



Keeyask Generation Project
Terrestrial Effects Monitoring Plan

Habitat Loss and Disturbance Monitoring Report

TEMP-2021-01



KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2021-01

HABITAT LOSS AND DISTURBANCE MONITORING

A Report Prepared for
Manitoba Hydro

By
ECOSTEM Ltd.

June 2021

This report should be cited as follows:

ECOSTEM Ltd. 2021. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2021-01: Habitat Loss and Disturbance Monitoring. A report prepared for Manitoba Hydro by ECOSTEM Ltd., June 2021.

SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station are affecting the environment, and whether or not more needs to be done to reduce harmful effects.

This report describes the results of terrestrial habitat loss and disturbance monitoring conducted during the seventh summer of Project construction.

Why is the study being done?

Habitat is the place where a plant, animal or its population lives. Terrestrial habitat includes all land habitat for all species. The habitat for a particular species is named for that species (e.g., moose habitat, rusty blackbird nesting habitat or black spruce habitat). Each habitat type represents a different kind of ecosystem.

The partner First Nations have said that all terrestrial habitats are important. Plants and animals need habitat to exist and having more good quality habitat helps them to be more widespread and abundant. Changes to terrestrial habitat can affect many species and ecosystems.

Because changes to terrestrial habitat can have such wide-ranging effects across the environment, terrestrial habitat monitoring provides the single best way to see important changes, and to discover any unexpected effects on that environment.



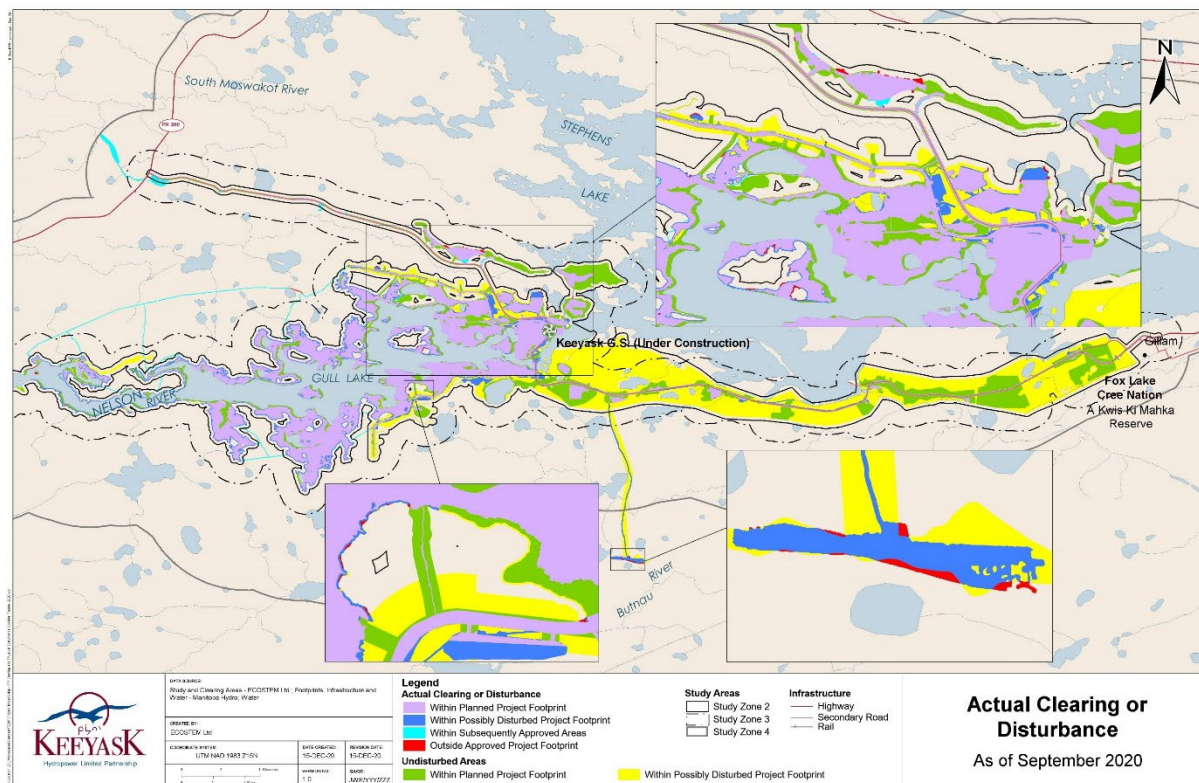
Black spruce habitat found throughout the Keeyask region

What was done?

In 2020, Project clearing and physical disturbance were mapped from high-resolution satellite imagery that was captured from August 3 to September 10, 2020, and from helicopter and ground surveys that took place on September 9, 10, 12 and 13.

What was found?

Monitoring showed that Project clearing or physical disturbance totaled 5,723 ha as of September 2020 (see map below), which was 39.5 ha more than in 2019. Disturbance accounted for the vast majority (98.6%) of this increase. Almost all of this disturbance was in the portions of Borrow Area G-5 that had been previously created for the Keeyask Infrastructure Project.



About 97% of the 5,723 ha of Project clearing or disturbance was in areas that had been classified as terrestrial habitat in the environmental assessment. The remaining area was aquatic habitat that had been dewatered to build Project infrastructure.

As expected, the majority (about 93%) of the Project clearing and disturbance was in the planned portions of the Project footprint, which are the areas that include the permanent infrastructure and reservoir.

To date, there has been no Project clearing or disturbance in about 94% of the area in the “possibly disturbed” portion of the licensed footprint. Most of this undisturbed area is expected to remain this way at the end of construction.

Between September of 2019 and 2020, there was 0.2 ha of new clearing or disturbance outside of the approved Project footprint. This area was equal to only 0.12% of the 7,123 ha of the licensed Project footprint that had not yet been impacted.

What does it mean?

To date, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. As predicted in the environmental assessment, the total amount of clearing and physical disturbance as of September 2020 is much less than included in the overall licensed area.

The unintended clearing outside the areas approved for Project use was not a concern from the terrestrial habitat, ecosystem or plant perspectives. The Priority Habitats, Wetland Function and Priority Plant studies did not identify any major concerns with the specific areas affected. Also, the very small amount of additional clearing was equal to only 0.12% of the currently undisturbed portion of the licensed Project footprint, and it is expected that the Project will not impact most of this remaining undisturbed area.

What will be done next?

Monitoring to document the amount and locations of terrestrial habitat affected by the Project during construction, and to evaluate the effectiveness of mitigation measures, will continue in 2021. Additionally, terrestrial areas that are now permanently flooded by reservoir impoundment will be mapped.

ACKNOWLEDGEMENTS

ECOSTEM Ltd. would like to thank Rachel Boone, Sherrie Mason and the on-site Manitoba Hydro staff, including Kim Bryson, Rachelle Budge and Nathan Ricard. Their support and assistance in planning field activities and providing access to the sites. Rachel Boone and Sherrie Mason are also gratefully acknowledged for coordinating the terrestrial monitoring studies.

Chiefs and Councils of Tataskweyak Cree Nation (TCN), War Lake First Nation (WLFN), York Factory First Nation (YFFN) and Fox Lake Cree Nation (FLCN) are gratefully acknowledged for their support of this program.

We would also like to thank North/South Consultants Inc., in particular Ron Bretecher and Shari Fournier, for their guidance, logistical support and other resources that made these studies possible.

Prairie Helicopters is thanked for providing transportation during fieldwork and Derek Longley for coordinating the logistics.

STUDY TEAM

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GLOSSARY

Term	Definition
approved Project footprint areas	All areas that were either initially licenced or subsequently approved for use by the Government of Manitoba.
DOI	A spatial dataset produced from satellite images or digital stereo photos that have been stitched together and processed so that all pixels are positioned in an accurate ground position. Such processing is necessary because the earth's surface is round and has topography.
flooding	Flooding within the Project reservoir area
habitat disturbance	Physical disturbance in an area of intact vegetation or use of pre-existing trails or borrow areas.
habitat loss	Permanent physical removal or alteration of previously undisturbed habitat.
licensed Project footprint	Footprint licensed for Project use under the Project's <i>Environment Act</i> Licence.
planned Project footprint	A subdivision of the licensed Project footprint where clearing or disturbance was expected and is largely comprised of permanent Project features.
ponded water	Water accumulation due to altered water flows related to the Project outside of the reservoir area. Includes overland water-flow.
possibly disturbed Project footprint	A subdivision of the licensed Project footprint where clearing or disturbance could potentially occur.
Project clearing	Project areas with complete removal of trees and tall shrubs. Includes terrestrial areas that were flooded, or formerly aquatic areas that were dewatered.
Project component	Defined areas within the Project footprint that serve a specified general purpose.
Project footprint	Boundary of all areas affected by Project activities.
re-inundated	Area of previously dewatered aquatic habitat that has been flooded again.

ACRONYMS

Acronym	Name
DOI	Digital orthorectified imagery
EIS	Environmental Impact Statement
EMPA	Excavated material placement area
EnvPP	Environmental Protection Plan
GIS	Geographic Information System
GS	Generating Station
KHLP	Keeyask Hydropower Limited Partnership
KIP	Keeyask Infrastructure Project
KM	Kilometre
KTP	Keeyask Transmission Project
NAR	North Access Road
SAR	South Access Road
TEMP	Terrestrial Effects Monitoring Plan

1.0 INTRODUCTION

Construction of the Keeyask Generation Project (the Project), a 695-megawatt hydroelectric generating station (GS) and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle GS.

The *Keeyask Generation Project Response to EIS Guidelines* (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project (KHLP 2012a). Technical supporting information for the terrestrial environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement Terrestrial Supporting Volume* (TE SV; KHLP 2012b). The *Terrestrial Effects Monitoring Plan* (TEMP) was developed as part of the licensing process for the Project (KHLP 2015). Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, habitat loss and disturbance, during the construction and operation phases.

Habitat is the place where an organism or a population lives. Because all natural areas are habitat for something, “terrestrial habitat” refers to all land habitat for all species. Habitat for a particular species is identified with the species name of interest, such as moose habitat, rusty blackbird nesting habitat or jack pine habitat. Terrestrial habitat is a keystone driver for ecosystems and, for many reasons, provides the best single indicator for Project effects on terrestrial ecosystems.

As described in the Project’s TEMP, two studies are monitoring terrestrial habitat effects. During construction, the Terrestrial Habitat Loss and Disturbance study is focusing on Project-related effects on stand level habitat composition due to terrestrial habitat loss and disturbance. During operation, the Long-Term Effects on Habitat study will monitor indirect Project effects on terrestrial habitat. This latter study will also monitor recovery to native habitat in Project-affected areas and in areas where trails intersect the Project footprint. The Habitat Loss and Disturbance study is the subject of this report.

The goal of the Habitat Loss and Disturbance study is to determine direct Project effects on terrestrial habitat composition during construction. The associated objectives are to:

- Quantify and locate terrestrial habitat loss and physical disturbance; and,
- Quantify and locate Project effects on terrestrial habitat composition during construction.

Some components of the Keeyask Infrastructure Project (KIP), a related project completed in June 2014, are being used for the Project. ECOSTEM (2015) documented clearing and disturbance by the KIP.

Habitat loss and disturbance monitoring for the Project has been conducted in each year from 2015 to 2020. Reports by ECOSTEM (2016; 2017; 2018; 2019; 2020) provide results for the monitoring conducted in 2015, 2016, 2017, 2018 and 2019. This report presents the results of monitoring conducted during 2020.

2.0 METHODS

2.1 INTRODUCTION

Section 2.1.2 of the TEMP details methods for this study. The following summarizes the methods employed in 2020, which were the same as in 2016, 2017, 2018 and 2019 (ECOSTEM 2017; 2018; 2019; 2020).

In the terrestrial habitat, ecosystem and plant studies, clearing refers to the complete removal of trees and tall shrubs (e.g., the herbaceous and moss cover can be intact) in an area that is at least 400 m² in size. In the results, “clearing” also includes constructed infrastructure and areas where excavated material was piled on uncleared vegetation since the vegetation was no longer visible. Many of the cleared areas also included excavation of topsoil and overburden (e.g., in a borrow area). Clearing also includes terrestrial areas that were flooded, or formerly aquatic areas that were dewatered.

Disturbance refers to either physical disturbance in an area of intact vegetation (e.g., machinery trail, test pits, project-related erosion or sediment deposition, flooding or ponding related to altered water flows), use of pre-existing trails or borrow areas, or an isolated area of clearing smaller than 400 m².

