Drybrough
Glasspole Lake
Herriot
Mounteney Lake
Kaykayk Lake
Laurie River
Hone
Granville Lake
Stag Lake
Leaf Rapids
Watt L
Beaucage Lake
Bridal L
Bissett Is
Granville Lake
Lake
Costello Lake
Granville Falls
Elvyn L
Suwannee River
Suwannee Lake
Lake
Ruttan Mine
Ruttan L
Rat
Karsakuwigamak Lake
Pemichigamau Lake
Goodwin Lake
Rat
Rat Terrestrial Region
Baldock Terrestrial Region
Ridge L
Livingston Lake
Kinwaw Lake
Harding L
Myharski Lakes
Leftrook Lake
Nile L
Macheewin Lake
Misinagu Lake
Fold L
Osik Lake
Notigi Lake
Notigi
Wapiso Lake
Hall Lake
Nelson Lake
Wuskwatim Terrestrial Region
Nisichawayasihk Cree Nation
Nelson House (NAC)
Threepoint Lake
Opegano Lake
Osnwagan
Wuskwatim Lake
Wuskwatim G.S.
Paint Terrestrial Region
Apeganau Lake
Apeganau R
Burntwood River
Burntwood Lake
Flatrock Lake
Highrock
Highrock Lake
Takipy
Takipy Lake
Ratter
Jetait
McCallum Lake
Runner L
McKnight L
Ck
Pearson Lake
Evans
Churchill
Loon Lake
Britton Lake
Loon Lake
Sisipuk L
Pukatawagan
Pukatawagan Lake
Barnett Lake
Siers Lake
Morin Lake
Wright Lake
Girouard Lake
Dey L
Gestur L
Russick Lake
Tait Lake
Kipahigan Lake
Crow
Kississing
Driftwood
N

Created By: cstrynatka - B:\Gis Landscape\MB - MAP 2015 - Scale 1:4,500,000
File Location: Z:\Workspace\mxd\RCEA\Regional System\Bank Material Rat Region Post.mxd

Manitoba Hydro
Regional Cumulative Effects Assessment

DATA SOURCE: Manitoba Hydro; Government of Manitoba; Government of Canada; ECOSTEM Ltd.

CREATED BY: ECOSTEM Ltd.

COORDINATE SYSTEM: NAD 1983 UTM Zone 14N

DATE CREATED: 14-OCT-15

REVISION DATE: 18-NOV-15

0 7 14 Kilometres
0 6 12 Miles

VERSION NO: 1.0

QA/QC:

Legend

- Terrestrial Region
- RCEA Region of Interest

Bank Material

- Bedrock
- Clay
- Clay on Bedrock
- Clay on Low Bedrock
- Human
- Peat
- Unknown

Infrastructure

- Generating Station (Existing)
- Transmission Line (Existing)
- Transmission Line (Under Construction)
- Highway
- Rail

Bank Material Post-Hydroelectric Development

Rat Terrestrial Region

Map 6.3.2-17

Along shoreline where beach width could be interpreted, most width classes increased in length (Table 6.3B-12), as a large amount of new shoreline was established. Very wide beaches were absent along the mapped existing environment shoreline, and mixtures of narrow and moderate width beaches were reduced. The loss of these mixtures was offset by increases in narrow beach and moderately wide beach, and mixtures of moderately wide and very wide beach. Narrow beaches were the only class to increase in both length (1,412 km) and proportion (68% to 81%) along the mapped shoreline.

While vegetation colonized some of the initially flooded land areas, many years were generally required for marsh and beach vegetation to develop on flooded land, disintegrating peatlands, eroding mineral banks and evolving beach substrates. Typical shore zone vegetation, or even vegetated beaches, were not apparent along much of the mapped Rat River shoreline in 2013.

Shore zone wetlands changed considerably during the hydroelectric development period. Marsh in the various density and width classes was reduced from about 336 to about 28 km of shoreline, or from about 29% to about 1% of shoreline length (Table 6.3.2-31; Map 6.3.2-18). Riparian peatlands were also reduced considerably, going from 36 to 12 km of shoreline. These reductions were replaced by relatively large increases in shallow open water, sunken marsh and peatlands. The amount of shoreline with shallow open water increased to 1,852 km, which comprised 94% of shoreline length. Sunken marsh (refers to emergent vegetation growing on the sunken fringes of floating peatlands or on top of recently sunken peat mats) was absent in the pre-hydroelectric development mapping but occurred along 26 km, or 1%, of the existing environment shoreline. Peatland increased from none in the pre-hydroelectric development mapping to occurring along 51 km, or 2%, of the existing environment shoreline, and disintegrating peatland made up the remaining shoreline (2%).

In offshore areas, wide and very wide marsh as well as pondweed were absent in the existing environment mapping. The proportion of occasional marsh increased to 28 km from 1 km prior to hydroelectric development. Disintegrating peatland and no mappable type increased considerably (about 162 km and 1,628 km, respectively; Table 6.3.2-32). Most of the mapped offshore wetland in the existing environment was disintegrating peatland (162 km), a type which was absent before hydroelectric development.

Tall shrub bands disappeared along the entire mapped shoreline in the existing environment mapping (Table 6.3B-13).

Shoreline debris went from being absent along the mapped shoreline to occurring along 48% of the shoreline where debris was mapped (Table 6.3.2-29; 54% of the existing environment shoreline was mapped for shoreline debris). Debris accumulations occurred in various concentrations from low density and sparsely scattered to high density and continuous along the shore segment. Moderate density accumulations with moderate coverage along the shore were the most common (265 km or 18% of mapped shoreline). Heavy accumulations and mixtures of moderate to heavy accumulations ranging from scattered to continuous cover occurred along about 3% of the existing environment shoreline.

Shoreline debris occurred throughout the mapped shoreline in the terrestrial region. Heavier accumulations occurred in Wapisu Lake (Map 6.3.2-19).

Table 6.3.2-31: Shore Zone Wetland Composition of the Pre-Hydroelectric Development and Existing Environment Classified Shorelines of the Rat Terrestrial Region System for Overlapping Areas

Shore Zone Wetland Type	Pre-Hydroelectric Development		Existing Environment	
	Length (km)	Percentage of Mapped Shoreline	Length (km)	Percentage of Mapped Shoreline
Occasional marsh	88	7	-	-
Mixture of occasional marsh and moderately wide marsh	4	0	-	-
Mixture of occasional marsh and wide marsh	2	0	-	-
Narrow marsh	30	2	28	1
Moderately wide marsh	115	9	-	-
Wide marsh	61	5	-	-
Marsh on sunken peat	-	-	26	1
Riparian peatland	36	3	12	0
Mixture of occasional marsh and riparian peatland	4	0	-	-
Mixture of narrow marsh and riparian peatland	24	2	-	-
Mixture of moderately wide marsh and riparian peatland	43	3	-	-
Mixture of wide marsh and riparian peatland	35	3	-	-
Mixture of riparian peatland and moderately wide marsh	1	0	-	-
Peatland	-	-	51	2
Mixture of peatland and marsh on sunken peat	-	-	17	1
Disintegrating peatland	-	-	32	1
Mixture of disintegrating peatland and open water	-	-	11	0
Mixture of open water and disintegrating peatland	-	-	37	1
Mixture of open water and human infrastructure	-	-	15	1
Mixture of open water and peatland	-	-	29	1

Table 6.3.2-31: Shore Zone Wetland Composition of the Pre-Hydroelectric Development and Existing Environment Classified Shorelines of the Rat Terrestrial Region System for Overlapping Areas

Shore Zone Wetland Type	Pre-Hydroelectric Development		Existing Environment	
	Length (km)	Percentage of Mapped Shoreline	Length (km)	Percentage of Mapped Shoreline
Open water	788	64	2,558	91
Mixture of human infrastructure and open water	-	-	1	0
Total	**1,230**	**100**	**2,817**	**100**

Notes: Values of "0" indicate a number that rounds to zero.
Values of "-" indicate an absence.
Subtotals may not appear to reflect sum due to rounding.

