Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Bank Swallow Habitat Effects Monitoring Report

TEMP-2023-14

KEEYASK

Manitoba Environment and Climate Client File 5550.00
Manitoba Environment Act Licence No. 3107

2022 - 2023

KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2023-14

BANK SWALLOW HABITAT EFFECTS

YEAR 1 OPERATION

2022

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

June 2023

This report should be cited as follows:

Wildlife Resource Consulting Services MB Inc. 2023. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2023-14: Bank Swallow Habitat Effects – Year 1 Operation, 2022. A report prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., June 2023.

SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at the former Gull Rapids began in July 2014 and all generating units were in service by March 2022. 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 will affect the environment, and whether or not more needs to be done to reduce harmful effects.

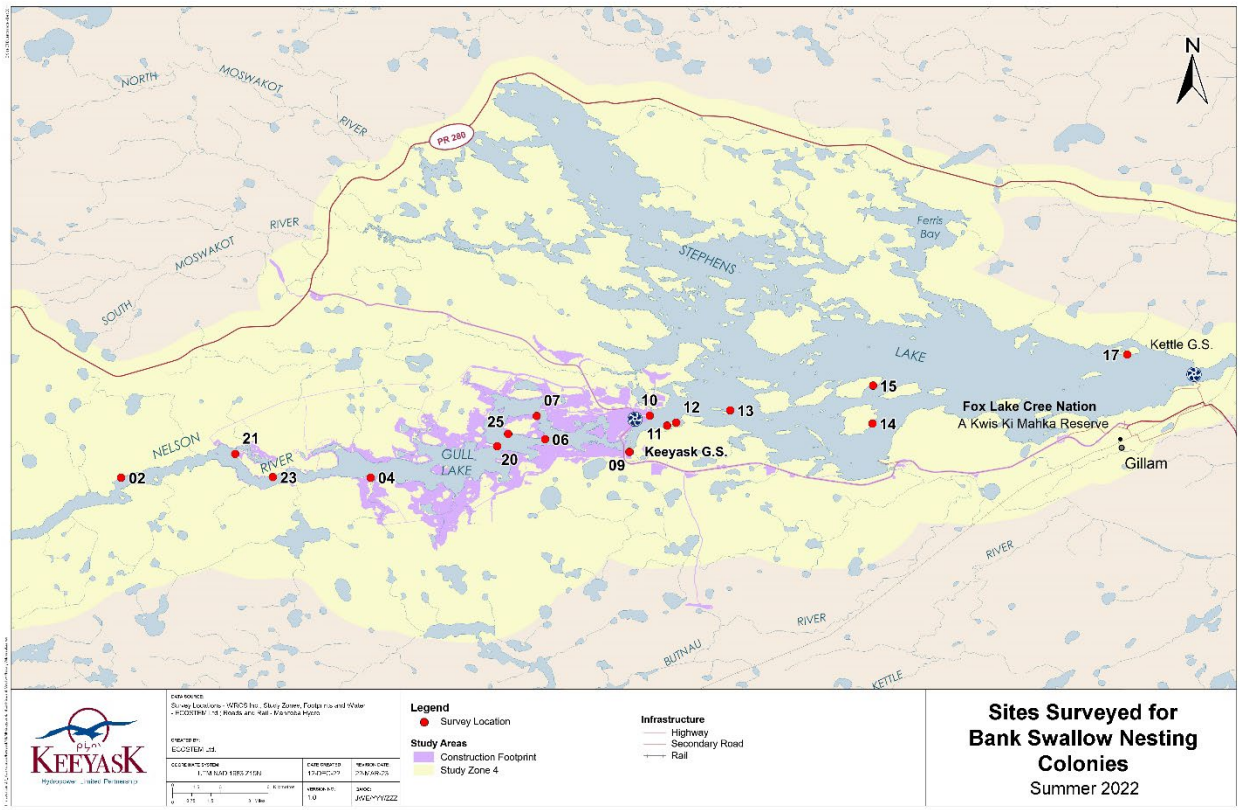
Banks swallows are small, insect-eating birds that excavate nesting burrows in sandy riverbanks and gravel pits. Relatively few bank swallows were observed in the Clark Lake to Stephens Lake area during pre-Project field studies; at most 40 individuals were identified in a single year. Potential construction-related effects on bank swallows identified in the Project's environmental assessment were loss or alteration of some breeding or foraging habitat; sensory disturbances from people, machinery, and equipment near breeding colonies; and possible increased mortality. Construction monitoring for bank swallows began in 2016 and continued in 2018, 2020, and 2021. Operation monitoring for bank swallows began in 2022.

Why is the study being done?

Bank swallow is a priority bird to be monitored because of its designation as Threatened by the Committee on the Status of Endangered Wildlife in Canada in 2013. It was officially listed as Threatened under the federal *Species at Risk Act* (SARA) in 2017. The main objective of the 2022 bank swallow study was to evaluate their presence or absence in the Keeyask region during Project operation, and to verify anticipated Project effects on these SARA-listed birds.