2.2 PROJECT AREAS

In this study, four distinct Project areas are used when reporting on where Project clearing or disturbance occurred. This is being done to facilitate future comparisons with EIS predictions.

The first two Project areas are a subdivision of the footprint licensed for Project use under the Project's *Environment Act* Licence (i.e., licensed Project footprint) into: the planned Project footprint; and, the possibly disturbed Project footprint (Map 2-1). The planned Project footprint is largely comprised of permanent Project components. There is little to no opportunity to reduce Project impacts in these areas.

The possibly disturbed Project footprint provided for some of the unknown components of the Project design at the time the Project was being licensed (e.g., the actual volume of suitable material available in each borrow area, or the actual area needed for each of the Excavated Material Placement Areas (EMPAs)). There is some flexibility in locating clearing, disturbance or material placement within the possibly disturbed Project footprint. The Project's environmental protection plans (EnvPPs) include provisions to minimize clearing and disturbance and to avoid environmentally sensitive sites, to the extent feasible, within the possibly disturbed Project footprint. Another study, Priority Habitats, monitors Project effects on environmentally sensitive terrestrial sites (see ECOSTEM 2021a).

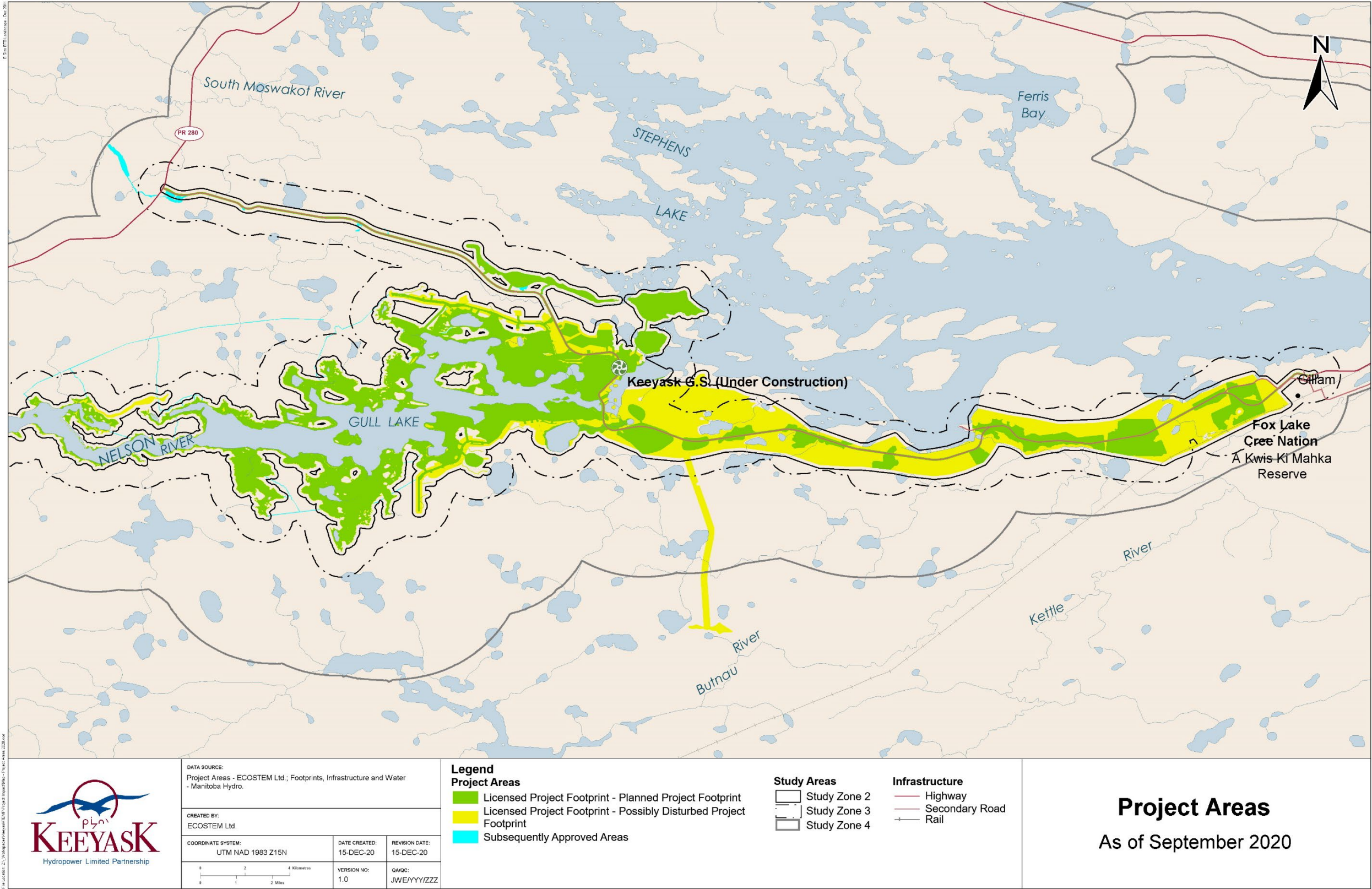
After the Project was licensed, several additional areas (called “subsequently approved Project areas” in this report) were approved for Project use by the Government of Manitoba (initially Conservation and Water Stewardship, then Sustainable Development, now Conservation and Climate). This is the third type of Project area. This category also includes Project areas that were originally licensed as part of the KIP project. These areas primarily include the former KIP start-up camp (which was originally planned as only a temporary camp for the KIP), Borrow Area G-5 and trails that were used to access reservoir clearing areas.

The subsequently approved trails were evaluated for potential effects by the Project’s terrestrial specialists prior to their submission to the Government of Manitoba, and their locations were modified to alleviate any ecological concerns that were identified at that time. Given the modifications recommended by terrestrial specialists, the subsequently approved areas were not a concern from the terrestrial ecosystem health perspective.

An important consideration for the evaluation of areas that were subsequently submitted for approval was how these potential additions would alter predicted cumulative effects. This evaluation primarily focused on the characteristics of the potentially affected areas and the amount of the licensed Project footprint that was expected to remain undisturbed at the end of construction. For the latter factor, it was expected that a large proportion of the licensed Project footprint would remain undisturbed because the EIS intentionally erred on the side of overestimating the amount of habitat loss and disturbance. As of September 2020, about half (56%) of the licensed Project footprint had not been impacted by the Project.

This report refers to the licensed Project footprint and the subsequently approved areas as the “approved Project footprint”.

The fourth, and final, type of Project area used in this report includes all cleared or disturbed areas that are outside of the approved Project footprint.



Map 2-1: Project areas as of September 2020

2.3 OVERALL APPROACH

For this study, terrestrial habitat loss and disturbance are being monitored as mapped Project clearing or disturbance in terrestrial areas. Areas of Project clearing or disturbance are mapped using a combination of remote sensing and ground surveys (remote sensing refers to data obtained from above the ground such as satellite imagery, digital stereo photos acquired from an airplane or photos taken from a helicopter). Remote sensing identifies the spatial extent and nature of clearing or disturbance. Ground surveys collect more detailed data at sites identified as having impacts of special concern (e.g. erosion of a magnitude to merit installation of containment measures). Areas of Project clearing and disturbance are mapped annually as of September in each year. Mapping in 2020 did not include changing the disturbance type for the newly formed reservoir from clearing to flooding (see Section 2.5.1). The newly formed reservoir shoreline position will be mapped in 2021 as part of the operation-phase footprint.

Project clearing and disturbance reporting includes breakdowns by Project footprint component and study zone.

2.4 DATA COLLECTION

In September of each year, all areas cleared or disturbed for the Project were surveyed while flying in a Bell 206 helicopter around the perimeter of all areas cleared or disturbed by the Project. Clearing, physical disturbance and other relevant conditions were documented with geo-referenced aerial photographs, marked-up maps and notes. Additionally, impacts of concern that had been identified in previous years, and new impacts of concern identified during the current year's aerial surveys were surveyed by foot.

Table 2-1 provides the dates when the aerial and ground surveys were conducted in each year. Ground survey dates do not include the days in which sites were surveyed while conducting ground surveys for other TEMP studies.

Table 2-1: Dates of aerial and ground surveys, by year

Year	Aerial Survey Dates	Ground Survey Dates ¹
2016	August 20 and 21; September 7	September 4 and 6
2017	July 5; September 19	September 17, 18 and 19
2018	July 5; September 15	September 11, 12, 13, 15, 16 and 17
2019	September 9 and 10	September 7 and 8
2020	September 10 and 13	September 9, 10 and 12

Notes: ¹ Not including days for sites surveyed while conducting monitoring for other TEMP studies.

2.5 MAPPING

2.5.1 APPROACH

Project clearing and disturbance were mapped regardless of whether they occurred in terrestrial or in aquatic habitat.

Aquatic areas dewatered during construction were included under the “Project clearing” umbrella. Dewatered area mapping was completed for two reasons: some of these former aquatic areas will permanently become infrastructure or terrestrial habitat; and, the remaining mapped areas provide complete documentation of the overall Project footprint during construction. The only dewatered areas that have not been mapped are the areas downstream of the spillway because they were not expected to be permanent. The extent of permanently dewatered areas will be mapped once the temporary footprint components are decommissioned, and all the generating units are commissioned (approximately 2022).

While aquatic areas in the altered water zone that were not dewatered are technically part of the licensed Project footprint, this report does not include them in the overall Project footprint if they never became temporary terrestrial habitat.

By September 2020, some of the temporary Project infrastructure that had been constructed in dewatered or aquatic areas (e.g., causeways, cofferdams) had either been removed or were in the process of being removed. These components were reclassified from dewatered to “re-inundated” in the 2020 Project footprint mapping. Similarly, dewatered areas that remained as exposed river bottom during construction (e.g., the tailrace, portions of the Generating Station area) were reclassified as re-inundated after cofferdams were removed. The re-inundated areas did not add to or subtract from the total amount of clearing within the Project footprint as they were simply a change in “clearing” type.

As construction progressed, some Project footprint polygons experienced a change in boundaries or type of use. By September 2020, small portions of what had previously been reservoir clearing became either the Generating Station, South Dyke or borrow area component type. These transitions explain small differences in the areas of some Project component types when this report is compared with the previous annual report.

The extent of reservoir flooding was not mapped for this report because the water inundation process was still ongoing at the time that portions of the base imagery used for mapping were acquired (see Section 2.5.2). Mapping the reservoir flooding would not change the total area impacted by the Project for this report, however, because flooding occurred within areas that were already mapped as reservoir clearing. Reservoir flooding and the reservoir shoreline will be mapped for next year’s annual report.

One focus of the reporting is on the amount of clearing or disturbance within the possibly disturbed Project footprint since the EnvPPs include provisions to minimize impacts in this Project area. To

identify whether the clearing or disturbance fell within or outside of the possibly disturbed Project footprint, GIS polygons for the planned and possibly disturbed Project footprint were used to subdivide the actual clearing or disturbance into the relevant Project footprint area. Any resulting long slivers along linear features that were less than 1 m wide were deleted on the basis that they fell within the spatial accuracy of the DOIs used to digitize clearing.

Observed clearing that was associated with other projects only was not considered in this report. This includes areas cleared for the KIP (which was completed under a separate license) provided they had no additional Project-related clearing or disturbance. The KIP was developed under a separate license, and the actual project effects on terrestrial habitat had already been assessed in the final KIP monitoring report (ECOSTEM 2015). Similarly, clearing solely for the Keeyask Transmission Project (KTP) that was adjacent to the approved Project footprint was not included in the data as this is a separate and independently licensed project. The cumulative effects of these and other projects in combination with the Project will be evaluated as a component of the Long-Term Effects on Habitat study.

As of September 2020, portions of Borrow Area G-5, which had been a KIP footprint component, were now being used by the Project for re-surfacing the North Access Road starting in July, 2020. As the specific areas within G-5 being used by the Project could not be determined from the available data, all of the excavated areas within it were included in the Project footprint as physical disturbance. New clearing beyond what had been completed for KIP was also observed, and this was included as Project clearing. All of these areas are included in the KIP Environment Act License and are categorized as subsequently approved for this report.

Most of Borrow Areas KM-4 and KM-9, which were developed for KIP, are not discussed in this report since aerial surveys and information provided by Manitoba Hydro indicated they had not been incrementally cleared or used by the Project as of September, 2020 (i.e., observed clearing or disturbance was from previous projects or activities such as the KIP).

