manpower and resources increases the productivity of construction activities to speed construction and minimize work within the critical timing window. Noise associated with construction is unavoidable, regardless of the manpower. Expediting construction activities to complete construction within a single season (i.e., rather than delaying construction to a second season to avoid working within the critical timing window) is beneficial for reducing the duration of habitat disturbance (i.e., time lag between clearing and restoration activities).
		J) Table 3 lists mitigation measures for cleanup and reclamation activities, stating that activities would take place the following season outside the critical timing period. EC notes that delay of cleanup and reclamation activities to outside the caribou critical timing period could increase impacts on caribou depending on the lag time. Accordingly, EC requests more information on the biological rationale used to determine that to delay the complete cleanup and reclamation outside the critical timing window would result in fewer impacts on caribou. Additionally, further information on the specific season that the mitigation measure would be carried out in, and on the proposed cleanup and reclamation activities for which there is a lag time, is recommended.	Table 5-4	Table 5 has been clarified.
		K) In relation to Section 3.4.1 and the statement “in the event that caribou are observed in close proximity to the Project…,” EC requests that the Proponent quantify this distance in the finalized Caribou Mitigation Plan.	Table 5-4	The statement is in reference to incidental sightings of caribou by construction staff, which could occur in caribou range on access to or in the construction footprint.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	L) Section 4, Table 4 lists mitigation measures for caribou during construction. EC seeks clarification on which measures provided would be likely to be implemented. EC's ability to comment on the efficacy of these measures to reduce impacts on caribou is limited given that there is considerable uncertainty on the locations and extent to which they would be implemented. M) Section 5.1, Table 5 of the plan discusses and lists post-construction habitat restoration measures. EC seeks clarification from the Proponent on which measures would be likely implemented. EC's ability to comment on the efficacy of these measures to reduce impacts on caribou is limited given that there is considerable uncertainty on the locations and extent to which they would be implemented.	3 Table 5-3	The planning and mitigation measures identified in the Preliminary CHRP comprise the toolbox of measures available to NGTL to avoid or minimize Project effects on caribou and caribou habitat. Selection of the habitat restoration measures will require as-built construction information to allow for validation of site-specific conditions, and input from the NGTL construction and operation/maintenance staff, Project biologists and reclamation specialists, as well as appropriate regulatory agencies. Site-specific details will be provided in the Final CHRP. NGTL will implement the CHROMMP, including adaptive measures where warranted, to ensure the efficacy of mitigation measures implemented.
		N) EC notes that First Nations were not listed on the consultation record for this Plan. Aboriginal groups along the proposed pipeline corridor might have established or asserted Aboriginal or treaty rights to access caribou. Accordingly, it is important to ensure that Aboriginal groups are appropriately engaged regarding potential Project impacts on caribou.	7.1	NGTL has engaged with Aboriginal communities to collect Traditional Knowledge, which has been incorporated in the Preliminary CHRP. Communities engaged for the Project were advised of NGTL's commitment to complete a CHRP and NGTL will advise communities when the Preliminary CHRP and CHROMMP are filed. NGTL is committed to continuing engagement with Aboriginal communities in regard to concerns related to caribou.
		O) The Preliminary Caribou Mitigation Plan does not distinguish between the two northern ecotypes. EC requests that the Proponent clarify the local populations to which this plan applies.	8.3	The Preliminary CHRP discusses the differentiation between the Pink Mountain and Graham caribou in Sections 8.3. The mitigation and procedure for identifying appropriate site-specific methods discussed in the remainder of the Preliminary CHRP applies to both the Graham and Pink Mountain caribou herds.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	P) In addition to a Caribou Mitigation Plan, EC supports the development of an AMP for caribou outlining access control measures proposed for construction, operation and decommissioning. Implementing access control measures might limit predator access to caribou habitat and might reduce regulated and unregulated hunting access to caribou habitat, while allowing caribou to access to their critical habitat to carry out life processes. The AMP could include: • goals and objectives regarding access management for the control of both human and predator access • criteria for measuring the plan's success in achieving these goals and objectives • summary of related baseline information to be collected and, if no additional information would be collected, justification for why not • list of sites where access control measures would be implemented, control measure(s) proposed at those sites and rationale for selecting those sites and measures • summary of the Proponent's consultation with appropriate federal and provincial authorities, other appropriate stakeholders and potentially affected • Aboriginal groups regarding the AMP – summary should include any issues or concerns about the plan raised by those consulted and how the Proponent has addressed or responded to those issues or concerns • methods for monitoring the effectiveness of access control measures implemented • description of adaptive management measures available and of the criteria the Proponent would use to determine if and when adaptive management measures are warranted • detailed description of the locations where access control measures would be put in place specifically for construction, as well as those that would remain in place into operations and be monitored for the life of the Project • commitment to report on the results of the control measures implemented, monitoring undertaken and success of control measures in meeting the goals and objectives of the AMP, as part of the Proponent's post-construction environmental monitoring reports	5.3	Access control is one of the three primary objectives of restoring habitat, along with vegetation restoration and line-of-sight blocking (Section 4.3 of the Preliminary CHRP). The Final CHRP will specify access control measures in caribou ranges. NGTL is also committed to implementing access control outside caribou ranges. The details of these measures (e.g., location, type of access control) will be documented in the EPP and Environmental Alignment Sheets prepared for the Project before construction. NGTL is also required to prepare an Access Management Plan with a separate cover for non-parallel disturbances along the ROW for each section of the Section 52 facilities, in accordance with Condition 16.
		Q) EC recommends that the Proponent provide a description of how available and applicable Aboriginal Traditional Knowledge and TLU studies were considered in the Preliminary Caribou Mitigation Plan.	7.1	Available and applicable TEK and TLU studies were considered in the Preliminary CHRP. Wildlife features (e.g., trails, mineral licks) located in caribou range will be considered during routing, mitigation and access management planning.
		R) EC recommends an adaptive management approach for mitigation. The purpose of such an approach would be to ensure that effectiveness of mitigation measures, such as reductions to lines of sight, habitat restoration, decommissioning of access, is monitored and measures would be adjusted as needed during Project operations to ensure objectives for habitat disturbance and access would be achieved.	5.5	Adaptive management will be detailed in the CHROMMP filed under separate cover.
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	July 2, 2014 Email	NGTL provided an update on Attachment 1 (comments on the Southern Mountain and Northern populations of woodland caribou for the North Montney Project) and Attachment 2 (comments on the Preliminary Caribou Mitigation Plan). NGTL explained to EC that they notified the NEB that they would be delaying filing of the CMP (and the Preliminary CMMP) so that NGTL could address EC's comments on Attachment 2.	5.1	The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km. NGTL is continuing to engage EC regarding spatial delineation of critical habitat, including matrix habitat.
	July 4 and 11, 2014 Email(s) Telephone	NGTL understands that in regard to EC's comment letter addressing the North Montney Preliminary Caribou Mitigation Plan, dated June 20, 2014, EC indicates that the Project overlaps with 0.43 ha of critical habitat. Subsequently, EC indicated that it would advise the NEB that this would constitute a significant effect. NGTL requested an opportunity to review the spatial data showing this overlap, preferably before EC's letter to the NEB, planned for July 10, 2014. NGTL did receive all critical habitat data currently in the public domain, and those data do not overlap with the Project. EC explained that Canadian Wildlife Service has indicated they were able to use additional data from what was used for the June 20, 2014 letter NGTL received. Therefore, using the updated data, Canadian Wildlife Service revised conclusions made from that correspondence. EC's Letter of Comment to the NEB reflects those revised conclusions. EC indicated NGTL will be in receipt of the Letter of Comment shortly as it has been couriered to them and will also be posted to the NEB site.		

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	August 8 and 12, 2014 Email(s)	NGTL followed up with EC, noting that they have not received a response from EC or Canadian Wildlife Service regarding the 0.43 ha of critical habitat described In EC's Letter of Comment to the NEB dated July 8, 2014. In Attachment 2, page 4 it states "there is likely destruction of 0.43 ha of matrix critical habitat arising from the Project's 55 m project development area corridor (i.e., Project ROW)". NGTL indicated strong interest in receiving spatial data on the location of this critical habitat so that options for reducing adverse effects on critical habitat can be reviewed. NGTL did previously receive some critical habitat mapping from EC, but this critical habitat did not overlap the Project ROWs. NGTL indicated they would appreciate if this request could be completed by August 31, 2014 to provide sufficient time for review before start of the hearing. EC responded that they had forwarded the NGTL request to Canadian Wildlife Service colleagues and have followed up with them now. EC/Canadian Wildlife Service provided publicly available links for the southern mountain caribou spatial data. EC stated, it is important to note that the analysis is ongoing, and that the classification of critical habitat type (i.e., high elevation, low elevation and matrix) might also change in the future. Information will be provided to the public as it becomes available.	–	
	October 21, 2014 Email	NGTL emailed EC the draft Klinse-Za Action Plan and indicated it was provided to NGTL by the West Moberly First Nation. NGTL noted the document is in draft form; dated 2013. NGTL indicated they do not see it listed on the SARA website and that it is very briefly mentioned in EC's Recovery Strategy – in a list of examples of Action Plans that have been developed. NGTL asked Canadian Wildlife Service to comment as to their position on this Action Plan.	8.2	NGTL understands the critical habitat identified in WMFN 2014 and the draft Action Plan for the Klinse-Za herd (McNay et al. 2013) was developed using an approach that was informed by traditional knowledge about historic distribution and range of caribou, which differs the delineation of caribou local population units and critical habitat in the federal Recovery Strategy (EC 2014). The Preliminary CHRP has been developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.
BC Ministry of Forests, Lands and Natural Resource Operations				
Matt Austin, Director: Resource Management Megan Watters, Ecosystem Biologist Chris Ritchie, Fish and Wildlife Recovery Manager Gerald Kuzyk, Ungulate Specialist	July 23 and 25, 2013 Email(s)	NGTL sought direction for the Project in regard to caribou (e.g., status of regulatory guidelines; available information on the Graham and Pink Mountain herds; and guidance related to mitigation). BC MFLNRO indicated that NGTL's questions should be directed to the Regional Wildlife Biologist in Fort St. John.	–	N/A
Kerry Harvey, Ecosystem Biologist	August 15, 2013 Meeting in Fort St. John	NGTL provided a summary of the Project in caribou range for discussion. BC MFLNRO indicated that with respect to routing, particularly in caribou range, there should be an effort to maximize paralleling existing linear infrastructure and an overall attempt to reduce project footprint. It was suggested that C. Ritchie (BC MFLNRO Fish and Wildlife Recovery Manager) be engaged to provide a broader perspective and information on standardized industry practices and management practices for restoration. A Mitigation Plan was recommended, to be prepared in advance of applying to the BC OGC.	5.1	Routing criteria provided in Section 4.1 of the ESA outline the key components used to avoid or minimize adverse Project effects on caribou and caribou habitat, including paralleling existing linear disturbances and reducing the Project footprint.
Chris Ritchie, Fish and Wildlife Recovery Manager	August 16 and 20, 2013 Email(s)	NGTL provided a Project overview and asked for direction related to caribou (e.g., application of implementation plan; requirement to prepare a CMMP; application of offsets; standard reclamation practices; and applicability of existing plans to the Pink Mountain caribou herd). BC MFLNRO noted that the Project in the Graham caribou herd did not require a formal CMMP or offsets since the route is not located in high elevation range. However, BC MFLNRO advised NGTL to address concerns such as minimizing the footprint, controlling human and predator access, discouraging early seral vegetation and avoiding the use of palatable species for erosion control. Regarding the Pink Mountain caribou herd, BC MFLNRO confirmed that there is no herd-specific management plan.	5	NGTL incorporated suggestions into the Preliminary CHRP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist	August 26 and September 16, 2013 Email(s)	BC MFLRNO provides a summary letter that provides web-links to relevant provincial information for the Project and requested additional information related to route selection and consideration of route alternatives (i.e., the northern most portion of the Kahta Section).	5.1	NGTL's response noted that the route selection process considers minimizing the length, meeting applicable regulatory requirements and reducing the footprint, while carefully reviewing costs and constructability. The northernmost km's to Kahta (13 km in Pink Mountain range) were officially dropped in NGTL's March 10, 2014 project update to the NEB (Filing ID: A59202). The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km.
Kerry Harvey, Ecosystem Biologist	October 15, 2013 Email	BC MFLRNO provided further information on the proposed UWR in the Pink Mountain caribou range.	–	NGTL committed to review routing in this UWR.
Kerry Harvey, Ecosystem Biologist Jocelyn Campbell, Ecosystem Biologist	December 4, 2013 Email	NGTL proposed to schedule a meeting in January 2014. In regard to caribou, items to review include: routing through the Pink Mountain range, the effects assessment for caribou (i.e., assessment approach); and mitigation, specifically if any changes are expected given the proposed release of a draft Recovery Strategy.	–	N/A
Chris Ritchie, Fish and Wildlife Recovery Manager Jocelyn Campbell, Ecosystem Biologist Kerry Harvey, Ecosystem Biologist	January 14, 15 and 22, 2014 Email(s)	NGTL asked, in light of EC's forthcoming release of the draft Recovery Strategy, whether there were any changes to provincial plans or delineation of critical habitat (HEWR, low-elevation winter range and matrix), specifically in the Graham range. This information would be useful in Project planning and development of mitigation.	–	No additional or revised provincial planning documents were provided.
Kerry Harvey, Ecosystem Biologist	January 27, 2014 Meeting	NGTL provided a Project overview and noted that the pipeline route is no longer located in an UWR in the Pink Mountain caribou range. Mitigation measures related to caribou and caribou habitat and the CMP were discussed. NGTL agreed to provide a draft plan to BC MFLNRO for review and feedback and noted that a final plan identifying specific measures and locations would be prepared following construction.	5	Recommendations regarding mitigation have been considered and incorporated in the Preliminary CMP. Draft Preliminary CMP was provided to BC MFLNRO for review on April 21, 2014.
Kerry Harvey, Ecosystem Biologist	January 28, 2014 February 5, 2014 Email	NGTL provided detailed maps of Project routing in the Graham range (Aitken Section), and noted detailed mapping in the Pink Mountain range (Kahta Section) will be completed soon (e.g., front end engineering and design [FEED] maps).	–	FEED maps for the Kahta Section were provided to BC MFLNRO on February 5, 2014.
Kerry Harvey, Ecosystem Biologist	March 2 and 14, 2014 Email	NGTL requested guidance from the province related to possible changes associated with the proposed Recovery Strategy (e.g., delineation of critical habitat and standard mitigation measures). NGTL also asked if BC MFLNRO has any concerns, based on review of FEED plans, related to routing in caribou range and noted that a preliminary CMP is being prepared for the Project.	–	No additional concerns were identified.
Elizabeth Hunt, Resource Management Officer	March 24, 2014 Telephone	NGTL discussed with BC MFLNRO the use of merchantable timber for rollback for access control in caribou range. BC MFLNRO did not have any issues and requested that they be consulted once locations have been selected. The transportation of mountain pine beetle-infected timber is not an issue and there are no transportation or harvesting restrictions on mountain pine beetle-infected pine trees.	5.3	Rollback for access control is considered one of the tools that NGTL will incorporate into the implementation of caribou mitigation and Final CHRP, where appropriate. Potential rollback locations for access management will be selected and described in the AMP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist Chris Ritchie, Fish and Wildlife Recovery Manager	March 31, 2014 Telephone	NGTL noted that a preliminary CMP is being developed for the Project and would address routing, scheduling and mitigation planning before, during and after construction. NGTL again asks if the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* will be updated. BC MFLNRO will review the draft Preliminary CMP before submission to the NEB.	–	Updated provincial planning documents are not available.
Kerry Harvey, Ecosystem Biologist	April 1, 3 and 4, 2014 Email	BC MFLNRO noted that standardized industry management practices are in their infancy and that stakeholders and First Nations will be engaged in this process and there will be an opportunity to review and provide comment in the future. In reference to FEED plans, BC MFLNRO indicated it appears as though NGTL has paralleled existing footprint to a great extent, which is good. BC MFLNRO indicated it would like to reiterate that NGTL make every attempt to minimize new footprint and avoid activities during critical timing windows. BC MFLNRO did not express any additional concerns.	5.6	In response to timing, NGTL provided BC MFLNRO with the response to NEB Information Request 2.32 on this topic. Scheduling information is provided in Section 5.6 of the Preliminary CHRP, including discussion of critical timing windows for caribou.
Kerry Harvey, Ecosystem Biologist	April 14, 2014 Email	NGTL provided follow-up in regard to FEED plans and routing in caribou range. NGTL's construction, environment and engineering team members reviewed the FEED plans to address BC MFLNRO's request.	–	Routing and siting information is described in Section 4.1 of the ESA. No additional opportunities were identified to reduce the footprint in the Pink Mountain range. In the Graham range, NGTL's Lands Department approached an adjacent third-party line to determine whether a portion of their ROW could be used, as this would reduce NGTL's footprint. The third party responded that they could not accommodate that request.
Kerry Harvey, Ecosystem Biologist	April 21, 2014 Email	NGTL provided a draft Preliminary CMP for review.	–	N/A
Kerry Harvey, Ecosystem Biologist	May 1, 2014 Email	BC MFLNRO reviewed the draft Preliminary CMP and provided comments pertaining to: • inclusion of indirect project effects (e.g., noise, aircraft if applicable, annual integrity inspections or monitoring) and, in particular, mitigating potential effects of integrity inspections/maintenance associated with operations • reference to the BC MOE (2014) Science Update for the South Peace Northern Caribou (*Rangifer tarandus caribou* pop. 15) in BC • modification of cautionary period timing window • provision of the document number for the EPP • inclusion of mitigation measures regarding incident/sighting reporting protocols related to traffic management, exclusion of wildlife from open excavations or other potential hazards (e.g., sumps), proper storage of construction materials, site-specific habitat features (e.g., mineral licks) and minimum disturbance construction techniques	Throughout	Comments have been incorporated in the Preliminary CHRP.
Kerry Harvey, Ecosystem Biologist	June 23, 2014 Email	BC MFLNRO provided comments on draft Preliminary CMP pertaining to discrepancy in timing windows. Acknowledged that the BC OGC only has a critical timing window for caribou extending from May 15 through July 15. The BC MFLNRO critical timing window (January 15 through July 15) encapsulates a late-winter period and BC MFLNRO ask that activities also be planned considering that critical period. Perhaps this is an entirely moot point given vegetation restoration success (in all likelihood) needs to be assessed under snow-free conditions (and as such would avoid the said timing window). BC MFLNRO requested a short call in early July to follow up on a few issues.	5.6	The BC MFLNRO critical timing window is incorporated in Section 5.6.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist	October 22, 2014 Email	BC MFLNRO indicated the Province is aware of and interested in the information in the Klinse-Za Action Plan (as while it used different method to determine a management regime for caribou than the Peace Northern Caribou Plan it is not without merit) and is currently undertaking a comparative assessment of the relevant caribou plans. However, the Province has not endorsed this plan at this time and is comfortable with the management regime as set out in the South Peace Northern Implementation Plan, but remains open to amending/augmenting the current regime if new, compelling information becomes available. With regard to the federal Recovery Plan and their critical habitat maps, as BC MFLRNO understand it the boundaries were determined largely using the provincial data. However, BC MFLRNO cannot confirm this was the only source of data they used, so would be very cautious about using provincial data to better understand EC's mapping. BC MFLRNO understands that EC will be making the shapefiles for their critical habitat publicly available as soon as possible.	8.2	In the absence of an amended South Peace Northern Implementation Plan, NGTL is developing the CHRP to the most recent version of the South Peace Northern Implementation Plan. NGTL understands the critical habitat identified in WMFN 2014 and the draft Action Plan for the Klinse-Za herd (McNay et al. 2013) was developed using an approach that was informed by traditional knowledge about historic distribution and range of caribou, which differs from the delineation of caribou local population units and critical habitat in the federal Recovery Strategy (EC 2014). The Preliminary CHRP has been developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.

8.0 LITERATURE REVIEW

This section describes the literature review that was conducted to provide regulatory and ecological context relevant to mountain caribou and specifically to the Graham and Pink Mountain caribou range, including threats to and management considerations for recovery of mountain caribou. This context provides an understanding of the current knowledge of the value and purpose of habitat restoration in caribou range.

In addition, available information on mitigation measures and habitat restoration methods was compiled and summarized in Section 5 and Appendix C. This summary was used to provide the foundation for the suite of measures available to NGTL to effectively restore potential Project effects on caribou and caribou habitat. Knowledge gaps that contribute to uncertainty in caribou habitat restoration are identified in Section 8.9. Based on the results of the literature review, the habitat restoration measures best suited for caribou range have been identified.

8.1 LITERATURE REVIEW METHODS

The literature review incorporates regulatory and ecological context relevant to the ESAR caribou range to inform the selection of appropriate mitigation and habitat restoration measures. The key results from current boreal caribou literature as well as previous and ongoing habitat restoration initiatives, techniques implemented and their reported successes and failures were reviewed to inform the CHRP.

The literature review was completed using a systematic approach and standard research techniques, which enabled NGTL to consider the most recent published information about caribou habitat restoration in the Preliminary CHRP. Sources reviewed include federal and provincial recovery strategies and management plans, previously submitted NGTL CHRPs, publically available government reports, in-house reference material and peer-reviewed journal articles.

The literature review for the Preliminary CHRP included a systematic search of the following industry and scholarly databases for queried keywords and phrases:

- Google
- Google Scholar
- BioOne
- Web of Science
- BC Ministry of Forests (BC MOF) Forest Practices Codes Guidebooks
- Cumulative Environmental Management Association (CEMA) database, including Oil Sands Leadership Initiative (OSLI) historic filings

The following search terms were used in the literature review:

- caribou habitat restoration
- northern caribou
- mountain caribou
- subalpine/conifer/mature/old forest restoration
- forested wetlands restoration
- linear corridor restoration/reclamation
- linear feature restoration in subalpine/conifer/mature/old forest and forested wetlands
- BC caribou recovery/range plan/policy/action plan

The COSIA website was searched to gather knowledge on current restoration measures, including the LiDea Project, the Algar Historic Restoration Project and OSLI environmental performance projects. Similarly, documents available on the BC Science and Community Environmental Knowledge (SCEK) Fund website, in particular those associated with the SCEK Fund's research and effectiveness monitoring and caribou programs, were reviewed. The Boreal Caribou Habitat Restoration Operational Toolkit for British Columba (Golder 2015) provided a summary of habitat restoration techniques appropriate for boreal caribou range in BC, and is based largely on lessons learned from restoration activities in northern Alberta.

TERA, a CH2M Hill Company, attended the 15th North American Caribou Workshop (North American Caribou Workshop 2014), where several technical sessions related to habitat restoration for caribou were presented. Relevant information for CHRP planning related to use of rollback and monitoring wildlife use of restored linear features that was presented at the workshop is summarized in the relevant sections of the literature review.

Caribou habitat restoration is receiving increasing research attention and it is anticipated that methods to restore habitat will continue to be tested and modified in the near future. NGTL has incorporated this information in the AMP for the Project and will continue to incorporate new information in the Final CHRP and post-construction monitoring reports.

8.2 REGULATORY POLICY AND GUIDELINES FOR MOUNTAIN CARIBOU

The Preliminary CHRP was developed considering the current regulatory policies specific to mountain caribou. NGTL began consultation and working collaboratively with provincial regulators, Aboriginal communities, stakeholders and industry partners several years ago at the outset of the Project. NGTL will continue to work with provincial and federal regulators to align the CHRP measures with provincial and federal policy.

The identified regulatory policy and management documents considered to develop the Preliminary CHRP include:

- *Management Plan for the Northern Mountain Population of Woodland Caribou* (Rangifer tarandus caribou) *in Canada* (EC 2012a), as it applies to the Pink Mountain herd
- *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (BC MOE 2013), as it applies to the Graham herd
- *Recovery Strategy for the Woodland Caribou, Southern Mountain Population* (Rangifer tarandus caribou) *in Canada* (EC 2014), as it applies to the Graham herd
- *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014 [Filing ID: A3Z0H2])
- *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013 [Filing ID: A3X4D3])
- *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Interim Guidance)* (BC MFLNRO 2014)
- *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005)

Further information on each of the documents listed above is summarized in the following paragraphs.

The *Management Plan for the Northern Mountain Population of Woodland Caribou* (Rangifer tarandus caribou) *in Canada* (EC 2012a) applies to the Pink Mountain herd. Objectives of the plan for northern mountain caribou include determining herd status and trends, managing harvest and identifying and managing important habitats. The main threat identified for the Pink Mountain herd is reduction in range due to industrial development. An increase in predation by both wolves and wolverines was noted, and is attributed to the increase in moose populations following prescribed burns.

The *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (BC MOE 2013) applies to the Graham herd. Objectives include:

- protecting 90% of HEWR
- implementing management objectives and standardized management practices in HEWR and low-elevation winter range (there is currently no low-elevation winter range identified for the Graham herd)
- addressing non-habitat related threats
- monitoring compliance and effectiveness of management actions

Management objectives for industrial footprints are to restore, reduce or prohibit surface disturbance in high-elevation winter habitat, thereby reducing the potential for disturbance and displacement of caribou to lower elevation winter habitats that have a relatively higher predation risk. Implementation of standardized industry management practices to reduce or avoid habitat disturbance is one of the key implementation objectives of the Plan. The Plan suggests that these standardized management practices would be regulated under the *Oil and Gas Activities Act*, the *Forest and Range Practices Act* or the *Mines Act*. Currently, the standardized management practices suggested in the Plan have not been developed or implemented. The Project does not intersect defined HEWR in caribou range and, therefore, does not trigger the provincial requirement for a Caribou Mitigation and Monitoring Plan, which could include a requirement for offset (compensation) measures.

EC released the *Recovery Strategy for Woodland Caribou, Southern Mountain population* (Rangifer tarandus caribou) *in Canada* in June 2014, with the goal to achieve self-sustaining populations in all local population units within their current distribution (EC 2014). The Recovery Strategy applies to the Graham herd, or local population unit, but not the Pink Mountain herd. The Graham herd is part of the Northern Group subpopulation, and the Recovery Strategy has set a population target of 4,600 caribou for this group, which is 24% higher than the current population estimate of 3,707 caribou.

Population and distribution objectives identified in the Recovery Strategy include:

- stop the decline in both size and distribution of all local population units
- maintain the current distribution within each local population unit
- increase the size of all local population units to self-sustaining levels and, where appropriate and attainable, to levels that can sustain a harvest with dedicated or priority access to Aboriginal peoples (EC 2014)

The federal Recovery Strategy delineates critical habitat in the Northern Group into five categories:

- high-elevation summer or winter range
- low-elevation summer range
- low-elevation winter range
- Type 1 matrix range within annual ranges
- Type 2 matrix range surrounding annual ranges

Only high-elevation summer or winter range is currently spatially defined in the Recovery Strategy for the Graham range. The definition of critical habitat is subject to change in updates to the Recovery Strategy or through the development of federal action plans.

Maintenance of low and sustainable predation risk and access to food resources is the key habitat function of each of these identified range categories (EC 2014). In low-elevation winter range and Type 1 matrix range, a minimum 65% undisturbed habitat should be achieved or maintained (for Northern and Central groups), and, in Type 2 matrix range, ecological conditions to support low predation risk should be maintained. The Recovery Strategy considers minimal disturbance of high-elevation summer and winter ranges as necessary for the recovery of southern mountain caribou local population units.

Critical habitat for southern mountain caribou is partially mapped in the EC Recovery Strategy. The Project is not located in critical habitat as currently mapped for the Graham local population unit. NGTL acknowledges the incomplete identification of critical habitat for the Graham herd, and will continue to engage the appropriate regulatory agencies to incorporate updated information as results from the schedule of studies identified in the Recovery Strategy become available.

During the NEB application review process for the Project, West Moberly First Nations submitted written evidence, entitled *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014), hereafter referred to as the Seven Herds report. In the Seven Herds report, additional critical habitat is proposed for woodland caribou, including the Graham and Klinse-Za (Moberly) herds, and current and historical population and distribution information is provided. The stated intent of the document is to provide information for inclusion in the development of the federal Recovery Strategy and Action Plans under SARA.

The *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013) identifies population and distribution objectives, disturbance thresholds for the critical habitat proposed in the draft Action Plan for the Klinse-Za herd and recommended measures to stabilize the Klinse-Za caribou herd population. The recovery actions listed in the draft Action Plan for the Klinse-Za herd, in order of priority, include:

- wolf reductions and calf penning
- protection of terrestrial lichen
- avoidance of calving areas during calving period
- restoration of early seral habitats
- deactivation of linear features
- implementing a range plan and cumulative effects assessment plan

NGTL understands the critical habitat proposed in the Seven Herds report and the draft Action Plan for the Klinse-Za herd was developed using an approach informed by traditional knowledge about historic distribution and range of caribou.

This approach differs from the delineation of caribou local population units and critical habitat in the federal Recovery Strategy, which is based on current and recently historic (since the 1980s) occupancy (EC 2014). NGTL recognizes that proposed critical habitat in the Sevens Herd report and the draft Action Plan for the Klinse-Za herd overlaps with a portion of the Aitken Creek Section of the Project. However, neither critical habitat nor the local population unit boundary for the Moberly (Klinse-Za) herd delineated in the EC Recovery Strategy overlaps with the Aitken Creek Section. Similarly, although the Graham local population unit boundary does overlap with the Aitken Creek Section, no critical habitat as delineated in the federal Recovery Strategy overlaps with the Project.

Given these differences in mapping, it was determined that the Preliminary CHRP would be developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities. NGTL has adopted the definition of critical habitat as defined in the Recovery Strategy. NGTL is developing a consistent approach for all its projects, which aligns with the federal and provincial regulatory authorities. Furthermore, the mitigation measures that NGTL has proposed within this Preliminary CHRP are consistent with and have been developed in consideration of the objectives described in provincial and federal management and recovery plans. NGTL recognizes that critical habitat for caribou is only partially delineated by EC, and that the process is ongoing. Any changes made to the boundaries delineated in the Recovery Strategy will be considered in the development of the Final CHRP. The mitigation measures described in the EPP will be applied to the entire Project. In addition, access management measures will be implemented throughout the entire Project. The NEB Report concurs that NGTL has identified current caribou distribution in a manner consistent with the NEB Filing Manual, and that the mitigation applied to protect the Graham herd will ultimately protect the Moberly herd. The NEB noted that the Project does not overlap with the current distribution of the Moberly (Klinse-Za) caribou herd.

In addition to the regulatory policies and recovery objectives summarized above, the Preliminary CHRP considered regulatory guidelines relevant to industrial development in caribou ranges. Regulatory guidelines provide recommendations for industrial development to protect caribou habitat, avoid sensory disturbance during sensitive periods and manage human and predator access.

The recently released *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia* (*Interim Guidance*) (BC MFLNRO 2014) provides recommendations for mitigating potential impacts on wildlife and wildlife habitat during the planning, development and operation of industrial projects, including pipelines.

The compendium focuses on northern BC, including the Northeast, Omineca and Skeena regions. With respect to caribou, the compendium indicates that threats to caribou are similar across ecotypes and are primarily changes to predator–prey dynamics and sensory disturbance during critical periods (late winter when cows are in their poorest physical condition and spring during calving and rearing). To address these threats, the identified management objectives of the compendium include maintaining the functional integrity of important habitats, avoiding or minimizing disturbance to caribou, and avoiding or minimizing an increase in predation risk. To meet these objectives, the compendium identifies 11 points of guidance:

1. Identify caribou habitat and historic and current caribou use of those habitats within the proposed project footprint and its area of influence.
2. Identify caribou indicators (e.g., habitat use and characteristics, population structure and dynamics, etc.) within the project area by caribou ecotype.
3. Identify the impacts of proposed activities on caribou and caribou habitat.
4. Avoid or minimize new disturbance to caribou habitat and the loss of important habitats.
5. Avoid increasing the density of linear disturbances within or in proximity to caribou habitat.
6. Avoid displacing caribou and minimize direct and indirect mortality on caribou populations.
7. Avoid increasing the predation risk for caribou populations.
8. Avoid contaminating caribou habitat.
9. Restore habitats to a condition that provides a similar level of functional caribou habitat as before any industrial activity took place.
10. Develop a monitoring and adaptive management plan to monitor effectiveness of measures to avoid, minimize and restore.
11. Risk timing windows for caribou.

The previously released *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005) contains information on northern caribou, as well as a review of existing management strategies. Over 100 documents were reviewed, including provincial strategies and relevant Land and Resource Management Plans.

Management strategies were grouped into several categories, including:

- landscape level (direction on how an entire caribou range will be managed with respect to spatial and temporal disturbance and associated activities; landscape level strategies are consistent across caribou herds)
- stand level (direction on how industrial activities will be conducted in caribou range, with a focus on managing forage lichens; stand level strategies vary by caribou herd)
- access strategies (direction on how to avoid and minimize impacts from increased access and development of linear corridors, with an emphasis on road planning)
- oil and gas and mining strategies (focus on low impact methods for exploration, restoration of disturbed habitat and minimizing the creation of movement barriers)
- caribou population/monitoring strategies (complement caribou habitat strategies, and suggest further research)

The *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005) refers to the *1996/97 Operating Guidelines for Industrial Activity in Caribou Ranges in West Central Alberta* (Alberta West Central Standing Committee 1996). The Operating Guidelines are for the West Central Alberta caribou ranges, including both mountain and boreal ecotype caribou. The main concerns addressed by the Operating Guidelines are public access routes, predation rates on caribou, caribou habitat availability and quality, and displacing or causing sensory disturbance to caribou. The strategy to address these concerns includes managing short- and long-term impacts of access, applying an "early in/early out" construction schedule, and identifying and providing an adequate supply of quality habitat.

The BC Oil and Gas Commission ([BC OGC] 2013) *Environmental Protection and Management Guide* provides information on the requirements of the Environmental Protection and Management Regulation. The guide provides timing windows for northern and boreal caribou, including:

- low risk (activities should be scheduled during these times, where ground conditions permit)
- cautionary (operations may proceed, subject to BC OGC review; recommend avoidance of intensive activities and additional mitigation measures might be required)
- critical (most activities are restricted during this time; if working within the timing window is unavoidable, operations must be accompanied by a rationale and mitigation and/or monitoring plans, subject to BC OGC approval)

8.3 MOUNTAIN CARIBOU ECOLOGY

As previously mentioned, both the Graham and Pink Mountain herds are provincially designated northern ecotype caribou (BC MOE 2010) – the Graham herd is part of the Southern Mountain Population and the Pink Mountain herd is part of the Northern Mountain Population (EC 2015). Mountain caribou are found in west-central and northern BC, where they span two National Ecological Areas: the Southern Mountain National Ecological Area (SMNEA) and the Northern Mountain National Ecological Area (NMNEA) (BC MFLNRO 2014). The Pink Mountain herd belongs to the NMNEA and the Pink Mountain herd is in the SMNEA. Northern ecotype caribou use terrestrial lichens as a primary food source in winter and overwinter either in low-elevation pine–lichen stands or at high elevation on windswept alpine ridges (BC MFLNRO 2014). Mountain caribou typically calve at high elevations, often migrating over large distances to open subalpine ridges where they maintain a spatial separation from predators, primarily wolves (BC MFLNRO 2014).

8.3.1 Graham Caribou

In 2009 the population estimate for the Graham caribou herd was 708 individuals (EC 2014). There is low confidence in this estimate, and BC MFLNRO has scheduled a census for winter 2015 (Seip pers. comm.). EC (2014) currently considers the population to be stable and BC MOE (2014) considers it to be decreasing in the short term by. However, the long-term population trend is unknown (EC 2014). The seasonal habitat use and movement patterns of the Graham caribou herd are variable and largely dependent on snow conditions (e.g., depth and density) (Backmeyer 2000; Culling et al. 2005). Graham caribou use upland coniferous forests from 1,200 m to 1,600 m in elevation. Preferred habitats include subalpine parkland, alpine tundra, mature and old pine forests and wetland conifer forests, while early seral, deciduous forests are often avoided (Culling et al. 2005). The Engelmann Spruce-Subalpine Fir (ESSF) and Boreal White and Black Spruce (BWBS) biogeoclimatic zones are preferred by the Graham caribou, and use of each zone varies by season (Backmeyer 2000).

The following description of Graham caribou seasonal habitat use is based on a radio-collar study (Culling et al. 2005). During the spring (early April to mid-May), Graham caribou use habitats below 1,300 m, although alpine tundra areas can be used during spring in years with higher than average snowfall. Pregnant females move to higher elevations (1,500 m) to calve in mid-May through the end of June, where they typically remain below the treeline. In summer (July through August) caribou are found in high-elevation alpine tundra and subalpine parkland, and males tend to use higher elevations (1,650 m) than females (1,550 m).

Both males and females begin to move to lower elevations (> 1,500 m) during fall (September through October), where males show a preference for spruce-fir forests and alpine tundra, and females show a preference for subalpine parkland and alpine tundra. Alpine and subalpine habitats are used during the rut. Habitat use during the early winter (November through January) is quite variable, with both alpine tundra and wetland conifer habitats being selected. This variability in habitat selection might be the result of variability in snow conditions and access to forage.

A substantial proportion of the Graham herd detected in the study selected old and mature pine forests and subalpine parkland in late winter (February through March) (Culling et al. 2005). The core winter habitat used by the Graham caribou herd is located along the eastern foothills and is lower in elevation (1,300 m) than habitats used in the summer. More variable use of habitats by the Graham herd in late winter was reported in another study, with a split between individuals using low- and high-elevation habitats (Backmeyer 2000). The federal recovery strategy for southern mountain caribou indicates that low-elevation winter range for the Northern Group (Graham herd) is characterized by low-elevation pine forests 80-250+ years in age with ground cover of terrestrial lichens (EC 2014).

In the Graham caribou herd, there are both migratory (i.e., distinct summer and winter ranges) and resident (i.e., overlapping summer and winter ranges) individuals (Backmeyer 2000, Culling et al. 2005). For the migratory individuals, the spring migration to calving areas is fairly consistent across years, whereas fall migration is more variable and dependent on weather and snow conditions (Culling et al. 2005). Graham caribou favour alpine and subalpine ridges as movement corridors (52% of point locations during migratory periods) and tend to avoid valley bottoms (Culling et al. 2005). The authors of that study speculate that the avoidance of valley bottoms might be due to long-term exposure to predation risk since the area used by the Graham herd has historically had higher moose populations than other parts of the province (Culling et al. 2005).

The annual habitat use described above is supported by the biophysical attributes for the Northern Group of southern mountain caribou, identified in the federal Recovery Strategy. Attributes of critical habitat for Northern Group caribou include low predation risk, low sensory disturbance and access to forage resources (e.g., terrestrial and arboreal lichens, forbs, grasses, sedges, horsetails, emergent vegetation), as well as mineralized soils and wetlands (mineral licks) and minimal physical obstructions (to allow movement) (EC 2014).

8.3.2 Pink Mountain Caribou

In 2000, the population estimate for the Pink Mountain herd was 850 individuals and the population trend is currently unknown (EC 2012a). Information on ecology and habitat use specific to Pink Mountain caribou is limited.

Available information indicates that seasonal movements of Pink Mountain caribou are dependent on snow conditions, as they spend the summer in high-elevation alpine and subalpine habitats and move to lower-elevation coniferous forests during winter. Winter forage consists primarily of terrestrial lichen (COSEWIC 2002).

8.4 THREATS AND LIMITING FACTORS

Threats to southern mountain caribou identified in the federal Recovery Strategy, in descending order of direct impact on caribou population trend, are:

- predation
- habitat alteration from industrial activities
- roads and other linear features affecting direct mortality, habitat fragmentation and predation
- recreational activities causing displacement and facilitating predator access
- natural disturbance of habitat
- hunting

Other threats of lower concern include implications of climate change, avalanches, parasites and diseases, and stress responses associated with sensory disturbance (noise and light). Although the Pink Mountain herd is not covered under the Recovery Strategy, current literature suggests that threats to the Pink Mountain herd are likely similar to those listed for southern mountain caribou.

Apparent competition was identified as the likely causal pathway for woodland caribou population declines. As primary prey species (e.g., moose, deer) increase with increasing proportions of early seral habitat on the landscape, there is a corresponding increase in the numerical response of predators (BC MOE 2013; COSEWIC 2002; EC 2014; Latham 2009; Seip and Cichowski 1996; Wittmer et al. 2005). Wolves are considered the primary predator of caribou across northern Canada and predation by wolves was the most common cause of death for adult caribou in northeast Alberta (McLoughlin et al. 2003). Black bear could also be a common predator of caribou (Rettie and Messier 1998; Zager and Beechman 2006). 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. 2013; Wittmer et al. 2005).

Predation on caribou is thought to be largely incidental, given the low densities of woodland caribou compared with much more abundant prey species (Wittmer et al. 2005).

The primary selection of peatlands and old-growth forest by caribou and the non-use of, or lack of positive habitat selection, for these areas by moose, wolves (Rettie and Messier 2000) and black bears (Latham et al. 2011) was determined to result in spatial separation (James et al. 2004). This strategy is believed to be used to combat the widespread influence that wolves have in an ecosystem (e.g., Ripple and Beschta 2004; Ripple et al. 2014). Removal or alteration of habitat (e.g., forest harvesting [McCutchen 2007]) can also reduce the spatial separation between caribou and primary prey (i.e., moose). Following forest harvest, moose and woodland caribou were more likely to use the same habitat, and woodland caribou suffered higher rates of wolf predation (Peters et al. 2013).

A recent study found that roads increased predation risk for mountain caribou, but early seral habitat and edge created by logging, power lines and wildfire did not (Apps et al. 2013). The study showed that with the exception of roads, early seral/edge habitats influence caribou predation risk less than habitat variables such as elevation, terrain conditions (i.e., complexity, slope) and variation in canopy cover (Apps et al. 2013). Vulnerability to predation for mountain caribou increases as they move to lower-elevation habitats that are selected by primary prey (i.e., moose and deer) regardless of habitat disturbance on the landscape (Apps et al. 2013).

Vulnerability has also been shown to increase in rugged terrain and narrow valleys rather than wide valleys or plateau areas (Apps et al. 2013). This suggests that aside from roads, the functional response of predators to habitat changes in the landscape is less relevant than the population-level numerical response of predators to their primary prey (Apps et al. 2013).

Similarly, the ultimate cost to caribou habitat suitability appears lower for linear feature-induced changes compared with forestry-induced (i.e., cutblocks) changes (DeCesare et al. 2012). Linear feature-induced changes have been previously linked to changes in predator functional response (predator kill rate) while forestry-induced changes have been previously linked to changes in predator numerical response (predator density). 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). Over the long term, managing timber harvest practices in the winter ranges of early seral ungulates to reduce the continuous production of early seral habitat might have the most influential impact on recovery and sustainability of caribou populations (Apps et al. 2013).

Although landscape-scale habitat characteristics that influence ungulate and predator densities might have the greatest impact on caribou population sustainability and recovery (Apps et al. 2013), the influence of anthropogenic linear feature density on predation rates is an important factor for caribou mortality (Whittington et al. 2011).

Linear corridors provide improved access for predators such as wolves. Several studies have found that linear corridors are attractive to bears (McKay et al. 2014) and especially wolves as easy travel routes (James 1999; James and Stuart-Smith 2000; Stuart-Smith et al. 1997; Thurber et al. 1994; Whittington et al. 2011). As a result, linear disturbances might influence predator/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). Furthermore, it is suggested that while wolves increase movement rates on linear disturbance features, their movement rates in close proximity to disturbance features decreases, implying behaviours closely associated with prey searching and hunting (Ehlers et al. 2014). However, modelling the dynamic use of the landscape by wolves, primary prey (moose) and caribou showed that wolves experience no additional advantage accessing caribou from linear features, although they do benefit in accessing primary prey species (McCutchen 2007). This is supported by a study that found that kill sites were no closer to linear features than random (Latham et al. 2011).

Caribou are sensitive to direct and indirect anthropogenic disturbance (e.g., industrial activity [Dyer et al. 2001, 2002]) and habitat alteration (e.g., forestry [Peters et al. 2013]), in addition to natural disturbance such as burns (Schaefer and Pruitt 1991). Specific to linear corridors, long-term reduction in habitat effectiveness adjacent to linear features might occur as caribou have been shown to partially avoid habitats near ROWs (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. Methods 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]) and 1,000 m (industrial developments such as well sites [Dyer et al. 2001]).

By calculating the spatial difference between potential and realized habitat, a study of northern mountain caribou in BC estimated that as a result of avoidance of the cumulative zone of influence around multiple developments, approximately 8% of high-quality habitat was indirectly lost in the study area in winter and and 2% in summer (Polfus et al. 2011).

Despite an apparent reduction in habitat use in proximity to disturbance, studies have concluded that pipelines do not create a movement barrier to boreal caribou (Joint Pipeline Office 1999; Carruthers and Jakimchuk 1987 in Dyer et al. 2002), except where they parallel roads with traffic (Curatolo and Murphy 1986 in Dyer et al. 2002).

The federal Recovery Strategy for southern mountain caribou defines disturbance to critical habitat as the area affected by natural disturbances such as fire and avalanches or by human-caused disturbance, including a 500-m buffer around anthropogenic disturbance to account for avoidance by caribou (EC 2014). Critical habitat for southern mountain caribou is identified as all of the area of high-elevation winter and/or summer range; within the Northern and Central Groups that contain low-elevation winter range, a perpetual state of a minimum of 65% undisturbed habitat; and a matrix range that provides an overall ecological condition that will allow for low predation risk (EC 2014).

The Recovery Strategy considers at this time that “very minimal disturbance” for high-elevation winter and/or summer ranges is required for achieving recovery of local population units in all of the southern mountain caribou groups. For the Northern Group of southern mountain caribou (including the Graham herd), the federal Recovery Strategy identifies a minimum of 65% undisturbed habitat as a reference disturbance level for low-elevation winter ranges and Type 1 matrix range (EC 2014).

The threshold of 65% undisturbed habitat is derived from population response models developed for boreal woodland caribou ranges (EC 2011, 2012b), which, like the low-elevation and Type 1 matrix range for Northern Group southern mountain caribou, consist of fire-adapted ecosystems. The 65% threshold might be revisited on completion of studies to determine appropriate disturbance thresholds specific to low-elevation and Type 1 matrix range, or evidence that indicates the disturbance level is not supporting recovery of a caribou local population unit. Additional studies are needed to determine disturbance thresholds that will achieve recovery objectives for high-elevation ranges (EC 2014).

Until such thresholds are identified, disturbance in high-elevation ranges should be minimized and mitigated (EC 2014). In addition, maintaining functional Type 2 matrix range (outside the local population unit boundaries) is an essential component of recovery of southern mountain caribou local population units to self-sustaining levels (EC 2014). The habitat condition of Type 2 matrix habitat that is necessary for caribou recovery is identified as a wolf density of less than 3 wolves/1,000 km^2. This target might be achieved through management of habitat disturbance levels or management of primary prey and predator abundance (EC 2014).

Woodland caribou populations are very low in many areas and, therefore, populations might not rebound due to increasing rates of inbreeding and other, well-defined detrimental effects of genetic drift that are characteristic of small, genetically isolated populations (Bijlsma et al. 2000; Frankham 2005; Hedrick and Kalinowski 2000; Keller and Waller 2002). This phenomenon, known as the Allee effect, was recently suggested to occur in the boreal population of woodland caribou in Alberta (Hervieux et al. 2013; Serrouya et al. 2012) and potentially to occur in the Southern Mountain population of woodland caribou (Wittmer et al. 2005).

8.5 CARIBOU RECOVERY AND HABITAT RESTORATION

Restoration of disturbed habitat has become one of the key components for caribou conservation identified through the federal Recovery Strategy (EC 2012a, 2014) and in provincial mountain caribou recovery planning (BC MOE 2013). This section summarizes information from habitat restoration guidelines, previous caribou habitat restoration initiatives and published research. Information on restoration methods employed and effectiveness or success of restoration is included, where available.

Results of the literature review provide habitat restoration information specific to mountain caribou ranges. However, given the limited availability of literature specific to mountain caribou ranges, relevant literature from research and restoration initiatives in boreal woodland caribou range is included. This section is supplemented with further information specific to restoration initiatives completed in boreal woodland caribou range (Appendix A), which was considered as context within which to develop this Preliminary CHRP. This is supported by similarities in ecological characteristics, restoration objectives and silvicultural practices between the Project area in northern BC and boreal caribou ranges in Alberta where additional documentation for habitat restoration initiatives is available.

Both boreal and mountain woodland caribou require undisturbed habitats with mature and old coniferous forest, and lichen forage opportunities (EC 2012b, 2014). While there are similarities among these habitat requirements, mountain caribou are distinguished from boreal woodland caribou by seasonal migrations between low-elevation and high-elevation ranges (Heard and Vagt 1998; Spalding 2000; EC 2014). See Section 8.3 for further description of northern ecotype, mountain caribou ecology. In contrast, boreal woodland caribou inhabit boreal landscapes where terrain is lacking high-elevation features, and elevational migration between seasonal habitats does not occur. Despite differences in seasonal movements and habitat use between mountain and boreal woodland caribou, there is overlap in habitat types that occur in some northern ecotype mountain caribou ranges and boreal woodland caribou ranges.

The Project area in the Graham and Pink Mountain caribou ranges is mostly located in the transitional area between the Subboreal Interior and the Boreal Plains ecoprovinces of BC, east of the Rocky Mountains (Demarchi 2011). This area corresponds to the western fringe of the Boreal Plains Ecozone of Canada, which extends across the boreal region of western Canada (Smith and Marshall 1995) and overlaps many of the boreal woodland caribou ranges in western Canada. The northern part of the Kahta Section is characterized by a mosaic of forested (predominantly coniferous) wetlands and upland habitats, not unlike those in boreal regions. The rolling terrain along the Aitken Creek Section in the Graham caribou range is characterized by upland conifer and deciduous forests, with relatively little forested wetlands. The similarities in habitats between the Graham and Pink Mountain caribou ranges encountered by the Project and those encountered in some boreal woodland caribou ranges where habitat restoration is better understood, supports transfer of habitat restoration information between the regions.

The effects of linear developments are similar across caribou range, regardless of the caribou ecotype. Effects of linear disturbance on woodland caribou associated with loss of suitable old forest habitat features (e.g., loss of forage and cover habitat) is considered of lower consequence than indirect effects, due to the relatively small impact of clearing narrow linear features when considered in proportion to habitat availability at the range scale. The effects associated with regenerating early seral habitats and access, and the potential resultant indirect changes in predator–prey dynamics, similarly affect mountain and boreal woodland caribou.

The focus of mitigation and habitat restoration applied in boreal and mountain caribou ranges are similar. Namely, the objectives of habitat restoration initiatives include re-establishing natural vegetation communities that do not encourage highly palatable forage for primary prey, blocking motorized access to facilitate vegetation establishment and growth and limiting sightlines. When successfully implemented, these measures are expected to reduce residual effects of linear developments associated with predation risk. Given the similar objectives for caribou habitat restoration in boreal and mountain caribou ranges, similar measures are applied to restore habitat within linear disturbances, including silvicultural methods to establish vegetation (e.g., site preparation techniques and planting or seeding native vegetation) and measures to block access and line-of-sight.

8.5.1 Guidelines Relevant to Habitat Restoration in Mountain Caribou Range

A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (*Interim Guidance*) (BC MFLNRO 2014) provides guidelines for habitat restoration in caribou range. The main objectives for habitat restoration are to restore habitats to a similar functional level as before disturbance and to develop monitoring and adaptive management plans to monitor the effectiveness of restoration measures.

This compendium provides a list of recommendations to achieve these objectives, as follows:

- restore habitat as soon as possible following development
- deactivate and restore linear features as soon as possible following development
- limit attracting predators and early-seral ungulates to the development area
- explore opportunities to restore areas not directly affected by development activities
- prevent the establishment and spread of invasive species
- develop monitoring plans to ensure that mitigation measures are implemented as planned and are effective at meeting measurable targets
- align the type and degree of monitoring with the degree of risk to caribou and the uncertainty around mitigation measures
- ensure that monitoring plans are planned and implemented by a qualified professional with knowledge of caribou ecology
- share all data with provincial regulatory agencies to facilitate future mitigation and caribou management
- ensure that monitoring plans include changes over time, a before-and-after control study design, habitat modelling and adaptive management

A *Compendium of Northern Caribou Winter Range Management Guidelines and Strategies in British Columbia* was prepared for the BC Ministry of Water, Land and Air Protection (MWLAP) in 2005 (Cichowski 2005). This report targets the northern caribou ecotype, which consists of both the Graham and Pink Mountain herds, along with 29 other herds. This compendium summarizes provincial strategies, guidelines and recommendations for management and recovery of northern caribou at landscape and stand-level scales, including strategies to address both forage and predator avoidance requirements, and management concerns specific to seasonal habitats.

Limiting disturbance and exposure to predators is identified as a key consideration for summer and calving habitat, high-elevation and low-elevation winter habitat, as well as matrix habitat (Cichowski 2005). This compendium states linear corridor development and access associated with industrial activities is one of the major threats to northern caribou, so considerable effort was put into developing linear corridor and access management strategies. The identified strategies include avoiding road development to alpine and subalpine habitats, on eskers, on south slopes or through travel/connectivity corridors, and avoiding extended sightlines (Cichowski 2005).

Numerous strategies related to road planning, construction and decommissioning are summarized in this compendium. Many of these strategies are relevant to pipeline construction and operation, and are adopted as industry best management practices, including:

- planning access development to minimize disturbance footprint
- coordinating shared access
- using temporary access
- decommissioning access as soon as site conditions and timing restrictions allow following construction
- implementing measures to reduce lines-of-sight (e.g., bends, retaining vegetation screens)
- reclaiming linear corridors
- minimizing snow plowing
- implementing access prevention measures
- timing restrictions

The *Ecological Restoration Guidelines for British Columbia* (BC MWLAP n.d.) provide guidance on how to plan a restoration program. This guidance includes establishing goals and objectives, effective monitoring programs and restoration priorities. The guidelines provide recommendations on issues to consider, such as planting prescriptions, species at risk, soil rehabilitation, slope instability and bioengineering. However, recommendations for specific mitigation measures that are best suited for specific habitat types are not provided.

The BC OGC (2013) recommends using Land Resource Management Plans and Sustainable Resource Management Plans as guidelines for end land use goals. The forestry industry guidebooks prepared under the BC *Forest and Range Practices Act* (previously *Forest Practices Code of British Columbia Act*) provide valuable information for silvicultural practices and techniques that are commonly used to restore vegetation in disturbed sites. Guidebooks reviewed for relevant information to support caribou habitat restoration planning for the Project include *Soil Rehabilitation Guidebook* (BC MOF 1997) and *Establishment to Free Growing Guidebook Prince George Forest Region* (BC MOF 2000). These guidebooks provide information relevant to mechanical site preparation for creating suitable microsite conditions for seedling establishment, seedling planting, stocking standards and species. This information is incorporated in the post-construction habitat restoration information provided in this Preliminary CHRP, including specifications and targets.

Although not directly intended for northern or mountain ecotype caribou ranges, the *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia* (Golder 2015), prepared under the SCEK Fund, provides a review of restoration tools for caribou habitat restoration that can be applied to caribou ranges for other ecotypes. Access management (human and predator) and recovery of natural vegetation are the stated objectives for caribou habitat restoration in the toolkit, which identifies mechanical site preparation (mounding or ripping), tree/shrub planting, spreading woody material, tree felling/bending and installing fences as restoration techniques to be considered for boreal caribou habitat restoration in BC. Until further information for habitat restoration in northern and mountain caribou ecotypes has been collected through monitoring of implemented restoration programs, much of the information available for caribou habitat restoration comes from restoration initiatives in boreal caribou ranges of Alberta.

Provincial guidance for restoration of wetlands was reviewed, because treed wetland habitat types occur along much of the Kahta Section in caribou range. These habitat types are known to naturally have very slow rates of vegetation establishment and growth, making tree seedling establishment and growth in the short- to medium term unpredictable. There is currently no overarching provincial policy for wetlands or wetland restoration in BC, although the *Forest Practices Code* protects wetlands on Crown land and the Ministry of Transportation has a no net loss of wetland policy (Wetland Stewardship Partnership 2010). While wetland restoration is a primary focus of the *Wetlands Action Plan*, no guidelines or recommendations are provided for restoration (Wetland Stewardship Partnership 2010).

8.6 VEGETATION REESTABLISHMENT

Restoration of disturbed habitat has become one of the key components for caribou conservation. This section summarizes information from habitat restoration guidelines, previous caribou habitat restoration initiatives and published research. Information on restoration methods employed and effectiveness or success of restoration is included.

8.6.1 Tree Planting and Natural Regeneration

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 site preparation to create microsite conditions (i.e., silvicultural methods) that are conducive to both planted seedling growth and natural vegetation encroachment (CRRP 2007b; COSIA 2012). Measures such as rollback can address site condition issues, including competition from non-target or undesired plant species, erosion, frost, and heat or moisture deficiencies (CRRP 2007b).

These methods are consistent with the approach adopted by NGTL in previous CHRPs, and in the recommended measures summarized in the *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia* (Golder 2015).

Natural revegetation and successful planting initiatives benefit from construction practices that minimize disturbance during development of the footprint. Minimum disturbance pipeline construction techniques that avoid grubbing and grading are effective at facilitating rapid regeneration of native vegetation within the ROW, in areas with a deciduous vegetation component (TERA 2011a,b, 2012). Implementation of minimum disturbance construction can be limited by such factors as terrain that requires grading, ground conditions (e.g., non-frozen soils) and construction methods (e.g., crossings of third-party dispositions).

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 (CRRP 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 [DES] 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 (COSIA 2012). It might also provide important habitat benefits for wildlife, compared with only planting tree seedlings, by providing hiding cover (Bayne et al. 2011).

Conventional 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 can 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 was 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., ATVs, animal browsing, repeated exploration) on seismic lines (Revel et al. 1984; MacFarlane 1999, 2003; Sherrington 2003; Lee and Boutin 2006).

Since tree regeneration on seismic lines is a key determinant of recovery success (MacFarlane 2003), factors that hinder revegetation efforts should be mitigated. Drawing parallels between regeneration success on seismic lines and pipeline ROWs should be done with caution.

Restoration success on seismic lines might not be comparable to that of pipeline ROWs given differences in disturbance mechanisms, degree of soil and vegetation disturbance, reclamation practices and width of the features (i.e., the wider openings of ROWs allow more light and insolation than narrow seismic lines, which might facilitate better vegetation regrowth).

At the 15th North American Caribou Conference (2014), positive scientific evidence was presented on winter tree planting and mechanically bending live trees into the ROW as emerging mitigation options for seismic lines in the oil sands region of Alberta. Tree bending could be particularly promising as it promotes natural revegetation by increasing cone deposition on the disturbance footprint and creating microsites through shading and dropped dead woody debris. These mitigation measures, however, have only initially been evaluated and their full utility remains unknown. Furthermore, these techniques were applied only on seismic lines, which are considerably narrower than pipeline ROWs and do not require continued operational activities, as do pipelines.

8.6.2 Transplanting and Seeding

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 2012a):

- 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), which can reduce their viability
- other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison

An alternative to salvage and transplanting vegetation is to seed disturbed areas using seed collected from the same geographic region as the restoration project. Broadcasting seed either aerially or using ground methods (by hand or mechanically) is also an option. However, since pipeline ROWs are relatively narrow openings (compared with cutblocks, for example), sufficient natural seed ingress from the adjacent undisturbed habitat can facilitate natural recovery without additional seed application. Logistically, the feasibility of seeding can be constrained where the reclamation project is a substantial distance from an airport or airfield (i.e., for aerial seeding), or where ground access during non-frozen conditions is restricted by wet soils. Furthermore, direct seeding of conifers is not a preferred reforestation technique, partly due to problems with seed predation (BC MOF 1997).

Transplanting or seeding lichen species has many of the same challenges as transplanting or seeding vascular plants. In addition, conditions required for successful establishment of terrestrial lichens may be limited along pipeline ROWs (e.g., adequate amounts of shade) or are not compatible with other habitat restoration measures or access management measures (e.g., presence of woody debris) (Gough 2010; Miege et al. 2001). The costs associated with lichen collection might be prohibitive (Roturier et al. 2007). Few studies have determined the effectiveness of lichen transplantation or seeding, and these have focused on regenerating cutblocks (Gough 2010; Roturier et al. 2007). Further studies are required before applying this method on a larger scale (Roturier et al. 2007).

8.7 EFFECTS OF HUMAN USE ON RESTORATION

The ability of linear features to recover to a natural forested state is affected considerably by human use. 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 such as re-clearing to ground level for winter access or seismic program use (Golder 2009). The average age of trees on linear disturbances that were repeatedly disturbed was only 10 years, and the trees achieved an average height of less than or equal to 0.5 m. These results suggest that 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, 2012b). The effect of repeated motorized access on vegetation establishment and regrowth supports the use of access management tools to enhance restoration success.

Subjective expert ratings suggest that the effectiveness of most physical access management measures (e.g., berms, excavations, rollback, visual screening) varies considerably between negligible and high effectiveness in managing human access (Golder 2007). Effectiveness of access management measures depends on suitable placement (e.g., placed to prevent detouring around an access management point), enforcement, and public education of the intent of the access management (AXYS Environmental Consulting Ltd. [AXYS] 1995). Public education (e.g., signs) facilitates respect for the purpose of, and compliance with, access management measures.

Mounding has been found to deter human access (i.e., truck and ATV) during snow-free periods and also creates microsites that improve vegetation establishment (review in Golder 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 management and/or microsite creation purposes can vary from 1,400 to 2,000 mounds/ha (Golder 2012a, 2015).

These mound densities, however, relate to restoring seismic lines that were not frozen-in to allow heavy equipment access. Given the challenges of the wet conditions and frost requirements for accessing the Project footprint (i.e., freezing-in the peat for access can make it difficult to excavate small mounds), the size of mounds potentially could be substantially larger than mounds achieved on previous seismic line restoration projects. Furthermore, mounds cannot be excavated within 5 m of the operating pipeline, which reduces the mound density relative to disturbances that do not have similar restrictions. As a result, the mound density that can realistically be achieved in pipeline ROWs is lower.

Human access on open and closed (i.e., gated, barriered and recontoured) roads was monitored using remote cameras (Switalski and Nelson 2011). That study 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. The monitoring results 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). A similar study investigated the effectiveness of different approaches (i.e., year-round closure, seasonal closure, deactivation, and deactivation and closure) at limiting motorized vehicle traffic on unpaved roads designed to support forestry operations (i.e., resource roads) (Hunt and Hupf 2014). Results demonstrated that closure and/or deactivation approaches significantly reduced traffic on resource roads (about 78%), with year-round closure being the least effective, whereas seasonal (i.e., hunting) closure was among the most effective approaches (Hunt and Hupf 2014). The effectiveness of different approaches did not depend on road quality (Hunt and Hupf 2014). Physical access management 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, they no longer facilitate ATV access (Sherrington 2003).

The techniques described above to block human access also contribute to achieving sufficient revegetation to block line–of–sight. Short term management for access and line-of-sight blocking should ultimately lead to long-term access management by way of revegetation of disturbed areas (Golder 2007). Expediting growth of visual barriers along linear features can be achieved by concentrating restoration efforts on productive upland habitats, as woody vegetation species grow more quickly on these sites compared with lowland sites. Although regeneration of conifer species provides the best year-round visual barrier, their growth can be slow. Using combined plantings of conifer and fast-growing deciduous woody species in small areas (e.g., narrow strips of plantings across the ROW) can establish visual barriers in the short- to medium term, while maintaining the objective of regenerating conifer-leading vegetation in the long term.

Coarse woody material (rollback) can be effective at managing human access as well as at conserving soil moisture, moderating soil temperatures, providing nutrients as debris decomposes, limiting soil erosion, providing microsites for seed germination and protection for introduced tree seedlings (Pyper and Vinge 2012; Vinge and Pyper 2012).

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 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 60 to 100 m^3/ha on upland sites and 25 to 50 m^3/ha on lowland sites, to mimic natural processes (Pyper and Vinge 2012; Vinge and Pyper 2012). Where sufficient material is available, woody debris coverage of 150 to 200 m^3/ha along ROWs might be used to manage human and wildlife access (Vinge and Pyper 2012).

Storage and placement of woody debris needs to consider the presence of ladder fuels to reduce fire hazard (Pyper and Vinge 2012). Fire risk can be managed by implementing a 25 m fuel break every 250 m along linear features (Pyper and Vinge 2012). Short segments (i.e., <100 m) of rollback might be less effective at deterring human access since ATV and snowmobile riders might try to ride through the debris or traverse around it in adjacent forest stands (Vinge and Pyper 2012). Complete rollback (i.e., over an entire linear disturbance) could be used to prevent motorized access (Pyper and Vinge 2012) but availability of material is a limiting factor.

8.8 WILDLIFE USE OF REGENERATING LINEAR DISTURBANCE

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 in the Little Smoky caribou range measured 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 naturally revegetated seismic lines (i.e., minimum 1.5 m vegetation regrowth) were preferred by both predator and prey species compared with control lines (disturbed sites, cleared areas with minimal vertical cover of vegetation and vegetation regrowth of 0.5 m or less). The study also found that the control (disturbed) lines with minimal vegetation were used primarily for travel (i.e., both predators and prey species were constantly moving as opposed to standing or foraging). In addition, human use was almost exclusive to the control lines. The line-of-sight measured on the revegetating lines was typically less than 50 m long.

Moose and deer might have been attracted to the revegetated lines for forage availability and perceived cover protection (Golder 2009). The preference for regenerating seismic lines by wolves can 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.

Further to this, a study of displacement of Hart Range mountain caribou in east-central BC by snowmobiles reported that caribou were observed in all four mountain blocks (110 to 214 km^2/block) of core winter range delineated for census with little or no snowmobile activity. However, during three of four census years, no caribou were observed in the only mountain block surveyed that had intensive snowmobile activity (Seip et al. 2007).

Another ongoing project in northern Alberta involving the Cold Lake boreal caribou herd is currently investigating the responses of predator and prey species to the deactivation or restoration of habitat disturbance features (McNay et al. 2014). The goal of the project is to determine how different species (wolves, bears, moose and caribou) use the landscape, and how the presence or absence of linear disturbances can influence the functional and numerical response of predators (McNay et al. 2014).

The project is still in its early stages, but preliminary results suggest among all species that seasonal and annual movements are variable with substantial overlap between the range extents of all four species. Also, in these range overlaps, were 19 instances where predator and prey could have encountered one another. Furthermore, preliminary results present 11 deaths of 94 collared animals: 2 caribou, 3 moose, 1 bear and 5 wolves. Predator kill sites were identified: 143 bear sites and 93 wolf sites. These kill sites were implicated in the deaths of 11 caribou, 22 moose and 6 deer. Ongoing data collection and processing will provide future results from scat analysis, prey body condition, habitat modelling and mapping. The project aims to address several management questions regarding the desired vegetative and spatial characteristics on the landscape to reduce caribou mortality, how silvicultural techniques and mitigation measures can be implemented to achieve these characteristics, the association between specific characteristics and predator efficiency and/or density, and when deactivated linear features can be considered to have lost their disturbance function (McNay et al. 2014). This project is associated with the RICC initiative.

Mechanically bending or felling live trees over a linear disturbance (often referred to as line-blocking, particularly when used in conjunction with other treatments such as mounding) is another potential measure that could have benefits for managing access and reducing wolf use. Trees are typically bent or felled from both sides of the linear disturbance. Tree felling entails cutting trees at the base from the edge of the linear disturbance, and allowing them to fall across the linear disturbance.

Tree bending requires mechanically bending trees from the base of the tree, partially exposing roots, so that the tree leans over the linear feature, close to the ground. Tree bending can be expensive and the process is time consuming. A preliminary assessment of tree felling along seismic lines to block access was conducted in the Little Smoky herd range in Alberta during the summer and fall of 2004 (Neufeld 2006). While results of that study showed no statistical significance between wolf use of blocked versus non-blocked seismic lines, there was an indication that wolves tended to use areas with unblocked seismic lines more often than areas with blocked seismic lines). Based on these results, it was concluded that if tree felling is to be used as a line-blocking measure, it should be investigated more thoroughly, and not relied on solely as a mitigation tool. Preferably, line-blocking should be used in combination with other management actions such as habitat restoration, and continue to be evaluated for effectiveness using an adaptive management approach.

From the 15th North American Caribou Conference (2014) some very preliminary results of linear feature blocking programs suggest that this type of mitigation can be effective at reducing wildlife use of linear features.

8.9 KNOWLEDGE GAPS AND LIMITATIONS OF THE LITERATURE REVIEW

The following gaps in knowledge were identified during the literature review:

- scarcity of information on effective habitat restoration measures applicable to mountain caribou habitat
- restoration criteria (e.g., defined guidelines or measurable objectives) for restoration of mountain ecosystems for wildlife habitat values, in particular habitats that do not support merchantable timber (e.g., treed bogs and fens)
- functional responses of caribou, wolves and primary prey (e.g., moose, deer) to reclaimed habitats in various stages of successional progression, as well as to access and line of sight management
- long-term monitoring of vegetation recovery on linear disturbances and of predator response to access management measures

There is limited information available on the types and efficacy of habitat restoration techniques in mountain caribou ranges. This is compounded by the issue that results and documentation of recently initiated restoration projects are often unpublished, and proprietary information is difficult to obtain. Available information for restoration techniques in mountain caribou ranges is mostly limited to reclamation and revegetation of drastically disturbed industrial sites, in particular mines, or reforestation of commercially harvested stands.

The techniques used for these large polygonal disturbance types might not translate directly to restoration of linear developments (i.e., some modification is needed to address the different site conditions and objectives). Recommendations in the available literature specific to northern and mountain caribou ranges in BC typically include protection of high-elevation habitats and seasonal movement habitats necessary to maintain connectivity (Backmeyer 2000; Culling et al. 2005; Hatler 1986).

Results of the literature review provide habitat restoration information specific to mountain caribou ranges, where it is available. However, given the limited availability of literature specific to mountain caribou ranges, relevant literature from research and restoration initiatives in boreal woodland caribou range is included. As previously noted, this is supplemented by a table of historic and current restoration initiatives in caribou ranges that was considered as context to develop this Preliminary CHRP.

Despite differences in habitat use and forage selection between mountain and boreal woodland caribou, components of mitigation and restoration planning applied in boreal ranges is transferrable, particularly in low-elevation range and where boreal and mountain caribou have similar ecologies (e.g., fire regime, climate and biophysical attributes). This provides useful background information on restoration initiatives in caribou range and their reported successes and failures.

9.0 REFERENCES

9.1 CONTENT REFERENCES

Alberta West Central Standing Committee. 1996. 1996/97 *Operating Guidelines for Industrial Activity in Caribou Ranges in West Central Alberta*. 12 pp.

Apps, C.D., B.N. McLellan, T.A. Kinley, R. Serrouya, D.R. Seip and H.U. Wittmer. 2013. Spatial factors related to mortality and population decline of endangered mountain caribou. *The Journal of Wildlife Management* 77(7):1409–1419.

Athabasca Landscape Team. 2009. *Athabasca Caribou Landscape Management Options Report*. Athabasca Landscape Team. May 2009. 99 pp.

AXYS Environmental Consulting Ltd. (AXYS). 1995. *A Compendium of Physical Access Control Measures for Roads and Other Rights-of-Way*. March 1995. A Component of the Access Management Initiative in Northeastern BC. 46 pp.

AXYS. 2003. *Literature Review of Reclamation Techniques for Wildlife Habitats in the Boreal Forest*. Prepared for: Biodiversity and Wildlife Subgroup of the Reclamation Working Group, Cumulative Effects Management Association. Prepared by AXYS Environmental. Sidney, BC.

Backmeyer, R. J. 2000. *Seasonal Habitat Use and Movements of Woodland Caribou in the Graham River Drainage, 1988–1994*. Prince George, BC.

Bayne, E.M., H. Lankau and J. Tigner. 2011. *Ecologically Based Criteria to Assess the Impact and Recovery of Seismic Lines: The Importance of Width, Regeneration, and Seismic Line Density*. Edmonton, AB.

British Columbia Conservation Data Centre. 2015. *BC Species and Ecosystems Explorer. Ministry of Environment*. Website: http://a100.gov.bc.ca/pub/eswp/. Accessed: March 2015.

British Columbia Ministry of Environment (BMOE). 2010. *Caribou Distribution in British Columbia by Ecotype*. Website: http://www.env.gov.bc.ca/wld/speciesconservation/caribou_by_ecotype.html. Accessed: March 2015.

BMOE. 2013. *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (Rangifer tarandus caribou *pop. 15*) *in British Columbia*. Victoria, BC. 15 pp.

BMOE. 2014. *Science update for the South Peace Northern Caribou (*Rangifer tarandus caribou *pop. 15) in British Columbia*. Victoria, BC. 43 pp.

British Columbia Ministry of Forests. 1997. *Soil Rehabilitation Guidebook*. Forest Practices Branch, BC Ministry of Forests, Victoria, BC Forest Practices Code of British Columbia Guidebook.

British Columbia Ministry of Forests. 2000. *Establishment to Free Growing Guidebook*. Prince George Forest Region. BC Forest Practices Code of British Columbia Guidebook. Victoria, BC. 162 pp.

British Columbia Ministry of Forests, Lands and Natural Resource Operations. 2011. *Peace Region Selected Terrestrial and Aquatic Wildlife Least-Risk Windows – April, 2011*. Fort St. John, BC. 1 pp.

British Columbia Ministry of Forests, Lands and Natural Resource Operations. 2014. *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia*. Interim Guidance. 206 pp.

British Columbia Ministry of Water, Land and Air Protection. n.d. *Ecological Restoration Guidelines for British Columbia*. Victoria, BC. 80 pp.

British Columbia Oil and Gas Commission. 2013. 2013. *Environmental Protection and Management Guide: June 2013*. 96 pp.

Bergerud, A.T., R.D. Jakimchuk and D.R. Carruthers. 1984. The buffalo of the north: Caribou (*Rangifer tarandus*) and human developments. *Arctic* 37(1):7–22.

Bijlsma, R., J. Bundgaard and A.C. Boerema. 2000. Does inbreeding affect the extinction risk of small populations? Predictions from Drosophila. *Journal of Evolutionary Biology* 13(3):502–514.

Camill, P. 1999. Patterns of boreal permafrost peatland vegetation across environmental gradients sensitive to climate warming. *Canadian Journal of Botany* 77:721–733.

Canada's Oil Sands Innovation Alliance (COSIA). 2012. *COSIA*. Website: http://www.cosia.ca/. Accessed: March 2015.

Canadian Standards Association. 2011. *Z662-11 Oil and Gas Pipeline Systems*. Reprinted January 2012. 555 pp.

Caribou Range Restoration Project. 2007a. *Permanent Sample Plot Manual for the Caribou Range Restoration Project in Alberta, March 23, 2007*. Draft Unpublished Document.

Caribou Range Restoration Project. 2007b. *Caribou Range Restoration Project: Guidelines for Planning and Implementation*. Unpublished document for the West–Central Alberta Petroleum Producers Group, Canadian Association of Petroleum Producers and Environment Canada. September 19, 2007.

Caribou Range Restoration Project. 2007c. *Little Smoky Caribou Habitat Restoration Pilot Project Summary*. Unpublished document prepared for Suncor Energy, ConocoPhillips Canada, Canadian Forest Products and Alberta Newsprint Co.

CH2M Hill Energy Canada, Ltd. (CH2M Hill). 2014a. *(April) Supplemental Traditional Knowledge Report for the Proposed NOVA Gas Transmission Ltd. North Montney Project*. Prepared for NOVA Gas Transmission Ltd.

CH2M Hill. 2014b. *(July) Supplemental Traditional Knowledge Report for the Proposed NOVA Gas Transmission Ltd. North Montney Project*. Prepared for NOVA Gas Transmission Ltd.

CH2M Hill. 2014c. *(October) Supplemental Traditional Knowledge Report for the Proposed NOVA Gas Transmission Ltd. North Montney Project*. Prepared for NOVA Gas Transmission Ltd.

Cichowski, D. 2005. *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia*. Prepared for BC Ministry of Water, Lands and Air Protection. Smithers, BC.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002. *COSEWIC Assessment and Update Status Report on the Woodland Caribou* Rangifer tarandus caribou in Canada. Ottawa, ON. xi + 98 pp.

COSEWIC. 2011. *Designatable Units for Caribou (*Rangifer tarandus*) in Canada*. Ottawa, ON. 88 pp.

COSEWIC. 2015. *Canadian Species at Risk*. Website: http://www.cosewic.gc.ca/eng/sct5/index_e.cfm. Accessed: March 2015.

Courtin, P.J. and K.R. Brown. 2001. The use of red alder to enhance Sitka spruce growth in the Queen Charlotte Islands. *Forest Research Extension Notes* EN-008:1–4.

Culling, D.E., B.A. Culling and T. Raabis. 2005. *Seasonal Habitat Use and Movements of Graham Caribou 2001 to 2003*. Canadian Forest Products Ltd. and BC Ministry of Water, Land and Air Protection. St. John, BC. 88 pp.

DeCesare, N.J., M. Hebblewhite, F. Schmiegelow, D. Hervieux, G.J. McDermid, L. Neufeld, M. Bradley, J. Whittington, K.G. Smith, L.E. Morgantini, M. Wheatley and M. Musiani. 2012. Transcending scale dependence in identifying habitat with resource selection functions. *Ecological Applications* 22(4):1068–1083.

DeLong, C. 2004. *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*. Land Management Handbook No. 54. BC Ministry of Forests, Resources Branch. Victoria, BC.

DeLong, C., A. Banner, W.H. MacKenzie, B.J. Rogers and B. Kaytor. 2011. *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia*. Land Management Handbook No. 65. BC Ministry of Forests and Range, Forest Science Program. Victoria, BC. 250 pp.

DeLong, C., A. MacKinnon and L. Jang. 1990. *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region*. Land Management Handbook No. 22. BC Ministry of Forests, Research Branch. Victoria, BC. 51 pp.

Demarchi, D.A. 2011. *The British Columbia Ecoregion Classification*. Third Edition March 2011. BC Ministry of Environment, Ecosystem Information Section, Victoria, BC. Website: http://www.env.gov.bc.ca/ecology/ecoregions/#top. Accessed: March 2015.

Diversified Environmental Services. 2004. *Canadian Natural Resources Ltd. Ladyfern Pipeline d-87-H/94-H-1, British Columbia to NE Section 20-Township 94-Range 12 W6M, Alberta: Revegetation Monitoring Report Year 2 (2003)*. Prepared for Canadian Natural Resources Ltd. 18 pp.

Dyer, S. J. 1999. *Movement and Distribution of Woodland Caribou (*Rangifer tarandus caribou*) in Response to Industrial Development in Northeastern Alberta*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

Dyer, S. J., J. P. O'Neill, S. M. Wasel and S. Boutin. 2001. Avoidance of industrial development by woodland caribou. *Journal of Wildlife Management* 65(3):531–542.

Dyer, S.J., J.P. O'Neill, S.M. Wasel and S. Boutin. 2002. Quantifying barrier effects of roads and seismic lines on movements of female woodland caribou in northeastern Alberta. *Canadian Journal of Zoology* 80(5):839–845.

Edmonds, E.J and M. Bloomfield. 1984. *A Study of Woodland Caribou (*Rangifer tarandus caribou*) in West–Central Alberta, 1979 to 1983*. Alberta Energy and Natural Resources, Fish and Wildlife Division. Edmonton, AB.

Ehlers, L.P.W., C.J. Johnson and D.R. Seip. 2014. Movement ecology of wolves across an industrial landscape supporting threatened populations of woodland caribou. *Landscape Ecology* 29(3):451–465.

Enbridge Pipelines (Athabasca) Inc. 2010. *Waupisoo Pipeline Project: 2010 Green Area Post-Construction Reclamation Assessment*. Submitted to Alberta Sustainable Resource Development.

Environment Canada. 2011. *Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada: 2011 Update*. Ottawa, ON. 103 pp.

Environment Canada. 2012a. *Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada*. *Species at Risk Act* Management Plan Series. Ottawa, ON. vii + 79 pp.

Environment Canada. 2012b. *Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada*. *Species at Risk Act* Recovery Strategy Series. Ottawa, ON. xi + 138 pp.

Environment Canada. 2014. *Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada*. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. viii + 103 pp.

Environment Canada. 2015. *Species at Risk Public Registry*. Website: http://www.sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1. Accessed: March 2015.

Esri User Conference. 1996. *1996 User Conference Proceedings: Esri User Conference*. Website: http://proceedings.esri.com/library/userconf/proc96/WELCOME.HTM. Accessed: March 2015.

Frankham, R. 2005. Genetics and extinction. *Biological Conservation* 126(2):131–140.

Girard, M., C. Lavoie and M. Thériault. 2002. The regeneration of a highly disturbed ecosystem: A mined peatland in southern Québec. *Ecosystems* 5(3):274–288.

Golder Associates Ltd. (Golder). 2005. *Firebag Project 2004 Seismic Line Reclamation Study Annual Report*. Submitted to: Suncor Firebag Inc.

Golder. 2007. *Audit of Operating Practices and Mitigation Measures Employed Within Woodland Caribou Ranges*. Submitted to Caribou Landscape Management Association. Peace River, AB.

Golder. 2009. *Caribou Habitat Restoration Pilot Study*. Prepared for Conoco Phillips Canada, Suncor Energy and Canadian Association of Petroleum Producers. Edmonton, AB. 61 pp.

Golder. 2010. *Canadian Natural Resources Limited: Primrose and Wolf Lake: Wildlife Habitat Enhancement Program Development and Implementation*. Submitted to: Canadian Natural Resources Ltd, Calgary, AB.

Golder. 2011. *Waupisoo Pipeline 2011 Seedling Monitoring Plot Summary*. Submitted to Enbridge Pipelines (Athabasca) Inc.

Golder. 2012a. *Boreal Caribou Habitat Restoration*. Prepared for: Ministry of Forests, Lands and Natural Resource Operations. Fish Wildlife and Habitat Management Branch, Government of British Columbia. Prince George, BC. 24 pp.

Golder. 2012b. *Interconnect Pipeline 2011 Seedling Monitoring Plot Summary*. Memo submitted to CNRL February 23, 2012.

Golder. 2014. *Final Caribou Habitat Restoration Plan for the NOVA Gas Transmission Ltd. Leismer to Kettle River Crossover Project*. Prepared for NOVA Gas Transmission Ltd.

Golder. 2015. *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia*. Prepared for BC Science and Community Environmental Knowledge (SCEK) Fund's Research and Effectiveness Monitoring Board (REMB). Calgary, AB.

Gough, A. 2010. *Effects of Historical Timber Harvesting Practices on Caribou Forage Lichen Abundance near Marsh Lake, Yukon: Phase 1 Final Report*. Department of Energy, Mines and Resources, Government of Yukon. 55 pp.

Government of British Columbia. 2011. *Interim Operating Practices for Oil and Gas Activities in Identified Boreal Caribou Habitat in British Columbia*.

Hatler, D.F. 1986. *Studies of Radio-Collared Caribou in the Spatsizi Wilderness Park Area, British Columbia*. Spatsizi Association for Biological Research. Smithers, BC. 102 pp.

Hawkes, V.C. 2011. *Early Successional Wildlife Monitoring On Reclamation Plots in the Athabasca Oil Sands Region*. British Columbia Mine Reclamation Symposium.

Heard, D.C., and K.L. Vagt. 1998. Caribou in British Columbia: A 1996 status report. *Rangifer Special Issue* 10:117–123.

Hedrick, P.W. and S.T. Kalinowski. 2000. Inbreeding depression in conservation biology. *Annual Review of Ecology and Systematics* 31:139–162.

Hervieux, D., M. Hebblewhite, N.J. DeCesare, M. Russell, K. Smith, S. Robertson and S. Boutin. 2013. Widespread declines in woodland caribou (*Rangifer tarandus caribou*) continue in Alberta. *Canadian Journal of Zoology* 91(12):872–882.

Hunt, L.M. and M. Hupf. 2014. The effectiveness of road closures and deactivations at reducing traffic: A case of resource roads used for recreational activities in Ontario, Canada. *The Forestry Chronicle* 90(5):670–677.

James, A.R.C. 1999. *Effects of Industrial Development On the Predator–Prey Relationship Between Wolves and Caribou in Northeastern Alberta*. Ph.D. Dissertation, University of Alberta. Edmonton, AB.

James, A.R.C. and A.K. Stuart-Smith. 2000. Distribution of caribou and wolves in relation to linear corridors. *The Journal of Wildlife Management* 64(1):154-159.

James, A.R.C., S. Boutin, D.M. Hebert and A.B. Rippin. 2004. Spatial separation of caribou from moose and its relation to predation by wolves. *The Journal of Wildlife Management* 68(4):799–809.

Joint Pipeline Office. 1999. *Evaluation of the Alaska Pipeline Service Company's Operation of the Trans-Alaska Pipeline System*. Comprehensive Monitoring Program Report February 1999. 41 pp.

Keller, L.F. and D.M. Waller. 2002. Inbreeding effects in wild populations. *Trends in Ecology and Evolution* 17(5):230–241.

Khasa, P.D., L. Sigler, P. Chakravarty, B.P. Dancik, L. Erikson and D. McCurdy. 2001. Effect of fertilization on growth and ectomycorrhizal development of container-grown and bare-root nursery conifer seedlings. *New Forests* 22(3):179–197.

Latham, A.D.M. 2009. *Wolf Ecology and Caribou–Primary Prey–Wolf Spatial Relationships in Low-Productivity Peatland Complexes in Northeastern Alberta*. Ph.D. Dissertation, University of Alberta. Edmonton, AB.

Latham, A.D.M., M.C. Latham, N.A. McCutchen and S. Boutin. 2011. Invading white-tailed deer change wolf-caribou dynamics in northeastern Alberta. *Journal of Wildlife Management* 75(1):204–212.

Lee, P. and S. Boutin. 2006. Persistence and developmental transition of wide seismic lines in the western Boreal Plains of Canada. *Journal of Environmental Management* 78:240–250.

Macadam, A. and L. Bedford. 1998. Mounding in the Sub-Boreal Spruce Zone of west–central British Columbia: 8-year results. *The Forestry Chronicle* 74(3):421–427.

MacDonald, E., S. Quideau and S. Landhäusser. 2012. Rebuilding boreal forest ecosystems after industrial disturbance. 123–159 in *Restoration and Reclamation of Boreal Ecosystems*. D.H. Vitt and J.S. Bhatti, (eds.). Cambridge University Press, Cambridge, UK.

MacFarlane, A. 1999. *Revegetation of Wellsites and Seismic Lines in the Boreal Forest*. B.Sc. Honour’s Thesis, University of Alberta. Edmonton, AB.

MacFarlane, A.K. 2003. *Vegetation Response to Seismic Lines: Edge Effects and Online Succession*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

MacIsaac, D.A., G.R. Hillman and P.A. Hurdle. 2004. *Alternative Silvicultural Systems for Harvesting and Regenerating Spruce-Dominated Boreal Mineral Wetlands*. Information Report Nor-X-399. Canadian Forest Service, Northern Forestry Centre. Edmonton, AB. 60 pp.

McCutchen, N. A. 2007. *Factors Affecting Caribou Survival in Northern Alberta: The role of Wolves, Moose and Linear Features*. Ph.D. Dissertation, University of Alberta. Edmonton, AB.

McKay, T., K. Graham and G. Stenhouse. 2014. *Grizzly Bears and Pipelines: Response to Unique Linear Features*. Year 2 (2013) Final Report. Alberta Upstream Petroleum Research Fund (13-AU-ERPC-03). Foothills Research Institute Grizzly Bear Program. Hinton, AB.

McKenzie, H.W., E.H. Merrill, R.J. Spiteri and M.A. Lewis. 2012. How linear features alter predator movement and the functional response. *Interface Focus* 2(2):205–216.

McLoughlin, P.D., E. Dzus, B. Wynes and S. Boutin. 2003. Declines in populations of woodland caribou. *The Journal of Wildlife Management* 67(4):755–761.

McNay, R.S., D. Cichowski, and B.R. Muir. 2013. *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]*. *Species at Risk Act* Action Plan Series, West Moberly First Nation. Moberly Lake, BC. 28 pp.

McNay, R.S., G. Sutherland, L. Giguere, J. Gollner, K. Sittler, F. MacDonald and V. Brumovsky. 2014. *Multi-Scale Responses by Predators and Prey to Deactivation/Restoration of Disturbance Features – Individual and Population Components*. Interim Report 2013-2014. Wildlife Infometrics Report 470. Wildlife Infometrics Inc. Mackenzie, BC.

Miège, D.J., H.M. Armleder, M.J. Waterhouse and T. Goward. 2001. *A Pilot Study of Silvicultural Systems for Northern Caribou Winter Range: Lichen Response*. Working Paper 56/2001. BC Ministry of Forests, Research Branch. Victoria, BC. 22 pp.

Naeth, M.A., D.J. White, D.S. Chanasyk, T.M. Macyk, C.B. Powter and D.J. Thacker. 1991. *Soil Physical Properties in Reclamation*. Alberta Land Conservation and Reclamation Council Report No. RRTAC 91-4. Edmonton, AB.

Neufeld, L.M. 2006. *Spatial Dynamics of Wolves and Woodland Caribou in an Industrial Forest Landscape in West–Central Alberta*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

North American Caribou Workshop. 2014. *Caribou Conservation and Management: What's Working?* Website: http://www.2014nacw.ca/Portals/10/NACWprogramfinal_web.pdf. Accessed: March 2015.

Nova Gas Transmission Ltd. 2014a. *Additional Written Evidence for the North Montney Project*. Prepared for the National Energy Board. Calgary, AB.

Nova Gas Transmission Ltd. 2014b. *North Montney Project Response to Information Request No. 2*. Hearing Order GH-001-2014. March 25, 2014.

Oberg, P.R. 2001. *Responses of Mountain Caribou to Linear Features in a West–Central Alberta Landscape*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

Osko, T.J. and A.K. MacFarlane. 2000. *Natural Reforestation Rates on Seismic Lines and Wellsites in Comparison to Natural Burns or Logged Sites*. Alberta–Pacific Forest Industries. Boyle, Alberta.

Osko, T. and M. Glasgow. 2010. *Removing the Well Site Footprint: Recommended Practices for Construction and Reclamation of Well Sites on Upland Forests in Boreal Alberta*. Department of Biological Sciences, University of Alberta. Edmonton, AB. 61 pp.

Peters, W., M. Hebblewhite, N. DeCesare, F. Cagnacci and M. Musiani. 2013. Resource separation analysis with moose indicates threats to caribou in human altered landscapes. *Ecography* 34(4):487–498.

Polfus, J.L., M. Hebblewhite and K. Heinemeyer. 2011. Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain woodland caribou. *Biological Conservation* 144(11):2637–2646.

Polster, D.F. n.d. *Natural Processes: Restoration of Drastically Disturbed Sites*. 123 pp.

Polster, D.F. 2002. Soil bioengineering techniques for riparian restoration. 230-239 in *Proceedings of the 26th Annual British Columbia Mine Reclamation Symposium*. Dawson Creek, BC.

Pyper, M. and T. Vinge, 2012. *A Visual Guide to Handling Woody Materials for Forested Land Reclamation*. Report No. TR-31. University of Alberta, School of Energy and the Environment, Oil Sands Research and Information Network. Edmonton, AB. 10 pp.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. *Canadian Journal of Zoology* 76:251–259.

Rettie, W.J. and F. Messier. 2000. Hierarchical habitat selection by woodland caribou: its relationship to limiting factors. *Ecography* 23:466–478.

Revel, R.D., T.D. Dougherty and D.J. Downing. 1984. *Forest Growth and Revegetation Along Seismic Lines*. University of Calgary Press, Calgary, AB. 228 pp.

Ripple, W.J. and R.L. Beschta. 2004. Wolves and the ecology of fear: Can predation risk structure ecosystems? *BioScience* 54(8):755–766.

Ripple, W.J., J.A. Estes, R.L. Beschta, C.C. Wilmers, E.G. Ritchie, M. Hebblewhite, J. Berger, B. Elmhagen, M. Letnic, M.P. Nelson, O.J. Schmitz, D.W. Smith, A.D. Wallach and A.J. Wirsing. 2014. Status and ecological effects of the world's largest carnivores. *Science* 343(6167):1241484.

Robinson, S.D. and T.R. Moore. 2000. The influence of permafrost and fire upon carbon accumulation in high boreal peatlands, Northwest Territories, Canada. *Arctic, Antarctic and Alpine Research* 32:155–166.

Rohner, C. and G. Kuzyk. 2000. *Wolves and Caribou in West–Central Alberta: Predator Responses to Industrial Resource Development*. Research News 3, University of Alberta and West–Central Caribou Standing Committee. Edmonton, AB. 4 pp.

Roturier, S., S. Backlund, M. Sunden and U. Bersten. 2007. Influence of ground substrate on establishment of reindeer lichen after artificial dispersal. *Silva Fennica* 41(2):269–280.

Roy, V., P.-Y. Bernier, A.P. Plamondon and J.-C. Ruel. 1999. Effect of drainage and microtopography in forested wetlands on the microenvironment and growth of planted black spruce seedlings. *Canadian Journal of Forest Research* 29:563-574.

