Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Terrestrial Plant, Habitat and Ecosystem Monitoring Report

TEMP-2016-01

KEEYASK

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KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2016-01

TERRESTRIAL PLANT, HABITAT, AND ECOSYSTEM MONITORING REPORT

Prepared for

Manitoba Hydro

By

ECOSTEM Ltd.

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SUMMARY

BACKGROUND

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

This report describes the results from the terrestrial plant, habitat, and ecosystem monitoring conducted in 2015, which included studies related to terrestrial habitat loss and disturbance, priority habitats, wetland loss and disturbance, provincially rare plants and invasive plants.

WHY IS THE STUDY BEING DONE?

The terrestrial plant, habitat, and ecosystem monitoring studies are being done to document:

- How much land has been cleared or disturbed by the Project;
- The effects on important terrestrial habitat in and around the Project footprint;
- The effects on important wetlands located near the construction areas; and
- The effects on plants important for environmental reasons and to the partner First Nations.

WHAT WAS DONE?

Project clearing and physical disturbance were mapped from aerial surveys that took place in August, 2015 and from satellite imagery that was captured in June, August and September, 2015. The map of Project clearing or physical disturbance was then used to determine which of the important terrestrial habitats, and how much of them, were affected up to late summer 2015. Terrestrial habitats were considered to be priority habitat types if they were native types that: are rare or uncommon in the area; are highly diverse (*i.e.*, many different species); are highly sensitive to disturbance; have a high potential to support rare plants, and/or are highly valued by people. Other environmentally sensitive terrestrial sites, like important wildlife habitat (as identified in the Project's Environmental Protection Plans), were also monitored. Ground surveys were carried out at 14 of the priority habitat sites because they were of particular interest or were already being visited for other monitoring.

Off-system marshes, which are important wetlands in the Keeyask region that are not found along the regulated Nelson River, were the wetlands monitored under this study. Of the 41 wetlands being monitored, 16 were surveyed by helicopter in July, 2015 because they were within 1 km of construction activities in 2015. Six of these 16 wetlands were also ground surveyed in July, 2015

because they were within 100 m of construction activities and had a higher potential of being affected.

For rare plants, approximately 16 km of transects were surveyed by foot in July and August, 2015 to determine if any of these species were in places that still had to be cleared. During these surveys, a plant species of particular interest to the partner First Nations, known as *Wekhis* (sweet flag), was also searched for as it is not common in the Keeyask region. Additional searches for muskeg lousewort, the only provincially rare species found to date, were done in 28 locations in early August, 2015 to determine if this species was more common than previously thought.

Spring and fall invasive plant surveys were conducted to determine how Project development is affecting the spread of these species, and to guide recommendations for measures to control invasive plants. In early July and late August, 2015, surveys occurred within the cleared areas that were safe to work in.

WHAT WAS FOUND?

Monitoring in 2015 showed that approximately 1,028 ha of terrestrial habitat have been cleared or physically disturbed to date for the Project, which is less than one-tenth of the land area in the licensed Project footprint. The vast majority of this area was within the licensed Project footprint. A very small amount of inadvertent clearing occurred outside the licensed Project footprint (1.99 ha).

Aerial view of Main Camp clearing and development

As of late summer 2015, Project impacts on priority habitats were low, with clearing and disturbance occurring in less than 3% of these areas (124.9 ha). The majority of the priority habitat that was disturbed was one of two types: black spruce mixture vegetation on mineral sites and jack pine dominant vegetation on mineral sites.

Surveys in 2015 showed that Project activities have not directly affected any of the off-system marsh locations to date. Additional control measures (*i.e.,* silt fences) are recommended for three marsh locations where there is potential for Project effects from surface water runoff.

Pre-clearing rare plant surveys provided further evidence that rare plant species are not present in the Project footprint, with one exception - muskeg lousewort, a provincially rare species first found in the Project footprint in 2014. Surveys conducted in 2015 determined there are at least 22 muskeg lousewort locations in areas that will not be disturbed by development in the area. This indicates that muskeg lousewort is more common in the Keeyask region than previously thought. It also indicates that transplanting is not needed for any locations that cannot be avoided during Project construction. No locations of *Wekhis* (sweet flag) were observed during the 2015 surveys.

Muskeg lousewort flower

Sixteen species of invasive or non-native plants were observed during the 2015 monitoring surveys, largely within the Keeyask Infrastructure Project (KIP) footprint. Species recorded for the first time within the Project footprint, but which had previously been observed along Provincial Road 280, included Canada thistle, pineappleweed, and smooth catchfly. Species that were recorded for the first time in the Keeyask region included wormwood and scentless chamomile.

WHAT DOES IT MEAN?

To date, there are no unanticipated Project effects on terrestrial habitat, priority habitat sites, important wetlands or rare plants.

As expected, Project development is leading to further spread of some invasive and non-native plant species. Scentless chamomile was the only invasive/non-native plant species recorded in 2015 for which the Invasive Species Council of Manitoba (ISCM) recommends rapid response. Manitoba Hydro site staff removed and disposed of the one stem of scentless chamomile observed during surveys. The amounts and ways that invasive plants are spreading should be carefully monitored and, where appropriate, control measures implemented.

WHAT WILL BE DONE NEXT?

Surveys to document the amount of terrestrial habitat affected by the Project will continue in 2016, as will the monitoring that focuses on priority plants and habitat, and important wetlands. Invasive species control recommendations for the 2016 growing season are being developed based on the 2015 monitoring results.

ACKNOWLEDGEMENTS

ECOSTEM Ltd. would like to thank Sherrie Mason, Rachel Boone and the on-site Manitoba Hydro staff, including Caroline Walmsley and Megan Anger, for their support and assistance in planning field activities and access to the sites.

Chiefs and Councils of Tataskweyak Cree Nation (TCN), War Lake First Nation (WLCN), York Factory First Nation (YFFN) and Fox Lake Cree Nation (FLCN) are gratefully acknowledged for their support of this program. We would also like to thank Clayton Flett and Douglas Kitchekeesik of TCN for arranging logistic support and providing field staff for studies. Peter Massan (TCN) and Peter Beardy (TCN) are gratefully acknowledged for their guidance and work in the field.

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STUDY TEAM

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

Fieldwork was conducted by Peter Beardy, Charles Enns, Peter Massan, Ryan Sheffield, Alanna Sutton and Alex Snitowski.

Data analysis and report writing were completed by Alanna Sutton and James Ehnes. GIS analysis and cartography was completed by Alex Snitowski.

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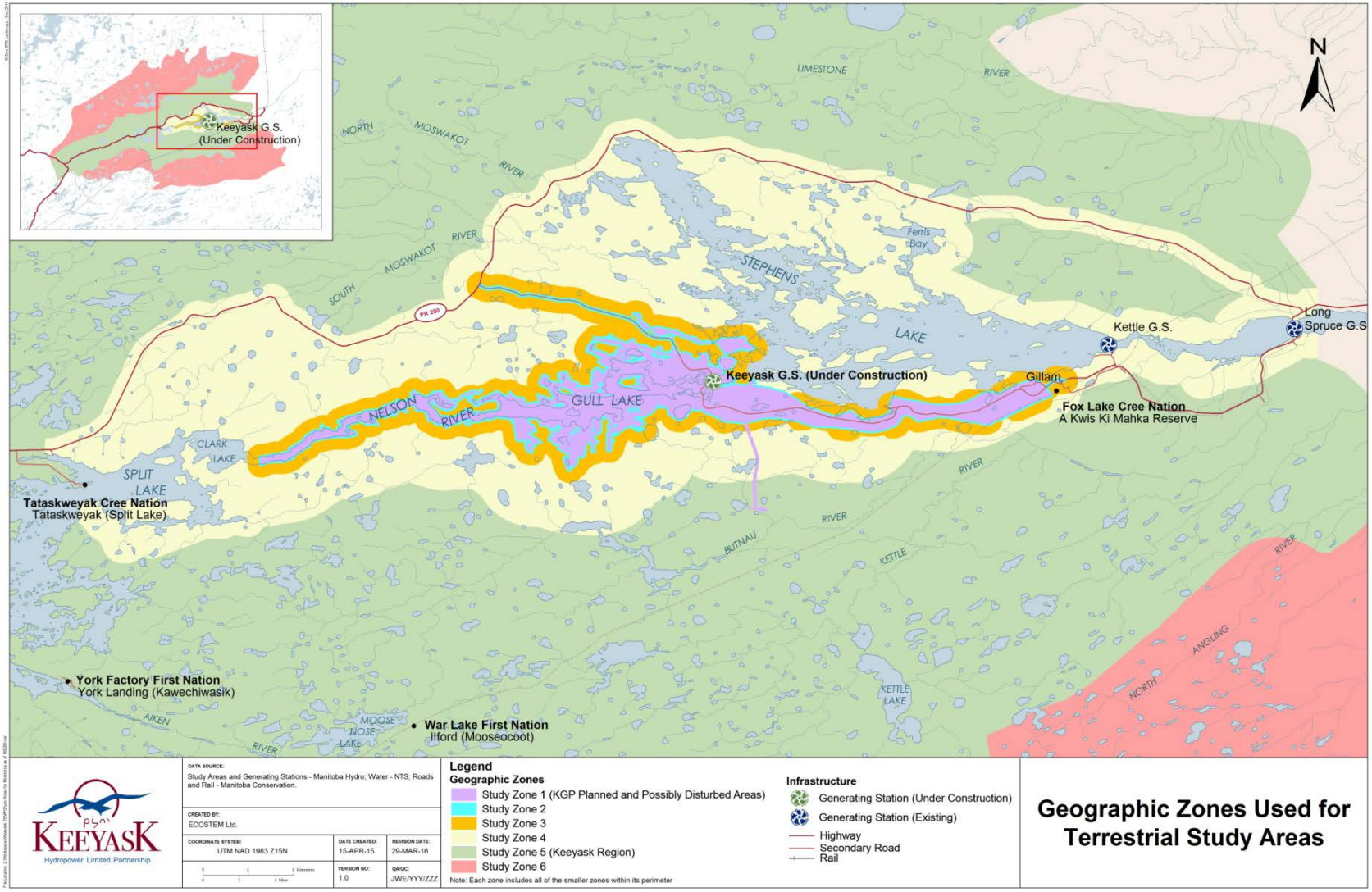
1.0 INTRODUCTION

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* (TE SV). 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. A Terrestrial Effects Monitoring Plan (TEMP) was developed detailing the monitoring activities of various components of the terrestrial environment including the focus of this report - terrestrial habitat, ecosystems, and plants - for the construction and operation phases of the Project.

This report describes the terrestrial plant, habitat and ecosystems monitoring conducted for the Project for the 2015/2016 reporting period. It includes results from monitoring studies conducted between April 1, 2015 and March 31, 2016, which are the following: habitat loss and disturbance, priority habitats, wetland loss and disturbance, priority plants, and invasive species spread and control. The report is organized by study. Discussions of study results are generally brief since this was the first monitoring year for all but the pre-clearing priority plant surveys. Map 1-1 shows the study zones generally used for the studies.



Map 1-1: Keeyask Region and terrestrial study zones.

2.0 TERRESTRIAL HABITAT CLEARING, DISTURBANCE AND INDIRECT EFFECTS

2.1 INTRODUCTION

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

As described in the Project's Terrestrial Effects Monitoring Plan (TEMP), two studies will monitor terrestrial habitat effects. During construction, the Habitat Loss and Disturbance study focuses on Project-related effects on stand level habitat composition due to habitat loss and disturbance. During operation, the Long-Term Effects on Habitat study will monitor indirect Project effects on terrestrial habitat as well as natural recovery to native habitat in Project-affected areas and in areas where trails intersect the Project Footprint.

Monitoring for the Habitat Loss and Disturbance study was conducted in 2015.

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

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

2.2 METHODS

Section 2.1.2 of TEMP details the methods for this study. The following summarizes the activities conducted during 2015. A separate monitoring study and report (ECOSTEM 2015a) previously documented clearing and disturbance from the Keeyask Infrastructure Project (KIP), which ended in June 2014.

During the 2015 aerial surveys, all areas cleared or disturbed for the Project were surveyed and photographed from a helicopter. Project-related clearing, physical disturbance and other relevant conditions were documented with geo-referenced aerial photographs, marked-up maps and notes. Map 2-1 shows the aerial survey routes flown between August 24 and 28, 2015.

The GPS tracklog gathered while flying the perimeter of the cleared or disturbed areas was used to identify the approximate maximum extent of clearing or physical disturbance for the Project. Digital orthorectified imagery (DOI) created from Worldview 2 high resolution satellite imagery served as the base map for digitizing the field data. Boundaries for cleared or disturbed areas that could be outside of the licensed Project footprint were precisely digitized using the DOIs and geo-referenced aerial photographs. Precise mapping of clearing and disturbance inside the licensed footprint occurs at the end of the construction phase.

Within the licensed Project footprint, there were two distinct areas identified: the planned footprint and the possibly disturbed areas. The planned footprint is largely comprised of permanent features, which means there is limited opportunity to reduce Project impacts in these areas. The possibly disturbed areas provided for some of the unknown components of the Project design at the time the Project was being licensed (*e.g.*, the actual volume of suitable material available in each borrow area, or the actual area needed for each of the Excavated Material Placement Areas [EMPAs]). Because there is some flexibility in the location of clearing, disturbance or material placement within the possibly disturbed areas, the Project's Environmental Protection Plans (EnvPPs) include provisions to minimize clearing or disturbance to the extent practicable within this portion of the licensed Project Footprint. On this basis, this report focuses on quantifying and situating clearing or disturbance located within the possibly disturbed areas, where there is more flexibility regarding the location of some Project components.

2.3 RESULTS

2.3.1 OVERALL

Project components with visible clearing or physical disturbance from the aerial surveys included the entire north and south access roads, the start-up and main camps, the borrow areas along both access roads, Borrow Area G-5 north of PR 280, the camp well access road, the cofferdam and cleared/dewatered area and all work and otherwise cleared areas. The start-up camp as well as borrow areas G-5, KM-4 and KM-9 are not discussed in this report since aerial surveys and information provided by Manitoba Hydro indicated they had not been incrementally impacted by the Project as of September, 2015 other than accessing construction materials stored in Borrow Areas KM-4 and KM-9 (*i.e.*, observed clearing or disturbance was from previous projects or activities such as the KIP).

Figures 2-1 to 2-13 provide photos showing examples of clearing or physical disturbance at the time of the 2015 surveys. Tabular and map results are provided below. As an informal means of demonstrating change, these photos can be compared with photos of the same locations in 2012, 2013 and 2014, as photographed during the KIP monitoring surveys (as provided in previous monitoring reports; ECOSTEM 2013, 2014, 2015a).

The 2015 surveys documented approximately 1,028 ha of Project clearing or disturbance in addition to that previously completed by the KIP. Of this total, 939 ha was within the planned

areas of the Project footprint. Clearing within the Project footprint that was attributable to the Keeyask Transmission Project (KTP; a separate and independently licensed project) is not included in these totals. Conversely, approximately 23 ha of borrow material extraction for the Project occurred within transmission line rights-of-way for the KTP. Note that results in this paragraph were an approximation of the clearing or disturbance limits as they were predominantly based on an aerial tracklog (Section 2.2). For this reason, there were uncleared patches within the broader clearing and disturbance tracklog.

Clearing in numerous small areas within the possibly disturbed portion of the Project footprint (Table 2-1; Map 2-2) amounted to approximately 58.4 ha (Table 2-1). More precise mapping using high resolution satellite imagery and georeferenced aerial photos identified an additional 1.99 ha that was inadvertently cleared outside of the combined planned and possibly disturbed footprint areas (Table 2-1; Map 2-2), with most of this area being located at Borrow Area G-1 and within a cutline south of the north dyke. These totals do not include areas previously cleared or disturbed by the KIP, unless these they were incrementally affected by the Project. The following sections detail the clearing or disturbance in the various Project components.

Table 2-1: Clearing and physical disturbance (ha) within the possibly disturbed areas and outside of the combined planned and possibly disturbed areas as of September 2015, by main Project component and footprint

Project Component	Footprint	Clearing or Disturbance (ha)	
		Within Possibly Disturbed Areas*	Outside of Combined Planned and Possibly Disturbed Areas*
Access Roads	South access road	0.99	-
Generating Station	Main camp	1.50	-
	Work Area A	11.71	-
	Portage route	0.12	-
	Spillway cofferdam	6.23	-
Borrow Areas	G-1	-	1.31
	N-5	-	0.09
	Q-7	0.24	-
EMPAs	D-12	21.61	-
	D-16 (north of batch plant)	13.98	0.15
Dykes	North dyke	2.14	-
	North dyke trail	0.49	0.44
Total		*58.43*	*1.99*

Notes: *a – indicates no area, a 0.00 indicates a very small (negligible) area

NAR/PR 280 junction

Approximately halfway along the North Access Road

Bridge at Looking Back Creek

Near the south end of the North Access Road

Figure 2-1: Footprint areas along the North Access Road (August 25, 2015)

Figure 2-2: Cleared portions of the South Access Road ROW (August 25, 2015)

Figure 2-3: South Access Road construction areas (August 25, 2015)

Figure 2-4: Access road from the Butnau dyke to the South Access Road (August 25, 2015), with KTP ROW clearing in the foreground

Figure 2-5: South Access Road camp and work area

Figure 2-6: Main camp and work area A, with helicopter pad and gas refill station (August 25, 2015)

Figure 2-7: Well road (August 25, 2015)

Figure 2-8: Concrete batch plant (August 25, 2015)

Figure 2-9: EMPA north of concrete batch plant (August 25, 2015)

KM-15

KM-17

G-3

N-5

Q-7

S-17a

Figure 2-10: Borrow areas (August 25, 2015)

S-18

S-2a

S-2b

Figure 2-10 Borrow areas (August 25, 2015) continued

North Dyke

South Dyke

Figure 2-11: North and South Dykes (August 25, 2015)

D12(1)

D12(2)

D17

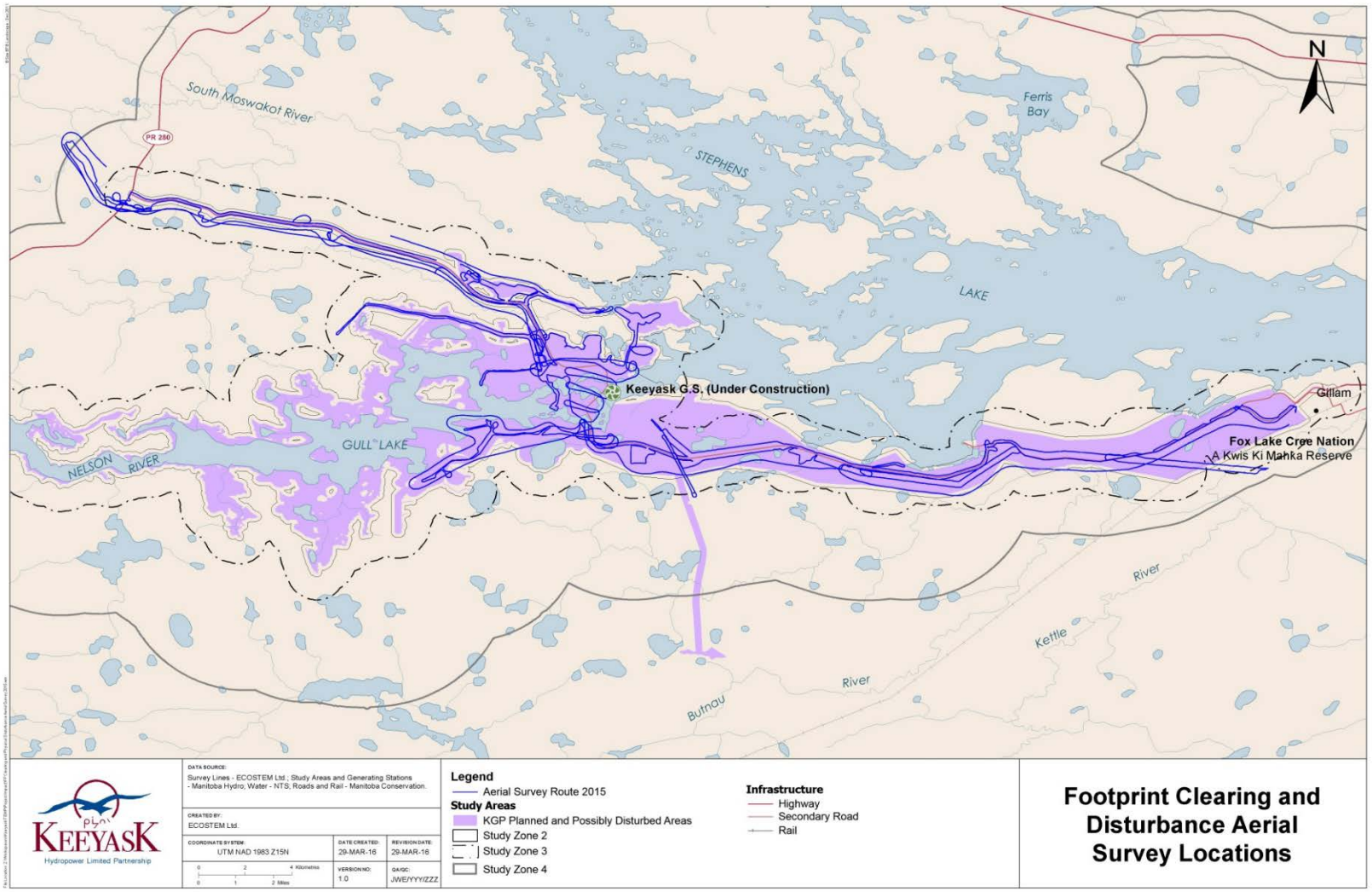
Figure 2-12: Excavated Material Placement Areas (August 25, 2015)

North channel rock groin

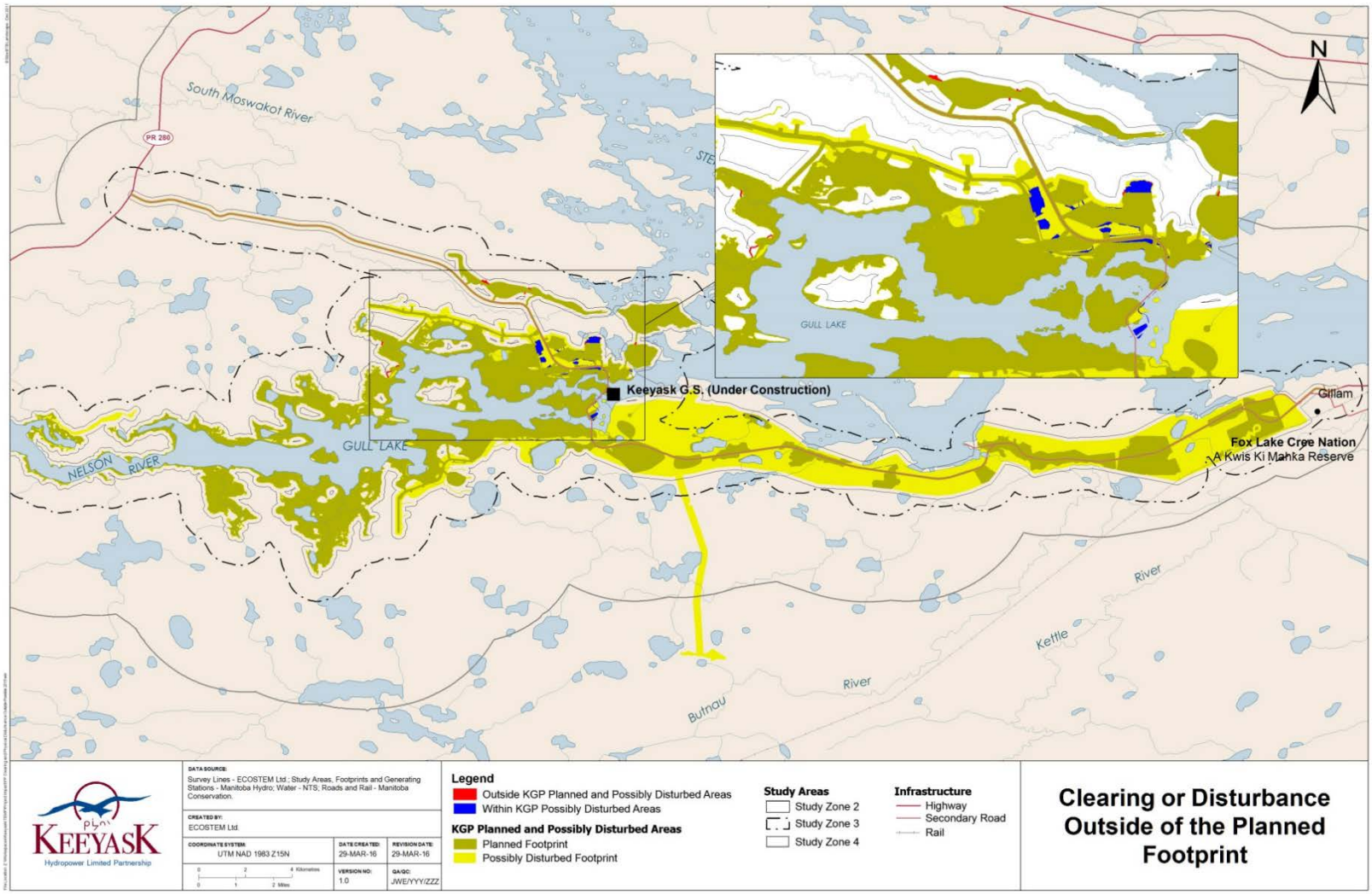
North channel cofferdam

Powerhouse area

Figure 2-13: River Works (August 25, 2015)



Map 2-1: Routes of aerial surveys on August 24 and 28, 2015 to document Project clearing and physical disturbance



Map 2-2: Project clearing or physical disturbance outside of the planned portion of the Project footprint as of late August, 2015

2.3.2 ACCESS ROADS

All North Access Road (NAR) clearing observed in September 2015 (Figure 2-1) was within the planned Project footprint boundary. Construction of the South Access Road (SAR) was underway during the surveys. The SAR ROW had been cleared from Kettle Creek at the Butnau boat launch to the south shore of Gull Rapids (Figure 2-2), and gravelled from approximately 1.2 km south of Kettle Creek and Borrow Area S-a (approximately 2.4 km southeast of the south shore of Gull Rapids; Figure 2-3). A small access road off the end of the Butnau dyke was finished and in use (Figure 2-4). A small camp and work area approximately 1 km west of the Butnau access road (Figure 2-5) was gravelled and in use.

There was a small access road off the end of the Butnau dyke that created 0.99 ha of clearing within the possibly disturbed area of the Project footprint.

2.3.3 MAIN CAMP, NORTH SHORE WORK AREAS AND WELL AREA

In September 2015, the main camp had been cleared and a majority of the camp was either built or being built (Figure 2-6). The helicopter pad and gas refill station was cleared and in use. The well road was finished and in use (Figure 2-7).

A batch plant and several buildings were present in Work Area A at the time of the 2015 survey (Figure 2-8). Ponded water was observed in the borrow area south of the batch plant. The EMPA north of the batch plant was cleared and gravelled (Figure 2-9).

South of Work Area A, the construction office and storage area (north of the access road) was complete and being used when the surveys were conducted. The water treatment area was also in use.

Clearing or disturbance within the possibly disturbed area of the Project footprint was observed in a few locations in September, 2015. These included a 14 ha area in the EMPA north of the batch plant, a number of small cleared areas, trails and roads (including areas between the camp and Work Area A, the south end of the clearing in Work Area A, some work areas around the NAR, and just east of the water treatment area). These areas added up to an additional 11.7 ha.

A 0.15 ha portion of the EMPA north of the batch plant was outside of the combined planned and possibly disturbed areas (Map 2-2).

2.3.4 BORROW AREAS

Borrow Area G-1 at KM-15 was in use as a storage area for explosives (Figure 2-10) and was not in active use as a borrow area. Borrow Area KM-17 was not in use at the time of the survey, but test holes were being drilled at locations just outside the previously cleared areas (Figure 2-10).

Several additional test holes were observed east and west of the previously cleared areas, between the well road and Borrow Area G-1 at KM-15.

Borrow Areas G-3 and N-5 (Figure 2-10) had been partially cleared and were starting to be used at the time of the survey. Construction in this area included the haul road and two causeways that would be used to access these borrow areas, which were located on islands in Stephens Lake.

The rock quarry Q-7 was in use at the time of the aerial survey. Portions of the area were water-filled (Figure 2-10).

On the south side of the Nelson River, a small portion of Borrow Areas S-18 and S-17a had been excavated. Borrow Areas S-2a and S-2b were partially cleared and in use at the time of the survey (Figure 2-10). The rock quarry Q-9 was also in use.

Borrow Areas N-21, N-6, S-11 and S-4 were not cleared at the time of the survey.

Borrow area clearing or disturbance outside of the possibly disturbed area of the Project footprint as of fall 2015 (Map 2-2) included a small, less than 0.1 ha sliver of the road between N5 and G3, and a testing pitting area with six boreholes around Borrow Area G-1 (affected approximately 1.3 ha outside, or partially outside of the combined planned and possibly disturbed areas.

2.3.5 DYKES

The north dyke footprint was cleared from the north shore of Gull Rapids to the western end of the dyke at the time of the 2015 surveys (Figure 2-11). The north dyke was not under construction or use at this time. A narrow cutline was present along the south dyke from the south shore of Gull Lake west approximately 2 km, where it became wider. At this location, there was a cleared strip adjacent to the cut line. The cut line continued to just past Borrow Area S-17a, where a strip had been gravelled. A similar strip was gravelled just south of Borrow Area S-18.

Dyke clearing within the possibly disturbed area of the Project footprint in September, 2015 included several areas, totaling approximately 2.1 ha along the north dyke, and several small segments of the cutline along the south dyke covering approximately 1.3 ha.

The north and south dyke both had negligible areas (<0.005 ha) outside of the combined planned and possibly disturbed area.

2.3.6 EMPAS

The D12 EMPAs along the north dyke were cleared and a portion of EMPA D12 (2) was being used at the time of the surveys (Figure 2-12). None of the other EMPAs along the north dyke were cleared.

Aside from the EMPA north of the batch plant (described in Section 2.3.3), one other EMPA was in use on the north shore - the west side of D17-E, located north of the construction offices.

The EMPAs located within Gull Rapids were not in use, and it appeared they were still being dewatered. None of the EMPAs on the south shore had been cleared or were in use at the time of the surveys.

Clearing for the D12 EMPAs was mainly within the possibly disturbed area, and covered an area of approximately 21.6 ha. All the remaining EMPA clearing was within the planned portions of the Project footprint (except for EMPA D16, described in Section 3.1.2).

None of the area cleared for EMPA D12 or D17 was outside of the combined planned and possibly disturbed area.