What was done?

Bank swallow colonies initially identified in summer 2016 and/or subsequent monitoring years during construction were surveyed again in 2022. Sixteen sites were surveyed once or twice by boat in late June and early July, including two that were not observed during construction monitoring. The number of birds was estimated, and a series of photographs were taken at sites where burrows were observed. Two independent observers counted the number of burrows in the photographs, and an estimate of the bank swallow population in Study Zone 4 (the Regional Study Area) was generated.



Sites Surveyed for Bank Swallow Nesting Colonies, Summer 2022

What was found?

Bank swallow burrows were observed at 14 of the 16 sites surveyed in 2022, including two colonies that had not been identified during Project construction monitoring. A total of 433 birds were counted in June and 907 in July. Two former colonies were inactive; no birds or burrows were observed in 2022. Colonies ranged in size from seven to 1,900 burrows, not all of which were occupied. An estimated 2,695 breeding pairs (or 5,390 adults) inhabited Study Zone 4 in 2022, an increase of 64% from 2021 and of 34% from 2016, when monitoring studies began for this species.

Following reservoir impoundment in September 2020, new shorelines formed rapidly and resulted in the collapse of some unoccupied bank swallow burrows at three sites (04, 06, and 07 see map above) in the affected area. At the time, the habitat at each of these sites appeared to remain suitable for future nesting. In 2022, no burrows or birds were observed at site 06, but the colonies at sites 04 and 07 were active.

What does it mean?

Overall, the regional Keeyask bank swallow population appears to be stable or possibly increasing. The bank burrows and birds observed at sites 04 and 07 in the Keeyask reservoir indicate that they remain suitable for nesting. The habitat at site 06 appeared to be considerably

less suitable for nesting than in previous years due to the reduced height of the bank. Two additional sites were colonized by bank swallows in 2022, indicating that alternative habitat for bank swallows is available in the region.

What will be done next?

Long-term bank swallow monitoring that began in 2016 will continue in 2024.

STUDY TEAM

We would like to thank James Ehnes of ECOSTEM Ltd. for providing maps, and Sherrie Mason and Rachel Boone of Manitoba Hydro for reviewing the report. Biologists, technicians, and other personnel who designed, participated in, and drafted the survey results included:

- Robert Berger, Wildlife Resource Consulting Services MB Inc. (WRCS) – Design and reporting
- Andrea Ambrose (WRCS) – Analysis and reporting
- Mark Baschuk (WRCS) – Survey personnel
- Thomas Wood (WRCS) – Survey personnel
- James Redhead (Fox Lake Cree Nation) – Boat operator

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

LIST OF PHOTOS

LIST OF APPENDICES

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 the former 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. Project construction began in July 2014 and all generating units were in service by March 2022.

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. 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). The *Terrestrial Effects Monitoring Plan* (TEMP) was developed as part of the licensing process for the Project. Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, bank swallow (*Riparia riparia*), during the construction and operation phases.

Bank swallows are small, insect-eating birds that migrate to Manitoba in spring (Weatherhead et al. 1985; Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2013). In the Keeyask region, the breeding season typically extends from late May to early August (Taylor 2018). Bank swallow is a priority bird for Project monitoring because it was assessed as Threatened by COSEWIC in 2013 and was officially listed as Threatened under the federal *Species at Risk Act* (SARA) in 2017. It is not listed as a species at risk under *The Endangered Species and Ecosystems Act* of Manitoba.

Bank swallows are colonial breeders that excavate nesting burrows in sandy riverbanks and gravel pits (Grieef 2003). Steep, nearly vertical banks are typically selected (Hjertaas 1984; COSEWIC 2013). Many burrows may be excavated in a single colony, but up to two thirds are unoccupied in a typical breeding season (Grieef 2003; Burke 2017). The availability of suitable nesting habitat is a major factor limiting the size and distribution of breeding populations in Canada (COSEWIC 2013).

Relatively few bank swallows were observed in the region during pre-Project field studies for other birds from 2001 to 2014; at most 40 individuals were identified in the Clark, Gull, and Stephens lakes area in a single year. No surveys targeting bank swallow were conducted during the EIS field studies and all observations were incidental. Potential construction-related effects on bank swallow were loss or alteration of some breeding or foraging habitat; sensory disturbances from people, machinery, and equipment near breeding colonies; and possible increased mortality. No Project-related effects on bank swallows during the operation period were anticipated. The objectives of the bank swallow monitoring study, outlined in Section 5.8.6 of the TEMP, were to evaluate their presence or absence in suitable habitat in Study Zone 4 (the Regional Study Area), and to verify anticipated Project effects on these SARA-listed birds.