Sanborn, P., R. Brockley and C. Preston. 2001. *Effects of Sitka Alder Retention and Removal on the Growth of Young Lodgepole Pine in the Central Interior of British Columbia (EP 1185): Establishment Report*. Working Paper 60/2001. BC Ministry of Forests, Research Branch. Victoria, BC. 44 pp.

Schaefer, J.A. and W.O. Pruitt, Jr. 1991. Fire and woodland caribou in southeastern Manitoba. *Wildlife Monographs* 116:3–39.

Seip, D.R. and D.B. Cichowski. 1996. Population ecology of caribou in British Columbia. *Rangifer* 9:73-80.

Seip, D.R., C.J. Johnson and G.S. Watts. 2007. Displacement of mountain caribou from winter habitat by snowmobiles. *The Journal of Wildlife Management* 71(5):1539–1544.

Serrouya, R., D. Paetkau, B.N. McLellan, S. Boutin, M. Campbell and D.A. Jenkins. 2012. Population size and major valleys explain microsatellite variation better than taxonomic units for caribou in western Canada. *Molecular Ecology* 21(11):2588–2601.

Sherrington, P.M. 2003. *Measuring Boreal Forest Fragmentation Change in Response to Seismic Line, Wellsite and Road Revegetation With Scanned False-Colour Infrared Aerial Photography*. M.Sc. Thesis, University of Calgary. Calgary, AB.

Simard, S. and J. Heineman. 1996. *Nine-Year Response of Lodgepole Pine and the Dry Alder Complex to Chemical and Manual Release Treatments on an ICHmk1 Site Near Kelowna*. Forest Resource Development Agreement Report 259. Canadian Forest Service and BC Ministry of Forests. Victoria, BC. 19 pp.

Smith, S. and I. Marshall. 1995. *The Ecoregions of Canada*. Website: http://ecozones.ca/english/. Accessed: March 2015.

Spalding, D.J. 2000. *The Early History of Woodland Caribou (*Rangifer tarandus caribou*) in British Columbia*. Wildlife Bulletin No. B-100. BC Ministry of Environment, Lands and Parks. Victoria, BC. 61 pp.

Stantec Consulting Limited. 2013. *North Montney Project Environmental and Socio-Economic Assessment*. Prepared for Nova Gas Transmission Ltd., in association with TERA Environmental Consultants. Calgary, AB.

Stantec Consulting Limited. 2014. *Final Caribou Habitat Restoration Plan for the Chinchaga Lateral Loop No. 3 (Chinchaga Section)*. Prepared for NOVA Gas Transmission Ltd. Calgary, AB.

Stuart-Smith, A.K., C.J.A. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. *Journal of Wildlife Management* 61:622-633.

Sweeney, S. 2005. *Ontario Trees and Shrubs*. Website: http://www.ontariotrees.com/mondaygarden/index.php. Accessed: March 2015.

Switalski, T.A. and C.R. Nelson. 2011. Efficacy of road removal for restoring wildlife habitat: Black bear in the Northern Rocky Mountains, USA. *Biological Conservation* 144(11):2666–2673.

Tedder, W.S. and L.W. Turchenek. 1996. Natural revegetation of an Alberta peatland after horticultural peat extraction. 51–113 in *4th Annual Canadian Peatland Restoration Workshop, 13-14 July, Quebec City, Canada*. Universite Laval, Faculte des Sciences de Sciences de L'agriculture et de l'alimentation. Quebec City, QC.

TERA Environmental Consultants (TERA). 2011a. *Caribou Habitat Restoration Plan for the Proposed Nova Gas Transmission Ltd. Horn River Mainline Project, Part II*. Prepared for Nova Gas Transmission Ltd. Calgary, AB.

TERA. 2011b. 2011 *Post-Construction Monitoring Report for the Trans Mountain Pipeline L.P. TMX – Anchor Loop Project*. Prepared for Trans Mountain Pipeline L.P. Calgary, AB.

TERA. 2012. *Supplemental Update for the Caribou Habitat Restoration Plan for the Nova Gas Transmission Ltd. Horn River Mainline Project, Part II*. Calgary, AB.

TERA. 2013. *Traditional Knowledge Summary Report for the Proposed NOVA Gas Transmission Ltd. North Montney Mainline (Aitken Creek Section) Project*. Prepared for NOVA Gas Transmission Ltd.

TERA. 2014. *Final Caribou Habitat Restoration Plan for the NOVA Gas Transmission Ltd. Northwest Mainline Expansion*. Prepared for NOVA Gas Transmission Ltd.

Thurber, J.M., R.O. Peterson, T.D. Drummer and S.A. Thomasma. 1994. Gray wolf response to refuge boundaries and roads in Alaska. *Wildlife Society Bulletin* 22:61–68.

Turetsky, M.R., R.K. Wieder, C.J. Williams and D.H. Vitt. 2000. Organic matter accumulation, peat chemistry, and permafrost melting in peatlands in boreal Alberta. *Ecoscience* 7(3):379–392.

Turner, J., D. Stokes and S. Duncan. 2009. *An Adaptive Approach to Reclaiming the First Coal Corporation Central South Property*. British Columbia Mine Reclamation Symposium 2009.

Vinge, T. and M. Pyper. 2012. *Managing Woody Materials on Industrial Sites: Meeting Economic, Ecological and Forest Health Goals through a Collaborative Approach*. University of Alberta, Department of Renewable Resources. Edmonton, AB. 32 pp.

Westland Resource Group. 2011. TMX Anchor Loop Project: Wildlife and Wildlife Habitat Post Construction Monitoring Year 2 Report. Prepared for Kinder Morgan Canada. Calgary, AB.

West Moberly First Nations. 2014. Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia. Moberly Lake, BC. 23 pp.

Wetland Stewardship Partnership. 2010. *A Wetland Action Plan for British Columbia*. 62 pp.

Whittington, J., M. Hebblewhite, N.J. DeCesare, L. Neufeld, M. Bradley, J. Wilmshurst and M. Musiani. 2011. Caribou encounters with wolves increase near roads and trails: a time-to-event approach. *Journal of Applied Ecology* 48:1535–1542.

Wittmer, H.U., A.R.E. Sinclair and B.N. McLellan. 2005. The role of predation in the decline and extirpation of woodland caribou. *Oecologia* 144:257–267.

Zager, P. and J. Beecham. 2006. The role of American black bears and brown bears as predators on ungulates in North America. *Ursus* 17(2):95–108.

9.2 GIS DATA AND MAPPING REFERENCES

This subsection includes references cited in the figures accompanying this report.

BC Hydro. 2011. *Transmission Circuit* (digital file). Previously available: http://transmission.bchydro.com/transmission_system/maps/, no longer on website. Acquired: September 2011. Last Update Check: May 23, 2013.

BC Ministry of Environment. 2008. *Caribou Herd Locations for BC* (digital file). Victoria, BC. Available: https://apps.gov.bc.ca/pub/dwds/home.so. Acquired: July 2011. Last Update Check: November 7, 2014.

BC Ministry of Environment. 2010. *BC Ungulate Winter Range – Proposed – Peace Region* (digital file). Fort St. John, BC. Available: https://apps.gov.bc.ca/pub/dwds/home.so. Acquired: November 2013. Last Update Check: November 7, 2014.

BC Ministry of Forests, Lands and Natural Resource Operations. 2008. *Tantalis Parks, Ecological Reserves and Protected Areas* (digital file). Victoria, BC. Available: https://apps.gov.bc.ca/pub/dwds/home.so. Acquired: May 2014. Last Update Check: November 20, 2014.

Government of Canada. 2014. *Aboriginal Lands, Canada* (digital file). Edmonton, AB. Available: http://www.geobase.ca. Acquired: January 2015. Last Update Check: January 15, 2015.

IHS Inc. 2004. *IHS Hydro Line Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: June 2011. Last Update Check: April 21, 2014.

IHS Inc. 2004. *IHS Hydro Region Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: June 2011. Last Update Check: April 21, 2014.

IHS Inc. 2014. *IHS Enhanced Pipeline Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

IHS Inc. 2014. *IHS Facility Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

IHS Inc. 2014. *IHS Road Segments* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

IHS Inc. 2014. *IHS Wells – Surface Hole* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

Natural Resources Canada (NRCan). 2014. *National Road Network – British Columbia* (digital file). Sherbrooke, QC. Available: http://www.geobase.ca/geobase/en/data/nrn/index.html. Acquired: September 2014. Last Update Check: January 2, 2015.

NRCan. 2003. *Canadian Geographical Names* (digital file). Ottawa, ON. Available: http://geobase.ca/geobase/en/data/cgn/index.html. Acquired: June 2014. Last Update Check: January 6, 2015.

NRCan. 2007-2011. *National Hydro Network* (digital files). Sherbrooke, QC. Available: http://www.geobase.ca/geobase/en/data/nhn/index.html. Acquired: April 2012. Last Update Check: May 2012.

NRCan. 2012. *CanVec – Transportation – 1020009 Railway* (digital file). Sherbrooke, QC. Available: http://geogratis.cgdi.gc.ca/geogratis/en/download/topographic.html. Acquired: June 2012. Last Update Check: November 2012.

TERA Environmental Consultants (TERA). 2008. *Hillshade*. Derived from Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. 2000-2008. Canadian Digital Elevation Data 250k (digital files). Sherbrooke, QC. Available: http://www.geobase.ca/geobase/en/data/cded/index.html. Acquired: 2008. Last Update Check: December 2010.

TERA. 2010. Derived from BC Land Title Survey Authority 2003. *Petroleum and Natural Gas Grids* (Theme) (digital file). Victoria, BC. Available: https://apps.gov.bc.ca/pub/geometadata/home.do. Acquired: November 2010. Last Update Check: August 2012.

Appendix A

Photoplates

Plate 1: Example of coarse woody debris rollback, used to enhance revegetation. The coverage in this photo is insufficient for access management.
Photo source: Pyper and Vinge 2012.

Plate 2: Example of coarse woody debris rollback for access management on a pipeline right-of-way. The debris also creates microsites to enhance vegetation establishment and growth. The trench material has not yet settled in this photo. Photo source: NGTL.

Plate 3: Example of conifer seedling planting on a pipeline right-of-way. The upland area has sufficient drainage and suitable soils for seedling establishment and growth. Photo source: CH2M HILL.

Plate 4: Example of mounding used as an access management measure and to facilitate caribou habitat restoration through the creation of microsites that improve vegetation establishment. The treated linear disturbance is a seismic line, which is substantially narrower than a pipeline right-of-way. Photo source: Golder 2013, in TERA 2014.

Plate 5: Example of mounding a seismic line. Photo source: Golder 2013, in TERA 2014.

Plate 6: Example of a wood berm to deter access and reduce line-of-sight. To effectively block line-of-sight, berms should be constructed to an approximate minimum height of 1.5-2 m. Alternate measures are preferred over berms given the multiple limitations and low value. Value may be improved with shrub planting at base of berm and extending into adjacent forest. Photo source: NGTL.

Plate 7: Woody debris berms were installed in Jasper National Park to break sight lines of long, straight sections of a pipeline right-of-way. Photo source: CH2M HILL.

Plate 8: Supported woody debris berms resemble log fences or walls, constructed using timber cleared from the right-of-way. Limitations to supported berms include availability of material, ability of the soils to support the structure, and whether the right-of-way is adjacent to an existing linear disturbance that cannot be blocked. Photo source: CH2M HILL.

Plate 9: Supported woody debris berms can be constructed in different ways. This structure more closely resembles a fence rather than a berm. Alternatively, lumber fences can be an effective measure to create immediate breaks in lines-of-sight. Fences and berms are easily circumvented by off-road vehicles and may be poorly-suited for access management unless used in combination with other methods. Photo source: CH2M HILL.

Plate 10: Example of a vegetation screen retained along edge of pipeline right-of-way at intersection with an existing linear disturbance. Vegetation screens block line-of-sight and can effectively manage access. Photo source: CH2M HILL.

Plate 11: Example of a ramp-over area where a snow ramp was packed over vegetation in a treed lowland. The resultant vegetation screen will contribute to natural regeneration on the adjacent areas of the footprint. Site conditions and construction requirements can limit the use of this measure. Photo source: CH2M HILL.

Plate 12: Example of a ramp-over area. This method can be an effective option in treed lowlands where alternate measures such as mounding and conifer seedling planting can be logistically difficult to implement successfully. Photo source: CH2M HILL.

Plate 13: Example of natural regeneration during the first growing season following pipeline construction in an upland/transitional site where minimum disturbance construction was implemented. Natural regeneration of alder, willow, rose, and various forbs is evident. Natural regeneration was supplemented with white spruce seedling planting in this location. Photo source: CH2M HILL.

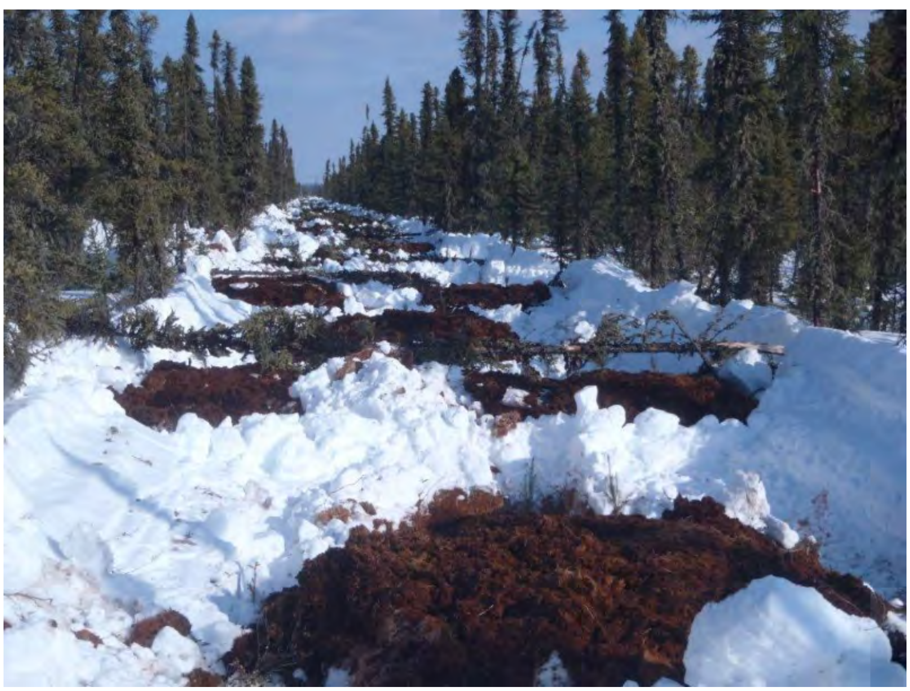


Plate 14: Example of mounding combined with tree-felling and conifer seedling planting on a seismic line. The combination of measures (often referred to as "line-blocking") is intended to manage human and predator access, and facilitate revegetation of conifers. Photo source: Golder 2013, in TERA 2014.

Appendix B

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					Preliminary CHRP Potential Restoration Treatment Options
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		
Aitken Creek Section - Graham Caribou Range															
Upland/Transitional – Conifer	Sb–lingonberry – coltsfoot	BWBSmw-04	Submesic – hygric	Poorly structured soil (compacted or massive) and/or high water table limits soils aeration and thus root development	4.5	12.5	Pl	–	Sb Sw	1,200	700	**High disturbance (no LFH[6])** CWD: 150 m^3/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed **Low disturbance (LFH present)** CWD: 75-100 m^3/ha Mound density: 1,200/ha Planting density: 800 stems/ha (Sb), 400 stems/ha (Pl) Stock size: small Treatment: plant or natural seed	**High disturbance (no LFH)** Target spp.: Sb or Pl Coverage: 25% woody or herbaceous Number of spp.: 3 **Low disturbance (LFH present)** Target spp: Sb or Pl Coverage: 25% woody or herbaceous Number of spp.: 5	Minimum disturbance and natural regeneration Mounding for access control/microsites: • Transitional areas between upland and lowland forests • Target mound density: 400-1,400 mounds/ha • Typical mound density achieved: 700-1,400 mounds/ha CWD rollback for access control: • Typical coverage: 250-300 m^3/ha; spread over 50-100 m length spanning width of footprint Conifer seedling planting: • Target planting density on mounded sites: 800-1,400 stems/ha • Target planting density on unmounded sites: 2,000-2,500 stems/ha • Typical planting densities achieved: to be determined with monitoring	Construction measures that facilitate restoration (e.g., minimum disturbance where construction requirements and site conditions allow; retain vegetation screens) Natural regeneration CWD for access control: • Target CWD coverage: 200-300 m^3/ha spread over minimum length of 50 m (target 70-100 m) for full footprint width Mounding for access control/microsites in transitional habitats: • Target mound density: 700-1,200 mounds/ha Conifer seedling planting (species to be determined based on adjacent site characteristics and post-construction site conditions on the footprint): • Target planting density (mounded): 1,200-1,400 stems/ha (depending on mound density) • Target planting density (unmounded): 1,600-2,000 stems/ha • Bio-engineering/shrub staking at riparian areas with erosion risk

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]		Treatment Options	Treatment Targets		Preliminary CHRP Potential Restoration Treatment Options
							Primary	Secondary	Tertiary	TSS	MSS0				
Aitken Creek Section - Graham Caribou Range (cont'd)															
Upland/Transitional – Conifer (cont'd)	White spruce – trembling aspen – step moss	BWBSmw-01	Submesic – subhygric	Poorly structured soil (compacted or massive) and/or high water table limits soils aeration and thus root development	7.6	20.9	Pl Sw	–	–	1,200	700	**High disturbance (no LFH)** CWD: 150 m^3/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed **Low disturbance (LFH present)** CWD: 75 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sw) Stock size: large Treatment: plant or natural seed	Target spp: Sw Coverage: 25% woody or herbaceous Number of spp.: 5	See above	See above
Upland/Transitional – Deciduous	Trembling aspen – creamy peavine	BWBSmw-01$	Submesic – mesic	Few limiting factors; fine-textured soils could limit soil aeration and rooting depth	9.9	27.1	At	–	Ep, Sw (15%)	2,500	2,000	–	–	Minimum disturbance and natural regeneration Mounding for access control/microsites: • Transitional areas between upland and lowland forests • Target mound density: 400-1,400 mounds/ha • Typical mound density achieved: 700-1,400 mounds/ha CWD rollback for access control: • Typical coverage: 250-300 m^3/ha; spread over 50-100 m length spanning width of footprint	Construction measures that facilitate restoration (e.g., minimum disturbance where construction requirements and site conditions allow; retain vegetation screens; etc.) Natural regeneration CWD for access control: • Target CWD coverage: 200-300 m^3/ha spread over minimum length of 50 m (target 70-100 m) for full footprint width Mounding for access control/microsites in transitional habitats: • Target mound density: 700-1,200 mounds/ha

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					Preliminary CHRP Potential Restoration Treatment Options
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		
Aitken Creek Section - Graham Caribou Range (cont'd)															
Upland/Transitional – Deciduous (cont'd)	See above	See above	See above	See above	See above	See above	See above	See above	See above	See above	See above	See above	See above	Conifer seedling planting: • Where there is a conifer component in adjacent stands and where minimal disturbance was not implemented (because minimal disturbance results in rapid natural regeneration of forested stands with a deciduous component) • Target planting density on mounded sites: 800-1,400 stems/ha • Target planting density on unmounded sites: 2,000-2,500 stems/ha • Typical planting densities achieved: to be determined with monitoring	Conifer seedling planting (species to be determined based on adjacent site characteristics and post-construction site conditions on the footprint): • Target planting density (mounded): 1,200-1,400 stems/ha (depending on mound density) • Target planting density (unmounded): 1,600-2,000 stems/ha • Note that target densities for conifer species in deciduous-leading habitats are designed to account for likely natural regeneration/ingress of deciduous trees. This will increase the overall stem density. • Bio-engineering/shrub staking at riparian areas with erosion risk

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Conifer Species[5,6] Primary	Conifer Species[5,6] Secondary	Conifer Species[5,6] Tertiary	Stocking Standard (Well-Spaced/ha)[4] TSS	Stocking Standard (Well-Spaced/ha)[4] MSS0	Treatment Options	Treatment Targets		Preliminary CHRP Potential Restoration Treatment Options
Aitken Creek Section - Graham Caribou Range (cont'd)															
Riparian	Mountain alder – common horsetail	BWBSmw-Fl01	Subhygric – hygric	Rooting depth and aeration could be limited by high water tables, increasing windthrow hazard and limiting productivity	1.0	2.6	Sw	–	–	–	–	**High disturbance (no LFH)** CWD: 150 m^3/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed **Low disturbance (LFH present)** CWD: 75 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sw) Stock size: large Treatment: plant or natural seed	Target spp: Sw Coverage: 25% woody or herbaceous Number of spp.: 5	• Minimum disturbance and natural regeneration	• Natural regeneration • Bio-engineering/shrub staking at riparian areas with erosion risk

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		Preliminary CHRP Potential Restoration Treatment Options
Aitken Creek Section - Graham Caribou Range (cont'd)															
Riparian (cont'd)	Cottonwood – spruce – red-osier dogwood	BWBSmw-Fm02	Subhygric – hygric	Periodic flooding and very high vegetation competition could limit spruce establishment	<0.1	<0.1	Ac	–	Ep, Sw (15%)	2,500	2,000	**High disturbance (no LFH)** CWD: 150 m³/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed **Low disturbance (LFH present)** CWD: 75 m³/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (balsam poplar), 1,200 stems/ha (Sw) Stock size: large Treatment: plant or natural seed	Target spp: balsam poplar or Sw Coverage: 25% woody or herbaceous Number of spp.: 5	See above	See above

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					Preliminary CHRP Potential Restoration Treatment Options
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		
Aitken Creek Section - Graham Caribou Range (cont'd)															
Treed Wetland	Sb – lingonberry – peat moss	BWBSmw/ BWBSwk-Wb03	Hygric – subhydric	Soil temperature, drainage and nutrients	0.4	1.0	–	–	–	–	–	CWD: 10-50 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sb) Stock size: medium Treatment: plant or natural seed	Target spp: Sb Coverage: 25% woody or herbaceous Number of spp.: 3	Minimum disturbance and natural regeneration Mounding for access control/microsites: • Target mound density: 400-1,400 mounds/ha • Typical mound density achieved: 700-1,400 mounds/ha CWD rollback for access control: • Typical coverage: 250-300 m^3/ha; spread over 50-100 m length spanning width of footprint Conifer seedling planting: • Target planting density on mounded sites: 400-1,000 stems/ha • Target planting density on unmounded sites: 2,000-2,500 stems/ha • Typical planting densities achieved: to be determined with monitoring	Construction measures that facilitate restoration (e.g., minimum disturbance where construction requirements and site conditions allow; retain vegetation screens) Natural regeneration

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		Preliminary CHRP Potential Restoration Treatment Options
Aitken Creek Section - Graham Caribou Range (cont'd)															
Treed Wetland (cont'd)	Tamarack – water sedge – fen moss	BWBSmw-Wb06	Hygric – subhydric	Soil temperature, drainage and nutrients	<0.1	0.1	–	–	–	–	–	CWD: 10-50 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sb) Stock size: medium Treatment: plant or natural seed	Target spp: Sb Coverage: 25% woody or herbaceous Number of spp.: 3	See above	CWD for access control: • Target CWD coverage: 200-300 m^3/ha spread over minimum length of 50 m (target 70-100 m) for full footprint width Mounding for access control/microsites: • Target mound density: 700-1,200 mounds/ha Conifer seedling planting (species to be determined based on adjacent site characteristics and post-construction site conditions on the footprint): • Target planting density (mounded): 1,200-1,400 stems/ha (depending on mound density) • Target planting density (unmounded): 1,600-2,000 stems/ha (if appropriate, depending on site drainage and nutrients) Bio-engineering/shrub staking at riparian areas with erosion risk
Non-Vegetated	Exposed soil	–	–	–	0.4	1.2	–	–	–	–	–	–	–	–	Reclaim to conditions similar to pre-construction
	Gravel bar	–	–	–	0.1	0.3	–	–	–	–	–	–	–		
	River	–	–	–	<0.1	0.2	–	–	–	–	–	–	–		
	Rock outcrop	–	–	–	0.2	0.6	–	–	–	–	–	–	–		
Anthropogenic	Cultivated field	–	–	–	3.6	9.9	–	–	–	–	–	–	–	–	Reclaim to conditions similar to pre-construction
	Corridor and/or industry-related disturbance	–	–	–	5.1	13.9	–	–	–	–	–	–	–		
	Rural	–	–	–	0.9	2.4	–	–	–	–	–	–	–		
	Road surface	–	–	–	1.2	3.2	–	–	–	–	–	–	–		

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					Preliminary CHRP Potential Restoration Treatment Options
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		
Kahta Section - Pink Mountain Caribou Range															
Upland/Transitional – Conifer	White spruce – trembling aspen – step moss	BWBSmw-01	Submesic – subhygric	Poorly structured soil (compacted or massive) and/or high water table limits soils aeration and thus root development	0.6	0.7	Pl Sw	–	–	1,200	700	**High disturbance (no LFH)** CWD: 150 m^3/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed **Low disturbance (LFH present)** CWD: 75 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sw) Stock size: large Treatment: plant or natural seed	Target spp: Sw Coverage: 25% woody or herbaceous Number of spp.: 5	Minimum disturbance and natural regeneration Mounding for access control/microsites: • Transitional areas between upland and lowland forests • Target mound density: 400-1,400 mounds/ha • Typical mound density achieved: 700-1,400 mounds/ha CWD rollback for access control: • Typical coverage: 250-300 m^3/ha; spread over 50-100 m length spanning width of footprint Conifer seedling planting: • Target planting density on mounded sites: 800-1,400 stems/ha • Target planting density on unmounded sites: 2,000-2,500 stems/ha • Typical planting densities achieved: to be determined with monitoring	Construction measures that facilitate restoration (e.g., minimum disturbance where construction requirements and site conditions allow; retain vegetation screens; etc.) Natural regeneration CWD for access control: • Target CWD coverage: 200-300 m^3/ha spread over minimum length of 50 m (target 70-100 m) for full footprint width Mounding for access control/microsites in transitional habitats: • Target mound density: 700-1,200 mounds/ha Conifer seedling planting (species to be determined based on adjacent site characteristics and post-construction site conditions on the footprint): • Target planting density (mounded): 1,200-1,400 stems/ha (depending on mound density) • Target planting density (unmounded): 1,600-2,000 stems/ha • Bio-engineering/shrub staking at riparian areas with erosion risk
	Sb – lingonberry – coltsfoot	BWBSmw-04	Submesic – hygric	Poorly structured soil (compacted or massive) and/or high water table limits soils aeration and thus root development	35.7	44.7	Pl Sb	–	Sb Sw	1,200	700	**High disturbance (no LFH)** CWD: 150 m^3/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed	**High disturbance (no LFH)** Target spp.: Sb or Pl Coverage: 25% woody or herbaceous Number of spp.: 3		

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Conifer Species[5,6] Primary	Conifer Species[5,6] Secondary	Conifer Species[5,6] Tertiary	Stocking Standard (Well-Spaced/ha)[4] TSS	Stocking Standard (Well-Spaced/ha)[4] MSS0	Treatment Options	Treatment Targets		Preliminary CHRP Potential Restoration Treatment Options
Kahta Section - Pink Mountain Caribou Range															
Upland/Transitional – Conifer (cont'd)	See above	See above	See above	See above	See above	See above	See above	See above	See above	See above	See above	**Low disturbance (LFH present)** CWD: 75-100 m^3/ha Mound density: 1,200/ha Planting density: 800 stems/ha (Sb), 400 stems/ha (Pl) Stock size: small Treatment: plant or natural seed	**Low disturbance (LFH present)** Target spp: Sb or Pl Coverage: 25% woody or herbaceous Number of spp.: 5	See above	See above
	White spruce – currant – horsetail	BWBSmw-07	Subhygric – hygric	The water table may rise, reducing suitable planting microsites and lower productivity; sites with >10 cm humus will have reduced rooting availability in the mineral soil, increasing windthrow hazard and limiting productivity	1.3	1.6	Sw	Pl	–	1,000	500	**High disturbance (no LFH)** CWD: 150 m^3/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed **Low disturbance (LFH present)** CWD: 75 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sw) Stock size: large Treatment: plant or natural seed	Target spp: Sw Coverage: 25% woody or herbaceous Number of spp.: 5		

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		Preliminary CHRP Potential Restoration Treatment Options
Kahta Section - Pink Mountain Caribou Range															
Upland/Transitional – Conifer (cont'd)	White spruce – huckleberry – step moss	BWBSwk2-01	Submesic – mesic	Few limiting factors; fine-textured soils may limit soil aeration and rooting depth	9.7	12.1	Pl Sw	–	–	1,200	700	**High disturbance (no LFH)** CWD: 150 m^3/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed	Target spp: Sw or Bl Coverage: 25% woody or herbaceous Number of spp.: 5	See above	See above
												Low disturbance (LFH present) CWD: 75 m^3/ha Mound density: 1,200/ha Planting density: 800 stems/ha (Sw), 400 stems/ha (Bl) Stock size: large Treatment: plant or natural seed			
	Lodgepole pine – lingonberry – velvet-leaved blueberry	BWBSmk-02	Xeric – subxeric	Productivity limited by growing season drought; removal of LFH[7] will further limit productivity	<0.1	<0.1	Pl	–	Sw	1,200	700	CWD: 75-100 m^3/ha Mound density: none Planting density: none Stock size: none Treatment: natural or applied seed	Target spp: Pl Coverage: 25% woody or herbaceous Number of spp.: 3		

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		Preliminary CHRP Potential Restoration Treatment Options
Kahta Section - Pink Mountain Caribou Range															
Upland/Transitional – Deciduous (cont'd)	Trembling aspen – creamy peavine	BWBSmw-01$	Submesic – mesic	Few limiting factors; fine-textured soils could limit soil aeration and rooting depth	0.1	0.2	At	–	Ep, Sw (15%)	2,500	2,000	–	–	Minimum disturbance and natural regeneration Mounding for access control/microsites: • Transitional areas between upland and lowland forests • Target mound density: 400-1,400 mounds/ha • Typical mound density achieved: 700-1,400 mounds/ha CWD rollback for access control: • Typical coverage: 250-300 m^3/ha; spread over 50-100 m length spanning width of footprint Conifer seedling planting: • Where there is a conifer component in adjacent stands and where minimal disturbance was not implemented (because minimal disturbance results in rapid natural regeneration of forested stands with a deciduous component) • Target planting density on mounded sites: 800-1,400 stems/ha • Target planting density on unmounded sites: 2,000-2,500 stems/ha • Typical planting densities achieved: to be determined with monitoring	Construction measures that facilitate restoration (e.g., minimum disturbance where construction requirements and site conditions allow; retain vegetation screens; etc.) Natural regeneration

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]		Treatment Options	Treatment Targets		Preliminary CHRP Potential Restoration Treatment Options
							Primary	Secondary	Tertiary	TSS	MSS0				
Kahta Section - Pink Mountain Caribou Range															
Upland/Transitional – Deciduous (cont'd)	Trembling aspen – highbush cranberry	BWBSwk2-01$	Mesic – subhygric	Few limiting factors; fine-textured soils could limit soil aeration and rooting depth	2.3	2.8	At	–	Ep, Sw (15%)	2,500	2,000	–	–		
	Trembling aspen – Labrador tea	BWBSmw-04$	Submesic – subhygric	Poorly structured soil (compacted or massive) and/or high water table limits soils aeration and thus root development	1.0	1.2	At	–	Ep, Sw (15%)	2,500	2,000	–	–		CWD for access control: • Target CWD coverage: 200-300 m^3/ha spread over minimum length of 50 m (target 70-100 m) for full footprint width Mounding for access control/microsites in transitional habitats: • Target mound density: 700-1,200 mounds/ha Conifer seedling planting (species to be determined based on adjacent site characteristics and post-construction site conditions on the footprint): • Target planting density (mounded): 1,200-1,400 stems/ha (depending on mound density) • Target planting density (unmounded): 1,600-2,000 stems/ha • Note that target densities for conifer species in deciduous-leading habitats are designed to account for likely natural regeneration/ingress of deciduous trees. This will increase the overall stem density. • Bio-engineering/shrub staking at riparian areas with erosion risk
	Trembling aspen – Labrador tea – lingonberry	BWBSwk2-03$	Submesic	Drought could limit tree productivity during dry growing season	0.3	0.4	At	–	Ep, Sw (15%)	2,500	2,000	–	–		

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					Preliminary CHRP Potential Restoration Treatment Options
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		
Kahta Section - Pink Mountain Caribou Range															
Riparian	Mountain alder – common horsetail	BWBSmw-Fl01	Subhygric - hygric	Rooting depth and aeration may be limited by high water tables, increasing windthrow hazard and limiting productivity	0.7	0.9	–	–	–	–	–	**High disturbance (no LFH)** CWD: 150 m^3/ha Mound density: 500/ha Planting density: none Stock size: none Treatment: natural or applied seed	Target spp: Sw Coverage: 25% woody or herbaceous Number of spp.: 5	• Minimum disturbance and natural regeneration	• Natural regeneration • Bio-engineering/shrub staking at riparian areas with erosion risk
	See above	See above	See above	See above	See above	See above	See above	See above	See above	See above	See above	**Low disturbance (LFH present)** CWD: 75 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sw) Stock size: large Treatment: plant or natural seed	See above	See above	See above
	Bebb's willow – mountain alder – bluejoint swamp	BWBSmk-Ws03	Hygric - subhydric	Soil and hydrology typical of wetland ecosystems; typically, low cover of obligate hydrophytes	0.3	0.4	–	–	–	–	–	–	–		
	Scrub birch – willow – water sedge fen	BWBSmk/ BWBSmw/ BWBSwk2-Wf02	Subhydric	Soil temperature, drainage and nutrients	<0.1	<0.1	–	–	–	–	–	CWD: 10-50 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sb), 1,200 stems/ha (Lt) Stock size: medium Treatment: plant or natural seed	Target spp: Sb or Lt Coverage: 25% woody or herbaceous Number of spp.: 3		

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					Preliminary CHRP Potential Restoration Treatment Options
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		
Kahta Section - Pink Mountain Caribou Range															
Treed Wetland	Sb–lingonberry – peat moss	BWBSmk/ BWBSmw/ BWBSwk2-Wb03	Hygric - subhydric	Soil temperature, drainage and nutrients	17.9	22.4	–	–	–	1,200	700	CWD: 10-50 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sb) Stock size: medium Treatment: plant or natural seed	Target spp: Sb Coverage: 25% woody or herbaceous Number of spp.: 3	Minimum disturbance and natural regeneration Mounding for access control/microsites: • Target mound density: 400-1,400 mounds/ha • Typical mound density achieved: 700-1,400 mounds/ha	Construction measures that facilitate restoration (e.g., minimum disturbance where construction requirements and site conditions allow; retain vegetation screens; etc.) Natural regeneration
	Tamarack – water sedge – fen moss	BWBSmk/ BWBSwk2-Wb06	Hygric - subhydric	Soil temperature, drainage and nutrients	<0.1	<0.1	–	–	–	1,200	700	CWD: 10-50 m^3/ha Mound density: 1,200/ha Planting density: 1,200 stems/ha (Sb) Stock size: medium Treatment: plant or natural seed	Target spp: Sb Coverage: 25% woody or herbaceous Number of spp.: 3	CWD rollback for access control: • Typical coverage: 250-300 m^3/ha; spread over 50-100 m length spanning width of footprint Conifer seedling planting: • Target planting density on mounded sites: 400-1,000 stems/ha • Target planting density on unmounded sites: 2,000-2,500 stems/ha • Typical planting densities achieved: to be determined with monitoring	CWD for access control: • Target CWD coverage: 200-300 m^3/ha spread over minimum length of 50 m (target 70-100 m) for full footprint width Mounding for access control/microsites: • Target mound density: 700-1,200 mounds/ha Conifer seedling planting (species to be determined based on adjacent site characteristics and post-construction site conditions on the footprint): • Target planting density (mounded): 1,200-1,400 stems/ha (depending on mound density) • Target planting density (unmounded): 1,600-2,000 stems/ha (if appropriate, depending on site drainage and nutrients) Bio-engineering/shrub staking at riparian areas with erosion risk
Graminoid/Shrub Wetland	Water sedge – beaked sedge fen	BWBSmk/ BWBSmw/ BWBSwk2-Wf01	Subhydric	Soil temperature, drainage and nutrients	0.5	0.6	–	–	–	–	–	–	–	Minimum disturbance and natural regeneration	Minimum disturbance and natural regeneration

Preliminary CHRP Treatment Matrix and Key Considerations Summary for the NGTL North Montney Project (cont'd)

Project-Specific Information[1]							Establishment to *Free Growing Guidebook*, Prince George Forest Region (BC MOF 2000)					Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015)[4]		NGTL Caribou Habitat Restoration – Implementation Lessons from Previous Projects	Project-Specific Information[1]
							Conifer Species[5,6]			Stocking Standard (Well-Spaced/ha)[4]					Preliminary CHRP Potential Restoration Treatment Options
Habitat Types	TEM Unit/ Ecosystem Description[1]	Site Series[2,3]	Moisture/ Nutrient Regime	Limiting Factors	Area (ha)	Percent of Total (%)	Primary	Secondary	Tertiary	TSS	MSS0	Treatment Options	Treatment Targets		
Kahta Section - Pink Mountain Caribou Range															
Non-Vegetated	Cutbank	–	–	–	0.1	0.1	–	–	–	–	–	–	–	–	Reclaim to conditions similar to pre-construction
	Exposed soil	–	–	–	0.3	0.4	–	–	–	–	–	–	–		
	River	–	–	–	<0.1	<0.1	–	–	–	–	–	–	–		
Anthropogenic	Corridor and/or industry-related disturbance	–	–	–	7.1	8.9	–	–	–	–	–	–	–	–	Reclaim to conditions similar to pre-construction
	Reservoir	–	–	–	0.3	0.4	–	–	–	–	–	–	–		
	Road surface	–	–	–	<0.1	<0.1	–	–	–	–	–	–	–		

Note:

1 TEM = terrestrial ecosystem mapping. Site-specific information will be supplemented with information collected during construction (e.g., construction methods such as location and degree of grading) and during the first growing season following construction.

2 TEM was completed as part of the Project Application (Stantec 2013). The area and percentage calculations are based on the entire TEM polygon (i.e., the deciled TEM polygon data are assumed to be reflective of the area and percent of ecosystem units affected by the Project footprint). Cutblocks are incorporated into the TEM unit classifications (site series).

3 Site series are derived from TEM data (Stantec 2013) based on *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*, *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region* and *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia* Land Management Handbooks (DeLong 2004, DeLong et al. 1990, 2011). The $ denotes seral stage, indicating early seral communities, usually deciduous dominated.

4 At = trembling aspen; Ep = common paper birch; Pl = lodgepole pine; Sb = black spruce; Sw = white spruce; Bl = subalpine fir; tamarack = Lt.

5 TSS = target stocking standard; MSS = minimum stocking standard.

6 LFH = organic layers developed under well- to imperfectly drained conditions, which are important for sustaining forest productivity; L = litter, relatively fresh organic residue with little to no evidence of decomposition, and the original structure is still discernible (e.g., needles); F = fermented, moderately decomposed organic residue where origin is still identifiable; H = humus, well-decomposed organic residue dominated by fine substances where the origin is no longer discernible (BC MOF 1997b).

Appendix C

Historic and Current Habitat Restoration Initiatives

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 AESRD) (previously referred to as Alberta Sustainable Resource Development)	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, 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 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 Energy /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 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.
				CRRP 2007a,b,c
				Neufeld 2006

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
Suncor	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
Canadian Natural Resources Limited (CNRL), DES	Ladyfern Pipeline Revegetation 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. • Recolonization 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.	DES 2004

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
AXYS	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 revegetation of peatlands and to guide the direction of revegetation. 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 [1]Tedder and Turchenek 1996 [2]Girard et al. 2002 [3]Naeth et al. 1991 [4]Khasa et al. 2001 [5]Robinson and Moore 2000 [5]Turetksy et al. 2000 [5]Camill 1999

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports

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 rollback for access management 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 manage access.
			• Approximately 250,000 seedlings were planted at strategic locations over three summers. Locations included:
			  • intersections with other linear corridors;
			  • upland sites to create line-of-sight breaks; and
			  • riparian areas.
			• 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 5 year period.
			• Good survival of seedlings was observed on upland sites; lowland site seedling survival to be evaluated during monitoring in fall 2012.
			• Vegetation ingress of clover and native grasses has had a negative impact on seedling survival in some areas.
			• Where no access management measures were applied, human use of the right-of-way by ATV damaged many seedlings.
			• Seedlings planted in conjunction with rollback were not damaged.
				Enbridge 2010
				Golder 2011

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports

CNRL, 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 manage access.
			• Planting sites are currently subject to monitoring over a 5 year period.
			• Approximately 60,250 seedlings planted at strategic locations over two summers. Locations included:
			  • intersections with other linear corridors;
			  • upland sites to create line-of-sight breaks; and
			  • riparian areas.
			• 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

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
University of Alberta led project, supported by a number of oil/gas companies, Canadian Association of Petroleum Producers (CAPP), Forest Resource Improvement Association, and Alberta-Pacific Forest Industries Inc.	Integrated Land Management	• Ongoing study began in 2004 and focused on contributing to best practices for well site 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 well sites component involved monitoring soils and vegetation. • New well sites 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; • 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

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
OSLI (now referred to as COSIA)	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).	COSIA 2012
	Winter Wetland Planting Trial	• Wetlands revegetation 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 ongoing Algar Reclamation Program.	

	Algar Reclamation Program	• Program targeting the restoration of seismic lines through revegetation and access management 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).
			• Micro-scale restoration activities began in winter 2011/2012 and include:
			  • excavator mounding;
			  • rollback; and
			  • frozen tree seedling planting.	

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
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 deter recreational use of linear features.	COSIA 2012
	See above	• See above	• Well-designed scientific monitoring of wildlife use is needed to provide managers with an understanding of treatment effectiveness.	See above

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports

CNRL	Habitat Enhancement Program	• Program is part of the Terms and Conditions of the Environmental Protection and Enhancement Act approval for the construction, operation and reclamation of the Canadian Natural Primrose and Wolf Lake Project.
		• Program targeted the restoration of seismic lines, old lease roads, and abandoned well and core hole sites through revegetation and access management 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 management and micro-site creation for introduced tree seedlings, using the following three treatments:
			  • mounding;
			  • tree seedling planting; and
			  • rollback.
			• Planting sites are subject to monitoring over a 5 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.
				Golder 2010

ConocoPhillips, CAPP 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.	Golder 2009

Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
ConocoPhillips, CAPP and Suncor (cont'd)	See above	• See above	• Caribou were shown to have a slight preference for revegetated 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 revegetated sites and engaged in standing related behaviours only while on revegetated 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.	See above

NGTL	Northwest Mainline Expansion CHRP Leismer to Kettle River Crossover Pipeline CHRP	Pipeline construction occurred during winter 2012/2013.
		• Promoted revegetation on pipeline developments within caribou habitat by: promoting the growth of native species from seed; use of minimum disturbance construction techniques; planting tree and shrub seedlings; transplanting existing shrubs; and using rollback for access management 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.
			• Detailed CHRPs developed.
			• Restoration activities began during construction in winter 2012/2013 and continued through final clean-up in winter 2013/2014.
			• Focused on access management and microsite creation for introduced tree seedlings, using the following three treatments:
			  • mounding;
			  • tree seedling planting; and
			  • rollback.
			• Seedlings were planted at strategic locations in summer 2014.
			• Habitat restoration measures are subject to monitoring over a 5 year period.
				TERA Environmental Consultants 2014
				Golder 2014

Note:
Table modified from Golder 2012b.

Appendix D

Project Contact List

Project Contact List

Project Contacts	
Patricia Zuczek Project Manager, Pipeline Projects TransCanada PipeLines Limited 450 - 1st Street S.W. Calgary, Alberta T2P 5H1 Telephone: (403) 920-5378 Email: patricia_zuczek@transcanada.com	TransCanada Project Manager
Nancy Porter Senior Environmental Project Manager exp Services, Inc. for TransCanada 411 - 1st Street S.E. Calgary, Alberta T2G 4Y5 Telephone: (587) 933-3215 Email: nancy_porter@transcanada.com	TransCanada Environmental Contact
Government Contacts	
Karen Muttersbach Environmental Assessment Officer Environment Canada 201 - 401 Burrard Street Vancouver, BC V6C 3C5 Phone: (604) 666-6480 Email: karen.muttersbach@ec.gc.ca	Environment Canada Representative
Kerry Harvey, R.P. Bio. Ecosystems Biologist Ministry of Forests, Lands and Natural Resource Operations - Northeast Region 400, 10003 - 110th Avenue Fort St. John, BC, V1J 6M7 Telephone: (250) 787-3204 Email: Kerry.Harvey@gov.bc.ca	BC MFLNRO Representative
Conservation Officer Service BC Ministry of Environment – Peace Region 400, 10003 - 110th Avenue Fort St. John, BC, V1J 6M7 Telephone: (250) 787-3411	Conservation Officer – Peace Region Representative
Mohammad Farah Authorizations Manager BC Oil and Gas Commission, Fort St. John 6534 Airport Road Fort St John, BC V1J 4M6 Telephone: (250) 794-5274 Email: Mohammad.Farah@bcogc.ca	BC OGC Representative

Appendix E

Caribou Observation Form

Caribou Observation Form

	Date and Time:
Weather Conditions (temperature, precipitation):	**Location:** **KP** **GPS**
Description of Location (*e.g.*, nearest Highway, access road or town, seen on a road, in a clearing or in the bush):	
Observation: No. of caribou observed: Any calves or young present (circle one): Yes or No Additional notes:	
Habitat Type: ☐ sparsely or non-vegetated ☐ treed wetland ☐ shrubby wetland ☐ grass or grass-like wetland	☐ deciduous-dominated forest ☐ coniferous-dominated forest ☐ mixedwood forest
Recorded by: Telephone:	
Send this information to the relevant provincial regulator: BC MFLNRO, Northeast Region 400-10003-110th Avenue Fort St. John, BC V1J 6M7	

Appendix F

Blackline Comparison with Liege Lateral Loop 2 (Thornbury Section) and Leismer East Compressor Station Revised Preliminary CHRP June 30, 2015

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION AND ORGANIZATION

~~1.1 INTRODUCTION~~

This section provides an introduction to the preliminary Caribou Habitat Restoration Plan (Preliminary CHRP) for the North Montney Mainline (Project) and outlines how this document is organized.

1.1 INTRODUCTION

NOVA Gas Transmission Ltd. (NGTL), a wholly owned subsidiary of TransCanada~~-~~ PipeLines Limited (TransCanada), ~~received~~ filed an application with the National Energy Board (NEB or Board) ~~Order XG-N081-003-2015 approval~~ on ~~January 28, 2015 under section 58~~November 8, 2013 for a Certificate of Public Convenience and Necessity pursuant to section 52 of the *National Energy Board Act* (NEB Act) ~~for authorization~~ to construct and operate ~~Liege Lateral Loop 2 (Thornbury Section) and Leismer East Compressor Station (the Project).~~the Project and other approvals pursuant to section 58 and Part IV of the Act. For the Project regional location, see Figure 1-1. On June 11, 2015, the Governor in Council directed the Board to issue Certificate of Public Convenience and Necessity GC-125 to NGTL for the Project, subject to the terms and conditions in the GH-001-2014 Report (NEB Report) issued by the Board on April 15, 2015.

The Project is split into two sections: Aitken Creek Section and Kahta Section. The Aitken Creek Section is approximately 182 km, of which 8.1 km occurs in the Graham caribou range (see Figure 1-2), while the Kahta Section is approximately 119 km, of which 19 km occurs in the Pink Mountain caribou range (see Figure 1-3). No compressor or meter stations are proposed in the Graham caribou range and there are two proposed meter station sites in the Pink Mountain caribou range. Project scheduling was designed to avoid the critical timing period for caribou from January 15 to July 15.

This Preliminary ~~Caribou Habitat Restoration Plan (~~CHRP~~)~~ was prepared for the Project pursuant to ~~NEB Order XG-N081-003-2015~~Certificate Condition ~~6~~15 and outlines NGTL's plan to ~~avoid impacts,~~ minimize Project effects on caribou and restore affected caribou habitat~~.~~ of the Aitken Creek and Kahta Sections,. This document also incorporates~~-~~:

- feedback ~~received~~ from applicable regulators ~~and~~, technical experts~~,~~ and Aboriginal communities
- lessons learned from field experience~~,~~
- industry experience ~~and~~
- updated results from ongoing literature review~~.~~

The goal of both the Preliminary and Final CHRP will be to minimize ~~“~~residual effects~~”~~ of the Project on caribou habitat. Residual effects are environmental effects predicted to remain after mitigation is applied.~~ Tailored to site-specific conditions, mitigation measures related to the disturbance of caribou habitat will be implemented on the Project footprint throughout the pre-construction, construction and post-construction phases of the Project.~~

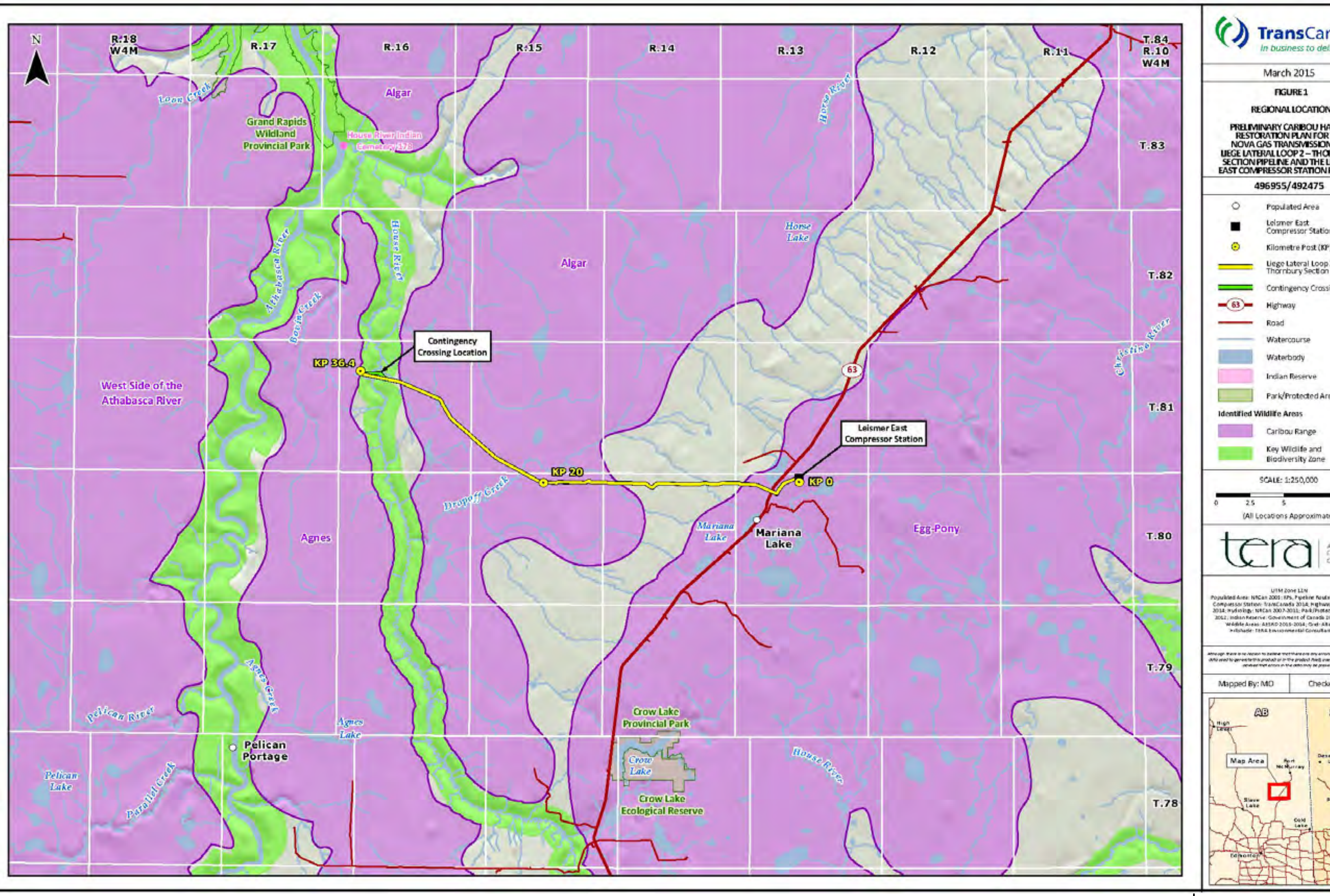
Tailored to site-specific conditions, restoration measures related to the disturbance of caribou habitat will be implemented in the Project footprint throughout the pre-construction, construction and post-construction phases of the Project.

The Final CHRP will ~~supplement this Preliminary CHRP by detailing the~~ detail the location and type of restoration that ~~is planned~~will be implemented along the Project right-of-way (ROW~~), and by predicting~~). The residual effects requiring caribou habitat offsetting measures~~. Residual effects~~ presented in the Final CHRP will consider the length of time required for restoration measures to reach maturity (lag time) and factor in uncertainty associated with offsets~~.~~, and will be further detailed in the Offset Measures Plan for Residual Impacts on Caribou Habitat (OMP) that will be prepared pursuant to Condition 36. The Final CHRP will be filed on or before November 1 after the first complete growing season following the Project being placed into service.

The approach to validate residual effects predictions (direct~~-~~ and indirect) and restoration success is described in this Preliminary CHRP, ~~with~~and the detailed adaptive management plan ~~to~~will be described in the Caribou Habitat Restoration and Offset Measures Monitoring Program (CHROMMP~~). The Final CHRP will be filed on or before November 1 after the first complete growing season following the project being placed into service.~~

~~In addition to the CHRP and CHROMMP~~) for the Project. Pursuant to Condition 37, NGTL will file the CHROMMP with the Board on or before February 1 after the first complete growing season following the Project being placed into service. The CHROMMP will explain the Program for monitoring and verifying the effectiveness of the caribou habitat restoration and offset measures implemented as part of the CHRP and OMP. The monitoring period for the CHROMMP will be a minimum of 10 years.

NGTL will also develop an ~~Offset Measures Plan (~~OMP~~)~~ to address Project residual effects on critical caribou habitat for the Aitken Creek Section pursuant to Condition ~~7~~ 36. The Preliminary OMP will ~~be filed with the NEB at least 90 days before requesting leave to open the Project. The Preliminary OMP~~detail a plan to offset all residual effects of the Aitken Creek Section (the only section that includes critical caribou habitat) resulting from directly and indirectly disturbed critical habitat for caribou, after taking into account implementation of the Environmental Protection Plan (EPP) and CHRP measures, and will further detail the method used to quantify the offsets



. The Preliminary OMP will be filed with the Board at least 90 days before requesting Leave to Open the Aitken Creek Section of the Project.

NGTL filed the Access Management Plan (AMP) pursuant to Condition 16 on June 3, 2015 (NEB Filing ID: A70510). The AMP detailed a plan for managing access along the ROW for non-parallel disturbances for each of the Aitken Creek and Kahta Sections.

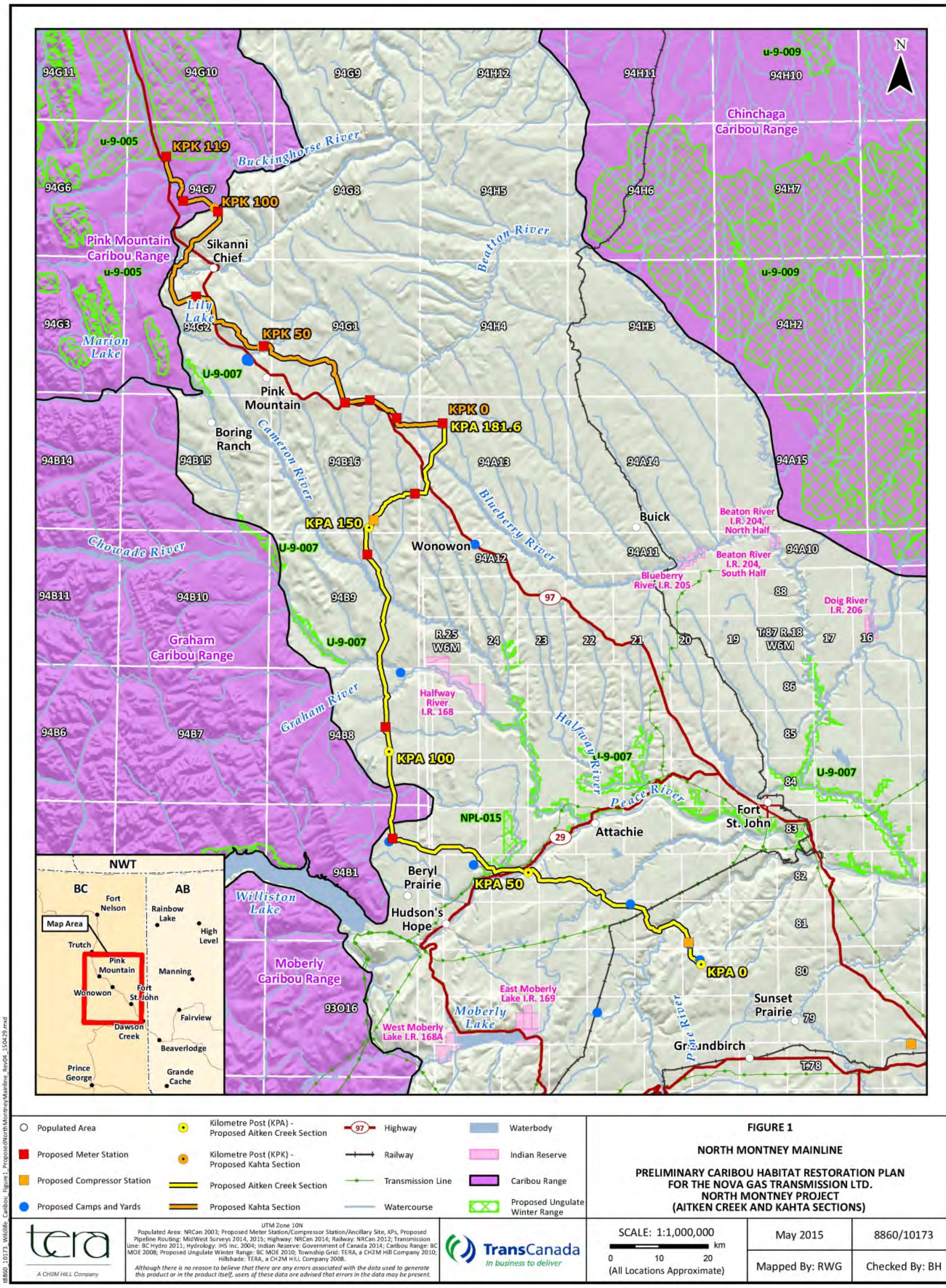


Figure 1-1: Regional Location

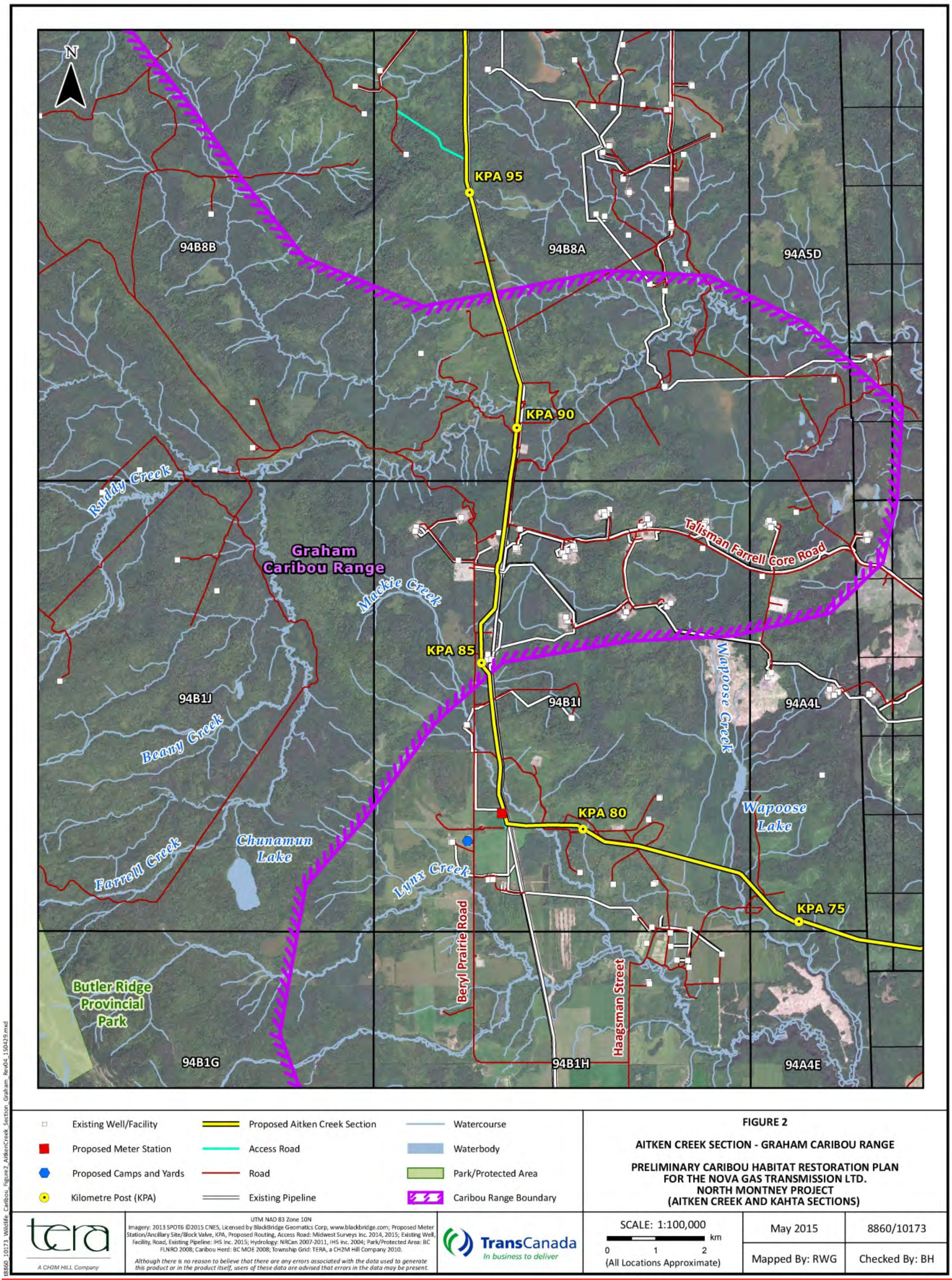


Figure 1-2: Aitken Creek Section – Graham Caribou Range

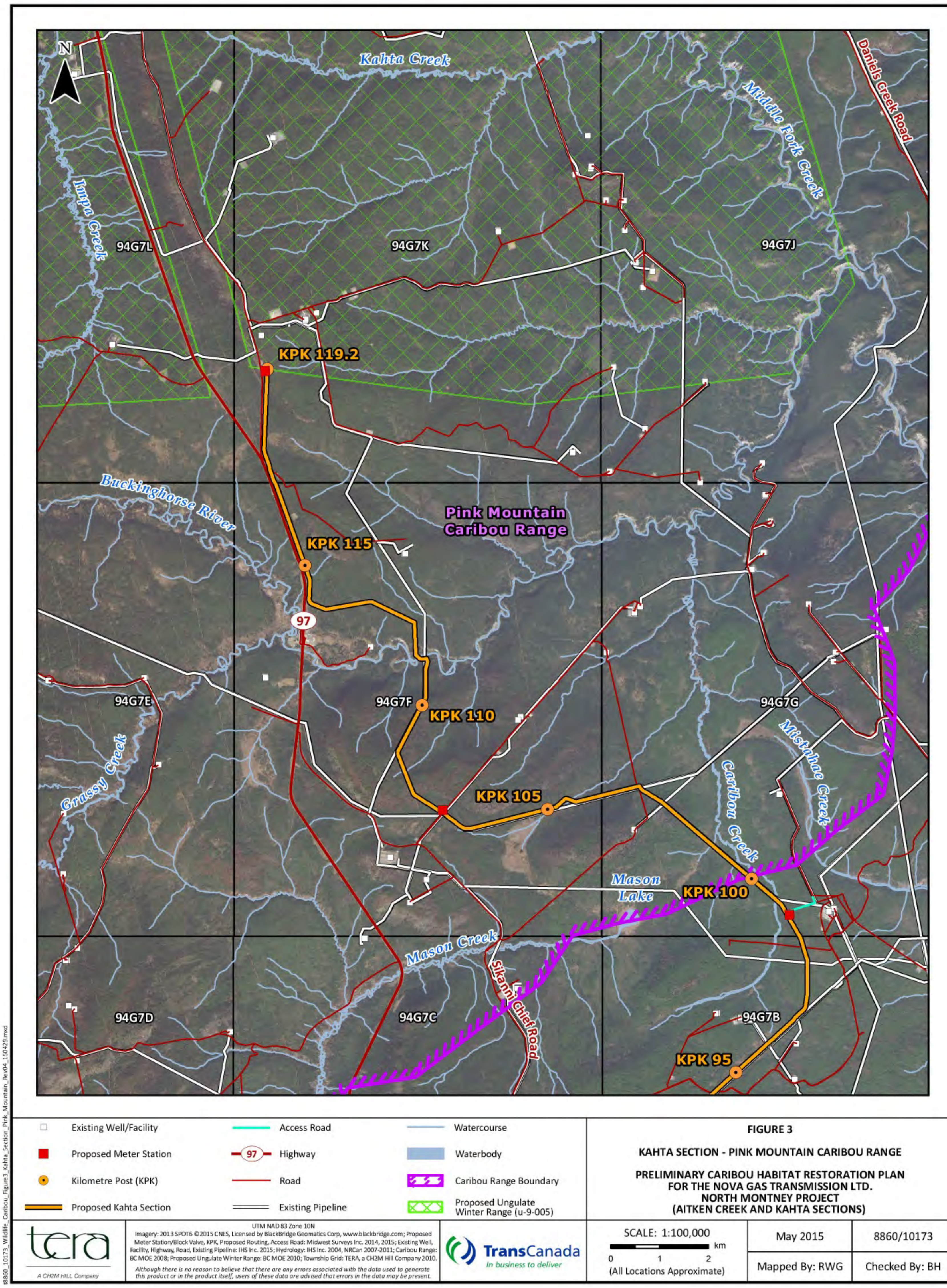


Figure 1-3: Kahta Section – Pink Mountain Caribou Range

1.2 ORGANIZATION OF THE ~~PRELIMINARY~~PRELIMINARY CHRP

This Preliminary CHRP is organized in ~~eight~~nine sections, as follows:

Section 2: introduces the goal, objectives and quantifiable targets.

Section 3: introduces the habitat restoration decision framework used to ~~prioritize~~decide on potential caribou habitat restoration sites and to ~~prioritize mitigative actions to be used~~determine restoration measures in different site types, considering typical site factors that could constrain implementation.

Section 4: outlines quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects, ~~the~~ extent to which ~~the~~ goals and objectives have been met~~,~~ and the need for consequent compensation offsets.

Section 5:~~ describes the CHRP, which~~ includes a description of how the spatial disturbance will be calculated (as the calculation will not be completed until the ~~final~~ Final CHRP is prepared), habitat restoration, ~~further~~ monitoring~~ details~~, adaptive management and the proposed implementation schedule for each of the Aitken Creek and Kahta Sections.

Section 6: describes how field innovations and previous experience have been incorporated into this Preliminary CHRP for the Project.

Section 7: provides a summary of caribou-specific consultation with ~~federal~~Aboriginal communities and ~~provincial~~applicable regulators to~~-~~-date, as well as a summary of how feedback was incorporated in ~~the Preliminary CHRP. NGTL will continue to maintain open communication with federal and provincial regulatory agencies, as well as potentially affected communities, through the various Project phases. The Final~~this Preliminary CHRP~~ will include updated consultation records~~.

Section 8: is a literature review, on which the decision framework for this document is based, that includes:

- identification of temporal and spatial caribou habitat restoration methods applicable to ~~woodland~~both boreal and mountain caribou
- assessment of the relative effectiveness of the identified methods
- description of the literature review approach

~~The~~**Section 9**: cites references used throughout the document.

This Preliminary CHRP is organized to address each requirement of ~~Order XG-N081-003-2015~~GC-125 Condition ~~6~~15. For the locations in this document that outline how each condition has been met, see Table 1-1.

Table 1-1: ~~NEB ORDER-XG-N081-003-2015 –~~GC-125 Condition ~~6~~15: Caribou Habitat Restoration Plan

~~NEB ORDER-XG-N081-003-2015 Conditions~~Condition	Details and Location in Report
~~6~~15. Caribou Habitat Restoration Plan (CHRP) NGTL shall file with the Board~~,~~ for approval, in accordance with the timelines below, preliminary and final versions of a CHRP for each of the ~~Project,~~Aitken Creek and Kahta Sections of the section 52 Facilities. At the time of filing with the Board, NGTL shall provide a copy of ~~each version~~the filings to Environment Canada and ~~Alberta Environment and Sustainable Resource Development (AESRD) at the time of filing with the Board. The CHRP shall comprise:~~the appropriate provincial authorities.	This document addresses the restoration plan for each of the Aitken Creek and Kahta Sections of the Project in Section 5. All other sections of this document are applicable to both the Aitken Creek and Kahta Sections of the Project.
a) ~~A preliminary~~Preliminary CHRP to be filed at least 90 days prior to ~~commencement of~~commencing construction~~, to~~. This version of the CHRP shall include, but not be limited to: i) the goals and ~~measurable~~measureable objectives of the CHRP; ii) ~~the~~ decision frameworks that will be used to prioritize potential caribou habitat restoration sites and to prioritize mitigative actions to be used at different types of sites, including consideration of typical site factors that may constrain implementation; iii) a review of literature upon which the decision frameworks are based including: i. an identification of temporal and spatial caribou habitat restoration methodologies applicable to ~~woodland~~mountain caribou; ii. an assessment of the relative effectiveness of the identified methodologies; iii. detailed methodology of how the literature review was conducted.	Section 2 of the Preliminary CHRP introduces the goal, objectives and quantifiable targets. Section 3 provides a decision framework. Section 8 of the Preliminary CHRP summarizes relevant literature and describes the method for the literature review.
iv) the quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects, the extent to which the goals and objectives have been met, and the need for consequent compensation offsets; v) a schedule indicating when measures will be initiated and completed; vi) ~~evidence and~~ a ~~summary of consultation feedback with Environment Canada and AESRD regarding~~table summarizing any differences or updates from the last previous NGTL CHRP filed with the Board for other projects; and	Section 2 and Section 4 of the Preliminary CHRP describe quantitative criteria to evaluate effectiveness, and include a brief description of monitoring and adaptive management measures. Further information on monitoring and offsets will be provided in the OMP and CHROMMP under separate cover in accordance with ~~Order~~GC-125 Conditions ~~7~~36 and ~~8~~37. Section 5.~~6~~8 of the Preliminary CHRP provides the schedule for construction and habitat restoration activities for each of the Aitken Creek and Kahta Sections. Section ~~7 of~~ 6.4 provides a table summarizing differences and updates since the ~~Preliminary~~last NGTL CHRP ~~summarizes consultation and feedback on~~filed with the ~~CHRP from Environment Canada (EC) and AESRD~~Board.

vii) evidence and a summary of how consultation feedback ~~with~~from Environment Canada and ~~AESRD~~appropriate provincial authorities is integrated into the CHRP.	Section 7 ~~of the Preliminary CHRP~~ summarizes consultation and feedback ~~on the CHRP~~ from EC, BC MFLNRO, and ~~AESRD~~potentially affected Aboriginal communities.

~~**Table 1-1: NEB ORDER-XG-N081-003-2015 – Condition 6: Caribou Restoration Plan (cont'd)**~~

Table 1-2: GC-125 Condition 15: Caribou Habitat Restoration Plan (cont'd)

~~NEB ORDER XG-N081-003-2015 Conditions~~Condition	Details and Location in Report
b) ~~A final~~Final CHRP to be filed on or before 1 November after the first complete growing season following the commencement of operation for the Section 52 Facilities. This updated version of the ~~Project, to~~CHRP shall include, but not be limited to: i) the preliminary CHRP, with any updates identified in a revision log that includes the rationale for any changes to decision making criteria; ii) a complete table describing caribou habitat restoration sites, including but not limited to location, spatial area, description of habitat quality, site-specific restoration activities and challenges; iii) specification drawings for the implementation of each restoration method; iv) maps or Environmental Alignment Sheets showing the locations of the sites; v) evidence ~~and a summary~~ of how further consultation feedback from Environment Canada and ~~AESRD~~appropriate provincial authorities is integrated into the plan; and vi) a quantitative and qualitative assessment of the total area of direct disturbance to caribou habitat that will be restored, the duration of spatial disturbance, and the aerial extent of the resulting residual effects to be offset, which also includes indirect disturbance.	The Final CHRP will be filed on or before November 1~~, 2016.~~ after the first complete growing season following the Project being placed into service. For schedule information, see Section 5.~~6~~8.

2.0 GOAL, OBJECTIVES AND QUANTIFIABLE TARGETS

This section describes the goal, objectives and quantifiable targets of the CHRP.

~~2.1 GOAL~~

2.1 GOAL

The overarching goal of NGTL's caribou habitat restoration plan is to minimize the predicted residual effects of the Project and the Project's contribution to cumulative effects on caribou and caribou habitat in a manner that aligns with provincial and federal policies.

~~2.2 OBJECTIVES~~

2.2 OBJECTIVES

The objectives of the CHRP were designed to achieve the goal in a way that incorporates the best information available, and can be implemented and ~~can be~~ measured to quantify residual effects on caribou and impacted caribou habitat. The three objectives of the CHRP are:

1. **Habitat restoration**: revegetation of the Project footprint that achieves establishment, survival and growth of target species in the short term, so natural ecosystems, consistent with adjacent ecosystems, are expected to regenerate over the long term. For example, caribou habitat will be restored in the Project footprint through revegetation, mounding, bioengineering and berms to provide both immediate and sustainable functional habitat that supports caribou recovery over the long term.
2. **Access control**: effectively discourages access in the Project footprint as an interim measure until results of the monitoring program indicate long~~-~~ term habitat restoration has been successful. For example, access and use of the ROW is controlled through placement of coarse woody debris, tree felling, sign placement~~,~~ and rollback to limit access.
3. **Line-of-sight blocking**: reduce lines-of-sight along the Project footprint using barriers such as screens and vegetation. For example, tree planting, tree felling, vegetative and fabricated site screening are intended to reduce visibility along the ROW.

The CHRP goal to minimize Project residual effects on impacted caribou habitat will be attained by implementing the three objectives identified above. The Final CHRP will assess the objectives from a qualitative and quantitative perspective.

~~2.3 QUANTIFIABLE TARGETS~~

2.3 QUANTIFIABLE TARGETS

Quantifiable targets are the criteria that will be used to determine whether the CHRP objectives identified in Section 2.2 have been achieved:

- extent of predicted residual effects
- whether the CHRP objectives have been achieved
- need for compensation offsets

For more information on quantifiable targets and performance measures, see Section 4.

3.0 DECISION FRAMEWORK

The decision framework (see Figures 3-1, 3-2 and 3-3) will be used to guide the Project in meeting the goal of the CHRP. The decision framework NGTL has developed is a principle based logic model ~~specific~~ that supports each of the three objectives and forms the basis for quantifiable targets.

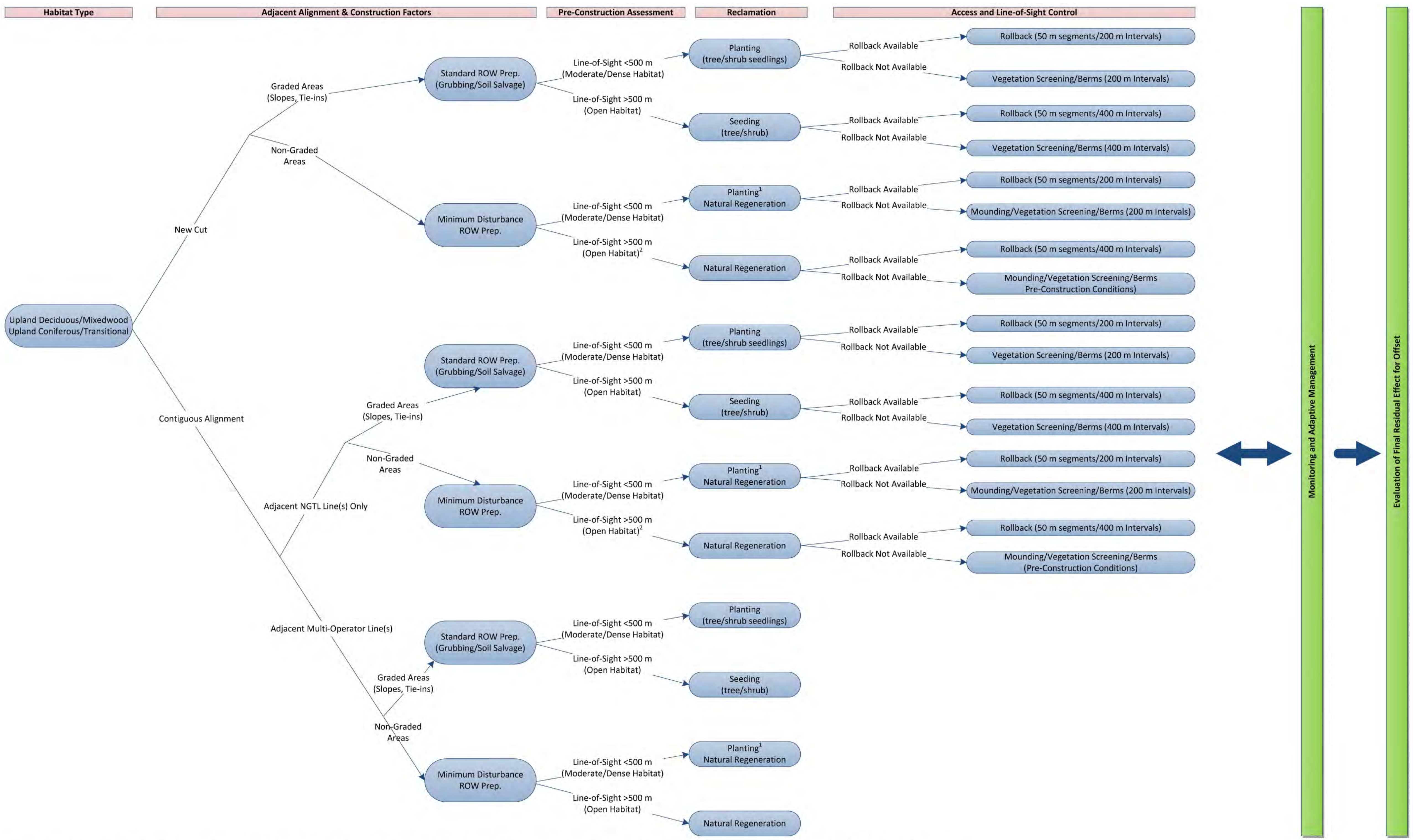
The decision framework was initially developed by NGTL from information obtained in the literature review, as well as industry best management practices and industry consultation. However, the decision framework included in this Preliminary CHRP has been revised to reflect recent lessons learned from field experience on other NGTL projects that impact caribou habitat. In particular, the decision framework has been revised to incorporate lessons learned in implementing line of sight blocks and access control measures on the recently constructed Chinchaga ~~Section project~~Project.

The decision framework will be applied at the start of construction to identify candidate sites for mitigation measures and reviewed during construction to identify any changes in inputs. Mitigation will be applied during final cleanup.

Figures 3-1, 3-2 and 3-3 are presented in chronological order ~~of~~in which they are implemented: access control, line of sight blocking and habitat restoration. These figures show restoration measures or tools that can be applied to the Project footprint in order to meet the CHRP goal. However, only restoration measures or tools applicable to the Project~~, as restoration measures,~~ will be applied. These are outlined in Section 5, Table 5-3.

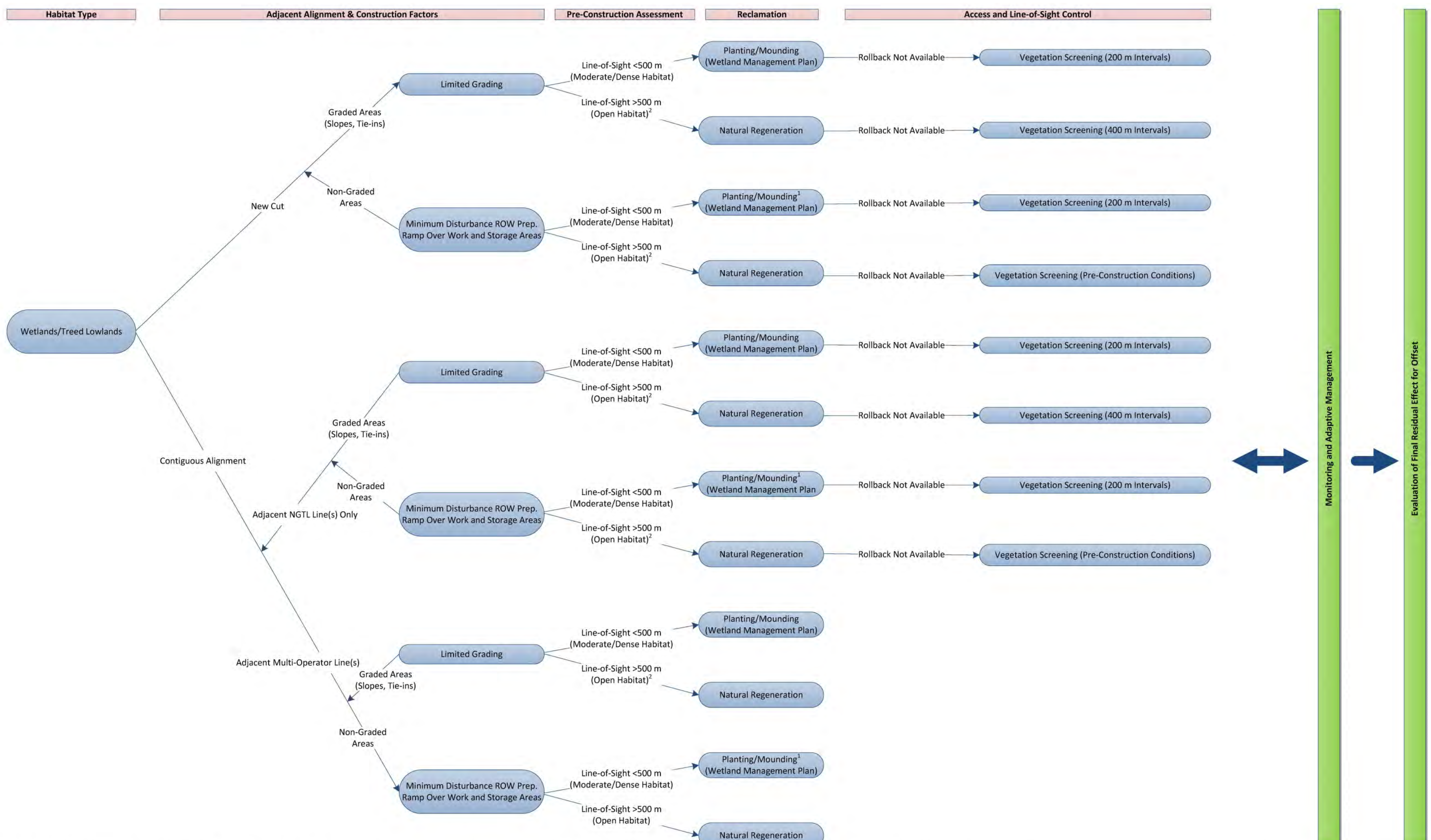
Key factors in the choice of these restoration measures or tools include:

- natural site characteristics
- existing disturbance and activities
- regulatory requirements
- site-specific construction methods



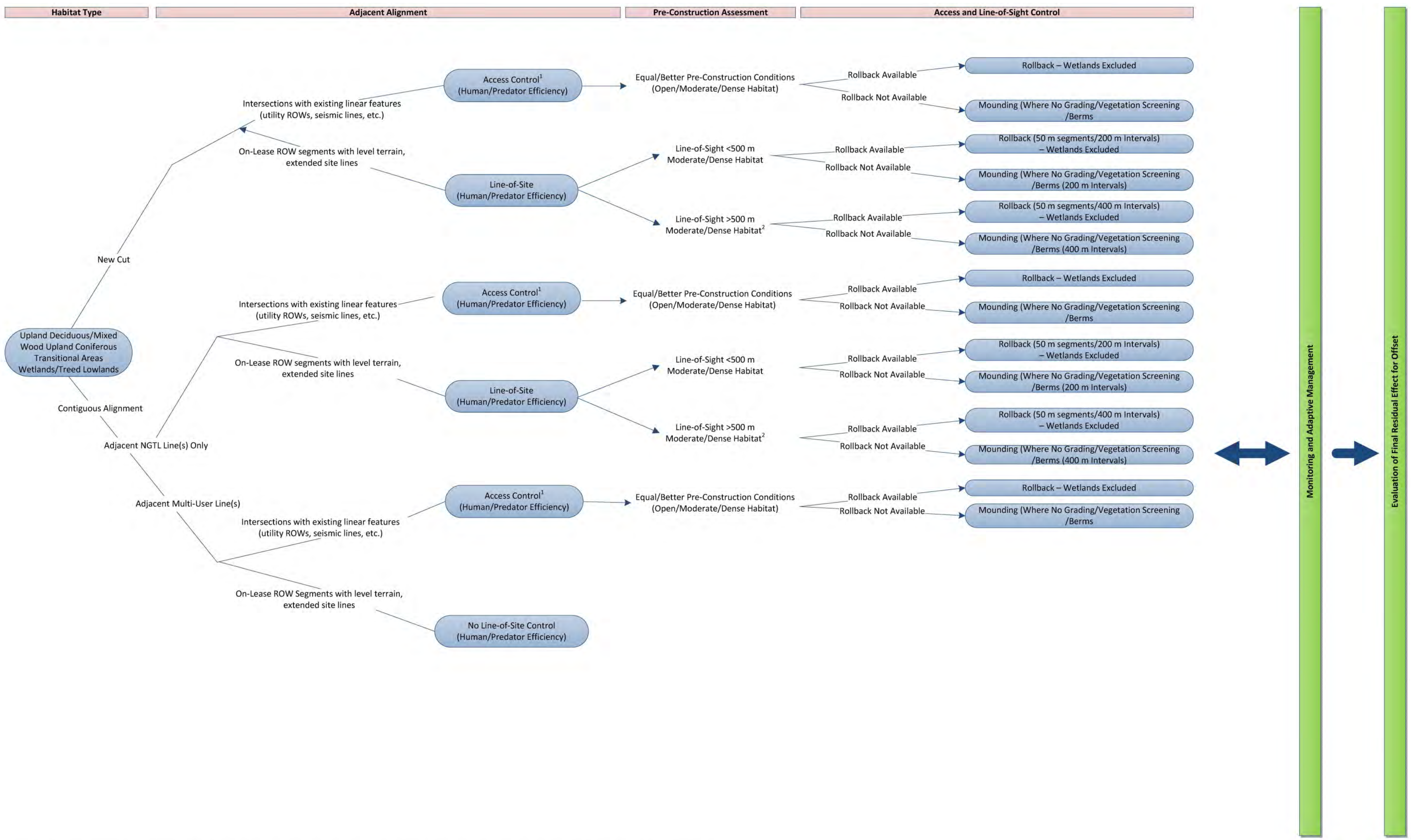
Note: (1) Habitat-specific planting to accelerate natural regeneration in areas of minimal disturbance ROW preparation with line-of-sight <500 m will be considered from detailed habitat information.
(2) In areas of new cut or contiguous alignment with NGTL lines only, where minimum disturbance ROW preparation and pre-construction conditions.

Figure 3-1: Decision Framework (for Upland Mixedwood/Upland Coniferous/Transitional Habitat)



Note: (1) Habitat-specific planting to accelerate natural regeneration in areas of minimal disturbance ROW preparation with line-of-sight <500 m will be considered from detailed habitat information.
(2) In areas of new cut or contiguous alignment with NGTL lines only, where minimum disturbance ROW preparation and pre-construction line-of-site extends >500 m on-easement (i.e., open habitat), line-of-site blocking will be placed at intervals that achieve pre-construction conditions.

Figure 3-2: Decision Framework (for Treed Lowlands and Wetlands)



Note: (1) Access control at intersecting existing linear features (i.e., utility ROW, seismic lines, etc.) will not be implemented or inhibit traditional use.

Figure 3-3: Decision Framework (for Line-of-Sight and Access Control)

4.0 QUANTIFIABLE TARGETS AND PERFORMANCE MEASURES

This section describes:

- quantifiable targets and performance measures used to evaluate the extent of predicted residual effects
- the extent to which CHRP goal and objectives have been met
- the need for compensation offsets for any residual effects remaining after implementation of CHRP measures

For a summary of the quantifiable targets and performance measures available to the Project, see Table~~ 4-1.~~ 4-1. The quantifiable targets and performance measures selected for the Project work in conjunction with the decision framework described in Section 3.

Table 4-1: Quantifiable Targets and Performance Measures

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Habitat Restoration	• Successful native vegetation re-establishment using the proposed habitat restoration measures will achieve trajectories toward natural ecosystem types, which will eventually re-establish native wildlife habitat. • The Project footprint in a caribou range is the proposed clearing of new area (i.e., excludes overlapping/shared areas with existing disturbances). • NGTL's operation and maintenance practice includes vegetation control over the pipe centreline (approximately 6–10 m wide area centred over the pipeline) as a corporate mechanism to meet compliance with CSA-Z662-15. This Standard requires that vegetation is controlled along rights~~-~~-of--way to maintain clear visibility from the air and provide ready access for maintenance crews (CSA 2015). Although, there is flexibility in NGTL's vegetation control practice to allow for wildlife habitat objectives yet remain in compliance with CSA Z662-15~~,~~. NGTL acknowledges limitations for sustained revegetation success along the pipe centreline while the pipeline is in operation. NGTL understands its obligations for achieving equivalent land capability at end of pipeline life.	Upland Deciduous/Mixedwood/Transitional/ Upland Coniferous • Achieve >80% or higher survival rate for planted seedlings within ~~15~~ 10 years following implementation of CHRP measures~~.~~. • Demonstrate sustained growth trends across >80% of restoration locations within ~~15 years following implementation of CHRP measures.~~ ~~Upland Coniferous~~ ~~• Achieve >80% or higher survival rate for planted seedlings within 15 years following implementation of CHRP measures.~~ • ~~Demonstrate sustained vegetation growth trends across >80% of restoration locations within~~ ~~15~~10 years following implementation of CHRP measures.	• Quantitative measures of success will include comparisons of regeneration parameters (e.g., vigour, height, percent cover, species composition) between Years 1, 3, 5~~,~~ and 10~~, 15~~ following start of operation, with the objective of ensuring establishment of each habitat type and a trend toward achieving equivalent land capacity. If regeneration parameters are not met, adaptive management measures will be implemented to meet vegetation reestablishment trajectory. It is intended that plantings will be monitored for ~~15~~10 years pursuant to Condition 37. • GPS location, number and type of restoration treatments and the frequency of monitoring sessions will be defined and mapped in ~~the final~~ thefinal CHRP.

~~Table 4-2: Quantifiable Targets and Performance Measures (cont'd)~~

Table 4-2: Quantifiable Targets and Performance Measures (cont'd) (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria

Habitat Restoration (cont'd)	• Areas ~~of~~in the Project footprint that parallel existing footprints with grass cover could have limited successful survival of planted species, due to competition from species ingress from adjacent disturbance.
	• Overlapping dispositions such as a gravel roads or facilities could limit long-term restoration success.
		Treed Wetlands/Treed Lowlands
		• ~~Achieve~~Where tree seedlings are planted (i.e., mounded sites):
		  • achieve >50% survival rate for ~~planted~~ seedlings/ transplants within ~~15~~ 10 years following ~~implementation of CHRP measures.~~planting
		  • ~~Demonstrate~~demonstrate sustained growth trends across >50% of restoration locations within ~~15~~ 10 years following implementation of CHRP measures
		Shrub/Graminoid Wetland
		• Within 10 years following installation of CHRP measures~~.~~:
		  • >50% cover of native vegetation species in the footprint
		  • no restricted weeds
			• Where revegetation success ~~is inadequate~~does not meet quantifiable targets, NGTL will determine ~~an~~ appropriate adaptive management. For example, if seedling mortality is unexpectedly high, NGTL will do additional planting, improve site conditions for seedling success or improve restoration efforts at other sites.