2.3.7 RIVER WORKS AREA

The north channel rock groin and road were constructed from the NAR to the north shore, across the north channel to William Smith island, and across the island to the south shore (Figure 2-13). The spillway cofferdam was also constructed, along with the associated access roads. The north channel was excavated. Dewatering was underway.

River works clearing within the possibly disturbed areas of the Project footprint in 2015 included parts of the spillway cofferdam, which covered 6.2 ha.

None of the river work areas were outside of the combined planned and possibly disturbed areas.

2.3.8 LINEAR FEATURES

One new cutline was observed starting at the north dyke, going south towards the future reservoir clearing area (Map 2-2). The new cutline was generally contained within the planned and possibly disturbed portions of the Project footprint. The exception was three short segments totalling approximately 0.44 ha outside of the combined planned and possibly disturbed area.

The trail leading between the start-up camp and the old borrow area to the south of the camp has been blocked with a concrete block; however, none of the other trails intersecting with the Project Footprint have had any works implemented to block them.

2.4 SUMMARY AND DISCUSSION

The Habitat Loss and Disturbance study is monitoring the actual extent of Project clearing and disturbance annually during construction. The licensed Project Footprint includes the planned footprint and the possibly disturbed areas. This report focuses on quantifying and situating clearing or disturbance located: (i) within the possibly disturbed areas; and, (ii) outside of the combined planned and possibly disturbed areas. The reasons for this focus are that there is little flexibility in moving or adjusting the planned Project features (*i.e.*, the planned footprint), and the Project EnvPPs include measures to minimize clearing and disturbance outside of the planned footprint to the extent practicable.

Monitoring in fall 2015 documented approximately 1,028 ha of clearing or physical disturbance additional to that previously completed by the KIP. Of this total, 939 ha was within the planned footprint. This was an overestimate of total clearing and disturbance as the limits of these impacts were predominantly based on an aerial tracklog.

Project clearing or disturbance in the possibly disturbed portion of the Project footprint amounted to 58.4 ha, which was only 1.1% of the 5,123 ha included in this component of the Project footprint. More precise mapping identified 1.99 ha of inadvertent clearing outside the licensed Project footprint, which was very small relative to the approximately 5,000 ha of undisturbed area remaining in the possibly disturbed portion of the Project footprint. Field surveys in 2016 will confirm the amount of clearing in one of the areas south of the work area.

Clearing within the possibly disturbed footprint was mostly related to four EMPAs. The remaining clearing was in a few small areas along the dykes, Borrow Areas G-1 and N-3, the SAR and within the river works area. Most of the 1.99 ha of clearing or disturbance outside of the combined planned and possibly disturbed areas was located at Borrow Area G-1 and in a cutline running from the north dyke to a reservoir clearing area.

2.5 NEXT STEPS

Monitoring fieldwork for all of the above studies will continue in 2016. No major changes to field methods are anticipated.

3.0 ECOSYSTEM DIVERSITY

3.1 INTRODUCTION

Ecosystem diversity refers to the number of different ecosystem types, and their size distribution, within a defined geographic area. Habitat composition and priority habitat types were the indicators for effects on ecosystem diversity. Habitat composition provides an overall representation of ecosystem diversity. Priority habitat types were those native habitat types that were particularly important for ecological and/or social reasons. Specifically, priority habitat types were the native habitat types that were regionally rare or uncommon, highly diverse (*i.e.*, species rich and/or structurally complex), highly sensitive to disturbance, had a high potential to support rare plants and/or were highly valued by people.

The ecosystem diversity monitoring program includes a single study, the Priority Habitats study, which periodically evaluates changes to ecosystem diversity based on effects to the priority habitat types. This study also includes sensitive terrestrial sites not being monitored by other studies.

The goal of the Priority Habitats study is to determine the nature of Project effects on ecosystem diversity. The objectives of this study are to:

- Confirm that the N-6 priority habitat site identified in the EIS is not disturbed;
- Determine the degree to which the other priority habitat patches and other environmentally sensitive terrestrial sites identified in the EnvPP (excluding sites whose condition is being monitored by another program) are disturbed;
- Quantify and situate the amounts and locations of priority habitat types affected by the Project; and,
- Quantify and situate Project effects on ecosystem diversity.

3.2 METHODS

Section 2.3.2 of the TEMP details the methods for this study. The following summarizes the activities conducted during 2015.

Effects on sensitive sites were identified within two distinct areas: the sensitive site areas within the possibly disturbed area, as outlined in the Project's Environmental Protection Plans (EnvPPs; Map 3-1); and other sensitive site areas within Study Zone 3, outside of the areas included in the EnvPPs (Map 3-2). The planned footprint is largely comprised of permanent features, which means there is limited opportunity to reduce Project impacts in these areas. As such, there are no requirements for the contractor to avoid any areas within the planned portion of the Project

Footprint. Because there is some flexibility in the location of clearing, disturbance or material placement within the possibly disturbed areas, the EnvPPs include provisions to minimize clearing or disturbance to the extent practicable within this portion of the licensed Project Footprint. The EnvPP maps show these sensitive site areas as "red zones" while the remaining portions of the possibly disturbed areas are shown as "yellow zones" (Map 3-1).

Sensitive site areas in the EnvPPs (Map 3-1) are monitored to meet the first and second objectives of this study. Other sensitive sites within Study Zone 3 (Map 3-2) are also monitored to meet the third and fourth objectives of this study.

The EIS predictions anticipated that a portion of the planned Project footprint area would not be used (*e.g.*, it was likely that not all of the planned borrow areas would be required for Project construction). Additionally, clearing, disturbance and other impacts within the areas included in Map 3-1 would have indirect effects in the nearby areas.

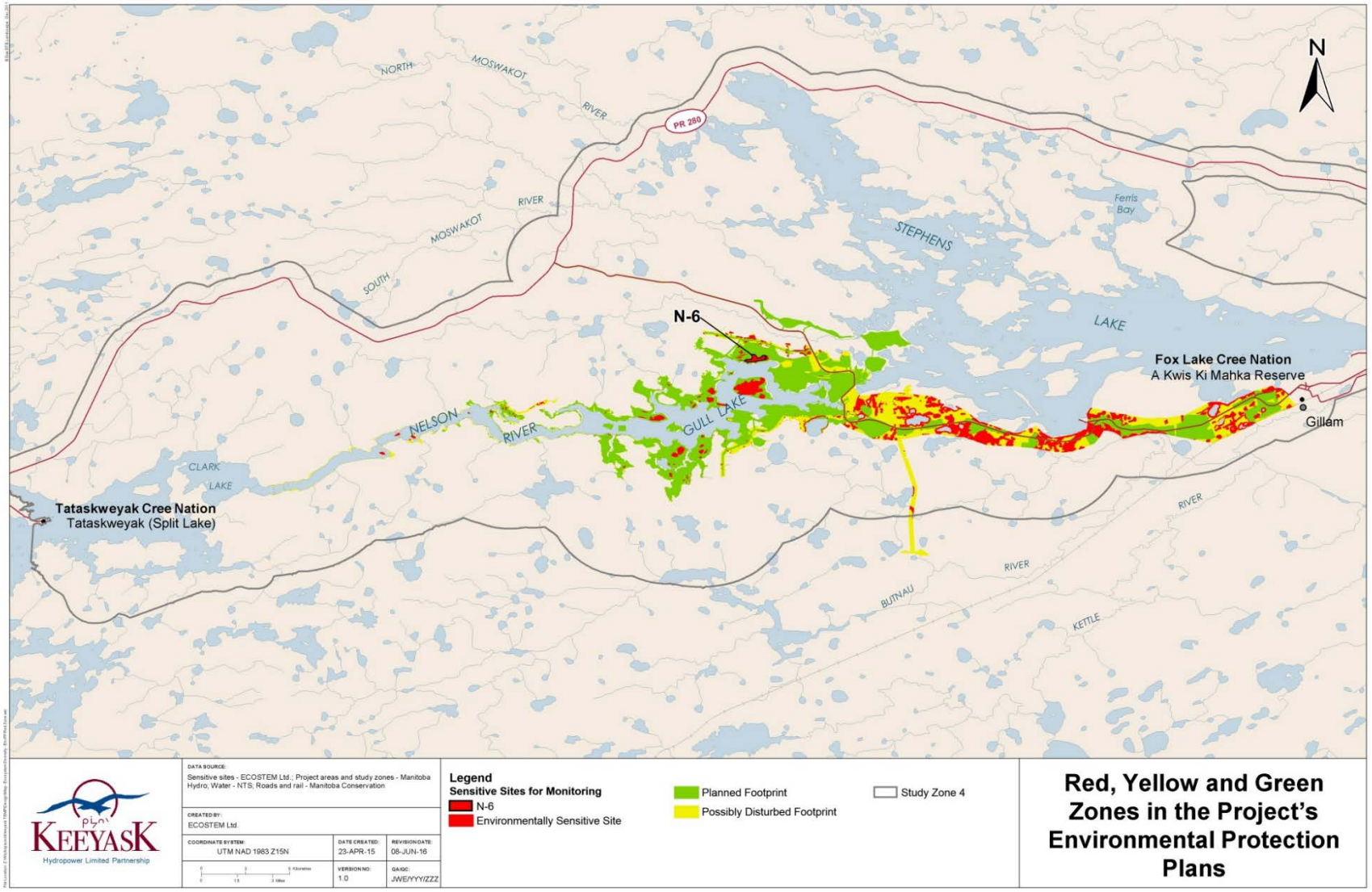
Map 3-2 shows the 5,529 ha of priority habitats and other types of sensitive terrestrial sites being monitored for all components of this study. This total area was subdivided into 2,694 individual sensitive sites based on priority habitat, riparian, and/or off-system marsh sensitivities. A given sensitive site may include more than one type of environmental sensitivity. All of the resulting sites are referred to as sensitive sites regardless of their reasons for inclusion. Some of the individual sites were very small in size, primarily because overlaps with permanent Project features were removed.

Site selection for field surveys began by overlaying a GPS tracklog of current clearing on the most recent available high resolution remote sensing. The GPS tracklog was obtained by flying the perimeter of the actual cleared or disturbed areas for the habitat loss and disturbance survey (see Section 2.0). This tracklog was an approximation of the maximum extent of actual Project clearing or disturbance at the time of the survey, plus a buffer that typically varied from 10 m to 40 m in width. Results presented in this report are an approximation of effects on sensitive sites due to the clearing limits being determined from the aerial tracklog. Precise clearing and disturbance mapping for the entire Project footprint, which is used to produce more precise sensitive site effects, will occur at the end of the construction phase since precise mapping is very time consuming to complete and the actual extent of clearing is changing.

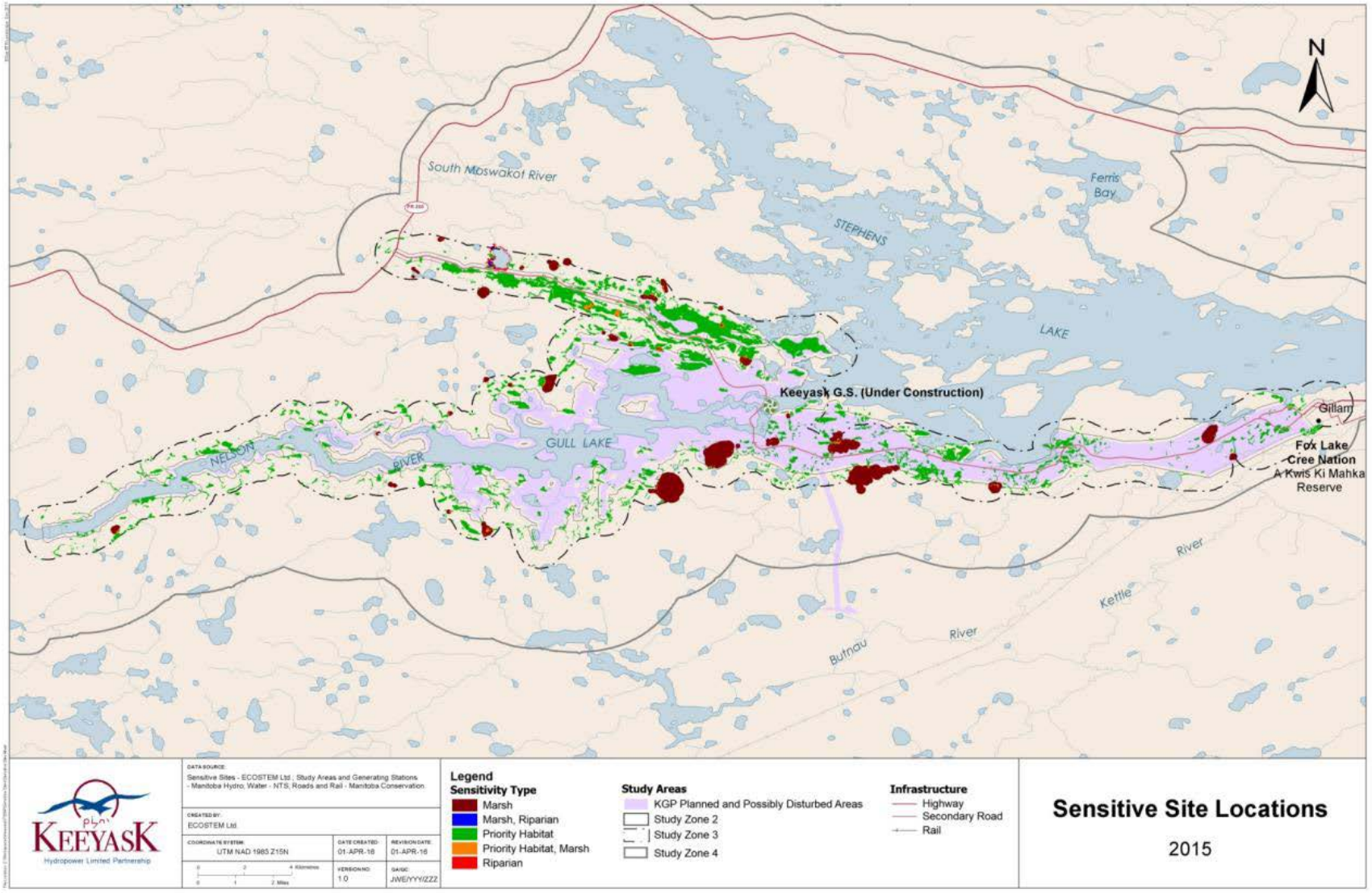
Map 2-1 shows the GPS tracklogs used to approximate Project clearing or disturbance as of late August, 2015 (Section 3.2). Sensitive sites that were within or intersected by areas that had been cleared after the most recent available high resolution remote sensing was acquired were included in aerial surveys. A total of 614 sensitive sites encompassing 1,931 ha were within or intersected by this tracklog (as previously noted, some of these sites were very small). Of the 614 sites potentially affected by the Project, 245 were surveyed by helicopter because clearing in their vicinity was ongoing or had changed since June, 2015, which is when the most recent Worldview 2 satellite imagery prior to fieldwork was acquired. These sites were mainly located along the SAR. Manitoba Hydro acquired additional Worldview 2 imagery approximately two weeks after the field surveys.

Fourteen of the sensitive sites were also surveyed on the ground because they were within the N-6 priority habitat site area or because they were visited for the wetland loss and disturbance study (i.e., Marsh 53; see Section 4.0). Since Project construction clearing and disturbance were ongoing in 2015, other sensitive sites will be surveyed by foot where appropriate in future years of construction. Ground sampling recorded conditions in the designated patches using reconnaissance surveys, geo-referenced photographs, marked-up maps and notes. Field data were mapped in a GIS using digital orthorectified imagery as the base maps.

To define Project clearing and disturbance limits for this study, the GPS tracklog-based perimeter was modified to precisely capture impacts outside of the combined planned and possibly disturbed areas using aerial photos and Worldview 2 imagery acquired in 2015. This produced an overestimate of actual impacts because the tracklog used to identify the extent of clearing and disturbance generally included a small buffer of these impacts as well as including smaller patches of undisturbed areas. As noted in Section 2.2, precise clearing and disturbance mapping for the entire actual Project footprint will occur at the end of the construction phase.



Map 3-1: Sensitive site areas included in the Project's Environmental Protection Plans



Map 3-2: Sensitive sites included in the Ecosystem Diversity study

3.3 RESULTS

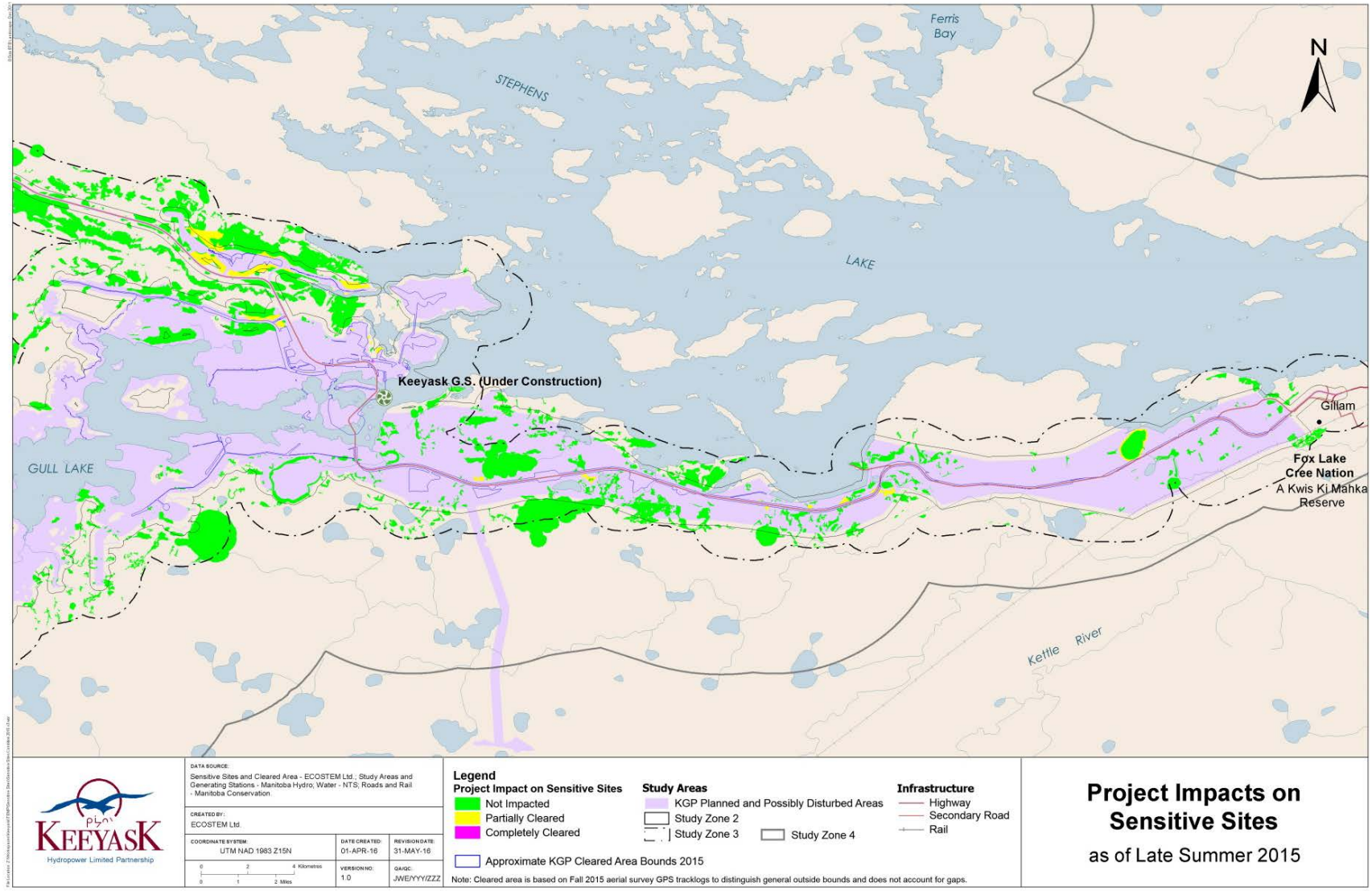
Map 3-3 shows the sensitive sites that were partially cleared (see Photo 3-2 for an example) or completely cleared (see example Photo 3-3) by the Project at the time of the 2015 survey.

The vast majority of sensitive site area (5,404.6 ha or 98%) was not impacted by the Project as of fall 2015. All of the area within the N-6 priority habitat site was undisturbed (Photo 3-1). At the time of the 2015 survey, the Project had not impacted any of the riparian sensitive sites or the priority habitats that were within the off-system marsh site buffers.

The total sensitive site area impacted by Project development as of the 2015 survey was approximately 124.9 ha, or 2.3%, of total sensitive site area (Table 3-1), based on the approximate clearing or disturbance limits. Of this total, only 1.2 ha were in the EnvPP red zones, which is where provisions to minimize impacts on sensitive sites were applicable. Clearing or disturbance of sensitive sites outside of the combined planned and possibly disturbed areas totaled 1.3 ha. For the reasons identified in Section 3.2, the reported areas were an overestimate of actual impacts on sensitive sites. As noted in Section 3.2, precise clearing and disturbance mapping for the entire actual Project footprint will be created at the end of the construction phase.

Table 3-1: Project clearing or disturbance in sensitive sites as of fall 2015

Condition	Monitoring Area	Area (ha)
Not impacted by the Project		**5,404.6**
Impacted by the Project		
	- Within the planned footprint	122.4
	- Within the possibly disturbed footprint (EnvPP red zones)	1.2
	- Outside of the planned and possibly disturbed footprint	1.3
	Sub-total	**124.9**
Total		**5,529.5**



Map 3-3: Project impacts on sensitive sites outside of the planned footprint as of late summer 2015

The 12 cleared or disturbed sensitive site areas larger than 2 ha were situated at Borrow Areas G-1, G-3, N-5, S-2a, EMPAs D16 and D12 and the SAR ROW. There were 202 other smaller sensitive sites that have been partially or completely cleared to date.

The habitat types with the largest areas impacted as of fall 2015 were black spruce mixture vegetation on mineral ecosites and jack pine dominant vegetation on mineral ecosites, with approximately 50 and 26 ha disturbed or cleared (Table 3-2), respectively. In relative terms, black spruce dominant vegetation on shallow peatland had the highest impacts at 72% (0.74 ha) of the total area being monitored. None of the other habitat types had impacts on more than 15% of their total monitored area.

Table 3-3 shows the areas impacted by Project as of fall 2015 by habitat type and Project impact zone. Black spruce mixture vegetation on mineral ecosites had the largest area impacted within the planned portion of the Project footprint (49.61 ha), followed by jack pine dominant vegetation on mineral ecosites (25.52 ha) and tamarack mixture vegetation on mineral (10.22 ha). Tall shrub vegetation on thin peatland had the largest area disturbed or cleared outside of the combined planned and possibly disturbed areas (0.54 ha), while trembling aspen dominant on all ecosites had the second largest area (0.24 ha).

Table 3-2: Number and area of sensitive sites documented as not impacted, partially cleared or completely cleared by the Project as of fall, 2015 by habitat type

Broad Habitat Type	Reasons for inclusion[1]	Number of sensitive sites			Area Cleared
		Not Impacted	Partially Cleared[2]	Completely Cleared	ha
Balsam poplar dominant on all ecosites	P	2			0.00
Black spruce dominant on ground ice peatland	P	5			0.00
Black spruce dominant on mineral	P	6	1	1	0.02
Black spruce dominant on riparian peatland	P	2			0.00
Black spruce dominant on shallow peatland	P	12	1	5	0.53
Black spruce dominant on thin peatland	P	19			0.00
	P,M	1			0.00
Black spruce dominant on wet peatland	P	407	9	5	6.32
	P,M	36			0.00
Black spruce mixedwood on mineral	P	36		1	1.16
Black spruce mixedwood on shallow peatland	P	5			0.00
Black spruce mixedwood on thin peatland	P	17		1	0.01
Black spruce mixture on ground ice peatland	P	1			0.00
Black spruce mixture on mineral	P	116	15	2	49.61
	P,M	6			0.00
Black spruce mixture on shallow peatland	P	221	1		1.37
	P,M	6			0.00
Black spruce mixture on thin peatland	P	253	12	13	8.25
	P,M	6			0.00
Black spruce mixture on wet peatland	P	23	1		0.05
Emergent island in littoral	P,M	5			0.00
Emergent on lower beach	P,M	15			0.00
Emergent on upper beach	P,M	32			0.00
Jack pine dominant on mineral	P	61	13		25.86
	P,M	2			0.00
Jack pine dominant on shallow peatland	P	2			0.00

Broad Habitat Type	Reasons for inclusion[1]	Number of sensitive sites			Area Cleared
		Not Impacted	Partially Cleared[2]	Completely Cleared	ha
Jack pine dominant on thin peatland	P	15	1		0.61
	P,M	1			0.00
Jack pine mixedwood on mineral	P	22	1		0.62
	P,M	11			0.00
Jack pine mixedwood on shallow peatland	P	4			0.00
Jack pine mixedwood on thin peatland	P	15			0.00
	P,M	5			0.00
Jack pine mixture on shallow peatland	P	9			0.00
	P,M	2			0.00
Jack pine mixture on thin peatland	P	65	9	1	6.55
	P,M	7			0.00
Low vegetation on mineral	P	4			0.00
Low vegetation on riparian peatland	P	5			0.00
Low vegetation on shallow peatland	P	1			0.00
Low Vegetation on thin peatland	P	3			0.00
Low vegetation on wet peatland	P	1			0.00
Marsh	M	180	1		0.48
Riparian	R	13			0.00
Riparian- Looking Back Creek	P	4			0.00
	P,M	4			0.00
Riparian, Marsh	M,R	10			0.00
Tall shrub on mineral	P	17	1		0.37
Tall shrub on riparian peatland	P	1			0.00
Tall shrub on shallow peatland	P	60			0.00
	P,M	3			0.00
Tall shrub on thin peatland	P	48	3		8.16
	P,M	1			0.00
Tall shrub on wet peatland	P	52			0.00
	P,M	9			0.00
Tamarack- black spruce mixture on riparian peatland	P	3			0.00
Tamarack dominant on mineral	P	4	2	1	0.65
Tamarack dominant on shallow peatland	P	7			0.00
	P,M	2			0.00
Tamarack dominant on thin peatland	P	4	1		0.41

Broad Habitat Type	Reasons for inclusion[1]	Number of sensitive sites			Area Cleared
		Not Impacted	Partially Cleared[2]	Completely Cleared	ha
Tamarack dominant on wet peatland	P	15			0.00
	P,M	1			0.00
Tamarack mixture on mineral	P	27	7	2	10.22
	P,M	2			0.00
Tamarack mixture on shallow peatland	P	147		2	0.06
	P,M	9			0.00
Tamarack mixture on thin peatland	P	119	4	2	1.92
	P,M	2			0.00
Tamarack mixture on wet peatland	P	71	2	3	0.69
	P,M	20			0.00
Trembling aspen dominant on all ecosites	P	73		1	0.29
	P,M	14			0.00
Trembling aspen mixedwood on all ecosites	P	45	1		0.66
	P,M	8			0.00
White birch dominant on all ecosites	P	12			0.00
	P,M	11			0.00
White birch mixedwood on all ecosites	P	12			0.00
	P,M	2			0.00
Total		*2,479*	*86*	*40*	*124.9*

1: P=Priority Habitat, M=Marsh, R=Riparian.

Table 3-3: Sensitive site area disturbed or cleared by the Project by Impact Zone

Habitat Type	Reasons for inclusion[1]	Total Area Impacted by the Project (ha)	Area within Planned Footprint (ha)	Area within Possibly Disturbed Areas (ha)	Area outside combined Planned and Possibly Disturbed Areas (ha)
Black spruce dominant on mineral	P	0.02	0.02		
Black spruce dominant on shallow peatland	P	0.53	0.53		
Black spruce dominant on wet peatland	P	6.32	6.22		0.09
Black spruce mixedwood on mineral	P	1.16	1.16		0.00
Black spruce mixedwood on thin peatland	P	0.01	0.01		
Black spruce mixture on mineral	P	49.61	49.61	0.00	0.00
Black spruce mixture on shallow peatland	P	1.37	1.37		
Black spruce mixture on thin peatland	P	8.25	8.25		0.00
Black spruce mixture on wet peatland	P	0.05	0.04		0.01
Jack pine dominant on mineral	P	25.86	25.52	0.33	0.00
Jack pine dominant on thin peatland	P	0.61	0.61		
Jack pine mixedwood on mineral	P	0.62	0.62		
Jack pine mixture on thin peatland	P	6.55	6.23	0.32	
Tall shrub on mineral	P	0.37	0.37		
Tall shrub on thin peatland	P	8.16	7.62		0.54
Tamarack dominant on mineral	P	0.65	0.65		
Tamarack dominant on thin peatland	P	0.41	0.41		0.00
Tamarack mixture on mineral	P	10.22	10.22		
Tamarack mixture on shallow peatland	P	0.06	0.06		0.01
Tamarack mixture on thin peatland	P	1.92	1.72		0.20
Tamarack mixture on wet peatland	P	0.69	0.63		0.06
Trembling aspen dominant on all ecosites	P	0.29	0.05		0.24
Trembling aspen mixedwood on all ecosites	P	0.66		0.66	
Marsh	M	0.48	0.43		0.05
Total		*124.88*	*122.35*	*1.31*	*1.21*
1: P=Priority Habitat, M=Marsh, R=Riparian					

Photo 3-1: N-6 priority habitat site was intact in 2015 (the 2013 fire burned portions of the area)

Photo 3-2: Tamarack dominant vegetation on thin peatland (taller trees in the foreground), partially cleared by Borrow Area Q-9

Photo 3-3: Example of a cleared black spruce mixture vegetation on mineral ecosite sensitive site within the Project footprint

3.4 SUMMARY AND DISCUSSION

The Priority Habitats study is monitoring Project effects on 2,694 individual sensitive sites encompassing 5,529 ha. A given sensitive site may include more than one type of environmental sensitivity. Some of the individual sites were very small in size, primarily due to removing overlaps with the permanent Project features.

In 2015, 614 of the sensitive sites were visually inspected from the air, the ground, or using recent Worldview 2 satellite imagery because they were potentially affected by the Project as of fall 2015. The remaining sensitive sites were deemed to be free from Project impacts, as they were outside of the aerial tracklog used to approximate the maximum extent of actual Project clearing or disturbance as of fall 2015, and Project clearing or disturbance was not observed during aerial surveys.

The 614 sensitive sites evaluated in 2015 were classified as being undisturbed, partially cleared or completely cleared by the Project. At the time of the fall 2015 survey, the Project had disturbed or completely cleared approximately 124.9 ha, or 2.3%, of total sensitive site area. The majority of the impacted sites were located along either the SAR, or the NAR. Many of the impact locations were small. In total, 12 of the disturbed or removed areas were larger than 2 ha.

