Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Waterfowl Habitat Effects Monitoring Report

TEMP-2018-11

KEEYASK

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KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2018-11

WATERFOWL HABITAT EFFECTS MONITORING

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services 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 waterfowl. 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.

Canada geese and mallard are identified as Valued Environmental Components in the Project's environmental assessment and Terrestrial Effects Monitoring Plan due to their abundance in the area and importance as a food source for local First Nations members. Canada geese, mallard, and other species of waterfowl are relatively abundant in the Keeyask area during the spring migration. Waterfowl habitat is provided by numerous waterbodies, including the Nelson River and Gull Lake, which often support migrating waterfowl in the spring and fall. Nesting and brood-rearing habitat occurs in wetlands, and along the shorelines of many ponds, creeks, rivers and lakes.

Previous waterfowl surveys have occurred in the Keeyask region as part of pre-construction and construction monitoring. Pre-construction waterfowl surveys were conducted from 2001-03, 2006 and in 2011. The first construction-phase waterfowl survey occurred in 2015. Results from these studies showed that large numbers of waterfowl use the Keeyask region during the spring and fall migrations, and that waterfowl often use inland (off-system) lakes during these times.

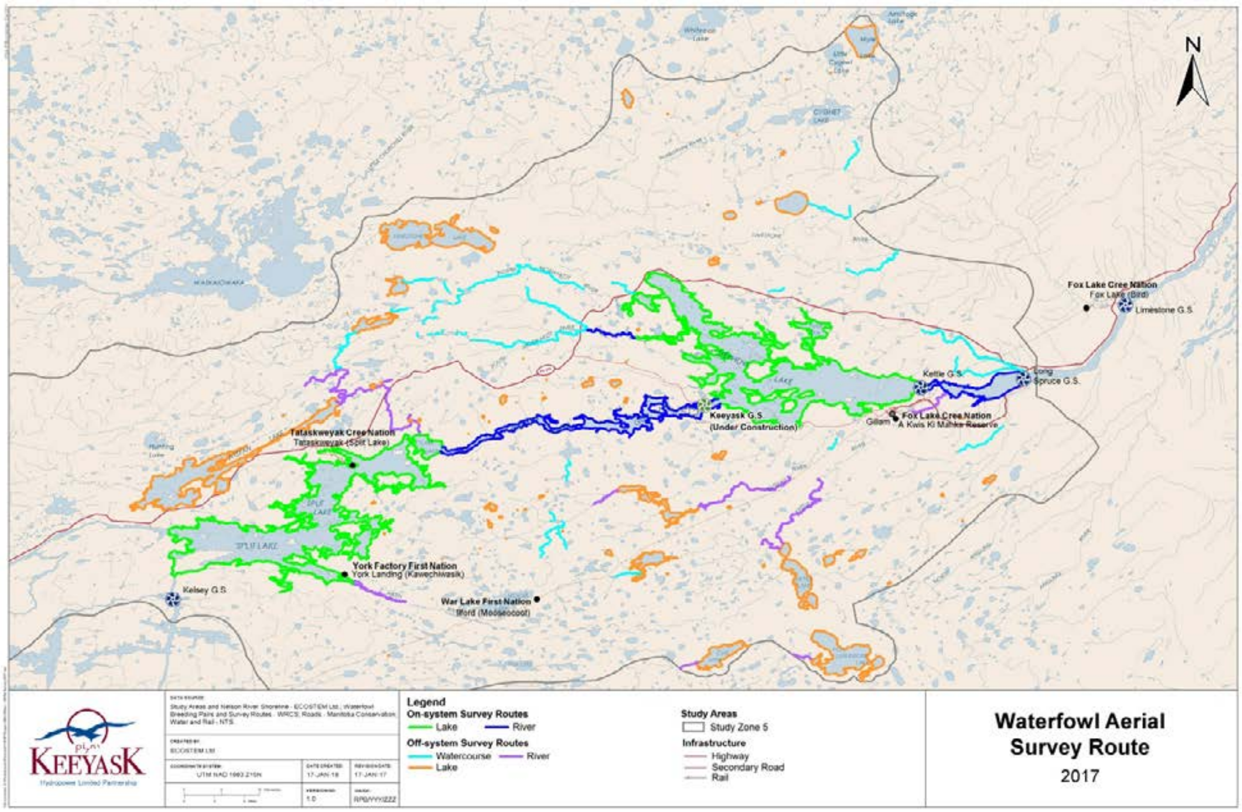
Why is the study being done?

According to the environmental assessment done for the Project, change to habitat availability is the main predicted Project impact for Canada goose and mallard. Project construction is anticipated to cause an indirect loss of waterfowl habitat due to noise and disturbance caused by construction activities. Project operation is anticipated to reduce the amount and quality of waterfowl habitat in the Nelson River and Gull Lake due to flooding of the reservoir. In order to assess the Project impacts of habitat loss and alteration on Canada geese, mallard, and other waterfowl species, the relative abundance and distribution of waterfowl during construction and operation will be monitored.

What was done?

A series of aerial waterfowl surveys were conducted in 2017, starting in early spring and continuing into the fall. These surveys were done along shorelines of the Nelson River between the Kelsey Generating Station (GS) and the Limestone GS and in areas that are not affected by Keeyask or other hydroelectric development (off-system), but within the regional study area.

The surveys were timed to correspond with major waterfowl life-cycle events (*i.e.,* staging, breeding, brood-rearing). Surveys for staging waterfowl occurred on May 5-7 (early-May) and September 13-16, 2017; breeding pair surveys were conducted on May 20-22 (late-May) and June 18-21, 2017; and brood surveys were conducted on July 10-14, 2017. The survey route consisted of 3,452 km of shoreline on different waterbody types. To assess potential impacts of the Project on waterfowl in the area, waterfowl densities observed in 2017 were compared to the densities observed during pre-construction surveys and during the 2015 construction-monitoring survey. The presence of hunting groups was also recorded during the spring waterfowl surveys to estimate the amount of harvest pressure in the area surveyed.



What was found?

Waterfowl abundance was variable throughout the survey period from spring to fall. Staging Canada geese and mallard were most abundant during the early-May survey, while the abundance of other waterfowl species peaked in late-May. Waterfowl abundance decreased in the June and July surveys due to staging waterfowl leaving the region for their nesting grounds further north. July was the peak of nest hatching, and Canada goose and mallard were the most common species of brood observed. In September, large numbers of waterfowl, particularly diving duck species, were observed in the area, highlighting how important the area surveyed is to staging waterfowl.

Waterfowl densities observed in 2017 were similar to those observed during the pre-construction surveys and the 2015 construction-monitoring survey. This suggests that waterfowl use in the area surveyed has been relatively consistent since the start of construction and construction activity does not appear to be limiting waterfowl use of habitat in the region.

A total of 34 hunting groups were observed during the 2017 waterfowl surveys, eleven of which were located near York Landing on the south end of Split Lake.

What does it mean?

Surveys conducted in 2017 did not indicate any unexpected effects of Project construction on waterfowl abundance or distribution to date. The relatively high variability of waterfowl abundance during the different survey periods highlighted the need for multiple surveys from spring to fall in order to monitor habitat use of waterfowl during major life-cycle events. Hunting access did not appear to be increased by Project construction developments. Most hunting groups observed were located near existing towns or communities, or near previously established hunting camps.

What will be done next?

Aerial waterfowl surveys will be conducted again beginning in the spring of 2019. Data from the 2015 and 2017 surveys will be used to further refine the waterfowl habitat selection model previously developed. The habitat selection model can then be used to predict the amount of habitat disturbance as a result of the Project and its potential impact on Canada goose, mallard, and other waterfowl species.

STUDY TEAM

We would like to thank Sherrie Mason and Rachel Boone of Manitoba Hydro for editorial comments, and Megan Anger of Manitoba Hydro, Ben Hofer of Custom Helicopters, and Ron Bretecher of North/South Consultants Inc., for logistical assistance in the field. We would also like to thank Dr. James Ehnes, ECOSTEM Ltd., for GIS support, study design, and cartography.

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

- Robert Berger (M.N.R.M) – Design, analysis, and reporting
- Mark Baschuk (M.Sc.) – Survey personnel, analysis, and reporting
- Nicholas LaPorte (M.N.R.M) – Survey personnel
- Donald Flett (TCN) – Survey personnel
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1.0 INTRODUCTION

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

The *Keeyask Generation Project Response to EIS Guidelines* (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. 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* (TESV). The *Keeyask Generation Project 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, waterfowl habitat effects, during the construction and operation phases.

Waterfowl surveys focused on Canada goose (*Branta canadensis*) and mallard (*Anas platyrhynchos*), which were identified as Valued Environmental Components (VECs) during the environmental assessment for the Project. These species were chosen as VECs based on their importance to local communities and their protection under the *Migratory Birds Convention Act*.

Previous waterfowl surveys have occurred in the Keeyask region as part of pre-construction and construction monitoring. Pre-construction waterfowl surveys were conducted from 2001-03, 2006 and in 2011. The first waterfowl survey during construction occurred in 2015. Results from these studies showed that large numbers of waterfowl use the Keeyask region during the spring and fall migrations, and that waterfowl often use inland (off-system) lakes during these times.

The objectives of waterfowl monitoring during Project construction are to identify changes in abundance or distribution due to construction activities. The main concerns of construction activities on waterfowl are sensory disturbance, loss of habitat, and increased hunter access. To identify potential construction effects, several components that influence waterfowl populations will be monitored, including habitat, mortality, and habitat enhancement efficacy. This report presents general findings of the waterfowl surveys conducted in 2017 and basic habitat use patterns for lakes, rivers, and watercourses. Monitoring focusing on waterfowl mortality and habitat enhancement efficacy were not done in 2017, as these studies are focused on Project components not yet in place; as such, they will be presented at a later date.

