Keeyask Generation Project

Environmental Impact Statement

Response to EIS Guidelines

KEEYASK

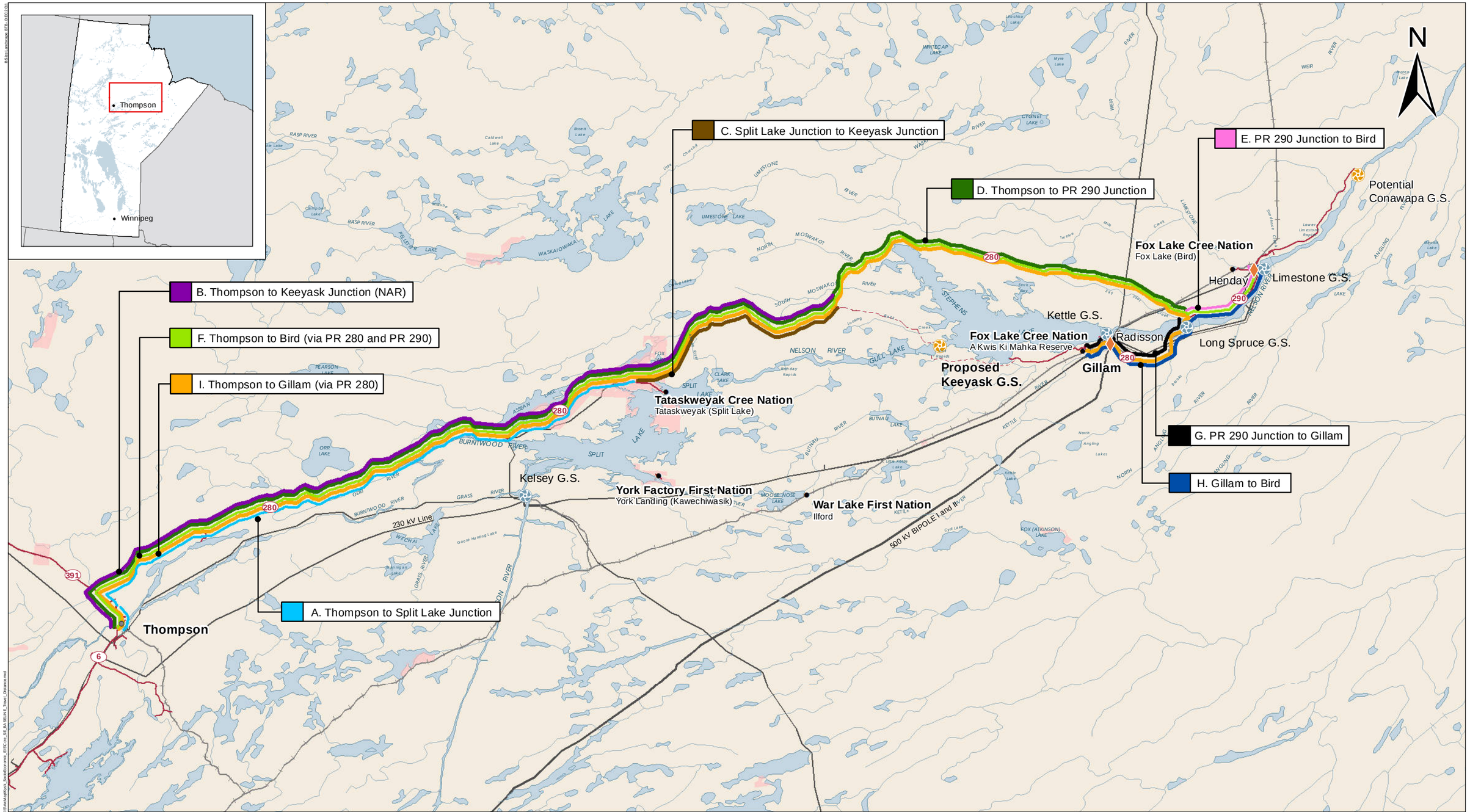
Hydropower Limited Partnership

June 2012

CHAPTER 6

ENVIRONMENTAL EFFECTS ASSESSMENT

KEEYASK
Hydropower Limited Partnership



DATA SOURCE:
Manitoba Hydro, NTS, Stantec Consulting Ltd.

CREATED BY:
Stantec Consulting Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	16-DEC-10	18-MAY-12
0 8.5 17 Kilometres / 0 7 14 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Legend

Road Segment	Distance (km)
A Thompson to Split Lake Junction	135.4
B Thompson to Keeyask Junction (NAR)	182.7
C Split Lake Junction to Keeyask Junction	47.3
D Thompson to PR 290 Junction	269.5
E PR 290 Junction to Bird	23.2
F Thompson to Bird (via PR 280 and PR 290)	292.7
G PR 290 Junction to Gillam	29.8
H Gillam to Bird	53.0
I Thompson to Gillam (via PR 280)	299.3

Travel Distances in Local Study Area

Map 6-40

File Location: G:_GIS_Project_Folder\00_Hydro\111420017_Kysk_GS_Overall_EIS\ArcMap\Kysk_SocioEconomic_EIS\Core_SE_BASELINE_Socio-Economic_Regional_Study_Area.mxd

B Size Portrait BTB - DEC 2011

N

HUDSON BAY

Churchill

Lynn Lake

South Indian Lake

Tataskweyak Cree Nation
Tataskweyak (Split Lake)

Leaf Rapids

Granville Lake

Keeyask G.S.
(Proposed)

Fox Lake Cree Nation
Fox Lake (Bird)

Gillam
Fox Lake Cree Nation
A Kwis Ki Mahka Reserve

York Factory First Nation
York Landing (Kawechiwasik)