Of the 124.9 ha of impacted by the Project as of fall 2015, only 1.2 ha were within the EnvPP red zones, which is where provisions to minimize impacts on sensitive sites were applied. Approximately 1.3 ha were outside of the combined planned and possibly disturbed areas.

The sensitive site habitat types most affected by the Project in Study Zone 3 were trembling aspen mixedwood vegetation on all ecosites (0.66 ha), jack pine dominant vegetation on mineral ecosites (0.33 ha) and jack pine mixture vegetation on thin peatland (0.32 ha). Tall shrub vegetation on thin peatland (0.54 ha) and trembling aspen dominant vegetation on all ecosites (0.24 ha) had the largest cleared or disturbed areas outside of the combined planned footprint and possibly disturbed areas. Riparian sensitive sites were unaffected at the time of the survey, and less than 0.5 ha of sites with marsh sensitivities were cleared or disturbed.

3.5 NEXT STEPS

Monitoring fieldwork for all of the above studies will continue in 2016. No major changes to field methods are anticipated.

4.0 WETLAND FUNCTION

4.1 INTRODUCTION

A wetland is a land ecosystem where periodic or prolonged water saturation at or near the soil surface is the dominant factor shaping soil attributes and vegetation composition and distribution. Wetland functions are the natural properties or processes that are associated with wetlands, stated in ways that describe what they do for the ecosystem.

Similar to the Terrestrial Habitat Clearing, Disturbance and Indirect Effects monitoring program (Section 2.0), separate studies monitor direct Project effects on wetlands during construction (Wetland Loss and Disturbance study), and then long-term direct and indirect Project effects on wetland function (Long-Term Effects on Wetlands study; see KHLP 2015, Section 2.5.3). The Creation Wetlands monitoring program (see KHLP 2015, Section 8.1) evaluates the efficacy of measures implemented to create 12 ha of off-system marsh.

Monitoring for the Wetland Loss and Disturbance study was conducted in 2015.

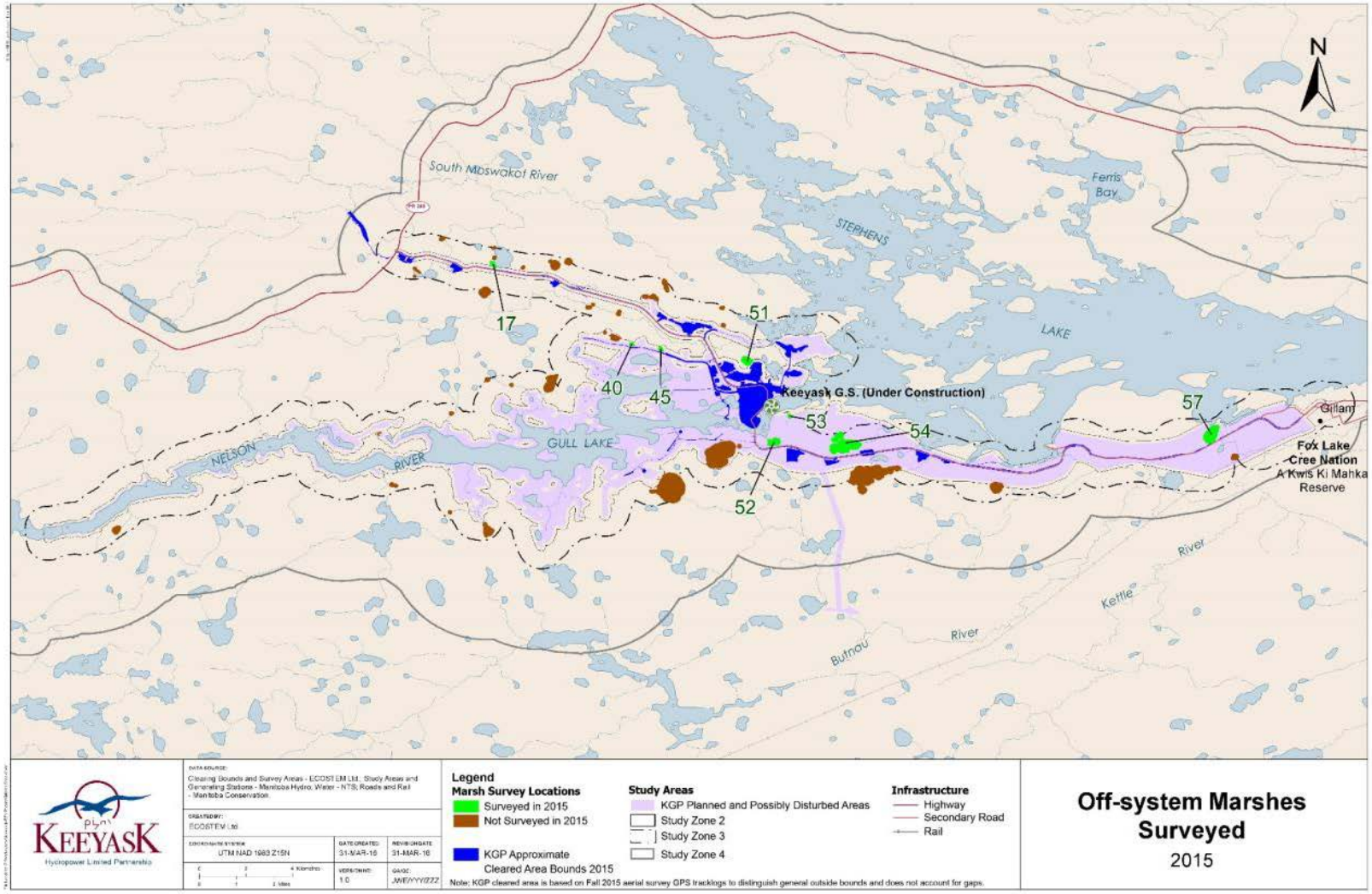
The goal of the Wetland Loss and Disturbance study is to determine direct Project effects on wetland function during construction. The objectives of this study are to:

- Verify the implementation and effectiveness of off-system marsh protection measures; and,
- Quantify and situate direct Project effects on wetland function during construction based on wetland quality scores.

4.2 METHODS

Section 2.5.2 of the TEMP details the methods for this study. The following summarizes the activities conducted during 2015.

Map 4-1 shows the 41 individual off-system marsh locations being monitored for potential Project effects within Study Zone 3, including the eight visited on the ground in 2015. These locations include the off-system marshes mapped for the EIS in 2012, as well as off-system marsh habitat (which may include marsh patches that were too small to map in 2012). Selected marshes outside of Study Zone 2 were included because some potential hydrological effects can extend for a considerable distance.



Map 4-1: Off-system marsh locations surveyed by foot in 2015.

For the 2015 monitoring, selection of marshes for field surveys began using Worldview 2 imagery acquired in the fall of 2014 and spring of 2015. This imagery was used to determine which marsh locations were within approximately 1 km of cleared areas in the most recent imagery. During the second stage of site selection, an aerial survey determined which marsh locations were within 100 m of Project clearing or disturbance at the time of the surveys. All marsh locations within 100 m of existing disturbance were ground surveyed.

The desktop selection step identified 16 of the 41 marsh locations for inclusion in the 2015 aerial surveys because they had the potential to have been affected by construction activities to date based on their location. Aerial surveys conducted on July 7 and 8, 2015 indicated that Marsh Locations 17, 40, 45, 51 to 54 and 57 were within 100 m of Project clearing or disturbance to date (Figure 4-1 and Figure 4-2). Ground surveys on July 7 and 8 and on August 24 and 26 documented mitigation measures and possible Project effects at these eight marsh locations. Conditions in the relevant marshes and their habitat were recorded using reconnaissance surveys, geo-referenced photographs, marked-up maps and notes. The nature of works to control Project-related erosion, siltation, and surface hydrological alteration were recorded, as well as any erosion, siltation, or surface hydrological alteration. Field data were mapped in a GIS using the digital orthorectified imagery as the base maps.

4.3 RESULTS

Marsh 17 was located on the southwest shore of a small lake situated at approximately KM-6 along the NAR (Map 4-1). There was no observed physical disturbance from Project construction within the marsh or its buffer zone. A large fire in 2013 burned the area surrounding the lake where this marsh was located. In addition, a small natural depression between the NAR and the lake near the south end of the marsh had the potential to carry runoff towards the marsh. There were no obvious signs of water level changes. As there were no signs of water runoff from the road or ditch area, a sedimentation survey was not carried out within the natural depression. Future surveys at Marsh 17 will include the adjacent depression area.

Some shrub and white birch mortality was observed in Marsh 17 along the south side of the off-system marsh at the shoreline (Figure 4-3). Some of the dead stems were emerging from the water. It was unclear if this mortality was caused by the 2013 fire, by ground water depth changes after the fire, degradation of massive ground ice in a former peat plateau bog, indirect construction effects, or by some other effect. Some shoreline slumping was observed near the northern end of the marsh, but this seemed more likely to have been caused by fire effects from the fire itself or by degrading ground ice in peat given its distance from the NAR. Future surveys will continue to monitor this location.

Marsh 17

Marsh 40

Marsh 45

Marsh 51

Figure 4-1: Aerial views of marsh locations 17, 40, 45 and 51 in 2015

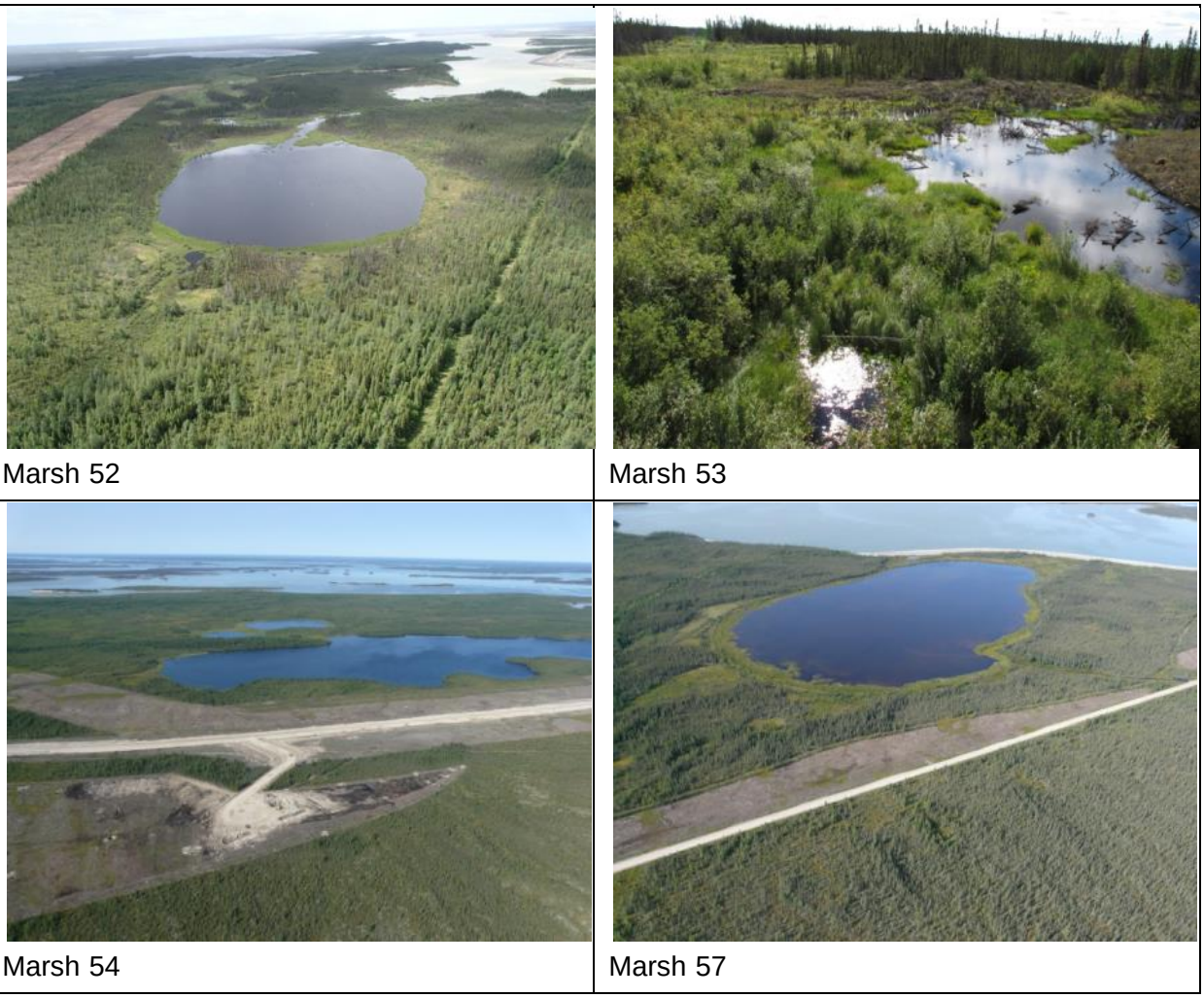


Figure 4-2: Aerial views of marsh locations 52, 53, 54 and 57 in 2015

View along the Marsh 17 shore

Slump (potentially slumping ground ice in peat plateau bog)

Shrub mortality

Figure 4-3: Ground photos of Marsh 17 in 2015

Marsh 40 was located along the north dyke (Map 4-1). A cleared cutline was present along the planned dyke footprint at the time of the survey. There was no observed construction disturbance in the actual marsh during ground surveys (Figure 4-4). The area south of the marsh burned during the 2013 fire, leaving only a thin layer of organic matter in some spots. A slight slope from the construction clearing towards the marsh in the burned area created the potential for runoff into the marsh in the future. It is recommended that a silt fence be erected at the base of the mineral slope.

Marsh 45 was also located along the north dyke, 1.5 km east of Marsh 40. The dyke clearing narrowed to a cutline just east of this marsh at the time of the survey (Figure 4-5). The 2013 fire burned the area adjacent to the marsh. While no disturbance was observed within the marsh location, it was noted that a 15% slope from the dyke clearing towards the marsh, through the burned area, created the potential for runoff into the marsh in the future. It is recommended that a silt fence be erected at the base of the mineral slope.

View along the Marsh 40 shore

Burned ground adjacent to Marsh 40

Figure 4-4: Ground photos of Marsh 40 in 2015

Figure 4-5: Ground photos of Marsh 45 in 2015

Marsh 51 (Figure 4-6) was located north of the concrete batch plant in Work Area A (Map 4-1). The EMPA between the batch plant and the marsh was in use at the time of the survey. A silt fence was in place around a portion of the west side of the EMPA (Map 4-2). At the south end of the fence, runoff from the EMPA appeared to be flowing off of the slope into the area at the end of the fencing. A portion of the silt fence near the northern end was lying flat on the ground. Machine tracks were visible on either side of the fence, but it is unclear if they were present before the installation of the fence or not. The stability of the stake at this location should be checked. After the surveys it was recommended that the siltation control measures along the northern edges of the EMPA north of the work area (D17) should be inspected and enhanced where needed, to prevent further spread towards the channel between the Nelson River and Stephens Lake and the marsh habitat to the northwest.

The EMPA continued north of the silt fence across one of the creeks flowing into Marsh 51 (Figure 4-6). There was no observed mitigation implemented at this location. Erosion along the side of the EMPA slopes created sedimentation extending 2-3 m from the base of the EMPA slope into the creek. Some dead vegetation was also observed in this area. It was unclear if construction activity or sedimentation had a direct effect on these plants; however, mineral soil had begun to cover the creek bed in areas where marsh plants were growing (outside of the actual marsh location). Sediment deposition into this inlet creek could potentially affect the marsh, particularly during a heavy runoff event. Sediment could be carried down the creek towards the lake in the case of increased flow. It was not anticipated that normal flow of the creek will cause siltation effects into the marsh location, however continuing surveys will monitor this location.

Along the northwest and northern side of the EMPA, there was machinery and mechanical disturbance to trees and the ground at the base of the slope. In these locations, there were erosion rills on the slope and deposition at the bottom of the slope. It appeared that a soil berm was built in one area to prevent water runoff from the EMPA area towards the marsh (Figure 4-6; Map 4-2). No further mitigation was observed along the north end of the EMPA. Erosion and some sediment deposition were visible along portions of the base of the slope. Closer to the marsh, no visible signs of disturbance were observed in the actual marsh. Due to the potential for sedimentation during heavy runoff events, it is recommended that a silt fence be built around the north and northwest side of the EMPA, and connected to the existing fence.

Marsh 52 was located south of Gull Rapids, and was in the area where the marsh wetland will be constructed, a Project mitigation measure for off-system marsh habitat. (Map 4-1). At the time of the survey, the SAR ROW had been cleared, but road construction had not reached the area. A previously existing cutline passed within 100 m of the north shore of the lake (Figure 4-7). There was no observed disturbance in or near the marsh during the survey.

Marsh 53 was located on the south side in the tailrace area (Map 4-1). The only clearing nearby was the cleared KTP ROW, which encroached into the marsh area (Figure 4-8). Clearing and cut trees continued into the creek/marsh area and an access trail crossed the creek. There was some flooded vegetation at the cleared transition zone between the creek/marsh and the degrading peat plateau bog (see Figure 4-2), just outside of the marsh buffer zone.

Marsh 54, the largest marsh surveyed by foot, was located along the SAR north of Borrow Area S-2b (Map 4-1). At the time of the survey, the SAR ROW had been cleared and road construction was underway (Figure 4-9). The Keeyask Transmission Project outlet transmission line ROW had also been cleared. It appeared that the initial clearing was as close as 20 m to the marsh lake water's edge, but that a larger buffer was left during the final clearing of the ROW (See Figure 4-9). No evidence of siltation or erosion was observed during ground surveys. Monitoring in 2016 will evaluate whether revegetation efforts of the cleared areas within 100 m of the waterbody is desirable.

Marsh 57 was located along the Butnau Road, south of Stephens Lake (Map 4-1). In addition to the Butnau Road, a larger ROW was cleared to the south east of the marsh at the time of the survey (Figure 4-10). No construction related disturbance was evident during the survey. Monitoring at this location will continue.

The remaining eight marshes were not ground surveyed as they were more than 100 m from Project clearing or disturbance to date. Figure 4-11 shows the state of some of these marshes during the aerial surveys. Marsh 3 was located close to the reservoir, west of Gull Lake, and this area was not disturbed. Marsh locations 36 and 37 were located north of the north dyke, well outside of the cleared portion of the dyke during the 2015 survey. Marsh locations 41 and 49 were located along the northern arms of Borrow Area G-1, and these portions of the Borrow Area had not been used. Marsh locations 43, 47 and 50 were located along the south dyke, and were more than 100 m away from the cleared areas during the 2015 survey.

Ground view

Silt fence

South end of fence

South end of fence

North end of fence

Siltation leak through fence

Creek crossing with siltation at foot of slope

Ground view at creek with siltation in water

Soil berm (top middle of photo)

Soil berm

Figure 4-6: Ground photos of Marsh 51 in 2015

Figure 4-7: Ground photo of Marsh 52 in 2015

Ground view

Cut trees in the marsh area

Access trail across creek

Peat slump on one side of creek

Figure 4-8: Ground photos of Marsh 53 in 2015

Ground view

Clearing near Marsh 54

Figure 4-9: Ground and aerial photos of Marsh 54 in 2015

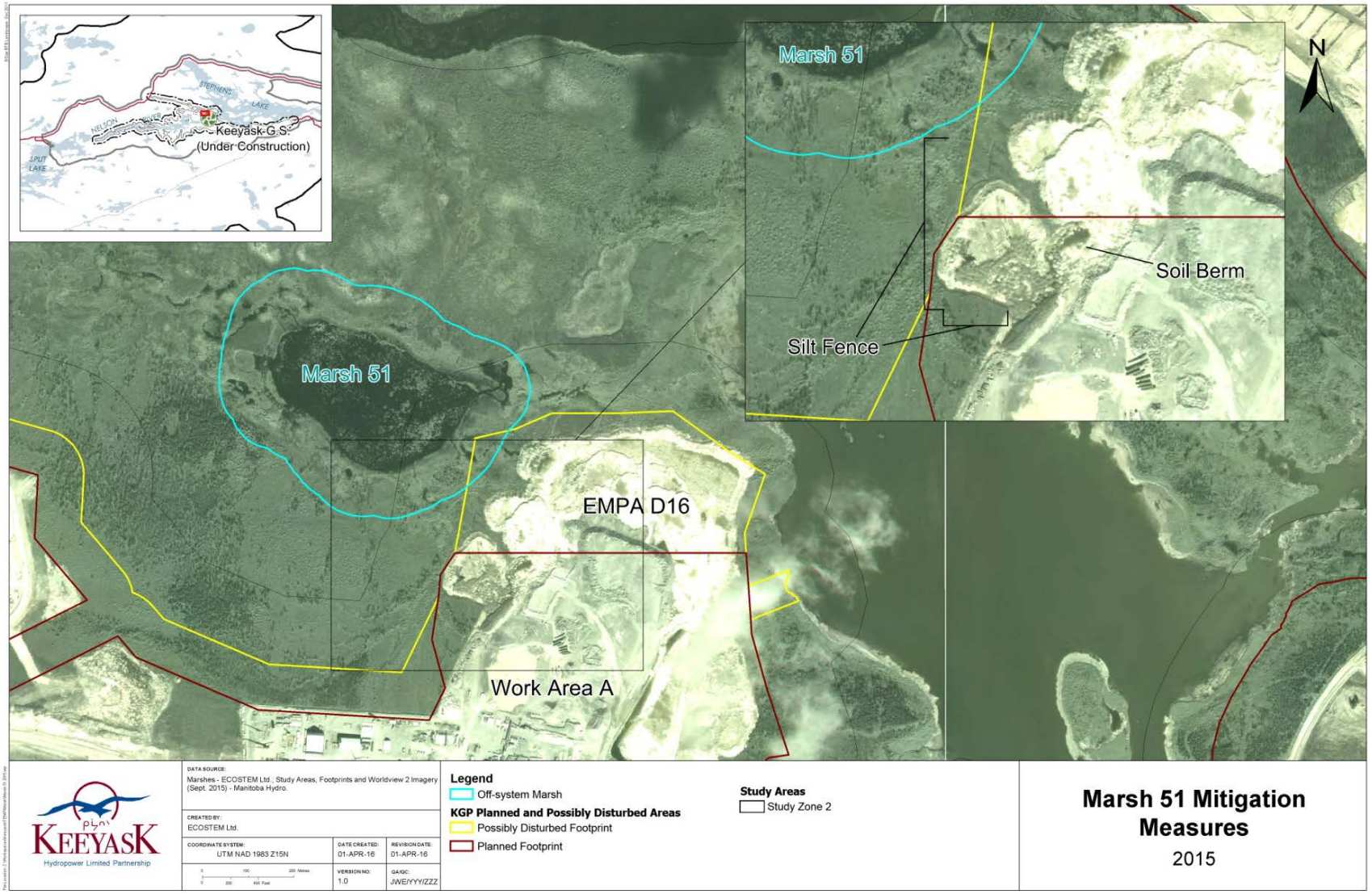
Figure 4-10: Ground photo of Marsh 57 in 2015

Marsh 37

Marsh 47

Marsh 50

Figure 4-11: Examples of marshes surveyed from the air only in 2015



Map 4-2: Marsh 51 mitigation measures in 2015

4.4 SUMMARY AND DISCUSSION

Wetlands typically make relatively high contributions to ecosystem function. In the Keeyask region, off-system marsh is the only particularly important wetland type based on its contributions to the range of wetland functions. The Wetland Loss and Disturbance study is monitoring wetland loss and disturbance due to Project, as well as effects on off-system marsh and its habitat.

Of the 41 individual off-system marsh locations being monitored for potential Project effects, 16 were selected for aerial surveys in September 2015 due to their proximity to Project clearing or disturbance. Eight of these marshes were then ground surveyed because they were within 100m of clearing or construction activity during the aerial survey. Of the eight marshes selected for ground survey, one was along the NAR, one was north of work area A, two were along the north dyke, three were along the SAR and one was south of the tailrace.

There was no observed physical disturbance at six of the eight marsh locations ground surveyed in 2015.

Marsh Locations 40 and 42 were close to mineral slopes burned in the 2013 fire, creating the potential for runoff and sediment deposition from Project construction areas. Continuing care should be taken by construction crews when working in these areas. It is recommended that a silt fence be added between the dyke clearing and these marsh locations at the base of the mineral slope.

Potential effects observed at Marsh Location 17 included a small amount of ground collapsing due to permafrost melting and shrub dieback along the southwest shore. It was unclear whether these changes resulted from degrading massive ground ice in a former peat plateau bog, indirect effects of the 2013 fire, indirect construction effects or by some other effect. Also, a natural runnel between the NAR and the marsh has the potential to carry runoff from the road. The 2016 monitoring will revisit these locations to further evaluate the likely source of observed indirect effects and determine whether mitigation is recommended.

Marsh Location 51 is situated near the north side of an EMPA. A silt fence was in place around a portion of the west side of the EMPA. There were signs of machinery movement between the EMPA and the marsh. Sediment deposition was noted at the base of the EMPA, into a creek that leads into the marsh. It is recommended that the existing silt fence be extended at both ends to span the area where further runoff or sedimentation may occur. Measures to control erosion and stabilize the EMPA slopes should also be considered.

Marsh Location 53 was not affected by Project clearing, however there was some Keeyask Transmission Project ROW clearing within the marsh buffer, which may interact with Project effects in the future. Revisits to the physical disturbance and ground subsidence locations in 2016 will further evaluate the likely source of observed indirect effects and the possible need for revegetation efforts.

The Project did not physically impact Marsh 54.

4.5 NEXT STEPS

Monitoring fieldwork for all of the above studies will continue in 2016. No major changes to field methods are anticipated.

5.0 PRIORITY PLANTS

5.1 INTRODUCTION

Priority plants are defined as those plants that are particularly important for ecological and/or social reasons. Priority plants are the native plant species that are highly sensitive to Project features, make high contributions to ecosystem function and/or are of particular interest to the Partner First Nations. A plant species is considered to be highly sensitive to human features if it is globally, nationally, provincially or regionally rare, near a range limit, has low reproductive capacity, depends on rare environmental conditions and/or depends on the natural disturbance regime (wildlife studies monitor plant species that are critical for the survival and/or reproduction of an animal species). The Partner First Nations have noted a variety of plants of traditional importance that are present in the Project area, including *wihkis* (sweet flag), cranberries, Labrador tea, and white birch.

Because it is possible that existing locations of provincially very rare to rare plant species were not found during EIS studies, the Provincially Very Rare and Rare Plant Mitigation study conducts additional searches and, in the unlikely event any of these species are found, prescribes appropriate mitigation.

The Priority Plants and Their Habitats study (see KHLP 2015, Section 3.1.3) verifies actual Project effects on known priority plant locations and priority plant habitats, including those plants that are important to the partner First Nations. This study commences in the final year of construction.

Monitoring for the Provincially Very Rare and Rare Plant Mitigation study was conducted in 2015.

The objectives of the Provincially Very Rare and Rare Plant Mitigation study are to:

- Determine if any provincially very rare or rare plants occur within the Project zone of influence; and,
- In the unlikely event that a provincially very rare or rare plant is discovered:
    - Confirm that any identified locations are well marked for avoidance where avoidance is practicable;
    - Develop a transplanting plan for provincially very rare plant locations where avoidance is not practicable; and,
    - Monitor the survival and vigor of all plants in any identified locations.

5.2 METHODS

Section 3.1.2 of TEMP details the methods for this study. The following summarizes the activities conducted during 2015.

Pre-clearing rare plant surveys were conducted in areas that could be directly or indirectly affected by the Project (Study Zone 2; Map 1-1), were not previously surveyed and had the highest potential for supporting provincially very rare to rare species. Known habitat associations of the provincially very rare or rare plant species that could potentially occur in Study Zone 2 were used to identify the stand level habitat types with the highest potential for including these species. Using the detailed terrestrial habitat map, habitat patches from these habitat types that were situated within Study Zone 2 and were not already surveyed during EIS or monitoring studies were selected for sampling. An exception was that shallow lakes were not surveyed for small pondweed or Robbins pondweed since the EIS analysis concluded that, while these species were provincially rare, they were not rare in the Keeyask region.

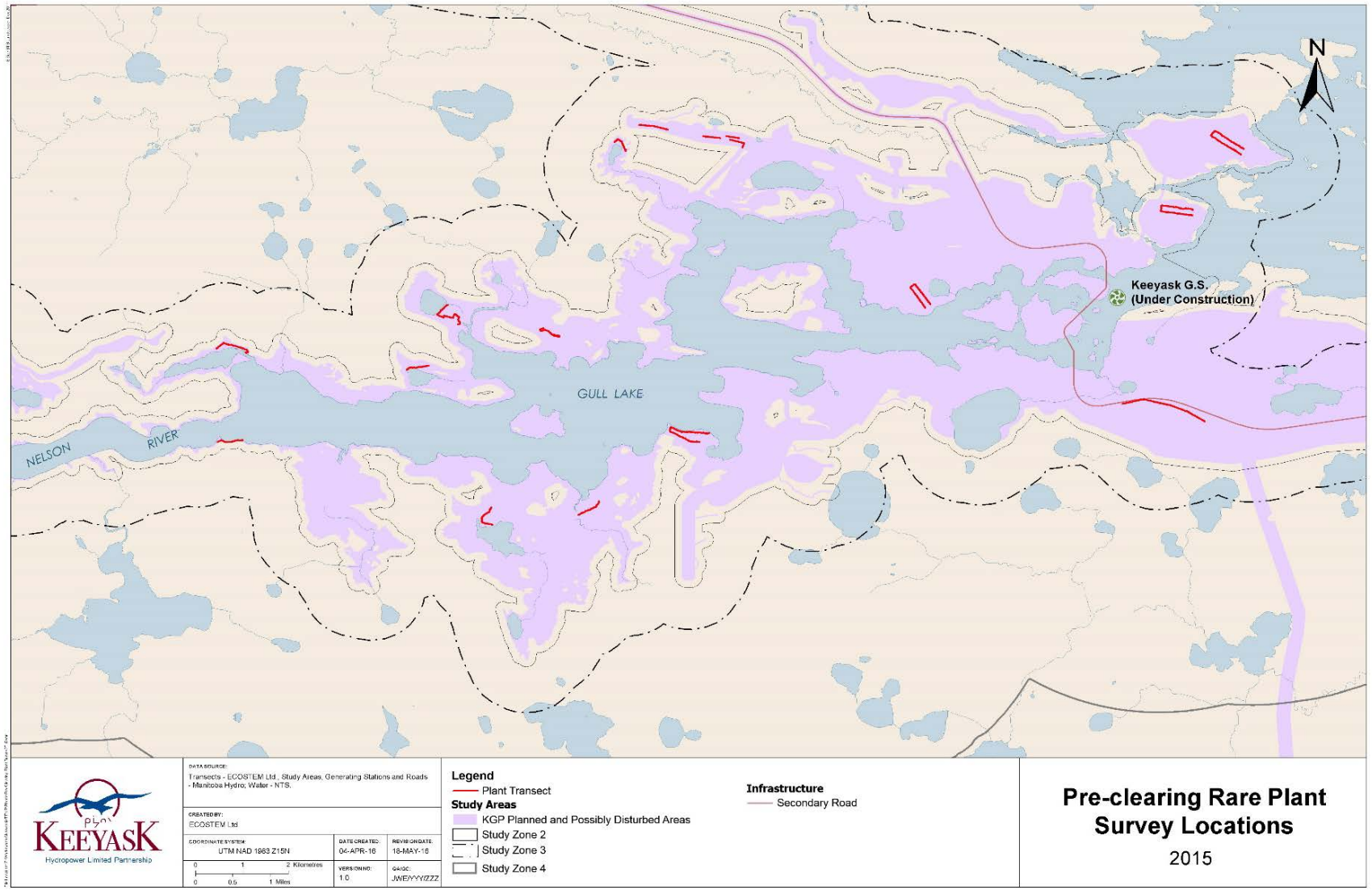
The pre-identified habitat patches were sampled using a combination of systematic and meandering transects. Several transects were surveyed in each habitat patch. Depending on the size and shape of the habitat patch, one or two parallel transects ran lengthwise through the patch. Meandering surveys also occurred through areas deemed by the botanist to have potential for harboring the target plant species.