2.0 METHODS

2.1 AERIAL SURVEYS

Aerial surveys for waterfowl were conducted five times, from May to September 2017, within Study Zone 5 (Map 1). The surveys in 2017 were timed to be as similar as possible with the surveys that were conducted in 2015. However, due to the relatively late spring in 2017, the survey previously conducted in April was delayed to early May until waterbodies began to thaw and some open water was present.

The survey route consisted of 3,452 km of shoreline of various waterbody types (Map 1). A random, stratified design (a sample of waterbody types and size classes) 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 three basic categories (lake, river, or watercourse), and grouped into five different size classes (<0.5, 0.5-1, 1-10, 10-100, 100-1,000, >1,000 ha). Lakes are defined as non-linear waterbodies with minimal water flow, rivers are large, linear water bodies with flow, and watercourses are narrow, linear waterbodies with flow (creeks and streams). The total shoreline lengths and distribution of waterbodies are presented in Table 1 and Map 1.

Different spatial data was used in 2017 than in 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 2015 dataset that was used in the 2015 survey. As a result, the shoreline lengths presented in this report are different from those presented in the 2016 waterfowl report (WRCS 2016). Calculations in this report, including those made on 2015 data, are based on the shoreline lengths presented in Table 1, and may differ from those presented in the 2016 report.

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

System	Waterbody Type	Size Class (ha)						Total Shoreline Length (km)
		<0.5	0.5-1	1-10	10-100	100-1,000	>1,000	
On-system	Lake	0	0	0	0	0	1,823	1,823
	River	0	0	0	0	56	331	387
	Watercourse[1]	NA	NA	NA	NA	NA	NA	0
Off-system	Lake	9	7	15	41	130	544	746
	River	0	0	8	133	122	0	263
	Watercourse[1]	234	NA	NA	NA	NA	NA	234
Total		242	7	23	174	307	2,698	3,452

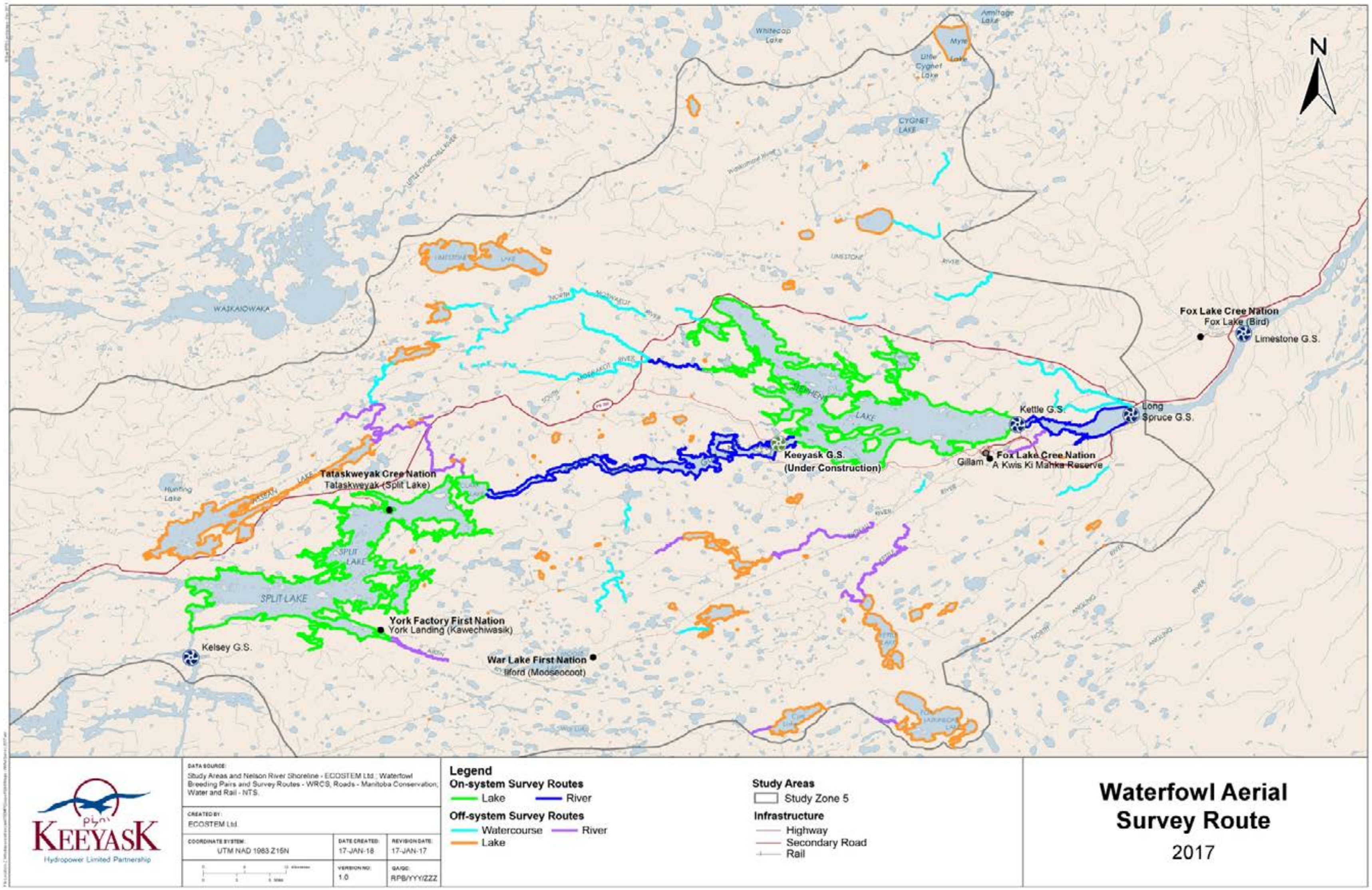
[1] Size class (area) of watercourses are not available

Surveys were timed to correspond with major waterfowl life-cycle events (*i.e.,* staging, breeding, brood-rearing). Surveys for staging waterfowl occurred on May 5-7 (early-May) and September 13-16, 2017; breeding pair surveys were conducted on May 20-22 (late-May) and June 18-21, 2017; and brood surveys were conducted on July 10-14, 2017.

Surveys were not conducted if winds exceeded 25 km/hr or if inclement weather (rain, fog, etc.) obscured visibility. All surveys were conducted from a helicopter equipped with bubble windows in the rear that travelled approximately 80 km/hr at an altitude of approximately 20-30 m, following the general contours of waterbodies (Appendix A). Two observers, on the left side of the aircraft (front and rear seats), recorded all waterfowl observed using a dependent double-observer technique (Koneff *et al.* 2008). The front-seat observer recorded all waterfowl observed and indicated this through the aircraft's communication system to the rear-seat observer. The rear-seat observer recorded all waterfowl not observed by the front-seat observer. An additional third observer was present on the right side (rear seat) of the aircraft and recorded waterfowl opportunistically. Observations by the third observer typically occurred when the aircraft was unable to follow relatively small shoreline contours and small bays or inlets were "cut-off" from the left side of the aircraft. Bird species, sex, and flock arrangement (*e.g.,* pair [drake and hen], flock of three drakes and two hens, etc.) were recorded, as well as opportunistic observations of other waterbird species (*e.g.*, loons, grebes, cranes, etc).

All swans observed were classified as "unknown swans" due to the difficulty distinguishing between the trumpeter swan (*Cygnus buccinator*) and tundra swan (*Cygnus columbianus*) from a distance. Despite a relatively low probability of observing trumpeter swans in northern Manitoba, there are several areas within Study Zone 5 containing possible breeding evidence of trumpeter swans (Manitoba Breeding Bird Atlas 2015). Similarly, greater scaup (*Aythya marila*) and lesser scaup (*Aythya affinis*) were recorded as "unknown scaup" due to the difficulty in distinguishing between the two species from a distance.

The number of hunting groups observed was recorded opportunistically in May, when local resource harvesters are actively pursuing Canada geese and other waterfowl species. A hunting group was recorded when blinds, decoys, hunters, etc. were observed. Care was taken to avoid flying too near active hunting groups in order to minimize disturbance.



Map 1: Overview of Waterfowl Aerial Survey Routes in 2017

2.2 DATA ANALYSIS

2.3 WATERFOWL DENSITIES

Total waterfowl densities within different waterbody types were calculated by first assigning each waterfowl observation to the nearest waterbody type. The total number of waterfowl observed and shoreline length of the waterbody type were then used to calculate the number of birds per kilometre surveyed (birds/km). Common loon (*Gavia immer*), grebe, and sandhill crane (*Grus canadensis*) observations were not included in the calculations.

To provide a comparison of waterfowl densities observed during the 2015 construction-monitoring survey and pre-construction surveys, waterfowl densities for 2017 were calculated using data from the May, July, and September surveys. Similar to pre-construction surveys, only observations of ducks, geese, and swans were included (all merganser, common loon, grebe, and sandhill crane observations were removed). Observations were assumed to fall within 200-m of the helicopter, and this distance was used to estimate the total area (km^2) surveyed and the waterfowl density (birds/km^2).

To assess the potential effects of construction on waterfowl, waterfowl densities (birds/km^2) from Gull Lake and Gull Rapids were compared between pre-construction surveys (2001-2003 and 2011), the 2015 construction-monitoring survey, and the 2017 construction-monitoring survey. Gull Lake and Gull Rapids were chosen as comparison areas between years because these areas were under active construction in 2015 and 2017.

2.4 INDICATED BREEDING PAIRS

Data from the late-May (May 20-22) and June breeding surveys were used to determine the number of indicated breeding pairs (IBPs) of waterfowl, as a measure of the number of breeding waterfowl in Study Zone 5. Data from the late-May survey were used to determine the number of indicated breeding pairs of early-nesting species, including mallard, northern pintail (*Anas acuta*), and Canada goose. Data from the June survey were used to determine the number of indicated breeding pairs for all other species, including American wigeon (*Anas americana*), ring-necked duck (*Aythya collaris*), scaup, and common loon.

