



Keeyask Generation Project Terrestrial Effects Monitoring Plan

Habitat Loss and Disturbance Monitoring Report

TEMP-2019-01



KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2019-01

HABITAT LOSS AND DISTURBANCE MONITORING



A Report Prepared for
Manitoba Hydro

By
ECOSTEM Ltd.

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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 fourth 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 jack pine 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.

What was done?

Project clearing and physical disturbance were mapped from satellite imagery that was captured on July 9, 2018, and from helicopter surveys that took place on July 5 and September 15, 2018.

What was found?

Monitoring showed that approximately 5,640 ha of terrestrial habitat had been cleared or physically disturbed for the Project as of September 2018. About 93% of this total area was in the planned portions of the Project footprint, which are the areas that include the permanent infrastructure and future reservoir. Most (about 75%) of the clearing that happened between September 2017 and 2018 was in the future reservoir area.

About 94% of the area in the “possibly disturbed” portion of the licensed footprint was still undisturbed, and most of this area was expected to remain undisturbed by the Project. While

there was 8.29 ha of inadvertent clearing outside the approved Project footprint, this area was only 0.12% of the 7,170 ha of the licensed Project footprint that has 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 expected, the total amount of clearing and physical disturbance as of September 2017 is much less than included in the overall licensed area.

The inadvertent 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, this amount of additional clearing was 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 undisturbed area.

What will be done next?

Monitoring to document the amount and locations of terrestrial habitat affected by the Project, and to evaluate the effectiveness of mitigation measures, will continue in 2019.

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STUDY TEAM

Dr. James Ehnes was the project manager and study designer.

Fieldwork in 2018 was conducted by Nathan Ricard and Brock Epp.

Data analysis and report writing in 2018 were completed by Brock Epp and James Ehnes. GIS analysis and cartography were completed by Brock Epp and Nathan Ricard.

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

- Quantify and situate terrestrial habitat loss and physical disturbance; and,
- Quantify and situate 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 2018. Reports by ECOSTEM (2016; 2017; 2018) provide results for the monitoring

conducted in 2015, 2016 and 2017. This report presents the results of monitoring conducted during 2018.

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 2018, which were the same as in 2016 and 2017 (ECOSTEM 2017; 2018).

In the terrestrial habitat, ecosystem and plant studies, clearing refers to complete vegetation removal (except for very low shrub, herbaceous and moss cover in some cases) in a terrestrial habitat patch that was at least 400 m² in size. Disturbance refers to either physical disturbance in an area of intact vegetation (e.g., machinery trail, test pits), use of a pre-existing trail or an area of clearing smaller than 400 m².

Many of the cleared areas also included topsoil or overburden excavation (e.g., in a borrow area). “Clearing” also included uncleared areas where excavated material was piled since the vegetation was no longer visible.

Dewatered areas outside of pre-existing terrestrial habitat are also included in the Project impact mapping. Such changes are not direct impacts on terrestrial habitat. However, dewatered areas become temporary and, in some cases, new permanent terrestrial habitat.

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 areas are a subdivision of the footprint licensed for Project use under the Project's *Environment Act* Licence (i.e., licensed Project footprint): the planned Project footprint and the possibly disturbed Project footprint. The planned Project footprint is largely comprised of permanent Project features. 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. Project environmental protection plans (EnvPPs) include provisions to minimize clearing or disturbance within the possibly disturbed Project footprint, and the avoidance of environmentally sensitive sites to the

extent feasible within this area. Another study, Priority Habitats, monitors Project effects on environmentally sensitive terrestrial sites (see ECOSTEM 2019).

After the Project was licensed, several additional areas (called “subsequently approved Project areas” in this report) were approved for Project use by Manitoba Conservation and Water Stewardship (now Manitoba Sustainable Development (MSD)). This is the third type of Project area. These subsequently approved areas primarily included the former KIP start-up camp (which was originally planned as only a temporary camp for the KIP) and trails that were used to access reservoir clearing areas.

The subsequently approved trails were evaluated for potential effects by terrestrial specialists prior to their submission to MSD, and their locations 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 evaluations of the subsequently approved areas was how these areas would alter predicted cumulative effects, which was largely related to the characteristics of the areas and the amount of the licensed Project footprint that was expected to remain undisturbed at the end of construction. 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 2018, most (56%) of the licensed Project footprint had not been impacted by the Project (ECOSTEM 2018).

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 is any areas cleared or disturbed outside the approved Project footprint. This includes all areas that are not part of the approved Project footprint.

2.3 DATA COLLECTION

On July 5 and September 15, 2018, all areas cleared or disturbed for the Project were surveyed while flying in a Bell 206 helicopter around the perimeter of the cleared or disturbed areas. Project-related clearing, physical disturbance and other relevant conditions were documented with geo-referenced aerial photographs, marked-up maps and notes. Project-related impacts of concern identified in previous years, or new impacts of concern identified during the 2018 aerial surveys were also surveyed by foot on September 11 to 13, and 15 to 17, 2018.

In the office, digital orthorectified imagery (DOI) obtained by Manitoba Hydro on July 9, 2018 was also used to identify the spatial extents of Project clearing or physical disturbance.

2.4 MAPPING

Project clearing or disturbance boundaries as of September 2016, 2017 and 2018 were precisely digitized from high resolution DOIs and the aerial survey data. All clearing or disturbance was digitized at a scale of 1 inch = 30 metres.

For the 2016 mapping, a DOI created from Worldview 2 imagery acquired on September 21, 2016 was the primary data source for clearing or disturbance boundaries, which covered most of the approved Project footprint area.

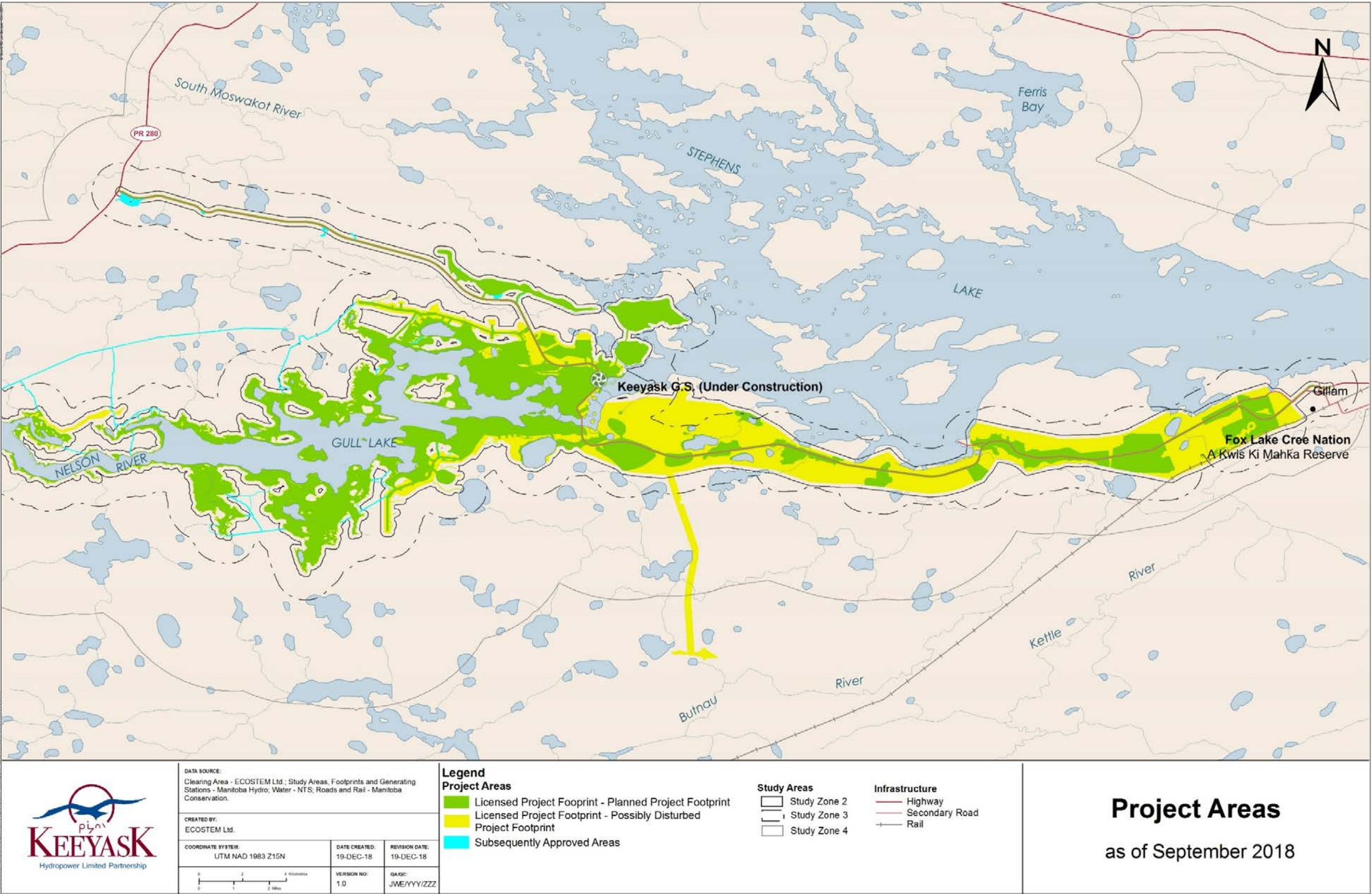
For the 2017 and 2018 clearing or disturbance mapping, a DOI created from Worldview 2 imagery acquired on July 11, 2017 and July 9, 2018, which covered the entire (or most of, respectively) approved Project footprint area, was the primary data source for boundaries. For the areas not captured in the 2018 DOI, aerial survey photos acquired on September 15, 2018 were used to determine which areas had been cleared since July 9, 2018.