War Lake
First Nation
Ilford

Shamattawa

Thompson

Nelson House

Pikwitonei

Thicket Portage

Flin Flon

Wabowden

Cross Lake

The Pas

Norway House

CEDAR LAKE

LAKE WINNIPEGOSIS

LAKE WINNIPEG

LAKE MANITOBA

LAKE WINNIPEG

Winnipeg

Legend

- Northern Communities in Churchill / Burntwood / Nelson River Water Power Reserve Area - Preference Zone 1 (Article 12.1.1.3(a))
- Manitoba Communities
- Generating Station (Planned)
- Southern Boundary of Preference Zone 2 (Northern Affairs Boundary) (Article 12.1.1.3(b,(c),(d)+13.2))

Derived from BNA Hiring Preference Map Schedule D - May 2009

KEEYASK Hydropower Limited Partnership

DATA SOURCE: Manitoba Hydro, NTS, Stantec Consulting Ltd., Government of Canada			
CREATED BY: Stantec Consulting Ltd.			
COORDINATE SYSTEM: UTM NAD 1983 Z15N		DATE CREATED: 18-JAN-12	REVISION DATE: 18-MAY-12
0 40 80 Kilometers 0 30 60 Miles		VERSION NO: 1.0	QA/QC: GS/YYY/MWZ

Socio-Economic Regional Study Area

Map 6-41

N

HUDSON BAY

RIVER

CHURCHILL

Split Lake RMA

Fox Lake RMA

RIVER

NELSON

RIVER

HAYES

York Factory RMA

Potential Conawapa G.S.

WASKAIOWAKA LAKE

Fox Lake Cree Nation
Fox Lake (Bird)

Limestone G.S.

STEPHENS LAKE

Proposed Keeyask G.S.

Gillam

Kettle G.S.

Long Spruce G.S.

Fox Lake Cree Nation
A Kwis Ki Mahka Reserve

Tataskweyak Cree Nation
Tataskweyak (Split Lake)

SPLIT LAKE

York Factory First Nation
York Landing (Kawechiwasik)

Kelsey G.S.

War Lake First Nation
Ilford

War Lake Traditional Area

York Factory RMA (TL13)

NELSON RIVER

Shamattawa

MANITOBA

ONTARIO

KEEYASK Hydropower Limited Partnership

Legend

- Local Study Area
- Regional Study Area
- Resource Management Areas
- War Lake Traditional Area
- First Nation Reserve
- Highways
- Rail
- Abandoned Rail

DATA SOURCE:
Manitoba Conservation and Water Stewardship

CREATED BY:
North/South Consultants Inc.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	24-MAY-12	28-MAY-12
0 20 40 Kilometres / 0 7 14 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Resource Use
Local and Regional Study Areas

Map 6-42

N

Myre Lake
CYGNET LAKE
WEIR
RIVER
Little Limestone Lake
LIMESTONE RIVER
Potential Conawapa G.S.
Lower Limestone Rapids
Limestone G.S.
ANGLING LAKE
Fox Lake Cree Nation
Fox Lake (Bird)
PR 280
Ferris Bay
NELSON RIVER
Long Spruce G.S.
Kettle G.S.
Gillam
Fox Lake Cree Nation
A Kwis Ki Mahka Reserve
LAKE
Back
Creek
Looking
Proposed Keeyask G.S.
15
25
09
07
NELSON RIVER
GULL LAKE
Birthday Rapids
STEPHENS
MOSWAKOT RIVER
SOUTH
NORTH
Crying Lake
LIMESTONE LAKE
Little Churchill River
Campbell Lake
PELLETIER LAKE
WASKAIOWAKA LAKE
FOX LAKE
Assean River
CLARK LAKE
SPLIT LAKE
Tataskweyak Cree Nation
Tataskweyak (Split Lake)
ASSEAN LAKE
BURNTWOOD RIVER
ORR LAKE
ODEI RIVER
GRASS RIVER
WITCHAI LAKE
Goose Hunting Lake
Kelsey G.S.
NELSON RIVER
Armstrong Lake
Dafoe Lake
Thompson
Mistuka R.
Ripple River
AIKEN RIVER
MOOSE NOSE LAKE
York Factory First Nation
York Landing (Kawechiwasik)
War Lake First Nation
Ilford
BUTNAU RIVER
BUTNAU LAKE
TL KN36
TL R2K6
Little Kettle Lake
KETTLE RIVER
KETTLE
Kettle Lake
Cyril Lake
FOX (ATKINSON) LAKE
Bipoles 1 & 2
Dafoe River
Bigstone River
Fox River
North Angling Lakes
ANGLING
RIVER

DATA SOURCE:
Government of Canada

CREATED BY:
North/South Consultants Inc.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	25-MAY-12	28-MAY-12
0 8 16 Kilometres 0 6 12 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Legend