A botanist surveyed approximately 16 km of pre-clearing rare plant transects on July 8 and 9 and August 5, 8 and 9, 2015 (Map 5-1). Project components surveyed included the future reservoir area (on both sides of the Nelson River), the west end of the north dyke and Borrow Areas G-3, N-5 and S-2a.

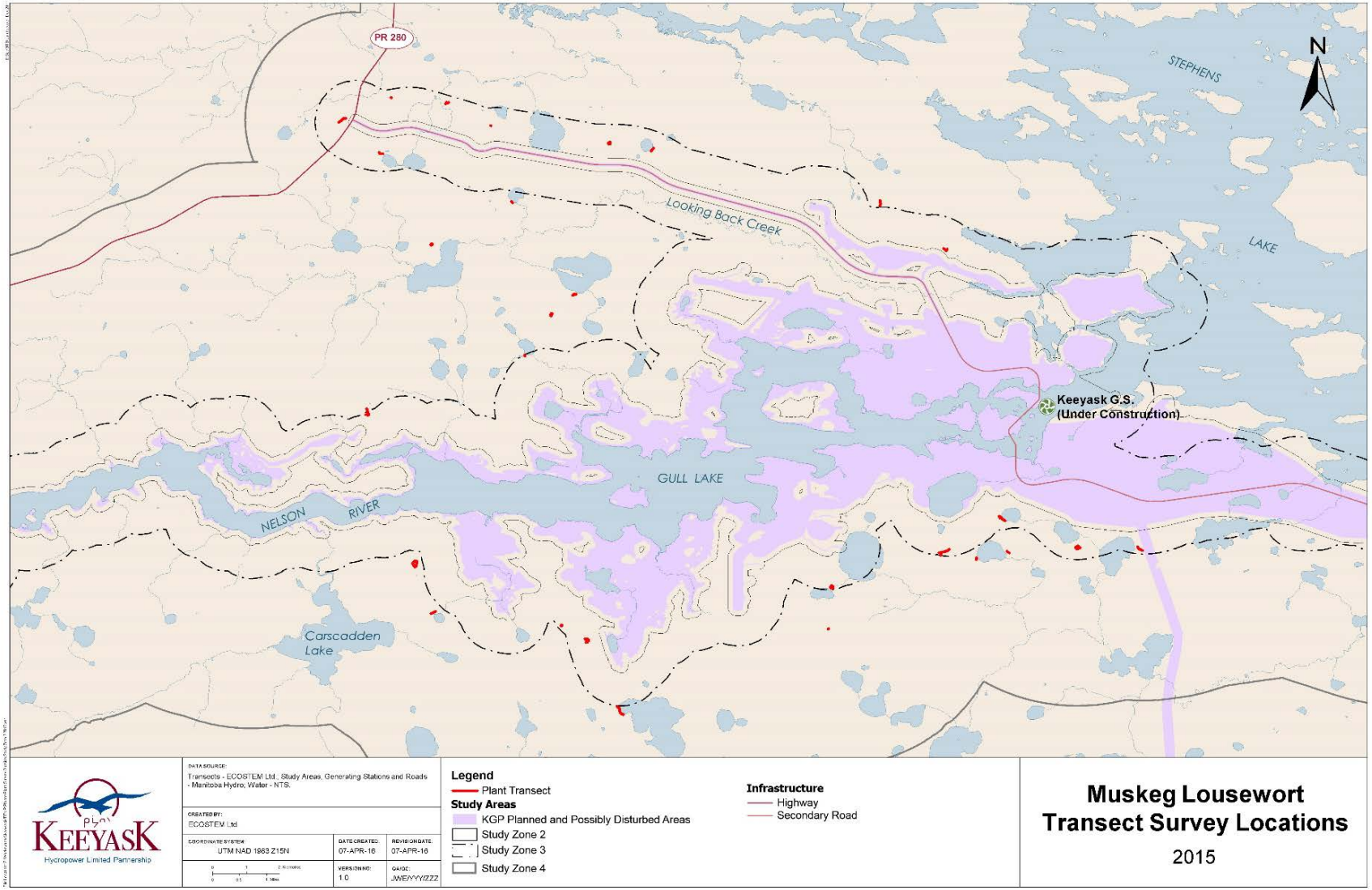
Muskeg lousewort (*Pedicularis macrodonta*), an S2 species, was observed in five locations within Study Zone 2 during the 2014 pre-clearing rare plant surveys (ECOSTEM 2015b). In order to determine whether transplanting or some other mitigation measure was needed for these plants, locations outside of Study Zone 2 were surveyed to determine if at least 20 patches of this species would remain undisturbed.

A botanist searched approximately 6.5 km of survey transects in 28 locations outside of Study Zone 2 between August 5 and 8, 2015 (Map 5-2). Survey transects were situated in habitats with the highest potential to support this species (see ECOSTEM 2015b).

During the pre-clearing and muskeg lousewort surveys, all discovered patches of provincially very rare and rare species were documented with geo-referenced photographs, marked-up maps and notes, and the location was flagged. Recorded information included attributes such as plant species, plant vigor, site conditions and habitat associations. The locations and sizes of the plant patches were mapped in a GIS. The locations of any provincially very rare or rare species will were reported to Manitoba Hydro.



Map 5-1: Pre-clearing rare plant transects surveyed in 2015



Map 5-2: Muskeg lousewort transects survey locations in 2015

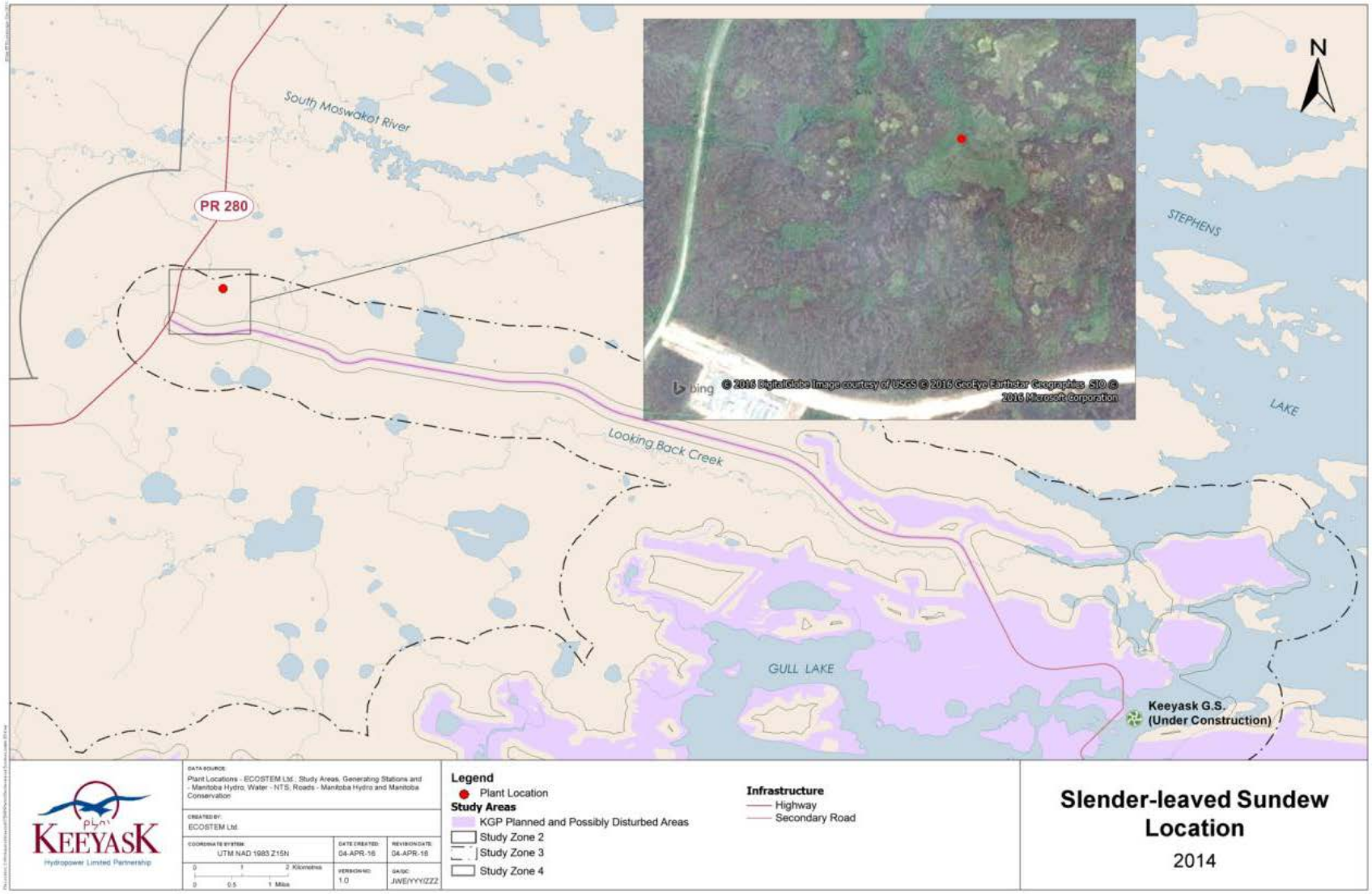
5.3 RESULTS

5.3.1.1 PRE-CLEARING RARE PLANT SURVEYS

No S1 or S2 species were observed along any of the transects surveyed in 2015. No rare plant species were identified incidentally in Study Zone 2 during any of the 2015 monitoring surveys.

Outside of Study Zone 2, slender-leaved sundew (*Drosera linearis*; Photo 5-1) was incidentally observed in a single very wet collapse scar (*i.e.*, a crater formed in a peatland after permafrost melts) situated approximately 1.3 km northeast of the start-up camp area (Map 5-3).

Photo 5-1: Slender-leaved sundew



Map 5-3: Slender-leaved sundew location observed during 2014 field surveys

5.3.1.2 MUSKEG LOUSEWORT SURVEYS

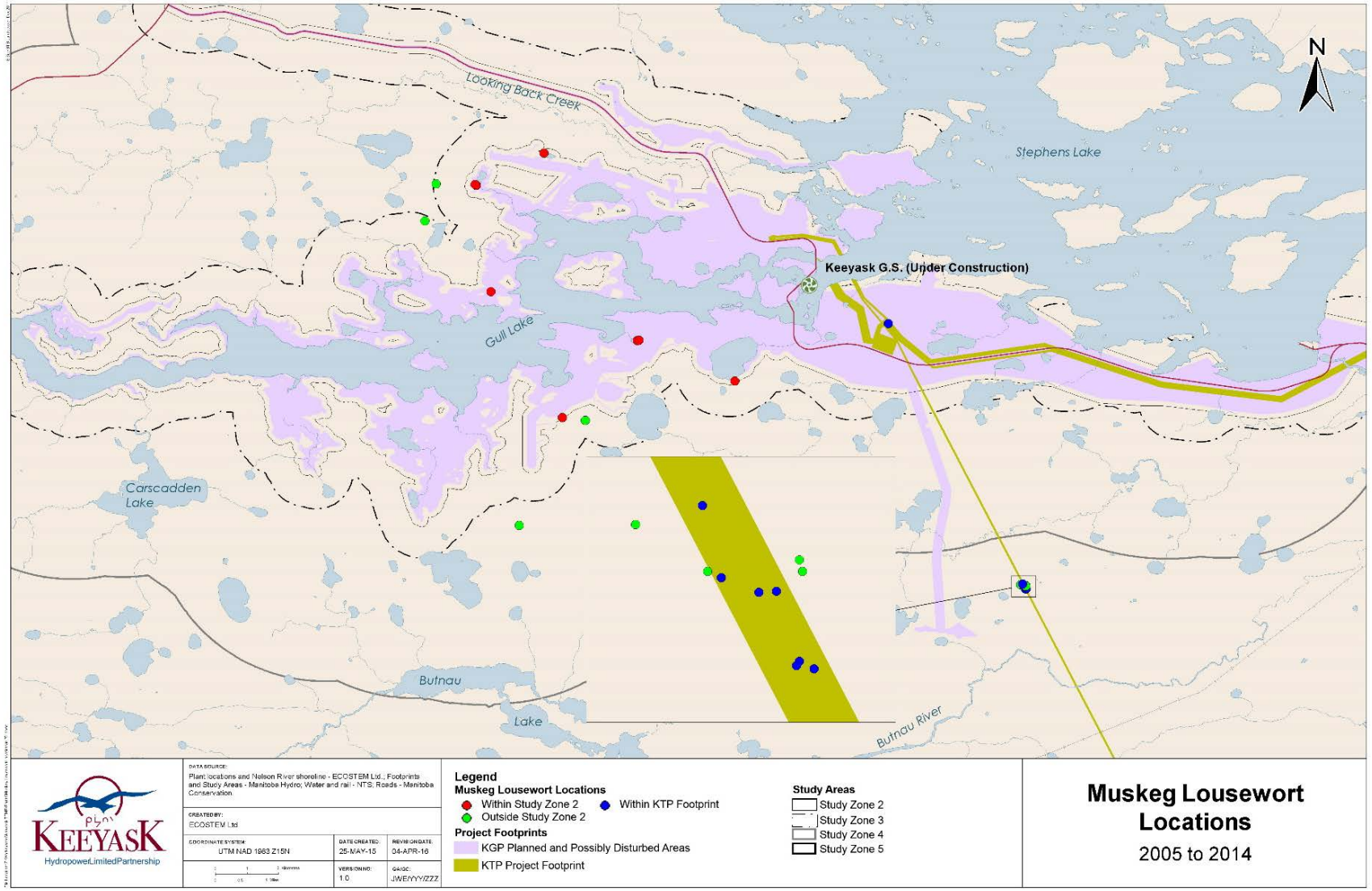
Prior to the 2015 surveys, muskeg lousewort had been observed in 24 locations, either during rare plant surveys or incidentally while doing other surveys (Map 5-4). Seven of these locations were subsequently affected by the KTP clearing. After excluding these locations and those within Study Zone 2, there were eight known muskeg locations outside of Study Zone 2.

Muskeg lousewort (Photo 5-2 to Photo 5-4) was observed at 14 additional locations during the 2015 surveys, at locations on both the north and south side of the LNR and north and south of the NAR (Map 5-5). The 2015 observations brought the total number of known locations outside of Study Zone 2 and the KTP ROWs to 22.

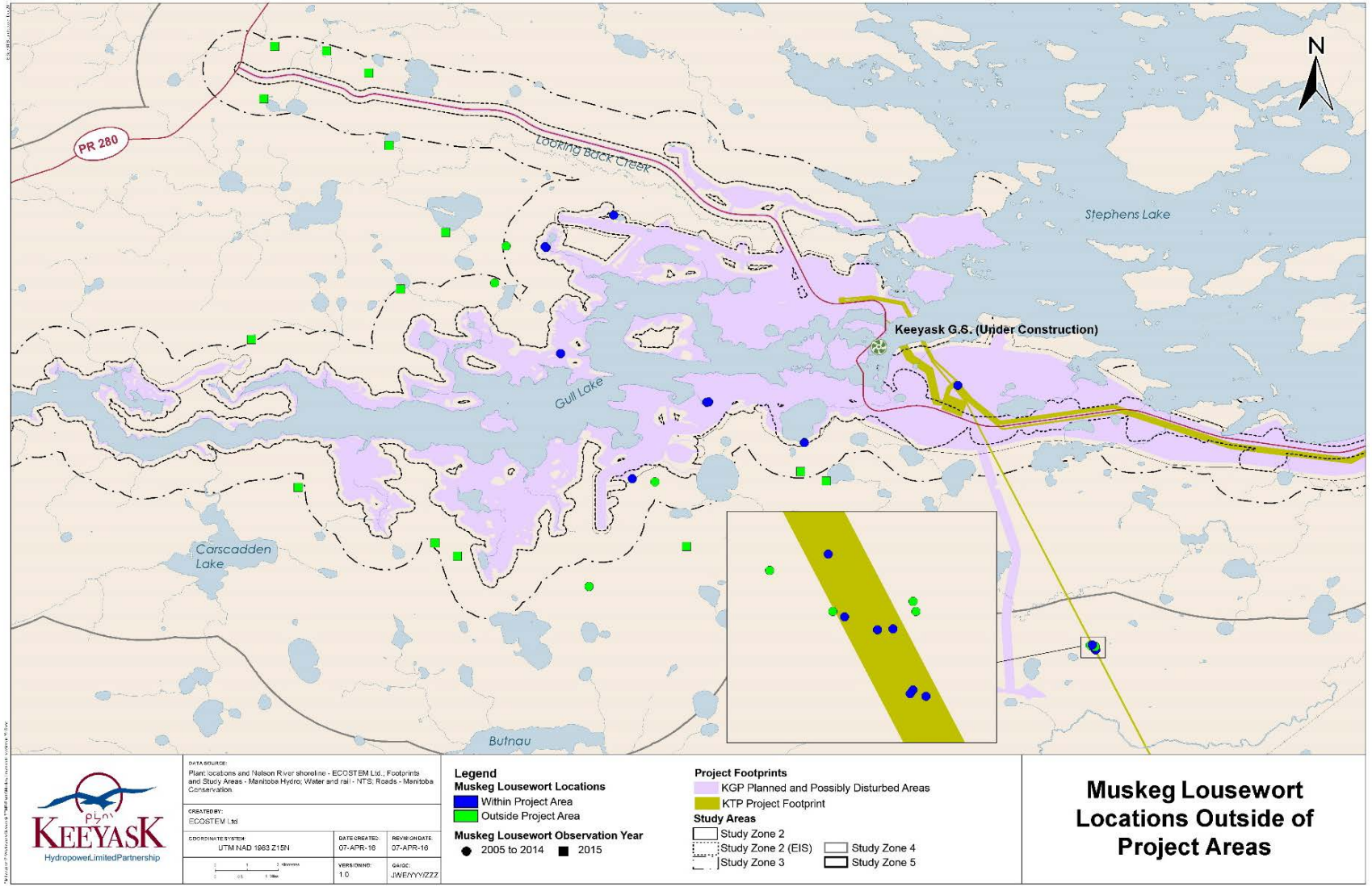
Photo 5-2: Muskeg lousewort flower

Photo 5-3: Common muskeg lousewort habitat type (note the white "cotton" of the alpine cotton grass)

Photo 5-4: Muskeg lousewort growing with bogbean, water horsetail and sedges



Map 5-4: Muskeg lousewort locations identified during field surveys between 2005 and 2014



Map 5-5: Muskeg lousewort locations outside of Keeyask project areas

5.4 SUMMARY AND DISCUSSION

5.4.1 PROVINCIALLY VERY RARE AND RARE PLANTS MONITORING

Priority plants are those plants that are particularly important for ecological and/or social reasons. Of particular interest are plants that are provincially very rare (S1 species) or provincially rare (S2 species). The Provincially Very Rare and Rare Plant Monitoring study includes pre-clearing searches for these species in areas that may be directly or indirectly affected by the Project (Study Zone 2) that were not previously surveyed. In the event that very rare or rare plant locations are identified, appropriate mitigation and follow-up monitoring are prescribed.

Approximately 16 km of transects were searched prior to clearing in 2015 to further verify the absence of S1 or S2 plants in the Project Footprint.

No S1 or S2 species were observed within the Project Footprint or Study Zone 2 during pre-clearing or other surveys in 2015. Outside of Study Zone 2, there was a single incidental observation of slender-leaved sundew (*Drosera linearis*) in a very wet crater formed in a peatland after permafrost had melted.

Muskeg lousewort (*Pedicularis macrodonta*), an S2 species, was observed in five locations within Study Zone 2 during the 2014 pre-clearing rare plant surveys. In 2015, additional rare plant surveys were conducted in locations outside of Study Zone 2 to determine if muskeg lousewort was growing in at least 20 locations outside of this area as well as areas that could be disturbed by other projects. Finding at least 20 locations in these areas would indicate that muskeg lousewort is more common in the Keeyask region than suggested by its provincial conservation concern ranking, and that a sufficient number of patches would remain in the broader area (Study Zone 4) to maintain this species. In that case, transplanting musket lousewort patches found in the Project Footprint would not be required.

Searches along approximately 6.5 km of transects in 2015 identified 14 muskeg lousewort locations outside of Study Zone 2. These observations brought the total number of known muskeg lousewort locations outside of Study Zone 2 and the KTP ROWs to 22. Additionally, it is likely that some of the identified locations within Study Zone 2 will not be affected by any Project based on their distance from the ultimate actual clearing and disturbance given trends to date.

Based on the results to 2015, the revised recommended mitigation measures for Project effects on muskeg lousewort are to:

- Mark any muskeg lousewort patches identified in Study Zone 2, and avoid these locations during construction and operation where practicable; and,
- Monitor site disturbance and the condition of plants in sites marked for avoidance.

5.5 NEXT STEPS

Pre-clearing rare plant surveys will continue in the reservoir area in 2016. No major changes to field methods are anticipated.

6.0 INVASIVE PLANTS

6.1 INTRODUCTION

Non-native plants are those plants that are growing outside of their country or region of origin. Invasive plants are non-native plants that can out-compete or even replacing native plants. Invasive plants are of concern because they can crowd out other plant species and, in extreme cases, change vegetation composition or other ecosystem attributes. Non-native plant species that are not generally invasive may become invasive under some local conditions or may do so in the future with changing climate.

The invasive plant monitoring program includes a single study, the Invasive Plant Spread and Control study. The goals of this study are to determine the degree to which the Project contributes to introducing and spreading invasive and non-native plants, and to evaluate the effectiveness of mitigation measures. The overall objectives of the Invasive Plant Spread and Control study are to:

- Verify that appropriate seed mixtures were used where seeding is implemented as a rehabilitation or erosion control measure;
- Document the degree of invasive plant introduction and spread;
- Document if invasive plant introduction and/or spread occurs:
- Recommend appropriate control and eradication programs; and,
- Verify the efficacy of any programs implemented to control or eradicate invasive plants.

6.2 METHODS

The Invasive Plant Spread and Control study includes two components. The first component monitors invasive plant distribution and abundance in Project areas. In the event that control or eradication programs are needed, the second study component provides relevant recommendations and monitors their effectiveness.

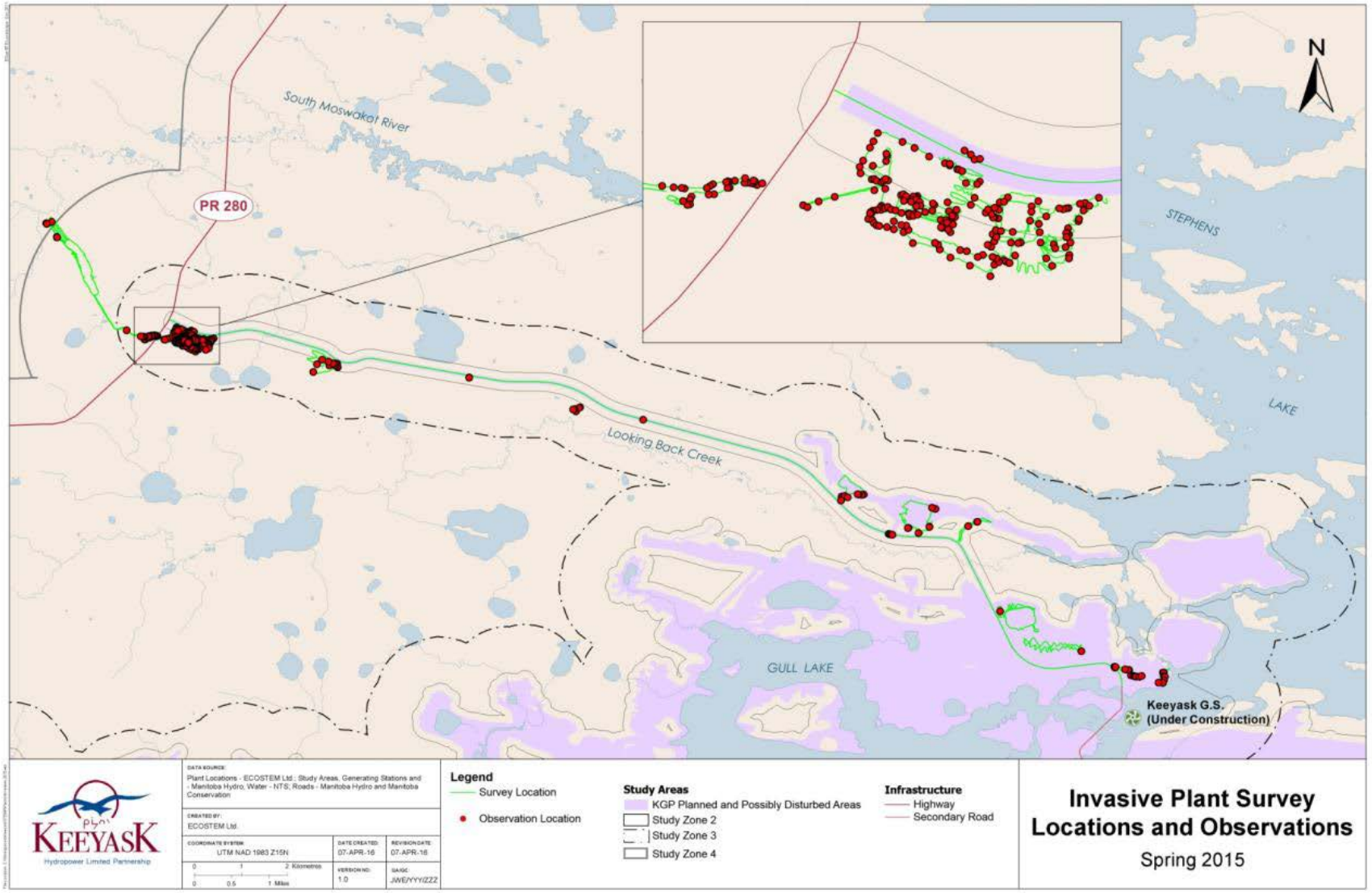
Section 3.3.2 of TEMP details the methods for this study. The following summarizes the activities conducted during 2015.

A botanist conducted surveys on foot and by truck within cleared areas that were both safe to survey and were not undergoing clearing at the time of the surveys. For the access roads, a stop was generally made every 2 km along the road and a 200 m transect was surveyed by foot where it was safe to do so. Some planned stops were skipped due to safety considerations.

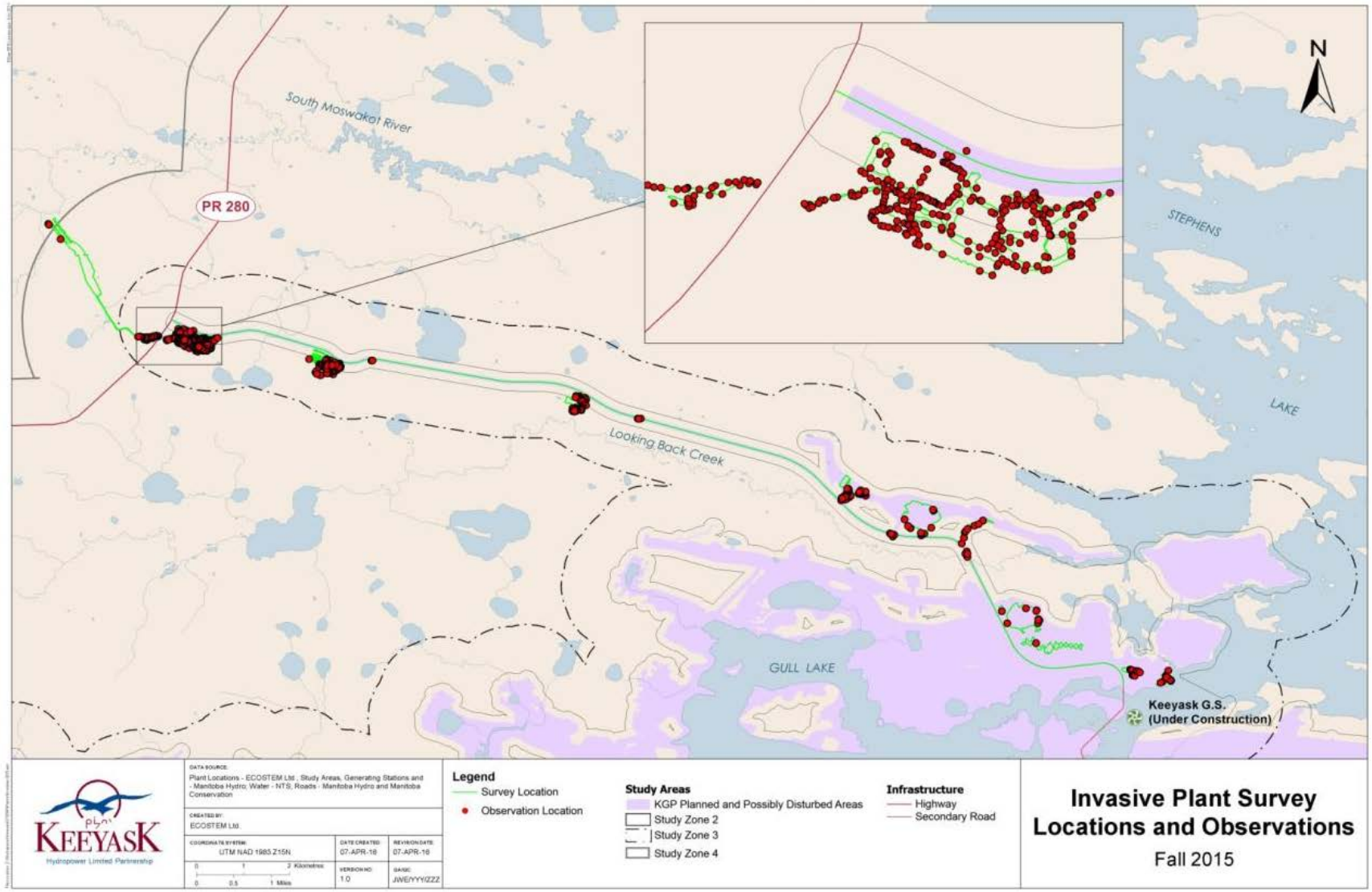
Several transects were surveyed in each of the other cleared areas. One transect followed a route near the perimeter of the clearing while a second ran through the center of the site. Additional meandering surveys also occurred through areas deemed by the botanist to have potential for harboring invasive or non-native plants.

