Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Colonial Waterbird Habitat Effects Monitoring Report

TEMP-2018-08

KEEYASK

Manitoba Sustainable Development Client File 5550.00
Manitoba Environment Act Licence No. 3107

2017 -2018

KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2018-08

COLONIAL WATERBIRD HABITAT EFFECTS MONITORING

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Service MB Inc.

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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, including colonial waterbirds. 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.

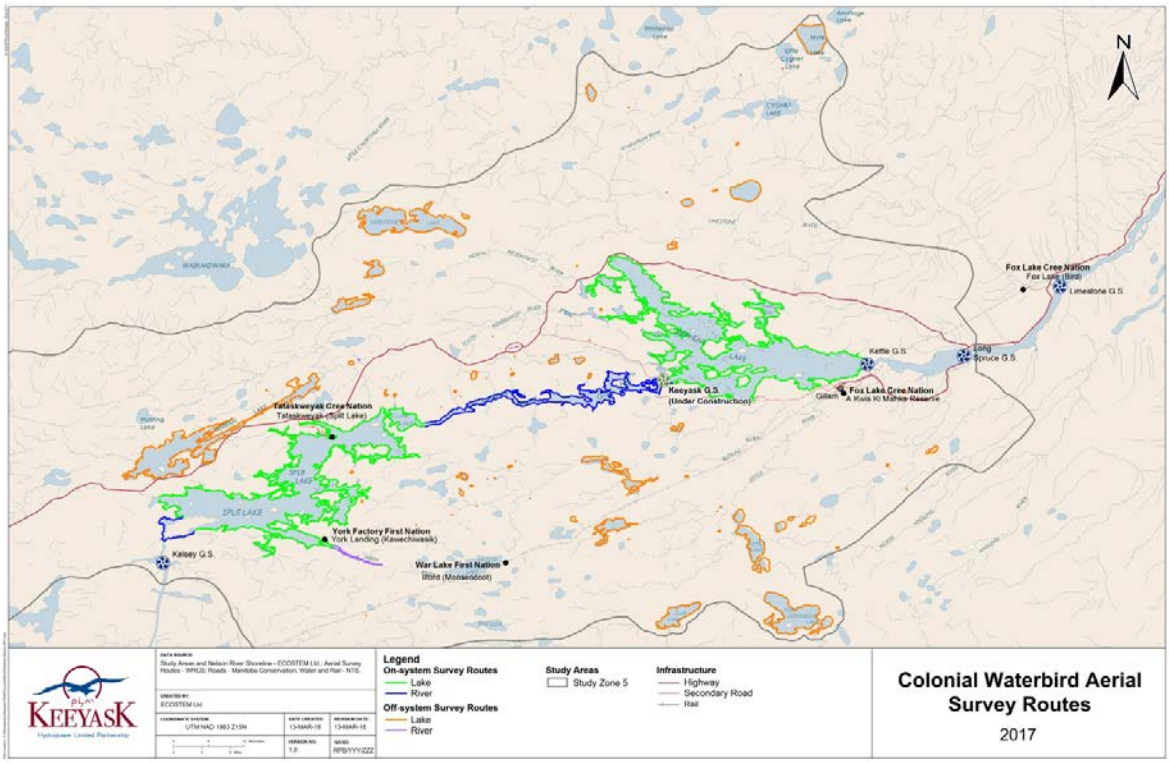
This report describes the results of colonial waterbird (gulls and terns) habitat effects monitoring conducted during the summer of 2017, the fourth summer of Project construction. Monitoring occurred along the shorelines of the Nelson River from the Kelsey Generating Station downstream to the Limestone Generating Station, including Split Lake and Stephens Lake, and at reference waterbodies off the Nelson River system.

Why is the study being done?

The Project has the potential to affect gull and tern populations through alteration and loss of habitat, as well as noise and light disturbance from construction activities. Monitoring is being done to evaluate Project effects on the distribution and relative abundance of ring-billed gulls and common terns and their breeding habitats.

What was done?

Helicopter surveys of the bird study area and unmanned aerial vehicle (UAV or drone) surveys focused on the Gull Rapids area were conducted to determine the numbers of gulls and terns, where they are found, and what kinds of habitat they are using – both in areas expected to be affected by the Project and in areas away from the Project. UAV surveys allowed the observation of gull and tern nests and chicks, from which productivity (number of chicks produced per nest) could be determined. This is the third year of colonial waterbird habitat effects monitoring; surveys were also conducted in 2015 and 2016.


N
Fox Lake Cree Nation
Fox Lake (Bird)
Limestone G.S.
Kettle G.S.
Long Spruce G.S.
Keeyask G.S.
(Under Construction)
Fox Lake Cree Nation
Gillam - A Kwis Ki Mahke Reserve
Tataskweyak Cree Nation
Tataskweyak (Split Lake)
SPLIT LAKE
York Factory First Nation
York Landing (Kawechiwesak)
Kelsey G.S.
War Lake First Nation
Ilford (Mooseocoot)
Legend
On-system Survey Routes
Lake
River
Off-system Survey Routes
Lake
River
Study Areas
Study Zone 5
Infrastructure
Highway
Secondary Road
Rail
Colonial Waterbird Aerial Survey Routes
2017

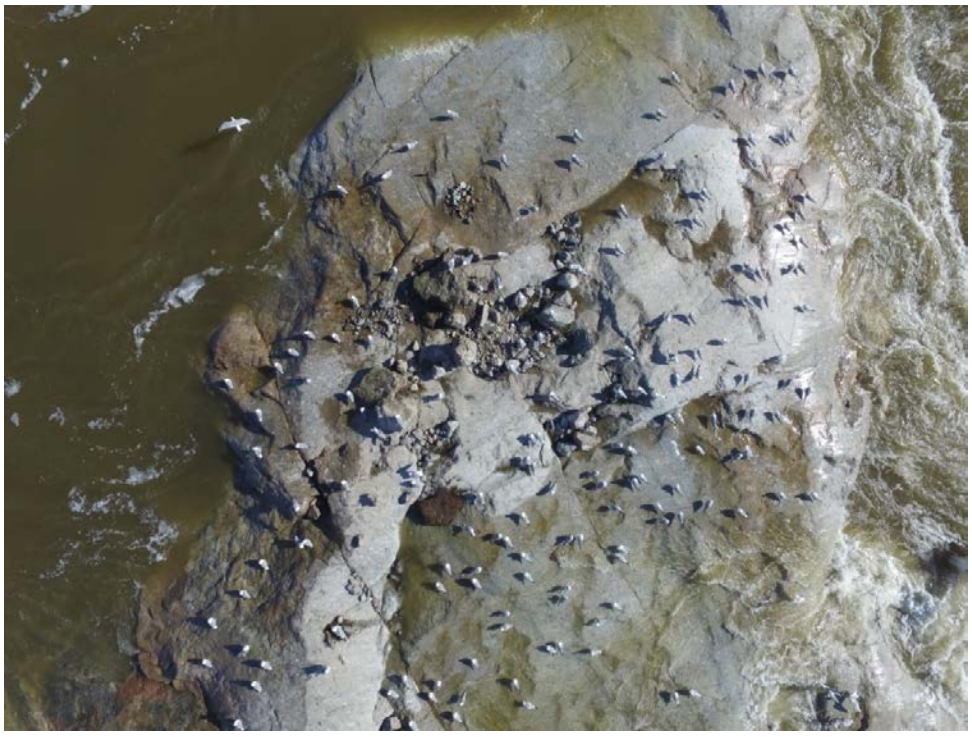

N
Wpt 83
Wpt 561
Wpt 478
Wpt 226
Wpt 225
Wpt 224
Legend
Surveyed Island
Islands Surveyed by UAV
Gull Rapids, 2017

What was found?

High water levels in the Nelson River system reduced the amount of gull and tern nesting habitat available in 2017, including at Gull Rapids where large colonies are known to occur. Because of the high water, several islands in Gull Rapids were under water during the survey period and the remaining islands were partially flooded. Fewer gulls and terns used the islands in Gull Rapids in 2017 compared to 2015 and 2016. However, several islands upstream of Gull Rapids, including an island that had been cleared of vegetation for the Project, was available and was used by colonial waterbirds for nesting. It appears that the presence of this more natural, alternate nesting habitat in the area may be preferred by colonial waterbirds and is limiting the use of the William Smith Island gull habitat enhancement area and the tern nesting platforms.

Gulls and terns attempted to nest on available habitat within Gull Rapids and at eight other locations in the study area in 2017, but the nests were abandoned and no gull or tern chicks were seen. It is unclear why nests were abandoned, but it may have been a result of their susceptibility to storm-generated waves, crowding, or available food resources.

The high water levels in the Nelson River system in spring 2017 also appeared to reduce the amount of gull and tern habitat use and overall productivity in the study area. The study area supported fewer gulls and terns in July 2017 compared to July 2016. There were also fewer ring-billed gull colonies and herring gull nest sites in the study area in 2017 compared to 2016 and 2015.



UAV Photo of an Island in Gull Rapids

What does it mean?

As observed in 2015 and 2016, noise and light disturbance from construction activities did not appear to affect gull and tern use of the islands in Gull Rapids. These birds returned to the islands in Gull Rapids and attempted to nest on the available habitat; however, Project construction may have amplified the already high water conditions in Gull Rapids, contributing to the reduction in the amount of nesting habitat available. Because high water levels were receding in June and July, it is unclear why there was a substantial change in the numbers of nests, eggs and young observed between late June, when nests were present, and mid-July when no nests or young were observed on the Gull Rapids islands.

What will be done next?

Aerial surveys will be conducted again in the spring and summer of 2018, to continue monitoring the number of gulls and terns, where they are found, and their breeding habitats. New nesting islands documented in 2017, located approximately 12 km upstream of Gull Rapids, will be surveyed by UAV to count tern and gull nests, eggs and chicks. Data that describes the type of habitat chosen by gulls and terns during construction monitoring and in future years will be incorporated into an expert information model. The model can then be used to verify the amount of habitat disturbance as a result of the Project and its potential impact on colonial waterbird populations. Since the conditions created by the Project's reservoir impoundment and operations may create new breeding habitat types, the habitat model will be confirmed during operation.

STUDY TEAM

We would like to thank Sherrie Mason and Rachel Boone of Manitoba Hydro for reviewing the report. Megan Anger of Manitoba Hydro, Ben Hofer of Custom Helicopters, and Ron Bretecher of North/South Consultants Inc. are acknowledged for logistical assistance in the field. We would also like to thank Dr. James Ehnes, ECOSTEM Ltd., for GIS supported study design and cartography and Unmanned Aerial Imaging Solutions Inc. (UAIS) for Unmanned Aerial Vehicle (UAV) operations and photography.

Biologists, technicians and other personnel who designed, participated in, and drafted the study results included:

- Robert Berger, M.N.R.M., Design, analysis, and reporting
- Mark Baschuk, M.Sc., Survey personnel
- Nicholas LaPorte, M.N.R.M., Survey personnel
- Kristian Bernjak, UAV photography

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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*, 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 Environment Supporting Volume* (TESV). 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, colonial waterbird habitat effects monitoring, for the construction and operation phases of the Project.

The Project has the potential to affect colonial waterbird populations through alteration and loss of habitat, as well as sensory disturbance. Three species of colonial waterbird - ring-billed gull (*Larus delawarensis*), herring gull (*Larus argentatus*), and common tern (*Sterna hirundo*) - commonly breed on rocky islands and reefs in the Nelson River near the Project site. Previous colonial waterbird surveys, conducted from 2001-03, 2006, 2011, and 2013-16 have counted between 3,000-6,200 (±1,000) gulls and 100-200 common terns (KHLP 2012; Stantec 2014; Stantec 2015; WRCS 2016; WRCS 2017) in the Gull Rapids area. Other colonial waterbird species that have been observed to breed in the region include herring gull, Bonaparte's gull (*Chroicocephalus philadelphia*), and Caspian tern (*Sterna caspia*). Colonial waterbirds that occur in the region but for which there is no evidence of breeding include American white pelican (*Pelecanus erythrorhynchos*), black tern (*Chlidonias niger*), and double-crested cormorant (*Phalacrocorax auritus*) (KHLP 2012).

Colonial waterbirds are generally gregarious birds that congregate into conspecific or multi-species groups of nesting birds at colony sites; the congregation of nesting birds is the colony (Kushlan 1986). Waterbird colonies range from a few birds to many thousands; however, two breeding pairs nesting at a site qualify as a colony (Kushlan *et al*. 2002). If nesting is not taking place, the group of birds is a congregation. At such sites, if birds are sleeping or resting the site is referred to as a communal roost site. Often confused with roosting, loafing includes activities involved in comfort behaviour (preening, stretching) and digestion; such sites are referred to as loafing sites (Campbell and Lack 1985).

At Gull Rapids, loss of foraging and breeding habitat and habitat avoidance due to Project sensory disturbances are anticipated construction-related effects on the local colonial waterbird population. Colonial waterbirds receive regulatory protection under the *Manitoba Wildlife Act* (2015) and the federal *Migratory Birds Convention Act* (1994). To avoid disturbing breeding

colonial waterbirds near Project construction activities, avian control measures to deter colonial waterbirds were implemented in areas affected by construction at Gull Rapids. Permitted control measures included active falconry, pyrotechnics, kites, and egg and/or nest removal. All of these measures are permitted annually by Environment and Climate Change Canada under Damage and Danger permits. To monitor potential Project construction effects on colonial waterbirds in the Gull Rapids area, an Unmanned Aerial Vehicle (UAV or drone) was used to determine abundance, distribution, and habitat use of colonial waterbirds.

The primary goal of the colonial waterbird habitat effects monitoring is to evaluate how ring-billed gull and common tern breeding habitat distribution and abundance change due to the Project. Secondly, this study will evaluate how ring-billed gull and common tern habitat effectiveness changes due to Project sensory disturbance, by measuring changes in the distribution and abundance of ring-billed gulls and common terns in the vicinity of Project disturbances. This report contains the results of the third year (2017) of the Colonial Waterbird Habitat Effects study.