2.0 METHODS

Surveys for bank swallow were conducted in summer 2022, mainly at sites along the Nelson River from Birthday Rapids downstream to the Kettle GS area on Stephens Lake in Study Zone 4 (the Regional Study Area; Map 1). Fourteen sites identified as bank swallow colonies during Project construction monitoring and two previously unidentified colonies were visited once or twice by boat on June 20 and July 20, 2022 (Table 1), in the primary breeding season. Two observers estimated the number of birds present during each site visit. A series of photographs were taken at all active nesting colonies for burrow counts. A total of 16 nesting sites were surveyed, nine in the Keeyask reservoir or upstream to Clark Lake, and seven in Stephens Lake.

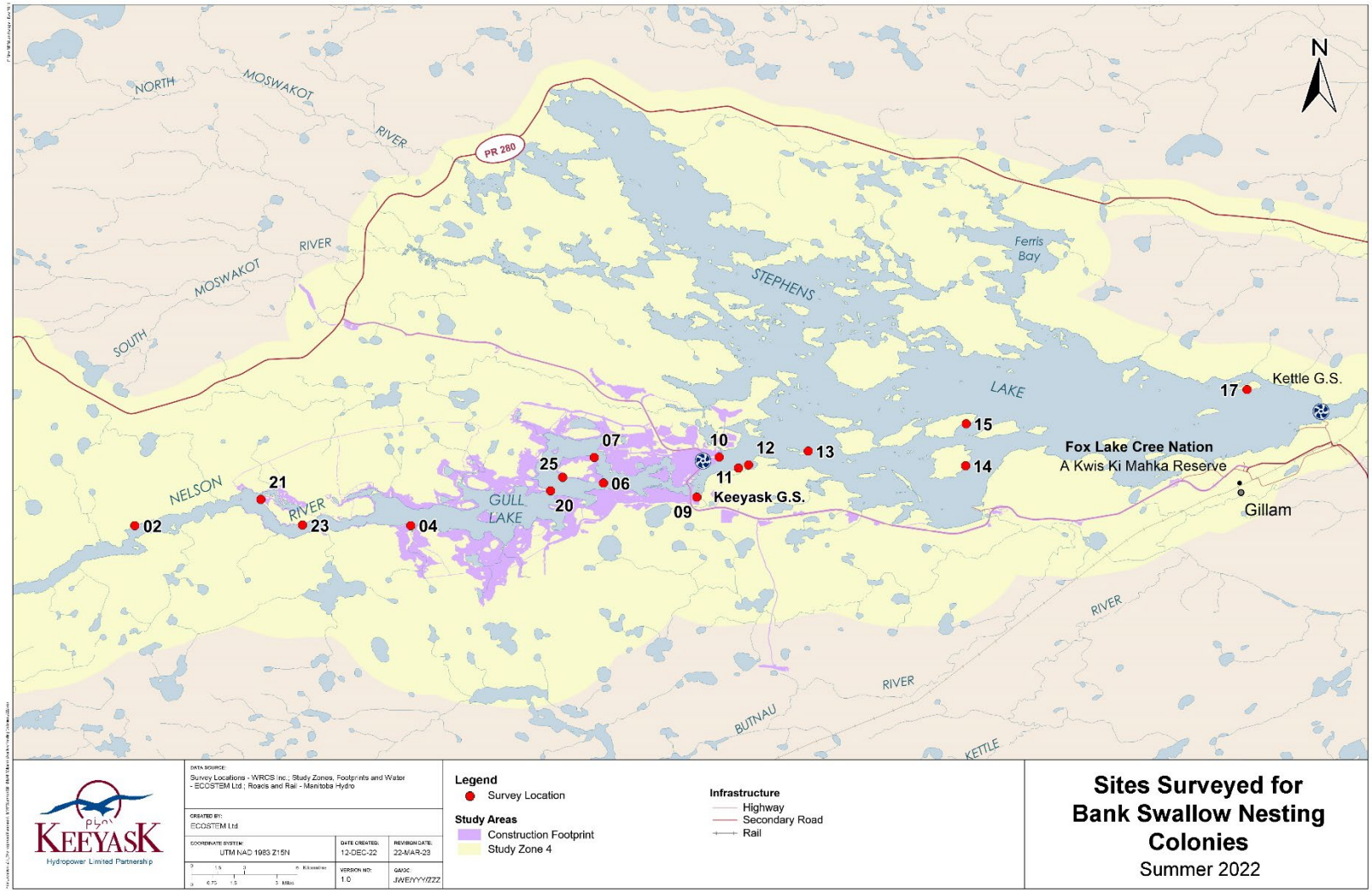
Photos taken at each colony were magnified in Paint 3D and the number of burrows was counted independently by two observers (Appendix 1). The mean of these counts plus standard deviation and 95% confidence interval were calculated at each site for each visit.