2.5.2 METHODS

Areas of Project clearing or disturbance were mapped from high resolution digital orthorectified imagery (DOI) and the field data (Section 2.4). Table 2-2 provides the specifications of the Worldview 2 satellite imagery used to create the DOIs for each year of monitoring.

Table 2-2: Specifications of Worldview 2 imagery used to create DOIs, by year

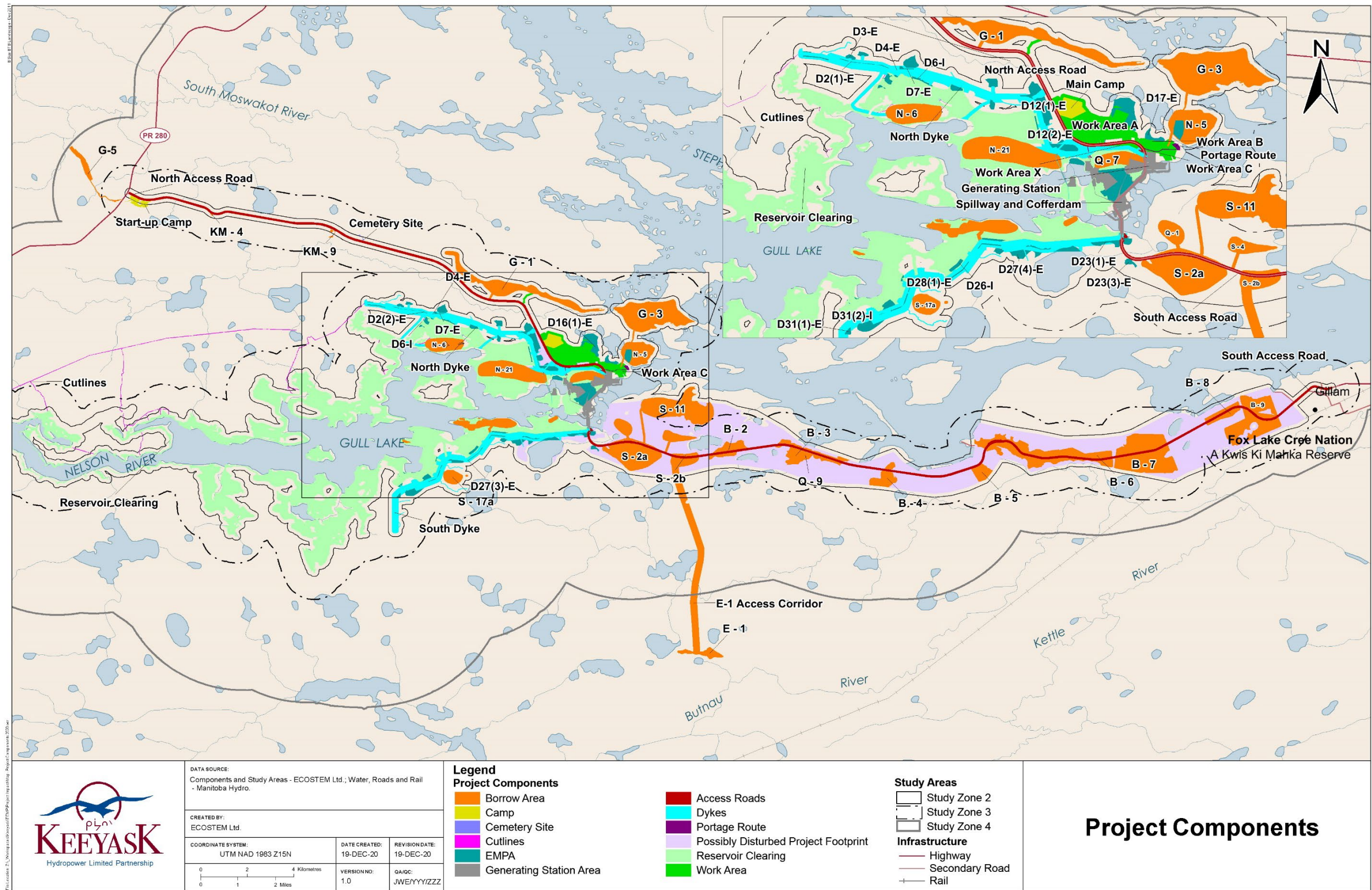
Year	Acquisition Date	Resolution	Approved Project Footprint Coverage
2016	September 21	50 cm	Most ¹
2017	July 11	50 cm	All
2018	July 9	30 cm	Most ¹
2019	October 2	30 cm	All
2020	August 3 and 27, September 10	30 cm	Most ¹

Notes: ¹ Aerial survey data used for areas outside of DOI coverage.

Project clearing or disturbance boundaries were digitized from DOIs while using the field data to assist in interpreting where the clearing or disturbance ended. In some years, the field data were also used to map boundaries for areas that were outside of the DOI spatial extents, or when the remote sensing for the DOI was acquired before September. Boundaries mapped from aerial survey photography were not as precise as those digitized from the DOI because they were taken from an oblique angle. These boundaries were reviewed and revised in the subsequent year using more recent satellite imagery.

For the years when the satellite imagery was acquired in July, aerial survey photos acquired in September were used to determine which areas had been cleared since July. All clearing or disturbance was digitized at a scale of 1 inch = 30 meters.

Digitized footprint polygons were classified into a Project component type (Map 2-2).



Map 2-2: Project components

3.0 RESULTS

3.1 OVERVIEW

As of September 2020, overall actual Project clearing or disturbance (i.e., the Project footprint) totaled 5,723 ha (Table 3-1; Map 3-1). This was an increase of 39.5 ha from September 2019. The vast majority (93.4%) of this increase was disturbance related to the reuse of Borrow Area G-5, which had been previously used for the KIP.

Project disturbance comprised a small percentage (1.4%) of the Project footprint up to September 2020. Disturbances included mechanical types (machinery trails, test pits), re-use of pre-existing trails, Project-related erosion and sediment deposition, and ponding related to altered water flows.

Of the 5,723 ha classified as cleared or disturbed in the Project footprint, 97.4% was in areas that had been classified as terrestrial habitat in the EIS analysis. The remainder of the 2020 Project footprint was: aquatic habitat that had been converted to terrestrial habitat by either dewatering or displacement by Project infrastructure; and, previously dewatered aquatic habitat that was re-inundated.

Disturbance accounted for the vast majority (98.6%) of the 39.5 ha increase in Project footprint area between September 2019 and 2020 (Table 3-1).

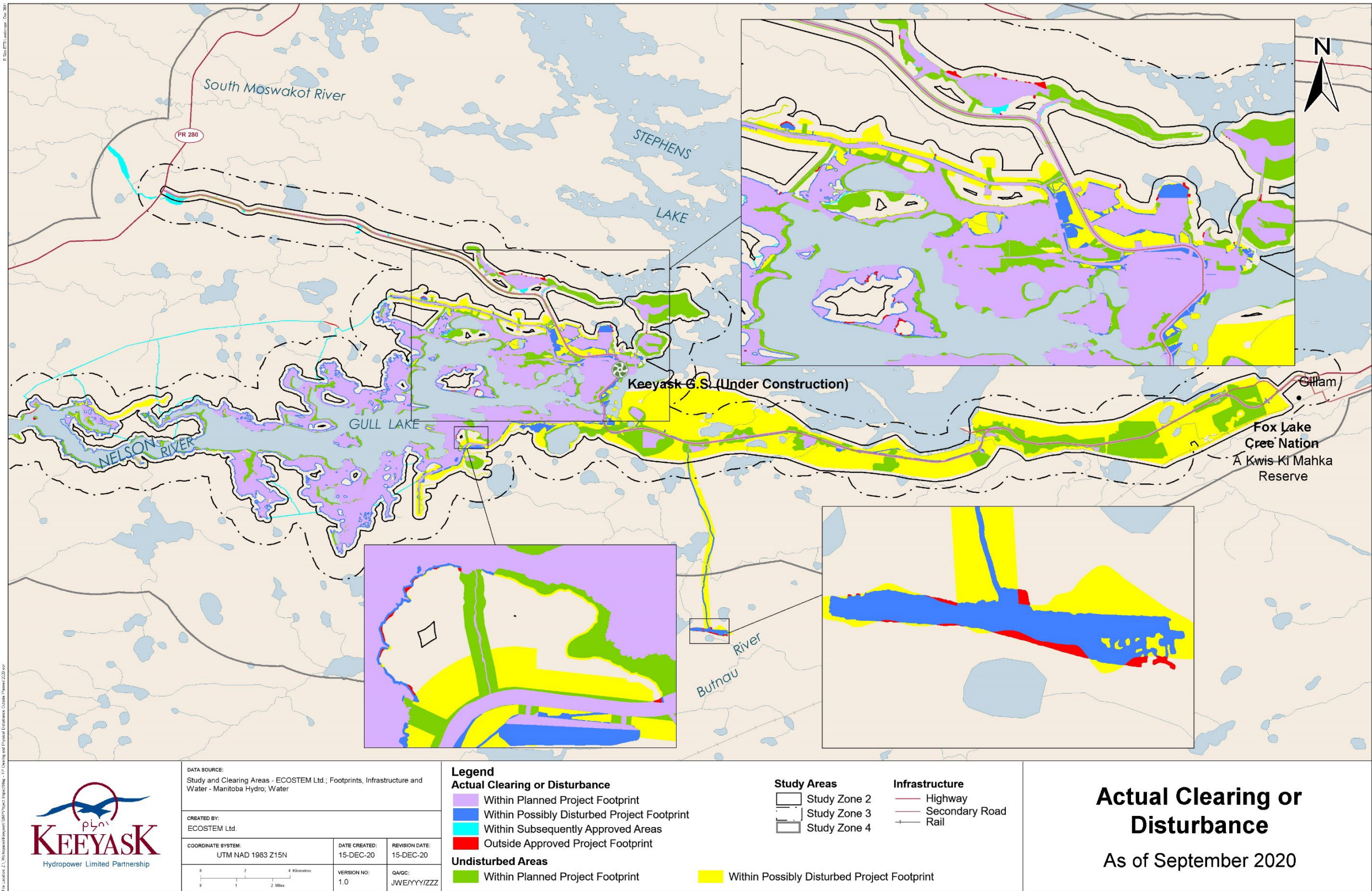
Clearing accounted for a very small percentage (1.4%) of the increase (0.1% of which was dewatering). The removal of cofferdams and causeways in the Project footprint resulted in the re-inundation of 1.9% of the Project footprint in 2020. This decommissioning did not alter the total Project footprint area as it was a transfer from dewatering.

Table 3-1: Total Project clearing and disturbance up to September 2020, by type

Impact Type	Cumulative Impacts to 2020		Impacts since September 2019	
	Area Impacted (ha)	Percentage of Total Impacted Area	Area Impacted (ha)	Percentage of Total Impacted Area
Clearing ¹				
Terrestrial habitat clearing	5,506.0	96.2	0.5	1.3
Dewatered	23.2	0.4	0.0	0.1
Re-inundated ²	111.4	1.9	-	-
Flooding or ponded water outside reservoir area	1.4	0.0	-	-
Disturbance	81.2	1.4	39.0	98.6
Total Project footprint	5,723.2	100.0	39.5	100.0

Notes: A "0" value indicates an area less than 0.05 ha; a "-" value indicates no area.

¹ "Clearing" includes EMPAs, dewatering and constructed infrastructure. ² These areas were dewatered in a previous year.



Map 3-1: Actual Project clearing or disturbance as of September 2020

3.2 CLEARING OR DISTURBANCE BY PROJECT APPROVAL AREA

As described in Section 2.2, the approved Project footprint areas included all areas that were either initially licenced or subsequently approved for use by the Government of Manitoba.

As of September 2020, only 45% of the originally licensed Project footprint area had been impacted by the Project.

Of the 5,723 ha of Project impacts (i.e., clearing or disturbance) recorded up to September 2020, 93% was within the planned Project footprint (Map 3-1). Impacts within the planned Project footprint areas increased by 2.3 ha between September 2019 and 2020 (Table 3-2).

Impacts in the possibly disturbed Project footprint (Table 3-2; Map 3-1) totaled approximately 314 ha as of September 2020. This was an increase of about 0.6 ha over 2019. The newly impacted area was distributed between EMPAs D27(4)-E, D28(1)-E and D16(1)-E, along the Ellis Esker access corridor, the GS Area and main camp (Appendix 1: Table 7-1).