Table 4-2: Quantifiable Targets and Performance Measures (cont'd) (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria

Access Control	• Access control measures are most effective when implemented at intersections of the Project ROW with existing perpendicular linear features (e.g., roads, utility~~-~~ corridors, seismic lines).
	• Access by NGTL staff and contractors, including operations personnel as well as reclamation and monitoring crews, will be recorded and monitored. Access by Project personnel within the footprint in caribou~~-~~ range will be limited to the extent practical. Traditional access will be maintained.
	• ~~Traditional~~The access control evaluation might ~~need~~be guided by the Access Management Plan (AMP), which was prepared pursuant to ~~be maintained~~Condition 16.
		Access Control:
		The following quantifiable targets will be used to measure the access control objective:
		• a lower measure (e.g.,~~-~~ rate, proportion, count) of access along the segments of the Project ~~right-of-way~~ROW where access is controlled relative to uncontrolled segments
		• <20% increase in access (e.g.,~~-~~ rate, proportion, count) from the baseline assessment as measured by remote cameras
		The quantifiable targets for access in the Project ROW are expected to be achieved within 5 years following CHRP implementation, though monitoring will continue over ~~15~~10 years.
			• Evidence and level of access along Project~~-~~ ROW using criteria ratings such as:
			  • access evident: Yes/No
			  • access type: all-terrain vehicle (ATV~~/~~)/ truck/ snowmobile/ non-motorized/
			  • predator/~~-~~other
			• Access level:~~ low (~~
			  • No access evident
			  • Low: tracks/~~-~~trail evident but difficult to discern or appears to be infrequently used~~)/high (~~
			  • High: tracks/trails appear to be well-used; vegetation is trampled down, bare~~-~~ ground from frequent use might be visible~~).~~)
			• Access level definitions will be refined in the ~~final~~Final CHRP.
			• An evaluation of whether the objective for access control is achieved will consider ~~recorded evidence of~~collected qualitative and quantitative data.

Table 4-2: Quantifiable Targets and Performance Measures (cont'd) (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Line-of-Sight Blocking	• Operating practices for energy development in sensitive caribou range in British Columbia (BC Ministry of Environment 2011) suggest implementing line-of-sight management every 500 m on linear features that do not share a ROW boundary with a road. Line-of-sight blocking as part of this Project will follow this guideline where it is not collocated with roads or other linear developments. • Bends in the pipeline (doglegs) can reduce line-of-sight, but opportunities to do this for the Project might be limited where the ROW parallels other linear developments. • Wetlands and some treed lowlands encountered by the Project footprint naturally have low and/or open vegetation structure. The line-of-sight distance in these areas is naturally long and, therefore, sightline management techniques are not practical for these locations. • Concern from provincial regulators regarding fire hazard and forest health (pathogen spread), availability of line of sight blocking material, suitability of substrate to support structures (i.e., peat does not support fencing), introduction of weeds from imported material and potential for alteration in surface hydrology (particularly from earth berms) can limit the use of line of sight blocking measures. • Appropriate locations for line-of-sight blocks will be identified post-construction when final clearing is complete and included and as-built drawings.	Line-of-Sight Blocking: • Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, achieve sightline distance of < 500 m within 10 years following implementation of CHRP measures. • Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, where planting for future vegetation screens in combination with or without rollback have been installed, achieve 80% or higher survival rate for planted seedlings that are intended as line-of-sight blocks within 10 years following implementation of CHRP measures.	• Establish line-of-sight blocks in forested areas of the footprint in caribou range that will achieve a sightline distance of 500 m or less in areas of new cut or in sections contiguous with, and adjacent to, NGTL lines only.

Table 4-2: Quantifiable Targets and Performance Measures (cont'd) (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Line-of-Sight Blocking (cont'd)	• A combination of measures, including vegetation screening, rollback and mounding will be applied. Feasibility of installing berms or fencing will be investigated post-construction. • Few limitations are associated with using vegetation screening to reduce line-of-sight. • Paralleling an existing linear corridor presents challenges for line-of-sight blocking where the adjacent line is owned by a company other than TransCanada. • Application of sightline management techniques should extend across the width of the Project footprint and adjacent disturbance to be effective.		

Note:
1 Restoration objectives will continue to be evaluated for the Final CHRP to consider any updated consultation with stakeholders or if any other relevant information becomes available.

~~**Table 4-3: Quantifiable Targets and Performance Measures (cont'd)**~~

~~Objective[1]~~	~~Rationale/Limitations/Assumptions~~	~~Quantifiable Targets~~	~~Evaluation Criteria~~

~~**Line-of-Sight Blocking**~~	• ~~There is no direct provincial regulation in Alberta for line-of-sight management for linear features. Reclamation programs for previous developments in Alberta have targeted maximum sightlines of 400 m (Golder 2007; DES 2004). Operating practices for energy development in sensitive caribou range in BC (BC Ministry of Environment 2011) suggest implementing line-of-sight management every 500 m on linear features that do not share a ROW boundary with a road.~~ • ~~Bends in the pipeline (doglegs) can reduce line-of-sight, but opportunities to do this for the Project might be limited where it parallels other ROWs.~~ • ~~Wetlands and some treed lowlands encountered by the Project footprint naturally have low and/or open vegetation structure. The line-of-sight distance in these areas is naturally long and, therefore, sightline management techniques are not practical for these locations.~~ • ~~Concern from provincial regulators regarding fire hazard and forest health (pathogen spread), availability of material, suitability of substrate to support structures (i.e., peat does not support fencing), introduction of weeds from imported material and potential for alteration in surface hydrology (particularly from earth berms) can limit applicability of this treatment type.~~	~~Line-of-Sight Blocking:~~ • ~~Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, achieve sightline distance of < 500 m within 15 years following implementation of CHRP measures.~~ • ~~Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, where planting for future vegetation screens in combination with or without rollback have been installed, achieve 80% or higher survival rate for planted seedlings that are intended as line-of-sight blocks within 15 years following implementation of CHRP measures.~~ • ~~Where existing linear features intersect the Project ROW (i.e., seismic and other utility ROWs), achieve line-of-sight block distances equal to or less than pre-construction distances.~~	~~Establish line-of-sight blocks in forested areas of the footprint in caribou range that will achieve a sightline distance of 500 m or less in areas of new cut or in sections contiguous with, and adjacent to, NGTL lines only.~~

~~**Table 4-4: Quantifiable Targets and Performance Measures (cont'd)**~~

~~**Objective**~~ [1]	~~**Rationale/Limitations/Assumptions**~~	~~**Quantifiable Targets**~~	~~**Evaluation Criteria**~~
~~**Line-of-Sight Blocking (cont'd)**~~	• ~~Appropriate locations for line-of-sight blocks will be identified post-construction when final clearing is complete.~~ • ~~A combination of measures, including vegetation screening, rollback and mounding will be applied. Feasibility of installing berms or fencing will be investigated post-construction.~~ • ~~Fewer limitations are associated with using vegetation screening to reduce line-of-sight.~~ • ~~Paralleling an existing linear corridor presents challenges for line-of-sight blocking where the adjacent line is owned by a different company. Application of sightline management techniques should extend across the width of the Project footprint and adjacent disturbance to be effective.~~		

~~Notes:~~

[1] ~~Restoration objectives will continue to be evaluated for the Final CHRP to consider any updated consultation with Alberta Environment and Sustainable Resource (AESRD) now referred to as Alberta Environment and Parks [AEP] or other information that becomes available.~~

~~Available footprint is the area of the Project footprint that is not anticipated to be disturbed by future operation and maintenance activities during the life of the Project.~~

5.0 THE RESTORATION IMPLEMENTATION PLAN

This section provides a high-level summary of Project impacts to affected ~~boreal woodland~~mountain caribou habitat. This section also describes NGTL's plan to implement a decision-~~ ~~framework (see Section-~~ ~~3) which will be used by the Project to achieve the overarching goal of the CHRP. The content of this section presents NGTL's plan to reduce residual and cumulative effects of the Project on caribou and impacted caribou habitat.

5.1 PROJECT IMPACTS TO CARIBOU HABITAT

The Environmental and Socio-Economic Assessment (ESA) for the Project identified potential direct and indirect effects of the Project on ~~boreal woodland~~ caribou and ~~boreal woodland~~ caribou habitat through changes in habitat conditions, herd movement and caribou mortality risk. The cumulative effects analysis completed as part of the ESA determined that the Project will ~~result in an~~have small, incremental ~~contribution~~contributions to the overall cumulative effects ~~on~~to the ~~Egg–Pony~~Graham and ~~Algar herds of the East Side Athabasca~~ Pink Mountain~~River~~ ~~(ESAR)~~ caribou ranges (see Figure 1-1). The Project linear disturbance presented in Table 5-1 reflects the most recent Project design at the time this Preliminary CHRP was prepared. Final determination of linear disturbance in caribou range~~. Baseline conditions identified in the ESA~~ will be ~~used to determine~~presented in the ~~level of vegetation restoration required~~Final CHRP.

~~The Project linear disturbance presented inTable 5-1 reflects the most recent Project design at the time this Preliminary CHRP was prepared. The pipeline route is located in the Egg–Pony caribou range for approximately 4.9 km, of which 3.1 km (64%) parallels existing pipeline ROWs. The entire length is in an area of historical forest fire that occurred in 1981. The pipeline route is located in the Algar caribou range for approximately 18.9 km, and parallels an existing pipeline, road or seismic line for the entire length. In the Algar caribou range, approximately 12.2 km (65%) of the pipeline route is in an area of historical forest fire that occurred in 1995 and the House River fire that occurred in 2002 (see Figure~~ The NEB Report stated that the Project will still result in loss of habitat (and could result in disturbance to caribou) beginning with construction and continuing through the lifecycle of the Project, notwithstanding the proposed mitigation within NGTL's EPP and CMP. The Board stated that disturbances within caribou ranges should be minimized, and measures taken before and during construction to help accelerate the restoration of caribou habitat. The Board is of the view that Project proponents have a responsibility to not only reduce effects on caribou habitat, but to also restore affected habitat as soon as possible and as much as possible. The Board, therefore, imposed Condition 15 requiring NGTL to prepare a Preliminary and Final CHRP for the Project. The Board acknowledged NGTL's preparation and submission of the preliminary CMP and noted that the CHRP will supersede and replace the CMP.

5.1.1 Impacted Caribou Habitat

The Project will impact the Graham and Pink Mountain caribou ranges (see Section 8.3). The Aitken Creek Section of the Project will result in a linear disturbance of approximately 8 km within the Graham caribou range. The linear disturbance on the Kahta Section extends approximately 19 km within the Pink Mountain caribou range (see Table 5-1).

Table 5~~-1). The ROW width will vary based on the workspace and will be reported in the final CHRP.~~

-1 also describes both the Graham and Pink Mountain herds listing status. Both herds are provincially designated northern ecotype caribou (BC Ministry of Environment [MOE] 2010), but are classified differently at the population level.

The Graham herd belongs to the Southern Mountain population, Northern Group, and is designated as Threatened on Schedule 1 of the *Species at Risk Act* (SARA) and by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and is blue-listed in BC (BC Conservation Data Centre [CDC] 2015; COSEWIC 2015; Environment Canada (EC) 2015).

The Pink Mountain herd is part of the Northern Mountain population, and is designated as Special Concern on Schedule 1 of SARA and by COSEWIC, and is blue-listed in BC (BC CDC 2015; COSEWIC 2015; EC 2015). COSEWIC has further divided each population into Designatable Units (DU), and both the Graham and Pink Mountain herds are included in Northern Mountain DU7 (COSEWIC 2011).

Species designated as Special Concern (SC) on Schedule 1 of SARA, such as the Pink Mountain herd, require management plans developed by the federal government for the species and its habitat, whereas species designated as Threatened or Endangered, such as the Graham herd, require a recovery strategy. Because the Pink Mountain caribou population is designated SC, a management plan was developed for this population, where it is referred to in the collective as Northern Mountain caribou.

Table 5-1: Caribou Nomenclature and Ranges that Interact with the Project

Project Component	Caribou Range	~~Alberta~~BC Provincial ~~and Federal~~ Status Designation and Nomenclature	Federal Status Designation and Nomenclature	Current Population Trend	Project Linear Disturbance in Caribou Range ~~(km)~~		
					Total Length in Caribou Range	~~Parallels~~Total Parallel to Existing Linear Disturbance	New Linear Disturbance
~~ESAR~~Aitken Creek Section (pipeline)	~~Threatened[1,2,3]~~Graham	~~Declining[4]~~Blue[1] Northern ecotype[2] Northern caribou[3]	~~Egg– Pony~~Threatened[4,5] Northern Group subpopulation of the Southern Mountain population[6] DU7[7]	~~4.9 km~~Stable[8]	~~3~~8.1 km ~~(64%)~~	~~0.1~~7 km (~~3~~86.4%)	1.~~6~~1 km ~~(33~~ (13.6%)

Kahta Section (pipeline and two meter station sites)	Pink Mountain	Blue[1] Northern ecotype[2]	~~Algar~~Special Concern[4,5] Northern Mountain population[6] DU7[7]	~~18.9 km~~Unknown[9]	~~1.3~~19 km ~~(7%)~~	13.~~4~~3 km ~~(71~~ (70%)	~~18.9~~5.7 km (~~100~~30%)
~~Note:~~ ~~1 Alberta provincial status designation under the *Wildlife Act* (AESRD 2014a).~~ ~~2 Status designation under Schedule 1 of the *Species at Risk Act* (SARA) (Environment Canada 2015).~~ ~~3 Status designation by COSEWIC 2015.~~ ~~4 Population trend reported by Environment Canada 2012.~~							

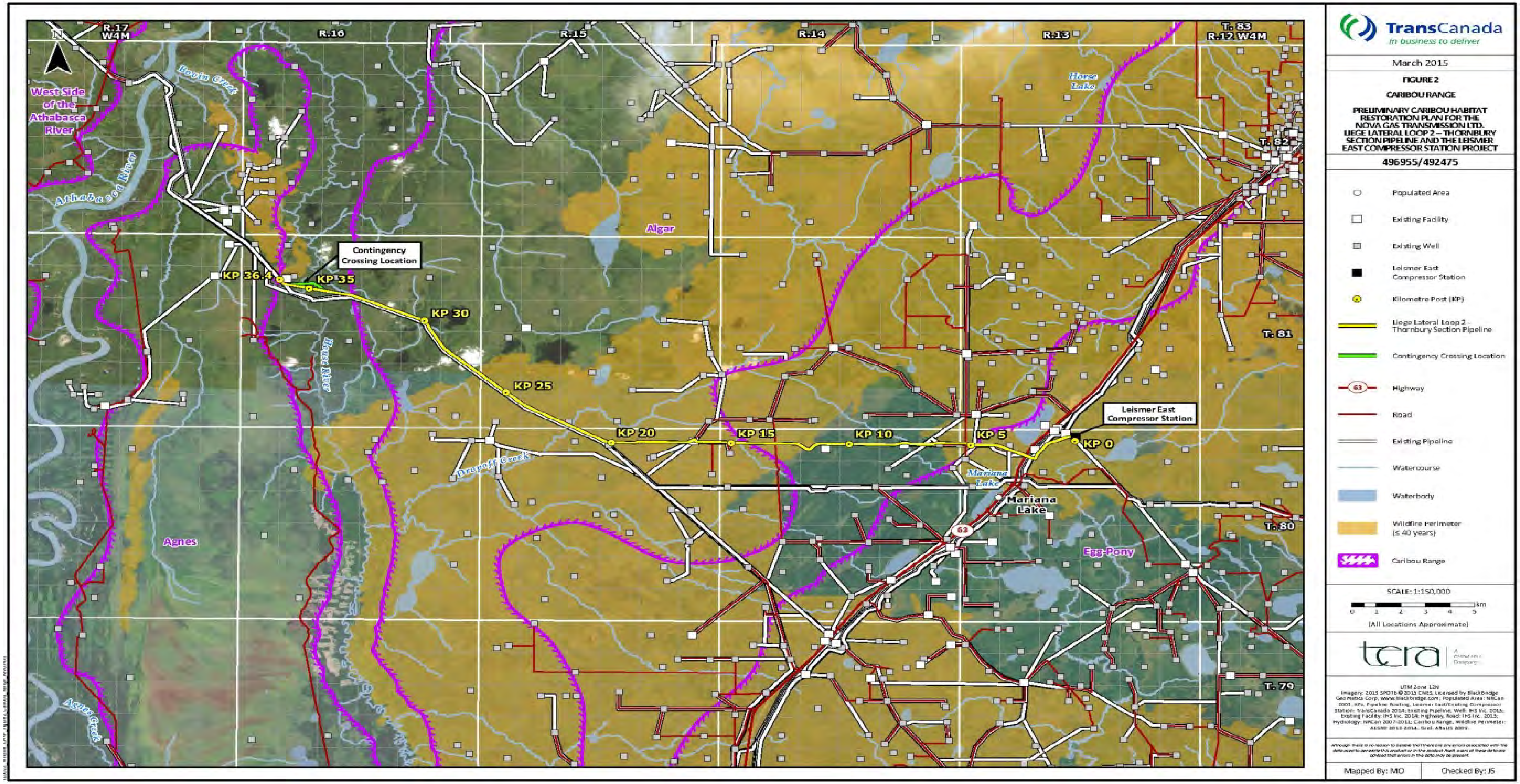
Table 5-1: Caribou Nomenclature and Ranges that Interact with the Project (cont'd)

Note: 1 BC provincial status designation (BC CDC 2015). 2 Ecotypes assigned by BC MOE (2010). 3 Northern caribou as described in the Implementation Plan for the Ongoing Management of South Peace Northern Caribou (BC MOE 2013) 4 Status designation under Schedule 1 of SARA (EC 2015). 5 Status designation under COSEWIC (2015). 6 Caribou populations described by COSEWIC (2002) and the SARA Public Registry (EC 2015), and subpopulation described by EC (2014). 7 Northern Mountain DU7 assigned by COSEWIC (2011). 8 Population trend reported by EC (2014). 9 Population trend reported by EC (2012a).

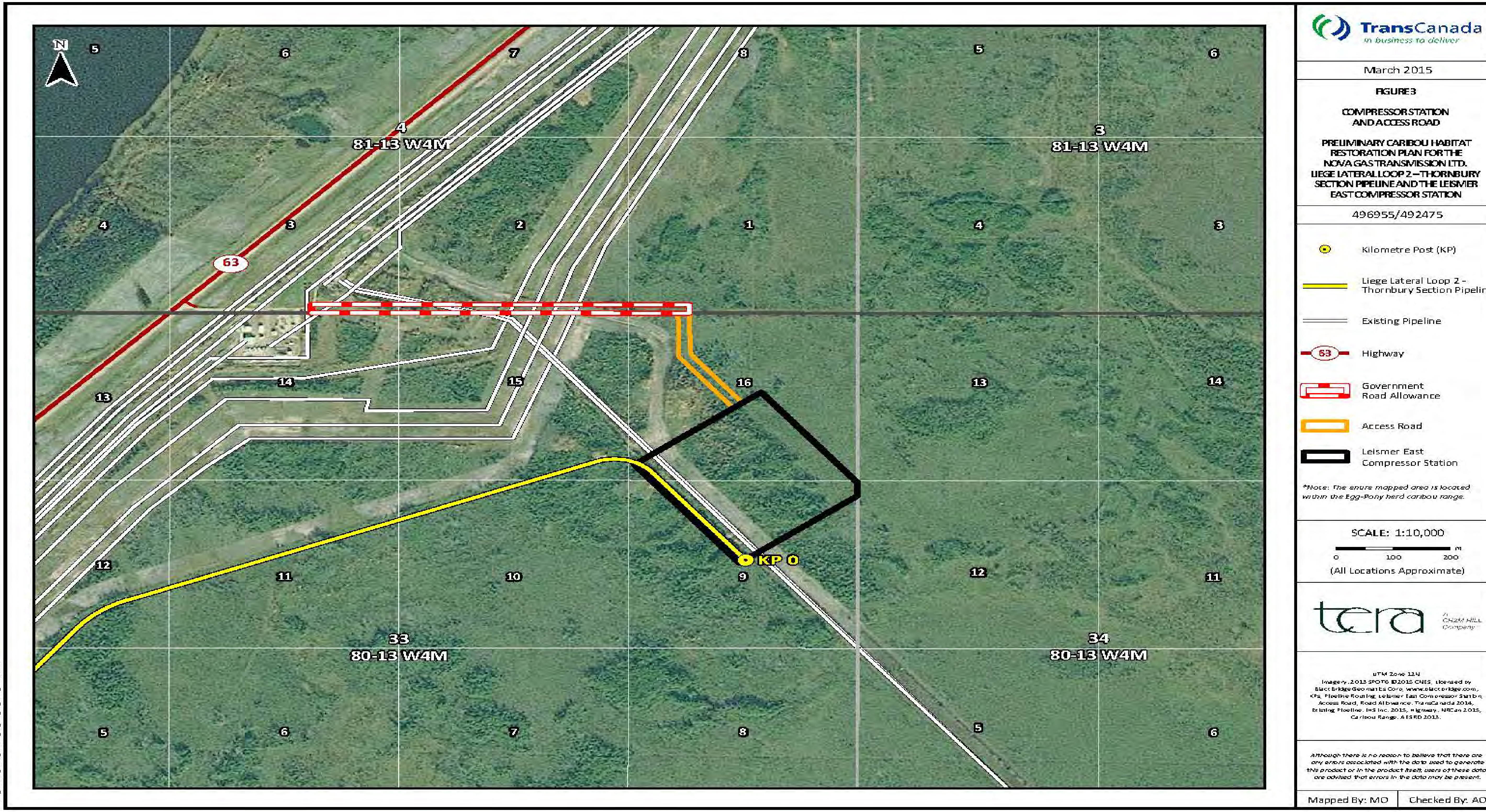
5.2 QUANTIFICATION OF ~~HABITAT DISTURBANCE~~HABITAT DISTURBANCE

Restoration of disturbed habitat assumes that caribou will return to spatial separation from primary prey (moose and deer) and predators and, as a result, return to pre--disturbance levels of mortality risk (Athabasca Landscape Team 2009). Restoration of anthropogenic disturbances is also expected to reduce the degradation of functional habitat for caribou, since caribou will no longer exhibit reduced use on or near (i.e., in a zone of influence) the reclaimed disturbance (Oberg 2001). As such, restoration of caribou habitat is expected to alleviate the residual direct habitat disturbance over the long term.

By addressing residual direct habitat disturbance, indirect residual effects will also be addressed. Included in the direct disturbance footprint are the ROW, meter stations, temporary workspace, ~~compressor station site~~ new temporary construction access and new permanent access ~~(see Figure 5-2).~~. The Final CHRP will provide schematics that illustrate the quantification of direct and indirect residual effects of the Project on caribou habitat using as--built information. Indirect disturbance (i.e., reduced habitat effectiveness) is defined as the area within the 500 m buffer of anthropogenic disturbance features.



~~**Figure 5-1: Caribou Range**~~



~~Figure 5-2: Compressor Station and Access Road~~

The spatial residual effect will be quantified using a method consistent with *Recovery Strategy for the Woodland Caribou Southern Mountain population* (Rangifer~~-~~ tarandus caribou~~), *Boreal Population,*~~) *in Canada* (~~Environment Canada 2011, 2012~~EC 2014). The Recovery Strategy defines undisturbed caribou habitat in the Environmental Site Assessment Repository (ESAR) caribou range as habitat that has not burned in the last 40 years and is not in or within 500 m of anthropogenic disturbance. Although the Project footprint is in an area that has been burned by forest fires within the last 40 years, NGTL will still consider this non-permanent disturbance in its quantification of spatial residual effect.

Restoration of ~~the~~ impacted ~~ESAR~~mountain caribou habitat through implementation of the CHRP measures will not completely eliminate adverse Project effects on caribou habitat. During operations, NGTL will periodically manage vegetation within 5 to 10 m of the centreline of the operational pipeline, in accordance with TransCanada operational procedures for integrity monitoring under Canadian Standards Association (CSA) Z662-15 (CSA~~-~~ 2015).

This area will be allowed to regenerate naturally, but will be periodically mowed or mulched. This theoretical access area will not achieve the quantifiable targets for the CHRP and is quantified as a residual direct disturbance of caribou habitat.

The area of direct disturbance in the Pink Mountain and Graham caribou ranges estimated during the application phase of the Project was approximately 162 ha and 29 ha. After application of the CHRP measures outlined in this document, the final disturbance footprint will be determined. Direct and indirect Project disturbance on caribou habitat will be quantified and presented in the Final CHRP, as outlined in Table 5-2.

Table 5-2: Quantification of Direct and Indirect Project Disturbance of Caribou Habitat

Area (ha)				
Length of Pipeline Segment	**Direct Project Disturbance**	**Restored Project Footprint**	**Residual Direct Project Disturbance**	**Incremental Indirect Disturbance**
TBD~~**Length of Pipeline Segment**~~	TBD	TBD	TBD	TBD

To calculate the final offset requirements for the Graham herd within the Aitken Creek Section, pursuant to Condition 36~~The proportion of total area for each mitigation measure in each habitat type will be used to estimate the remaining Project effect using the following equation:~~

~~**Calculation 5-1:**~~

~~$Remaining\ Project\ Effect\ (ha) = Inherent\ Project\ Effect\ (ha) \times \{1 - (Measure\ Effectiveness\ \times Delay\ Penalty)\}$~~~~To calculate the final offset requirement for the Project~~, the first step involves calculating the remaining project effect after CHRP measures are applied to the Project footprint. The restored Project footprint will be categorized as either new alignment or parallel alignment. New alignment is assumed to have full effect on caribou use of this part of the range~~-~~, whereas segments parallel to adjacent disturbances have less effect on ~~range~~ caribou use (this will be further outlined in the OMP).

The second step (inherent project effect) involves categorizing the portion of total area for new alignment and parallel alignment in their respective habitat classes to apply the appropriate delay factors (i.e., time lags) associated with each mitigation measure.

The third step categorizes the proportion of total area for each mitigation measure in each habitat type. The proportion of total area for each mitigation measure in each habitat type will be used to estimate the remaining Project effect using the following equation:

Calculation 5-1:

$$Remaining\ Project\ Effect\ (ha) = Inherent\ Project\ Effect\ (ha) \times \{1 - (Measure\ Effectiveness\ \times Delay\ Penalty)\}$$

The remaining project effect calculation will be used to populate Table ~~5-~~5-2 in the Final CHRP.

For previous NGTL projects that impacted caribou habitat, NGTL allowed intermittent alternating plantings of woody vegetation over the pipeline centreline. For the Project, trees will be planted across the centreline where open~~-~~ areas are left at alternating sides of the ROW. This will allow for a meandering access line over the centreline, and will in time, establish line-of-sight breaks (i.e., vegetation screens). Using this alternating planting method, the quantifiable targets for habitat restoration (revegetation) are expected to be achievable in the long term.

The entire width of the Project planted footprint will not be considered restored in the short term. In the short term, there will be a spatial residual effect on the area of operational access. In the long term, the area of operational access is not expected to be a spatial residual effect where the ROW segment is planted with trees. The spatial residual effect is expected to be effectively addressed once the habitat regenerates in the long term.

Some restoration measures are designed to be effective immediately or in the short term. For example, retention of vegetated visual screens, mounding and tree- felling (particularly if in conjunction with mounding) are expected to reduce Project residual effects on caribou habitat immediately.

The lag time required to achieve habitat value equivalent to pre-construction conditions is important and will be considered in the quantification of residual effects in the Final CHRP. Residual effects will also be presented in the Final CHRP and will consider ~~spatial residual effect;~~ lag time and ~~the~~also factor in uncertainty associated with offsets ~~(see Calculation 5-1).~~. Over the long term, the vegetation community composition and structure is expected to mature to a seral stage that will provide functional caribou- habitat and restore pre-disturbance predator–prey dynamics.

NGTL will develop an OMP to address Project residual effects on critical caribou habitat~~, in accordance with Condition 7. The Preliminary OMP will be filed with the NEB at least 90 days before requesting leave to open the Project.~~ for the Aitken Creek Section pursuant to Condition 36. The Preliminary OMP will further detail the method used to quantify the offsets. The Project OMP will use a method of offset quantification that aligns with NGTL's previous OMPs for projects constructed in boreal woodland caribou range. ~~Residual effects will also be presented in the Final CHRP and will consider lag time and factor in uncertainty associated with offsets.~~

The residual effects to be quantified in the Final CHRP using the method described above will be modified in the calculation of residual effects in the OMP to factor in:

- uncertainty associated with effectiveness of the CHRP measures
- context of the footprint related to existing disturbance (e.g., contiguous or non-contiguous)
- time lag or duration of residual effects

5.3 HABITAT RESTORATION

The decision framework (see Section 3) and regulatory guidelines summarized in Section 8 provide the basis for the Preliminary CHRP and will further guide the Final- CHRP. The decision framework provides direction on restoration factors such as variability in natural site characteristics, planting prescriptions, target vegetation, soil and site stability, and access management. This in-turn informs the quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects and the extent to which goals and objectives have been met.

For a suite of caribou habitat restoration measures, see Table ~~5-3.~~5-3. After applying the decision framework, suitable restoration measures will be selected. Several restoration methods described in the literature review and included in Table~~5-~~ 5-3 are considered not suitable given the limitations to implementation or effectiveness. These measures could be reconsidered~~,~~ if additional information becomes available to support their use.

For photos of potential restoration measures, including site conditions showing constraints and opportunities, see Appendix A.

Table 5-3: Habitat Restoration Measures

Restoration Measure	Objectives	Rationale	Comments
Berms	Access control Line-of-sight blocking	Berms can be constructed of coarse woody debris and timbers, or a combination of coarse woody debris and earth. Supported berms are constructed using timber cleared from the ROW. To effectively block line-of-sight, berms should be constructed to an approximate minimum height of 1.5-2 m. Promote rapid shrub/tree regeneration at ends of berms (e.g., shrub staking/transplants, seedling planting) to increase effectiveness as access control. Earth berms were 76% effective at excluding vehicles over 50 inch wide and 22% effective at excluding all vehicles including off-road vehicles (Esri User Conference 1996). Berms create a barrier that can be effective immediately following implementation. Coarse woody debris/timber berms are dependent on approval from provincial authorities to retain coarse woody debris on-site, as well as sufficient space to store the material during construction. Woody debris berms may present an increased fire hazard, depending on composition and location. NGTL has found on its existing ROWs where this measure was used, that woody debris berms deteriorate relatively quickly after installation (within several years), particularly if berms are moved to allow access to the ROW. Quantity of source material is usually not sufficient for earth berm construction in areas where minimum disturbance construction techniques are employed. Importing material is not preferred given the risk of introducing invasive plants. Earth berms should not be located in peatlands due to potential for settling and alteration of surface hydrology.	Limitations of this measure reduce its value. Woody material available for inclusion in berms is often limited, which can make this option less useful. Woody debris berms might be used as CHRP measures if sufficient wood exists at the Project site. Earth berms will not be considered a viable option for the Project as NGTL has found that there is generally insufficient source material to create earth berms.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Bioengineering • shrub staking/planting • tree seedling planting	Habitat Restoration Access control Line of sight blocking	Bioengineering in combination with stabilization measures (e.g., soil wraps) might be suitable at watercourses crossed with an open cut method. Bioengineering is the use of existing live vegetation to stabilize and revegetate a site (e.g., transplants; installing cuttings) and is a technique often used on slopes or riparian banks (Polster 2002). Species and planting densities used for bioengineering are site-dependent (Golder 2012a). Vegetation used is typically collected either from the disturbance site (i.e., before or during clearing), or from the adjacent area, in the form of cuttings (Golder 2012a). Vegetation might be planted during the growing season or during winter. 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 (Golder 2012a). Nursery-grown shrub seedlings might be planted where staking is not practical due to lack of available material, limitations associated with collecting material off-site, or where a restoration prescription calls for shrub planting of species that do not readily regenerate through cuttings/staking (e.g., alder). Alder 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 inter-planting alder with conifers. When alder is interspersed with conifer plantings, line-of-sight and 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 (Courtin and Brown 2001; Simard and Heineman 1996). The fast growth of alder can reduce growth rates of conifer plantings due to competition when alder densities are high (CRRP 2007b; Simard and Heineman 1996). Species are determined based on the adjacent forest stand and restoration objectives (e.g., low palatability for ungulates). Combined plantings of shrub and tree seedlings can be appropriate, depending on site conditions and anticipated natural revegetation of both species. Procurement of shrub seedlings (container or bare-root) can be challenging given limited seed availability. Planted shrubs can be slow to establish.	Shrub planting is a suitable CHRP measure for select site-specific locations if a need for combined conifer/shrub plantings is identified. Many shrub species can attract prey species such as moose and deer, which can attract wolves, thus its application will be limited as these species can have a negative effect on caribou (see Section 8).

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Conifer seedling planting	Habitat restoration Access control Line of sight blocking	Restoration species are determined based on the biophysical characteristics of the site, adjacent forest stand composition, and restoration objectives (e.g., low palatability for ungulates). Tree seedling planting is considered a long-term restoration treatment (full effectiveness is expected to take longer than 10 years). Planting densities for reclamation of forested areas in Canada have been based on forestry standards, ranging from 1,500–2,500 stems/ha (MacDonald et al. 2012). In the Prince George Forest Region of BC, target stocking densities for coniferous trees range from 400-1,200 stems/ha and the minimum stocking standards range from 200-700 stems/ha (BC MOF 2000). Target stocking density for deciduous trees is 2,500 stems/ha and the minimum stocking densities range from 1,700-2,000 stems/ha (BC MOF 2000). Given the relatively harsh growing conditions inherent to boreal ecosystems, mortality of planted seedlings is anticipated to range from approximately 5% to 20% in most site types (Golder 2012a,b). A planting density of 2,000-2,500 stems/ha is recommended for restoration of linear disturbances in boreal caribou ranges in northeast BC (Golder 2015). Although the above information was used to determine seeding densities there is no direct information or literature available on appropriate planting densities in the mountain caribou range where this Project occurs. The Project terrain includes more upland habitat than would typically be commercially harvested and researched. For example, Kahta has mineral soils within the top 50 cm or less in peat so mounding might be necessary to create suitable growing conditions. Given this information and the literature specified above, the following planting prescription has been formulated for this CHRP: • minimum seedling density of 1,200-1,600 stems/ha on sites that are not mounded • minimum seedling density of 900-1,100 stems/ha (combined planted seedlings and/or natural regeneration) on mounded sites (dependent on mound density)	Conifer seedling planting is a suitable CHRP measure for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Mounding	Restore vegetation (create microsites) 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 to enhance seedling survival. Mounding treed wetlands (e.g., bogs, 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 (Golder 2012a; Macadam and Bedford 1998). Soil properties (e.g., substrate, drainage) affect the ability of mounds to retain their structure. Mounding has been used as an access control measure on old roads and seismic lines to discourage off-road vehicle activity. It can be effective immediately following implementation. For access control purposes, mounds should be created using an excavator to 0.75 m deep, where site conditions allow (Golder 2012a). The excavated material is dumped beside the hole (Macadam and Bedford 1998). Transitional areas, or places with shallow peat (< 50 cm) are preferred for mounding. Suggested densities of mounding for access management or microsite creation purposes vary from 1,400-2,000 mounds/ha (Golder 2012a). Implementation of this mound density might be suitable for restoring disturbances such as seismic lines where specialized equipment is used and where frost is not driven into the soils to allow heavy equipment access. The mound density that can realistically be achieved on pipeline ROWs is lower (approximately 700-1,400 mounds/ha on previous NGTL projects). The limitations of mounding on pipeline ROWs include scheduling mounding for restoration during final cleanup, which typically depends on freezing-in of soils, availability of specialized equipment and minimum spatial separation of 5 m between mounds and the centreline of the operating pipeline.	Mounding is a suitable CHRP measure that will be used in conjunction with conifer seedling planting for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Minimum disturbance construction	Habitat Restoration Line of sight blocking	Construction during winter conditions allows for minimum disturbance construction techniques, which reduce the need for soil salvage and grading, and limit the width of grubbing to the trench area where grading is required. Reduced disturbance to vegetation and root systems is achieved by cutting, mowing or walking down and mulching shrubs and small-diameter trees at ground level. Intact root systems and seed beds with little soil disturbance facilitate rapid regeneration of vegetation. Use of snow padding or matting can limit the need for cutting or mowing shrubs and small trees, thereby speeding regeneration of native vegetation. The extent of minimum disturbance construction might be limited by scheduling to avoid the restricted timing window for caribou (January 15 to July 15). Soil conditions limit the applicability of minimum disturbance construction methods. Construction in well to moderately drained sites during non-frozen conditions requires grubbing and grading to salvage surface soils so they can be stored separately from subsoils and replaced following construction. This prevents admixing and loss of the productive surface soils that facilitate regeneration of vegetation.	Minimum disturbance construction is a suitable CHRP measure for the Project, and will be implemented where scheduling and soil conditions (e.g., frozen) allow.
Transplanting	Habitat Restoration Access control Line of sight blocking	Transplanting has the advantage of immediately establishing relatively large trees/shrubs (e.g., saplings). There are limitations to 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). Other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison (Golder 2012a). See Section 8.6.2 for more details.	Transplanting native vegetation is not a suitable CHRP measure for the Project as it has been shown to be a difficult technique to implement on a large scale, with multiple limitations. This technique could prove more suitable for future projects if advances in the method improve survival success rates.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Tree felling or bending	Access control Habitat Restoration Line of sight blocking	Mechanically bending or felling live trees onto a linear disturbance has been tested as a measure to restore habitat and manage access on seismic lines in caribou range (COSIA 2012).Trees are typically bent or felled from both sides of the linear disturbance. Tree felling involves deliberately felling trees over the linear disturbance. It does not require specialized machinery. Tree bending requires specialized machinery to mechanically bend live stems over the linear disturbance. Mechanical tree bending can be expensive and time consuming. These measures are often used in conjunction with other restoration techniques such as mounding and conifer seedling planting. Tree felling/bending is only initially being evaluated and its utility remains unverified (Neufeld 2006). It is recommended that if tree felling is to be used as a line of sight blocking measure, it should be investigated more thoroughly, and not solely be relied on as a mitigation tool (Neufeld 2006). Preferably, line of sight blocking with tree felling (or tree bending) should be used in combination with other management actions such as habitat restoration (Neufeld 2006), and continue to be evaluated for effectiveness using an adaptive management approach. Tree felling/bending can promote natural revegetation by increasing cone deposition onto the ROW, creating microsites through shading and dropped dead woody debris, and protecting planted seedlings from extreme weather, wildlife trampling and damage from access. Application in pipeline ROWs might be limited due to the width (i.e., much wider than typical seismic lines where tree bending/felling has previously been implemented). Furthermore, NGTL has narrowed the construction ROW for the Project to minimize the footprint as much as site conditions and construction requirements allow, leaving inadequate space for tree retention along the edges of the footprint for tree felling. Provided regulatory permitting (e.g., temporary field authorization to fell trees adjacent to the approved construction ROW) could be obtained, this measure could be a valid option for non-contiguous portions of the Project footprint.	Tree felling might be an option for the CHRP; however, due to the uncertainty of its effectiveness and limitations to application to pipeline ROWs, its use will be on a limited and/or trial basis for the Project. Another consideration for tree felling is the amount of available trees that can be used for the technique and that will be determined after final construction. Tree bending is not a suitable CHRP measure for the Project, given constraints associated with specialized machinery and time necessary to implement. As well, this technique is still being studied and as new research on the technique emerges, it could be considered for future projects.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Tree/shrub seeding	Habitat Restoration Access control Line of sight blocking	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 ROWs 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 might 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. Predation of conifer seed might be a problem when this technique is used for reforestation (BC MOF 1997).	Seeding is not a suitable CHRP measure, given logistical constraints (i.e., availability of native seed, accessibility of seeding equipment), likelihood of native seed ingress from vegetation in the adjacent undisturbed areas and predation of seed.
Coarse woody debris	Access control Habitat restoration Reduce Line of Sight	Coarse woody debris rollback might be used for access control and to enhance restoration of natural habitat characteristics (e.g., conserve soil moisture, moderate soil temperatures, provide nutrients as debris decomposes, prevent soil erosion, provide microsites for seed germination and protection for introduced tree seedlings [Pyper and Vinge 2012; Vinge and Pyper 2012]). Mulch depths less than 3 cm are preferred to avoid limiting natural ingress and vegetation growth (Pyper and Vinge 2012; Vinge and Pyper 2012).	Woody debris rollback is a suitable CHRP measure for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Coarse woody debris (cont'd)	Access control Habitat restoration Reduce Line of Sight (cont'd)	Coarse woody debris should be spread evenly across the entire footprint width at a coverage/density that will not restrict ability to plant seedlings or limit planted or natural seedling growth. Woody debris should be applied at a density/volume that does not exceed 400 t/ha to deter access (Osko and Glasgow 2010). Where sufficient material is available, woody debris coverage can range from 60-100 m^3/ha on upland sites and 25-50 m^3/ha on lowland sites, to mimic natural processes (Pyper and Vinge 2012; Vinge and Pyper 2012). Where sufficient material is available, woody debris coverage of 150-250 m^3/ha along ROWs might be appropriate to manage access (Vinge and Pyper 2012). Research presented at the North American Caribou Workshop (2014) suggested that application of high densities (200 m^3/ha) of salvage logs (i.e., rollback) at linear feature intersections reduces human use of the intersection by 100%, wolf use by 90%, and deer use by 50%. NGTL has found on previous caribou habitat restoration projects that coverage ranging from 200-300 m^3/ha can deter access while allowing sufficient spaces between the debris to allow seedling planting. Rollback can be effective immediately following implementation, provided adequate material is available and properly applied (Vinge and Pyper 2012). The implementation and length of a rollback segment is dependent on sufficient quantities of coarse woody debris during clearing of new disturbance and the tradeoff between its use and the ability/space to store it during construction (CRRP 2007b). Long rollback segments are more effective at managing human access because ATV riders will be less inclined to try to ride through the debris or traverse around it in adjacent forest stands. Sections of rollback ≤100 m long might not be effective at deterring motorized access (Vinge and Pyper 2012). An expert opinion survey cited 400 m long rollback segments as sufficient length (Golder 2007). NGTL has found on previous caribou habitat restoration projects that material availability often limits the segment length that can be achieved to 50–100 m (approximately 75 m on average). Fire risk is a consideration when using or storing materials for rollback. Fire risk can be minimized through proper storage and placement of materials (Pyper and Vinge 2012; Vinge and Pyper 2012). A 25 m rollback-free fuel break placed at 250 m intervals along rollback segments is suggested (Pyper and Vinge 2012).	

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Coarse woody debris (cont'd)	Access control Habitat restoration Reduce Line of Sight (cont'd)	Coarse woody debris rollback blocks constructed at 500 m intervals can be used as reducing line of sight measures. To allow operational access, the blocks consist of three segments placed in a staggered pattern approximately 10 m apart. Guidelines for application of rollback where materials are available recommend placement of rollback across the entire pipeline/easement width for a distance of at least 200 m from all points of intersection with wellsites, plant sites, roads and permanent watercourses (AER 2013). NGTL has found on previous caribou habitat restoration projects that material availability often limits the segment length that can be achieved to 50–100 m (75 m on average). Fire risk is a consideration when using or storing materials for rollback. Fire risk can be minimized through proper storage and placement of materials (Pyper and Vinge 2012). A 25 m rollback-free fuel break placed at 250 m intervals along rollback segments is recommended by the *Integrated Standards and Guidelines for the Enhanced Approval Process* (AER 2013).	Woody debris rollback is a suitable CHRP measure for the Project.

Site-specific caribou habitat restoration measures implemented for the Project will be described in the Final CHRP, which will include maps or Environmental Alignment Sheets showing the locations of selected sites.

For an illustrative table showing site-specific restoration methods and location details that may be included in the Final CHRP, see Appendix B. The Final CHRP table will also include the rationale for restoration measure selection, additional site-specific details to inform implementation and implementation status. Accomplishments and lessons learned from implementing and monitoring NGTL's other caribou habitat restoration initiatives will be included in the Final CHRP, and will inform the rationale for selection of restoration methods and locations. The Final CHRP will also include specification drawings of the restoration measures, in accordance with Condition ~~6b~~ 16 b (iii).

~~Table 5-3: Habitat Restoration Measures~~

~~Restoration Measure~~	~~Objectives~~	~~Rationale~~	~~Comments~~
~~Berms~~	~~Access control~~ ~~Reduce line-of-sight~~	~~Berms can be constructed of coarse woody debris and timbers, or a combination of coarse woody debris and earth. Supported berms are constructed using timber cleared from the ROW. To effectively block line-of-sight, berms should be constructed to an approximate minimum height of 1.5-2 m. Promote rapid shrub/tree regeneration at ends of berms (e.g., shrub staking/transplants, seedling planting) to increase effectiveness as access control. Earth berms were 76% effective at excluding vehicles over 50 inch in width and 22% effective at excluding all vehicles including off-road vehicles (Esri User Conference 1996). Berms create a barrier that can be effective immediately following implementation. Coarse woody debris/timber berms are dependent on approval from provincial authorities to retain coarse woody debris on-site, as well as sufficient space to store the material during construction. Woody debris berms may present an increased fire hazard, depending on composition and location. NGTL has found on its existing ROWs where this measure was used, that woody debris berms deteriorate relatively quickly after installation (within several years), particularly if berms are moved to allow access to the ROW.~~ ~~Availability of source material is usually not sufficient for earth berm construction in areas where minimum disturbance construction techniques are employed. Importing material is not preferred given the risk of introducing invasive plants. Earth berms should not be located in peatlands due to potential for settling and alteration of surface hydrology.~~	~~Limitations of this measure reduce its value. Woody material available for inclusion in berms is often limited, so can make this option less useful. Woody debris berms might be used as CHRP measures if sufficient wood exists at the Project site.~~ ~~Earth berms will not be considered a viable option for the Project as NGTL has found that there is generally insufficient source material to create earth berms.~~

~~**Table 5-3: Habitat Restoration Measures (cont'd)**~~

~~Restoration Measure~~	~~Objectives~~	~~Rationale~~	~~Comments~~

~~**Restoration Measure**~~	~~**Objectives**~~	~~**Rationale**~~	~~**Comments**~~
~~Bioengineering – shrub staking/planting or tree seedling planting~~	~~Habitat Restoration~~ ~~Access control~~ ~~Reduce line-of-sight~~	~~Bioengineering in combination with stabilization measures (e.g., soil wraps) might be suitable at watercourses crossed with an open cut method.~~ ~~It is the use of existing live vegetation to stabilize and revegetate a site (e.g., transplants; installing cuttings) and is a technique often used on slopes or riparian banks (Polster 2002).~~ ~~Species and planting densities used for bioengineering are site dependent (Golder 2012a). Vegetation used is typically collected either from the disturbance site (i.e., before or during clearing), or from the adjacent area, in the form of cuttings (Golder 2012a). Vegetation may be planted during the growing season or during winter. 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 (Golder 2012a).~~ ~~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 a restoration prescription calls for shrub planting of species that do not readily regenerate through cuttings/staking (e.g., alder). Alder 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 inter-planting alder with conifers. When alder is interspersed with conifer plantings, line-of-sight and 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 (Courtin and Brown 2001; Simard and Heineman 1996). The fast growth of alder can reduce growth rates of conifer plantings due to competition when alder densities are high (CRRP 2007b; Simard and Heineman 1996).~~ ~~Species are determined based on the adjacent forest stand and restoration objectives (e.g., low palatability for ungulates). Combined plantings of shrub and tree seedlings can be appropriate, depending on site conditions and anticipated natural revegetation of both species. Procurement of shrub seedlings (container or bare-root) can be challenging given limited seed availability. Planted shrubs can be slow to establish.~~	~~Shrub planting is a suitable CHRP measure for select site-specific locations if a need for combined conifer/shrub plantings is identified. Many shrub species can attract prey species such as moose and deer which can attract wolves thus its application will be limited as these species can have a negative effect on caribou (see Section 8).~~

~~Table 5-3: Habitat Restoration Measures (cont'd)~~

~~Restoration Measure~~	~~Objectives~~	~~Rationale~~	~~Comments~~
~~Conifer seedling planting~~	~~Habitat restoration~~ ~~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). Tree seedling planting is considered a long-term restoration treatment (effectiveness is expected to take longer than 10 years).~~ ~~Planting densities for reclamation of forested areas in Canada have been based on forestry standards, ranging from 1,500-2,500 stems/ha (MacDonald et al. 2012). The Government of Alberta (AESRD 2013b)~~ ~~*Reclamation Criteria for Wellsites and Associated Facilities for Forested Lands*~~ ~~is unclear in its recommendations, stating that the expected planting density for sites planted with merchantable species is 2,000 stems/ha and vegetation assessments conducted at least two growing seasons after planting are expected to have a minimum stem density of 2,000 stems/ha. This allows for no seedling mortality. The~~ ~~*Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region*~~ ~~(AENV 2010) specify ranges of planting densities that vary by the site type and tree species planted. For example, to achieve medium to dense crown closure, the planting density of conifer (pine and white spruce) seedlings in dry, moist poor or moist rich site types is 1,400-2,000 stems/ha. In wet poor sites, the recommended planting density of black spruce is 1,400–2,800 stems/ha. The~~ ~~*Reforestation Standard of Alberta*~~ ~~(AESRD 2014b) is specific to reforesting cutblocks and defines successful regeneration as having 80% stocking of acceptable trees during establishment surveys conducted 4 to 8 years after harvest (i.e., 80% of sample plots have at least one live conifer tree 30 cm tall or taller, or one live deciduous tree that is at least 130 cm tall). This gives a minimum target stem density of approximately 800 stems/ha. Given the relatively harsh growing conditions inherent to boreal ecosystems, mortality of planted seedlings is anticipated to range from approximately 5% to 20% in most site types (Golder 2012a,b). A planting density of 2,000–2,500 stems/ha has been recommended for restoration of linear disturbances in boreal caribou ranges in northeastern BC (Golder 2015). A linear restoration matrix developed by AEP recommends a planting density of 1,200 stems/ha in boreal caribou range in Alberta (Vinge unpublished). Given the densities were developed for forestry practices and this project relates to linear ROWs, the monitoring program might show a reduced success rate and the survival target might need to be adjusted over time.~~	~~Conifer seedling planting is a suitable CHRP measure for the Project.~~

~~Table 5-3: Habitat Restoration Measures (cont'd)~~

~~Restoration Measure~~	~~Objectives~~	~~Rationale~~	~~Comments~~
~~Conifer seedling planting (cont'd)~~	~~Habitat restoration~~ ~~Access control.~~ ~~Reduce line-of-sight (cont'd)~~	~~Based on the above information and also considering Alberta ecosystems, the following planting prescription has been formulated for this CHRP:~~ • ~~minimum live seedling density of 1,600-2,000 stems/ha on sites that are not mounded;~~ • ~~minimum live seedling density of 1,200-2,000 stems/ha (combined planted seedlings and/or natural regeneration) on mounded sites (dependent on mound density)~~	
~~Mounding~~	~~Restore vegetation (create microsites)~~ ~~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 to enhance seedling survival.~~ ~~Mounding treed wetlands (e.g., bogs, 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 (Golder 2012a; Macadam and Bedford 1998). Soil properties (e.g., substrate, drainage) affect the ability of mounds to retain their structure.~~ ~~Mounding has been used as an access control measure on old roads and seismic lines to discourage off-road vehicle activity. It can be effective immediately following implementation. For access control purposes, mounds should be created using an excavator to approximately 0.75 m deep, where site conditions allow (Golder 2012a). The excavated material is dumped right beside the hole (Macadam and Bedford 1998).~~ ~~Suggested densities of mounding for access control or microsite creation purposes vary from 1,200 to 2,000 mounds/ha (AENV 2010; Golder 2012a; Vinge unpublished). Implementation of this mound density may be suitable for restoring disturbances such as seismic lines where specialized equipment is used, and where frost is not driven into the soils to allow heavy equipment access. The mound density that can realistically be achieved on pipeline ROWs is lower since mounding is completed in conjunction with final cleanup. The limitations include scheduling mounding for restoration during final cleanup, which typically requires freezing-in of soils, availability of specialized equipment and minimum spatial separation of 5 m between mounds and the centreline of the operating pipeline. For previous NGTL caribou habitat restoration projects on pipeline ROWs, the achievable range in mound density was approximately 700-1,400 mounds/ha.~~	~~Mounding is a suitable CHRP measure that will be used in conjunction with conifer seedling planting for the Project.~~

~~**Table 5-3: Habitat Restoration Measures (cont'd)**~~

~~Restoration Measure~~	~~Objectives~~	~~Rationale~~	~~Comments~~
~~Minimum disturbance construction~~	~~Habitat Restoration~~ ~~Reduce line-of-sight~~	~~Construction during winter conditions reduces the need for soil salvage and grading, and the width of grubbing is limited to the trench area where grading is required. Reduced disturbance to vegetation and root systems is achieved by cutting, mowing or walking down and mulching shrubs and small diameter trees at ground level. The intact root systems and seed bed with little soil disturbance facilitates rapid regeneration of vegetation. Use of snow padding or matting can limit the need for cutting or mowing shrubs and small trees, thereby speeding regeneration of native vegetation. The extent of minimum disturbance construction is limited by scheduling to avoid the restricted timing window for caribou (February 15 to July 15) and also by existing ground topography.~~ ~~Soil conditions limit the applicability of minimum disturbance construction methods. Construction in well to moderately drained sites during non-frozen conditions requires grubbing and grading to salvage surface soils so they can be stored separately from subsoils and replaced following construction. This prevents admixing and loss of the productive surface soils that facilitate regeneration of vegetation.~~	~~Minimum disturbance construction is a suitable CHRP measure for the Project, and will be implemented where scheduling, soil conditions (e.g., frozen), and topography allow.~~
~~Transplanting~~	~~Habitat Restoration~~ ~~Access control~~ ~~Reduce line-of-sight~~	~~Transplanting has the advantage of immediately establishing relatively large trees/shrubs (e.g., saplings). There are limitations to 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).~~	~~Transplanting of native vegetation is not a suitable CHRP measure for the Project as it has been shown to be a difficult technique to implement on a large scale, with marginal results and multiple limitations. This technique could prove more suitable for future projects if advances in the method improve survival success rates.~~

~~**Table 5-3: Habitat Restoration Measures (cont'd)**~~

~~Restoration Measure~~	~~Objectives~~	~~Rationale~~	~~Comments~~
~~Tree felling or bending~~	~~Access control~~ ~~Habitat Restoration~~ ~~Reduce line-of-sight~~	~~Mechanically bending or felling live trees onto the linear disturbance has been tested as a measure to restore habitat and manage access on seismic lines in caribou range (COSIA 2012).Trees are typically bent or felled from both sides of the linear disturbance.~~ ~~Tree felling involves deliberately felling trees over the linear disturbance. It does not require specialized machinery andwill be considered where adjacent trees are tall enough. Tree bending requires specialized machinery to mechanically bend live stems over the linear disturbance. Mechanical tree bending can be expensive and time consuming. These measures are often used in conjunction with other restoration techniques such as mounding and conifer seedling planting. Tree felling/bending is only initially being evaluated and its utility remains unverified (Neufeld 2006). It is recommended that if tree felling is to be used as a line blocking measure, it should be investigated more thoroughly, and not solely be relied on as a mitigation tool (Neufeld 2006). Preferably, line-blocking with tree felling (or tree bending) should be used in combination with other management actions such as habitat restoration (Neufeld 2006), and continue to be evaluated for effectiveness using an adaptive management approach.~~ ~~Tree felling/bending can promote natural revegetation by increasing cone deposition onto the ROW, creating microsites through shading and dropped dead woody debris, and protecting planted seedlings from extreme weather, wildlife trampling and damage from access.~~ ~~Application in pipeline ROWs might be limited due to the width (i.e., much wider than typical seismic lines where tree bending/felling has previously been implemented). The narrowed permanent ROW does not include space for tree retention along edge of the ROW and requires trees to be felled from beyond the limits of a typical ROW as the edge of ROW is inherently variable due to spatial distribution of trees. Provided regulatory permitting (e.g., temporary field authorization to fell trees adjacent to the approved construction ROW) could be obtained, this measure could be a valid option for non-contiguous portions of the Project footprint.~~	~~Tree felling may be an option for the CHRP; however, due to the uncertainty of its effectiveness and limitations to application to pipeline ROWs, its application will be on a limited and/or trial basis for the Project. Another consideration for tree felling is the amount of available trees that can be used for the technique and that will be determined after final construction.~~ ~~Tree bending is not a suitable CHRP measure for the Project, given constraints associated with specialized machinery and time necessary to implement. As well, this technique is still being studied and as new research on the technique emerges, it could be considered for future projects.~~

~~Table 5-3: Habitat Restoration Measures (cont'd)~~

~~Restoration Measure~~	~~Objectives~~	~~Rationale~~	~~Comments~~
~~Tree/shrub seeding~~	~~Habitat Restoration~~ ~~Access 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 ROWs 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 could 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. Seed predation is also a limitation of applying tree seed.~~	~~Seeding is not a suitable CHRP measure, given logistical constraints (i.e., availability of native seed, accessibility of seeding equipment) and likelihood of native seed ingress from vegetation in the adjacent undisturbed areas.~~
~~Coarse woody debris~~	~~Access control~~ ~~Habitat restoration~~ ~~Reduce Line of Sight~~	~~Coarse woody debris rollback can be used for access control and to enhance restoration of natural habitat characteristics. Woody debris rollback can enhance revegetation as it can conserve soil moisture, moderate soil temperatures and provide nutrients as debris decomposes, prevent soil erosion, provide microsites for seed germination and protection for introduced tree seedlings (Pyper and Vinge 2012; Vinge and Pyper 2012). Fine woody debris (e.g., chipped or mulched debris) can be detrimental to soil thermal conditions, carbon:nitrogen (C:N) ratios and plant recruitment where the depth of debris is excessive (AENV 2010). Mulch depths less than 3 cm are preferred to avoid limiting natural ingress and vegetation growth (Pyper and Vinge 2012; Vinge and Pyper 2012).~~ ~~Coarse woody debris should be spread evenly across the entire width of the footprint at a coverage/density that will not restrict ability to plant seedlings or limit planted or natural seedling growth. Woody debris should be applied at a density/volume that does not exceed 400 tonnes/ha to discourage access along a ROW (Osko and Glasgow 2010). Where sufficient material is available, woody debris coverage can range from 60-100 m^3/ha on upland sites and 25-50 m^3/ha on lowland sites, to mimic natural processes (Pyper and Vinge 2012; Vinge and Pyper 2012). Where sufficient material is available, woody debris coverage of 150–250 m^3/ha along ROWs might be appropriate to manage access (Vinge and Pyper 2012).~~ ~~Coarse woody debris rollback blocks constructed at 500 m intervals can be used as reducing line of sight measures. To allow operational access, the blocks consist of three segments placed in a staggered pattern approximately 10 m apart.~~	~~Woody debris rollback is a suitable CHRP measure for the Project.~~

~~Table 5-3: Habitat Restoration Measures (cont'd)~~

~~Restoration Measure~~	~~Objectives~~	~~Rationale~~	~~Comments~~
~~Woody debris (cont'd)~~	~~Access control~~ ~~Habitat restoration (cont')~~	~~Research presented at the North American Caribou Workshop (2014) suggested that application of high densities (200 m^3/ha) of salvage logs (i.e., rollback) at linear feature intersections reduces human use by 100%, wolf use by 90% and deer use by 50%. NGTL has found on previous caribou habitat restoration projects that coverage ranging from 200–300 m^3/ha can deter access while allowing sufficient spaces between the debris to allow seedling planting.~~ ~~Rollback can be effective immediately following implementation, provided adequate material is available and properly applied (Vinge and Pyper 2012). The implementation and length of a rollback segment is dependent on sufficient quantities of coarse woody debris during clearing of new disturbance and the trade-off between its use and the ability/space to store it during construction (CRRP 2007b). Long rollback segments are more effective at managing human access because ATV riders will be less inclined to try to ride through the debris or traverse around it in adjacent forest stands. Sections of rollback ≤ 100 m in length may not be effective at deterring motorized access (Vinge and Pyper 2012). An expert opinion survey cited 400 m long rollback segments as sufficient length (Golder 2007). Guidelines for application of rollback where materials are available recommend placement of rollback across the entire pipeline/easement width for a distance of at least 200 m from all points of intersection with wellsites, plant sites, roads and permanent watercourses (AER 2013). NGTL has found on previous caribou habitat restoration projects that material availability often limits the segment length that can be achieved to 50–100 m (75 m on average).~~ ~~Fire risk is a consideration when using or storing materials for rollback. Fire risk can be minimized through proper storage and placement of materials (Pyper and Vinge 2012). A 25 m rollback-free fuel break placed at 250 m intervals along rollback segments is is recommended by the *Integrated Standards and Guidelines for the Enhanced Approval Process* (AER 2013).~~	~~Woody debris rollback is a suitable CHRP measure for the Project.~~

5.3.1 Natural Regeneration

Minimum disturbance construction is a promising approach for promoting native vegetation re-establishment. Minimal disturbance procedures relate to the removal of vegetation, work area preparation and clean-up activities associated with construction of the Project. The objective of this construction technique is to minimize impacts on the soils and vegetation substructure, with the goal of allowing the Project footprint to re-vegetate to a similar pre-construction condition, subject to land-use guidelines specific to the disposition. NGTL will, therefore, implement minimal disturbance construction techniques to facilitate natural regeneration to restore habitat along the ROW. This construction technique is restricted to areas where grading is not required. Stripping and grading will be required in areas of significant cross-fall of the ROW (i.e., greater than 1.0 m), irregular ground profile along the pipeline, and at tie-in sites (road bores and pipeline crossings). Minimal disturbance installation is most suitable for straight pipe installation.

5.3.2 Tree Planting

Established reclamation and forestry reforestation practices will be applied to promote revegetation where natural regeneration might not achieve the quantifiable targets. Restoration measures that incorporate tree planting techniques, such as site preparation (e.g., mounding) and planting trees/shrubs, will be considered where site conditions allow (including construction methods and level of disturbance).

For a summary of habitat types that will be disturbed in caribou habitat as a result of the Project footprint, see Table ~~5-~~ 5-4~~. For the planting prescription for each habitat type, see the performance measures identified in~~ (Aitken Creek Section) and Table~~4-1.~~

5-5 (Kahta Section).

Table 5-4: Aitken Creek Section – Habitat Types in ~~ESAR~~Graham Caribou Range

Habitat Types	TEM Unit/Ecosystem ~~Description~~Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree Species[4]	Area (ha)	Percent of Total (%)
~~Treed Wetland~~**Aitken Creek Section – Graham Caribou Range**					
	~~**Total**~~	~~23.5~~	~~26.5~~		
~~Shrubby/Herbaceous Wetland~~	~~Wetland – Shrub (82)~~	~~14.4~~	~~16.3~~		
	~~Wetland – Herb (83)~~	~~17.2~~	~~19.4~~		
	~~**Total**~~	~~31.6~~	~~35.7~~		
Upland/Transitional ~~Coniferous Forest~~ – Conifer	~~Coniferous Dense (211)~~Black spruce–lingonberry – coltsfoot	BWBSmw-04	Pl(Sb)	~~19.~~4.5	~~21.9~~12.5
	~~Coniferous Open (212)~~White spruce – trembling aspen – step moss	~~8.1~~BWBSmw-01	Sw, At, Pl, Ep, Acb	7.6	20.9~~.1~~
	~~**Total**~~	~~27.5~~	~~31.0~~		
Upland/Transitional – Deciduous ~~and Mixedwood Forest~~	~~Broadleaf Dense (221)~~Trembling aspen – creamy peavine	BWBSmw-01$	At	9.9	~~5~~27.1
Riparian	~~Mixedwood Dense (231)~~Mountain alder – common horsetail	~~0.6~~BWBSmw-Fl01	-	1.0~~.7~~	2.6
	~~**Total**~~	~~5.7~~	~~6.5~~		
~~Graminoid/Herbaceous~~	~~Herb (100)~~Cottonwood – spruce – red-osier dogwood	BWBSmw-Fm02	Sb/Sw, Acb	<0.1	<0.1
Treed Wetland	Black spruce – lingonberry – peat moss	BWBSmw/BWBSwk-Wb03	Lt, Sb	0.4	1.0
	~~**Total**~~Tamarack – water sedge – fen moss	BWBSmw-Wb06	Lt	<0.1	~~-~~0.1
~~Anthropogenic~~Non-Vegetated	Exposed ~~Land (33)~~soil	-	-	0.24	~~0~~1.2
	Gravel bar	-	-	0.1	0.3
	River~~**Total**~~	-	-	<0.21	0.2
~~All Habitat Types~~	~~**Total**~~Rock outcrop	-	-	0.2	~~88~~0.6
Anthropogenic	Cultivated field	-	-	3.6	9.9
	Corridor and/or industry-related disturbance	-	-	5.1	13.9

	Rural	-	-	0.9	2.4
	Road surface	-	-	1.2	3.2

Note:

1 TEM was completed as part of the Project Application (Stantec 2013). The area and percentage calculations are based on the entire TEM polygon (i.e., the deciled TEM polygon data are assumed to be reflective of the area and percent of ecosystem units affected by the Project footprint).

2 Site series are derived from TEM data (Stantec 2013) based on *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*, *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region* and *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia Land Management Handbooks* (DeLong 2004, DeLong et al. 1990, DeLong et al. 2011). The "$" denotes seral stage, indicating early seral communities, usually deciduous-dominated.

3 Cutblocks are incorporated in the TEM unit classifications (site series).

4 Tree codes: Acb – balsam poplar; At – trembling aspen; Ep – common paper birch; Lt – tamarack; Pl – lodgepole pine; Sb – black spruce; Sw – white spruce.

5 Wetland codes: Fl and Fm – flood association; Wb – bog; Wf – fen; Ws – swamp.

Table 5-5: Kahta Section – Habitat Types in Pink Mountain Caribou Range

Habitat Types	TEM Unit/Ecosystem Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree Species[4]	Area (ha)	Percent of Total (%)
Kahta Section - Pink Mountain Caribou Range					
Upland/Transitional – Conifer	White spruce– trembling aspen – step moss	BWBSmw-01	Sw, At, Pl, Ep, Acb	0.6	0.7
	Black spruce – lingonberry – coltsfoot	BWBSmw-04	Pl(Sb)	35.7	44.7
	White spruce – currant – horsetail	BWBSmw-07	Sw	1.3	1.6
Upland/Transitional – Conifer	White spruce – huckleberry – step moss	BWBSwk2-01	Sw, Pl	9.7	12.1
	Lodgepole pine – lingonberry – velvet-leaved blueberry	BWBSmk-02	Pl, At, Sb, Sw	<0.1	<0.1
Upland/Transitional – Deciduous	Trembling aspen – creamy peavine	BWBSmw-01$	At	0.1	0.2
	Trembling aspen – highbush cranberry	BWBSwk2-01$	At	2.3	2.8
	Trembling aspen – Labrador tea	BWBSmw-04$	At	1.0	1.2
	Trembling aspen – Labrador tea – lingonberry	BWBSwk2-03$	At	0.3	0.4
Riparian	Mountain alder – common horsetail	BWBSmw-Fl01	–	0.7	0.9
	Bebb's willow – mountain alder – bluejoint swamp	BWBSmk-Ws03	–	0.3	0.4
	Scrub birch – willow – water sedge fen	BWBSmk/BWBSmw/BWBSwk2-Wf02	–	<0.1	<0.1
Treed Wetland	Black spruce– lingonberry – peat moss	BWBSmk/BWBSmw/BWBSwk2-Wb03	Lt, Sb	17.9	22.4

	Tamarack – water sedge – fen moss	BWBSmk/BWBSwk2-Wb06	Lt	< 0.1	< 0.1
Graminoid/ Shrub Wetland	Water sedge – beaked sedge fen	BWBSmk/BWBSmw/BWBSwk2-Wf01	–	0.5	0.6
Non-Vegetated	Cutbank	–	–	0.1	0.1
	Exposed soil	–	–	0.3	0.4
	River	–	–	<0.1	<0.1
Anthropogenic	Corridor and/or industry-related disturbance	–	–	7.1	8.9

Table 5-5: Kahta Section – Habitat Types in Pink Mountain Caribou Range (cont'd)

Habitat Types	TEM Unit/Ecosystem Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree Species[4]	Area (ha)	Percent of Total (%)
Kahta Section - Pink Mountain Caribou Range					
Anthropogenic (cont'd)	Reservoir	–	–	0.3	0.4
	Road surface	–	–	<0.1	<0.1

Note:
1 TEM was completed as part of the Project Application (Stantec 2013). The area and percentage calculations are based on the entire TEM polygon (i.e., the deciled TEM polygon data are assumed to be reflective of the area and percent of ecosystem units affected by the Project footprint).
2 Site series are derived from TEM data (Stantec 2013) based on *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*, *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region* and *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia Land Management Handbooks* (DeLong 2004, DeLong et al. 1990, DeLong et al. 2011). The "$" denotes seral stage, indicating early seral communities, usually deciduous-dominated.
3 Cutblocks are incorporated in the TEM unit classifications (site series).
4 Tree codes: Acb – balsam poplar; At – trembling aspen; Ep – common paper birch; Lt – tamarack; Pl – lodgepole pine; Sb – black spruce; Sw – white spruce.
5 Wetland codes: Fl – flood association; Wb – bog; Wf – fen; Ws – swamp.

Implementation targets and specifications for habitat restoration (e.g., seedling planting densities, mounding densities) will be designed to meet the quantifiable targets for the CHRP. These will be informed by available guidelines and standards (see Section 8), NGTL's experience implementing caribou habitat restoration measures and complementary research.

For the planting prescription for each habitat type, see the ~~quantifiable targets~~Quantifiable Targets column in Table 4-1. The quantifiable targets and performance measures in Table 4-1 should be considered preliminary and subject to change. The restoration methods and targets will be affected by variables such as extent of grading, construction method and availability of shared workspace and access.

The proposed habitat restoration quantifiable targets are designed to demonstrate restoration success in terms of survival and sustained growth trends of conifer and deciduous trees within ~~15~~ 10 years following completion of restoration. These targets are to be met over the portion of the Project footprint available for restoration (i.e., excluding overlap with third-party developments or operational access outside planted areas).

5.4 ACCESS CONTROL

Access control principles outlined in this CHRP were guided by the Project's AMP. The goals of access control for the Project in caribou habitat are to:

- manage access along the pipeline ROW in a manner that discourages all forms of access
- maintain accessibility necessary for safe pipeline operations compliant with applicable regulations and guidelines
- maintain existing access at identified locations (e.g., third-party industry access, traditional access identified by Aboriginal communities through engagement~~-~~ activities)

5.4.1 Baseline Data on Access Control

Geographic Information System (GIS) will be used to mark selected locations of monitoring plots in order to establish the baseline assessment for this Project. The locations will be chosen based on a review of the Project's construction alignment sheets and proposed access control treatment locations.

Based on early review of the Project's spatial configuration, 32 existing linear features (for example, seismic lines, utilities corridors or roads) have been identified that intersect with the Project ROW. NGTL will control access where the Project intersects active crossings, and will assess these areas as potential treated sites.

An assessment of these potential control sites will include the deployment of Reconyx remote cameras over a six week period. However, several of the sites cross wetlands with little or no trees and may not be good candidates for access control treatments. NGTL intends to deploy cameras prior to construction in order to collect baseline data. The Final CHRP will outline a detailed review of the baseline access study and further detail the final locations of the monitoring plots.

5.4.2 Access Control Measures

Access control measures are most effective when implemented on non~~-~~-contiguous segments of the ~~pipeline portion of the~~ Project ROW, and at intersections of the pipeline portion of the ~~Project's~~Project ROW with existing perpendicular linear features (e.g., roads, utility corridors, seismic lines). Quantifiable targets and criteria used to evaluate the effectiveness of access control measures will align with those in the CHROMMP.

Access control measures ~~that will be~~ considered for the Project, but not necessarily utilized, include:

- ~~extended bored crossings~~

- vegetation screens
- rollback
- fencing and signs
- vegetation planting
- mounding
- installation of berms
- tree felling over the ROW

Rollback, mounding and planting vegetation will be the key access control measures implemented for the Project. Some of these measures might not be selected for final restoration because of site--specific conditions. For example, lack of materials necessary for the installation of berms could limit the applicability of berm installation for this Project.

NGTL has engaged the British Columbia Oil and Gas Commission (BC OGC) and BC MFLNRO regarding use of merchantable timber for access management purposes in caribou ranges. BC MFLNRO has indicated that merchantable timber may be used for rollback for the Project with the following provisions (to which NGTL has agreed):

- Provide BC OGC and BC MFLNRO with the locations of proposed access management areas.
- Identify if any mitigation measures will be required for fire hazard abatement.
- Identify if any mitigation measures will be required for forest health issues.
- Identify how merchantable timber will be accounted for post clearing.

Locations for access control measures on the pipeline ROW will focus on intersections with other linear features, such as roads, utility ROWs, seismic lines or watercourses and non-contiguous sections of the ROW. NGTL might install signs at select locations to discourage access.

5.5 LINE OF SIGHT BLOCKING

Line-of-sight blocks include planting vegetation (e.g., tree planting or willow- staking), fabricated site screens and minimal disturbance construction to preserve vegetation. Line-of-sight blocks will be implemented in locations with sightlines >500 m, particularly where they intersect with existing road access. Trees will be planted in an alternating pattern across the pipeline centreline along portions of the ROW. Specifically, trees will be planted across the centreline with open vegetation left at alternating sides of the ROW along some sections. This alternating vegetation pattern will create a line-of-sight break. Details on exact configuration of seedling planting to achieve line-of-sight breaks depend on as-built location of the pipe centreline and adjacent linear disturbances.

Measures to reduce sightlines might discourage access and might also decrease predator efficiency. In nature, sightlines are often longer in more open habitats of lowland muskeg communities compared with upland forest communities. As a result, line-of-sight distances can vary, depending on the location and structure of the adjacent vegetation community. In forested areas of the Project footprint where sightlines are 500 m long or more~~,~~ line-of-sight blocks will be established.

~~There are no provincial guidelines in Alberta for line-of-sight management for linear features. Reclamation programs for previous developments in Alberta have targeted maximum sightlines of 400 m (Golder 2007; DES 2004).~~ Operating practices for energy development in sensitive caribou range in ~~BC~~British Columbia (BC Ministry of Environment 2011) suggest implementing line~~-~~-of~~-~~-sight management every 500~~-~~ m on linear features that do not share a ROW~~-~~ boundary with a road~~ (see Section 8). As science is still emerging in~~. Line-of-sight blocking as part of this ~~area, the long term monitoring of~~Project will follow this ~~and~~guideline where it is not co-located with roads or other ~~NGTL CHRP measures, will be modified based on monitoring results to determine the appropriate line of sight breaks~~linear developments.

NGTL has implemented 500 m line-of-sight breaks to be consistent across provincial boundaries regardless of the location of the pipeline segment and has incorporated this approach in other Project CHRPs. Previously, NGTL attempted to apply the line of sight and access control features on the landscape as suggested in the Alberta Energy Regulator (AER) Enhanced Approval Process (EAP); however, it has become apparent that over the course of implementing those features on other NGTL projects that impact caribou habitat (Leismer, NWML, Chinchaga) meeting the recommended intervals was not feasible. In particular, recent field experience on the Chinchaga Section provided several examples of why these features cannot be applied at EAP recommended intervals. For lessons learned on other NGTL projects about implementing line of sight blocking intervals see Section 6.3.

As science is still emerging in this area, the long term monitoring of this and other NGTL CHRP measures will be modified based on monitoring results to determine the appropriate line-of-sight breaks.

Topography~~,~~ bends in the ROW, minimum disturbance construction to preserve vegetation and willow staking create immediate line-of-sight blocks (i.e., create visual barriers after restoration activities are implemented). Line-of-sight measures such as tree plantings will be implemented in areas where sightlines are not blocked by terrain or bends. Planting at staggered intervals across the pipeline centreline will establish these 500 m line-of-sight breaks in the long term.

The exact locations for implementing line-of-sight breaks will be determined after construction and presented in the Final CHRP.

5.6 MONITORING AND ADAPTIVE MANAGEMENT

NGTL will create a CHROMMP for the Project to monitor effectiveness of planned habitat restoration measures that will be fully described in the Final CHRP. Adaptive management, i.e., the systematic process of monitoring and assessing outcomes and modifying restoration measures if necessary, will be implemented by adjusting and/or supplementing restoration measures, where warranted, to achieve the objectives of the CHRP.

Given that science is still emerging on caribou habitat restoration methods and effectiveness, adaptive management principles will be an important means of addressing uncertainty.

Adaptive management might be necessary to address uncertainty relating to planting trees in mountain caribou range. There might be soil limitations (e.g., poor nutrients and drainage, soil temperatures) that do not support tree seedling establishment without silvicultural site preparation (e.g., mounding). If seedling survival rates and/or sustained growth trends are not meeting the quantifiable targets (i.e., poorly understood planting conditions in higher-elevation habitat) this measure might need to be re-evaluated considering site-specific conditions.

Monitoring will be conducted on each pipeline segment for up to ~~15~~10 years, starting one year after CHRP measures have been implemented. At each monitoring interval, performance measures will be evaluated and compared with quantifiable restoration targets. If measures indicate that restoration has achieved or is on a trajectory to achieving targets, no further restoration measures will be undertaken. If, however, at any point in the monitoring program evaluations indicate that targets are unlikely to be achieved after ~~15~~10 years, restoration measures must be adjusted and additional monitoring (longer ~~than15~~than 10 years) added.

This could include implementation of existing restoration measures or new measures, discovered through research or industry practice, that are proving to be successful. For example, NGTL is engaged in linear feature restoration research with the Regional Industry Caribou Collaboration in northeastern Alberta and lessons learned from this research can be applied to the Project.

Monitoring results, as well as any necessary adaptive management actions, will be reported to the NEB, ~~Environment Canada~~EC and ~~AEP~~BC MFLNRO following the end ~~following~~of each monitoring interval.

Habitat restoration measures that require adaptive management at the conclusion of the ~~15~~ 10 year monitoring program will require additional ground-based monitoring until they are successful. If adaptive management actions fail, a revised monitoring program and timeframe will be developed to address unsuccessful measures.

This Preliminary CHRP includes brief descriptions of the restoration targets and how they will be measured. The Final CHRP will detail the actual habitat restoration methods implemented and their locations in the Project footprint~~.~~ for each pipeline segment. The residual disturbance to critical caribou habitat resulting from the Project will be calculated and finalized in ~~the~~an OMP for ~~the Project~~Aitken Creek. Specific details on the quantitative framework of the monitoring program, frequency, timing and locations will be included in the CHROMMP. The CHROMMP will describe a comprehensive monitoring program for Project CHRP measures and potential offset areas, as finalized in the OMP, to compensate for residual effects in caribou habitat.

~~5.7 QUANTITATIVE FRAMEWORK~~

5.7 QUANTITATIVE FRAMEWORK

NGTL will implement a monitoring program to verify the effectiveness of CHRP and OMP, which will be prepared pursuant to Condition 36, measures and plans to integrate monitoring outcomes into future decision-making as part of a continual improvement process. The monitoring program will employ a quantitative framework using both aerial and ground-based sampling protocols to assess the effectiveness of habitat restoration, access control and line of sight blocking measures. As discussed above, specific details concerning the monitoring program methods will be discussed in the CHROMMP~~.~~, which will be prepared pursuant to Condition 37. The following provides a brief example of the quantitative framework used to assess habitat restoration effectiveness (i.e., revegetation) in upland/transitional coniferous forest as a preliminary guide.

5.7.1 Experimental Design

A one-way repeated measures experimental design will be used to evaluate restoration effectiveness for each individual habitat type separately due to the inherent differences associated with their biophysical characteristics. Repeated measure designs are generally preferred over other factorial designs as they improve the precision of estimates derived on the response variable (Montgomery 2001; Kuehl 2000). Quantifiable targets associated with each restoration measure collected during the monitoring program will be repeated at each monitoring plot location for each monitoring year. The experimental design is represented by the following model:

$$y_{ik} = \mu + \alpha_i + \tau_j + \varepsilon_{ij}$$

where y_{ik} is the estimated response of the quantifiable target, μ is the overall mean, α_i is the effect of each monitoring year, τ_j is the effect of each monitoring plot and ε_{ij} is the natural variability (i.e., error) (Montgomery 2001). The model term τ_j denotes the repeated measure effect associated with each monitoring plot, each monitoring year. The degree to which restoration measures achieve their respective targets will be determined by a positive difference of the mean for each quantifiable target between each monitoring year, where the first monitoring year will act as a baseline.

5.7.2 Results

Table 5-~~5~~6 provides an example subset of data for upland/transitional coniferous forest with vegetation height (m) as the quantifiable target. To illustrate the proposed repeated measure design, statistical analysis and results, the following example in Table 5-6 is demonstrated for five sample plots across five monitoring years.

.

Table 5-6: Example Data Subset for Upland/Transitional Coniferous Forest (Vegetation Height)

Monitor Plot ID	Habitat Type	Description	Location (KP)	Monitoring Year	Vegetation Height (m)
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	1	0.19
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	1	0.13
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	1	0.15
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	1	0.19
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	1	0.16
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	2	0.22
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	2	0.16
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	2	0.22
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	2	0.26
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	2	0.27
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	3	0.41
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	3	0.48
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	3	0.49
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	3	0.40
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	3	0.40
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	4	1.20
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	4	1.12
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	4	1.32
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	4	1.41
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	4	1.36
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	5	2.10
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	5	2.23
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	5	2.56
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	5	2.80
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	5	2.65

Habitat restoration is achieved when a positive increase in mean vegetation height is observed between the first monitoring year (i.e., baseline) and each subsequent monitoring year. As such, the analysis focuses on the mean difference in vegetation height for the fixed effect monitoring year, with monitoring plots treated as random effects to control for natural variability associated with each monitoring plot.

Table 5-~~6~~7 provides a summary of the model output and pairwise comparisons used to identify differences in mean vegetation height between the first monitoring year and each subsequent monitoring year. In the example, a significant difference is observed for the fixed effect monitoring year (p<0.001). Pairwise comparisons of mean vegetation height (m) between the first monitoring year and each subsequent year demonstrate a positive increase in mean vegetation height between each monitoring year, with the exception of the second monitoring year (p=0.940). Ongoing review and monitoring comparisons will be integral in determining if vegetation targets can be met and then can be used in effectiveness determination.

Table ~~5-6~~5-7: Example Results for Upland/Transitional Coniferous Forest (Vegetation Height)

Model Output

Factor	Type	Levels Values
Monitoring Year	Fixed	1, 2, 3, 4, 5
Monitor Plot ID	Random	Liege U 1, Liege U 2, Liege U 3, Liege U 4, Liege U 5

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Monitoring Year	4	19.073	4.7683	282.80	**<0.001**
Sample Plot ID	4	0.1493	0.0373	2.21	0.113
Error	16	0.2698	0.0168		
Total	24	19.492			

Pairwise Comparisons of Mean Vegetation Height (m)

Monitoring Year	N	Mean Vegetation Height	Grouping
5	5	2.468	A
4	5	1.282	B
3	5	0.436	C
2	5	0.226	CD
1	5	0.164	D

Means that do not share a letter are significantly different.

Monitoring Year Comparison	SE of of Means	Simultaneous Difference	Adjusted 95% CI	T-Value	P-Value
2 – 1	0.062	0.0821	(-0.1894, 0.3134)	0.75	0.940
3 – 1	0.272	0.0821	(0.0206, 0.5234)	3.31	**0.031**
4 – 1	1.118	0.0821	(0.8666, 1.3694)	13.61	**<0.001**
5 – 1	2.304	0.0821	(2.0526, 2.5554)	28.06	**<0.001**

5.8 SCHEDULE

Scheduling and logistical coordination before restoration implementation for each pipeline segment will consider seasonal access constraints, critical timing periods for caribou (see Section 5.7.1) and other valued components, production of nursery seedlings and appropriate timing for restoration efforts (e.g., season of planting).

Final cleanup ~~activities~~ will ~~be completed~~occur the summer/winter season following construction~~ and within one year following the start of operations~~. As-built construction information will be compiled following construction and used to determine appropriate site-specific restoration measures and access ~~control~~management locations. Final site selection for caribou habitat restoration treatments will be completed during the first growing season following construction.

For the~~ current~~ proposed schedule for construction and habitat restoration activities, see Table ~~5-5~~5-8 and Table 5-9.

5.8.1 Caribou Timing Windows

~~NGTL is employing an early in/early out strategy to reduce disturbance of caribou by initiating activities as early as possible in the winter and working expeditiously to limit late winter activities.~~

~~Clearing activities at the compressor station will be complete and the site will be fenced prior to February 15, 2016, after which work will generally occur within buildings. Pipeline access preparation and clearing will commence in mid-September 2015 as conditions allow, and will be completed prior to February 15, 2016. NGTL is committed to reporting construction progress to the regulators on a bi-weekly basis so they are informed of any circumstances that may lead to delays with the construction schedule.~~

~~Final clean-up and reclamation is scheduled to occur in early winter 2017 during frozen conditions and in the late summer, outside the February 15 to July 15 timing restriction.~~

There are multiple regulatory guidance documents for BC that identify timing windows that apply to caribou herds that overlap with the Project. The *Peace Region Least-Risk Timing Windows, April 2011 Update* (BC MFLNRO 2011) defines timing windows for northern ecotype caribou:

- **Low Risk:** July 16 to September 14 – Restrictions would not normally apply. Where ground conditions permit, plan development activities within these timeframes.
- **Cautionary:** September 15 to January 14 – Operators should avoid development activities during these timeframes.
- **Critical:** January 15 to July 15 – Development activities are not appropriate during this timeframe. Aerial activities should adhere to guidelines. In the event that working within a critical timing window is unavoidable, proponent should contact an appropriate qualified professional (e.g., Registered Professional Biologist with BC accreditation) to discuss alternatives, and potential mitigation and monitoring plans.

The recently released *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Interim Guidance)* (BC MFLNRO 2014) presents the same timing windows as the BC MFLNRO 2011 document, but includes an additional critical timing window for northern ecotype caribou that relates to the migration period (April 1 to May 20 and December 1 to January 1; BC MFLNRO 2014). There are no identified migration corridors for caribou in proximity to the Project in either the Graham or Pink Mountain caribou ranges.

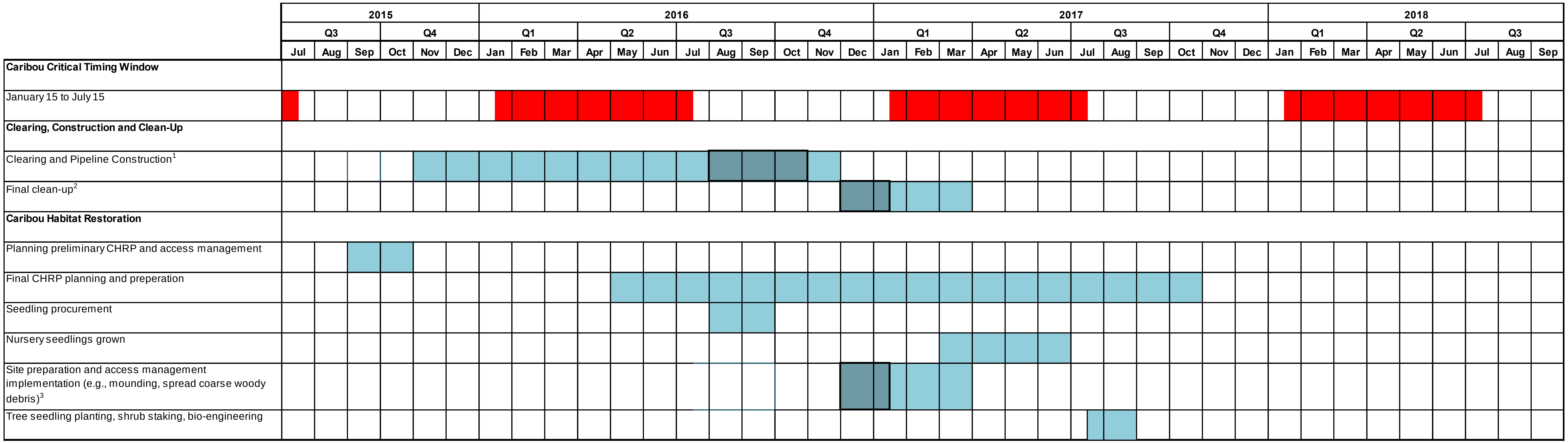
NGTL's intent is to apply the January 15 to July 15 critical timing window described by BC MFLNRO (2011, 2014). The NEB Report for the Project requires that NGTL proactively plan construction activities in caribou ranges in compliance with provincial and federal timing restrictions. NGTL will file construction progress reports with the NEB pursuant to Condition 27. These progress reports will include information on any mitigation implemented to complete construction activity outside the critical timing window.

To minimize the potential need for work to occur within the critical timing window in the Graham and Pink Mountain caribou ranges, NGTL will potentially increase construction manpower or use alternate equipment (e.g., wheel ditcher in place of a hoe) to increase productivity, where feasible to do so. NGTL's ability to implement these measures might be affected by factors beyond NGTL's control, such as adverse weather conditions.

Depending on logistical constraints and site conditions, habitat restoration efforts are expected to be completed during the first or second growing season following final cleanup. These activities are part of the post construction phase, and will be scheduled outside the critical timing window for caribou in the Graham and Pink Mountain caribou ranges.

Table 5-7~~: Liege Lateral Loop 2~~: North Montney Aitken Creek Section – Graham Caribou Range – Proposed Construction and Habitat Restoration Preliminary Schedule

	2015												2016												2017											
	Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Caribou Timing Window																																				
February 15 to July 15																																				
Clearing, Construction and Clean-up																																				
Clearing and construction of the compressor station site and access road																																				
Pipeline access preparation, right-of-way and temporary work space clearing in the Egg-Pony and Algar Caribou Ranges																																				
Pipeline construction in the Egg-Pony and Algar Caribou Ranges																																				
Final clean-up																																				
Caribou Habitat Restoration																																				
Planning Prelim. CHRP and access management																																				
Camera deployment for baseline access control data collection																																				
Field assessments and planning Final CHRP																																				
Seedling procurement																																				
Nursery seedlings grown																																				
Site preparation and access management implementation																																				
Shrub staking, bio engineering (riparian areas) and seedling planting																																				



Notes:

1. Project construction is scheduled between November 2015 and November 2016; construction work will be prioritized within the Graham Caribou range between August and October 2016.
2. Project final clean-up is scheduled between December 2016 and March 2017; clean-up work will be prioritized within the Graham Caribou range between December 2016 and January 15, 2017.
3. Site preparation and access management implementation will be prioritized within the Graham Caribou range between December 2016 and January 15, 2017.

Table 5-8: North Montney Kahta Section – Pink Mountain Caribou Range – Proposed Construction and Habitat Restoration Preliminary Schedule

	2015						2016												2017												2018								
	Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3		
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Caribou Critical Timing Window																																							
January 15 to July 15																																							
Clearing, Construction and Clean-Up																																							
Clearing and site preparation																																							
Pipeline construction[1]																																							
Final clean-up[2]																																							
Caribou Habitat Restoration																																							
Planning preliminary CHRP and access management																																							
Final CHRP planning and preparation																																							
Seedling procurement																																							
Nursery seedlings grown																																							
Site preparation and access management implementation (e.g., mounding, spread coarse woody debris)[3]																																							
Tree seedling planting, shrub staking, bio-engineering																																							

Notes:

1. Project construction is scheduled between August 2016 and April 2017; construction work will be prioritized within the Pink Mountain Caribou range between August and December 2016.
2. Project final clean-up is scheduled between December 2017 and March 2018; clean-up will be prioritized within the Pink Mountain Caribou range between December 2017 and January 15, 2018.
3. Site preparation and access management implementation will be prioritized within the Pink Mountain Caribou range between December 2017 and January 15, 2018.

6.0 CONTINUOUS IMPROVEMENT

~~This Preliminary CHRP has incorporated updated results from~~ In regards to caribou habitat restoration, NGTL is committed to continuous improvement. Continuous improvement will come from NGTL's analysis in the short, near, and long term of applied practice, the monitoring program and pure research.

~~ongoing literature assessment, research completed by industry associations, lessons learned from previous NGTL projects, consultation with applicable regulators and resource managers, and adaptive management practices in the field.~~

This section describes caribou habitat restoration initiatives, industry collaboration and lessons learned by NGTL on other projects ~~with~~that impacted caribou habitat. ~~Continuous~~Because of NGTL's commitment to continuous improvement ~~comes from NGTL's analysis~~, NGTL will continue to monitor all of the ~~monitoring program (short term), applied practice (near term)~~aforementioned components and ~~pure research (long term).~~incorporate learnings into its caribou habitat restoration efforts.

This Preliminary CHRP has incorporated updated results from:

- ongoing literature assessment
- research completed by industry associations
- lessons learned from previous NGTL projects
- consultation with applicable regulators and resource managers

~~6.1~~ ADAPTIVE MANAGEMENT PRACTICES IN THE FIELD~~CARIBOU HABITAT INITIATIVES~~

-

Most of the updated results from these sources reference boreal caribou. Since there is little research applicable to mountain caribou in the area affected by the Project and boreal and mountain caribou are the same species, boreal caribou data will be used to inform mountain caribou restoration and monitoring plans for the Project. The monitoring program developed for the Project will add to the emerging database on mountain caribou habitat restoration.

For a list of historic and current habitat restoration initiatives, see Appendix C.