All discovered invasive and non-native plant patches were documented with geo-referenced photographs, marked-up maps and notes. Recorded information included attributes such as plant species, plant vigor, site conditions and the possible source of the introduction or spreading. The locations and sizes of invasive plant patches were mapped in a GIS. Control or eradication recommendations were developed where appropriate for observed invasive plant patches, and provided to Manitoba Hydro for implementation.

Spring surveys were conducted from July 6 to 9 at the locations shown in Map 6-1. Fall surveys were conducted from August 24 to 27, 2015 at the locations shown in Map 6-2.



Map 6-1: Invasive plant survey locations and invasive/non-native species observations in spring 2015



Map 6-2: Invasive plant survey locations and invasive/non-native species observations in fall 2015

6.3 RESULTS

6.3.1 SPRING SURVEYS

A total of 11 invasive or non-native plant species were found in the surveyed areas in spring 2015 (see individual species Map 1A-1 to Map 1A-11 in Appendix 1A). At least one invasive plant species was found in most of the areas searched (Map 6-1), with the number of species and abundances varying by location.

The distribution of invasive plants in spring 2015 (Map 6-1) was similar to that at the end of the KIP monitoring in 2014 (ECOSTEM 2015a), with the exception of the construction offices and a few work areas south of the construction offices. Active construction in the work areas south of the construction offices precluded searches within them.

Areas lacking invasive species observations during the spring survey included, the main camp, work area A (except for one dandelion) and a few portions of some of the borrow areas (a portion of Borrow Area KM-9 could not be surveyed due to construction timing conflicts and safety concerns). In general, the same areas lacked invasive species observations at the end of the KIP monitoring (ECOSTEM 2015a) and in spring 2015. The exception was at the main camp, which had a few invasive plants at the eastern end in 2014.

Invasive plant species stem density was highest in the start-up camp, the start-up camp well area, portions of Borrow Areas KM-0, KM-4, KM-9, KM-15, the entrance to Borrow Area G-5, the work areas at the end of the access road, and the construction office area.

Species observed during the spring 2015 surveys (Table 6-1) included lamb's quarters (*Chenopodium album*), white sweet clover (*Melilotus albus*), alfalfa (*Medicago sativa*), common plantain (*Plantago major*), perennial sow thistle (*Sonchus arvensis*), alsike clover (*Trifolium hybridum*), Canada thistle (*Cirsium arvense*), pineappleweed (*Matricaria discoidea*), wormwood (*Artemisia absinthium*), smooth catchfly (*Silene csereii*) and common dandelion (*Taraxacum officinale*). Canada thistle, pineappleweed and smooth catchfly had not been previously recorded in the Project or the KIP Footprint, but had been identified in at least one location along highway PR 280. Wormwood had not been previously identified during studies in the Keeyask region. Figure 6-1 provides example photos of invasive plants found during the surveys.

Common dandelion was the most frequent invasive species during spring surveys (Table 6-1), followed by white sweet clover and lamb's quarters. Common dandelion was observed in 153 locations, including several locations within the startup camp, Borrow Area KM-0, the entrance and north a portion of Borrow Area G-3, the perimeter of Borrow Areas KM-4 and KM-17, the main camp well road, the construction office area, the water treatment area and Work Area A. One location was also recorded along the North Access Road (Map 6-1).

Table 6-1: Number of invasive species locations by species and season[1]

Scientific Name	Common Name	2013 Fall	2014 Spring	2014 Fall	2015 Spring	2015 Fall
Artemisia absinthium	Wormwood				1	1
Chenopodium album	Lamb's quarters		2	64	47	229
Cirsium arvense	Canada thistle				3	1
Matricaria discoidea	Pineappleweed				2	8
Medicago lupulina	Black medick			2		3
Medicago sativa	Alfalfa	9	2	12	1	36
Melilotus albus	White sweet clover	10		65	93	155
Melilotus officinalis	Yellow sweet clover			2		5
Plantago major	Common plantain		2	12	17	27
Silene csereii	Smooth catchfly				1	2
Sonchus arvensis	Perennial sow thistle	6	6	37	26	83
Taraxacum officinale	Common dandelion	4	45	98	153	126
Trifolium hybridum	Alsike clover			10	14	40
Trifolium pratense	Red clover			2		1
Trifolium repens	White clover			1		2
Tripleurospermum inodorum2	Scentless chamomile					1
Total		29	57	305	358	720
Total transect length surveyed (km)		*11.5*	*39.1*	*57.9*	*48.2*	*55.0*

Notes: [1] Species observed and number of locations varies from one survey to the next in part due to differences in locations and total areas sampled. [2] ICSM recommends rapid response.

White sweet clover was observed in 93 locations (Map 1A-2), mainly in the start-up camp and Borrow Area KM-0, with a few locations observed in the G3 entrance, one location in Borrow Area KM-15 and one location on the helicopter pad.

Lamb's quarters was observed in 47 locations (Map 1A-1), including a large patch in the startup camp, a large portion of the Borrow Area KM-0, the entrance of Borrow Area KM-4, a portion of Borrow Area KM-9 (note that the entire Borrow Area was not surveyed in the spring), portions of Borrow Area KM-15, one location on the helicopter pad and a few single plants behind the construction offices.

The remaining invasive species observed during the spring 2015 survey were found in approximately the same locations within the Project Footprint as the three most frequent species (Map 1A-3 to Map 1A-11). Areas where other invasive species were observed included the startup camp, Borrow Areas KM-0, KM-4, KM-9, KM-15, the helicopter pad, construction offices and the water treatment area. Perennial sow thistle, smooth catchfly and common plantain were identified along the North Access Road ditch near the start-up camp at approximately KM-10 and KM-16.

6.3.2 FALL SURVEYS

A total of 16 invasive species were observed during the fall 2015 surveys (Table 6-1), which was five more species than in the spring (see individual species Map 1A-12 to Map 1A-27 in Appendix 1A). This was the highest number of species observed in invasive surveys conducted since the beginning of the KIP construction monitoring (see ECOSTEM 2015a). The increasingly large survey area contributed to the increasing number of locations over time.

Invasive species were in the same general locations in the fall as in the spring, but in most cases there were simply more locations observed within each area. Invasives were more frequent in stops along the North Access Road, along the well road and in the main camp area, as well as in the construction offices area.

New species observed during the fall survey included black medick (*Medicago lupulina*), yellow sweet clover (*Melilotus officinalis*), scentless chamomile (*Tripleurospermum inodorum*), red clover (*Trifolium pratense*) and white clover (*Trifolium repens*) (see Figure 6-1; see Map 1A-12 to Map 1A-27). Scentless chamomile had not previously been identified during studies in the Keeyask region. Figure 6-1 provides example photos of invasive plants found during the surveys.

Lamb's-quarters (Map 1A-12), white sweet clover (Map 1A-13) and common dandelion (Map 1A-22) remained the most common species recorded in the fall (Table 6-1). The number of locations recorded increased for each of the species recorded, except for common dandelion and Canada thistle, which both decreased slightly. These species were also the species with the highest general abundance, along with perennial sow thistle. All four species were generally found in small to large patches of very sparse to low coverage, however, each species was also found in larger patches of moderate to high coverage (or to very high coverage in the case of white sweet clover). The higher density locations were found in the start-up camp, the entrance to Borrow Area G-5 and in Borrow Areas KM-4 and KM-15. The very high density of lamb's quarters were

located in the start-up camp, in the area of the old volleyball court and the side of the ditch, south of the accomodation trailers.

Most of this increase in the number of invasive species locations was attributable to one species, which was lamb's quarter. The number of lamb's quarters locations increased nearly five times to 229 locations (Map 1A-12). Lamb's quarters was recorded in the same general areas as in the spring, but it was typically recorded more frequently in these general areas. The start-up camp and the borrow areas from KM-0 to KM15 had more occurrences of this species than previously (although the Borrow Area KM-9 survey was not complete in the spring, due to scheduling difficulties, a visual inspection was done by the botanist). In addition, the well road, the main camp, the water treatement area and Borrow Area KM-17 were found to contain lamb's quarters during the fall survey, but not the spring survey. Lamb's quarters had been observed at these locations in the fall of 2014 (ECOSTEM 2015a). It was also observed for the first time along the road at Borrow Areas KM-10 and KM-18. One location was also observed in the entrance to Borrow Area G-3 for the first time.

The lamb's quarters locations seemed to be associated with areas that appeared to have been hydroseeded prior to the 2014 field surveys under the KIP. This association will be investigated further.

Lamb's quarters

White and yellow sweet clover

Alfalfa

Common plantain

Perennial sow thistle

Common dandelion

Figure 6-1: Example photos of invasive plant species observed during spring and fall surveys in 2015 (June 6-9 and August 24-27, 2015)

Wormwood

Smooth catchfly

Scentless chamomile

Red clover

Alsike clover

White clover

Figure 6-1. . . continued

6.3.3 CONTROL OR ERADICATION MEASURES

Several sources classify invasive species in Manitoba and Canada. The ISCM (2016) describes the category 2 and "other" species as species which are present in Manitoba, capable of further spread and have an established pathway for spread. Category 2 species are also on the early detection and rapid response list.

Of the invasive plant species found during field surveys, scentless chamomile is the only ISCM category 2 species. Canada thistle, white clover and yellow sweet clover are ranked as moderate invasives in Canada (White et al. 1993; Table 6-2). Canada thistle is also a weed seed (Government of Canada 2005) and considered an invasive of some concern in Manitoba (Government of Canada 2005, Invasive Species Council of Manitoba (ISCM) 2016). Scentless chamomile (category 2) and perennial sow thistle ("other") are listed as species of concern in Manitoba, along with Canada thistle (ISCM 2016). Scentless chamomile and perennial sow thistle are weed seeds and scentless chamomile is a noxious weed. Lamb's quarters, smooth catchfly and common dandelion are noxious weeds (Government of Manitoba 1988). The remaining species were non-native.

Many of the invasive species recorded during field surveys are commonly found in disturbed areas throughout the Province (*e.g.*, dandelion, white clover), particularly along roadsides, making it difficult to prevent spreading. Based on surveys conducted in summer 2011 to 2013 under the KIP, at least three invasive species were likely already well established in the start-up camp area when KIP construction began (white sweet clover, common plantain and common dandelion).

Field surveys during 2015 identified one scentless chamomile plant within the road ROW between the start-up camp and the well (Map 6-3). Since scentless chamomile is a fast growing, prolific seed producer that can form dense monocultures (Leafy Spurge Stakeholders Group (LSSG) 2010), it was recommended that Manitoba Hydro site staff carefully hand pull the plant and remove the soil from around the base of the plant, and place all material into a double layer of garbage bags prior to disposal. On September 5, 2015, Manitoba Hydro staff removed and disposed of the scentless chamomile plant located in the well road ROW in two layers of garbage bag (Photo 6-1 and Photo 6-2).

Since Canada thistle is moderately invasive and a noxious weed, it is recommended that the plants identified during the fall 2015 surveys be removed when they emerge in the spring. Site staff should carefully hand pull the plant and remove the soil from around the base of the plant, and place all material into a double layer of garbage bags. The preferable method to dispose of the bags is by burning in a controlled area.

Table 6-2: Invasive plant species degree of concern and spread rate notes

Scientific Name	Common Name	Canada		Manitoba		Spread Rate Notes[5]
		Invasive rank[1]	Weed Seed[2]	Invasive rank[3]	Noxious Weed[4]	
Artemisia absinthium	Wormwood	Minor			yes	
Chenopodium album	Lamb's quarters				Yes	Spread by seeds
Cirsium arvense	Canada thistle	Moderate	primary	other	Yes	Hardy seeds
Matricaria discoidea	Pineappleweed					Spread by seeds
Medicago lupulina	Black medick					Seeds and spreading stems
Medicago sativa	Alfalfa	Minor				
Melilotus albus	White sweet clover	Moderate				Hardy seeds
Melilotus officinalis	Yellow sweet clover	Moderate				Hardy seeds
Plantago major	Common plantain					Spread by seeds
Silene csereii	Smooth catchfly				Yes	
Sonchus arvensis	Perennial sow thistle		primary	other		Spread by seeds
Taraxacum officinale	Common dandelion				Yes	Seeds spread by wind
Trifolium hybridum	Alsike clover					
Trifolium pretense	Red clover					
Trifolium repens	White clover					
Tripleurospermum inodorum	Scentless chamomile		secondary	Category 2	yes	Rapid and prolific spread

Notes: [1] White et al. (2003). [2] Government of Canada (2005). [3] Invasive Species Council of Manitoba (2016). [4] Government of Manitoba (1988). [5] LSSG (2010), Government of Saskatchewan (2016b).

Source: Manitoba Hydro

Photo 6-1: Scentless chamomile plant just before removal, September 5, 2015

Source: Manitoba Hydro

Photo 6-2: Scentless chamomile plant after hand pulling, September 5, 2015

Map 6-3: Scentless chamomile location identified in fall 2015

Lamb's quarters have spread within the current Project footprint, beginning during the KIP construction and continuing through the Project construction. It was previously recommended that the area in the start-up camp around the old volleyball court be mowed or hand weeded, as this was the location with the highest density of the species; this will be done in upcoming growing seasons. The density of lamb's quarters in this area was very high at the time of the 2015 survey. Control measures for this species in other locations within the Project footprint may be required in the future, depending on its rate of spread.

The remaining invasive/non-native species were fairly common in disturbed areas surrounding the Project and may simply require revegetation to occur to decrease their numbers. Additionally, none of these species appeared to be spreading at the same rate as lamb's quarters, or appeared to be associated with hydroseeding areas to the same extent. Control recommendations for the 2016 growing season are being developed based on the fall 2015 survey results.

6.4 SUMMARY AND DISCUSSION

Non-native plants are plant species that are growing outside of their country or region of origin. Invasive plants are non-native plants that can out-compete or even replace native plants. Invasive plants are of concern because they can crowd out other plant species and, in extreme cases, adversely change vegetation composition or other ecosystem attributes. The Invasive Plant Spread and Control study determines the degree to which the Project contributes to introducing and spreading invasive and non-native plants. This study also recommends control measures where appropriate, and evaluates the effectiveness of mitigation measures.

Project footprint areas surveyed for invasive and non-native plants in 2015 included the NAR borrow areas, camp areas and work areas. The remaining footprint areas were not surveyed in 2015 due to safety concerns relating to the ongoing construction activities, or they were in the first year of clearing.

By fall 2015, 16 invasive or non-native species were found in the areas surveyed, largely within the KIP footprint. At least one invasive/non-native plant species was found in most of the areas searched, with the number of species and abundances varying by location. The distribution of invasive/non-native plants was similar to that at the end of the KIP monitoring in 2014, but the abundances of some species were higher.

The increases in the number of invasive/non-native species and their recorded locations between the spring and fall of 2015 was likely because plants were not detectable earlier in the spring as they had not germinated yet or their stems and leaves were not sufficiently developed.

The increases in the number of invasive/non-native species and their recorded locations from the last KIP survey in 2014 to fall, 2015 was attributed to several factors. First, the increased amount of construction activity and number of vehicles in the footprint from year to year likely spread these species. Second, many of these species were widespread in human disturbed areas the Keeyask region, and thus easily transported to Project areas on vehicles, footwear and other materials.

Third, it appeared that one species (lamb's quarters) may have been spread by hydroseeding done to revegetate areas for the KIP, and this may have subsequently facilitated its spread into other areas.

The five new species recorded in 2015 were smooth catchfly, Canada thistle, pineappleweed, wormwood and scentless chamomile.

Scentless chamomile was the only invasive/non-native plant species recorded in 2015 for which the Invasive Species Council of Manitoba (ISCM) recommends rapid response. One single scentless chamomile plant was identified within the start-up camp well road ROW. After its discovery, it was recommended that the plant be carefully removed and disposed of. On September 5, 2015, the Manitoba Hydro field staff removed and disposed the plant and soil material.

Of the remaining invasive/non-native plant species recorded in 2015, Canada thistle, white sweet clover, yellow sweet clover, perennial sow thistle, lamb's quarters, smooth catchfly and common dandelion were ranked as species of some concern in Manitoba and/or Canada (the remaining species were non-native). For Manitoba, three of these were considered to be moderately invasive and six were listed as noxious weeds (Canada thistle and scentless chamomile are on both lists). It was recommended that the Canada thistle plants identified during the fall 2015 surveys be removed when they emerge in the spring.

Lamb's quarters tended to be more abundant in areas that appeared to have been hydroseeded prior to the 2014 field surveys. This possibility is being investigated and, if determined likely to have occurred, recommendations will be developed to prevent future occurrences.

Many of the invasive/non-native species recorded in the Project footprint are commonly found in disturbed areas throughout the Province (*e.g.*, dandelion, sweet clover), particularly along roadsides, making it difficult to prevent vehicles and people from inadvertently spreading these species into the Project footprint. Based on surveys conducted prior to the KIP construction, it was likely that at least three invasive species were already well established in the start-up camp area when the KIP construction began.

Control recommendations for 2016 growing season are being developed based on the 2015 monitoring results. An example of a potential measure is training site staff to recognize the invasive species occurring in the area so they can initiate hand pulling where a species is seen establishing in a new construction area. Ultimately, revegetation through the Project's Vegetation Rehabilitation Plan is intended to dramatically reduce the distributions and abundances of the invasive species observed to date.

6.5 NEXT STEPS

Control recommendations for the 2016 growing season are being developed based on the fall 2015 survey results. Invasive plant monitoring will continue in 2016. No major changes to field methods are anticipated.

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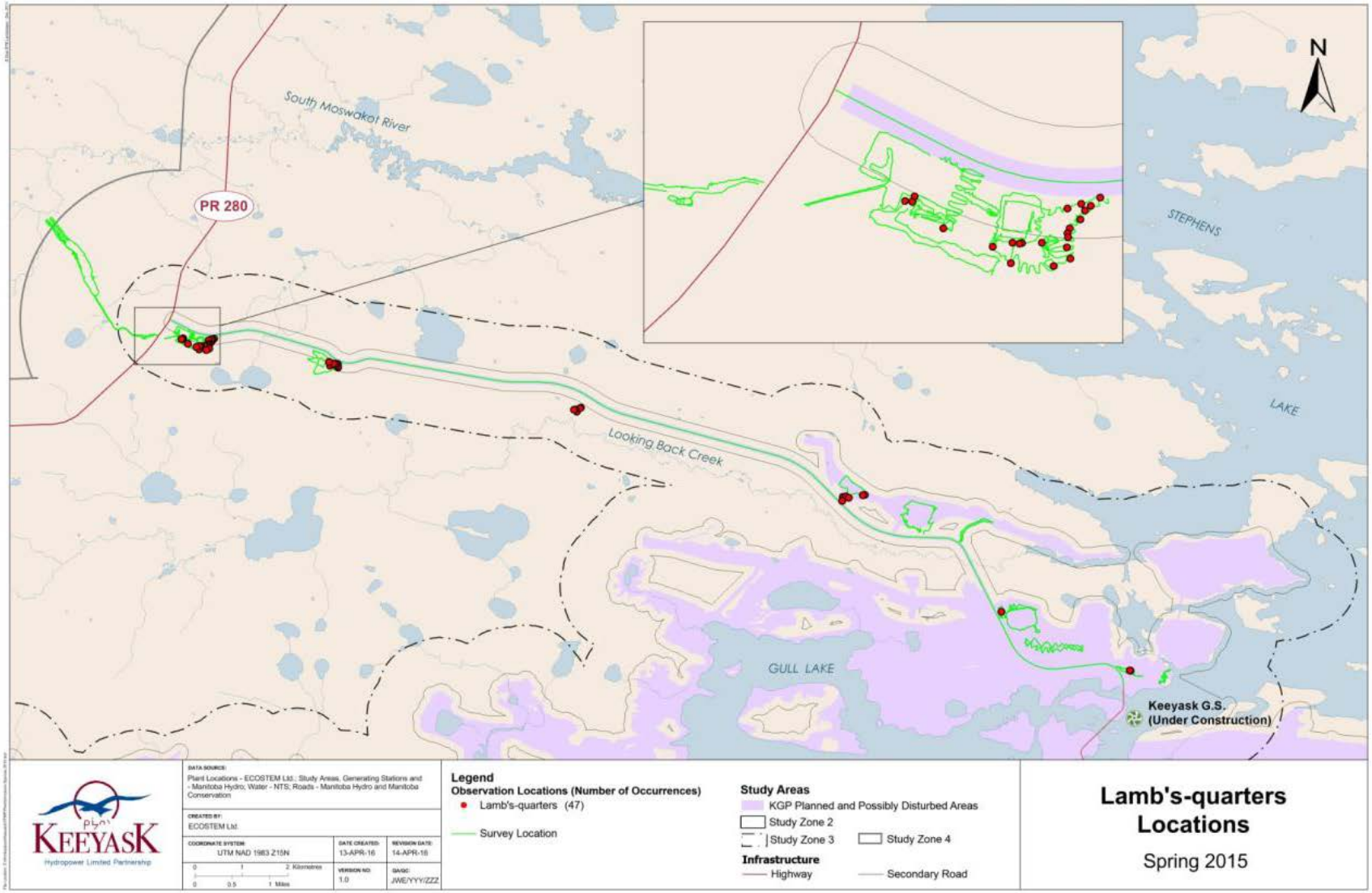
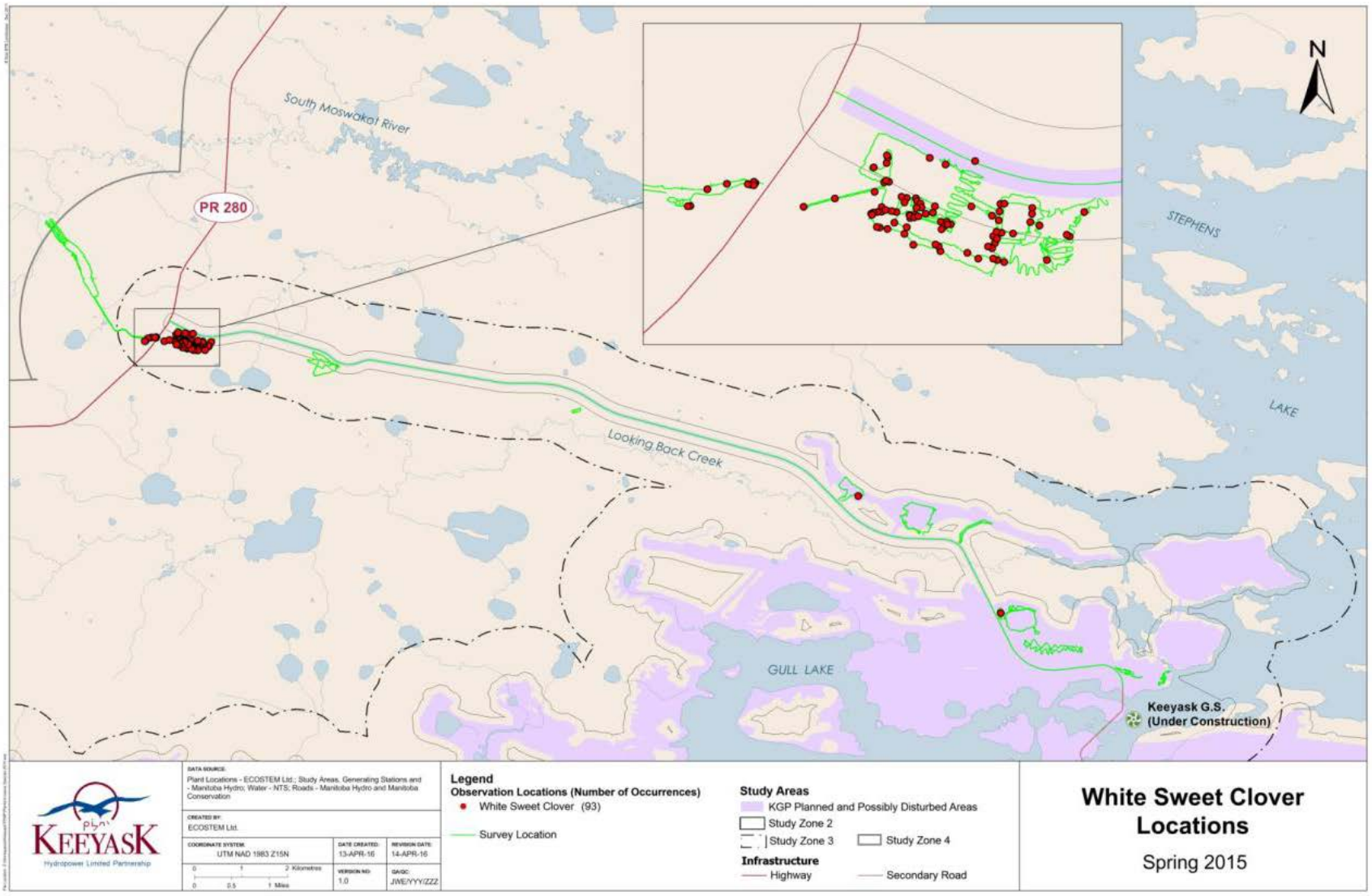
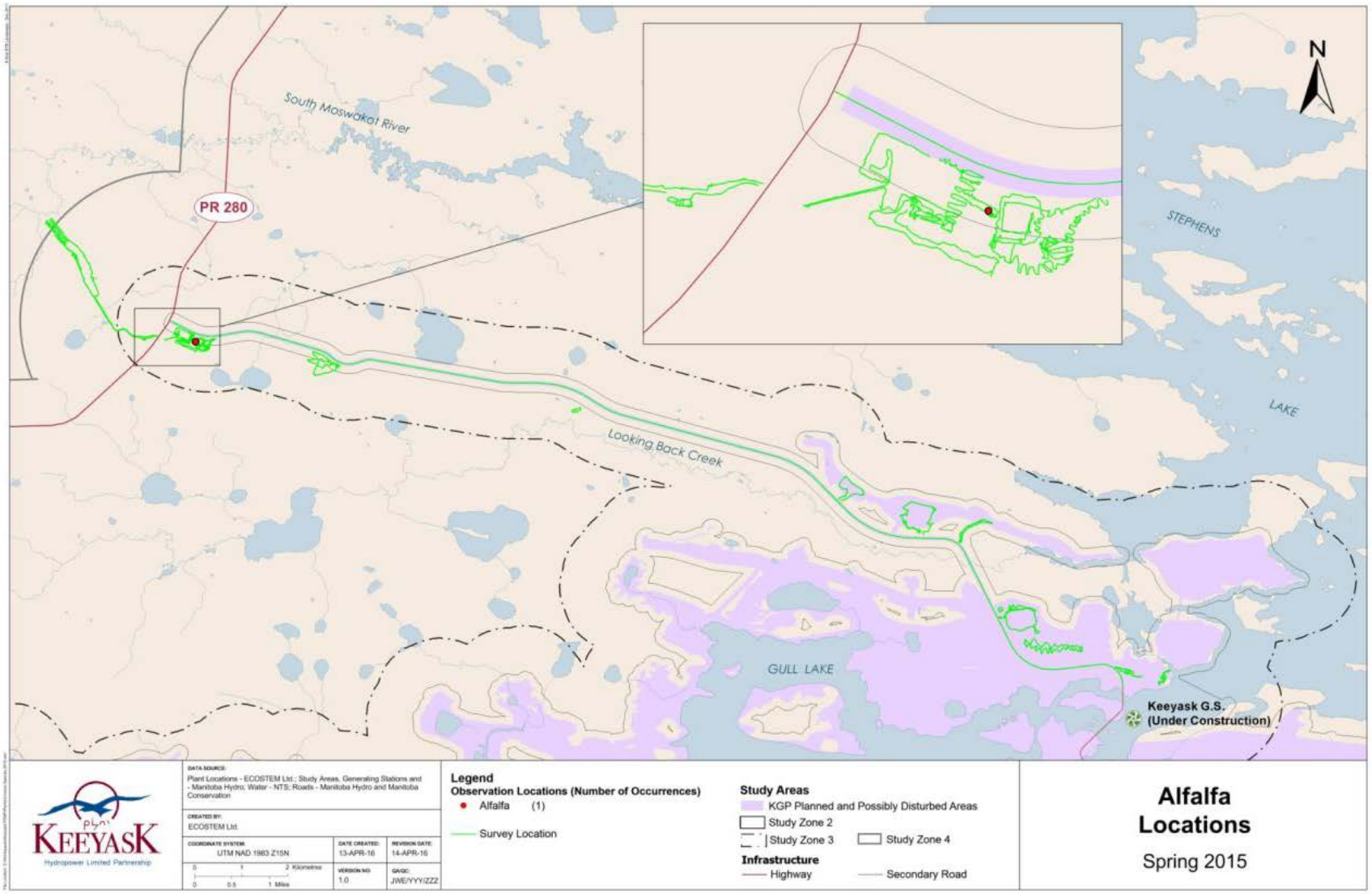
Appendix 1A:
Individual Invasive Species Maps