As of September 2020, 100 ha of the impacts were in subsequently approved Project areas. Over half of this area (65%) was in areas previously cleared for the KIP. These subsequently approved areas included the KIP Start-up Camp near PR 280, portions of Borrow Areas KM-4, KM-9, G-1 and G-5 (which had previously been used and is licensed for the KIP), the cemetery site adjacent to the NAR, and several pre-existing access trails utilized for accessing the reservoir clearing areas north and south of the Nelson River.

Areas impacted outside of the approved Project footprint totalled 8.5 ha (Table 3-2; Map 3-1), or 0.15% of total impacted area as of September 2020. As illustrated in Map 3-1, this 8.5 ha of impacts was very small (0.12%) relative to the 7,123 ha of remaining undisturbed area within the licensed Project footprint.

The total area impacted outside of the approved Project footprint increased by 0.21 ha from 2019. This increase was due to clearing activities at Borrow Area G-5 (Section 2.5.1) and erosion effects in several other Project components.

Table 3-2: Cumulative actual Project clearing or disturbance area as of September 2020, by year and Project area

Project Area	Total Approved Area (ha)	Total Area (ha) ¹							Change (ha) from Previous Year ²					
		2014 (from KIP)	2015	2016	2017	2018	2019	2020	2015	2016	2017	2018	2019	2020
Planned Project Footprint	7,615.6	420.2	1,245.7	3,294.3	4,970.9	5,278.6	5,299.0	5,301.3	825.5	2,048.6	1,676.6	307.7	20.4	2.3
Possibly Disturbed Project Footprint	5,122.6	9.6	62.6	190.5	241.5	305.7	313.1	313.7	53.1	127.9	51.0	64.2	7.5	0.6
Subsequently Approved Project Areas ³	n/a	28.9	29.4	56.1	63.3	63.3	63.3	99.7	0.5	26.7	7.2	-	-	36.5
Outside the Approved Project Footprint	n/a	-	1.7	4.6	5.6	8.3	8.3	8.5	1.7	2.9	1.0	2.7	-	0.2
All	12,738.3	458.7	1,339.5	3,545.5	5,281.3	5,655.9	5,683.7	5,723.2	880.8	2,206.1	1,735.8	374.6	27.8	39.5

Notes:

¹ Areas for some Project areas differ slightly from those presented in the 2016 through 2019 annual reports because some infrastructure downstream of the spillway was removed.² Due to rounding, some of the change values are slightly different than obtained from subtracting the numbers in the table.³ Areas subsequently approved by the provincial government that are not part of the licensed Project footprint [DN: Value may change following confirmation of subsequently approved areas.].

3.3 CLEARING OR DISTURBANCE BY PROJECT COMPONENT

Of the 39.5 ha of additional Project impacts that occurred between September 2019 and 2020, approximately 92% was attributed to Borrow Area G-5, 4% to EMPA D35(1)-E and 1.3% to Borrow Areas N-21, G-1 and G-3 (Table 3-3; Map 3-1). The remaining new area was evenly distributed among several other footprint components.

This section details clearing and disturbance observed within each Project component. Table 7-2 (Appendix 2) summarizes mitigation recommendations provided since monitoring began, as well as the associated follow-up actions.

Table 3-3: Cumulative actual area of Project clearing¹ or disturbance as of September 2020, by year and Project component

Project Component ²	Total Cleared or Disturbed ³ (ha)							Change from Previous Year ⁴ (ha)					
	2014 (from KIP)	2015	2016	2017	2018	2019	2020	2015	2016	2017	2018	2019	2020
North access road	191.6	192.4	192.6	192.6	192.6	192.6	192.6	0.8	0.2	-	-	-	-
South access road	0.0	299.5	325.5	325.5	325.5	325.5	325.5	299.5	26.0	0.1	-	-	-
Camp and work areas	186.7	232.3	235.6	236.9	238.5	239.0	239.2	45.5	3.4	1.2	1.7	0.5	0.2
Borrow areas	49.3	266.3	360.3	413.4	471.6	482.8	521.6	217.0	94.1	53.1	58.2	11.3	38.8
North dyke and associated areas	18.5	133.4	183.2	197.8	199.0	199.5	199.5	114.9	49.7	14.6	1.2	0.4	-
South dyke and associated areas	0.0	24.9	121.9	182.4	190.6	202.0	202.5	24.9	97.0	60.5	8.1	11.5	0.5
Generating station and river works	10.9	181.8	205.4	212.3	232.9	236.8	236.9	170.9	23.6	6.9	20.6	3.9	0.1
Reservoir clearing and access trails	1.7	9.0	1,921.0	3,520.4	3,805.2	3,805.4	3,805.4	7.3	1,912.0	1,599.4	284.8	0.2	-
All cleared or disturbed areas	458.7	1,339.5	3,545.5	5,281.3	5,655.9	5,683.7	5,723.2	880.8	2,206.1	1,735.8	374.6	27.8	39.5

Notes: A "0" value indicates an area less than 0.5 ha; a "-" value indicates no area.

¹ "Clearing" includes EMPAs, dewatering and constructed infrastructure.

² Footprint types are coarse groupings of components. In general, a component includes any adjacent EMPAs. Dykes include associated small borrow areas.

³ Areas for some footprint types differ slightly from those presented in the 2016 through 2019 annual reports because some clearing was reclassified into other project components as construction progressed, and some infrastructure in the river works area was removed.

⁴ Due to rounding, some of the values are slightly different than what results from subtracting the numbers in the table.

3.3.1 ACCESS ROADS

The North Access Road (NAR) and South Access Road (SAR) clearing remained unchanged from September 2017 to 2020 (Table 3-3 and Table 3-4). No road construction activity was observed during 2020 surveys (although road maintenance was ongoing). All NAR clearing was within the planned Project footprint, and a small amount of SAR clearing was in the possibly disturbed Project footprint.

Table 3-4: Clearing or disturbance within the possibly disturbed Project footprint, and areas cleared or disturbed outside the approved Project footprint as of September 2020, by main Project component

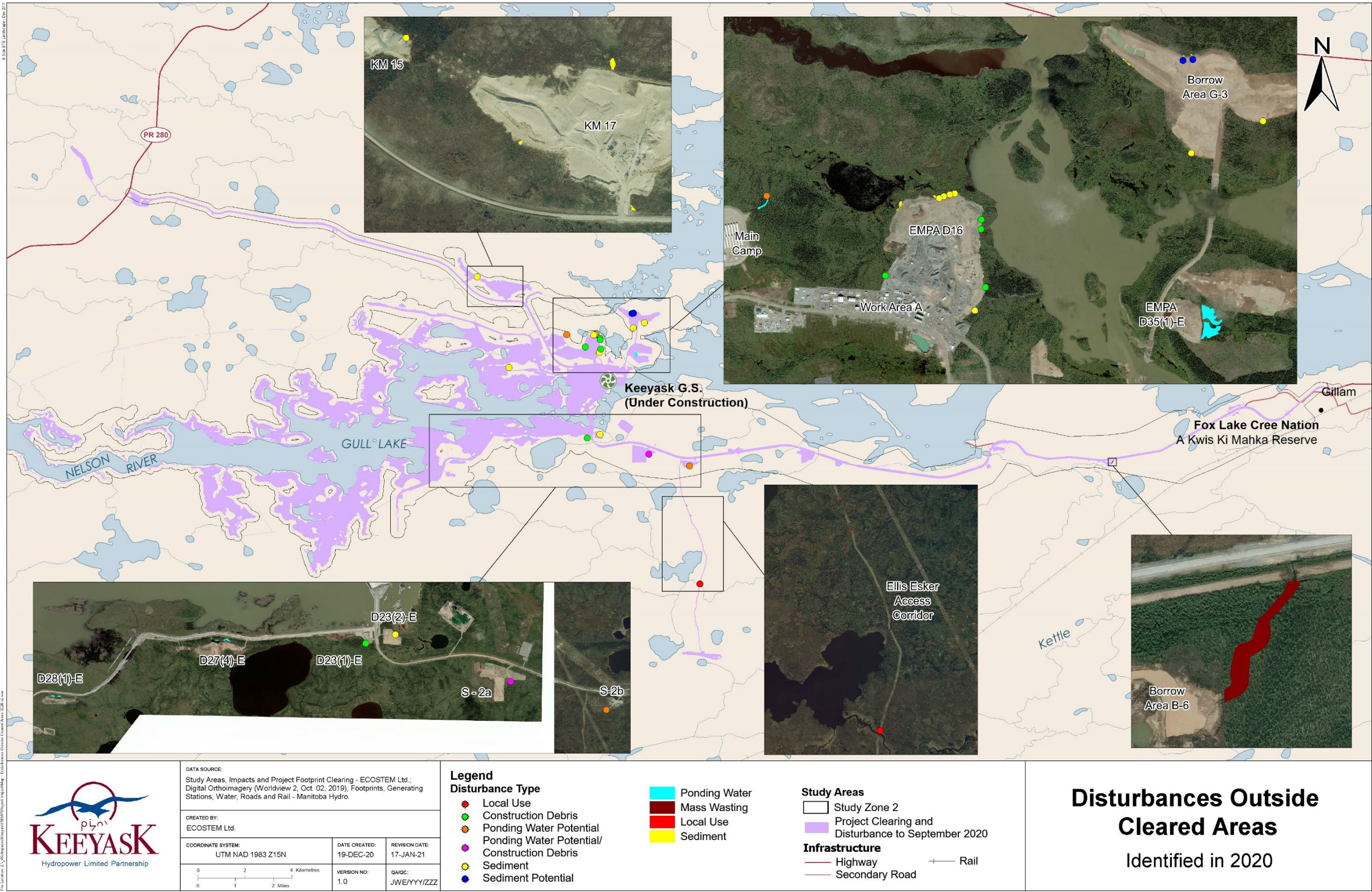
Project Component	Clearing or Disturbance (ha)					
	Within the Possibly Disturbed Project Footprint			Outside the Approved Project Footprint		
	2019	2020	Change	2019	2020	Change
Access Roads	4.45	4.45	-	-	-	-
Camp & Work Areas	3.49	3.55	0.05	0.01	0.06	0.06
Generating Station Area	12.74	12.80	0.06	-	-	-
Borrow Areas	58.00	58.03	0.03	5.39	5.54	0.16
EMPAs	66.33	66.75	0.42	0.52	0.52	-
Dykes	35.82	35.82	-	0.05	0.05	-
Reservoir Clearing & Cutlines	122.60	122.60	-	2.32	2.32	-
Total	303.43	303.99	0.56	8.29	8.50	0.21

Notes: a "-" indicates no area, a 0 indicates a very small (negligible) area.

Erosion disturbance on the south ditch bank of the NAR adjacent to Borrow Area KM-1 had created a gully since it was first identified during 2016 surveys. Erosion had expanded the gully between the ditch and the borrow area between 2016 and 2018 (Map 3-2). Field surveys in 2019 found that the area had since been remediated by filling the eroded area. Some minor erosion and sediment deposition around the eastern fringes of the remediated area was noted in 2019. The bank was subsequently covered with organic material. The 2020 monitoring recorded new but minor erosion on the ditch slope (Photo 3-1). The site will be monitored for substantive changes in 2021.



Photo 3-1: Erosion on ditch bank adjacent to Borrow Area KM-1



Map 3-2: Disturbances outside of cleared areas identified in September 2020

3.3.2 MAIN CAMP, NORTH SHORE WORK AREAS AND WELL AREA

The extent of clearing for the Main Camp, North Shore Work Areas, Well Area and Helicopter Pad did not change from September 2019 to 2020.

At the northeast corner of the Main Camp, a disturbance created by water outflow from a culvert extended approximately 160 m into the uncleared forest in 2020 (Map 3-2; Figure 3-1). This was an increase of 80 m since September 2019. The associated disturbed area expanded by 0.05 ha in the possibly disturbed Project area, and by 0.06 ha outside of the planned and possibly disturbed Project footprint area. At the time of the 2020 survey, this disturbance extended more than 75 metres past the approved Project footprint boundary.