6.1 CARIBOU HABITAT INITIATIVES

This section summarizes caribou habitat restoration initiatives planned or implemented in woodland caribou ranges. Given the limited available information specific to northern and mountain caribou range restoration, this section includes identification of temporal and spatial caribou habitat restoration methods compiled from boreal caribou ranges. Boreal woodland caribou habitat restoration provides context and lessons learned from caribou habitat restoration initiatives that have been implemented in the recent past, and where available, monitoring results and effectiveness of measures. As the monitoring program progresses for this Project in northern caribou range, lessons learned and emerging data will be incorporated in NGTL's plans as adaptive management.

Although restoration ecology specific to caribou habitat is a relatively new science, some key initiatives have identified important lessons learned related to oil and gas development in caribou range. Common among many of these initiatives are lessons learned on which plant species to use, when and where to replant, ~~development of~~ effective techniques to promote natural revegetation and a better understanding of effective methods to manage access.

Lessons learned from these initiatives were incorporated in large-scale habitat restoration projects near Grande Prairie, Cold Lake and Fort McMurray, Alberta, as well as NGTL's projects in caribou habitat. Though initiatives focused on revegetation and access management have been conducted in boreal caribou ranges (Caribou Range Restoration Project [CRRP] 2007a,b; Golder Associates Ltd. [Golder] 2010; Osko and Glasgow 2010); however, the research provides valuable information for the Project restoration program, as well as providing relevant information regarding limiting growth and establishment of plant species favourable to primary prey.

~~These initiatives focused on revegetation and access management, as well as limiting growth and establishment of plant species favourable to primary prey (e.g., Caribou Range Restoration Project [CRRP] 2007a,b; Golder Associates Ltd. [Golder] 2010; Osko and Glasgow 2010). Projects~~Oil sands-funded projects also included tree-~~-~~ planting initiatives, coarse woody debris management best practices, habitat-~~-~~ enhancement programs and habitat restoration trials in caribou range (CRRP~~-~~ 2007a,b; Enbridge Pipelines [Athabasca] Inc. [Enbridge] 2010; Golder~~-~~ 2010, 2011; COSIA~~-~~ 2012).

Another example of caribou habitat improvement initiatives is First Coal Corporation's proposed reclamation plan for a disturbed mine site, with the objective of restoring foraging habitat for caribou in the Burnt–Pine caribou range, while minimizing the creation or improvement of foraging habitat for early seral ungulate (primary prey) species (Turner et al. 2009). The Burnt–Pine caribou herd is part of the Central Group of the Southern Mountain Caribou Population located south of the Moberly (Klinse-Za) and Graham ranges. First Coal Corporation's reclamation plan adopted an ecosystem-specific approach, whereby reclamation strategies were developed considering biophysical site characteristics.

First Coal Corporation's proposed reclamation plan focused on introduction of terrestrial lichen as a mechanism for regenerating plants that might act as attractants to caribou, and manual brushing of "less desirable" vegetation was suggested to encourage establishment of plants attractive to caribou and to minimize forage for early seral ungulates (moose and deer). Transplanting conifers was suggested as a potential measure that would be considered for reclamation of engelmann spruce-subalpine fir (ESSF) forested sites. Research and monitoring of restoration trials was a key component of First Coal Corporation's proposed reclamation plan. The proponent withdrew the project in 2012, however, and the reclamation plan was not implemented.

Blocking line-of-sight ~~is a~~ will be implemented as a restoration tool ~~implemented through land use guidelines~~for this Project because it is a tool believed to mitigate increased risk of predation in the short term, while longer-term goals of revegetation of sightlines are achieved. The Project monitoring program will feed into emerging science on this restoration tool.

6.2 INDUSTRY COLLABORATION

Canada's Oil Sands Innovation Alliance (COSIA) was launched in 2012 to enable responsible and sustainable growth of Canada's oil~~-~~ sands while delivering accelerated improvement in environmental performance through collaborative action and innovation (COSIA~~-~~ 2012).

The organization's four key focus areas are tailings, water, land and greenhouse gases. Part of the land focus area is a caribou habitat restoration initiative with the goal of improving woodland caribou habitat quality and herd survival through restoration of historic linear disturbances.

COSIA has developed the following habitat restoration initiatives:

- Determining effectiveness of different restoration techniques such as winter tree planting, mounding, seeding and placement of coarse woody debris. The winter tree planting trial was set up to determine the effectiveness of planting black spruce seedlings in wetland areas during winter. Results of the tree planting trial indicated 90% survival of the 900 seedlings planted.
- Development of the Landscape Ecological Assessment Planning (LEAP) tool to provide baseline levels of varying land use. LEAP can be used to determine the long-term effects of restoration in a given area, which can help guide planting initiatives.
- The Algar Historic Restoration Project takes an integrated regional approach, with six companies working together to repair fragmented habitat across an area of land outside their actual licence areas. This is a five-year program to replant trees and shrubs along the linear footprint in the Algar Region, covering an area approximately 570 km^2.
- The LiDea Project aims to restore linear disturbances using mounding and tree felling. Rigorous monitoring and measurement programs have been designed

for the life of the project, and currently include 37,000 ha of active treatment area. During spring and summer, conifer seedlings are planted along older, mounded seismic lines. LiDea is also experimenting with forest stand modification, which involves bending tree stems from the adjacent forest across the seismic line to create physical barriers and reduce sightlines along the linear corridor.

The Regional Industry Caribou Collaboration (RICC) is part of COSIA, and is a multi-industry partnership focused on restoring caribou habitat through regional, collaborative, range-based efforts. The objectives of RICC are to coordinate habitat restoration in the short term and long term, coordinate future activity, support and lead scientific research, conduct applied trials and align caribou habitat restoration programs with provincially led Range Plans and Action Plans.

NGTL has recently joined RICC. A major RICC research effort is to verify the effectiveness of restoration measures using a multi-scale predator/prey collaring program to address current knowledge gaps in habitat use and function. As new information on habitat restoration becomes available, NGTL will incorporate it in the planning and implementation process for its projects in caribou habitat.

6.3 LESSONS LEARNED FROM NGTL HABITAT RESTORATION

Preliminary and Final CHRPs were completed for NGTL's Northwest Mainline Expansion Project, Leismer to Kettle River Crossover Project and Chinchaga Lateral Loop No. 3 Project (Chinchaga Section). A Preliminary CHRP was filed on June 30, 2015 (NEB Filing ID: A71014) for Liege Lateral Loop 2 and Leismer East Compressor Station and refiled on August 18, 2015 (NEB Filing ID: A4S5W1).

Based on NGTL's experience with these ~~three~~ projects, the following lessons learned were incorporated in this Preliminary CHRP:

- Rollback was used as firewood by land users when stacked as ladders. A more random arrangement of wood piles to discourage wood removal might be used in the future.
- Line-of-sight breaks on co-located ROWs are not effective because of unrestricted access on parallel ROWs. NGTL has learned that such methods are better used in non-contiguous ROWs and that such line-of-sight breaks are redundant on contiguous ROWs. There have been structural stability issues with constructed line-of-sight blocks (versus vegetation screens). NGTL has, therefore, been experimenting with constructing alternative line-of-sight structures (e.g., snow fencing constructed with 2x4s was tested during winter 2014/15).
- Tree planting on a linear corridor appears to not be as effective as on cutblocks (typical silvicultural practices) because of shading. This could result in changes to the planting densities and configurations as the monitoring program progresses.

- Access control cannot be absolute because of safety, operating and maintenance activities that must occur. On previous NGTL projects, lack of access resulted in CHRP measures being destroyed or removed by TransCanada staff to access the ROW. In the future, access-control locations will be strategically placed to allow for maintenance and traditional use access.
- Where CHRP measures have failed or been removed, they have been replaced as part of adaptive management.
- As NGTL has attempted to apply the line of sight/access control features on the landscape as suggested in the EAP; however, it has become apparent that over the course of implementing those features on other NGTL projects that impact caribou habitat (Leismer, NWML, Chinchaga) meeting the recommended intervals was not feasible. For further details about why NGTL has not adopted the EAP suggested intervals, see Section 5.5.
- Based on recent field experience on the Chinchaga Section with implementing access control and line of sight blocks, NGTL determined that there are several reasons why these features cannot be applied at EAP recommended intervals and the intervals that were identified within the decision framework from the Chinchaga Final CHRP:
    - Materials to construct line of sight blocks are not often available and limit the capacity to implement at the EAP recommended intervals (for example, 200m and 400m):
        - There would be insufficient woody material to implement line of sight blocks, even using merchantable timber, to construct these features every 200m to 400m.
        - There is often not enough suitable material to implement rollback at the EAP recommended intervals.
        - Limited opportunities to implement mounding due to the unsuitability of soil types and ecosite type.
    - Conflicting interests for timber and woody materials:
        - Timber salvage waivers must be approved prior to construction and acceptable to the Forest Management Agreement (FMA) holder
        - In regards to woody materials, merchantable timber is prioritized first and used for access control then the remaining materials go to FMA.
        - Any woody materials remaining must be distributed efficiently among the locations where CHRP measures are required (line of sight blocks, mounding).
        - Often NGTL has experienced a lack of available material to implement CHRP measure at 500m intervals.

- Operational concerns:
  - From a safety and maintenance perspective, implementing CHRP measures at 200m and/or 400m makes operational access difficult and potentially unsafe in case of an emergency situation precious time would be lost removing the access control and line of sight measures.
  - For Leismer in particular, NGTL personnel had issues gaining access to the ROW as a result of access control measures. These measures were then removed to gain access. However, the integrity of the wood feature had degraded so replacement of the feature was not possible. There were no additional replacement materials available to reconstruct the feature.

6.4 CHRP CONCORDANCE TABLE

For a summary of differences and updates from the most recent NGTL CHRP filed with the Board, which is the Liege Lateral Loop 2 (Thornbury Section) Preliminary CHRPrefiled on August 18, 2015 (NEB Filing ID: A4S5W1) , see Table 6-1 (compiled pursuant to Condition 15 a) vi). For a blackline comparison of this CHRP and the Liege Preliminary CHRP, see Appendix F.

Table 6-1: Concordance Table

Component of CHRP	Location in Liege Preliminary CHRP	Location in Preliminary North Montney CHRP	Differences or Updates
Introduction and Organization	Section 1	Section 1	There are no significant differences in this section between the two CHRPs, other than tailoring to project-specific details.
Goal, Objectives and Targets	Section 2	Section 2	No differences or updates in this section in between the two CHRPs.
Decision Framework	Section 3	Section 3	The decision framework used for this Project is consistent with the framework used in past NGTL CHRPs and is intended to be used going forward.
Targets and Measures	Section 4	Section 4	There are no significant differences in this section between the two CHRPs other than tailoring to project-specific details.
The Plan	Section 5	Section 5	This section of the North Montney CHRP was tailored to both the Aitken Creek and Kahta Sections, and accommodates the differences between boreal and mountain caribou.

Continuous Improvement	Section 6	Section 6	Information from a reclamation plan for a disturbed mine site was included in Section 6.1. The concordance table in Section 6.4 has been added to the North Montney CHRP and was not included in the Liege CHRP.
Consultation	Section 7	Section 7	This section of the North Montney CHRP includes a summary of consultation with Aboriginal communities, which was not included in the Liege CHRP.
Literature Review	Section 8	Section 8	The North Montney CHRP includes BC-specific regulatory policies and guidelines for mountain caribou, mountain caribou ecology and caribou habitat restoration initiatives for previous industrial developments.

Table 6-1: Concordance Table (cont'd)

Component of CHRP	Location in Liege Preliminary CHRP	Location in Preliminary North Montney CHRP	Differences or Updates
References	Section 9	Section 9	There are no significant differences in this section between the two CHRPs other than tailoring in each CHRP relevant to boreal and mountain caribou.

7.0 CONSULTATION

This section ~~summarizes NGTL's caribou-related~~ provides a summary of consultation with ~~EC~~Aboriginal communities and ~~AEP for the~~ applicable regulators related to Project ~~(see Table 7-1).~~impacts on caribou and caribou habitat, as well as a summary of how feedback was incorporated in the Preliminary CHRP.

NGTL began consultation and working collaboratively with provincial regulators, Aboriginal communities, stakeholders and industry partners ~~several years ago at the outset of~~in 2011 regarding the Project~~ and~~. NGTL will continue to ~~work~~maintain open communication with federal and provincial ~~and federal regulators~~regulatory agencies to align the CHRP measures with provincial and federal ~~policies~~policy, as well as potentially affected Aboriginal communities, through the various Project phases. The Final CHRP will include updated consultation records.

~~This Preliminary CHRP was developed based on ongoing consultation with EC and AEP. NGTL will continue to work with AEP to identify and address caribou-related concerns before construction, and will continue to facilitate open communication throughout Project execution.~~

~~A draft Preliminary Caribou Management Plan (CMP) was provided to federal and provincial regulators for review. The CMP was replaced by this Preliminary CHRP following receipt of draft Conditions from the NEB. The key recommendations from EC were to reduce the Project footprint by paralleling existing linear features and avoid sensitive periods for caribou. In June 2015, NGTL received extensive feedback from AEP on the Preliminary CHRP, which has been incorporated in this document. General concerns included:~~

- ~~use of ambiguous language~~
- ~~lack of clear definition of quantifiable targets and performance measures~~
- ~~adherence to restricted activity periods (RAP)~~
- ~~implementation of a caribou monitoring plan~~

7.1 ABORIGINAL ENGAGEMENT

Aboriginal communities had opportunities to inform the development of caribou mitigation through meetings, Information Requests (IRs), community-led Traditional Land Use (TLU) studies, Traditional Ecological Knowledge (TEK), independent technical review and through the hearing process for the Project (i.e., oral evidence, TLU studies).

Blueberry River First Nations, Prophet River First Nations, Saulteau First Nations and West Moberly First Nations all presented oral evidence at the North Montney Hearing in Fort St. John, BC. Each potentially affected and interested Aboriginal community received copies of the preliminary Caribou Management Plan (CMP) and updates, with requests by NGTL to review these documents and to provide input. Meetings have also been requested with each interested community to review the plan, respond to questions and receive further feedback from Aboriginal communities on the plan. For a summary of engagement activities related to caribou, see Table 7-1. The CMP preceded, and has been replaced by, this Preliminary CHRP.

In addition to comments and written evidence, NGTL has reviewed and considered the following reference documents submitted by Aboriginal communities for the Project:

- Saulteau First Nations and West Moberly First Nations provided, as an aid to cross-examination at the Project hearing, *Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada* (NEB Filing ID: A4E9U2).
- West Moberly First Nations submitted as part of their additional written evidence (AWE) Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace of British Columbia (Filing ID: A3Z0H2) and Action Plan for the Klinse-Za Herd of Woodland Caribou (Rangifer tarandus caribou) in Canada (Filing ID: A3X4D3).

Given differences in mapping approaches described in Section 8.2 (traditional knowledge about historic distribution and range of caribou versus caribou local population units and critical habitat in the federal Recovery Strategy), it was determined that the Preliminary CHRP would be developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.

NGTL has adopted the definition of critical habitat as defined in the Recovery Strategy (EC 2014). For the reasons described in NGTL's response to West Moberly First Nations IR No. 2 (Filing ID: A3Z6Y1), Final Argument (Filing ID: A64632) and Reply Argument to West Moberly First Nations (Filing ID: A4F7T5) (summarized in Section 8.2), NGTL will apply CHRP measures within the boundaries of the Recovery Strategy-delineated caribou herd ranges (equivalent to local population units). The caribou herd ranges are mapped by provincial and federal regulatory authorities responsible for management and recovery of the Graham and Pink Mountain caribou herds. However, mitigation measures described in the Environmental Protection Plan (EPP) and AMP will be applied for the entire Project.

The Independent Technical Review Group (Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations) commissioned a third-party consultant, LGL Ltd., to review the draft Preliminary CHRP and provide comments. The review provided by LGL Ltd. to NGTL supported the restoration measures and monitoring program detailed in the Preliminary CHRP. Comments focused mainly on differences in mapping of caribou critical habitat between the federal Recovery Strategy and Seven Herds report. LGL Ltd. also suggested the implementation of a lichen collection and transplantation program (see Table 7-1).

Table 7-1: Summary of Aboriginal Engagement

Aboriginal Community/ Date and Method	**Engagement Related to Caribou**	**Section in the Preliminary CHRP**	**Comments and Rationale**
Blueberry River First Nations			
July 21, 2014	NGTL emailed Blueberry River First Nations information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a Caribou Mitigation Monitoring Plan (CMMP) would be prepared. A PDF document of the Preliminary CMP was included for Blueberry River First Nations' review. NGTL noted that access management mitigation measures have been included in the project's EPP. NGTL requested to meet with Blueberry River First Nations to discuss the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input into the proposed plans.	N/A (no comments received)	–
September 8, 2014	NGTL emailed Blueberry River First Nations to request a meeting. Possible meeting dates were provided, with the request that Blueberry River First Nations provide alternative dates if the provided dates do not fit in with Blueberry River First Nations' schedule. The purpose of the meeting would be to discuss the CMP (NEB Filing ID: A4C5V4) and the access management measures and locations.	N/A (no comments received)	–
Doig River First Nation			
July 21, 2014	NGTL emailed Doig River First Nation information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Doig River First Nation's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Doig River First Nation to discuss the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A (no comments received)	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	**Engagement Related to Caribou**	**Section in the Preliminary CHRP**	**Comments and Rationale**
Halfway River First Nations			
July 21, 2014	NGTL emailed Halfway River First Nations information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Halfway River First Nations' review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Halfway River First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
August 21, 2014	NGTL conducted a meeting to present Halfway River First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and access management measures and locations. NGTL requested feedback on the access planning during the meeting. Halfway River First Nations commented that scoop-outs prevent trucks, but attract quads and motor bikes. It was also stated that signs are an informative way to deter access as well. Halfway River First Nations inquired about monitoring access points.	All Sections	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the three main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16).
McLeod Lake Indian Band			
July 21, 2014	NGTL emailed McLeod Lake Indian Band information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for McLeod Lake Indian Band's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with McLeod Lake Indian Band to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
McLeod Lake Indian Band (cont'd)			
September 8, 2014	NGTL emailed McLeod Lake Indian Band to request a meeting. Possible meeting dates were provided, with the request that McLeod Lake Indian Band provide alternative dates if the provided dates do not fit in with McLeod Lake Indian Band's schedule. The purpose of the meeting would be to discuss Serious Harm to Fisheries, the CMP (NEB Filing ID: A4C5V4) and the AMP.	N/A	–
Prophet River First Nation			
July 21, 2014	NGTL emailed Prophet River First Nation information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Prophet River First Nation's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Prophet River First Nation to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
September 24, 2014	NGTL conducted a meeting to present Prophet River First Nation with the Preliminary CMP (NEB Filing ID: A4C5V4) and access management measures and locations. No concerns specific to caribou or access management were recorded.	N/A	–
Saulteau First Nations			
February 28, 2012	NGTL attended the 2012 Caribou Workshop held by Saulteau First Nations. The purpose of the workshop was to bring together all proponents in the region whose activities might have an impact on caribou. Saulteau First Nations' goal was to develop a plan to protect boreal, northern and southern caribou herds.	N/A	Specific recommendations or comments related to planning or implementing caribou habitat restoration for the Project were not discussed.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
January 29, 2013	NGTL attended the Caribou Planning Session for the Peace Northern Caribou Committee on January 29-30, 2013. Approximately 35 people attended from industry, local First Nations communities and government. The workshop was a planning session to identify an appropriate governance structure for the committee and a discussion on how to immediately protect the Moberly caribou herd.	N/A	Specific recommendations or comments related to planning or implementing caribou habitat restoration for the Project were not discussed. The Project does not encounter the provincially/federally delineated range of the Moberly caribou herd.
April 25, 2013	NGTL met with Saulteau First Nations. Saulteau First Nations is concerned about caribou and how declining Moberly caribou population counts will be addressed.	8.2	The Project does not encounter the provincially/federally delineated range of the Moberly caribou herd. Regulatory objectives, including stopping decline of caribou populations, are reviewed and provide context for the development of the Preliminary CHRP. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
		8.3, 8.4	Ecology of the caribou herds encountered by the Project is discussed, including population trend, threats and limiting factors. This information provides ecological context considered in the development of the Preliminary CHRP, in particular, development of CHRP objectives.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
April 25, 2013 (cont'd)	See above	2,3,4,5	The goal of the CHRP is to reduce the residual effects of the Project on caribou and caribou habitat in a manner that aligns with provincial and federal policies, and will not affect the capacity for stated caribou recovery and habitat management objectives to be achieved. As noted above, regulatory policy identifies stopping caribou population decline as an objective. The toolbox of measures that NGTL can implement is detailed for all phases of the Project, from pre-construction through operations. Many of the relevant measures have already been implemented as part of the pre-construction (Project planning and design) phase. These, and the measures identified in Section 5 for the construction phase, will facilitate habitat restoration of the Project footprint in caribou range following completion of construction (post-construction phase).

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	**Engagement Related to Caribou**	**Section in the Preliminary CHRP**	**Comments and Rationale**
Saulteau First Nations (cont'd)			
September 6, 2013	NGTL emailed Saulteau First Nations requesting a list of priority areas to visit for the helicopter overflight with Saulteau First Nations representatives scheduled for September 11, 2013. Saulteau First Nations replied the same day with an attachment outlining the focal areas of interest for the overflight. Focal areas included: • Saturn Meter Station • Pine River crossing • Moberly River crossing • Entry into Peace Moberly Tract • Peace Moberly Tract Section • Peace River crossings East and Preferred Route • Caribou habitat crossing (north of Farrell Creek) • Prince Rupert Gas Transmission Project tie-in location (NEB Filing ID: A3Q6U2)	7.1	TEK presented during field studies is summarized in this section.
September 11, 2013	A helicopter overflight was conducted with Saulteau First Nations that included a flyover of the Graham caribou range. Saulteau First Nations was shown where NGTL proposed to parallel the existing pipeline corridor (NEB Filing ID: A3Q6U2).	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
		7.1	TEK presented during field studies is summarized in Section 7.1.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
September 25, 2013	Saulteau First Nations emailed NGTL a routing memo that: • outlined routing review work completed to date • listed Saulteau First Nations' concern with disturbance in Area of Critical Community Interest and Peace Moberly Tract • noted Saulteau First Nations' preferred route is the Chetwynd Route • stated that Tetra Tech agrees that the East Route is not feasible • requested implications for caribou habitat during construction (in vicinity of Farrell Creek) • requested NGTL comments on noted items (including suggestion for following the Chetwynd Route) (NEB Filing ID: A3Q6U2)	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
July 21, 2014	NGTL emailed Saulteau First Nations information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Saulteau First Nations' review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Saulteau First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
October 5, 2014	NGTL provided the links to the Preliminary CMP filed with the NEB (NEB Filing ID: A4C5V4).	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
October 6, 2014	NGTL presented Saulteau First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations.	All Sections	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the 3 main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16).
West Moberly First Nations			
February 14, 2013	NGTL met with West Moberly First Nations to discuss the Project and Community Agreements. West Moberly First Nations does not want pipelines through the Moberly caribou range west of Moberly Lake. West Moberly First Nations would like to have the government defer tenure in the northeast area of the Peace Moberly Tract, including the adjacent area to the east and would like NGTL to influence government to defer tenure in that area.	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
April 15, 2013	NGTL met with West Moberly First Nations to discuss the Project. West Moberly First Nations is concerned that the Project will open the door to further development through the Peace Moberly Tract and does not want pipeline development through critical caribou habitat. West Moberly First Nations is exploring the idea of a pipeline corridor to manage all the proposed pipelines in the area. West Moberly First Nations members would need a chance to provide feedback on the Project before a decision of support can be made (NEB Filing ID: A3Q6U2).	7.1	The routing criteria described in Section 4.1 of the ESA. The Peace Moberly Tract is outside provincially/federally delineated caribou range. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
West Moberly First Nations (cont'd)			
July 18, 2013	NGTL met with West Moberly First Nations to discuss the Project. West Moberly First Nations is concerned that the ROW will become an access point for hunters and predators; the community wants to monitor and limit the access to hunting areas. West Moberly First Nations is also concerned about a decline in wildlife (including caribou) (NEB Filing ID: A3Q6U2).	2,5.3,8.5	Access management is one of the objectives of the CHRP. Section 8.5 presents a summary of literature relevant to human access and interaction with habitat restoration. Section 5.3 presents information relevant to planning access control. The AMP for the Project will include additional information, and will be submitted under separate cover in accordance with Certificate Condition 16. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
July 21, 2014	NGTL emailed West Moberly First Nations information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for West Moberly First Nations' review. NGTL noted that access management mitigation measures were included in the Project's EPP. NGTL requested to meet with West Moberly First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
West Moberly First Nations (cont'd)			
October 15, 2014	NGTL conducted a meeting to present West Moberly First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management mitigation measures and locations. West Moberly First Nations suggested *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014) and *Action Plan for the Klinse-Za Herd of Woodland Caribou* (Rangifer tarandus caribou) *in Canada [Draft]* (McNay et al. 2013) be applied to the CMP.	7.1	The routing criteria described in Section 4.1 of the ESA. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations			
January 30, 2015	NGTL met with the Independent Technical Review Group to discuss NGTL caribou habitat restoration and access management plans. Questions were raised regarding the development of camps and yards and the potential impact on caribou. It was indicated that the Treaty 8 communities want to take an active role in the development of the CHRP and the AMP.	7.1	The routing criteria described in Section 4.1 of the ESA. Construction of the section 58 components of the Project (e.g., camps, pipe yards) is proposed to start during summer 2015; however, none of these ancillaries are proposed in the Graham or Pink Mountain caribou ranges.
March 3, 2015	NGTL met with the Independent Technical Review Group to discuss the independent technical review of the CMP and the access management mitigation measures and locations. Questions were raised regarding the method and utility of the proposed restoration and access management mitigation measures, and monitoring of the restoration and access management mitigation. Interest in collaboration on the caribou habitat restoration planning was expressed.	7.1	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the 3 main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16). The AMP is relevant to the entire Project.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	**Engagement Related to Caribou**	**Section in the Preliminary CHRP**	**Comments and Rationale**
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations (cont'd)			
March 4, 2015	Email correspondence between LGL Ltd., representing the Treaty 8 collaborative Nations, and NGTL. LGL Ltd. requested a draft Preliminary CHRP to review before the meeting with NGTL tentatively scheduled on April 7, 2015 to discuss mitigation measures proposed for the Project.	N/A	–
March 23, 2015	NGTL provided a draft copy of the Preliminary CHRP to the Independent Technical Review Group and requested review and comment.	N/A	–
April 6, 2015 April 7, 2015 April 9, 2015 April 14, 2015	Email correspondence between LGL Ltd. (on behalf of the Independent Technical Review Group and NGTL related to the technical review of the draft Preliminary CHRP.	N/A	The tentative meeting for April 7, 2015 was cancelled. LGL Ltd. advised on April 9, 2015 that written comments on the draft Preliminary CHRP would be provided.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations (cont'd)			
April 28, 2015	LGL Ltd. provided the results of a technical review of the draft Preliminary CHRP to NGTL on behalf of the Independent Technical Review Group. It was again suggested that the caribou habitat mapping by West Moberly First Nations in *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014) and *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013) be applied to the CHRP. LGL Ltd. also suggested implementation of a lichen collection and transplantation program. LGL Ltd. acknowledged that this Preliminary CHRP describes planning considerations and provides mitigation measures and habitat restoration options that can be implemented during the pre-construction, construction and post-construction phases of the Project. It was further recognized that mitigation measures and habitat restoration options (specifically Tables 6 and 7) detailed in this Preliminary CHRP will likely be effective if they are implemented in appropriate locations and follow-up monitoring and adaptive management actions are applied.	8	Comments provided by LGL Ltd. were reviewed and considered by NGTL. Critical habitat as delineated by federal and provincial regulatory authorities will continue to be used to inform the Preliminary CHRP. Any changes to these boundaries will be considered in the development of the Final CHRP. NGTL has considered the use of lichen transplanting as a possible mitigation measure for the Project. Lichens are described throughout Section 8. NGTL is committed to continued engagement with the Treaty 8 collaborative Nations. The Final CHRP will incorporate updated records of consultation and engagement, including how additional information received from Aboriginal communities is incorporated in the Final CHRP.

7.2 REGULATORY CONSULTATION\

For a summary of caribou-related consultation for the Project with federal and provincial agencies, see Table 7-2. NGTL initiated consultation early (2011; 2013-specific to caribou) in the Project planning phase to enable regulatory agencies to provide relevant information and input in a timely manner. The two key recommendations received from BC MFLNRO were to:

- reduce the Project footprint by paralleling existing linear features
- avoid critical timing periods for caribou

A draft Preliminary CMP was provided to EC and BC MFLNRO regulators for review on April 21, 2014 and comments were received. The CMP was later replaced by this Preliminary CHRP following receipt of draft Conditions from the NEB, and also was provided to EC and BC MFLNRO regulators for review on March 20, 2015. NGTL has not received comments to the CHRP from EC or BC MFLNRO regarding caribou mitigation or habitat restoration planning at the time of finalizing this Preliminary CHRP. NGTL will continue to maintain open communication with EC and BC MFLNRO as the Project progresses.

Comments and recommendations received from both EC and BC MFLNRO from their review of the Preliminary CMP were considered and incorporated in the Preliminary CHRP. Key comments and recommendations provided during consultation with regulators include:

- The Project is not anticipated to affect high-elevation winter or summer critical habitat, or low-elevation summer critical habitat for the Graham Local Population Unit. The Project is likely to destroy a small area of matrix critical habitat.
- Aboriginal groups should be appropriately engaged regarding potential Project impacts on caribou.
- The construction schedule should adhere to the critical timing window for caribou.
- Avoid activities likely to destroy critical habitat for mountain caribou by means of alternative pipeline construction and operation activities. Consider extending trenchless crossings to reduce habitat disturbance if it is found that trenchless crossings reduce impacts on caribou.
- Maximize paralleling existing linear infrastructure and minimize the Project footprint.
- Discourage early seral vegetation and avoid the use of palatable species for erosion control.
- Mitigate the potential effects of integrity inspections/maintenance associated with operations.

NGTL will continue to work with provincial and federal regulators to align the CHRP measures with provincial and federal policy. Any future comments provided to NGTL will be considered for incorporation into the Final CHRP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities ~~Related to Caribou~~

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Environment Canada				
~~Paul Gregoire Head Program and Planning Coordination, Canadian Wildlife Service~~Joanne Kwok, Environmental Assessment Officer	~~June 18, 2014~~ ~~June 27, 2014~~ ~~July 18, 2014~~ ~~Email~~August 28, 2013 November 25, 2013 Email(s)	~~June 18, 2014: NGTL provided project description and proposed schedule to EC and inquired about starting work at the compressor station during the caribou timing restriction.~~ ~~June 27, 2014: EC stated that mitigation principles should be in accordance with the following hierarchical sequence: avoidance, mitigation and compensation/offset for any residual environmental effects that cannot be avoided or sufficiently minimized.~~ ~~July 18, 2014: NGTL stated that NGTL is awaiting provincial guidance on whether clearing at the compressor station can occur within the caribou timing restriction.~~NGTL indicated being aware that EC was developing a federal recovery plan. EC understood the recovery plan was for the Southern Mountain National Ecological Area (SMNEA). NGTL requested EC to comment whether Graham, Pink Mountain, or both, are included in EC's current planning work and to comment on when EC planned to have a draft of the current planning work available for public review EC provided comment on their current planning work in regard to the Graham and Pink Mountain herds. The Graham herd is included in recovery planning for the Southern Mountain population of Woodland Caribou, as it falls in the SMNEA, which is the current area that the recovery strategy will apply to. Under COSEWIC's DUs, this herd falls in DU7. EC explained the Pink Mountain herd is not included in the current recovery planning processes as it does not fall in the SMNEA, but is in the NMNEA and DU7. The Pink Mountain herd is included in the Management plan for the Northern Mountain population of Woodland Caribou. EC indicated plans to post a draft recovery strategy for the Southern Mountain population of Woodland Caribou on the *SARA* registry for public comment by spring 2014.	8.3,8.5~~.6~~ ~~4,5,6,7~~ ~~5.1~~	~~The schedule is provided in Section 5.6.~~ ~~The mitigation hierarchy is applied to the CHRP, and is reflected in the measures described in Section 4 to Section 7, which span pre-construction (planning), construction, post-construction (restoration) and operations phases. Offsets will be addressed in the OMP and CHROMMP as per Conditions 7 and 8.~~ ~~Timing windows are discussed in Section 5.1.~~Conservation status and recovery/management planning for the Graham and Pink Mountain caribou ranges is provided in Sections 8.3 and 8.5
Joanne Kwok, Environmental Assessment Officer	December 4 and 6, 2013 Email(s)	NGTL suggested a meeting in January to introduce the project to EC, to discuss any issues/concerns/questions EC might have, and to speak further regarding project effects and mitigation for caribou. EC indicated they would like to take the opportunity to meet with NGTL and discuss various components of this project including some wildlife issues, wetlands, caribou. EC proposed to have a meeting in mid-February (February 14, 2014).	–	N/A
~~Paul Gregoire Head Program and Planning Coordination, Canadian Wildlife Service~~Cindy Hubbard, Environmental Assessment Officer Holly Middleton, Canadian Wildlife Service Jennifer Wilson, Special Projects Officer Joanne Kwok, Environmental Assessment Officer Darcy Peel, Canadian Wildlife Service Greg Ferguson, Canadian Wildlife Service Hugo Gherbavaz, Environmental Assessment Advisor	February ~~3, 2015~~ 13, 2014 Meeting in Vancouver, BC February 14, 2014 Email	~~NGTL stated that an NEB approval has been received (Order XG-N081-003-201). NGTL stated that they are committed to completing a CHRP, an OMP and a CHROMMP for the Project. NGTL asked how EC would like to be consulted with respect to these plans.~~ ~~EC would like to review all caribou management plans.~~NGTL provided a Project overview and a summary of consultation with BC MFLNRO related to caribou (i.e., BC MFLNRO advised that the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* should be considered for both the Graham and Pink Mountain caribou ranges and the Project does not intersect high elevation range in the Graham range and therefore does not trigger the requirement for offset measures). NGTL indicated they will prepare a CMP to address Project effects on caribou and caribou habitat in caribou ranges crossed by the proposed Project. NGTL agreed to provide a draft of the preliminary CMP to EC for review before the NEB Hearing (scheduled in August 2014). A final CMP would be prepared following construction. EC requested comments on the draft *Recovery Strategy for the Woodland Caribou, Southern Mountain Population (*Rangifer tarandus caribou*) in Canada* and offered to meet with NGTL to discuss how the draft recovery strategy could affect the Project. NGTL followed up with an email (February 14, 2014) and provided a map that shows routing revisions (the re-route at the Sikanni Chief River and a reduction in length in the Pink Mountain caribou range). These revisions were made after the NEB application was filed and were addressed in the AWE filed with the NEB in April 2014. NGTL provided web-links to the most recently filed CHRPs prepared by NGTL as a helpful reference to EC and noted that this work has evolved with each NGTL Project.	~~1~~8.2	~~The Preliminary and Final CHRP will be provided for EC review. NGTL plans to also provide EC the OMP and CHROMMP for review.~~*Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* exempts activities that occur outside identified high-elevation winter range (HEWR) for South Peace Northern Caribou from preparation of a CMMP. The Preliminary CMP and CHRP align with the first three levels of the mitigation hierarchy (i.e., avoid, minimize, restore onsite), and the associated principles and considerations described in the Implementation Plan have been considered. The Preliminary CMP is replaced by this Preliminary CHRP.
Cindy Hubbard, Environmental Assessment Officer	March 5, 10 and 11, 2014 Email(s)	An effort was made to meet with EC to discuss the draft Recovery Strategy but EC was busy with the preparation of the draft Recovery Strategy and offered to meet at a later date. NGTL indicated their interest in meeting to discuss and determine how the draft Recovery Strategy will affect the Project. NGTL advised of their intent to circulate the preliminary CMP in mid-April 2014 and request to incorporate EC's comments before filing the report with the NEB in June 2014. For the purposes of Project planning and mitigation, NGTL requested EC's early input, specifically in regard to clarity on critical habitat. Further, NGTL reminded EC of NGTL's approach (as discussed at the February 13, 2014 meeting) and sought to understand if this was reasonable. NGTL noted that the process of "march charting" (construction scheduling) is ongoing and will include important timing windows for caribou to the extent possible.	–	N/A

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
~~Paul Gregoire Head Program and Planning Coordination, Canadian Wildlife Service~~Cindy Hubbard, Environmental Assessment Officer	~~March 30, 2015~~April 3 and 4, 2014 Email(s)	~~Draft Preliminary CHRP sent to EC for review and comment.~~Before the meeting with EC on April 11, 2014, NGTL provided the following based on a request from EC: portions of the ESA that address Project residual and cumulative effects on wildlife and wildlife habitat; and maps that show the Project in caribou range. NGTL noted that the preliminary CMP will provide information on mitigation measures to reduce the predicted residual effects of the Project's construction and operation on caribou and caribou habitat. Since the Project does not intersect defined HEWR in the Graham caribou herd range, the Project does not trigger the requirement for a CMMP under the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC*, which would include a requirement for offset (compensation) measures. The Preliminary CMP will include information on: regulatory context; literature review; mitigation measures to be implemented before, during and following construction; and a summary of consultation with federal and provincial regulators. The Final CMP will document the onsite restoration measures implemented, identify their locations, and present them on Environmental Alignment Sheets. The Final CMP will be filed with the NEB following completion of final construction, cleanup and reclamation activities.	~~–~~Figure 1-1 7.8	~~N/A~~The relevant components are incorporated in the Preliminary CHRP. Detailed information will be filed with the Final CHRP following completion of reclamation activities.

~~**Table 7-1: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)**~~

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
~~**Environment Canada (cont'd)**~~				
~~Paul Gregoire~~ Stephen Hureau, Head ~~Program and Planning Coordination,~~ Species at Risk Recovery Unit, Canadian Wildlife Service Jennifer Wilson, Special Projects Officer Joanne Kwok, Environmental Assessment Officer Greg Ferguson, Canadian Wildlife Service	April ~~17, 2015~~ ~~Email~~ 11, 2014 Meeting in Vancouver, BC	~~EC reviewed the Preliminary CHRP and had few concerns overall. EC identified concern regarding the method used to quantify residual effects in burned areas, and the implications for quantifying offsets. EC advises that some burned areas might be only 10 years from providing good habitat and the Project could set this area back another 30 years. Therefore, burned areas should not be excluded entirely from the quantification of residual effects and offsets. Additionally, EC advised that there will be a considerable time lag before the plantings in restored areas are effective, and this should be considered in the determination of residual effects and offsets.~~NGTL began the discussion with an introduction to their approach to mitigating Project effects on caribou: As routed, the Project does not intersect any defined HEWR in the Graham range and, thus the Project is not subject to the *Implementation Plan for the Ongoing Management of South Peace Northern Caribou*, and does not trigger the requirement for a CMMP, which would include a requirement for offsets. NGTL, in its ESA, committed to develop a CMP to address project effects on caribou and caribou habitat. This plan will consider and incorporate the threats and mitigation presented in applicable regulatory guidelines. NGTL also noted that a follow-up plan with adaptive management, to monitor the effectiveness of habitat restoration measures will be implemented. NGTL noted that the pipeline length had been reduced in the Pink Mountain range and the portion of the route in the UWR had been removed. EC noted this was a reasonable or appropriate approach. EC indicated the comment period on the proposed Recovery Strategy ended mid-March 2014. The final Recovery Strategy will include more detail on disturbance type and matrix habitat. It was noted that the 65% threshold is the best available information at this time and that mapping disturbance is one of the top priorities.	~~6~~8.2	~~NGTL will quantify direct and indirect spatial residual effects in the Final CHRP. The method to quantify residual effects has been clarified in Section 6.2 since the draft version of the Preliminary CHRP reviewed by EC. The temporal aspect of the residual effects will be discussed in the Final CHRP, and will be incorporated in the method used to determine offsets (e.g., offset ratios reflect time lag considerations).~~The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km. NGTL is continuing to engage EC regarding spatial delineation of critical habitat, including matrix habitat.
~~**Alberta Environment and Parks**~~ Cindy Hubbard, Environmental Assessment Officer	April 21, 2014	NGTL provided a draft Preliminary CMP for review.	–	N/A

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
~~Steven Stryde~~ ~~Forest Officer~~ ~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~ ~~David Lind~~ ~~Land Management Planner~~ ~~Lac La Biche, AB~~Alisha Drinkwater, Senior Environmental Assessment Coordinator	~~April 9 and 15, 2013~~ ~~April 24 and 25, 2013~~ ~~Email~~ ~~Telephone~~June 20, 2014 Letter response	~~NGTL provided factsheet and overview of Project. NGTL requested a time to meet and discuss Project details.~~EC provided comments on draft Preliminary CMP. EC advised the Project is not anticipated to affect high elevation winter or summer critical habitat, or low elevation summer critical habitat for the Graham Local Population Unit. However, EC advised the Project is likely to destroy a small area of matrix critical habitat. EC recommends that the Proponent work with the province to address Project effects in the range of the Graham local population unit that have the potential to result in the destruction of critical habitat. EC is prepared to share its critical habitat data with the Proponent. EC recommends avoidance of activities likely to destroy critical habitat for southern mountain caribou (i.e., Graham local population unit) by means of alternative pipeline construction and operation activities. EC recommends that the Proponent ensures that all activities that are in the Pink Mountain local population unit are consistent with the Northern Mountain Caribou Management Plan. Specific comments on the draft Preliminary CMP were provided in an attachment, and are addressed individually in the following rows.	~~–~~8	~~N/A~~NGTL has requested further clarification of the Project's interaction with critical habitat, and has been advised that critical habitat mapping for the area of the Graham Local Population Unit overlapping the Project is currently in development. NGTL will continue to consult with EC to obtain spatial data files for critical habitat for the Graham Local Population Unit. Information will be considered in Project design and mitigation planning. NGTL is aware of the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada, and has incorporated key elements of the plan into the Preliminary CHRP. Application of the identified management objectives and recovery goals to a specific project or proponent is limited, given the purpose of the Management Plan is to provide directives for the authorities responsible for management of the caribou populations discussed in the Plan. Please refer to entries beginning in the second section of this table for consultation to date with BC MFLNRO. NGTL will continue to consult with BC MFLNRO to address Project effects.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	A) Generally, EC recommends that the Proponent integrate the following criteria in the Preliminary Caribou Mitigation Plan: • goals and objectives regarding mitigation measures that would be implemented to minimize impacts on southern mountain caribou • criteria for measuring the plan's success in achieving these goals and objectives • a summary of related baseline information that would be collected and, if no additional information will be collected, justification • a list of sites where mitigation measures would be implemented, the mitigation measure(s) proposed at those sites, and the rationale for selecting those sites and measures • the methods for monitoring the effectiveness of mitigation measures implemented • a description of adaptive management measures available and of the criteria the Proponent would use to determine if and when adaptive management measures are warranted • a detailed description of the locations where mitigation measures are put in place specifically for construction, as well as those that would remain in place into operations and would be monitored for the life of the Project • a commitment to report on the results of the mitigation measures implemented, monitoring undertaken, and the success of mitigation measures in meeting the goals and objectives of the Preliminary Caribou Mitigation Plan, as part of NGLT's post-construction environmental monitoring reports	1.2	a) The goal of measures to be implemented under the CHRP is to reduce potential Project effects on caribou habitat. The certificate conditions for Caribou Habitat Restoration as well as organization of the Preliminary CHRP are described in Section 1.2. The planning and mitigation measures identified in the Preliminary CHRP comprise the toolbox of measures available to NGTL to avoid or minimize Project effects on caribou and caribou habitat. b, e, f, g) The criteria for measuring success, methods for monitoring effectiveness, description of adaptive management approach, and proposed timeline for monitoring will be included in the CHROMMP in accordance with Certificate Condition 37 and will be submitted under separate cover. c) Additional baseline information collected will include 360° aerial imagery. Detailed engineering design and construction planning information, and as-built documentation will also inform the CHRP. d, g) The Final CHRP will provide the list of sites where mitigation measures were implemented, including measures implemented during and following construction, in addition to the rationale for selecting those sites and measures. Detailed engineering and construction information is needed to determine the most appropriate mitigation tools on a site-specific basis. h) NGTL confirms their commitment to report results of mitigation and monitoring activities.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	B) EC recognizes that this is a preliminary mitigation plan and requests confirmation on when a final version would be filed with the NEB. In the case that the final version is filed after the environmental assessment process is complete, it will limit EC's ability to review the plan and provide recommendations.	1.7.2	The Final CHRP will be filed on or before November 1 after the first complete growing season following start of operation of the Section 52 facilities. NGTL will continue to engage EC through the development, implementation and monitoring phases of the CHRP, to the extent requested by EC.
		C) Section 3.1 discusses measures that could be used to minimize adverse effects, including extending trenchless crossings to reduce habitat disturbance. To evaluate the potential impacts of trenchless crossing methods on southern mountain caribou, EC recommends information on the likely effects on caribou for this pipeline construction method is provided for segment(s) that might overlap with the Graham local population unit. If it is found that trenchless crossings reduce impacts on caribou, then EC might recommend that the Proponent consider applying this installation method throughout caribou range.	5.3	Section 5.3 notes that NGTL is investigating opportunities for trenchless pipeline installation (e.g., extending trenchless crossings). There are no trenchless watercourse crossings planned in the Graham range. NGTL is considering opportunity to extend bored/drilled crossings of third-party dispositions, however, NGTL's options might be limited by the terms and conditions specified by the third party under their crossing agreement. Feasibility of trenchless crossings might also be constrained by technical considerations (e.g., access, additional workspace requirements, geological characteristics), as well as scheduling construction activities to avoid work during the critical timing window for caribou. Where extended trenchless crossings are not feasible, NGTL will consider other measures, as outlined in Section 5.3.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	D) Section 3.1 lists opportunities to minimize Project effects and facilitate habitat restoration, including considering opportunities to narrow the Project ROW. EC requests that the Proponent clearly state how much (in metre) the ROW would be narrowed.	5.1,5.2,5.3	NGTL balances environmental and stakeholder concerns, engineering design, and constructability when determining ROW width requirements. The ROW width requirements have been established to achieve this balance, and account for a safe and efficient progression of project activities. A minimum 32 m ROW is required for construction of the Project, based initially on pipe size. Additional workspace requirements will be necessary. NGTL will fully evaluate opportunities to reduce disturbance in caribou ranges. The extent and location of narrowing the construction footprint will be determined as the Project progresses through detailed engineering and construction planning phases.
		E) Section 3.2.3 considers identification of candidate sites for short-term and long-term measures for line-of-sight blocks to reduce predator access. EC requests clarification on when these candidate locations would be identified and finalized. EC also recommends the criteria used to determine a 500 m line-of-sight threshold be provided (i.e., peer-reviewed literature).	5.4	Candidate locations for line-of-sight blocks are best identified as part of detailed construction planning and refined following completion of construction. The reason for this is to allow for incorporation of topographic variation and final footprint configuration, which are key components in determining effective line-of-sight blocking locations. Line-of-sight locations will be identified in the Final CHRP. Standard distances for line-of-sight breaks and supporting literature are not available. There is considerable variation in recommended distances for line-of-sight breaks across provincial regulatory jurisdictions responsible for managing woodland caribou habitat in western Canada. In consultation with BC MFLNRO for the Project, NGTL was advised that BC MFLNRO does not specify distance frequency for line-of-sight breaks, but noted that the BC OGC recommends sight breaks at least every 200 m for seismic operations and although a different ecotype, *Interim Operating Practices for Oil and Gas Activities in Identified Boreal Caribou Habitat in British Columbia* suggest 500 m between visual breaks for linear features.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	F) Section 3.3 discusses implementation opportunities and constraints, and states that selection for habitat restoration measures would require as-built construction information. EC recommends that as-built information be provided for review in the environmental assessment process.	8.3	As-built information is collected following completion of construction and consists of a legal survey (showing areas disturbed by construction, including clearing and grading), as well as construction documentation, which would include change management documentation to address site-specific conditions. As such, this information cannot be provided before construction.
		G) Section 3.3.1 contains a hyperlink to a Decision Framework that does not link to anything. EC requests resubmission of the complete version of the Decision Framework for review in the environmental assessment process.	Figure 3-1,3-2,3-3	The decision framework was provided in the pdf version of the draft Preliminary CMP submitted to EC for review. The framework is provided as Figure 4 in this Preliminary CHRP.
		H) Section 3.4 discusses the scheduling of construction activities that would be initiated in caribou range. EC notes that pipeline installation activities would be initiated for the both sections of the pipeline (Atiken and Kahta) in Q3 2015. EC understands that the Q3 period is between July–September, which was proposed to avoid working in the critical timing window for caribou, which is January 15–July 15. EC advises that the proposed construction schedule would overlap with the end of the critical timing window for caribou. Accordingly, EC advises that the proposed construction schedule does not appear to adhere to the critical timing window for caribou as stipulated by BC MOE.	5.6	Construction will not start until after July 15 to align with the critical timing window for caribou.
		I) Section 3.4.1, Table 3 lists mitigation measures for work during the critical timing period for caribou. EC requests clarification on how "increase manpower resources to increase productivity" can be used as a mitigation measure, as this could result in additional noise disturbance or other effects for caribou.	Table 5-4	Increased manpower and resources increases the productivity of construction activities to speed construction and minimize work within the critical timing window. Noise associated with construction is unavoidable, regardless of the manpower. Expediting construction activities to complete construction within a single season (i.e., rather than delaying construction to a second season to avoid working within the critical timing window) is beneficial for reducing the duration of habitat disturbance (i.e., time lag between clearing and restoration activities).
		J) Table 3 lists mitigation measures for cleanup and reclamation activities, stating that activities would take place the following season outside the critical timing period. EC notes that delay of cleanup and reclamation activities to outside the caribou critical timing period could increase impacts on caribou depending on the lag time. Accordingly, EC requests more information on the biological rationale used to determine that to delay the complete cleanup and reclamation outside the critical timing window would result in fewer impacts on caribou. Additionally, further information on the specific season that the mitigation measure would be carried out in, and on the proposed cleanup and reclamation activities for which there is a lag time, is recommended.	Table 5-4	Table 5 has been clarified.
		K) In relation to Section 3.4.1 and the statement "in the event that caribou are observed in close proximity to the Project…," EC requests that the Proponent quantify this distance in the finalized Caribou Mitigation Plan.	Table 5-4	The statement is in reference to incidental sightings of caribou by construction staff, which could occur in caribou range on access to or in the construction footprint.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	L) Section 4, Table 4 lists mitigation measures for caribou during construction. EC seeks clarification on which measures provided would be likely to be implemented. EC's ability to comment on the efficacy of these measures to reduce impacts on caribou is limited given that there is considerable uncertainty on the locations and extent to which they would be implemented. M) Section 5.1, Table 5 of the plan discusses and lists post-construction habitat restoration measures. EC seeks clarification from the Proponent on which measures would be likely implemented. EC's ability to comment on the efficacy of these measures to reduce impacts on caribou is limited given that there is considerable uncertainty on the locations and extent to which they would be implemented.	3 Table 5-3	The planning and mitigation measures identified in the Preliminary CHRP comprise the toolbox of measures available to NGTL to avoid or minimize Project effects on caribou and caribou habitat. Selection of the habitat restoration measures will require as-built construction information to allow for validation of site-specific conditions, and input from the NGTL construction and operation/maintenance staff, Project biologists and reclamation specialists, as well as appropriate regulatory agencies. Site-specific details will be provided in the Final CHRP. NGTL will implement the CHROMMP, including adaptive measures where warranted, to ensure the efficacy of mitigation measures implemented.
		N) EC notes that First Nations were not listed on the consultation record for this Plan. Aboriginal groups along the proposed pipeline corridor might have established or asserted Aboriginal or treaty rights to access caribou. Accordingly, it is important to ensure that Aboriginal groups are appropriately engaged regarding potential Project impacts on caribou.	7.1	NGTL has engaged with Aboriginal communities to collect Traditional Knowledge, which has been incorporated in the Preliminary CHRP. Communities engaged for the Project were advised of NGTL's commitment to complete a CHRP and NGTL will advise communities when the Preliminary CHRP and CHROMMP are filed. NGTL is committed to continuing engagement with Aboriginal communities in regard to concerns related to caribou.
		O) The Preliminary Caribou Mitigation Plan does not distinguish between the two northern ecotypes. EC requests that the Proponent clarify the local populations to which this plan applies.	8.3	The Preliminary CHRP discusses the differentiation between the Pink Mountain and Graham caribou in Sections 8.3. The mitigation and procedure for identifying appropriate site-specific methods discussed in the remainder of the Preliminary CHRP applies to both the Graham and Pink Mountain caribou herds.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	P) In addition to a Caribou Mitigation Plan, EC supports the development of an AMP for caribou outlining access control measures proposed for construction, operation and decommissioning. Implementing access control measures might limit predator access to caribou habitat and might reduce regulated and unregulated hunting access to caribou habitat, while allowing caribou to access to their critical habitat to carry out life processes. The AMP could include: • goals and objectives regarding access management for the control of both human and predator access • criteria for measuring the plan's success in achieving these goals and objectives • summary of related baseline information to be collected and, if no additional information would be collected, justification for why not • list of sites where access control measures would be implemented, control measure(s) proposed at those sites and rationale for selecting those sites and measures • summary of the Proponent's consultation with appropriate federal and provincial authorities, other appropriate stakeholders and potentially affected • Aboriginal groups regarding the AMP – summary should include any issues or concerns about the plan raised by those consulted and how the Proponent has addressed or responded to those issues or concerns • methods for monitoring the effectiveness of access control measures implemented • description of adaptive management measures available and of the criteria the Proponent would use to determine if and when adaptive management measures are warranted • detailed description of the locations where access control measures would be put in place specifically for construction, as well as those that would remain in place into operations and be monitored for the life of the Project • commitment to report on the results of the control measures implemented, monitoring undertaken and success of control measures in meeting the goals and objectives of the AMP, as part of the Proponent's post-construction environmental monitoring reports	5.3	Access control is one of the three primary objectives of restoring habitat, along with vegetation restoration and line-of-sight blocking (Section 4.3 of the Preliminary CHRP). The Final CHRP will specify access control measures in caribou ranges. NGTL is also committed to implementing access control outside caribou ranges. The details of these measures (e.g., location, type of access control) will be documented in the EPP and Environmental Alignment Sheets prepared for the Project before construction. NGTL is also required to prepare an Access Management Plan with a separate cover for non-parallel disturbances along the ROW for each section of the Section 52 facilities, in accordance with Condition 16.
		Q) EC recommends that the Proponent provide a description of how available and applicable Aboriginal Traditional Knowledge and TLU studies were considered in the Preliminary Caribou Mitigation Plan.	7.1	Available and applicable TEK and TLU studies were considered in the Preliminary CHRP. Wildlife features (e.g., trails, mineral licks) located in caribou range will be considered during routing, mitigation and access management planning.
		R) EC recommends an adaptive management approach for mitigation. The purpose of such an approach would be to ensure that effectiveness of mitigation measures, such as reductions to lines of sight, habitat restoration, decommissioning of access, is monitored and measures would be adjusted as needed during Project operations to ensure objectives for habitat disturbance and access would be achieved.	5.5	Adaptive management will be detailed in the CHROMMP filed under separate cover.
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	July 2, 2014 Email	NGTL provided an update on Attachment 1 (comments on the Southern Mountain and Northern populations of woodland caribou for the North Montney Project) and Attachment 2 (comments on the Preliminary Caribou Mitigation Plan). NGTL explained to EC that they notified the NEB that they would be delaying filing of the CMP (and the Preliminary CMMP) so that NGTL could address EC's comments on Attachment 2.	5.1	The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km. NGTL is continuing to engage EC regarding spatial delineation of critical habitat, including matrix habitat.
	July 4 and 11, 2014 Email(s) Telephone	NGTL understands that in regard to EC's comment letter addressing the North Montney Preliminary Caribou Mitigation Plan, dated June 20, 2014, EC indicates that the Project overlaps with 0.43 ha of critical habitat. Subsequently, EC indicated that it would advise the NEB that this would constitute a significant effect. NGTL requested an opportunity to review the spatial data showing this overlap, preferably before EC's letter to the NEB, planned for July 10, 2014. NGTL did receive all critical habitat data currently in the public domain, and those data do not overlap with the Project. EC explained that Canadian Wildlife Service has indicated they were able to use additional data from what was used for the June 20, 2014 letter NGTL received. Therefore, using the updated data, Canadian Wildlife Service revised conclusions made from that correspondence. EC's Letter of Comment to the NEB reflects those revised conclusions. EC indicated NGTL will be in receipt of the Letter of Comment shortly as it has been couriered to them and will also be posted to the NEB site.		

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
~~David Lind~~ ~~Land Management Planner~~ ~~Lac La Biche, AB~~Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	~~May 1~~August 8 and ~~2, 2013~~12, 2014 Email(s)	~~NGTL followed up with meeting request.~~NGTL followed up with EC, noting that they have not received a response from EC or Canadian Wildlife Service regarding the 0.43 ha of critical habitat described In EC's Letter of Comment to the NEB dated July 8, 2014. In Attachment 2, page 4 it states "there is likely destruction of 0.43 ha of matrix critical habitat arising from the Project's 55 m project development area corridor (i.e., Project ROW)". NGTL indicated strong interest in receiving spatial data on the location of this critical habitat so that options for reducing adverse effects on critical habitat can be reviewed. NGTL did previously receive some critical habitat mapping from EC, but this critical habitat did not overlap the Project ROWs. NGTL indicated they would appreciate if this request could be completed by August 31, 2014 to provide sufficient time for review before start of the hearing. EC responded that they had forwarded the NGTL request to Canadian Wildlife Service colleagues and have followed up with them now. EC/Canadian Wildlife Service provided publicly available links for the southern mountain caribou spatial data. EC stated, it is important to note that the analysis is ongoing, and that the classification of critical habitat type (i.e., high elevation, low elevation and matrix) might also change in the future. Information will be provided to the public as it becomes available.	–	~~N/A~~
	October 21, 2014 Email	NGTL emailed EC the draft Klinse-Za Action Plan and indicated it was provided to NGTL by the West Moberly First Nation. NGTL noted the document is in draft form; dated 2013. NGTL indicated they do not see it listed on the SARA website and that it is very briefly mentioned in EC's Recovery Strategy – in a list of examples of Action Plans that have been developed. NGTL asked Canadian Wildlife Service to comment as to their position on this Action Plan.	8.2	NGTL understands the critical habitat identified in WMFN 2014 and the draft Action Plan for the Klinse-Za herd (McNay et al. 2013) was developed using an approach that was informed by traditional knowledge about historic distribution and range of caribou, which differs the delineation of caribou local population units and critical habitat in the federal Recovery Strategy (EC 2014). The Preliminary CHRP has been developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.
BC Ministry of Forests, Lands and Natural Resource Operations				
Matt Austin, Director: Resource Management Megan Watters, Ecosystem Biologist Chris Ritchie, Fish and Wildlife Recovery Manager Gerald Kuzyk, Ungulate Specialist	July 23 and 25, 2013 Email(s)	NGTL sought direction for the Project in regard to caribou (e.g., status of regulatory guidelines; available information on the Graham and Pink Mountain herds; and guidance related to mitigation). BC MFLNRO indicated that NGTL's questions should be directed to the Regional Wildlife Biologist in Fort St. John.	–	N/A
Kerry Harvey, Ecosystem Biologist	August 15, 2013 Meeting in Fort St. John	NGTL provided a summary of the Project in caribou range for discussion. BC MFLNRO indicated that with respect to routing, particularly in caribou range, there should be an effort to maximize paralleling existing linear infrastructure and an overall attempt to reduce project footprint. It was suggested that C. Ritchie (BC MFLNRO Fish and Wildlife Recovery Manager) be engaged to provide a broader perspective and information on standardized industry practices and management practices for restoration. A Mitigation Plan was recommended, to be prepared in advance of applying to the BC OGC.	5.1	Routing criteria provided in Section 4.1 of the ESA outline the key components used to avoid or minimize adverse Project effects on caribou and caribou habitat, including paralleling existing linear disturbances and reducing the Project footprint.
Chris Ritchie, Fish and Wildlife Recovery Manager	August 16 and 20, 2013 Email(s)	NGTL provided a Project overview and asked for direction related to caribou (e.g., application of implementation plan; requirement to prepare a CMMP; application of offsets; standard reclamation practices; and applicability of existing plans to the Pink Mountain caribou herd). BC MFLNRO noted that the Project in the Graham caribou herd did not require a formal CMMP or offsets since the route is not located in high elevation range. However, BC MFLNRO advised NGTL to address concerns such as minimizing the footprint, controlling human and predator access, discouraging early seral vegetation and avoiding the use of palatable species for erosion control. Regarding the Pink Mountain caribou herd, BC MFLNRO confirmed that there is no herd-specific management plan.	5	NGTL incorporated suggestions into the Preliminary CHRP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist	August 26 and September 16, 2013 Email(s)	BC MFLRNO provides a summary letter that provides web-links to relevant provincial information for the Project and requested additional information related to route selection and consideration of route alternatives (i.e., the northern most portion of the Kahta Section).	5.1	NGTL's response noted that the route selection process considers minimizing the length, meeting applicable regulatory requirements and reducing the footprint, while carefully reviewing costs and constructability. The northernmost km's to Kahta (13 km in Pink Mountain range) were officially dropped in NGTL's March 10, 2014 project update to the NEB (Filing ID: A59202). The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km.
Kerry Harvey, Ecosystem Biologist	October 15, 2013 Email	BC MFLRNO provided further information on the proposed UWR in the Pink Mountain caribou range.	–	NGTL committed to review routing in this UWR.
Kerry Harvey, Ecosystem Biologist Jocelyn Campbell, Ecosystem Biologist	December 4, 2013 Email	NGTL proposed to schedule a meeting in January 2014. In regard to caribou, items to review include: routing through the Pink Mountain range, the effects assessment for caribou (i.e., assessment approach); and mitigation, specifically if any changes are expected given the proposed release of a draft Recovery Strategy.	–	N/A
Chris Ritchie, Fish and Wildlife Recovery Manager Jocelyn Campbell, Ecosystem Biologist Kerry Harvey, Ecosystem Biologist	January 14, 15 and 22, 2014 Email(s)	NGTL asked, in light of EC's forthcoming release of the draft Recovery Strategy, whether there were any changes to provincial plans or delineation of critical habitat (HEWR, low-elevation winter range and matrix), specifically in the Graham range. This information would be useful in Project planning and development of mitigation.	–	No additional or revised provincial planning documents were provided.
Kerry Harvey, Ecosystem Biologist	January 27, 2014 Meeting	NGTL provided a Project overview and noted that the pipeline route is no longer located in an UWR in the Pink Mountain caribou range. Mitigation measures related to caribou and caribou habitat and the CMP were discussed. NGTL agreed to provide a draft plan to BC MFLNRO for review and feedback and noted that a final plan identifying specific measures and locations would be prepared following construction.	5	Recommendations regarding mitigation have been considered and incorporated in the Preliminary CMP. Draft Preliminary CMP was provided to BC MFLNRO for review on April 21, 2014.
Kerry Harvey, Ecosystem Biologist	January 28, 2014 February 5, 2014 Email	NGTL provided detailed maps of Project routing in the Graham range (Aitken Section), and noted detailed mapping in the Pink Mountain range (Kahta Section) will be completed soon (e.g., front end engineering and design [FEED] maps).	–	FEED maps for the Kahta Section were provided to BC MFLNRO on February 5, 2014.
Kerry Harvey, Ecosystem Biologist	March 2 and 14, 2014 Email	NGTL requested guidance from the province related to possible changes associated with the proposed Recovery Strategy (e.g., delineation of critical habitat and standard mitigation measures). NGTL also asked if BC MFLNRO has any concerns, based on review of FEED plans, related to routing in caribou range and noted that a preliminary CMP is being prepared for the Project.	–	No additional concerns were identified.
Elizabeth Hunt, Resource Management Officer	March 24, 2014 Telephone	NGTL discussed with BC MFLNRO the use of merchantable timber for rollback for access control in caribou range. BC MFLNRO did not have any issues and requested that they be consulted once locations have been selected. The transportation of mountain pine beetle-infected timber is not an issue and there are no transportation or harvesting restrictions on mountain pine beetle-infected pine trees.	5.3	Rollback for access control is considered one of the tools that NGTL will incorporate into the implementation of caribou mitigation and Final CHRP, where appropriate. Potential rollback locations for access management will be selected and described in the AMP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist Chris Ritchie, Fish and Wildlife Recovery Manager	March 31, 2014 Telephone	NGTL noted that a preliminary CMP is being developed for the Project and would address routing, scheduling and mitigation planning before, during and after construction. NGTL again asks if the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* will be updated. BC MFLNRO will review the draft Preliminary CMP before submission to the NEB.	–	Updated provincial planning documents are not available.
Kerry Harvey, Ecosystem Biologist	April 1, 3 and 4, 2014 Email	BC MFLNRO noted that standardized industry management practices are in their infancy and that stakeholders and First Nations will be engaged in this process and there will be an opportunity to review and provide comment in the future. In reference to FEED plans, BC MFLNRO indicated it appears as though NGTL has paralleled existing footprint to a great extent, which is good. BC MFLNRO indicated it would like to reiterate that NGTL make every attempt to minimize new footprint and avoid activities during critical timing windows. BC MFLNRO did not express any additional concerns.	5.6	In response to timing, NGTL provided BC MFLNRO with the response to NEB Information Request 2.32 on this topic. Scheduling information is provided in Section 5.6 of the Preliminary CHRP, including discussion of critical timing windows for caribou.
Kerry Harvey, Ecosystem Biologist	April 14, 2014 Email	NGTL provided follow-up in regard to FEED plans and routing in caribou range. NGTL's construction, environment and engineering team members reviewed the FEED plans to address BC MFLNRO's request.	–	Routing and siting information is described in Section 4.1 of the ESA. No additional opportunities were identified to reduce the footprint in the Pink Mountain range. In the Graham range, NGTL's Lands Department approached an adjacent third-party line to determine whether a portion of their ROW could be used, as this would reduce NGTL's footprint. The third party responded that they could not accommodate that request.
Kerry Harvey, Ecosystem Biologist	April 21, 2014 Email	NGTL provided a draft Preliminary CMP for review.	–	N/A
Kerry Harvey, Ecosystem Biologist	May 1, 2014 Email	BC MFLNRO reviewed the draft Preliminary CMP and provided comments pertaining to: • inclusion of indirect project effects (e.g., noise, aircraft if applicable, annual integrity inspections or monitoring) and, in particular, mitigating potential effects of integrity inspections/maintenance associated with operations • reference to the BC MOE (2014) Science Update for the South Peace Northern Caribou (*Rangifer tarandus caribou* pop. 15) in BC • modification of cautionary period timing window • provision of the document number for the EPP • inclusion of mitigation measures regarding incident/sighting reporting protocols related to traffic management, exclusion of wildlife from open excavations or other potential hazards (e.g., sumps), proper storage of construction materials, site-specific habitat features (e.g., mineral licks) and minimum disturbance construction techniques	Throughout	Comments have been incorporated in the Preliminary CHRP.
Kerry Harvey, Ecosystem Biologist	June 23, 2014 Email	BC MFLNRO provided comments on draft Preliminary CMP pertaining to discrepancy in timing windows. Acknowledged that the BC OGC only has a critical timing window for caribou extending from May 15 through July 15. The BC MFLNRO critical timing window (January 15 through July 15) encapsulates a late-winter period and BC MFLNRO ask that activities also be planned considering that critical period. Perhaps this is an entirely moot point given vegetation restoration success (in all likelihood) needs to be assessed under snow-free conditions (and as such would avoid the said timing window). BC MFLNRO requested a short call in early July to follow up on a few issues.	5.6	The BC MFLNRO critical timing window is incorporated in Section 5.6.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist	October 22, 2014 Email	BC MFLNRO indicated the Province is aware of and interested in the information in the Klinse-Za Action Plan (as while it used different method to determine a management regime for caribou than the Peace Northern Caribou Plan it is not without merit) and is currently undertaking a comparative assessment of the relevant caribou plans. However, the Province has not endorsed this plan at this time and is comfortable with the management regime as set out in the South Peace Northern Implementation Plan, but remains open to amending/augmenting the current regime if new, compelling information becomes available. With regard to the federal Recovery Plan and their critical habitat maps, as BC MFLRNO understand it the boundaries were determined largely using the provincial data. However, BC MFLRNO cannot confirm this was the only source of data they used, so would be very cautious about using provincial data to better understand EC's mapping. BC MFLNRO understands that EC will be making the shapefiles for their critical habitat publicly available as soon as possible.	8.2	In the absence of an amended South Peace Northern Implementation Plan, NGTL is developing the CHRP to the most recent version of the South Peace Northern Implementation Plan. NGTL understands the critical habitat identified in WMFN 2014 and the draft Action Plan for the Klinse-Za herd (McNay et al. 2013) was developed using an approach that was informed by traditional knowledge about historic distribution and range of caribou, which differs from the delineation of caribou local population units and critical habitat in the federal Recovery Strategy (EC 2014). The Preliminary CHRP has been developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.

~~**Table 7-1: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)**~~

~~Name and Title~~	~~Date and Method~~	~~Consultation Related to Caribou~~	~~Section in Preliminary CHRP~~	~~Comments and Rationale~~
~~**Alberta Environment and Parks (cont'd)**~~				
~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~ ~~David Lind~~ ~~Land Management Planner~~ ~~Lac La Biche, AB~~	~~May 16, 2013~~ ~~Meeting~~	~~NGTL provided a Project overview. There is currently no AESRD contact for receipt of the CMP.~~ ~~May 17, 2013: NGTL provided AESRD with the meeting minutes.~~	~~–~~	~~N/A~~
~~Grant Chapman~~ ~~Senior Wildlife Biologist~~ ~~Lac La Biche, AB~~	~~July 16, 2013~~ ~~Telephone, Email~~	~~NGTL provided a Project overview and requested a discussion about the Project CMP. AESRD requested that information also be provided to Joann Skilnick.~~	~~–~~	~~N/A~~
~~Grant Chapman~~ ~~Senior Wildlife Biologist~~ ~~Lac La Biche, AB~~ ~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~	~~September 25, 2013~~ ~~Email~~	~~NGTL provided AESRD a Project overview and update.~~	~~–~~	~~N/A~~

~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~ ~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~ ~~Grant Chapman~~ ~~Senior Wildlife Biologist~~ ~~Lac La Biche, AB~~	~~January 31, 2014~~ ~~Email~~ ~~March 11, 2014~~ ~~Meeting~~	~~January 31, 2014: NGTL invited Ed Barnett, Joann Skilnick and Grant Chapman to attend a meeting in Wandering River March 11, 2014 to discuss Project construction in caribou range.~~ ~~March 11, 2014: Meeting with Ed Barnett. NGTL stated that a discussion with AESRD Fish and Wildlife is necessary to discuss construction constraints and the possibility of constructing the compressor station during the caribou timing restriction.~~	~~5.1~~ ~~5.6~~	~~Section 5.1 discusses the caribou timing window and NGTL's approach to "early in/early out" scheduling and additional mitigation to reduce the duration of activities that might extend past February 15. Section 5.6 provides the proposed construction and restoration schedule.~~

~~Table 7-1: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)~~

~~Name and Title~~	~~Date and Method~~	~~Consultation Related to Caribou~~	~~Section in Preliminary CHRP~~	~~Comments and Rationale~~
~~Alberta Environment and Parks (cont'd)~~				
~~Bill Black~~ ~~Acting Approvals Manager~~ ~~Athabasca, AB~~ ~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~	~~April 22, 2014~~ ~~Email~~	~~NGTL experienced difficulties reaching the AESRD Wildlife Biologist in Fort McMurray, and requested AESRD's direction regarding project constraints (i.e., scheduling) with respect to constructing in the caribou range.~~	~~5.1~~ ~~5.6~~	~~Section 5.1 discusses the caribou timing window and NGTL's approach to "early in/early out" scheduling and additional mitigation to reduce the duration of activities that might extend past February 15. Section 5.6 provides the proposed construction and restoration schedule.~~
~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~ ~~Grant Chapman~~ ~~Senior Wildlife Biologist~~ ~~Lac La Biche, AB~~ ~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~ ~~Bill Black~~ ~~Acting Approvals Manager~~ ~~Athabasca, AB~~	~~May 4, 2014~~ ~~June 19, 2014~~ ~~July 16, 2014~~ ~~Emails~~	~~May 4, 2014: AESRD (Joann Skilnick) recommended that the company develop a caribou habitat restoration plan, and encouraged coordination with restoration activities occurring on adjacent pipeline ROWs.~~ ~~June 19, 2014: NGTL requested whether construction of the compressor station can occur within the caribou timing window given that it is considered a permanent installation.~~ ~~July 16, 2014: NGTL inquired whether AESRD had had a chance to consider the information request from June 19, 2014.~~	~~1.2~~ ~~5.1~~ ~~5.6~~	~~NGTL will prepare Preliminary and Final CHRP in accordance with NEB Order.~~ ~~Construction and commissioning of the compressor station is planned to start outside the timing window for caribou (i.e., after July 15, 2015) but activities will extend to April 2016, which overlaps the timing window for caribou. Section 5.1 provides NGTL's approach to scheduling, and Section 5.6 provides the construction schedule.~~
~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~ ~~Grant Chapman~~ ~~Senior Wildlife Biologist~~ ~~Lac La Biche, AB~~	~~November 11 and 13, 2014~~ ~~Email, Telephone~~	~~November 11, 2014: NGTL provided an update on the CMP schedule and requested a meeting to discuss.~~ ~~November 13, 2014: NGTL provided shapefiles and project fact sheet to Joann Skilnick and requested confirmation of meeting on November 28, 2014.~~	~~–~~	~~N/A~~

~~Table 7-1: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)~~

~~Name and Title~~	~~Date and Method~~	~~Consultation Related to Caribou~~	~~Section in Preliminary CHRP~~	~~Comments and Rationale~~
~~Alberta Environment and Parks (cont'd)~~				
~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~	~~November 28, 2014~~ ~~Meeting~~	~~NGTL provided an update of Project route, location and schedule. NGTL introduced the draft CMP to AESRD and discussed the differences between a CMP and a CHRP.~~ ~~AESRD recommended:~~ • ~~specifically linking mitigation to the desired outcomes listed in the EAP guidelines~~ • ~~demonstrating clearly how they link back, as opposed to the current EPP format used~~ • ~~including monitoring plans, monitoring to be effective – monitoring wolf densities or have wildlife cameras~~ • ~~avoiding use of following terms – "if practical," "if feasible" or "if possible" – identify when it will or won't be specifically~~ • ~~include information on helicopter protocols~~ • ~~include restoration~~ ~~AESRD requested in the CHRP that NGTL address access management plan. AESRD also advised that all areas have "facilitated" restoration unless evidence of where natural recovery is appropriate. Lastly for restoration, AESRD recommended that NGTL follow CEMA Restoration Guidelines (Stony Mountain Linear Restoration Project).~~	~~4 to 6~~	~~The CHRP incorporates the mitigation hierarchy (i.e., avoid, minimize, restore) to achieve CHRP goals and objectives (Section 2). Measures described in Section 4 to Section 6 reflect the mitigation hierarchy and are designed to achieve CHRP goals and objectives. EAP guidelines were considered in development of CHRP measures. Factors that constrain implementation are listed, where mitigation or restoration commitments include qualifiers such as "where site conditions allow."~~ ~~The CEMA Stony Mountain linear footprint and access management multi-stakeholder planning pilot project (Ohlson 2014) was reviewed during evelopment of the Preliminary CHRP. Intent of the project was to provide regional-scale recommendations amenable to a broad range of stakeholders, and inform design and implementation of future multi-stakeholder subregional planning processes undertaken as part of implementing the Lower Athabasca Regional Plan. The report provided high-level considerations and recommendations for planning multi-stakeholder restoration projects and managing linear features and access at the regional scale. The CHRP aligns with the applicable linear footprint and access management actions listed. The habitat and site-condition approach to selecting restoration methods and locations for the CHRP align with CEMA's suggested ecosystem-based revegetation matrix that was developed to support prioritization of linear features for treatment and evaluation of reclamation performance.~~

~~Table 7-1: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)~~

~~Name and Title~~	~~Date and Method~~	~~Consultation Related to Caribou~~	~~Section in Preliminary CHRP~~	~~Comments and Rationale~~
~~Alberta Environment and Parks (cont'd)~~				
~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~ ~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~	~~January 7, 2015~~ ~~Email~~	~~NGTL has considered AESRD's input and will complete a CHRP for the Project, which will supersede the CMP. As per AESRD's input, the construction start date at the proposed compressor station site has been altered to avoid the caribou timing restriction. The planned start date is now July 16, 2015. NGTL will use up to 8 m of temporary workspace over the existing pipeline ROW to reduce the Project footprint. The Project team is investigating opportunities to further reduce the permanent ROW. NGTL requested another meeting with J. Skilnick and E. Barnett.~~	~~4~~ ~~5.1~~ ~~5.6~~	~~Pre-construction planning considerations to reduce the Project footprint are discussed in Section 4. Timing windows and scheduling are discussed in Section 5.1 and Section 5.6.~~
~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~ ~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~	~~January 30, 2015~~ ~~Email~~	~~NGTL stated that the NEB issued an approval Order for the Project. Clearing and construction at the compressor station is scheduled from July 16, 2015 to April 1, 2016. Pipeline construction will start on September 1, 2015 as conditions allow and will continue into March 2015.~~	~~5.1~~ ~~5.6~~	~~Timing windows and scheduling are discussed in Section 5.1 and Section 5.6.~~
~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~ ~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~	~~February 2, 2015~~ ~~Email~~	~~AESRD stated that it is their expectation that the timing restriction in caribou range be adhered to. AESRD will not be in favour of providing extensions for construction activities into this timing restriction.~~	~~5.1~~ ~~5.6~~	~~Timing windows and scheduling are discussed in Section 5.1 and Section 5.6.~~

~~Table 7-1: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)~~

~~Name and Title~~	~~Date and Method~~	~~Consultation Related to Caribou~~	~~Section in Preliminary CHRP~~	~~Comments and Rationale~~
~~Alberta Environment and Parks(cont'd)~~				
~~Ed Barnett~~ ~~Forest Officer~~ ~~Wandering River, AB~~	~~March 2, 2015~~ ~~Meeting~~	~~NGTL provided a Project update indicating NEB approval and the caribou conditions (CHRP, OMP and CHROMMP) were discussed. NGTL provided recent details on the construction schedule. Use of timber for restoration measures was discussed and was confirmed as not being a concern. The applicability of the EAP guidelines to the Project and the ROW width were discussed.~~	~~5.1~~ ~~5.6~~ ~~4–6~~	~~Timing windows and scheduling are discussed in Sections 5.1 and Section 5.6. Pre-construction planning considerations to reduce the Project footprint are discussed in Section 4. Use of timber (coarse woody debris) is considered throughout the CHRP as a potential habitat restoration measure (particularly as it relates to rollback for access management).~~
~~Joann Skilnick~~ ~~Senior Wildlife Biologist~~ ~~Fort McMurray, AB~~ ~~Grant Chapman~~ ~~Senior Wildlife Biologist~~ ~~Lac La Biche, AB~~	~~March 26, 2015~~ ~~Meeting~~	~~AESRD indicated they will not have time to comment on the Preliminary CHRP until end of April. AESRD mentioned in previous CHRPs they were not invited to comment. NGTL stated this is a condition for Project approval.~~	~~3.5.2.2., Appendix A, 2, 6.2, 4.5.1~~	~~This Preliminary CHRP incorporates feedback from previous CHRPs, consultation and AESRD review of the CMP.~~
		~~AESRD recommended the option of transplanting trees, creating vegetation screens every 200 m, which provides immediate restoration in black spruce areas, line-of-sight control and restores connectivity.~~	~~3.5.4, 6.1, 6.2.5~~	~~Transplanting native vegetation is not a suitable CHRP measure since it has been shown to be a difficult technique to implement on a large scale, with marginal results and multiple limitations. In forested areas of the Project footprint where sight lines are 500 m long or more, line-of-sight blocks will be established.~~
		~~AESRD recommened minimum disturbance and boring techniques. NGTL mentioned that these activities increase duration of construction. AESRD stated that the timing restrictions should not be used as an excuse not to minimize more impacts.~~	~~6.1, 4.4, 4.5~~	~~Minimum disturbance construction is a suitable CHRP measure, and will be implemented where scheduling and soil conditions (i.e., frozen) allow. NGTL is considering extending the length of bored crossings to retain vegetation screens though logistical constraints (e.g., alternate access, technology capacity, pipe requirements) might inhibit implementation of this measure.~~
		~~AESRD requested that NGTL coordinate with Grand Rapids on caribou habitat restoration treatments.~~	~~–~~	~~NGTL states commitment to working with Grand Rapids and sharing information to facilitate this.~~

~~Table 7-1: Summary of Consultation Activities with Federal and Provincial Authorities Related to Caribou (cont'd)~~

~~Name and Title~~	~~Date and Method~~	~~Consultation Related to Caribou~~	~~Section in Preliminary CHRP~~	~~Comments and Rationale~~
~~Alberta Environment and Parks (cont'd)~~				
	~~March 26, 2015~~ ~~Meeting (cont'd)~~	~~AESRD requested that NGTL talk to COSIA regarding provincial assessment of CHRPs/effectiveness published winter 2014/15.~~ ~~Offsets Management Plan: NGTL discussed the OMP condition from the NEB and asked if AESRD had any offset ideas. AESRD preference is for NGTL to restore habitat in the ESAR and on existing ROWs. AESRD would prefer NGTL spend money on minimizing and restoring, and then offsetting on own ROW or neighbouring ROWs. AESRD stated preference of 4:1 ratio.~~	~~3.5.2~~ ~~1.2~~	~~Caribou habitat restoration initiatives, including COSIA, are described in Section 3.5.2 of the Preliminary CHRP.~~ ~~As per condition 7 outlined in NEB Order XG-N081-003-2015, NGTL will prepare a Preliminary and Final OMP, which will be filed under separate cover. The method used to calculate offset ratio will account for uncertainty and time lag.~~
	~~March 30, 2015~~ ~~Email~~	~~NGTL provided AESRD with a Draft Preliminary CHRP for review and comment.~~	~~–~~	~~–~~

~~Joana Burgar Wildlife Biologist, on behalf of Joann Skilnick Senior Wildlife Biologist Fort McMurray, AB~~	~~June 17, 2015 Email~~	~~Ambiguous terms should be removed from the CHRP.~~ ~~Specify how mitigation measures criteria will be evaluated.~~ ~~EAP standards will be considered for this Project only if all EAP standards, guidelines and best management practices are considered, including Section 8: Wildlife, which states that in forested areas, line-of-sight should be limited to 200 m on non-roadway linear features. Until a detailed rationale for 500 m line-of-sight break is provided and deemed effective in mitigating impacts on caribou, target line-of-sight distance should be no greater than 200 m in forested segments.~~ ~~Provide rationale for natural revegetation vs active restoration.~~ ~~Concern about activity within the RAP and will not allow it if NGTL has not shown due diligence in completing work outside the RAP. AESRD plans status meetings with NGTL every two weeks during construction.~~ ~~Concerns about caribou mitigation measures during construction.~~ ~~AESRD recommended caribou monitoring project for duration of CHRP.~~	~~Throughout~~ ~~5.1~~ ~~5.4~~ ~~6.3~~ ~~5.2.1~~ ~~Table 5-3~~ ~~5.6~~ ~~5.5~~	~~NGTL recognized this and has revised this CHRP to be more specific and clear in its approach.~~ ~~NGTL has provided rationale for the 500 m line-of-sight break.~~ ~~Active restoration (e.g., tree planting) will be promoted in areas where natural revegetation is not expected to achieve the quantifiable targets.~~ ~~NGTL is planning construction for outside the RAP and will update AESRD at biweekly meetings during construction.~~ ~~This section removed from the CHRP.~~ ~~NGTL will develop a Project CHROMMP that will span 15 years.~~

8.0 LITERATURE REVIEW

~~A~~ This section describes the literature review that was conducted to provide regulatory and ecological context relevant to ~~boreal~~mountain caribou and specifically to the ~~ESAR~~Graham and Pink Mountain caribou range, including threats to and management considerations for recovery of ~~boreal~~mountain caribou. This context provides an understanding of the current knowledge of the value and purpose of habitat restoration in caribou range.

In addition, available information on mitigation measures and habitat restoration methods was compiled and summarized in Section 5 and Appendix C. This summary was used to provide the foundation for the ~~toolbox~~suite of measures available to NGTL to effectively ~~mitigate~~restore potential Project effects on caribou and caribou habitat. Knowledge gaps that contribute to uncertainty in caribou habitat restoration are identified in Section 8.~~6~~9. Based on the results of the literature review, the habitat restoration measures best suited for caribou range ~~are~~have been identified.

8.1 LITERATURE REVIEW METHODS

The literature review incorporates regulatory and ecological context relevant to the ESAR caribou range to inform the selection of appropriate mitigation and habitat restoration measures. The key results from current boreal caribou literature as well as previous and ongoing habitat restoration initiatives, techniques implemented and their reported successes and failures were reviewed to inform the CHRP.

~~This methods section is provided to address Condition 6 of NEB Order XG-N081-003-2015.~~ The literature review was completed using a systematic approach and standard research techniques, which enabled NGTL to consider the most recent published ~~knowledge of~~information about caribou habitat restoration in the Preliminary CHRP. Sources reviewed include federal and provincial recovery strategies and management plans, previously submitted NGTL CHRPs, publically available government reports, in-house reference material and peer-reviewed journal articles.

The literature review for the Preliminary CHRP included a systematic search of the following industry and scholarly databases for queried keywords and phrases:

- Google
- Google Scholar
- BioOne
- Web of Science
- BC Ministry of Forests (BC MOF) Forest Practices Codes Guidebooks
- Cumulative Environmental Management Association (CEMA) database, including Oil Sands Leadership Initiative (OSLI) historic filings

The following search terms were used in the literature review:

- caribou habitat restoration
- ~~boreal~~northern caribou
- ~~boreal~~mountain caribou
- subalpine/conifer/mature/old forest ~~and~~ restoration
- forested wetlands restoration
- linear corridor restoration/reclamation
- linear feature restoration in ~~boreal~~subalpine/conifer/mature/old forest and forested- wetlands
- ~~Alberta~~BC caribou recovery/range plan/policy/action plan

The COSIA website ~~(COSIA 2012)~~ was searched to gather knowledge on current restoration measures, including the LiDea Project, the Algar Historic Restoration Project and OSLI environmental performance projects. Similarly, documents available on the BC Science and Community Environmental Knowledge (SCEK) Fund website, in particular those associated with the SCEK Fund's research and effectiveness monitoring and caribou programs, were reviewed. The Boreal Caribou Habitat Restoration Operational Toolkit for British Columba (Golder 2015) provided a summary of habitat restoration techniques appropriate for boreal caribou range in BC, and is based largely on lessons learned from restoration activities in northern Alberta.

TERA, a CH2M Hill Company, attended the 15th North American Caribou Workshop (North American Caribou Workshop 2014), where several technical sessions related to habitat restoration for caribou were presented. Relevant information for CHRP planning related to use of rollback and monitoring wildlife- use of restored linear features that was presented at the workshop is summarized in the relevant sections of the literature- review.

Caribou habitat restoration is receiving increasing research attention and it is anticipated that methods to restore habitat will continue to be tested and modified in the near future. NGTL has incorporated this information in the AMP for the Project and will continue to incorporate ~~this~~ new information in the Final CHRP and post--construction monitoring reports.

8.2 REGULATORY POLICY~~, RECOVERY OBJECTIVES~~ AND GUIDELINES FOR ~~BOREAL~~MOUNTAIN CARIBOU

The Preliminary CHRP was developed considering the current regulatory policies specific to ~~boreal~~mountain caribou. ~~The identified regulatory policy and management documents considered to develop the Project CHRP include:~~

- ~~*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)~~
- ~~federal *Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* (Environment Canada 2012)~~

~~Further information on each of the documents listed above is summarized in the following paragraphs.~~ NGTL began consultation and working collaboratively with provincial regulators, Aboriginal communities, stakeholders and industry partners ~~in~~several years ago at the ~~early planning stages~~outset of the Project. NGTL will continue to work with provincial and federal regulators to align the CHRP measures with ~~current~~ provincial and federal ~~policies~~ policy.

~~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 (i.e., action plans), 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).~~

~~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 in fire management plans, establishing key protected areas and incorporating 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). The Preliminary CHRP adopts the definition of caribou habitat provided in the Recovery Strategy (i.e., habitat in defined caribou ranges that is necessary to maintain or recover self-sustaining local populations throughout their distribution).~~

~~NGTL is continuing to work with AESRD to align the CHRP measures with the provincial caribou policy and the future provincial Caribou Action Plan for the ESAR caribou range. Range-specific Caribou Action Plans are required as part of the province's commitment to the proposed federal Recovery Strategy. A range-specific assessment or recovery plan for the ESAR caribou range has not yet been developed by the province.~~

~~The goal of the *Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* is to achieve self-sustaining local populations~~

~~in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible (Environment Canada 2012). The Recovery Strategy applies to the ESAR caribou range. Population and distribution objectives identified in the Recovery Strategy include, to the extent possible:~~

- ~~maintain current status of the 14 existing self-sustaining local populations~~
- ~~stabilize and achieve self-sustaining status for the 37 non-self-sustaining local populations (a group that includes the ESAR caribou range)~~

~~The federal Recovery Strategy identifies critical habitat for the boreal 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~~
- ~~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 in the range (Environment Canada 2012).~~

~~In addition to the recovery planning and policy documents described above, NGTL considered the *Integrated Standards and Guidelines – Enhanced Approval Process* (Alberta Energy Regulator [AER] 2013) to develop caribou-specific mitigation measures. These standards and guidelines identify desired outcomes, which include:~~

- ~~reduction of human-caused direct mortality associated with linear features~~
- ~~excessive predator-caused mortality~~
- ~~habitat loss~~
- ~~partial avoidance demonstrated by caribou in relation to industrial features~~
- ~~increases in distribution and productivity of other prey species~~

~~Approval standards are specified, as are best management practices.~~

~~8.3 BOREAL WOODLAND CARIBOU ECOLOGY~~

~~As previously mentioned, the boreal population of woodland caribou is listed as Threatened on Schedule 1 of *SARA*, by COSEWIC and under the Alberta *Wildlife Act* (AESRD 2014a; COSEWIC 2015; Environment Canada 2015).~~

~~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). Therefore, woodland caribou require large tracts of continuous undisturbed habitat, as they disperse when calving to reduce predation risk (Vistnes and Nellemann 2001; Environment Canada 2011). Preferred habitat is typically mature coniferous forest (e.g., jackpine and black spruce) with abundant lichen, muskeg and peatlands intermixed with upland or hilly areas (Brown, Huot et al. 1986; Bradshaw et al. 1995; Stuart-Smith et al. 1997; Neufeld 2006; O'Brien et al. 2006; Brown, Rettie et al. 2007; Rettie and Messier 2000; Courtois and Ouellet 2007).~~

~~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 in 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 to maintain low population densities across their range as an anti-predator tactic (Alberta Woodland Caribou Recovery Team~~ The identified regulatory policy and management documents considered to develop the Preliminary CHRP include:

- *Management Plan for the Northern Mountain Population of Woodland Caribou* (Rangifer tarandus caribou) *in Canada* (EC 2012a), as it applies to the Pink Mountain herd
- *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (BC MOE 2013), as it applies to the Graham herd
- *Recovery Strategy for the Woodland Caribou, Southern Mountain Population* (Rangifer tarandus caribou) *in Canada* (EC 2014), as it applies to the Graham herd
- *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014 [Filing ID: A3Z0H2])
- *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013 [Filing ID: A3X4D3])
- *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Interim Guidance)* (BC MFLNRO 2014)
- *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005)

~~2005). Boreal caribou maintain spatial separation from other ungulates by occupying habitat that has a lower density of other ungulate species (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).~~

~~Compared with other forest-dwelling ungulate species, woodland caribou exhibit low reproductive potential. Adult cows are typically three years old before they begin producing young and only produce a single calf annually (ASRD and ACA 2010).~~

~~The ESAR caribou range is located east of the Athabasca River, and includes 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 indicate that very little movement occurs between caribou ranges (ASRD and ACA 2010). The Project is located in the Egg-Pony and Algar ranges.~~

~~Estimated caribou population size in the ESAR caribou range is 90 to 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). The population growth for the ESAR caribou range was 0.81 in 2007/2008, with calf recruitment between 12.6 and 16.1 calves per 100 cows. A total of 116 caribou were observed in the ESAR caribou range during the 2008 caribou/calf surveys. The population of the ESAR caribou range was stable to declining between 1992/1993 and 1999/2000, but has consistently declined since (Athabasca Landscape Team 2009). Environment Canada (2012) reports that 81% of the ESAR caribou range is affected by anthropogenic and fire disturbance, which exceeds the threshold level of disturbance (35%) that will support a self-sustaining caribou population.~~

Further information on each of the documents listed above is summarized in the following paragraphs.