The definition of an IBP was based on work conducted by Lemelin *et al.* (2010) and Messmer *et al.* (2015). Indicated breeding pairs of Canada geese were defined as observations of one to three birds. For dabbling ducks (*e.g.,* mallard, America wigeon, etc.), IBPs were classified as the number of males observed singly or in groups up to four individuals, including females and unsexed individuals, with the exception of groups consisting of three males and one female. For diving ducks, IBPs were classified based on the number of males observed singly or in groups up to four, including females and unsexed individuals (Lemelin *et al.* 2010; Messmer *et al.* 2015). Observations of one or two common loons were considered one IBP (Lemelin *et al.* 2010; Messmer *et al.* 2015).

Indicated breeding pair density was calculated using the same method that was used for calculating total waterfowl density.

2.5 WATERFOWL BROODS

The dates of brood observations were used to determine the approximate dates of the beginning of the nesting period. Nest initiation was approximated for individual broods by subtracting the age of the brood in days, the days required for egg incubation (28 days for mallard and Canada goose), and one day for each egg laid (number of ducklings/goslings observed) from the observation date. This information is useful for determining the timing of future breeding surveys, which ideally occur at the start of the incubation period after most migrants have left (Lemelin *et al.* 2010).

Brood density was calculated using the same method that was used for calculating total waterfowl density.

3.0 RESULTS

3.1 WATERFOWL DENSITIES

During the early-May survey, 5,189 birds, consisting of 12 species, were observed (Table 2). The majority of observations (63%) consisted of Canada goose, while mallard was the next most common species observed (23% of all observations). Ring-necked duck, unknown swans, and northern pintail were less common, and relatively few observations were made of the remaining species (Table 2).

Most waterbodies were still frozen during the early-May survey. The majority of waterfowl observations were concentrated at areas of open water, which occurred at creek mouths or in areas where water flow was sufficiently fast to prevent freezing (Appendix A). Most of these areas occurred within off-system rivers, which supported the greatest densities of waterfowl in early-May (Table 3; Map 2). These findings were consistent with those observed in 2015 (Table 4).

The greatest number of waterfowl were observed during the late-May survey. A total of 14,783 birds, consisting of 20 species, were observed during the survey in late-May (Table 2). There was a substantial decrease (88% decrease) in the number of Canada geese present in Study Zone 5 compared to the early-May survey. Unknown scaup were the most common bird observed and a relatively large numbers of other diving ducks, including ring-necked duck, unknown diving duck species, and unknown scoters (*i.e.,* likely white-winged scoter) were also observed (Table 2).

Most waterbodies were still partially ice-covered during the late-May survey. Large waterbodies, including Stephens Lake, Assean Lake, and Limestone Lake only contained open water in shallow bays and creek mouths (Appendix A). Split Lake was predominantly ice-free in late-May. Due to the preference of large waterbodies by diving ducks, which were the most common waterfowl group observed, on-system rivers supported the greatest densities of waterfowl in late-May (Table 3; Map 3).

In the June survey, a total of 3,074 birds, consisting of 18 species, were observed (Table 2). A decline in the number of most species, particularly diving duck species, was observed compared to the late-May survey. Common merganser (*Mergus merganser*) and common goldeneye were the most abundant species observed, comprising 20% and 18% of all observations, respectively (Table 2). Off-system lakes and watercourses supported the greatest densities of waterfowl in June, but densities were relatively low on all waterbody types in comparison to those observed in late-May (Table 3; Map 4).

The lowest number of waterfowl were observed during the July survey. In total, 2,073 waterfowl, consisting of 14 species, were observed (Table 2). Ring-necked duck, unknown scaup, and unknown diving ducks were the most common observations (Table 2). Off-system lakes supported the greatest densities of waterfowl in July (Table 3; Map 5).

In the September survey, 14,318 waterfowl, consisting of 14 different species, were observed (Table 2). Unknown diving ducks and ring-necked ducks were the most common observations, comprising 36% and 23% of all observations, respectively (Table 2). Off-system lakes and rivers supported the greatest densities of waterfowl in September (Table 3; Map 6).

Average waterfowl densities in 2017 were lower than those observed in the 2015 construction-monitoring surveys, and higher or about the same as those observed during pre-construction surveys conducted from 2001-2003 and in 2011 (KHLP 2012). Average waterfowl densities observed during the pre-construction period ranged from 8-16, 3-6, and 12-15 birds/km^2 in the spring (May), summer (July), and fall (September), respectively (KHLP 2012). In 2015, waterfowl densities were 14, 6, and 24 birds/km^2 in the spring, summer, and fall, respectively. In 2017, waterfowl densities were 10, 3, and 20 birds/km^2 in the spring, summer, and fall, respectively.

In Gull Lake, waterfowl densities in 2017 were similar to densities observed in 2015, and during the spring and summer pre-construction surveys. Waterfowl densities were lower in fall in comparison to the pre-construction surveys. Pre-construction waterfowl densities on Gull Lake ranged from 20-37, 0.4-11, and 13-58 birds/km^2 in the spring (May), summer (July), and fall (September), respectively (KHLP 2012). In 2015, waterfowl densities were 25, 4, and 10 birds/km^2 in the spring, summer, and fall, respectively. In 2017, waterfowl densities on Gull Lake were 24, 4, and 6 birds/km^2 in the spring, summer, and fall.

In Gull Rapids, waterfowl densities in 2017 were greater in the spring compared to densities observed in 2015 and during the pre-construction surveys, but were lower in the fall in comparison to pre-construction surveys. Pre-construction waterfowl densities on Gull Rapids ranged from 1-11, 3-5, and 29 birds/km^2 in the spring (May), summer (July), and fall (September), respectively (KHLP 2012). In 2015, waterfowl densities were 3, 4, and 7 birds/km^2 in the spring, summer, and fall, respectively. In 2017, waterfowl densities were 19, 3, and 3 birds/km^2 in the spring, summer, and fall.

The number of waterfowl species observed (n=20 plus swans and scaups) during this monitoring survey was similar to pre-construction surveys (n=23) conducted from 2001-2003 and in 2011 (KHLP 2012) and the same as the number observed during the first construction-phase survey in 2015 (n=20). Differences included pacific loon (*Gavia pacifica*), which was observed during the pre-construction surveys, but not observed in 2017, and greater and lesser scaup, which were not differentiated in 2017.

Table 2: Total Number of Waterfowl Observed During Aerial Surveys in 2017

Species	Month					
	May 5*	May 20*	June	July	September	Total
American Black Duck (*Anas rubripes*)	0	2	0	0	0	2
American Wigeon (*Anas americana*)	13	233	101	36	150	533
Black Scoter (Melanitta americana)	0	4	0	0	0	4
Blue-winged Teal (*Anas discors*)	4	0	3	0	0	7
Bufflehead (Bucephala albeola)	15	148	31	12	19	225
Canada Goose (Branta canadensis)	3,244	388	308	281	1,976	6,197
Common Goldeneye (*Bucephala clangula*)	49	218	557	0	661	1,485
Common Loon (*Gavia immer*)	0	1,067	98	103	74	1,342
Common Merganser (*Mergus merganser*)	10	438	615	100	461	1,624
Green-winged Teal (*Anas carolinensis*)	85	306	48	23	211	673
Mallard (Anas platyrhynchos)	1,177	404	133	123	1,713	3,550
Northern Pintail (*Anas acuta*)	150	120	0	0	0	270
Northern Shoveler (*Anas clypeata*)	0	9	0	0	0	9
Red-breasted Merganser (*Mergus serrator*)	0	0	2	4	8	14
Red-necked Grebe (*Podiceps grisegena*)	0	0	1	0	0	1
Ring-necked Duck (*Aythya collaris*)	244	1,571	352	463	3,313	5,943
Sandhill Crane (*Grus canadensis*)	18	18	2	6	0	44
Snow Goose (Chen caerulescens)	0	1	0	0	2	3
Surf Scoter (Melanitta perspicillata)	0	6	6	0	0	12
Unknown Dabbler	0	63	4	17	175	259
Unknown Diver	1	2,951	241	404	5,213	8,810
Unknown Duck	0	0	10	1	0	11
Unknown Grebe	0	4	1	0	0	5
Unknown Scaup (Aythya affinis/marila)	0	4,830	212	411	196	5,649
Unknown Scoter	0	1,029	306	57	82	1,474
Unknown Swan (Cygnus buccinator/columbianus)	179	818	9	30	64	1,100
White-winged Scoter (*Melanitta deglandi*)	0	155	34	2	0	191
Total	5,189	14,783	3,074	2,073	14,318	39,437