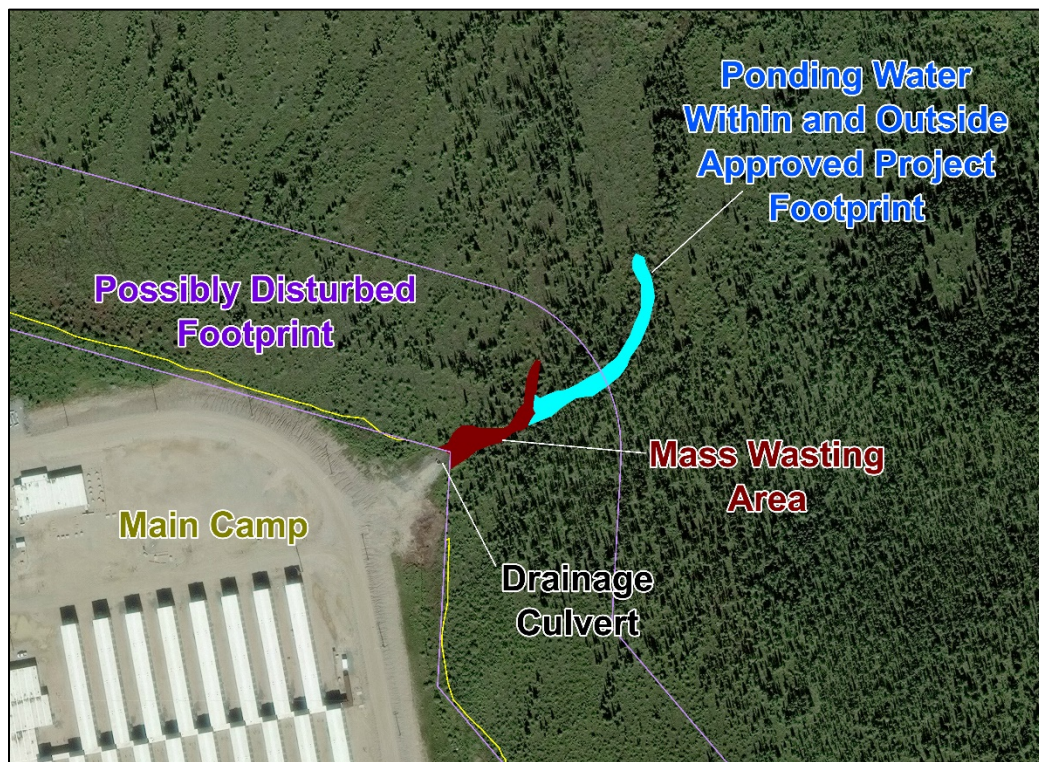


Figure 3-1: Mass wasting (in brown) and ponded water (in blue) outside Main Camp in 2020

Within this disturbed area, rapidly flowing water had created a channel through the vegetation. This water started flowing underground in spots, which created mass wasting and hollow areas within the substrate, and then toppled trees in towards the hollowed areas (Photo 3-2 and Photo 3-3). Outside of the Project footprint, this disturbance was affecting a common habitat type (black spruce dominant vegetation on thin peatland). This disturbance also has the potential to affect an off-system marsh if it reaches the low area adjacent to the marsh.



Photo 3-2: Mass wasting northeast of Main Camp



Photo 3-3: Trees toppling into hollowed out area northeast of Main Camp

In the northwestern edge of Work Area A, a site where sediment had been deposited into uncleared areas was remediated in 2018 by excavating the deposited sediment. The excavation disturbed the buried vegetation and substrate. By the time of the 2019 surveys, new vegetation was colonizing the excavated area and sediment fencing had been installed at the base of the mineral slope. These mitigation efforts appeared to have prevented further disturbance in 2019 and 2020.

A good deal of construction debris was found at the northwestern edge of Work Area A in 2020 (Map 3-2).

Other issues noted during field surveys in 2020 included erosion and sediment deposition into uncleared forest at the northern corner of the helicopter pad and ponded water at the western edge of Work Area X, between the NAR and North Dyke. This ponded water has the potential to spread into uncleared area further to the west.

Approximately 0.1 ha of previously cleared area at the eastern edge of the downstream boat launch was also flooded by September 2020.

3.3.3 START-UP CAMP

The Start-up Camp (i.e., initially developed under the KIP as a temporary camp) was a subsequently approved Project area (Section 2.2). While there has been no additional clearing in this area since the end of the KIP, vehicle traffic and other forms of activity created ongoing physical disturbance within previously cleared areas. Use of the Start-up Camp for accommodations ceased in 2019. In 2020, the parking lot was being used to store the vehicles of staff staying at the Main Camp.

3.3.4 BORROW AREAS

Between September 2019 and 2020, the locations of new borrow area clearing were limited to N-21 (0.4 ha) and G-5 (0.1 ha). Excavation continued in 2020 at borrow areas G-1 and S-2a but this did not require any new clearing.

There was no borrow area clearing within the possibly disturbed Project footprint between September 2019 and 2020 (Table 3-4).

New or expanding disturbance totaling 39 ha was observed at several borrow areas during the 2020 surveys. The following paragraphs detail the occurrences.

3.3.4.1 BORROW AREA G-1

Extensive erosion and sediment deposition into uncleared forest totaling 0.1 ha along the northern edge of Borrow Area G-1 at KM 17 was observed in 2020 (Photo 3-4; Map 3-1). An additional 0.06 ha of sediment deposition was found on the southeastern edge and at the access road

entrance of KM 17 (Photo 3-5). Of the total new disturbance in KM 17, 78% was outside of the approved Project footprint (Appendix 1: Table 7-1). Erosion and sediment deposition was also observed at the eastern corner of G-1 at KM 15 (Map 3-2).



Photo 3-4: Erosion and sediment deposition at northern edge of Borrow Area G-1 at KM 17



Photo 3-5: Sediment deposition at entrance of Borrow Area G-1 at KM 17

3.3.4.2 BORROW AREA G-3

In past years at Borrow Area G-3, erosion on mineral slopes around the perimeter had been depositing sediment into the uncleared forest at several locations. Sediment fences had been installed along portions of the south side of the borrow area in spring of 2019, but September surveys found that sediment was bypassing them. Surveys in 2020 found that sediment deposition was ongoing in several spots around the perimeter despite all slopes being graded and sediment fences removed in the borrow area (Map 3-1; Map 3-2). Two locations on the northern edge where sediment deposition into uncleared vegetation were taking place had the potential to affect a much greater area due to the natural topography. Sediment deposition into an adjacent marsh on the western edge of the borrow area was also occurring as of September 2020 (Photo 3-6).



Photo 3-6: Sediment deposits in marsh adjacent to Borrow Area G-3

Rock barriers were installed on the western edge of G-3 in mid-June 2020 and appeared to have been effective at retaining sediment within its bounds during surveys in 2020. Also found was sediment deposition into uncleared forest past the eastern end of the rock barrier. A very small portion of this sediment deposition at the eastern end of the rock barrier was outside of the Approved Project footprint (Appendix 1: Table 7-1).

In the eastern half of Borrow Area G-3, erosion on excavated slopes was washing away planted seedlings and also flooding planted seedlings in the basin of the excavated area (Figure 3-2; Photo 3-7). Seedling mortality and dieback of a large number of planted seedlings in the basin were also observed during surveys in 2020.

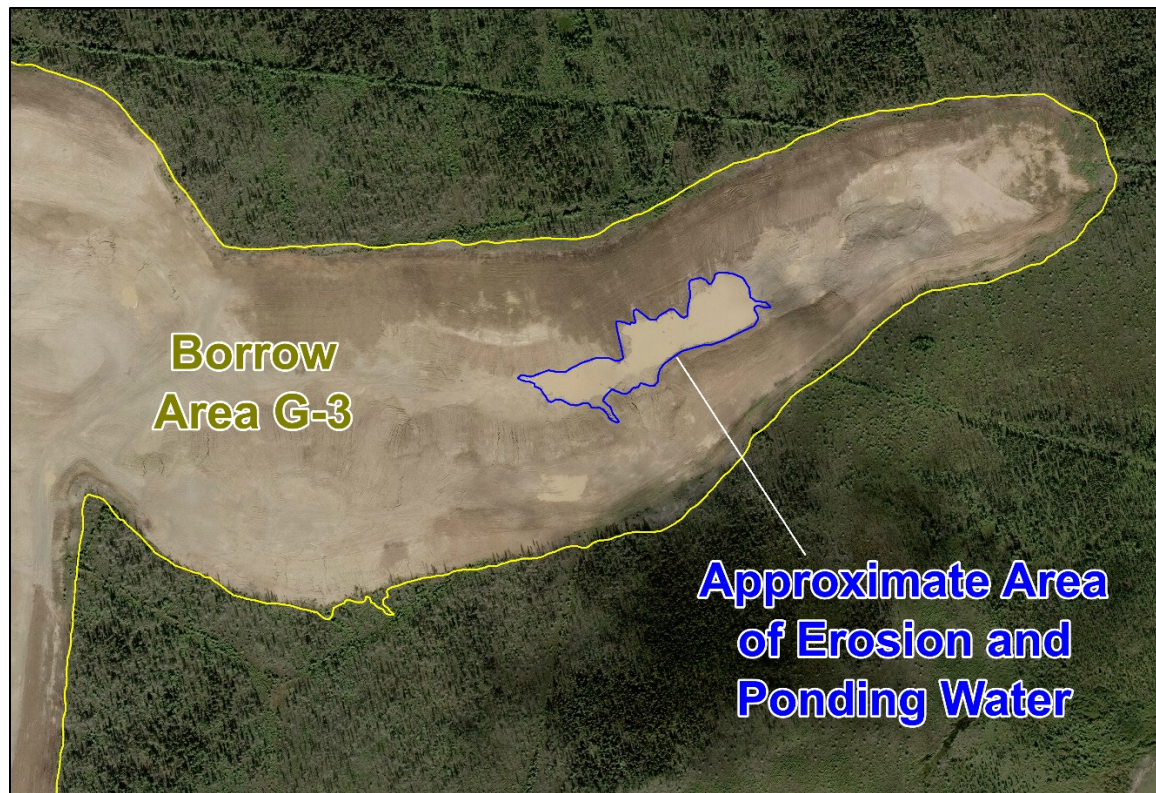


Figure 3-2: Approximate area where erosion and ponded water were affecting planted seedlings in the eastern portion of Borrow Area G-3



Photo 3-7: Erosion and ponded water affecting planted seedlings in Borrow Area G-3

3.3.4.3 BORROW AREA G-5

The bulk (93.4%) of new disturbance since 2019 was found in Borrow Area G-5 where construction equipment was actively using 36.4 ha of the area previously cleared for KIP, for re-surfacing of the NAR. There was approximately 0.1 ha of new clearing west of the entrance to the borrow area.

3.3.4.4 BORROW AREA KM-1

In Borrow Area KM-1, 2020 surveys found that erosion runnels continued to widen and deepen (Photo 3-8). The erosion was washing away vegetation and could eventually affect nearby planted tree seedlings.



Photo 3-8: Erosion in Borrow Area KM-1

3.3.4.5 BORROW AREA N-5

Surveys in Borrow Area N-5 up to September 2019 found that water from drainage hoses in various locations had eroded mineral slopes and deposited sediment into the uncleared forest. Subsequently, hoses had been moved or removed from the area. Surveys in 2020 found that all the slopes had been graded, sometimes right to the treeline. These actions have been effective at slowing or stopping any further erosion and sediment deposition into uncleared forest. This site will be monitored for additional adverse effects in 2021.

On the south side of Borrow Area N-5, a sediment bag left after a drainage hose was removed was still in place as of September 2020.

3.3.4.6 BORROW AREA N-21

The construction of a rock berm around the western half of Borrow Area N-21 in 2020 occupied 2.4 ha of previously classified reservoir clearing area (Figure 3-3). Construction of the rock berm created approximately 0.4 ha of new clearing (Figure 3-3). This berm was constructed to keep fish out of the excavated area following reservoir impoundment.