The *Management Plan for the Northern Mountain Population of Woodland Caribou* (Rangifer tarandus caribou) *in Canada* (EC 2012a) applies to the Pink Mountain herd. Objectives of the plan for northern mountain caribou include determining herd status and trends, managing harvest and identifying and managing important habitats. The main threat identified for the Pink Mountain herd is reduction in range due to industrial development. An increase in predation by both wolves and wolverines was noted, and is attributed to the increase in moose populations following prescribed burns.

The *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (BC MOE 2013) applies to the Graham herd. Objectives include:

- protecting 90% of HEWR

- implementing management objectives and standardized management practices in HEWR and low-elevation winter range (there is currently no low-elevation winter range identified for the Graham herd)
- addressing non-habitat related threats
- monitoring compliance and effectiveness of management actions

Management objectives for industrial footprints are to restore, reduce or prohibit surface disturbance in high-elevation winter habitat, thereby reducing the potential for disturbance and displacement of caribou to lower elevation winter habitats that have a relatively higher predation risk. Implementation of standardized industry management practices to reduce or avoid habitat disturbance is one of the key implementation objectives of the Plan. The Plan suggests that these standardized management practices would be regulated under the *Oil and Gas Activities Act*, the *Forest and Range Practices Act* or the *Mines Act*. Currently, the standardized management practices suggested in the Plan have not been developed or implemented. The Project does not intersect defined HEWR in caribou range and, therefore, does not trigger the provincial requirement for a Caribou Mitigation and Monitoring Plan, which could include a requirement for offset (compensation) measures.

EC released the *Recovery Strategy for Woodland Caribou, Southern Mountain population* (Rangifer tarandus caribou) *in Canada* in June 2014, with the goal to achieve self-sustaining populations in all local population units within their current distribution (EC 2014). The Recovery Strategy applies to the Graham herd, or local population unit, but not the Pink Mountain herd. The Graham herd is part of the Northern Group subpopulation, and the Recovery Strategy has set a population target of 4,600 caribou for this group, which is 24% higher than the current population estimate of 3,707 caribou.

Population and distribution objectives identified in the Recovery Strategy include:

- stop the decline in both size and distribution of all local population units
- maintain the current distribution within each local population unit
- increase the size of all local population units to self-sustaining levels and, where appropriate and attainable, to levels that can sustain a harvest with dedicated or priority access to Aboriginal peoples (EC 2014)

The federal Recovery Strategy delineates critical habitat in the Northern Group into five categories:

- high-elevation summer or winter range
- low-elevation summer range
- low-elevation winter range
- Type 1 matrix range within annual ranges
- Type 2 matrix range surrounding annual ranges

Only high-elevation summer or winter range is currently spatially defined in the Recovery Strategy for the Graham range. The definition of critical habitat is subject to change in updates to the Recovery Strategy or through the development of federal action plans.

Maintenance of low and sustainable predation risk and access to food resources is the key habitat function of each of these identified range categories (EC 2014). In low-elevation winter range and Type 1 matrix range, a minimum 65% undisturbed habitat should be achieved or maintained (for Northern and Central groups), and, in Type 2 matrix range, ecological conditions to support low predation risk should be maintained. The Recovery Strategy considers minimal disturbance of high-elevation summer and winter ranges as necessary for the recovery of southern mountain caribou local population units.

Critical habitat for southern mountain caribou is partially mapped in the EC Recovery Strategy. The Project is not located in critical habitat as currently mapped for the Graham local population unit. NGTL acknowledges the incomplete identification of critical habitat for the Graham herd, and will continue to engage the appropriate regulatory agencies to incorporate updated information as results from the schedule of studies identified in the Recovery Strategy become available.

During the NEB application review process for the Project, West Moberly First Nations submitted written evidence, entitled *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014), hereafter referred to as the Seven Herds report. In the Seven Herds report, additional critical habitat is proposed for woodland caribou, including the Graham and Klinse-Za (Moberly) herds, and current and historical population and distribution information is provided. The stated intent of the document is to provide information for inclusion in the development of the federal Recovery Strategy and Action Plans under SARA.

The *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013) identifies population and distribution objectives, disturbance thresholds for the critical habitat proposed in the draft Action Plan for the Klinse-Za herd and recommended measures to stabilize the Klinse-Za caribou herd population. The recovery actions listed in the draft Action Plan for the Klinse-Za herd, in order of priority, include:

- wolf reductions and calf penning
- protection of terrestrial lichen
- avoidance of calving areas during calving period
- restoration of early seral habitats
- deactivation of linear features
- implementing a range plan and cumulative effects assessment plan

NGTL understands the critical habitat proposed in the Seven Herds report and the draft Action Plan for the Klinse-Za herd was developed using an approach informed by traditional knowledge about historic distribution and range of caribou.

This approach differs from the delineation of caribou local population units and critical habitat in the federal Recovery Strategy, which is based on current and recently historic (since the 1980s) occupancy (EC 2014). NGTL recognizes that proposed critical habitat in the Sevens Herd report and the draft Action Plan for the Klinse-Za herd overlaps with a portion of the Aitken Creek Section of the Project. However, neither critical habitat nor the local population unit boundary for the Moberly (Klinse-Za) herd delineated in the EC Recovery Strategy overlaps with the Aitken Creek Section. Similarly, although the Graham local population unit boundary does overlap with the Aitken Creek Section, no critical habitat as delineated in the federal Recovery Strategy overlaps with the Project.

Given these differences in mapping, it was determined that the Preliminary CHRP would be developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities. NGTL has adopted the definition of critical habitat as defined in the Recovery Strategy. NGTL is developing a consistent approach for all its projects, which aligns with the federal and provincial regulatory authorities. Furthermore, the mitigation measures that NGTL has proposed within this Preliminary CHRP are consistent with and have been developed in consideration of the objectives described in provincial and federal management and recovery plans. NGTL recognizes that critical habitat for caribou is only partially delineated by EC, and that the process is ongoing. Any changes made to the boundaries delineated in the Recovery Strategy will be considered in the development of the Final CHRP. The mitigation measures described in the EPP will be applied to the entire Project. In addition, access management measures will be implemented throughout the entire Project. The NEB Report concurs that NGTL has identified current caribou distribution in a manner consistent with the NEB Filing Manual, and that the mitigation applied to protect the Graham herd will ultimately protect the Moberly herd. The NEB noted that the Project does not overlap with the current distribution of the Moberly (Klinse-Za) caribou herd.

In addition to the regulatory policies and recovery objectives summarized above, the Preliminary CHRP considered regulatory guidelines relevant to industrial development in caribou ranges. Regulatory guidelines provide recommendations for industrial development to protect caribou habitat, avoid sensory disturbance during sensitive periods and manage human and predator access.

The recently released *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Interim Guidance)* (BC MFLNRO 2014) provides recommendations for mitigating potential impacts on wildlife and wildlife habitat during the planning, development and operation of industrial projects, including pipelines.

The compendium focuses on northern BC, including the Northeast, Omineca and Skeena regions. With respect to caribou, the compendium indicates that threats to caribou are similar across ecotypes and are primarily changes to predator–prey dynamics and sensory disturbance during critical periods (late winter when cows are in their poorest physical condition and spring during calving and rearing). To address these threats, the identified management objectives of the compendium include maintaining the functional integrity of important habitats, avoiding or minimizing disturbance to caribou, and avoiding or minimizing an increase in predation risk. To meet these objectives, the compendium identifies 11 points of guidance:

1. Identify caribou habitat and historic and current caribou use of those habitats within the proposed project footprint and its area of influence.
2. Identify caribou indicators (e.g., habitat use and characteristics, population structure and dynamics, etc.) within the project area by caribou ecotype.
3. Identify the impacts of proposed activities on caribou and caribou habitat.
4. Avoid or minimize new disturbance to caribou habitat and the loss of important habitats.
5. Avoid increasing the density of linear disturbances within or in proximity to caribou habitat.
6. Avoid displacing caribou and minimize direct and indirect mortality on caribou populations.
7. Avoid increasing the predation risk for caribou populations.
8. Avoid contaminating caribou habitat.
9. Restore habitats to a condition that provides a similar level of functional caribou habitat as before any industrial activity took place.
10. Develop a monitoring and adaptive management plan to monitor effectiveness of measures to avoid, minimize and restore.
11. Risk timing windows for caribou.

The previously released *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005) contains information on northern caribou, as well as a review of existing management strategies. Over 100 documents were reviewed, including provincial strategies and relevant Land and Resource Management Plans.

Management strategies were grouped into several categories, including:

- landscape level (direction on how an entire caribou range will be managed with respect to spatial and temporal disturbance and associated activities; landscape level strategies are consistent across caribou herds)
- stand level (direction on how industrial activities will be conducted in caribou range, with a focus on managing forage lichens; stand level strategies vary by caribou herd)
- access strategies (direction on how to avoid and minimize impacts from increased access and development of linear corridors, with an emphasis on road planning)
- oil and gas and mining strategies (focus on low impact methods for exploration, restoration of disturbed habitat and minimizing the creation of movement barriers)
- caribou population/monitoring strategies (complement caribou habitat strategies, and suggest further research)

The *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005) refers to the *1996/97 Operating Guidelines for Industrial Activity in Caribou Ranges in West Central Alberta* (Alberta West Central Standing Committee 1996). The Operating Guidelines are for the West Central Alberta caribou ranges, including both mountain and boreal ecotype caribou. The main concerns addressed by the Operating Guidelines are public access routes, predation rates on caribou, caribou habitat availability and quality, and displacing or causing sensory disturbance to caribou. The strategy to address these concerns includes managing short- and long-term impacts of access, applying an "early in/early out" construction schedule, and identifying and providing an adequate supply of quality habitat.

The BC Oil and Gas Commission ([BC OGC] 2013) *Environmental Protection and Management Guide* provides information on the requirements of the Environmental Protection and Management Regulation. The guide provides timing windows for northern and boreal caribou, including:

- low risk (activities should be scheduled during these times, where ground conditions permit)
- cautionary (operations may proceed, subject to BC OGC review; recommend avoidance of intensive activities and additional mitigation measures might be required)
- critical (most activities are restricted during this time; if working within the timing window is unavoidable, operations must be accompanied by a rationale and mitigation and/or monitoring plans, subject to BC OGC approval)

8.3 MOUNTAIN CARIBOU ECOLOGY

As previously mentioned, both the Graham and Pink Mountain herds are provincially designated northern ecotype caribou (BC MOE 2010) – the Graham herd is part of the Southern Mountain Population and the Pink Mountain herd is part of the Northern Mountain Population (EC 2015). Mountain caribou are found in west-central and northern BC, where they span two National Ecological Areas: the Southern Mountain National Ecological Area (SMNEA) and the Northern Mountain National Ecological Area (NMNEA) (BC MFLNRO 2014). The Pink Mountain herd belongs to the NMNEA and the Pink Mountain herd is in the SMNEA. Northern ecotype caribou use terrestrial lichens as a primary food source in winter and overwinter either in low-elevation pine–lichen stands or at high elevation on windswept alpine ridges (BC MFLNRO 2014). Mountain caribou typically calve at high elevations, often migrating over large distances to open subalpine ridges where they maintain a spatial separation from predators, primarily wolves (BC MFLNRO 2014).

8.3.1 Graham Caribou

In 2009 the population estimate for the Graham caribou herd was 708 individuals (EC 2014). There is low confidence in this estimate, and BC MFLNRO has scheduled a census for winter 2015 (Seip pers. comm.). EC (2014) currently considers the population to be stable and BC MOE (2014) considers it to be decreasing in the short term by. However, the long-term population trend is unknown (EC 2014). The seasonal habitat use and movement patterns of the Graham caribou herd are variable and largely dependent on snow conditions (e.g., depth and density) (Backmeyer 2000; Culling et al. 2005). Graham caribou use upland coniferous forests from 1,200 m to 1,600 m in elevation. Preferred habitats include subalpine parkland, alpine tundra, mature and old pine forests and wetland conifer forests, while early seral, deciduous forests are often avoided (Culling et al. 2005). The Engelmann Spruce-Subalpine Fir (ESSF) and Boreal White and Black Spruce (BWBS) biogeoclimatic zones are preferred by the Graham caribou, and use of each zone varies by season (Backmeyer 2000).

The following description of Graham caribou seasonal habitat use is based on a radio-collar study (Culling et al. 2005). During the spring (early April to mid-May), Graham caribou use habitats below 1,300 m, although alpine tundra areas can be used during spring in years with higher than average snowfall. Pregnant females move to higher elevations (1,500 m) to calve in mid-May through the end of June, where they typically remain below the treeline. In summer (July through August) caribou are found in high-elevation alpine tundra and subalpine parkland, and males tend to use higher elevations (1,650 m) than females (1,550 m).

Both males and females begin to move to lower elevations (> 1,500 m) during fall (September through October), where males show a preference for spruce-fir forests and alpine tundra, and females show a preference for subalpine parkland and alpine tundra. Alpine and subalpine habitats are used during the rut. Habitat use during the early winter (November through January) is quite variable, with both alpine tundra and wetland conifer habitats being selected. This variability in habitat selection might be the result of variability in snow conditions and access to forage.

A substantial proportion of the Graham herd detected in the study selected old and mature pine forests and subalpine parkland in late winter (February through March) (Culling et al. 2005). The core winter habitat used by the Graham caribou herd is located along the eastern foothills and is lower in elevation (1,300 m) than habitats used in the summer. More variable use of habitats by the Graham herd in late winter was reported in another study, with a split between individuals using low- and high-elevation habitats (Backmeyer 2000). The federal recovery strategy for southern mountain caribou indicates that low-elevation winter range for the Northern Group (Graham herd) is characterized by low-elevation pine forests 80-250+ years in age with ground cover of terrestrial lichens (EC 2014).

In the Graham caribou herd, there are both migratory (i.e., distinct summer and winter ranges) and resident (i.e., overlapping summer and winter ranges) individuals (Backmeyer 2000, Culling et al. 2005). For the migratory individuals, the spring migration to calving areas is fairly consistent across years, whereas fall migration is more variable and dependent on weather and snow conditions (Culling et al. 2005). Graham caribou favour alpine and subalpine ridges as movement corridors (52% of point locations during migratory periods) and tend to avoid valley bottoms (Culling et al. 2005). The authors of that study speculate that the avoidance of valley bottoms might be due to long-term exposure to predation risk since the area used by the Graham herd has historically had higher moose populations than other parts of the province (Culling et al. 2005).

The annual habitat use described above is supported by the biophysical attributes for the Northern Group of southern mountain caribou, identified in the federal Recovery Strategy. Attributes of critical habitat for Northern Group caribou include low predation risk, low sensory disturbance and access to forage resources (e.g., terrestrial and arboreal lichens, forbs, grasses, sedges, horsetails, emergent vegetation), as well as mineralized soils and wetlands (mineral licks) and minimal physical obstructions (to allow movement) (EC 2014).

8.3.2 Pink Mountain Caribou

In 2000, the population estimate for the Pink Mountain herd was 850 individuals and the population trend is currently unknown (EC 2012a). Information on ecology and habitat use specific to Pink Mountain caribou is limited.

Available information indicates that seasonal movements of Pink Mountain caribou are dependent on snow conditions, as they spend the summer in high-elevation alpine and subalpine habitats and move to lower-elevation coniferous forests during winter. Winter forage consists primarily of terrestrial lichen (COSEWIC 2002).

8.4 THREATS AND LIMITING FACTORS

Threats to ~~boreal woodland~~southern mountain caribou identified ~~by~~in the federal Recovery Strategy~~ (Environment Canada 2012),~~, in descending order of direct impact on caribou population trend, are:

- predation
- habitat alteration from ~~human land-use~~industrial activities
- roads and other linear features affecting direct mortality, habitat fragmentation and predation
- recreational activities causing displacement and facilitating predator access
- natural disturbance of habitat
- hunting
- ~~climate change and severe weather~~

Other threats ~~considered to have a~~ of lower ~~level of~~ concern include implications of climate change, avalanches, parasites and ~~disease,~~ diseases, and stress~~-~~ responses associated with sensory disturbance (noise and light~~), vehicle collisions and pollution.~~

~~Available~~). Although the Pink Mountain herd is not covered under the Recovery Strategy, current literature ~~supports apparent~~suggests that threats to the Pink Mountain herd are likely similar to those listed for southern mountain caribou.

Apparent competition was identified as the likely causal pathway for woodland~~-~~ caribou population declines~~, whereby~~. As primary prey species (e.g., moose, deer) increase with increasing proportions of early seral habitat on the landscape, ~~causing a~~there is a corresponding increase in the numerical response of predators (BC MOE 2013; COSEWIC~~-~~ 2002; ~~Environment Canada 2012~~EC 2014; Latham 2009; Seip and Cichowski 1996; Wittmer et al. 2005). Wolves are considered the primary ~~predators~~predator of caribou across northern~~-~~ Canada and predation by~~-~~ wolves was ~~implicated as~~ the most common cause of death for adult caribou in ~~northeastern~~northeast Alberta (McLoughlin et al. 2003). Black~~-~~ bear ~~can~~could also be a common predator of caribou (Rettie and Messier 1998; Zager and Beechman~~-~~ 2006).

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. 2013; Wittmer et al. 2005).

Predation on caribou is thought to be largely incidental, given the low densities of woodland caribou compared with much more abundant prey species (Wittmer et al. 2005).

The primary selection of peatlands and old-growth forest by caribou~~,~~ and the non-use of, or lack of positive habitat selection ~~non-use of~~, for these areas by moose, wolves (Rettie and Messier 2000) and black bears (Latham et al. 2011) was determined to result in spatial separation (James et al. 2004). This strategy is believed to be used to combat the widespread influence that wolves have in an ecosystem (e.g., Ripple and Beschta 2004; Ripple et al. 2014). Removal or alteration of habitat (e.g., forest harvesting [McCutchen 2007]) ~~will dissolve what spatially separates~~can also reduce the spatial separation between caribou and primary prey (i.e., moose). Following forest harvest, moose and woodland caribou were more likely to use the same habitat, and woodland caribou suffered higher rates of wolf predation (Peters et al. 2013).

~~The influence of anthropogenic linear feature density on predation rates might be equally as important to caribou mortality as the density of predators (Whittington et al. 2011). The ultimate cost to caribou~~ A recent study found that roads increased predation risk for mountain caribou, but early seral habitat and edge created by logging, power lines and wildfire did not (Apps et al. 2013). The study showed that with the exception of roads, early seral/edge habitats influence caribou predation risk less than habitat variables such as elevation, terrain conditions (i.e., complexity, slope) and variation in canopy cover (Apps et al. 2013). Vulnerability to predation for mountain caribou increases as they move to lower-elevation habitats that are selected by primary prey (i.e., moose and deer) regardless of habitat disturbance on the landscape (Apps et al. 2013).

Vulnerability has also been shown to increase in rugged terrain and narrow valleys rather than wide valleys or plateau areas (Apps et al. 2013). This suggests that aside from roads, the functional response of predators to habitat changes in the landscape is less relevant than the population-level numerical response of predators to their primary prey (Apps et al. 2013).

Similarly, the ultimate cost to caribou habitat suitability appears lower for linear feature-induced changes compared with forestry-induced (i.e., cutblocks) changes (DeCesare et al. 2012). Linear feature-induced changes have been previously linked to changes in predator functional response (predator kill rate) while forestry-induced changes have been previously linked to changes in predator numerical response (predator density).

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~~). Forestry cutblocks~~), 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~~ level) scale (DeCesare et al. 2012). Over the long term, managing timber harvest practices in the winter ranges of early seral ungulates to reduce the continuous production of early seral habitat might have the most influential impact on recovery and sustainability of caribou populations (Apps et al. 2013).

Although landscape-scale habitat characteristics that influence ungulate and predator densities might have the greatest impact on caribou population sustainability and recovery (Apps et al. 2013), the influence of anthropogenic linear feature density on predation rates is an important factor for caribou mortality (Whittington et al. 2011). Linear corridors provide improved access for predators such as wolves. Several studies have found that linear corridors are attractive to bears (McKay et al. 2014) and especially wolves as easy travel routes (James 1999; James and Stuart-Smith 2000; Stuart-Smith et al. 1997; Thurber et al. 1994; Whittington et al. 2011). As a result, linear disturbances ~~can~~might influence predator/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).

Furthermore, it is suggested that while wolves increase movement rates on linear disturbance features, their movement rates ~~decrease~~ in close proximity to disturbance features~~. This implies behaviour~~ decreases, implying behaviours closely associated with prey searching and hunting (Ehlers et al. 2014). However, modelling the dynamic use of the landscape by wolves, primary prey (moose) and caribou showed that wolves experience no additional advantage accessing caribou from linear features, although they do benefit in accessing primary prey species (McCutchen 2007). This is supported by a study that found that kill sites were no closer to linear features than random (Latham et al. 2011).

Caribou are sensitive to direct and indirect anthropogenic disturbance (e.g., industrial activity [Dyer et al. 2001, 2002]) and habitat alteration (e.g., forestry [Peters et al. 2013]), ~~and~~in addition to natural disturbance ~~(e.g.,~~such as burns ~~[~~(Schaefer and Pruitt 1991~~]). Long~~). Specific to linear corridors, long-term reduction in habitat effectiveness adjacent to linear features ~~can~~might occur as caribou have been shown to partially avoid habitats near ROWs (Dyer 1999~~;~~, Oberg 2001). ~~Avoidance~~This avoidance of habitat near ~~anthropogenic~~linear disturbances, well sites, facilities and cutblocks leads to indirect habitat loss through reduced habitat effectiveness for caribou (Dyer et al. ~~2001).~~2001), and is often referred to as a zone of influence. Methods 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]) and 1,000 m (industrial developments such as well sites [Dyer et al. 2001]).

~~Methods~~By calculating the spatial difference between potential and realized habitat, a study ~~populations vary among research studies that demonstrate~~of northern mountain caribou in BC estimated that as a result of avoidance of ~~disturbances by varying distances: 70 m (seismic lines and maintained trails [DeCesare et al. 2012]), 250 m (roads and seismic lines [~~the cumulative zone of influence around multiple developments, approximately 8% of high-quality habitat was indirectly lost in the study area in winter and and 2% in summer (Polfus et al. 2011).

Despite an apparent reduction in habitat use in proximity to disturbance, studies have concluded that pipelines do not create a movement barrier to boreal caribou (Joint Pipeline Office 1999; Carruthers and Jakimchuk 1987 in Dyer et al. ~~2001]) and 1,000 m (industrial developments such as well sites [~~2002), except where they parallel roads with traffic (Curatolo and Murphy 1986 in Dyer et al. ~~2001]).~~ 2002).

The federal Recovery~~-~~ Strategy for ~~boreal~~southern mountain caribou defines disturbance ~~of~~to critical habitat as the area affected by natural disturbances such as fire and avalanches or by human-caused disturbance, including a 500~~-~~ m buffer around ~~the~~anthropogenic disturbance to account for avoidance by caribou~~, and the area affected by fire~~ (EC 2014). Critical habitat for southern mountain caribou is identified as all of the area of high-elevation winter and/or summer range; within the Northern and Central Groups that contain low-elevation winter range, a perpetual state of a minimum of 65% undisturbed habitat; and a matrix range that provides an overall ecological condition that will allow for low predation risk (EC 2014).

The Recovery Strategy considers at this time that “very minimal disturbance” for high-elevation winter and/or summer ranges is required for achieving recovery of local population units in all of the southern mountain caribou groups. For the Northern Group of southern mountain caribou (including the Graham herd), the federal Recovery Strategy identifies a minimum of 65% undisturbed habitat as a reference disturbance level for low-elevation winter ranges and Type 1 matrix range (EC 2014).

The threshold of 65% undisturbed habitat is derived from population response models developed for boreal woodland caribou ranges (EC 2011, 2012b), which, like the low-elevation and Type 1 matrix range for Northern Group southern mountain caribou, consist of fire-adapted ecosystems. The 65% threshold might be revisited on completion of studies to determine appropriate disturbance thresholds specific to low-elevation and Type 1 matrix range, or evidence that indicates the disturbance level is not supporting recovery of a caribou local population unit. Additional studies are needed to determine disturbance thresholds that will achieve recovery objectives for high-elevation ranges (EC 2014).

Until such thresholds are identified, disturbance in high-elevation ranges should be minimized and mitigated (EC 2014). In addition, maintaining functional Type 2 matrix range (outside the local population unit boundaries) is an essential component of recovery of southern mountain caribou local population units to self-sustaining levels (EC 2014). The habitat condition of Type 2 matrix habitat that is necessary for caribou recovery is identified as a wolf density of less than ~~40 years old (Environment Canada 2012~~3 wolves/1,000 km^2. This target might be achieved through management of habitat disturbance levels or management of primary prey and predator abundance (EC 2014).

~~Restoration of disturbance assumes that caribou will return to being spatially separated from primary prey (moose, deer) and predators, and hence natural levels of mortality risk (Athabasca Landscape Team 2009). Management of boreal caribou habitat to maintain viable populations over time will require both minimizing the impact of future development and recovery of the existing industrial footprint.~~

Woodland caribou populations are very low in many areas and, therefore, populations ~~simply~~ might not rebound due to increasing rates of inbreeding and other, well-defined detrimental effects of genetic drift that are characteristic of small, genetically-~~ ~~isolated populations (Bijlsma et al. 2000; Frankham 2005; Hedrick and Kalinowski 2000; Keller and Waller 2002). This phenomenon, known as the Allee-~~ ~~effect, was recently suggested to ~~likely~~ occur in the boreal population of woodland caribou in Alberta (Hervieux et al. 2013; Serrouya et al. 2012) and potentially to occur in the Southern Mountain population of woodland caribou (Wittmer et al. 2005).

8.5 CARIBOU RECOVERY AND HABITAT RESTORATION

~~The lowland habitat types naturally have very slow rates of vegetation establishment and growth, making tree seedling establishment and growth in a 15-year period unpredictable. Guidelines for wetland restoration associated with oil sands mining (AENV 2008) focus on disturbance types that are not applicable to pipeline construction and operation. Furthermore, reclamation of bogs and fens (i.e., the treed lowland and shrubby/graminoid lowland habitat types addressed in this CHRP), is in experimental stages and is not addressed in the current guidelines. The *Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region* includes specifications for various indicators using an "end land use" approach that targets reclamation to commercial forests, which conceptually provide other ecosystem functions including wildlife habitat (AENV 2010).The application of these guidelines to the CHRP needs to be approached with caution, since they relate to a very different disturbance type (i.e., bitumen mining vs. pipeline ROW) and are developed for different objectives.~~

~~With these limitations in mind, it is recognized that the AENV guidelines for oil sands reclamation are developed for boreal forests with similar attributes to those on the Project and, therefore, some of the thresholds and indicators were used to guide the development of quantifiable targets for the CHRP.~~

~~In particular, the quantifiable targets associated with treed lowland and shrubby/graminoid lowland habitat types incorporated the concept of plant community composition as an appropriate indicator to assess reclamation status and progress (AENV 2010). This is supported by the suggestion that the number and abundance of characteristic species (i.e., species typically found in undisturbed native wetland plant communities) and the number of restricted weeds are measures for plant community health (Cibrowski et al. 2012).~~

~~Plant community composition as described in the *Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region* (AENV 2010) and characteristics of healthy plant communities in treed lowlands were used to develop quantifiable targets for the lowland habitat types in this CHRP. A threshold of two characteristic species in wet poor sites is suggested, which was derived to be conservative (low) with respect to realistic achievement of thresholds (AENV 2010). This species threshold was determined based on data from reclaimed oil sands 20 or more years after reclamation (AENV 2010). Given the much lower disturbance level associated with pipeline construction and operation compared with oil sands mining, three characteristic species within the 15-year monitoring period is likely a reasonable quantifiable target and has been adopted for restoration of the lowland habitat types in the Preliminary CHRP (see Table 4-1). Characteristic species can include vascular and non-vascular plants, provided they are species found in the adjacent undisturbed native plant community. The other quantifiable targets for lowland habitats are absence of restricted weeds to indicate vegetation community health and 80% vegetation cover by characteristic species. Quantifiable targets are also provided in Table 4-1 for lowlands where conifer seedlings are planted in mounded sites.~~

~~There are no existing specifications for design and implementation of caribou habitat restoration measures. As a result, restoration criteria and guidelines for forested areas in Alberta and reforestation standards in Alberta specific to the Project area (Alberta Environment [AENV] 2001, 2008, 2010; AESRD 2013b,c, 2014b) were used to develop appropriate specifications for the CHRP restoration measures.~~

~~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., AENV 2010; AESRD 2013b). In relation to oil sands mining in northeastern Alberta, Straker and Donald (2011) and Hawkes (2011) have suggested that current reclamation standards might 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.~~

~~*The Reclamation Assessment Criteria for Pipelines* (AENV 2001) recommends that equivalent land capability should take into account natural variability, which considers the range of landscape attributes that are encountered and influenced by slope, drainage, coarse fragments, vegetation growth and composition, and soil color, texture, aggregate strength and size.~~

~~The *Guideline for Wetland Establishment on Reclaimed Oil Sands Leases* (AENV 2008) focuses on disturbance types that are not applicable to pipeline construction and operation. Furthermore, reclamation of bogs and fens (i.e., the treed lowland and shrubby/graminoid lowland habitat types addressed in this CHRP), is in experimental stages and is not addressed in the current guidelines.~~

~~The *Reclamation Criteria for Wellsites and Associated Facilities for Forested Lands* (AESRD 2013b) provides reclamation criteria that apply to well site leases and access roads, and associated facilities such as pits, campsites and offsite sumps. Criteria are provided to determine whether a reclaimed site meets equivalent land capability, based on function and operability of the land to support the production of goods and services consistent in quality and quantity with the surrounding landscape. A minimum 25% cover of herbaceous and of woody species is recommended for naturally regenerating and planted sites in forested lands. The document suggests that ecosystem function can be determined when natural processes are evident, such as proper drainage, moisture retention and cycling, soil and site stability, and nutrient cycling (i.e., litter formation). Recommendations for assessing reclamation success are provided for various factors such as drainage, erosion, soil stability, woody debris, plant community composition and cover, litter and LFH development, and soil characteristics.~~

~~The *Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region* includes specifications for various indicators using an "end land use" approach that targets reclamation to commercial forests (AENV 2010). In concept, commercial forests also provide other ecosystem functions. The application of these guidelines to the CHRP needs to be approached with caution, since they relate to a very different disturbance type (i.e., bitumen mining vs. pipeline ROW) and are developed for different objectives. The *Alberta Regeneration Standards for the Mineable Oil Sands* (AESRD 2013c) are similarly applicable to reforestation of oil sands mines. The standards outline protocols for establishment and performance surveys to determine reforestation establishment and continued growth, where commercial forestry is the end land use. Seedling planting or target densities are not specified. The standard does, however, provide guidance on determining "poorly revegetated areas" based on the size (≥0.5 ha) and proportion (≥25%) of trees affected by mortality, foliage loss/discolouration, missing or low density, physical damage, or poor form or vigour.~~

~~The *Reforestation Standard of Alberta* (AESRD 2014b) specifies that openings (i.e., cutblocks) are considered sufficiently regenerated if 80% or more of area contains acceptable tree regeneration. Regeneration is assessed by tree characteristics including species composition and density, spatial distribution, height, well-defined stems and damage. The standards are intended for reforestation of commercially harvested forests, with the intent of regenerating commercially viable forests.~~

~~8.6 VEGETATION REESTABLISHMENT~~

Restoration of disturbed habitat has become one of the key components for caribou conservation identified through the federal Recovery Strategy (~~Environment Canada 2012~~EC 2012a, 2014) and in provincial ~~boreal~~mountain caribou ~~recover~~recovery planning (BC MOE 2013). This section summarizes information from habitat restoration guidelines, previous caribou habitat restoration initiatives and published research. Information on restoration methods employed and effectiveness or success of restoration is included, where available.

Results of the literature review provide habitat restoration information specific to mountain caribou ranges. However, given the limited availability of literature specific to mountain caribou ranges, relevant literature from research and restoration initiatives in boreal woodland caribou range is included. This section is supplemented with further information specific to restoration initiatives completed in boreal woodland caribou range (Appendix A), which was considered as context within which to develop this Preliminary CHRP. This is supported by similarities in ecological characteristics, restoration objectives and silvicultural practices between the Project area in northern BC and boreal caribou ranges in Alberta ~~Woodland~~where additional documentation for habitat restoration initiatives is available.

Both boreal and mountain woodland caribou require undisturbed habitats with mature and old coniferous forest, and lichen forage opportunities (EC 2012b, 2014). While there are similarities among these habitat requirements, mountain caribou are distinguished from boreal woodland caribou by seasonal migrations between low-elevation and high-elevation ranges (Heard and Vagt 1998; Spalding 2000; EC 2014). See Section 8.3 for further description of northern ecotype, mountain caribou ecology. In contrast, boreal woodland caribou inhabit boreal landscapes where terrain is lacking high-elevation features, and elevational migration between seasonal habitats does not occur. Despite differences in seasonal movements and habitat use between mountain and boreal woodland caribou, there is overlap in habitat types that occur in some northern ecotype mountain caribou ranges and boreal woodland caribou ranges.

The Project area in the Graham and Pink Mountain caribou ranges is mostly located in the transitional area between the Subboreal Interior and the Boreal Plains ecoprovinces of BC, east of the Rocky Mountains (Demarchi 2011). This area corresponds to the western fringe of the Boreal Plains Ecozone of Canada, which extends across the boreal region of western Canada (Smith and Marshall 1995) and overlaps many of the boreal woodland caribou ranges in western Canada. The northern part of the Kahta Section is characterized by a mosaic of forested (predominantly coniferous) wetlands and upland habitats, not unlike those in boreal regions. The rolling terrain along the Aitken Creek Section in the Graham caribou range is characterized by upland conifer and deciduous forests, with relatively little forested wetlands. The similarities in habitats between the Graham and Pink Mountain caribou ranges encountered by the Project and those encountered in some boreal woodland caribou ranges where habitat restoration is better understood, supports transfer of habitat restoration information between the regions.

The effects of linear developments are similar across caribou range, regardless of the caribou ecotype. Effects of linear disturbance on woodland caribou associated with loss of suitable old forest habitat features (e.g., loss of forage and cover habitat) is considered of lower consequence than indirect effects, due to the relatively small impact of clearing narrow linear features when considered in proportion to habitat availability at the range scale. The effects associated with regenerating early seral habitats and access, and the potential resultant indirect changes in predator–prey dynamics, similarly affect mountain and boreal woodland caribou.

The focus of mitigation and habitat restoration applied in boreal and mountain caribou ranges are similar. Namely, the objectives of habitat restoration initiatives include re-establishing natural vegetation communities that do not encourage highly palatable forage for primary prey, blocking motorized access to facilitate vegetation establishment and growth and limiting sightlines. When successfully implemented, these measures are expected to reduce residual effects of linear developments associated with predation risk. Given the similar objectives for caribou habitat restoration in boreal and mountain caribou ranges, similar measures are applied to restore habitat within linear disturbances, including silvicultural methods to establish vegetation (e.g., site preparation techniques and planting or seeding native vegetation) and measures to block access and line-of-sight.

8.5.1 Guidelines Relevant to Habitat Restoration in Mountain Caribou ~~Recovery Team~~Range

A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Interim Guidance) (BC MFLNRO 2014) provides guidelines for habitat restoration in caribou range. The main objectives for habitat restoration are to restore habitats to a similar functional level as before disturbance and to develop monitoring and adaptive management plans to monitor the effectiveness of restoration measures.

This compendium provides a list of recommendations to achieve these objectives, as follows:

- restore habitat as soon as possible following development
- deactivate and restore linear features as soon as possible following development
- limit attracting predators and early-seral ungulates to the development area
- explore opportunities to restore areas not directly affected by development activities
- prevent the establishment and spread of invasive species
- develop monitoring plans to ensure that mitigation measures are implemented as planned and are effective at meeting measurable targets
- align the type and degree of monitoring with the degree of risk to caribou and the uncertainty around mitigation measures
- ensure that monitoring plans are planned and implemented by a qualified professional with knowledge of caribou ecology
- share all data with provincial regulatory agencies to facilitate future mitigation and caribou management
- ensure that monitoring plans include changes over time, a before-and-after control study design, habitat modelling and adaptive management

A *Compendium of Northern Caribou Winter Range Management Guidelines and Strategies in British Columbia* was prepared for the BC Ministry of Water, Land and Air Protection (MWLAP) in 2005~~; Government~~ (Cichowski 2005). This report targets the northern caribou ecotype, which consists of both the Graham and Pink Mountain herds, along with 29 other herds. This compendium summarizes provincial strategies, guidelines and recommendations for management and recovery of northern caribou at landscape and stand-level scales, including strategies to address both forage and predator avoidance requirements, and management concerns specific to seasonal habitats.

Limiting disturbance and exposure to predators is identified as a key consideration for summer and calving habitat, high-elevation and low-elevation winter habitat, as well as matrix habitat (Cichowski 2005). This compendium states linear corridor development and access associated with industrial activities is one of the major threats to northern caribou, so considerable effort was put into developing linear corridor and access management strategies. The identified strategies include avoiding road development to alpine and subalpine habitats, on eskers, on south slopes or through travel/connectivity corridors, and avoiding extended sightlines (Cichowski 2005).

Numerous strategies related to road planning, construction and decommissioning are summarized in this compendium. Many of these strategies are relevant to pipeline construction and operation, and are adopted as industry best management practices, including:

- planning access development to minimize disturbance footprint
- coordinating shared access
- using temporary access
- decommissioning access as soon as site conditions and timing restrictions allow following construction
- implementing measures to reduce lines-of-sight (e.g., bends, retaining vegetation screens)
- reclaiming linear corridors
- minimizing snow plowing
- implementing access prevention measures
- timing restrictions

The *Ecological Restoration Guidelines for British Columbia* (BC MWLAP n.d.) provide guidance on how to plan a restoration program. This guidance includes establishing goals and objectives, effective monitoring programs and restoration priorities. The guidelines provide recommendations on issues to consider, such as planting prescriptions, species at risk, soil rehabilitation, slope instability and bioengineering. However, recommendations for specific mitigation measures that are best suited for specific habitat types are not provided.

The BC OGC (2013) recommends using Land Resource Management Plans and Sustainable Resource Management Plans as guidelines for end land use goals. The forestry industry guidebooks prepared under the BC *Forest and Range Practices Act* (previously *Forest Practices Code of British Columbia Act*) provide valuable information for silvicultural practices and techniques that are commonly used to restore vegetation in disturbed sites. Guidebooks reviewed for relevant information to support caribou habitat restoration planning for the Project include *Soil Rehabilitation Guidebook* (BC MOF 1997) and *Establishment to Free Growing Guidebook Prince George Forest Region* (BC MOF 2000). These guidebooks provide information relevant to mechanical site preparation for creating suitable microsite conditions for seedling establishment, seedling planting, stocking standards and species. This information is incorporated in the post-construction habitat restoration information provided in this Preliminary CHRP, including specifications and targets.

Although not directly intended for northern or mountain ecotype caribou ranges, the *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia* (Golder 2015), prepared under the SCEK Fund, provides a review of restoration tools for caribou habitat restoration that can be applied to caribou ranges for other ecotypes. Access management (human and predator) and recovery of natural vegetation are the stated objectives for caribou habitat restoration in the toolkit, which identifies mechanical site preparation (mounding or ripping), tree/shrub planting, spreading woody material, tree felling/bending and installing fences as restoration techniques to be considered for boreal caribou habitat restoration in BC. Until further information for habitat restoration in northern and mountain caribou ecotypes has been collected through monitoring of implemented restoration programs, much of the information available for caribou habitat restoration comes from restoration initiatives in boreal caribou ranges of Alberta ~~2011)~~..

Provincial guidance for restoration of wetlands was reviewed, because treed wetland habitat types occur along much of the Kahta Section in caribou range. These habitat types are known to naturally have very slow rates of vegetation establishment and growth, making tree seedling establishment and growth in the short- to medium term unpredictable. There is currently no overarching provincial policy for wetlands or wetland restoration in BC, although the *Forest Practices Code* protects wetlands on Crown land and the Ministry of Transportation has a no net loss of wetland policy (Wetland Stewardship Partnership 2010). While wetland restoration is a primary focus of the *Wetlands Action Plan*, no guidelines or recommendations are provided for restoration (Wetland Stewardship Partnership 2010).

8.6 VEGETATION REESTABLISHMENT

Restoration of disturbed habitat has become one of the key components for caribou conservation. This section summarizes information from habitat restoration guidelines, previous caribou habitat restoration initiatives~~,~~ and published research. Information on restoration methods employed and effectiveness or success of restoration is included. ~~This section is supplemented with information specific to restoration initiatives already completed in boreal woodland caribou range (see Appendix C), which was considered as context in Preliminary CHRP development.~~

8.6.1 Tree Planting and Natural Regeneration

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 site preparation to create microsite conditions (i.e., ~~tree planting~~silvicultural methods) that are conducive to both planted seedling growth and natural vegetation encroachment (CRRP 2007b; COSIA 2012). Measures such as rollback can address site condition issues, including competition from non-target or undesired plant species, erosion, frost, and heat or moisture deficiencies (CRRP

2007b).~~ These methods are consistent with the approach adopted by NGTL in previous CHRPs.~~

These methods are consistent with the approach adopted by NGTL in previous CHRPs, and in the recommended measures summarized in the *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia* (Golder 2015).

Natural revegetation and successful planting initiatives benefit from construction practices that minimize disturbance during development of the footprint. Minimum ~~disurbance~~disturbance pipeline construction techniques that avoid grubbing and grading are effective at facilitating rapid regeneration of native vegetation ~~in~~within the ROW,~~ in particular~~ in areas with a deciduous vegetation component (TERA 2011a,b, 2012). Implementation of minimum disturbance construction can be limited by such factors as terrain that requires grading, ground conditions (e.g., non-frozen soils) and construction methods (e.g., crossings of third~~-~~-party dispositions).

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 (CRRP 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 [DES] 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 (COSIA 2012). It might also provide important habitat benefits for wildlife, compared with only planting tree seedlings, by providing hiding cover (Bayne et al. 2011).

Conventional 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 can 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~~was 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), ~~site~~ 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 (Revel et al. 1984; MacFarlane~~-~~ 1999, 2003; Sherrington 2003; Lee and Boutin 2006).~~ However,~~

Since tree regeneration on seismic lines is a key determinant of recovery success (MacFarlane~~-~~ 2003~~) and, therefore,~~), factors that hinder revegetation efforts should be mitigated. ~~Although seismic lines and pipeline ROWs are both linear disturbances,~~

~~drawing~~Drawing parallels between regeneration success on ~~these different features~~ seismic lines and pipeline ROWs should be done with caution.

Restoration ~~issues~~success on seismic~~-~~ lines might not be comparable to that of pipeline ROWs~~,~~ given differences in disturbance mechanisms, degree of soil and vegetation disturbance, reclamation practices and width of the features (i.e., the wider openings of ROWs allow more light and insolation than narrow seismic lines, which might facilitate better vegetation regrowth).

~~Evidence presented at~~At the 15th North American Caribou ~~Workshop demonstrated~~Conference (2014), positive scientific evidence was presented on winter tree planting and mechanically bending live trees into the ROW ~~are~~as emerging mitigation options ~~that are currently being implemented~~ for seismic lines in the ~~Alberta~~ oil~~-~~ sands region ~~(North American Caribou Workshop 2014).~~of Alberta. Tree bending ~~might~~could be particularly promising as it promotes natural revegetation by increasing cone deposition ~~onto~~on the disturbance footprint and creating microsites through shading and dropped dead woody debris. ~~However, these~~ These mitigation measures ~~are~~, however, have only initially ~~being~~been evaluated and their full utility remains unknown. Furthermore, ~~they~~these techniques were applied only on seismic lines ~~that~~, which are ~~substantially~~considerably narrower than pipeline ROWs and do not require continued ~~operation~~operational activities, as do pipelines.

8.6.2 Transplanting and Seeding

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 2012a):

- 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~~)~~), which can reduce their viability
- other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison

An alternative to salvage and transplanting vegetation is to seed disturbed areas using seed collected from the same geographic region as the restoration project. Broadcasting seed either aerially or using ground methods (by hand or mechanically) is also an option. However, since pipeline ROWs are relatively narrow openings (compared with cutblocks, for example), sufficient natural seed ingress from the adjacent undisturbed habitat can facilitate natural recovery without additional seed application. Logistically, the feasibility of seeding can be constrained where the reclamation project is a substantial distance from an airport or airfield (i.e., for aerial seeding), or where ground access during non~~-~~-frozen conditions is restricted by wet soils. Furthermore, direct seeding of conifers is not a preferred reforestation technique, partly due to problems with seed predation (~~British Columbia Ministry of Forests~~BC MOF 1997).

Transplanting or seeding lichen species has many of the same challenges as transplanting or seeding vascular plants. In addition, conditions required for successful establishment of terrestrial lichens may be limited along pipeline ROWs (e.g., adequate amounts of shade) or are not compatible with other habitat restoration measures or access management measures (e.g., presence of woody debris) (Gough 2010; Miege et al. 2001). The costs associated with lichen collection might be prohibitive (Roturier et al. 2007). Few studies have determined the effectiveness of lichen transplantation or seeding, and these have focused on regenerating cutblocks (Gough 2010; Roturier et al. 2007). Further studies are required before applying this method on a larger scale (Roturier et al. 2007).

8.7 EFFECTS OF HUMAN USE ON RESTORATION

The ability of linear features to recover to a natural forested state is affected considerably by human use. ~~Recovery of conventional seismic lines to functioning mountain caribou habitat occurs was identified to be within 20 years following disturbance in west-central Alberta (Oberg 2001).~~

~~Seismic lines in~~In the Little~~-~~ Smoky caribou range~~-~~, seismic lines that were allowed to revegetate naturally ~~reportedly~~ 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.,~~ such as re~~-cleared-~~clearing to ground level for winter access or seismic program use ~~[~~(Golder~~-~~ 2009~~]).~~). The average age of trees on ~~the control lines~~ linear disturbances that were repeatedly disturbed was only 10 years, ~~suggesting~~and the trees achieved an average height of less than or equal to 0.5 m. These results suggest that 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, 2012b). ~~Evidence of the effects~~The effect of repeated motorized access on vegetation establishment and regrowth supports the use of access management tools to enhance restoration success.

Subjective expert ratings suggest that the effectiveness of most physical access management measures (e.g.,~~-~~ berms, excavations, rollback, visual screening) varies considerably between negligible and high effectiveness in managing human access (Golder~~-~~ 2007). Effectiveness of access management measures~~ likely~~ depends on suitable placement (e.g., placed to prevent detouring around an access management point), enforcement, and public education of the intent of the access management

(AXYS~~-~~ Environmental Consulting Ltd. [AXYS] 1995). Public education (e.g.,~~-~~ signs) facilitates respect for the purpose of, and compliance with, access management measures.

Mounding has been found to ~~discourage~~deter human access (i.e., truck and ATV) during snow~~-~~-free periods and also creates microsites that improve vegetation establishment (review~~-~~ in Golder 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~~-~~ management and/or microsite creation purposes can vary from 1,400 to 2,000~~-~~ mounds/ha (~~AENV 2010;~~ Golder 2012a~~). However, these~~, 2015).

These mound densities, however, relate to restoring seismic lines that were not frozen-in to allow heavy equipment access. Given the challenges of the wet conditions and frost requirements for accessing the Project footprint (i.e.,~~-~~ freezing~~-~~-in the peat for access can make it difficult to excavate small mounds), the size of mounds ~~could~~ potentially could be substantially larger than mounds achieved on previous seismic line restoration projects. Furthermore, mounds cannot be excavated within 5 m of the operating pipeline, which reduces the mound density relative to disturbances that do not have similar restrictions. As a result, the mound density that can realistically be achieved in pipeline ROWs is lower.

Human access on open and closed (i.e., gated, barriered and recontoured) roads was monitored using remote cameras (Switalski and Nelson 2011). That study 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. The monitoring results also indicated significantly higher levels of hiding cover and lower line-of-sight distances on barriered and recontoured roads compared ~~with~~to open roads (Switalski~~-~~ and Nelson~~-~~ 2011). A similar study investigated the effectiveness of different approaches (i.e., year~~-~~-round closure, seasonal closure, deactivation, and deactivation and closure) at limiting motorized vehicle traffic on unpaved roads designed to support forestry operations (i.e., resource roads) (Hunt and Hupf 2014).

Results demonstrated that closure and/or deactivation approaches significantly reduced traffic on resource roads (about 78%), with year~~-~~-round closure being the least~~-~~ effective~~ while~~, whereas seasonal (i.e., hunting) closure ~~being~~was among the most effective ~~approach~~approaches (Hunt and Hupf 2014). The effectiveness of different approaches did not depend on road quality (Hunt and Hupf 2014). Physical access management 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, they no longer facilitate ATV access (Sherrington 2003).

The techniques described above to block human access also contribute to achieving sufficient revegetation to block line–of–sight. Short~~-~~ term management for access and line-of-sight blocking should ultimately lead to long-term access management by way of revegetation of disturbed areas (Golder 2007). Expediting growth of visual barriers along linear features can be achieved by concentrating restoration efforts on productive upland habitats, ~~since~~as woody vegetation species grow more quickly on these sites compared with lowland sites. Although regeneration of conifer species provides the best year-round visual barrier, their growth can be slow. Using combined plantings of conifer and fast-growing deciduous woody species in small areas (e.g., narrow strips of plantings across the ROW) can establish visual barriers in the short- to medium term, while maintaining the objective of regenerating conifer-leading vegetation in the long term.

Coarse woody material (rollback) can be effective ~~to manage~~at managing human access as well as ~~to conserve~~at conserving soil moisture, ~~moderate~~moderating soil temperatures, ~~provide~~providing nutrients as debris decomposes, ~~limit~~limiting soil erosion, ~~provide~~providing microsites for seed germination and protection for introduced tree seedlings (Pyper and Vinge 2012; Vinge and Pyper 2012).

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 ability to plant seedlings or limit planted or natural seedling growth. Where sufficient material is available, the ~~suggested~~target woody debris coverage at selected locations is 60 to 100 m^3/ha on upland sites and 25 to 50 m^3/ha on lowland sites, to mimic natural processes (Pyper and Vinge 2012; Vinge and Pyper 2012). Where sufficient material is available, woody debris coverage of 150 to 200 m^3/ha along ROWs ~~can~~might be used to manage human and wildlife access (Vinge and Pyper 2012). ~~The storage~~

Storage and placement of woody debris ~~must~~needs to consider ~~reducing~~the presence of ladder fuels to reduce fire hazard (Pyper and Vinge 2012). Fire risk can be managed by implementing a 25 m fuel break every 250 m along linear features (Pyper and Vinge 2012). Short segments (i.e., <100 m) of rollback might be less effective at deterring human access ~~because~~since ATV and snowmobile riders might try to ride through the debris or traverse around it in adjacent forest stands (Vinge and Pyper 2012). Complete rollback (i.e., over an entire linear disturbance) could be used to prevent motorized access (Pyper and Vinge 2012~~), however,~~) but availability of material is a limiting factor. ~~The *Integrated Standards and Guidelines for the Enhanced Approval Process* recommend a 25 m rollback-free fuel break be placed every 250 m along segments of rollback (AER 2013).~~

8.8 WILDLIFE USE OF REGENERATING LINEAR DISTURBANCE

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 in the Little-Smoky caribou range measured 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 naturally revegetated seismic lines (i.e., minimum 1.5 m vegetation regrowth) were preferred by both predator and prey species compared with control lines (~~i.e.,~~ disturbed sites, cleared areas with minimal vertical cover of vegetation and vegetation regrowth of 0.5 m or less~~), and~~). The study also found that the control (disturbed) lines with minimal vegetation were used primarily for travel (i.e., both predators and prey species were constantly moving as opposed to standing or foraging). In addition, human use was almost exclusive to the control lines. The line-of-sight measured on the revegetating lines was typically less than 50 m long.

~~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 long. It was suggested that moose~~Moose and deer might have been attracted to the revegetated lines for forage availability and perceived cover protection (Golder 2009). The preference for regenerating seismic lines by wolves can 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 ~~behaviour~~behaviours on control lines, whereas on revegetating lines~~,~~ running was rare and standing-related ~~behaviour~~behaviours occurred more often.

Further to this, a study of displacement of Hart Range mountain caribou in east-central BC by snowmobiles reported that caribou were observed in all four mountain blocks (110 to 214 km^2/block) of core winter range delineated for census with little or no snowmobile activity. However, during three of four census years, no caribou were observed in the only mountain block surveyed that had intensive snowmobile activity (Seip et al. 2007).

Another ongoing project in northern Alberta involving the Cold Lake boreal caribou herd is currently investigating the responses of predator and prey species to the deactivation or restoration of habitat disturbance features (McNay et al. 2014). The goal of the project is to determine how different species (wolves, bears, moose and caribou) use the landscape, and how the presence or absence of linear disturbances ~~might~~can influence the functional and numerical response of predators (McNay et al. 2014).

The project is still in ~~the~~its early stages~~. Preliminary~~, but preliminary results suggest ~~that~~ among all species that seasonal and annual movements are variable~~,~~ with substantial overlap between the range extents of all four species. ~~Additionally~~Also, in these range overlaps, were 19 instances where predator and prey could have encountered one another. Furthermore, preliminary results present 11 deaths of 94 collared animals: 2~~-~~ caribou, 3 moose, 1~~-~~ bear and 5 wolves. Predator kill sites were identified~~ included~~: 143 bear sites and 93~~-~~ wolf~~-~~ sites. These kill sites were implicated in the deaths of 11 caribou, 22~~-~~ moose and 6 deer. Ongoing data collection and processing will provide future results from scat analysis, prey body condition, habitat modelling and mapping.

The project aims to address several management questions regarding the desired vegetative and spatial characteristics on the landscape to reduce caribou mortality, how silvicultural techniques and mitigation measures can be implemented to achieve these characteristics, the association between specific characteristics and predator efficiency and/or density, and when deactivated linear features can be considered to have lost their disturbance function (McNay et al.~~-~~ 2014). This project is associated with the RICC initiative.

Mechanically bending or felling live trees over a linear disturbance (often referred to as line~~-~~-blocking, particularly when used in conjunction with other treatments such as mounding) is another potential measure that ~~might~~could have benefits for managing access and reducing wolf use. Trees are typically bent or felled from both sides of the linear disturbance. Tree felling entails cutting trees at the base from the edge of the linear disturbance, and allowing them to fall across the linear disturbance.

Tree bending requires mechanically bending trees from the base of the tree, partially exposing roots, so that the tree leans over the linear feature, close to the ground. Tree bending can be expensive and the process is time consuming. A preliminary assessment of tree felling along seismic lines to block access was ~~completed~~conducted in the Little~~-~~ Smoky herd range in Alberta during the summer and fall of 2004 (Neufeld~~-~~ 2006). While results of that study showed no statistical significance between wolf use of blocked versus non~~-~~-blocked seismic~~-~~ lines, there was an indication that wolves tended to use areas with unblocked seismic lines more often than areas with blocked seismic lines~~ (Neufeld 2006).~~

). Based on these results, it was concluded that if tree felling is to be used as a line~~-~~-blocking measure, it should be investigated more thoroughly, and not relied on solely as a mitigation tool~~ (Neufeld 2006).~~. Preferably, line~~-~~-blocking should be used in combination with other management actions such as habitat restoration~~ (Neufeld 2006),~~, and continue to be evaluated for effectiveness using an adaptive management approach~~. As previously described, tree felling or bending is often completed in conjunction with other measures, such as mounding, spreading coarse woody debris or seedling planting to achieve line-blocking~~.

~~As presented at~~From the 15th North American Caribou ~~Workshop,~~Conference (2014) some very preliminary results of linear feature blocking programs suggest that this type of mitigation can be effective ~~in~~at reducing wildlife use of linear features~~ (North American Caribou Workshop 2014).~~.

8.9 KNOWLEDGE GAPS AND LIMITATIONS OF THE LITERATURE REVIEW

The following gaps in knowledge were identified during the literature review ~~provided the opportunity~~:

- scarcity of information on effective habitat restoration measures applicable to ~~identify the following knowledge gaps:~~mountain caribou habitat
- restoration criteria (e.g., defined guidelines or ~~quantifiable~~measurable objectives) for restoration of ~~boreal~~mountain ecosystems for wildlife habitat values, in particular habitats that do not support merchantable timber (e.g., treed bogs and fens)
- functional responses of caribou, wolves and primary prey (e.g., moose, deer) to reclaimed habitats in various stages of successional progression, as well as to access and line~~-~~ of~~-~~ sight management
- long-term monitoring of vegetation recovery on linear disturbances and of predator response to access management measures

There is limited information available on the types and efficacy of habitat restoration techniques in mountain caribou ranges. This is compounded by the issue that results and documentation of recently initiated restoration projects are often unpublished, and proprietary information is difficult to obtain. Available information for restoration techniques in mountain caribou ranges is mostly limited to reclamation and revegetation of drastically disturbed industrial sites, in particular mines, or reforestation of commercially harvested stands.

The techniques used for these large polygonal disturbance types might not translate directly to restoration of linear developments (i.e., some modification is needed to address the different site conditions and objectives). Recommendations in the available literature specific to northern and mountain caribou ranges in BC typically include protection of high-elevation habitats and seasonal movement habitats necessary to maintain connectivity (Backmeyer 2000; Culling et al. 2005; Hatler 1986).

Results of the literature review provide habitat restoration information specific to mountain caribou ranges, where it is available. However, given the limited availability of literature specific to mountain caribou ranges, relevant literature from research and restoration initiatives in boreal woodland caribou range is included. As previously noted, this is supplemented by a table of historic and current restoration initiatives in caribou ranges that was considered as context to develop this Preliminary CHRP.

Despite differences in habitat use and forage selection between mountain and boreal woodland caribou, components of mitigation and restoration planning applied in boreal ranges is transferrable, particularly in low-elevation range and where boreal and mountain caribou have similar ecologies (e.g., fire regime, climate and biophysical attributes). This provides useful background information on restoration initiatives in caribou range and their reported successes and failures.

9.0 REFERENCES

9.1 ~~TEXT~~CONTENT REFERENCES

Alberta ~~Energy Regulator.~~West Central Standing Committee. 1996. 1996/97 *Operating* ~~2013.~~ ~~*Integrated Standards and*~~ *Guidelines*~~. Enhanced Approval Process (EAP). Effective: December1, 2013. Edmonton, AB. 94 pp.~~

~~Alberta Environment and Sustainable Resource Development. 2012. *Caribou Protection Plan Guidelines and Caribou Calving Information*. Edmonton, AB. 3 pp.~~

~~Alberta Environment and Sustainable Resource Development. 2013a. *Caribou Protection Plan (CPP) Submission Requirements*~~ *for* ~~*Winter 2013/14*. Industry Bulletin. October~~*Industrial Activity* ~~2013. Edmonton, AB. 2 pp.~~

~~Alberta Environment and Sustainable Resource Development. 2013b. 2010 *Reclamation Criteria for Wellsites and Associated Facilities for Forested Lands (Updated July 2013)*. Edmonton, AB. 81 pp.~~

~~Alberta Environment and Sustainable Resource Development. 2013c. *Alberta Regeneration Standards for the Mineable Oil Sands*. Government of Alberta, Department of Environment and Sustainable Resource Development. Edmonton, AB. 71 pp.~~

~~Alberta Environment and Sustainable Resource Development. 2013d. *Alberta Wildlife Animal Care Committee Class Protocol 013*. July 2013. Edmonton, AB. 3 pp.~~

~~Alberta Environment and Sustainable Resource Development. 2014. *Species Assessed by Alberta's Endangered Species Conservation Committee*. Updated July 4, 2014. Fish and Wildlife Policy Branch. Edmonton, AB. 2 pp.~~

~~Alberta Environment and Sustainable Resource Development. 2014b. *Reforestation Standard of Alberta*. Government of Alberta, Department of Environment and Sustainable Resource Development. Edmonton, AB. 264 pp.~~

~~Alberta Environment. 2001. *Reclamation Assessment Criteria for Pipelines – 2001 Draft*. Edmonton, AB. 70 pp. + Appendices.~~

~~Alberta Environment. 2008. *Guideline for Wetland Establishment on Reclaimed Oil Sands Leases, 2nd Edition*. Prepared by M.L. Harris of Lorax Environmental for the Wetlands and Aquatics Subgroup of the Reclamation Working Group of the Cumulative Environmental Management Association. Fort McMurray, AB. 103 pp. + Appendices.~~

~~Alberta Environment. 2010. *Guidelines for Reclamation to Forest Vegetation*~~ *in* ~~*the Athabasca Oil Sands Region, 2nd Edition*. Prepared by the Terrestrial Subgroup of the Reclamation Working Group of the Cumulative Environmental Management Association. Fort McMurray, AB. 332~~*Caribou Ranges in West Central Alberta*. 12 pp.

Apps, C.D., B.N. McLellan, T.A. Kinley, R. Serrouya, D.R. Seip and H.U. Wittmer. 2013. ~~Alberta Sustainable Resource Development and Alberta Conservation Association~~Spatial factors related to mortality and population decline of endangered mountain caribou. *The Journal of Wildlife Management* 77(7):1409–1419.

~~. 2010. *Status of the Woodland Caribou (*Rangifer tarandus caribou*) in Alberta: Update* 2010. Wildlife Status Report No. 30. Alberta Sustainable Resource Development. Edmonton, AB. 88 pp.~~

~~Alberta Woodland Caribou Recovery Team. 2005. *Alberta Woodland Caribou Recovery Plan 2004/05-2013/14*. Alberta Species at Risk Recovery Plan No. 4. Alberta Sustainable Resource Development, Fish and Wildlife Division. Edmonton, AB. 48 pp.~~

Athabasca Landscape Team. 2009. *Athabasca Caribou Landscape Management Options Report*. ~~75 pp. + Appendices~~Athabasca Landscape Team. May 2009. 99 pp.

AXYS Environmental Consulting Ltd. (AXYS). 1995. *A Compendium of Physical Access Control Measures for Roads and Other Rights-of-Way*. March 1995. A Component of the Access Management Initiative in Northeastern BC. 46 pp.

~~AXYS Environmental Consulting Ltd. 2003. Appendix 13D.C *Access Management Plan. Ekwan Pipeline Project Environmental Protection Plan*. Prepared for EnCana Ekwan Pipeline Inc. Calgary, AB.~~

AXYS. 2003. *Literature Review of Reclamation Techniques for Wildlife Habitats in the Boreal Forest*. Prepared for: Biodiversity and Wildlife Subgroup of the Reclamation Working Group, Cumulative Effects Management Association. Prepared by AXYS Environmental. Sidney, BC.

Backmeyer, R. J. 2000. *Seasonal Habitat Use and Movements of Woodland Caribou in the Graham River Drainage, 1988–1994*. Prince George, BC.

Bayne, E.M., H. Lankau and J. Tigner. 2011. *Ecologically-Based Criteria to Assess the Impact and Recovery of Seismic Lines: The Importance of Width, Regeneration, and Seismic Line Density*. ~~Environmental Studies Research Funds Report No. 192.~~ Edmonton, AB~~. 98 pp~~.

British Columbia Conservation Data Centre. 2015. *BC Species and Ecosystems Explorer*. *Ministry of Environment*. Website: http://a100.gov.bc.ca/pub/eswp/. Accessed: March 2015.

British Columbia Ministry of Environment (BMOE). 2010. *Caribou Distribution in British Columbia by Ecotype*. Website: http://www.env.gov.bc.ca/wld/speciesconservation/caribou_by_ecotype.html. Accessed: March 2015.

BMOE. 2013. *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (Rangifer tarandus caribou *pop. 15*) *in British Columbia*. Victoria, BC. 15 pp.

BMOE. 2014. *Science update for the South Peace Northern Caribou (*Rangifer tarandus caribou *pop. 15) in British Columbia*. Victoria, BC. 43 pp.

British Columbia Ministry of Forests. 1997. *Soil Rehabilitation Guidebook*. Forest Practices Branch, BC Ministry of Forests, Victoria, BC Forest Practices Code of British Columbia Guidebook.

British Columbia Ministry of Forests. 2000. *Establishment to Free Growing Guidebook*. Prince George Forest Region. BC Forest Practices Code of British Columbia Guidebook. Victoria, BC. 162 pp.

British Columbia Ministry of Forests, Lands and Natural Resource Operations. 2011. *Peace Region Selected Terrestrial and Aquatic Wildlife Least-Risk Windows – April, 2011*. Fort St. John, BC. 1 pp.

British Columbia Ministry of Forests, Lands and Natural Resource Operations. 2014. *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia*. Interim Guidance. 206 pp.

British Columbia Ministry of Water, Land and Air Protection. n.d. *Ecological Restoration Guidelines for British Columbia*. Victoria, BC. 80 pp.

British Columbia Oil and Gas Commission. 2013. 2013. *Environmental Protection and Management Guide: June 2013*. 96 pp.

Bergerud, A.T., ~~H.E. Butler and~~ R.D. Jakimchuk and D.R. ~~Miller~~Carruthers. 1984. ~~Antipredator tactics of calving caribou: Dispersion in mountains. *Canadian Journal of Zoology* 62: 1566–1575~~The buffalo of the north: Caribou (*Rangifer tarandus*) and human developments. *Arctic* 37(1):7–22.

Bijlsma, R., J. Bundgaard and A.C. Boerema. 2000. Does inbreeding affect the extinction risk of small populations? Predictions from Drosophila. *Journal of Evolutionary Biology* 13(3):~~-~~502–514.

~~Bradshaw, C.J.A., D.M. Hebert, A.B. Rippin and S. Boutin. 1995. Winter peatland habitat selection by woodland caribou in northeastern Alberta. *Canadian Journal of Zoology* 73: 1567–1574.~~

~~British Columbia *Ministry of Environment*. 2011. *Interim Operating Practices for Oil and Gas Ac tivities in Identified Boreal Caribou Habitat in British Columbia*. September 22, 2011.~~

~~Website:http://www.env.gov.bc.ca/wld/speciesconservation/bc/documents/Operating%20Practices.pdf. Accessed September 2012.~~

~~British Columbia Ministry of Forests. 1997. *Silviculture Prescriptions Field Methods Book*. Interim Draft. Victoria, BC. Available online at: https://www.for.gov.bc.ca/hfd/pubs/docs/sil/Sil411/Sil411.htm. Accessed: April 2015.~~

~~Brown, G.S., W.J. Rettie, R.J. Brooks and F.F. Mallory. 2007. Predicting the impacts of forest management on woodland caribou habitat suitability in black spruce boreal forest. *Forest Ecology and Management* 245: 137–147.~~

~~Brown, W.K., J. Huot, P. Lamothe, S.N. Luttich, M. Pare, G. St. Martin and J.B. Theberge. 1986. The distribution and movement patterns of four woodland caribou herds in Quebec and Labrador. *Rangifer Special Issue* 1: 43–49.~~

Camill, P. 1999. Patterns of boreal permafrost peatland vegetation across environmental gradients sensitive to climate warming. *Canadian Journal of Botany* 77:~~-~~721–~~33~~733.

Canada's Oil Sands Innovation Alliance~~.~~ (COSIA). 2012. *COSIA*. Website: http://www.cosia.ca/. Accessed: March 2015.

Canadian Standards Association. 2011. *Z662-11 Oil and Gas Pipeline Systems*. Reprinted January 2012. 555 pp.

Caribou Range Restoration Project. 2007a. *Permanent Sample Plot Manual for the Caribou Range Restoration Project in Alberta, March 23, 2007*. Draft Unpublished Document.

Caribou Range Restoration Project. 2007b. *Caribou Range Restoration Project: Guidelines for Planning and Implementation*. Unpublished document ~~created~~ for the West–Central Alberta Petroleum Producers Group, Canadian Association of Petroleum Producers and Environment Canada. September 19, 2007.

Caribou Range Restoration Project. 2007c. *Little Smoky Caribou Habitat Restoration Pilot Project Summary*. Unpublished document prepared for Suncor Energy, ConocoPhillips Canada, Canadian Forest Products and Alberta Newsprint Co.

CH2M ~~HILL~~Hill Energy Canada, Ltd. (CH2M Hill). 2014a. *(April) Supplemental Traditional Knowledge Report*~~2014.~~ ~~*Environmental and Socio-Economic Assessment*~~ *for the Proposed NOVA Gas Transmission Ltd.* ~~*Liege Lateral Loop 2 – Thornbury Section Pipeline and the Leismer East Compressor Station*~~*North Montney Project*. Prepared for NOVA Gas Transmission Ltd. ~~September 2014.~~

CH2M Hill. 2014b. *(July) Supplemental Traditional Knowledge Report for the Proposed NOVA Gas Transmission Ltd. North Montney Project*. Prepared for NOVA Gas Transmission Ltd.

CH2M Hill. 2014c. *(October) Supplemental Traditional Knowledge Report for the Proposed NOVA Gas Transmission Ltd. North Montney Project*. Prepared for NOVA Gas Transmission Ltd.

Cichowski, D. 2005. ~~Cibrowski, J.J.H., A. Grgicak-Mannion, M. Kang, R. Rooney, Z. Hongcheng, K. Kovalenko, S.E. Bayley and A.L. Foote. 2012.~~ ~~*Development of a Regional Monitoring Program to Assess the Effects of Oil Sands Development on Wetland Communities Final Report*. Submitted to the Cumulative Environmental Management Association (CEMA). CEMA Contract. 2010-0029.~~

~~Collins, W.B. and T.S. Smith. 1991. Effects of wind-hardened snow on foraging by reindeer (*Rangifer tarandus*). *Arctic* 44(3): 217–222.~~

Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia. Prepared for BC Ministry of Water, Lands and Air Protection. Smithers, BC.

Committee on the Status of Endangered Wildlife in Canada~~.~~ (COSEWIC). 2002. *COSEWIC Assessment and Update Status Report on the Woodland Caribou* Rangifer tarandus ~~*Caribou*~~caribou in Canada. Ottawa, ON. xi ~~+~~ + 98 pp.

~~Committee on the Status of Endangered Wildlife in Canada.~~COSEWIC. 2011. *Designatable Units for Caribou (*Rangifer tarandus*) in Canada*. Ottawa, ON. 88 pp.

~~Committee on the Status of Endangered Wildlife in Canada.~~COSEWIC. 2015. *Canadian Species at Risk*. Website: http://www.cosewic.gc.ca/eng/sct5/index_e.cfm. Accessed: ~~April~~ March 2015.

Courtin, P.J. and K.R. Brown. 2001. The ~~*Use*~~use of ~~*Red Alder*~~red alder to ~~*Enhance*~~enhance Sitka ~~*Spruce Growth*~~spruce growth in the Queen Charlotte Islands. *Forest Research Extension* ~~Note~~*Notes* EN~~-~~-008~~. BC Ministry of Forests, Vancouver~~:1–4.

Culling, D.E., B.A. Culling and T. Raabis. 2005. *Seasonal Habitat Use and Movements of Graham Caribou 2001 to 2003*. Canadian Forest ~~Region. Nanaimo, BC. 4~~Products Ltd. and BC Ministry of Water, Land and Air Protection. St. John, BC. 88 pp.

~~Courtois, R. and J.P. Ouellet. 2007. Modelling the impact of moose and wolf management on persistence of woodland caribou. *Alces* 43: 13–27.~~

DeCesare, N.J., M. Hebblewhite, F. Schmiegelow, D. Hervieux, G.J. McDermid, L.~~-~~ Neufeld, M. Bradley, J. Whittington, K.G. Smith, L.E~~.,~~. Morgantini, M.~~-~~ Wheatley and M. Musiani. 2012. Transcending scale dependence in identifying habitat with resource selection functions. *Ecological Applications* 22(4):~~-~~1068–1083.

DeLong, C. 2004. *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*. Land Management Handbook No. 54. BC Ministry of Forests, Resources Branch. Victoria, BC.

DeLong, C., A. Banner, W.H. MacKenzie, B.J. Rogers and B. Kaytor. 2011. *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia*. Land Management Handbook No. 65. BC Ministry of Forests and Range, Forest Science Program. Victoria, BC. 250 pp.

DeLong, C., A. MacKinnon and L. Jang. 1990. *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region*. Land Management Handbook No. 22. BC Ministry of Forests, Research Branch. Victoria, BC. 51 pp.

Demarchi, D.A. 2011. *The British Columbia Ecoregion Classification*. Third Edition March 2011. BC Ministry of Environment, Ecosystem Information Section, Victoria, BC. Website: http://www.env.gov.bc.ca/ecology/ecoregions/#top. Accessed: March 2015.

Diversified Environmental Services. 2004. *Canadian Natural Resources Ltd. Ladyfern Pipeline d~~-~~-87~~-~~-H/94-H-1, British Columbia to NE Section 20-Township 94-Range 12 W6M, Alberta: Revegetation Monitoring Report Year~~-~~ 2 (2003)*. Prepared for~~:~~ Canadian Natural Resources Ltd. 18 pp~~. + Appendices~~.

Dyer, S. J. 1999. *Movement and Distribution of Woodland Caribou (*Rangifer tarandus caribou*) in Response to Industrial Development in Northeastern Alberta*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

Dyer, S. J., J. P. O'Neill, S. M. Wasel and S. Boutin. 2001. Avoidance of industrial development by woodland caribou. *Journal of Wildlife Management* 65(3): 531–542.

Dyer, S.J., J.P. O'Neill, S.M. Wasel and S. Boutin. 2002. Quantifying barrier effects of roads and seismic lines on movements of female woodland caribou in northeastern Alberta. *Canadian Journal of Zoology* 80(5): 839–845.

Edmonds, E.J and M. Bloomfield. 1984. *A Study of Woodland Caribou (*Rangifer tarandus caribou*) in West–Central Alberta, 1979 to 1983*. Alberta Energy and Natural Resources, Fish and Wildlife Division. Edmonton, AB.

Ehlers, L.P.W., C.J. Johnson and D.R. Seip. 2014. Movement ecology of wolves across an industrial landscape supporting threatened populations of woodland caribou. *Landscape Ecology* 29(3): 451–465.

Enbridge Pipelines (Athabasca) Inc. 2010. *Waupisoo Pipeline Project: 2010 Green Area Post-Construction Reclamation Assessment*. Submitted to Alberta Sustainable Resource Development.

Environment Canada. 2011. *Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada: 2011 Update*. Ottawa, ON. 103 pp.

Environment Canada. 2012a. *Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada. Species at Risk Act* Management Plan Series. Ottawa, ON. ~~2012.~~ vii + 79 pp.

Environment Canada. 2012b. *Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. Species at Risk Act* Recovery Strategy Series. Ottawa, ON. xi + 138 pp.

Environment Canada. 2014. *Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. viii + 103 pp.

Environment Canada. 2015. *Species at Risk Public Registry*. Website: http://www.sararegistry.gc.ca/~~species/~~default~~_e.cfm.~~.asp?lang=En&n=24F7211B-1. Accessed: ~~April~~March 2015.

Esri User Conference. 1996. *1996 User Conference Proceedings*~~.~~: *Esri User Conference*. Website: http://proceedings.esri.com/library/userconf/proc96/WELCOME.HTM. Accessed: ~~April~~March 2015.

Frankham, R. 2005. Genetics and extinction. *Biological Conservation* 126(2):~~-~~131–140.

Girard, M., C. Lavoie and M. Thériault. 2002. The regeneration of a highly disturbed ecosystem: A mined peatland in southern Québec. *Ecosystems* 5~~: ~~(3):274–288.

Golder Associates Ltd. (Golder). 2005. *Firebag Project 2004 Seismic Line Reclamation Study Annual Report*. Submitted to: Suncor Firebag Inc.

Golder ~~Associates Ltd~~. 2007. *Audit of Operating Practices and Mitigation Measures Employed Within Woodland Caribou Ranges*. Submitted to Caribou Landscape Management Association. Peace River, AB.

Golder ~~Associates Ltd~~. 2009. *Caribou Habitat Restoration Pilot Study*. Prepared for Conoco Phillips Canada, Suncor Energy and Canadian Association of Petroleum Producers. Edmonton, AB. ~~41~~ 61 pp.

Golder ~~Associates Ltd~~. 2010. *Canadian Natural Resources Limited: Primrose and Wolf Lake: Wildlife Habitat Enhancement Program Development and Implementation*. Submitted to: Canadian Natural Resources Ltd~~.~~, Calgary, AB.

Golder ~~Associates Ltd~~. 2011. *Waupisoo Pipeline 2011 Seedling Monitoring Plot Summary*. Submitted to Enbridge Pipelines (Athabasca) Inc.

Golder ~~Associates Ltd~~. 2012a. *Boreal Caribou Habitat Restoration*. Prepared for: Ministry of Forests, Lands and Natural Resource Operations. Fish Wildlife and Habitat Management Branch, Government of British Columbia. Prince George, BC. 24 pp.

Golder ~~Associates Ltd.~~. 2012b. *Interconnect Pipeline 2011 Seedling Monitoring Plot Summary*. Memo submitted to CNRL February 23, 2012.

Golder ~~Associates Ltd.~~. 2014. *Final Caribou Habitat Restoration Plan for the NOVA Gas Transmission Ltd. Leismer to Kettle River Crossover Project*. Prepared for NOVA Gas Transmission Ltd.

Golder ~~Associates Ltd.~~. 2015. *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia*. Prepared for BC Science and Community

Environmental Knowledge (SCEK) ~~Fund's~~Fund's Research and Effectiveness Monitoring Board (REMB). Calgary, AB.

Gough, A. 2010. *Effects of Historical Timber Harvesting Practices on Caribou Forage Lichen Abundance near Marsh Lake, Yukon: Phase 1 Final Report*. Department of Energy, Mines and Resources, Government of Yukon. 55 pp.

Government of British Columbia. 2011. *Interim Operating Practices for Oil and Gas Activities in Identified Boreal Caribou Habitat in British Columbia*.

Hatler, D.F. 1986. ~~Government of Alberta~~*Studies of Radio-Collared Caribou in the Spatsizi Wilderness Park Area, British Columbia*. Spatsizi Association for Biological Research. Smithers, BC. 102~~. 2011. *A Woodland Caribou Policy for Alberta*. 2~~ pp.

Hawkes, V.C. 2011. *Early Successional Wildlife Monitoring On Reclamation Plots in the Athabasca Oil~~-~~ Sands Region*. British Columbia Mine Reclamation Symposium. ~~British Columbia Technical and Research Committee on Reclamation, Vancouver, BC.~~

Heard, D.C., and K.L. Vagt. 1998. Caribou in British Columbia: A 1996 status report. *Rangifer Special Issue* 10:117–123.

Hedrick, P.W. and S.T. Kalinowski. 2000. Inbreeding depression in conservation biology. *Annual~~-~~ Review of Ecology and Systematics* 31:~~-~~139–162.

Hervieux, D., M. Hebblewhite, N.J. DeCesare, M. Russell, K. Smith, S. Robertson and S. Boutin. 2013. Widespread declines in woodland caribou (*Rangifer~~-~~ tarandus caribou*) continue in Alberta. *Canadian Journal of Zoology* 91(12):~~-~~872–882.

Hunt, L.M. and M. Hupf. 2014. The effectiveness of road closures and deactivations at reducing traffic: A case of resource roads used for recreational activities in Ontario, Canada. *The Forestry Chronicle* 90(5):~~-~~670–677.

James, A.R.C. 1999. *Effects of Industrial Development On the Predator–Prey Relationship Between Wolves and Caribou in Northeastern Alberta*. Ph.D.~~-~~ Dissertation, University of Alberta. Edmonton, AB.

James, A.R.C. and A.K. Stuart-Smith. 2000. Distribution of caribou and wolves in relation to linear corridors. *The Journal of Wildlife Management* 64~~:~~(1):154~~–~~-159.

James, A.R.C., S. Boutin, D.M. Hebert and A.B. Rippin. 2004. Spatial separation of caribou from moose and its relation to predation by wolves. *The Journal of Wildlife Management* 68~~:~~(4):799–809.

Joint Pipeline Office. 1999. *Evaluation of the Alaska Pipeline Service Company's Operation of the Trans-Alaska Pipeline System*. Comprehensive Monitoring Program Report February 1999. 41 pp.

Keller, L.F. and D.M. Waller. 2002. Inbreeding effects in wild populations. *Trends in Ecology and Evolution* 17(5):230–241.

Khasa, P.D., L. Sigler, P. Chakravarty, B.P. Dancik, L. Erikson and D. ~~Mc Curdy~~McCurdy. 2001. Effect of fertilization on growth and ectomycorrhizal development of container-grown and bare-root nursery conifer seedlings. *New ~~Forestry~~Forests* 22~~:~~(3):179–197.

~~LaPerriere, A.J. and P.C. Lent. 1977. Caribou feeding sites in relation to snow characteristics in northeastern Alaska. *Arctic* 30: 101–108.~~

Latham, A.D.M. 2009. *Wolf Ecology and Caribou–Primary Prey–Wolf Spatial Relationships in Low-Productivity Peatland Complexes in Northeastern Alberta*. Ph.D. Dissertation, University of Alberta. Edmonton, AB.

Latham, A.D.M., M.C. Latham, N.A. McCutchen and S. Boutin. 2011. Invading white-tailed deer change wolf-caribou dynamics in northeastern Alberta. ~~*The*~~ *Journal of Wildlife Management* 75(1):204–212.

Lee, P. and S. Boutin. 2006. Persistence and developmental transition of wide seismic lines in the western Boreal Plains of Canada. *Journal of Environmental Management*~~.~~ 78:240–250.

Macadam, A. and L. Bedford. 1998. Mounding in the Sub-Boreal Spruce Zone of west-central British Columbia: 8-year results. *The Forestry Chronicle* 74(3): 421–427.

MacDonald, E., S. Quideau and S. Landhäusser. 2012. Rebuilding boreal forest ecosystems after industrial disturbance. ~~Pp~~ 123–159 in *Restoration and Reclamation of Boreal Ecosystems*. D.H. Vitt and J.S. Bhatti, (~~Eds~~eds.). Cambridge University Press, Cambridge, UK.

MacFarlane, A.~~K.~~ 1999. *Revegetation of Wellsites and Seismic Lines in the Boreal Forest*. B.Sc. Honour's Thesis, University of Alberta. Edmonton, AB.

MacFarlane, A.K. 2003. *Vegetation Response to Seismic Lines: Edge Effects and Online Succession*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

MacIsaac, D.A., G.R. Hillman and P.A. Hurdle. 2004. *Alternative Silvicultural Systems for Harvesting and Regenerating Spruce-Dominated Boreal Mineral Wetlands*. Information Report Nor-X-399. Canadian Forest Service, Northern Forestry Centre. Edmonton, AB. ~~Information Report Nor-X-399~~60 pp.

McCutchen, N. A. 2007. *Factors Affecting Caribou Survival in Northern Alberta: The ~~Role~~role of Wolves, Moose and Linear Features*. Ph.D. Dissertation, University of Alberta. Edmonton, AB.

McKay, T., K. Graham and G. Stenhouse. 2014. *Grizzly Bears and Pipelines: Response to Unique Linear Features*. Year 2 (2013) Final Report. Alberta Upstream Petroleum Research Fund (13-AU-ERPC-03). Foothills Research Institute Grizzly Bear Program. Hinton, AB.

McKenzie, H.W., E.H. Merrill, R.J. Spiteri and M.A. Lewis. 2012. How linear features alter predator movement and the functional response. *Interface Focus* 2(2):~~-~~205–216.

McLoughlin, P.D., E. Dzus, B. Wynes and S. Boutin. 2003. Declines in populations of woodland caribou. *The Journal of Wildlife Management* 67(4):~~-~~755–761.

McNay, R.S., D. Cichowski, and B.R. Muir. 2013. *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]. Species at Risk Act* Action Plan Series, West Moberly First Nation. Moberly Lake, BC. 28 pp.

McNay, R.S., G. Sutherland, L. Giguere, J. Gollner, K. Sittler, F. MacDonald and V.~~-~~ Brumovsky. 2014. *Multi-Scale Responses by Predators and Prey to Deactivation/Restoration of Disturbance Features – Individual and Population Components*. Interim Report 2013-2014. Wildlife~~-~~ Infometrics Report 470~~,~~. Wildlife Infometrics Inc. Mackenzie, BC.

Miège, D.J., H.M. Armleder, M.J. Waterhouse and T. Goward. 2001. *A Pilot Study of Silvicultural Systems for Northern Caribou Winter Range: Lichen Response*. Working Paper 56/2001. BC Ministry of Forests, Research Branch. Victoria, BC. 22 pp.

Naeth, M.A., D.J. White, D.S. Chanasyk, T.M. Macyk, C.B. Powter and D.J. Thacker. 1991. *Soil Physical Properties in Reclamation*. Alberta Land Conservation and Reclamation Council Report No. RRTAC 91-4. Edmonton, AB.

Neufeld, L.M. 2006. *Spatial Dynamics of Wolves and Woodland Caribou in an Industrial Forest Landscape in West–Central Alberta*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

North American Caribou Workshop. 2014. *Caribou Conservation and Management: What's Working?* Website: http://www.2014nacw.ca/Portals/10/NACWprogramfinal_web.pdf. Accessed: ~~April~~March 2015.

~~NOVA~~Nova Gas Transmission Ltd. 2014a. *Additional Written Evidence for the North Montney Project*. Prepared for the National Energy Board. Calgary, AB.

Nova Gas Transmission Ltd. 2014b. ~~*Liege Lateral Loop 2 (Thornbury Section) and Leismer East Compressor Station*~~*North Montney Project Response to Information Request No.* ~~*1*~~*2*. Hearing~~-~~ Order~~-N081-~~ GH-001-2014. ~~November 14~~March 25, 2014.

~~NOVA Gas Transmission Ltd. 2014b. *Liege Lateral Loop 2 (Thornbury Section) and Leismer East Compressor Station Project Response to Information Request No. 2*. Hearing Order N081-2014. December 19, 2014.~~

~~NOVA Gas Transmission Ltd. 2015. *Liege Lateral Loop 2 (Thornbury Section) and Leismer East Compressor Station Project Response to Information Request No. 3*. Hearing Order N081-2014. January 7, 2015.~~

~~O'Brien, D., M. Manseau and A. Fall. 2006. Testing the importance of spatial configuration of winter habitat for woodland caribou: An application of graph theory. *Biological Conservation* 130: 70–83.~~

Oberg, P.R. 2001. *Responses of Mountain Caribou to Linear Features in a West–Central Alberta Landscape*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

Osko, T.J. and A.K. MacFarlane. ~~Ohlson, D. 2014. *SM 800 – Linear Footprint and Access Management*. CEMA Linear Footprint Task Group Stony Mountain 800 Multi-Stakeholder Planning Pilot. Cumulative Environmental Management Association. Fort McMurray, AB. 209 pp.~~

2000. *Natural Reforestation Rates on Seismic Lines and Wellsites in Comparison to Natural Burns or Logged Sites*. Alberta–Pacific Forest Industries. Boyle, Alberta.

Osko, T. and M. Glasgow. 2010. *Removing the* ~~*Wellsite*~~*Well Site Footprint: Recommended Practices for Construction and Reclamation of* ~~*Wellsites*~~*Well Sites on Upland Forests in Boreal Alberta*. ~~University of Alberta,~~ Department of Biological Sciences~~.~~, University of Alberta. Edmonton, AB. 61 pp.

~~Osko, T. J. and A. K. MacFarlane. 2000. *Natural Reforestation Rates on Seismic Lines and Wellsites in Comparison to Natural Burns Or Logged Sites.* Alberta-Pacific Forest Industries. Boyle, AB.~~

Peters, W., M. Hebblewhite, N. DeCesare, F. Cagnacci and M. Musiani. 2013. Resource separation analysis with moose indicates threats to caribou in human altered landscapes. *Ecography* 34(4):487–498.

Polfus, J.L., M. Hebblewhite and K. Heinemeyer. 2011. Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain woodland caribou. *Biological Conservation* 144(11):2637–2646.

Polster, D.F. n.d. *Natural Processes: Restoration of Drastically Disturbed Sites.* 123 pp.

Polster, D.F. 2002. Soil bioengineering techniques for riparian restoration. ~~In~~230-239 in *Proceedings of the 26th Annual British Columbia Mine Reclamation Symposium*. Dawson Creek, BC. ~~230–239.~~

Pyper, M. and T. Vinge, 2012. *A Visual Guide to Handling Woody Materials for Forested Land Reclamation*. Report No. TR-31. University of Alberta, School of Energy and the Environment, Oil Sands Research and Information Network. Edmonton, AB. 10 pp.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. *Canadian Journal of Zoology* 76:251–259.

Rettie, W.J. and F. Messier. 2000. Hierarchical habitat selection by woodland caribou: its relationship to limiting factors. *Ecography* 23:466–478.

Revel, R.D., T.D. Dougherty and D.J. Downing. 1984. *Forest Growth and Revegetation Along Seismic Lines*. University of Calgary Press., Calgary, AB. 228 pp.

Ripple, W.J. and R.L. Beschta. 2004. Wolves and the ecology of fear: Can predation risk structure ecosystems? *BioScience* 54(8):755–766.

Ripple, W.J., J.A. Estes, R.L. Beschta, C.C. Wilmers, E.G. Ritchie, M. Hebblewhite, J. Berger, B. Elmhagen, M. Letnic, M.P. Nelson, O.J. Schmitz, D.W. Smith, A.D. Wallach and A.J. Wirsing. 2014. Status and ecological effects of the world's largest carnivores. *Science* 343(6167): 1241484.

Robinson, S.D. and T.R. Moore~~, T.R~~. 2000. The influence of permafrost and fire upon carbon accumulation in high boreal peatlands, Northwest Territories, Canada. *Arctic, Antarctic and Alpine Research* 32:155–166.

Rohner, C. and G. Kuzyk. 2000. *Wolves and Caribou in West–Central Alberta: Predator Responses to Industrial Resource Development*. Research News 3, University of Alberta and West–Central Caribou Standing Committee. Edmonton, AB. 4 pp.

Roturier, S., S. Backlund, M. Sunden and U. Bersten. 2007. Influence of ground substrate on establishment of reindeer lichen after artificial dispersal. *Silva Fennica* 41(2):269–280.

Roy, V., P.-Y. Bernier, A.P. Plamondon and J.-C. Ruel. 1999. Effect of drainage and microtopography in forested wetlands on the microenvironment and growth of planted black spruce seedlings. *Canadian Journal of Forest Research* 29: 563~~–~~-574.

Sanborn, P., R. Brockley and C. Preston. 2001. *Effects of Sitka Alder Retention and Removal on the Growth of Young Lodgepole Pine in the Central Interior of British Columbia (EP 1185): Establishment Report*. Working Paper 60/2001. BC Ministry of Forests, Research Branch. Victoria, BC. 44 pp.

Schaefer, J.A. and W.O. Pruitt, Jr. 1991. Fire and woodland caribou in southeastern Manitoba. *Wildlife Monographs* 116:~~1~~3–39.

Seip, D.R. and D.B. Cichowski. 1996. Population ecology of caribou in British Columbia. *Rangifer* 9:73-80.

Seip, D.R., C.J. Johnson and G.S. Watts. 2007. Displacement of mountain caribou from winter habitat by snowmobiles. *The Journal of Wildlife Management* 71(5):1539–1544.

Serrouya, R., D. Paetkau, B.N. McLellan, S. Boutin, M. Campbell and D.A. Jenkins. 2012. Population size and major valleys explain microsatellite variation better than taxonomic units for caribou in western Canada. *Molecular Ecology* 21(11):2588–2601.

Sherrington, P.M. 2003. *Measuring Boreal Forest Fragmentation Change in Response to Seismic Line, Wellsite and Road Revegetation With Scanned False-Colour Infrared Aerial Photography*. ~~MGIS~~M.Sc. Thesis, University of Calgary. Calgary, AB.

Simard, S. and J. Heineman. 1996. *Nine-Year Response of Lodgepole Pine and the Dry Alder Complex to Chemical and Manual Release Treatments on an ICHmk1 Site Near Kelowna*. ~~FRDA~~ Forest Resource Development Agreement Report- 259. Canadian Forest Service and BC Ministry of Forests. ~~Kamloops~~Victoria, BC. 19 pp.

Smith, S. and I. Marshall. 1995. *The Ecoregions of Canada*. Website: http://ecozones.ca/english/. Accessed: March 2015.

Spalding, D.J. 2000. *The Early History of Woodland Caribou (*Rangifer tarandus caribou*) in British Columbia*. Wildlife Bulletin No. B-100. BC Ministry of Environment, Lands and Parks. Victoria, BC. 61 pp.

Stantec Consulting Limited. 2013. *North Montney Project Environmental and Socio-Economic Assessment*. Prepared for Nova Gas Transmission Ltd., in association with TERA Environmental Consultants. Calgary, AB.

Stantec Consulting Limited. 2014. *Final Caribou Habitat Restoration Plan for the Chinchaga Lateral Loop No. 3 (Chinchaga Section)*. Prepared for NOVA- Gas- Transmission Ltd. Calgary,- AB.

~~Stokes, D., S. Duncan and J.R. Turner. 2009. *An Adaptive Approach to Reclaiming the First Coal Corporation Central South Property*. British Columbia Mine Reclamation Symposium 2009.~~

~~Straker, J. and G. Donald. 2011. *Assessing Re-Establishment of Functional Forest Ecosystems on Reclaimed Oil Sands Mine Lands*. British Columbia Mine Reclamation Symposium. British Columbia Technical and Research Committee on Reclamation, Vancouver, BC.~~

Stuart-Smith, A.K., C.J.A. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. ~~*The*~~ *Journal of Wildlife Management* 61:-622–-633.