2.0 METHODS

2.1 UNMANNED AERIAL VEHICLE SURVEYS

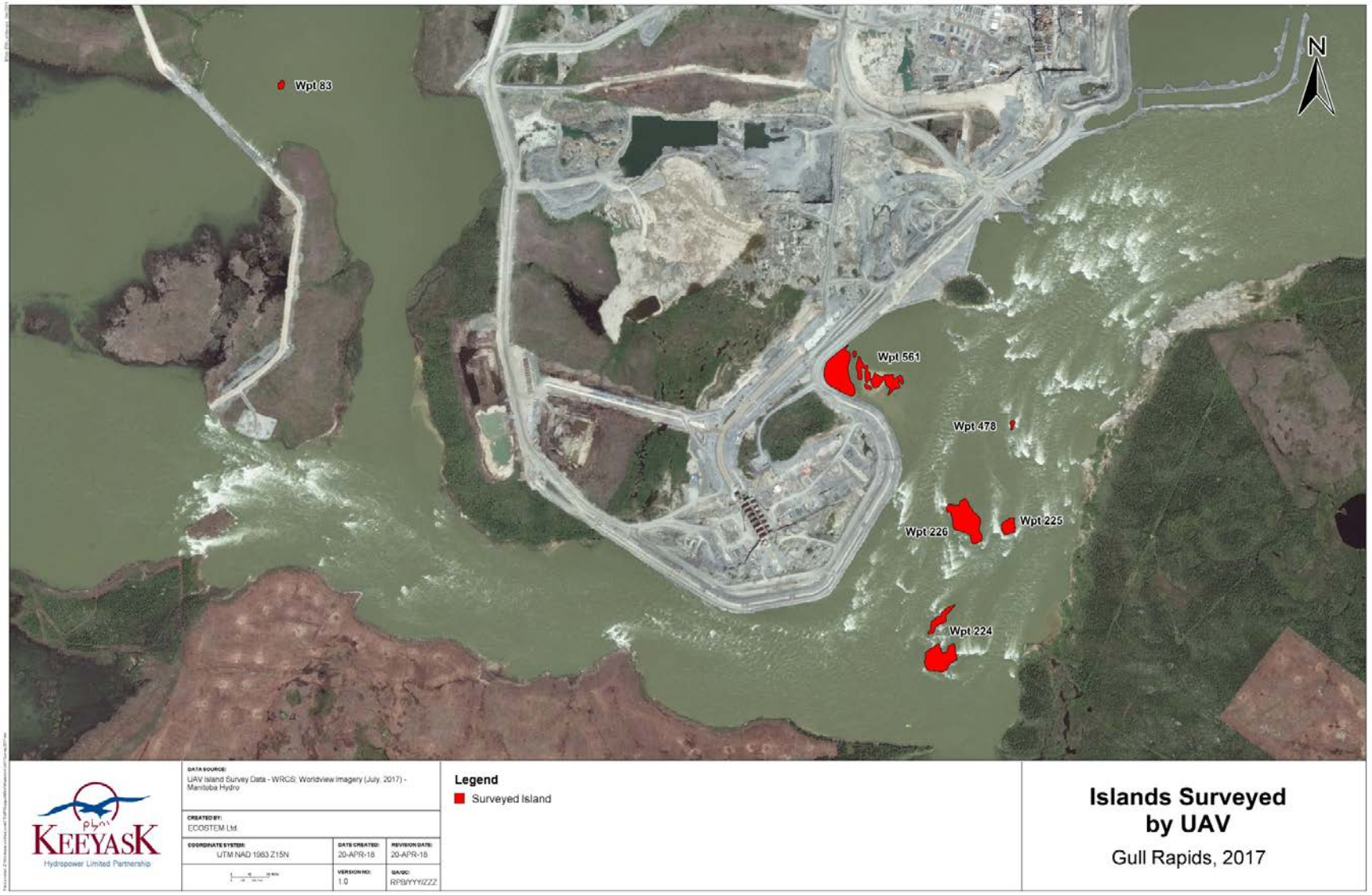
The distribution and abundance of colonial waterbirds at Gull Rapids was monitored using photographs taken from an Unmanned Aerial Vehicle (UAV or drone). Unmanned Aerial Imaging Solutions Inc. (UAIS) was contracted to conduct UAV flights and produce high-resolution images of colonial waterbird colonies and potential nesting areas in the Gull Rapids area.

UAIS deployed a DJI Phantom 3 Professional quad-copter equipped with a 12 mega-pixel camera to survey islands and shorelines in Gull Rapids. Using the software Mission Planner, camera parameters, flight path, speed, and altitude were programmed into the UAV to guide it during each flight mission. Six islands within the Gull Rapids area, known to support colonial waterbirds, were photographed by the UAV platform in a grid pattern to produce overlapping photographs (Map 1). All flights were conducted at approximately 40 m above ground level (agl) to minimize disturbance to waterbird colonies.

UAV surveys were conducted during three periods in 2017: May 30-31, June 28, and July 19, in an attempt to capture the nesting and brood rearing periods. During each of these survey periods, islands were photographed during the morning (0600-1200 hours) and afternoon (1200-1700 hours). Photographs taken in the morning and afternoon, for each survey period, were examined to determine the number of colonial waterbirds, nests, hatch-year birds (chicks), and species present on each of the nesting islands in the Gull Rapids area. A single observer examined the photographs to maintain a consistent interpretation and reduce subjectivity.

The maximum number of birds/nests/chicks observed from the morning or afternoon photographs was used to determine the potential suitability of islands for nesting colonial waterbirds. To describe the difference between morning and afternoon bird abundances, the standard deviations of bird/nests/chicks were calculated using the morning and afternoon data from the same period.

Photo 1: UAV Used to Photograph Islands in Gull Rapids in 2017



Map 1: Islands Surveyed by UAV in Gull Rapids in 2017

2.2 HELICOPTER SURVEY

Helicopter surveys were conducted to monitor the abundance, distribution, and habitat use of colonial waterbirds in portions of Study Zone 5 (the study area) during the breeding season (Map 2). A random, stratified design was used to select waterbodies to be surveyed. Waterbodies were classified broadly as either on-system (influenced by existing or future hydroelectric operations) or off-system (unaffected by hydroelectric operations), grouped into two basic waterbody types (lake or river), and grouped into five different size classes (<1, 1-10, 11-100, 101-1,000, >1,000 ha). Small watercourses (*e.g.*, creeks) were excluded from the design and selection as gulls and terns do not typically use these features as nesting habitat. The total shoreline lengths and distribution of waterbodies are presented in Table 1 and Map 2. The first survey occurred between June 22-24, 2017 when gull and tern nests are typically initiated and most gulls and terns are incubating eggs, whereas the second survey occurred during the typical chick-rearing period on July 18-19.

Different spatial data was used in 2017 than 2015 to determine the shoreline lengths of waterbodies. The CanVec Hydro Features (Natural Resources Canada 2017) dataset was used in 2017 as it was found to more accurately represent shorelines in Study Zone 5 compared to the National Hydro Network (Natural Resources Canada 2016) dataset that was used in 2015. As a result, the shoreline lengths presented in this report are different from those presented in 2016.

Table 1: Shoreline Length (km) of Waterbody Size Classes and Types Surveyed in 2017

System	Waterbody Type	Waterbody Size Class (ha)					Total Shoreline Length (km)
		<1	1-10	11-100	101-1,000	>1,000	
On-system	Lake	0	0	0	0	818	818
	River	0	0	0	32	245	277
Off-system	Lake	6	10	41	145	544	746
	River	0	0	6	23	0	28
Total		6	10	47	200	1,607	1,869

Daily flights were conducted when wind speeds were below 25 km/h and when rain or fog did not restrict observers' ability to count birds. The survey was flown at approximately 100 km/h, at elevations no less than 150 m agl, and at distances no closer than 300 m to minimize disturbance to waterbird colonies and avoid collisions with flying birds.

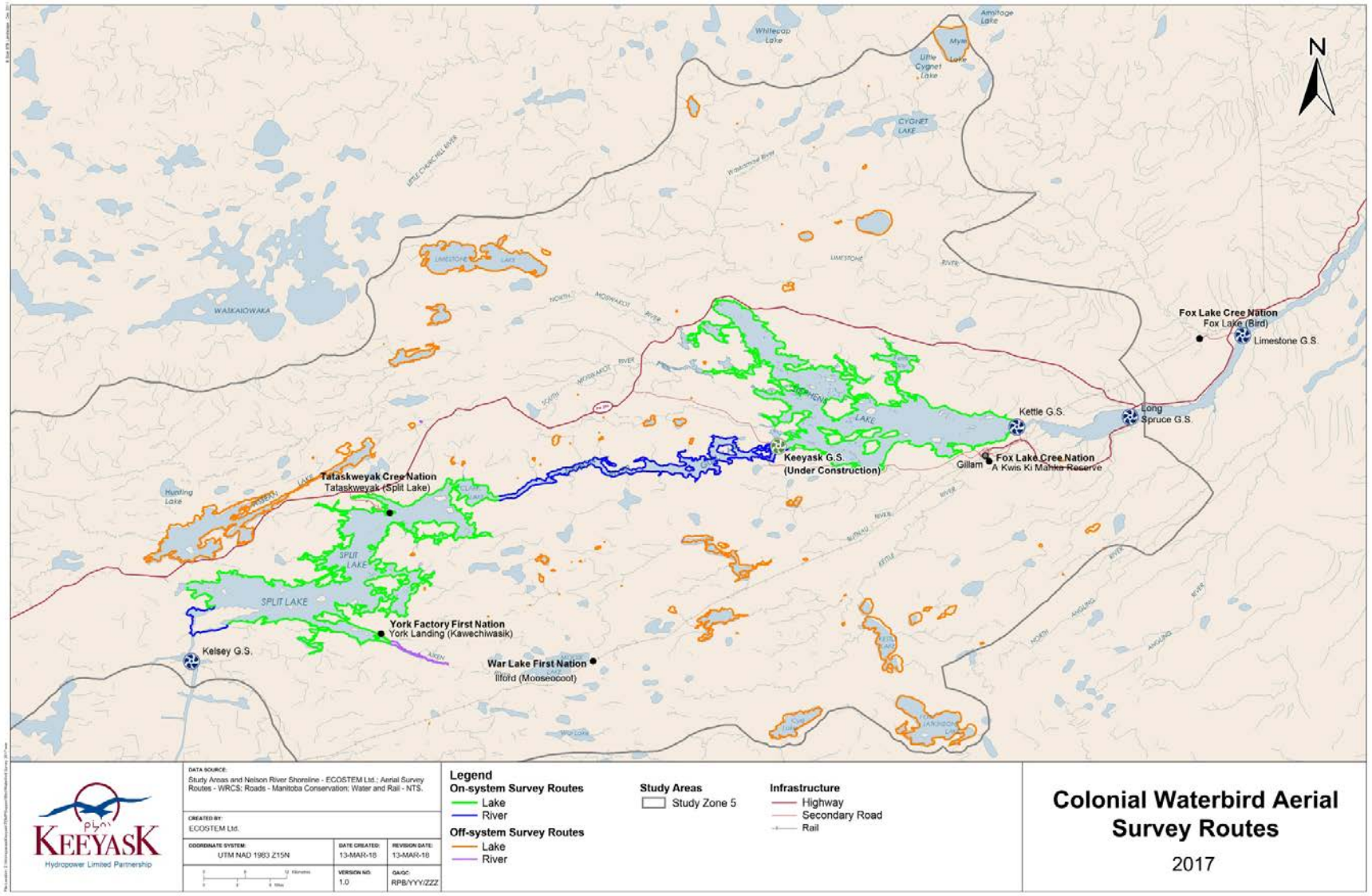
The aerial survey crew consisted of three observers and the helicopter pilot. The primary observer was seated in the front left seat and was responsible for preliminary counts of colonial waterbirds observed during the survey. The secondary observer, seated in the rear left seat, was responsible for recording observations and photographing congregations using a Nikon Coolpix Aw130, 16.0 megapixel camera. The assistant, seated in the right rear seat, counted all colonial waterbirds and incidental observations inland. The helicopter followed a shoreline transect with open water on the left and terrestrial habitat on the right. When colonial waterbirds

were spotted on rocky reefs in open water areas, the helicopter departed from the shoreline transect to investigate.

During the survey, numbers of waterbirds at all colony and congregation sites (Photo 2), and all dispersed waterbirds were recorded along with their locations. Dispersed birds were single birds and flocks of waterbirds in flight. Congregated birds were groups of birds that showed no indication of nesting (*i.e.,* nests). A group of birds was considered a colony when there were at least two breeding pairs present and signs of nesting. When a congregation of waterbirds was observed the helicopter slowed and circled the site briefly for survey personnel to photograph and count individuals and nests. Preliminary abundance estimates were made by counting all nests and individuals. In-flight counts and photography were conducted quickly to minimize disturbing birds. All observations were georeferenced with a Garmin GPS 64 global positioning system (GPS). Notes on the terrestrial habitat of congregation sites were recorded and island size (ha) was determined from remotely-sensed data. Island sizes were classified as <0.1 ha, 0.1-0.9 ha, 1.0-1.9 ha, 2.0-2.9, 3.0-3.9 ha, and >4.0 ha.

Although individuals in small congregations of colonial waterbirds could be counted during the aerial survey, their numbers were determined with the in-flight photographs. Photographs were analysed in Microsoft Paint to permit mark-up of the photo to facilitate the counting of adults sitting tight with no nest visible, birds flying, standing or swimming, and occupied and unoccupied nests in the photographs. Evidence of nesting included presence of visible nests, adults sitting tight, or chicks. Adults sitting tight are likely to be sitting on a nest, but may otherwise be loafing. On a few occasions the in-flight photographs were of insufficient quality for birds to be counted, thus preliminary observer counts were included in lieu of photographic data in the final abundance estimates.

Photo 2: Colony of Ring-billed Gulls and Common Terns on an Island in the Nelson River on June 23, 2017



Map 2: Colonial Waterbird Helicopter Survey Routes and Waterbody Classification

3.0 RESULTS

3.1 UNMANNED AERIAL VEHICLE SURVEY

Water levels in the Nelson River in the spring and summer of 2017 were higher than average and peaked in late May (Appendix 1). Due to these high water levels in 2017, two islands (Wpt 227 and Wpt 480 remained underwater and were not surveyed in spring or summer. Water levels remained high through the survey period and large portions of other islands in Gull Rapids were underwater and reduced the amount of habitat available to colonial waterbirds (Appendix 1).

Ring-billed gulls were the most common species of colonial waterbird observed in the Gull Rapids area. Notably, two islands – Wpt 226 and Wpt 224, supported the majority of adults (77% during the May 30-31 survey period) and nests (98% during June 28) (Appendix 2; Map 3). The number of ring-billed gulls at Gull Rapids remained relatively consistent throughout the survey period from May to July, with the lowest number observed in June. The greatest survey count in 2017 (1,900 ring-billed gulls) was observed on the afternoon of July 19 (Table 2). The presence of ring-billed gulls varied in the morning and afternoon and relatively large standard deviations of abundance were observed. Ring-billed gull nests were observed on three of the islands surveyed (Map 4), and up to 879 nests were observed on June 28. No ring-billed chicks were observed in 2017 (Table 2).

Common terns were relatively uncommon in the Gull Rapids area compared to other species. Common terns were observed on a single island in 2017 (Wpt 224; Map 3). Up to 21 common terns nests were observed on the island, but no common tern chicks were observed (Table 2; Map 4).

Herring gulls were also relatively uncommon in the Gull Rapids area compared to ring-billed gulls. Herring gulls were observed on all six of the islands surveyed (Map 3), but occurred in much lower numbers. The greatest number of herring gulls observed in the Gull Rapids area was 27, which occurred during the June 28 survey (Table 2). Herring gull nests were observed on four of the surveyed islands (Map 4), and up to 10 nests were observed during the June 28 survey period (Table 2). No herring gull chicks were observed.