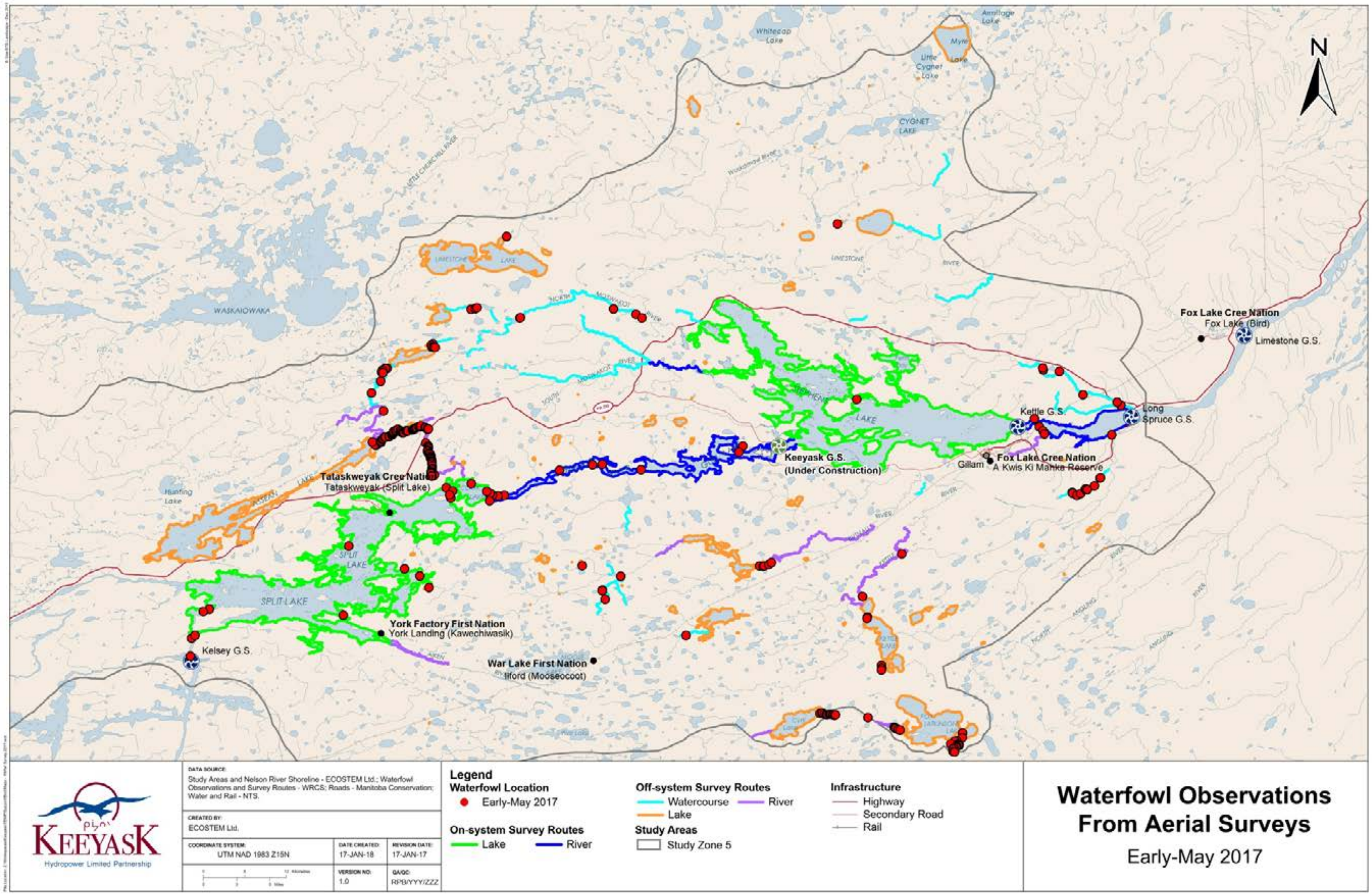
*Note: As there were two surveys conducted in May 2017, the months are labelled with the start date.

Table 3: Waterfowl Density (birds/km) within Waterbody Types in 2017

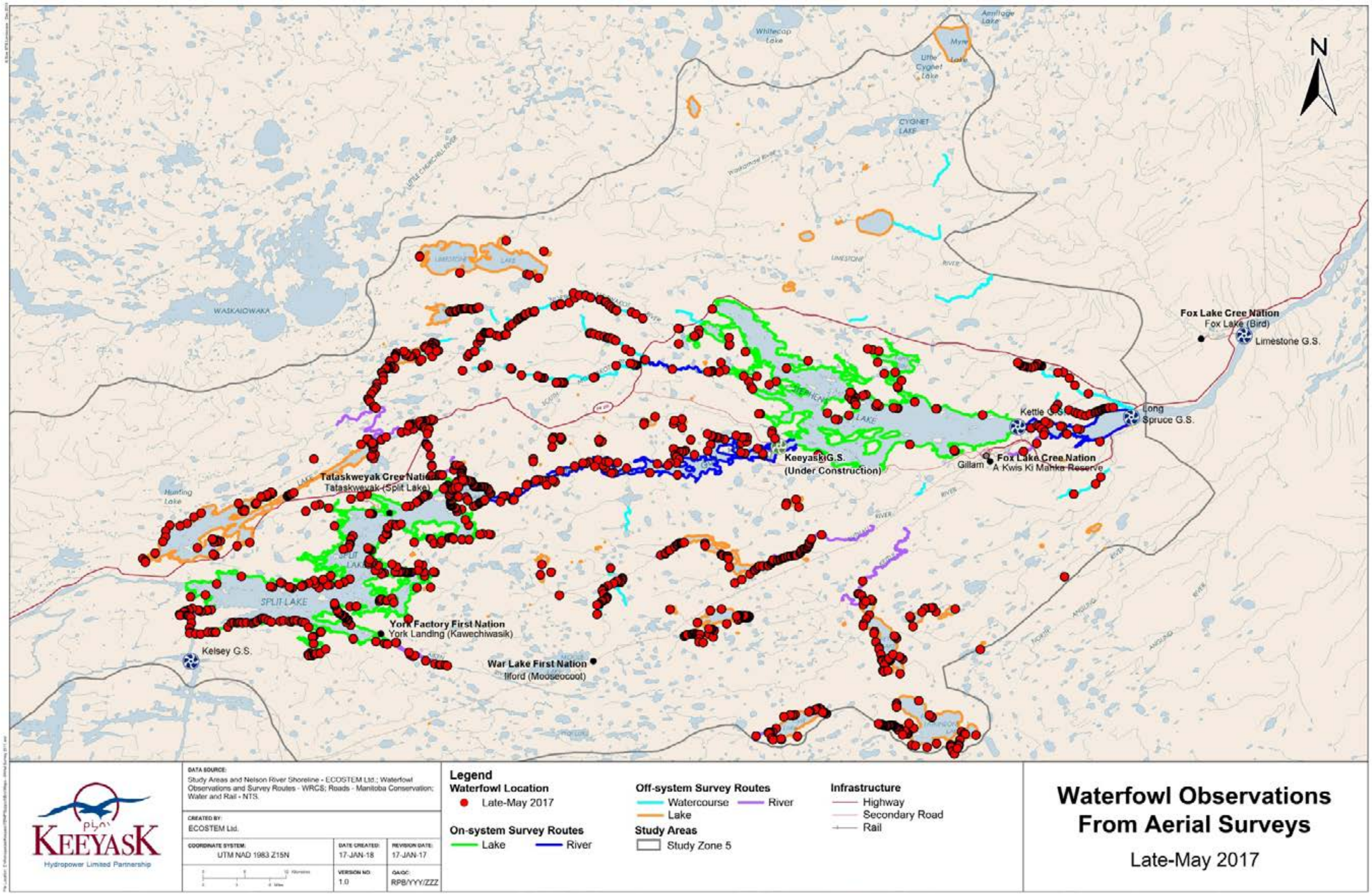
System	Waterbody Type	Survey Month				
		May 5	May 20	June	July	September
On-system	Lake	0.2	2.4	0.6	0.1	1.0
	River	0.6	6.8	0.8	0.6	1.6
	Watercourse	NA	NA	NA	NA	NA
Off-system	Lake	2.6	5.5	1.5	1.7	14.4
	River	8.6	5.9	0.4	0.4	3.2
	Watercourse	1.6	4.0	1.2	0.3	1.0

Table 4: Waterfowl Density (birds/km) within Waterbody Types in 2015

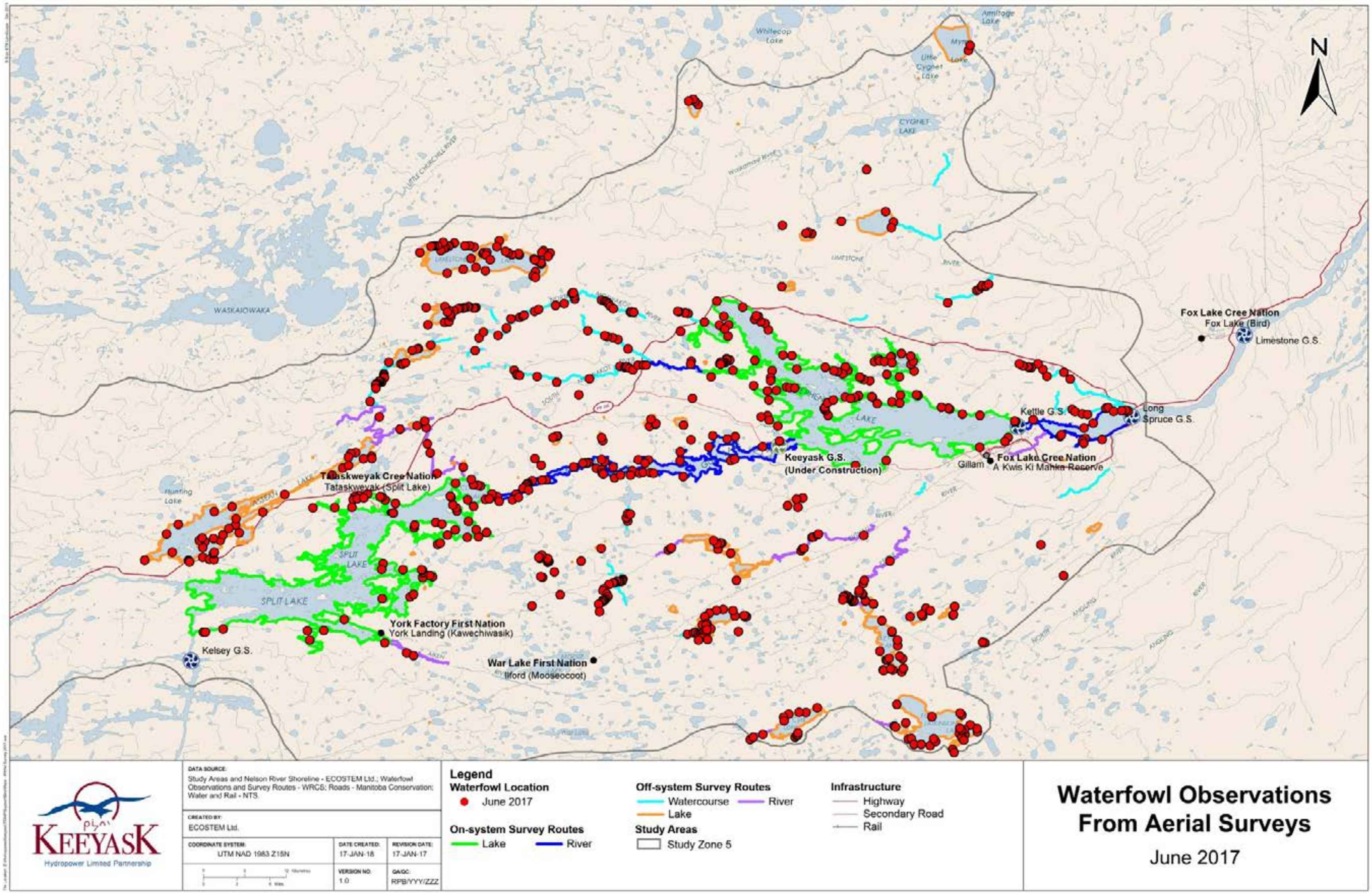
System	Waterbody Type	Survey Month				
		April	May	June	July	September
On-system	Lake	0.3	2.6	0.7	0.6	1.8
	River	0.5	3.5	1.2	0.7	2.1
	Watercourse	NA	NA	NA	NA	NA
Off-system	Lake	1.4	3.1	1.5	3.7	15.9
	River	3.4	2.0	0.4	0.8	1.4
	Watercourse	3.0	2.3	1.2	0.4	1.1