Sweeney, S. 2005. ~~Alder: The nitrogen fix:~~ *Ontario* ~~trees~~*Trees and* ~~shrubs. *The Monday Garden* 151. February 13, 2005~~*Shrubs*. Website: http://www.ontariotrees.com/mondaygarden/index.php. Accessed: March 2015.

Switalski, T.A. and C.R. Nelson. 2011. Efficacy of road removal for restoring wildlife habitat: Black bear in the ~~northern~~Northern Rocky Mountains, USA. *Biological Conservation* 144(~~2011):~~ 11):2666–2673.

Tedder, W.S. and L.W. Turchenek. 1996. Natural revegetation of an Alberta- peatland after horticultural peat extraction. ~~In~~51–113 in *4th Annual Canadian Peatland*

Restoration Workshop, 13~~–~~–14 July, Quebec~~-~~ City, Canada. Universite Laval, Faculte des Sciences de Sciences de L'agriculture et de ~~.~~l'alimentation. Quebec City, QC.

TERA Environmental Consultants~~.~~ (TERA). 2011a. *Caribou Habitat Restoration Plan for the Proposed ~~NOVA~~Nova Gas Transmission Ltd. Horn River Mainline Project, Part II*. ~~Updated September 2011.~~ Prepared for ~~NOVA~~Nova Gas Transmission Ltd. Calgary, AB.

TERA ~~Environmental Consultants~~. 2011b. 2011 *Post-Construction Monitoring Report for the Trans Mountain Pipeline L.P. TMX – Anchor Loop Project*. Prepared for Trans Mountain Pipeline L.P. ~~December~~ Calgary, AB~~2011. 78 pp. + Appendices~~.

TERA ~~Environmental Consultants.~~. 2012. *Supplemental Update for the Caribou~~-~~ Habitat Restoration Plan for the ~~NOVA~~Nova Gas Transmission Ltd. Horn~~-~~ River Mainline Project, Part II*. Calgary, AB.

~~TERA Environmental Consultants. 2014a.~~TERA. 2013. *Traditional Knowledge Summary Report for the Proposed NOVA Gas Transmission Ltd. North Montney Mainline (Aitken Creek Section) Project*. Prepared for NOVA Gas Transmission Ltd.

TERA. 2014. *Final Caribou Habitat Restoration Plan for the NOVA Gas Transmission Ltd. Northwest Mainline Expansion*. Prepared for NOVA Gas Transmission Ltd.

~~TERA Environmental Consultants. 2014b. *Traditional Knowledge Report (NEB Filing ID A4C2V4) for the Proposed NOVA Gas Transmission Ltd. Liege Lateral Loop 2 (Thornbury Section) Project* Prepared for NOVA Gas Transmission Ltd.~~

~~Thomas, D.C. and D.R. Gray. 2002. Update COSEWIC status report on the woodland caribou *Rangifer tarandus caribou* in Canada. In *COSEWIC Assessment and Update Status Report on the Woodland Caribou* Rangifer tarandus caribou *in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. 98 pp.~~

Thurber, J.M., R.O. Peterson, T.D. Drummer and S.A. Thomasma. 1994. Gray wolf response to refuge boundaries and roads in Alaska. *Wildlife Society Bulletin* 22:~~-~~61–68.

Turetsky, M.R., R.K. Wieder, C.J. Williams and D.H. Vitt. 2000. Organic matter accumulation, peat chemistry, and permafrost melting in peatlands ~~of~~in boreal Alberta. ~~*Écoscience*~~*Ecoscience* 7~~:~~(3):379–392.

~~Vinge, T. (unpublished). *Treatment Matrix for Linear Restoration*. 2014.~~

Turner, J., D. Stokes and S. Duncan. 2009. *An Adaptive Approach to Reclaiming the First Coal Corporation Central South Property*. British Columbia Mine Reclamation Symposium 2009.

Vinge, T. and M. Pyper. 2012. *Managing Woody Materials on Industrial Sites: Meeting Economic, Ecological and Forest Health Goals ~~Through~~through a Collaborative Approach*. University of Alberta, Department of Renewable Resources. Edmonton, AB. 32 pp.

~~Vistnes, I. and C. Nellemann. 2001. Avoidance of cabins, roads and power lines by reindeer during calving. *Journal of Wildlife Management* 65: 915–925.~~

Westland Resource Group. 2011. TMX Anchor Loop Project: Wildlife and Wildlife Habitat Post Construction Monitoring Year 2 Report. Prepared for Kinder~~-~~ Morgan Canada~~ c/o TERA Environmental Consultants~~. Calgary, AB.

West Moberly First Nations. 2014. Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia. Moberly Lake, BC. 23 pp.

Wetland Stewardship Partnership. 2010. *A Wetland Action Plan for British Columbia*. 62 pp.

Whittington, J., M. Hebblewhite, N.J. DeCesare, L. Neufeld, M. Bradley, J. Wilmshurst and M. Musiani. 2011. Caribou encounters with wolves increase near roads and trails: ~~A~~ a time-~~-~~to-~~-~~event approach. *Journal of Applied Ecology* 48:~~ ~~1535–1542.

Wittmer, H.U., A.R.E. Sinclair and B.N. McLellan. 2005. The role of predation in the decline and extirpation of woodland caribou. *Oecologia* 144:~~ ~~257–267.

Zager, P. and J. Beecham. 2006. The role of American black bears and brown bears as predators on ungulates in North America. *Ursus* 17(2):~~ ~~95–108.

9.2 GIS DATA AND MAPPING REFERENCES

This subsection includes references cited in the figures accompanying this report.

~~AESRD. 2014. *Alberta Wildfire Perimeters: 1931 to 2013(digital file)*. Edmonton, AB. Available: http://esrd.alberta.ca/wildfire/wildfire-maps/historical-wildfire-information/spatial-wildfire-data.aspx. Acquired: April 30,~~ BC Hydro. 2011. *Transmission Circuit* (digital file). Previously available:

http://transmission.bchydro.com/transmission_system/maps/, no longer on website. Acquired: September 2011. Last Update Check: May 23, 2013.

BC Ministry of ~~2014. Update Interval: Annually.~~

~~Alberta~~ Environment. 2008. ~~and Sustainable Resource Development. 2013.~~ *Caribou ~~Range~~ Herd Locations for BC* (digital file). ~~Edmonton, AB~~Victoria, BC. Available: ~~http://esrd.alberta~~https://apps.gov.bc.ca/~~forms-maps-services/maps/wildlife-sensitivity-maps/default.aspx~~pub/dwds/home.so. Acquired: ~~April 2013~~July 2011. Last Update Check: ~~February 20, 2015~~November 7, 2014.

~~Alberta~~BC Ministry of Environment. 2010. ~~and Sustainable Resource Development. 2014.~~ *~~Key Wildlife and Biodiversity Zone~~BC Ungulate Winter Range – Proposed – Peace Region* (digital file). ~~Edmonton, AB.~~Fort St. John, BC. Available: ~~http://esrd.alberta.ca/forms-maps-services/maps/wildlife-sensitivity-maps/default.aspx.~~https://apps.gov.bc.ca/pub/dwds/home.so. Acquired: ~~March 2014.~~November 2013. Last Update Check: ~~February 20, 2015~~November 7, 2014.

~~Alberta Tourism, Parks and Recreation. 2012.~~ BC Ministry of Forests, Lands and Natural Resource Operations. 2008. *Tantalis Parks, Ecological Reserves and Protected Areas* (~~pashape_ocsites_10tm) (~~digital file). ~~Edmonton, AB~~Victoria, BC. Available: ~~http://albertaparks.ca/albertaparksca/library/downloadable-data-sets.aspx.~~https://apps.gov.bc.ca/pub/dwds/home.so. Acquired: ~~February 2013~~May 2014. Last Update Check: November ~~7~~ 20, 2014.

~~AltaLIS. 2009. *Alberta Township System Version 4.1* (digital file). Calgary, AB. Available: http://www.altalis.com. Acquired: October 2009. Last Update Check: June 5, 2014.~~

~~BlackBridge Geomatics. 2015. *SPOT6 1.5 m Colour Satellite Imagery* (digital file). Lethbridge, AB. Available: www.blackbridge.com. Acquired: December, 2014.~~

Government of Canada. 2014. *Aboriginal Lands, Canada* (digital file). Edmonton, AB. Available: http://www.geobase.ca. Acquired: January 2015. Last Update Check: January 15, 2015.

IHS Inc. 2004. *IHS Hydro Line Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: June 2011. Last Update Check: April 21, 2014.

IHS Inc. 2004. *IHS Hydro Region Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: June 2011. Last Update Check: April 21, 2014.

IHS Inc. 2014. *IHS Enhanced Pipeline Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

IHS Inc. 2014. *IHS Facility Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.~~com for~~comfor more info. Acquired: ~~February 17, 2015.~~December 16, 2014. Update Interval: Monthly.

IHS Inc. ~~2015. *IHS*~~ 2014.~~*Enhanced Pipeline Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.com for more info. Acquired: February 17, 2015. Update Interval: Monthly.~~

~~IHS Inc. 2015.~~ *IHS Road Segments* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.~~com for~~comfor more info. Acquired: ~~February 17, 2015.~~December 16, 2014. Update Interval: Monthly.

IHS Inc. ~~2015~~2014. *IHS Wells ~~—~~ Surface Hole* (digital file). Calgary, AB. Received: via DVD, visit ~~http://www.ihs.com for~~http://www.ihs.comfor more info. Acquired: ~~February 17, 2015.~~December 16, 2014. Update Interval: Monthly.

Natural Resources Canada (NRCan). 2014. *National Road Network – British Columbia* (digital file). Sherbrooke, QC. Available: http://www.geobase.ca/geobase/en/data/nrn/index.html. Acquired: September 2014. Last Update Check: January 2, 2015.

NRCan. 2003. *Canadian Geographical Names* (digital file). Ottawa, ON. Available: http://geobase.ca/geobase/en/data/cgn/index.html. Acquired: June 2014. Last Update Check: January 6, 2015.

~~Natural Resources Canada.~~NRCan. 2007-2011. *National Hydro Network* (digital files). Sherbrooke, QC. ~~Available: http://www.geobase.ca/geobase/en/data/nhn/index.html.~~Available: http://www.geobase.ca/geobase/en/data/nhn/index.html. Acquired: April 2012. Last Update Check: May 2012.

NRCan. 2012. ~~Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. 2009. *Land Cover, Circa 2000 – Vector* (digital files).~~ *CanVec – Transportation – 1020009 Railway* (digital file). Sherbrooke, QC. Available: http://~~www.geobase~~geogratis.cgdi.gc.ca/~~geobase~~geogratis/en/~~data/landcover/index~~download/topographic.html. Acquired: ~~September 2009.~~June 2012. Last Update Check: November ~~2011~~2012.

~~Natural Resources Canada. 2014. *National Road Network – Alberta* (digital file). Sherbrooke, QC. Available:~~

~~http://www.geobase.ca/geobase/en/data/nrn/index.html. Acquired: September 2014. Last Update Check: January 2, 2015.~~

~~TERA, a CH2M HILL Company.~~TERA Environmental Consultants (TERA). 2008. *Hillshade*. Derived from Natural Resources Canada, Earth- Sciences Sector, Centre for Topographic Information. 2000–-2008. Canadian Digital Elevation Data 250k (digital files). Sherbrooke, ~~QC. Available: http://www.geobase.ca/geobase/en/data/cded/index.html.~~ QC. Available: http://www.geobase.ca/geobase/en/data/cded/index.html. Acquired: 2008. Last- Update- Check: December 2010.

~~TransCanada~~TERA. 2010. Derived from BC Land Title Survey Authority 2003. *Petroleum and Natural Gas Grids* (Theme) (digital file). Victoria, BC. Available: https://apps.gov.bc.ca/pub/geometadata/home.do. Acquired: November 2010. Last Update Check: August 2012.

~~2014. *Leismer East Compressor Station* (digital files). Calgary, AB. Acquired: June 2014. Last Update Check: June 2, 2014.~~

~~TransCanada 2014. *Liege Lateral Loop 2 – Thornbury Section Pipeline, KPs* (digital files). Calgary, AB. Acquired: November 2014. Last Update Check: November 18, 2014.~~

~~TransCanada. 2014. *Access Road, Government Road Allowance* (digital files). Calgary, AB. Received: October 31, 2014.~~

~~TransCanada. 2014. *Contingency Crossing Location* (digital file). Calgary, AB. Received May 9, 2014.~~

~~TransCanada. 2014. *Existing Compressor Station* (digital files). Calgary, AB. Received: June 23, 2014.~~

Appendix G

Blackline of July 13, 2015 North Montney Preliminary CHRP

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION AND ORGANIZATION

This section provides an introduction to the preliminary Caribou Habitat Restoration Plan (Preliminary CHRP) for the North Montney Mainline (Project) and outlines how this document is organized.

1.1 INTRODUCTION

NOVA Gas Transmission Ltd. (NGTL), a wholly owned subsidiary of TransCanada PipeLines Limited (TransCanada), filed an application with the National Energy Board (NEB or Board) on November 8, 2013 for a Certificate of Public Convenience and Necessity pursuant to section 52 of the *National Energy Board Act* (NEB Act) to construct and operate the Project and other approvals pursuant to section 58 and Part IV of the Act. For the Project regional location, see Figure 1-1. On June 11, 2015, the Governor in Council directed the Board to issue Certificate of Public Convenience and Necessity GC-125 to NGTL for the Project, subject to the terms and conditions in the GH-001-2014 Report (NEB Report) issued by the Board on April 15, 2015.

The Project is split into two sections: Aitken Creek Section and Kahta Section. The Aitken Creek Section is approximately 182 km, of which 8.1 km occurs in the Graham caribou range (see Figure 1-2), while the Kahta Section is approximately 119 km, of which 19 km occurs in the Pink Mountain caribou range (see Figure 1-3). No compressor or meter stations are proposed in the Graham caribou range and there are two proposed meter station sites in the Pink Mountain caribou range. Project scheduling was designed to avoid the critical timing period for caribou from January 15 to July 15.

This Preliminary ~~Caribou Habitat Restoration Plan (~~CHRP~~)~~ was prepared for the Project pursuant to Certificate Condition 15 and outlines NGTL's plan to ~~avoid impacts for each of the Aitken Creek and Kahta Sections,~~ minimize Project effects on caribou and restore affected caribou habitat~~.~~ of the Aitken Creek and Kahta Sections,. This document also incorporates:

- feedback from applicable regulators, technical experts and Aboriginal communities
- lessons learned from field experience
- industry experience
- updated results from ongoing literature review

The goal of both the Preliminary and Final CHRP will be to minimize residual effects of the Project on caribou habitat. Residual effects are environmental effects predicted to remain after mitigation is applied.

Tailored to site-specific conditions, restoration measures related to the disturbance of caribou habitat will be implemented in the Project footprint throughout the pre-construction, construction and post-construction phases of the Project.

The Final CHRP will detail the location and type of restoration that will be implemented along the Project right-of-way (ROW). The residual effects requiring caribou habitat offsetting measures presented in the Final CHRP will consider the length of time required for restoration measures to reach maturity (lag time) and factor in uncertainty associated with offsets, and will be further detailed in the Offset Measures Plan for Residual Impacts on Caribou Habitat (OMP~~).~~) that will be prepared pursuant to Condition 36. The Final CHRP will be filed on or before November 1 after the first complete growing season following the Project being placed into service.

The approach to validate residual effects predictions (direct and indirect) and restoration success is described in this Preliminary CHRP, and the detailed adaptive management plan will be described in the Caribou Habitat Restoration and Offset Measures Monitoring Program (CHROMMP) for the Project. Pursuant to Condition 37, NGTL will file the CHROMMP with the Board on or before February~~-~~ 1 after the first complete growing season following the Project being placed into service. The CHROMMP will explain the Program for monitoring and verifying the effectiveness of the caribou habitat restoration and offset measures implemented as part of the CHRP and OMP. The monitoring period for the CHROMMP will be a minimum of 10 years.

NGTL will also develop an OMP to address Project residual effects on critical caribou habitat for the Aitken Creek Section pursuant to Condition 36. The Preliminary OMP will detail a plan to offset all residual effects of the Aitken Creek Section (the only section that includes critical caribou habitat) resulting from directly and indirectly disturbed critical habitat for caribou, after taking into account implementation of the Environmental Protection Plan (EPP) and CHRP measures, and will further detail the method used to quantify the offsets. The Preliminary OMP will be filed with the Board at least 90 days before requesting Leave to Open the Aitken Creek Section of the Project.

NGTL filed the Access Management Plan (AMP) pursuant to Condition 16 on June 3, 2015 (NEB Filing ID: A70510). The AMP detailed a plan for managing access along the ROW for non-parallel disturbances for each of the Aitken Creek and Kahta Sections.

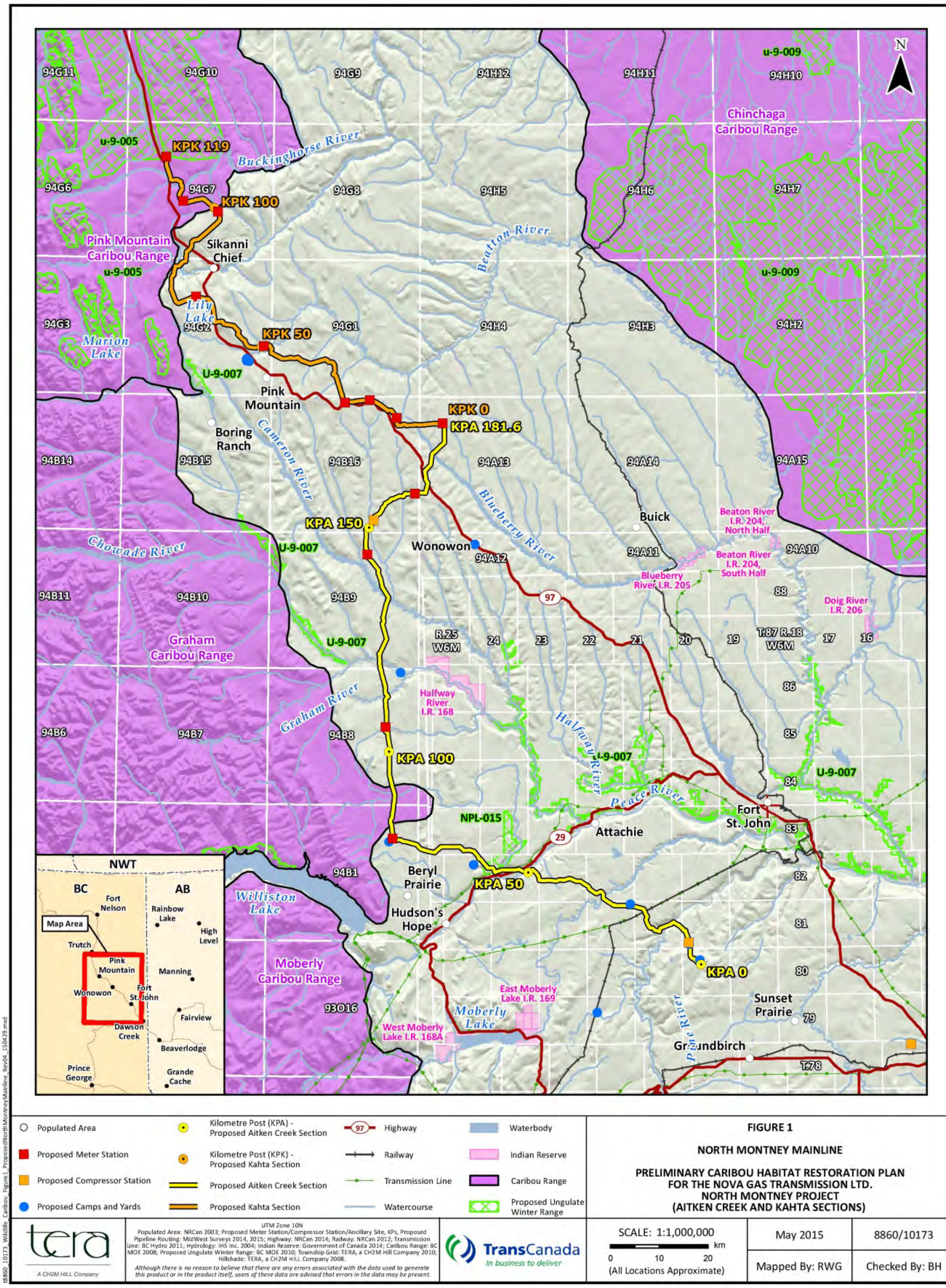


Figure 1-1: Regional Location

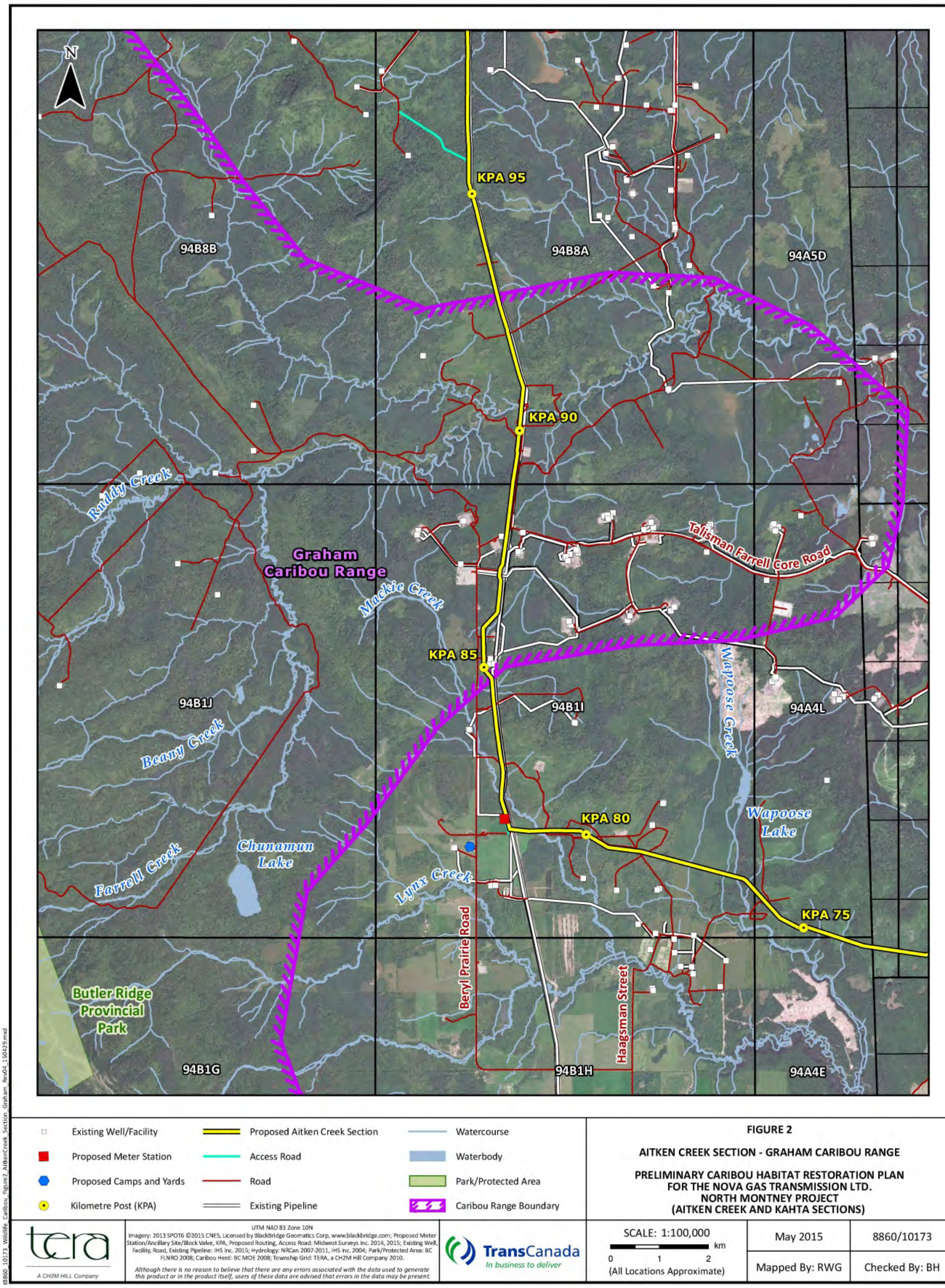


Figure 1-2: Aitken Creek Section – Graham Caribou Range

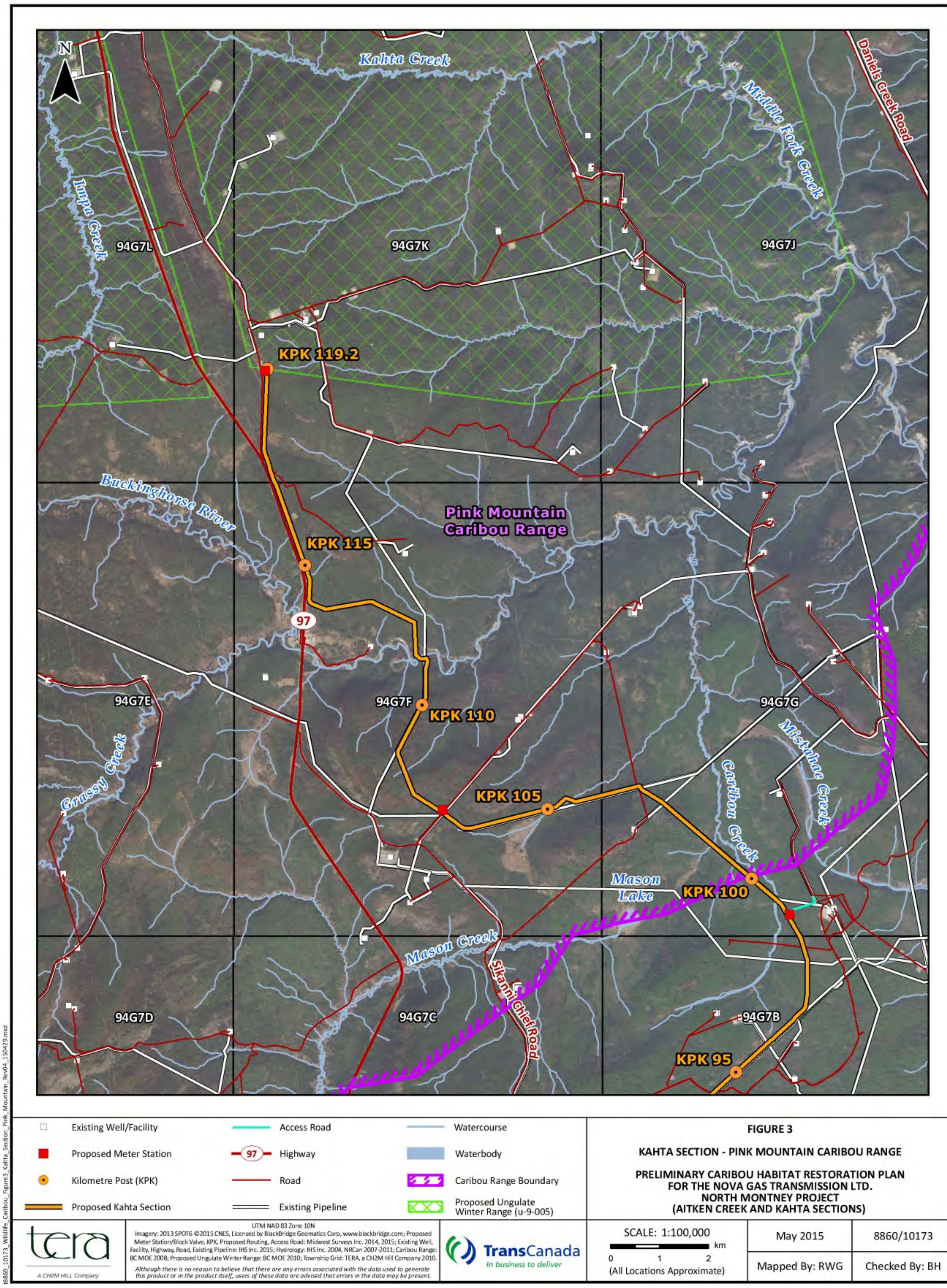


Figure 1-3: Kahta Section – Pink Mountain Caribou Range

1.2 ORGANIZATION OF THE PRELIMINARY CHRP

This Preliminary CHRP is organized in nine sections, as follows:

Section 2: introduces the goal, objectives and quantifiable targets.

Section 3: introduces the habitat restoration decision framework used to decide on potential caribou habitat restoration sites and to determine restoration measures in different site types, considering typical site factors that could constrain implementation.

Section 4: outlines quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects, extent to which goals and objectives have been met and the need for consequent compensation offsets.

Section 5: includes a description of how the spatial disturbance will be calculated (as the calculation will not be completed until the Final CHRP is prepared), habitat restoration, monitoring, adaptive management and the proposed implementation schedule for each of the Aitken Creek and Kahta Sections.

Section 6: describes how field innovations and previous experience have been incorporated into ~~the~~this Preliminary CHRP for the Project.

Section 7: provides a summary of caribou-specific consultation with Aboriginal communities and applicable regulators to-date, as well as a summary of how feedback was incorporated in ~~the~~this Preliminary CHRP.

Section 8: is a literature review, on which the decision framework for this document is based, that includes:

- identification of temporal and spatial caribou habitat restoration methods applicable to both boreal and mountain caribou
- assessment of the relative effectiveness of the identified methods
- description of the literature review approach

Section 9: cites references used throughout the document.

This Preliminary CHRP is organized to address each requirement of GC-125 Condition 15. For the locations in this document that outline how each condition has been met, see Table 1-1.

Table 1-1: GC-125 Condition 15: Caribou Habitat Restoration Plan

Condition	Details and Location in Report
15. Caribou Habitat Restoration Plan (CHRP) NGTL shall file with the Board for approval, in accordance with the timelines below, preliminary and final versions of a CHRP for each of the Aitken Creek and Kahta Sections of the section 52 Facilities. At the time of filing with the Board, NGTL shall provide a copy of the filings to Environment Canada and the appropriate provincial authorities.	This document addresses the restoration plan for each of the Aitken Creek and Kahta Sections of the Project in Section 5. All other sections of this document are applicable to both the Aitken Creek and Kahta Sections of the Project.
a) Preliminary CHRP to be filed at least 90 days prior to commencing construction. This version of the CHRP shall include, but not be limited to:	
i) the goals and measureable objectives of the CHRP;	Section 2 of the Preliminary CHRP introduces the goal, objectives and quantifiable targets.
ii) decision frameworks that will be used to prioritize potential caribou habitat restoration sites and to prioritize mitigative actions to be used at different types of sites, including consideration of typical site factors that may constrain implementation;	Section 3 provides a decision framework.
iii) a review of literature upon which the decision frameworks are based including: i. an identification of temporal and spatial caribou habitat restoration methodologies applicable to mountain caribou; ii. an assessment of the relative effectiveness of the identified methodologies; iii. detailed methodology of how the literature review was conducted.	Section 8 of the Preliminary CHRP summarizes relevant literature and describes the method for the literature review.
iv) the quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects, the extent to which the goals and objectives have been met, and the need for consequent compensation offsets;	Section 2 and Section 4 of the Preliminary CHRP describe quantitative criteria to evaluate effectiveness, and include a brief description of monitoring and adaptive management measures. Further information on monitoring and offsets will be provided in the OMP and CHROMMP under separate cover in accordance with GC-125 Conditions 36 and 37.
v) a schedule indicating when measures will be initiated and completed;	Section 5.~~6~~8 of the Preliminary CHRP provides the schedule for construction and habitat restoration activities for each of the Aitken Creek and Kahta Sections.
vi) a table summarizing any differences or updates from the last previous NGTL CHRP filed with the Board for other projects; and	Section 6.4 provides a table summarizing differences and updates since the last NGTL CHRP filed with the Board.
vii) evidence and a summary of how consultation feedback from Environment Canada and appropriate provincial authorities is integrated into the CHRP.	Section 7 summarizes consultation and feedback from EC, BC MFLNRO, and ~~effected~~potentially affected Aboriginal communities.

~~Table 1-1: GC-125 Condition 15: Caribou Habitat Restoration Plan (cont'd)~~

Table 1-2: GC-125 Condition 15: Caribou Habitat Restoration Plan (cont'd)

Condition	Details and Location in Report
b) Final CHRP to be filed on or before 1 November after the first complete growing season following the commencement of operation for the Section 52 Facilities. This updated version of the CHRP shall include, but not be limited to: i) the preliminary CHRP, with any updates identified in a revision log that includes the rationale for any changes to decision making criteria; ii) a complete table describing caribou habitat restoration sites, including but not limited to location, spatial area, description of habitat quality, site-specific restoration activities and challenges; iii) specification drawings for the implementation of each restoration method; iv) maps or Environmental Alignment Sheets showing the locations of the sites; v) evidence of how further consultation feedback from Environment Canada and appropriate provincial authorities is integrated into the plan; and vi) a quantitative and qualitative assessment of the total area of direct disturbance to caribou habitat that will be restored, the duration of spatial disturbance, and the aerial extent of the resulting residual effects to be offset, which also includes indirect disturbance.	The Final CHRP will be filed on or before November 1 after the first complete growing season following the Project being placed into service. For schedule information, see Section 5.~~6~~8.

2.0 GOAL, OBJECTIVES AND QUANTIFIABLE TARGETS

This section describes the goal, objectives and quantifiable targets of the CHRP.

2.1 GOAL

The overarching goal of NGTL's caribou habitat restoration plan is to minimize the predicted residual effects of the Project and the Project's contribution to cumulative effects on caribou and caribou habitat in a manner that aligns with provincial and federal policies.

2.2 OBJECTIVES

The objectives of the CHRP were designed to achieve the goal in a way that incorporates the best information available, and can be implemented and measured to quantify residual effects on caribou and impacted caribou habitat. The three objectives of the CHRP are:

1. **Habitat restoration**: revegetation of the Project footprint that achieves establishment, survival and growth of target species in the short term, so natural ecosystems, consistent with adjacent ecosystems, are expected to regenerate over the long term. For example, caribou habitat will be restored in the Project footprint through revegetation, mounding, bioengineering and berms to provide both immediate and sustainable functional habitat that supports caribou recovery over the long term.
2. **Access control**: effectively discourages access in the Project footprint as an interim measure until results of the monitoring program indicate long term habitat restoration has been successful. For example, access and use of the ROW is controlled through placement of coarse woody debris, tree felling, sign placement and rollback to limit access.
3. **Line-of-sight blocking**: reduce lines-of-sight along the Project footprint using barriers such as screens and vegetation. For example, tree planting, tree felling, vegetative and fabricated site screening are intended to reduce visibility along the ROW.

The CHRP goal to minimize Project residual effects on impacted caribou habitat will be attained by implementing the three objectives identified above. The Final CHRP will assess the objectives from a qualitative and quantitative perspective.

2.3 QUANTIFIABLE TARGETS

Quantifiable targets are the criteria that will be used to determine whether the CHRP objectives identified in Section 2.2 have been achieved:

- extent of predicted residual effects
- whether the CHRP objectives have been achieved
- need for compensation offsets

For more information on quantifiable targets and performance measures, see Section 4.

3.0 DECISION FRAMEWORK

The decision framework (see Figures 3-1, 3-2 and 3-3) will be used to guide the Project in meeting the goal of the CHRP. The decision framework NGTL has developed is a principle based logic model ~~specific to~~that supports each of the three objectives and forms the basis for quantifiable targets. ~~It~~

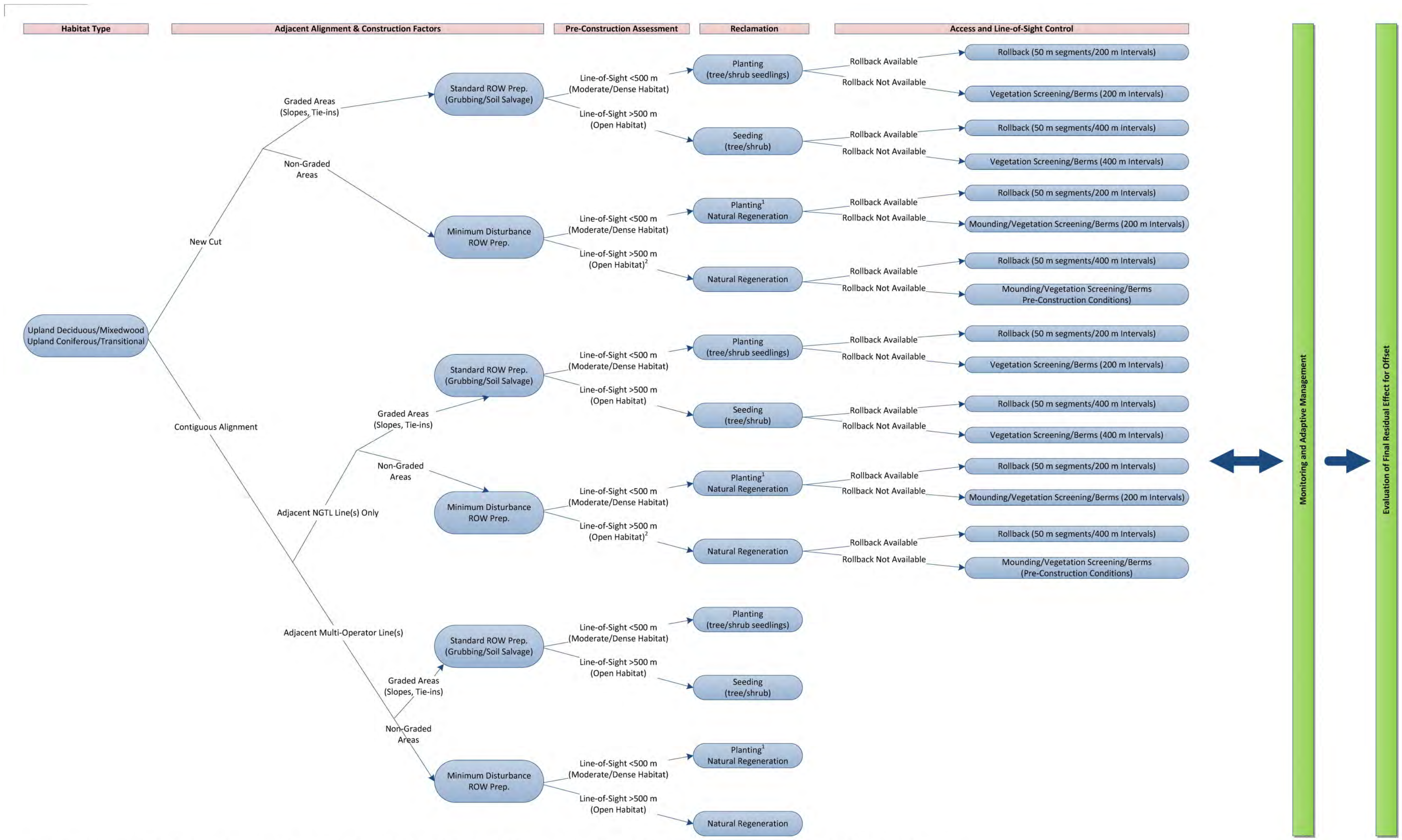
The decision framework was initially developed by NGTL from information obtained in the literature review, as well as industry best management practices and industry consultation. However, the decision framework included in this Preliminary CHRP has been revised to reflect recent lessons learned from field experience on other NGTL projects that impact caribou habitat. In particular, the decision framework has been revised to incorporate lessons learned in implementing line of sight blocks and access control measures on the recently constructed Chinchaga Project.

The decision framework will be applied at the start of construction to identify candidate sites for mitigation measures and reviewed during construction to identify any changes in inputs. Mitigation will be applied during final cleanup.

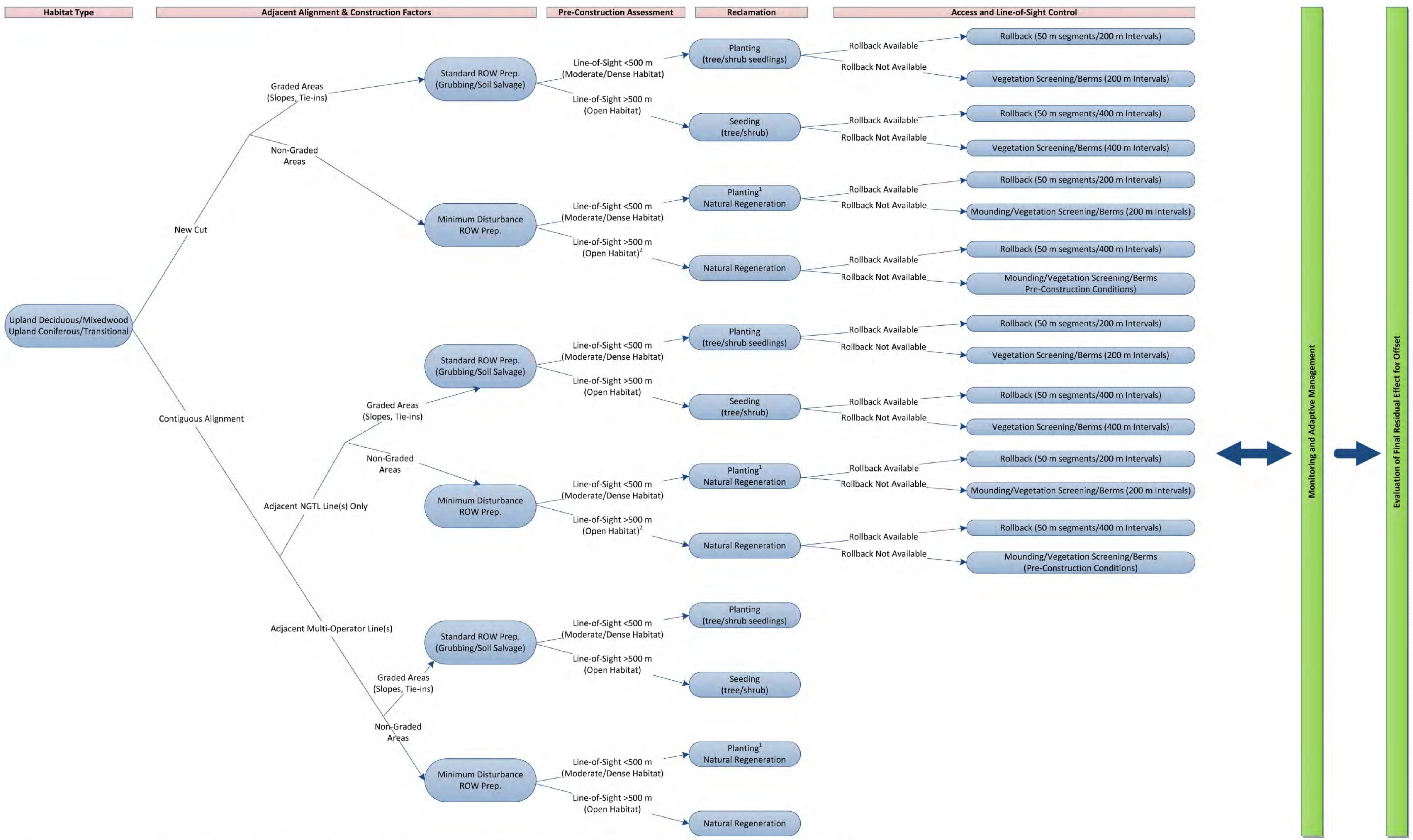
Figures 3-1, 3-2 and 3-3 ~~also~~are presented in chronological order in which they are implemented: access control, line of sight blocking and habitat restoration. These figures show restoration measures or tools that can be applied to the Project footprint in order to meet the CHRP goal. However, only restoration measures or tools applicable to the Project~~, as restoration measures,~~ will be applied. These are outlined in Section 5, Table 5-3.

Key factors in the choice of these restoration measures or tools include:

- natural site characteristics
- existing disturbance and activities
- regulatory requirements
- site-specific construction methods

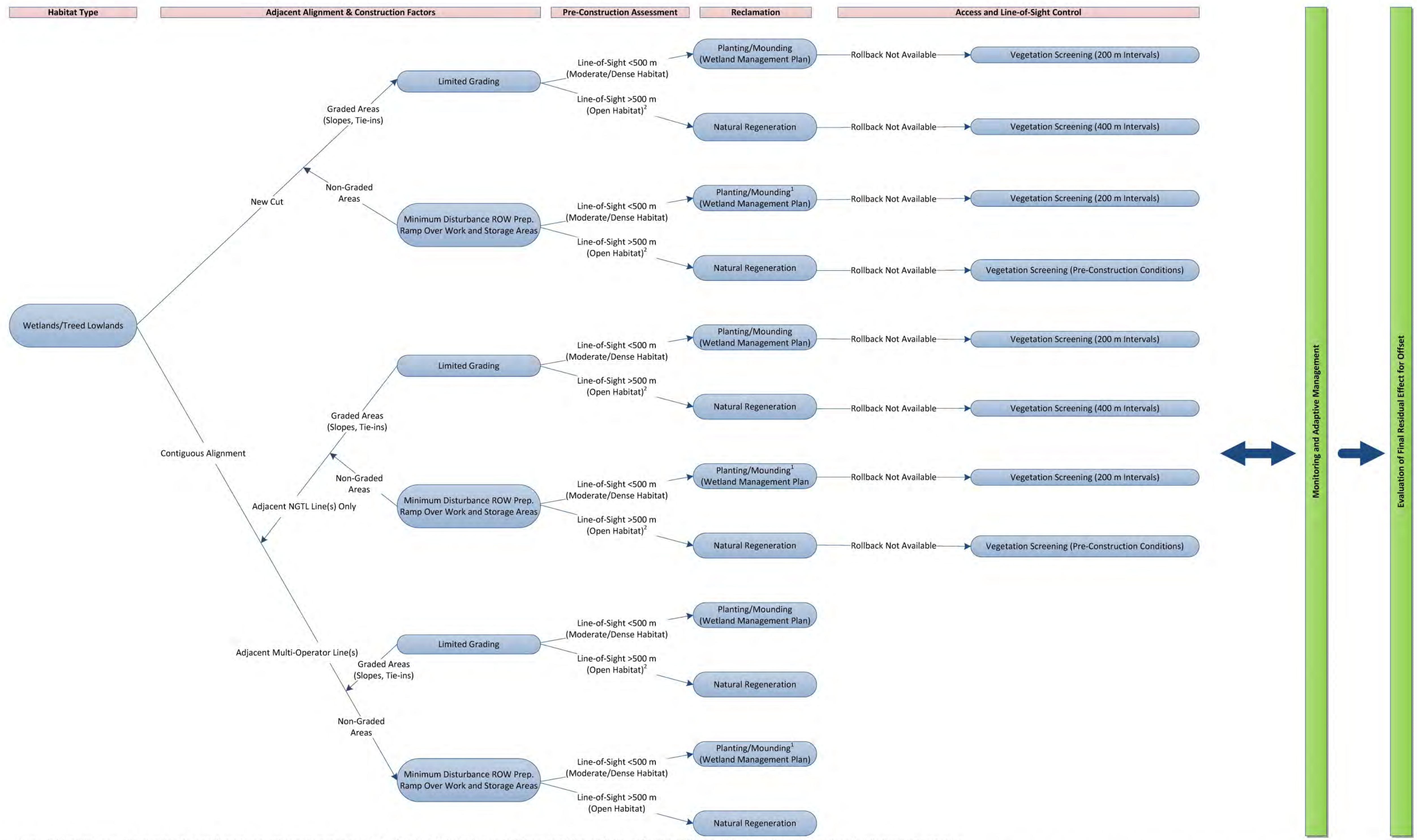


Note: (1) Habitat-specific planting to accelerate natural regeneration in areas of minimal disturbance ROW preparation with line-of-sight <500 m will be considered from detailed habitat information.
(2) In areas of new cut or contiguous alignment with NGTL lines only, where minimum disturbance ROW preparation and pre-construction conditions.

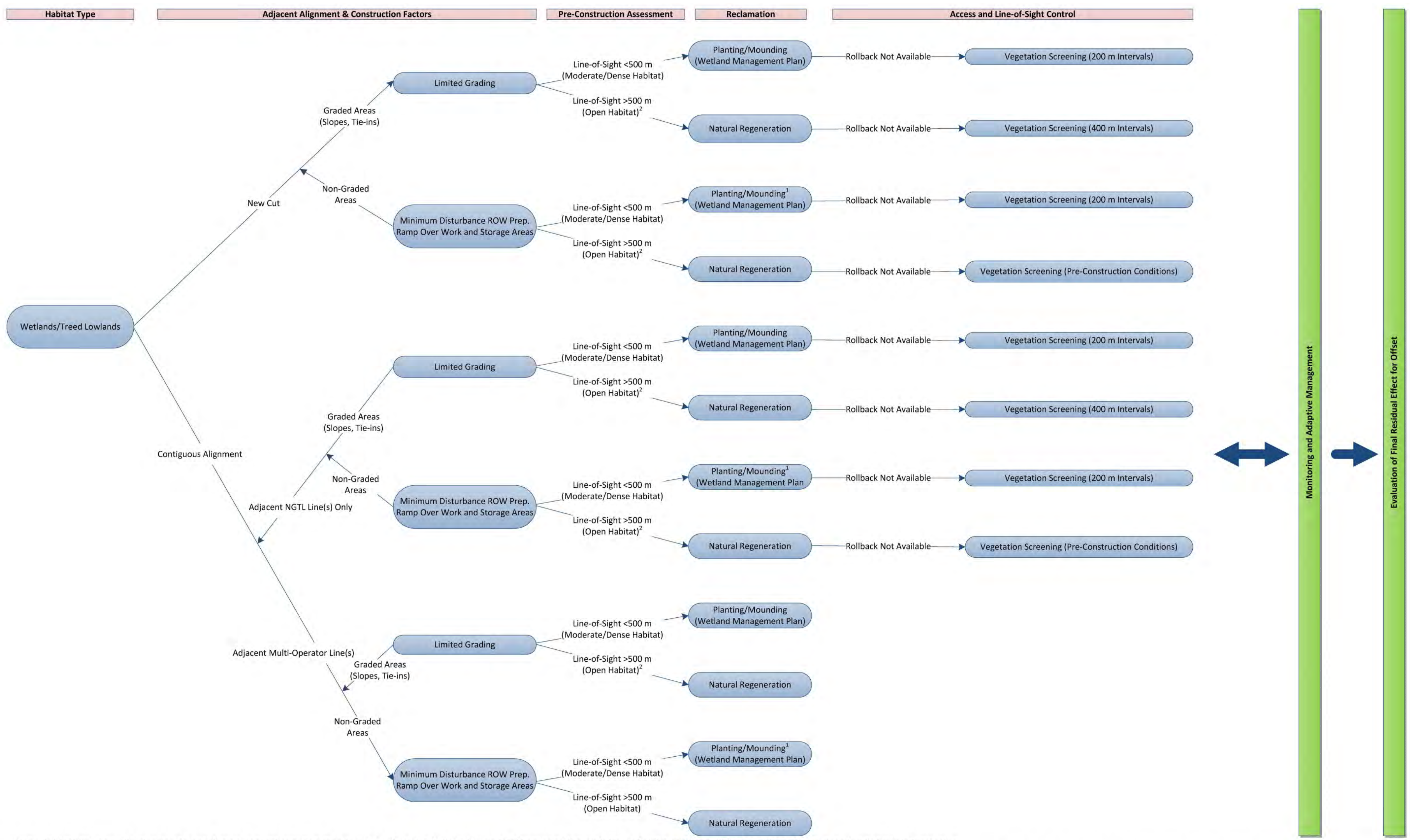


Note: (1) Habitat-specific planting to accelerate natural regeneration in areas of minimal disturbance ROW preparation with line-of-sight <500 m will be considered from detailed habitat information.
(2) In areas of new cut or contiguous alignment with NGTL lines only, where minimum disturbance ROW preparation and pre-construction conditions.

Figure 3-1: Decision Framework (for Upland Mixedwood/Upland Coniferous/Transitional Habitat)



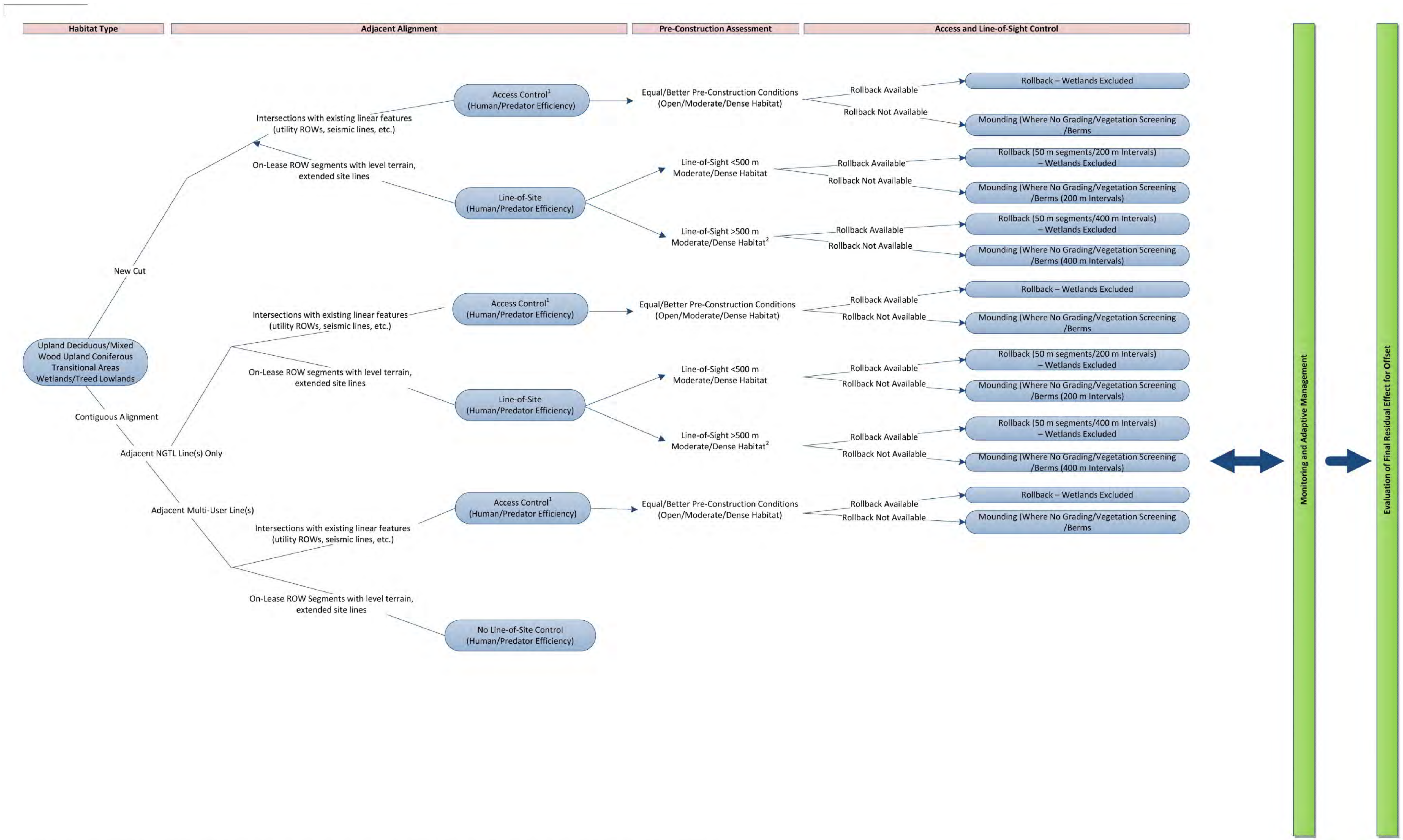
Note: (1) Habitat-specific planting to accelerate natural regeneration in areas of minimal disturbance ROW preparation with line-of-sight <500 m will be considered from detailed habitat information.
(2) In areas of new cut or contiguous alignment with NGTL lines only, where minimum disturbance ROW preparation and pre-construction line-of-site extends >500 m on-easement (i.e., open habitat), line-of-site blocking will be placed at intervals that achieve pre-construction conditions.



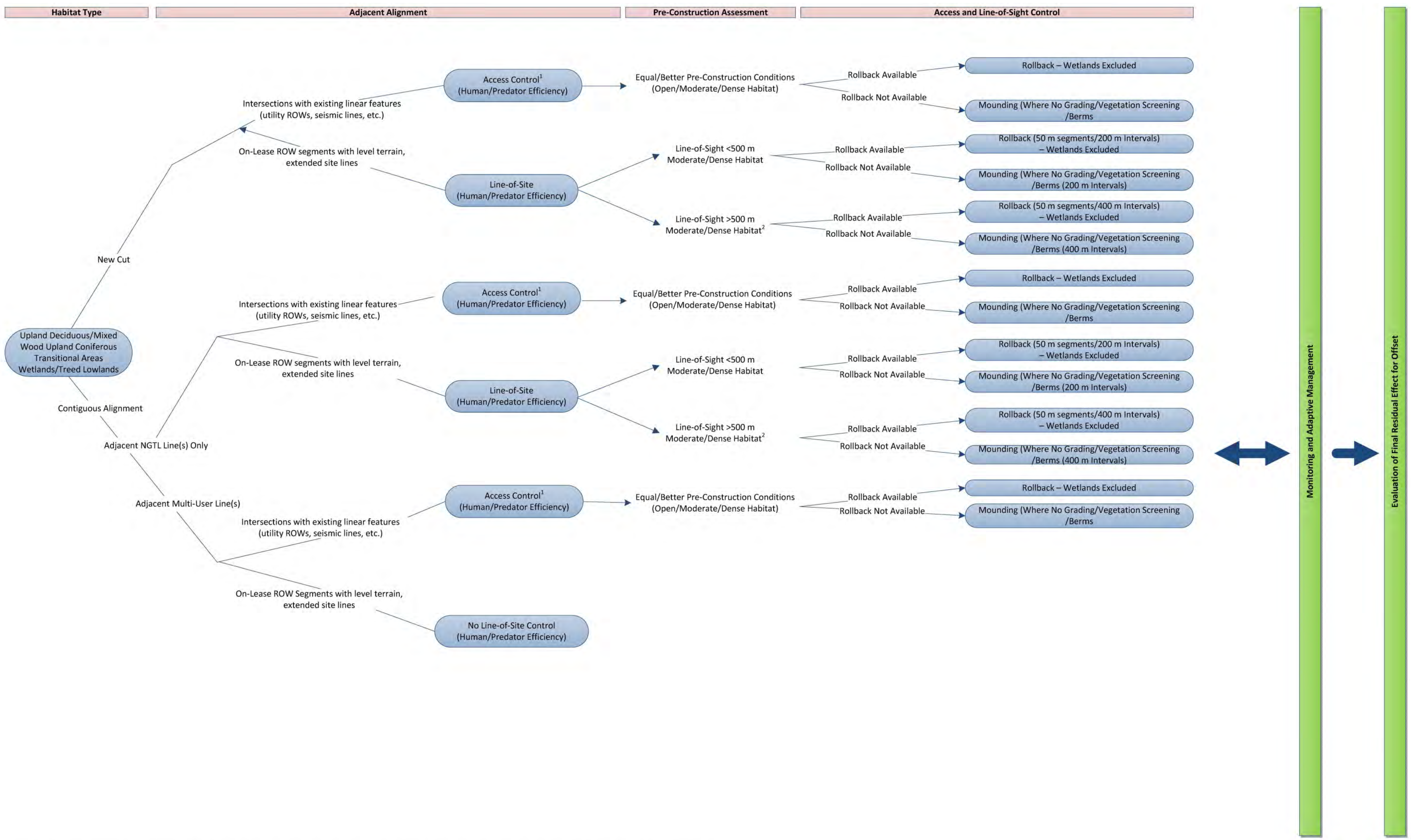
Note: (1) Habitat-specific planting to accelerate natural regeneration in areas of minimal disturbance ROW preparation with line-of-sight <500 m will be considered from detailed habitat information.

(2) In areas of new cut or contiguous alignment with NGTL lines only, where minimum disturbance ROW preparation and pre-construction line-of-site extends >500 m on-easement (i.e., open habitat), line-of-site blocking will be placed at intervals that achieve pre-construction conditions.

Figure 3-2: Decision Framework (for Treed Lowlands and Wetlands)



Note: (1) Access control at intersecting existing linear features (i.e., utility ROW, seismic lines, etc.) will not be implemented or inhibit traditional use.



Note: (1) Access control at intersecting existing linear features (i.e., utility ROW, seismic lines, etc.) will not be implemented or inhibit traditional use.

Figure 3-3: Decision Framework (for Line-of-Sight and Access Control)

4.0 QUANTIFIABLE TARGETS AND PERFORMANCE MEASURES

This section describes:

- quantifiable targets and performance measures used to evaluate the extent of predicted residual effects
- the extent to which CHRP goal and objectives have been met
- the need for compensation offsets for any residual effects remaining after implementation of ~~the~~ CHRP measures

For a summary of the quantifiable targets and performance measures available to the Project, see Table 4-1. The quantifiable targets and performance measures selected for the Project work in conjunction with the decision framework described in Section 3.

Table 4-1: Quantifiable Targets and Performance Measures

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Habitat Restoration	• Successful native vegetation re-establishment using the proposed habitat restoration measures will achieve trajectories toward natural ecosystem types, which will eventually re-establish native wildlife habitat. • The Project footprint in a caribou range is the proposed clearing of new area (i.e., excludes overlapping/shared areas with existing disturbances). • NGTL's operation and maintenance practice includes vegetation control over the pipe centreline (approximately 6–10 m wide area centred over the pipeline) as a corporate mechanism to meet compliance with CSA-Z662-15. This Standard requires that vegetation is controlled along rights-of-way to maintain clear visibility from the air and provide ready access for maintenance crews (CSA 2015). ~~However~~Although, there is flexibility ~~within~~in NGTL's vegetation control practice to allow for wildlife habitat objectives ~~while still ensuring~~yet remain in compliance with CSA Z662-15. NGTL acknowledges limitations for sustained revegetation success along the pipe centreline while the pipeline is in operation. NGTL ~~also~~ understands its obligations for achieving equivalent land capability at end of pipeline life.	Upland Deciduous/~~Mixed Wood~~Mixedwood/Transitional/ Upland Coniferous • Achieve ≥80% or higher survival rate for planted seedlings within 10 years following ~~planting.~~implementation of CHRP measures.. • Demonstrate sustained growth trends across ≥~~50~~80% of restoration locations within 10 years following implementation of CHRP measures.	• Quantitative measures of success will include comparisons of regeneration parameters (e.g., vigour, height, percent cover, species composition) between Years 1, 3, 5 and 10 following start of operation, with the objective of ensuring establishment of each habitat type and a trend toward achieving equivalent land capacity. If regeneration parameters are not met, adaptive management measures will be implemented to meet vegetation reestablishment trajectory. It is intended that plantings will be monitored for 10 years pursuant to Condition 37. • GPS location, number and type of restoration treatments and the frequency of monitoring sessions will be defined and mapped in ~~the Final~~thefinal CHRP.

Table 4-1: Quantifiable Targets and Performance Measures (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria

Habitat Restoration (cont'd)	• Areas in the Project footprint that parallel existing footprints with grass cover could have limited successful survival of planted species, due to competition from species ingress from adjacent disturbance.
	• Overlapping dispositions such as a gravel roads or facilities could limit long-term restoration success.
		Treed Wetlands/Treed Lowlands
		• Where tree seedlings are planted (i.e., mounded sites):
		  • achieve >50% survival rate for seedlings/ transplants within 10 years following planting
		  • demonstrate sustained growth trends across >50% of restoration locations within 10 years following implementation of CHRP measures
		Shrub/Graminoid Wetland
		• Within 10 years following installation of CHRP measures:
		  • >50% cover of native vegetation species in the footprint
		  • no restricted weeds
			• Where revegetation success does not meet quantifiable targets, NGTL will determine appropriate adaptive management. For example, if seedling mortality is unexpectedly high, NGTL will do additional planting, improve site conditions for seedling success or improve restoration efforts at other sites.

Table 4-1: Quantifiable Targets and Performance Measures (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria

Access Control	• Access control measures are most effective when implemented at intersections of the Project ROW with existing perpendicular linear features (e.g., roads, utility corridors, seismic lines).
	• Access by NGTL staff and contractors, including operations personnel as well as reclamation and monitoring crews, will be recorded and monitored. Access by Project personnel ~~in~~within the footprint in caribou range will be limited to the extent practical. Traditional access will be maintained.
	• The access control evaluation might be guided by the Access Management Plan (AMP), which ~~will be~~was prepared pursuant to Condition 16.
		Access Control:
		The following quantifiable targets will be used to measure the access control objective:
		• a lower measure (e.g., rate, proportion, count) of access along the segments of the Project ROW where access is controlled relative to uncontrolled segments
		• <20% increase in access (e.g., rate, proportion, count) from the baseline assessment as measured by remote cameras
		The quantifiable targets for access in the Project ROW are expected to be achieved within 5 years following CHRP implementation, though monitoring will continue over 10 years.
			• Evidence and level of access along Project ROW using criteria ratings such as:
			  • access evident: Yes/No
			  • access type: all-terrain vehicle (ATV)/ truck/ snowmobile/ non-motorized/
			  • predator/other
			• Access level:
			  • No access evident
			  • Low: tracks/trail evident but difficult to discern or appears to be infrequently used
			  • High: tracks/trails appear to be well-used; vegetation is trampled down, bare ground from frequent use might be visible)
			• Access level definitions will be refined in the Final CHRP.
			• An evaluation of whether the objective for access control is achieved will consider collected qualitative and quantitative data.

Table 4-1: Quantifiable Targets and Performance Measures (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Line-of-Sight Blocking	• Operating practices for energy development in sensitive caribou range in British Columbia (BC Ministry of Environment 2011) suggest implementing line-of-sight management every 500 m on linear features that do not share a ROW boundary with a road. Line-of-sight blocking as part of this Project will follow this guideline where it is not collocated with roads or other linear developments. • Bends in the pipeline (doglegs) can reduce line-of-sight, but opportunities to do this for the Project might be limited where the ROW parallels other linear developments. • Wetlands and some treed lowlands encountered by the Project footprint naturally have low and/or open vegetation structure. The line-of-sight distance in these areas is naturally long and, therefore, sightline management techniques are not practical for these locations. • Concern from provincial regulators regarding fire hazard and forest health (pathogen spread), availability of line of sight blocking material, suitability of substrate to support structures (i.e., peat does not support fencing), introduction of weeds from imported material and potential for alteration in surface hydrology (particularly from earth berms) can limit the use of line of sight blocking measures. • Appropriate locations for line-of-sight blocks will be identified post-construction when final clearing is complete and included and as-built drawings.	Line-of-Sight Blocking: • Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, achieve sightline distance of < 500 m within 10 years following implementation of CHRP measures. • Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, where planting for future vegetation screens in combination with or without rollback have been installed, achieve 80% or higher survival rate for planted seedlings that are intended as line-of-sight blocks within 10 years following implementation of CHRP measures.	• Establish line-of-sight blocks in forested areas of the footprint in caribou range that will achieve a sightline distance of 500 m or less in areas of new cut or in sections contiguous with, and adjacent to, NGTL lines only.

Table 4-1: Quantifiable Targets and Performance Measures (cont'd)

Objective[1]	Rationale/Limitations/Assumptions	Quantifiable Targets	Evaluation Criteria
Line-of-Sight Blocking (cont'd)	• A combination of measures, including vegetation screening, rollback and mounding will be applied. Feasibility of installing berms or fencing will be investigated post-construction. • Few limitations are associated with using vegetation screening to reduce line-of-sight. • Paralleling an existing linear corridor presents challenges for line-of-sight blocking where the adjacent line is owned by a company other than TransCanada. • Application of sightline management techniques should extend across the width of the Project footprint and adjacent disturbance to be effective.		

Note:
1 Restoration objectives will continue to be evaluated for the Final CHRP to consider any updated consultation with stakeholders or if any other relevant information becomes available.

5.0 THE RESTORATION IMPLEMENTATION PLAN

This section provides a high-level summary of Project impacts to affected mountain caribou habitat. This section also describes NGTL's plan to implement a decision framework (see Section 3) which will be used by the Project to achieve the overarching goal of the CHRP. The content of this section presents NGTL's plan to reduce residual and cumulative effects of the Project on caribou and impacted caribou habitat.

5.1 PROJECT IMPACTS TO CARIBOU HABITAT

The Environmental and Socio-Economic Assessment (ESA) for the Project identified potential direct and indirect effects of the Project on caribou and caribou habitat through changes in habitat conditions, ~~heard~~herd movement and caribou mortality risk. The cumulative effects analysis completed as part of the ESA determined that the Project will have small, incremental contributions to the overall cumulative effects to the Graham and Pink Mountain caribou ranges (see Figure 1-1). The Project linear disturbance presented in Table 5-1 reflects the most recent Project design at the time this Preliminary CHRP was prepared. Final determination of linear disturbance in caribou range will be presented in the Final CHRP.

The NEB Report stated that the Project will still result in loss of habitat (and could result in disturbance to caribou) beginning with construction and continuing through the lifecycle of the Project, notwithstanding the proposed mitigation within NGTL's EPP and CMP. The Board stated that disturbances within caribou ranges should be minimized, and measures taken before and during construction to help accelerate the restoration of caribou habitat. The Board is of the view that Project proponents have a responsibility to not only reduce effects on caribou habitat, but to also restore affected habitat as soon as possible and as much as possible. The Board, therefore, imposed Condition 15 requiring NGTL to prepare a Preliminary and Final CHRP for the Project. The Board acknowledged NGTL's preparation and submission of the preliminary CMP and noted that the CHRP will supersede and replace the CMP.

5.1.1 Impacted Caribou Habitat

The Project will impact the Graham and Pink Mountain caribou ranges (see Section 8.3). The Aitken Creek Section of the Project will result in a linear disturbance of approximately 8 km within the Graham caribou range. The linear disturbance on the Kahta Section extends approximately 19 km within the Pink Mountain caribou range (see Table 5-1).

Table 5-1 also describes both the Graham and Pink Mountain herds listing status. Both herds are provincially designated northern ecotype caribou (BC Ministry of Environment [MOE] 2010), but are classified differently at the population level.

The Graham herd belongs to the Southern Mountain population, Northern Group, and is designated as Threatened on Schedule 1 of the *Species at Risk Act* (SARA) and by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and is blue-listed in BC (BC Conservation Data Centre [CDC] 2015; COSEWIC 2015; Environment Canada (EC) 2015).

The Pink Mountain herd is part of the Northern Mountain population, and is designated as Special Concern on Schedule 1 of SARA and by COSEWIC, and is blue-listed in BC (BC CDC 2015; COSEWIC 2015; EC 2015). COSEWIC has further divided each population into Designatable Units (DU), and both the Graham and Pink Mountain herds are included in Northern Mountain DU7 (COSEWIC 2011).

Species designated as Special Concern (SC) on Schedule 1 of SARA, such as the Pink Mountain herd, require management plans developed by the federal government for the species and its habitat, whereas species designated as Threatened or Endangered, such as the Graham herd, require a recovery strategy. Because the Pink Mountain caribou population is designated SC, a management plan was developed for this population, where it is referred to in the collective as Northern Mountain caribou.

Table 5-1: Caribou Nomenclature and Ranges that Interact with the Project

Project Component	Caribou Range	BC Provincial Status Designation and Nomenclature	Federal Status Designation and Nomenclature	Current Population Trend	Project Linear Disturbance in Caribou Range		
					Total Length in Caribou Range	Total Parallel to Existing Linear Disturbance	New Linear Disturbance
Aitken Creek Section (pipeline)	Graham	Blue[1] Northern ecotype[2] Northern caribou[3]	Threatened[4,5] Northern Group subpopulation of the Southern Mountain population[6] DU7[7]	Stable[8]	8.1 km	7 km (86.4%)	1.1 km (13.6%)
Kahta Section (pipeline and two meter station sites)	Pink Mountain	Blue[1] Northern ecotype[2]	Special Concern[4,5] Northern Mountain population[6] DU7[7]	Unknown[9]	19 km	13.3 km (70%)	5.7 km (30%)

Table 5-1: Caribou Nomenclature and Ranges that Interact with the Project (cont'd)

Note:
1 BC provincial status designation (BC CDC 2015).
2 Ecotypes assigned by BC MOE (2010).
3 Northern caribou as described in the Implementation Plan for the Ongoing Management of South Peace Northern Caribou (BC MOE 2013)
4 Status designation under Schedule 1 of SARA (EC 2015).
5 Status designation under COSEWIC (2015).
6 Caribou populations described by COSEWIC (2002) and the SARA Public Registry (EC 2015), and subpopulation described by EC (2014).
7 Northern Mountain DU7 assigned by COSEWIC (2011).
8 Population trend reported by EC (2014).
9 Population trend reported by EC (2012a).

5.2 QUANTIFICATION OF HABITAT DISTURBANCE

Restoration of disturbed habitat assumes that caribou will return to spatial separation from primary prey (moose and deer) and predators and, as a result, return to pre-disturbance levels of mortality risk (Athabasca Landscape Team 2009). Restoration of anthropogenic disturbances is also expected to reduce the degradation of functional habitat for caribou, since caribou will no longer exhibit reduced use on or near (i.e., in a zone of influence) the reclaimed disturbance (Oberg 2001). As such, restoration of caribou habitat is expected to alleviate the residual direct habitat disturbance over the long term.

By addressing residual direct habitat disturbance, indirect residual effects will also be addressed. Included in the direct disturbance footprint are the ROW, meter stations, temporary workspace, new temporary construction access and new permanent access. The Final CHRP will provide schematics that illustrate the quantification of direct and indirect residual effects of the Project on caribou habitat using as-built information. Indirect disturbance (i.e., reduced habitat effectiveness) is defined as the area within the 500 m buffer of anthropogenic disturbance features.

The spatial residual effect will be quantified using a method consistent with *Recovery Strategy for the Woodland Caribou Southern Mountain population* (Rangifer tarandus caribou) *in Canada* (EC 2014). The Recovery Strategy defines undisturbed caribou habitat in the Environmental Site Assessment Repository (ESAR) caribou range as habitat that has not burned in the last 40 years and is not in or within 500 m of anthropogenic disturbance. Although the Project footprint is in an area that has been burned by forest fires within the last 40 years, NGTL will still consider this non-permanent disturbance in its quantification of spatial residual effect.

Restoration of impacted mountain caribou habitat through implementation of the CHRP measures will not completely eliminate adverse Project effects on caribou habitat. During operations, NGTL will periodically manage vegetation within 5 to

10 m of the centreline of the operational pipeline, in accordance with TransCanada operational procedures for integrity monitoring under Canadian Standards Association (CSA) Z662-15 (CSA 2015). This area will be allowed to regenerate naturally, but will be periodically mowed or mulched. This theoretical access area will not achieve the quantifiable targets for the CHRP and is quantified as a residual direct disturbance of caribou habitat.

The area of direct disturbance in the Pink Mountain and Graham caribou ranges estimated during the application phase of the Project was approximately 162 ha and 29 ha. After application of the CHRP measures outlined in this document, the final disturbance footprint will be determined. Direct and indirect Project disturbance on caribou habitat will be quantified and presented in the Final CHRP, as outlined in Table 5-2.

Table 5-2: Quantification of Direct and Indirect Project Disturbance of Caribou Habitat

Area (ha)				
Length of Pipeline Segment	**Direct Project Disturbance**	**Restored Project Footprint**	**Residual Direct Project Disturbance**	**Incremental Indirect Disturbance**
TBD	TBD	TBD	TBD	TBD

To calculate the final offset ~~requirement for the Project~~requirements for the Graham herd within the Aitken Creek Section, pursuant to Condition 36, the first step involves calculating the remaining project effect after CHRP measures are applied to the Project footprint. The restored Project footprint will be categorized as either new alignment or parallel alignment. New alignment is assumed to have full effect on caribou use of this part of the range, whereas segments parallel to adjacent disturbances have less effect on caribou use (this will be further outlined in the OMP).

The second step (inherent project effect) involves categorizing the portion of total area for new alignment and parallel alignment in their respective habitat classes to apply the appropriate delay factors (i.e., time lags) associated with each mitigation measure.

The third step categorizes the proportion of total area for each mitigation measure in each habitat type. The proportion of total area for each mitigation measure in each habitat type will be used to estimate the remaining Project effect using the following equation:

Calculation 5-1:

$$Remaining\ Project\ Effect\ (ha) = \\ Inherent\ Project\ Effect\ (ha) \times \{1 - (Measure\ Effectiveness\ \times Delay\ Penalty)\}$$

The remaining project effect calculation will be used to populate Table 5-2 in the Final CHRP.

For previous NGTL projects that impacted caribou habitat, NGTL allowed intermittent alternating plantings of woody vegetation over the pipeline centreline. For the Project, trees will be planted across the centreline ~~with~~where open areas are left at alternating sides of the ROW. This will allow for a meandering access line over the centreline, and will in time, establish line-of-sight breaks (i.e., vegetation screens). Using this alternating planting method, the quantifiable targets for habitat restoration (revegetation) are expected to be achievable in the long term.

The entire width of the Project planted footprint ~~that is planted~~ will not be considered restored in the short term. ~~The~~In the short term, there will be a spatial residual effect ~~can be effectively addressed once the habitat regenerates in~~on the ~~long term~~area of operational access. . In the long term, the area of operational access is not expected to be a spatial residual effect where the ROW segment is planted with trees. The spatial residual effect is expected to be effectively addressed once the habitat regenerates in the long term.

Some restoration measures are designed to be effective immediately or in the short term. For example, retention of vegetated visual screens, mounding and tree felling (particularly if in conjunction with mounding) are expected to reduce Project residual effects on caribou habitat immediately.

The lag time required to achieve habitat value equivalent to pre-construction conditions is important and will be considered in the quantification of residual effects in the Final CHRP. Residual effects will also be presented in the Final CHRP and will consider lag time and also factor in uncertainty associated with offsets. Over the long term, the vegetation community composition and structure is expected to mature to a seral stage that will provide functional caribou habitat and restore pre-disturbance predator–prey dynamics.

NGTL will develop an OMP to address Project residual effects on critical caribou habitat for the Aitken Creek Section pursuant to Condition 36. The Preliminary OMP will further detail the method used to quantify the offsets. The Project OMP will use a method of offset quantification that aligns with NGTL's previous OMPs for projects constructed in boreal woodland caribou range.

The residual effects to be quantified in the Final CHRP using the method described above will be modified in the calculation of residual effects in the OMP to factor in:

- uncertainty associated with effectiveness of the CHRP measures
- context of the footprint related to existing disturbance (e.g., contiguous or non-contiguous)
- time lag or duration of residual effects

5.3 HABITAT RESTORATION

The decision framework (see Section 3) and regulatory guidelines summarized in Section 8 provide the basis for the Preliminary CHRP and will further guide the Final CHRP. The decision framework provides direction on restoration factors such as variability in natural site characteristics, planting prescriptions, target vegetation, soil and site stability, and access management. This in-turn informs the quantifiable targets and performance measures that will be used to evaluate the extent of predicted residual effects and the extent to which goals and objectives have been met.

For a suite of caribou habitat restoration measures, see Table 5-3. After applying the decision framework, suitable restoration measures will be selected. Several restoration methods described in the literature review and included in Table 5-3 are considered not suitable given the limitations to implementation or effectiveness. These measures could be reconsidered if additional information becomes available to support their use. For photos of potential restoration measures, including site conditions showing constraints and opportunities, see Appendix A.

Table 5-3: Habitat Restoration Measures

Restoration Measure	Objectives	Rationale	Comments
Berms	Access control Line-of-sight blocking	Berms can be constructed of coarse woody debris and timbers, or a combination of coarse woody debris and earth. Supported berms are constructed using timber cleared from the ROW. To effectively block line-of-sight, berms should be constructed to an approximate minimum height of 1.5-2 m. Promote rapid shrub/tree regeneration at ends of berms (e.g., shrub staking/transplants, seedling planting) to increase effectiveness as access control. Earth berms were 76% effective at excluding vehicles over 50 inch wide and 22% effective at excluding all vehicles including off-road vehicles (Esri User Conference 1996). Berms create a barrier that can be effective immediately following implementation. Coarse woody debris/timber berms are dependent on approval from provincial authorities to retain coarse woody debris on-site, as well as sufficient space to store the material during construction. Woody debris berms may present an increased fire hazard, depending on composition and location. NGTL has found on its existing ROWs where this measure was used, that woody debris berms deteriorate relatively quickly after installation (within several years), particularly if berms are moved to allow access to the ROW. Quantity of source material is usually not sufficient for earth berm construction in areas where minimum disturbance construction techniques are employed. Importing material is not preferred given the risk of introducing invasive plants. Earth berms should not be located in peatlands due to potential for settling and alteration of surface hydrology.	Limitations of this measure reduce its value. Woody material available for inclusion in berms is often limited, which can make this option less useful. Woody debris berms might be used as CHRP measures if sufficient wood exists at the Project site. Earth berms will not be considered a viable option for the Project as NGTL has found that there is generally insufficient source material to create earth berms.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Bioengineering • shrub staking/planting • tree seedling planting	Habitat Restoration Access control Line of sight blocking	Bioengineering in combination with stabilization measures (e.g., soil wraps) might be suitable at watercourses crossed with an open cut method. Bioengineering is the use of existing live vegetation to stabilize and revegetate a site (e.g., transplants; installing cuttings) and is a technique often used on slopes or riparian banks (Polster 2002). Species and planting densities used for bioengineering are site-dependent (Golder 2012a). Vegetation used is typically collected either from the disturbance site (i.e., before or during clearing), or from the adjacent area, in the form of cuttings (Golder 2012a). Vegetation might be planted during the growing season or during winter. 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 (Golder 2012a). Nursery-grown shrub seedlings might be planted where staking is not practical due to lack of available material, limitations associated with collecting material off-site, or where a restoration prescription calls for shrub planting of species that do not readily regenerate through cuttings/staking (e.g., alder). Alder 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 inter-planting alder with conifers. When alder is interspersed with conifer plantings, line-of-sight and 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 (Courtin and Brown 2001; Simard and Heineman 1996). The fast growth of alder can reduce growth rates of conifer plantings due to competition when alder densities are high (CRRP 2007b; Simard and Heineman 1996). Species are determined based on the adjacent forest stand and restoration objectives (e.g., low palatability for ungulates). Combined plantings of shrub and tree seedlings can be appropriate, depending on site conditions and anticipated natural revegetation of both species. Procurement of shrub seedlings (container or bare-root) can be challenging given limited seed availability. Planted shrubs can be slow to establish.	Shrub planting is a suitable CHRP measure for select site-specific locations if a need for combined conifer/shrub plantings is identified. Many shrub species can attract prey species such as moose and deer, which can attract wolves, thus its application will be limited as these species can have a negative effect on caribou (see Section 8).

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Conifer seedling planting	Habitat restoration Access control Line of sight blocking	Restoration species are determined based on the biophysical characteristics of the site, adjacent forest stand composition, and restoration objectives (e.g., low palatability for ungulates). Tree seedling planting is considered a long-term restoration treatment (full effectiveness is expected to take longer than 10 years). Planting densities for reclamation of forested areas in Canada have been based on forestry standards, ranging from 1,500–2,500 stems/ha (MacDonald et al. 2012). In the Prince George Forest Region of BC, target stocking densities for coniferous trees range from 400-1,200 stems/ha and the minimum stocking standards range from 200-700 stems/ha (BC MOF 2000). Target stocking density for deciduous trees is 2,500 stems/ha and the minimum stocking densities range from 1,700-2,000 stems/ha (BC MOF 2000). Given the relatively harsh growing conditions inherent to boreal ecosystems, mortality of planted seedlings is anticipated to range from approximately 5% to 20% in most site types (Golder 2012a,b). A planting density of 2,000-2,500 stems/ha is recommended for restoration of linear disturbances in boreal caribou ranges in northeast BC (Golder 2015). Although the above information was used to determine seeding densities there is no direct information or literature available on appropriate planting densities in the mountain caribou range where this Project occurs. The Project terrain includes more upland habitat than would typically be commercially harvested and researched. For example, Kahta has mineral soils within the top 50 cm or less in peat so mounding might be necessary to create suitable growing conditions. Given this information and the literature specified above, the following planting prescription has been formulated for this CHRP: • minimum seedling density of 1,200-1,600 stems/ha on sites that are not mounded • minimum seedling density of 900-1,100 stems/ha (combined planted seedlings and/or natural regeneration) on mounded sites (dependent on mound density)	Conifer seedling planting is a suitable CHRP measure for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Mounding	Restore vegetation (create microsites) 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 to enhance seedling survival. Mounding treed wetlands (e.g., bogs, 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 (Golder 2012a; Macadam and Bedford 1998). Soil properties (e.g., substrate, drainage) affect the ability of mounds to retain their structure. Mounding has been used as an access control measure on old roads and seismic lines to discourage off-road vehicle activity. It can be effective immediately following implementation. For access control purposes, mounds should be created using an excavator to 0.75 m deep, where site conditions allow (Golder 2012a). The excavated material is dumped beside the hole (Macadam and Bedford 1998). Transitional areas, or places with shallow peat (< 50 cm) are preferred for mounding. Suggested densities of mounding for access management or microsite creation purposes vary from 1,400-2,000 mounds/ha (Golder 2012a). Implementation of this mound density might be suitable for restoring disturbances such as seismic lines where specialized equipment is used and where frost is not driven into the soils to allow heavy equipment access. The mound density that can realistically be achieved on pipeline ROWs is lower (approximately 700-1,400 mounds/ha on previous NGTL projects). The limitations of mounding on pipeline ROWs include scheduling mounding for restoration during final cleanup, which typically depends on freezing-in of soils, availability of specialized equipment and minimum spatial separation of 5 m between mounds and the centreline of the operating pipeline.	Mounding is a suitable CHRP measure that will be used in conjunction with conifer seedling planting for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Minimum disturbance construction	Habitat Restoration Line of sight blocking	Construction during winter conditions allows for minimum disturbance construction techniques, which reduce the need for soil salvage and grading, and limit the width of grubbing to the trench area where grading is required. Reduced disturbance to vegetation and root systems is achieved by cutting, mowing or walking down and mulching shrubs and small-diameter trees at ground level. Intact root systems and seed beds with little soil disturbance facilitate rapid regeneration of vegetation. Use of snow padding or matting can limit the need for cutting or mowing shrubs and small trees, thereby speeding regeneration of native vegetation. The extent of minimum disturbance construction might be limited by scheduling to avoid the restricted timing window for caribou (January 15 to July 15). Soil conditions limit the applicability of minimum disturbance construction methods. Construction in well to moderately drained sites during non-frozen conditions requires grubbing and grading to salvage surface soils so they can be stored separately from subsoils and replaced following construction. This prevents admixing and loss of the productive surface soils that facilitate regeneration of vegetation.	Minimum disturbance construction is a suitable CHRP measure for the Project, and will be implemented where scheduling and soil conditions (e.g., frozen) allow.
Transplanting	Habitat Restoration Access control Line of sight blocking	Transplanting has the advantage of immediately establishing relatively large trees/shrubs (e.g., saplings). There are limitations to 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). Other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison (Golder 2012a). See Section 8.6.2 for more details.	Transplanting native vegetation is not a suitable CHRP measure for the Project as it has been shown to be a difficult technique to implement on a large scale, with multiple limitations. This technique could prove more suitable for future projects if advances in the method improve survival success rates.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Tree felling or bending	Access control Habitat Restoration Line of sight blocking	Mechanically bending or felling live trees onto a linear disturbance has been tested as a measure to restore habitat and manage access on seismic lines in caribou range (COSIA 2012).Trees are typically bent or felled from both sides of the linear disturbance. Tree felling involves deliberately felling trees over the linear disturbance. It does not require specialized machinery. Tree bending requires specialized machinery to mechanically bend live stems over the linear disturbance. Mechanical tree bending can be expensive and time consuming. These measures are often used in conjunction with other restoration techniques such as mounding and conifer seedling planting. Tree felling/bending is only initially being evaluated and its utility remains unverified (Neufeld 2006). It is recommended that if tree felling is to be used as a line of sight blocking measure, it should be investigated more thoroughly, and not solely be relied on as a mitigation tool (Neufeld 2006). Preferably, line of sight blocking with tree felling (or tree bending) should be used in combination with other management actions such as habitat restoration (Neufeld 2006), and continue to be evaluated for effectiveness using an adaptive management approach. Tree felling/bending can promote natural revegetation by increasing cone deposition onto the ROW, creating microsites through shading and dropped dead woody debris, and protecting planted seedlings from extreme weather, wildlife trampling and damage from access. Application in pipeline ROWs might be limited due to the width (i.e., much wider than typical seismic lines where tree bending/felling has previously been implemented). Furthermore, NGTL has narrowed the construction ROW for the Project to minimize the footprint as much as site conditions and construction requirements allow, leaving inadequate space for tree retention along the edges of the footprint for tree felling. Provided regulatory permitting (e.g., temporary field authorization to fell trees adjacent to the approved construction ROW) could be obtained, this measure could be a valid option for non-contiguous portions of the Project footprint.	Tree felling might be an option for the CHRP; however, due to the uncertainty of its effectiveness and limitations to application to pipeline ROWs, its use will be on a limited and/or trial basis for the Project. Another consideration for tree felling is the amount of available trees that can be used for the technique and that will be determined after final construction. Tree bending is not a suitable CHRP measure for the Project, given constraints associated with specialized machinery and time necessary to implement. As well, this technique is still being studied and as new research on the technique emerges, it could be considered for future projects.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
Tree/shrub seeding	Habitat Restoration Access control Line of sight blocking	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 ROWs 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 might 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. Predation of conifer seed might be a problem when this technique is used for reforestation (BC MOF 1997).	Seeding is not a suitable CHRP measure, given logistical constraints (i.e., availability of native seed, accessibility of seeding equipment), likelihood of native seed ingress from vegetation in the adjacent undisturbed areas and predation of seed.
~~Woody~~Coarse woody debris	Access control Habitat restoration Reduce Line of Sight	Coarse woody debris rollback might be used for access ~~management~~control and to enhance restoration of natural habitat characteristics (e.g., conserve soil moisture, moderate soil temperatures, provide nutrients as debris decomposes, prevent soil erosion, provide microsites for seed germination and protection for introduced tree seedlings [Pyper and Vinge 2012; Vinge and Pyper 2012]). Mulch depths less than 3 cm are preferred to avoid limiting natural ingress and vegetation growth (Pyper and Vinge 2012; Vinge and Pyper 2012).	Woody debris rollback is a suitable CHRP measure for the Project.

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
~~Woody~~Coarse woody debris (cont'd)	Access control Habitat restoration Reduce Line of Sight (cont'd)	Coarse woody debris should be spread evenly across the entire footprint width at a coverage/density that will not restrict ability to plant seedlings or limit planted or natural seedling growth. Woody debris should be applied at a density/volume that does not exceed 400 t/ha to deter access (Osko and Glasgow 2010). Where sufficient material is available, woody debris coverage can range from 60-100 m^3/ha on upland sites and 25-50 m^3/ha on lowland sites, to mimic natural processes (Pyper and Vinge 2012; Vinge and Pyper 2012). Where sufficient material is available, woody debris coverage of 150-250 m^3/ha along ROWs might be appropriate to manage access (Vinge and Pyper 2012). Research presented at the North American Caribou Workshop (2014) suggested that application of high densities (200 m^3/ha) of salvage logs (i.e., rollback) at linear feature intersections reduces human use of the intersection by 100%, wolf use by 90%, and deer use by 50%. NGTL has found on previous caribou habitat restoration projects that coverage ranging from 200-300 m^3/ha can deter access while allowing sufficient spaces between the debris to allow seedling planting. Rollback can be effective immediately following implementation, provided adequate material is available and properly applied (Vinge and Pyper 2012). The implementation and length of a rollback segment is dependent on sufficient quantities of coarse woody debris during clearing of new disturbance and the tradeoff between its use and the ability/space to store it during construction (CRRP 2007b). Long rollback segments are more effective at managing human access because ATV riders will be less inclined to try to ride through the debris or traverse around it in adjacent forest stands. Sections of rollback ≤100 m long might not be effective at deterring motorized access (Vinge and Pyper 2012). An expert opinion survey cited 400 m long rollback segments as sufficient length (Golder 2007). NGTL has found on previous caribou habitat restoration projects that material availability often limits the segment length that can be achieved to 50–100 m (approximately 75 m on average). Fire risk is a consideration when using or storing materials for rollback. Fire risk can be minimized through proper storage and placement of materials (Pyper and Vinge 2012; Vinge and Pyper 2012). A 25 m rollback-free fuel break placed at 250 m intervals along rollback segments is suggested (Pyper and Vinge 2012).	