As the 2017 and 2018 DOIs did not provide information on clearing or development occurring after their July acquisition dates, the aerial survey photos acquired in September (Section 2.3) were used to identify clearing or development that occurred between July and September. The boundaries mapped from aerial photography were not as precise as those digitized from the DOI because they were taken from an oblique angle, but were still adequate for fieldwork planning. These boundaries will be subject to revision once newer satellite imagery has been acquired.

In a GIS, the clearing or disturbance that had occurred between September 2017 and 2018 was appended to the 2017 clearing/disturbance dataset. This dataset already incorporated subdivisions for the September 2015 and 2016 clearing or disturbance limits.

A focus of the reporting is 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.



Map 2-1: Project areas as of September 2018

3.0 RESULTS

This section begins with an overview of Project clearing or disturbance. Subsequent sections detail clearing or disturbance in the various Project components.

3.1 OVERVIEW

As of September 2018, Project clearing or disturbance totaled 5,640 ha, or 44% of the originally licensed Project footprint area. This was an increase of 359 ha from that documented as of September 2017.

Clearing accounted for the vast majority of the Project impacts (98.9%) as of September 2018 (mapped clearing includes areas excavated, or built up due to material placement, and infrastructure). Approximately 75% of the new clearing was in the future reservoir area, with an additional 16% associated with borrow areas.

Disturbance and dewatering (e.g. cofferdams) accounted for the remaining 1.1% of the Project footprint as of September 2018.

Of the 5,640 ha of total clearing or disturbance, 91% was in areas classified as terrestrial habitat in the EIS analysis (the remainder was classified as aquatic).

Much of the planned Project footprint had been cleared by September 2017. Specific Project components included: the entire north access road (NAR) and south access road (SAR); main camp; borrow areas along both access roads; north dyke, south dyke; excavated material placement areas (EMPAs); short access roads used for dyke construction; north and south reservoir clearing areas; camp well access road; cofferdam and cleared/dewatered area; and all work areas.

Project components (Map 3-1) with additional clearing or disturbance (including dewatering) as of September 2018 included: south reservoir clearing area; borrow areas E-1 (including its access corridor) and Q-1; Work Area C; EMPA D23(2)-E; the tailrace channel; and, the south dam.

About 269 ha, or 75%, of the area that was cleared or disturbed between September of 2017 and 2018 was situated in the future reservoir area south of the Nelson River (

Table 3-1). An additional 58 ha, or 16% of the area was associated with Borrow Area E-1 and its access corridor. Other footprint components with major contributions to the additional clearing or disturbance during this period were the south dyke, and dewatering associated with the tailrace cofferdams and the south dam in the river works area.

The start-up camp (i.e., initially developed under the KIP as a temporary camp) was a subsequently approved Project area (Section 2.2). Staff working on the Project stayed in the trailers located within this site. 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 continued in 2018.

Borrow Area G-5, and most of Borrow Area 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, 2018 (i.e., observed clearing or disturbance was from previous projects or activities such as the KIP).

The photos in Figure 3-1 to Figure 3-19 show examples of clearing or disturbance in various Project areas at the time of the 2018 surveys (these photos are discussed in the relevant Project footprint sections below). As an informal means of demonstrating change, these photos can be compared with photos of the same locations in each year from 2012 to 2017 (see previous monitoring reports: ECOSTEM 2013, 2014, 2015, 2016, 2017, 2018).

Table 3-1: Cumulative actual Project clearing or disturbance area as of September 2018, by Project component

Project Component ¹	Total Area Cleared or Disturbed (ha)					Change from Previous Year ⁴ (ha)			
	2014 (existing from KIP)	2015 ^{2,3}	2016 ³	2017 ³	2018	2015	2016	2017	2018
North access road	191.6	192.4	192.6	192.6	192.6	0.8	0.2	-	-
South access road	-	299.5	325.5	325.5	325.5	299.5	26.0	0.1	-
Camp and work areas	186.5	232.0	235.3	236.5	238.1	45.4	3.3	1.2	1.7
Borrow areas	49.5	266.6	358.4	411.4	469.6	217.1	91.8	53.1	58.2
North dyke and associated areas	18.6	133.5	183.3	197.9	199.1	114.9	49.7	14.6	1.2
South dyke and associated areas	-	24.9	121.9	180.3	188.5	24.9	97.0	58.4	8.1
Generating station and river works	10.9	181.9	205.1	210.8	231.4	171.0	23.2	5.7	20.6
Reservoir clearing and access trails	1.7	9.0	1,923.9	3,526.5	3,795.3	7.3	1,914.9	1,602.7	268.8
All cleared or disturbed areas	458.8	1,339.7	3,545.8	5,281.6	5,640.1	880.9	2,206.1	1,735.8	358.5

Notes: a "-" indicates no area, a 0 indicates an area less than 0.5 ha.

¹ Footprint types are coarse groupings of components. In general, they include adjacent EMPAs, and dykes include associated borrow areas.

² Areas for 2015 differ than those presented in the 2015 annual report because 2015 mapping was subsequently refined within the planned project footprint (see ECOSTEM 2016).

³ Areas for some footprint types differ slightly from those presented in the 2016 and 2017 annual reports because some clearing was reclassified into other project components as the footprint developed, 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.



North Access Road (NAR)/PR 280 junction (looking northeast) on September 15, 2018



Approximately halfway along the NAR (looking northeast) on September 15, 2018

Figure 3-1: Clearing and other impacts along the NAR



Bridge at Looking Back Creek (looking southwest) on September 15, 2018



Southeast end of the NAR (indicated by arrow, looking south) on September 15, 2018

Figure 3–1: Continued...



West end of SAR (looking southwest) on September 15, 2018



View of the Sigfusson Northern/Voltage camp and borrow area B-3 (looking north) on Sept 15, 2018

Figure 3-2: Clearing and other impacts along the SAR



Crossing at the Butnau River (looking north) on September 15, 2018



Near the east end (looking northeast) on September 15, 2018

Figure 3–2: Continued...