The mean number of burrows at each colony (the larger of the observations during each site visit) was multiplied by 0.5 to provide an estimate of the number of breeding pairs in Study Zone 4. There are typically more burrows in a colony than there are nesting pairs of bank swallows (Garrison 1999; Falconer et al. 2016; Burke 2017). New burrows are constructed each season (Garrison 1999; Falconer et al. 2016) leaving older, intact burrows unoccupied. In some cases, burrow excavation is abandoned as obstacles are encountered (Garrison 1999; Falconer et al. 2016), resulting in more holes than birds to occupy them. Mean occupancy of bank swallow burrows ranges from 43 to 74% (Garrison 1999; Bird Studies Canada unpubl. data in COSEWIC 2013). It has most recently been suggested that the number of breeding pairs in a colony can be estimated as 50% of the number of burrows (Wright et al. 2011; Falconer et al. 2016), and it was assumed that 50% burrow occupancy would provide a reasonably conservative estimate of the bank swallow population in Study Zone 4.

Table 1: Sites Surveyed for Bank Swallow Nesting Colonies, Summer 2022

Location	Site	Location	Dates Surveyed
Reservoir or upstream	02	15 V 331606 6243531	June 20, July 20
	04	15 V 347288 6243533	June 20, July 20
	06	15 V 358235 6245942	June 20, July 20
	07	15 V 357720 6247397	June 20, July 20
	09	15 V 363536 6245149	June 20
	20	15 V 363536 6245149	June 20, July 20
	21	15 V 338769 6245016	June 20, July 20
	23[1]	15 V 341128 6243558	June 20, July 20
	25[1]	15 V 355913 6246268	June 20, July 20
Stephens Lake	10	15 V 364806 6247412	June 20, July 20
	11	15 V 365903 6246796	June 20, July 20
	12	15 V 366476 6246968	June 20, July 20
	13	15 V 369874 6247761	June 20, July 20
	14	15 V 378819 6246929	July 20
	15	15 V 378855 6249312	July 20
	17	15 V 394805 6251247	July 20

1. Bank swallow burrows observed for the first time in 2022.



Map 1: Sites Surveyed for Bank Swallow Nesting Colonies, Summer 2022

3.0 RESULTS

Of the 16 sites surveyed in 2022, bank swallow burrows were photographed at 14, including two where none were previously observed during Project construction monitoring (sites 23 and 25; Map 2, Appendix 2). No bank swallow burrows were observed at two of the thirteen colony sites identified during construction monitoring (sites 06 and 21; Table 2).

Where burrows were observed, the mean number at each colony ranged from seven to 1,900. The largest colony was located at site 12 on an island in Stephens Lake. The colonies at sites 20, 10, and 17 were small, with fewer than 20 burrows at each. In general, there were fewer burrows at colonies on sloped, shrubby banks (Photo 1) than on steep banks with little vegetation (Photo 2). Most nesting burrows were located near the top of the bank. However, at site 23, which was first identified as a colony in 2022, burrows were excavated at the bottom of a short, shrubby bank, closer to the water than at other colonies (Photo 3).

The mean number of burrows observed was greater during the July survey than the June one at all but five sites, likely because additional burrows were excavated as the breeding season progressed. Variations in observer counts at sites 07, 25, 11, 12, and 13 were likely due in part to differences in shadows, photo angles, and direction of travel that could have resulted in more burrows being counted earlier in the season. The lower counts during the July survey could also have been a result of collapsed burrows due to ongoing erosion.

Bank swallows were observed at all sites with burrows during at least one of the two surveys in 2022. A total of 433 birds were estimated during the June survey and 907 during the July one. Where birds were observed, a minimum of four were recorded at site 17 during the July survey and a maximum of 200 were estimated at sites 07 and 12, also during the July survey (Table 2). Bank swallows were observed at both colonies first identified in 2022, suggesting that they were active. No bank swallows were observed at sites 06 and 21.

Table 2: Mean Number of Bank Swallow Burrows at 16 Sites, Summer 2022

Location	Site	Survey Date	Mean Number of Burrows	Standard Deviation	95% Confidence Interval	Number of Birds
Reservoir or upstream	02	June 20	624	61.5	85	35
		July 20	647	53.0	73	120
	04	June 20	240	2.8	4	65
		July 20	306	103.2	143	120
	06	June 20	0	–	–	0
		July 20	0	–	–	0
	07	June 20	762	4.9	7	120
		July 20	719	33.2	46	200
	09	June 20	128	8.5	12	0
	20	June 20	15	6.4	9	6
		July 20	19	0	0	10
	21	June 20	0	–	–	0
		July 20	0	–	–	0
	23[1]	June 20	11	1.4	2	9
		July 20	97	2.8	4	15
	25[1]	June 20	294	32.5	45	17
		July 20	288	16.3	23	80
Stephens Lake	10	June 20	7	1.4	2	6
		July 20	10	3.5	5	0
	11	June 20	382	21.2	29	80
		July 20	222	13.4	19	12
	12	June 20	1,900	104.7	145	70
		July 20	1,780	35.4	49	200
	13	June 20	249	4.9	7	25
		July 20	223	33.9	47	15
	14	July 20	178	32.5	45	31
	15	July 20	402	60.1	83	100
	17	July 20	16	2.1	3	4

1. Observed for the first time in 2022.

Red oval indicates bank swallow burrows; note toppled trees and bank erosion.