Table 5-3: Habitat Restoration Measures (cont'd)

Restoration Measure	Objectives	Rationale	Comments
~~Woody~~Coarse woody debris (cont'd)	Access control Habitat restoration Reduce Line of Sight (cont'd)	Coarse woody debris rollback blocks constructed at 500 m intervals can be used as reducing line of sight measures. To allow operational access, the blocks consist of three segments placed in a staggered pattern approximately 10 m apart. Guidelines for application of rollback where materials are available recommend placement of rollback across the entire pipeline/easement width for a distance of at least 200 m from all points of intersection with wellsites, plant sites, roads and permanent watercourses (AER 2013). NGTL has found on previous caribou habitat restoration projects that material availability often limits the segment length that can be achieved to 50–100 m (75 m on average). Fire risk is a consideration when using or storing materials for rollback. Fire risk can be minimized through proper storage and placement of materials (Pyper and Vinge 2012). A 25 m rollback-free fuel break placed at 250 m intervals along rollback segments is recommended by the *Integrated Standards and Guidelines for the Enhanced Approval Process* (AER 2013).	Woody debris rollback is a suitable CHRP measure for the Project.

Site-specific caribou habitat restoration measures implemented for the Project will be described in the Final CHRP, which will include maps or Environmental Alignment Sheets showing the locations of selected sites.

For an illustrative table showing site-specific restoration methods and location details that may be included in the Final CHRP, see Appendix B. The Final CHRP table will also include the rationale for restoration measure selection, additional site-specific details to inform implementation and implementation status. Accomplishments and lessons learned from implementing and monitoring NGTL's other caribou habitat restoration initiatives will be included in the Final CHRP, and will inform the rationale for selection of restoration methods and locations. The Final CHRP will also include specification drawings of the restoration measures, in accordance with Condition 16 b (iii).

5.3.1 Natural Regeneration

Minimum disturbance construction is a promising approach for promoting native vegetation re-establishment. Minimal disturbance procedures relate to the removal of vegetation, work area preparation and clean-up activities associated with construction of the Project. The objective of this construction technique is to minimize impacts on the soils and vegetation substructure, with the goal of allowing the Project footprint to re-vegetate to a similar pre-construction condition, subject to land-use guidelines specific to the disposition. NGTL will, therefore, implement minimal disturbance construction techniques to facilitate natural regeneration to restore habitat along the ROW. This construction technique is restricted to areas where grading is not required. Stripping and grading will be required in areas of significant cross-fall of the ROW (i.e., greater than 1.0 m), irregular ground profile along the pipeline, and at tie-in sites (road bores and pipeline crossings). Minimal disturbance installation is most suitable for straight pipe installation.

5.3.2 Tree Planting

Established reclamation and forestry reforestation practices will be applied to promote revegetation where natural regeneration might not achieve the quantifiable targets. Restoration measures that incorporate tree planting techniques, such as site preparation (e.g., mounding) and planting trees/shrubs, will be considered where site conditions allow (including construction methods and level of disturbance).

For a summary of habitat types that will be disturbed in caribou habitat as a result of the Project footprint, see Table 5-4 (Aitken Creek Section) and Table 5-5 (Kahta Section).

Table 5-4: Aitken Creek Section – Habitat Types in Graham Caribou Range

Habitat Types	TEM Unit/Ecosystem Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree ~~Species~~Species[4]	Area (ha)	Percent of Total (%)
Aitken Creek Section – Graham Caribou Range					
Upland/Transitional – Conifer	Black spruce–lingonberry – coltsfoot	BWBSmw-04	Pl(Sb)	4.5	12.5
	White spruce – trembling aspen – step moss	BWBSmw-01	Sw, At, Pl, Ep, Acb	7.6	20.9
Upland/Transitional – Deciduous	Trembling aspen – creamy peavine	BWBSmw-01$	At	9.9	27.1

~~**Table 5-4: Aitken Creek Section – Habitat Types in Graham Caribou Range (cont'd)**~~

~~Habitat Types~~	~~TEM Unit/Ecosystem Description[1]~~	~~BEC Subzone-Site Series[2]~~	~~Leading Tree Species~~	~~Area (ha)~~	~~Percent of Total (%)~~
Riparian	Mountain alder – common horsetail	BWBSmw-Fl01	-	1.0	2.6
	Cottonwood – spruce – red-osier dogwood	BWBSmw-Fm02	Sb/Sw, Acb	<0.1	<0.1
Treed Wetland	Black spruce – lingonberry – peat moss	BWBSmw/BWBSwk-Wb03	Lt, Sb	0.4	1.0
	Tamarack – water sedge – fen moss	BWBSmw-Wb06	Lt	<0.1	0.1
Non-Vegetated	Exposed soil	-	-	0.4	1.2
	Gravel bar	-	-	0.1	0.3
	River	-	-	<0.1	0.2
	Rock outcrop	-	-	0.2	0.6
Anthropogenic	Cultivated field	-	-	3.6	9.9
	Corridor and/or industry-related disturbance	-	-	5.1	13.9
	Rural	-	-	0.9	2.4
	Road surface	-	-	1.2	3.2

Note:
1 TEM was completed as part of the Project Application (Stantec 2013). The area and percentage calculations are based on the entire TEM polygon (i.e., the deciled TEM polygon data are assumed to be reflective of the area and percent of ecosystem units affected by the Project footprint).
2 Site series are derived from TEM data (Stantec 2013) based on *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*, *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region* and *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia Land Management Handbooks* (DeLong 2004, DeLong et al. 1990, DeLong et al. 2011). The "$" denotes seral stage, indicating early seral communities, usually deciduous-dominated.
3 Cutblocks are incorporated in the TEM unit classifications (site series).
4 Tree codes: Acb – balsam poplar; At – trembling aspen; Ep – common paper birch; Lt – tamarack; Pl – lodgepole pine; Sb – black spruce; Sw – white spruce.
5 Wetland codes: Fl and Fm – flood association; Wb – bog; Wf – fen; Ws – swamp.

Table 5-5: Kahta Section – Habitat Types in Pink Mountain Caribou Range

Habitat Types	TEM Unit/Ecosystem Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree ~~Species~~Species[4]	Area (ha)	Percent of Total (%)
Kahta Section - Pink Mountain Caribou Range					
Upland/Transitional – Conifer	White spruce–trembling aspen – step moss	BWBSmw-01	Sw, At, Pl, Ep, Acb	0.6	0.7
	Black spruce – lingonberry – coltsfoot	BWBSmw-04	Pl(Sb)	35.7	44.7
	White spruce – currant – horsetail	BWBSmw-07	Sw	1.3	1.6
Upland/Transitional – Conifer	White spruce – huckleberry – step moss	BWBSwk2-01	Sw, Pl	9.7	12.1
	Lodgepole pine – lingonberry – velvet-leaved blueberry	BWBSmk-02	Pl, At, Sb, Sw	<0.1	<0.1

~~**Table 5-5: Kahta Section – Habitat Types in Pink Mountain Caribou Range (cont'd)**~~

~~Habitat Types~~	~~TEM Unit/Ecosystem Description[1]~~	~~BEC Subzone-Site Series[2]~~	~~Leading Tree Species~~	~~Area (ha)~~	~~Percent of Total (%)~~
~~Kahta Section - Pink Mountain Caribou Range (cont'd)~~					
Upland/Transitional – Deciduous	Trembling aspen – creamy peavine	BWBSmw-01$	At	0.1	0.2
	Trembling aspen – highbush cranberry	BWBSwk2-01$	At	2.3	2.8
	Trembling aspen – Labrador tea	BWBSmw-04$	At	1.0	1.2
	Trembling aspen – Labrador tea – lingonberry	BWBSwk2-03$	At	0.3	0.4
Riparian	Mountain alder – common horsetail	BWBSmw-Fl01	–	0.7	0.9
	Bebb's willow – mountain alder – bluejoint swamp	BWBSmk-Ws03	–	0.3	0.4
	Scrub birch – willow – water sedge fen	BWBSmk/BWBSmw/BWBSwk2-Wf02	–	<0.1	<0.1
Treed Wetland	Black spruce– lingonberry – peat moss	BWBSmk/BWBSmw/BWBSwk2-Wb03	Lt, Sb	17.9	22.4
	Tamarack – water sedge – fen moss	BWBSmk/BWBSwk2-Wb06	Lt	< 0.1	< 0.1
Graminoid/ Shrub Wetland	Water sedge – beaked sedge fen	BWBSmk/BWBSmw/BWBSwk2-Wf01	–	0.5	0.6
Non-Vegetated	Cutbank	–	–	0.1	0.1
	Exposed soil	–	–	0.3	0.4
	River	–	–	<0.1	<0.1
Anthropogenic	Corridor and/or industry-related disturbance	–	–	7.1	8.9

	~~Reservoir~~	~~–~~	~~–~~	~~0.3~~	~~0.4~~
	~~Road surface~~	~~–~~	~~–~~	~~<0.1~~	~~<0.1~~

Table 5-5: Kahta Section – Habitat Types in Pink Mountain Caribou Range (cont'd)

Habitat Types	TEM Unit/Ecosystem Description[1,3]	BEC Subzone-Site Series[2,5]	Leading Tree Species[4]	Area (ha)	Percent of Total (%)
Kahta Section - Pink Mountain Caribou Range					
Anthropogenic (cont'd)	Reservoir	–	–	0.3	0.4
	Road surface	–	–	<0.1	<0.1

Note:

1 TEM was completed as part of the Project Application (Stantec 2013). The area and percentage calculations are based on the entire TEM polygon (i.e., the deciled TEM polygon data are assumed to be reflective of the area and percent of ecosystem units affected by the Project footprint).

2 Site series are derived from TEM data (Stantec 2013) based on *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*, *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region* and *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia Land Management Handbooks* (DeLong 2004, DeLong et al. 1990, DeLong et al. 2011). The "$" denotes seral stage, indicating early seral communities, usually deciduous-dominated.

3 Cutblocks are incorporated in the TEM unit classifications (site series).

4 Tree codes: Acb – balsam poplar; At – trembling aspen; Ep – common paper birch; Lt – tamarack; Pl – lodgepole pine; Sb – black spruce; Sw – white spruce.

5 Wetland codes: Fl – flood association; Wb – bog; Wf – fen; Ws – swamp.

Implementation targets and specifications for habitat restoration (e.g., seedling planting densities, mounding densities) will be designed to meet the quantifiable targets for the CHRP. These will be informed by available guidelines and standards (see Section 8), NGTL's experience implementing caribou habitat restoration measures and complementary research.

For the planting prescription for each habitat type, see the Quantifiable Targets column in Table 4-1. The quantifiable targets and performance measures in Table 4-1 should be considered preliminary and subject to change. The restoration methods and targets will be affected by variables such as extent of grading, construction method and availability of shared workspace and access.

The proposed habitat restoration quantifiable targets are designed to demonstrate restoration success in terms of survival and sustained growth trends of conifer and deciduous trees within 10 years following completion of restoration. These targets are to be met over the portion of the Project footprint available for restoration (i.e., excluding overlap with third-party developments or operational access outside planted areas).

5.4 ACCESS CONTROL

Access control principles outlined in this CHRP were guided by the Project's AMP. The goals of access control for the Project in caribou habitat are to:

- manage access along the pipeline ROW in a manner that discourages all forms of access
- maintain accessibility necessary for safe pipeline operations compliant with applicable regulations and guidelines
- maintain existing access at identified locations (e.g., third-party industry access, traditional access identified by Aboriginal communities through engagement activities)

5.4.1 Baseline Data on Access Control

Geographic Information System (GIS) will be used to mark selected locations of monitoring plots in order to establish the baseline assessment for this Project. The locations will be chosen based on a review of the Project's construction alignment sheets and proposed access control treatment locations.

Based on early review of the Project's spatial configuration, 32 existing linear features (for example, seismic lines, utilities corridors or roads) have been identified that intersect with the Project ROW. NGTL will control access where the Project intersects active crossings, and will assess these areas as potential treated sites.

An assessment of these potential control sites will include the deployment of Reconyx remote cameras over a six week period. However, several of the sites cross wetlands with little or no trees and may not be good candidates for access control treatments. NGTL intends to deploy cameras prior to construction in order to collect baseline data. The Final CHRP will outline a detailed review of the baseline access study and further detail the final locations of the monitoring plots.

5.4.2 Access Control Measures

Access control measures are most effective when implemented on non-contiguous segments of the Project ROW, and at intersections of the pipeline portion of the Project ROW with existing perpendicular linear features (e.g., roads, utility corridors, seismic lines). Quantifiable targets and criteria used to evaluate the effectiveness of access control measures will align with those in the CHROMMP.

Access control measures considered for the Project, but not necessarily utilized, include:

- vegetation screens
- rollback
- fencing and signs
- vegetation planting
- mounding
- installation of berms
- tree felling over the ROW

Rollback, mounding and planting vegetation will be the key access control measures implemented for the Project. Some of these measures might not be selected for final restoration because of site-specific conditions. For example, lack of materials necessary for the installation of berms could limit the applicability of berm installation for this Project.

NGTL has engaged the British Columbia Oil and Gas Commission (BC OGC) and BC MFLNRO regarding use of merchantable timber for access management purposes in caribou ranges. BC MFLNRO has indicated that merchantable timber may be used for rollback for the Project with the following provisions (to which NGTL has agreed):

- Provide BC OGC and BC MFLNRO with the locations of proposed access management areas.
- Identify if any mitigation measures will be required for fire hazard abatement.
- Identify if any mitigation measures will be required for forest health issues.
- Identify how merchantable timber will be accounted for post clearing.

Locations for access control measures on the pipeline ROW will focus on intersections with other linear features, such as roads, utility ROWs, seismic lines or watercourses and non-contiguous sections of the ROW. NGTL might install signs at select locations to discourage access.

5.5 LINE OF SIGHT BLOCKING

Line-of-sight blocks include planting vegetation (e.g., tree planting or willow staking), fabricated site screens and minimal disturbance construction to preserve vegetation. Line-of-sight blocks will be implemented in locations with sightlines >500 m, particularly where they intersect with existing road access. Trees will be planted in an alternating pattern across the pipeline centreline along portions of the ROW. Specifically, trees will be planted across the centreline with open vegetation left at alternating sides of the ROW along some sections. This alternating vegetation pattern will create a line-of-sight break. Details on exact configuration of seedling planting to achieve line-of-sight breaks depend on as-built location of the pipe centreline and adjacent linear disturbances.

Measures to reduce sightlines might discourage access and might also decrease predator efficiency. In nature, sightlines are often longer in more open habitats of lowland muskeg communities compared with upland forest communities. As a result, line-of-sight distances can vary, depending on the location and structure of the adjacent vegetation community. In forested areas of the Project footprint where sightlines are 500 m long or more line-of-sight blocks will be established.

Operating practices for energy development in sensitive caribou range in British Columbia (BC Ministry of Environment 2011) suggest implementing line-of-sight management every 500 m on linear features that do not share a ROW boundary with a road. Line-of-sight blocking as part of this Project will follow this guideline where it is not co-located with roads or other linear developments.

NGTL has implemented 500 m line-of-sight breaks to be consistent across provincial boundaries regardless of the location of the pipeline segment and has incorporated this approach in other Project CHRPs. Previously, NGTL attempted to apply the line of sight and access control features on the landscape as suggested in the Alberta Energy Regulator (AER) Enhanced Approval Process (EAP); however, it has become apparent that over the course of implementing those features on other NGTL projects that impact caribou habitat (Leismer, NWML, Chinchaga) meeting the recommended intervals was not feasible. In particular, recent field experience on the Chinchaga Section provided several examples of why these features cannot be applied at EAP recommended intervals. For lessons learned on other NGTL projects about implementing line of sight blocking intervals see Section 6.3.

As science is still emerging in this area, the long term monitoring of this and other NGTL CHRP measures will be modified based on monitoring results to determine the appropriate line-of-sight breaks.

Topography bends in the ROW, minimum disturbance construction to preserve vegetation and willow staking create immediate line-of-sight blocks (i.e., create visual barriers after restoration activities are implemented). Line-of-sight measures such as tree plantings will be implemented in areas where sightlines are not blocked by terrain or bends. Planting at staggered intervals across the pipeline centreline will establish these 500 m line-of-sight breaks in the long term.

The exact locations for implementing line-of-sight breaks will be determined after construction and presented in the Final CHRP.

5.6 MONITORING AND ADAPTIVE MANAGEMENT

NGTL will create a CHROMMP for the Project to monitor effectiveness of planned habitat restoration measures that will be fully described in the Final CHRP. Adaptive management, i.e., the systematic process of monitoring and assessing outcomes and modifying restoration measures if necessary, will be implemented by adjusting and/or supplementing restoration measures, where warranted, to achieve the objectives of the CHRP.

Given that science is still emerging on caribou habitat restoration methods and effectiveness, adaptive management principles will be an important means of addressing uncertainty.

Adaptive management might be necessary to address uncertainty relating to planting trees in mountain caribou range. There might be soil limitations (e.g., poor nutrients and drainage, soil temperatures) that do not support tree seedling establishment without silvicultural site preparation (e.g., mounding). If seedling survival rates and/or sustained growth trends are not meeting the quantifiable targets (i.e., poorly understood planting conditions in higher-elevation habitat) this measure might need to be re-evaluated considering site-specific conditions.

Monitoring will be conducted on each pipeline segment for up to 10 years, starting one year after CHRP measures have been implemented. At each monitoring interval, performance measures will be evaluated and compared with quantifiable restoration targets. If measures indicate that restoration has achieved or is on a trajectory to achieving targets, no further restoration measures will be undertaken. If, however, at any point in the monitoring program evaluations indicate that targets are unlikely to be achieved after 10 years, restoration measures must be adjusted and additional monitoring (longer than 10 years) added.

This could include implementation of existing restoration measures or new measures, discovered through research or industry practice, that are proving to be successful. For example, NGTL is engaged in linear feature restoration research with the Regional Industry Caribou Collaboration in northeastern Alberta and lessons learned from this research can be applied to the Project.

Monitoring results, as well as any necessary adaptive management actions, will be reported to the NEB, EC and BC MFLNRO following the end of each monitoring interval.

Habitat restoration measures that require adaptive management at the conclusion of the 10 year monitoring program will require additional ground-based monitoring until they are successful. If adaptive management actions fail, a revised monitoring program and timeframe will be developed to address unsuccessful measures.

This Preliminary CHRP ~~include~~includes brief descriptions of the restoration targets and how they will be measured. The Final CHRP will detail the actual habitat restoration methods implemented and their locations in the Project footprint for each pipeline segment. The residual disturbance to critical caribou habitat resulting from the Project will be calculated and finalized in an OMP for Aitken Creek. Specific details on the quantitative framework of the monitoring program ~~methods~~, frequency, timing and locations will be included in the CHROMMP. The CHROMMP will describe a comprehensive monitoring program for Project CHRP measures and potential offset areas, as finalized in the OMP, to compensate for residual effects in caribou habitat.

5.7 QUANTITATIVE FRAMEWORK

NGTL will implement a monitoring program to verify the effectiveness of CHRP and OMP, which will be prepared pursuant to Condition 36, measures and plans to integrate monitoring outcomes into future decision-making as part of a continual improvement process. The monitoring program will employ a quantitative framework using both aerial and ground-based sampling protocols to assess the effectiveness of habitat restoration, access control and line of sight blocking measures. As discussed above, specific details concerning the monitoring program methods will be discussed in the CHROMMP, which will be prepared pursuant to Condition 37. The following provides a brief example of the quantitative framework used to assess habitat restoration effectiveness (i.e., revegetation) in upland/transitional coniferous forest as a preliminary guide.

5.7.1 Experimental Design

A one-way repeated measures experimental design will be used to evaluate restoration effectiveness for each individual habitat type separately due to the inherent differences associated with their biophysical characteristics. Repeated measure designs are generally preferred over other factorial designs as they improve the precision of estimates derived on the response variable (Montgomery 2001; Kuehl 2000). Quantifiable targets associated with each restoration measure collected during the monitoring program will be repeated at each monitoring plot location for each monitoring year. The experimental design is represented by the following model:

$$y_{ik} = \mu + \alpha_i + \tau_j + \varepsilon_{ij}$$

where y_{ik} is the estimated response of the quantifiable target, μ is the overall mean, α_i is the effect of each monitoring year, τ_j is the effect of each monitoring plot and ε_{ij} is the natural variability (i.e., error) (Montgomery 2001). The model term τ_j denotes the repeated measure effect associated with each monitoring plot, each monitoring year. The degree to which restoration measures achieve their respective targets will be determined by a positive difference of the mean for each quantifiable target between each monitoring year, where the first monitoring year will act as a baseline.

5.7.2 Results

Table 5-6 provides an example subset of data for upland/transitional coniferous forest with vegetation height (m) as the quantifiable target. To illustrate the proposed repeated measure design, statistical analysis and results, the following example in Table 5-6 is demonstrated for five sample plots across five monitoring years.

Table 5-6: Example Data Subset for Upland/Transitional Coniferous Forest (Vegetation Height)

Monitor Plot ID	Habitat Type	Description	Location (KP)	Monitoring Year	Vegetation Height (m)
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	1	0.19
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	1	0.13
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	1	0.15
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	1	0.19
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	1	0.16
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	2	0.22
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	2	0.16
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	2	0.22
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	2	0.26
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	2	0.27
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	3	0.41
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	3	0.48
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	3	0.49
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	3	0.40
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	3	0.40
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	4	1.20
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	4	1.12
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	4	1.32
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	4	1.41
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	4	1.36
Liege U 1	Upland/Transitional Coniferous	Pl, Sw	3 + 350	5	2.10
Liege U 2	Upland/Transitional Coniferous	Pl, Sw	18 + 875	5	2.23
Liege U 3	Upland/Transitional Coniferous	Pl, Sw	27 + 850	5	2.56
Liege U 4	Upland/Transitional Coniferous	Pl, Sw	32 + 425	5	2.80
Liege U 5	Upland/Transitional Coniferous	Pl, Sw	34 + 300	5	2.65

Habitat restoration is achieved when a positive increase in mean vegetation height is observed between the first monitoring year (i.e., baseline) and each subsequent monitoring year. As such, the analysis focuses on the mean difference in vegetation height for the fixed effect monitoring year, with monitoring plots treated as random effects to control for natural variability associated with each monitoring plot.

Table 5-7 provides a summary of the model output and pairwise comparisons used to identify differences in mean vegetation height between the first monitoring year and each subsequent monitoring year. In the example, a significant difference is observed for the fixed effect monitoring year (p<0.001). Pairwise comparisons of mean vegetation height (m) between the first monitoring year and each subsequent year demonstrate a positive increase in mean vegetation height between each monitoring year, with the exception of the second monitoring year (p=0.940). Ongoing review and monitoring comparisons will be integral in determining if vegetation targets can be met and then can be used in effectiveness determination.

Table 5-7: Example Results for Upland/Transitional Coniferous Forest (Vegetation Height)

Model Output

Factor	Type	Levels Values
Monitoring Year	Fixed	1, 2, 3, 4, 5
Monitor Plot ID	Random	Liege U 1, Liege U 2, Liege U 3, Liege U 4, Liege U 5

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Monitoring Year	4	19.073	4.7683	282.80	**<0.001**
Sample Plot ID	4	0.1493	0.0373	2.21	0.113
Error	16	0.2698	0.0168		
Total	24	19.492			

Pairwise Comparisons of Mean Vegetation Height (m)

Monitoring Year	N	Mean Vegetation Height	Grouping
5	5	2.468	A
4	5	1.282	B
3	5	0.436	C
2	5	0.226	CD
1	5	0.164	D

Means that do not share a letter are significantly different.

Monitoring Year Comparison	SE of of Means	Simultaneous Difference	Adjusted 95% CI	T-Value	P-Value
2 – 1	0.062	0.0821	(-0.1894, 0.3134)	0.75	0.940
3 – 1	0.272	0.0821	(0.0206, 0.5234)	3.31	**0.031**
4 – 1	1.118	0.0821	(0.8666, 1.3694)	13.61	**<0.001**
5 – 1	2.304	0.0821	(2.0526, 2.5554)	28.06	**<0.001**

~~5.7~~5.8 SCHEDULE

Scheduling and logistical coordination before restoration implementation for each pipeline segment will consider seasonal access constraints, critical timing periods for caribou (see Section 5.7.1) and other valued components, production of nursery seedlings and appropriate timing for restoration efforts (e.g., season of planting).

Final cleanup will occur the summer/winter season following construction. As-built construction information will be compiled following construction and used to determine appropriate site-specific restoration measures and access management locations. Final site selection for caribou habitat restoration treatments will be completed during the first growing season following construction.

For the proposed schedule for construction and habitat restoration activities, see Table 5-~~6~~8 and Table 5-~~7~~9.

~~5.7.1~~5.8.1 Caribou Timing Windows

There are multiple regulatory guidance documents for BC that identify timing windows that apply to caribou herds that overlap with the Project. The *Peace Region Least-Risk Timing Windows, April 2011 Update* (BC MFLNRO 2011) defines timing windows for northern ecotype caribou:

- **Low Risk:** July 16 to September 14 – Restrictions would not normally apply. Where ground conditions permit, plan development activities within these timeframes.
- **Cautionary:** September 15 to January 14 – Operators should avoid development activities during these timeframes.
- **Critical:** January 15 to July 15 – Development activities are not appropriate during this timeframe. Aerial activities should adhere to guidelines. In the event that working within a critical timing window is unavoidable, proponent should contact an appropriate qualified professional (e.g., Registered Professional Biologist with BC accreditation) to discuss alternatives, and potential mitigation and monitoring plans.

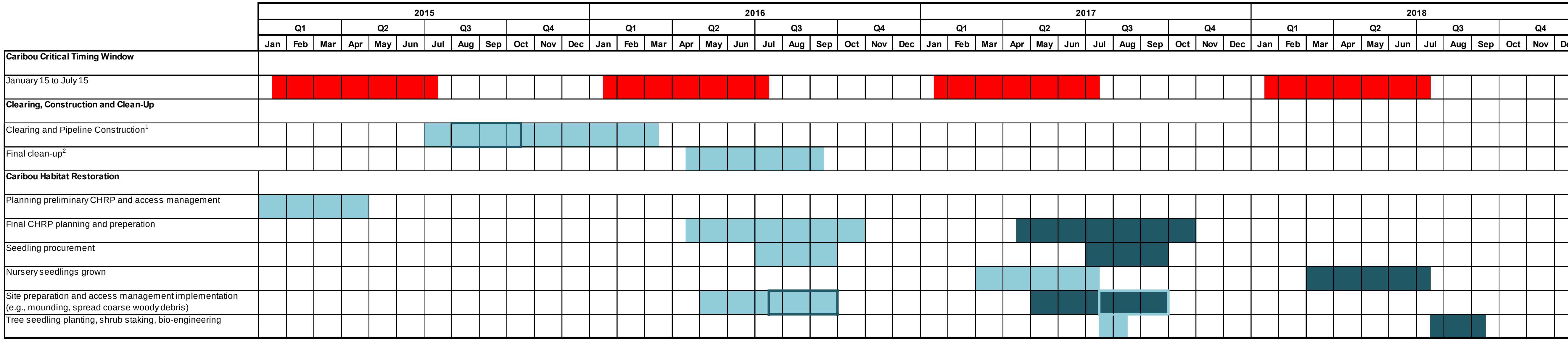
The recently released *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Interim Guidance)* (BC MFLNRO 2014) presents the same timing windows as the BC MFLNRO 2011 document, but includes an additional critical timing window for northern ecotype caribou that relates to the migration period (April 1 to May 20 and December 1 to January 1; BC MFLNRO 2014). There are no identified migration corridors for caribou in proximity to the Project in either the Graham or Pink Mountain caribou ranges.

NGTL's intent is to apply the January 15 to July 15 critical timing window described by BC MFLNRO (2011, 2014). The NEB Report for the Project requires that NGTL proactively plan construction activities in caribou ranges in compliance with provincial and federal timing restrictions. NGTL will file construction progress reports with the NEB pursuant to Condition 27. These progress reports will include information on any mitigation implemented to complete construction activity outside the critical timing window.

To minimize the potential need for work to occur within the critical timing window in the Graham and Pink Mountain caribou ranges, NGTL will potentially increase construction manpower or use alternate equipment (e.g., wheel ditcher in place of a hoe) to increase productivity, where feasible to do so. NGTL's ability to implement these measures might be affected by factors beyond NGTL's control, such as adverse weather conditions.

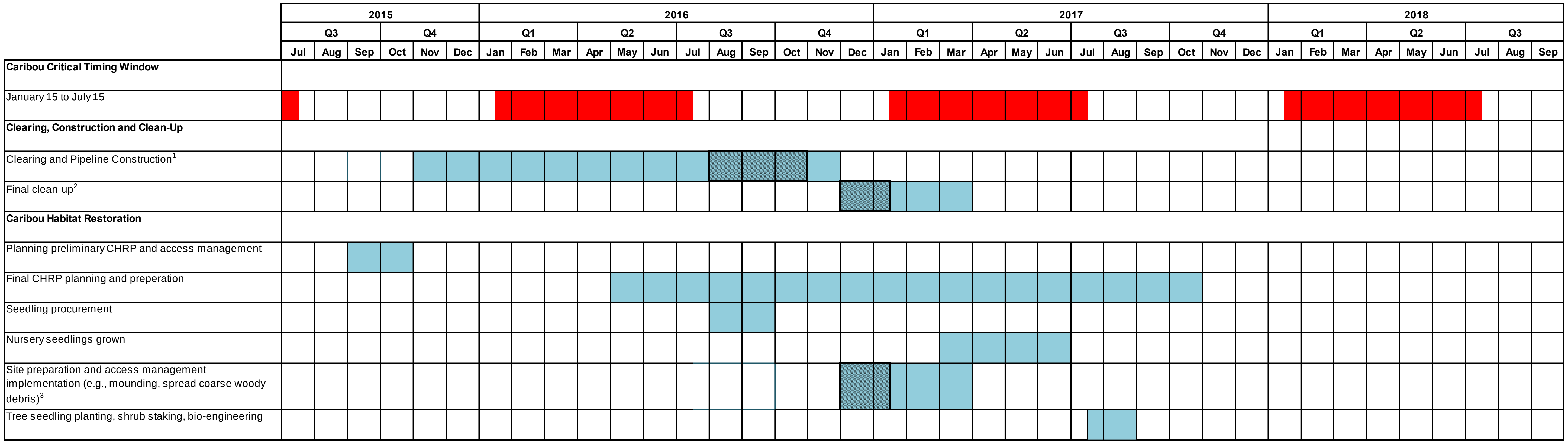
Depending on logistical constraints and site conditions, habitat restoration efforts are expected to be completed during the first or second growing season following final cleanup. These activities are part of the post construction phase, and will be scheduled outside the critical timing window for caribou in the Graham and Pink Mountain caribou ranges.

Table 5-7: North Montney Aitken Creek Section – Graham Caribou Range – Proposed Construction and Habitat Restoration Preliminary Schedule



Notes:

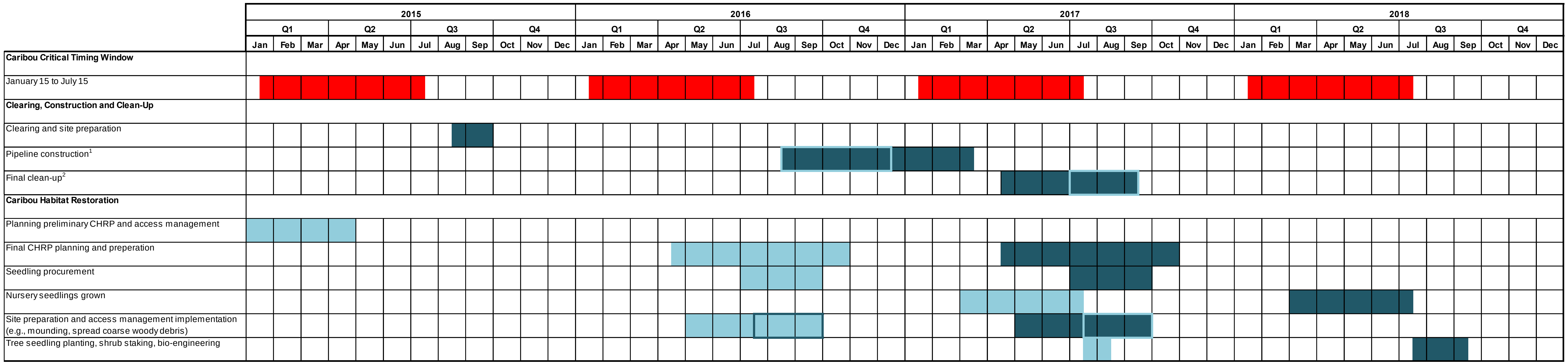
1. Camp infrastructure construction is scheduled to begin July 2015. Project construction is scheduled between August 2015 and April 2016; construction work will be prioritized within the Graham Caribou range between August and October 2015.
2. Project final clean-up is scheduled between May and September 2016; clean-up work will be prioritized within the Graham Caribou range between July 15 and September 2016.



Notes:

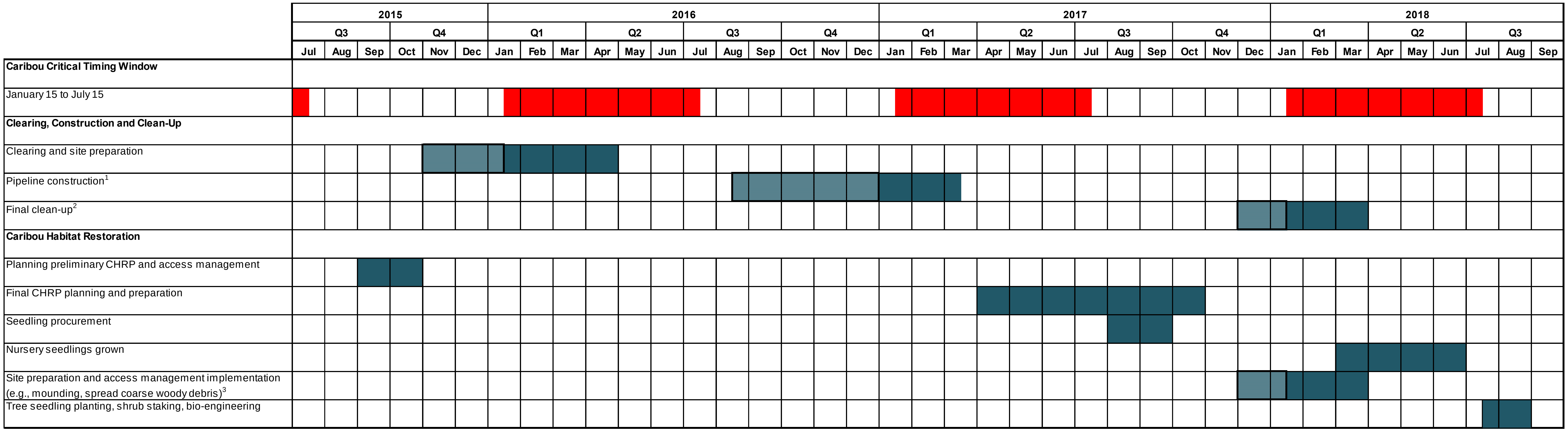
1. Project construction is scheduled between November 2015 and November 2016; construction work will be prioritized within the Graham Caribou range between August and October 2016.
2. Project final clean-up is scheduled between December 2016 and March 2017; clean-up work will be prioritized within the Graham Caribou range between December 2016 and January 15, 2017.
3. Site preparation and access management implementation will be prioritized within the Graham Caribou range between December 2016 and January 15, 2017.

Table 5-8: North Montney Kahta Section – Pink Mountain Caribou Range – Proposed Construction and Habitat Restoration Preliminary Schedule



Notes:

1. Project construction is scheduled between September 2016 and April 2017; construction work will be prioritized within the Pink Mountain Caribou range between September and December 2016.
2. Project final clean-up is scheduled between May and September 2017; clean-up will be prioritized within the Graham Caribou range between July 15 and September 2017.



Notes:

1. Project construction is scheduled between August 2016 and April 2017; construction work will be prioritized within the Pink Mountain Caribou range between August and December 2016.
2. Project final clean-up is scheduled between December 2017 and March 2018; clean-up will be prioritized within the Pink Mountain Caribou range between December 2017 and January 15, 2018.
3. Site preparation and access management implementation will be prioritized within the Pink Mountain Caribou range between December 2017 and January 15, 2018.

6.0 CONTINUOUS IMPROVEMENT

In regards to caribou habitat restoration, NGTL is committed to continuous improvement. Continuous improvement will come from NGTL's analysis in the short, near, and long term of applied practice, the monitoring program and pure research.

This section describes caribou habitat restoration initiatives, industry collaboration and lessons learned by NGTL on other projects that impacted caribou habitat. Because of NGTL's commitment to continuous improvement, NGTL will continue to monitor all of the aforementioned components and incorporate learnings into its caribou habitat restoration efforts.

This Preliminary CHRP has incorporated updated results from:

- ongoing literature assessment
- research completed by industry associations
- lessons learned from previous NGTL projects
- consultation with applicable regulators and resource managers
- adaptive management practices in the field

Most of the updated results from these sources reference boreal caribou. Since there is little research applicable to mountain caribou in the area affected by the Project and boreal and mountain caribou are the same species, boreal caribou data will be used to inform mountain caribou restoration and monitoring plans for the Project. The monitoring program developed for the Project will add to the emerging database on mountain caribou habitat restoration.

For a list of historic and current habitat restoration initiatives, see Appendix C.

6.1 CARIBOU HABITAT INITIATIVES

This section summarizes caribou habitat restoration initiatives planned or implemented in woodland caribou ranges. Given the limited available information specific to northern and mountain caribou range restoration, this section includes identification of temporal and spatial caribou habitat restoration methods compiled from boreal caribou ranges. Boreal woodland caribou habitat restoration provides context and lessons learned from caribou habitat restoration initiatives that have been implemented in the recent past, and where available, monitoring results and effectiveness of measures. As the monitoring program progresses for this Project in northern caribou range, lessons learned and emerging data will be incorporated in NGTL's plans as adaptive management.

Although restoration ecology specific to caribou habitat is a relatively new science, some key initiatives have identified important lessons learned related to oil and gas development in caribou range. Common among many of these initiatives are lessons learned on which plant species to use, when and where to replant, effective techniques to promote natural revegetation and a better understanding of effective methods to manage access.

Lessons learned from these initiatives were incorporated in large-scale habitat restoration projects near Grande Prairie, Cold Lake and Fort McMurray, Alberta, as well as NGTL's projects in caribou habitat. Though initiatives focused on revegetation and access management have been conducted in boreal caribou ranges (Caribou Range Restoration Project [CRRP] 2007a,b; Golder Associates Ltd. [Golder] 2010; Osko and Glasgow 2010); however, the research provides valuable information for the Project restoration program, as well as providing relevant information regarding limiting growth and establishment of plant species favourable to primary prey.

Oil sands-funded projects also included tree planting initiatives, coarse woody debris management best practices, habitat enhancement programs and habitat restoration trials in caribou range (CRRP 2007a,b; Enbridge Pipelines [Athabasca] Inc. [Enbridge] 2010; Golder 2010, 2011; COSIA 2012).

Another example of caribou habitat improvement initiatives is First Coal Corporation's proposed reclamation plan for a disturbed mine site, with the objective of restoring foraging habitat for caribou in the Burnt–Pine caribou range, while minimizing the creation or improvement of foraging habitat for early seral ungulate (primary prey) species (Turner et al. 2009). The Burnt–Pine caribou herd is part of the Central Group of the Southern Mountain Caribou Population located south of the Moberly (Klinse-Za) and Graham ranges. First Coal Corporation's reclamation plan adopted an ecosystem-specific approach, whereby reclamation strategies were developed considering biophysical site characteristics.

First Coal Corporation's proposed reclamation plan focused on introduction of terrestrial lichen as a mechanism for regenerating plants that might act as attractants to caribou, and manual brushing of "less desirable" vegetation was suggested to encourage establishment of plants attractive to caribou and to minimize forage for early seral ungulates (moose and deer). Transplanting conifers was suggested as a potential measure that would be considered for reclamation of engelmann spruce–-subalpine fir (ESSF) forested sites. Research and monitoring of restoration trials was a key component of First Coal Corporation's proposed reclamation plan. The proponent withdrew the project in 2012, however, and the reclamation plan was not implemented.

Blocking line-of-sight will be implemented as a restoration tool for this Project because it is a tool believed to mitigate increased risk of predation in the short term, while longer-term goals of revegetation of sightlines are achieved. The Project monitoring program will feed into emerging science on this restoration tool.

6.2 INDUSTRY COLLABORATION

Canada's Oil Sands Innovation Alliance (COSIA) was launched in 2012 to enable responsible and sustainable growth of Canada's oil sands while delivering accelerated improvement in environmental performance through collaborative action and innovation (COSIA 2012).

The organization's four key focus areas are tailings, water, land and greenhouse gases. Part of the land focus area is a caribou habitat restoration initiative with the goal of improving woodland caribou habitat quality and herd survival through restoration of historic linear disturbances.

COSIA has developed the following habitat restoration initiatives:

- Determining effectiveness of different restoration techniques such as winter tree planting, mounding, seeding and placement of coarse woody debris. The winter tree planting trial was set up to determine the effectiveness of planting black spruce seedlings in wetland areas during winter. Results of the tree planting trial indicated 90% survival of the 900 seedlings planted.
- Development of the Landscape Ecological Assessment Planning (LEAP) tool to provide baseline levels of varying land use. LEAP can be used to determine the long-term effects of restoration in a given area, which can help guide planting initiatives.
- The Algar Historic Restoration Project takes an integrated regional approach, with six companies working together to repair fragmented habitat across an area of land outside their actual licence areas. This is a five-year program to replant trees and shrubs along the linear footprint in the Algar Region, covering an area approximately 570 km^2.
- The LiDea Project aims to restore linear disturbances using mounding and tree felling. Rigorous monitoring and measurement programs have been designed for the life of the project, and currently include 37,000 ha of active treatment area. During spring and summer, conifer seedlings are planted along older, mounded seismic lines. LiDea is also experimenting with forest stand modification, which involves bending tree stems from the adjacent forest across the seismic line to create physical barriers and reduce sightlines along the linear corridor.

The Regional Industry Caribou Collaboration (RICC) is part of COSIA, and is a multi-industry partnership focused on restoring caribou habitat through regional, collaborative, range-based efforts. The objectives of RICC are to coordinate habitat restoration in the short term and long term, coordinate future activity, support and lead scientific research, conduct applied trials and align caribou habitat restoration programs with provincially led Range Plans and Action Plans.

NGTL has recently joined RICC. A major RICC research effort is to verify the effectiveness of restoration measures using a multi-scale predator/prey collaring program to address current knowledge gaps in habitat use and function. As new information on habitat restoration becomes available, NGTL will incorporate it in the planning and implementation process for its projects in caribou habitat.

6.3 LESSONS LEARNED FROM NGTL HABITAT RESTORATION

Preliminary and Final CHRPs were completed for NGTL's Northwest Mainline Expansion Project, Leismer to Kettle River Crossover Project and Chinchaga Lateral Loop No. 3 Project (Chinchaga Section). A Preliminary CHRP was filed on June 30, 2015 (NEB Filing ID: A71014) for Liege Lateral Loop 2 and Leismer East Compressor Station~~.~~ and refiled on August 18, 2015 (NEB Filing ID: A4S5W1).

Based on NGTL's experience with these projects, the following lessons learned were incorporated in this Preliminary CHRP:

- Rollback was used as firewood by land users when stacked as ladders. A more random arrangement of wood piles to discourage wood removal might be used in the future.
- Line-of-sight breaks on co-located ROWs are not effective because of unrestricted access on parallel ROWs. NGTL has learned that such methods are better used in non-contiguous ROWs and that such line-of-sight breaks are redundant on contiguous ROWs. There have been structural stability issues with constructed line-of-sight blocks (versus vegetation screens). NGTL has, therefore, been experimenting with constructing alternative line-of-sight structures (e.g., snow fencing constructed with 2x4s was tested during winter 2014/15).
- Tree planting on a linear corridor appears to not be as effective as on cutblocks (typical silvicultural practices) because of shading. This could result in changes to the planting densities and configurations as the monitoring program progresses.
- Access control cannot be absolute because of safety, operating and maintenance activities that must occur. On previous NGTL projects, lack of access resulted in CHRP measures being destroyed or removed by TransCanada staff to access the ROW. In the future, access-control locations will be strategically placed to allow for maintenance and traditional use access.
- Where CHRP measures have failed or been removed, they have been replaced as part of adaptive management.
- As NGTL has attempted to apply the line of sight/access control features on the landscape as suggested in the EAP; however, it has become apparent that over the course of implementing those features on other NGTL projects that impact caribou habitat (Leismer, NWML, Chinchaga) meeting the recommended

intervals was not feasible. For further details about why NGTL has not adopted the EAP suggested intervals, see Section 5.5.

- Based on recent field experience on the Chinchaga Section with implementing access control and line of sight blocks, NGTL determined that there are several reasons why these features cannot be applied at EAP recommended intervals and the intervals that were identified within the decision framework from the Chinchaga Final CHRP:
  - Materials to construct line of sight blocks are not often available and limit the capacity to implement at the EAP recommended intervals (for example, 200m and 400m):
    - There would be insufficient woody material to implement line of sight blocks, even using merchantable timber, to construct these features every 200m to 400m.
    - There is often not enough suitable material to implement rollback at the EAP recommended intervals.
    - Limited opportunities to implement mounding due to the unsuitability of soil types and ecosite type.
  - Conflicting interests for timber and woody materials:
    - Timber salvage waivers must be approved prior to construction and acceptable to the Forest Management Agreement (FMA) holder
    - In regards to woody materials, merchantable timber is prioritized first and used for access control then the remaining materials go to FMA.
    - Any woody materials remaining must be distributed efficiently among the locations where CHRP measures are required (line of sight blocks, mounding).
    - Often NGTL has experienced a lack of available material to implement CHRP measure at 500m intervals.
  - Operational concerns:
    - From a safety and maintenance perspective, implementing CHRP measures at 200m and/or 400m makes operational access difficult and potentially unsafe in case of an emergency situation precious time would be lost removing the access control and line of sight measures.
    - For Leismer in particular, NGTL personnel had issues gaining access to the ROW as a result of access control measures. These measures were then removed to gain access. However, the integrity of the wood feature had degraded so replacement

of the feature was not possible. There were no additional replacement materials available to reconstruct the feature.

6.4 CHRP CONCORDANCE TABLE

For a summary of differences and updates from the most recent NGTL CHRP filed with the Board, which is the Liege Lateral Loop 2 (Thornbury Section) Preliminary ~~CHRP filed~~CHRPrefiled on ~~June 30~~August 18, 2015 (NEB- Filing- ID: ~~A71014),~~ A4S5W1) , see Table 6-1 (compiled pursuant to Condition 15 a) vi). For a blackline comparison of this CHRP and the Liege Preliminary CHRP, see Appendix F.

Table 6-1: Concordance Table

Component of CHRP	Location in Liege Preliminary CHRP	Location in Preliminary North Montney CHRP	Differences or Updates
Introduction and Organization	Section 1	Section 1	There are no significant differences in this section between the two CHRPs, other than tailoring to project-specific details.
Goal, Objectives and Targets	Section 2	Section 2	No differences or updates in this section in between the two CHRPs.
Decision Framework	Section 3	Section 3	The decision framework used for this Project is consistent with the framework used in past NGTL CHRPs and is intended to be used going forward.
Targets and Measures	Section 4	Section 4	There are no significant differences in this section between the two CHRPs other than tailoring to project-specific details.
The Plan	Section 5	Section 5	This section of the North Montney CHRP was tailored to both the Aitken Creek and Kahta Sections, and accommodates the differences between boreal and mountain caribou.
Continuous Improvement	Section 6	Section 6	Information from a reclamation plan for a disturbed mine site was included in Section 6.1. The concordance table in Section 6.4 has been added to the North Montney CHRP and was not included in the Liege CHRP.
Consultation	Section 7	Section 7	This section of the North Montney CHRP includes a summary of consultation with Aboriginal communities, which was not included in the Liege CHRP.
Literature Review	Section 8	Section 8	The North Montney CHRP includes BC-specific regulatory policies and guidelines for mountain caribou, mountain caribou ecology and caribou habitat restoration initiatives for previous industrial developments.

Table 6-1: Concordance Table (cont'd)

Component of CHRP	Location in Liege Preliminary CHRP	Location in Preliminary North Montney CHRP	Differences or Updates
References	Section 9	Section 9	There are no significant differences in this section between the two CHRPs other than tailoring in each CHRP relevant to boreal and mountain caribou.

7.0 CONSULTATION

This section provides a summary of consultation with Aboriginal communities and applicable regulators related to Project impacts on caribou and caribou habitat, as well as a summary of how feedback was incorporated in the Preliminary CHRP.

NGTL began consultation and working collaboratively with provincial regulators, Aboriginal communities, stakeholders and industry partners in 2011 regarding the Project. NGTL will continue to maintain open communication with federal and provincial regulatory agencies to align the CHRP measures with provincial and federal policy, as well as potentially affected Aboriginal communities, through the various Project phases. The Final CHRP will include updated consultation records.

7.1 ABORIGINAL ENGAGEMENT

Aboriginal communities had opportunities to inform the development of caribou mitigation through meetings, Information Requests (IRs), community-led Traditional Land Use (TLU) studies, Traditional Ecological Knowledge (TEK), independent technical review and through the hearing process for the Project (i.e., oral evidence, TLU studies).

Blueberry River First Nations, Prophet River First Nations, Saulteau First Nations and West Moberly First Nations all presented oral evidence at the North Montney Hearing in Fort St. John, BC. Each potentially affected and interested Aboriginal community received copies of the preliminary Caribou Management Plan (CMP) and updates, with requests by NGTL to review these documents and to provide input. Meetings have also been requested with each interested community to review the plan, respond to questions and receive further feedback from Aboriginal communities on the plan. For a summary of engagement activities related to caribou, see Table 7-1. The CMP preceded, and has been replaced by, this Preliminary CHRP.

In addition to comments and written evidence, NGTL has reviewed and considered the following reference documents submitted by Aboriginal communities for the Project:

- Saulteau First Nations and West Moberly First Nations provided, as an aid to cross-examination at the Project hearing, *Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada* (NEB Filing ID: A4E9U2).
- West Moberly First Nations submitted as part of their additional written evidence (AWE) Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace of British Columbia (Filing ID: A3Z0H2) and Action Plan for the Klinse-Za Herd of Woodland Caribou (Rangifer tarandus caribou) in Canada (Filing ID: A3X4D3).

Given differences in mapping approaches described in Section 8.2 (traditional knowledge about historic distribution and range of caribou versus caribou local population units and critical habitat in the federal Recovery Strategy), it was determined that the Preliminary CHRP would be developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.

NGTL has adopted the definition of critical habitat as defined in the Recovery Strategy (EC 2014). For the reasons described in NGTL's response to West Moberly First Nations IR No. 2 (Filing ID: A3Z6Y1), Final Argument (Filing ID: A64632) and Reply Argument to West Moberly First Nations (Filing ID: A4F7T5) (summarized in Section 8.2), NGTL will apply CHRP measures within the boundaries of the Recovery Strategy-delineated caribou herd ranges (equivalent to local population units). The caribou herd ranges are mapped by provincial and federal regulatory authorities responsible for management and recovery of the Graham and Pink Mountain caribou herds. However, mitigation measures described in the Environmental Protection Plan (EPP) and AMP will be applied for the entire Project.

The Independent Technical Review Group (Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations) commissioned a third-party consultant, LGL Ltd., to review the draft Preliminary CHRP and provide comments. The review provided by LGL Ltd. to NGTL supported the restoration measures and monitoring program detailed in the Preliminary CHRP. Comments focused mainly on differences in mapping of caribou critical habitat between the federal Recovery Strategy and Seven Herds report. LGL Ltd. also suggested the implementation of a lichen collection and transplantation program (see Table 7-1).

Table 7-1: Summary of Aboriginal Engagement

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Blueberry River First Nations			
July 21, 2014	NGTL emailed Blueberry River First Nations information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a Caribou Mitigation Monitoring Plan (CMMP) would be prepared. A PDF document of the Preliminary CMP was included for Blueberry River First Nations' review. NGTL noted that access management mitigation measures have been included in the project's EPP. NGTL requested to meet with Blueberry River First Nations to discuss the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input into the proposed plans.	N/A (no comments received)	–
September 8, 2014	NGTL emailed Blueberry River First Nations to request a meeting. Possible meeting dates were provided, with the request that Blueberry River First Nations provide alternative dates if the provided dates do not fit in with Blueberry River First Nations' schedule. The purpose of the meeting would be to discuss the CMP (NEB Filing ID: A4C5V4) and the access management measures and locations.	N/A (no comments received)	–
Doig River First Nation			
July 21, 2014	NGTL emailed Doig River First Nation information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Doig River First Nation's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Doig River First Nation to discuss the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A (no comments received)	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Halfway River First Nations			
July 21, 2014	NGTL emailed Halfway River First Nations information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Halfway River First Nations' review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Halfway River First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
August 21, 2014	NGTL conducted a meeting to present Halfway River First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and access management measures and locations. NGTL requested feedback on the access planning during the meeting. Halfway River First Nations commented that scoop-outs prevent trucks, but attract quads and motor bikes. It was also stated that signs are an informative way to deter access as well. Halfway River First Nations inquired about monitoring access points.	All Sections	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the three main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16).
McLeod Lake Indian Band			
July 21, 2014	NGTL emailed McLeod Lake Indian Band information on the two preliminary plans related to the overall project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for McLeod Lake Indian Band's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with McLeod Lake Indian Band to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
McLeod Lake Indian Band (cont'd)			
September 8, 2014	NGTL emailed McLeod Lake Indian Band to request a meeting. Possible meeting dates were provided, with the request that McLeod Lake Indian Band provide alternative dates if the provided dates do not fit in with McLeod Lake Indian Band's schedule. The purpose of the meeting would be to discuss Serious Harm to Fisheries, the CMP (NEB Filing ID: A4C5V4) and the AMP.	N/A	–
Prophet River First Nation			
July 21, 2014	NGTL emailed Prophet River First Nation information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Prophet River First Nation's review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Prophet River First Nation to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
September 24, 2014	NGTL conducted a meeting to present Prophet River First Nation with the Preliminary CMP (NEB Filing ID: A4C5V4) and access management measures and locations. No concerns specific to caribou or access management were recorded.	N/A	–
Saulteau First Nations			
February 28, 2012	NGTL attended the 2012 Caribou Workshop held by Saulteau First Nations. The purpose of the workshop was to bring together all proponents in the region whose activities might have an impact on caribou. Saulteau First Nations' goal was to develop a plan to protect boreal, northern and southern caribou herds.	N/A	Specific recommendations or comments related to planning or implementing caribou habitat restoration for the Project were not discussed.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
January 29, 2013	NGTL attended the Caribou Planning Session for the Peace Northern Caribou Committee on January 29-30, 2013. Approximately 35 people attended from industry, local First Nations communities and government. The workshop was a planning session to identify an appropriate governance structure for the committee and a discussion on how to immediately protect the Moberly caribou herd.	N/A	Specific recommendations or comments related to planning or implementing caribou habitat restoration for the Project were not discussed. The Project does not encounter the provincially/federally delineated range of the Moberly caribou herd.
April 25, 2013	NGTL met with Saulteau First Nations. Saulteau First Nations is concerned about caribou and how declining Moberly caribou population counts will be addressed.	8.2	The Project does not encounter the provincially/federally delineated range of the Moberly caribou herd. Regulatory objectives, including stopping decline of caribou populations, are reviewed and provide context for the development of the Preliminary CHRP. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
		8.3, 8.4	Ecology of the caribou herds encountered by the Project is discussed, including population trend, threats and limiting factors. This information provides ecological context considered in the development of the Preliminary CHRP, in particular, development of CHRP objectives.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
April 25, 2013 (cont'd)	See above	2,3,4,5	The goal of the CHRP is to reduce the residual effects of the Project on caribou and caribou habitat in a manner that aligns with provincial and federal policies, and will not affect the capacity for stated caribou recovery and habitat management objectives to be achieved. As noted above, regulatory policy identifies stopping caribou population decline as an objective. The toolbox of measures that NGTL can implement is detailed for all phases of the Project, from pre-construction through operations. Many of the relevant measures have already been implemented as part of the pre-construction (Project planning and design) phase. These, and the measures identified in Section 5 for the construction phase, will facilitate habitat restoration of the Project footprint in caribou range following completion of construction (post-construction phase).

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
September 6, 2013	NGTL emailed Saulteau First Nations requesting a list of priority areas to visit for the helicopter overflight with Saulteau First Nations representatives scheduled for September 11, 2013. Saulteau First Nations replied the same day with an attachment outlining the focal areas of interest for the overflight. Focal areas included: • Saturn Meter Station • Pine River crossing • Moberly River crossing • Entry into Peace Moberly Tract • Peace Moberly Tract Section • Peace River crossings East and Preferred Route • Caribou habitat crossing (north of Farrell Creek) • Prince Rupert Gas Transmission Project tie-in location (NEB Filing ID: A3Q6U2)	7.1	TEK presented during field studies is summarized in this section.
September 11, 2013	A helicopter overflight was conducted with Saulteau First Nations that included a flyover of the Graham caribou range. Saulteau First Nations was shown where NGTL proposed to parallel the existing pipeline corridor (NEB Filing ID: A3Q6U2).	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
		7.1	TEK presented during field studies is summarized in Section 7.1.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
September 25, 2013	Saulteau First Nations emailed NGTL a routing memo that: • outlined routing review work completed to date • listed Saulteau First Nations' concern with disturbance in Area of Critical Community Interest and Peace Moberly Tract • noted Saulteau First Nations' preferred route is the Chetwynd Route • stated that Tetra Tech agrees that the East Route is not feasible • requested implications for caribou habitat during construction (in vicinity of Farrell Creek) • requested NGTL comments on noted items (including suggestion for following the Chetwynd Route) (NEB Filing ID: A3Q6U2)	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
July 21, 2014	NGTL emailed Saulteau First Nations information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for Saulteau First Nations' review. NGTL noted that access management mitigation measures have been included in the Project's EPP. NGTL requested to meet with Saulteau First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–
October 5, 2014	NGTL provided the links to the Preliminary CMP filed with the NEB (NEB Filing ID: A4C5V4).	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Saulteau First Nations (cont'd)			
October 6, 2014	NGTL presented Saulteau First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations.	All Sections	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the 3 main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16).
West Moberly First Nations			
February 14, 2013	NGTL met with West Moberly First Nations to discuss the Project and Community Agreements. West Moberly First Nations does not want pipelines through the Moberly caribou range west of Moberly Lake. West Moberly First Nations would like to have the government defer tenure in the northeast area of the Peace Moberly Tract, including the adjacent area to the east and would like NGTL to influence government to defer tenure in that area.	7.1	The routing criteria described in Section 4.1 of the ESA (Filing ID: A3Q6F8) comprise a key component of avoiding or minimizing adverse Project effects on caribou and caribou habitat at the pre-construction phase.
April 15, 2013	NGTL met with West Moberly First Nations to discuss the Project. West Moberly First Nations is concerned that the Project will open the door to further development through the Peace Moberly Tract and does not want pipeline development through critical caribou habitat. West Moberly First Nations is exploring the idea of a pipeline corridor to manage all the proposed pipelines in the area. West Moberly First Nations members would need a chance to provide feedback on the Project before a decision of support can be made (NEB Filing ID: A3Q6U2).	7.1	The routing criteria described in Section 4.1 of the ESA. The Peace Moberly Tract is outside provincially/federally delineated caribou range. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
West Moberly First Nations (cont'd)			
July 18, 2013	NGTL met with West Moberly First Nations to discuss the Project. West Moberly First Nations is concerned that the ROW will become an access point for hunters and predators; the community wants to monitor and limit the access to hunting areas. West Moberly First Nations is also concerned about a decline in wildlife (including caribou) (NEB Filing ID: A3Q6U2).	2,5.3,8.5	Access management is one of the objectives of the CHRP. Section 8.5 presents a summary of literature relevant to human access and interaction with habitat restoration. Section 5.3 presents information relevant to planning access control. The AMP for the Project will include additional information, and will be submitted under separate cover in accordance with Certificate Condition 16. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
July 21, 2014	NGTL emailed West Moberly First Nations information on the two preliminary plans related to the overall Project planning and ESA. The ESA states that a CMP and a CMMP would be prepared. A PDF document of the Preliminary CMP was included for West Moberly First Nations' review. NGTL noted that access management mitigation measures were included in the Project's EPP. NGTL requested to meet with West Moberly First Nations to share the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management measures and locations, and seek input.	N/A	–

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
West Moberly First Nations (cont'd)			
October 15, 2014	NGTL conducted a meeting to present West Moberly First Nations with the Preliminary CMP (NEB Filing ID: A4C5V4) and proposed access management mitigation measures and locations. West Moberly First Nations suggested *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014) and *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013) be applied to the CMP.	7.1	The routing criteria described in Section 4.1 of the ESA. The CHRP is specific to the provincially/federally delineated range boundaries of the Graham and Pink Mountain caribou herds. However, NGTL will implement the mitigation measures outlined in the EPP and the AMP, which are applicable to the entire Project.
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations			
January 30, 2015	NGTL met with the Independent Technical Review Group to discuss NGTL caribou habitat restoration and access management plans. Questions were raised regarding the development of camps and yards and the potential impact on caribou. It was indicated that the Treaty 8 communities want to take an active role in the development of the CHRP and the AMP.	7.1	The routing criteria described in Section 4.1 of the ESA. Construction of the section 58 components of the Project (e.g., camps, pipe yards) is proposed to start during summer 2015; however, none of these ancillaries are proposed in the Graham or Pink Mountain caribou ranges.
March 3, 2015	NGTL met with the Independent Technical Review Group to discuss the independent technical review of the CMP and the access management mitigation measures and locations. Questions were raised regarding the method and utility of the proposed restoration and access management mitigation measures, and monitoring of the restoration and access management mitigation. Interest in collaboration on the caribou habitat restoration planning was expressed.	7.1	The Preliminary CMP was incorporated in this Preliminary CHRP. Access management is included throughout this Preliminary CHRP as it is one of the 3 main objectives identified to achieve the CHRP goal. The AMP will provide further detail (to be filed under separate cover in accordance with Certificate Condition 16). The AMP is relevant to the entire Project.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations (cont'd)			
March 4, 2015	Email correspondence between LGL Ltd., representing the Treaty 8 collaborative Nations, and NGTL. LGL Ltd. requested a draft Preliminary CHRP to review before the meeting with NGTL tentatively scheduled on April 7, 2015 to discuss mitigation measures proposed for the Project.	N/A	–
March 23, 2015	NGTL provided a draft copy of the Preliminary CHRP to the Independent Technical Review Group and requested review and comment.	N/A	–
April 6, 2015 April 7, 2015 April 9, 2015 April 14, 2015	Email correspondence between LGL Ltd. (on behalf of the Independent Technical Review Group and NGTL related to the technical review of the draft Preliminary CHRP.	N/A	The tentative meeting for April 7, 2015 was cancelled. LGL Ltd. advised on April 9, 2015 that written comments on the draft Preliminary CHRP would be provided.

Table 7-1: Summary of Aboriginal Engagement (cont'd)

Aboriginal Community/ Date and Method	Engagement Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Independent Technical Review Group – Doig River First Nation, McLeod Lake Indian Band, Saulteau First Nations and West Moberly First Nations (cont'd)			
April 28, 2015	LGL Ltd. provided the results of a technical review of the draft Preliminary CHRP to NGTL on behalf of the Independent Technical Review Group. It was again suggested that the caribou habitat mapping by West Moberly First Nations in *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014) and *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013) be applied to the CHRP. LGL Ltd. also suggested implementation of a lichen collection and transplantation program. LGL Ltd. acknowledged that this Preliminary CHRP describes planning considerations and provides mitigation measures and habitat restoration options that can be implemented during the pre-construction, construction and post-construction phases of the Project. It was further recognized that mitigation measures and habitat restoration options (specifically Tables 6 and 7) detailed in this Preliminary CHRP will likely be effective if they are implemented in appropriate locations and follow-up monitoring and adaptive management actions are applied.	8	Comments provided by LGL Ltd. were reviewed and considered by NGTL. Critical habitat as delineated by federal and provincial regulatory authorities will continue to be used to inform the Preliminary CHRP. Any changes to these boundaries will be considered in the development of the Final CHRP. NGTL has considered the use of lichen transplanting as a possible mitigation measure for the Project. Lichens are described throughout Section 8. NGTL is committed to continued engagement with the Treaty 8 collaborative Nations. The Final CHRP will incorporate updated records of consultation and engagement, including how additional information received from Aboriginal communities is incorporated in the Final CHRP.

7.2 REGULATORY CONSULTATION\

For a summary of caribou-related consultation for the Project with federal and provincial agencies, see Table 7-2. NGTL initiated consultation early (2011; 2013-specific to caribou) in the Project planning phase to enable regulatory agencies to provide relevant information and input in a timely manner. The two key recommendations received from BC MFLNRO were to:

- reduce the Project footprint by paralleling existing linear features
- avoid critical timing periods for caribou

A draft Preliminary CMP was provided to EC and BC MFLNRO regulators for review on April 21, 2014 and comments were received. The CMP was later replaced by this Preliminary CHRP following receipt of draft Conditions from the NEB, and also was provided to EC and BC MFLNRO regulators for review on March 20, 2015. NGTL has not received comments to the CHRP from EC or BC MFLNRO regarding caribou mitigation or habitat restoration planning at the time of finalizing this Preliminary CHRP. NGTL will continue to maintain open communication with EC and BC MFLNRO as the Project progresses.

Comments and recommendations received from both EC and BC MFLNRO from their review of the Preliminary CMP were considered and incorporated in the Preliminary CHRP. Key comments and recommendations provided during consultation with regulators include:

- The Project is not anticipated to affect high-elevation winter or summer critical habitat, or low-elevation summer critical habitat for the Graham Local Population Unit. The Project is likely to destroy a small area of matrix critical habitat.
- Aboriginal groups should be appropriately engaged regarding potential Project impacts on caribou.
- The construction schedule should adhere to the critical timing window for caribou.
- Avoid activities likely to destroy critical habitat for mountain caribou by means of alternative pipeline construction and operation activities. Consider extending trenchless crossings to reduce habitat disturbance if it is found that trenchless crossings reduce impacts on caribou.
- Maximize paralleling existing linear infrastructure and minimize the Project footprint.
- Discourage early seral vegetation and avoid the use of palatable species for erosion control.
- Mitigate the potential effects of integrity inspections/maintenance associated with operations.

NGTL will continue to work with provincial and federal regulators to align the CHRP measures with provincial and federal policy. Any future comments provided to NGTL will be considered for incorporation into the Final CHRP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Environment Canada				
Joanne Kwok, Environmental Assessment Officer	August 28, 2013 November 25, 2013 Email(s)	NGTL indicated being aware that EC was developing a federal recovery plan. EC understood the recovery plan was for the Southern Mountain National Ecological Area (SMNEA). NGTL requested EC to comment whether Graham, Pink Mountain, or both, are included in EC's current planning work and to comment on when EC planned to have a draft of the current planning work available for public review EC provided comment on their current planning work in regard to the Graham and Pink Mountain herds. The Graham herd is included in recovery planning for the Southern Mountain population of Woodland Caribou, as it falls in the SMNEA, which is the current area that the recovery strategy will apply to. Under COSEWIC's DUs, this herd falls in DU7. EC explained the Pink Mountain herd is not included in the current recovery planning processes as it does not fall in the SMNEA, but is in the NMNEA and DU7. The Pink Mountain herd is included in the Management plan for the Northern Mountain population of Woodland Caribou. EC indicated plans to post a draft recovery strategy for the Southern Mountain population of Woodland Caribou on the *SARA* registry for public comment by spring 2014.	8.3,8.5	Conservation status and recovery/management planning for the Graham and Pink Mountain caribou ranges is provided in Sections 8.3 and 8.5
Joanne Kwok, Environmental Assessment Officer	December 4 and 6, 2013 Email(s)	NGTL suggested a meeting in January to introduce the project to EC, to discuss any issues/concerns/questions EC might have, and to speak further regarding project effects and mitigation for caribou. EC indicated they would like to take the opportunity to meet with NGTL and discuss various components of this project including some wildlife issues, wetlands, caribou. EC proposed to have a meeting in mid-February (February 14, 2014).	–	N/A
Cindy Hubbard, Environmental Assessment Officer Holly Middleton, Canadian Wildlife Service Jennifer Wilson, Special Projects Officer Joanne Kwok, Environmental Assessment Officer Darcy Peel, Canadian Wildlife Service Greg Ferguson, Canadian Wildlife Service Hugo Gherbavaz, Environmental Assessment Advisor	February 13, 2014 Meeting in Vancouver, BC February 14, 2014 Email	NGTL provided a Project overview and a summary of consultation with BC MFLNRO related to caribou (i.e., BC MFLNRO advised that the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* should be considered for both the Graham and Pink Mountain caribou ranges and the Project does not intersect high elevation range in the Graham range and therefore does not trigger the requirement for offset measures). NGTL indicated they will prepare a CMP to address Project effects on caribou and caribou habitat in caribou ranges crossed by the proposed Project. NGTL agreed to provide a draft of the preliminary CMP to EC for review before the NEB Hearing (scheduled in August 2014). A final CMP would be prepared following construction. EC requested comments on the draft *Recovery Strategy for the Woodland Caribou, Southern Mountain Population (*Rangifer tarandus caribou*) in Canada* and offered to meet with NGTL to discuss how the draft recovery strategy could affect the Project. NGTL followed up with an email (February 14, 2014) and provided a map that shows routing revisions (the re-route at the Sikanni Chief River and a reduction in length in the Pink Mountain caribou range). These revisions were made after the NEB application was filed and were addressed in the AWE filed with the NEB in April 2014. NGTL provided web-links to the most recently filed CHRPs prepared by NGTL as a helpful reference to EC and noted that this work has evolved with each NGTL Project.	8.2	*Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* exempts activities that occur outside identified high-elevation winter range (HEWR) for South Peace Northern Caribou from preparation of a CMMP. The Preliminary CMP and CHRP align with the first three levels of the mitigation hierarchy (i.e., avoid, minimize, restore onsite), and the associated principles and considerations described in the Implementation Plan have been considered. The Preliminary CMP is replaced by this Preliminary CHRP.
Cindy Hubbard, Environmental Assessment Officer	March 5, 10 and 11, 2014 Email(s)	An effort was made to meet with EC to discuss the draft Recovery Strategy but EC was busy with the preparation of the draft Recovery Strategy and offered to meet at a later date. NGTL indicated their interest in meeting to discuss and determine how the draft Recovery Strategy will affect the Project. NGTL advised of their intent to circulate the preliminary CMP in mid-April 2014 and request to incorporate EC's comments before filing the report with the NEB in June 2014. For the purposes of Project planning and mitigation, NGTL requested EC's early input, specifically in regard to clarity on critical habitat. Further, NGTL reminded EC of NGTL's approach (as discussed at the February 13, 2014 meeting) and sought to understand if this was reasonable. NGTL noted that the process of "march charting" (construction scheduling) is ongoing and will include important timing windows for caribou to the extent possible.	–	N/A
Cindy Hubbard, Environmental Assessment Officer	April 3 and 4, 2014 Email(s)	Before the meeting with EC on April 11, 2014, NGTL provided the following based on a request from EC: portions of the ESA that address Project residual and cumulative effects on wildlife and wildlife habitat; and maps that show the Project in caribou range. NGTL noted that the preliminary CMP will provide information on mitigation measures to reduce the predicted residual effects of the Project's construction and operation on caribou and caribou habitat. Since the Project does not intersect defined HEWR in the Graham caribou herd range, the Project does not trigger the requirement for a CMMP under the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC*, which would include a requirement for offset (compensation) measures. The Preliminary CMP will include information on: regulatory context; literature review; mitigation measures to be implemented before, during and following construction; and a summary of consultation with federal and provincial regulators. The Final CMP will document the onsite restoration measures implemented, identify their locations, and present them on Environmental Alignment Sheets. The Final CMP will be filed with the NEB following completion of final construction, cleanup and reclamation activities.	Figure 1-1 7,8	The relevant components are incorporated in the Preliminary CHRP. Detailed information will be filed with the Final CHRP following completion of reclamation activities.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Stephen Hureau, Head, Species at Risk Recovery Unit, Canadian Wildlife Service Jennifer Wilson, Special Projects Officer Joanne Kwok, Environmental Assessment Officer Greg Ferguson, Canadian Wildlife Service	April 11, 2014 Meeting in Vancouver, BC	NGTL began the discussion with an introduction to their approach to mitigating Project effects on caribou: As routed, the Project does not intersect any defined HEWR in the Graham range and, thus the Project is not subject to the *Implementation Plan for the Ongoing Management of South Peace Northern Caribou*, and does not trigger the requirement for a CMMP, which would include a requirement for offsets. NGTL, in its ESA, committed to develop a CMP to address project effects on caribou and caribou habitat. This plan will consider and incorporate the threats and mitigation presented in applicable regulatory guidelines. NGTL also noted that a follow-up plan with adaptive management, to monitor the effectiveness of habitat restoration measures will be implemented. NGTL noted that the pipeline length had been reduced in the Pink Mountain range and the portion of the route in the UWR had been removed. EC noted this was a reasonable or appropriate approach. EC indicated the comment period on the proposed Recovery Strategy ended mid-March 2014. The final Recovery Strategy will include more detail on disturbance type and matrix habitat. It was noted that the 65% threshold is the best available information at this time and that mapping disturbance is one of the top priorities.	8.2	The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km. NGTL is continuing to engage EC regarding spatial delineation of critical habitat, including matrix habitat.
Cindy Hubbard, Environmental Assessment Officer	April 21, 2014	NGTL provided a draft Preliminary CMP for review.	–	N/A
Alisha Drinkwater, Senior Environmental Assessment Coordinator	June 20, 2014 Letter response	EC provided comments on draft Preliminary CMP. EC advised the Project is not anticipated to affect high elevation winter or summer critical habitat, or low elevation summer critical habitat for the Graham Local Population Unit. However, EC advised the Project is likely to destroy a small area of matrix critical habitat. EC recommends that the Proponent work with the province to address Project effects in the range of the Graham local population unit that have the potential to result in the destruction of critical habitat. EC is prepared to share its critical habitat data with the Proponent. EC recommends avoidance of activities likely to destroy critical habitat for southern mountain caribou (i.e., Graham local population unit) by means of alternative pipeline construction and operation activities. EC recommends that the Proponent ensures that all activities that are in the Pink Mountain local population unit are consistent with the Northern Mountain Caribou Management Plan. Specific comments on the draft Preliminary CMP were provided in an attachment, and are addressed individually in the following rows.	8	NGTL has requested further clarification of the Project's interaction with critical habitat, and has been advised that critical habitat mapping for the area of the Graham Local Population Unit overlapping the Project is currently in development. NGTL will continue to consult with EC to obtain spatial data files for critical habitat for the Graham Local Population Unit. Information will be considered in Project design and mitigation planning. NGTL is aware of the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada, and has incorporated key elements of the plan into the Preliminary CHRP. Application of the identified management objectives and recovery goals to a specific project or proponent is limited, given the purpose of the Management Plan is to provide directives for the authorities responsible for management of the caribou populations discussed in the Plan. Please refer to entries beginning in the second section of this table for consultation to date with BC MFLNRO. NGTL will continue to consult with BC MFLNRO to address Project effects.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	A) Generally, EC recommends that the Proponent integrate the following criteria in the Preliminary Caribou Mitigation Plan: • goals and objectives regarding mitigation measures that would be implemented to minimize impacts on southern mountain caribou • criteria for measuring the plan's success in achieving these goals and objectives • a summary of related baseline information that would be collected and, if no additional information will be collected, justification • a list of sites where mitigation measures would be implemented, the mitigation measure(s) proposed at those sites, and the rationale for selecting those sites and measures • the methods for monitoring the effectiveness of mitigation measures implemented • a description of adaptive management measures available and of the criteria the Proponent would use to determine if and when adaptive management measures are warranted • a detailed description of the locations where mitigation measures are put in place specifically for construction, as well as those that would remain in place into operations and would be monitored for the life of the Project • a commitment to report on the results of the mitigation measures implemented, monitoring undertaken, and the success of mitigation measures in meeting the goals and objectives of the Preliminary Caribou Mitigation Plan, as part of NGLT's post-construction environmental monitoring reports	1.2	a) The goal of measures to be implemented under the CHRP is to reduce potential Project effects on caribou habitat. The certificate conditions for Caribou Habitat Restoration as well as organization of the Preliminary CHRP are described in Section 1.2. The planning and mitigation measures identified in the Preliminary CHRP comprise the toolbox of measures available to NGTL to avoid or minimize Project effects on caribou and caribou habitat. b, e, f, g) The criteria for measuring success, methods for monitoring effectiveness, description of adaptive management approach, and proposed timeline for monitoring will be included in the CHROMMP in accordance with Certificate Condition 37 and will be submitted under separate cover. c) Additional baseline information collected will include 360° aerial imagery. Detailed engineering design and construction planning information, and as-built documentation will also inform the CHRP. d, g) The Final CHRP will provide the list of sites where mitigation measures were implemented, including measures implemented during and following construction, in addition to the rationale for selecting those sites and measures. Detailed engineering and construction information is needed to determine the most appropriate mitigation tools on a site-specific basis. h) NGTL confirms their commitment to report results of mitigation and monitoring activities.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	B) EC recognizes that this is a preliminary mitigation plan and requests confirmation on when a final version would be filed with the NEB. In the case that the final version is filed after the environmental assessment process is complete, it will limit EC's ability to review the plan and provide recommendations.	1,7.2	The Final CHRP will be filed on or before November 1 after the first complete growing season following start of operation of the Section 52 facilities. NGTL will continue to engage EC through the development, implementation and monitoring phases of the CHRP, to the extent requested by EC.
		C) Section 3.1 discusses measures that could be used to minimize adverse effects, including extending trenchless crossings to reduce habitat disturbance. To evaluate the potential impacts of trenchless crossing methods on southern mountain caribou, EC recommends information on the likely effects on caribou for this pipeline construction method is provided for segment(s) that might overlap with the Graham local population unit. If it is found that trenchless crossings reduce impacts on caribou, then EC might recommend that the Proponent consider applying this installation method throughout caribou range.	5.3	Section 5.3 notes that NGTL is investigating opportunities for trenchless pipeline installation (e.g., extending trenchless crossings). There are no trenchless watercourse crossings planned in the Graham range. NGTL is considering opportunity to extend bored/drilled crossings of third-party dispositions, however, NGTL's options might be limited by the terms and conditions specified by the third party under their crossing agreement. Feasibility of trenchless crossings might also be constrained by technical considerations (e.g., access, additional workspace requirements, geological characteristics), as well as scheduling construction activities to avoid work during the critical timing window for caribou. Where extended trenchless crossings are not feasible, NGTL will consider other measures, as outlined in Section 5.3.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	D) Section 3.1 lists opportunities to minimize Project effects and facilitate habitat restoration, including considering opportunities to narrow the Project ROW. EC requests that the Proponent clearly state how much (in metre) the ROW would be narrowed.	5.1,5.2,5.3	NGTL balances environmental and stakeholder concerns, engineering design, and constructability when determining ROW width requirements. The ROW width requirements have been established to achieve this balance, and account for a safe and efficient progression of project activities. A minimum 32 m ROW is required for construction of the Project, based initially on pipe size. Additional workspace requirements will be necessary. NGTL will fully evaluate opportunities to reduce disturbance in caribou ranges. The extent and location of narrowing the construction footprint will be determined as the Project progresses through detailed engineering and construction planning phases.
		E) Section 3.2.3 considers identification of candidate sites for short-term and long-term measures for line-of-sight blocks to reduce predator access. EC requests clarification on when these candidate locations would be identified and finalized. EC also recommends the criteria used to determine a 500 m line-of-sight threshold be provided (i.e., peer-reviewed literature).	5.4	Candidate locations for line-of-sight blocks are best identified as part of detailed construction planning and refined following completion of construction. The reason for this is to allow for incorporation of topographic variation and final footprint configuration, which are key components in determining effective line-of-sight blocking locations. Line-of-sight locations will be identified in the Final CHRP. Standard distances for line-of-sight breaks and supporting literature are not available. There is considerable variation in recommended distances for line-of-sight breaks across provincial regulatory jurisdictions responsible for managing woodland caribou habitat in western Canada. In consultation with BC MFLNRO for the Project, NGTL was advised that BC MFLNRO does not specify distance frequency for line-of-sight breaks, but noted that the BC OGC recommends sight breaks at least every 200 m for seismic operations and although a different ecotype, *Interim Operating Practices for Oil and Gas Activities in Identified Boreal Caribou Habitat in British Columbia* suggest 500 m between visual breaks for linear features.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	F) Section 3.3 discusses implementation opportunities and constraints, and states that selection for habitat restoration measures would require as-built construction information. EC recommends that as-built information be provided for review in the environmental assessment process.	8.3	As-built information is collected following completion of construction and consists of a legal survey (showing areas disturbed by construction, including clearing and grading), as well as construction documentation, which would include change management documentation to address site-specific conditions. As such, this information cannot be provided before construction.
		G) Section 3.3.1 contains a hyperlink to a Decision Framework that does not link to anything. EC requests resubmission of the complete version of the Decision Framework for review in the environmental assessment process.	Figure 3-1,3-2,3-3	The decision framework was provided in the pdf version of the draft Preliminary CMP submitted to EC for review. The framework is provided as Figure 4 in this Preliminary CHRP.
		H) Section 3.4 discusses the scheduling of construction activities that would be initiated in caribou range. EC notes that pipeline installation activities would be initiated for the both sections of the pipeline (Atiken and Kahta) in Q3 2015. EC understands that the Q3 period is between July–September, which was proposed to avoid working in the critical timing window for caribou, which is January 15–July 15. EC advises that the proposed construction schedule would overlap with the end of the critical timing window for caribou. Accordingly, EC advises that the proposed construction schedule does not appear to adhere to the critical timing window for caribou as stipulated by BC MOE.	5.6	Construction will not start until after July 15 to align with the critical timing window for caribou.
		I) Section 3.4.1, Table 3 lists mitigation measures for work during the critical timing period for caribou. EC requests clarification on how “increase manpower resources to increase productivity” can be used as a mitigation measure, as this could result in additional noise disturbance or other effects for caribou.	Table 5-4	Increased manpower and resources increases the productivity of construction activities to speed construction and minimize work within the critical timing window. Noise associated with construction is unavoidable, regardless of the manpower. Expediting construction activities to complete construction within a single season (i.e., rather than delaying construction to a second season to avoid working within the critical timing window) is beneficial for reducing the duration of habitat disturbance (i.e., time lag between clearing and restoration activities).
		J) Table 3 lists mitigation measures for cleanup and reclamation activities, stating that activities would take place the following season outside the critical timing period. EC notes that delay of cleanup and reclamation activities to outside the caribou critical timing period could increase impacts on caribou depending on the lag time. Accordingly, EC requests more information on the biological rationale used to determine that to delay the complete cleanup and reclamation outside the critical timing window would result in fewer impacts on caribou. Additionally, further information on the specific season that the mitigation measure would be carried out in, and on the proposed cleanup and reclamation activities for which there is a lag time, is recommended.	Table 5-4	Table 5 has been clarified.
		K) In relation to Section 3.4.1 and the statement “in the event that caribou are observed in close proximity to the Project…,” EC requests that the Proponent quantify this distance in the finalized Caribou Mitigation Plan.	Table 5-4	The statement is in reference to incidental sightings of caribou by construction staff, which could occur in caribou range on access to or in the construction footprint.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	L) Section 4, Table 4 lists mitigation measures for caribou during construction. EC seeks clarification on which measures provided would be likely to be implemented. EC's ability to comment on the efficacy of these measures to reduce impacts on caribou is limited given that there is considerable uncertainty on the locations and extent to which they would be implemented. M) Section 5.1, Table 5 of the plan discusses and lists post-construction habitat restoration measures. EC seeks clarification from the Proponent on which measures would be likely implemented. EC's ability to comment on the efficacy of these measures to reduce impacts on caribou is limited given that there is considerable uncertainty on the locations and extent to which they would be implemented.	3 Table 5-3	The planning and mitigation measures identified in the Preliminary CHRP comprise the toolbox of measures available to NGTL to avoid or minimize Project effects on caribou and caribou habitat. Selection of the habitat restoration measures will require as-built construction information to allow for validation of site-specific conditions, and input from the NGTL construction and operation/maintenance staff, Project biologists and reclamation specialists, as well as appropriate regulatory agencies. Site-specific details will be provided in the Final CHRP. NGTL will implement the CHROMMP, including adaptive measures where warranted, to ensure the efficacy of mitigation measures implemented.
		N) EC notes that First Nations were not listed on the consultation record for this Plan. Aboriginal groups along the proposed pipeline corridor might have established or asserted Aboriginal or treaty rights to access caribou. Accordingly, it is important to ensure that Aboriginal groups are appropriately engaged regarding potential Project impacts on caribou.	7.1	NGTL has engaged with Aboriginal communities to collect Traditional Knowledge, which has been incorporated in the Preliminary CHRP. Communities engaged for the Project were advised of NGTL's commitment to complete a CHRP and NGTL will advise communities when the Preliminary CHRP and CHROMMP are filed. NGTL is committed to continuing engagement with Aboriginal communities in regard to concerns related to caribou.
		O) The Preliminary Caribou Mitigation Plan does not distinguish between the two northern ecotypes. EC requests that the Proponent clarify the local populations to which this plan applies.	8.3	The Preliminary CHRP discusses the differentiation between the Pink Mountain and Graham caribou in Sections 8.3. The mitigation and procedure for identifying appropriate site-specific methods discussed in the remainder of the Preliminary CHRP applies to both the Graham and Pink Mountain caribou herds.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	See above	P) In addition to a Caribou Mitigation Plan, EC supports the development of an AMP for caribou outlining access control measures proposed for construction, operation and decommissioning. Implementing access control measures might limit predator access to caribou habitat and might reduce regulated and unregulated hunting access to caribou habitat, while allowing caribou to access to their critical habitat to carry out life processes. The AMP could include: • goals and objectives regarding access management for the control of both human and predator access • criteria for measuring the plan's success in achieving these goals and objectives • summary of related baseline information to be collected and, if no additional information would be collected, justification for why not • list of sites where access control measures would be implemented, control measure(s) proposed at those sites and rationale for selecting those sites and measures • summary of the Proponent's consultation with appropriate federal and provincial authorities, other appropriate stakeholders and potentially affected • Aboriginal groups regarding the AMP – summary should include any issues or concerns about the plan raised by those consulted and how the Proponent has addressed or responded to those issues or concerns • methods for monitoring the effectiveness of access control measures implemented • description of adaptive management measures available and of the criteria the Proponent would use to determine if and when adaptive management measures are warranted • detailed description of the locations where access control measures would be put in place specifically for construction, as well as those that would remain in place into operations and be monitored for the life of the Project • commitment to report on the results of the control measures implemented, monitoring undertaken and success of control measures in meeting the goals and objectives of the AMP, as part of the Proponent's post-construction environmental monitoring reports	5.3	Access control is one of the three primary objectives of restoring habitat, along with vegetation restoration and line-of-sight blocking (Section 4.3 of the Preliminary CHRP). The Final CHRP will specify access control measures in caribou ranges. NGTL is also committed to implementing access control outside caribou ranges. The details of these measures (e.g., location, type of access control) will be documented in the EPP and Environmental Alignment Sheets prepared for the Project before construction. NGTL is also required to prepare an Access Management Plan with a separate cover for non-parallel disturbances along the ROW for each section of the Section 52 facilities, in accordance with Condition 16.
		Q) EC recommends that the Proponent provide a description of how available and applicable Aboriginal Traditional Knowledge and TLU studies were considered in the Preliminary Caribou Mitigation Plan.	7.1	Available and applicable TEK and TLU studies were considered in the Preliminary CHRP. Wildlife features (e.g., trails, mineral licks) located in caribou range will be considered during routing, mitigation and access management planning.
		R) EC recommends an adaptive management approach for mitigation. The purpose of such an approach would be to ensure that effectiveness of mitigation measures, such as reductions to lines of sight, habitat restoration, decommissioning of access, is monitored and measures would be adjusted as needed during Project operations to ensure objectives for habitat disturbance and access would be achieved.	5.5	Adaptive management will be detailed in the CHROMMP filed under separate cover.
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	July 2, 2014 Email	NGTL provided an update on Attachment 1 (comments on the Southern Mountain and Northern populations of woodland caribou for the North Montney Project) and Attachment 2 (comments on the Preliminary Caribou Mitigation Plan). NGTL explained to EC that they notified the NEB that they would be delaying filing of the CMP (and the Preliminary CMMP) so that NGTL could address EC's comments on Attachment 2.	5.1	The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km. NGTL is continuing to engage EC regarding spatial delineation of critical habitat, including matrix habitat.
	July 4 and 11, 2014 Email(s) Telephone	NGTL understands that in regard to EC's comment letter addressing the North Montney Preliminary Caribou Mitigation Plan, dated June 20, 2014, EC indicates that the Project overlaps with 0.43 ha of critical habitat. Subsequently, EC indicated that it would advise the NEB that this would constitute a significant effect. NGTL requested an opportunity to review the spatial data showing this overlap, preferably before EC's letter to the NEB, planned for July 10, 2014. NGTL did receive all critical habitat data currently in the public domain, and those data do not overlap with the Project. EC explained that Canadian Wildlife Service has indicated they were able to use additional data from what was used for the June 20, 2014 letter NGTL received. Therefore, using the updated data, Canadian Wildlife Service revised conclusions made from that correspondence. EC's Letter of Comment to the NEB reflects those revised conclusions. EC indicated NGTL will be in receipt of the Letter of Comment shortly as it has been couriered to them and will also be posted to the NEB site.		