Main camp and helicopter pad (looking west) on September 15, 2018



Well road entrance (looking northeast) on September 15, 2018



Well road north end (looking west) on September 15, 2018

Figure 3-3: Main camp, helicopter pad and well road



Figure 3-4: Cemetery site along the North Access Road (September 15, 2018)



Work Area A (looking east) on September 15, 2018



Work Area B (looking west) on September 15, 2018

Figure 3-5: Work areas



Work Area C and downstream boat launch (looking north) on September 15, 2018



Work Area X (looking northwest) on September 15, 2018

Figure 3–5: Continued...



Work Area A (looking east) on September 15, 2018. Yellow arrow identifies disturbance in remediated sediment deposition area



Understorey disturbance from drainage outflow at northeast corner of Main Camp on September 16, 2018

Figure 3-6: Disturbances outside of cleared areas in Work Area A and the Main Camp



Borrow Area G-1 at KM-15 (looking northeast) on September 15, 2018



Borrow Area G-1 at KM-17 (looking northeast) on September 15, 2018

Figure 3-7: Clearing and excavation in borrow areas north of the Nelson River



Borrow Area G-3 (looking west) on September 15, 2018



Borrow Area N-5 and EMPA D35 (looking southwest) on September 18, 2018

Figure 3–7: Continued...



Borrow Area N-21 (looking north) on September 15, 2018

Figure 3–7: Continued...



Quarry Area Q-1 (looking north) on September 15, 2018



Borrow Area B-2 (looking north) on September 15, 2018

Figure 3-8: Clearing and excavation in borrow areas south of the Nelson River



Borrow Area S-2a (looking south) on September 15, 2018



Borrow Area S-2b (looking southwest) on September 15, 2018

Figure 3–8: Continued...



Borrow Area E-1 clearing from ground (looking west) on August 24, 2018



Borrow Area E-1 excavation from ground (looking northwest) on August 24, 2018

Figure 3–8: Continued...



Borrow Area E-1 access entrance (looking south) on September 15, 2018



Borrow Area E-1 access at stream crossing (looking south) on August 24, 2018

Figure 3–8: Continued...



Quarry Area Q-9 (looking south) on September 15, 2018



Borrow Area B-3 (looking north) on September 15, 2018

Figure 3–8: Continued...



Borrow Area B-5 (looking southeast) on September 15, 2018



Borrow Area B-6 west portion and SAR Gate (looking south) on September 15, 2018

Figure 3–8: Continued...



Borrow Area B-6 east portion (looking south) on September 15, 2018

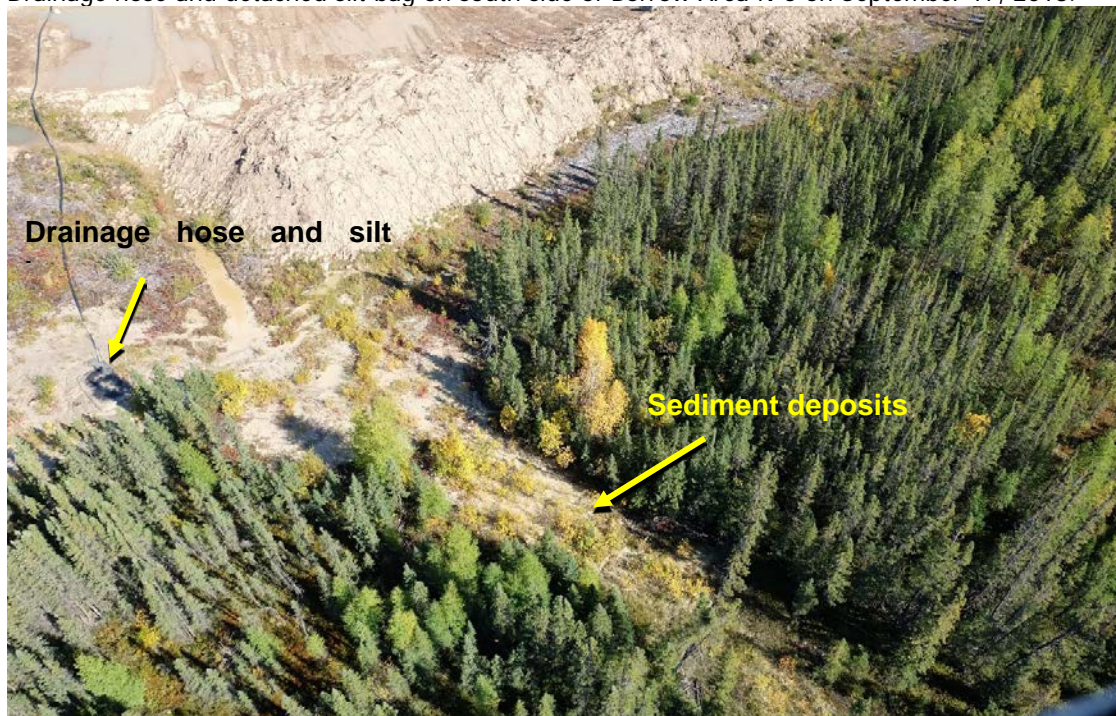


Borrow Area B-8 (looking southwest) on September 15, 2018

Figure 3–8: Continued...



Drainage hose and detached silt bag on south side of Borrow Area N-5 on September 17, 2018.



Sediment deposition into uncleared forest and cutline at south side of Borrow Area N-5 (looking northeast) on September 15, 2018

Figure 3-9: Sediment deposition into adjacent undisturbed habitat in borrow areas N-5 and G-3



New drainage hose location at north side of Borrow Area N-5 on July 3, 2018



Extended drainage hose and silt bag at north side of Borrow Area N-5 on September 17, 2018

Figure 3–9: Continued...



Sediment deposition into uncleared area near southeast end of Borrow Area G-3 on September 15, 2018

Figure 3–9: Continued...



Collapsing trees extending along drainage channel into borrow pit on September 15, 2018



Ground view of disturbance between SAR and borrow pit on August 30, 2018

Figure 3-10: Mass wasting between the SAR and Borrow Area B-6



North dyke, near east end (looking north) on September 15, 2018.



North dyke, near west end (looking east) on September 15, 2018

Figure 3-11: North dyke



South dyke, near west end (looking south) on September 15, 2018



South dyke, east end (looking west) on September 15, 2018

Figure 3-12: South dyke



EMPA D16 (looking south) on September 15, 2018



EMPA D17 (looking east) on September 15, 2018

Figure 3-13: Excavated material placement areas in use



EMPA D19-I (looking south) on September 15, 2018. Yellow arrow identifies EMPA.



Portion of EMPA D12 (looking southwest) on September 15, 2018

Figure 3–13: Continued...



EMPA D3-E (looking east) on September 15, 2018



EMPA D9-I (looking south) on September 15, 2018

Figure 3–13: Continued...



EMPA D23(2) (looking south) on September 15, 2018



EMPA D27 (looking southwest) on September 15, 2018

Figure 3–13: Continued...



EMPA D16 (looking southwest) on September 15, 2018. Yellow arrow identifies sediment.



Failed silt fence near northeast corner of EMPA D16 (looking north) on September 17, 2018

Figure 3-14: Disturbance outside of approved Project footprint associated with EMPA D16



Failed silt fence on northeast side of EMPA D17 (looking south) on September 17, 2018

Figure 3-14: Continued



Figure 3-15: Disturbed area adjacent to the east side of EMPA D16 on September 15, 2018.



Powerhouse and tailrace channel construction (looking northwest) on September 15, 2018



Spillway and south dam construction (looking west) on September 15, 2018

Figure 3-16: Generating station and river works area construction



Spillway laydown area (looking west) on September 15, 2018

Figure 3–15: Continued...