Drybrough
Glasspole Lake
Herriot
Mounteney Lake
Kaykayk Lake
Laurie River
Hone
Granville Lake
Stag Lake
Leaf Rapids
Leaf Rapids
Ruttan Mine
Ruttan L
Rat
Watt L
Beaucage Lake
Bridal L
Bissett Is
Granville
Karsakuwigamak Lake
Baldock Terrestrial Region
Livingston Lake
Ridge L
Pemichigamau Lake
Kinwaw Lake
Costello Lake
Lake
Granville Falls
Goodwin Lake
Wynarski L
Harding L
Suwannee River
Rat Lakes
Suwannee Lake
Rat Terrestrial Region
Macheewin Lake
Leftrook Lake
Nile L
Odei
Misinagu Lake
Ford L
Osk Lake
Notigi
Notigi Lake
Wapiso Lake
Nisichawayasihk Cree Nation
Nelson House (NAC)
Treepoint Lake
Highrock
Highrock Lake
Nelson Lake
Hall Lake
Elvyn L
McCallum Lake
Runner L
Jetait
McKnight L
Ck
Pearson Lake
Evans
Loon Britton Lake
Loon Lake
Churchill
Pukatawagan
Pukatawagan
Sisipuk L
Barnett Lake
Siers Lake
Morin Lake
Rafter
Flatrock Lake
Girouard Lake
Wright Lake
River
Apeganau R
Apeganau Lake
Burntwood River
Wuskwatim Terrestrial Region
Wuskwatim Lake
Wuskwatim River
Opegano Lake
Ospwagan
Wuskwatim G.S.
Paint Terrestrial Region
Dey L
Gestur L
Takipy
Takipy Lake
Burntwood Lake
Ck
River
Russick Lake
Tait Lake
Kipahigan
Crow L
Kississing
Guthrie
Driftwood
N
0 7 14 Kilometres
0 6 12 Miles

Manitoba Hydro
Regional Cumulative Effects Assessment

DATA SOURCE: Manitoba Hydro; Government of Manitoba; Government of Canada; ECOSTEM Ltd.

CREATED BY: ECOSTEM Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
NAD 1983 UTM Zone 14N	14-OCT-15	18-NOV-15
	VERSION NO: 1.0	QA/QC:

Legend

- Terrestrial Region
- RCEA Region of Interest

Shore Wetland Class

- Peatland
- Riparian Peatland
- Disintegrating Peatland
- Moderately Wide to Wide Marsh
- Marsh
- Sunken Marsh
- Shallow Water
- Human Feature
- Unknown

Infrastructure

- Generating Station (Existing)
- Transmission Line (Existing)
- Transmission Line (Under Construction)
- Highway
- Rail

Shore Zone Wetland Type Post-Hydroelectric Development

Rat Terrestrial Region

Map 6.3.2-18

Created By: cstrynatka - 8:30:24 AM - MAR 2016 Scale: 1:400,000
File Location: Z:\Workspace\wetRCE\rat\Rat Regulated System\Shore Wetland Rat Region Post.mxd

Table 6.3.2-32: Offshore Wetland Composition of the Pre-Hydroelectric Development and Existing Environment Classified Shorelines of the Rat Terrestrial Region System for Overlapping Areas

Offshore Wetland Type	Pre-Hydroelectric Development		Existing Environment	
	Length (km)	Percentage of Mapped Shoreline	Length (km)	Percentage of Mapped Shoreline
Occasional marsh	1	0	28	1
Narrow marsh	6	1	5	0
Moderately wide marsh	24	2	-	-
Wide marsh	21	2	-	-
Mixture of narrow marsh and none	2	0	6	0
Mixture of moderately wide marsh and pondweed	13	1	-	-
Mixture of wide marsh and pondweed	9	1	-	-
Mixture of moderately wide marsh and none	2	0	-	-
Disintegrating peatland	-	-	162	6
Pondweed	171	14	-	-
Riparian peatland	-	-	6	0
Mixture of none and pondweed	15	1	-	-
None	967	79	2,594	92
Mixture of none and disintegrating peatland	-	-	16	0
Total	**1,230**	**100**	**2,817**	**100**

Notes: Values of "0" indicate a number that rounds to zero.
Values of "-" indicate an absence.
Subtotals may not appear to reflect sum due to rounding.

Drybrough
Glasspole Lake
Herriot
Mounteney Lake
Kaykayk Lake
Laurie River
Hone
Granville Lake
Stag Lake
Leaf Rapids
Beaucage Lake
Bridal L
Bissett Is
Watt L
Granville Lake
Lake
Costello Lake
Granville Falls
Suwannee River
Suwannee Lake
Elvyn L
McCallum Lake
Runner L
Jetail
McKnight L
Loon Britton Lake
Loon Lake
Pearson Lake
Evans Lake
Churchill
Ck
Highrock
Highrock Lake
Nelson Lake
Hall Lake
Leaf Rapids
Ruttan Mine
Ruttan L
Karsakuwigamak Lake
Rat
Pemichigamau Lake
Goodwin Lake
Rat River
Rat Terrestrial Region
Baldock Terrestrial Region
Ridge L
Livingston Lake
Kinwaw Lake
Harding L
Mynarski Lakes
Leftrook Lake
Nile L
Odei
Macheewin Lake
Wisinagu Lake
Ford L
Osk Lake
Notigi Lake
Notigi
Wapiso Lake
Nisichawayasihk Cree Nation
Nelson House (NAC)
Threepoint Lake
Wuskwatim Terrestrial Region
Opegano Lake
Osnwagan
Wuskwatim Lake
Wuskwatim River
Wuskwatim G.S.
Paint Terrestrial Region
Apeganau R
Apeganau Lake
Burntwood River
Burntwood Lake
Ck
River
Driftwood
Takipy
Takipy Lake
Guthrie
Kississing
Crow
Kipahigan
Russick Lake
Tait Lake
Girouard Lake
Wright Lake
Dey L
Gestur L
Barnett Lake
Siers Lake
Morin Lake
Ratter
Sisipuk L
Pukatawagan
Pukatawagan
Lake
Flatrock Lake
River
N

Legend

- Terrestrial Region
- RCEA Region of Interest

Shoreline Debris (Density, Coverage)

- Heavy, Continuous
- Heavy, Moderate
- Heavy, Light
- Moderate, Continuous
- Moderate, Moderate
- Moderate, Light
- Light, Continuous
- Light, Moderate
- Light, Light
- None
- Unknown

Infrastructure

- Generating Station (Existing)
- Transmission Line (Existing)
- Transmission Line (Under Construction)
- Highway
- Rail

Manitoba Hydro

Regional Cumulative Effects Assessment

DATA SOURCE: Manitoba Hydro; Government of Manitoba; Government of Canada; ECOSTEM Ltd.

CREATED BY: ECOSTEM Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
NAD 1983 UTM Zone 14N	14-OCT-15	18-NOV-15
0 7 14 Kilometres / 0 6 12 Miles	VERSION NO: 1.0	QA/QC:

Shoreline Debris Post-Hydroelectric Development

Rat Terrestrial Region

Map 6.3.2-19

File Location: Z:\Workspace\mxd\CEAA\data\Regulated System\Shore Debris_Rat Region Post.mxd
Created By: cmorello - 8 Nov Landscape at 8.5 - MAR 2015 Scale: 1:400,000

6.3.2.1.4 Baldock Terrestrial Region

The development periods used for the Baldock Terrestrial Region were as follows:

- the pre-development period ends in 1969 with construction of PR 391;
- the pre-hydroelectric development period runs from 1969–1970; and
- the hydroelectric development period runs from 1971–2013 with construction of the winter road to Missi Falls.