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Alisha Drinkwater, Senior Environmental Assessment Coordinator (cont'd)	August 8 and 12, 2014 Email(s)	NGTL followed up with EC, noting that they have not received a response from EC or Canadian Wildlife Service regarding the 0.43 ha of critical habitat described In EC's Letter of Comment to the NEB dated July 8, 2014. In Attachment 2, page 4 it states "there is likely destruction of 0.43 ha of matrix critical habitat arising from the Project's 55 m project development area corridor (i.e., Project ROW)". NGTL indicated strong interest in receiving spatial data on the location of this critical habitat so that options for reducing adverse effects on critical habitat can be reviewed. NGTL did previously receive some critical habitat mapping from EC, but this critical habitat did not overlap the Project ROWs. NGTL indicated they would appreciate if this request could be completed by August 31, 2014 to provide sufficient time for review before start of the hearing. EC responded that they had forwarded the NGTL request to Canadian Wildlife Service colleagues and have followed up with them now. EC/Canadian Wildlife Service provided publicly available links for the southern mountain caribou spatial data. EC stated, it is important to note that the analysis is ongoing, and that the classification of critical habitat type (i.e., high elevation, low elevation and matrix) might also change in the future. Information will be provided to the public as it becomes available.	–	
	October 21, 2014 Email	NGTL emailed EC the draft Klinse-Za Action Plan and indicated it was provided to NGTL by the West Moberly First Nation. NGTL noted the document is in draft form; dated 2013. NGTL indicated they do not see it listed on the SARA website and that it is very briefly mentioned in EC's Recovery Strategy – in a list of examples of Action Plans that have been developed. NGTL asked Canadian Wildlife Service to comment as to their position on this Action Plan.	8.2	NGTL understands the critical habitat identified in WMFN 2014 and the draft Action Plan for the Klinse-Za herd (McNay et al. 2013) was developed using an approach that was informed by traditional knowledge about historic distribution and range of caribou, which differs the delineation of caribou local population units and critical habitat in the federal Recovery Strategy (EC 2014). The Preliminary CHRP has been developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.
BC Ministry of Forests, Lands and Natural Resource Operations				
Matt Austin, Director: Resource Management Megan Watters, Ecosystem Biologist Chris Ritchie, Fish and Wildlife Recovery Manager Gerald Kuzyk, Ungulate Specialist	July 23 and 25, 2013 Email(s)	NGTL sought direction for the Project in regard to caribou (e.g., status of regulatory guidelines; available information on the Graham and Pink Mountain herds; and guidance related to mitigation). BC MFLNRO indicated that NGTL's questions should be directed to the Regional Wildlife Biologist in Fort St. John.	–	N/A
Kerry Harvey, Ecosystem Biologist	August 15, 2013 Meeting in Fort St. John	NGTL provided a summary of the Project in caribou range for discussion. BC MFLNRO indicated that with respect to routing, particularly in caribou range, there should be an effort to maximize paralleling existing linear infrastructure and an overall attempt to reduce project footprint. It was suggested that C. Ritchie (BC MFLNRO Fish and Wildlife Recovery Manager) be engaged to provide a broader perspective and information on standardized industry practices and management practices for restoration. A Mitigation Plan was recommended, to be prepared in advance of applying to the BC OGC.	5.1	Routing criteria provided in Section 4.1 of the ESA outline the key components used to avoid or minimize adverse Project effects on caribou and caribou habitat, including paralleling existing linear disturbances and reducing the Project footprint.
Chris Ritchie, Fish and Wildlife Recovery Manager	August 16 and 20, 2013 Email(s)	NGTL provided a Project overview and asked for direction related to caribou (e.g., application of implementation plan; requirement to prepare a CMMP; application of offsets; standard reclamation practices; and applicability of existing plans to the Pink Mountain caribou herd). BC MFLNRO noted that the Project in the Graham caribou herd did not require a formal CMMP or offsets since the route is not located in high elevation range. However, BC MFLNRO advised NGTL to address concerns such as minimizing the footprint, controlling human and predator access, discouraging early seral vegetation and avoiding the use of palatable species for erosion control. Regarding the Pink Mountain caribou herd, BC MFLNRO confirmed that there is no herd-specific management plan.	5	NGTL incorporated suggestions into the Preliminary CHRP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist	August 26 and September 16, 2013 Email(s)	BC MFLRNO provides a summary letter that provides web-links to relevant provincial information for the Project and requested additional information related to route selection and consideration of route alternatives (i.e., the northern most portion of the Kahta Section).	5.1	NGTL's response noted that the route selection process considers minimizing the length, meeting applicable regulatory requirements and reducing the footprint, while carefully reviewing costs and constructability. The northernmost km's to Kahta (13 km in Pink Mountain range) were officially dropped in NGTL's March 10, 2014 project update to the NEB (Filing ID: A59202). The Project does not cross identified HEWR. NGTL has reduced the length of the northern segment of the Kahta Section, which now avoids disturbance in the proposed UWR (u-9-005), and reduces the length of the proposed pipeline route in the Pink Mountain caribou range by 13 km.
Kerry Harvey, Ecosystem Biologist	October 15, 2013 Email	BC MFLRNO provided further information on the proposed UWR in the Pink Mountain caribou range.	–	NGTL committed to review routing in this UWR.
Kerry Harvey, Ecosystem Biologist Jocelyn Campbell, Ecosystem Biologist	December 4, 2013 Email	NGTL proposed to schedule a meeting in January 2014. In regard to caribou, items to review include: routing through the Pink Mountain range, the effects assessment for caribou (i.e., assessment approach); and mitigation, specifically if any changes are expected given the proposed release of a draft Recovery Strategy.	–	N/A
Chris Ritchie, Fish and Wildlife Recovery Manager Jocelyn Campbell, Ecosystem Biologist Kerry Harvey, Ecosystem Biologist	January 14, 15 and 22, 2014 Email(s)	NGTL asked, in light of EC's forthcoming release of the draft Recovery Strategy, whether there were any changes to provincial plans or delineation of critical habitat (HEWR, low-elevation winter range and matrix), specifically in the Graham range. This information would be useful in Project planning and development of mitigation.	–	No additional or revised provincial planning documents were provided.
Kerry Harvey, Ecosystem Biologist	January 27, 2014 Meeting	NGTL provided a Project overview and noted that the pipeline route is no longer located in an UWR in the Pink Mountain caribou range. Mitigation measures related to caribou and caribou habitat and the CMP were discussed. NGTL agreed to provide a draft plan to BC MFLNRO for review and feedback and noted that a final plan identifying specific measures and locations would be prepared following construction.	5	Recommendations regarding mitigation have been considered and incorporated in the Preliminary CMP. Draft Preliminary CMP was provided to BC MFLNRO for review on April 21, 2014.
Kerry Harvey, Ecosystem Biologist	January 28, 2014 February 5, 2014 Email	NGTL provided detailed maps of Project routing in the Graham range (Aitken Section), and noted detailed mapping in the Pink Mountain range (Kahta Section) will be completed soon (e.g., front end engineering and design [FEED] maps).	–	FEED maps for the Kahta Section were provided to BC MFLNRO on February 5, 2014.
Kerry Harvey, Ecosystem Biologist	March 2 and 14, 2014 Email	NGTL requested guidance from the province related to possible changes associated with the proposed Recovery Strategy (e.g., delineation of critical habitat and standard mitigation measures). NGTL also asked if BC MFLNRO has any concerns, based on review of FEED plans, related to routing in caribou range and noted that a preliminary CMP is being prepared for the Project.	–	No additional concerns were identified.
Elizabeth Hunt, Resource Management Officer	March 24, 2014 Telephone	NGTL discussed with BC MFLNRO the use of merchantable timber for rollback for access control in caribou range. BC MFLNRO did not have any issues and requested that they be consulted once locations have been selected. The transportation of mountain pine beetle-infected timber is not an issue and there are no transportation or harvesting restrictions on mountain pine beetle-infected pine trees.	5.3	Rollback for access control is considered one of the tools that NGTL will incorporate into the implementation of caribou mitigation and Final CHRP, where appropriate. Potential rollback locations for access management will be selected and described in the AMP.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist Chris Ritchie, Fish and Wildlife Recovery Manager	March 31, 2014 Telephone	NGTL noted that a preliminary CMP is being developed for the Project and would address routing, scheduling and mitigation planning before, during and after construction. NGTL again asks if the *Implementation Plan for Ongoing Management of South Peace Northern Caribou in BC* will be updated. BC MFLNRO will review the draft Preliminary CMP before submission to the NEB.	–	Updated provincial planning documents are not available.
Kerry Harvey, Ecosystem Biologist	April 1, 3 and 4, 2014 Email	BC MFLNRO noted that standardized industry management practices are in their infancy and that stakeholders and First Nations will be engaged in this process and there will be an opportunity to review and provide comment in the future. In reference to FEED plans, BC MFLNRO indicated it appears as though NGTL has paralleled existing footprint to a great extent, which is good. BC MFLNRO indicated it would like to reiterate that NGTL make every attempt to minimize new footprint and avoid activities during critical timing windows. BC MFLNRO did not express any additional concerns.	5.6	In response to timing, NGTL provided BC MFLNRO with the response to NEB Information Request 2.32 on this topic. Scheduling information is provided in Section 5.6 of the Preliminary CHRP, including discussion of critical timing windows for caribou.
Kerry Harvey, Ecosystem Biologist	April 14, 2014 Email	NGTL provided follow-up in regard to FEED plans and routing in caribou range. NGTL's construction, environment and engineering team members reviewed the FEED plans to address BC MFLNRO's request.	–	Routing and siting information is described in Section 4.1 of the ESA. No additional opportunities were identified to reduce the footprint in the Pink Mountain range. In the Graham range, NGTL's Lands Department approached an adjacent third-party line to determine whether a portion of their ROW could be used, as this would reduce NGTL's footprint. The third party responded that they could not accommodate that request.
Kerry Harvey, Ecosystem Biologist	April 21, 2014 Email	NGTL provided a draft Preliminary CMP for review.	–	N/A
Kerry Harvey, Ecosystem Biologist	May 1, 2014 Email	BC MFLNRO reviewed the draft Preliminary CMP and provided comments pertaining to: • inclusion of indirect project effects (e.g., noise, aircraft if applicable, annual integrity inspections or monitoring) and, in particular, mitigating potential effects of integrity inspections/maintenance associated with operations • reference to the BC MOE (2014) Science Update for the South Peace Northern Caribou (*Rangifer tarandus caribou* pop. 15) in BC • modification of cautionary period timing window • provision of the document number for the EPP • inclusion of mitigation measures regarding incident/sighting reporting protocols related to traffic management, exclusion of wildlife from open excavations or other potential hazards (e.g., sumps), proper storage of construction materials, site-specific habitat features (e.g., mineral licks) and minimum disturbance construction techniques	Throughout	Comments have been incorporated in the Preliminary CHRP.
Kerry Harvey, Ecosystem Biologist	June 23, 2014 Email	BC MFLNRO provided comments on draft Preliminary CMP pertaining to discrepancy in timing windows. Acknowledged that the BC OGC only has a critical timing window for caribou extending from May 15 through July 15. The BC MFLNRO critical timing window (January 15 through July 15) encapsulates a late-winter period and BC MFLNRO ask that activities also be planned considering that critical period. Perhaps this is an entirely moot point given vegetation restoration success (in all likelihood) needs to be assessed under snow-free conditions (and as such would avoid the said timing window). BC MFLNRO requested a short call in early July to follow up on a few issues.	5.6	The BC MFLNRO critical timing window is incorporated in Section 5.6.

Table 7-2: Summary of Consultation Activities with Federal and Provincial Authorities (cont'd)

Name and Title	Date and Method	Consultation Related to Caribou	Section in the Preliminary CHRP	Comments and Rationale
Kerry Harvey, Ecosystem Biologist	October 22, 2014 Email	BC MFLNRO indicated the Province is aware of and interested in the information in the Klinse-Za Action Plan (as while it used different method to determine a management regime for caribou than the Peace Northern Caribou Plan it is not without merit) and is currently undertaking a comparative assessment of the relevant caribou plans. However, the Province has not endorsed this plan at this time and is comfortable with the management regime as set out in the South Peace Northern Implementation Plan, but remains open to amending/augmenting the current regime if new, compelling information becomes available. With regard to the federal Recovery Plan and their critical habitat maps, as BC MFLRNO understand it the boundaries were determined largely using the provincial data. However, BC MFLRNO cannot confirm this was the only source of data they used, so would be very cautious about using provincial data to better understand EC's mapping. BC MFLNRO understands that EC will be making the shapefiles for their critical habitat publicly available as soon as possible.	8.2	In the absence of an amended South Peace Northern Implementation Plan, NGTL is developing the CHRP to the most recent version of the South Peace Northern Implementation Plan. NGTL understands the critical habitat identified in WMFN 2014 and the draft Action Plan for the Klinse-Za herd (McNay et al. 2013) was developed using an approach that was informed by traditional knowledge about historic distribution and range of caribou, which differs from the delineation of caribou local population units and critical habitat in the federal Recovery Strategy (EC 2014). The Preliminary CHRP has been developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities.

8.0 LITERATURE REVIEW

This section describes the literature review that was conducted to provide regulatory and ecological context relevant to mountain caribou and specifically to the Graham and Pink Mountain caribou range, including threats to and management considerations for recovery of mountain caribou. This context provides an understanding of the current knowledge of the value and purpose of habitat restoration in caribou range.

In addition, available information on mitigation measures and habitat restoration methods was compiled and summarized in Section 5 and Appendix C. This summary was used to provide the foundation for the suite of measures available to NGTL to effectively restore potential Project effects on caribou and caribou habitat. Knowledge gaps that contribute to uncertainty in caribou habitat restoration are identified in Section 8.9. Based on the results of the literature review, the habitat restoration measures best suited for caribou range have been identified.

8.1 LITERATURE REVIEW METHODS

The literature review incorporates regulatory and ecological context relevant to the ESAR caribou range to inform the selection of appropriate mitigation and habitat restoration measures. The key results from current boreal caribou literature as well as previous and ongoing habitat restoration initiatives, techniques implemented and their reported successes and failures were reviewed to inform the CHRP.

The literature review was completed using a systematic approach and standard research techniques, which enabled NGTL to consider the most recent published information about caribou habitat restoration in the Preliminary CHRP. Sources reviewed include federal and provincial recovery strategies and management plans, previously submitted NGTL CHRPs, publically available government reports, in-house reference material and peer-reviewed journal articles.

The literature review for the Preliminary CHRP included a systematic search of the following industry and scholarly databases for queried keywords and phrases:

- Google
- Google Scholar
- BioOne
- Web of Science
- BC Ministry of Forests (BC MOF) Forest Practices Codes Guidebooks
- Cumulative Environmental Management Association (CEMA) database, including Oil Sands Leadership Initiative (OSLI) historic filings

The following search terms were used in the literature review:

- caribou habitat restoration
- northern caribou
- mountain caribou
- subalpine/conifer/mature/old forest restoration
- forested wetlands restoration
- linear corridor restoration/reclamation
- linear feature restoration in subalpine/conifer/mature/old forest and forested wetlands
- BC caribou recovery/range plan/policy/action plan

The COSIA website was searched to gather knowledge on current restoration measures, including the LiDea Project, the Algar Historic Restoration Project and OSLI environmental performance projects. Similarly, documents available on the BC Science and Community Environmental Knowledge (SCEK) Fund website, in particular those associated with the SCEK Fund's research and effectiveness monitoring and caribou programs, were reviewed. The Boreal Caribou Habitat Restoration Operational Toolkit for British Columba (Golder 2015) provided a summary of habitat restoration techniques appropriate for boreal caribou range in BC, and is based largely on lessons learned from restoration activities in northern Alberta.

TERA, a CH2M Hill Company, attended the 15th North American Caribou Workshop (North American Caribou Workshop 2014), where several technical sessions related to habitat restoration for caribou were presented. Relevant information for CHRP planning related to use of rollback and monitoring wildlife use of restored linear features that was presented at the workshop is summarized in the relevant sections of the literature review.

Caribou habitat restoration is receiving increasing research attention and it is anticipated that methods to restore habitat will continue to be tested and modified in the near future. NGTL has incorporated this information in the AMP for the Project and will continue to incorporate new information in the Final CHRP and post-construction monitoring reports.

8.2 REGULATORY POLICY AND GUIDELINES FOR MOUNTAIN CARIBOU

The Preliminary CHRP was developed considering the current regulatory policies specific to mountain caribou. NGTL began consultation and working collaboratively with provincial regulators, Aboriginal communities, stakeholders and industry partners several years ago at the outset of the Project. NGTL will continue to work with provincial and federal regulators to align the CHRP measures with provincial and federal policy.

The identified regulatory policy and management documents considered to develop the Preliminary CHRP include:

- *Management Plan for the Northern Mountain Population of Woodland Caribou* (Rangifer tarandus caribou) *in Canada* (EC 2012a), as it applies to the Pink Mountain herd
- *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (BC MOE 2013), as it applies to the Graham herd
- *Recovery Strategy for the Woodland Caribou, Southern Mountain Population* (Rangifer tarandus caribou) *in Canada* (EC 2014), as it applies to the Graham herd
- *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014 [Filing ID: A3Z0H2])
- *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013 [Filing ID: A3X4D3])
- *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (Interim Guidance)* (BC MFLNRO 2014)
- *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005)

Further information on each of the documents listed above is summarized in the following paragraphs.

The *Management Plan for the Northern Mountain Population of Woodland Caribou* (Rangifer tarandus caribou) *in Canada* (EC 2012a) applies to the Pink Mountain herd. Objectives of the plan for northern mountain caribou include determining herd status and trends, managing harvest and identifying and managing important habitats. The main threat identified for the Pink Mountain herd is reduction in range due to industrial development. An increase in predation by both wolves and wolverines was noted, and is attributed to the increase in moose populations following prescribed burns.

The *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (BC MOE 2013) applies to the Graham herd. Objectives include:

- protecting 90% of HEWR
- implementing management objectives and standardized management practices in HEWR and low-elevation winter range (there is currently no low-elevation winter range identified for the Graham herd)
- addressing non-habitat related threats
- monitoring compliance and effectiveness of management actions

Management objectives for industrial footprints are to restore, reduce or prohibit surface disturbance in high-elevation winter habitat, thereby reducing the potential for disturbance and displacement of caribou to lower elevation winter habitats that have a relatively higher predation risk. Implementation of standardized industry management practices to reduce or avoid habitat disturbance is one of the key implementation objectives of the Plan. The Plan suggests that these standardized management practices would be regulated under the *Oil and Gas Activities Act*, the *Forest and Range Practices Act* or the *Mines Act*. Currently, the standardized management practices suggested in the Plan have not been developed or implemented. The Project does not intersect defined HEWR in caribou range and, therefore, does not trigger the provincial requirement for a Caribou Mitigation and Monitoring Plan, which could include a requirement for offset (compensation) measures.

EC released the *Recovery Strategy for Woodland Caribou, Southern Mountain population* (Rangifer tarandus caribou) *in Canada* in June 2014, with the goal to achieve self-sustaining populations in all local population units within their current distribution (EC 2014). The Recovery Strategy applies to the Graham herd, or local population unit, but not the Pink Mountain herd. The Graham herd is part of the Northern Group subpopulation, and the Recovery Strategy has set a population target of 4,600 caribou for this group, which is 24% higher than the current population estimate of 3,707 caribou.

Population and distribution objectives identified in the Recovery Strategy include:

- stop the decline in both size and distribution of all local population units
- maintain the current distribution within each local population unit
- increase the size of all local population units to self-sustaining levels and, where appropriate and attainable, to levels that can sustain a harvest with dedicated or priority access to Aboriginal peoples (EC 2014)

The federal Recovery Strategy delineates critical habitat in the Northern Group into five categories:

- high-elevation summer or winter range
- low-elevation summer range
- low-elevation winter range
- Type 1 matrix range within annual ranges
- Type 2 matrix range surrounding annual ranges

Only high-elevation summer or winter range is currently spatially defined in the Recovery Strategy for the Graham range. The definition of critical habitat is subject to change in updates to the Recovery Strategy or through the development of federal action plans.

Maintenance of low and sustainable predation risk and access to food resources is the key habitat function of each of these identified range categories (EC 2014). In low-elevation winter range and Type 1 matrix range, a minimum 65% undisturbed habitat should be achieved or maintained (for Northern and Central groups), and, in Type 2 matrix range, ecological conditions to support low predation risk should be maintained. The Recovery Strategy considers minimal disturbance of high-elevation summer and winter ranges as necessary for the recovery of southern mountain caribou local population units.

Critical habitat for southern mountain caribou is partially mapped in the EC Recovery Strategy. The Project is not located in critical habitat as currently mapped for the Graham local population unit. NGTL acknowledges the incomplete identification of critical habitat for the Graham herd, and will continue to engage the appropriate regulatory agencies to incorporate updated information as results from the schedule of studies identified in the Recovery Strategy become available.

During the NEB application review process for the Project, West Moberly First Nations submitted written evidence, entitled *Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia* (West Moberly First Nations 2014), hereafter referred to as the Seven Herds report. In the Seven Herds report, additional critical habitat is proposed for woodland caribou, including the Graham and Klinse-Za (Moberly) herds, and current and historical population and distribution information is provided. The stated intent of the document is to provide information for inclusion in the development of the federal Recovery Strategy and Action Plans under SARA.

The *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]* (McNay et al. 2013) identifies population and distribution objectives, disturbance thresholds for the critical habitat proposed in the draft Action Plan for the Klinse-Za herd and recommended measures to stabilize the Klinse-Za caribou herd population. The recovery actions listed in the draft Action Plan for the Klinse-Za herd, in order of priority, include:

- wolf reductions and calf penning
- protection of terrestrial lichen
- avoidance of calving areas during calving period
- restoration of early seral habitats
- deactivation of linear features
- implementing a range plan and cumulative effects assessment plan

NGTL understands the critical habitat proposed in the Seven Herds report and the draft Action Plan for the Klinse-Za herd was developed using an approach informed by traditional knowledge about historic distribution and range of caribou.

This approach differs from the delineation of caribou local population units and critical habitat in the federal Recovery Strategy, which is based on current and recently historic (since the 1980s) occupancy (EC 2014). NGTL recognizes that proposed critical habitat in the Sevens Herd report and the draft Action Plan for the Klinse-Za herd overlaps with a portion of the Aitken Creek Section of the Project. However, neither critical habitat nor the local population unit boundary for the Moberly (Klinse-Za) herd delineated in the EC Recovery Strategy overlaps with the Aitken Creek Section. Similarly, although the Graham local population unit boundary does overlap with the Aitken Creek Section, no critical habitat as delineated in the federal Recovery Strategy overlaps with the Project.

Given these differences in mapping, it was determined that the Preliminary CHRP would be developed to align with the delineated caribou habitat provided by the federal and provincial regulatory authorities. NGTL has adopted the definition of critical habitat as defined in the Recovery Strategy. NGTL is developing a consistent approach for all its projects, which aligns with the federal and provincial regulatory authorities. Furthermore, the mitigation measures that NGTL has proposed within this Preliminary CHRP are consistent with and have been developed in consideration of the objectives described in provincial and federal management and recovery plans. NGTL recognizes that critical habitat for caribou is only partially delineated by EC, and that the process is ongoing. Any changes made to the boundaries delineated in the Recovery Strategy will be considered in the development of the Final CHRP. The mitigation measures described in the EPP will be applied to the entire Project. In addition, access management measures will be implemented throughout the entire Project. The NEB Report concurs that NGTL has identified current caribou distribution in a manner consistent with the NEB Filing Manual, and that the mitigation applied to protect the Graham herd will ultimately protect the Moberly herd. The NEB noted that the Project does not overlap with the current distribution of the Moberly (Klinse-Za) caribou herd.

In addition to the regulatory policies and recovery objectives summarized above, the Preliminary CHRP considered regulatory guidelines relevant to industrial development in caribou ranges. Regulatory guidelines provide recommendations for industrial development to protect caribou habitat, avoid sensory disturbance during sensitive periods and manage human and predator access.

The recently released *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia* (*Interim Guidance*) (BC MFLNRO 2014) provides recommendations for mitigating potential impacts on wildlife and wildlife habitat during the planning, development and operation of industrial projects, including pipelines.

The compendium focuses on northern BC, including the Northeast, Omineca and Skeena regions. With respect to caribou, the compendium indicates that threats to caribou are similar across ecotypes and are primarily changes to predator–prey dynamics and sensory disturbance during critical periods (late winter when cows are in their poorest physical condition and spring during calving and rearing). To address these threats, the identified management objectives of the compendium include maintaining the functional integrity of important habitats, avoiding or minimizing disturbance to caribou, and avoiding or minimizing an increase in predation risk. To meet these objectives, the compendium identifies 11 points of guidance:

1. Identify caribou habitat and historic and current caribou use of those habitats within the proposed project footprint and its area of influence.
2. Identify caribou indicators (e.g., habitat use and characteristics, population structure and dynamics, etc.) within the project area by caribou ecotype.
3. Identify the impacts of proposed activities on caribou and caribou habitat.
4. Avoid or minimize new disturbance to caribou habitat and the loss of important habitats.
5. Avoid increasing the density of linear disturbances within or in proximity to caribou habitat.
6. Avoid displacing caribou and minimize direct and indirect mortality on caribou populations.
7. Avoid increasing the predation risk for caribou populations.
8. Avoid contaminating caribou habitat.
9. Restore habitats to a condition that provides a similar level of functional caribou habitat as before any industrial activity took place.
10. Develop a monitoring and adaptive management plan to monitor effectiveness of measures to avoid, minimize and restore.
11. Risk timing windows for caribou.

The previously released *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005) contains information on northern caribou, as well as a review of existing management strategies. Over 100 documents were reviewed, including provincial strategies and relevant Land and Resource Management Plans.

Management strategies were grouped into several categories, including:

- landscape level (direction on how an entire caribou range will be managed with respect to spatial and temporal disturbance and associated activities; landscape level strategies are consistent across caribou herds)
- stand level (direction on how industrial activities will be conducted in caribou range, with a focus on managing forage lichens; stand level strategies vary by caribou herd)
- access strategies (direction on how to avoid and minimize impacts from increased access and development of linear corridors, with an emphasis on road planning)
- oil and gas and mining strategies (focus on low impact methods for exploration, restoration of disturbed habitat and minimizing the creation of movement barriers)
- caribou population/monitoring strategies (complement caribou habitat strategies, and suggest further research)

The *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia* (Cichowski 2005) refers to the *1996/97 Operating Guidelines for Industrial Activity in Caribou Ranges in West Central Alberta* (Alberta West Central Standing Committee 1996). The Operating Guidelines are for the West Central Alberta caribou ranges, including both mountain and boreal ecotype caribou. The main concerns addressed by the Operating Guidelines are public access routes, predation rates on caribou, caribou habitat availability and quality, and displacing or causing sensory disturbance to caribou. The strategy to address these concerns includes managing short- and long-term impacts of access, applying an "early in/early out" construction schedule, and identifying and providing an adequate supply of quality habitat.

The BC Oil and Gas Commission ([BC OGC] 2013) *Environmental Protection and Management Guide* provides information on the requirements of the Environmental Protection and Management Regulation. The guide provides timing windows for northern and boreal caribou, including:

- low risk (activities should be scheduled during these times, where ground conditions permit)
- cautionary (operations may proceed, subject to BC OGC review; recommend avoidance of intensive activities and additional mitigation measures might be required)
- critical (most activities are restricted during this time; if working within the timing window is unavoidable, operations must be accompanied by a rationale and mitigation and/or monitoring plans, subject to BC OGC approval)

8.3 MOUNTAIN CARIBOU ECOLOGY

As previously mentioned, both the Graham and Pink Mountain herds are provincially designated northern ecotype caribou (BC MOE 2010) – the Graham herd is part of the Southern Mountain Population and the Pink Mountain herd is part of the Northern Mountain Population (EC 2015). Mountain caribou are found in west-central and northern BC, where they span two National Ecological Areas: the Southern Mountain National Ecological Area (SMNEA) and the Northern Mountain National Ecological Area (NMNEA) (BC MFLNRO 2014). The Pink Mountain herd belongs to the NMNEA and the Pink Mountain herd is in the SMNEA. Northern ecotype caribou use terrestrial lichens as a primary food source in winter and overwinter either in low-elevation pine–lichen stands or at high elevation on windswept alpine ridges (BC MFLNRO 2014). Mountain caribou typically calve at high elevations, often migrating over large distances to open subalpine ridges where they maintain a spatial separation from predators, primarily wolves (BC MFLNRO 2014).

8.3.1 Graham Caribou

In 2009 the population estimate for the Graham caribou herd was 708 individuals (EC 2014). There is low confidence in this estimate, and BC MFLNRO has scheduled a census for winter 2015 (Seip pers. comm.). EC (2014) currently considers the population to be stable and BC MOE (2014) considers it to be decreasing in the short term by. However, the long-term population trend is unknown (EC 2014). The seasonal habitat use and movement patterns of the Graham caribou herd are variable and largely dependent on snow conditions (e.g., depth and density) (Backmeyer 2000; Culling et al. 2005). Graham caribou use upland coniferous forests from 1,200 m to 1,600 m in elevation. Preferred habitats include subalpine parkland, alpine tundra, mature and old pine forests and wetland conifer forests, while early seral, deciduous forests are often avoided (Culling et al. 2005). The Engelmann Spruce-Subalpine Fir (ESSF) and Boreal White and Black Spruce (BWBS) biogeoclimatic zones are preferred by the Graham caribou, and use of each zone varies by season (Backmeyer 2000).

The following description of Graham caribou seasonal habitat use is based on a radio-collar study (Culling et al. 2005). During the spring (early April to mid-May), Graham caribou use habitats below 1,300 m, although alpine tundra areas can be used during spring in years with higher than average snowfall. Pregnant females move to higher elevations (1,500 m) to calve in mid-May through the end of June, where they typically remain below the treeline. In summer (July through August) caribou are found in high-elevation alpine tundra and subalpine parkland, and males tend to use higher elevations (1,650 m) than females (1,550 m).

Both males and females begin to move to lower elevations (> 1,500 m) during fall (September through October), where males show a preference for spruce-fir forests and alpine tundra, and females show a preference for subalpine parkland and alpine tundra. Alpine and subalpine habitats are used during the rut. Habitat use during the early winter (November through January) is quite variable, with both alpine tundra and wetland conifer habitats being selected. This variability in habitat selection might be the result of variability in snow conditions and access to forage.

A substantial proportion of the Graham herd detected in the study selected old and mature pine forests and subalpine parkland in late winter (February through March) (Culling et al. 2005). The core winter habitat used by the Graham caribou herd is located along the eastern foothills and is lower in elevation (1,300 m) than habitats used in the summer. More variable use of habitats by the Graham herd in late winter was reported in another study, with a split between individuals using low- and high-elevation habitats (Backmeyer 2000). The federal recovery strategy for southern mountain caribou indicates that low-elevation winter range for the Northern Group (Graham herd) is characterized by low-elevation pine forests 80-250+ years in age with ground cover of terrestrial lichens (EC 2014).

In the Graham caribou herd, there are both migratory (i.e., distinct summer and winter ranges) and resident (i.e., overlapping summer and winter ranges) individuals (Backmeyer 2000, Culling et al. 2005). For the migratory individuals, the spring migration to calving areas is fairly consistent across years, whereas fall migration is more variable and dependent on weather and snow conditions (Culling et al. 2005). Graham caribou favour alpine and subalpine ridges as movement corridors (52% of point locations during migratory periods) and tend to avoid valley bottoms (Culling et al. 2005). The authors of that study speculate that the avoidance of valley bottoms might be due to long-term exposure to predation risk since the area used by the Graham herd has historically had higher moose populations than other parts of the province (Culling et al. 2005).

The annual habitat use described above is supported by the biophysical attributes for the Northern Group of southern mountain caribou, identified in the federal Recovery Strategy. Attributes of critical habitat for Northern Group caribou include low predation risk, low sensory disturbance and access to forage resources (e.g., terrestrial and arboreal lichens, forbs, grasses, sedges, horsetails, emergent vegetation), as well as mineralized soils and wetlands (mineral licks) and minimal physical obstructions (to allow movement) (EC 2014).

8.3.2 Pink Mountain Caribou

In 2000, the population estimate for the Pink Mountain herd was 850 individuals and the population trend is currently unknown (EC 2012a). Information on ecology and habitat use specific to Pink Mountain caribou is limited.

Available information indicates that seasonal movements of Pink Mountain caribou are dependent on snow conditions, as they spend the summer in high-elevation alpine and subalpine habitats and move to lower-elevation coniferous forests during winter. Winter forage consists primarily of terrestrial lichen (COSEWIC 2002).

8.4 THREATS AND LIMITING FACTORS

Threats to southern mountain caribou identified in the federal Recovery Strategy, in descending order of direct impact on caribou population trend, are:

- predation
- habitat alteration from industrial activities
- roads and other linear features affecting direct mortality, habitat fragmentation and predation
- recreational activities causing displacement and facilitating predator access
- natural disturbance of habitat
- hunting

Other threats of lower concern include implications of climate change, avalanches, parasites and diseases, and stress responses associated with sensory disturbance (noise and light). Although the Pink Mountain herd is not covered under the Recovery Strategy, current literature suggests that threats to the Pink Mountain herd are likely similar to those listed for southern mountain caribou.

Apparent competition was identified as the likely causal pathway for woodland caribou population declines. As primary prey species (e.g., moose, deer) increase with increasing proportions of early seral habitat on the landscape, there is a corresponding increase in the numerical response of predators (BC MOE 2013; COSEWIC 2002; EC 2014; Latham 2009; Seip and Cichowski 1996; Wittmer et al. 2005). Wolves are considered the primary predator of caribou across northern Canada and predation by wolves was the most common cause of death for adult caribou in northeast Alberta (McLoughlin et al. 2003). Black bear could also be a common predator of caribou (Rettie and Messier 1998; Zager and Beechman 2006). 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. 2013; Wittmer et al. 2005).

Predation on caribou is thought to be largely incidental, given the low densities of woodland caribou compared with much more abundant prey species (Wittmer et al. 2005).

The primary selection of peatlands and old-growth forest by caribou and the non-use of, or lack of positive habitat selection, for these areas by moose, wolves (Rettie and Messier 2000) and black bears (Latham et al. 2011) was determined to result in spatial separation (James et al. 2004). This strategy is believed to be used to combat the widespread influence that wolves have in an ecosystem (e.g., Ripple and Beschta 2004; Ripple et al. 2014). Removal or alteration of habitat (e.g., forest harvesting [McCutchen 2007]) can also reduce the spatial separation between caribou and primary prey (i.e., moose). Following forest harvest, moose and woodland caribou were more likely to use the same habitat, and woodland caribou suffered higher rates of wolf predation (Peters et al. 2013).

A recent study found that roads increased predation risk for mountain caribou, but early seral habitat and edge created by logging, power lines and wildfire did not (Apps et al. 2013). The study showed that with the exception of roads, early seral/edge habitats influence caribou predation risk less than habitat variables such as elevation, terrain conditions (i.e., complexity, slope) and variation in canopy cover (Apps et al. 2013). Vulnerability to predation for mountain caribou increases as they move to lower-elevation habitats that are selected by primary prey (i.e., moose and deer) regardless of habitat disturbance on the landscape (Apps et al. 2013).

Vulnerability has also been shown to increase in rugged terrain and narrow valleys rather than wide valleys or plateau areas (Apps et al. 2013). This suggests that aside from roads, the functional response of predators to habitat changes in the landscape is less relevant than the population-level numerical response of predators to their primary prey (Apps et al. 2013).

Similarly, the ultimate cost to caribou habitat suitability appears lower for linear feature-induced changes compared with forestry-induced (i.e., cutblocks) changes (DeCesare et al. 2012). Linear feature-induced changes have been previously linked to changes in predator functional response (predator kill rate) while forestry-induced changes have been previously linked to changes in predator numerical response (predator density). 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). Over the long term, managing timber harvest practices in the winter ranges of early seral ungulates to reduce the continuous production of early seral habitat might have the most influential impact on recovery and sustainability of caribou populations (Apps et al. 2013).

Although landscape-scale habitat characteristics that influence ungulate and predator densities might have the greatest impact on caribou population sustainability and recovery (Apps et al. 2013), the influence of anthropogenic linear feature density on predation rates is an important factor for caribou mortality (Whittington et al. 2011).

Linear corridors provide improved access for predators such as wolves. Several studies have found that linear corridors are attractive to bears (McKay et al. 2014) and especially wolves as easy travel routes (James 1999; James and Stuart-Smith 2000; Stuart-Smith et al. 1997; Thurber et al. 1994; Whittington et al. 2011). As a result, linear disturbances might influence predator/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). Furthermore, it is suggested that while wolves increase movement rates on linear disturbance features, their movement rates in close proximity to disturbance features decreases, implying behaviours closely associated with prey searching and hunting (Ehlers et al. 2014). However, modelling the dynamic use of the landscape by wolves, primary prey (moose) and caribou showed that wolves experience no additional advantage accessing caribou from linear features, although they do benefit in accessing primary prey species (McCutchen 2007). This is supported by a study that found that kill sites were no closer to linear features than random (Latham et al. 2011).

Caribou are sensitive to direct and indirect anthropogenic disturbance (e.g., industrial activity [Dyer et al. 2001, 2002]) and habitat alteration (e.g., forestry [Peters et al. 2013]), in addition to natural disturbance such as burns (Schaefer and Pruitt 1991). Specific to linear corridors, long-term reduction in habitat effectiveness adjacent to linear features might occur as caribou have been shown to partially avoid habitats near ROWs (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. Methods 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]) and 1,000 m (industrial developments such as well sites [Dyer et al. 2001]).

By calculating the spatial difference between potential and realized habitat, a study of northern mountain caribou in BC estimated that as a result of avoidance of the cumulative zone of influence around multiple developments, approximately 8% of high-quality habitat was indirectly lost in the study area in winter and and 2% in summer (Polfus et al. 2011).

Despite an apparent reduction in habitat use in proximity to disturbance, studies have concluded that pipelines do not create a movement barrier to boreal caribou (Joint Pipeline Office 1999; Carruthers and Jakimchuk 1987 in Dyer et al. 2002), except where they parallel roads with traffic (Curatolo and Murphy 1986 in Dyer et al. 2002).

The federal Recovery Strategy for southern mountain caribou defines disturbance to critical habitat as the area affected by natural disturbances such as fire and avalanches or by human-caused disturbance, including a 500-m buffer around anthropogenic disturbance to account for avoidance by caribou (EC 2014). Critical habitat for southern mountain caribou is identified as all of the area of high-elevation winter and/or summer range; within the Northern and Central Groups that contain low-elevation winter range, a perpetual state of a minimum of 65% undisturbed habitat; and a matrix range that provides an overall ecological condition that will allow for low predation risk (EC 2014).

The Recovery Strategy considers at this time that “very minimal disturbance” for high-elevation winter and/or summer ranges is required for achieving recovery of local population units in all of the southern mountain caribou groups. For the Northern Group of southern mountain caribou (including the Graham herd), the federal Recovery Strategy identifies a minimum of 65% undisturbed habitat as a reference disturbance level for low-elevation winter ranges and Type 1 matrix range (EC 2014).

The threshold of 65% undisturbed habitat is derived from population response models developed for boreal woodland caribou ranges (EC 2011, 2012b), which, like the low-elevation and Type 1 matrix range for Northern Group southern mountain caribou, consist of fire-adapted ecosystems. The 65% threshold might be revisited on completion of studies to determine appropriate disturbance thresholds specific to low-elevation and Type 1 matrix range, or evidence that indicates the disturbance level is not supporting recovery of a caribou local population unit. Additional studies are needed to determine disturbance thresholds that will achieve recovery objectives for high-elevation ranges (EC 2014).

Until such thresholds are identified, disturbance in high-elevation ranges should be minimized and mitigated (EC 2014). In addition, maintaining functional Type 2 matrix range (outside the local population unit boundaries) is an essential component of recovery of southern mountain caribou local population units to self-sustaining levels (EC 2014). The habitat condition of Type 2 matrix habitat that is necessary for caribou recovery is identified as a wolf density of less than 3 wolves/1,000 km^2. This target might be achieved through management of habitat disturbance levels or management of primary prey and predator abundance (EC 2014).

Woodland caribou populations are very low in many areas and, therefore, populations might not rebound due to increasing rates of inbreeding and other, well-defined detrimental effects of genetic drift that are characteristic of small, genetically isolated populations (Bijlsma et al. 2000; Frankham 2005; Hedrick and Kalinowski 2000; Keller and Waller 2002). This phenomenon, known as the Allee effect, was recently suggested to occur in the boreal population of woodland caribou in Alberta (Hervieux et al. 2013; Serrouya et al. 2012) and potentially to occur in the Southern Mountain population of woodland caribou (Wittmer et al. 2005).

8.5 CARIBOU RECOVERY AND HABITAT RESTORATION

Restoration of disturbed habitat has become one of the key components for caribou conservation identified through the federal Recovery Strategy (EC 2012a, 2014) and in provincial mountain caribou recovery planning (BC MOE 2013). This section summarizes information from habitat restoration guidelines, previous caribou habitat restoration initiatives and published research. Information on restoration methods employed and effectiveness or success of restoration is included, where available.

Results of the literature review provide habitat restoration information specific to mountain caribou ranges. However, given the limited availability of literature specific to mountain caribou ranges, relevant literature from research and restoration initiatives in boreal woodland caribou range is included. This section is supplemented with further information specific to restoration initiatives completed in boreal woodland caribou range (Appendix A), which was considered as context within which to develop this Preliminary CHRP. This is supported by similarities in ecological characteristics, restoration objectives and silvicultural practices between the Project area in northern BC and boreal caribou ranges in Alberta where additional documentation for habitat restoration initiatives is available.

Both boreal and mountain woodland caribou require undisturbed habitats with mature and old coniferous forest, and lichen forage opportunities (EC 2012b, 2014). While there are similarities among these habitat requirements, mountain caribou are distinguished from boreal woodland caribou by seasonal migrations between low-elevation and high-elevation ranges (Heard and Vagt 1998; Spalding 2000; EC 2014). See Section 8.3 for further description of northern ecotype, mountain caribou ecology. In contrast, boreal woodland caribou inhabit boreal landscapes where terrain is lacking high-elevation features, and elevational migration between seasonal habitats does not occur. Despite differences in seasonal movements and habitat use between mountain and boreal woodland caribou, there is overlap in habitat types that occur in some northern ecotype mountain caribou ranges and boreal woodland caribou ranges.

The Project area in the Graham and Pink Mountain caribou ranges is mostly located in the transitional area between the Subboreal Interior and the Boreal Plains ecoprovinces of BC, east of the Rocky Mountains (Demarchi 2011). This area corresponds to the western fringe of the Boreal Plains Ecozone of Canada, which extends across the boreal region of western Canada (Smith and Marshall 1995) and overlaps many of the boreal woodland caribou ranges in western Canada. The northern part of the Kahta Section is characterized by a mosaic of forested (predominantly coniferous) wetlands and upland habitats, not unlike those in boreal regions. The rolling terrain along the Aitken Creek Section in the Graham caribou range is characterized by upland conifer and deciduous forests, with relatively little forested wetlands. The similarities in habitats between the Graham and Pink Mountain caribou ranges encountered by the Project and those encountered in some boreal woodland caribou ranges where habitat restoration is better understood, supports transfer of habitat restoration information between the regions.

The effects of linear developments are similar across caribou range, regardless of the caribou ecotype. Effects of linear disturbance on woodland caribou associated with loss of suitable old forest habitat features (e.g., loss of forage and cover habitat) is considered of lower consequence than indirect effects, due to the relatively small impact of clearing narrow linear features when considered in proportion to habitat availability at the range scale. The effects associated with regenerating early seral habitats and access, and the potential resultant indirect changes in predator–prey dynamics, similarly affect mountain and boreal woodland caribou.

The focus of mitigation and habitat restoration applied in boreal and mountain caribou ranges are similar. Namely, the objectives of habitat restoration initiatives include re-establishing natural vegetation communities that do not encourage highly palatable forage for primary prey, blocking motorized access to facilitate vegetation establishment and growth and limiting sightlines. When successfully implemented, these measures are expected to reduce residual effects of linear developments associated with predation risk. Given the similar objectives for caribou habitat restoration in boreal and mountain caribou ranges, similar measures are applied to restore habitat within linear disturbances, including silvicultural methods to establish vegetation (e.g., site preparation techniques and planting or seeding native vegetation) and measures to block access and line-of-sight.

8.5.1 Guidelines Relevant to Habitat Restoration in Mountain Caribou Range

A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia (*Interim Guidance*) (BC MFLNRO 2014) provides guidelines for habitat restoration in caribou range. The main objectives for habitat restoration are to restore habitats to a similar functional level as before disturbance and to develop monitoring and adaptive management plans to monitor the effectiveness of restoration measures.

This compendium provides a list of recommendations to achieve these objectives, as follows:

- restore habitat as soon as possible following development
- deactivate and restore linear features as soon as possible following development
- limit attracting predators and early-seral ungulates to the development area
- explore opportunities to restore areas not directly affected by development activities
- prevent the establishment and spread of invasive species
- develop monitoring plans to ensure that mitigation measures are implemented as planned and are effective at meeting measurable targets
- align the type and degree of monitoring with the degree of risk to caribou and the uncertainty around mitigation measures
- ensure that monitoring plans are planned and implemented by a qualified professional with knowledge of caribou ecology
- share all data with provincial regulatory agencies to facilitate future mitigation and caribou management
- ensure that monitoring plans include changes over time, a before-and-after control study design, habitat modelling and adaptive management

A *Compendium of Northern Caribou Winter Range Management Guidelines and Strategies in British Columbia* was prepared for the BC Ministry of Water, Land and Air Protection (MWLAP) in 2005 (Cichowski 2005). This report targets the northern caribou ecotype, which consists of both the Graham and Pink Mountain herds, along with 29 other herds. This compendium summarizes provincial strategies, guidelines and recommendations for management and recovery of northern caribou at landscape and stand-level scales, including strategies to address both forage and predator avoidance requirements, and management concerns specific to seasonal habitats.

Limiting disturbance and exposure to predators is identified as a key consideration for summer and calving habitat, high-elevation and low-elevation winter habitat, as well as matrix habitat (Cichowski 2005). This compendium states linear corridor development and access associated with industrial activities is one of the major threats to northern caribou, so considerable effort was put into developing linear corridor and access management strategies. The identified strategies include avoiding road development to alpine and subalpine habitats, on eskers, on south slopes or through travel/connectivity corridors, and avoiding extended sightlines (Cichowski 2005).

Numerous strategies related to road planning, construction and decommissioning are summarized in this compendium. Many of these strategies are relevant to pipeline construction and operation, and are adopted as industry best management practices, including:

- planning access development to minimize disturbance footprint
- coordinating shared access
- using temporary access
- decommissioning access as soon as site conditions and timing restrictions allow following construction
- implementing measures to reduce lines-of-sight (e.g., bends, retaining vegetation screens)
- reclaiming linear corridors
- minimizing snow plowing
- implementing access prevention measures
- timing restrictions

The *Ecological Restoration Guidelines for British Columbia* (BC MWLAP n.d.) provide guidance on how to plan a restoration program. This guidance includes establishing goals and objectives, effective monitoring programs and restoration priorities. The guidelines provide recommendations on issues to consider, such as planting prescriptions, species at risk, soil rehabilitation, slope instability and bioengineering. However, recommendations for specific mitigation measures that are best suited for specific habitat types are not provided.

The BC OGC (2013) recommends using Land Resource Management Plans and Sustainable Resource Management Plans as guidelines for end land use goals. The forestry industry guidebooks prepared under the BC *Forest and Range Practices Act* (previously *Forest Practices Code of British Columbia Act*) provide valuable information for silvicultural practices and techniques that are commonly used to restore vegetation in disturbed sites. Guidebooks reviewed for relevant information to support caribou habitat restoration planning for the Project include *Soil Rehabilitation Guidebook* (BC MOF 1997) and *Establishment to Free Growing Guidebook Prince George Forest Region* (BC MOF 2000). These guidebooks provide information relevant to mechanical site preparation for creating suitable microsite conditions for seedling establishment, seedling planting, stocking standards and species. This information is incorporated in the post-construction habitat restoration information provided in this Preliminary CHRP, including specifications and targets.

Although not directly intended for northern or mountain ecotype caribou ranges, the *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia* (Golder 2015), prepared under the SCEK Fund, provides a review of restoration tools for caribou habitat restoration that can be applied to caribou ranges for other ecotypes. Access management (human and predator) and recovery of natural vegetation are the stated objectives for caribou habitat restoration in the toolkit, which identifies mechanical site preparation (mounding or ripping), tree/shrub planting, spreading woody material, tree felling/bending and installing fences as restoration techniques to be considered for boreal caribou habitat restoration in BC. Until further information for habitat restoration in northern and mountain caribou ecotypes has been collected through monitoring of implemented restoration programs, much of the information available for caribou habitat restoration comes from restoration initiatives in boreal caribou ranges of Alberta.

Provincial guidance for restoration of wetlands was reviewed, because treed wetland habitat types occur along much of the Kahta Section in caribou range. These habitat types are known to naturally have very slow rates of vegetation establishment and growth, making tree seedling establishment and growth in the short- to medium term unpredictable. There is currently no overarching provincial policy for wetlands or wetland restoration in BC, although the *Forest Practices Code* protects wetlands on Crown land and the Ministry of Transportation has a no net loss of wetland policy (Wetland Stewardship Partnership 2010). While wetland restoration is a primary focus of the *Wetlands Action Plan*, no guidelines or recommendations are provided for restoration (Wetland Stewardship Partnership 2010).

8.6 VEGETATION REESTABLISHMENT

Restoration of disturbed habitat has become one of the key components for caribou conservation. This section summarizes information from habitat restoration guidelines, previous caribou habitat restoration initiatives and published research. Information on restoration methods employed and effectiveness or success of restoration is included.

8.6.1 Tree Planting and Natural Regeneration

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 site preparation to create microsite conditions (i.e., silvicultural methods) that are conducive to both planted seedling growth and natural vegetation encroachment (CRRP 2007b; COSIA 2012). Measures such as rollback can address site condition issues, including competition from non-target or undesired plant species, erosion, frost, and heat or moisture deficiencies (CRRP 2007b).

These methods are consistent with the approach adopted by NGTL in previous CHRPs, and in the recommended measures summarized in the *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia* (Golder 2015).

Natural revegetation and successful planting initiatives benefit from construction practices that minimize disturbance during development of the footprint. Minimum disturbance pipeline construction techniques that avoid grubbing and grading are effective at facilitating rapid regeneration of native vegetation within the ROW, in areas with a deciduous vegetation component (TERA 2011a,b, 2012). Implementation of minimum disturbance construction can be limited by such factors as terrain that requires grading, ground conditions (e.g., non-frozen soils) and construction methods (e.g., crossings of third-party dispositions).

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 (CRRP 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 [DES] 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 (COSIA 2012). It might also provide important habitat benefits for wildlife, compared with only planting tree seedlings, by providing hiding cover (Bayne et al. 2011).

Conventional 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 can 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 was 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., ATVs, animal browsing, repeated exploration) on seismic lines (Revel et al. 1984; MacFarlane 1999, 2003; Sherrington 2003; Lee and Boutin 2006).

Since tree regeneration on seismic lines is a key determinant of recovery success (MacFarlane 2003), factors that hinder revegetation efforts should be mitigated. Drawing parallels between regeneration success on seismic lines and pipeline ROWs should be done with caution.

Restoration success on seismic lines might not be comparable to that of pipeline ROWs given differences in disturbance mechanisms, degree of soil and vegetation disturbance, reclamation practices and width of the features (i.e., the wider openings of ROWs allow more light and insolation than narrow seismic lines, which might facilitate better vegetation regrowth).

At the 15th North American Caribou Conference (2014), positive scientific evidence was presented on winter tree planting and mechanically bending live trees into the ROW as emerging mitigation options for seismic lines in the oil sands region of Alberta. Tree bending could be particularly promising as it promotes natural revegetation by increasing cone deposition on the disturbance footprint and creating microsites through shading and dropped dead woody debris. These mitigation measures, however, have only initially been evaluated and their full utility remains unknown. Furthermore, these techniques were applied only on seismic lines, which are considerably narrower than pipeline ROWs and do not require continued operational activities, as do pipelines.

8.6.2 Transplanting and Seeding

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 2012a):

- 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), which can reduce their viability
- other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison

An alternative to salvage and transplanting vegetation is to seed disturbed areas using seed collected from the same geographic region as the restoration project. Broadcasting seed either aerially or using ground methods (by hand or mechanically) is also an option. However, since pipeline ROWs are relatively narrow openings (compared with cutblocks, for example), sufficient natural seed ingress from the adjacent undisturbed habitat can facilitate natural recovery without additional seed application. Logistically, the feasibility of seeding can be constrained where the reclamation project is a substantial distance from an airport or airfield (i.e., for aerial seeding), or where ground access during non-frozen conditions is restricted by wet soils. Furthermore, direct seeding of conifers is not a preferred reforestation technique, partly due to problems with seed predation (BC MOF 1997).

Transplanting or seeding lichen species has many of the same challenges as transplanting or seeding vascular plants. In addition, conditions required for successful establishment of terrestrial lichens may be limited along pipeline ROWs (e.g., adequate amounts of shade) or are not compatible with other habitat restoration measures or access management measures (e.g., presence of woody debris) (Gough 2010; Miege et al. 2001). The costs associated with lichen collection might be prohibitive (Roturier et al. 2007). Few studies have determined the effectiveness of lichen transplantation or seeding, and these have focused on regenerating cutblocks (Gough 2010; Roturier et al. 2007). Further studies are required before applying this method on a larger scale (Roturier et al. 2007).

8.7 EFFECTS OF HUMAN USE ON RESTORATION

The ability of linear features to recover to a natural forested state is affected considerably by human use. 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 such as re-clearing to ground level for winter access or seismic program use (Golder 2009). The average age of trees on linear disturbances that were repeatedly disturbed was only 10 years, and the trees achieved an average height of less than or equal to 0.5 m. These results suggest that 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, 2012b). The effect of repeated motorized access on vegetation establishment and regrowth supports the use of access management tools to enhance restoration success.

Subjective expert ratings suggest that the effectiveness of most physical access management measures (e.g., berms, excavations, rollback, visual screening) varies considerably between negligible and high effectiveness in managing human access (Golder 2007). Effectiveness of access management measures depends on suitable placement (e.g., placed to prevent detouring around an access management point), enforcement, and public education of the intent of the access management (AXYS Environmental Consulting Ltd. [AXYS] 1995). Public education (e.g., signs) facilitates respect for the purpose of, and compliance with, access management measures.

Mounding has been found to deter human access (i.e., truck and ATV) during snow-free periods and also creates microsites that improve vegetation establishment (review in Golder 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 management and/or microsite creation purposes can vary from 1,400 to 2,000 mounds/ha (Golder 2012a, 2015).

These mound densities, however, relate to restoring seismic lines that were not frozen-in to allow heavy equipment access. Given the challenges of the wet conditions and frost requirements for accessing the Project footprint (i.e., freezing-in the peat for access can make it difficult to excavate small mounds), the size of mounds potentially could be substantially larger than mounds achieved on previous seismic line restoration projects. Furthermore, mounds cannot be excavated within 5 m of the operating pipeline, which reduces the mound density relative to disturbances that do not have similar restrictions. As a result, the mound density that can realistically be achieved in pipeline ROWs is lower.

Human access on open and closed (i.e., gated, barriered and recontoured) roads was monitored using remote cameras (Switalski and Nelson 2011). That study 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. The monitoring results 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). A similar study investigated the effectiveness of different approaches (i.e., year-round closure, seasonal closure, deactivation, and deactivation and closure) at limiting motorized vehicle traffic on unpaved roads designed to support forestry operations (i.e., resource roads) (Hunt and Hupf 2014). Results demonstrated that closure and/or deactivation approaches significantly reduced traffic on resource roads (about 78%), with year-round closure being the least effective, whereas seasonal (i.e., hunting) closure was among the most effective approaches (Hunt and Hupf 2014). The effectiveness of different approaches did not depend on road quality (Hunt and Hupf 2014). Physical access management 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, they no longer facilitate ATV access (Sherrington 2003).

The techniques described above to block human access also contribute to achieving sufficient revegetation to block line–of–sight. Short term management for access and line-of-sight blocking should ultimately lead to long-term access management by way of revegetation of disturbed areas (Golder 2007). Expediting growth of visual barriers along linear features can be achieved by concentrating restoration efforts on productive upland habitats, as woody vegetation species grow more quickly on these sites compared with lowland sites. Although regeneration of conifer species provides the best year-round visual barrier, their growth can be slow. Using combined plantings of conifer and fast-growing deciduous woody species in small areas (e.g., narrow strips of plantings across the ROW) can establish visual barriers in the short- to medium term, while maintaining the objective of regenerating conifer-leading vegetation in the long term.

Coarse woody material (rollback) can be effective at managing human access as well as at conserving soil moisture, moderating soil temperatures, providing nutrients as debris decomposes, limiting soil erosion, providing microsites for seed germination and protection for introduced tree seedlings (Pyper and Vinge 2012; Vinge and Pyper 2012).

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 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 60 to 100 m^3/ha on upland sites and 25 to 50 m^3/ha on lowland sites, to mimic natural processes (Pyper and Vinge 2012; Vinge and Pyper 2012). Where sufficient material is available, woody debris coverage of 150 to 200 m^3/ha along ROWs might be used to manage human and wildlife access (Vinge and Pyper 2012).

Storage and placement of woody debris needs to consider the presence of ladder fuels to reduce fire hazard (Pyper and Vinge 2012). Fire risk can be managed by implementing a 25 m fuel break every 250 m along linear features (Pyper and Vinge 2012). Short segments (i.e., <100 m) of rollback might be less effective at deterring human access since ATV and snowmobile riders might try to ride through the debris or traverse around it in adjacent forest stands (Vinge and Pyper 2012). Complete rollback (i.e., over an entire linear disturbance) could be used to prevent motorized access (Pyper and Vinge 2012) but availability of material is a limiting factor.

8.8 WILDLIFE USE OF REGENERATING LINEAR DISTURBANCE

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 in the Little Smoky caribou range measured 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 naturally revegetated seismic lines (i.e., minimum 1.5 m vegetation regrowth) were preferred by both predator and prey species compared with control lines (disturbed sites, cleared areas with minimal vertical cover of vegetation and vegetation regrowth of 0.5 m or less). The study also found that the control (disturbed) lines with minimal vegetation were used primarily for travel (i.e., both predators and prey species were constantly moving as opposed to standing or foraging). In addition, human use was almost exclusive to the control lines. The line-of-sight measured on the revegetating lines was typically less than 50 m long.

Moose and deer might have been attracted to the revegetated lines for forage availability and perceived cover protection (Golder 2009). The preference for regenerating seismic lines by wolves can 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.

Further to this, a study of displacement of Hart Range mountain caribou in east-central BC by snowmobiles reported that caribou were observed in all four mountain blocks (110 to 214 km^2/block) of core winter range delineated for census with little or no snowmobile activity. However, during three of four census years, no caribou were observed in the only mountain block surveyed that had intensive snowmobile activity (Seip et al. 2007).

Another ongoing project in northern Alberta involving the Cold Lake boreal caribou herd is currently investigating the responses of predator and prey species to the deactivation or restoration of habitat disturbance features (McNay et al. 2014). The goal of the project is to determine how different species (wolves, bears, moose and caribou) use the landscape, and how the presence or absence of linear disturbances can influence the functional and numerical response of predators (McNay et al. 2014).

The project is still in its early stages, but preliminary results suggest among all species that seasonal and annual movements are variable with substantial overlap between the range extents of all four species. Also, in these range overlaps, were 19 instances where predator and prey could have encountered one another. Furthermore, preliminary results present 11 deaths of 94 collared animals: 2 caribou, 3 moose, 1 bear and 5 wolves. Predator kill sites were identified: 143 bear sites and 93 wolf sites. These kill sites were implicated in the deaths of 11 caribou, 22 moose and 6 deer. Ongoing data collection and processing will provide future results from scat analysis, prey body condition, habitat modelling and mapping. The project aims to address several management questions regarding the desired vegetative and spatial characteristics on the landscape to reduce caribou mortality, how silvicultural techniques and mitigation measures can be implemented to achieve these characteristics, the association between specific characteristics and predator efficiency and/or density, and when deactivated linear features can be considered to have lost their disturbance function (McNay et al. 2014). This project is associated with the RICC initiative.

Mechanically bending or felling live trees over a linear disturbance (often referred to as line-blocking, particularly when used in conjunction with other treatments such as mounding) is another potential measure that could have benefits for managing access and reducing wolf use. Trees are typically bent or felled from both sides of the linear disturbance. Tree felling entails cutting trees at the base from the edge of the linear disturbance, and allowing them to fall across the linear disturbance.

Tree bending requires mechanically bending trees from the base of the tree, partially exposing roots, so that the tree leans over the linear feature, close to the ground. Tree bending can be expensive and the process is time consuming. A preliminary assessment of tree felling along seismic lines to block access was conducted in the Little Smoky herd range in Alberta during the summer and fall of 2004 (Neufeld 2006). While results of that study showed no statistical significance between wolf use of blocked versus non-blocked seismic lines, there was an indication that wolves tended to use areas with unblocked seismic lines more often than areas with blocked seismic lines). Based on these results, it was concluded that if tree felling is to be used as a line-blocking measure, it should be investigated more thoroughly, and not relied on solely as a mitigation tool. Preferably, line-blocking should be used in combination with other management actions such as habitat restoration, and continue to be evaluated for effectiveness using an adaptive management approach.

From the 15th North American Caribou Conference (2014) some very preliminary results of linear feature blocking programs suggest that this type of mitigation can be effective at reducing wildlife use of linear features.

8.9 KNOWLEDGE GAPS AND LIMITATIONS OF THE LITERATURE REVIEW

The following gaps in knowledge were identified during the literature review:

- scarcity of information on effective habitat restoration measures applicable to mountain caribou habitat
- restoration criteria (e.g., defined guidelines or measurable objectives) for restoration of mountain ecosystems for wildlife habitat values, in particular habitats that do not support merchantable timber (e.g., treed bogs and fens)
- functional responses of caribou, wolves and primary prey (e.g., moose, deer) to reclaimed habitats in various stages of successional progression, as well as to access and line of sight management
- long-term monitoring of vegetation recovery on linear disturbances and of predator response to access management measures

There is limited information available on the types and efficacy of habitat restoration techniques in mountain caribou ranges. This is compounded by the issue that results and documentation of recently initiated restoration projects are often unpublished, and proprietary information is difficult to obtain. Available information for restoration techniques in mountain caribou ranges is mostly limited to reclamation and revegetation of drastically disturbed industrial sites, in particular mines, or reforestation of commercially harvested stands.

The techniques used for these large polygonal disturbance types might not translate directly to restoration of linear developments (i.e., some modification is needed to address the different site conditions and objectives). Recommendations in the available literature specific to northern and mountain caribou ranges in BC typically include protection of high-elevation habitats and seasonal movement habitats necessary to maintain connectivity (Backmeyer 2000; Culling et al. 2005; Hatler 1986).

Results of the literature review provide habitat restoration information specific to mountain caribou ranges, where it is available. However, given the limited availability of literature specific to mountain caribou ranges, relevant literature from research and restoration initiatives in boreal woodland caribou range is included. As previously noted, this is supplemented by a table of historic and current restoration initiatives in caribou ranges that was considered as context to develop this Preliminary CHRP.

Despite differences in habitat use and forage selection between mountain and boreal woodland caribou, components of mitigation and restoration planning applied in boreal ranges is transferrable, particularly in low-elevation range and where boreal and mountain caribou have similar ecologies (e.g., fire regime, climate and biophysical attributes). This provides useful background information on restoration initiatives in caribou range and their reported successes and failures.

9.0 REFERENCES

9.1 CONTENT REFERENCES

Alberta West Central Standing Committee. 1996. 1996/97 *Operating Guidelines for Industrial Activity in Caribou Ranges in West Central Alberta*. 12 pp.

Apps, C.D., B.N. McLellan, T.A. Kinley, R. Serrouya, D.R. Seip and H.U. Wittmer. 2013. Spatial factors related to mortality and population decline of endangered mountain caribou. *The Journal of Wildlife Management* 77(7):1409–1419.

Athabasca Landscape Team. 2009. *Athabasca Caribou Landscape Management Options Report*. Athabasca Landscape Team. May 2009. 99 pp.

AXYS Environmental Consulting Ltd. (AXYS). 1995. *A Compendium of Physical Access Control Measures for Roads and Other Rights-of-Way*. March 1995. A Component of the Access Management Initiative in Northeastern BC. 46 pp.

AXYS. 2003. *Literature Review of Reclamation Techniques for Wildlife Habitats in the Boreal Forest*. Prepared for: Biodiversity and Wildlife Subgroup of the Reclamation Working Group, Cumulative Effects Management Association. Prepared by AXYS Environmental. Sidney, BC.

Backmeyer, R. J. 2000. *Seasonal Habitat Use and Movements of Woodland Caribou in the Graham River Drainage, 1988–1994*. Prince George, BC.

Bayne, E.M., H. Lankau and J. Tigner. 2011. *Ecologically Based Criteria to Assess the Impact and Recovery of Seismic Lines: The Importance of Width, Regeneration, and Seismic Line Density*. Edmonton, AB.

British Columbia Conservation Data Centre. 2015. *BC Species and Ecosystems Explorer. Ministry of Environment*. Website: http://a100.gov.bc.ca/pub/eswp/. Accessed: March 2015.

British Columbia Ministry of Environment (BMOE). 2010. *Caribou Distribution in British Columbia by Ecotype*. Website: http://www.env.gov.bc.ca/wld/speciesconservation/caribou_by_ecotype.html. Accessed: March 2015.

BMOE. 2013. *Implementation Plan for the Ongoing Management of South Peace Northern Caribou* (Rangifer tarandus caribou *pop. 15*) *in British Columbia*. Victoria, BC. 15 pp.

BMOE. 2014. *Science update for the South Peace Northern Caribou (*Rangifer tarandus caribou *pop. 15) in British Columbia*. Victoria, BC. 43 pp.

British Columbia Ministry of Forests. 1997. *Soil Rehabilitation Guidebook*. Forest Practices Branch, BC Ministry of Forests, Victoria, BC Forest Practices Code of British Columbia Guidebook.

British Columbia Ministry of Forests. 2000. *Establishment to Free Growing Guidebook*. Prince George Forest Region. BC Forest Practices Code of British Columbia Guidebook. Victoria, BC. 162 pp.

British Columbia Ministry of Forests, Lands and Natural Resource Operations. 2011. *Peace Region Selected Terrestrial and Aquatic Wildlife Least-Risk Windows – April, 2011*. Fort St. John, BC. 1 pp.

British Columbia Ministry of Forests, Lands and Natural Resource Operations. 2014. *A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia*. Interim Guidance. 206 pp.

British Columbia Ministry of Water, Land and Air Protection. n.d. *Ecological Restoration Guidelines for British Columbia*. Victoria, BC. 80 pp.

British Columbia Oil and Gas Commission. 2013. 2013. *Environmental Protection and Management Guide: June 2013*. 96 pp.

Bergerud, A.T., R.D. Jakimchuk and D.R. Carruthers. 1984. The buffalo of the north: Caribou (*Rangifer tarandus*) and human developments. *Arctic* 37(1):7–22.

Bijlsma, R., J. Bundgaard and A.C. Boerema. 2000. Does inbreeding affect the extinction risk of small populations? Predictions from Drosophila. *Journal of Evolutionary Biology* 13(3):502–514.

Camill, P. 1999. Patterns of boreal permafrost peatland vegetation across environmental gradients sensitive to climate warming. *Canadian Journal of Botany* 77:721–733.

Canada's Oil Sands Innovation Alliance (COSIA). 2012. *COSIA*. Website: http://www.cosia.ca/. Accessed: March 2015.

Canadian Standards Association. 2011. *Z662-11 Oil and Gas Pipeline Systems*. Reprinted January 2012. 555 pp.

Caribou Range Restoration Project. 2007a. *Permanent Sample Plot Manual for the Caribou Range Restoration Project in Alberta, March 23, 2007*. Draft Unpublished Document.

Caribou Range Restoration Project. 2007b. *Caribou Range Restoration Project: Guidelines for Planning and Implementation*. Unpublished document for the West–Central Alberta Petroleum Producers Group, Canadian Association of Petroleum Producers and Environment Canada. September 19, 2007.

Caribou Range Restoration Project. 2007c. *Little Smoky Caribou Habitat Restoration Pilot Project Summary*. Unpublished document prepared for Suncor Energy, ConocoPhillips Canada, Canadian Forest Products and Alberta Newsprint Co.

CH2M Hill Energy Canada, Ltd. (CH2M Hill). 2014a. *(April) Supplemental Traditional Knowledge Report for the Proposed NOVA Gas Transmission Ltd. North Montney Project*. Prepared for NOVA Gas Transmission Ltd.

CH2M Hill. 2014b. *(July) Supplemental Traditional Knowledge Report for the Proposed NOVA Gas Transmission Ltd. North Montney Project*. Prepared for NOVA Gas Transmission Ltd.

CH2M Hill. 2014c. *(October) Supplemental Traditional Knowledge Report for the Proposed NOVA Gas Transmission Ltd. North Montney Project*. Prepared for NOVA Gas Transmission Ltd.

Cichowski, D. 2005. *Compendium of Northern Woodland Caribou Forestry Guidelines in British Columbia*. Prepared for BC Ministry of Water, Lands and Air Protection. Smithers, BC.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002. *COSEWIC Assessment and Update Status Report on the Woodland Caribou* Rangifer tarandus caribou in Canada. Ottawa, ON. xi + 98 pp.

COSEWIC. 2011. *Designatable Units for Caribou (*Rangifer tarandus*) in Canada*. Ottawa, ON. 88 pp.

COSEWIC. 2015. *Canadian Species at Risk*. Website: http://www.cosewic.gc.ca/eng/sct5/index_e.cfm. Accessed: March 2015.

Courtin, P.J. and K.R. Brown. 2001. The use of red alder to enhance Sitka spruce growth in the Queen Charlotte Islands. *Forest Research Extension Notes* EN-008:1–4.

Culling, D.E., B.A. Culling and T. Raabis. 2005. *Seasonal Habitat Use and Movements of Graham Caribou 2001 to 2003*. Canadian Forest Products Ltd. and BC Ministry of Water, Land and Air Protection. St. John, BC. 88 pp.

DeCesare, N.J., M. Hebblewhite, F. Schmiegelow, D. Hervieux, G.J. McDermid, L. Neufeld, M. Bradley, J. Whittington, K.G. Smith, L.E. Morgantini, M. Wheatley and M. Musiani. 2012. Transcending scale dependence in identifying habitat with resource selection functions. *Ecological Applications* 22(4):1068–1083.

DeLong, C. 2004. *A Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region*. Land Management Handbook No. 54. BC Ministry of Forests, Resources Branch. Victoria, BC.

DeLong, C., A. Banner, W.H. MacKenzie, B.J. Rogers and B. Kaytor. 2011. *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia*. Land Management Handbook No. 65. BC Ministry of Forests and Range, Forest Science Program. Victoria, BC. 250 pp.

DeLong, C., A. MacKinnon and L. Jang. 1990. *A Field Guide for Identification and Interpretation of Ecosystems of the Northeast Portion of the Prince George Forest Region*. Land Management Handbook No. 22. BC Ministry of Forests, Research Branch. Victoria, BC. 51 pp.

Demarchi, D.A. 2011. *The British Columbia Ecoregion Classification*. Third Edition March 2011. BC Ministry of Environment, Ecosystem Information Section, Victoria, BC. Website: http://www.env.gov.bc.ca/ecology/ecoregions/#top. Accessed: March 2015.

Diversified Environmental Services. 2004. *Canadian Natural Resources Ltd. Ladyfern Pipeline d-87-H/94-H-1, British Columbia to NE Section 20-Township 94-Range 12 W6M, Alberta: Revegetation Monitoring Report Year 2 (2003)*. Prepared for Canadian Natural Resources Ltd. 18 pp.

Dyer, S. J. 1999. *Movement and Distribution of Woodland Caribou (*Rangifer tarandus caribou*) in Response to Industrial Development in Northeastern Alberta*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

Dyer, S. J., J. P. O'Neill, S. M. Wasel and S. Boutin. 2001. Avoidance of industrial development by woodland caribou. *Journal of Wildlife Management* 65(3):531–542.

Dyer, S.J., J.P. O'Neill, S.M. Wasel and S. Boutin. 2002. Quantifying barrier effects of roads and seismic lines on movements of female woodland caribou in northeastern Alberta. *Canadian Journal of Zoology* 80(5):839–845.

Edmonds, E.J and M. Bloomfield. 1984. *A Study of Woodland Caribou (*Rangifer tarandus caribou*) in West–Central Alberta, 1979 to 1983*. Alberta Energy and Natural Resources, Fish and Wildlife Division. Edmonton, AB.

Ehlers, L.P.W., C.J. Johnson and D.R. Seip. 2014. Movement ecology of wolves across an industrial landscape supporting threatened populations of woodland caribou. *Landscape Ecology* 29(3):451–465.

Enbridge Pipelines (Athabasca) Inc. 2010. *Waupisoo Pipeline Project: 2010 Green Area Post-Construction Reclamation Assessment*. Submitted to Alberta Sustainable Resource Development.

Environment Canada. 2011. *Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada: 2011 Update*. Ottawa, ON. 103 pp.

Environment Canada. 2012a. *Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada*. *Species at Risk Act* Management Plan Series. Ottawa, ON. vii + 79 pp.

Environment Canada. 2012b. *Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada*. *Species at Risk Act* Recovery Strategy Series. Ottawa, ON. xi + 138 pp.

Environment Canada. 2014. *Recovery Strategy for the Woodland Caribou*, *Southern Mountain population (*Rangifer tarandus caribou*) in Canada*. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. viii + 103 pp.

Environment Canada. 2015. *Species at Risk Public Registry*. Website: http://www.sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1. Accessed: March 2015.

Esri User Conference. 1996. *1996 User Conference Proceedings: Esri User Conference*. Website: http://proceedings.esri.com/library/userconf/proc96/WELCOME.HTM. Accessed: March 2015.

Frankham, R. 2005. Genetics and extinction. *Biological Conservation* 126(2):131–140.

Girard, M., C. Lavoie and M. Thériault. 2002. The regeneration of a highly disturbed ecosystem: A mined peatland in southern Québec. *Ecosystems* 5(3):274–288.

Golder Associates Ltd. (Golder). 2005. *Firebag Project 2004 Seismic Line Reclamation Study Annual Report*. Submitted to: Suncor Firebag Inc.

Golder. 2007. *Audit of Operating Practices and Mitigation Measures Employed Within Woodland Caribou Ranges*. Submitted to Caribou Landscape Management Association. Peace River, AB.

Golder. 2009. *Caribou Habitat Restoration Pilot Study*. Prepared for Conoco Phillips Canada, Suncor Energy and Canadian Association of Petroleum Producers. Edmonton, AB. 61 pp.

Golder. 2010. *Canadian Natural Resources Limited: Primrose and Wolf Lake: Wildlife Habitat Enhancement Program Development and Implementation*. Submitted to: Canadian Natural Resources Ltd, Calgary, AB.

Golder. 2011. *Waupisoo Pipeline 2011 Seedling Monitoring Plot Summary*. Submitted to Enbridge Pipelines (Athabasca) Inc.

Golder. 2012a. *Boreal Caribou Habitat Restoration*. Prepared for: Ministry of Forests, Lands and Natural Resource Operations. Fish Wildlife and Habitat Management Branch, Government of British Columbia. Prince George, BC. 24 pp.

Golder. 2012b. *Interconnect Pipeline 2011 Seedling Monitoring Plot Summary*. Memo submitted to CNRL February 23, 2012.

Golder. 2014. *Final Caribou Habitat Restoration Plan for the NOVA Gas Transmission Ltd. Leismer to Kettle River Crossover Project*. Prepared for NOVA Gas Transmission Ltd.

Golder. 2015. *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia*. Prepared for BC Science and Community Environmental Knowledge (SCEK) Fund's Research and Effectiveness Monitoring Board (REMB). Calgary, AB.

Gough, A. 2010. *Effects of Historical Timber Harvesting Practices on Caribou Forage Lichen Abundance near Marsh Lake, Yukon: Phase 1 Final Report*. Department of Energy, Mines and Resources, Government of Yukon. 55 pp.

Government of British Columbia. 2011. *Interim Operating Practices for Oil and Gas Activities in Identified Boreal Caribou Habitat in British Columbia*.

Hatler, D.F. 1986. *Studies of Radio-Collared Caribou in the Spatsizi Wilderness Park Area, British Columbia*. Spatsizi Association for Biological Research. Smithers, BC. 102 pp.

Hawkes, V.C. 2011. *Early Successional Wildlife Monitoring On Reclamation Plots in the Athabasca Oil Sands Region*. British Columbia Mine Reclamation Symposium.

Heard, D.C., and K.L. Vagt. 1998. Caribou in British Columbia: A 1996 status report. *Rangifer Special Issue* 10:117–123.

Hedrick, P.W. and S.T. Kalinowski. 2000. Inbreeding depression in conservation biology. *Annual Review of Ecology and Systematics* 31:139–162.

Hervieux, D., M. Hebblewhite, N.J. DeCesare, M. Russell, K. Smith, S. Robertson and S. Boutin. 2013. Widespread declines in woodland caribou (*Rangifer tarandus caribou*) continue in Alberta. *Canadian Journal of Zoology* 91(12):872–882.

Hunt, L.M. and M. Hupf. 2014. The effectiveness of road closures and deactivations at reducing traffic: A case of resource roads used for recreational activities in Ontario, Canada. *The Forestry Chronicle* 90(5):670–677.

James, A.R.C. 1999. *Effects of Industrial Development On the Predator–Prey Relationship Between Wolves and Caribou in Northeastern Alberta*. Ph.D. Dissertation, University of Alberta. Edmonton, AB.

James, A.R.C. and A.K. Stuart-Smith. 2000. Distribution of caribou and wolves in relation to linear corridors. *The Journal of Wildlife Management* 64(1):154-159.

James, A.R.C., S. Boutin, D.M. Hebert and A.B. Rippin. 2004. Spatial separation of caribou from moose and its relation to predation by wolves. *The Journal of Wildlife Management* 68(4):799–809.

Joint Pipeline Office. 1999. *Evaluation of the Alaska Pipeline Service Company's Operation of the Trans-Alaska Pipeline System*. Comprehensive Monitoring Program Report February 1999. 41 pp.

Keller, L.F. and D.M. Waller. 2002. Inbreeding effects in wild populations. *Trends in Ecology and Evolution* 17(5):230–241.

Khasa, P.D., L. Sigler, P. Chakravarty, B.P. Dancik, L. Erikson and D. McCurdy. 2001. Effect of fertilization on growth and ectomycorrhizal development of container-grown and bare-root nursery conifer seedlings. *New Forests* 22(3):179–197.

Latham, A.D.M. 2009. *Wolf Ecology and Caribou–Primary Prey–Wolf Spatial Relationships in Low-Productivity Peatland Complexes in Northeastern Alberta*. Ph.D. Dissertation, University of Alberta. Edmonton, AB.

Latham, A.D.M., M.C. Latham, N.A. McCutchen and S. Boutin. 2011. Invading white-tailed deer change wolf-caribou dynamics in northeastern Alberta. *Journal of Wildlife Management* 75(1):204–212.

Lee, P. and S. Boutin. 2006. Persistence and developmental transition of wide seismic lines in the western Boreal Plains of Canada. *Journal of Environmental Management* 78:240–250.

Macadam, A. and L. Bedford. 1998. Mounding in the Sub-Boreal Spruce Zone of west–central British Columbia: 8-year results. *The Forestry Chronicle* 74(3):421–427.

MacDonald, E., S. Quideau and S. Landhäusser. 2012. Rebuilding boreal forest ecosystems after industrial disturbance. 123–159 in *Restoration and Reclamation of Boreal Ecosystems*. D.H. Vitt and J.S. Bhatti, (eds.). Cambridge University Press, Cambridge, UK.

MacFarlane, A. 1999. *Revegetation of Wellsites and Seismic Lines in the Boreal Forest*. B.Sc. Honour’s Thesis, University of Alberta. Edmonton, AB.

MacFarlane, A.K. 2003. *Vegetation Response to Seismic Lines: Edge Effects and Online Succession*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

MacIsaac, D.A., G.R. Hillman and P.A. Hurdle. 2004. *Alternative Silvicultural Systems for Harvesting and Regenerating Spruce-Dominated Boreal Mineral Wetlands*. Information Report Nor-X-399. Canadian Forest Service, Northern Forestry Centre. Edmonton, AB. 60 pp.

McCutchen, N. A. 2007. *Factors Affecting Caribou Survival in Northern Alberta: The role of Wolves, Moose and Linear Features*. Ph.D. Dissertation, University of Alberta. Edmonton, AB.

McKay, T., K. Graham and G. Stenhouse. 2014. *Grizzly Bears and Pipelines: Response to Unique Linear Features*. Year 2 (2013) Final Report. Alberta Upstream Petroleum Research Fund (13-AU-ERPC-03). Foothills Research Institute Grizzly Bear Program. Hinton, AB.

McKenzie, H.W., E.H. Merrill, R.J. Spiteri and M.A. Lewis. 2012. How linear features alter predator movement and the functional response. *Interface Focus* 2(2):205–216.

McLoughlin, P.D., E. Dzus, B. Wynes and S. Boutin. 2003. Declines in populations of woodland caribou. *The Journal of Wildlife Management* 67(4):755–761.

McNay, R.S., D. Cichowski, and B.R. Muir. 2013. *Action Plan for the Klinse-Za Herd of Woodland Caribou (*Rangifer tarandus caribou*) in Canada [Draft]*. *Species at Risk Act* Action Plan Series, West Moberly First Nation. Moberly Lake, BC. 28 pp.

McNay, R.S., G. Sutherland, L. Giguere, J. Gollner, K. Sittler, F. MacDonald and V. Brumovsky. 2014. *Multi-Scale Responses by Predators and Prey to Deactivation/Restoration of Disturbance Features – Individual and Population Components*. Interim Report 2013-2014. Wildlife Infometrics Report 470. Wildlife Infometrics Inc. Mackenzie, BC.

Miège, D.J., H.M. Armleder, M.J. Waterhouse and T. Goward. 2001. *A Pilot Study of Silvicultural Systems for Northern Caribou Winter Range: Lichen Response*. Working Paper 56/2001. BC Ministry of Forests, Research Branch. Victoria, BC. 22 pp.

Naeth, M.A., D.J. White, D.S. Chanasyk, T.M. Macyk, C.B. Powter and D.J. Thacker. 1991. *Soil Physical Properties in Reclamation*. Alberta Land Conservation and Reclamation Council Report No. RRTAC 91-4. Edmonton, AB.

Neufeld, L.M. 2006. *Spatial Dynamics of Wolves and Woodland Caribou in an Industrial Forest Landscape in West–Central Alberta*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

North American Caribou Workshop. 2014. *Caribou Conservation and Management: What's Working?* Website: http://www.2014nacw.ca/Portals/10/NACWprogramfinal_web.pdf. Accessed: March 2015.

Nova Gas Transmission Ltd. 2014a. *Additional Written Evidence for the North Montney Project*. Prepared for the National Energy Board. Calgary, AB.

Nova Gas Transmission Ltd. 2014b. *North Montney Project Response to Information Request No. 2*. Hearing Order GH-001-2014. March 25, 2014.

Oberg, P.R. 2001. *Responses of Mountain Caribou to Linear Features in a West–Central Alberta Landscape*. M.Sc. Thesis, University of Alberta. Edmonton, AB.

Osko, T.J. and A.K. MacFarlane. 2000. *Natural Reforestation Rates on Seismic Lines and Wellsites in Comparison to Natural Burns or Logged Sites*. Alberta–Pacific Forest Industries. Boyle, Alberta.

Osko, T. and M. Glasgow. 2010. *Removing the Well Site Footprint: Recommended Practices for Construction and Reclamation of Well Sites on Upland Forests in Boreal Alberta*. Department of Biological Sciences, University of Alberta. Edmonton, AB. 61 pp.

Peters, W., M. Hebblewhite, N. DeCesare, F. Cagnacci and M. Musiani. 2013. Resource separation analysis with moose indicates threats to caribou in human altered landscapes. *Ecography* 34(4):487–498.

Polfus, J.L., M. Hebblewhite and K. Heinemeyer. 2011. Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain woodland caribou. *Biological Conservation* 144(11):2637–2646.

Polster, D.F. n.d. *Natural Processes: Restoration of Drastically Disturbed Sites*. 123 pp.

Polster, D.F. 2002. Soil bioengineering techniques for riparian restoration. 230-239 in *Proceedings of the 26th Annual British Columbia Mine Reclamation Symposium*. Dawson Creek, BC.

Pyper, M. and T. Vinge, 2012. *A Visual Guide to Handling Woody Materials for Forested Land Reclamation*. Report No. TR-31. University of Alberta, School of Energy and the Environment, Oil Sands Research and Information Network. Edmonton, AB. 10 pp.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. *Canadian Journal of Zoology* 76:251–259.

Rettie, W.J. and F. Messier. 2000. Hierarchical habitat selection by woodland caribou: its relationship to limiting factors. *Ecography* 23:466–478.

Revel, R.D., T.D. Dougherty and D.J. Downing. 1984. *Forest Growth and Revegetation Along Seismic Lines*. University of Calgary Press, Calgary, AB. 228 pp.

Ripple, W.J. and R.L. Beschta. 2004. Wolves and the ecology of fear: Can predation risk structure ecosystems? *BioScience* 54(8):755–766.

Ripple, W.J., J.A. Estes, R.L. Beschta, C.C. Wilmers, E.G. Ritchie, M. Hebblewhite, J. Berger, B. Elmhagen, M. Letnic, M.P. Nelson, O.J. Schmitz, D.W. Smith, A.D. Wallach and A.J. Wirsing. 2014. Status and ecological effects of the world's largest carnivores. *Science* 343(6167):1241484.

Robinson, S.D. and T.R. Moore. 2000. The influence of permafrost and fire upon carbon accumulation in high boreal peatlands, Northwest Territories, Canada. *Arctic, Antarctic and Alpine Research* 32:155–166.

Rohner, C. and G. Kuzyk. 2000. *Wolves and Caribou in West–Central Alberta: Predator Responses to Industrial Resource Development*. Research News 3, University of Alberta and West–Central Caribou Standing Committee. Edmonton, AB. 4 pp.

Roturier, S., S. Backlund, M. Sunden and U. Bersten. 2007. Influence of ground substrate on establishment of reindeer lichen after artificial dispersal. *Silva Fennica* 41(2):269–280.

Roy, V., P.-Y. Bernier, A.P. Plamondon and J.-C. Ruel. 1999. Effect of drainage and microtopography in forested wetlands on the microenvironment and growth of planted black spruce seedlings. *Canadian Journal of Forest Research* 29:563-574.

Sanborn, P., R. Brockley and C. Preston. 2001. *Effects of Sitka Alder Retention and Removal on the Growth of Young Lodgepole Pine in the Central Interior of British Columbia (EP 1185): Establishment Report*. Working Paper 60/2001. BC Ministry of Forests, Research Branch. Victoria, BC. 44 pp.

Schaefer, J.A. and W.O. Pruitt, Jr. 1991. Fire and woodland caribou in southeastern Manitoba. *Wildlife Monographs* 116:3–39.

Seip, D.R. and D.B. Cichowski. 1996. Population ecology of caribou in British Columbia. *Rangifer* 9:73-80.

Seip, D.R., C.J. Johnson and G.S. Watts. 2007. Displacement of mountain caribou from winter habitat by snowmobiles. *The Journal of Wildlife Management* 71(5):1539–1544.

Serrouya, R., D. Paetkau, B.N. McLellan, S. Boutin, M. Campbell and D.A. Jenkins. 2012. Population size and major valleys explain microsatellite variation better than taxonomic units for caribou in western Canada. *Molecular Ecology* 21(11):2588–2601.

Sherrington, P.M. 2003. *Measuring Boreal Forest Fragmentation Change in Response to Seismic Line, Wellsite and Road Revegetation With Scanned False-Colour Infrared Aerial Photography*. M.Sc. Thesis, University of Calgary. Calgary, AB.

Simard, S. and J. Heineman. 1996. *Nine-Year Response of Lodgepole Pine and the Dry Alder Complex to Chemical and Manual Release Treatments on an ICHmk1 Site Near Kelowna*. Forest Resource Development Agreement Report 259. Canadian Forest Service and BC Ministry of Forests. Victoria, BC. 19 pp.

Smith, S. and I. Marshall. 1995. *The Ecoregions of Canada*. Website: http://ecozones.ca/english/. Accessed: March 2015.

Spalding, D.J. 2000. *The Early History of Woodland Caribou (*Rangifer tarandus caribou*) in British Columbia*. Wildlife Bulletin No. B-100. BC Ministry of Environment, Lands and Parks. Victoria, BC. 61 pp.

Stantec Consulting Limited. 2013. *North Montney Project Environmental and Socio-Economic Assessment*. Prepared for Nova Gas Transmission Ltd., in association with TERA Environmental Consultants. Calgary, AB.

Stantec Consulting Limited. 2014. *Final Caribou Habitat Restoration Plan for the Chinchaga Lateral Loop No. 3 (Chinchaga Section)*. Prepared for NOVA Gas Transmission Ltd. Calgary, AB.

Stuart-Smith, A.K., C.J.A. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. *Journal of Wildlife Management* 61:622-633.

Sweeney, S. 2005. *Ontario Trees and Shrubs*. Website: http://www.ontariotrees.com/mondaygarden/index.php. Accessed: March 2015.

Switalski, T.A. and C.R. Nelson. 2011. Efficacy of road removal for restoring wildlife habitat: Black bear in the Northern Rocky Mountains, USA. *Biological Conservation* 144(11):2666–2673.

Tedder, W.S. and L.W. Turchenek. 1996. Natural revegetation of an Alberta peatland after horticultural peat extraction. 51–113 in *4th Annual Canadian Peatland Restoration Workshop, 13-14 July, Quebec City, Canada*. Universite Laval, Faculte des Sciences de Sciences de L'agriculture et de l'alimentation. Quebec City, QC.

TERA Environmental Consultants (TERA). 2011a. *Caribou Habitat Restoration Plan for the Proposed Nova Gas Transmission Ltd. Horn River Mainline Project, Part II*. Prepared for Nova Gas Transmission Ltd. Calgary, AB.

TERA. 2011b. 2011 *Post-Construction Monitoring Report for the Trans Mountain Pipeline L.P. TMX – Anchor Loop Project*. Prepared for Trans Mountain Pipeline L.P. Calgary, AB.

TERA. 2012. *Supplemental Update for the Caribou Habitat Restoration Plan for the Nova Gas Transmission Ltd. Horn River Mainline Project, Part II*. Calgary, AB.

TERA. 2013. *Traditional Knowledge Summary Report for the Proposed NOVA Gas Transmission Ltd. North Montney Mainline (Aitken Creek Section) Project*. Prepared for NOVA Gas Transmission Ltd.

TERA. 2014. *Final Caribou Habitat Restoration Plan for the NOVA Gas Transmission Ltd. Northwest Mainline Expansion*. Prepared for NOVA Gas Transmission Ltd.

Thurber, J.M., R.O. Peterson, T.D. Drummer and S.A. Thomasma. 1994. Gray wolf response to refuge boundaries and roads in Alaska. *Wildlife Society Bulletin* 22:61–68.

Turetsky, M.R., R.K. Wieder, C.J. Williams and D.H. Vitt. 2000. Organic matter accumulation, peat chemistry, and permafrost melting in peatlands in boreal Alberta. *Ecoscience* 7(3):379–392.

Turner, J., D. Stokes and S. Duncan. 2009. *An Adaptive Approach to Reclaiming the First Coal Corporation Central South Property*. British Columbia Mine Reclamation Symposium 2009.

Vinge, T. and M. Pyper. 2012. *Managing Woody Materials on Industrial Sites: Meeting Economic, Ecological and Forest Health Goals through a Collaborative Approach*. University of Alberta, Department of Renewable Resources. Edmonton, AB. 32 pp.

Westland Resource Group. 2011. TMX Anchor Loop Project: Wildlife and Wildlife Habitat Post Construction Monitoring Year 2 Report. Prepared for Kinder Morgan Canada. Calgary, AB.

West Moberly First Nations. 2014. Population and Distribution Objectives and Identification of Critical Habitat for Seven Herds of Woodland Caribou in the South Peace Area of British Columbia. Moberly Lake, BC. 23 pp.

Wetland Stewardship Partnership. 2010. *A Wetland Action Plan for British Columbia*. 62 pp.

Whittington, J., M. Hebblewhite, N.J. DeCesare, L. Neufeld, M. Bradley, J. Wilmshurst and M. Musiani. 2011. Caribou encounters with wolves increase near roads and trails: a time-to-event approach. *Journal of Applied Ecology* 48:1535–1542.

Wittmer, H.U., A.R.E. Sinclair and B.N. McLellan. 2005. The role of predation in the decline and extirpation of woodland caribou. *Oecologia* 144:257–267.

Zager, P. and J. Beecham. 2006. The role of American black bears and brown bears as predators on ungulates in North America. *Ursus* 17(2):95–108.

9.2 GIS DATA AND MAPPING REFERENCES

This subsection includes references cited in the figures accompanying this report.

BC Hydro. 2011. *Transmission Circuit* (digital file). Previously available: http://transmission.bchydro.com/transmission_system/maps/, no longer on website. Acquired: September 2011. Last Update Check: May 23, 2013.

BC Ministry of Environment. 2008. *Caribou Herd Locations for BC* (digital file). Victoria, BC. Available: https://apps.gov.bc.ca/pub/dwds/home.so. Acquired: July 2011. Last Update Check: November 7, 2014.

BC Ministry of Environment. 2010. *BC Ungulate Winter Range – Proposed – Peace Region* (digital file). Fort St. John, BC. Available: https://apps.gov.bc.ca/pub/dwds/home.so. Acquired: November 2013. Last Update Check: November 7, 2014.

BC Ministry of Forests, Lands and Natural Resource Operations. 2008. *Tantalis Parks, Ecological Reserves and Protected Areas* (digital file). Victoria, BC. Available: https://apps.gov.bc.ca/pub/dwds/home.so. Acquired: May 2014. Last Update Check: November 20, 2014.

Government of Canada. 2014. *Aboriginal Lands, Canada* (digital file). Edmonton, AB. Available: http://www.geobase.ca. Acquired: January 2015. Last Update Check: January 15, 2015.

IHS Inc. 2004. *IHS Hydro Line Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: June 2011. Last Update Check: April 21, 2014.

IHS Inc. 2004. *IHS Hydro Region Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: June 2011. Last Update Check: April 21, 2014.

IHS Inc. 2014. *IHS Enhanced Pipeline Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

IHS Inc. 2014. *IHS Facility Data* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

IHS Inc. 2014. *IHS Road Segments* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

IHS Inc. 2014. *IHS Wells – Surface Hole* (digital file). Calgary, AB. Received: via DVD, visit http://www.ihs.comfor more info. Acquired: December 16, 2014. Update Interval: Monthly.

Natural Resources Canada (NRCan). 2014. *National Road Network – British Columbia* (digital file). Sherbrooke, QC. Available: http://www.geobase.ca/geobase/en/data/nrn/index.html. Acquired: September 2014. Last Update Check: January 2, 2015.

NRCan. 2003. *Canadian Geographical Names* (digital file). Ottawa, ON. Available: http://geobase.ca/geobase/en/data/cgn/index.html. Acquired: June 2014. Last Update Check: January 6, 2015.

NRCan. 2007-2011. *National Hydro Network* (digital files). Sherbrooke, QC. Available: http://www.geobase.ca/geobase/en/data/nhn/index.html. Acquired: April 2012. Last Update Check: May 2012.

NRCan. 2012. *CanVec – Transportation – 1020009 Railway* (digital file). Sherbrooke, QC. Available: http://geogratis.cgdi.gc.ca/geogratis/en/download/topographic.html. Acquired: June 2012. Last Update Check: November 2012.

TERA Environmental Consultants (TERA). 2008. *Hillshade*. Derived from Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. 2000-2008. Canadian Digital Elevation Data 250k (digital files). Sherbrooke, QC. Available: http://www.geobase.ca/geobase/en/data/cded/index.html. Acquired: 2008. Last Update Check: December 2010.

TERA. 2010. Derived from BC Land Title Survey Authority 2003. *Petroleum and Natural Gas Grids* (Theme) (digital file). Victoria, BC. Available: https://apps.gov.bc.ca/pub/geometadata/home.do. Acquired: November 2010. Last Update Check: August 2012.