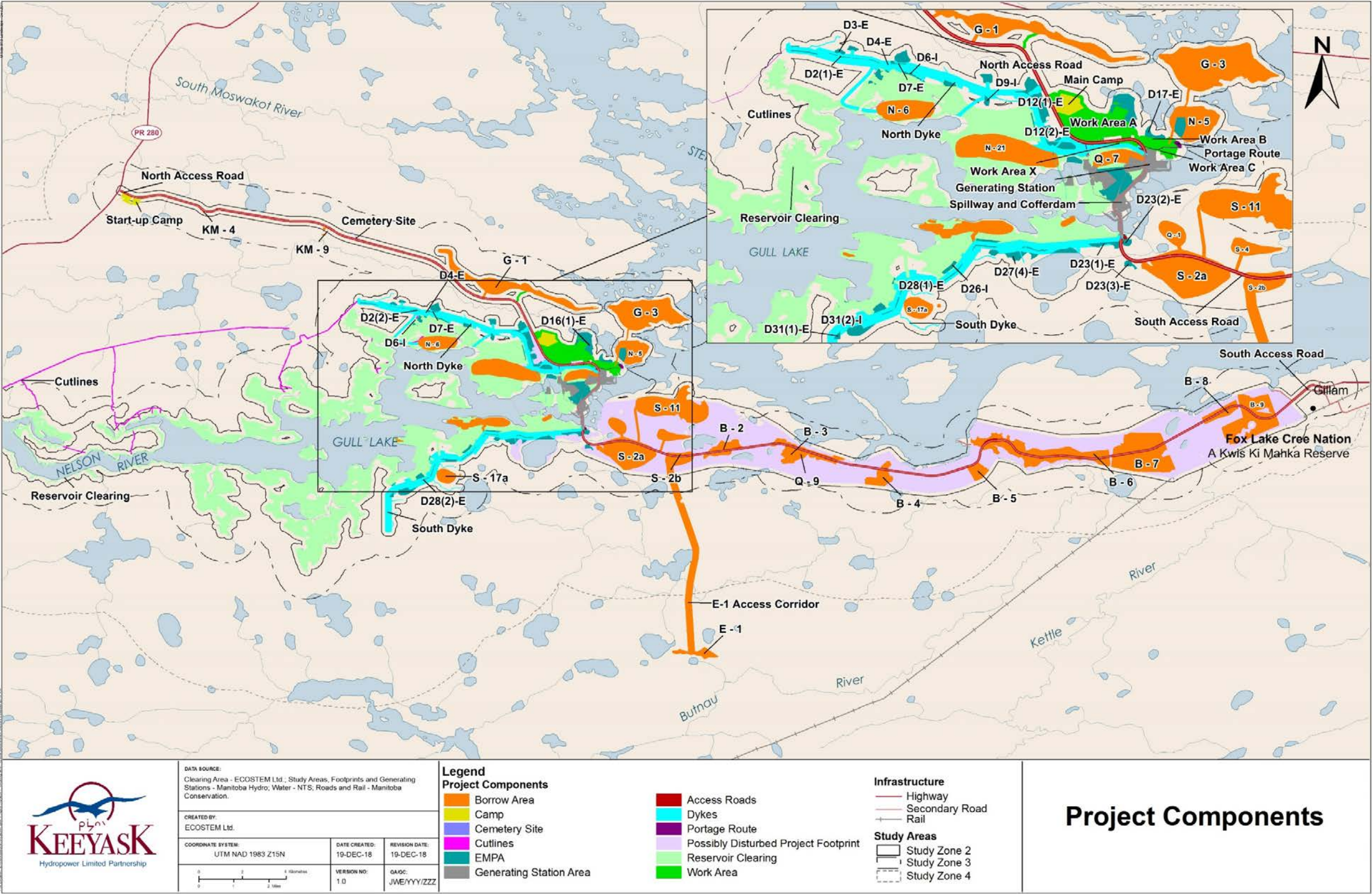
Reservoir clearing south of Nelson River (looking east) on July 5, 2018

Figure 3-17: Reservoir clearing



Pre-existing cutline (indicated by yellow arrow) used for access to reservoir clearing areas (looking west) on July 5, 2018. The darker track to the right in the photo is a trail created for reservoir clearing

Figure 3-18: Pre-existing cutline used for access to reservoir clearing (looking west) on July 5, 2018



Map 3-1: Project components

3.2 CLEARING OR DISTURBANCE IN PROJECT AREAS

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 Manitoba Sustainable Development (MSD).

Of the 5,640 ha of total clearing or disturbance recorded up to September 2018, 93% was within the planned Project footprint (Map 3-2). Clearing or disturbance within the planned Project footprint areas had increased by 292 ha since September 2017 (Table 3-2).

Clearing or disturbance in the possibly disturbed Project footprint (Table 3-2; Map 3-2) amounted to approximately 306 ha as of September 2018. This was an increase of 64 ha over 2017. Most of the newly impacted area was situated in the south-side reservoir clearing area and Borrow Area E-1 (Appendix Table 6-1).

As of September 2018, 63 ha of the clearing or disturbance was in subsequently approved Project areas, with nearly half of this area (45%) being in areas previously cleared for the KIP. These subsequently approved areas included the KIP start-up camp near PR 280, and portions of Borrow Areas KM-4, KM-9 and G-1 (which had previously been used for the KIP), the cemetery site adjacent to the NAR, and several pre-existing and newly cleared access trails utilized for accessing the reservoir clearing areas north and south of the Nelson River.

Areas cleared or disturbed outside of the approved Project footprint totalled 8 ha (Table 3-2; Map 3-2), or 0.15% of total impacted area as of September 2018. As illustrated in Map 3-2, this 8 ha of impacts was very small (0.12%) relative to the 7,170 ha of remaining undisturbed area within the licensed Project footprint. The Project is not expected to impact most of the area that was undisturbed in 2018.