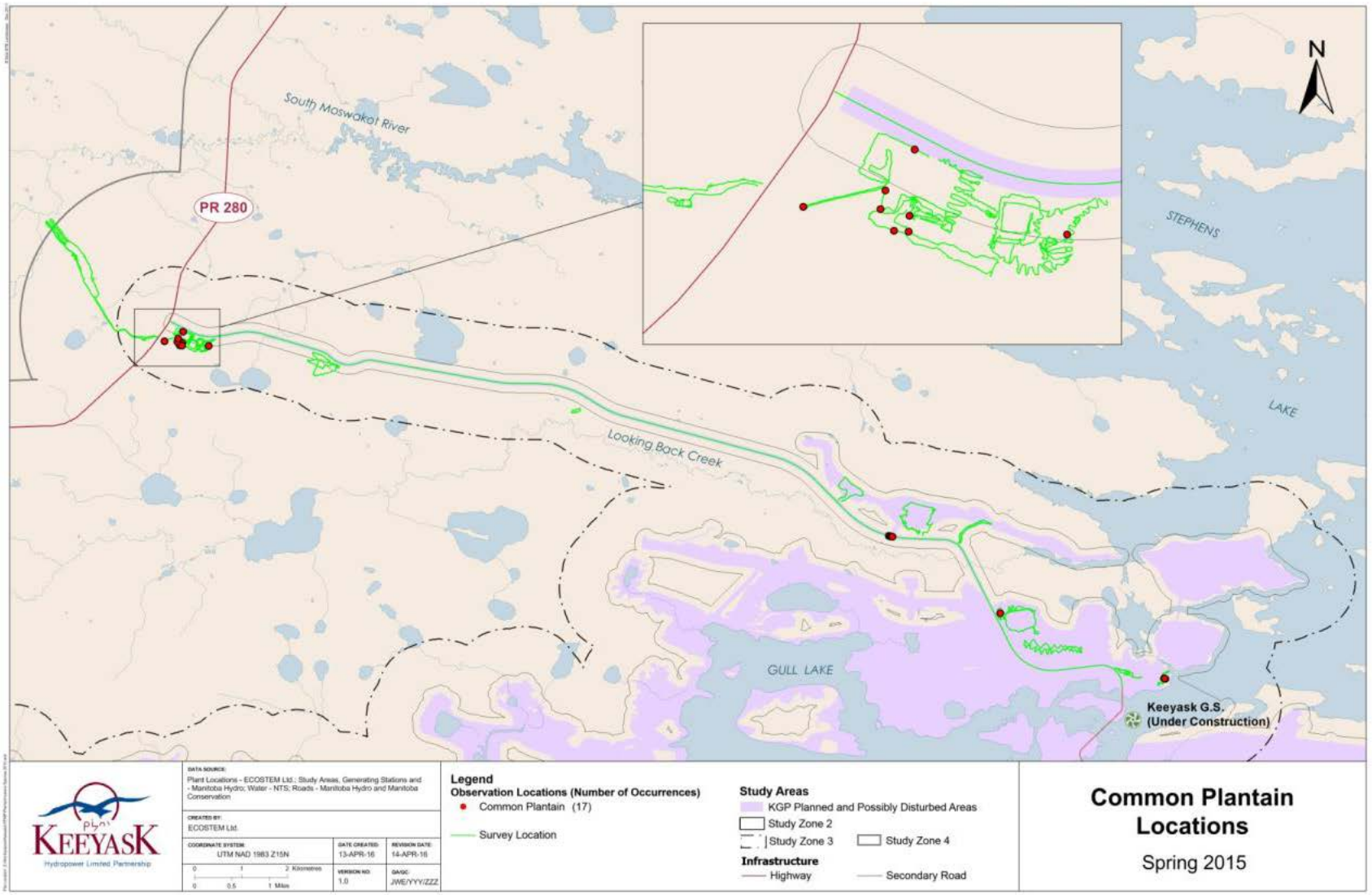
Map 1A-1: Lamb's quarters locations observed in spring 2015



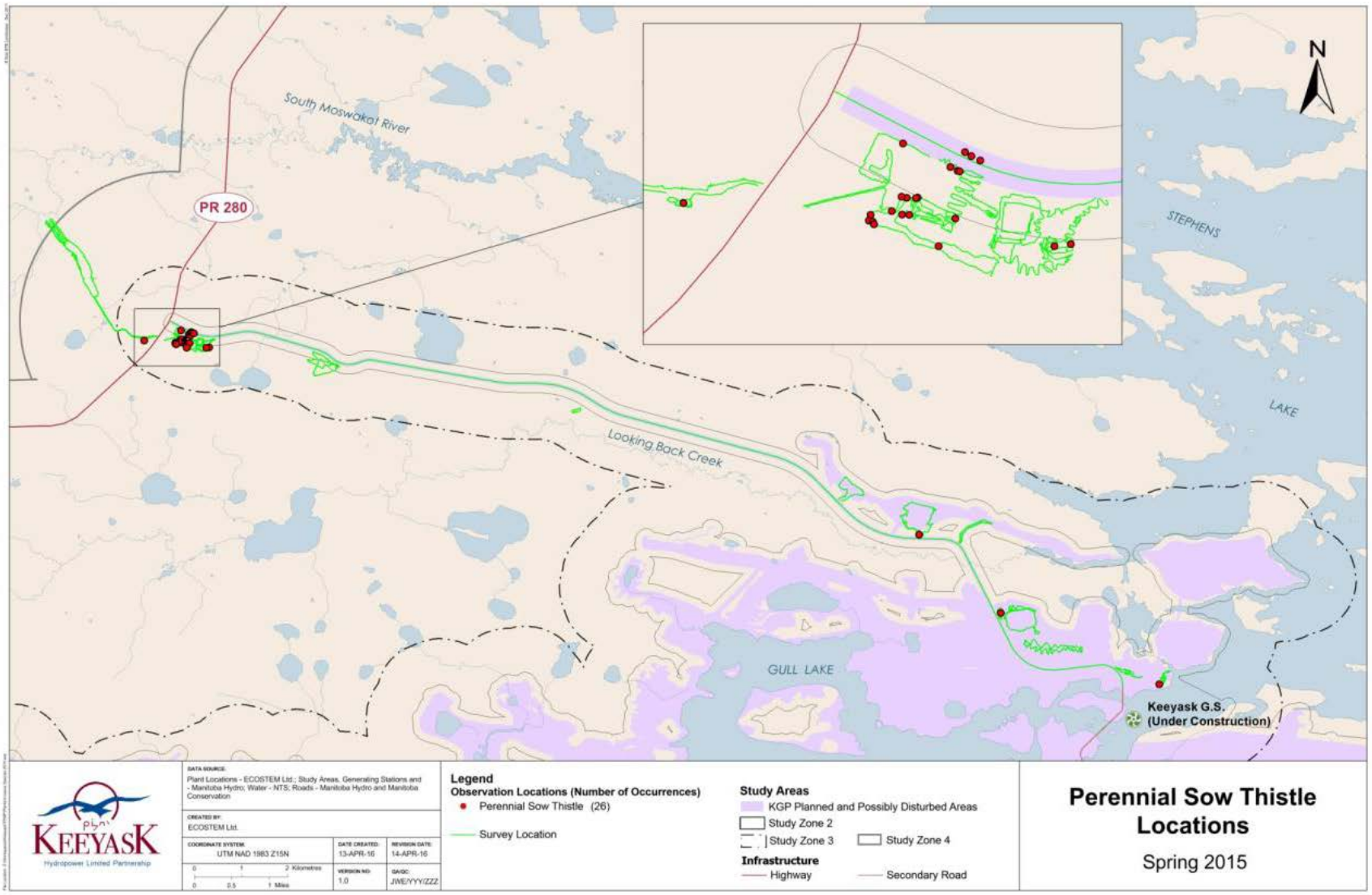
Map 1A-2: White sweet clover locations observed in spring 2015



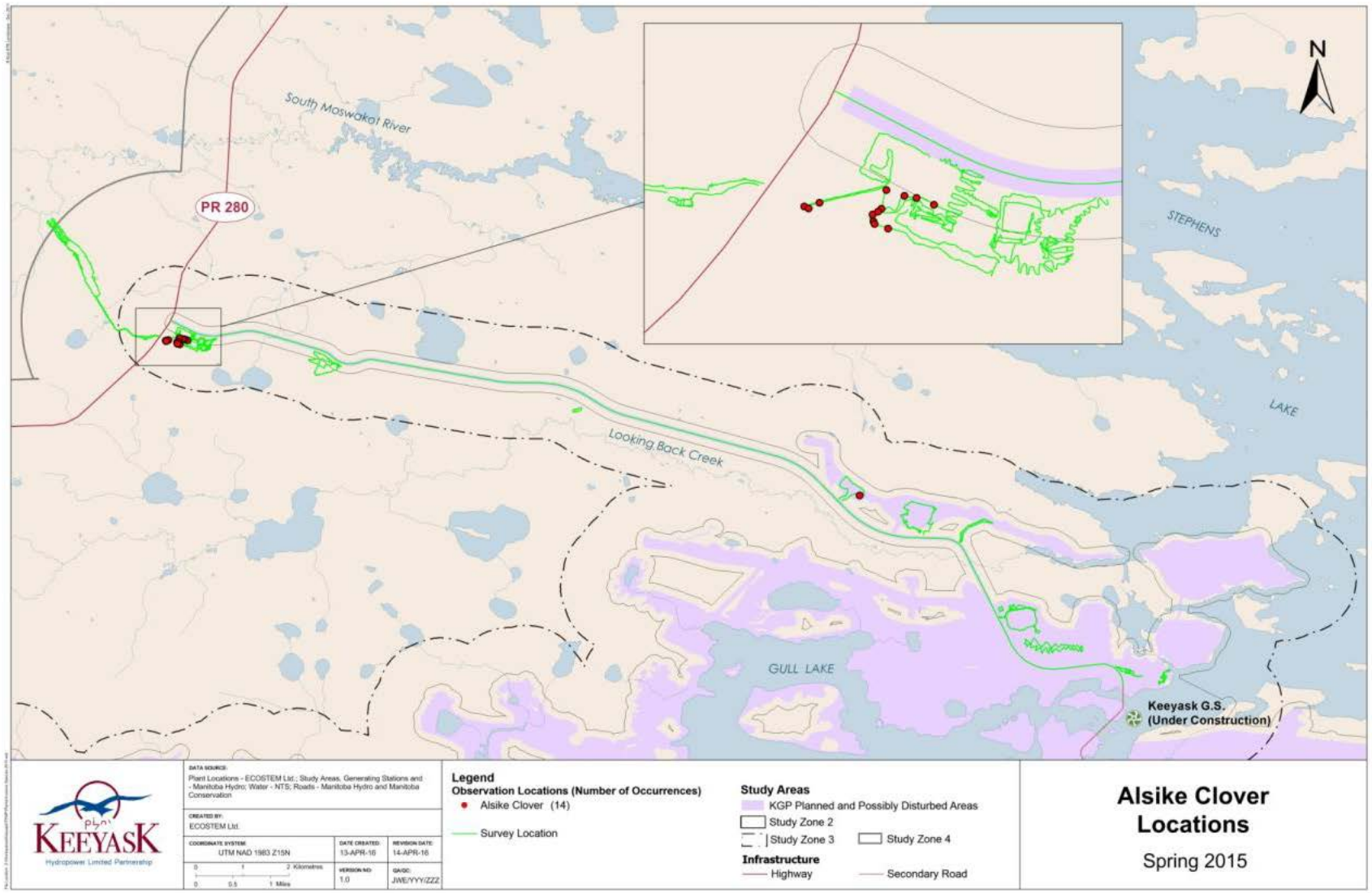
Map 1A-3: Alfalfa locations observed in spring 2015



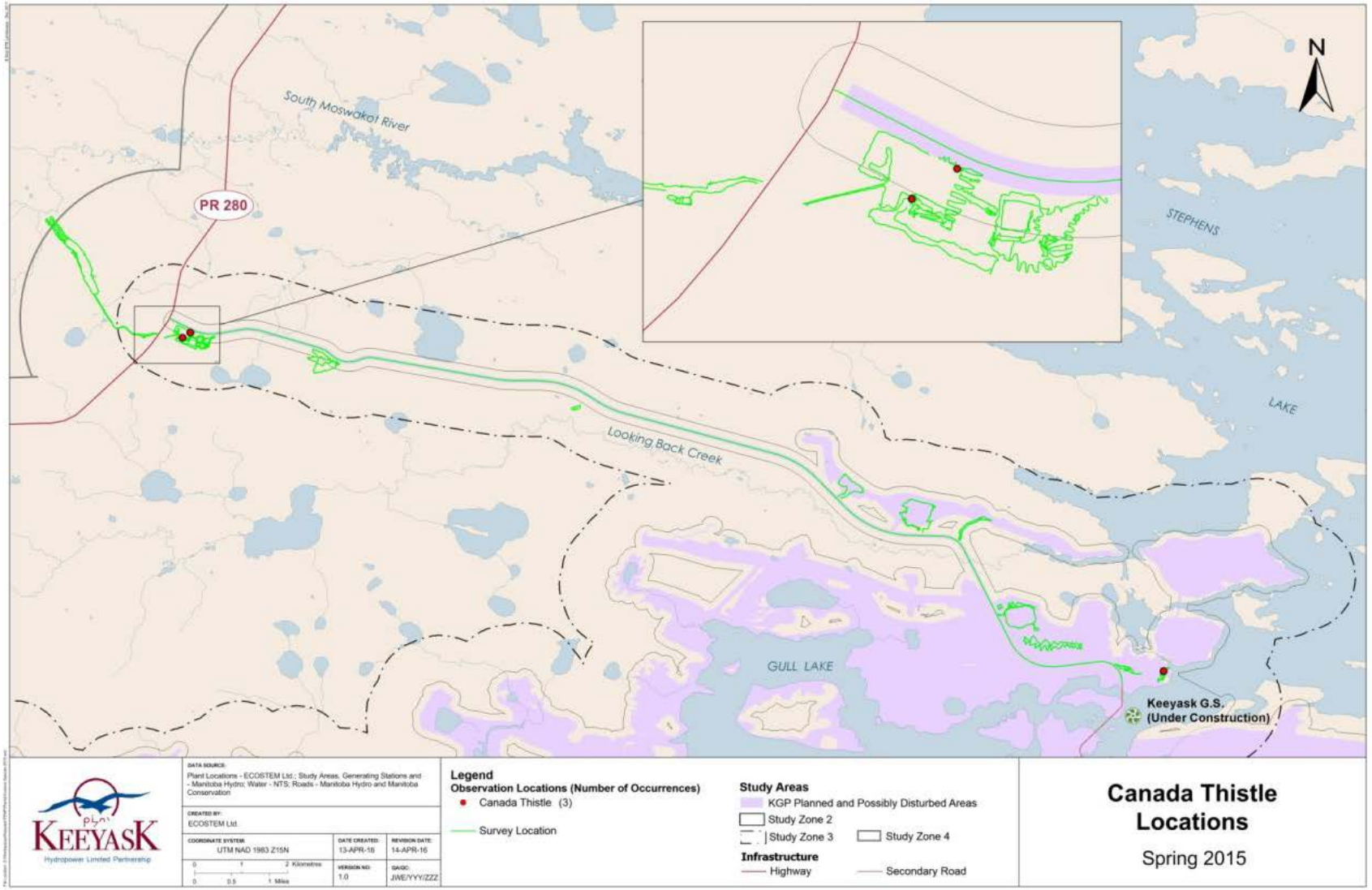
Map 1A-4: Common plantain locations observed in spring 2015



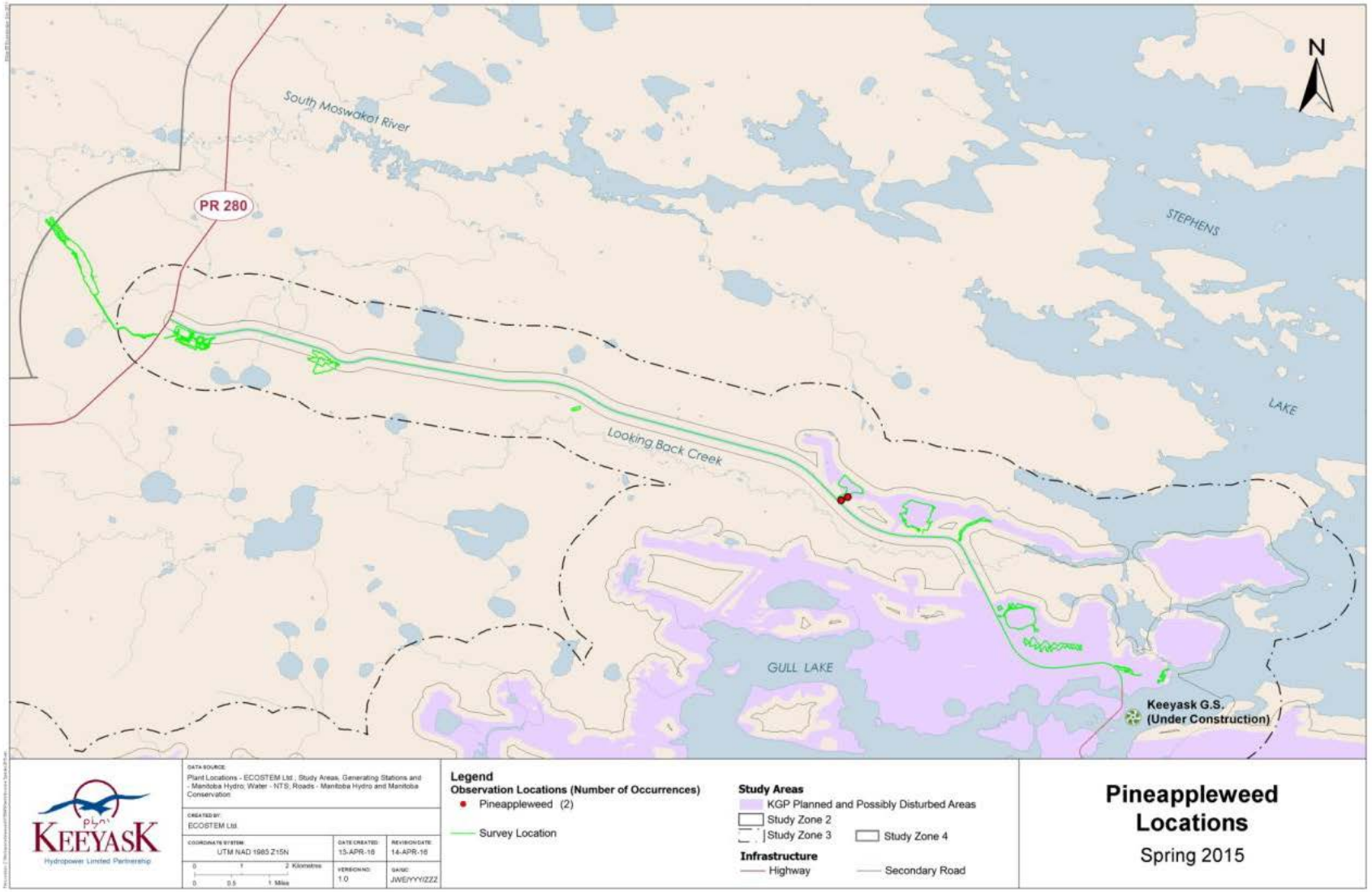
Map 1A-5: Perennial sow thistle locations observed in spring 2015



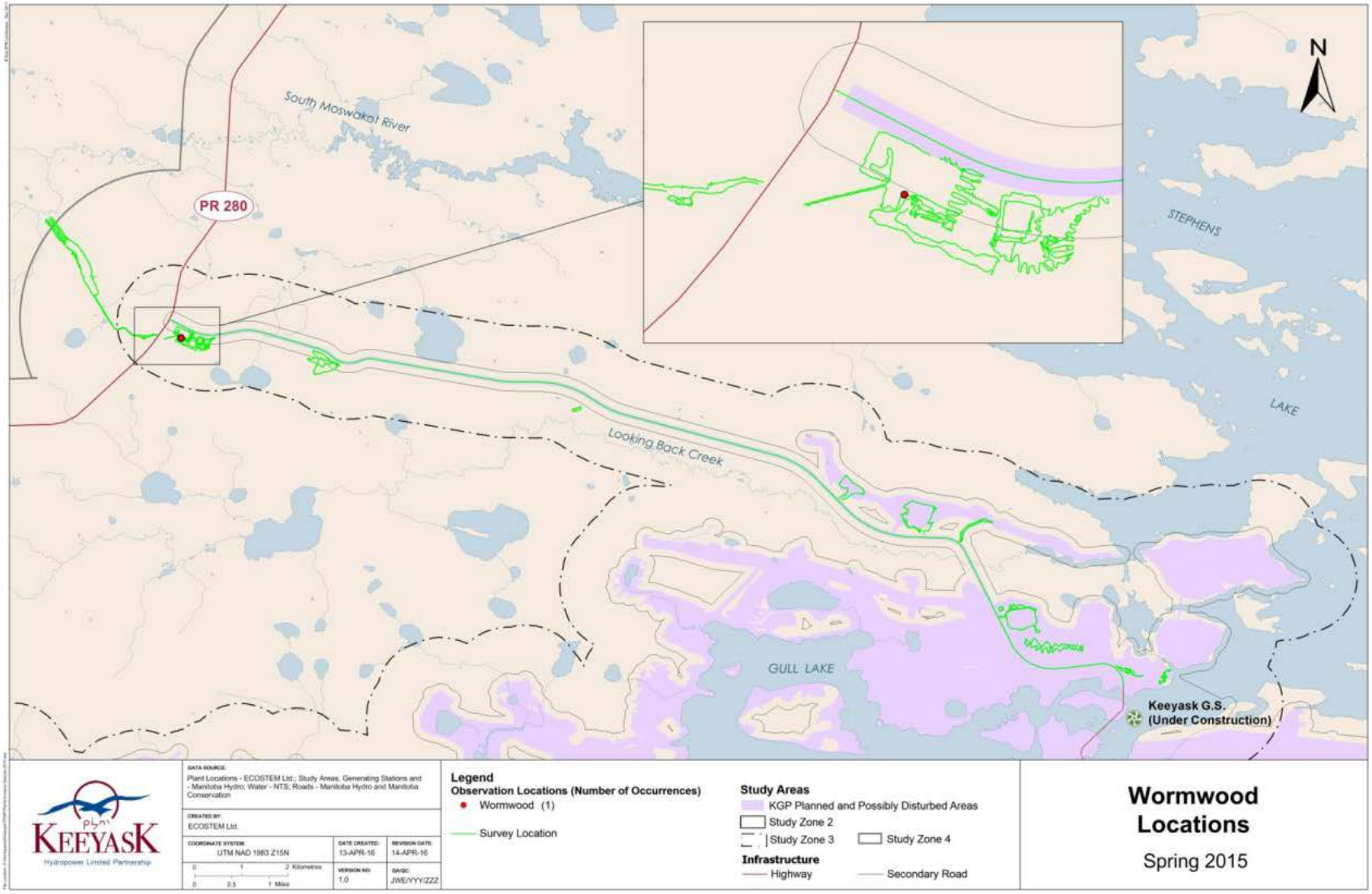
Map 1A-6: Alsike clover locations observed in spring 2015



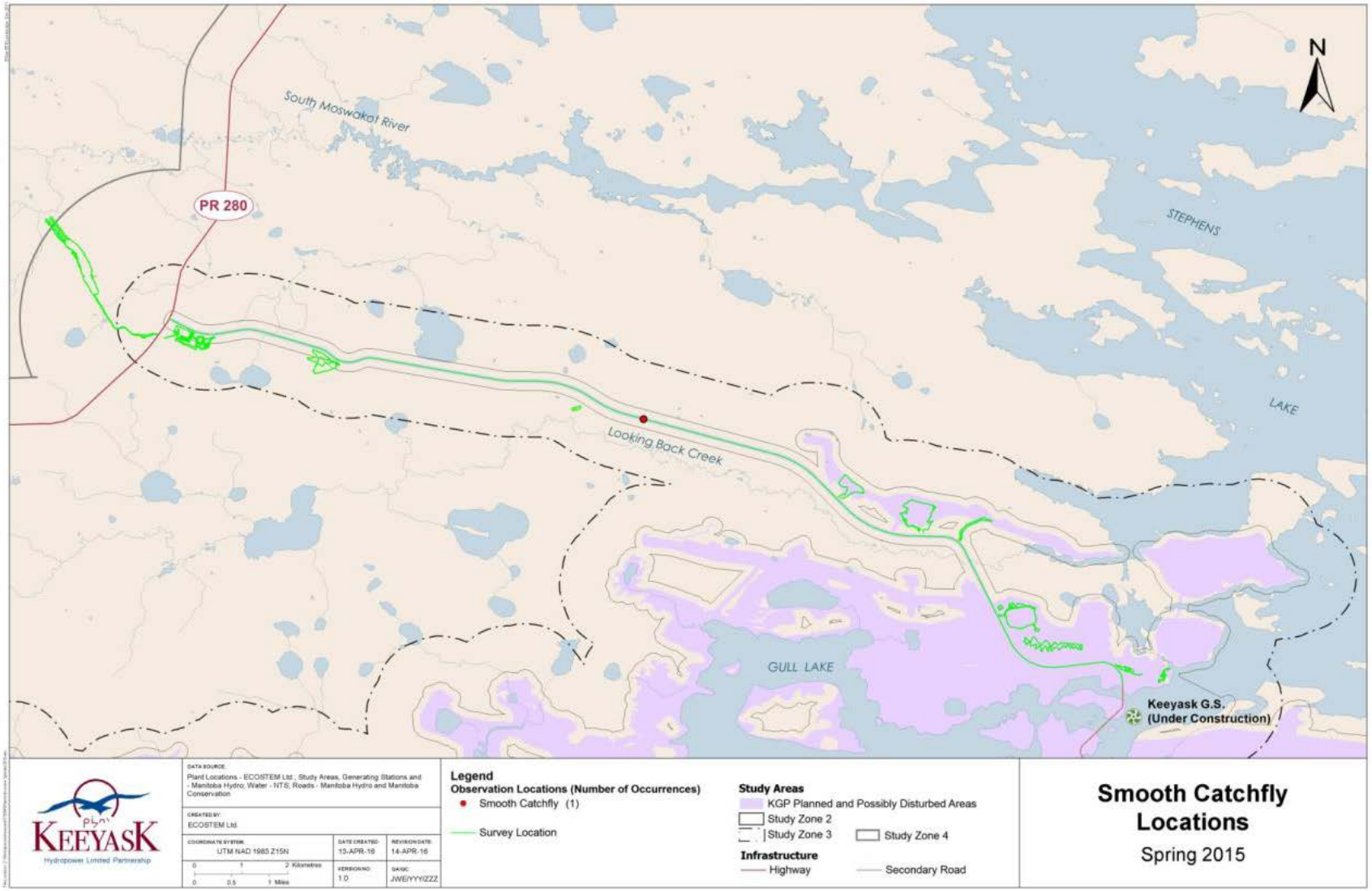
Map 1A-7: Canada thistle locations observed in spring 2015



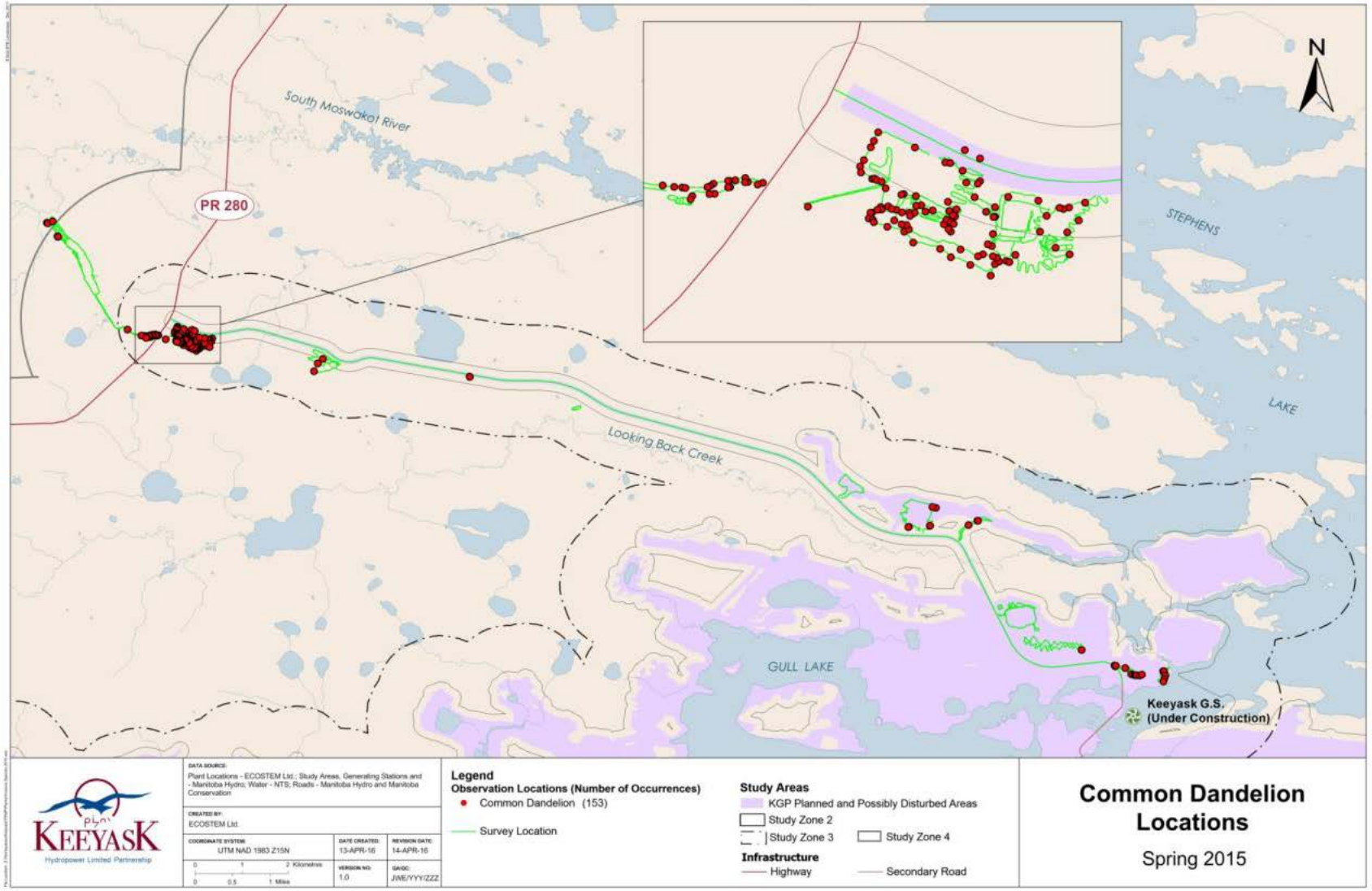
Map 1A-8: Pineappleweed locations observed in spring 2015