Photo 1: Portion of a Small Bank Swallow Colony at Site 20, July 2022

Photo 2: Portion of a Large Bank Swallow Colony at Site 12, July 2022

Photo 3: Portion of a Bank Swallow Colony at Site 23, July 2022

The regional (Study Zone 4) bank swallow population was estimated at 2,695 breeding pairs or 5,390 individuals in 2022 (Table 3). The population increased from 2016 to 2018, declined in 2020 and 2021, and then increased considerably (64%) in 2022. The estimated number of breeding pairs was 34% greater in 2022 than when surveys began in 2016.

Table 3: Estimated Bank Swallow Population in Study Zone 4 during (2016, 2018, 2020, 2021) and after (2022) Project Construction

Year	Number of Breeding Pairs	Number of Individuals	Percentage Change from Previous Year
2016	2,005	4,010	–
2018	2,261	4,522	+13
2020	2,033	4,066	-10
2021	1,641	3,282	-19
2022	2,695	5,390	+64

The subpopulations of individual colonies in Study Zone 4 ranged from five to 950 breeding pairs in 2022, based on the largest of the mean numbers of nesting burrows during two surveys at each site. From 2021 to 2022, the mean number of bank swallow burrows increased at nine of the 13 colonies previously identified in the region, by as little as 1% at site 04 and by as much as 128% at site 12 (Table 4). The mean number of burrows decreased between 5% and 100% at four sites from 2021 to 2022. At site 06, the height of the bank was reduced after reservoir impoundment and only eight burrows were observed in 2021, a 98% decrease from the previous year. No

burrows or birds were observed there in 2022. At site 07, which was on the same large island in Gull Lake as site 06 before impoundment, a large increase in the mean number of burrows was observed from 2021 to 2022. There was little change in the mean number of burrows at sites 04 and 09, which were in the reservoir or upstream of it, and at sites 11 and 15 in Stephens Lake. The two colonies first identified in 2022 were in the Keeyask reservoir or upstream. Site 25 was located on the same large island as site 07, and site 23 was upstream on the Nelson River (see Map 2).

Table 4: Mean Number of Bank Swallow Burrows at 16 Sites during (2016, 2018, 2020, 2021) and after (2022) Project Construction

Location	Site	Mean Number of Burrows[1]					Percentage Change 2021–2022
		2016	2018	2020	2021	2022	
Reservoir or upstream	02	313	357	505	413	647	+57
	04	183	386	288	302	306	+1
	06	69	292	343	8	0	-100
	07	139	486	359	381	762	+100
	09	10	151	132	126	128	+2
	20	–	11	–	25[2]	19	-24
	21	–	–	–	11	0	-100
	23[3]	–	–	–	–	97	–
	25[3]	–	–	–	–	294	–
Stephens Lake	10	2	5	14	6	10	+67
	11	421	373	537	403	382	-5
	12	1,600	1,694	956	835	1,900	+128
	13	89	135	186	223	249	+12
	14	180	53	174	122	178	+46
	15	463	446	547	421	402	-5
	17	12	14	24	11	16	+46

1. Greatest mean number observed during the first and second surveys.
2. 127% increase from 2018.
3. Observed for the first time in 2022.

From 2021 to 2022, the number of bank swallows observed increased at seven of the 14 previously identified colonies (Table 5). The largest increase (210%) was at site 14, where more birds were observed in 2022 than in any previous survey year. The number of bank swallows decreased between 29% and 100% at four sites. Despite the relatively large percentage change (33% increase) in the number of birds observed at site 17 from 2021 to 2022, only one more bird was observed in 2022 than in 2021. An increasing trend in the mean number of nesting burrows and maximum number of birds recorded in Study Zone 4 has been observed since monitoring began in 2016 (Figure 1).

Table 5: Maximum Number of Bank Swallows at 16 Sites during (2016, 2018, 2020, 2021) and after (2022) Project Construction

Location	Site	Maximum Number of Bank Swallows[1]					Percentage Change 2021–2022
		2016	2018	2020	2021	2022[2]	
Reservoir or upstream	02	77	95	171	120	120	0
	04	34	50	74	106	120	+13
	06	11	21	79	4	0	-100
	07	35	28	189	80	200	+150
	09	12	28	3	6	0	-100
	20	–	2	–	14[3]	10	-29
	21	–	–	–	0	0	0
	23[4]	–	–	–	–	15	–
	25[4]	–	–	–	–	80	–
Stephens Lake	10	2	6	0	0	6	–
	11	77	70	119	75	80	+7
	12	225	57	110	101	200	+98
	13	27	25	11	57	25	-56
	14	7	12	4	10	31	+210
	15	76	31	68	62	100	+61
	17	0	0	0	3	4	+33

1. Greatest number observed during the first and second surveys.
2. Numbers estimated in 2022.
3. 600% increase from 2018.
4. Observed for the first time in 2022.