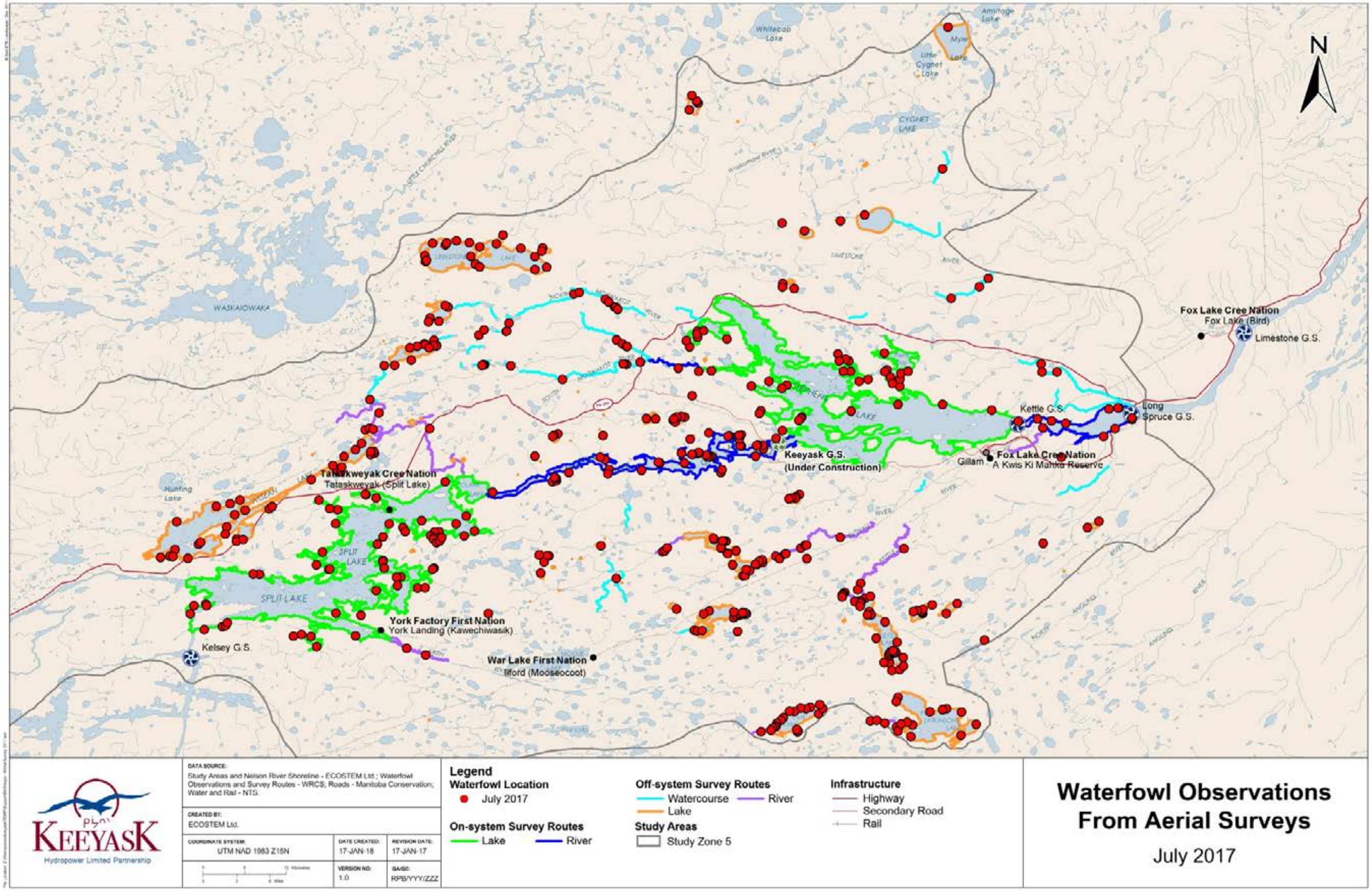
Map 2: Waterfowl Observations from Aerial Surveys in Early-May 2017



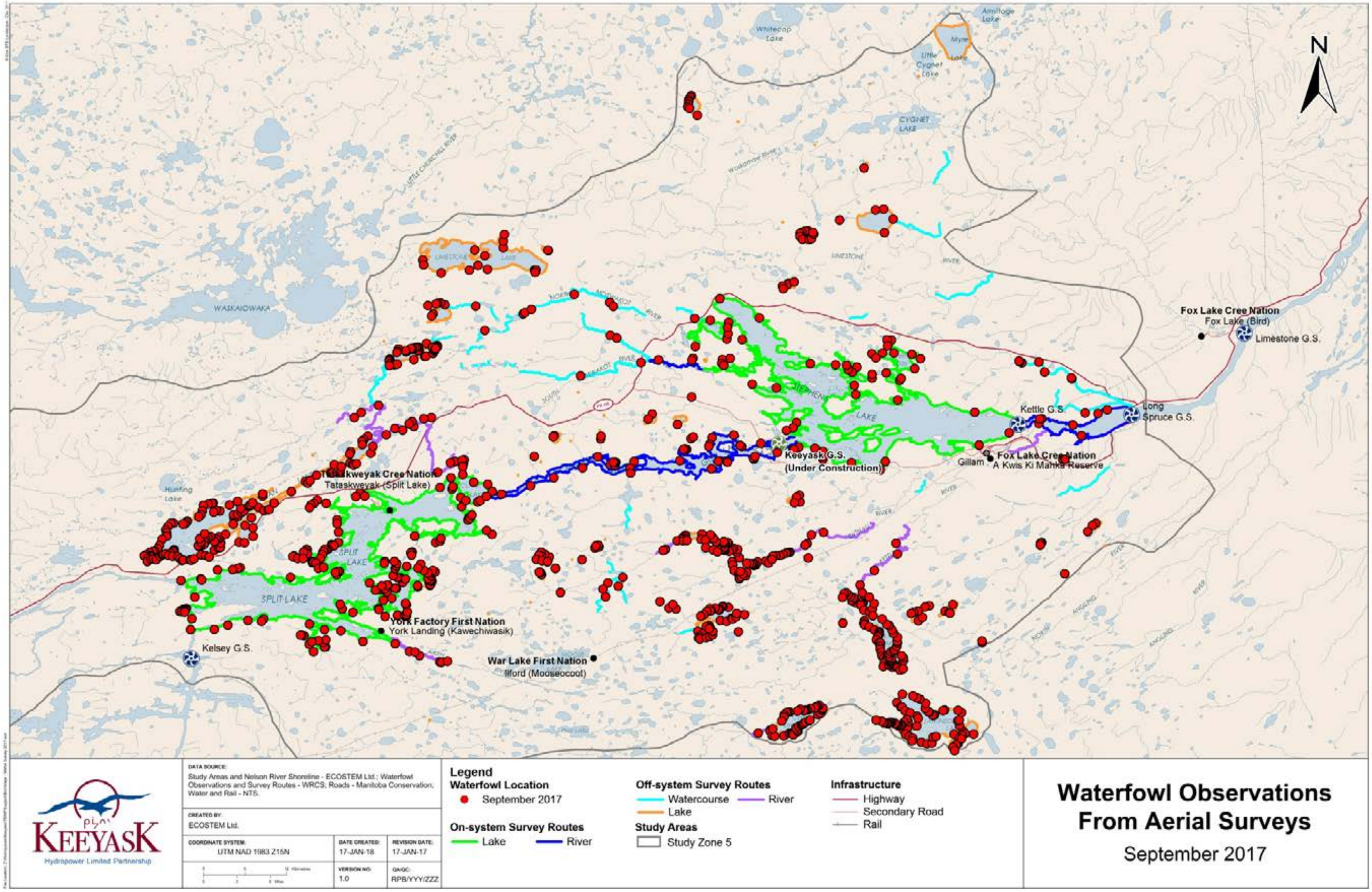
Map 3: Waterfowl Observations from Aerial Surveys in Late-May 2017