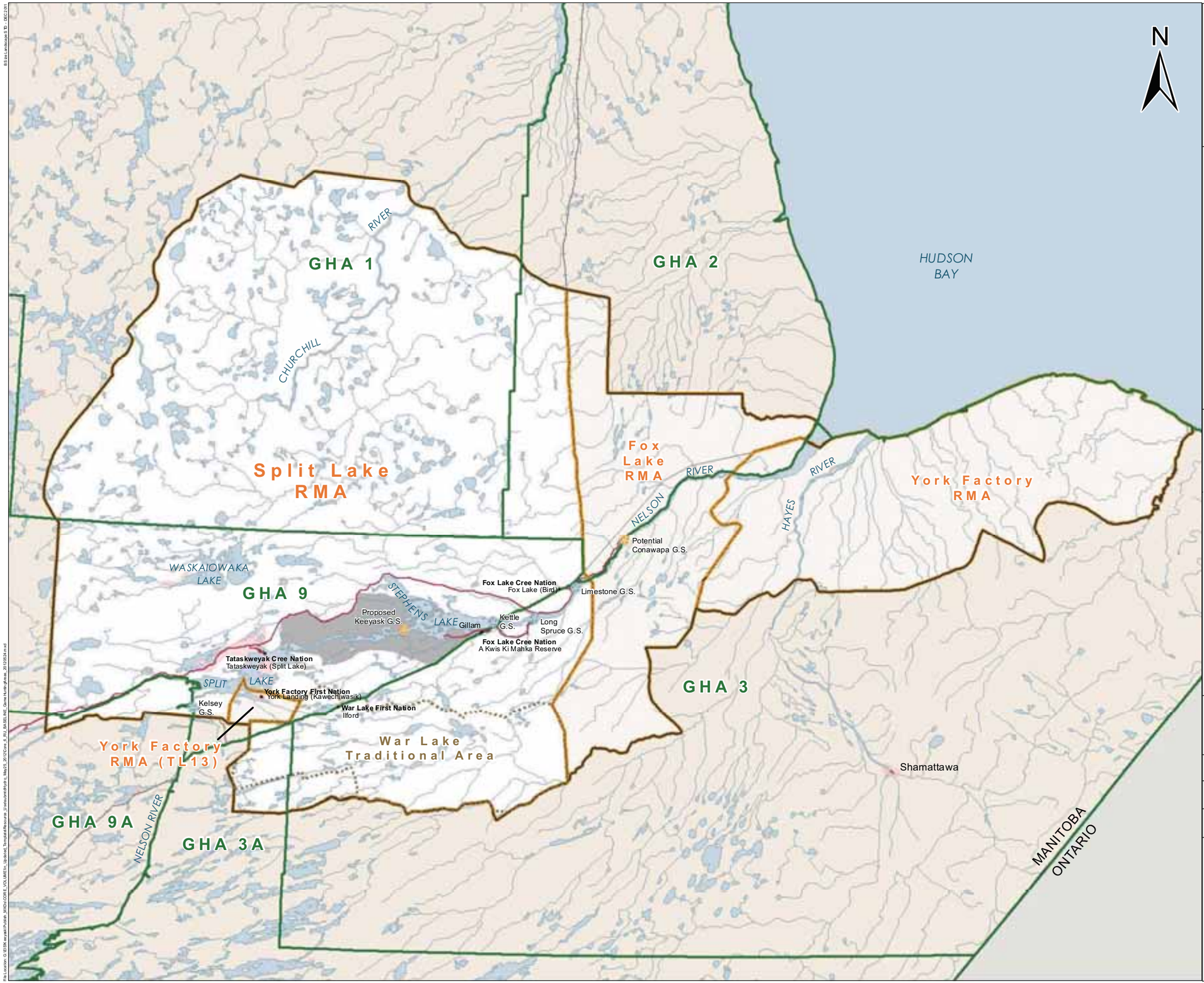
- Local Study Area
- Trapline Boundary
- First Nation Reserve
- Highway
- Rail
- Transmission Line
- Abandoned Rail

NOTE: Lillian Island is reported to be located less than 1.6 km upstream from Gull Rapids (CNP SV)

Resource Use
Locations and Local Study Area Traplines

Map 6-43

File Location: G:\EIS\Keyask\Output_MXD\CORE_VOLUME1\L_Updated_Terrestrial&Resource_LU\resUse\phys\c_May25_2012\Core_6_RU_BASELINE_ResourceUseLocations_20120119.mxd



KEEYASK Hydropower Limited Partnership

Legend

- Game Hunting Areas
- Local Study Area
- Regional Study Area
- Resource Management Areas
- War Lake Traditional Area
- First Nation Reserve
- Highways
- Rail
- Abandoned Rail

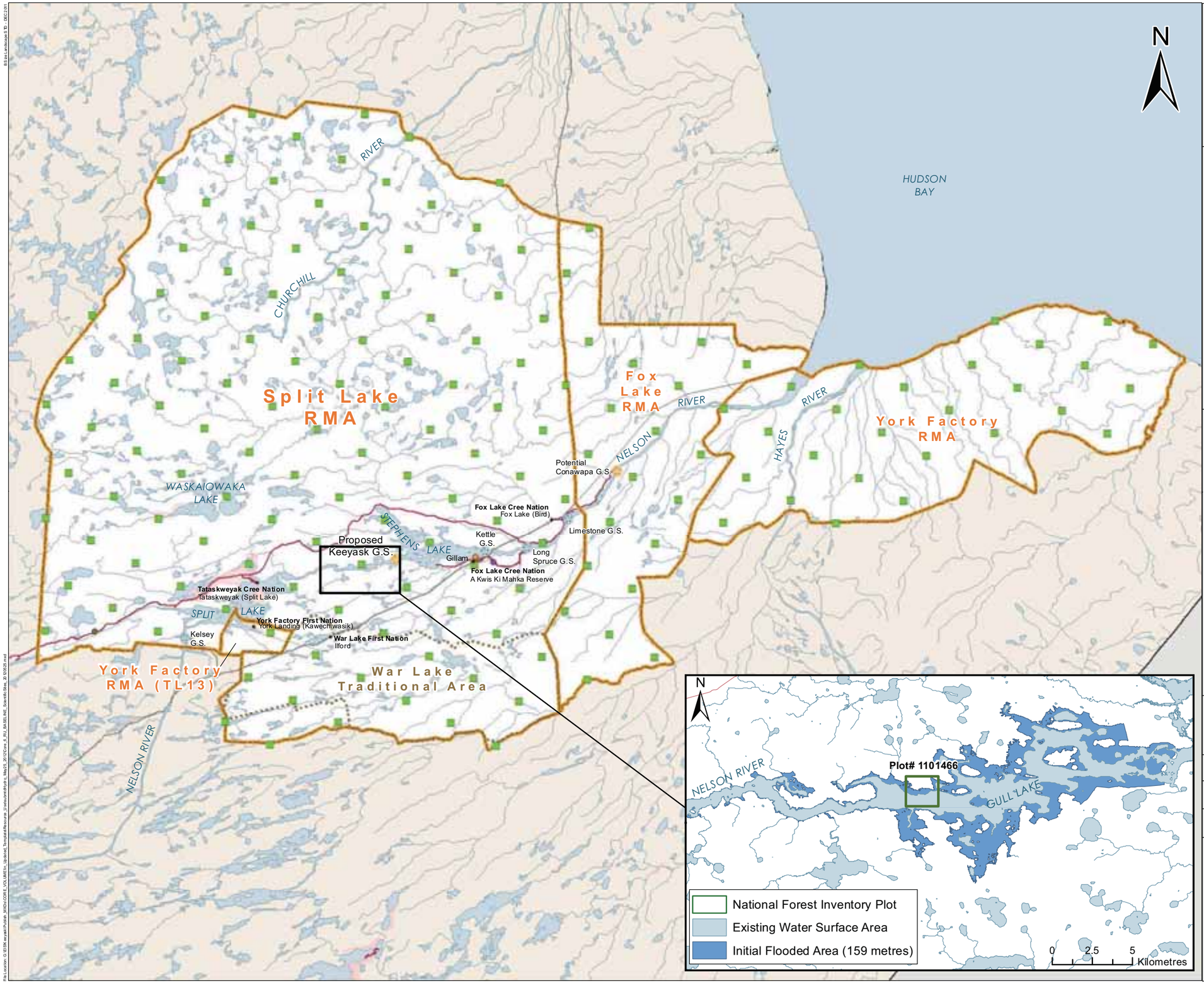
DATA SOURCE:
Manitoba Conservation and Water Stewardship