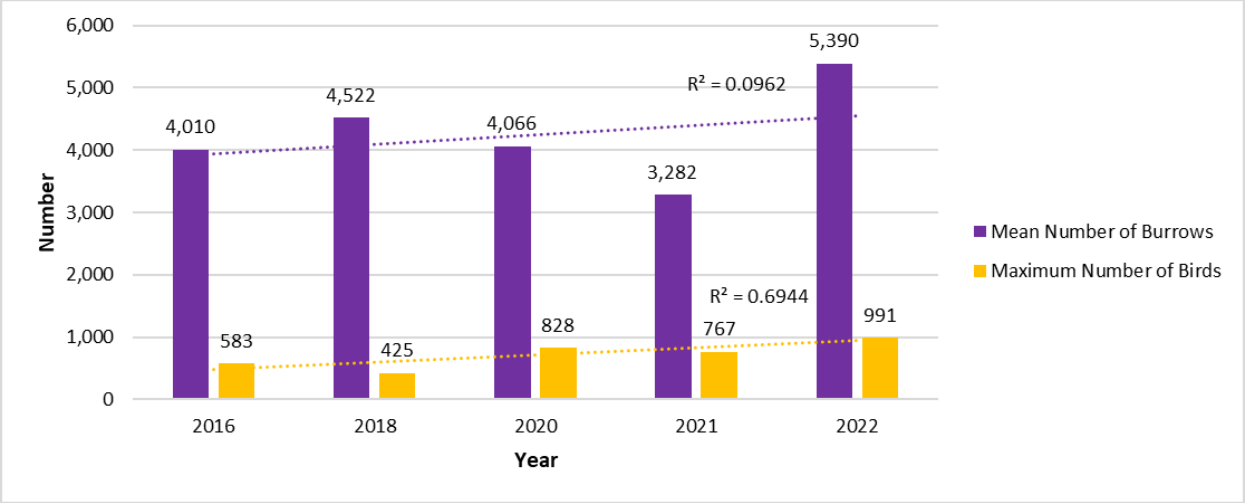
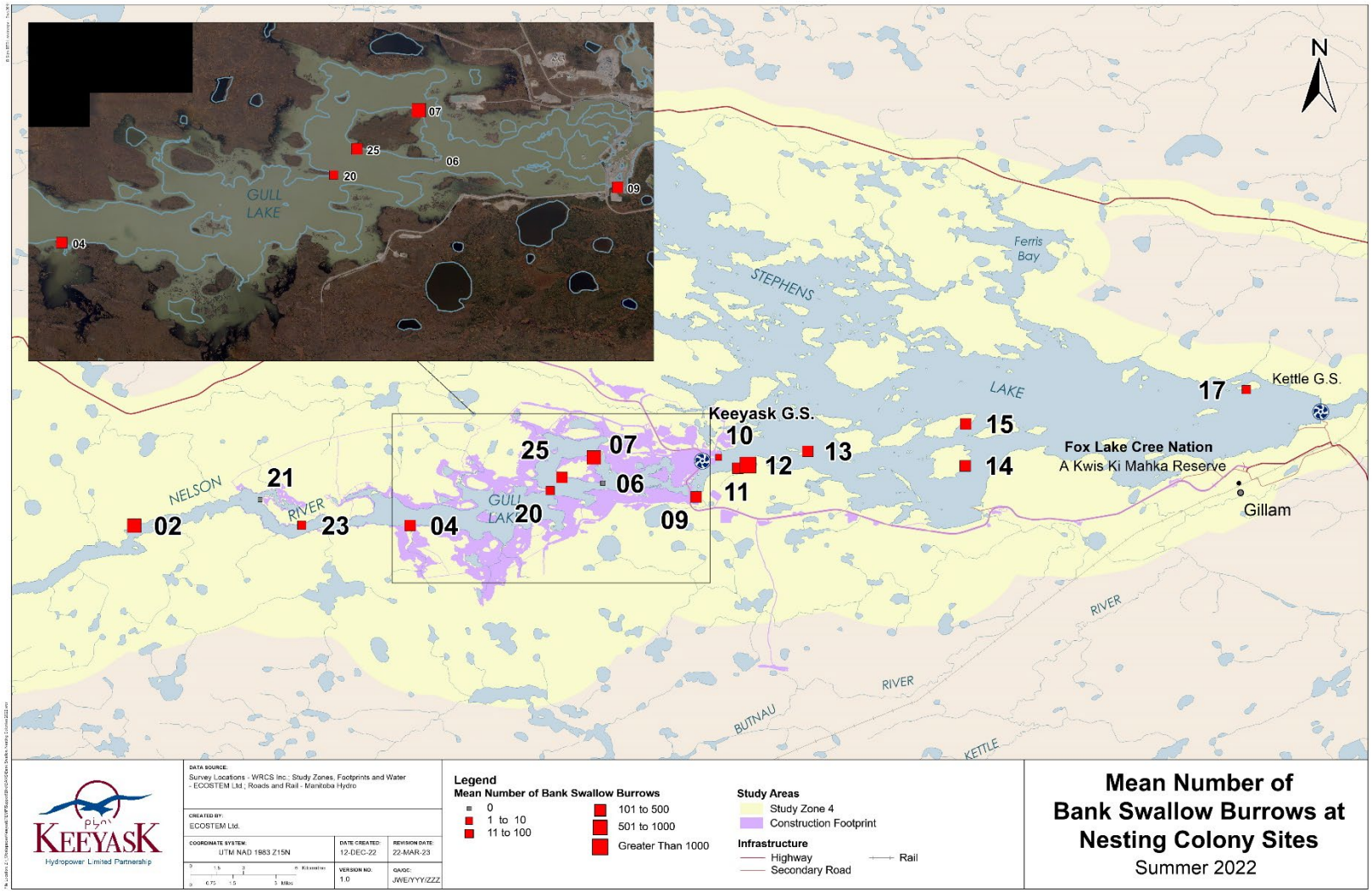