BEFORE HYDROELECTRIC DEVELOPMENT

Terrestrial Habitat Composition

Land, which equates to native habitat prior to all human infrastructure development, comprised approximately 88% of the 1,055,186 ha Baldock Terrestrial Region in 1968, which was when infrastructure development began in the terrestrial region with construction of PR 391.

Fine-textured lacustrine surface materials dominated the terrestrial region (76% of land area), followed by till veneer (12%) and glaciofluvial complexes (9%). The remaining area was a mixture of till blanket and coarse-textured lacustrine materials (2% and 1%, respectively). By 1968, approximately 30% of the mineral deposits were covered by organic material that developed over millennia. Approximately 66% of the regional land area remained mineral soil (Table 6.3.2-1). Bedrock outcrop made up 3% of the regional land cover. Permafrost was widespread in organic soils.

Pre-development native habitat composition for the entire terrestrial region was estimated from the existing environment habitat mapping. The non-flooding human footprint in 2013 comprised only 0.3% of the regional land area, which was not high enough to noticeably affect habitat proportions at the regional level. While the mapping of the eventual flooded area for the entire terrestrial region indicated that there was a higher proportion of shallow and riparian peatlands in the flooded areas, the size of the flooding footprint was not large enough (2.2% of pre-development land area) to substantially change the habitat proportions.

Based on detailed mapping, regional land cover was dominated by needleleaf treed vegetation on mineral or thin peatlands (53%, predominantly black spruce and jack pine needleleaf cover), followed by needleleaf treed vegetation on other peatlands (42%; see Table 6.3.2-2 for complete habitat composition).

Needleleaf treed vegetation other peatlands (predominantly black spruce on shallow peatland) was distributed throughout the terrestrial region (Map 6.3.2-20; Section 6.3.1.5.3 provides rationale for showing pre-hydroelectric development and existing environment habitat composition in the same map). Jack pine treed vegetation on mineral or thin peatland was scattered throughout the western half of the terrestrial region, and in the east was concentrated in a wide band extending from west to east. Broadleaf habitat was concentrated in the western third of the terrestrial region.

Legend

- Terrestrial Region
- RCEA Region of Interest

Coarse Habitat from Detailed Terrestrial Habitat

- Barren on All Ecosites
- Broadleaf Treed or Mixedwood on All Ecosites
- Black Spruce Dominant on Outcrop
- Black Spruce Treed or Black Spruce-Tamarack Mixture on Mineral or Thin Peatland
- Black Spruce Treed or Black Spruce-Tamarack Mixture on Shallow or Wet Peatland
- Black Spruce Treed or Black Spruce-Tamarack Mixture on riparian peatland
- Black Spruce Mixedwood on Outcrop
- Black Spruce Mixedwood on Mineral or Thin Peatland
- Black Spruce Mixedwood on Shallow Peatland
- Black Spruce Mixedwood on Wet Peatland
- Black Spruce Mixture on Outcrop
- Jack Pine Treed on Outcrop
- Jack Pine Treed on Mineral or Thin Peatland
- Jack Pine Treed on Shallow Peatland
- White Spruce or Eastern Cedar or Balsam Fir Treed on Mineral
- White Spruce Mixture on Shallow Peatland
- Tall Shrub on Mineral or Thin Peatland
- Tall Shrub on Shallow Peatland
- Tall Shrub on Wet Peatland
- Tall Shrub on Riparian Peatland
- Low Vegetation on Mineral or Thin Peatland
- Low Vegetation on Shallow Peatland
- Low Vegetation on Wet Peatland
- Low Vegetation on Riparian Peatland
- Marsh
- Young Regeneration
- Small Island
- Water
- Human Feature

Infrastructure

- Transmission Line (Existing)
- Transmission Line (Under Construction)
- Highway

Manitoba Hydro

Regional Cumulative Effects Assessment

DATA SOURCE:
Manitoba Hydro; Government of Manitoba; Government of Canada; ECOSTEM Ltd.; Habitat based on most recent Government of Manitoba Forest Inventory.

CREATED BY:
ECOSTEM Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
NAD 1983 UTM Zone 14N	16-JUN-15	30-NOV-15
0 7.5 15 Kilometres / 0 6.5 13 Miles	VERSION NO: 1.0	QA/QC:

Coarse Habitat Pre and Post-Hydroelectric Development

Baldock Terrestrial Region

Map 6.3.2-20

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The mapped human footprint, which is the amount of direct terrestrial habitat loss and alteration, grew from nothing in 1967 to 195 ha, or 0.02% of regional terrestrial habitat by 1970, which was when hydroelectric development began in this terrestrial region. Terrestrial habitat composition was virtually unchanged by this very small amount of habitat loss.

Ecosystem Diversity

As of 1967, the Baldock Terrestrial Region included about 28 broad habitat types (Table 6.3.2-33). The three regionally common broad habitat types comprised 63% of the total habitat area. These included black spruce mixture vegetation on shallow peatland (33%), jack pine mixture vegetation on mineral (15%) and black spruce dominant vegetation on thin peatland (15%). The 18 least common broad habitat types made up 3% of the total habitat area.

Of the 28 broad habitat types found in the ecozone, 25 were priority habitat types based on their rarity (Table 6.3.2-33). Six broad habitat types were regionally uncommon and 19 were regionally rare. The rarest of the priority habitat types were tamarack mixture vegetation on thin peatland, jack pine dominant vegetation on thin peatland and low vegetation on swamp. Each of these broad habitat types had less than five ha within the ecozone. The former two types were transitional between mineral ecosites and wetlands.

Priority habitat was distributed throughout the terrestrial region. Broadleaf habitat was more abundant in the western third (Map 6.3.2-20).

Wetland Function

Wetlands covered approximately 73% of the detailed mapping area in this region (this total does not include shallow open water since water depths were not available), with peatlands accounting for 99% of this total (Table 6.3.2-4). Marsh made up the remaining area. Blanket bog was the most abundant wetland type, followed by veneer bog.

In descending order, the highest quality wetlands in this region were marsh (1% of wetland area), followed by riparian fen (1%), swamp (<0.1%) and “all other” peatlands (4%; Table 6.3.2-4). The remaining peatland types had much lower wetland quality ratings than the other wetland types.

Shore zone wetlands, not including the pre-hydroelectric on-system wetlands addressed in the Shoreline Ecosystems section below, comprised 2% of the total mapped wetland area. These consisted mostly of marsh and with riparian fen, with swamp making up the remainder.

Shoreline Ecosystems

Shoreline ecosystems in the Baldock Terrestrial Region were virtually unaffected by human infrastructure development prior to the CRD. South Indian Lake was the only settlement abutting the future CRD system. Other human features coming close to or crossing the Rat River system were limited to trapper’s cabins and roads.