CREATED BY:
North/South Consultants Inc.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	24-MAY-12	28-MAY-12
0 20 40 Kilometres / 0 7 14 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Game Hunting Areas

Map 6-44



KEEYASK Hydropower Limited Partnership

Legend

- Acid Rain National Early Warning System
- Boreal Forest Transect Case Study Site
- BOREAS Weather Station
- Vale
- National Forest Inventory Plots
- Resource Management Areas
- First Nation Reserve
- Highways
- Rail
- Abandoned Rail

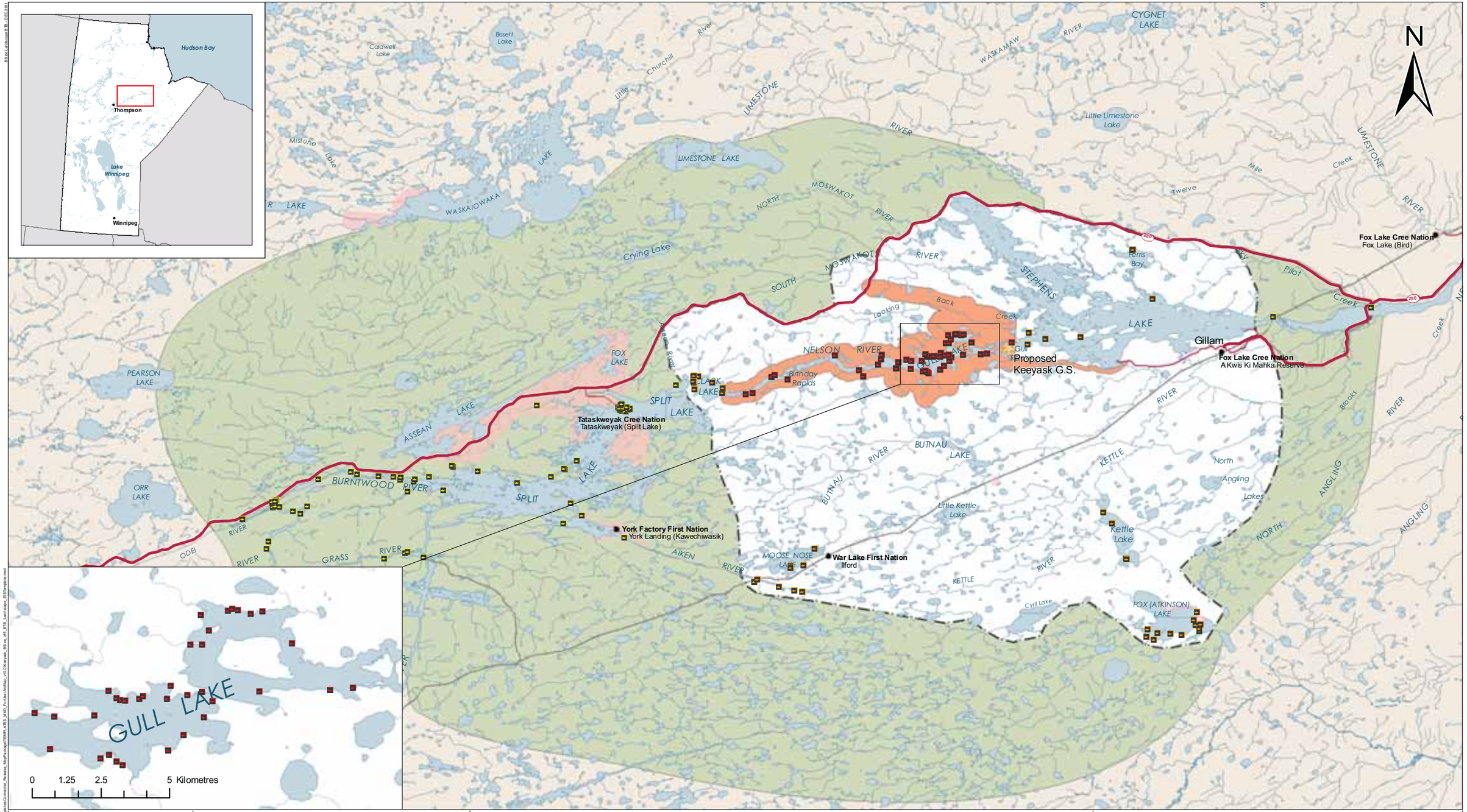
DATA SOURCE:
Government of Canada,Canadian Forest Service; Government of Manitoba; VALE - INCO

CREATED BY:
North/South Consultants Inc.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	24-MAY-12	29-MAY-12
0 20 40 Kilometres / 0 7 14 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Scientific Sites

Map 6-45



Legend

- Archaeological Site (Core), 50
- Archaeological Site (Local), 100
- Archaeological Site (Regional), 162
- Generating Station (Planned)
- First Nation Community
- Town
- Highway
- Rail
- Core Study Area
- Local Study Area
- Regional Study Area
- First Nation Reserve

Note: the number of archaeological sites in each Study Area is cumulative and incorporates sub-regions.