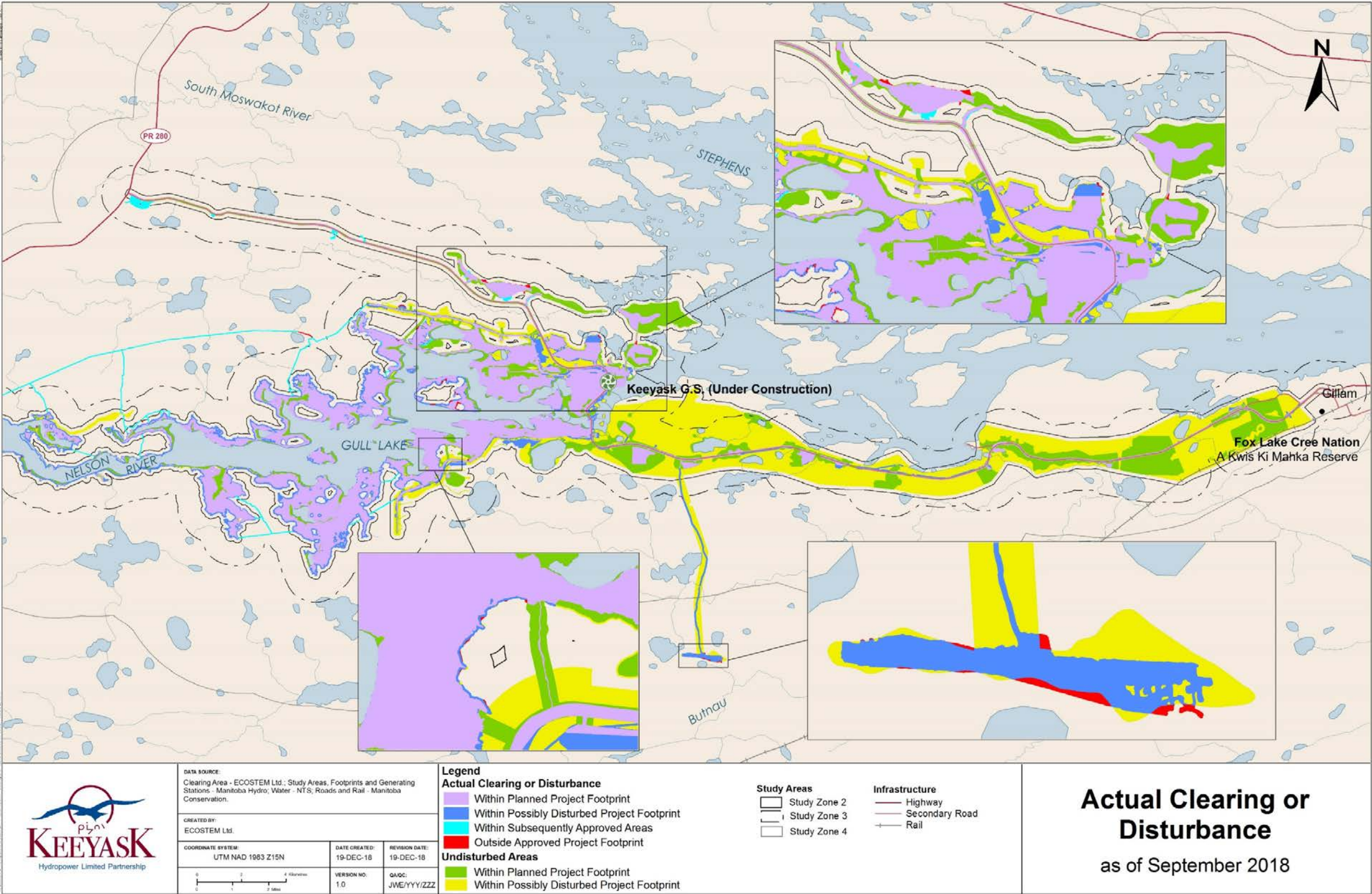
Most of the new area cleared or disturbed outside of the approved Project footprint was associated with Borrow Area E-1. Most of the remaining clearing and disturbance to areas outside the approved Project footprint was caused by sediment deposition from eroding slopes on the north side of EMPA D16, and a peat plateau bog on the east side of the same EMPA that collapsed after it was disturbed by a bulldozer (Tanner Booth pers. comm.; Figure 3-15).

Table 3-2: Cumulative actual Project clearing or disturbance area as of September, 2018, by Project area

Project Area	Total Approved Area (ha)	Total Area (ha)					Change (ha) from Previous Year ¹			
		2014 (existing from KIP)	2015 ³	2016 ³	2017 ³	2018	2015	2016	2017	2018
Planned Project Footprint	7,615.6	420.3	1,245.9	3,294.6	4,971.1	5,262.8	825.6	2,048.6	1,676.6	291.7
Possibly Disturbed Project Footprint	5,122.6	9.6	62.6	190.6	241.6	305.7	53.1	127.9	51.0	64.2
Subsequently Approved Project Areas ²	n/a	28.9	29.4	56.1	63.3	63.3	0.5	26.7	7.2	-
Areas Cleared or Disturbed Outside the Approved Project Footprint	n/a	-	1.7	4.6	5.6	8.3	1.7	2.9	1.0	2.7
All	12,738.3	458.8	1,339.7	3,545.8	5,281.6	5,640.1	880.9	2,206.1	1,735.8	358.5

Notes:

¹ Due to rounding, some of the change values are slightly different than obtained from subtracting the numbers in the table.² Areas subsequently approved by MSD that are not part of the licensed Project footprint.³ Areas for some Project areas differ slightly from those presented in the 2016 and 2017 annual reports because some infrastructure in the waterworks area was removed.



Map 3-2: Actual Project clearing or disturbance as of early September 2018

3.3 CLEARING OR DISTURBANCE BY PROJECT COMPONENT

This section describes clearing and disturbance observed at each Project component. Recommendations regarding mitigating impacts, as well as the associated follow up actions, are summarized in Appendix 2: Table 6-2.

3.3.1 ACCESS ROADS

All NAR and SAR clearing mapped as of September 2018 was unchanged from September 2017 (Figure 3-1 and Figure 3-2; Table 3-1 and Table 3-3). No road construction activity was observed during 2018 surveys (road maintenance was ongoing).

All NAR and SAR clearing was within the planned Project footprint boundary. The clearing visible outside of the SAR ROW was part of the Keeyask Transmission Project (KTP).

One instance of disturbance was observed within the NAR footprint. Erosion on the south ditch bank adjacent to Borrow Area KM-1 had created a gully. This gully was first identified during 2016 surveys. Since then, erosion has expanded the gully and removed the mineral material under a treed area between the ditch and the borrow area (Map 3-3; Figure 3-19). Gully expansion between the 2017 and 2018 surveys was about 3 m², which was less than that observed between 2016 and 2017.

Table 3-3: Clearing or disturbance within the possibly disturbed Project footprint, and areas cleared or disturbed outside the approved Project footprint as of September 2018, by main Project component

Project Component	Clearing or Disturbance (ha)					
	Within the Possibly Disturbed Project Footprint			Outside the Approved Project Footprint		
	2017 ¹	2018	Change	2017	2018	Change
South Access Road	4.45	4.45	-	-	-	-
Camp & Work Areas	2.55	3.33	0.78	0.01	0.01	-
Generating Station Area	10.99	11.60	0.61	-	-	-
Borrow Areas	6.34	58.00	51.66	2.95	5.39	2.43
EMPAs	59.30	61.08	1.79	0.32	0.52	0.20
Dykes	32.86	34.31	1.45	0.03	0.05	0.02
Reservoir Clearing & Cutlines	115.38	123.25	7.88	2.32	2.32	0.00
Total	231.87	296.03	64.17	5.63	8.29	2.66

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

¹ Areas for some footprint types differ slightly from previous report because some clearing was reclassified into other Project components as the footprint developed, and some infrastructure in the generating station area (river works) was removed.

September 2017



September 2018



Figure 3-19: Majority of the erosion gully in NAR ditch along treed bank in September 2017 and September 2018

3.3.2 MAIN CAMP, NORTH SHORE WORK AREAS AND WELL AREA

The extent of clearing for the Main Camp, Well Road and Helicopter Pad did not change from September 2017 to 2018 (Figure 3-3).

The extent of clearing in work areas A, B and X north of the Nelson River has remained unchanged since 2015 (Figure 3-5).

At the east side of Work Area C there was an additional 0.3 ha of clearing and infrastructure development associated with the downstream boat launch (Table 3-3).

In 2018, an area already cleared for the Keeyask Transmission Project adjacent to the SAR was utilized for a Manitoba Hydro work area (site offices) during construction of the South Dyke. This area totalled approximately 0.4 ha.

At the Main Camp, water outflow from a culvert at its northeast corner extended approximately 60 m into the uncleared forest in 2018. Pooling water and wetter ground were killing understory vegetation, including herbs and shrubs (Map 3-3; Figure 3-6).

On the west side of the batch plant in Work Area A, sediment had been deposited over approximately 0.16 ha of uncleared vegetation (Map 3-3) at the time of the 2017 surveys. When this sediment was subsequently excavated from the area, the underlying vegetation and substrate was disturbed. The 2018 surveys found that sediment excavation expanded the disturbed area by approximately 448 m², or 0.04 ha (Figure 3-6).

The only new clearing or disturbance within the possibly disturbed Project footprint was 0.31 ha of clearing associated with the downstream boat launch, 0.11 ha of clearing at the south side of Work Area C near the tailrace cofferdam, and 0.37 ha associated with the SAR site offices.

3.3.3 BORROW AREAS

Between September 2017 and 2018, most (55 ha) of the new vegetation clearing associated with borrow areas was for the newly developed Borrow Area E-1 and its 8.6 km winter access road (Figure 3-8). The remaining borrow area clearing was an approximately 2.5 ha expansion of Borrow Area Q-1.