Figure 1: Bank Swallows and Burrows Observed in Study Zone 4 during (2016, 2018, 2020, and 2021) and after (2022) Project Construction



Map 2: Mean Number of Bank Swallow Burrows at Nesting Colony Sites, Summer 2022

4.0 DISCUSSION

Overall, the regional Keeyask bank swallow population appears stable. A small decrease in the estimated bank swallow population was observed in Study Zone 4 (the Regional Study Area) from 2018 to 2020 and a larger decrease was observed from 2020 to 2021. However, a substantial increase in the estimated population was recorded from 2021 to 2022. Reduced numbers of burrows during some years could be due to the collapse of older nesting holes as a result of localized bank erosion. This process "refreshes" the bank face, maintaining it at the steep angle required for bank swallow nesting (Garrison 1999; Florsheim et al. 2008; Falconer et al. 2016). Bank swallows often return to previous nesting sites (Falconer et al. 2016; Government of Canada 2019) but because of the unstable nature of their nesting habitat, colony sites may change from year to year, or individuals will relocate if habitat becomes unsuitable (Government of Canada 2019).

No nesting burrows or birds were observed at site 21 in 2022. Eleven burrows were counted in 2021, when the site was first identified, but it did not appear to be active as no bank swallows were observed. Because there were no burrows or birds at this site in 2022, it was removed from consideration as a colony.

In September 2020, bank undercutting and erosion were noted underneath the existing bank swallow burrows at sites 04, 06, and 07 during reservoir impoundment, resulting in the collapse of up to half of the unoccupied burrows at each location (WRCS 2021). The steep, sandy banks required for bank swallow nesting persisted at each site. While the remaining habitat appeared be suitable for nesting at the time of the impoundment monitoring survey, it was uncertain if these sites would continue to be suitable in the future. The large increase in the number of burrows at site 07, within the reservoir, from 2020 to 2021 and from 2021 to 2022 indicates that it remained suitable for nesting early in the Project operation monitoring period. At site 04, there was no change in the number of burrows observed from 2021 to 2022. More than 100 bank swallows were observed at this colony in 2022, indicating that it was still active. A large decrease in the number of burrows was observed at site 06, also within the reservoir, from 2020 to 2022. The unoccupied burrows collapsed during or after reservoir impoundment in 2020 and only eight were counted the following year. The site was inactive in 2022, when no birds or burrows were observed. It appeared to be considerably less suitable for nesting than in previous years due to the reduced height of the bank following impoundment.

The large colony at site 12 was formed from erosion processes shortly after a small peninsula separated from the mainland and formed two islands on Stephens Lake circa 2005. There was no evidence of bank swallow colonies on the small island in 2008. A small to moderate-sized cluster of nesting burrows was first observed in 2011, suggesting that the colony formed between 2009 and 2011. Substantial numbers of burrows were recorded on this island in 2016 and 2018. The size of the pioneering bank swallow colony is unclear, and it is unknown whether the increase in colony size several years later might be attributed to con-specific attraction, high colony productivity and survival, or both. The number of burrows at the site fluctuated during Project

construction monitoring, having decreased 44% from 2018 to 2020 and 13% from 2020 to 2021. The cause of the decline at this location is unknown, as the colony is in Stephens Lake and was not affected by reservoir impoundment. As indicated above, localized bank erosion may have caused burrows to collapse. The number of nesting burrows at the site more than doubled from 2021 to 2022 and it remained the largest colony in the study area throughout the Project construction and early operation monitoring periods, indicating that it is an important area for bank swallow nesting in the Keeyask region.

More bank swallows and nesting burrows were observed in Study Zone 4 in 2022 than during any Project construction monitoring year. While the number of each fluctuated over the construction and early operation monitoring periods, the regional bank swallow population appears to be stable or increasing.