KEEYASK Hydropower Limited Partnership

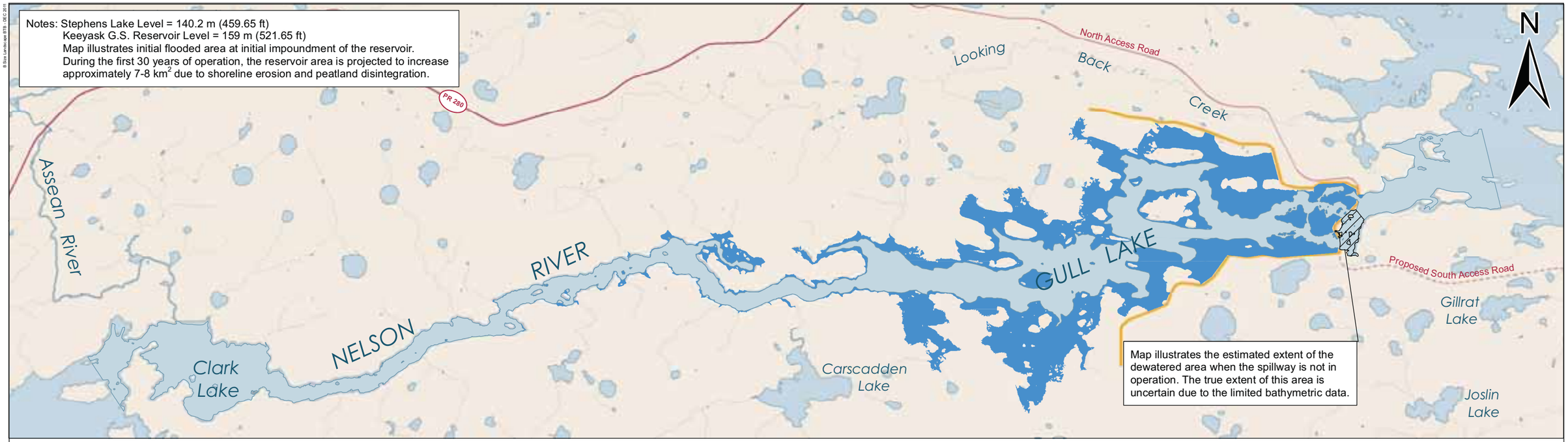
DATA SOURCE: Manitoba Hydro, Historic Resources Branch, Culture, Heritage and Tourism		
CREATED BY: Northern Lights Heritage Services Inc.		
COORDINATE SYSTEM: UTM NAD 1983 Z15N	DATE CREATED: 24-MAY-12	REVISION DATE: 24-MAY-12
0 5 10 Kilometres / 0 4 8 Miles	VERSION NO: 1.0	QA/QC: APPROVED

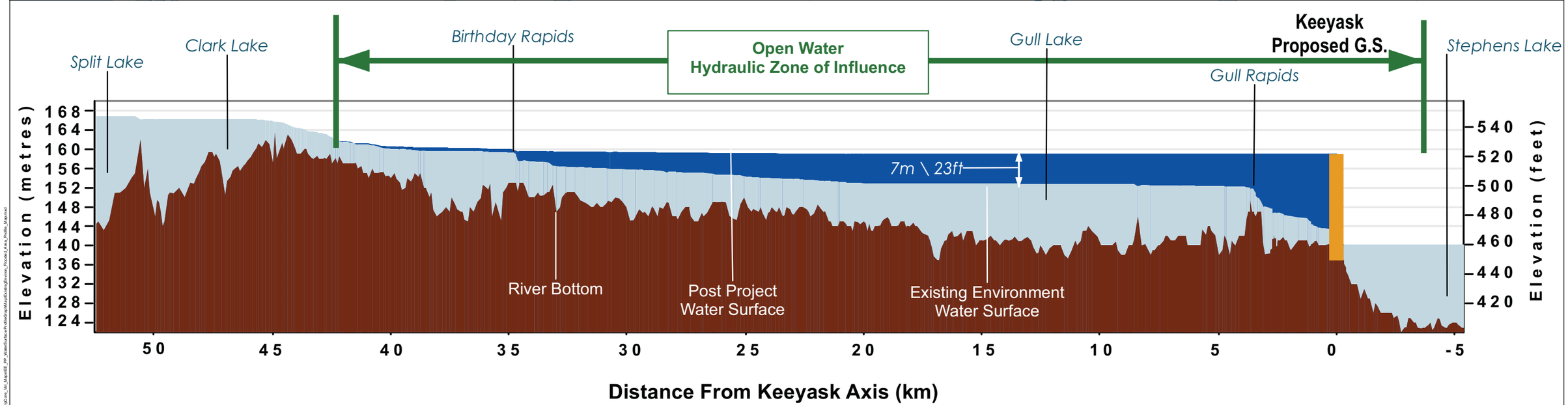
Heritage Resources Study Areas
with Registered Archaeological Sites

Map 6-46

File Location: W:\Wetmore_Group\Power_Supply\Project\Keeyask\Map Templates\Contractor_Releases_MapPackage\TEMPLATES_MXD_For Use\ArcMap_v10.0\Keeyask_BSIs_ch_6\6_BTB_Landscape_BSIStemplate.mxd

Notes: Stephens Lake Level = 140.2 m (459.65 ft)
Keeyask G.S. Reservoir Level = 159 m (521.65 ft)
Map illustrates initial flooded area at initial impoundment of the reservoir.
During the first 30 years of operation, the reservoir area is projected to increase approximately 7-8 km^2 due to shoreline erosion and peatland disintegration.