Map 4: **Waterfowl Observations from Aerial Surveys in June 2017**



Map 5: Waterfowl Observations from Aerial Surveys in July 2017



Map 6: Waterfowl Observations from Aerial Surveys in September 2017

3.2 INDICATED BREEDING PAIRS

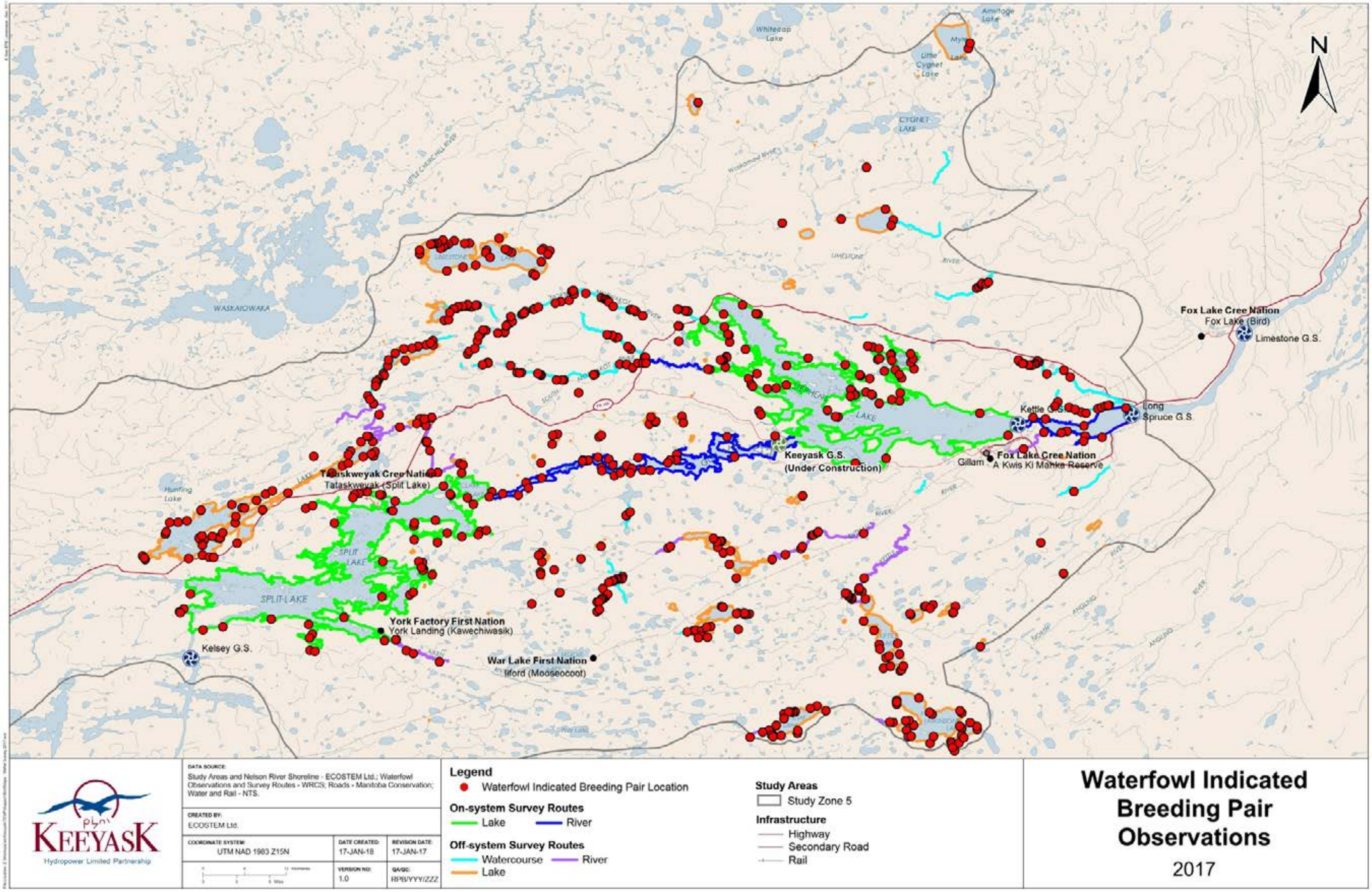
A total of 795 IBPs were observed in May/June 2017 (Table 4; Map 7). Indicated breeding pairs of mallard were the most common waterfowl species observed in Study Zone 5. Indicated breeding pairs of ring-necked duck, Canada goose, and common loon were also relatively common (Table 5).

Total IBP densities were greatest in off-system lakes and watercourses (Table 6). On-system rivers supported greater densities of IBPs compared to on-system lakes (Table 6).

In 2017, IBP densities of mallard and Canada goose were greatest on off-system lakes and watercourses (Table 5). Indicated breeding pairs of other common waterfowl species, including American wigeon, green-winged teal, and ring-necked duck were also observed in the greatest densities on off-system rivers and watercourses (Table 6). These findings are consistent with the observations made in 2015. In 2015, off-system lakes supported slightly higher IBP densities compared to off-system rivers (Table 7).

Table 5: Number of Indicated Breeding Pairs Observed in 2017

Species	No. Indicated Breeding Pairs
American Wigeon	60
Blue-winged Teal	2
Bufflehead	21
Canada Goose	101
Common Goldeneye	26
Common Loon	75
Common Merganser	71
Green-winged Teal	22
Mallard	214
Northern Pintail	16
Red-breasted Merganser	1
Ring-necked Duck	164
Unknown Scaup	18
White-winged Scoter	4
Total	**795**



Map 7: Waterfowl Indicated Breeding Pair Observations from Aerial Surveys in 2017

Table 6: Density of Indicated Breeding Pairs (pairs/km) within Waterbody Types in 2017

Species	On-system			Off-system			
	Lake	River	Total	Lake	River	Watercourse	Total
American Wigeon	0.01	0.03	0.01	0.02	0.03	0.07	0.03
Blue-winged Teal	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Bufflehead	0.00	<0.01	<0.01	0.01	0.01	0.05	0.02
Canada Goose	0.01	0.01	0.01	0.05	0.01	0.15	0.06
Common Goldeneye	<0.01	0.01	0.01	0.02	0.00	0.00	0.01
Common Loon	0.01	0.01	0.01	0.06	0.00	<0.01	0.04
Common Merganser	0.01	0.03	0.01	0.06	0.01	<0.01	0.04
Green-winged Teal	<0.01	<0.01	<0.01	0.01	<0.01	0.04	0.01
Mallard	0.02	0.03	0.02	0.10	0.07	0.30	0.13
Northern Pintail	<0.01	0.01	<0.01	<0.01	0.01	0.03	0.01
Red-breasted Merganser	0.00	0.00	0.00	<0.01	0.00	0.00	<0.01
Ring-necked Duck	0.01	0.01	0.01	0.08	0.09	0.27	0.11
Unknown Scaup	<0.01	0.00	<0.01	0.01	0.01	0.03	0.01
White-winged Scoter	<0.01	0.00	<0.01	<0.01	0.00	0.00	<0.01
Total	0.09	0.14	0.10	0.40	0.24	0.95	0.47

Table 7: Density of Indicated Breeding Pairs (pairs/km) within Waterbody Types in 2015

Species	On-system			Off-system			
	Lake	River	Total	Lake	River	Watercourse	Total
American Wigeon	0.03	0.03	0.03	0.05	0.04	0.03	0.04
Black Scoter	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00
Bufflehead	<0.01	0.01	<0.01	0.01	<0.01	0.02	0.01
Blue-winged Teal	<0.01	0.01	<0.01	<0.01	0.00	0.00	<0.01
Canada Goose	0.02	0.02	0.02	0.06	0.03	0.10	0.06
Common Goldeneye	0.02	0.02	0.02	0.02	0.00	0.00	0.01
Common Loon	0.02	0.02	0.02	0.06	0.00	0.02	0.04
Common Merganser	0.01	0.05	0.02	0.05	<0.01	<0.01	0.03
Green-winged Teal	0.01	0.01	0.01	0.01	0.02	0.06	0.02
Hooded Merganser	0.00	0.00	0.00	<0.01	0.00	0.00	<0.01
Mallard	0.23	0.10	0.21	0.25	0.31	0.47	0.30
Northern Pintail	0.00	0.00	0.00	0.01	<0.01	0.00	<0.01
Northern Shoveler	<0.01	0.00	<0.01	<0.01	0.00	0.00	<0.01
Ring-necked Duck	0.02	0.02	0.02	0.06	0.10	0.30	0.11
Surf Scoter	0.00	0.00	0.00	<0.01	0.00	0.00	<0.01
Unknown Scaup	<0.01	0.01	<0.01	0.05	0.03	0.16	0.07
White-winged Scoter	<0.01	0.01	<0.01	0.03	0.00	0.00	0.02
Total	**0.38**	**0.29**	**0.36**	**0.66**	**0.55**	**1.17**	**0.73**

3.3 WATERFOWL BROODS

A total of 39 waterfowl broods were observed during the 2017 waterfowl surveys (Map 8). Two Canada goose broods were observed in June, with the remaining broods all observed in July (Table 8). Canada goose was the most common species of brood observed, followed by mallard and common loon (Table 8). The number of individual Canada goose broods is likely underestimated due to numerous amalgamated broods observed. Of the 26 Canada goose broods observed in July, eight broods appeared to be amalgamated as they were being attended by more than two adults. Amalgamated broods of other species were not observed.

The earliest Canada goose broods were observed on June 18, 2017, and the latest were observed on July 14, 2017. Backdating these observations based on the age of the broods indicates that nest initiation peaked on approximately May 15, 2017 for Canada geese in Study Zone 5. This is later than the nest initiation date observed in 2015, which was estimated to be May 7.

All mallard broods were observed from July 13-14, 2017. Backdating these observations suggests that nest initiation peaked on approximately May 27, 2017 for mallards in Study Zone 5. This is later than the nest initiation date observed in 2015, which was estimated to be May 15.

In 2017, off-system lakes and watercourses contained a greater density of waterfowl broods compared to on-system waterbodies (Table 9). Canada goose and mallard broods were observed in the greatest densities on off-system waterbodies. These findings are consistent with the observations made in 2015. In 2015, off-system lakes supported slightly higher IBP densities compared to off-system watercourses (Table 10).