Table 6.3.2-33: Priority and Other Broad Habitat Types in the in the Baldock Terrestrial Region of the Western Boreal Shield Ecozone

Broad Habitat Type	Area (ha)	Percentage of Native Habitat	Priority Habitat Type [1]
Balsam poplar mixedwood on all ecosites	115	0.0	R
Trembling aspen mixedwood on all ecosites	6,508	0.7	R
White birch mixedwood on all ecosites	4,967	0.5	R
Balsam poplar dominant on all ecosites	24	0.0	R
Trembling aspen dominant on all ecosites	123	0.0	R
Trembling aspen mixture on all ecosites	3,447	0.4	R
White birch dominant on all ecosites	532	0.1	R
White birch mixture on all ecosites	1,258	0.1	R
Low vegetation on mineral	107	0.0	R
Low vegetation on swamp	1	0.0	R
Black spruce mixedwood on mineral	141	0.0	R
Black spruce mixedwood on thin peatland	10,750	1.2	U
Black spruce mixture on mineral	79,996	8.7	U
Black spruce dominant on thin peatland	136,534	14.8	C
Black spruce mixture on thin peatland	88,662	9.6	U
Tamarack mixture on thin peatland	5	0.0	R
Jack pine dominant on mineral	23,596	2.6	U
Jack pine dominant on thin peatland	3	0.0	R
Jack pine mixedwood on mineral	7,337	0.8	R
Jack pine mixture on mineral	140,925	15.3	C
White spruce mixture on mineral	44	0.0	R
Black spruce dominant on shallow peatland	81,980	8.9	U
Black spruce mixture on shallow peatland	303,348	32.9	C
Tamarack mixture on wet peatland	578	0.1	R
Tamarack mixture on shallow peatland	10	0.0	R
Low vegetation on wet peatland	23,876	2.6	U
Tall shrub on riparian peatland	2,001	0.2	R
Emergent on upper beach	6,139	0.7	R
Total native habitat area (ha)	**923,067**		

Notes: Values of "0" indicate a number that rounds to zero.

Subtotals may not appear to reflect sum due to rounding.

1. Priority habitat includes regionally rare or uncommon broad habitat types. Rarity codes: R = Regionally rare; U = Regionally uncommon; C = Regionally common; "-" = Does not qualify (*e.g.*, transitional or disturbed habitat types).

Based on estimates from 1:50,000 NTS data, the pre-hydroelectric development Rat Terrestrial Region included approximately 126,837 ha of surface water and 8,303 km of shorelines that provided potential shore zone and offshore wetland habitat (see Sections 6.3.1.5.5 and 6.3.1.5.6 for the limitations of these data). Based on a combination of available terrestrial habitat mapping outside of human-affected areas and pre-development habitat mapping in human footprints, shoreline wetlands and riparian peatlands comprised approximately 2% of total terrestrial habitat area in the terrestrial region. This percentage would have fluctuated from year to year in these dynamic ecosystems.

Waterbodies that would eventually be affected by the CRD contributed approximately 23% (28,698 ha) of the surface water area and 16% (1,305 km) of the shoreline length. Approximately 18% of this shoreline was in the main Rat River channel (Table 6.3.2-34). Connected lakes provided 36% of shoreline length and riverine lakes provided an additional 27%. Unconnected lakes that would become part of the regulated system after hydroelectric development made up 24%. The rest of the shoreline was in back bays and small tributary rivers (5% each), and the main Rat River channel (1%). Islands accounted for 12% of shoreline length.

Table 6.3.2-34: Waterbody Types for the Pre-Hydroelectric Development and Existing Environment Shorelines in the Baldock Terrestrial Region of the Western Boreal Shield Ecozone

Waterbody Type	Pre-Hydroelectric Development		Existing Environment	
	Length (km)	Percentage of Length	Length (km)	Percentage of Length
Large lake	5	0	112	7
Lake	473	36	447	27
Riverine lake	357	27	499	30
River	9	1	136	8
River widening	-	-	16	1
Back bay	70	5	222	13
Riverine bay	-	-	105	6
Small river	69	5	119	7
Off-system waterbody	318	24	-	-
Total	**1,301**	**100**	**1,657**	**100**

Notes: Values of "0" indicate a number that rounds to zero.
Values of "-" indicate an absence.
Subtotals may not appear to reflect sum due to rounding.

Data were available to classify approximately nearly 99% (1,291 km) of the pre-development on-system shoreline in the terrestrial region from historical aerial photographs acquired on various dates between August 3 and November 4, 1969. Mapping was at a scale of approximately 1:17,740 for the Upper Churchill River and south basin of Opachuanau Lake, and 1:32,000 for the remaining area.

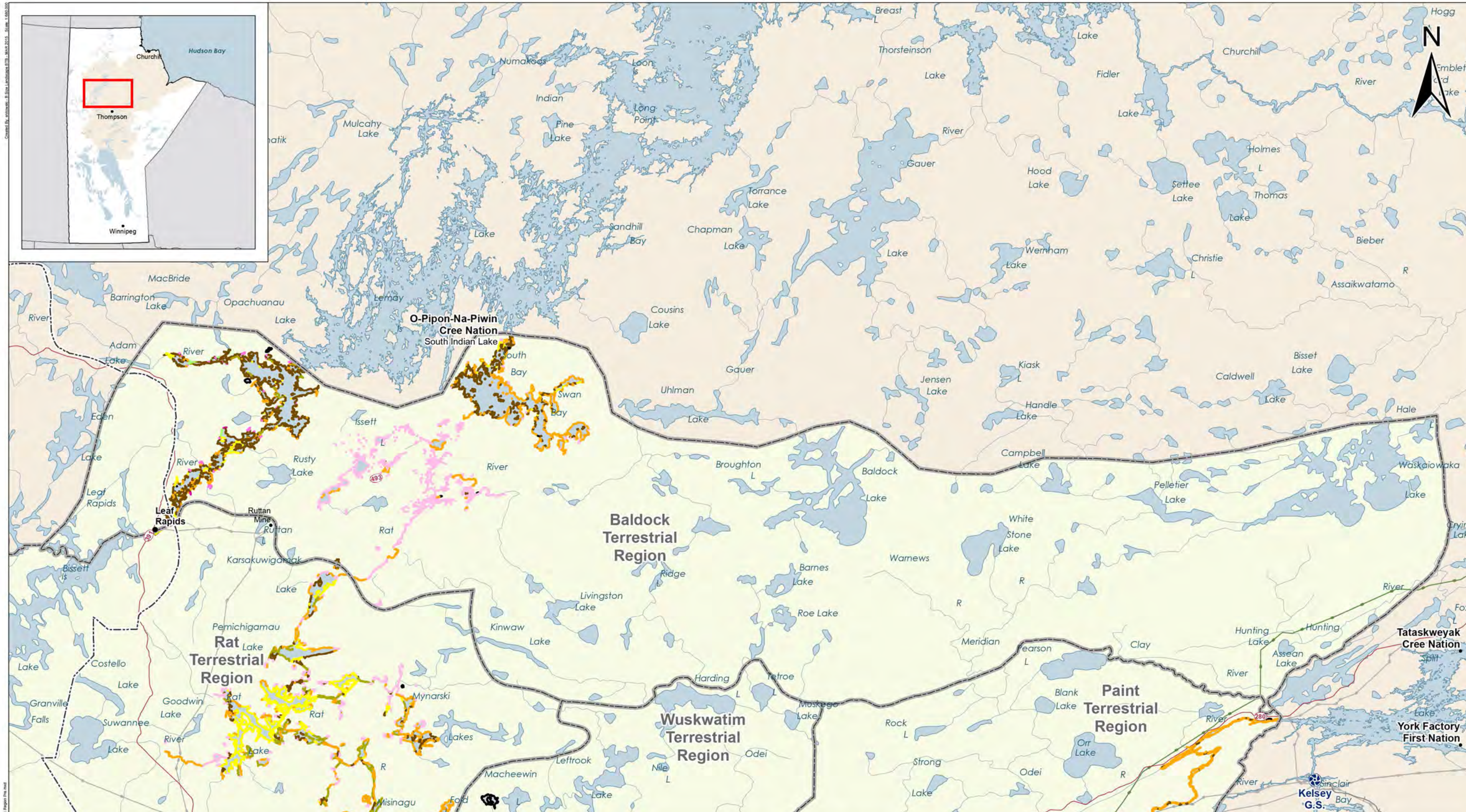
Clay bank materials made up the largest proportion of the mapped shoreline (60% of shoreline length; Map 6.3.2-21), either as a pure type (21%) or overlying bedrock (39%; Table 6.3.2-35; bank material mapped for 99% of the shoreline). Peat banks were also extensive in this terrestrial region, making up the approximately 34% of the shoreline. The remainder of the banks were bedrock (4%) and sand (2%), with a small amount of granular bank materials (<1%). Mappable bank failures were not apparent in the stereophotos. In this terrestrial region, most of the peat banks were concentrated in the reaches of the Rat River, and the off-system lakes that were flooded following the CRD, where this bank type made up the vast majority of shoreline. Clay banks dominated the shorelines of the Upper Churchill River, Opachuanau Lake, and Southern Indian Lake (SIL) South Bay.