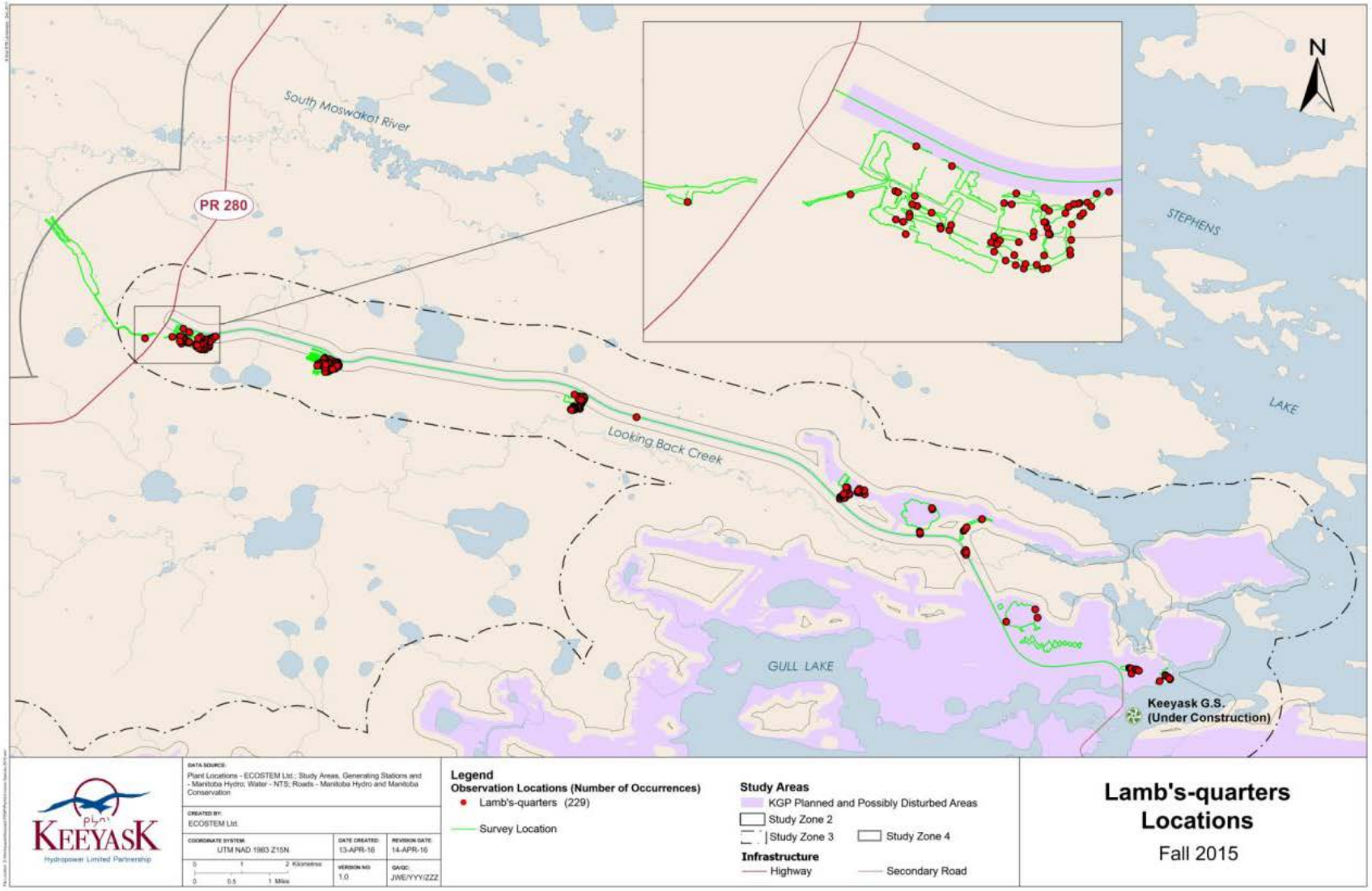
Map 1A-9: Wormwood locations observed in spring 2015



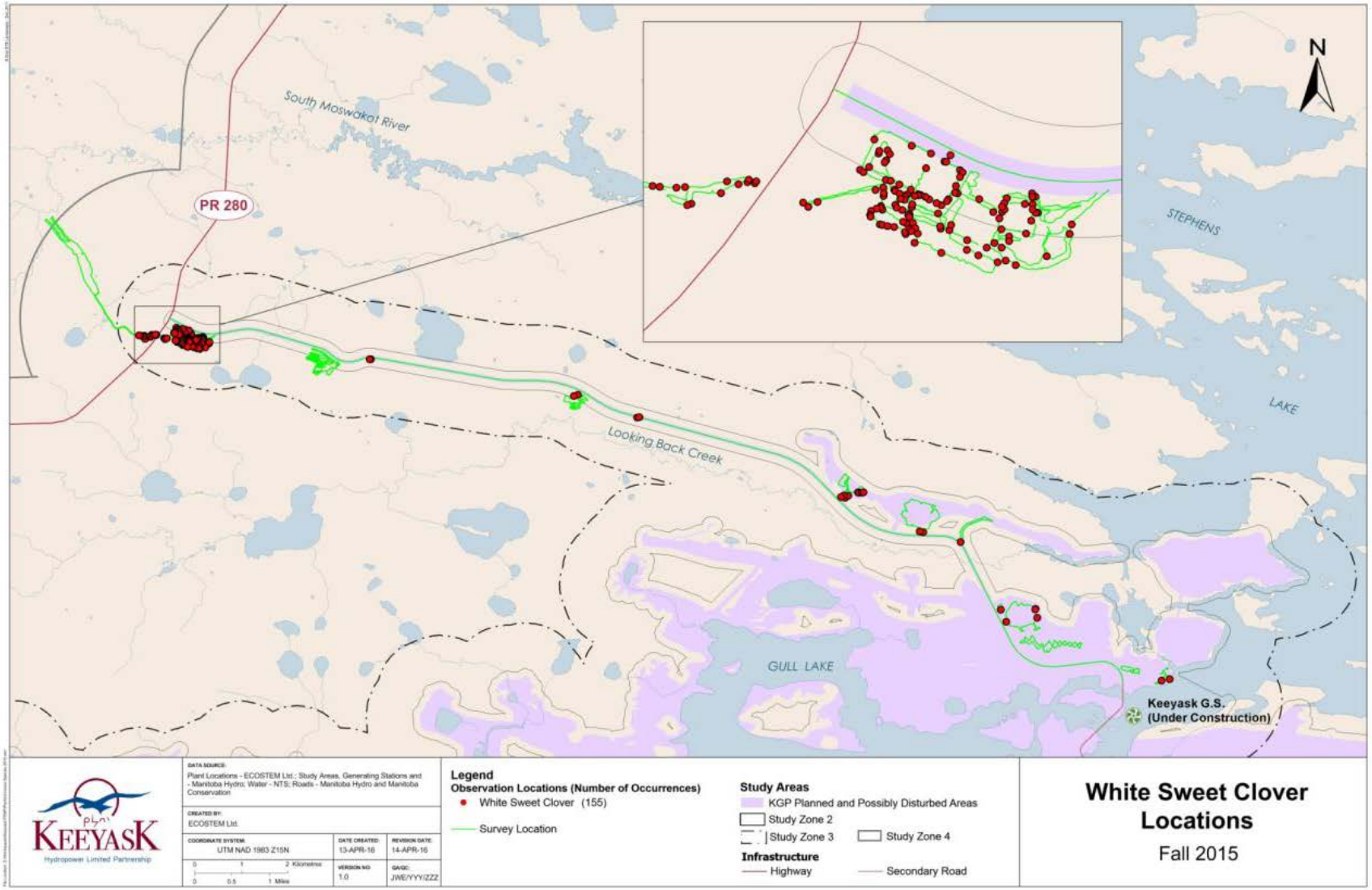
Map 1A-10: Smooth catchfly locations observed in spring 2015



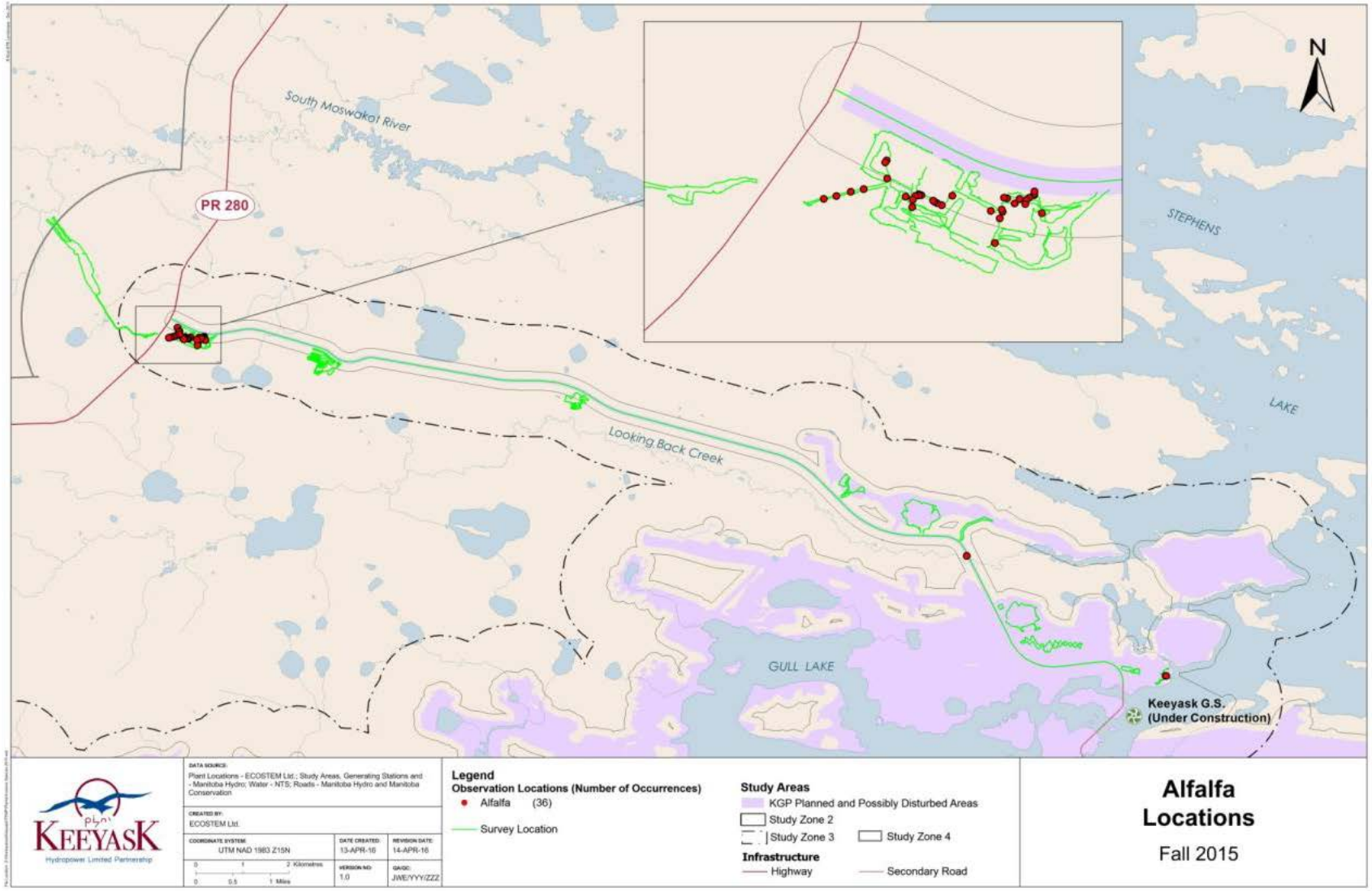
Map 1A-11: Common dandelion locations observed in spring 2015



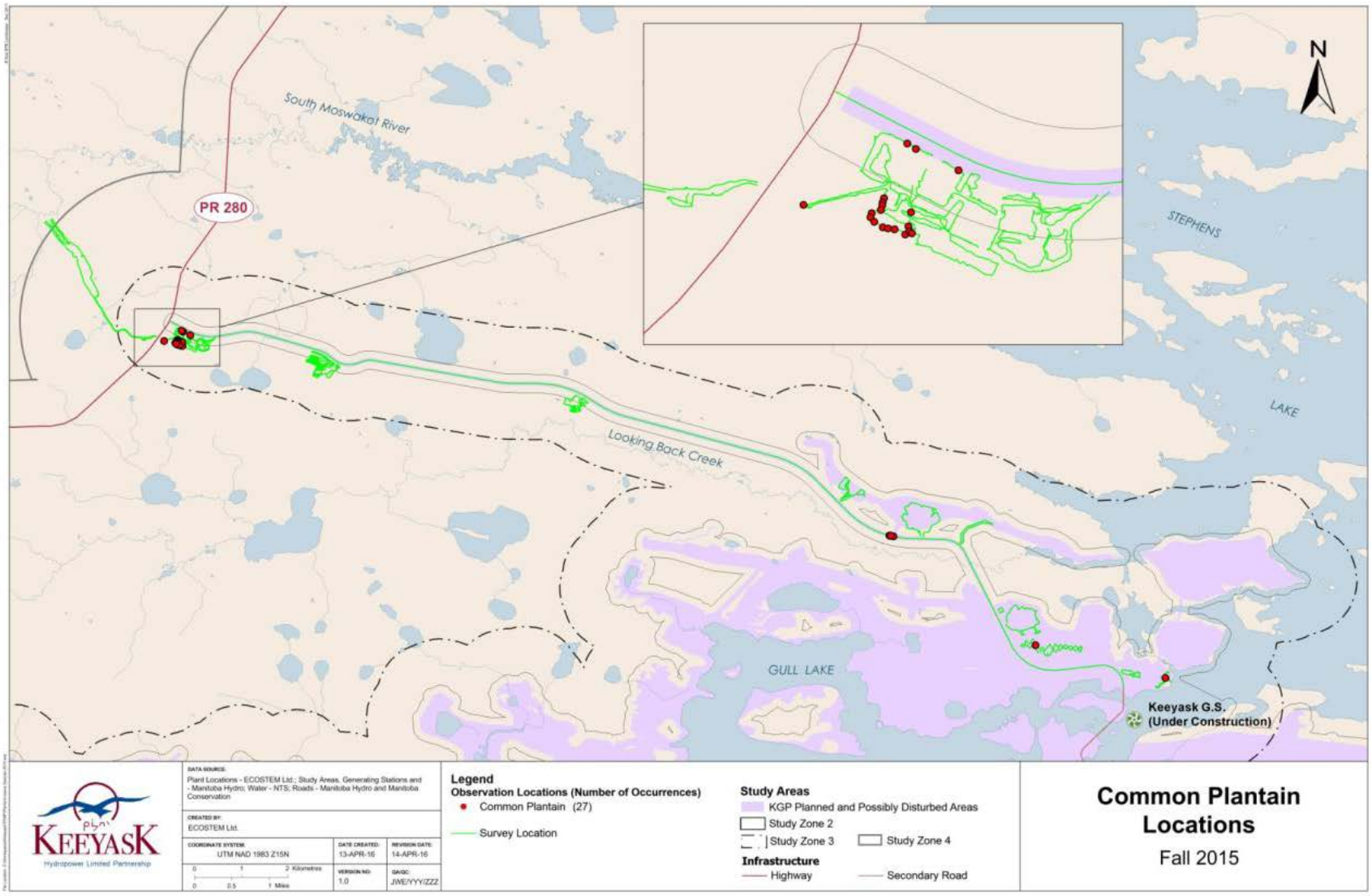
Map 1A-12: Lamb's quarters locations observed in fall 2015



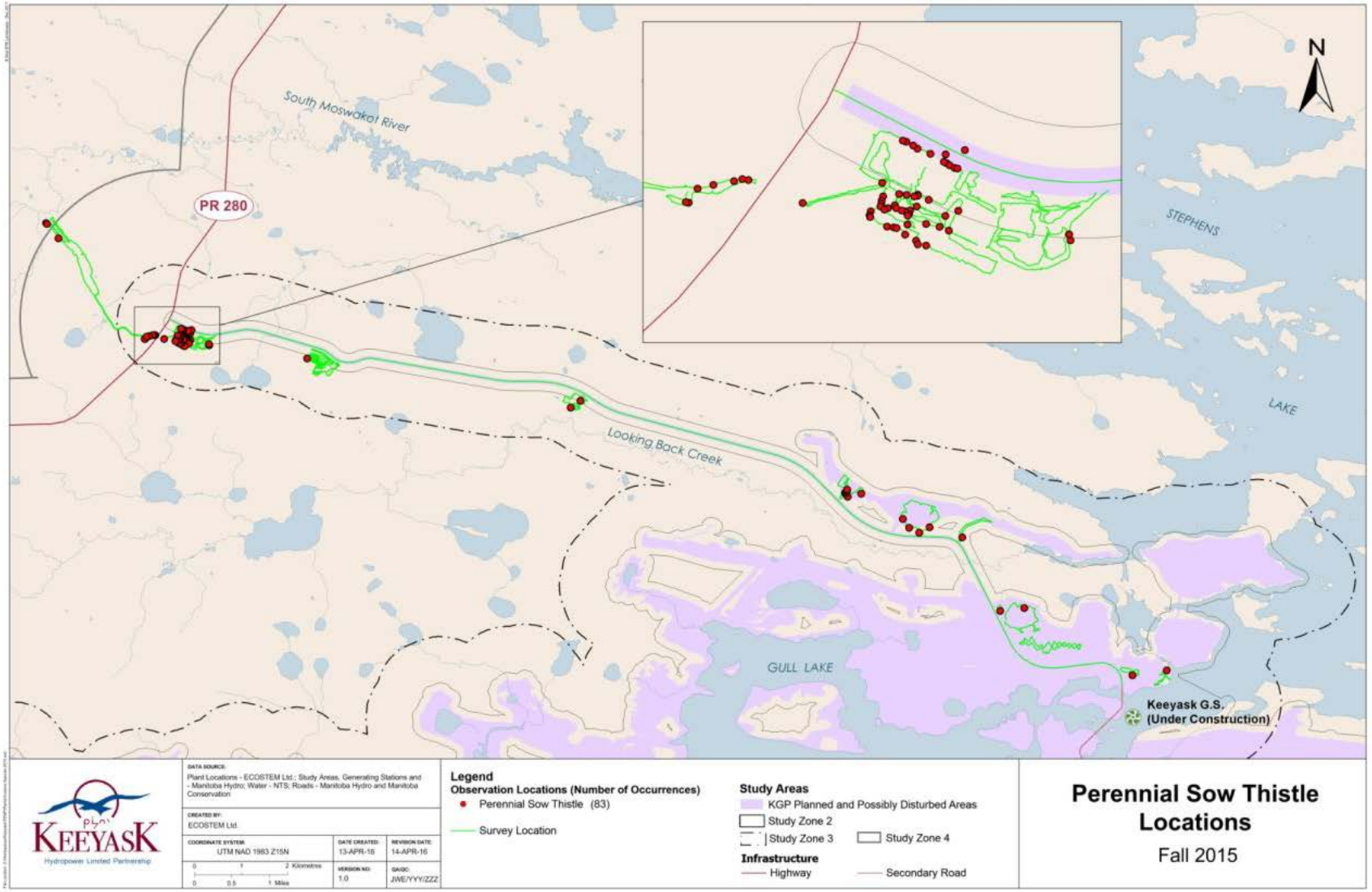
Map 1A-13: White sweet clover locations observed in fall 2015



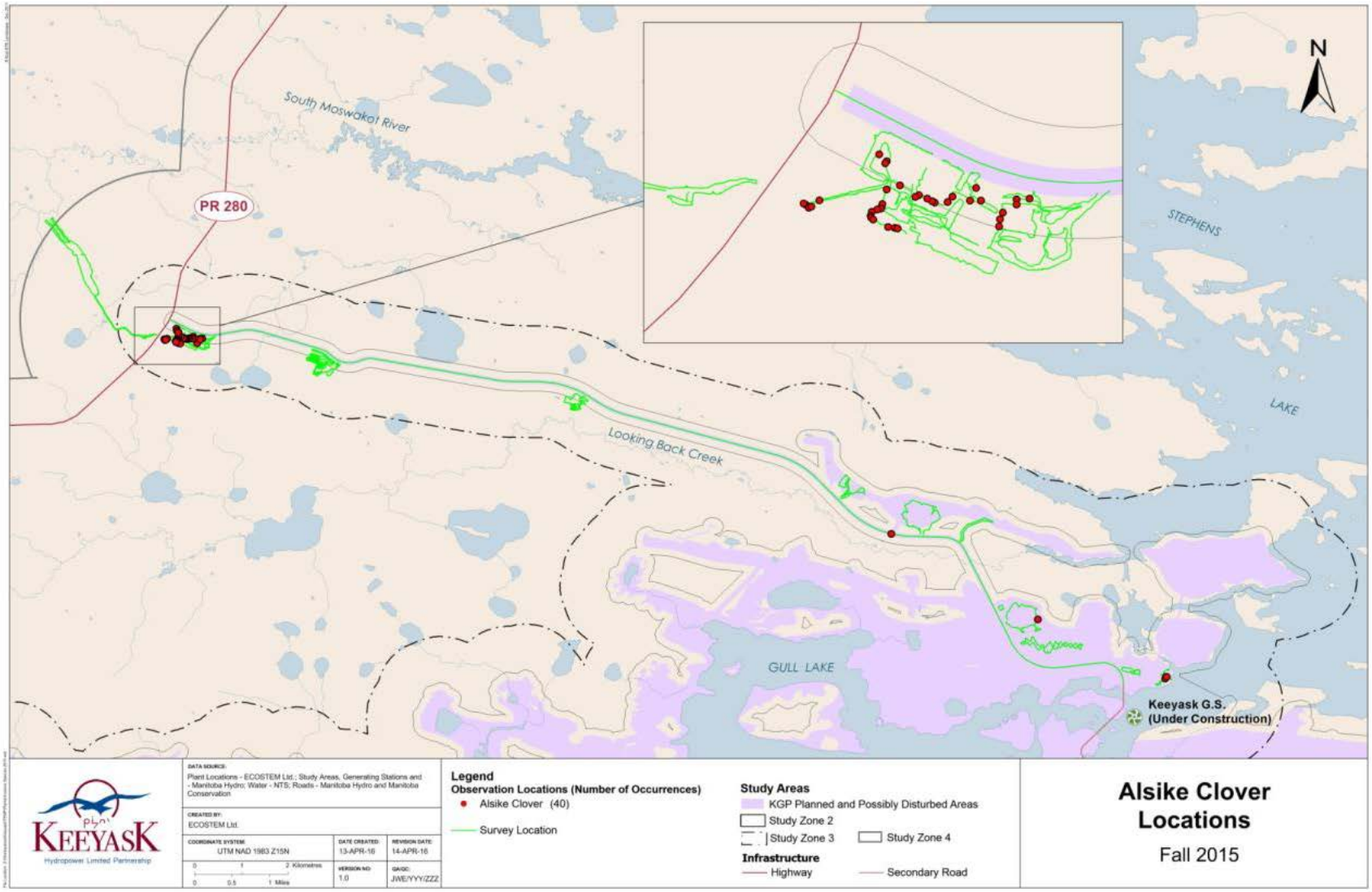
Map 1A-14: Alfalfa locations observed in fall 2015



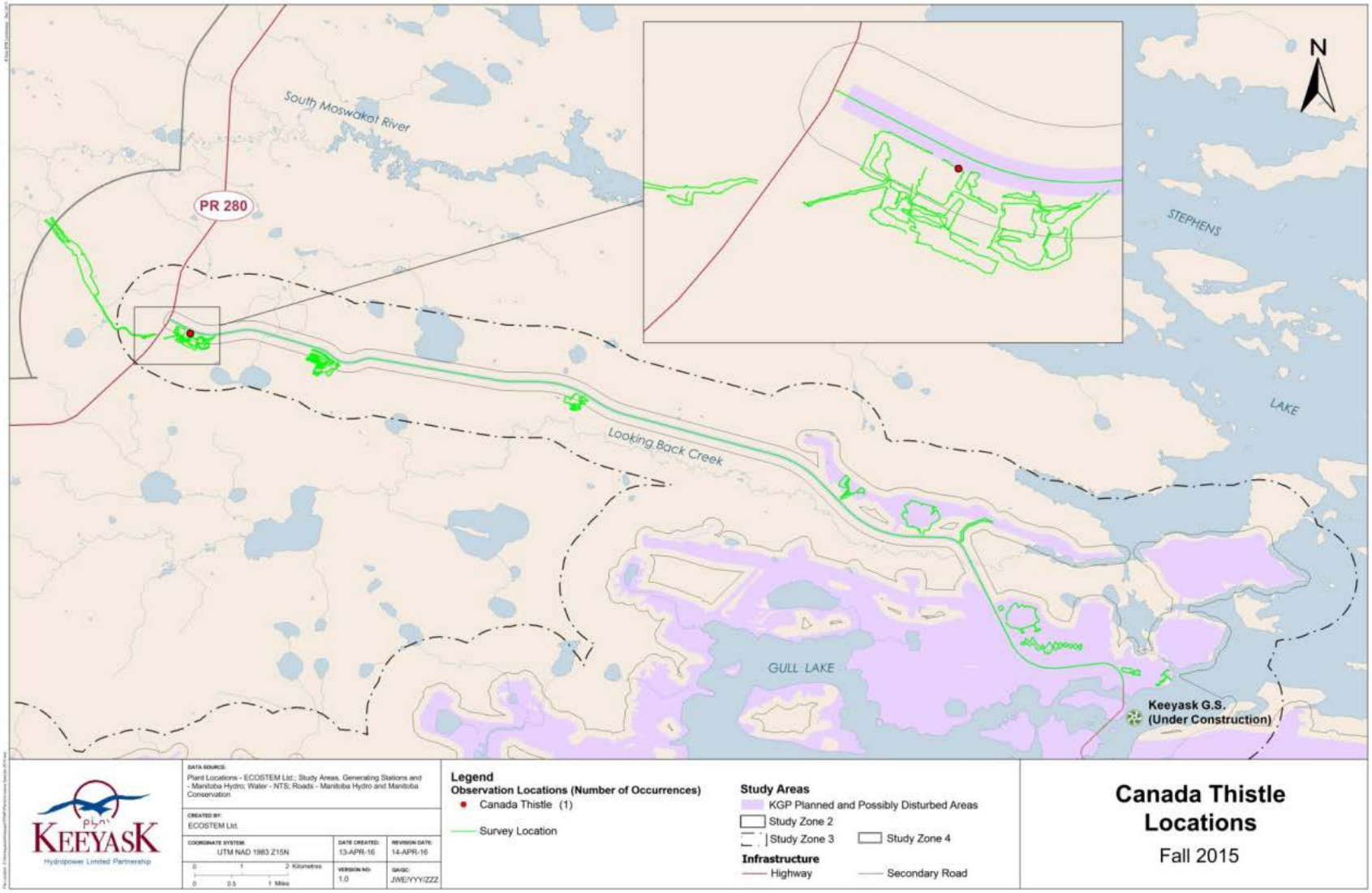
Map 1A-15: Common plantain locations observed in fall 2015



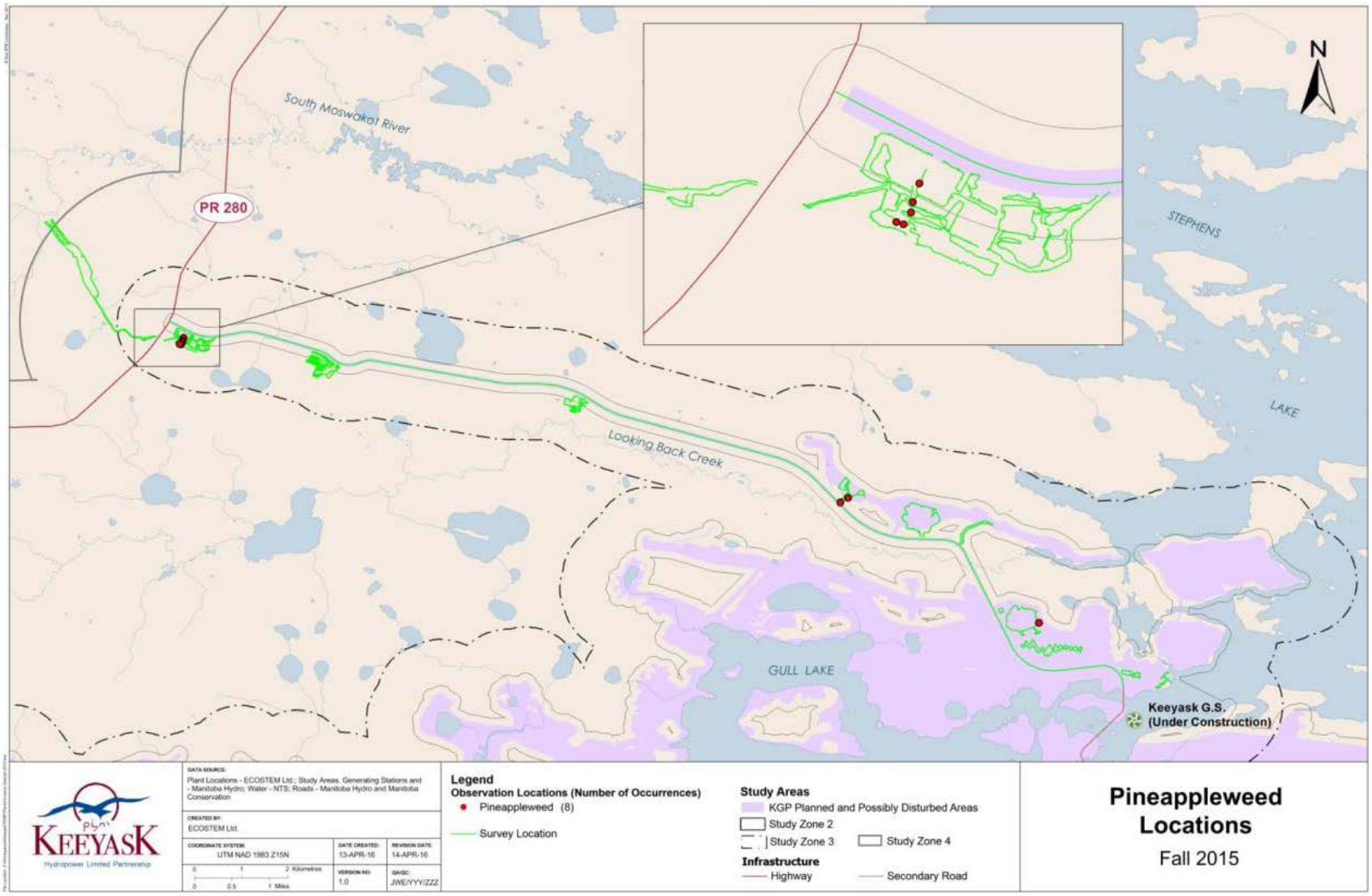
Map 1A-16: Perennial sow thistle locations observed in fall 2015