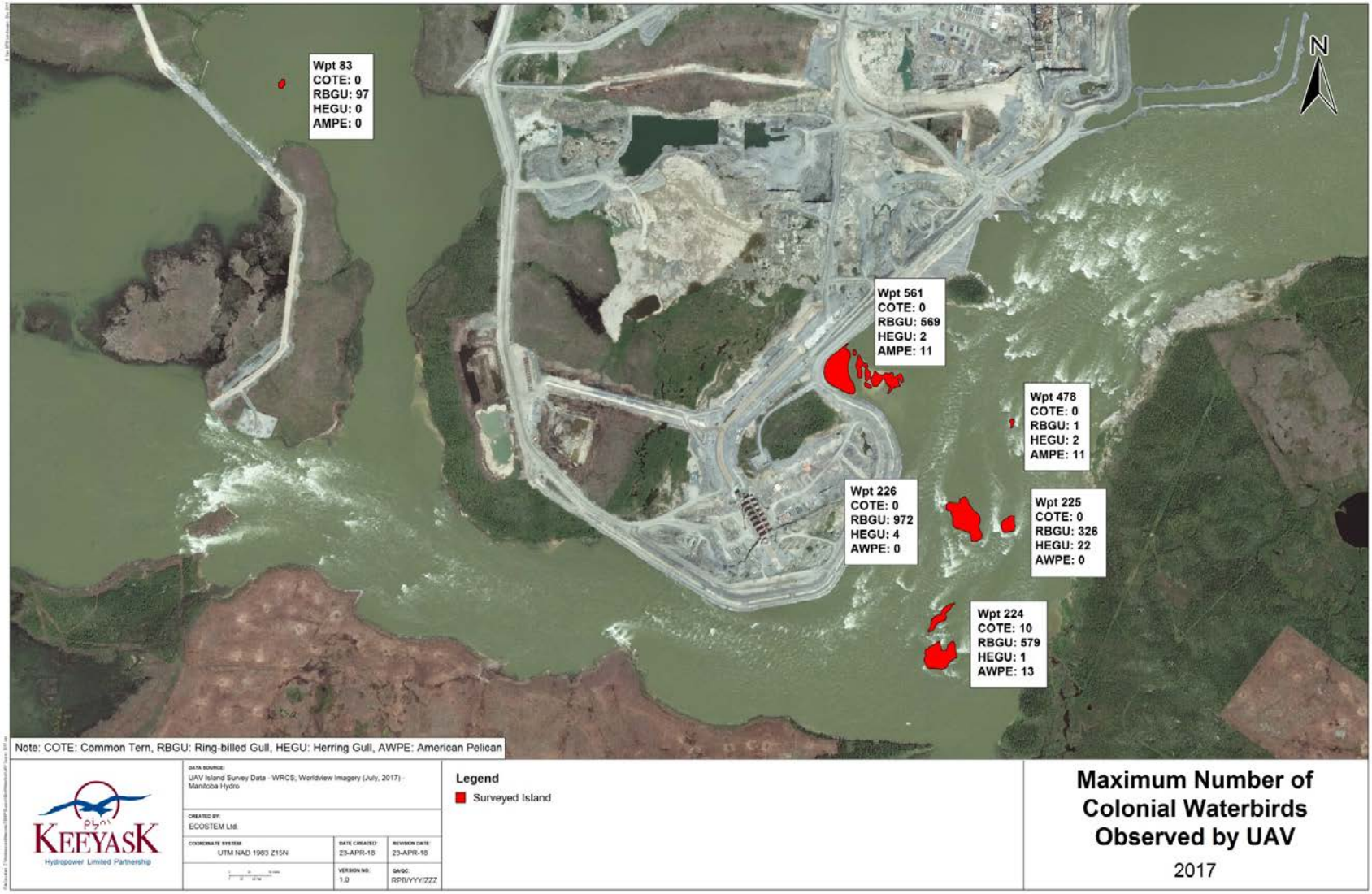
Several flocks of American white pelicans were observed in Gull Rapids in 2017. No signs of nesting were observed and the greatest number (36) was observed during the July 19 survey (Table 2).

The maximum number of ring-billed gulls observed in the 2017 survey (1,900) was lower than the maximum number of ring-billed gulls observed in 2016 (5,092) and gulls (ring-billed and herring gulls combined) observed in 2015 (4,976). The number of ring-billed gulls and herring gulls was combined in 2015 due to the difficulty in distinguishing between species due to lower resolution UAV photographs.

Gull numbers were lower on select islands in 2017, compared to 2015 and 2016. Similar to previous years, the largest islands, including Wpt 226, Wpt 224, and Wpt 225, supported the greatest numbers of colonial waterbirds.

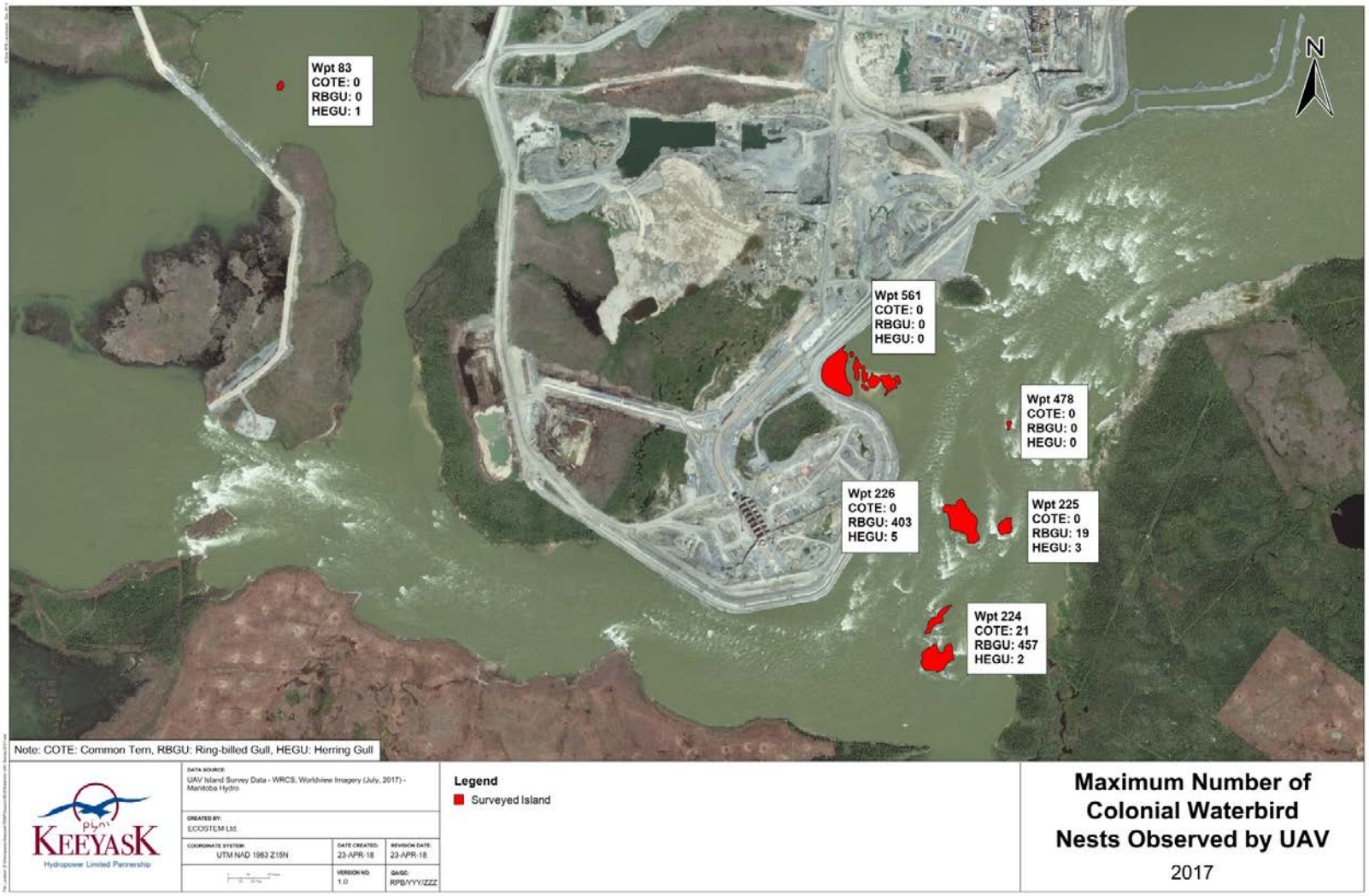
Table 2: Maximum Number (Standard Deviation) of Colonial Waterbirds, Nests, and Chicks Observed in the Morning/Afternoon on Islands in the Gull Rapids Area in 2017 for Each Survey Period

Observation	May 30-31	June 28	July 19
Ring-billed Gull	1,884 (682)	1,334 (257)	1,900 (749)
Ring-billed Gull w. Nest	71 (47)	852 (21)	0 (0)
Ring-billed Gull Chick	0 (0)	0 (0)	0 (0)
Common Tern	10 (7)	2 (1)	1 (1)
Common Tern w. Nest	0 (0)	21 (4)	0 (0)
Common Tern Chick	0 (0)	0 (0)	0 (0)
Herring Gull	5 (2)	27 (16)	7 (4)
Herring Gull w. Nest	4 (3)	10 (2)	1 (1)
Herring Gull Chick	0 (0)	0 (0)	0 (0)
American Pelican	0 (0)	5 (4)	36 (6)



Note: the maximum number of colonial waterbirds was selected from pooled data from all survey periods (May 30-31, June 28, July 19) and morning/afternoon periods.

Map 3: Maximum Number of Colonial Waterbirds Observed on Each Island by the UAV in Gull Rapids in 2017



Note: the maximum number of colonial waterbird nests was selected from pooled data from all survey periods (May 30-31, June 28, July 19) and morning/afternoon periods.

Map 4: Maximum Number of Colonial Waterbird Nests Observed on Each Island by the UAV in Gull Rapids in 2017

3.2 HELICOPTER SURVEY

Five species of colonial waterbirds were observed during the 2017 helicopter surveys. During both helicopter surveys, in June and July, ring-billed gulls were the most abundant colonial waterbird, with common terns being the second most abundant. Bonaparte's gull, herring gull, and American white pelican were less abundant, which was consistent with the findings from 2016 (Table 3; Table 4; Table 5). Black terns, which were observed in low numbers in 2016, were not observed in 2017 or in 2015.

Table 3: Colonial Waterbird Abundance Observed During Helicopter Surveys in 2017

Species	June			July		
	Congregated Birds	Dispersed Birds	Total	Congregated Birds	Dispersed Birds	Total
Ring-billed Gull	5,835	1,708	7,543	7,780	422	8,202
Common Tern	1,377	4	1,381	979	5	984
Bonaparte's Gull	50	30	80	0	31	31
Herring Gull	5	0	5	13	0	13
American White Pelican	37	46	83	393	210	603

Table 4: Colonial Waterbird Abundance Observed During Helicopter Surveys in 2016

Species	June			July		
	Congregated Birds	Dispersed Birds	Total	Congregated Birds	Dispersed Birds	Total
Ring-billed Gull	5,217	359	5,576	12,087	1,229	13,316
Common Tern	861	54	915	579	218	797
Bonaparte's Gull	55	44	99	58	62	120
Herring Gull	67	5	72	42	3	45
American White Pelican	0	52	52	0	343	343
Black Tern	0	0	0	0	8	8

Table 5: Colonial Waterbird Abundance Observed During Helicopter Surveys in 2015

Species	June			July		
	Congregated Birds	Dispersed Birds	Total	Congregated Birds	Dispersed Birds	Total
Ring-billed Gull	3,026	894	3,925	3,439	302	3,741
Common Tern	451	173	624	572	461	1,033
Bonaparte's Gull	26	137	163	0	56	56
Herring Gull	23	4	27	9	8	17
American White Pelican	0	1	1	228	0	228

3.2.1 RING-BILLED GULL

Ring-billed gulls were the most common species of colonial waterbird observed in 2017. The total number of ring-billed gulls stayed relatively stable from June to July (Table 3), which was similar to 2015 (Table 5) but differed from 2016. In 2016, ring-billed gull numbers increased (more than doubled) from June to July) (Table 4).

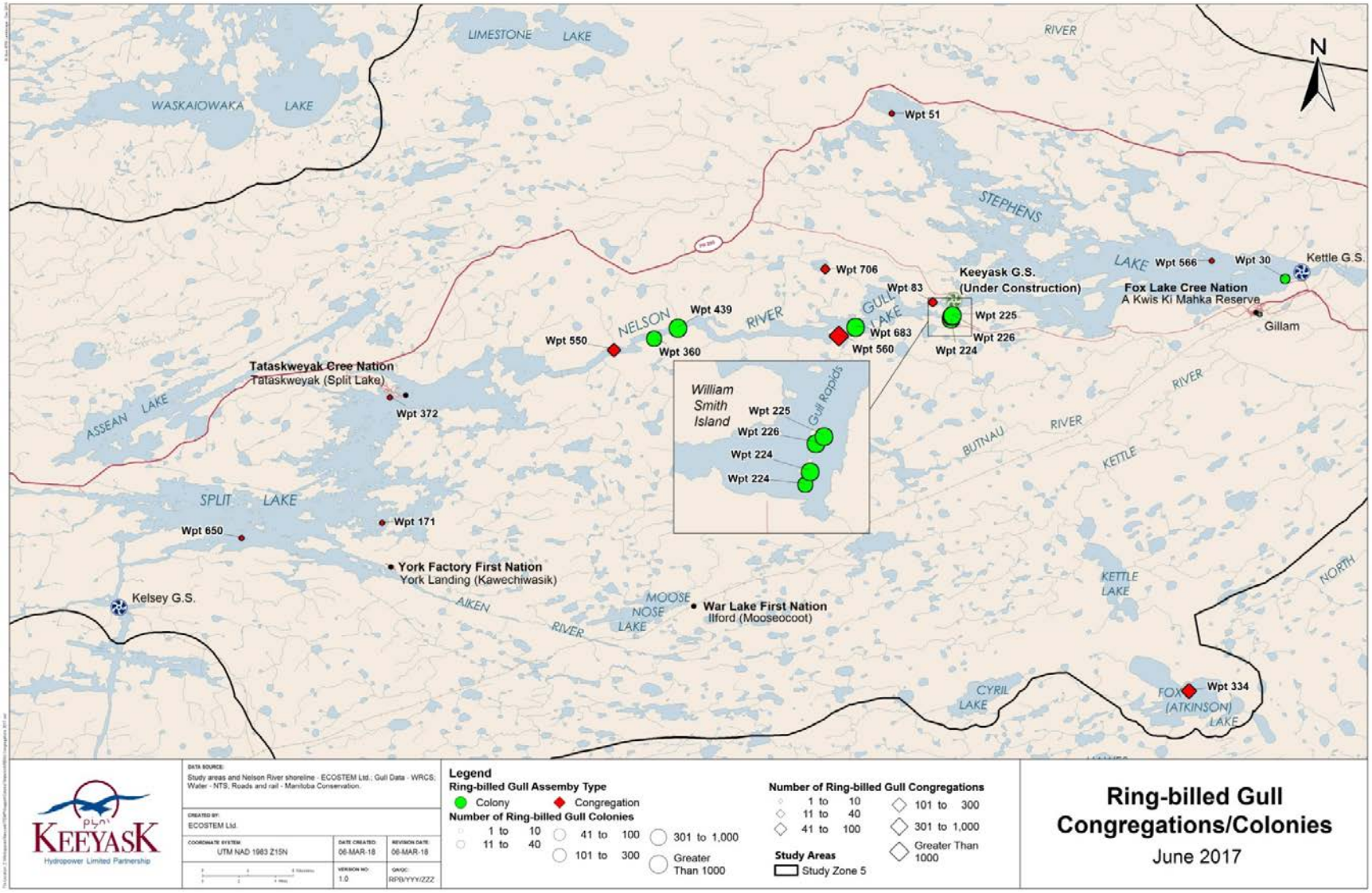
In June 2017, ring-billed gulls were observed congregating at 10 sites and nesting at eight sites (Map 5). In July 2017, ring-billed gulls were observed congregating at 34 sites and nesting at three sites (Map 6). The largest concentration of ring-billed gulls occurred on an island in the Nelson River, approximately 12 km upstream of Gull Rapids that had been cleared of vegetation during the winter of 2015/16. This island supported a congregation of 2,231 individuals in June and 3,982 individuals in July (40% and 49% of all ring-billed gull observations, respectively).

The islands within Gull Rapids supported a relatively large number of ring-billed gulls, 2,499 in June, and 1,055 in July (34% and 13% of all ring-billed gull observations, respectively) (Table 6). These findings differed from 2016 and 2015, when the majority of ring-billed gulls were found within the Gull Rapids area.