Banks of low height were the most common along the shoreline (50% of shoreline length); followed by no banks (27%), moderate height banks (22%) and high banks (1%; Table 6.3B-4; bank height mapped for 99% of the shoreline). Low banks were mostly associated with clay, clay on low bedrock and peat bank materials, while moderate height and high banks were more often associated with bedrock and clay on bedrock bank materials. No banks were present along peat shorelines.

Where beaches could be classified from the aerial photographs, they were predominantly peat (36% of shoreline length) and bedrock (30%; beach material mapped for 74% of the shoreline). Granular material made up 19% of the classified beach, clay made up 10%, and sand made up most of the remaining 5%. Granular beach material was most extensive in SIL South Bay, and also occurred in long reaches of the Upper Churchill River and Opachuanau Lake (Table 6.3B-5), and sand beaches were scattered throughout these areas. Bedrock beaches dominated in the Upper Churchill River and Opachuanau Lake. Peat beaches formed the classified beach materials in the Rat River and surrounding off-system waterbodies.

Shallow open water was the most abundant shore zone wetland type (46%) along the classified shoreline (Table 6.3.2-36; Map 6.3.2-22; shore zone wetlands mapped for 97% of the shoreline). Marsh occurring in the various density and width classes was present along 29% of the mapped shoreline, and mixtures of marsh and riparian peatland made up an additional 17%. Riparian peatlands accounted for 9% of the shoreline.

Wide marshes were scattered in off-system waterbodies, riverine lakes and back bays throughout the terrestrial region (Map 6.3.2-22; as described in Section 6.3.1.5). Riparian peatlands were most abundant in the off-system waterbodies.



DATA SOURCE:
Manitoba Hydro; Government of Manitoba; Government of Canada; ECOSTEM Ltd.

CREATED BY:
ECOSTEM Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
NAD 1983 UTM Zone 14N	14-OCT-15	18-NOV-15
0 7.5 15 Kilometres / 0 6.5 13 Miles	VERSION NO: 1.0	QA/QC:

Manitoba Hydro

Regional Cumulative Effects Assessment

Legend

Terrestrial Region
RCEA Region of Interest

Bank Material

- Bedrock
- Clay
- Clay on Bedrock
- Clay on Low Bedrock
- Gravel
- Human
- None
- Peat
- Sand
- Sand on Clay
- Unknown

Post-Hydroelectric Infrastructure

- Generating Station (Existing)
- Transmission Line (Existing)
- Transmission Line (Under Construction)
- Highway
- Rail

Bank Material Pre-Hydroelectric Development

Baldock Terrestrial Region

Map 6.3.2-21

Table 6.3.2-35: Bank Material Composition of the Pre-Hydroelectric Development Classified Shorelines in the Baldock Terrestrial Region of the Western Boreal Shield Ecozone

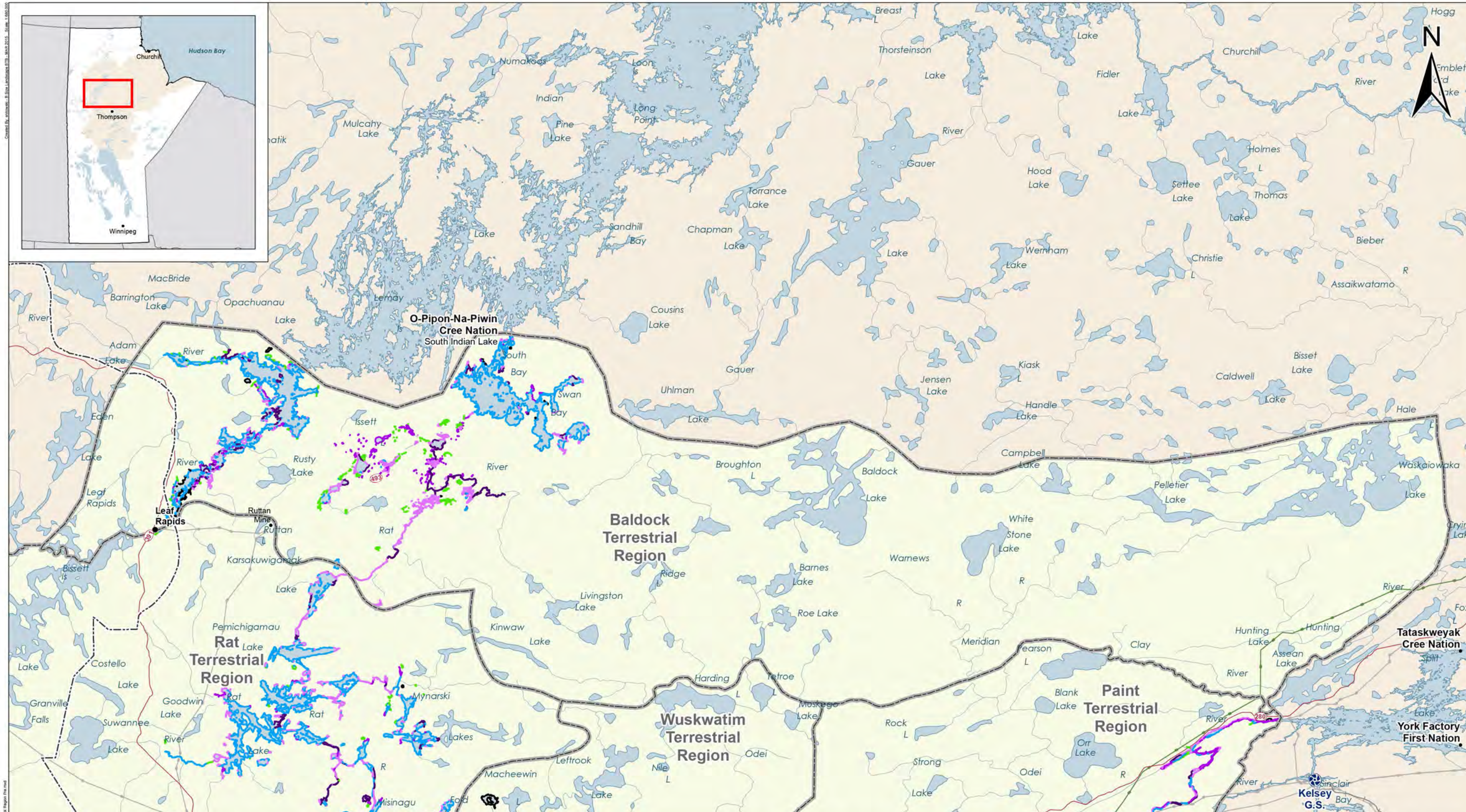
Bank Material	Length (km)	Percentage of Mapped Shoreline
Bedrock	51	4
Clay on low bedrock	484	37
Mixture of clay on low bedrock and clay	3	0
Clay on bedrock	16	1
Clay	251	19
Mixture of clay and clay on low bedrock	11	1
Mixture of clay and peat	11	1
Sand	20	2
Sand on clay	2	0
Granular	6	0
Peat	435	34
Human infrastructure	2	0
Total	**1,291**	**100**
Total unmapped shoreline	10	

Notes: Values of "0" indicate a number that rounds to zero.
Subtotals may not appear to reflect sum due to rounding.