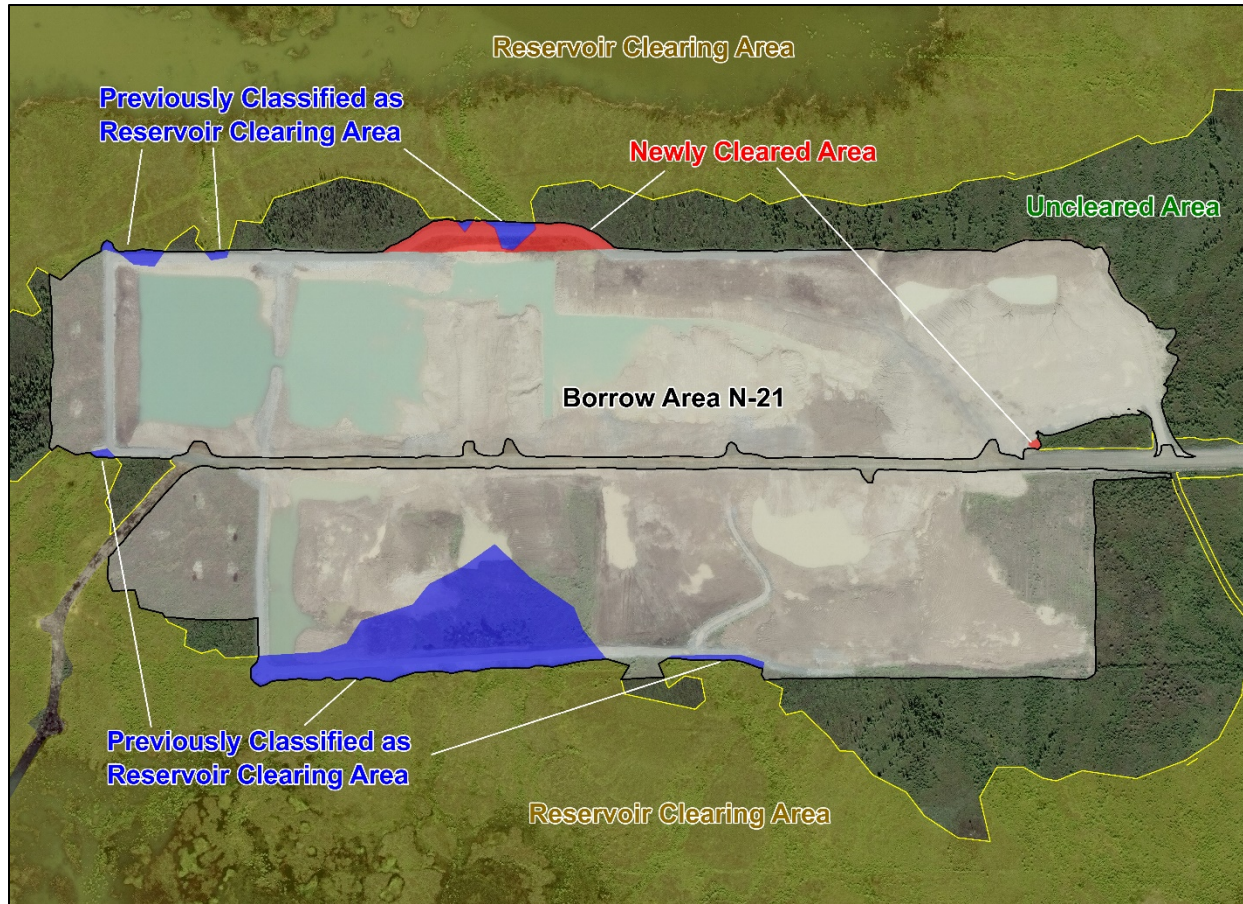


Figure 3-3: Locations of rock berms constructed within previously uncleared areas (red) and within area previously classified as reservoir clearing (blue) in Borrow Area N-21

As of September 2020, sediment was being deposited several meters into adjacent otherwise undisturbed forest on the eastern edge of this borrow area at the location where new clearing had been recorded in 2019 (Map 3-2).

3.3.4.7 BORROW AREA B-2

On the south side of the Nelson River, a portion of Borrow Area B-2 had been developed into a temporary camp area in 2018. In 2019, all but two of the trailers had been removed. At the time of the 2020 surveys, all of the trailers were removed and it appeared that the area was no longer in use.

3.3.4.8 BORROW AREA B-6

In Borrow Area B-6, mass wasting continued to create a disturbance along a natural drainage channel, affecting otherwise undisturbed habitat (Map 3-1). Significant water flow from the SAR to the east edge of the pit undermined the uncleared forest and created a deep, wide channel (Photo 3-9). The 2020 surveys found that the impacted area had not expanded substantially since 2019.

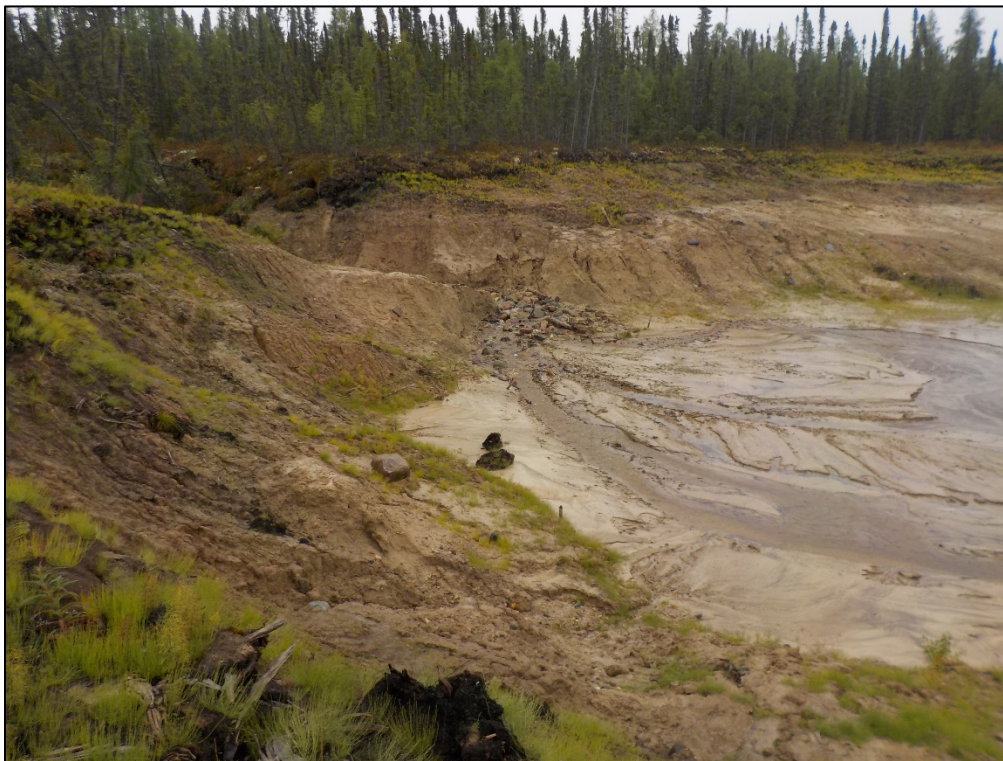


Photo 3-9: Erosion and ponded water at eastern edge of Borrow Area B-6

3.3.4.9 BORROW AREA E-1

Additional disturbance along the Ellis Esker (E-1) access corridor was observed in 2020 outside previously cleared areas (Map 3-1). These additional disturbances, which were ATV trails, totaled 0.03 ha within the possibly disturbed Project footprint (Appendix 1: Table 7-1). Other disturbances in the corridor observed in 2020 included a broken-down ATV, two boats and several plywood planks located where the corridor intersected the stream flowing from Joslin Lake (Photo 3-10; Map 3-2).



Photo 3-10: Boat and plywood planks in Borrow Area E-1 access corridor

3.3.4.10 BORROW AREAS S-2A AND S-2B

Other disturbances found during the 2020 surveys included localized water ponding in Borrow Areas S-2a and S-2b (Map 3-2). No vegetation mortality was observed in adjacent uncleared vegetation during surveys in 2020, however these locations will be monitored for adverse effects in 2021.

3.3.5 DYKES

For this report, the term dyke includes the dyke areas, the associated possibly disturbed Project footprint, and the narrow linear EMPAs that run parallel to the dykes within the planned Project footprint.

New clearing since September 2018 was not observed along the North Dyke. Similarly, no new clearing was observed on the South Dyke in 2020.

Ponded water disturbance was observed inside the South Dyke bounds. This ponding was entirely within planned Project footprint bounds at the time of the 2020 survey (Photo 3-11).

Disturbance within the possibly disturbed Project footprint was not observed along the north or south dykes during 2020 surveys. (Appendix 1: Table 7-1).



Photo 3-11: Ponding water inside South Dyke bounds

3.3.6 EXCAVATED MATERIAL PLACEMENT AREAS

No new clearing was found in EMPAs throughout the Project footprint during surveys in 2020.

3.3.6.1 EMPA D16

In previous years, several measures to mitigate erosion and sediment deposition around the edges of EMPA D16 were implemented, including:

- The northern portion of the EMPA was graded to smooth out the gullies caused by previous erosion;
- a continuous rock berm was constructed around the northern and eastern edges to curb erosion; and,
- straw wattles were placed in gullies along the western edges to reduce the movement of sediment downhill.

Surveys in 2020 found that an additional 350 m of rock berm was constructed along the northern and western edges of the EMPA and portions of the eastern edge slope were graded.

As of September 2020, sediment deposition from bank erosion was continuing around the perimeter of EMPA D16. Water and sediment were flowing through and sometimes over the rock berm into the surrounding uncleared vegetation in many locations (Photo 3-12; Map 3-1; Map 3-2). Sediment deposition had disturbed an additional 0.08 ha (93% of which was within the possibly disturbed Project footprint) of uncleared vegetation in four locations along the western, northern and eastern edges of the EMPA. This included a 0.06 ha area of sediment deposition on the western edge, bringing the disturbance closer to the adjacent marsh. This disturbance resulted from a gap left in the rock barrier, which allowed sediment to pass through into the adjacent marsh habitat (Photo 3-13).



Photo 3-12: Low spot in rock barrier with sediment flowing over top at the northern edge of EMPA D16



Photo 3-13: Gap in rock barrier in EMPA D16 that allowed sediment to pass through into adjacent marsh

The rock barrier along the eastern edge of EMPA D16 was eroding and breaking down in some spots due to heavy upslope runoff (Photo 3-14). One portion of the rock barrier on the northern edge of the EMPA appeared to be at a lower elevation than the rest of the barrier to the east and west and sediment was observed to begin flowing over it, stopping short of the outer edge (Photo 3-12). Another stretch of the rock barrier along the northeastern edge of the EMPA where sediment deposition was occurring appeared to be composed mainly of large boulders as opposed to variable sized material as the rest of the barrier (Photo 3-15).

As of 2020, the straw wattles that had been placed into the largest gully on the western edge of the EMPA did not appear to be appreciably slowing the amount of sediment that was transported to the bottom of the hill, and then through the gap in the rock barrier and into the adjacent marsh (Photo 3-16).

The 2020 surveys also found construction debris at several sites within and outside of EMPA D16 bounds (Photo 3-17; Map 3-2).



Photo 3-14: Rock barrier erosion at eastern edge of EMPA D16



Photo 3-15: Rock barrier composed mainly of large boulders allowing sediment to pass through at the northern edge of EMPA D16



Photo 3-16: Sediment passing through straw wattles installed on western edge of EMPA D16



Photo 3-17: Construction debris in uncleared vegetation outside EMPA D16

3.3.6.2 EMPA D17

Previous surveys at EMPA D17 found that sediment from slope erosion was overwhelming sediment fences and being deposited into uncleared vegetation. Additionally, runoff was entering an adjacent pond to the northeast.

While some of these effects were ongoing at the time of the 2020 surveys, it was unlikely that the sediment deposition would expand further as much of the surrounding ground was higher in elevation. The remaining slopes had dense vegetation growing at their base (Photo 3-18), indicating that those slopes were being naturally stabilized. This site will continue to be monitored for adverse effects in 2021.



Photo 3-18: Vegetation growing at base of EMPA D17 slopes

3.3.6.3 EMPA D23(1)

At the time of the 2020 survey, the eastern half of EMPA D23(1) was being used as a granular material storage area. Construction material and debris in the adjacent uncleared forest was also noted during surveys at the southern edge of the EMPA (Photo 3-19).



Photo 3-19: Aerial view of construction debris on southern edge of EMPA D23(1)

3.3.6.4 EMPA D23(2)-E

Erosion and sediment deposition within the planned Project footprint area was found overtopping previously installed rock berms at the northeastern edge of EMPA D23(2)-E (Photo 3-20). These impacts were at a location that could potentially affect the dewatered portion of Stephens Lake to the northeast if the disturbance should expand (Map 3-1; Figure 3-4).



Photo 3-20: Sediment overtopping rock berms in EMPA D23(2)-E



Figure 3-4: Erosion and sediment deposition from EMPA D23(2)-E

3.3.6.5 EMPA D27(4)

Approximately 0.3 ha of additional disturbance was found along the northern edge of EMPA D27(4) in 2020, bringing the total amount of disturbance outside previously cleared areas to 0.7 ha (Map 3-1). Over half (56%) of the additional disturbance was located in the possibly disturbed Project footprint (Appendix 1: Table 7-1).