Excavation continued in 2018 at borrow areas G-3, N-5, N-21, S-2a, and S-2b, but this did not require any new vegetation clearing.

New or expanding disturbance was observed at several borrow areas during the 2018 surveys. The following paragraphs detail the occurrences.

On the south side of Borrow Area N-5 (Map 3-3), a silt bag became detached from a drainage hose, and sediment was deposited approximately 60 m into the adjacent uncleared forest, disturbing approximately 0.16 ha (Figure 3-9).

On the south side of the Nelson River, a portion of Borrow Area B-2 had been developed into a temporary camp area (Figure 3-8). The camp was not in use at the time of the 2018 surveys.

In Borrow Area B-6, erosion had created a disturbance along a natural drainage channel, affecting approximately 0.28 ha of undisturbed habitat (Figure 3-10; Map 3-3). Water flow from the SAR to the east edge of the pit was undermining the uncleared forest, causing trees to collapse and killing forest floor vegetation. As the erosion appeared to be ongoing, Manitoba Hydro staff were notified after it was discovered.

In total, 58 ha of borrow area clearing along the SAR fell within the possibly disturbed Project footprint as of September 2018 (Table 3-3).

The 2017 surveys had observed a drainage hose along the north side of Borrow Area N-5 eroding a mineral slope and depositing sediment into the uncleared forest. The field report recommended that erosion barriers be constructed where needed, and that the drainage hose be extended to the base of the slope and secured. Surveys in early July, 2018 found that the hose had been moved to a new location on the slope, a new erosion gully was forming (Figure 3-9) and sediment was being deposited into the adjacent uncleared forest. Manitoba Hydro staff were notified while staff were conducting the July surveys. By the time of the September 2018 surveys, the hose had been extended to the base of the slope, and a sediment bag was attached. However, it was noted that a hole had formed in the sediment bag, and a small amount of sediment was escaping into the uncleared area (Map 3-3).

In Borrow Area G-3, erosion on the mineral slopes around the perimeter was depositing sediment into the uncleared forest at several locations (Map 3-3; Figure 3-9). It was recommended that site staff inspect the locations and evaluate if additional erosion control measures would be needed to prevent sediment from entering undisturbed terrestrial habitat. As of March 2019, sediment fence had been installed along a portion of the south side of the borrow area.

At one location within the borrow area at KM-9, which was used by the KIP, a 2 m wide erosion gully formed within an area planted with tree seedlings. The planted seedlings were being washed away.

In total, there was 58 ha of borrow area clearing within the possibly disturbed Project footprint as of September 2018 (Table 3-3). This was a nearly 52 ha increase from September 2017. The large increase was due to the clearing of Borrow Area E-1, none of which was in the planned Project footprint. Clearing or disturbance outside of the approved Project footprint associated with borrow area clearing increased to 5.39 ha in 2018, all of which was associated with Borrow Area E-1 (Figure 3-8; Map 3-2; Appendix 1: Table 6-1).

3.3.4 DYKES

For this section, 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 footprint.

Between September 2017 and 2018, an additional 1 ha of new clearing had occurred along the North Dyke as its construction continued (Figure 3-11). Additionally, 8 ha of new clearing was present along the South Dyke (Map 3-2; Figure 3-12). Since September 2017, several sections of the South Dyke were gravelled, and the east end of the dyke was under active construction at the time of the 2018 surveys.

Dyke clearing within the possibly disturbed Project footprint in September 2018 totalled 34.31 ha, an increase of 1.45 ha since September 2017 (Table 3-3). This clearing was along both the north and south dykes (Appendix 1: Table 6-1). Along the North Dyke, most of the clearing in the possibly disturbed Project footprint was associated with drainage ditches extending away from the dyke. Approximately 0.02 ha of clearing outside the approved Project footprint occurred at two new locations. One was a small area at the northern extent of a ditch extending north from the North Dyke, and the other approximately midway along the south dyke on the north side (Map 3-2). The latter was a slight expansion of an area outside the approved Project footprint that was cleared in 2017.

3.3.5 EXCAVATED MATERIAL PLACEMENT AREAS

The situations at EMPAs D16 and D17 in September 2018 were similar to each other. Between September 2017 and 2018, bank slopes had been graded (Figure 3-13) and erosion was carrying sediment from the banks into undisturbed areas. Measures taken in 2017 and 2018 to contain the sediment transport were not effective at many locations. Grading did not increase the area of EMPA D17. While grading expanded EMPA D16 by approximately 0.21 ha, there was no additional clearing.

For EMPA D16, surveys in 2017 found that sediment from slope erosion had overwhelmed the silt fences, and sediment was being deposited into uncleared vegetation adjacent to the northern and eastern slopes of EMPA D16. The silt fences were subsequently reinforced in those locations. However, surveys in 2018 found that they had been overwhelmed again (Figure 3-14; Map 3-3).

Similar to what was found in 2017, the largest such disturbance at EMPA D16 was near its northeast corner. Erosion had created a channel, which drained a pond in the EMPA adjacent to the rock crusher. Water drainage from the pond carried sediment through the wetland north of the EMPA into the water of Stephens Lake. In combination, these disturbances affected approximately 0.17 ha (Map 3-3).

It was recommended that site staff inspect the entire northeast side of EMPA D16 and repair existing and/or add new erosion containment measures to prevent sediment from entering Stephens Lake. Silt fences were repaired or reinforced in the fall of 2018. Implementation of additional mitigation measures at the north side of EMPA D16 began in March, 2019. As of March 31, 2019, a rock berm had been installed along the base of the northeast slopes of EMPA D16, and organic material had been spread over the mineral materials downslope from the berm.

An additional approximately 0.16 ha disturbance was observed adjacent to the east side of the EMPA D16 (Figure 3-14). Site environmental staff indicated that a peat plateau bog there was disturbed by heavy equipment. The surface peat disturbance appears to have led to ground ice melting, which caused the bog to collapse and a small pond to form.

At EMPA D17, surveys in 2017 found that sediment from slope erosion had overwhelmed the silt fences and was being deposited into uncleared vegetation adjacent to the northern slopes. The silt fences were subsequently reinforced in those locations. However, surveys in 2018 found that they had been overwhelmed again (Figure 3-14; Map 3-3). These silt fences were repaired or reinforced in the fall of 2018.

The EMPAs along the North Dyke had no additional clearing or disturbance since September 2017. The small expansion of EMPA D19-I on William Smith Island since September 2017 was contained within previously cleared areas.

South of the Nelson River, several EMPAs along the south dyke had been cleared by 2017, but were not yet in use. These included D23(1), D27, D28 and two D31 areas. By September 2018,

EMPAs D27 and D23(1) were in use, but there was no clearing or disturbance outside of the previously cleared boundaries (Figure 3-13). The eastern portion of D23(1) was being utilized as a rock crusher area. By 2018, an additional 3.6 ha had been cleared for EMPA D23(2) on the east side of the SAR (Map 3-2).

Clearing for the EMPAs within the possibly disturbed Project footprint covered an area of approximately 61.1 ha by September 2018 (Appendix 1: Table 6-1). In EMPA D16, approximately 0.2 ha of the new clearing and disturbance was in the possibly disturbed Project footprint, and in EMPA D23(2) 1.6 ha of the new clearing was in the possibly disturbed Project footprint. Most of the remaining EMPA-related clearing or disturbance was within the planned Project footprint.

A 0.20 ha portion of the new clearing and disturbance in EMPA D16 was outside the approved Project footprint (Map 3-2). This included almost all of the excavation adjacent to its west side, most of the large disturbed area in the wetland at its northeast edge, and the new sediment deposition disturbances near its northeast corner.