Table 6.3.2-36: Shore Zone Wetland Composition of the Pre-Hydroelectric Development Classified Shorelines in the Baldock Terrestrial Region of the Western Boreal Shield Ecozone

Shore Zone Wetland Type	Length (km)	Percentage of Mapped Shoreline
Occasional marsh	153	12
Narrow marsh	50	4
Moderately wide marsh	103	8
Wide marsh	57	4
Riparian peatland	108	9
Mixture of occasional marsh and riparian peatland	1	0
Mixture of narrow marsh and riparian peatland	72	6
Mixture of moderately wide marsh and riparian peatland	89	7
Mixture of wide marsh and riparian peatland	44	3
Mixture of riparian peatland and narrow marsh	3	0
Mixture of riparian peatland and moderately wide marsh	4	0
Mixture of riparian peatland and wide marsh	1	0
Shallow open water	581	46
Human infrastructure	1	0
Total	**1,268**	**100**
Total unmapped shoreline	33	

Notes: Values of "0" indicate a number that rounds to zero.
Subtotals may not appear to reflect sum due to rounding.



Legend	
Terrestrial Region	RCEA Region of Interest

Shore Wetland Class

- Peatland
- Riparian Peatland
- Disintegrating Peatland
- Moderately Wide to Wide Marsh
- Marsh
- Scattered Marsh
- Shallow Water
- Human Feature
- Unknown

Post-Hydroelectric Infrastructure

- Generating Station (Existing)
- Transmission Line (Existing)
- Transmission Line (Under Construction)
- Highway
- Rail

Manitoba Hydro

Regional Cumulative Effects Assessment

DATA SOURCE:
Manitoba Hydro; Government of Manitoba; Government of Canada; ECOSTEM Ltd.

CREATED BY:
ECOSTEM Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
NAD 1983 UTM Zone 14N	14-OCT-15	18-NOV-15
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Shore Zone Wetland Type Pre-Hydroelectric Development

Baldock Terrestrial Region

Map 6.3.2-22

Offshore emergent or floating-leaved vegetation occurred along 28% of the mapped shoreline, consisting of marsh in various width and density classes and pondweed (Table 6.3.2-37; offshore wetlands mapped for nearly 100% of the shoreline). Offshore pondweed was present along approximately 11% of the shoreline, and was most extensive in Issett Lake, SIL South Bay, Opachuanau Lake and the Rat River. Offshore marsh was scattered throughout the terrestrial region but was most extensive in the Rat River. Offshore emergent and floating-leaved vegetation was most abundant in the off-system and connected lakes in the terrestrial region.

Tall shrub bands in width classes ranging from none to very wide were classified along approximately 17% of the mapped shoreline (Table 6.3B-8; tall shrubs mapped for 99% of the shoreline). Tall shrubs were scattered along the shorelines of most waterbodies, but were most extensive along the Rat River and off-system waterbodies. They most often occurred along the shorelines of off-system waterbodies and lakes.

None of the classified shoreline had mappable shoreline debris.

Table 6.3.2-37: Offshore Wetland Composition of the Pre-Hydroelectric Development Classified Shorelines in the Baldock Terrestrial Region of the Western Boreal Shield Ecozone

Offshore Wetland Type	Length (km)	Percentage of Mapped Shoreline
Occasional marsh	1	0
Narrow marsh	6	1
Moderately wide marsh	58	5
Wide marsh	52	4
Mixture of moderately wide marsh and pondweed	14	1
Mixture of wide marsh and pondweed	58	5
Mixture of wide marsh, pondweed and riparian peatland	12	1
Pondweed	137	11
Riparian peatland	2	0
Mixture of none and riparian peatland	2	0
None	898	72
Total	**1,241**	**100**
Total unmapped shoreline	60	

Notes: Values of "0" indicate a number that rounds to zero.
Subtotals may not appear to reflect sum due to rounding.

AFTER HYDROELECTRIC DEVELOPMENT

Terrestrial Habitat Composition

Infrastructure development and flooding during the hydroelectric development period directly removed approximately 22,333 ha, or 2.5%, of native terrestrial habitat in the Baldock Terrestrial Region (Intactness, Section 6.2.2.1). The indirect effects of all human infrastructure development were estimated to have altered an additional 8,830 ha, or 1.0%, of terrestrial habitat as of 2013 (see Section 6.3.1.5.1. for discussion of the potential indirect effects).

Hydroelectric development contributed 90% of the direct habitat loss and 83% of the indirect habitat effects in this terrestrial region. Flooding accounted for most (90%) of these changes as of 2013.

The terrestrial habitat types most affected by all forms of infrastructure development in this terrestrial region included needleleaf treed vegetation on mineral or thin peatland and needleleaf treed vegetation on other peatlands. Based on the land cover mapping of flooded areas, the land cover types most affected by flooding in the Baldock Terrestrial Region included needleleaf treed vegetation on other peatlands (80%), followed by tall shrub and low vegetation on riparian peatland (16%; Table 6.3.2-10). Needleleaf treed vegetation on mineral or thin peatlands and on outcrop, and mixedwood treed vegetation on other peatlands, made up an additional 4% of the flooded areas combined.

The remaining hydroelectric development footprint in this terrestrial region was a small amount of transmission lines. These features typically affected all types of ecosites because they were not preferentially located on upland terrain. Transportation development, including highways, borrow areas, cleared areas, settlements and mines, made up most of the non-hydroelectric footprint in the region (9% of total footprint area). These features preferentially affected habitat on upland mineral sites. The direct and indirect effects of transmission lines on terrestrial habitat were less than from other human footprint types since the associated impacts were generally limited to clearing taller vegetation, whereas other footprint types typically included soil excavation and a permanent infrastructure cover. Pre-development mapping of these areas was not available, but the small size of the non-flooding footprint (0.3% of pre-development land area) would not substantially affect the regional habitat composition.

Ecosystem Diversity

Flooded area mapping indicated that it was unlikely that the habitat lost to waterbody expansion up to 2013 removed any broad habitat types in the Baldock Terrestrial Region, and did not substantially change the proportion of any broad habitat types. The possible exceptions were tall shrub and low vegetation on riparian peatlands, which were disproportionately affected by flooding. These were priority habitat types (regionally rare) in the terrestrial region. Flooded area mapping suggested that up to 46% of these habitat types in the terrestrial region were lost to flooding, resulting in a high magnitude effect on these two priority habitat types. While mapping also indicated that needleleaf treed vegetation on other peatland cover was higher in the flooded areas, the amount affected compared to the overall area of this common type was not large enough to change its regional proportion. It appeared that the total number of

common, uncommon and rare habitat types within the detailed mapping area as of 2013 was the same as in 1969.

As indicated in the terrestrial habitat section, transmission lines, which contributed to the remaining habitat loss due to hydroelectric development, typically affected all types of ecosites because they were not preferentially located on upland terrain. The largest proportion of footprints, including transportation development, settlements and mines, tended to preferentially affect mineral and upland habitats (*e.g.*, borrow areas), but affected a relatively small proportion of area at the regional level. These were not likely to remove or substantially change the proportions of priority habitat types, but since pre-development mapping for these areas was not available, this conclusion is not certain.

During the hydroelectric development period, hydroelectric development contributed most of the habitat loss in the terrestrial region through waterbody expansion.