5.0 SUMMARY AND CONCLUSIONS

There is a large bank swallow population in the Keeyask region. In 2022, the estimated bank swallow population in Study Zone 4 (the Regional Study Area) was 5,390 individuals, an increase of 64% from the previous year. The estimated population was 34% greater in 2022 than when surveys began in 2016. Overall, the regional Keeyask bank swallow population appears to be stable or increasing.

Bank swallows rely on eroding mineral soils and steep sandy banks to form suitable nesting habitat substrate, especially in the Keeyask region. Following reservoir impoundment in September 2020, new shorelines formed rapidly and abruptly altered unoccupied bank swallow burrows at three colonies in the affected area. The habitat at two of the sites remained suitable for nesting; however, no bank swallow activity of any kind was observed at the third site in 2022, and the suitability of the habitat for nesting appeared to be considerably reduced. Two new colonies that were not observed during Project construction monitoring were found in 2022. Long-term bank swallow monitoring that began in 2016 will continue in 2024, as outlined in the TEMP.

6.0 LITERATURE CITED

Burke, T. 2017. Bank swallow (*Riparia riparia*) breeding in aggregate pits and natural habitats. M.Sc. thesis, Environmental and Life Sciences M.Sc. Graduate Program, Trent University, Peterborough, ON. 99 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2013. COSEWIC assessment and status report on the Bank Swallow *Riparia riparia* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 48 pp.

Falconer, M., Richardson, A., Heagy, A., Tozer, D., Stewart, B., McCracken, J., and Reid, R. 2016. Recovery strategy for the bank swallow (*Riparia riparia*) in Ontario. Ontario Recovery Strategy Series. Prepared for Ontario Ministry of Natural Resources and Forestry, Peterborough, ON. 70 pp.

Florsheim, J.L., Mount, J.F., and Chin, A. 2008. Bank erosion as a desirable attribute of rivers. BioScience 58(6): 519–529.

Garrison, B.A. 1999. Bank swallow (*Riparia riparia*). In The Birds of North America. Edited by A.F. Poole and F.B. Gill. Cornell Lab of Ornithology, Ithaca, NY.

Government of Canada. 2019. *Species at Risk Act* Public Registry, Residence Descriptions. Description of residence for bank swallow (*Riparia riparia*) in Canada. 7 pp.

Grieef, G.D. 2003. Bank swallow. In The Birds of Manitoba. Edited by P. Taylor. Manitoba Naturalists Society, Winnipeg, MB. pp. 282–283.

Hjertaas, D.G. 1984. Colony site selection in bank swallows. M.Sc. thesis, Department of Biology, The University of Saskatchewan, Saskatoon, SK. 129 pp.

Stantec Consulting Ltd. 2013. Avian 2011 field studies report. Report #TERR-11-01. Keeyask Project Environmental Studies Program. Draft Report prepared for Manitoba Hydro by Stantec Consulting Ltd., Winnipeg, MB. 132 pp.

Taylor, P. 2018. Bank swallow. In The Atlas of the Breeding Birds of Manitoba, 2010–2014. Edited by C. Artuso, A.R. Couturier, K.D. DeSmet, R.F. Koes, D. Lepage, J. McCracken, R.D. Mooi, and P. Taylor. Bird Studies Canada, Winnipeg, MB. Available from https://www.birdatlas.mb.ca/accounts/speciesaccount.jsp?sp=BANS&lang=en [accessed September 17, 2018].

Weatherhead, P.J. 1985. Risks of clustering in thermally-stressed swallows. The Condor 87: 443–444.

Wright, D.H., Lomeli, H., Hofmann, P.S., and Nguyen, C. 2011. Burrow occupancy and nesting phenology of bank swallows along the Sacramento River. California Fish and Game 97(3): 138–147.

WRCS (Wildlife Resource Consulting Services MB Inc.). 2021. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2021-12: Bank Swallow Monitoring 2020. A report prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., June 2021.

APPENDIX 1:
EXAMPLE COUNT OF BURROWS IN PHOTOGRAPH

Alternating colours were used for each group of 10 burrows to facilitate counting.

APPENDIX 2:
BANK SWALLOW BURROW COUNTS 2022

Location	Colony	Survey Date	Photo Count 1	Photo Count 2
Reservoir or upstream	02	June 20	667	580
		July 20	684	609
	04	June 20	242	238
		July 20	379	233
	06[1]	June 20	–	–
		July 20	–	–
	07	June 20	758	765
		July 20	742	695
	09	June 20	122	134
	20	June 20	19	10
		July 20	19	19
	21[1]	June 20	–	–
		July 20	–	–
	23[2]	June 20	12	10
		July 20	99	95
	25[2]	June 20	317	271
		July 20	299	276
Stephens Lake	10	June 20	8	6
		July 20	12	7
	11	June 20	397	367
		July 20	231	212
	12	June 20	1,826	1,974
		July 20	1,755	1,805
	13	June 20	252	245
		July 20	247	199
	14	July 20	201	155
	15	July 20	444	359
	17	July 20	17	14

1. No photo count was conducted because no burrows were observed during the surveys.
2. Not observed during construction monitoring.