3.3.6 RIVER WORKS AREA

Construction of the spillway and tailrace channel summer level cofferdam had been completed prior to September 2018 (Figure 3-16). Following completion of the spillway, the spillway cofferdams were removed, reducing the infrastructure (dewatered area) by approximately 16 ha. Between September 2017 and 2018, an additional 21 ha was dewatered or cleared by new infrastructure in the river works area.

The river works area expanded by 0.61 ha within the possibly disturbed Project footprint between September 2017 and 2018. This area change occurred in parts of the South Dam and GS Area. None of the river work areas were outside the approved Project footprint.

3.3.7 RESERVOIR CLEARING

The entire planned reservoir clearing south of the Nelson River was completed prior to the 2018 surveys, with the vast majority of this clearing happening when the ground was frozen. Reservoir clearing accounted for 269 ha of the clearing between September 2017 and 2018, accounting for the majority (75%) of all new clearing.

As of September 2018, approximately 123 ha of the reservoir clearing were within the possibly disturbed Project footprint, situated around the perimeter of the reservoir clearing footprint (Appendix 1: Table 6-1).

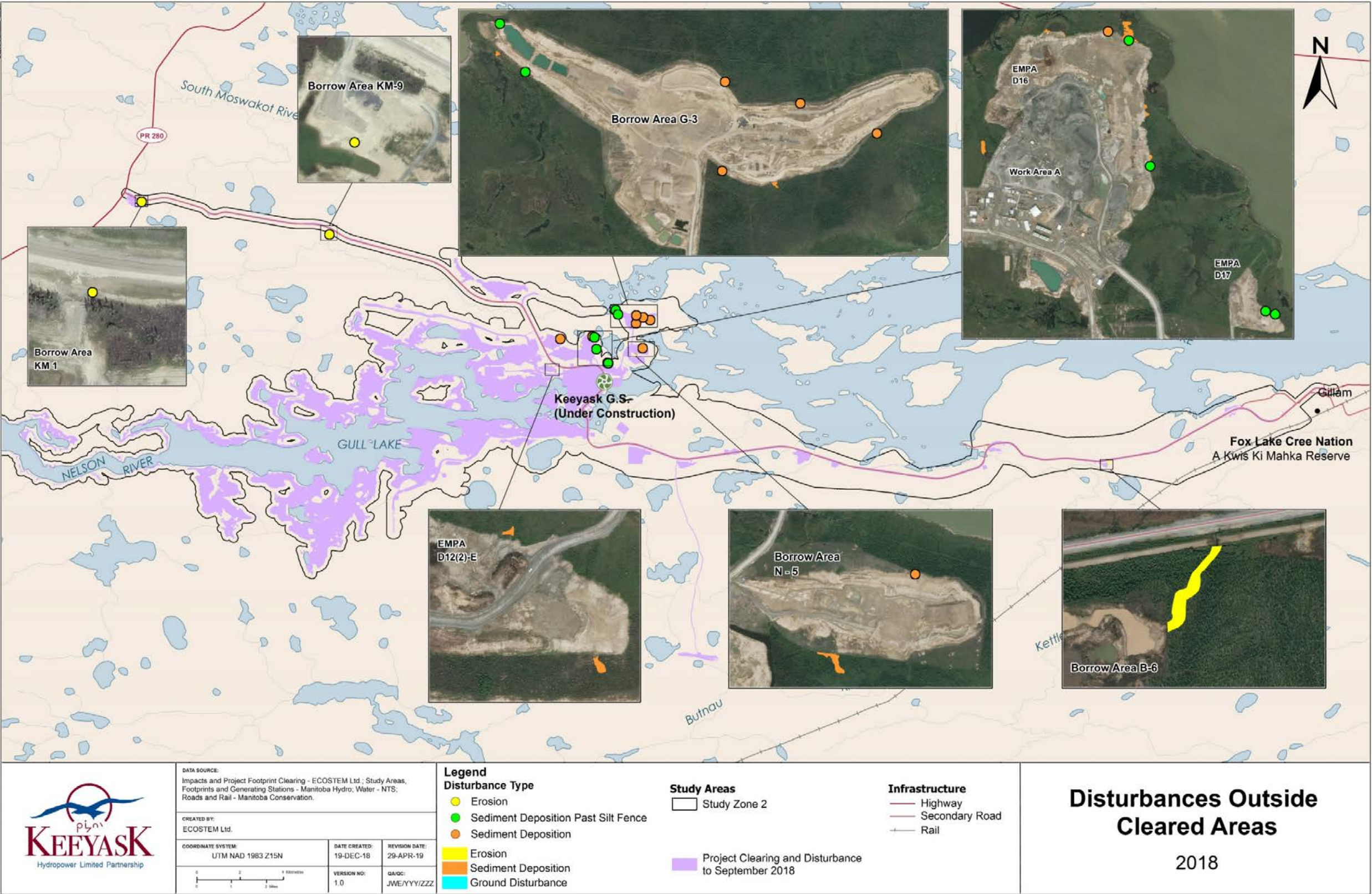
Approximately 1.60 ha of reservoir clearing was outside the approved Project footprint, which was unchanged from 2017. This area was very small (0.04%) relative to the extensive reservoir

clearing area that was covered; most of this area was in numerous scattered, small patches, primarily on Caribou Island and on the mainland just south of Caribou Island (Map 3-2).

3.3.8 TRAILS

Several access trails were used for reservoir clearing or to conduct geotechnical investigations near Little Gull Lake (Figure 3-18; Map 3-2). In some cases, new trails were cleared, but where possible pre-existing trails were utilized. The latter case was considered to be a Project disturbance, as opposed to Project clearing. By September 2018, the total area in trails was 41 ha, which is unchanged from 2017.

Approximately 0.33 ha of the trail clearing or disturbance fell within the possibly disturbed Project footprint (Appendix 1: Table 6-1). A total of 0.73 ha of the clearing or disturbance fell outside the approved Project footprint. These included two segments of pre-existing cutlines that were disturbed during north reservoir clearing which were not among the segments approved by the Province (Map 3-2). Three segments of trails used for south reservoir clearing (totalling 2.68 ha) were outside of the licensed Project footprint, but they were subsequently approved by MSD for Project use.



Map 3-3: Disturbances outside of cleared areas in 2018

4.0 DISCUSSION

Project clearing or disturbance between September 2017 and 2018 totalled 359 ha. This was the lowest annual amount of clearing and disturbance during Project construction. Manitoba Hydro has indicated that the vast majority of Project clearing is now complete.

Since the habitat monitoring began in 2014, recommendations regarding impacts that may merit mitigation were provided following field surveys and in annual reports (Appendix 2: Table 6-2). The mitigation carried out in response to these recommendations generally addressed the original concern. The exceptions entailed situations where the issue was shifted to a different location at the same footprint or the implemented measure was not adequate to address the concern. The following details these exceptions, and describes the subsequent mitigation.

In 2017, a drainage hose on the north side of Borrow Area N-5 was eroding the bank and depositing sediment into undisturbed terrestrial habitat. The location of the drainage hose was moved between September 2017 and July 2018. Monitoring in 2018 found that erosion and sediment deposition was now occurring at the new hose location. The 2018 recommendation following the field survey was to take steps to eliminate bank erosion at this new location. Site staff have since moved this hose to a new location and installed a silt bag. Surveys in 2019 will evaluate if the most recent measures are successfully containing the sediment.

At EMPAs D16 and D17, sediment has been overwhelming silt fences since 2017. Surface water runoff is depositing this sediment into a water channel that is connected to Stephens Lake and into a wetland that is adjacent to Stephens Lake. At both EMPAs, the sediment transport occurred in the presence of erosion control measures, including slope grading and the installation of silt fences. For both of these situations, the 2018 recommendation from the field survey was to inspect the entire relevant bank, repair existing silt fences, and add new erosion containment measures as needed to prevent sediment from entering Stephens Lake. Silt fencing was repaired and/or reinforced around the perimeters of both EMPAs in fall 2018. Implementation of more mitigation at the north side of EMPA D16, including re-sloping and installation of check dams and armouring, was completed in March 2019. Surveys in 2019 will evaluate if these measures have successfully contained the sediment.