In previous years, water had collected in localized sites at the base of the EMPA slope and formed ponds which extended into the adjacent undisturbed forest, causing vegetation mortality. While emergent marsh plants (likely sedges) had initially been colonizing the ponds, these plants had mostly disappeared by September 2019. At the time of the 2020 surveys, no vegetation was observed in the ponds and the amount of tree and vegetation dieback had increased (Photo 3-21). A strong stagnant odour was also noted in the general area around the pools at the time of the 2020 surveys.



Photo 3-21: Aerial view of ponded water and dying trees on northern edge of EMPA D27(4)

3.3.6.6 EMPA D28(1)-E

Newly ponded water was observed along the northern edge of EMPA D28(1)-E in 2020, inundating about 0.2 ha of adjacent undisturbed vegetation (Photo 3-22; Map 3-1). Some vegetation dieback was also observed at the time of the survey.

The bulk of this new disturbance (84%) was located within the possibly disturbed Project footprint (Appendix 1: Table 7-1).



Photo 3-22: Aerial view of ponded water and dying vegetation on northern edge of EMPA D28(1)-E

3.3.6.7 EMPA D35(1)-E

At the eastern edge of EMPA D35(1)-E in 2020, ponded water as well as significant tree dieback was observed in the adjacent uncleared forest (Photo 3-23; Map 3-2). This resulted in the disturbance of approximately 1.6 ha of planned Project area.



Photo 3-23: Ponded water and tree dieback at the eastern edge of EMPA D35(1)-E

3.3.7 RIVER WORKS AREA

Between September 2019 and 2020, approximately 0.03 ha of aquatic habitat was dewatered in the tailrace area and 0.03 ha of terrestrial habitat was cleared downstream of the spillway area (Map 3-1).

Approximately 93% of this area was within the possibly disturbed Project footprint (Appendix 1: Table 7-1).

Removal of causeways and coffer dams re-inundated about 111 ha of dewatered area in the powerhouse intake channel and surrounding areas, the tailrace channel and downstream of the spillway. Since these areas were previously dewatered and subsequently flooded, this did not add to the total amount of clearing or disturbance in 2020.

Construction continued between the spillway and the tailrace.

3.3.8 RESERVOIR CLEARING

No new clearing or disturbance was mapped in the reservoir clearing area in 2020.

A total of 6.1 ha of reservoir clearing area was converted to other Project footprint types, including portions of the GS Area, South Dyke and Borrow Area N-21, however this did not contribute to the total amount of clearing or disturbance in 2020. The planned reservoir clearing was completed prior to the time of the 2018 surveys and as of 2019, reservoir clearing accounted for the majority (66%) of all Project clearing to date.

As of September 2020, approximately 122 ha of reservoir clearing was within the possibly disturbed Project footprint, situated around the perimeter of the reservoir clearing footprint (Appendix 1: Table 7-1).

At the time of the 2020 surveys, the initial reservoir inundation process had just been completed. Reservoir flooding will be mapped once all seven units are commissioned and in operation, and the reservoir is being maintained within the licensed operating range. As noted in Section 2.5.1, all of the flooded area lies within areas previously mapped as reservoir clearing.

3.3.9 TRAILS

No new trails were cleared between September 2019 and 2020. No new trails were found in the possibly disturbed Project footprint (Appendix 1: Table 7-1).

4.0 DISCUSSION AND RECOMMENDATIONS

Project clearing or disturbance between September 2019 and 2020 totalled approximately 39.5 ha. Only about 0.6 ha of this total was clearing. This was by far the lowest annual amount of clearing since the start of Project construction, which was consistent with Manitoba Hydro's indication in May 2018 that the vast majority of Project clearing was complete.

Since habitat monitoring began in 2014, recommendations regarding impacts that may merit mitigation have been provided to Manitoba Hydro following the annual field surveys, and in annual reports. In general, the mitigation carried out in response to these recommendations effectively addressed the identified concern.

The exceptions to the immediately effective mitigation included situations where the implemented measure shifted the same issue to a different location at the same footprint, the implemented measure was not adequate to address the concern or new measures were required to respond to changing conditions. This section discusses the exceptions that were ongoing at the time of the 2020 surveys and provides mitigation recommendations for the more substantive ongoing disturbances. Table 7-2 (Appendix 2) summarizes all of the mitigation recommendations provided since Project construction began, as well as the associated follow-up actions.

At the northeast corner of the Main Camp, water outflow from the culvert draining the camp area has been impacting otherwise undisturbed terrestrial habitat adjacent to the camp footprint. These impacts include the creation of an intermittent stream extending up to 160 metres beyond the camp perimeter as well as mass wasting and vegetation collapse in the portion of the disturbance that is nearest to the camp (see Section 3.3.2 for details). Given that the terrain surrounding the camp slopes towards the culvert location, it is not possible to redirect a portion of the flow elsewhere. While the area impacted to date is small and in a common habitat type, it is progressing towards an off-system marsh. Therefore, it is recommended that measures be implemented to slow the water flow and contain it within the possibly disturbed Project footprint (Figure 3-1). The potential effects of this disturbance on the nearby off-system marsh is examined in the 2020 Wetland Loss and Disturbance Monitoring report (ECOSTEM 2021b).

At Borrow Area G-1, erosion is depositing sediment into adjacent uncleared vegetation at a number of locations (see Section 3.3.4.1 for details). To prevent an expansion of the sediment deposition area, it is recommended that sediment barriers be installed and/or slopes be regraded as needed at these locations.

At Borrow Area G-3, ongoing erosion and runoff is impacting otherwise undisturbed terrestrial habitat as well as planted tree seedlings (see Section 3.3.4.2 for details). For the locations where sediment deposition is impacting otherwise undisturbed terrestrial habitat, it is recommended that sediment barriers be installed or extended.

Planted tree seedlings in G-3 are being affected by upslope water runoff or erosion. In the area where planted tree seedlings are being inundated by upslope water runoff, it is not feasible to prevent further seedling mortality from occurring as the surrounding area is at a higher elevation. Additionally, it is possible that the ground surface of this area is at or below the top of the groundwater table. On this basis, it is recommended that trees not be planted at the bottom of low areas where periodic ponding of water may occur.

Mitigation is not recommended for the slopes in G-3 where planted tree seedlings are being washed away as it is unlikely that further impacts can be prevented or reduced. These slopes are long and have been planted with seedlings. It is noted that a factor contributing to the amount of erosion and tree seedling loss is that in some areas the grading and site preparation were implemented parallel to the slope (Figure 4-1), which increases the amount of downslope water flow and its velocity. A recommendation for future grading and site preparation is to complete the machine work in a direction that is perpendicular to the slope direction where this is safe to do.



Area on northern slope of G-3 with parallel discing pattern, with flooded seedlings at base



Example of erosion and water ponding in low areas, with seedlings washing away in same area

Figure 4-1: Grading and site preparation parallel to slope direction in G-3, and associated erosion and tree impacts

Within Borrow Area KM-1, there is potential for planted tree seedlings to be impacted by erosion, water runoff and the associated sediment deposition (see Section 3.3.4.4 for details). It is recommended that site staff inspect and evaluate these areas to determine if tree seedlings are likely to be lost or damaged and, if so, to implement erosion control measures as needed.

On the eastern edge of Borrow Area N-21, sediment was being deposited into adjacent otherwise undisturbed forest (see Section 3.3.4.6 for details). No mitigation is recommended at this time given that the impacted area is small, substantial expansion of the deposition area is not anticipated and a common habitat type is being affected.

Several disturbances were found along the access corridor to the Ellis Esker borrow area (see Section 3.3.4.9 for details). These disturbances did not appear to be caused by the Project. Ongoing consultations with the partner First Nations will determine if access to this corridor should be blocked.

At EMPA D16, rock berms and other structures had been constructed to stop the erosion and sediment deposition that was impacting otherwise undisturbed terrestrial habitat. At the time of the 2020 surveys, erosion and sediment deposition was being well contained in some sections of the rock berm, but continuing in others (see Section 3.3.6.1 for details). The sections of rock berm that performed the best were generally wider, higher, hard packed with variable sized material and located at the bottom of the affected slope (Photo 4-1).

As the sediment deposition occurring on the western edge of this EMPA D16 was extending towards an off-system marsh, it is recommended that the rock berm be reinforced where it is collapsing or inadequately containing sediment. It is also recommended that site staff monitor the rock berm for other locations where this situation is occurring and implement reinforcement measures as appropriate.



Photo 4-1: Well-performing portion of a rock berm at western end of EMPA D16

At EMPA D17, erosion-transported sediment had been overwhelming sediment fences in past years (see Section 3.3.6.2 for details). While the 2020 surveys found that this deposition was still occurring, mitigation is not recommended as it appears likely that the size of this footprint has stabilized. Most of the surrounding ground is at a higher elevation and vegetation has been naturally regenerating at the bottom of slopes. Surveys in 2021 will continue to monitor this situation.

At the northeastern edge of EMPA D23(2)-E, erosion-related sediment deposition was approaching Stephens Lake (see Section 3.3.6.4 for details). It is recommended that measures be implemented to eliminate or reduce sediment movement beyond the existing rock berm.

Project-related water ponding was observed in many locations in 2020. This ponding has been present for several years in some of these locations. The ponding water has caused substantial tree and vegetation dieback in some locations (i.e., at EMPAs D27(4)-E, D28(1)-E and D35(1)-E), and has the potential to do so at additional locations (i.e., west of Work Area X; interior portions of the South Dyke). No mitigation is recommended for these locations as they mostly lie between the EMPA and the dyke, all of the impacted areas are relatively small, and/or they exist as a narrow band along the dyke.

Erosion and sediment deposition into uncleared vegetation was observed in several other sites around the Project footprint. No mitigation is recommended for these sites at this time given that

each of the impacted sites is small in area, substantial expansion of the deposition area is not anticipated and a common habitat type is being affected.

Construction debris was also found in several areas during site surveys in 2020. These included the western edge of Work Area A, the perimeter of EMPA D16 and the southern edge of EMPA D23(1)-E. Additionally, a relict sediment bag remained at the southern edge of Borrow Area N-5. It is recommended that the debris and relict sediment bag be removed.

5.0 SUMMARY

The Habitat Loss and Disturbance study is monitoring the actual extent of Project-related clearing and disturbance during construction. This is the largest direct Project effect on terrestrial habitat, ecosystems and plants.

Much of the planned Project footprint had been cleared by September 2017, and most of the future reservoir area had been cleared by September 2018. Additional Project clearing from 2018 to 2020 totaled approximately 28 ha.

As of September 2020, the Project clearing (includes dewatered areas) or disturbance (i.e., the Project footprint) totalled 5,723 ha (this total did not include reservoir impoundment, which will be mapped in 2021).

While the size of the cleared and disturbed Project footprint increased by 39.5 ha between September 2019 and 2020, disturbance accounted for the vast majority (98.6%) of this total. Almost all of this disturbance was in portions of Borrow Area G-5 that had been previously created for the Keeyask Infrastructure Project, and was being used for re-surfacing of the NAR.

As of September 2020, 45% of the originally licensed Project footprint had been cleared or disturbed.

Of the total area cleared or disturbed by September 2020, 93% (5,301 ha) was within the planned Project footprint, and 5.5% (314 ha) was within the possibly disturbed Project footprint (Map 2-1). The total impacted area in the possibly disturbed Project footprint was only 6.1% of the 5,123 ha included within this Project area.

To date, there has been 8.5 ha of clearing or disturbance outside the approved Project footprint. Most of this area was located at Borrow Areas G-1 and E-1, around EMPA D16 and around the fringes of the reservoir clearing area (Map 3-1).

The 8.5 ha of clearing or disturbance outside the approved Project footprint was very small (0.12%) relative to the 7,123 ha of still undisturbed area in the licensed Project footprint. Additionally, virtually all of the still undisturbed area within the licensed Project footprint in 2020 is expected to remain undisturbed by the Project.

6.0 CONCLUSIONS

To date, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. As predicted in the environmental assessment, the total amount of clearing and physical disturbance as of September 2020 is much less than included in the overall licensed Project footprint.

Results from the 2020 monitoring led to recommendations for additional mitigation in 9 localized areas. There are no recommendations to modify the study methods based on monitoring results to date.

Monitoring fieldwork for the Habitat Loss and Disturbance study will continue in 2021.