DATA SOURCE:
Government of Canada; Government of Manitoba; Manitoba Hydro: gull-ee-50perc-3032cms-rev3; pp-50perc-3032-159-shore-rev3; pp-DS-50perc-3030-140p2-shore-rev1

CREATED BY:
Manitoba Hydro - Water Resources Engineering Department

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	26-Jan-10	23-MAY-12
0 1.5 3 Kilometres / 0 1.5 3 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Legend
- Existing Environment
- Post Project
- Keeyask Principal Structures

Note:
50th Percentile, Open Water Flow
Existing Environment
and Post-Project Environment

Water Surface Profiles and Flooded Area

Map 6-47

© Nisa Landscape BTB - DEC 2011
File Location: W:\Hydro\Section\Data\Rivers\Nelson\Gull\EE\Drawings\&Figures\EIS_Design\Core_Mxd_Maps\EE_PP_WaterSurfaceProfileGraphMap\Environ_Flooded_Area_Profile_Map.mxd

Notes: Stephens Lake Level = 141.1 m
Keeyask G.S. Reservoir Level = 159 m
This map does not illustrate additional flooded area resulting from shoreline erosion that will occur after reservoir impoundment.

Looking Back Creek
North Access Road
NELSON RIVER
GULL LAKE
Proposed South Access Road
Gillrat Lake
Clark Lake
Carscadden Lake
Joslin Lake
PR 280
N

5th Percentile Flow

Map illustrates the estimated extent of the dewatered area when the spillway is not in operation. The true extent of this area is uncertain due to the limited bathymetric data.

50th Percentile Flow

Map illustrates the estimated extent of the dewatered area when the spillway is not in operation. The true extent of this area is uncertain due to the limited bathymetric data.

95th Percentile Flow

Due to limited bathymetry in this area, exact location of post project shoreline is uncertain downstream of spillway.

KEEYASK
Hydropower Limited Partnership

Legend

Depth (m)
- 0 - 4
- 4 - 8
- 8 - 12
- 12 - 18
- 18 - 23
- 23 - 31

Keeyask Principal Structures

DATA SOURCE:
Manitoba Hydro; Government of Manitoba; Government of Canada

CREATED BY:
Manitoba Hydro - Water Resources Department

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	08-JAN-10	23-MAY-12
0 2 4 Kilometres / 0 1 2 Miles	VERSION NO: 1.0	QA/QC: APPROVED

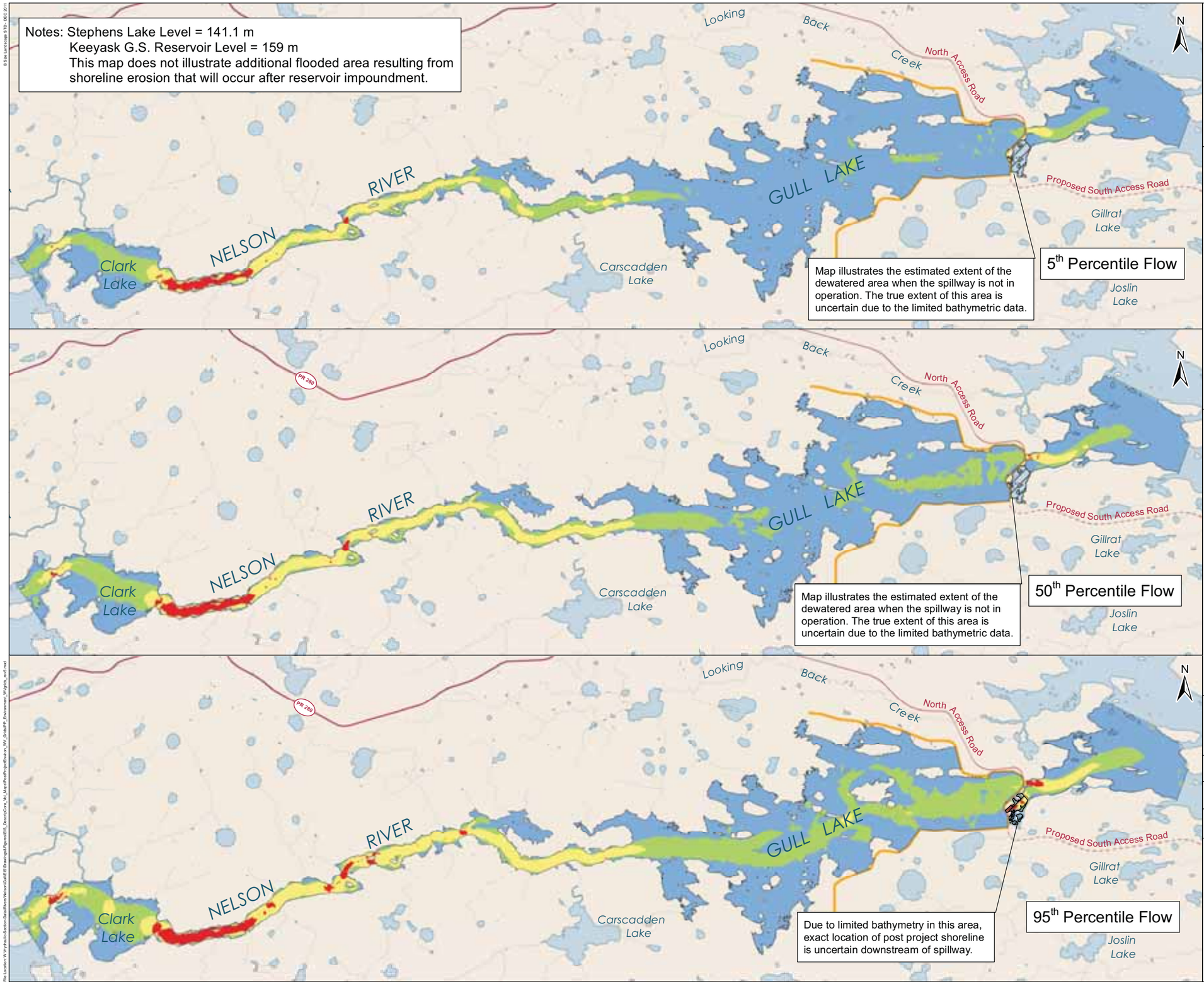
Water Depth Grid
Post Project Environment