Localized sediment deposition into undisturbed areas was occurring at two borrow areas. At Borrow Area G-3, sediment from eroding banks was bypassing silt fences along its southeast perimeter. Sediment was also being deposited at several other locations around the borrow area perimeter. On the south side of Borrow Area N-5, a new drainage hose was depositing silt approximately 60 m along a cutline and into uncleared vegetation. The 2018 field survey recommendation was for site staff to inspect these areas, install or reinforce silt fences where needed, and evaluate and implement additional erosion control measures as needed. As of March, 2019, no new erosion control measures had been implemented. Surveys in 2019 will document any newly installed measures.

5.0 SUMMARY AND CONCLUSIONS

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.

Most of the planned clearing had been completed by September 2018, and no other major clearing is anticipated. Since September 2017, new clearing and disturbance totalled 359 ha, which was the lowest annual amount since the start of Project construction.

Habitat loss and disturbance monitoring documented approximately 5,640 ha of clearing or physical disturbance as of September 2018. This area was still only 44% of the total area included in the licensed Project footprint.

Of the total area cleared or disturbed to September 2018, 93.3% (5,263 ha) was within the planned Project footprint, while 5.4% (306 ha) was within the possibly disturbed Project footprint (Map 2-1). Impacts in the possibly disturbed Project footprint were only 6.0% of the 5,123 ha included for this Project area.

Clearing within the possibly disturbed Project footprint since September 2017 was mostly associated with reservoir clearing and Borrow Area E-1. The remaining clearing was in a few small areas along the North and South Dykes and associated EMPAs, in the generating station area, and in the camp and work areas.

Most of the 8.29 ha of clearing or disturbance outside the approved Project footprint was located at Borrow Area G-1, in the future reservoir area and around Borrow Area E-1. Overall, this 8.29 ha area was very small relative to the 7,170 ha of still undisturbed area in the licensed Project footprint. As illustrated in Map 3-2, the area cleared or disturbed outside the approved Project footprint was only 0.12% of the remaining portions of the licensed Project footprint that have not yet been disturbed. Additionally, most of the still undisturbed area within the licensed Project footprint in 2018 was expected to remain undisturbed by the Project.

To date, the Project has not created any major unanticipated removal or alteration of terrestrial habitat. As expected, the total amount of clearing and physical disturbance as of September 2018 is much less than included in the licensed Project footprint. The 2018 monitoring led to recommendations for additional mitigation in five localized areas. There are no recommendations to modify the study methods based on monitoring results to date.

5.1 NEXT STEPS

Monitoring fieldwork for the Habitat Clearing and Disturbance study will continue in 2019. No major changes to field methods are anticipated.

6.0 LITERATURE CITED

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APPENDIX 1: DETAILED RESULTS

Table 6-1: Clearing or physical disturbance within the possibly disturbed areas and outside of the combined planned, possibly disturbed and subsequently approved areas as of September 2018, 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		
		2017	2018	Change	2017	2018	Change
Access Roads	South Access Road	4.45	4.45	-	-	-	-
Camp & Work Areas	Main Camp	0.00	0.00	-	-	-	-
	Work Area A	0.75	0.75	-	-	-	-
	Work Area B	0.42	0.42	-	0.01	0.01	-
	Work Area C	0.19	0.29	0.11	-	-	-
	Work Area X	0.11	0.11	-	-	-	-
	Hydro Offices South	-	0.37	0.37	-	-	-
	Portage Route	1.09	1.40	0.31	-	-	-
River Works Area	Generating Station	0.36	0.72	0.36	-	-	-
	Spillway & Cofferdam	10.62	10.88	0.25	-	-	-
Quarries and Borrow Areas	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	2.75	-
	G-3	-	-	-	0.00	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	26.72	-	0.01	0.01
Excavated Material Placement Areas	D1(2)-I	0.03	0.03	-	-	-	-
	D12(1)-E	0.01	0.01	-	-	-	-
	D12(2)-E	6.16	6.16	-	-	-	-
	D16(1)-E	15.11	15.31	0.20	0.25	0.46	0.20
	D17-E	0.00	0.00	-	0.02	0.02	-
	D23(1)-E	1.57	1.57	-	-	-	-
	D23(2)-E	-	1.58	1.58	-	-	-
	D27(4)-E	26.06	26.06	-	0.01	0.01	-
	D28(1)-E	5.85	5.85	-	-	-	-
	D31(1)-E	1.28	1.28	-	-	-	-
	D31(2)-I	0.12	0.12	-	0.00	0.00	-

Project Component	Component Name	Clearing or Disturbance (ha)					
		Within Possibly Disturbed Areas			Outside of Combined Planned, Possibly Disturbed and Subsequently Approved Areas		
		2017	2018	Change	2017	2018	Change
	D3-E	3.08	3.08	-	0.03	0.03	-
	D7-E	0.02	0.02	-	-	-	-
	D9-I	0.01	0.01	-	-	-	-
Dykes	North Dyke	24.21	24.81	0.60	-	0.01	0.01
	South Dyke	8.65	9.50	0.85	0.03	0.04	0.01
Reservoir Clearing	Reservoir Clearing	115.05	122.93	7.88	1.60	1.60	-
	Trails	0.33	0.33	-	0.73	0.73	-
Total		231.87	296.03	64.17	5.63	8.29	2.66

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

APPENDIX 2: MITIGATION RECOMMENDATIONS

Table 6-2: Summary of Mitigation Recommendations

Location	Year	Project Impact	Recommendation ¹	Mitigation Implemented
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.	Silt fence installed.
	2018	Sediment bypassing silt fences along SE perimeter. Erosion depositing sediment at several other locations around area perimeter.	Sep. 2018: Site staff inspect the area, reinforce silt fences where needed, and evaluate and implement additional erosion control measures as needed.	Silt fence installed along part of the south side.
Borrow Area G-5	2016	Sediment deposition into uncleared area adjacent to area.	Aug. 2016: Erosion control measures recommended along edge of area.	None to date.
Borrow Area KM-4	2017	Expanding erosion gully washing out planted trees.	Sep. 2017: Evaluate whether there are practicable ways to prevent further erosion.	None to date.
Borrow Area N-5	2017	Drainage hose on north side of area eroding 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 eroding 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 silt bag was installed.
	2018	Erosion and sediment deposition from drainage hose and failed silt 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.	None to date.
Excavated Material Placement Area D16	2017	Erosion and sediment deposition into uncleared habitat on north and east sides of the area.	Aug. 2017: Repair and reinforce silt fence on east side and install silt fence on the north side.	Silt 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. Silt 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.	Silt fences were repaired or reinforced in the fall of 2018. Installation of rock berm and organic material armouring along base of northeast slope in March, 2019.
Excavated	2017	Sediment overwhelmed silt fences	Sep. 2017: Repair and reinforce silt fences as	Silt fences were reinforced

Location	Year	Project Impact	Recommendation ¹	Mitigation Implemented
Material Placement Area D17	2018	along northeast slope. Sediment overwhelmed silt fences along northeast slope.	needed. 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.	between 2017 and 2018. Silt fences were repaired or reinforced in fall, 2018.
North Access Road at KM-1	2016 2017	Erosion of ditch bank under trees. Erosion of ditch bank under trees.	Aug. 2016: Consider erosion control measures at this location. Sep. 2017: Consider mitigation options to prevent further erosion or collapse of the bank.	None to date. None to date.
South Dyke	2016	Sunken ATV in wetland.	Aug. 2016: Remove ATV as soon as possible.	ATV removed.

Notes: ¹ Recommendations in addition to continued monitoring. The date at the beginning of a line indicates the month and year that the recommendation was made.