Wetland Function

Wetlands comprised approximately 97% of the habitat affected by flooding in the terrestrial region. Based on ecosite mapping, wetland forms associated with shallow peatland (blanket bog) was the wetland type most affected in terms of total area (44% of flooded wetlands), followed by peat plateau bog, riparian fen and wet deep ("all other") peatland (Table 6.3.2-11). The wetland forms associated with riparian and deep peatlands had relatively high quality ratings (Table 6.3.2-4). Adverse effects on on-system riparian peatlands are addressed in the shoreline ecosystems section below.

As indicated in the previous sections, pre-development wetland mapping was not available for the other types of footprints. However, the amount of wetlands lost in these footprints relative to the regional area was likely not enough to substantially affect wetland composition.

Shoreline Ecosystems

The major hydroelectric development works on the Churchill and Rat river system in the Baldock Terrestrial Region is the CRD. In this terrestrial region, the CRD included the South Bay Diversion Channel, which diverted water from the Churchill River system into the Rat River system via a channel excavated between the Rat River and SIL South Bay. Increased flows from the CRD also raised water levels in the Rat River system, and water levels in SIL South Bay, Opachuanau Lake and the Upper Churchill River were raised by operation of the Missi Falls CS outside of this terrestrial region.

Flooding resulting from the CRD altered waterbodies and shorelines along the Churchill and Rat river systems in this terrestrial region. Based on estimates from NTS data, the total regional surface water area increased from approximately 126,837 to 146,958 ha, and increased regulated system shoreline length to 8,660 km from 8,303 km. Total surface water area along the Churchill and Rat River systems increased in this terrestrial region by approximately 20,121 ha, or 70%, and total shoreline length by 357 km, or 27% (see Sections 6.3.1.5.5 and 6.3.1.5.6 for the limitations of these data). While higher total surface water area reduced upland area, it also created shallow water areas that could support shore zone or offshore wetland vegetation.

The CRD flooding covered many previously unconnected, off-system lakes and shifted 24% of the shoreline from smaller lakes into large lakes (Table 6.3.2-34). The percentage of shoreline in large lakes increased from none to 7%, and shoreline in back bays and riverine lakes increased from 5% to 13%, and 27% to 30%, respectively. The creation of large lakes resulted in a reduction of smaller lakes both in terms of shoreline length and proportion. The South Bay Diversion Channel resulted in the creation of new river channel, increasing the proportion of shoreline in river channels from 1% to 9%. Riverine bays were also created in this terrestrial region, increasing that shoreline from none to 6%. Island shoreline increased from 12% to 26%.

For the RCEA, one or more shore zone attributes were mapped at a scale of approximately 1:15,000 for nearly 76% of the existing environment shoreline from high resolution digital orthorectified imagery acquired in October 2011, and high resolution satellite imagery acquired in July 2006, depending on the river reach. Water levels in this remote sensing were close to immediately prior median levels in the reaches with daily water level data. Some mixture types for each of the shore zone wetland attributes show up or become more abundant in the existing environment mapping since the mapping became coarser during the process (Section 6.3.1.5.5).

Reaches with both pre-hydroelectric development and existing environment shore zone mapping for at least one attribute comprised 76% of shoreline length. All of the following results that compare existing environment with pre-hydroelectric development values are based on the areas that have both pre-hydroelectric development and existing environment mapping, the spatial extent for which varies with attribute (*e.g.*, bank material available for 75% of shoreline, shoreline debris for 37%).

In reaches with both pre-hydroelectric development and existing environment shore zone mapping, total surface water area increased by approximately 19,409 ha, or 127%, while total shoreline length increased from 910 km to 2,817 km, or 38%.

The amount of pure clay bank in areas with both pre-hydroelectric development and existing environment mapping increased by about 575 km, increasing the proportion from 24% to 85% of the shoreline (Table 6.3.2-38; Map 6.3.2-23; bank material mapped for 75% of the shoreline). The entire bedrock and sand bank was removed. Clay on low bedrock banks were reduced by 88 km from 21% to 9% of the shoreline, and peat banks were also reduced from 48% to 11%. Some of the loss in peat banks was mitigated by the creation of mixtures of peat and clay bank, which formed 189 km (15%) of the mapped shoreline. Flooding raised water levels above the bedrock base along much of the shoreline that was clay on low bedrock or bedrock prior to hydroelectric development, converting them to pure clay banks.

Shoreline with high banks, mixtures of high and moderate height banks, and mixtures of moderate height and low banks were absent in the existing environment mapping (Table 6.3B-9). Low banks and were reduced from 33% to 17% of the mapped shoreline. These reductions may have been partially replaced by large increases in length and proportion of mixtures of low and moderate height banks by 431 km (1% to 35%), moderate height banks by 226 km (9% to 25%) and mixtures of moderate height and high banks by 119 km (4% to 12%). There was also a decrease in shoreline with no banks (36% to 10%), which was associated with peat bank materials. This decrease, and the increase in moderate height banks, is largely due to the flooding of the inland wetlands that the Rat River flowed through in this

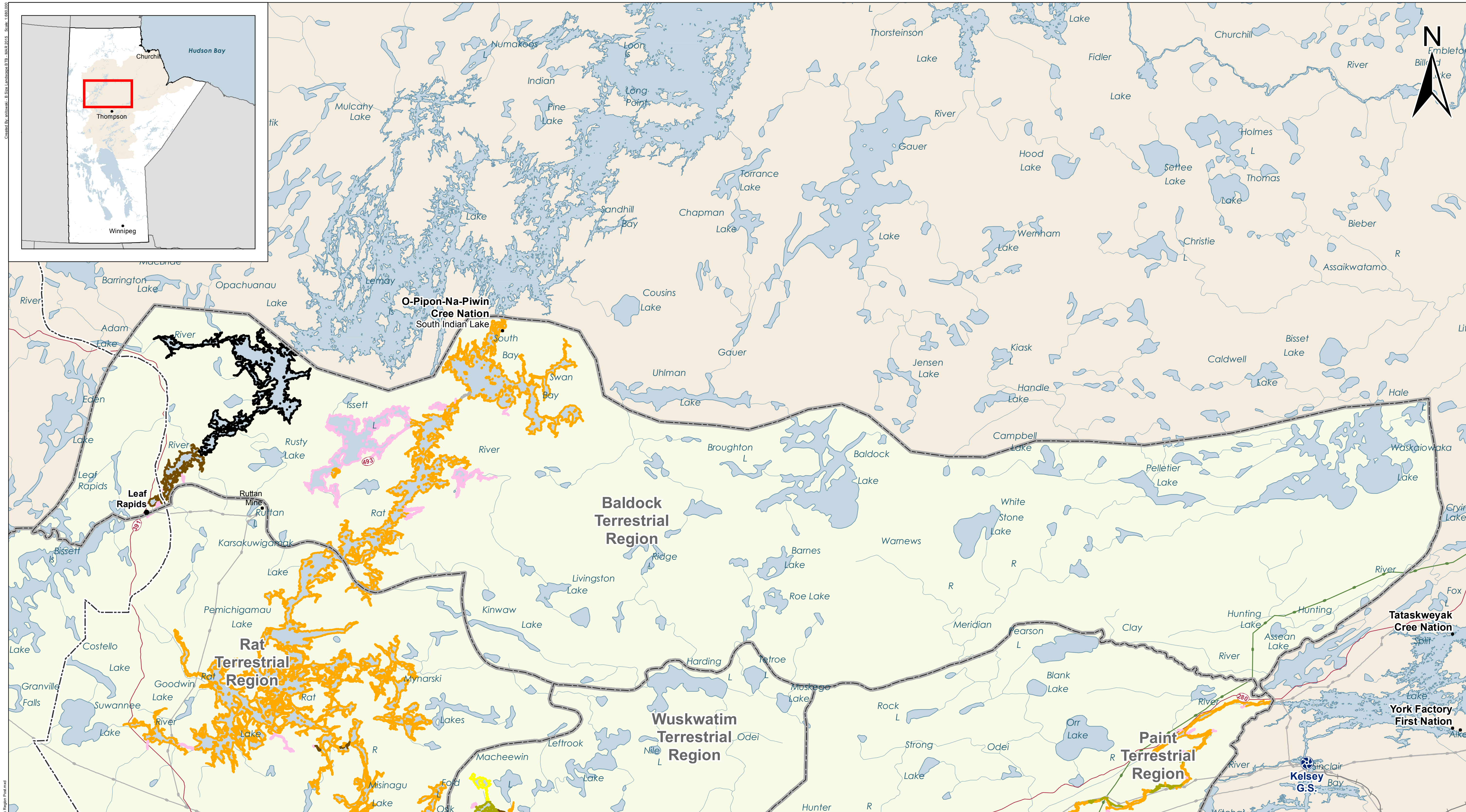
terrestrial region. Much of the new shoreline established along mineral uplands bordering the wetland areas.