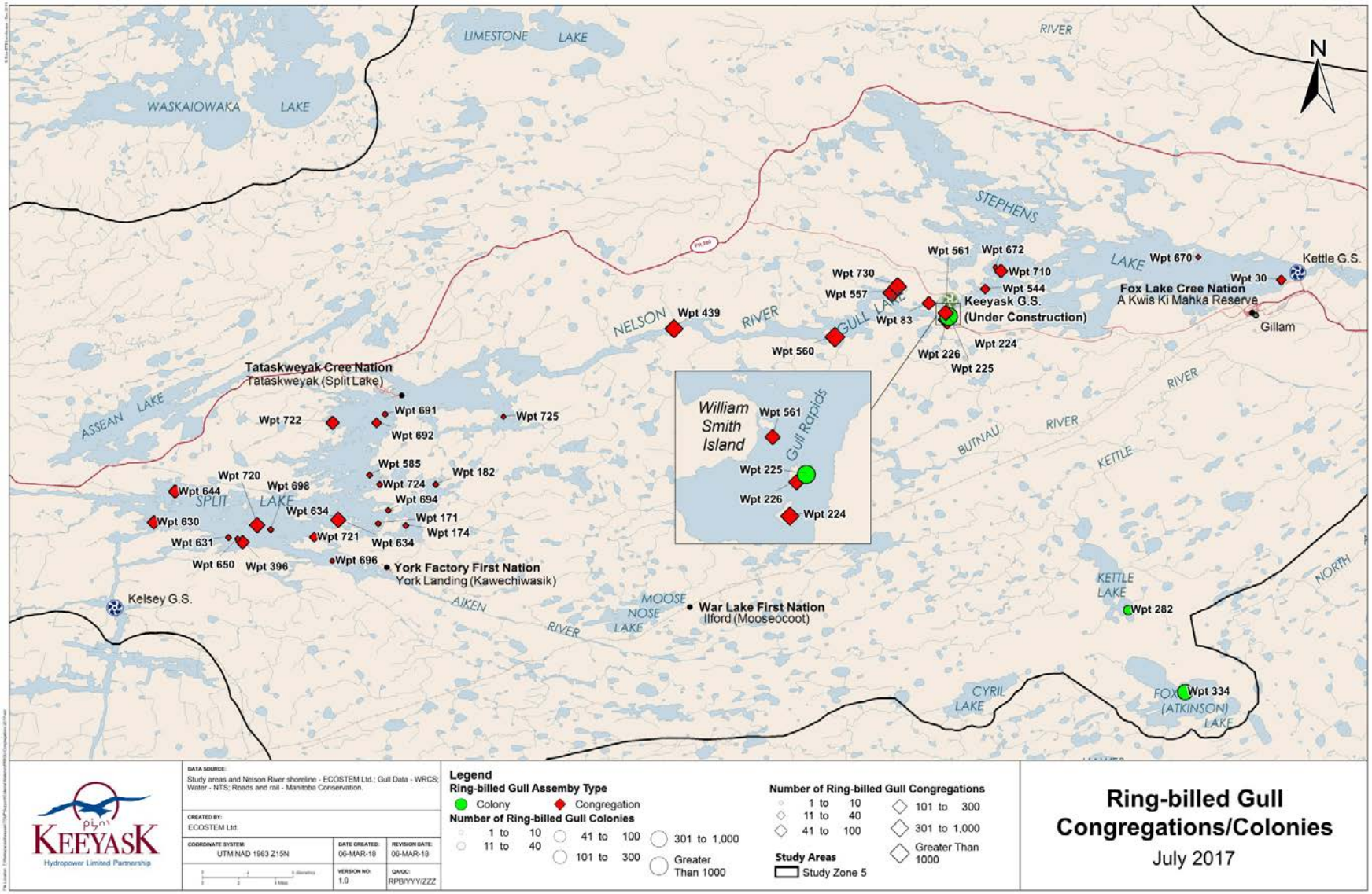
Ring-billed gull nests or probable nests were observed at nine unique sites in the study area in June and July 2017 (Map 5; Map 6). The largest nesting colonies were located within Gull Rapids (three colonies) and upstream on the Nelson River (three colonies). Individual colonies were also observed in Stephens Lake, Atkinson Lake, and Butnau Lake. There were fewer nesting sites in 2017 compared to 2016 and 2015, and no nesting sites were observed in Split Lake, which differed from 2016 and 2015. A hatch-year bird was observed at a single colony (Wpt 650) in 2017, which was located in Split Lake.

Of the 25 islands where ring-billed gulls were observed in June 2017, 5 (20%) were not used in 2016 and 6 (24%) were not used in 2015 (Table 7). In July, 12 of the 36 islands (33%) where ring-billed gulls were observed in 2017 were not used in 2016 and 14 (39%) were not used in 2015 (Table 7). In June and July, all of the islands not used in 2016 were also not used in 2015. The number of islands at which ring-billed gulls were observed increased from 2015 to 2017.

All but one congregation/colony were observed on islands. A single congregation of ring-billed gulls was observed along the shoreline in July in Gull Lake (Wpt 730). Most of the islands used consisted of exposed bedrock or boulders, <0.1 ha or 0.1-0.9 ha in size, within on-system lakes or rivers (Table 7).



Map 5: Ring-billed Gull Colonies and Congregations Observed During Helicopter Surveys in June 2017



Map 6: Ring-billed Gull Colonies and Congregations Observed During Helicopter Surveys in July 2017

Table 6: Ring-billed Gull Congregations/Colonies Observed During the Helicopter Surveys in 2017

Waypoint	June						July					
	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
0	0	0	0	0	0	0	0	0	0	2	2	0
30	0	2	2	16	20	0	0	0	0	15	15	0
51	0	0	0	1	1	0	0	0	0	0	0	0
83	0	0	1	31	32	0	0	0	0	84	84	0
151	0	0	0	1	1	0	0	0	0	0	0	0
171	0	1	0	1	2	0	0	0	0	1	1	0
174	0	0	0	0	0	0	0	0	0	2	2	0
182	0	0	0	0	0	0	0	0	0	3	3	0
224	0	13	93	675	781	0	0	0	0	349	349	0
225	0	6	8	386	400	0	0	0	35	266	301	0
226	0	71	95	539	705	0	0	0	0	115	115	0
282	0	0	0	0	0	0	0	0	3	20	23	0
334	0	0	0	214	214	0	0	0	11	205	216	0
360	0	0	3	145	148	0	0	0	0	0	0	0
372	0	0	0	4	4	0	0	0	0	0	0	0
396	0	0	0	0	0	0	0	0	0	66	66	0
439	0	0	149	416	565	0	0	0	0	515	515	0
499	0	0	0	2	2	0	0	0	0	0	0	0
544	0	0	0	0	0	0	0	0	0	12	12	0
550	0	0	0	99	99	0	0	0	0	0	0	0
553	0	0	0	0	0	0	0	0	0	0	0	0
557	0	0	0	0	0	0	0	0	0	600	600	0
560	0	0	0	2,231	2,231	0	0	0	0	3,982	3,982	0

Waypoint	June						July					
	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
561	0	0	0	0	0	0	0	0	0	206	206	0
566	0	0	0	5	5	0	0	0	0	0	0	0
585	0	0	0	0	0	0	0	0	0	2	2	0
630	0	0	0	0	0	0	0	0	0	80	80	0
631	0	0	0	0	0	0	0	0	0	8	8	0
634	0	0	0	0	0	0	0	0	0	185	185	0
644	0	0	0	1	1	0	0	0	0	43	43	0
650	0	0	0	3	3	0	0	0	0	2	2	1
663	0	0	0	20	20	0	0	0	0	2	2	0
667	0	0	0	2	2	0	0	0	0	0	0	0
668	0	0	0	5	5	0	0	0	0	0	0	0
669	0	0	0	11	11	0	0	0	0	0	0	0
670	0	0	0	1	1	0	0	0	0	100	100	0
672	0	0	0	0	0	0	0	0	0	40	40	0
673	0	0	0	6	6	0	0	0	0	0	0	0
675	0	0	0	2	2	0	0	0	0	0	0	0
677	0	0	0	1	1	0	0	0	0	0	0	0
679	0	0	0	1	1	0	0	0	0	0	0	0
680	0	0	0	6	6	0	0	0	0	0	0	0
681	0	0	0	4	4	0	0	0	0	0	0	0
682	0	0	0	1	1	0	0	0	0	0	0	0
683	0	0	189	411	600	0	0	0	0	0	0	0
684	0	0	0	16	16	0	0	0	0	0	0	0
685	0	0	0	6	6	0	0	0	0	0	0	0

Waypoint	June						July					
	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
686	0	0	0	43	43	0	0	0	0	0	0	0
687	0	0	0	75	75	0	0	0	0	0	0	0
688	0	0	0	400	400	0	0	0	0	0	0	0
689	0	0	0	100	100	0	0	0	0	0	0	0
690	0	0	0	400	400	0	0	0	0	0	0	0
691	0	0	0	6	6	0	0	0	0	2	2	0
692	0	0	0	0	0	0	0	0	0	36	36	0
694	0	0	0	1	1	0	0	0	0	3	3	0
696	0	0	0	1	1	0	0	0	0	10	10	0
697	0	0	0	1	1	0	0	0	0	0	0	0
698	0	0	0	2	2	0	0	0	0	3	3	0
699	0	0	0	5	5	0	0	0	0	0	0	0
703	0	0	0	500	500	0	0	0	0	0	0	0
704	0	0	0	10	10	0	0	0	0	0	0	0
705	0	0	0	75	75	0	0	0	0	0	0	0
706	0	0	0	25	25	0	0	0	0	0	0	0
707	0	0	0	2	2	0	0	0	0	0	0	0
709	0	0	0	1	1	0	0	0	0	0	0	0
710	0	0	0	0	0	0	0	0	0	53	53	0
712	0	0	0	0	0	0	0	0	0	200	200	0
713	0	0	0	0	0	0	0	0	0	120	120	0
714	0	0	0	0	0	0	0	0	0	50	50	0
720	0	0	0	0	0	0	0	0	0	120	120	0
721	0	0	0	0	0	0	0	0	0	16	16	0

Waypoint	June						July					
	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
722	0	0	0	0	0	0	0	0	0	50	50	0
723	0	0	0	0	0	0	0	0	0	18	18	0
724	0	0	0	0	0	0	0	0	0	2	2	0
725	0	0	0	0	0	0	0	0	0	100	100	0
729	0	0	0	0	0	0	0	0	0	30	30	0
730	0	0	0	0	0	0	0	0	0	435	435	0
Total	0	93	540	6,910	7,543	0	0	0	49	8,153	8,202	1

Table 7: Waterbody Classification and Island Use by Ring-billed Gulls in 2017

Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
30	Colony	June	On-system	Lake	>1,000	70% tree/shrub, 30% sand/gravel	1.0-1.9	Yes	Yes
224	Colony	June	On-system	River	>1,000	40% exposed bedrock, 60% treed	1.0-1.9	Yes	Yes
224	Colony	June	On-system	River	>1,000	40% exposed bedrock, 60% treed	1.0-1.9	Yes	No
226	Colony	June	On-system	River	>1,000	50% rock, 45% shrub/deadfall, 55% treed	1.0-1.9	Yes	Yes
225	Colony	June	On-system	River	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
683	Colony	June	On-system	River	>1,000	Cleared island	0.1-0.9	No	No
439	Colony	June	On-system	River	>1,000	50% bare rock, 50% grass	0.1-0.9	Yes	Yes
360	Colony	June	On-system	River	>1,000	Boulders	0.1-0.9	Yes	Yes
171	Congregation	June	On-system	Lake	>1,000	Exposed bedrock	<0.1	Yes	Yes
650	Congregation	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
372	Congregation	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
566	Congregation	June	On-system	Lake	>1,000	Gravel	0.1-0.9	Yes	Yes
51	Congregation	June	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
334	Congregation	June	Off-system	Lake	>1,000	95% boulders, 5% grass	0.1-0.9	Yes	Yes
83	Congregation	June	On-system	River	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
560	Congregation	June	On-system	River	>1,000	Cleared island	>4.0	Yes	Yes
550	Congregation	June	On-system	River	>1,000	Exposed bedrock	<0.1	Yes	Yes
706	Congregation	June	Off-system	Lake	100-1,000	Exposed bedrock	0.1-0.9	No	No
691	Dispersed	June	On-system	Lake	>1,000	80% tree/shrub, 20% sand/gravel	0.1-0.9	No	No
694	Dispersed	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	No	No
696	Dispersed	June	On-system	Lake	>1,000	80% tree/shrub, 20% sand/gravel	0.1-0.9	No	No
697	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
698	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
699	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
151	Dispersed	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
663	Dispersed	June	On-system	River	100-1,000	Exposed bedrock	0.1-0.9	Yes	Yes

Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
644	Dispersed	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
707	Dispersed	June	Off-system	Lake	>1,000	NA	NA	No	No
709	Dispersed	June	Off-system	Lake	>1,000	NA	NA	No	No
667	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
668	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
669	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
670	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
673	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
675	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
499	Dispersed	June	Off-system	Lake	10-100	Exposed bedrock	0.1-0.9	Yes	Yes
677	Dispersed	June	Off-system	Lake	100-1,000	Pond shoreline	NA	No	No
679	Dispersed	June	Off-system	Lake	>1,000	NA	NA	No	No
680	Dispersed	June	Off-system	Lake	>1,000	Pond shoreline	NA	No	No
681	Dispersed	June	Off-system	Lake	<1	NA	NA	No	No
682	Dispersed	June	Off-system	River	100-1,000	NA	NA	No	No
684	Dispersed	June	On-system	River	>1,000	NA	NA	No	No
685	Dispersed	June	On-system	River	>1,000	NA	NA	No	No
686	Dispersed	June	On-system	River	>1,000	Lake shoreline	NA	No	No
687	Dispersed	June	On-system	River	>1,000	NA	NA	No	No
688	Dispersed	June	On-system	River	>1,000	NA	NA	No	No
689	Dispersed	June	On-system	River	>1,000	NA	NA	No	No
703	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
704	Dispersed	June	Off-system	Lake	100-1,000	NA	NA	No	No
705	Dispersed	June	Off-system	Lake	100-1,000	NA	NA	No	No
690	Dispersed	June	On-system	River	>1,000	NA	NA	No	No
553	Dispersed	June	On-system	Lake	>1,000	NA	NA	Yes	Yes
334	Colony	July	Off-system	Lake	>1,000	95% boulders, 5% grass	0.1-0.9	Yes	Yes

Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
225	Colony	July	On-system	River	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
282	Colony	July	Off-system	Lake	>1,000	Boulders, 5% grass	0.1-0.9	Yes	Yes
691	Congregation	July	On-system	Lake	>1,000	80% tree/shrub, 20% sand/gravel	0.1-0.9	No	No
694	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	No	No
171	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	<0.1	Yes	Yes
634	Congregation	July	On-system	Lake	>1,000	Exposed bedrock, 5% shrub	<0.1	Yes	Yes
696	Congregation	July	On-system	Lake	>1,000	80% tree/shrub, 20% sand/gravel	0.1-0.9	No	No
698	Congregation	July	On-system	Lake	>1,000	NA	NA	No	No
396	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
650	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
644	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
692	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	No	No
585	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	<0.1	Yes	Yes
182	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
174	Congregation	July	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
630	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	No
720	Congregation	July	On-system	Lake	>1,000	80% tree/shrub, 20% debris	0.1-0.9	No	No
631	Congregation	July	On-system	Lake	>1,000	Boulders	0.1-0.9	Yes	Yes
721	Congregation	July	On-system	Lake	>1,000	Boulders, 10% shrub	0.1-0.9	No	No
634	Congregation	July	On-system	Lake	>1,000	Exposed bedrock, 5% shrub	<0.1	Yes	Yes
722	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	No	No
724	Congregation	July	On-system	Lake	>1,000	70% tree/shrub, 30% sand/gravel	1.0-1.9	No	No
30	Congregation	July	On-system	Lake	>1,000	70% tree/shrub, 30% sand/gravel	1.0-1.9	Yes	Yes
670	Congregation	July	On-system	Lake	>1,000	NA	NA	No	No
224	Congregation	July	On-system	River	>1,000	40% exposed bedrock, 60% treed	1.0-1.9	Yes	Yes
226	Congregation	July	On-system	River	>1,000	50% rock, 45% shrub/deadfall, 55% treed	1.0-1.9	Yes	Yes
83	Congregation	July	On-system	River	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes

Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
560	Congregation	July	On-system	River	>1,000	Cleared island	>4.0	Yes	Yes
439	Congregation	July	On-system	River	>1,000	50% bare rock, 50% grass	0.1-0.9	Yes	Yes
672	Congregation	July	On-system	Lake	>1,000	Boulders	0.1-0.9	No	No
544	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
710	Congregation	July	On-system	Lake	>1,000	Boulders	0.1-0.9	No	No
725	Congregation	July	On-system	Lake	>1,000	20% exposed bedrock, 80% treed	0.1-0.9	No	No
557	Congregation	July	On-system	River	>1,000	Burned island	>4.0	Yes	No
730	Congregation	July	On-system	River	>1,000	Lake shoreline	NA	No	No
561	Congregation	July	On-system	River	>1,000	Exposed bedrock	1.0-1.9	Yes	Yes
663	Dispersed	July	On-system	River	100-1,000	Exposed bedrock	0.1-0.9	Yes	Yes
723	Dispersed	July	On-system	Lake	>1,000	NA	NA	No	No
712	Dispersed	July	On-system	Lake	>1,000	Lake shoreline	NA	No	No
713	Dispersed	July	On-system	Lake	>1,000	Lake shoreline	NA	No	No
714	Dispersed	July	On-system	Lake	>1,000	Lake shoreline	NA	No	No
729	Dispersed	July	On-system	River	>1,000	NA	NA	No	No
0	Dispersed	July	On-system	River	>1,000	Floating platform	<0.1	Yes	No

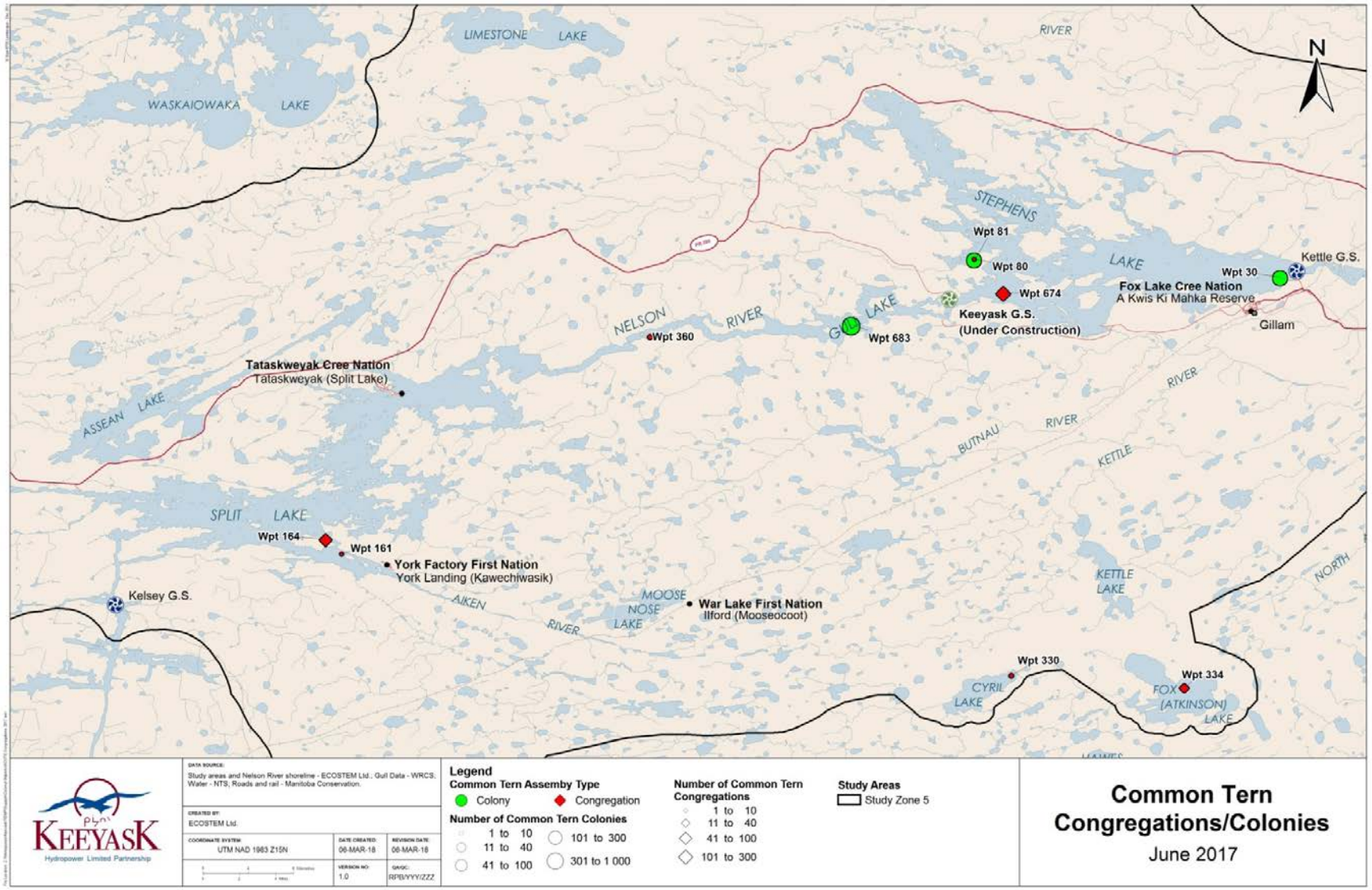
3.2.2 COMMON TERN

Common terns were the second most abundant species of colonial waterbird observed in the study area in 2017 (Table 3). The total number of common terns counted decreased from June (1,381) to July (984). The number of common terns observed in 2017 was higher than the number observed in 2016 (Table 4) or 2015 (Table 5), but the trend of decreasing numbers from June to July in 2017 was consistent with 2016. More common terns were observed in July 2015 than in June 2015.

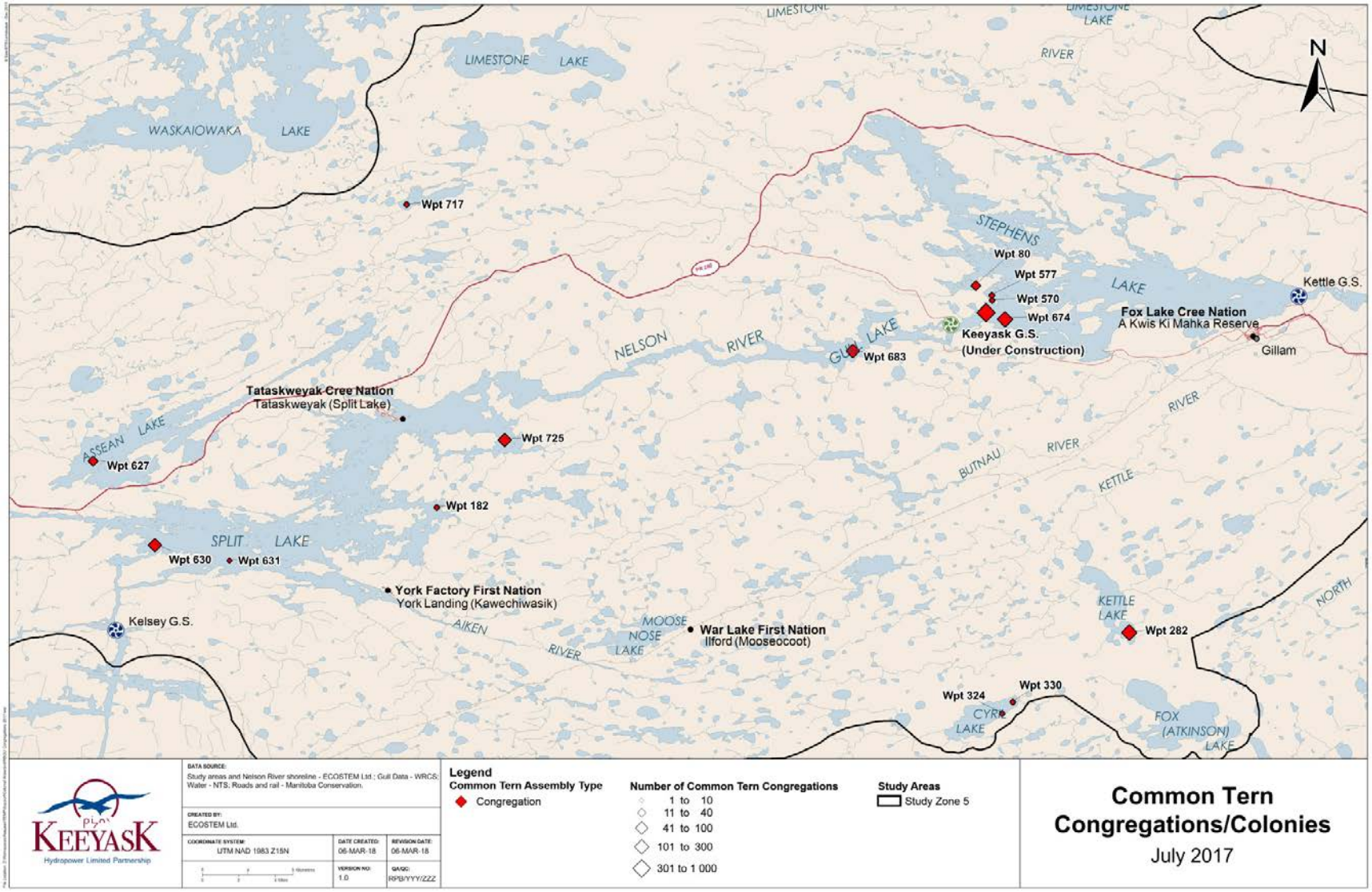
In June, common terns were observed congregating at eight sites and nesting at a three sites (Table 8; Map 7). The largest colony was observed upstream of Gull Rapids in the Nelson River on an island that had been cleared of vegetation for the Project in the winter of 2015/16 (Map 7). In July, 15 common tern congregations were observed and no colonies were observed (Map 8). The largest concentrations of common terns were observed on islands upstream and downstream of Gull Rapids. No common terns were observed during the helicopter survey in Gull Rapids in 2017 (Table 8), which differed from the findings of 2016 and 2015.

In June and July, five islands (33% and 31% of all islands used, respectively) where common terns were observed in 2017 were not used by any species of colonial waterbird in 2016 (Table 8).

All congregations/colonies were observed on islands. Most of the islands used consisted of boulders or exposed bedrock, either <0.1 ha or 0.1-0.9 ha in size, within large, on-system lakes or rivers (Table 9). A single island in Gull Lake (Wpt 683), cleared of all vegetation by Project reservoir clearing, supported a large colony of common terns in 2017, which was not used in 2016 or 2015.



Map 7: Common Tern Colonies and Congregations Observed During Helicopter Surveys in June 2017



Map 8: Common Tern Colonies and Congregations Observed During Helicopter Surveys in July 2017

Table 8: Common Tern Congregations/Colonies Observed During the Helicopter Surveys in 2017

Waypoint	June						July					
	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
30	0	23	0	149	172	0	0	0	0	0	0	0
80	0	0	8	96	104	0	0	0	1	14	15	0
81	0	0	0	120	120	0	0	0	0	0	0	0
161	0	0	0	40	40	0	0	0	0	0	0	0
164	0	0	0	80	80	0	0	0	0	0	0	0
182	0	0	0	0	0	0	0	0	0	6	6	0
282	0	0	0	0	0	0	0	0	0	134	134	0
324	0	0	0	0	0	0	0	0	0	2	2	0
330	0	0	0	2	2	0	0	0	0	6	6	0
334	0	0	0	20	20	0	0	0	0	0	0	0
360	0	0	0	2	2	0	0	0	0	0	0	0
544	0	0	0	0	0	0	0	0	0	400	400	0
570	0	0	0	1	1	0	0	0	0	5	5	0
577	0	0	0	0	0	0	0	0	0	2	2	0
627	0	0	0	0	0	0	0	0	0	15	15	0
630	0	0	0	0	0	0	0	0	0	48	48	0
631	0	0	0	0	0	0	0	0	0	10	10	0
671	0	0	0	1	1	0	0	0	0	0	0	0
674	0	0	0	200	200	0	0	0	0	220	220	0
676	0	0	0	1	1	0	0	0	0	0	0	0
683	0	0	629	8	637	0	0	0	0	64	64	0
695	0	0	0	1	1	0	0	0	0	0	0	0

Waypoint	June						July					
	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
711	0	0	0	0	0	0	0	0	0	5	5	0
717	0	0	0	0	0	0	0	0	0	2	2	0
725	0	0	0	0	0	0	0	0	0	50	50	0
Total	0	23	637	721	1,381	0	0	0	1	983	984	0

Table 9: Waterbody Classification and Island Use by Common Terns in 2017

Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
30	Colony	June	On-system	Lake	>1,000	70% tree/shrub, 30% sand/gravel	1.0-1.9	Yes	Yes
80	Colony	June	On-system	Lake	>1,000	50% grass, 50% shrubs	0.1-0.9	Yes	Yes
683	Colony	June	On-system	River	>1,000	Cleared island	0.1-0.9	No	No
164	Congregation	June	On-system	Lake	>1,000	Exposed bedrock, 10% grass	<0.1	Yes	Yes
161	Congregation	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
81	Congregation	June	On-system	Lake	>1,000	100% grass	0.1-0.9	Yes	Yes
81	Congregation	June	On-system	Lake	>1,000	100% grass	0.1-0.9	Yes	Yes
674	Congregation	June	On-system	Lake	>1,000	Boulders	0.1-0.9	No	No
334	Congregation	June	Off-system	Lake	>1,000	95% boulders, 5% grass	0.1-0.9	Yes	Yes
330	Congregation	June	Off-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
360	Congregation	June	On-system	River	>1,000	Boulders	0.1-0.9	Yes	Yes
695	Dispersed	June	On-system	Lake	>1,000	80% tree/shrub, 20% sand/gravel	0.1-0.9	No	No
671	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
570	Dispersed	June	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
676	Dispersed	June	On-system	Lake	>1,000	NA	NA	No	No
182	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
717	Congregation	July	Off-system	Lake	100-1,000	Boulders	0.1-0.9	No	No
627	Congregation	July	Off-system	Lake	>1,000	Boulders, 10% shrub	<0.1	Yes	Yes
630	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	No
631	Congregation	July	On-system	Lake	>1,000	Boulders	0.1-0.9	Yes	Yes
80	Congregation	July	On-system	Lake	>1,000	50% grass, 50% shrubs	0.1-0.9	Yes	Yes
570	Congregation	July	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
674	Congregation	July	On-system	Lake	>1,000	Boulders	0.1-0.9	No	No
330	Congregation	July	Off-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
683	Congregation	July	On-system	River	>1,000	Cleared island	0.1-0.9	No	No
577	Congregation	July	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes

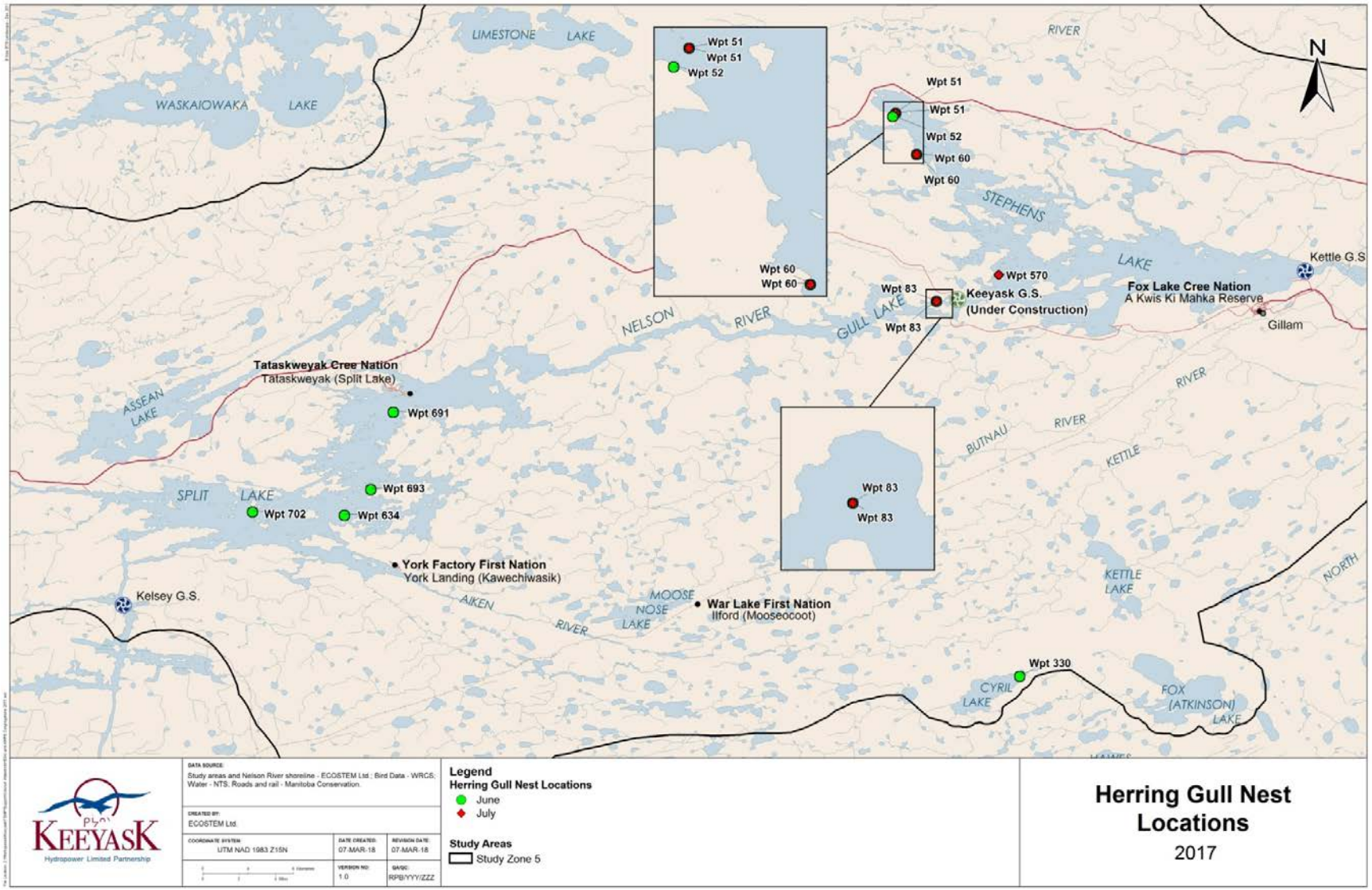
Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
282	Congregation	July	Off-system	Lake	>1,000	Boulders, 5% grass	0.1-0.9	Yes	Yes
544	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
324	Congregation	July	Off-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
725	Congregation	July	On-system	Lake	>1,000	20% exposed bedrock, 80% treed	0.1-0.9	No	No
711	Dispersed	July	On-system	Lake	>1,000	NA	NA	No	No

3.2.3 HERRING GULL

Relatively low numbers of herring gull were observed in the study area in 2017 compared to ring-billed gulls (Table 3), as in 2016 (Table 4) and 2015 (Table 5).

Herring gulls nests or probable nests were observed at 11 sites in the study area (Table 10). Six nesting sites were located on Stephens Lake, four on Split Lake, and one on Cyril Lake (Map 9). Two of the nesting sites contained two herring gull nests and at a single site, three herring gull nests were observed.

All herring gull nests observed were located on islands. Most islands used consisted of exposed bedrock or boulders, <0.1 ha in size, within large, on-system lakes or rivers (Table 11).



Map 9: Herring Gull Nests Observed During Helicopter Surveys in 2017

Table 10: Herring Gulls and Nest Sites Observed During the Helicopter Surveys in 2017

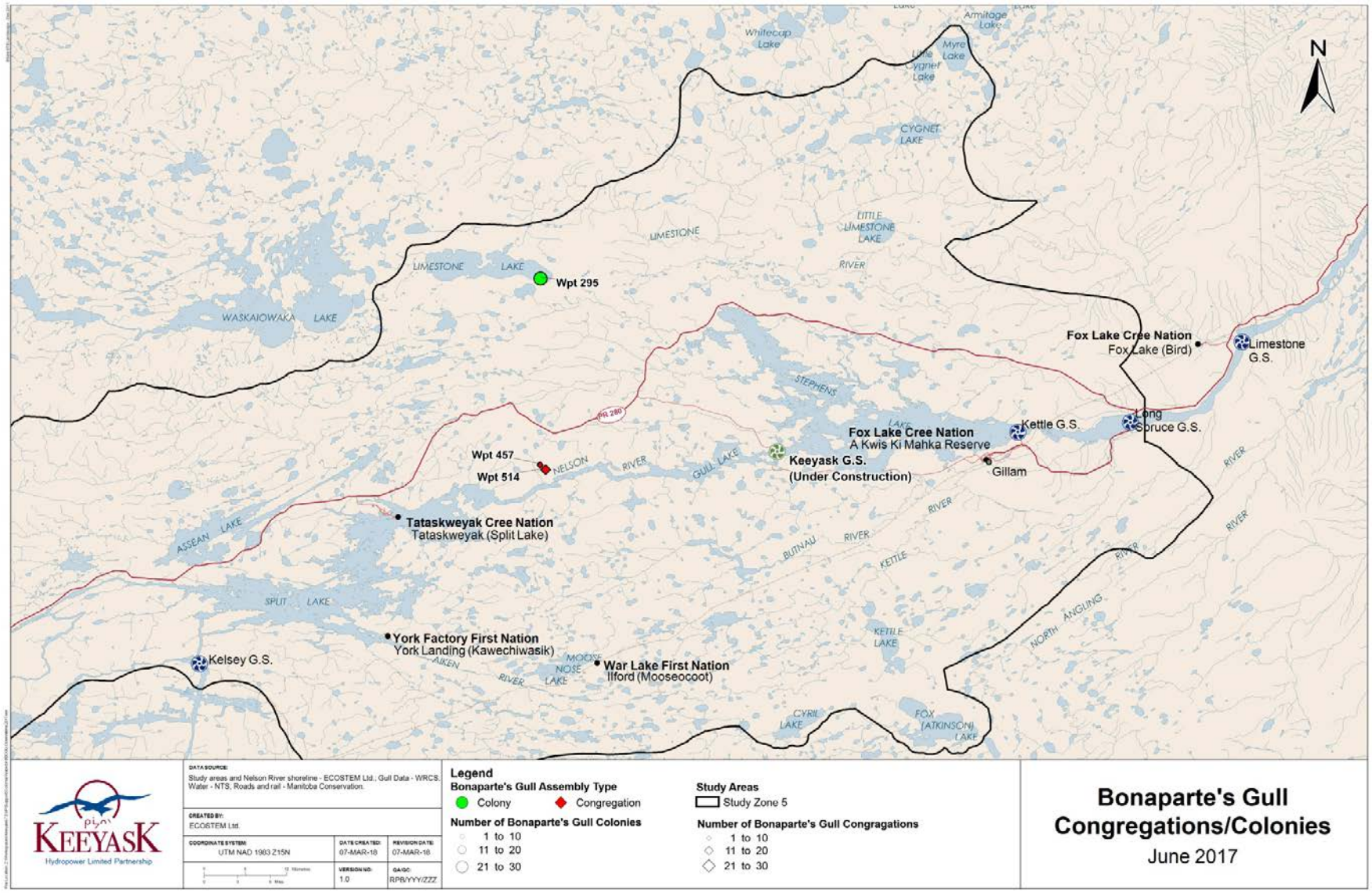
Waypoint	June						July					
	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
51	0	1	0	1	2	0	0	1	0	0	1	0
52	0	1	0	1	2	0	0	0	0	0	0	0
60	1	1	0	3	4	0	0	1	0	0	1	0
83	1	0	0	2	2	0	0	1	0	0	1	0
135	0	0	0	2	2	0	0	0	0	0	0	0
182	0	0	0	0	0	0	0	0	0	1	1	0
324	0	0	0	0	0	0	0	0	0	1	1	0
330	0	1	0	0	1	0	0	0	0	0	0	0
396	0	0	0	3	3	0	0	0	0	0	0	0
570	0	0	0	0	0	0	0	1	0	0	1	0
576	0	0	0	0	0	0	0	0	0	2	2	0
577	0	0	0	0	0	0	0	0	0	3	3	0
627	0	0	0	0	0	0	0	0	0	2	2	0
634	0	1	0	1	2	0	0	0	0	0	0	0
691	1	2	0	0	2	0	0	0	0	0	0	0
693	1	1	0	1	2	0	0	0	0	0	0	0
702	0	1	0	0	1	0	0	0	0	0	0	0
Total	4	9	0	14	23	0	0	4	0	9	13	0

Table 11: Waterbody Classification and Island Use by Herring Gulls in 2017

Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
396	Bird	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
135	Bird	June	On-system	Lake	>1,000	Exposed bedrock	<0.1	Yes	Yes
691	Nest	June	On-system	Lake	>1,000	80% tree/shrub, 20% sand/gravel	0.1-0.9	No	No
693	Nest	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	No	No
634	Nest	June	On-system	Lake	>1,000	Exposed bedrock, 5% shrub	<0.1	Yes	Yes
702	Nest	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	No	No
51	Nest	June	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
52	Nest	June	On-system	Lake	>1,000	Boulders	<0.1	Yes	No
60	Nest	June	On-system	Lake	>1,000	Exposed bedrock	<0.1	Yes	Yes
330	Nest	June	Off-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
83	Nest	June	On-system	River	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
182	Bird	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
627	Bird	July	Off-system	Lake	>1,000	Boulders, 10% shrub	<0.1	Yes	Yes
577	Bird	July	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
324	Bird	July	Off-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
576	Bird	July	On-system	Lake	>1,000	Exposed bedrock	<0.1	Yes	Yes
51	Nest	July	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
60	Nest	July	On-system	Lake	>1,000	Exposed bedrock	<0.1	Yes	Yes
570	Nest	July	On-system	Lake	>1,000	Boulders	<0.1	Yes	Yes
83	Nest	July	On-system	River	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes

3.2.4 BONAPARTE'S GULL

Bonaparte's gulls were relatively uncommon in the study area and were observed congregating at two locations in 2017. Nesting was observed at a single location (Table 3; Table 12). In June, a single colony of Bonaparte's gulls, containing at least two nests, was observed on the shore of Limestone Lake (Map 10). Two other congregations of Bonaparte's gulls (Wpt 457 and Wpt 514) were observed on the shores of two small, inland lakes that also supported birds in 2016 and 2015. In July, only dispersed Bonaparte's gulls were observed (Table 13; Map 10).



Map 10: Bonaparte's Gull Congregations Observed During Helicopter Surveys in June 2017

Table 12: Bonaparte's Gull Congregations and Nest Sites Observed during the Helicopter Surveys in 2017

	June						July					
Waypoint	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
83	0	0	0	0	0	0	0	0	0	5	5	0
295	2	0	0	29	29	0	0	0	0	20	20	0
303	0	0	0	1	1	0	0	0	0	0	0	0
319	0	0	0	20	20	0	0	0	0	0	0	0
457	0	0	0	8	8	0	0	0	0	0	0	0
491	0	0	0	3	3	0	0	0	0	0	0	0
514	0	0	0	13	13	0	0	0	0	0	0	0
546	0	0	0	1	1	0	0	0	0	0	0	0
677	0	0	0	2	2	0	0	0	0	0	0	0
678	0	0	0	1	1	0	0	0	0	0	0	0
681	0	0	0	2	2	0	0	0	0	0	0	0
715	0	0	0	0	0	0	0	0	0	4	4	0
716	0	0	0	0	0	0	0	0	0	2	2	0
Total	2	0	0	80	80	0	0	0	0	31	31	0