Map 6-48

B Size Landscape STD - DEC 2011

File Location: W:\Hydraulic-Section-Data\Rivers Nelson\GIS\ArcGIS Drawings\MapFigures\EIS_DevelopCons_WL\MapsProjects\Environ_WL\Depths_wrd.mxd

Notes: Stephens Lake Level = 141.1 m
Keeyask G.S. Reservoir Level = 159 m
This map does not illustrate additional flooded area resulting from shoreline erosion that will occur after reservoir impoundment.



KEEYASK
Hydropower Limited Partnership

Legend

Velocity (m/s)

- Standing (0 - 0.2)
- Low (0.2 - 0.5)
- Moderate (0.5 - 1.5)
- High (>1.5)
- Keeyask Principal Structures

DATA SOURCE:
Manitoba Hydro; Government of Manitoba; Government of Canada

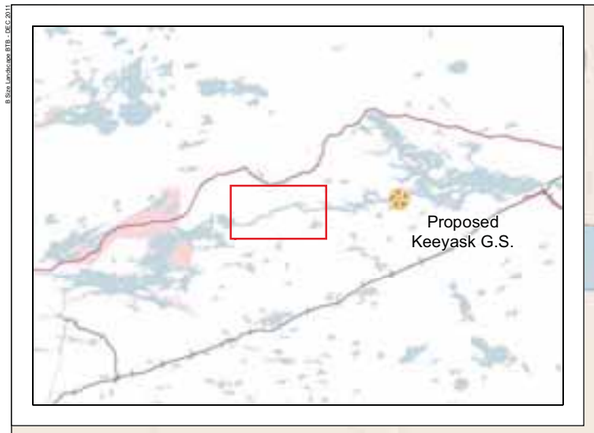
CREATED BY:
Manitoba Hydro - Water Resources Engineering Department

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	08-JAN-10	23-MAY-12
0 2 4 Kilometres / 0 1 2 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Water Velocity Grids
Post Project Environment

Map 6-49

B Size Landscape STD - DEC 2011
File Location: W:\Hydraulic-Section-Data\Rivers\Nelson\GIS\ESIDraienyck\Figures\ESI_DeanrycKore_Vel_Map\Post\Project\mxd\xx_VW_GridsPP_Environment_WVgrids_ar5.mxd



N

Two Goose Creek

Fork Creek

3

4

Kahpowinic Bay

RIVER

2

Birthday Rapids

NELSON

Portage Creek

Long Rapids

Nap Creek

1

CLARK LAKE

Carscadden Lake

KEEYASK
Hydropower Limited Partnership

DATA SOURCE:
Reaches - North/South Consultants Inc.; Peatland disintegration - ECOSTEM Ltd.; Mineral bank erosion - J D Mollard and Associates Ltd.; Existing water (gull-ee-95perc-4327cms-rev3), flooded area (pp-95perc-4327-159-shore-rev5), Infrastructure - Manitoba Hydro; Water - NTS; Roads and rail - Manitoba Conservation; First Nation Reserves - Natural Resources Canada.

CREATED BY:
ECOSTEM Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	19-JAN-12	14-FEB-12
0 1 2 Kilometres 0 0.4 0.8 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Legend

- Existing Water Surface Area
- Initial Flooded Area (159 m)
- Peatland Disintegration
- Mineral Bank Erosion

Post Project Reach

- 1 = Riverine Shore Zones Upstream of Birthday Rapids
- 2 = Riverine Shore Zones at Birthday Rapids
- 3 = Riverine Shore Zones Downstream of Birthday Rapids to the Inlet of Gull Lake
- 4 = Lake Shore Zones in Gull Lake

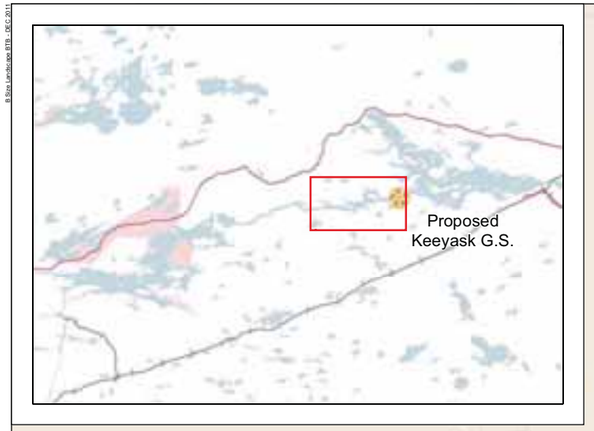
Peatland Disintegration and Erosion in the Western Upstream Reaches

During First 30 Years of Operation

Map 6-50

© Keeyask Hydropower Limited Partnership, 2011

File Location: Z:\Workspace\Keeyask GIS\EIS\Figure\Physical Environment\Shoreline Erosion\Map 6-4 Reservoir Expansion- Erosion versus PD Water\120130.mxd



KEEYASK Hydropower Limited Partnership

DATA SOURCE:
Reaches - North/South Consultants Inc.; Peatland disintegration - ECOSTEM Ltd.; Mineral bank erosion - J D Mollard and Associates Ltd.; Existing water (gull-ee-95perc-4327cms-rev3), flooded area (pp-95perc-4327-159-shore-rev5), Infrastructure - Manitoba Hydro; Water - NTS; Roads and rail - Manitoba Conservation; First Nation Reserves - Natural Resources Canada.