Table 8: Number of Waterfowl Broods Observed Monthly in 2017

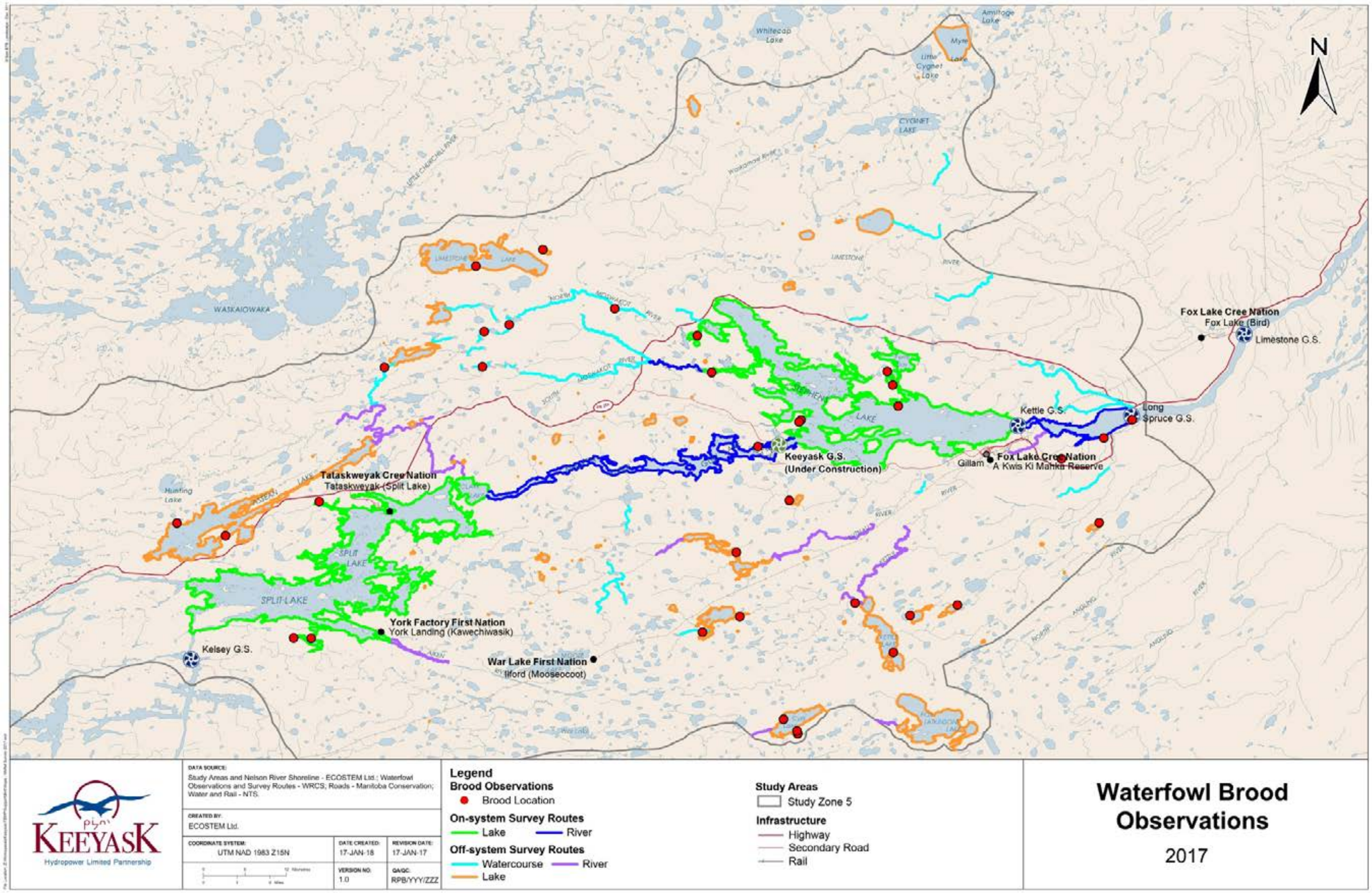
Species	Month		Total
	June	July	
American Wigeon	0	1	1
Canada Goose	2	24	26
Common Loon	0	5	5
Common Merganser	0	1	1
Mallard	0	5	5
Ring-necked Duck	0	1	1
Total	2	37	39

Table 9: Density of Waterfowl Broods (broods/km) in Waterbody Types in 2017

Species	On-system			Off-system				Grand Total
	Lake	River	Total	Lake	River	Watercourse	Total	
American Wigeon	0.000	0.000	0.000	0.001	0.000	0.000	0.001	<0.001
Canada Goose	0.005	0.005	0.005	0.016	0.004	0.009	0.012	0.008
Common Loon	0.001	0.000	<0.001	0.005	0.000	0.000	0.003	0.001
Common Merganser	0.000	0.003	<0.001	0.000	0.000	0.000	0.000	<0.001
Mallard	0.000	0.000	0.000	0.000	0.004	0.017	0.004	0.001
Ring-necked Duck	0.001	0.000	<0.001	0.000	0.000	0.000	0.000	0.000
Total	**0.006**	**0.008**	**0.006**	**0.023**	**0.008**	**0.026**	**0.020**	**0.011**

Table 10: Density of Waterfowl Broods (broods/km) in Waterbody Types in 2015

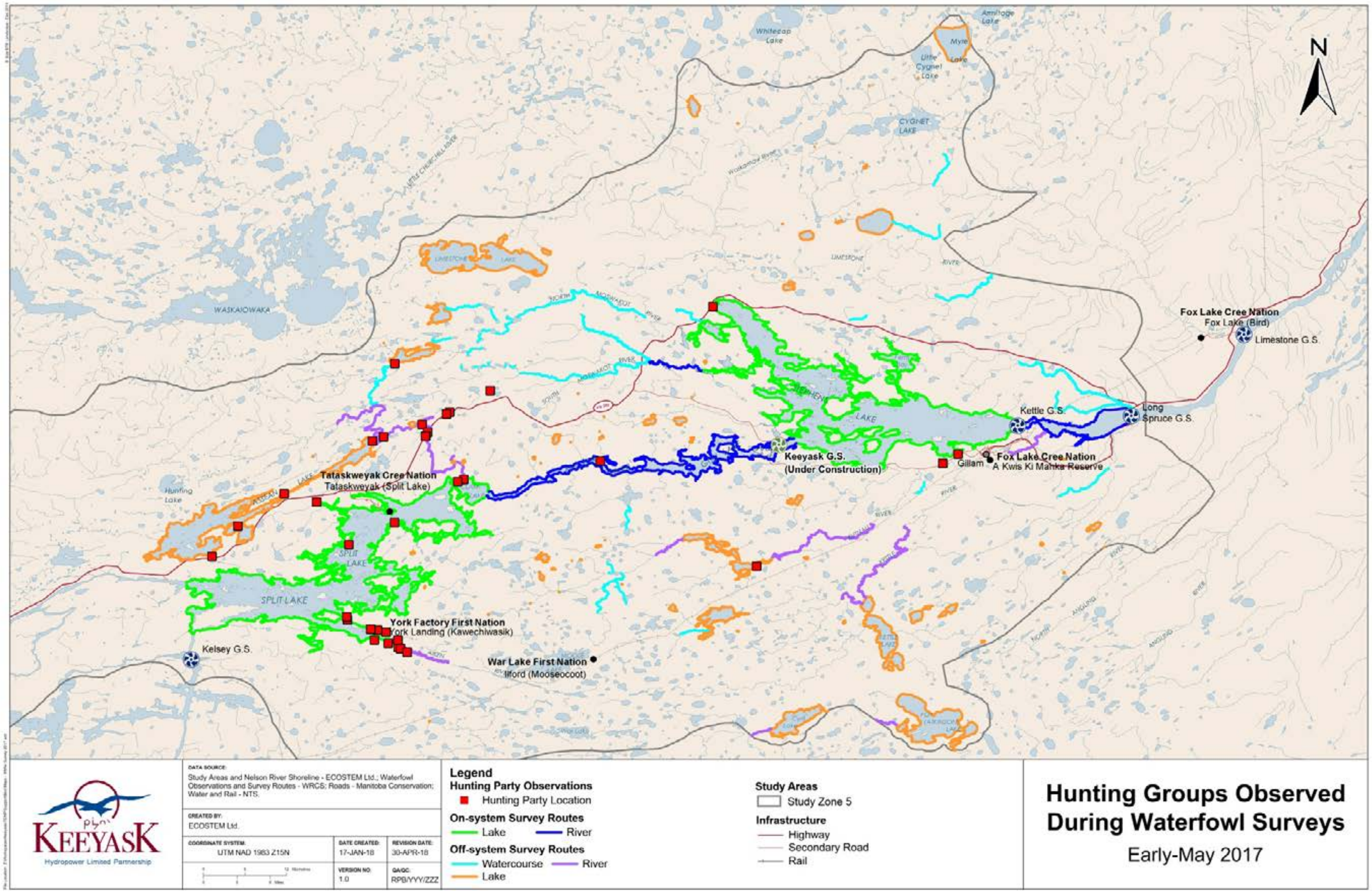
Species	On-system			Off-system				Grand Total
	Lake	River	Total	Lake	River	Watercourse	Total	
American Wigeon	0.001	0.003	0.001	0.003	0.000	0.004	0.002	0.002
Bufflehead	0.001	0.000	<0.001	0.000	0.000	0.000	0.000	<0.001
Canada Goose	0.002	0.005	0.002	0.020	0.004	0.030	0.019	0.008
Common Loon	0.001	0.000	<0.001	0.004	0.000	0.000	0.002	0.001
Common Merganser	0.001	0.000	<0.001	0.004	0.000	0.000	0.002	0.001
Green-winged Teal	0.000	0.000	0.000	0.001	0.000	0.000	0.001	<0.001
Mallard	0.008	0.008	0.008	0.020	0.011	0.009	0.016	0.011
Ring-necked Duck	0.000	0.000	0.000	0.001	0.000	0.000	0.001	<0.001
Red-necked Grebe	0.000	0.000	0.000	0.001	0.000	0.000	0.001	<0.001
Unknown Diving Duck	0.000	0.000	0.000	0.000	0.000	0.004	0.001	<0.001
Unknown Duck	0.001	0.000	0.001	0.004	0.000	0.004	0.003	0.002
Total	**0.013**	**0.016**	**0.014**	**0.059**	**0.015**	**0.051**	**0.048**	**0.026**



Map 8: All Waterfowl Brood Observations in 2017

3.4 HUNTING GROUPS

A total of 34 hunting groups were observed during the 2017 waterfowl surveys. Eleven of the hunting groups were located near York Landing on the south end of Split Lake (Map 9). The remaining hunting groups were located throughout Study Zone 5. The number of hunting groups observed in 2017 was greater than the number observed in 2015, which was only 16.