Table 13: Waterbody Classification and Habitat Use by Bonaparte's Gulls in 2017

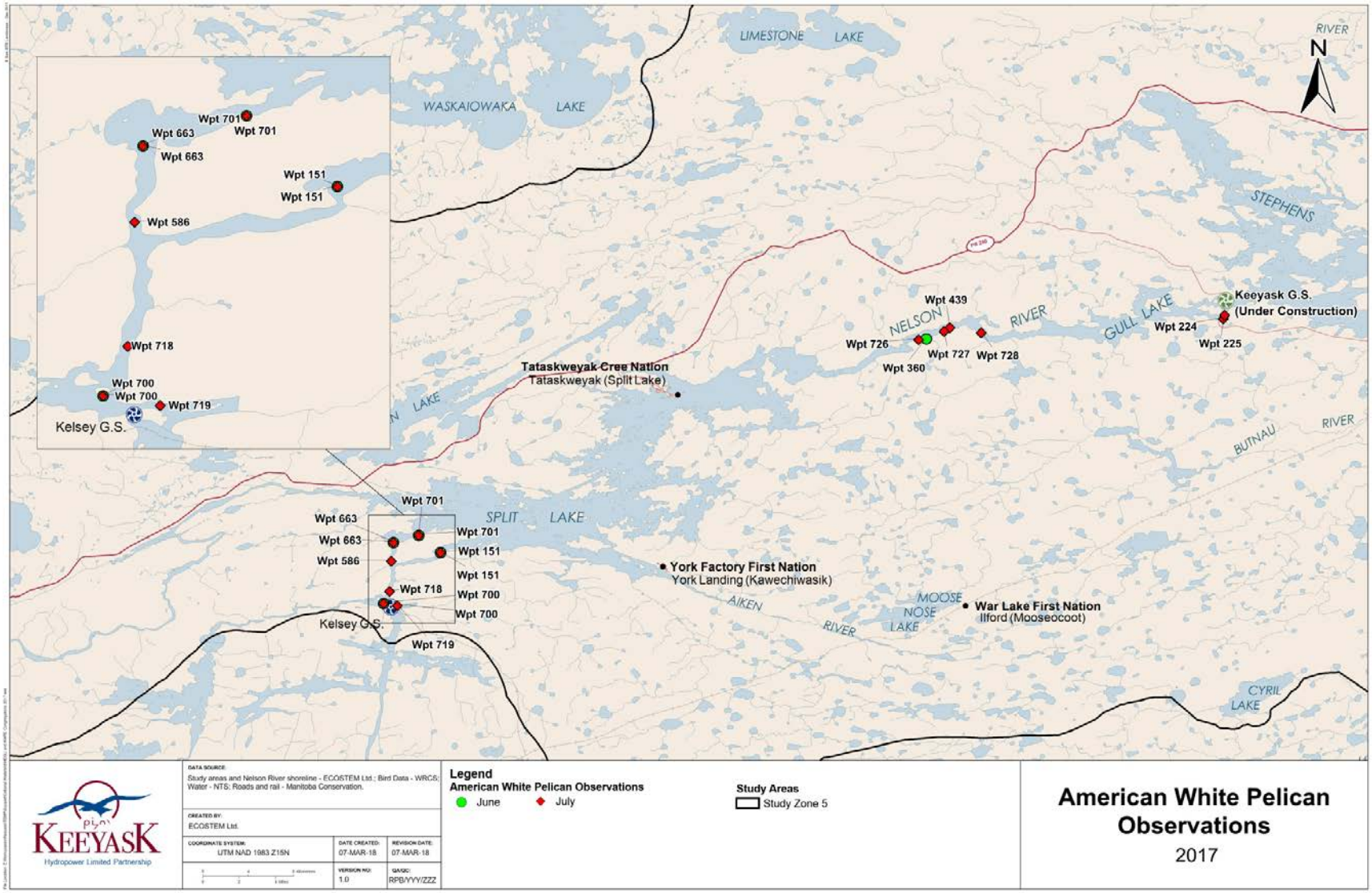
Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
295	Colony	June	Off-system	Lake	>1,000	Lake shoreline	NA	Yes	Yes
457	Congregation	June	Off-system	Lake	1-10	Pond shoreline	NA	Yes	Yes
514	Congregation	June	Off-system	Lake	<1	Pond shoreline	NA	Yes	Yes
319	Dispersed	June	Off-system	Lake	100-1,000	Pond shoreline	NA	Yes	Yes
491	Dispersed	June	Off-system	Lake	100-1,000	Pond shoreline	NA	Yes	Yes
546	Dispersed	June	Off-system	Lake	100-1,000	Pond shoreline	NA	Yes	Yes
677	Dispersed	June	Off-system	Lake	100-1,000	Pond shoreline	NA	No	No
678	Dispersed	June	Off-system	Lake	>1,000	NA	NA	No	No
681	Dispersed	June	Off-system	Lake	<1	NA	NA	No	No
303	Dispersed	June	Off-system	Lake	>1,000	Lake shoreline	NA	Yes	Yes
83	Dispersed	July	On-system	River	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
295	Dispersed	July	Off-system	Lake	>1,000	Lake shoreline	NA	Yes	Yes
715	Dispersed	July	Off-system	Lake	>1,000	Lake shoreline	NA	No	No
716	Dispersed	July	On-system	River	>1,000	Floating platform	<0.1	Yes	No

3.2.5 AMERICAN WHITE PELICAN

In 2017, American white pelicans were relatively uncommon in June and increased in abundance in July (Table 3). The largest concentration of American white pelicans was observed in the tailrace of the Kelsey Generating Station (Map 11). Numerous congregations were observed in the Nelson River between Split Lake and Gull Rapids (Table 14). All pelicans observed were located on large, on-system lakes or rivers (Table 15). Two congregations of seven and 17 birds was observed at Gull Rapids in July (Table 14; Map 11). No American white pelicans were observed nesting in the study area in 2017. These findings are consistent with the observations made in 2016 and 2015, with the exception that American white pelicans were more numerous in July 2017 in comparison to 2016 and 2015.

In June, two islands where American white pelicans were observed in 2017 were not used by any species of colonial waterbird in 2016 (Table 15). In July, seven islands where American white pelicans were observed did not support any species of colonial waterbird in 2016 (Table 15).

Islands used by American white pelicans were typically exposed bedrock, 0.1-0.9 ha in size, located on on-system lakes or rivers (Table 15).



Map 11: American White Pelican Observations Made During the Helicopter Surveys in 2017

Table 14: American White Pelican Observations Made During the Helicopter Surveys in 2017

Waypoint	June						July					
	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks	Unoccupied Nests	Occupied Nests	Birds Sitting Tight (Probable Nest)	Adults (No Nest)	Total Adults	Total Chicks
151	0	0	0	2	2	0	0	0	0	21	21	0
224	0	0	0	0	0	0	0	0	0	7	7	0
225	0	0	0	0	0	0	0	0	0	17	17	0
360	0	0	0	11	11	0	0	0	0	0	0	0
439	0	0	0	0	0	0	0	0	0	107	107	0
586	0	0	0	0	0	0	0	0	0	63	63	0
663	0	0	0	16	16	0	0	0	0	15	15	0
700	0	0	0	26	26	0	0	0	0	241	241	0
701	0	0	0	28	28	0	0	0	0	14	14	0
718	0	0	0	0	0	0	0	0	0	8	8	0
719	0	0	0	0	0	0	0	0	0	16	16	0
726	0	0	0	0	0	0	0	0	0	30	30	0
727	0	0	0	0	0	0	0	0	0	58	58	0
728	0	0	0	0	0	0	0	0	0	6	6	0
Total	0	0	0	83	83	0	0	0	0	603	603	0

Table 15: Waterbody Classification and Island Use by American White Pelicans in 2017

Waypoint	Gathering Type	Month	System	Waterbody Type	Waterbody Size Class (ha)	Island Habitat	Island Size Class (ha)	Used in 2016	Used in 2015
700	Congregation	June	On-system	River	100-1,000	Exposed bedrock	0.1-0.9	No	No
360	Congregation	June	On-system	River	>1,000	Boulders	0.1-0.9	Yes	Yes
151	Dispersed	June	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
663	Dispersed	June	On-system	River	100-1,000	Exposed bedrock	0.1-0.9	Yes	Yes
701	Dispersed	June	On-system	River	100-1,000	NA	NA	No	No
151	Congregation	July	On-system	Lake	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
700	Congregation	July	On-system	River	100-1,000	Exposed bedrock	0.1-0.9	No	No
224	Congregation	July	On-system	River	>1,000	40% exposed bedrock, 60% treed	1.0-1.9	Yes	Yes
225	Congregation	July	On-system	River	>1,000	Exposed bedrock	0.1-0.9	Yes	Yes
439	Congregation	July	On-system	River	>1,000	50% bare rock, 50% grass	0.1-0.9	Yes	Yes
663	Dispersed	July	On-system	River	100-1,000	Exposed bedrock	0.1-0.9	Yes	Yes
701	Dispersed	July	On-system	River	100-1,000	NA	NA	No	No
586	Dispersed	July	On-system	River	100-1,000	Exposed bedrock, 60% shrub	0.1-0.9	Yes	Yes
718	Dispersed	July	On-system	River	100-1,000	NA	NA	No	No
719	Dispersed	July	On-system	River	100-1,000	NA	NA	No	No
726	Dispersed	July	On-system	River	>1,000	NA	NA	No	No
727	Dispersed	July	On-system	River	>1,000	NA	NA	No	No
728	Dispersed	July	On-system	River	>1,000	NA	NA	No	No

4.0 DISCUSSION

The number of breeding colonial waterbirds within Gull Rapids was lower in 2017 compared to previous years of construction (2014-2016) and pre-construction (2001-2013) (KHLP 2012; Stantec 2015; WRCS 2016; WRCS 2017). High water levels in the Nelson River in 2017 was the most likely causal factor that drove the change in gull and tern habitat use and influenced colonial waterbird population responses. From October 2016 to October 2017, Split Lake outflows ranged from about 3,200-6,600 m^3/s. Flows exceeded the historical annual median flow of approximately 3,300 m^3/s each month except for October 2017 when it dropped to about 3,200 m^3/s. From about October 2016 through mid-September 2017, the flows exceeded the historical 75th percentile flow of about 3,780 m^3/s and from about May to mid-August 2017 the flows exceeded the 95th percentile flow of approximately 5,230 m^3/s. During the spring melt in May 2017, the flows rose to about 6,590 m^3/s, which was close to the historical maximum flow observed in August 2005. Water levels varied in conjunction with the flows, ranging from about 154.9-156.6 m ASL on Gull Lake, with the highest level observed during the near historical maximum flow in May.

High water levels in the Nelson River caused islands within Gull Rapids to be inundated or partially inundated and reduced the amount of habitat available for colonial waterbirds. These habitat conditions displaced large numbers of gulls and terns (primarily ring-billed gulls), which settled in several large congregations upstream of Gull Rapids on nearby islands in the Nelson River. Several islands upstream of Gull Rapids, including two islands that had been cleared of vegetation for the Project in winter 2015/16, were available and were used by colonial waterbirds for nesting. It appears that the presence of this more natural, alternate nesting habitat in the area may be preferred by colonial waterbirds and is limiting the use of the William Smith gull habitat enhancement area and the tern nesting platforms (WRCS 2018). Some of the remaining ring-billed gulls, herring gulls, and common terns within Gull Rapids attempted to nest on the islands, but no chicks were observed during helicopter or UAV surveys. Some nesting success was anecdotally observed on two islands, which were cleared of vegetation for the Project. On July 26, 2017, crews conducting a separate monitoring survey by boat observed both ring-billed gull and common tern adults, nests with eggs, and chicks on one island, and common tern adults, and nests with eggs on a second island.

Nests were unsuccessful at all colonies observed in the Gull Rapids area, on the Nelson River upstream of Gull Rapids, at Gull Lake, Stephens Lake, and at off-system lakes, except for the two islands cleared of vegetation for the Project in winter 2015/16 as described above. Although the reason for unsuccessful nests in 2017 is unclear, at Gull Rapids it is most likely related to the high water in the Nelson River that resulted in marginal nesting conditions. The high water levels may have resulted in nests being susceptible to storm-generated waves, which can cause nest abandonment (Cuthbert *et al.* 2003), or a single local storm event may have elevated water levels to the point of washing away nests, eggs or young. The high water levels may have also resulted in a greater competition for nesting space, crowding and/or affected the availability of

food, which can affect nest success and chick survival (Hunt and Hunt 1976; Pierotti 1982; Bukacinska *et al.*1996).

As observed in previous years, sensory disturbance caused by construction did not appear to affect colonial waterbird use of the islands in Gull Rapids. Colonial waterbirds returned to the islands in Gull Rapids and attempted to nest on the available habitat. However, the high water levels reduced the amount of nesting habitat available.

The high water levels in the Nelson River system also appeared to reduce the amount of habitat use and colonial waterbird productivity in the broader study area. The number of colonial waterbirds observed in July 2017 was less than that observed in July 2016. The reason for this may have been due to the higher water levels throughout the study area, which reduced the overall amount of nesting habitat available. As a result, the migrants that were observed in the study area in June did not appear to stay and nest and had left the study area by July. This was supported by the number of ring-billed gull colonies and herring gull nest sites, which was less in 2017 (nine and 11, respectively) compared to 2016 (18 and 42, respectively).

The number of American white pelicans in the study area in July 2017 (603) was nearly double that number observed in July 2016 (343). Several flocks of American white pelicans were also observed on the islands in Gull Rapids, where they have not been observed before. The increase in American white pelican numbers in the study area is likely a result of the increasing North American population and their range expansion (King and Anderson 2005).

Helicopter surveys and UAV surveys will continue in 2018. Data collected by these surveys will provide further insight into the potential effects of Project construction disturbance on colonial waterbird nesting, productivity, and population trends at Gull Rapids and within the broader study area. Because new nesting areas were formed on islands in Gull Lake that were recently cleared of trees, these islands will be surveyed by UAV to count tern and gull nests, eggs and chicks.

5.0 SUMMARY AND CONCLUSIONS

High water levels reduced the amount of colonial waterbird nesting habitat available in 2017, particularly in Gull Rapids where large colonies are known to occur. The high water levels in the Nelson River could have been amplified in Gull Rapids due to Project development narrowing the river channel. Because of the high water, several islands in Gull Rapids were inundated during the survey period and the remaining islands were partially inundated. Fewer gulls and terns used the islands in Gull Rapids in 2017 and it appeared that large numbers of displaced birds used habitat available elsewhere in the study area; in particular, two islands located approximately 12 km upstream of Gull Rapids that had been cleared of vegetation.

Construction activity did not appear to disturb colonial waterbirds. Gulls and terns attempted to nest on available habitat in Gull Rapids and elsewhere in the study area. However, likely due to the high water levels, it appeared that nests were abandoned and no gull or tern chicks were observed on the islands in Gull Rapids. It is unclear why nests were abandoned, but it may have been a result of their susceptibility to storm-generated waves, crowding, or available food resources.

The high water levels in the Nelson River system also appeared to reduce the amount of habitat use and colonial waterbird productivity in the broader study area. The study area supported fewer colonial waterbirds in July 2017 compared to July 2016. There were also fewer ring-billed gull colonies and herring gull nest sites in 2017.

Aerial surveys will be conducted in the spring and summer of 2018, to continue monitoring the distribution and relative abundance of colonial waterbirds and their breeding habitats.