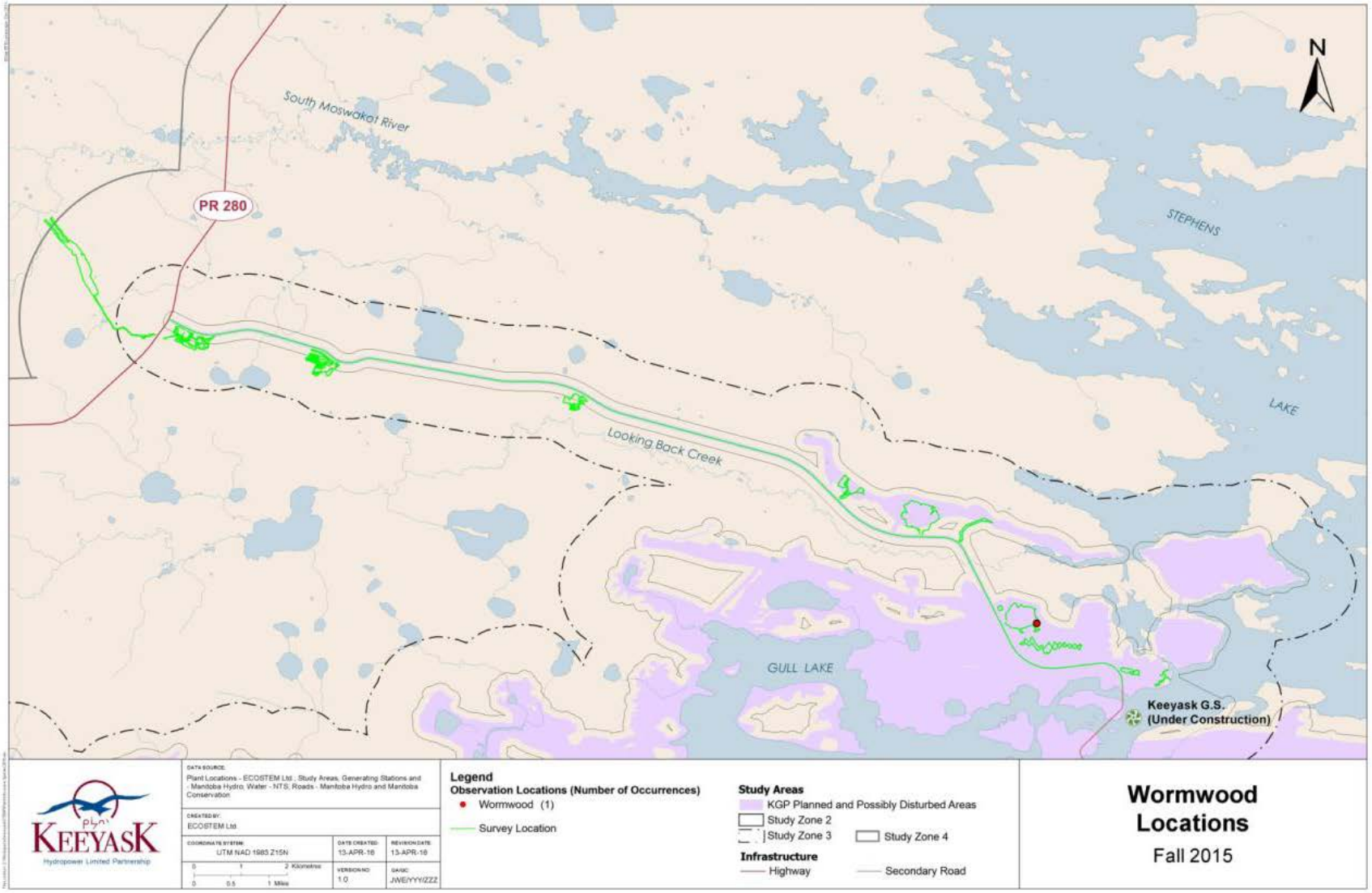
Map 1A-17: Alsike clover locations observed in fall 2015



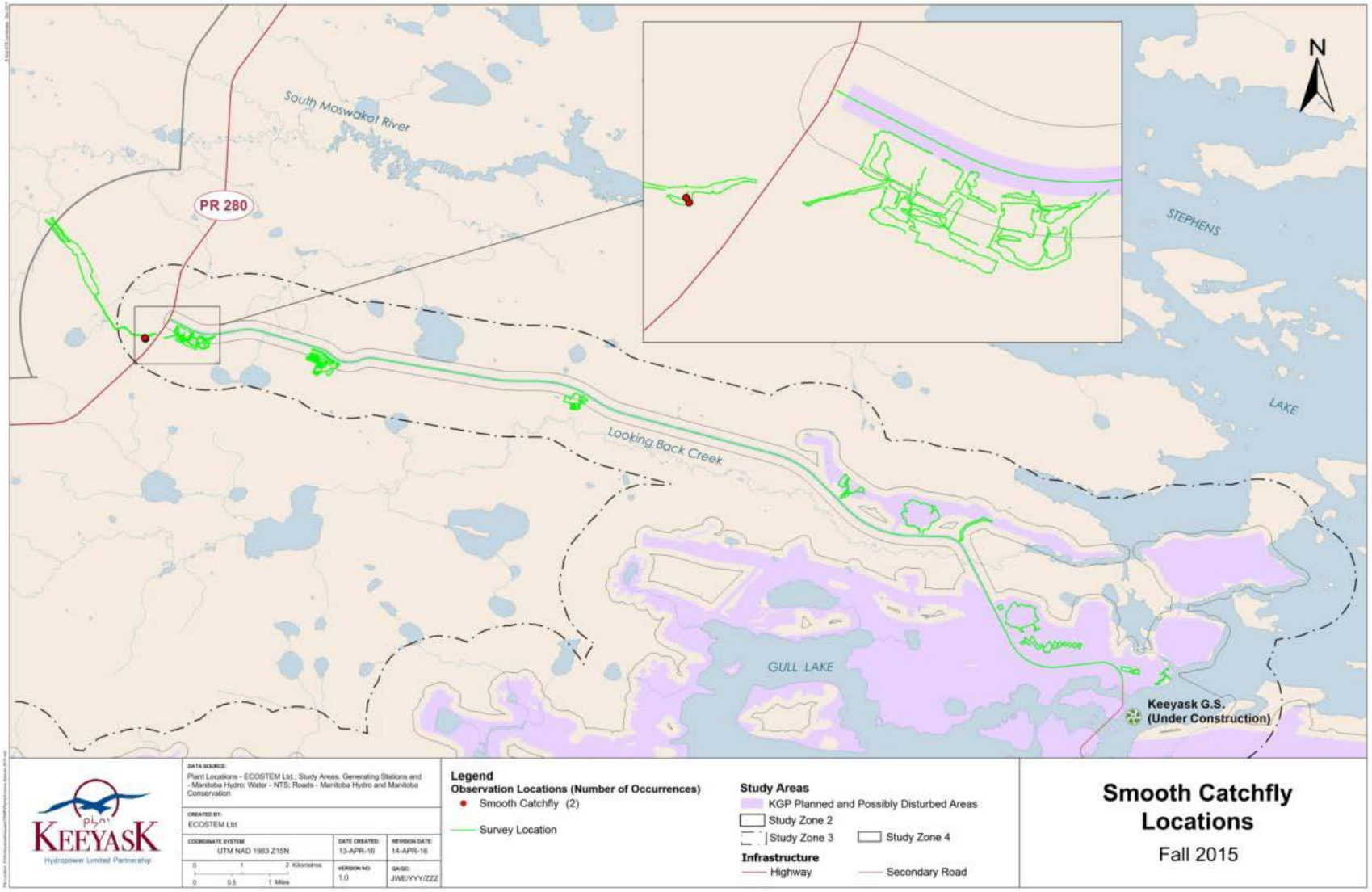
Map 1A-18: Canada thistle locations observed in fall 2015



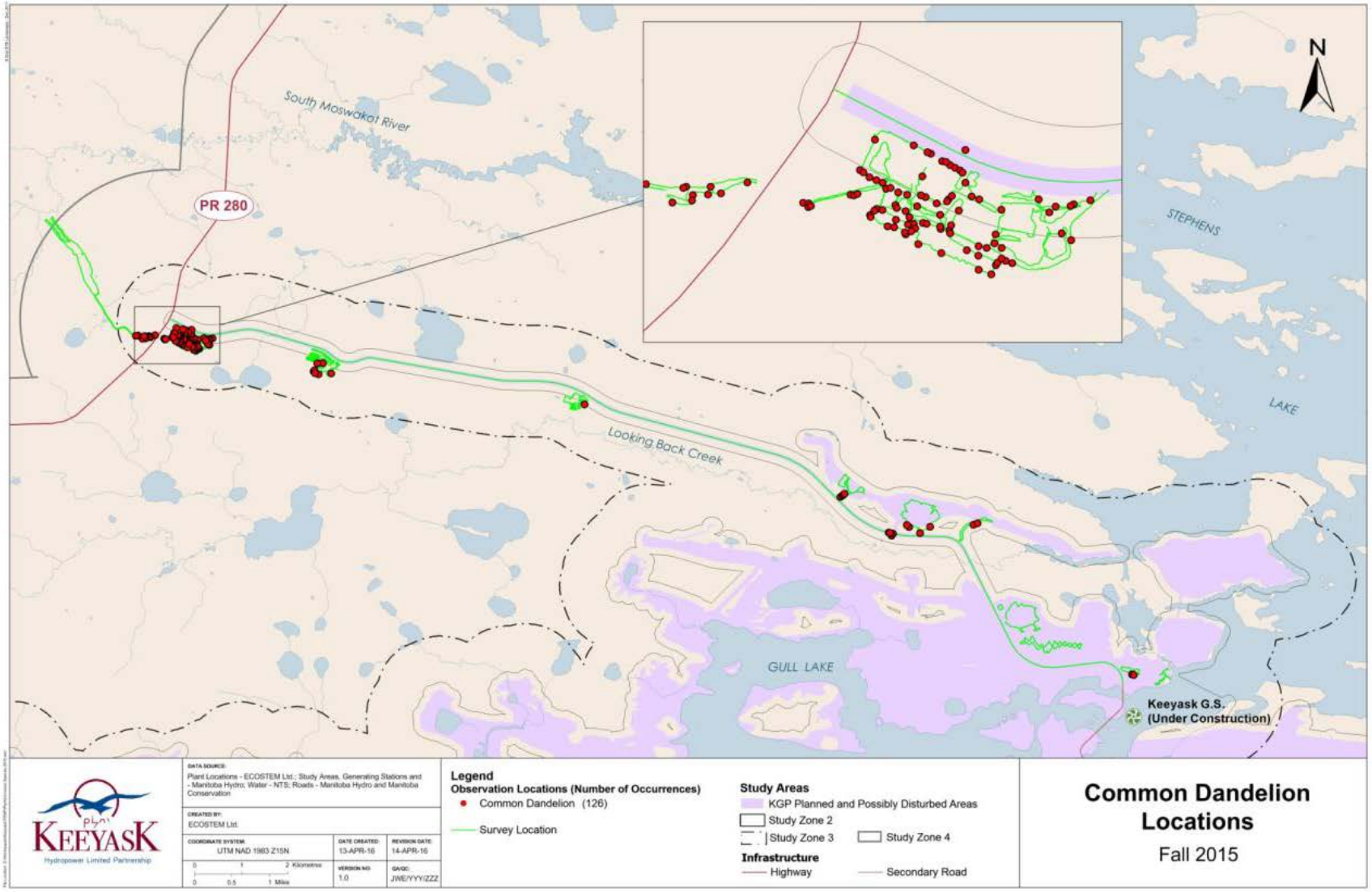
Map 1A-19: Pineappleweed locations observed in fall 2015



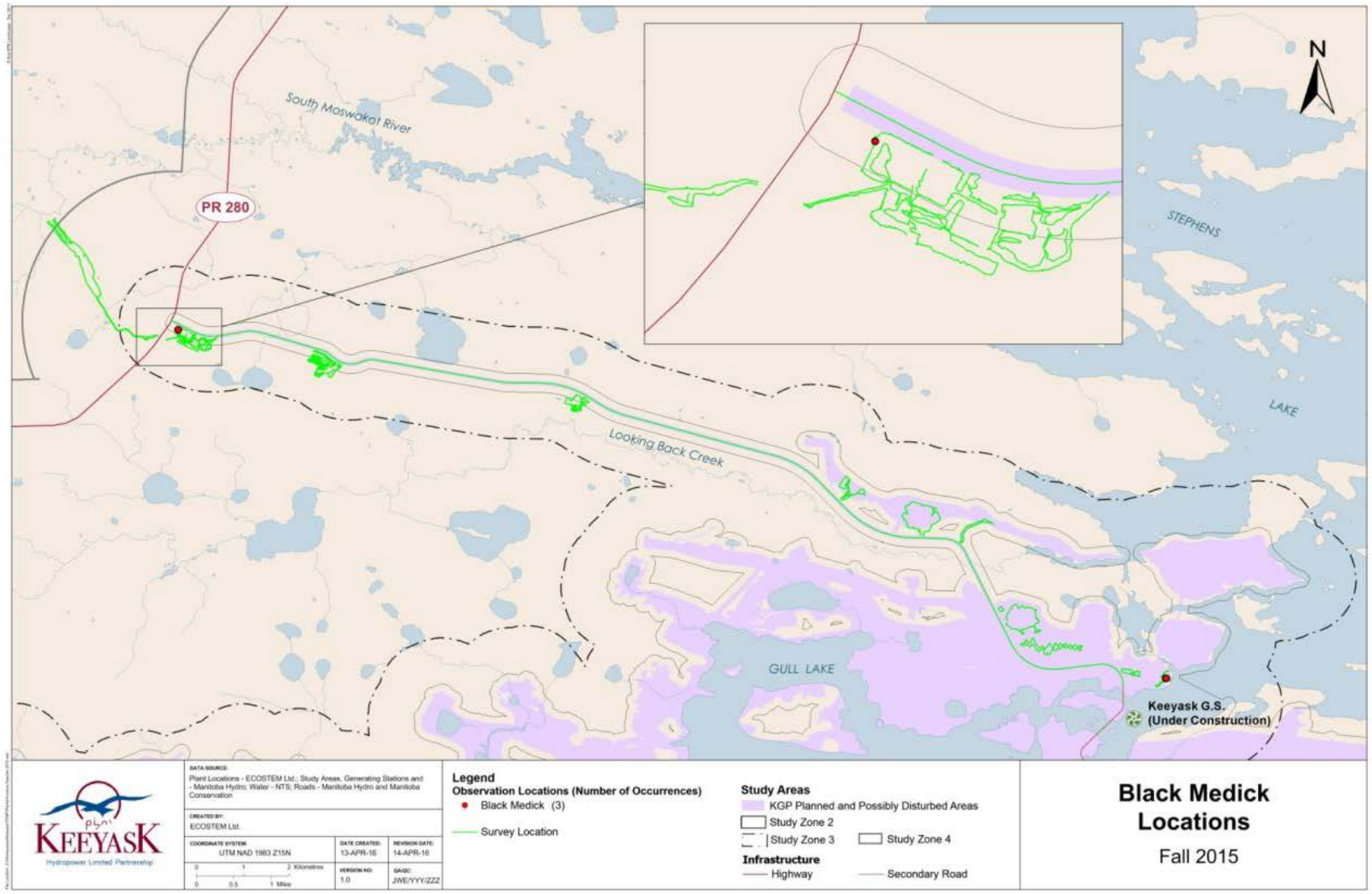
Map 1A-20: Wormwood locations observed in fall 2015



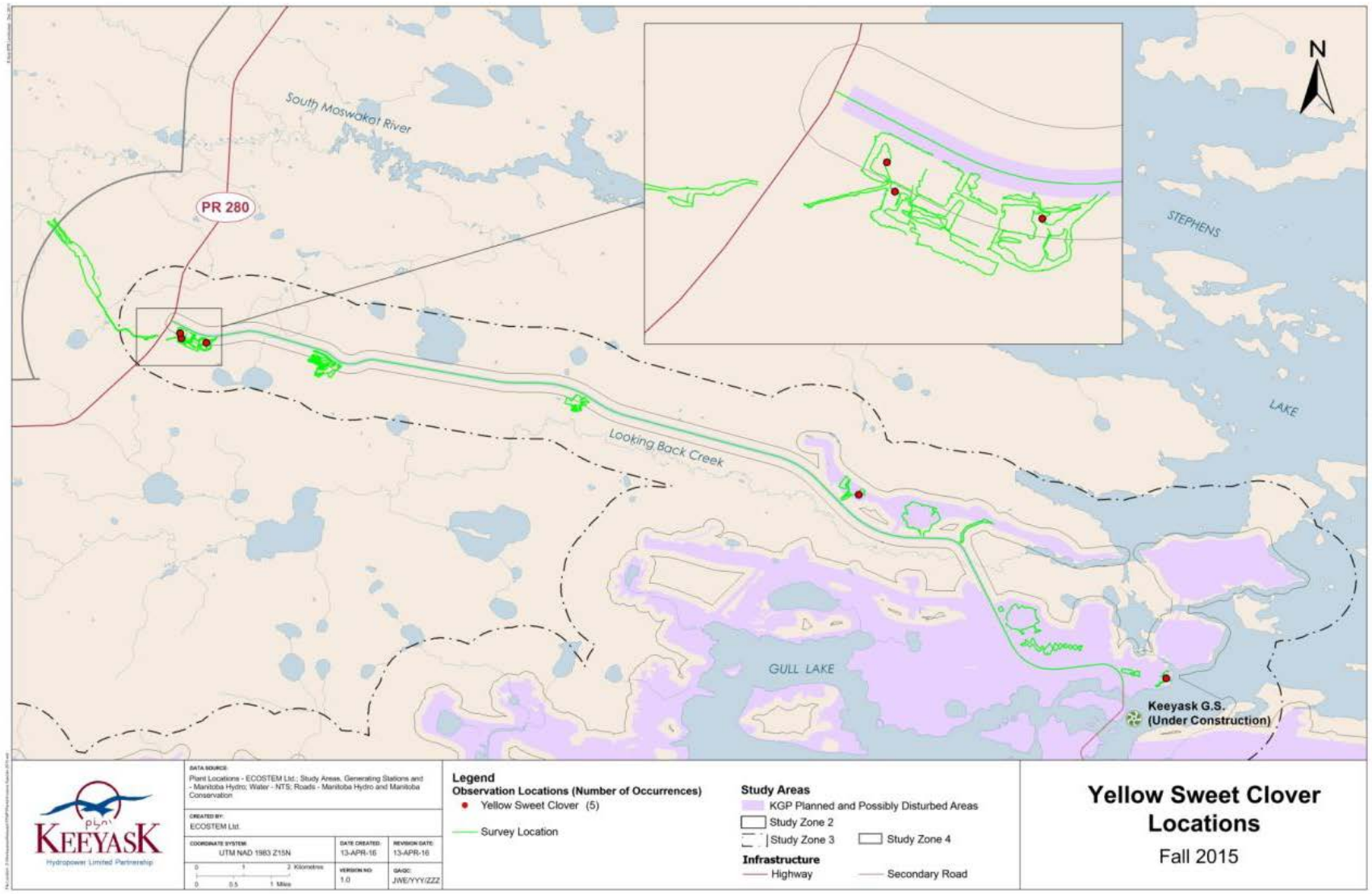
Map 1A-21: Smooth catchfly locations observed in fall 2015



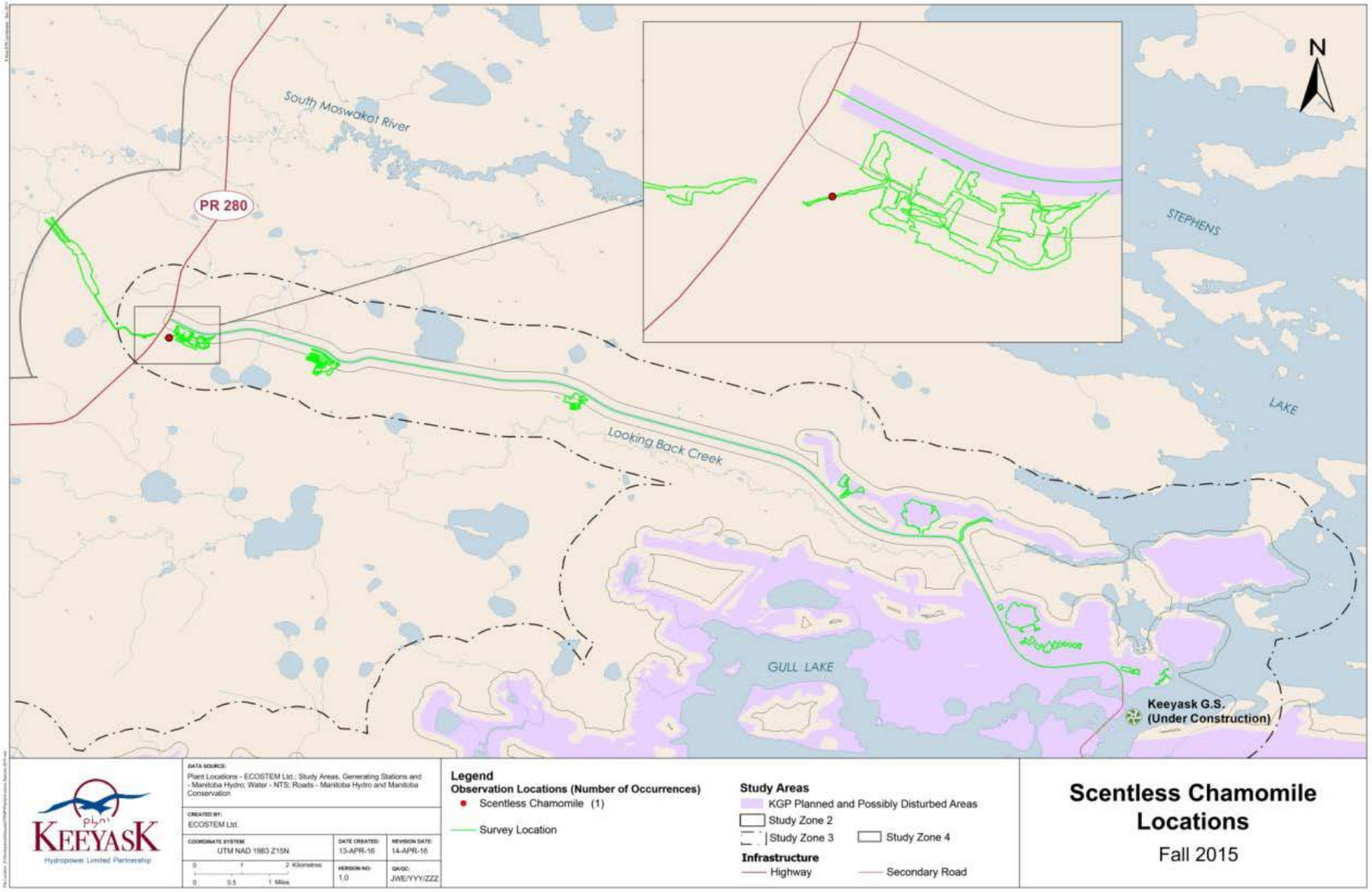
Map 1A-22: Common dandelion locations observed in fall 2015



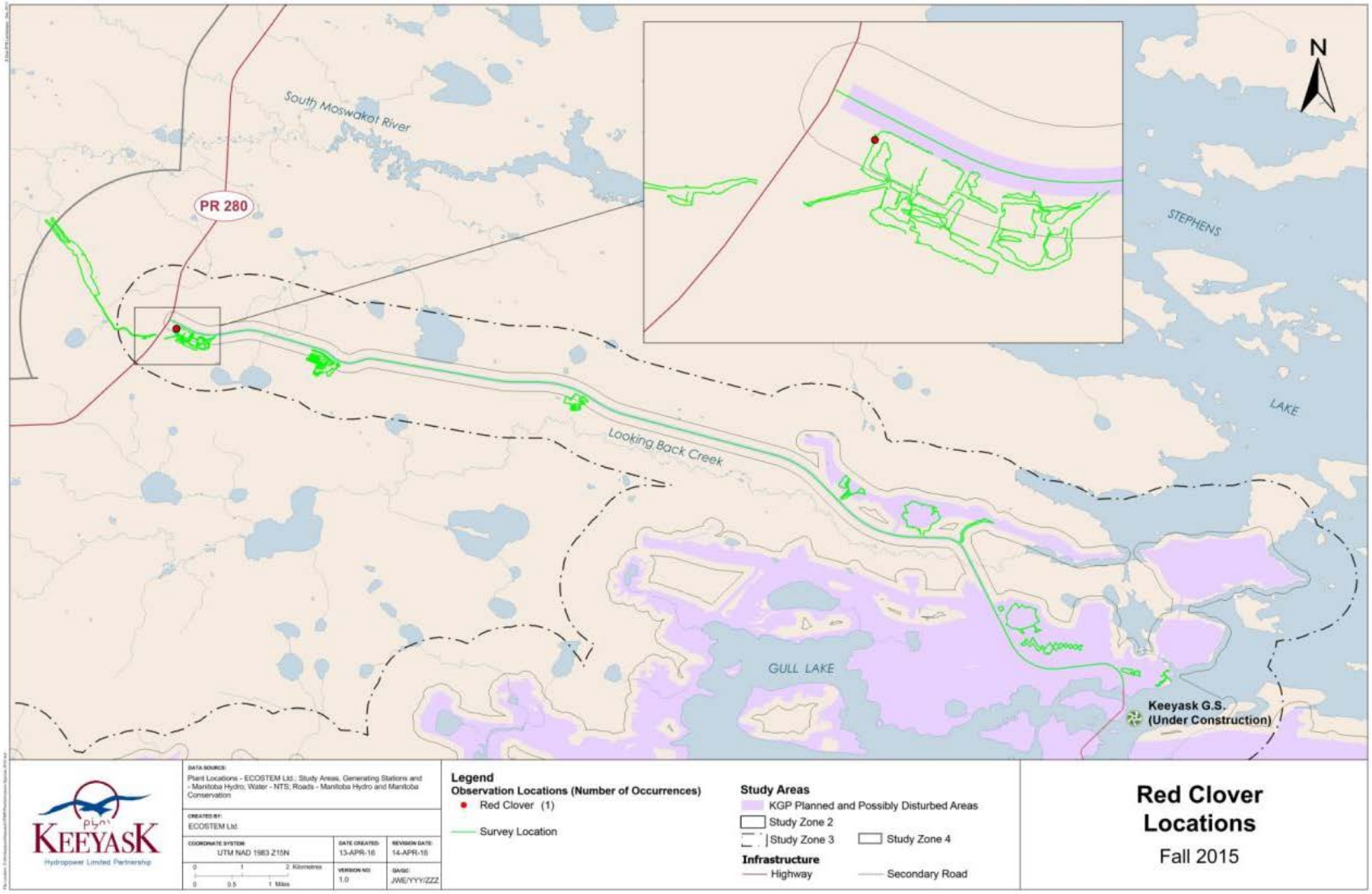
Map 1A-23: Black medick locations observed in fall 2015



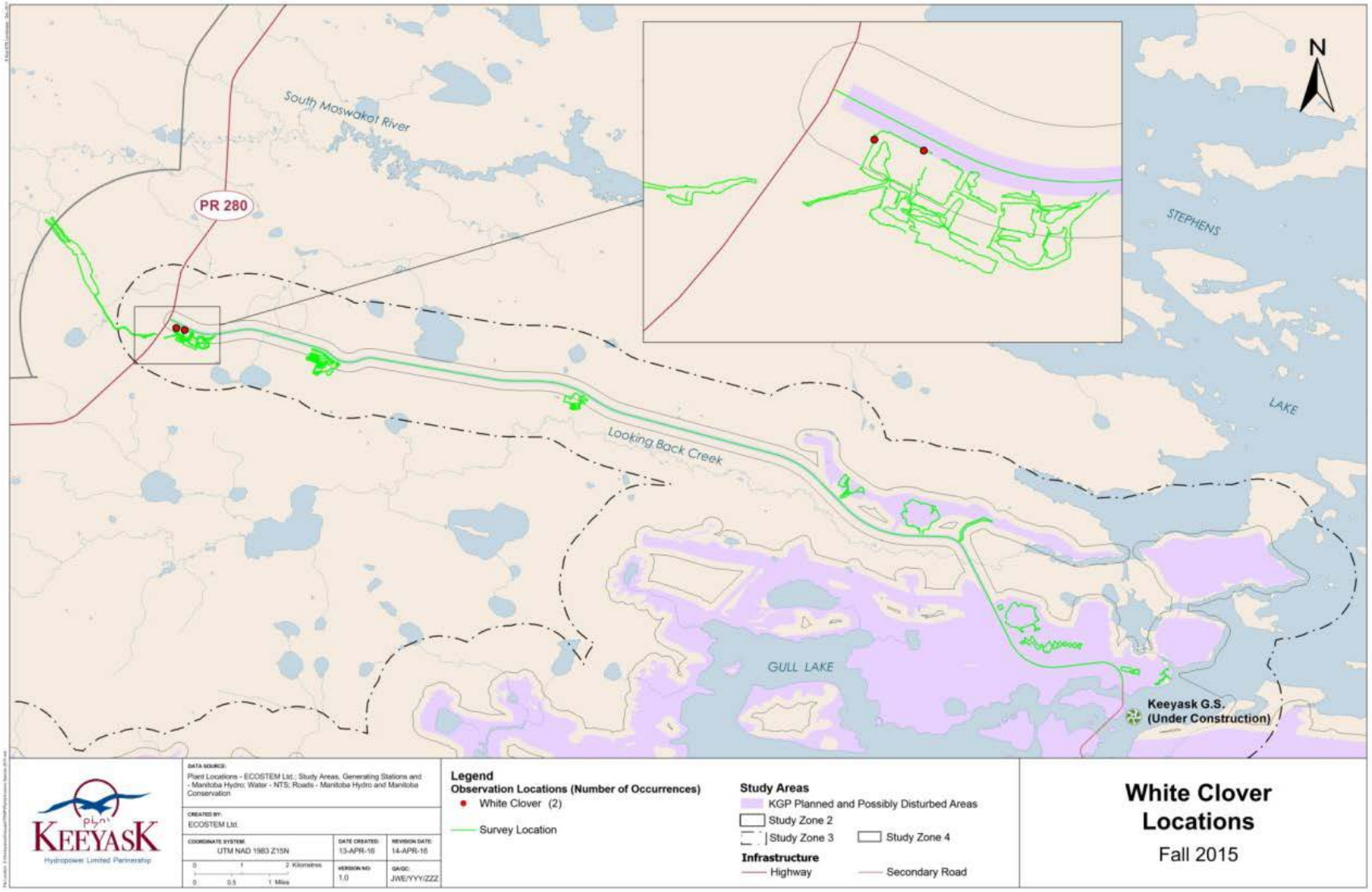
Map 1A-24: Yellow sweet clover locations observed in fall 2015



Map 1A-25: Scentless chamomile locations observed in fall 2015



Map 1A-26: Red clover locations observed in fall 2015



Map 1A-27: White clover locations observed in fall 2015

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