Bedrock, sand and granular beaches were absent in the areas with pre-hydroelectric development and existing environment mapping, while peat beaches were reduced (Table 6.3B-10). These were replaced by clay beaches, and mixtures of clay and peat beaches in terms of km of shoreline and as a percentage of shoreline length. The latter mixture somewhat offset the reduction in peat beaches. Eroding clay banks were producing beach material in an unknown proportion of these shorelines. The new peat beaches were generally the nearshore portions of flooded peatlands.

Table 6.3.2-38: Bank Material Composition of the Pre-Hydroelectric Development and Existing Environment Classified Shorelines in the Baldock Terrestrial Region of the Western Boreal Shield Ecozone

Bank Material	Pre-Hydroelectric Development		Existing Environment	
	Length (km)	Percentage of Mapped Shoreline	Length (km)	Percentage of Mapped Shoreline
Bedrock	31	3	-	-
Clay on low bedrock	195	21	110	9
Mixture of clay on low bedrock and clay	3	0	-	-
Clay on bedrock	0	0	-	-
Clay	215	24	790	63
Mixture of clay and clay on low bedrock	11	1	-	-
Mixture of clay and peat	11	1	23	2
Sand	6	1	-	-
Sand on clay	2	0	-	-
Peat	435	48	136	11
Mixture of peat and clay	-	-	189	15
Human infrastructure	1	0	5	0
Total	**910**	**100**	**1,252**	**100**

Notes: Values of "0" indicate a number that rounds to zero.
Values of "-" indicate an absence.
Subtotals may not appear to reflect sum due to rounding.



DATA SOURCE:	Manitoba Hydro; Government of Manitoba; Government of Canada; ECOSTEM Ltd.
CREATED BY:	ECOSTEM Ltd.
COORDINATE SYSTEM:	NAD 1983 UTM Zone 14N
DATE CREATED:	14-OCT-15
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VERSION NO:	1.0
QA/QC:	

0 7.5 15 Kilometres
0 6.5 13 Miles

Manitoba Hydro

Regional Cumulative Effects Assessment

Legend

Terrestrial Region

RCEA Region of Interest

Bank Material

- Bedrock
- Clay
- Clay on Bedrock
- Clay on Low Bedrock
- Human
- Peat
- Unknown

Infrastructure

- Generating Station (Existing)
- Transmission Line (Existing)
- Transmission Line (Under Construction)
- Highway
- Rail

Bank Material Post-Hydroelectric Development

Baldock Terrestrial Region

Map 6.3.2-23

Created By: snitowski - B Size Landscape BTB - MAR 2015 Scale: 1:680,000

File Location: Z:\Workspaces\RCEA\Habitat Regulated System\Bank Material Baldock Region Post.mxd

Along shoreline where beach width could be interpreted, moderately wide to very wide beaches were absent along the mapped shoreline, replaced by narrow beaches (Table 6.3B-12). Shoreline with no beach was also reduced in length and proportion, due to the flooding of riparian wetlands and re-establishment of new shoreline along upland terrain.

While vegetation colonized some of the initially flooded land areas, many years were generally required for marsh and beach vegetation to develop on flooded land, disintegrating peatlands, eroding mineral banks and evolving beach substrates. Typical shore zone vegetation, or even vegetated beaches, were not apparent along much of the Churchill and Rat River system shoreline in 2013.

Shore zone wetlands changed considerably. Marsh in the various density and width classes greatly reduced, from about 260 km to about 4 km of shoreline, or from about 34% to about 0.3% of shoreline length (Table 6.3.2-39; Map 6.3.2-24). Riparian peatlands and mixtures of riparian peatlands and marsh were virtually removed from the shoreline with both pre-hydroelectric development and existing environment mapping.

These reductions were replaced by relatively large increases in shallow open water and peatlands. The amount of shoreline with shallow open water increased to 927 km, which comprised 74% of shoreline length. Peatland increased from none in the pre-hydroelectric development mapping to occurring along 294 km, or 24%, of the existing environment shoreline. The remaining shoreline was made up of mixtures of riparian peatland and shallow open water, and mixtures of shallow open water with disintegrating peatland (2% combined).

In offshore areas, marsh and pondweed were virtually absent in the existing environment mapping, with approximately 4 km of narrow offshore marsh remaining. Offshore riparian peatland was also absent. Disintegrating peatland and no mappable type increased considerably (about 325 and 388 km, respectively; Table 6.3.2-40). Most of the mapped offshore wetland was disintegrating peatland (325 km), a type which was absent before hydroelectric development.

Tall shrub bands in the shore zone declined from 191 km to 11 km along the portions of shoreline with both pre-hydroelectric development and existing environment mapping (Table 6.3B-13).

Shoreline debris went from being absent along the mapped shoreline to occurring along 73% of the shoreline where debris was mapped (Table 6.3.2-41; 72% of the existing environment shoreline was mapped for shoreline debris). Debris accumulations occurred in various concentrations from low density with moderate coverage to high density and continuous along the shore segment. Low density accumulations with moderate coverage along the shore were the most common (351 km or 30% of mapped shoreline). Moderate accumulations and mixtures of moderate and heavy accumulations with moderate cover occurred along about 32% of the existing environment shoreline combined.

Shoreline debris occurred throughout the mapped shoreline in the terrestrial region. Heavier accumulations occurred in Issett Lake and SIL South Bay (Map 6.3.2-25).

Table 6.3.2-39: Shore Zone Wetland Composition of the Pre-Hydroelectric Development and Existing Environment Classified Shorelines in the Baldock Terrestrial Region of the Western Boreal Shield Ecozone

Shore Zone Wetland Type	Pre-Hydroelectric Development		Existing Environment	
	Length (km)	Percentage of Mapped Shoreline	Length (km)	Percentage of Mapped Shoreline
Occasional marsh	111	12	-	-
Narrow marsh	29	3	4	0
Moderately wide marsh	78	9	-	-
Wide marsh	43	5	-	-
Riparian peatland	96	11	-	-
Mixture of riparian peatland and shallow open water	-	-	16	1
Mixture of occasional marsh and riparian peatland	1	0	-	-
Mixture of narrow marsh and riparian peatland	72	8	-	-
Mixture of moderately wide marsh and riparian peatland	89	10	-	-
Mixture of wide marsh and riparian peatland	44	5	-	-
Peatland	-	-	294	23
Mixture of peatland and sunken marsh	-	-	5	0
Mixture of shallow open water and disintegrating peatland	-	-	6	1
Shallow open water	323	36	927	74
Human infrastructure	1	0	-	-
Total	**887**	**100**	**1,252**	**100**

Notes: Values of “0” indicate a number that rounds to zero.
Values of “-” indicate an absence.
Subtotals may not appear to reflect sum due to rounding.