CREATED BY:
ECOSTEM Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	19-JAN-12	27-APR-12
0 1 2 Kilometres 0 0.4 0.8 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Legend

- Existing Water Surface Area
- Initial Flooded Area (159 m)
- Peatland Disintegration
- Mineral Bank Erosion

Post Project Reach

- 3 = Riverine Shore Zones Downstream of Birthday Rapids to the Inlet of Gull Lake
- 4 = Lake Shore Zones in Gull Lake
- 5 = Riverine Shore Zones at Gull Rapids
- Keeyask Principal Structures

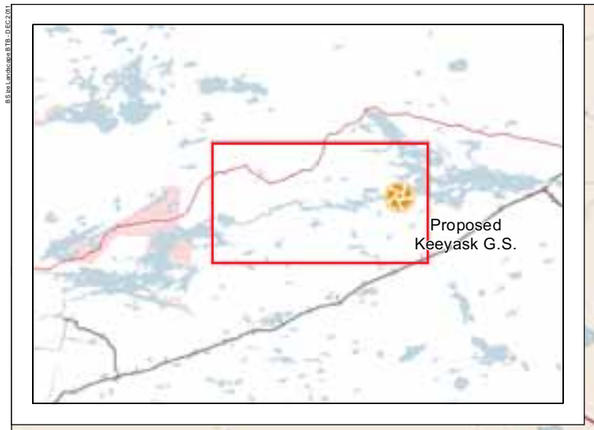
Peatland Disintegration and Erosion in the Eastern Upstream Reaches

During First 30 Years of Operation

Map 6-51

© Keeyask Hydropower Limited Partnership

File Location: Z:\Workspace\Keeyask GIS\EIS\Figure\Physical Environment\Shoreline Erosion\Map 14 Reservoir Expansion- Erosion versus PD 120130.mxd



Moswakot River

South

STEPHENS LAKE

N

North Access Road

Looking Back Creek

PR 280

Reach 8
North Nearshore:
Min: 5 mg/l
Mean: 6 mg/l
Max: 12 mg/l
Offshore:
Min: 5 mg/l
Mean: 8 mg/l
Max: 13 mg/l
South Nearshore:
Min: 7 mg/l
Mean: 11 mg/l
Max: 12 mg/l

Reach 4
North Nearshore:
Min: 5 mg/l
Mean: 7 mg/l
Max: 12 mg/l
Offshore:
Min: 5 mg/l
Mean: 7 mg/l
Max: 11 mg/l
South Nearshore:
Min: 5 mg/l
Mean: 6 mg/l
Max: 12 mg/l

Reach 5
North Nearshore:
Min: 5 mg/l
Mean: 7 mg/l
Max: 20 mg/l
Offshore:
Min: 5 mg/l
Mean: 9 mg/l
Max: 20 mg/l
South Nearshore:
Min: 5 mg/l
Mean: 10 mg/l
Max: 20 mg/l

RIVER

NELSON

GULL LAKE

Proposed South Access Road

Gillrat Lake

Clark Lake

Carscadden Lake

Reach 9
North Nearshore:
Min: 5 mg/l
Mean: 6 mg/l
Max: 11 mg/l
Offshore:
Min: 5 mg/l
Mean: 9 mg/l
Max: 12 mg/l
South Nearshore:
Min: 5 mg/l
Mean: 7 mg/l
Max: 10 mg/l

Joslin Lake

Reach 2
North Nearshore:
Min: 8 mg/l
Mean: 14 mg/l
Max: 20 mg/l
Offshore:
Min: 8 mg/l
Mean: 18 mg/l
Max: 20 mg/l
South Nearshore:
Min: 10 mg/l
Mean: 16 mg/l
Max: 20 mg/l

Reach 3
North Nearshore:
Min: 5 mg/l
Mean: 7 mg/l
Max: 13 mg/l
Offshore:
Min: 5 mg/l
Mean: 10 mg/l
Max: 20 mg/l
South Nearshore:
Min: 5 mg/l
Mean: 10 mg/l
Max: 20 mg/l

Reach 6
North Nearshore:
Min: 5 mg/l
Mean: 6 mg/l
Max: 16 mg/l
Offshore:
Min: 5 mg/l
Mean: 11 mg/l
Max: 20 mg/l
South Nearshore:
Min: 5 mg/l
Mean: 8 mg/l
Max: 19 mg/l

Reach 7
North Nearshore:
Min: 5 mg/l
Mean: 8 mg/l
Max: 15 mg/l
Offshore:
Min: 5 mg/l
Mean: 10 mg/l
Max: 20 mg/l
South Nearshore:
Min: 5 mg/l
Mean: 6 mg/l
Max: 13 mg/l

SPLIT LAKE

River

Butnau Lake

Butnau River

NOTE:
Estimated eroded shore mineral volume under PEAKING scenario has been considered

Hydropower Limited Partnership

DATA SOURCE:
TSS data from KGS Acres LTD., 2010
Modelling reach boundary data from North/South Consultants
Manitoba Hydro
Backround data provided by Geogratis

CREATED BY:
KGS Acres Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	02-MAY-12	03-MAY-12
0 1.5 3 Kilometres 0 1 2 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Legend

Total Suspended Solids (TSS mg/L)
High : 50
Low : 0

Reach Boundaries
Nearshore Boundaries

Keeyask Principal Structures
Access Road
Proposed Access Road
Highway
Rail

Spatial Distribution of Depth Averaged Sediment Concentration

Year 1 After Impoundment - 50th Percentile Flow

Map 6-52

File Location: P:\Pr\100\01\Enhancements\Environmental\05_Figures\Fish\3-2\MXD\Conc_6_P_E_BASELINE_Sediment_Distribution_of_Depth_Averaged_Sediment_Concentration_Year1_After_Impoundment_50th_Percentile_Rowand