Map 9: **Hunting Groups Observed During Waterfowl Surveys in Early-May 2017**

4.0 DISCUSSION

Disturbance of waterfowl may have occurred proximal to Project construction activities, but due to the temporal nature of disturbances and waterfowl use of potentially disturbed habitat, it is difficult to quantify. Overall, waterfowl densities on Gull Lake in 2017 were similar to those observed during pre-construction surveys. It was noted that the north and south shorelines of Gull Lake that were cleared of vegetation for the future Project reservoir, combined with the relatively high water levels in the Nelson River, provided waterfowl with suitable habitat. These shorelines included mudflats and shallow water pools that supported numerous species of waterfowl (Appendix 1). The use of disturbed areas by waterfowl was also noted in spring in roadside ditches with emerging sedges and grasses, and in habitats containing temporary standing water (Appendix 1). On several occasions, these areas supported Canada geese and mallard, and waterfowl broods were occasionally observed in roadside ditches during summer.

A comparison of waterfowl densities in Gull Rapids from the pre-construction surveys, 2015 construction-monitoring surveys, and 2017 surveys, suggest the use of this area is variable. In 2017, spring waterfowl densities were greater than those observed during pre-construction surveys, but in the fall were much lower than those observed during the pre-construction surveys. As the Gull Rapids area is relatively small, and pre-construction data are limited to the spring, summer, and fall of 2003 and the spring and summer of 2011, it is difficult to determine if these differences are attributed to construction disturbance or the temporal distribution of waterfowl. Future waterfowl surveys will provide a better understanding of waterfowl use within the construction footprint.

Overall waterfowl densities were lower in 2017 than those observed in 2015, and higher or similar to those observed during the pre-construction surveys. For all surveys, the seasonal trends of waterfowl densities were similar. Densities were greatest during the fall migration, lower during the spring migrations, and lowest during the summer. The temporal nature of waterfowl, particularly during the spring and fall migrations, likely accounts for some of the waterfowl density variation observed among survey years. The similarity of seasonal trends among survey years suggests that waterfowl use in Study Zone 5 has been relatively consistent.

Waterfowl surveys appeared to provide sufficient construction-phase numbers for future comparisons. The relatively large fluctuations in waterfowl numbers from spring to fall highlighted the need for recurring surveys based on major waterfowl life-cycle events (staging, breeding, brood rearing). Based on the backdating of mallard and Canada goose broods, the surveys conducted in May were ideal timing for observing IBPs of these species, which corresponds with the start of the nesting period.

Based on the early-May survey, Canada geese and mallards were the earliest waterfowl migrants in Study Zone 5. Canada geese in particular were abundant and were observed in their greatest densities in early-May. Habitat use of these early arriving species was largely limited to relatively small areas of open water, as most waterbodies remained ice-covered.

Typically, open water occurred within off-system rivers and watercourses, where creek mouths and creek bends created water flow that was sufficient to limit ice formation. These findings are consistent with those observed in 2015.

Similar to 2015, the peak of spring waterfowl migration in Study Zone 5 appeared to take place in late-May. The greatest number of waterfowl and the greatest number of species observed indicated the peak of migration. The highest densities of waterfowl during this time were observed on on-system rivers, which supported large flocks of diving ducks. The preference of on-system rivers by waterfowl at this time was due to the presence of large expanses of open water, whereas many other waterbodies remained partially frozen.

Indicated breeding pair density was greatest on off-system lakes and watercourses. Both dabbling species and diving species of waterfowl preferred these areas, which was consistent with the findings of 2015. Off-system lakes and watercourses may have been preferred by IBPs of waterfowl due to the presence of foraging or nesting opportunities provided by shallower water or aquatic vegetation. Habitat data may be available in the future to explore these findings further.

By June, spring migration had nearly finished and birds had shifted their focus to nesting. The number of many species in Study Zone 5 declined and densities on all waterbody types was relatively low. The decrease was likely due to most breeding waterfowl leaving the area to their nesting grounds further north and waterfowl in Study Zone 5 attending nests, which would have peaked at this time. Nesting birds were less likely to be detected during the survey in June.

Waterfowl densities decreased in July as compared to June in most waterbody types. Off-system lakes supported a relatively high density of waterfowl in comparison to other waterbody types in July. This is likely due to the greater productivity of the smaller lakes and wetlands, which provide more suitable habitat for broods and moulting birds (Rempel *et al.* 1997; Longcore *et al.* 2006). These findings were consistent with those observed in 2015.

Nest initiation appeared to be later in 2017 compared to 2015. This was likely due to the relatively late ice-breakup and persistence of snow cover. Due to the later spring, few broods were observed in June and nest hatching appeared to peak in July with Canada goose, mallard, and common loon being the most common species of brood observed. This was anticipated for Study Zone 5 based on the relatively high number of IBPs of these species. The number of broods observed in 2017 (39) was less than the number observed in 2015 (90). The reason for this is not apparent, but it could be attributed to study timing (*e.g.,* brood survey did not coincide with hatching), the lack of nesting habitat, potential nest failure, or other factors.

In 2017, brood density was greatest on off-system lakes and watercourses, which was similar to the observations in 2015. The preference of broods for off-system waterbodies may be due to the greater productivity of the smaller waterbodies and wetlands, which provide more suitable habitat for broods (Rempel *et al.* 1997; Longcore *et al.* 2006).

During the fall staging period, the greatest numbers of diving waterfowl were observed. Diving duck species, particularly ring-necked ducks, were found in large flocks and a relatively large number of unknown diving ducks were also observed during September. The tendency of staging diving ducks to use large water bodies and congregate away from the shoreline contributed to the relatively high number of diving ducks being unidentified in September. Diving ducks preferred off-system lakes in the fall, likely due to better foraging opportunities provided by these waterbodies (*i.e.,* submersed vegetation and relatively shallow water). Habitat data may be available in the future to explore these findings further

Based on the distribution of hunting groups observed in 2017, hunter access did not seem to be increased by construction activities despite a greater number of hunting groups being observed. The greater number of hunting groups observed in 2017 compared to 2015 was likely due to the timing of the survey and the temporal nature of hunting activities. Most hunting groups observed were near existing towns or communities, or near previously established hunting camps. The Project south access road remained inaccessible to the public in 2017. Monitoring will occur in future years to observe if the south access road will provide additional access to waterfowl hunters along the southern edge of Stephens Lake.

Aerial waterfowl surveys will be conducted again beginning in the spring of 2019. Data from the 2015 and 2017 surveys will be used to further refine the habitat selection model previously developed. The habitat selection model can then be used to predict the amount of habitat disturbance as a result of the Project and its potential impact on Canada goose, mallard, and other waterfowl species.

5.0 SUMMARY AND CONCLUSIONS

Waterfowl densities observed in 2017 were similar to those observed during the pre-construction surveys and the 2015 construction-monitoring survey. This suggests that waterfowl use in Study Zone 5 has been consistent since the start of construction and disturbance related to construction activities do not appear to be limiting waterfowl use.

A seasonal trend of waterfowl densities was observed in 2017 that was consistent with the pre-construction surveys and 2015 construction-monitoring survey. Waterfowl densities were greatest during the spring and fall migrations and lowest during the summer.

Staging Canada geese and mallard were most abundant during the early-May survey, while the abundance of other waterfowl species peaked in late-May. Waterfowl abundance decreased in the June and July surveys due to staging waterfowl leaving the region for their nesting grounds further north. July was the peak of nest hatching, and Canada goose and mallard were the most common species of brood observed. In September, large numbers of waterfowl, particularly diving duck species, were observed in the area, highlighting the importance of Study Zone 5 to staging waterfowl.

Off-system waterbodies were preferred by waterfowl during most surveys, with the exception of the late-May survey. It appears that waterbody preference in early spring is influenced by the availability of open water. As a result, on- and off-system rivers that are ice free earlier than other waterbody types tend to be preferred in early and late spring. During the nesting, brood rearing, and fall staging period, off-system waterbodies are preferred by waterfowl. This may be due to the presence of better foraging or nesting opportunities provided by shallower water or by more diverse or abundant aquatic vegetation.

A greater number of waterfowl hunters were observed in 2017 compared to 2015. The apparent increase in hunting pressure was likely due to survey timing and the temporal nature of hunting activities. Hunting pressure in Study Zone 5 did not appear to increase due to Project construction as most hunting groups were observed near settlements or established hunting camps.

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APPENDIX A: PHOTOS

Photo 1: Large Flock of Waterfowl Gathered in a Creek Mouth in Early-May 2017

Photo 2: Two Hunting Groups Observed Near York Landing in Early-May 2017

Photo 3: Canada Geese Near Project Helicopter Pad in Early-May 2017

Photo 4: Flock of Waterfowl Loafing on a Piece of Ice in Late-May 2017

Photo 5: Flock of Swans along Ice Edge in Late-May 2017

Photo 6: Mudflats and Shallow Water along the Shores of Gull Lake in 2017

Photo 7: Flock of Waterfowl Observed on an Off-system Watercourse in September 2017