7.0 LITERATURE CITED

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APPENDIX 1: DETAILED RESULTS

Table 7-1: Clearing or physical disturbance within the possibly disturbed areas and outside of the combined planned, possibly disturbed and subsequently approved areas as of September 2020, by Project component and Project Areas

Project Component	Component Name	Clearing or Disturbance (ha)					
		Within Possibly Disturbed Areas			Outside of Combined Planned, Possibly Disturbed and Subsequently Approved Areas		
		2019	2020	Change	2019	2020	Change
Access Roads	South Access Road	4.45	4.45	-	-	-	-
Camp & Work Areas	Main Camp	0.07	0.12	0.05	-	0.06	0.06
	Work Area A	0.75	0.75	-	-	-	-
	Work Area B	0.42	0.42	-	0.01	0.01	-
	Work Area C	0.29	0.29	-	-	-	-
	Work Area X	0.11	0.11	-	-	-	-
	Hydro Offices South	0.37	0.37	-	-	-	-
	Portage Route	1.49	1.49	-	-	-	-
River Works Area	Generating Station	1.54	1.54	-	-	-	-
Quarries and Borrow Areas	Spillway & Cofferdam	11.20	11.26	0.06	-	-	-
	B-2	0.40	0.40	-	-	-	-
	B-3	2.72	2.72	-	-	-	-
	B-5	0.75	0.75	-	-	-	-
	B-6	0.05	0.05	-	-	-	-
	B-8	1.79	1.79	-	-	-	-
	G-1	-	-	-	2.75	2.91	0.15
	G-3	-	-	-	0.00	0.01	0.00
	N-5	-	-	-	0.20	0.20	-
	Q-1	0.48	0.48	-	-	-	-
	Q-9	0.14	0.14	-	-	-	-
	E-1	24.95	24.95	-	2.42	2.42	-
	E-1 Access	26.72	26.75	0.03	0.01	0.01	-
	D1(2)-I	0.03	0.03	-	-	-	-
	D12(1)-E	0.01	0.01	-	-	-	-
Excavated Material Placement Areas	D12(2)-E	6.16	6.16	-	-	-	-
	D16(1)-E	15.52	15.60	0.08	0.46	0.46	-
	D17-E	0.00	0.00	-	0.02	0.02	-
	D23(1)-E	1.57	1.57	-	-	-	-
	D23(2)-E	6.40	6.40	-	-	-	-
	D27(4)-E	26.29	26.46	0.18	0.01	0.01	-
	D28(1)-E	5.85	6.02	0.16	-	-	-
	D31(1)-E	1.28	1.28	-	-	-	-
	D31(2)-I	0.12	0.12	-	0.00	0.00	-
	D3-E	3.08	3.08	-	0.03	0.03	-

Project Component	Component Name	Clearing or Disturbance (ha)					
		Within Possibly Disturbed Areas			Outside of Combined Planned, Possibly Disturbed and Subsequently Approved Areas		
		2019	2020	Change	2019	2020	Change
	D7-E	0.02	0.02	-	-	-	-
	D9-I	0.01	0.01	-	-	-	-
Dykes	North Dyke	24.81	24.81	-	0.01	0.01	-
	South Dyke	11.01	11.01	-	0.04	0.04	-
Reservoir	Reservoir Clearing	122.27	122.27	-	1.60	1.60	-
Clearing	Trails	0.33	0.33	-	0.73	0.73	-
Total		303.43	303.99	0.56	8.29	8.50	0.21

Notes: a "-" indicates no area, a 0 indicates a very small (negligible) area.

APPENDIX 2: MITIGATION RECOMMENDATIONS

Table 7-2: Summary of Mitigation Recommendations

Location	Year	Identified Impact	Mitigation Recommendation ¹	Mitigation Implemented
North Access Road at KM-1	2016	Erosion of ditch bank under trees.	Aug. 2016: Consider erosion control measures at this location.	Eroded area filled with earth in late summer, 2019.
	2017	Erosion of ditch bank under trees.	Sep. 2017: Consider mitigation options to prevent further erosion or collapse of the bank.	Eroded area filled with earth in late summer, 2019.
	2019	Minor erosion and sediment deposition around the eastern fringes of the remediated area in 2019.	Jun. 2020: Site staff inspect and evaluate these areas, and implement erosion control measures as needed.	None to date.
	2020	Minor erosion and sediment deposition around the eastern fringes and downslope of the remediated area in 2019.	Jun. 2021: Site staff inspect and evaluate these areas, and implement erosion control measures as needed.	None to date.
Main Camp	2019	Water outflow from culvert at northeast corner causing mass wasting and disturbance.	Sep. 2019: None.	None applicable to date.
	2020	Water outflow from culvert at northeast corner causing mass wasting and disturbance.	Jun. 2021: Implement measures to slow water flow and contain disturbance within the possibly disturbed Project footprint.	None to date.
Helicopter Pad	2020	Erosion and sediment deposition on northern corner of pad.	None to date.	None applicable to date.
Borrow Area G-1	2020	Erosion and sediment deposition in uncleared forest	Jun. 2021: Install sediment barriers and/or regrade slopes as needed.	None to date.
Borrow Area G-3	2016	Sediment deposition toward Stephens Lake from BA G-3.	Sep. 2016: Further mitigation methods in area were discussed with site staff.	Sediment fence installed.
	2018	Sediment bypassing sediment fences along SE perimeter. Erosion depositing sediment at several other locations around area perimeter.	Sep. 2018: Site staff inspect the area, reinforce sediment fences where needed, and evaluate and implement additional erosion control measures as needed.	Sediment fence installed along part of the south side.
	2019	Sediment bypassing new sediment fences along south perimeter. Erosion depositing or has potential to deposit	Sep. 2019: Site staff inspect the perimeter to evaluate and implement additional or enhanced erosion control measures as needed.	Slopes graded and sediment fences removed. Rock barriers

Location	Year	Identified Impact	Mitigation Recommendation ¹	Mitigation Implemented
		sediment at several other locations around G-3 perimeter.		constructed along western edges.
	2020	Sediment deposition in various locations around perimeter.	Jun. 2021: Install or extend sediment barriers where needed.	None to date.
	2020	Erosion and ponded water washing away and killing planted seedlings in eastern half of G-3.	Jun. 2021: In future, low areas within excavated borrow areas that are susceptible to ponding water will not be planted with trees.	To be implemented in 2021.
Borrow Area KM-1	2019	Erosion runnels widening/deepening in pit area.	Jun. 2020: Site staff inspect the perimeter to evaluate and implement erosion control measures as needed.	None to date.
	2020	Erosion runnels widening/deepening in pit area.	Jun. 2021: Site staff inspect the excavated areas to evaluate and implement erosion control measures as needed.	None to date.
Borrow Area N-5	2017	Drainage hose on north side of area eroded slope and depositing sediment into uncleared area.	Sep. 2017: Relocate the water discharge off the bank, extend the hose to the bottom of the bank.	Drainage hose moved to different location.
	2018	Drainage hose on north side of area eroded slope and depositing sediment into uncleared area.	Jul. 2018: Take steps to eliminate bank erosion at this new location - site staff notified following discovery.	Drainage hose extended to base of slope and sediment bag was installed.
	2018	Erosion and sediment deposition from drainage hose and failed sediment bag on south side of N-5.	Sep. 2018: Evaluate whether or not future sediment will be naturally contained within the existing deposition area and, if not, implement appropriate containment measures.	Drainage hose removed in 2019 and all slopes graded in 2020.
	2019	Sediment bag remained at old drainage hose location on south side of N-5.	Jun. 2020: Remove sediment bag from location.	Sediment bag removed in 2020.
Borrow Area N-21	2019	Sediment depositing several meters into uncleared adjacent forest on the eastern edge.	Jun. 2020: Site staff inspect and evaluate these areas and implement erosion control measures as needed.	None to date.
	2020	Sediment depositing several meters into uncleared adjacent forest on the eastern edge.	Jun. 2021: Install sediment barriers and/or regrade slopes along eastern edge.	None to date.

Location	Year	Identified Impact	Mitigation Recommendation¹	Mitigation Implemented
Borrow Area B-6	2019	Mass wasting causing disturbance along drainage channel between borrow area and South Access Road.	None to date.	None applicable to date.
	2020	Mass wasting causing disturbance along drainage channel between borrow area and South Access Road.	None to date.	None applicable to date.
Borrow Area E-1 (Ellis Esker) Access Corridor	2020	Local use of right-of-way causing disturbance in uncleared forest.	Sep. 2020: Site staff informed of local usage. Jun. 2021: Continued consultation with partner First Nations on use of this area.	None to date.
Borrow Areas S-2a and S-2b, Work Area X	2020	Inland water ponding with potential to affect surrounding uncleared vegetation.	None to date.	None applicable to date.
South Dyke	2016	Sunken ATV in wetland.	Aug. 2016: Remove ATV as soon as possible.	ATV removed.
	2020	Water ponding in areas inside dyke bounds.	None to date.	None applicable to date.
EMPA ² D16	2017	Erosion and sediment deposition into uncleared habitat on north and east sides of the area.	Aug. 2017: Repair and reinforce sediment fence on east side and install sediment fence on the north side.	Sediment fence installed at north side, repaired at east side.
	2018	Sediment deposition into bay of Stephens Lake on north side of area, water flow from calcareous pond. Sediment fences overwhelmed.	Sep. 2018: Inspect the entire northeast side of area, and repair existing and/or add new erosion containment measures to prevent sediment from entering Stephens Lake.	Sediment fences were repaired or reinforced in the fall of 2018. Installation of rock berms and organic material armouring along base of northeast slope in March 2019. Sediment fencing removed and straw wattles placed in gullies along west slopes in April 2019.
	2019	Sediment deposition into surrounding uncleared areas past rock barrier on eastern edge.	Sep. 2019: Enhance containment measures where needed and assess if further measures are feasible.	Cover crop seeding for erosion control planned for summer 2021.

Location	Year	Identified Impact	Mitigation Recommendation¹	Mitigation Implemented
EMPA D17	2019	Sediment deposition into surrounding cleared areas past straw wattles and removal of sediment fences on western edge.	Jun. 2020: Enhance containment measures where needed and assess if further measures are feasible.	Expansion of rock berm on western edges in 2019. Cover crop seeding for erosion control planned for summer 2021.
	2020	Sediment deposition into surrounding cleared areas around the EMPA and past straw wattles, through gap in rock berm.	Jun. 2021: Repair and reinforce sections of rock barrier that are insufficiently containing sediment.	Cover crop seeding for erosion control planned for summer 2021.
	2020	Construction debris inside and outside EMPA bounds.	Sep. 2020: Site staff informed of areas to focus on to clean up construction debris.	Clean-up commenced in spring 2021.
	2017	Sediment overwhelmed sediment fences along northeast slope.	Sep. 2017: Repair and reinforce sediment fences as needed.	Sediment fences were reinforced between 2017 and 2018.
	2018	Sediment overwhelmed sediment fences along northeast slope.	Sep. 2018: Inspect the entire northeast slope of area, repair existing, and add new erosion containment measures as needed to prevent sediment from entering Stephens Lake.	Sediment fences were repaired or reinforced in fall 2018.
	2019	Sediment overwhelmed sediment fences along northeast slope.	Sep. 2019: Enhance containment measures where needed and assess if further measures are feasible.	Cover crop seeding for erosion control planned for summer 2021.
	2020	Sediment overwhelmed sediment fences along northeast slope.	None to date.	Cover crop seeding for erosion control planned for summer 2021.
EMPA D23(1), Work Area A	2020	Construction debris on western edge of Work Area A and southern edge of EMPA D23(1).	Jun. 2021: Site staff remove debris.	None to date.
EMPA D23(2)	2020	Erosion and sediment deposition along northeastern edge close to Stephens Lake.	Jun. 2021: Implement measures to stop or reduce movement of sediment past rock barrier.	None to date.
EMPA D27(4)	2019	Ponding of water along northern edge causing tree mortality.	None to date.	None applicable to date.

Location	Year	Identified Impact	Mitigation Recommendation¹	Mitigation Implemented
	2020	Ponding of water along northern edge causing tree mortality.	None to date.	None applicable to date.
EMPA D28(1)	2020	Ponding of water along northern edge causing vegetation dieback.	None to date.	None applicable to date.
EMPA D35(1)	2020	Ponding of water along eastern edge causing large area of tree dieback.	None to date.	None applicable to date.