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APPENDIX 1:
NELSON RIVER HABITAT CONDITIONS 2017

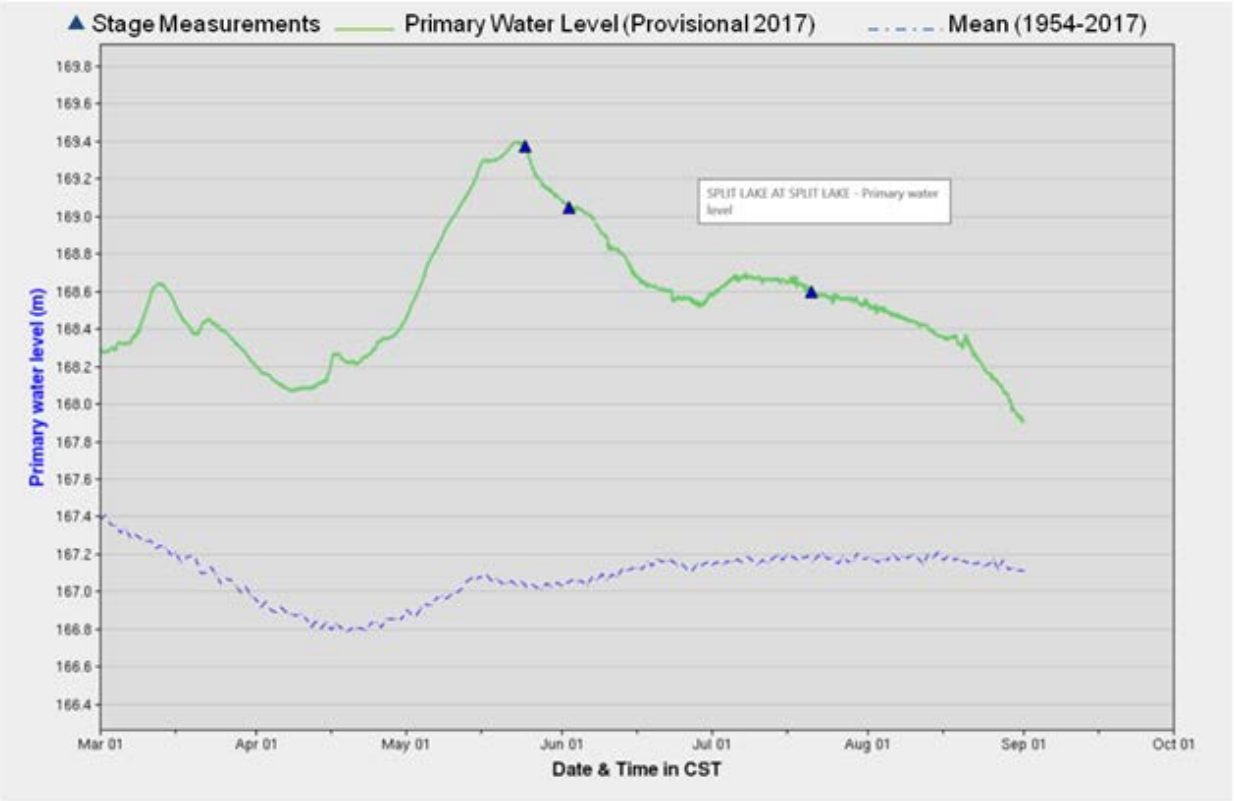

Figure 1: Comparison of Mean (March-September 1954 - 2017) and 2017 (March-September) Water Levels (magl) in the Nelson River System Measured at Split Lake, Manitoba (Government of Canada 2018)

Government of Canada 2018. Real-Time Hydrometric - Station 05UF003. Available from: https://wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html

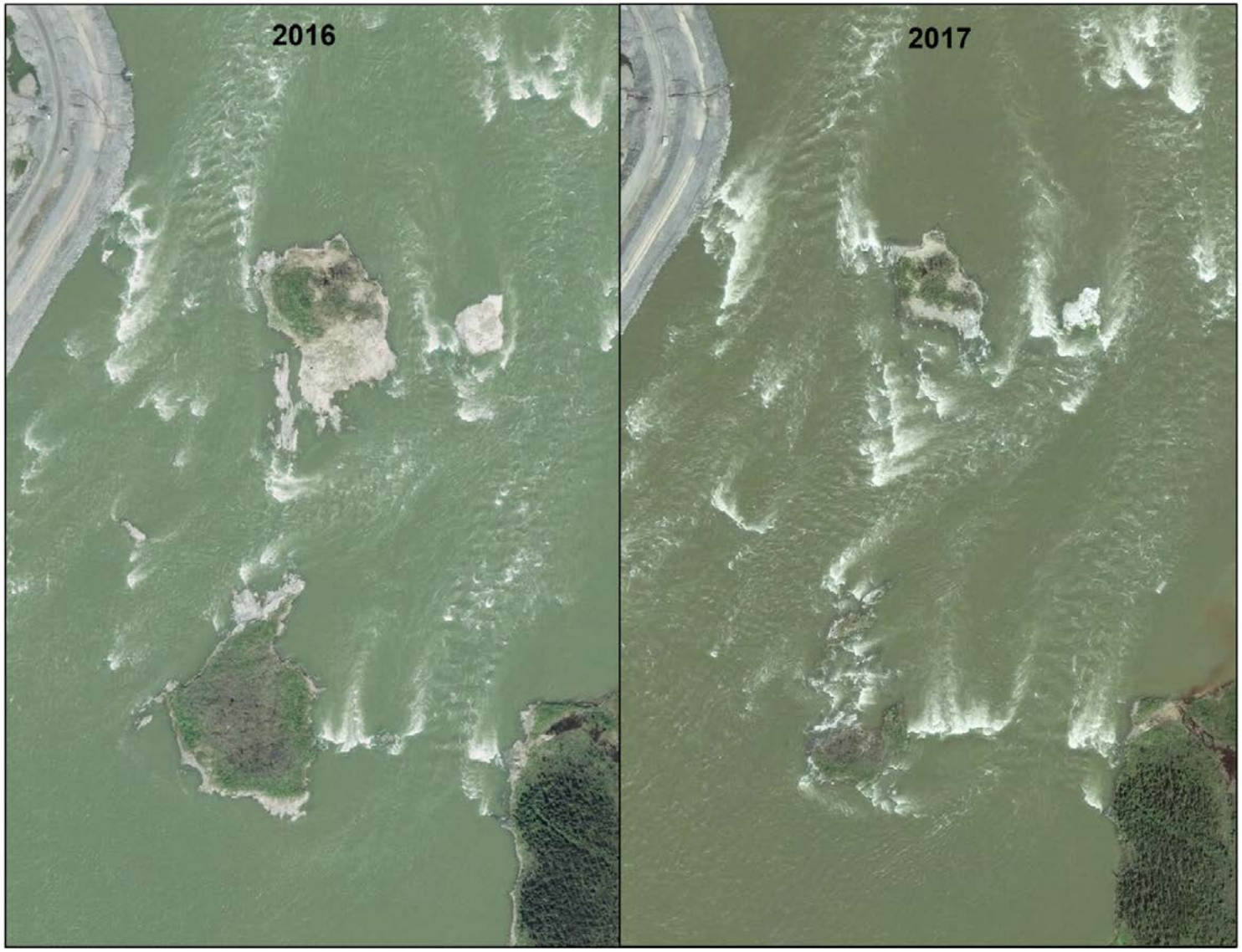

Figure 2: Comparison of Available Colonial Waterbird Habitat in Gull Rapids in June 2016 and July 2017

APPENDIX 2:
UAV SURVEY RESULTS

Table 16: Colonial Waterbirds Enumerated from Images of Islands in Gull Rapids taken by a UAV in 2017

Island	Observation	May 30-31		28-Jun		19-Jul	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Wpt 478	American Pelican	NA	NA	0	0	0	11
	Common Tern	NA	NA	0	0	0	0
	Common Tern Nest	NA	NA	0	0	0	0
	Common Tern Chick	NA	NA	0	0	0	0
	Herring Gull	NA	NA	0	0	0	2
	Herring Gull Nest	NA	NA	0	0	0	0
	Herring Gull Chick	NA	NA	0	0	0	0
	Ring-billed Gull	NA	NA	1	0	1	0
	Ring-billed Gull Nest	NA	NA	0	0	0	0
	Ring-billed Gull Chick	NA	NA	0	0	0	0
Wpt 226	American Pelican	0	0	0	0	0	0
	Common Tern	0	0	0	0	0	0
	Common Tern Nest	0	0	0	0	0	0
	Common Tern Chick	0	0	0	0	0	0
	Herring Gull	2	3	4	2	0	0
	Herring Gull Nest	2	0	5	4	0	0
	Herring Gull Chick	0	0	0	0	0	0
	Ring-billed Gull	972	714	466	866	108	329
	Ring-billed Gull Nest	18	5	403	376	0	0
	Ring-billed Gull Chick	0	0	0	0	0	0
Wpt 83	American Pelican	0	0	0	0	0	0
	Common Tern	0	0	0	0	0	0
	Common Tern Nest	0	0	0	0	0	0
	Common Tern Chick	0	0	0	0	0	0
	Herring Gull	0	0	0	0	0	0
	Herring Gull Nest	0	0	0	0	1	0
	Herring Gull Chick	0	0	0	0	0	0
	Ring-billed Gull	0	0	59	37	88	97
	Ring-billed Gull Nest	0	0	0	0	0	0
	Ring-billed Gull Chick	0	0	0	0	0	0
Wpt 225	American Pelican	0	NA	0	5	15	25
	Common Tern	0	NA	0	0	0	0
	Common Tern Nest	0	NA	0	0	0	0
	Common Tern Chick	0	NA	0	0	0	0
	Herring Gull	0	NA	22	0	0	4
	Herring Gull Nest	2	NA	3	2	0	0
	Herring Gull Chick	0	NA	0	0	0	0

Island	Observation	May 30-31		28-Jun		19-Jul	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
	Ring-billed Gull	286	NA	86	106	323	326
	Ring-billed Gull Nest	1	NA	16	19	0	0
	Ring-billed Gull Chick	0	NA	0	0	0	0
Wpt 561	American Pelican	0	0	0	0	0	0
	Common Tern	0	0	0	0	0	0
	Common Tern Nest	0	0	0	0	0	0
	Common Tern Chick	0	0	0	0	0	0
	Herring Gull	0	2	0	2	2	0
	Herring Gull Nest	0	0	0	0	0	0
	Herring Gull Chick	0	0	0	0	0	0
	Ring-billed Gull	146	134	0	0	184	569
	Ring-billed Gull Nest	0	0	0	0	0	0
	Ring-billed Gull Chick	0	0	0	0	0	0
Wpt 224	American Pelican	0	0	0	0	13	0
	Common Tern	10	0	2	1	0	1
	Common Tern Nest	0	0	21	16	0	0
	Common Tern Chick	0	0	0	0	0	0
	Herring Gull	0	0	1	1	0	1
	Herring Gull Nest	0	0	2	1	0	0
	Herring Gull Chick	0	0	0	0	0	0
	Ring-billed Gull	480	71	358	326	137	579
	Ring-billed Gull Nest	52	0	403	457	0	0
	Ring-billed Gull Chick	0	0	0	0	0	0

APPENDIX 3:
UAV MISSION SUMMARY

UAIS Mission Summary 2017

Mission Description, Method, and Execution

Unmanned Aerial Imaging Solutions (UAIS) uses unmanned aerial vehicles (UAVs) which are controlled by remote control, computer software, or a combination of both. The type of UAV that UAIS utilizes is a combination of fixed wing (traditional aircraft type) Mini Talon X-UAV foam body, and rotary wing (helicopter type) DJI Phantom plastic body. All other electrical components are either custom made or custom selected by UAIS. All Wildlife Resource Consulting Service (WRCS) missions flown in 2017 were accomplished using a DJI Phantom rotary wing. Using computer software (Mission Planner), the UAV operator creates a grid over a predetermined area and defines the speeds at which the UAV will fly, the altitude the UAV will fly, and boundaries that the UAV is not to penetrate (both horizontally and vertically). Once the flight plan is created, camera parameters specific to the onboard camera, are entered into the computer software and a grid pattern is created based on camera capability and desired image overlap and sidelap.

Launching of the UAV is accomplished using a small, clear, level and secure site to start the UAV while stationary on the ground and perform basic pre-start and pre-flight checks. The pre-start and pre-flight checks involve checking propeller response to remote control commands, GPS satellite status and acquisition condition and a final site check to ensure the safe launch of the UAV. Launch of the UAV is done in a relatively clear area for this purpose. Once the UAV operator takes control of the UAV, the flight plan is then initiated and the UAV is monitored using line of sight with secondary reference to UAV telemetry displayed on a personal computing device (iPad) mounted directly on the remote control. If at any time the UAV operator needs to terminate the flight plan, a “Return to Home” function immediately brings the UAV back to the mission launch location with no other required input from the UAV operator. The “Return to Home” route, altitude, and speed are part of the pre-start checks and are set prior to UAV engine start.

The landing site for the UAV requires a small and relatively clear, and flat area. The UAV operator will fly the UAV using the remote control into the approach phase, slowing the UAV down to landing speed and reducing the UAVs altitude in a controlled manner over the landing site. The UAV is landed on its landing gear in a controlled and stable manner. The data is then downloaded from the UAVs onboard memory and the camera memory card on to a computer and the data is then processed.

Data processing involves using the Mission Planner software to take the images and place “geo-referencing” meta-data into the images. Third party software can then be used to arrange the images in a sequential order and then another piece of third party software is used to “stitch” the images together into one large image. The final product is then delivered to the client.

High definition (4k) video is acquired by the UAVs onboard camera and is included in the data package.

The mission areas of interest were: "Wpt 83, Wpt 224, Wpt 226, Wpt 225, Floating Platform, and Wpt 561 (refer to Appendix 2 – Mission Area for an image of the mission areas and their naming conventions)."

The initial plan for data acquisition of the mission areas is as follows: each aforementioned mission area was flown to assess and locate nesting areas to focus on. Once all nesting areas were identified, the image acquisition plan was to fly each area three times per day at different times of day. Once all identified nesting areas were flown and all data captured at three different times of the day, the mission was considered complete. This would allow a much more accurate count as well as provide the greatest contrast in lighting and shadow contrast in the images.

The flight paths over the nesting areas were all flown at 100 feet above ground and in a grid pattern. The grid pattern was flown three times over each nesting area: once in a north to south grid pattern with a 45 degree camera angle, once in an east to west grid pattern with a 45 degree camera angle, and once in either a south west to north east grid pattern or south east to north west grid pattern and a 90 degree straight down camera angle (refer to appendix 2 – sample images). Larger nesting areas with higher concentrations of bird and nesting activity required more flights to capture more images and videos.

Due to high floodwater, a large majority of nesting areas had been reduced in size due to flooding. Mission parameters in regards to data acquisition and flight planned mission paths were modified to reduce time and cost to WRCS (Wildlife Resource Consulting Services). Where three separate missions were planned to be flown at various camera angles and flight path orientations, some areas had been reduced in size due to flooding and only a single flight with multiple camera shots was sufficient to capture accurate data in some mission areas, and in other cases the mission areas were completely underwater and not flown at all.

Mission 1 (May 30th – 31st)

Data acquisition of mission areas: "Wpt 83, Wpt 224, Wpt 226, and Wpt 561 (refer to Appendix 1 – Mission Area for an image of the mission areas and their naming conventions)" commenced late evening Tuesday, May 30th. The sky condition was clear and the winds were light (less than 5 knots or 10 kmph). The UAV captured 244 images of the proposed mission area successfully with a total flight time of 108 minutes. All phases of flight were uneventful.

Data acquisition of mission areas: "Wpt 83, Wpt 224, Wpt 226, Wpt 561, and an extra mission to the Sea Cans commenced early morning Wednesday, May 31st. The sky condition was overcast and the winds were light (less than 5 knots or 10 kmph). The UAV captured 703 images of the proposed mission areas successfully with a total flight time of 248 minutes. All phases of flight were uneventful.

Mission 2 (June 28th – June 29th)

June 28th data acquisition of morning mission areas: “Wpt 83, Wpt 224, Wpt 226, and Wpt 561" commenced early morning Wednesday, June 28th and were completed successfully late evening on Wednesday June 28th. The sky condition was overcast and the winds were light to moderate. The UAV captured 1182 images of the proposed mission areas successfully with a total flight time of 336 minutes. All phases of flight were uneventful.

June 29th data acquisition of evening mission areas: “Wpt 83, Wpt 224, Wpt 226, and Wpt 561" commenced early morning Thursday, June 29th. The sky condition was overcast and the winds were moderate. The UAV captured 1007 images of the proposed mission areas successfully with a total flight time of 314 minutes. All phases of flight were uneventful.

Mission 3 (July 19th – July 20st)

July 19th data acquisition of mission areas: “Wpt 83, Wpt 224, Wpt 226, and Wpt 561" commenced early morning Wednesday, June 28th and were completed successfully late evening on Wednesday, July 19th. The sky condition was overcast and the winds were light to moderate. The UAV captured 892 images of the proposed mission areas successfully with a total flight time of 245 minutes. All phases of flight were uneventful.

July 20th data acquisition of mission areas: “Wpt 83, Wpt 224, Wpt 226, and Wpt 561" commenced early morning Thursday, July 20th. The sky condition was overcast and the winds were moderate. The UAV captured 756 images of the proposed mission areas successfully with a total flight time of 229 minutes. All phases of flight were uneventful.

Appendix 1 – Mission Area

Appendix 2 – Sample Images

Top Down Image Nesting Area (Wpt 226) - Approximately 350 feet Above Ground

Grid Flight Image – Camera angle 45 degrees Down – Wpt 224 - Morning

Grid Flight Image – Camera angle 90 degrees Down – Wpt 224 - Morning